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STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Robert Allen

**Affiliation (if any):** Sierra Club

**Phone:** (616) 846-6852

**Email:** allenro@gvsu.edu

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** X **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

# MICHIGAN GOVERNOR'S ENERGY FORUM

February 25, 2013

Read Time: 3:00:00 / 2:30:00

Good afternoon.

My name is Robert Allen. I am an adjunct professor @ GVSU and MCC. I have a degree in Environmental Studies with graduate work in fresh water biology and ecology.

For the last decade, I have tried to reduce my energy use during the winter by insulating the walls, wrapping and residing the house,
insulating the pipes, caulking and glazing the windows,
closing off certain rooms, sealing the doors and thresholds, ,
covering the windows with a plastic film and redressing them,
buying energy star appliances, turning down the thermostat,
reducing the flow of water, and wearing layers of clothes inside. However, no matter what I do, the price of NRG keeps going up and up every year. With the increased cost of fresh-water fracking, tar-sands deforestation, and mountaintop removal, the prices will continue to increase. We are currently enduring the 5th largest mass extinction in the history of the planet.

The only way of reducing NRG bills is to leave the carbon footprint behind and to move forward with cleaner alternative sources of power. Right now I cannot afford to put solar panels on my roof nor a windmill in my yard.

In 2009, FBR Capital Markets predicted that the cost rooftop solar panels would drop from 32 cents/ kilowatt hour to 15 cents /kwh by 2012, including subsidies. Well, that has not happened. There are no subsidies. There is little interest.

Deepwater Horizon was anchored in 5000 feet of water. Lake Michigan is 925 ft. deep with an average depth of 279 ft. If an oil rig can be stabilized in 5000 ft of water, a windmill can be stabilized in 925 ft.
The more solar panels and windmills that are sold, the cheaper they will become, the more NRG prices will go down, the air will be cleaner, and Michigan can export this technology just like automobiles.

Thank you,

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Rachel Ball

**Affiliation (if any):** Dwelltech Solutions LLC

**Phone:** 616-516-0395

**Email:** rachel@dwelltechsolutions.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ✓ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** ✓ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

Dan Sapps

By no means have we reached energy optimization.

My name is Rachel Ball, and I am the office manager of Dwelltech Solutions. We are a local company that specializes in residential energy assessments and improvement. Dwelltech has been serving the West Michigan area since 2009. We are a group of good, hard-working people with ideas that matter, trying to make a difference.

Over the past four years, we have tested hundreds of homes, largely as part of state funded programs such as Better Buildings for Michigan. We perform various tests, including a blower door, CAZ and infrared imaging. Afterwards, we provide the homeowner with a list of recommendations, which are ordered from most important to least. From there, the customer will choose whether or not they'd like to move forward with improvements. Almost 100% of the time, additional incentives (such as utility rebates) play a role in whether or not a customer decides to do work. When the improvements are completed, we perform a test out and submit all necessary paperwork including rebate applications. From here, I understand that energy savings data is analyzed at the state level for efficacy.

I can see by those analyzing the data would deem energy optimization in the state of Michigan a success. But before anyone gets too excited, there are a couple of factors that need to be taken into consideration.

First, this is just the tip of the iceberg. As I mentioned earlier, we have been in hundreds of homes and have given thousands of recommendations for improvements since our 2009 inception. The amount of customers who have gone forward with improvements is not a lot. In just the past two years, we have tested 800 homes in West Michigan. This just includes those tested per BPI standards, and does not

include walk-throughs or "clipboard" audits. Out of those 800 homes, less than 300 of them have gone forward with any kind of energy efficiency improvements. This means that there are 500 homes out of 800 still in need of energy retrofits. If you extrapolate this data and project it on a larger scale, it becomes very evident that we have a lot more houses yet to fix. In Kent County alone, there are 149,719 owner-occupied homes and condos. If you add Ottawa, Ionia, Allegan & Barry counties into the mix, this number more than doubles. The way we see it, we have another 300,000 houses to test and at least 187,000 to fix before we need to start thinking about expanding into other markets. As a State, we have a long way to go before we can even dream of calling ourselves "energy-efficient."

Here is a second factor that you need to consider, and that is that these energy savings have not come easily. I don't mean the spray foaming of rim joists or crawling around an attic searching for air bypasses. What I am referring to is paperwork. Here is what I have learned about the energy efficiency business: there are minimum barriers in terms of accessing the industry, but there are the maximum number of bridges you must cross once you are "in." For example: utility rebates are wonderful incentives. In our line of work, they are great sales tools and motivators for homeowners to take action. How often can does your gas company cut you a check for using their service? In all seriousness, we think that without these rebates, there are not too many incentives out there for the average homeowner. Incentives make our business model possible.

The problem with rebates is that they have a dirty little secret: they are complicated. They take time and effort to complete. Contractors are required to fill them out on behalf of the customer for better accuracy, which is understandable. This is a service we provide because we love our customers and we want to reward them for doing the right thing. But with how complicated the process has been lately, we've discussed the possibility of charging customers for this service.

Without pointing figures or naming names, I can give you a recent example. One utility company requires a Beacon energy model along with a rebate submission. For those of you who don't know, these energy models are thorough and take our trained building analysts an hour to complete, and that is just for just one address. Another utility company requires the exact same energy model but wants us to complete it using their website so that it has their logo. As it turns out, the same company processes the rebates for both utilities. Seems a bit redundant, wouldn't you agree?

So here is what I propose as a recommendation: Simplify, simplify, simplify. There is an easier way to show energy savings. I am not suggesting that each utility must have the same rebate form, but there definitively needs to be some standardization amongst utilities. Help us help you by simplifying processes and procedures. Energy optimization should have to be so complicated.

Speaking of energy optimization, this is my final recommendation: We need more of it. There is a lot more work to be done and there are a lot more houses to fix. To leave that kind of potential on the table would be senseless. We need more energy optimization in order to fuel more private investment in renewable energy & energy efficiency, which will ultimately secure the future of Michigan.

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# Readying Michigan to Make Good Energy Decisions

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Kirk Barber

**Affiliation (if any):** GVSU Student

**Phone:** 269 908 3312

**Email:** barberki@mail.gvsu.edu

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** Hydrolic Fracturing

**Requested time to speak:** X **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

My name is John Kuiper. I am here on behalf of the Micah Center, a Christian Justice organization. I work as a home energy analyst and HERS rater with the Dwelltech Solutions – a contractor in the Better Buildings Program.

Support Efficiency & Move to renewables

**When I worked in an office along the tracks, my windows would rattle when the train came through on its way to Port Sheldon.** There was a daily reminder as 125 cars with 110 Tons of coal each rolled in from coming states in Appalachia or the Rockies. Those cars went back empty, but I envisioned them filled with dollar bills leaving the state.

All of the coal, which fuels 60% of our electricity and 2/3rds of our natural gas are imported. These are dollars lost.

With this economic loss comes environmental damage to our air, streams and lakes. The use of fossil fuels needs to be reduced through efficiency and replaced as quickly as possible with renewables. As a state, I hope we will NOT deny the science behind the dangers of Global Climate Change and work aggressively to reduce greenhouse gas emissions from fossil fuels. Home Energy Efficiency is not a State Program – but decisions made by individual owners.

**Efficiency First**

I evaluate the energy use of dozens of home's each month Every house has opportunities for savings and I expect that most commercial buildings have savings opportunities as well. Misconceptions exist that the only things that can be done are to replace windows and upgrade the furnace. With technology to diagnose and a better understanding of how homes can perform with better comfort and efficiency, most Michigan homes can be better. There are holes to be filled, walls to be insulated and gaps to be sealed all around this area and we have the icicles to prove it.

Obstacles for homeowners

There are many reasons that ~~I know~~ ~~are~~ ~~right data.~~ folks are ~~When I~~ talk to home owners ~~about energy, those that are~~ not making needed efficiency improvements ~~either~~ don't ~~know~~ understand, ~~don't care~~ not concerned, don't have the money, or don't own the house. Let's implement policies that move all of these types toward energy improvements.

Recommendations

– A common language.

1) **We need an MPG rating.** housing industry and energy efficiency is a lot like the auto industry. Federal standards are helping to push the advances in efficiency for cars and the newer building codes are requiring improvements in the efficiency of new homes. But, what cars have that most houses don't, is an MPG rating – some standard of comparison that will give buyers or renters an idea of the energy costs. Let's put market forces to work to promote this efficiency. There are standards out there: HERS ratings,

BTU/SF/HDD

Home Energy Score or the Home Heating Index (a simple ratio of energy used per square foot with a climate factor). If you knew that your house was costing twice as much to heat as the house across the street, would you do something about it? The State should take leadership and identify standards of comparison for home energy efficiency.

2) Continue Utility rebate programs. For many homeowners, they are making the difference between efficiency and inefficiency.
3) For Michigan families with limited incomes, investing in energy efficiency may not be an option. County weatherization programs are making a dent, but there are many more improvements to be made. Of particular concern are low income renters of single family homes that are paying their own utilities. The property owner may not be interested in making the investments in efficiency. In many cases, the tenant entered the lease without knowing how much it would cost to heat and cool the place. The energy use disclosure I mentioned would help prevent these situations. Home heating assistance should be connected to home weatherization assistance.
4) Some Michigan houses have no cheap remedy. Asbestos laden boilers and pipes, historic homes with old wiring in the walls that shouldn't have wall insulation against them. The resources may not be there for the owners to make the preliminary corrections so the energy enhancements can be made. So the occupants are stuck with the high gas bills. Special designated funds should be made available for these folks so our historic homes and older neighborhoods can be upgraded. – a homeowner's Super-fund

Let's recognize the reality of global ~~warming~~ climate change.

Let's put efficiency first

Let's set a standard of comparison, so owners and buyers know when they can do better

Let's continue and expand to utility rebate programs.

Let's find creative solutions to fund weatherization incentives for historic homes, rental housing and environmental hazard obstacles.

Let's move on a path toward renewables

~~Let's make it~~

Then we'll have another reason to boast about Pure Michigan.

Thank you.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** SUSAN BARNES

**Affiliation (if any):** _____

**Phone:** 616 887 1462

**Email:** SGBARNES2004@GMAIL.COM

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ✓ **Other Additional Energy Topic**

**(Please specify):** ALTERNATIVE ENERGY TECHNOLOGIES

**Requested time to speak:** ✓ **< 5 minutes** ___ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

Submitted by Susan Barnes to the Michigan Energy Policy Forum in Grand Rapids, Michigan on February 25, 2013

I want to speak as an advocate. Others much more involved in the industry today than I am, can speak to you of the numbers and directly address the questions you ask on your website. I would specifically refer you to John Sarver's comments in Lansing on Feb. 14, as Director of the Great Lakes Renewable Energy Association.

Although I am now retired, I have worked in and around the alternative energy industry since the early 1980's

I started working with Blackberry Systems, which was started by 2 young men from Western Michigan University who, working with the University, designed, tested, built and then started a company selling a site built solar air system. They inspired me and I worked with them for several years until the tax incentives were ended and the company, by necessity, moved on to other things along with most of the fledgling alternative energy industry.

By the early 90's I was in the Grand Rapids area and started working as Assistant to the Dean at The Energy Institute in Comstock Park. JEI was a graduate alternative energy program in the guise of a small private undergraduate college. The teachers were outstanding and people came from across the country to learn about solar, wind, energy efficiency and passive solar design. At that time it was about all there was. By the time interest resurged in the late 90's JEI was gone for lack of funding.

Most recently, I spent several years on the board of the Great Lakes Renewable Energy Association and have watched the industry grow within Michigan in very many ways.

Now for the apparent lack of support from Michigan's current administration, I am on the verge of seeing it collapse again and along with it, the businesses, educational programs and dreams of Michigan entrepreneurs, students, and teachers throughout the state.

This is our future. It is sustainable, it is clean and it is the path we will be on. So it is up to you to decide whether that industry will grow out from Michigan or wither and die, once again, while the torch is picked up by another state, or worse, another country.

My husband and I have a passive solar home, 2 solar electric systems and 1 water/air system on our roof. We know what solar can do.

One of our systems is part of the Consumer's Energy Experimental advanced Renewable Program, and it's output, which we can monitor online, today produced almost 5 KWH of electricity. Another system provides our home with enough electricity so we don't even know when there is a power outage and can last 3-4 days when the grid is down if we're careful. The third system is an almost 40 year old water and air system that heats our water year round and in winter puts the excess energy into our basement as warm air which then circulates through the house heating ducts.

I have watched this industry grow and collapse too many times with the rise and fall of government support while subsidies to the oil and gas industries have buoyed those companies up until we in this country and throughout the world have become so dependant on them that we can hardly even consider the damage they are doing to our land, air and water.

Alternative energies by their very nature, are safer, cleaner and more sustainable. They are a distributed resource making them a better option in a world that is less and less predictable. And IF we take into account all of the costs to our land air and water that is associated with obtaining and cleaning up fossil and nuclear fuel, they become very cost effective.

Please, put alternative energy on solid ground and help the industry grow. You WILL see it thrive and prosper.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Brian Bosgraaf (BOSGRAPH)

**Affiliation (if any):** Dwelltech Solutions and Cottagehome

**Phone:** 616-886-1840

**Email:** brian@cottagehome.com

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. X Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** X < 5 minutes  X 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

February 25, 2013

My name is Brian Bosgraaf, Owner and President of DwellTech Solutions, a West Michigan based home performance contractor. I started the company in West Michigan to make a difference. Houses don't need to keep wasting energy. We know how to build better houses, and we know how to fix houses.

I have nine full-time employees who are energetic and passionate building science geeks. We have been into thousands of houses in the last four years and fixed hundreds. Last year our total revenue was more than $1.2 million.

We wake up every day and do battle with the status quo. We know that houses don't have to say as they are; the houses can be improved. The people in these houses can be more comfortable, breathe better air and save money.

The status quo is that home owners often feel the house is what it is and cannot be fixed. I think there is also a perceptions by homeowners that they are not responsible and that the utility company is accepting some responsibility for the solution.

The marketing campaigns that the utility companies are running are not helping, and in fact make matters worse. The homeowners are expecting great incentives and are frozen when the big money doesn't pan out.

Point #1:
If the utility companies are getting energy optimization credits for these huge marketing campaigns, please stop this practice. Our building analysts are constantly battling this overpromising message to the under-delivering reality.

Point #2:
Energy optimization rebates and incentives should be larger and the marketing should be left to the home performance contractors. I even wonder if Michigan Saves couldn't more efficiently administer a rebate program. The coupling of financing options and rebates is very effective, with the utilities programs the variability of service areas and different utility programs leads to many challenges.

Point #3:
Energy optimization rebates and incentives should be focused on keeping heated and air conditioned air in the house longer:

- Whole home energy assessment and strategic renovation plan
- Air seal
- Insulation, walls and attics
- Windows and doors
- Furnace and air conditioning

Point #4:
Home performance labeling pilot programs should be funded by the energy optimization program. The goal in Michigan should be to have a market-driven volunteer home performance label statewide. More efficient homes would sell for more, rent for more, and use less energy.

Point #5:
Let's keep the money local. Sending dollars to other states for coal and gas is a huge drag on the Michigan economy. Here in Grand Rapids, could you imagine the economic impact of a thousand homes every year that saved $1,000 per year for the service life of that house?

Sincerely,
Brian Bosgraaf

616.886.1840
brian@cottagehome.com

dwelltech SOLUTIONS

Cottage Home
Designers & Builders of Well-Appointed Beach Houses & Cottages

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** KEN CHESTER

**Affiliation (if any):** OWNER, PRO-ACTIVE SEARCH

**Phone:** 616-363-8826

**Email:** PROACTKEN@AOL.COM

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** ✓ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

KEN CHESTER - Pro-Active Search 616-363-8826

# Making Good Energy Decisions

Alternative Energy, which includes solar, wind and hydroelectric, require heavy subsidies, lead to higher energy prices, and are regressive in nature on the groups least available to afford them; the poor, middle class and small businesses community!

## Alternative Energy Realities:

Wind and Solar powered plants cost more to build and run than coal or gas fired plants.

Both wind & solar require huge tracts of land.

They receive large tax subsidies compared to coal, natural gas & nuclear.

Provide temporary construction jobs, that are specialized, Joe six-pack isn't getting a job in these industries.

Parts required are big and come from mfg. industries that are more polluting then other forms of manufacturing. Plus, the industries that supply these parts are a small number, because of the enormous costs to produce them and these companies have a lot of unused capacity!

## Think About this:

Household income is at 1995 levels in the U.S.

27% of Michigan Workers are in low wage jobs.

Michigan leads the nation in loss of retail jobs over the last 5 years.

Michigan has one of the highest concentrations of mfg. jobs in the country; which increased alternative energy mandates would severely impact!

# From Ken Chester, Pro-Active Search

## Sources of info used in my statement:

EPA report

CBO

Census Bureau

MI League for Human Services

Dept. of Labor

Energy Information Administration

Intl. Energy Agency

SME

Economist

DOE

WSJ

World Resources Institute

Peterson Institute of International Economies

King Juan Carlos University- Madrid

Robert Bryce

Bur. Of Econ. Analysis

North American Elec. Reliability Corp.

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# Readying Michigan to Make Good Energy Decisions

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** SAM FLANERY

**Affiliation (if any):** Building Science Academy

**Phone:** 616-887-2311

**Email:** sflanery@buildingscienceenergyservices.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. X **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** Jobs

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

BSES

BUILDING SCIENCE ENERGY SERVICES

**Sam Flanery**

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BSA
Building Science Academy

AFFILIATE ORGANIZATION

February 25, 2013

Building Science Academy
343 S Union St.
Sparta, Michigan 49345

# Creating Jobs

BSA provides training and support to the energy efficient market not only in Michigan but to the entire country. Since 2009 BSA has trained hundreds of individuals and companies in techniques, standards and sound business practices for the energy efficient industry. We also developed a state chapter for the national Efficiency First organization to bring the industry together to have input on decisions relative to Energy policy in Michigan. BSA/BSES has participated in the EO collaborative from the beginning of the MPSC effort. We also have supported the Michigan Saves program by participating in the design of the program to the development of requirements and standards for contractors. BSES was contracted by Michigan Saves to develop and administer the Quality Assurance program. BSES was also involved in bringing the Home Performance with Energy Star as well as the Better Buildings program to the state of Michigan. We assembled a group of companies to testify in a Senate hearing before the Energy and Technology committee that included contractors, manufacturers/distributors that represented the creation of over 400 jobs driven by PA 295.

The decisions we as a state make going forward with our energy policy will have a very large impact on thousands of businesses, organizations and individuals either positively or negatively. The total investment in Energy programs driven by Public act 295 is over 255 million dollars per year for 4 years which totals over 1 Billion dollar investment by the end of 2015. In a report by ACEEE (http://aceee.org/files/pdf/fact-sheet/ee-job-creation.pdf) for every million dollar investment in EE there are over 17 jobs created. Another report by the Wisconsin Public service commission states as many as 29 jobs per Million dollar investment. The investment by PA 295 over the period of 2012-2015 has the potential to create 25,000 jobs based on these studies. We are submitting a comprehensive list of the current Trade Alleys, manufacturing / distribution companies, Not for profit organizations, faith based organizations and other individuals that currently participate in the energy efficient market driven by PA 295. This list provided is all public information. The total current number of companies that are currently working with in Michigan's EO programs totals 3,470 companies who are all impacted by these decisions. The majority of the jobs provided by these companies are middle to upper income jobs that are product and labor intensive jobs and have a very positive effect on Michigan's economy as they cannot be outsourced to other states or countries. We as a state have just begun to have a positive economic impact on jobs thru PA 295 and it takes time to mature such a market. All of the current participants in the energy efficient market here in Michigan have made substantial investments in training, equipment and systems that all required additional hires and upgrading the skills of their existing work force. Any negative change in the EE market will have a substantial retraction of jobs and job growth. If any change is made we need an increase in the energy efficient industry to continue to increase jobs and have a positive impact on Michigan's economy. We all know there are challenges that come with such legislation and there are many ways we can work on improving the energy efficiency industry for all stake holders. An energy efficient market must have within it a business model that works for all companies involved including the utilities. We need to look at how we are incentivizing the industry so they can also meet the needs of their company shareholders. The only thing worse than an EE industry that needs adjustments, is not having one to adjust.

The list provided does not include current and future jobs by all other energy efficient programs that have been impacted by PA 295 thru awareness of Energy Efficiency. Examples of other programs are Sustainable Energy Plans developed by cities such as, Ann Arbor, Grand Rapids, Holland, Traverse City and others in development. Programs such as MSHDA with support of HUD funds are not included in this information.

The Economic impact of PA 295 reaches beyond the information provided as most EE programs have a leverage of dollars of a 5 to 1 ratio of investment. Given the current 1 Billion million dollar investment by utilities in Energy programs over a four year period, the total economic impact for the 4 year period driven by PA 295 based on that ratio will be over 5 Billion dollars invested in Energy Efficiency. For every $1.00 invested in EE it returns $3.55 in benefit, such that the total benefit to the state of Michigan has the potential to provide $17.75 Billion dollars in benefit.

BSA
Building Science Academy

BPI
AFFILIATE ORGANIZATION

As a state we need stronger support for Energy Efficiency not reduced support. Energy Efficiency is a resource just as renewables, coal, natural gas and others. We must all work together to have an Energy Efficient industry in Michigan that can be sustainable through better program design, rules and incentives that provide models that work for all stake holders. BSA will be glad to work with stake holders in Michigan to improve these programs by bringing together companies, organizations and individuals that do not normally participate in such initiatives.

Thank you for your attention today.

Any questions or comments please contact:

Sam Flanery (Principle)
Building Science Energy Services
343 S Union St.
Sparta, Michigan 49345
616-887-2311
sflanery@buildingscienceenergyservices.com

The report also identifies some of the factors that go into the overall economic impact that they model. (from page 2-2)

**<<2.2 TYPES OF ECONOMIC DEVELOPMENT IMPACTS**

Focus directly affects Wisconsin's economy, and thus the income and jobs of Wisconsin residents, in four primary ways:

1. **Enhanced business competitiveness.** Decreasing energy costs through increased efficiency, conservation, and lower emission compliance costs can make business operations more profitable. By lowering costs of doing business, it also makes Wisconsin a more competitive location for additional business attraction, investment, and expansion. There is also a benefit (unmeasured to date and not part of this analysis) for Wisconsin firms that sell energy efficient products or include them in their services (as with construction contractors).
2. **Improved cost of living.** Decreasing electric and gas energy costs for residential customers, through increased efficiency, conservation and reduced emission compliance costs, can also leave more money in families' pockets (to spend on other discretionary purchases). Lowering the cost of living means that Wisconsin offers higher potential "real" income. This is not only attractive to the state's current residents, but also makes Wisconsin a more attractive place to live and work to people who offer skills the state economy needs in order to grow and expand.
3. **"Import substitution."** Focus also encourages more spending dollars to stay within Wisconsin. Wisconsin businesses are major manufacturers of heating and air conditioning equipment, motors, and controls. Focus stimulates sales for these industries in Wisconsin, as well as the development of solar, wind, and biomass energy production within the state. At the same time, the program has the effect of stopping *economic leakage* that occurs when money flows out-of-state to purchase coal and natural gas. These effects combine to stimulate job creation, increase personal income, and overall make the Wisconsin economy more efficient and competitive.
4. **Spin-off spending changes.** There are also various indirect and induced impacts that cause both positive and negative changes in spending. Suppliers to the directly affected businesses (as participants or as manufacturers, retailers, or installers of energy-efficient equipment) can realize increased orders for their products and services. Additional jobs and their associated worker income can mean more re-spending of that income on consumer purchases. On the other hand, reductions in the growth of demand for traditional energy sources can mean less growth (or actual reductions) in business sales and jobs associated with construction and operation of coal-fired power plants and retail sales from those plants. >>

Their modeling takes all of these effects into account.

ACEEE
American Council for an Energy-Efficient Economy
Fact Sheet

# How Does Energy Efficiency Create Jobs?

## JOBS ANALYSIS 101

In a time of sustained high unemployment, it is no wonder that job creation has become such a hot topic among pundits and policymakers. It is nearly impossible to read the news without encountering a reference to how a policy or industry creates a given number of jobs. Often, job creation is used as a justification for public sector investment in a program, policy, institution, or project. You may also see numbers from the energy industry as different sectors claim their particular resource creates jobs. These claims, however, rarely or clearly explain how job creation assessments are carried out and what those numbers actually mean. The American Council for an Energy-Efficient Economy (ACEEE) regularly prepares comprehensive analyses and reports regarding the impacts of energy efficiency on the economy, including employment. In this fact sheet, we hope to provide some clarity on how net job impacts should be estimated, and demonstrate how investments in cost-effective energy efficiency improvements can yield a net positive benefit for the nation's overall employment.

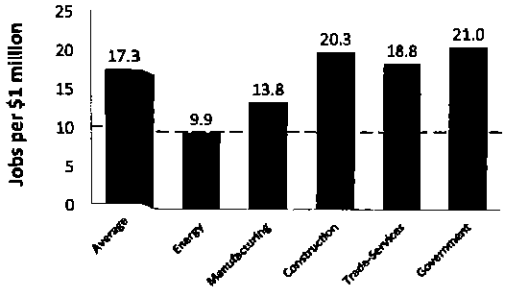
## HOW ARE JOBS DEFINED IN ECONOMIC ANALYSIS?

In almost all of ACEEE's assessments, jobs are defined as shown in Table 1. ACEEE evaluates energy policies for their contribution to net job creation against a baseline employment scenario. This means that net jobs (see Table 1) are created only when the employment created by an investment extends beyond the "business as usual" scenario—the number of jobs that would have been supported on average across all sectors of the economy by that same investment amount.

Readers should be aware that other analysts often opt to report job creation in terms of gross jobs (see Table 1) without assessing impacts relative to the "business as usual" case. This approach inflates the estimates by neglecting to provide context. For example, a power plant may support 100 jobs, but the economy might be able to support 170 jobs if funds were not required to keep the plant running. In this scenario, saying that the power plant creates 100 jobs is misleading.

| | |
|---|---|
| **Job** | A metric that is equivalent to the resources required to employ 1 person for 12 months (or 2 people working 6 months each, or 3 people for 4 months each). Can be full-time or part-time. |
| **Gross Jobs** | The total number of jobs supported by an industry and its supply chain. |
| **Net Jobs** | The number of jobs created in an industry and its supply chain compared to a "business as usual" reference case. |
| **Direct Jobs** | Jobs generated from a change in spending patterns resulting from an expenditure or effort. (e.g. construction jobs for a retrofit project). |
| **Indirect Jobs** | Jobs generated in the supply chain and supporting industries of an industry that is directly impacted by an expenditure or effort. |
| **Induced Jobs** | Jobs generated by the respending of received income resulting from direct and indirect job creation in the affected region. |
| **Labor Intensity** | The number of jobs necessary to support the spending required to produce goods and services. |

**Figure 1. Jobs per Million Dollars of Revenue by Key Sectors of the US Economy**




## HOW DOES ENERGY EFFICIENCY IMPACT EMPLOYMENT AND CREATE JOBS?

To understand how a cost-effective energy efficiency investment can create jobs, it is important to consider how efficiency redirects funds away from less labor intensive sectors of the economy in order to support greater overall employment. On average, $1 million spent in the U.S. economy supports approximately 17 total jobs (including direct, indirect, and induced jobs—defined in the example below). Investments directed towards a specific industry may support greater or fewer jobs depending on the industry (you can see in Figure 1 that manufacturing supports approximately 14 jobs per $1 million investment, while the trade-services sector supports just under 19 jobs).

So, an investment in energy efficiency will first create opportunities for workers in industries that are more labor intensive than average (as you will see in our example, a retrofit project will create jobs in the construction sector, which supports approximately 20 jobs per $1 million, compared to the all-sector average of 17). Then, it will continue to support jobs year after year by saving energy. The energy

savings generated by the investment redirects spending away from the energy industry, which supports just under 10 total jobs per $1 million (see Figure 1), back into the overall economy (which supports 17 jobs per $1 million).

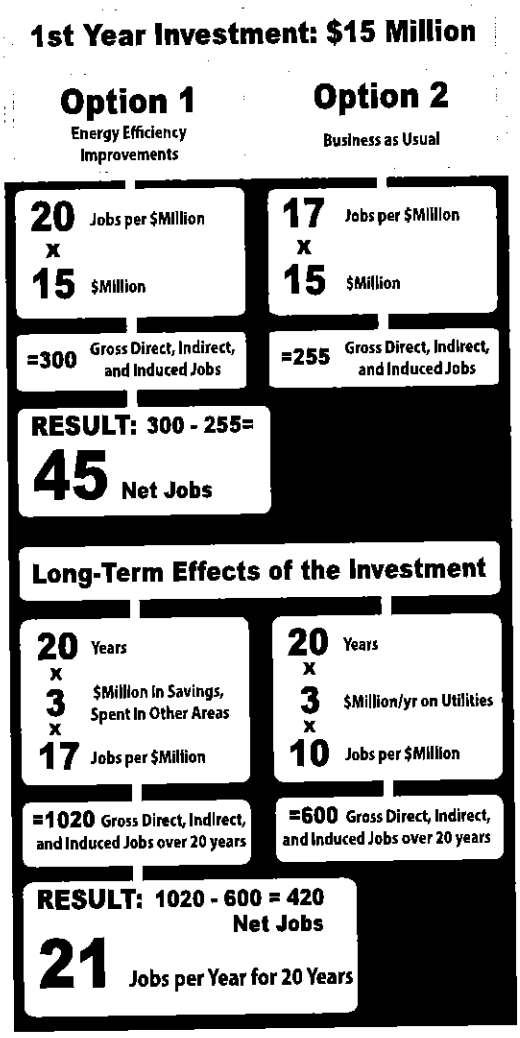
In other words, a net increase in jobs from energy efficiency, for the most part, is the result of two major changes: 1) an initial expenditure or effort that drives energy bill savings; and 2) the subsequent adjustment in spending patterns brought about by that initial expenditure or effort.

Let's look at an example:

*A city decides to use $15 million of its revenue to improve energy efficiency in public buildings. These improvements will save the city $3 million a year for the next 20 years.*

Three types of jobs are created from this investment. First, a construction contractor will have to hire workers to install the desired energy efficiency measures. These contractor jobs are the direct jobs resulting from the investment. In addition, the workers will require materials that they have to purchase from other companies (e.g., insulation, tools). These purchases create jobs throughout the economy for manufacturers and service providers that supply the building industry. These supply-chain jobs are the indirect jobs resulting from the investment. Finally, workers in these direct and indirect industries may choose to spend their earnings on goods and services in the local economy, creating induced jobs.

Figure 2: $15 Million for Energy Efficiency Improvements




For our example, we can assume that funds will be redirected from their "business as usual" spending pattern and channeled into the construction industry, which is more labor intensive than the average sector of the economy. This will support approximately 20 (direct, indirect, and induced) jobs per $1 million investment. In this case, the tradeoff (from spending that supports 17 jobs per $1 million to spending that supports 20 jobs per $1 million) results in an additional 45 jobs in the year the upgrade occurs (see Figure 2).

Additionally, energy efficiency generates energy bill savings over the life of the investment, which frees up funds to support more jobs in the economy by shifting jobs in the energy generation and distribution industries (lower labor intensity: 10 jobs per $1 million) to jobs in all other industries (higher labor intensity: 17 jobs per $1 million on average). We assume that our investment will save $3 million a year for 20 years, thus achieving a net gain of 21 jobs per year (see Figure 2).

As you can derive from Figure 2, the "business as usual" (pre-efficiency) scenario supports 855 gross jobs (255+600) in the first year, which sounds like a lot of jobs (and 600 gross jobs year after year for the next 19 years). However, you can also see that the efficiency scenario supports 1,320 gross jobs (300+1,020) in the first year (and 1,020 gross jobs year after year for the next 19 years), which is greater than the number of jobs supported by "business as usual." Therefore, energy efficiency creates 66 net jobs in the first year, and continues to support an additional 21 net jobs year after year for the 20-year life of the investment.

HOW DOES ACEEE DETERMINE THE NUMBER OF JOBS CREATED BY A GIVEN POLICY, PROGRAM, INSTITUTION, OR PROJECT?

ACEEE uses its in-house Dynamic Energy Efficiency Policy Evaluation Routine (DEEPER) modeling system to evaluate the economy-wide impacts of a variety of energy efficiency and climate policies at the local, state, and national level. For more information on the DEEPER modeling system, see http://aceee.org/fact-sheet/deeper-methodology.

1. This definition of jobs is also used by the U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and MIG, Inc.
2. These job multipliers are derived from IMPLAN. MIG, Inc. 2009. "IMPLAN US Model 2009 All Sec tors." Hudson, WI: MIG, Inc.
3. It is important to note that the $1 million expenditure does not divide neatly into workers' salaries (17 people are not making $59,000 a year as a result of this investment).
4. The energy industry, in Figure 1, includes power generation and distribution from a variety of fuels. The fuel mix can be adjusted depending on the analysis, which could slightly alter the number of jobs supported per $1 million.
5. The IMPLAN social accounting matrices used by ACEEE to perform input-output analyses accounts for leakages, or money that will be spent outside the analyzed region's economy. MIG, Inc. 2009. "IMPLAN US Model 2009 All Sectors." Hudson, WI: MIG, Inc.
6. Please note that to simplify our calculations in this example we assumed that energy savings would be recognized immediately in the first year of the investment. Typically in our analyses, we assume that energy savings are recognized at least six months to one year after the efficiency measures are implemented. Future estimates of net jobs will also be affected by changes in labor productivity and other factors such as price adjustments.

# State of Wisconsin
# Public Service Commission of Wisconsin
# ***Focus on Energy Evaluation***
# ***Economic Development Benefits:***
# ***CY09 Economic Impacts***
# March 2, 2010

From pages 1-1 and 1-2 of their report:

"Energy-efficiency programs like Focus are consistent with many of the "green job" objectives policy makers around the country are embracing. Focus is associated with direct jobs that administer/supply/deliver completed energy conserving projects and therefore qualify as "green" in their outcomes. These "green" jobs are embedded in the above total job impacts created across Wisconsin. The "green" job representation in Focus' YR10 activities is as follows:

**Table 1-1. "Green Job" Representation**
**Green Job Function Quantity**
Wisconsin-manufactured EE components 193
Program administration 579
Sales/distribution/installation of green components 941
**Focus' Green Jobs "direct job effects" 1,713**

This subset of total job impacts (33 percent of the 5,194 YR 10 total job impacts) come from specific segments of the Wisconsin economy, spanning the public/private sectors, the forprofit and not-for profit establishments, and manufacturers, professional/technical services, and sales channels at the wholesale and retail levels."

This means one-third of the 'jobs per million $' below are "direct 'green' jobs". The rest are indirect (e.g., suppliers) and "induced" (see 'Economic Development Impacts' below)

Remember, these are "net" new jobs.....after factoring in any reduced jobs in the energy supply businesses in Michigan.

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Note: this report also identified "jobs per Million $ of EE program spending" (Total effect: direct and indirect and economic development effects new jobs) These are an additional reference for an estimate of "jobs per million $ spent on EE programs".

For residential EE programs: 19 jobs per million $ of program spending.
For Business sector EE program: 29 jobs per million $ (p. 4-2)
(For Michigan's $200 million in 2011 utility spending on EO programs, could average those two figures. Note: MPSC report says MI utilities will spend $255 million/yr for 2012....assume that would be the same for 2013 and beyond at 2% spending cap.)

(They use the REMI model, which is commonly used for analyzing economic impacts of various policies.)

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| 1WEEKWEATHERIZATION.COM | 34028 Milford Rd #240 | New Hudson | MI | 48165 |
| 3R HOME IMPROVEMENT, LLC | 4165 Fort St | Lincoln Park | MI | 48146 |
| 3rd Generation Inc. | 27108 East River | Grosse Ile | MI | 48138 |
| 4 Point Electric | 6182 East Clyde Rd. | Howell | MI | 48855 |
| 911 Mechanical | 50577 Central Industrial Drive | Shelby Township | MI | 48315 |
| A & B Equipment & Sons, Inc. | 635 Wellington St. | Saginaw | MI | 48604 |
| A & C Heating & Air Conditioning | 2560 Rosewood St. | Jenison | MI | 49428 |
| A & H Electric | 5907 Williamson | Dearborn Hts | MI | 48126 |
| A & N Electric, Inc. | 813 Wildwood Lane | Ann Arbor | MI | 48103 |
| A Building Company | 3733 Christie LN | Shelby Twp | MI | 48317 |
| A Green Vision | 2135 Lewton Place | Lansing | MI | 48911 |
| A GREEN VISION, LLC. | 2135 Lewton Pl. | Lansing | MI | 48911 |
| A STANDARD ELECTRIC CO. | 2650 Trautner Dr. | Saginaw | MI | 48859 |
| A TO Z TOTAL HEATING & COOLING | 24614 | Dearborn Heights | MI | 48125 |
| A&A EXTREME HEATING & COOLING INC. | 7540 Steadman | Dearborn | MI | 48126 |
| A.F. Bellisario Inc | 245 Tilden | Pontiac | MI | 48341 |
| A.F. Smith Electric | 624 South Mansfield | Ypsilanti | MI | 48197 |
| A.H. CONSTRUCTION | 1744 west Michigan Avenue | Ypsilanti | MI | 48197 |
| A.H. General Maintenance | 1030 S. Wildwood St. | Westland | MI | 48186 |
| A.J. Damman Co. | 1180 East Big Beaver | Troy | MI | 48083 |
| A.M. Electric, Inc. | 4603 Tipton Drive | Troy | MI | 48098 |
| A.S. Contrera HVAC Sheet Metal Contractors | 26673 Lawrence | Center Line | MI | 48015 |
| A/B Electrical & General Contracting | 7144 Michigan Avenue | Detroit | MI | 48210 |
| A-1 COMFORT CONTROL INC. | 31128 W. 8 Mile | Farmington Hills | MI | 48336 |
| A1 CONSTRUCTION AND WEATHERIZATION | 21955 Pine St | Sand Lake | MI | 49343 |
| A-1 Electrical Services Inc. | 1813 Turner Ave NW | Grand Rapids | MI | 49504 |
| A1 ENERGY AUDITS | 20374 Brockwood St | Dearborn Heights | MI | 48127 |
| A-1 Handyman | 11695 Ridge Rd. | Shelby Township | MI | 48315 |
| AA Energy Efficiency Contractors | 920 Loyola Dr, Suite 107 | Ann Arbor | MI | 48103 |
| AA PARADIGM ENERGY SERVICES | 11195 Essex Road | Ellsworth | MI | 49729 |
| AAA Dunlop's Service Network | 898 South Main Street | Plymouth | MI | 48170 |
| AAA ELECTRICAL SERVICE, INC. | 51462 Oro Dr. | Shelby Twp. | MI | 48315 |
| AAA Energy Audits | 4433 Bunker Ave. | West Bloomfield | MI | 48323 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| AAA SERVICE NETWORK | 4675 East Grand River | Howell | MI | 48843 |
| AAC Mechanical | 50642 Sabrina Dr. | Shelby Twp. | MI | 48315 |
| AAC SERVICES | 513 W. 11 Mile Rd | Madison Heights | MI | 48071 |
| AAEEC (DIVISION OF INFRARED ENERGY ANALYSIS) | 920 Loyola Street, Suite 107 | Ann Arbor | MI | 48103 |
| AARON'S HOME IMPROVEMENT | 37829 S. Groesbeck Highway | Clinton Township | MI | 48036 |
| Aarons Home Improvement, Inc. | 37829 S. Groesbeck Hwy | Clinton TWP | MI | 48036 |
| ABC HVAC Company | 8328 Foster Road | Clarkston | MI | 48346 |
| ABCO HEATING, COOLING & CHIMNEY SERVICE | 67901 Dequindre | Oakland | MI | 48363 |
| Abednego Environmental Services, LLC | 120 West Main Street | Northville | MI | 48167 |
| ABERCROMBIE CONSTRUCTION | 13565 Dix-Toledo | Southgate | MI | 48195 |
| ABI MECHANICAL | P.O. Box 970 | Traverse City | MI | 49685 |
| ABI Mechanical Contractors | PO Box 970 | Traverse City | MI | 49685 |
| ABLE ELECTRIC CO. | 816 Westwood | Ann Arbor | MI | 48103 |
| ABM ELECTRIC | 899 W Drayton | Ferndale | MI | 48220 |
| Absolute Comfort Mechanical Contractors, Inc. | 9398 Mason Dr | Newago | MI | 49337 |
| Absolute Comfort Systems | 6102 Rogue River Meadows Dr | Belmont | MI | 49306 |
| ABSOTEMP CLIMATE CONTROL, INC. | 1036 Benstein Rd. Suite # 101 | Walled lake | MI | 48390 |
| ACC Planned Service Inc | 2085 W Packard Street | Appleton | MI | 54911 |
| ACCENT BUILDING CORP. | 414S. Henry | Bay City | MI | 48706 |
| Accurate Energy Audits | 4414 Cass Elizabeth Rd. | Waterford | MI | 48328 |
| ACCURATE ENERGY AUDITS, LLC | 4414 Cass Elizabeth | Waterford | MI | 48328 |
| Accurate Energy Solutions | 4594 Stable Drive | Hudsonville | MI | 49426 |
| ACCURATE HEATING & COOLING | 2575 N. Johnson Road P.O. Box 132 | Weidman | MI | 48893 |
| Accurate Insulation | 3367 28th St., S.W. | Grandville | MI | 49418 |
| ACCURATE INSULATION 1, LLC | 3367 28th St. S.W. | Grandville | MI | 49418 |
| ACCURATE SPA AND PUMP DESIGN | 29440 Calahan | Roseville | MI | 48066 |
| Accu-Temp Mech Servuces | 8162 E. Fulton, Ste. D | Ada | MI | 49301 |
| Accu-Temp, Inc | 46554 Erb Dr | Macomb | MI | 48042 |
| Ace and Sons Insulation | 23944 Eureka | Taylor | MI | 48180 |
| ACE AND SONS INSULATION, INC | 23944 Eureka Rd Suite 103 | Taylor | MI | 48180 |
| ACE HEATING & COOLING | 1979 E. Sherman Blvd. | Muskegon | MI | 49444 |
| Ace Heating & Cooling Company | 1979 E Sherman Blvd | Muskegon | MI | 49444 |
| ACME Enterprises | 15751 Martin Rd. | Roseville | MI | 48066 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Action Electric | 207 Pigeon Rd. | Bad Axe | MI | 48413 |
| Action Mechanical | PO Box 395 | Belleville | MI | 48111 |
| ACTIVE AIR TECHNOLOGY, INC. | 300 North Ave. | Mt. Clemens | MI | 48043 |
| Adamczyk Electric | 5551 East Marlette | Marlette | MI | 48453 |
| Adopt-A-Watt | 1204 Grove, Ste. 247 | Royal Oak | MI | 48067 |
| Advance Electrical Systems | 6481 Hatchery Rd | Waterford | MI | 48329 |
| Advance Tech Engineering | 5686 Mesa Verde Trail | White Lake | MI | 48383 |
| Advanced Air Services, Inc | 12700 Burt Road | Detroit | MI | 48223 |
| ADVANCED BUILDING COMPANY | 15884 Swathmore | LIVONIA | MI | 48154 |
| Advanced Building Inc. | 1625 Seven Mile Rd. | Whitmore Lake | MI | 48189 |
| Advanced Energy Ideas | 1113 W Birchwood Ave | Mesa | AZ | 85210 |
| ADVANCED ENERGY MANAGEMENT, INC. | 10052 US HWY 31 | Montague | MI | 49437 |
| ADVANCED ENERGY OPTIONS | 2505 S. Waverly Hwy | Lansing | MI | 48911 |
| ADVANCED GREEN ENERGY | 583 Whitney | Rochester | MI | 48307 |
| Advanced Heating and Cooling | 2923A Byron Center | Wyoming | MI | 49519 |
| ADVANCED INSPECTIONS & MANAGEMENT | 20120 Westview Dr. | Northvile | MI | 48167 |
| ADVANCED LIGHTING SOLUTIONS | 725 S. Adams, Suite 280 | Birmingham | MI | 48009 |
| Advantage Air-Conditioning and Heating LLC | 19186 Fort Street #331 | Riverview | MI | 48192 |
| Advantage Electric & Controls, Inc. | 13240 West Stan Dr. | Shelby Twp | MI | 48315 |
| ADVANTAGE MECHANICAL REFRIGERATION, INC. | 4870-F West River Dr. NE | Comstock | MI | 49321 |
| Advantage Mechanical-Refrigeration Inc. | 4870-F West River Road NE | Comstock Park | ME | 49321 |
| Aelux LLC | 2842 Mt Carmel Ave | Glenside | PA | 19038 |
| AELUX, LLC | 2842 Mt. Carmel Ave. | Glenside | PA | 19038 |
| AEP Energy | 363 W. Erie St. Suite 700 | Chicago | IL | 60654 |
| AERO HEATING & COOLING, INC. | 25954 Hawthorne | Harrison Twp. | MI | 48045 |
| Aerobee Electric, Inc. | 2026 Massoit Rd | Royal Oak | MI | 48073 |
| Affordable Spaces | 22517 Telegraph Rd | Southfield | MI | 48033 |
| AFFORDABLE WINDOWS AND SIDING GROUP | 7005 Jackson | Ann Arbor | MI | 48103 |
| AG Heating & Coolin Inc. | 30223 Spring River DR | Southfield | MI | 48076 |
| Agree Construction Company | 3549 S. Dort Highway | Flint | MI | 48507 |
| AH CONSTRUCTION | 5417 Daytona | Ypsilanti | MI | 48197 |
| AIM, ADVANCED INDUSTRIAL MAINTENANCE | 3911 Fort Street #116 | Trenton | MI | 48183 |
| Air and Liquid Systems | 1680 S Livernois | Rochester Hills | MI | 48307 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Air Center Inc | 2175 Stephenson Hwy | Troy | MI | 48083 |
| AIR CENTER, INC. | 2175 Stephenson Hwy. | Troy | MI | 48083 |
| Air Compressor Energy Systems Inc | 6735 Brandt Street | Romulus | MI | 48174 |
| AIR COMPRESSOR ENERGY SYSTEMS, INC, | 6735 Brandt St | Romulus | MI | 48174 |
| AIR CONDITIONING ENGINEERS | 5250 Auburn | Utica | MI | 48317 |
| Air Handlers Service Corp. | 8457 Andersonville Rd. | Clarkston | MI | 48346 |
| AIR MASTERS HEATING & AIR CONDITIONING | 2870 Coolidge Hwy. | Berkley | MI | 48072 |
| Air Technologies | 11771 Belden Ct | Livonia | MI | 48150 |
| Air Works | 300 North Ave. | Mount Clemens | MI | 48043 |
| Aire Serv of South East Michigan | 2816 Benjamin | Royal oak | MI | 48073 |
| AIRELECT, Inc. | 1663 E. Auburn Rd. | Rochester Hills | MI | 48307 |
| AireServ of West MI | 4870-F W Rivers Dr NE | Comstock Park | MI | 49321 |
| Airleader | 4661 Oakwright Dr. NE | Ada | MI | 49301 |
| Air-Master heating & Air Conditioning | 2870 Coolidge Hwy | Berkley | MI | 48072 |
| Air-Master Heating & Air Conditioning LLC | 2870 Coolidge Highway | 2870 Coolidge Highway | MI | 48072 |
| Air-N-Energy Consulting, Inc. | 2200 Gibbs Rd. | Traverse City | MI | 49696 |
| Airport Lighting LLC | 6320 N. State Road PO Box 210 | Luther | MI | 49565 |
| Air-Row Fan Company | 2346 S Lynhurst Dr #E201K | Indianpolis | IN | 46241 |
| AIRTEC HEATING & COOLING | 1724 Beidler | Muskegon | MI | 49441 |
| Airtech Equipment Inc. | 3523 Lousma Drive | Grand Rapids | MI | 49548 |
| Air-Tite Insulation, LLC | 7153 Osprey Ave SW | Byron Center | MI | 49315 |
| Airtronic Heating & Cooling | 26666 Grand River Ave. | Redford | MI | 48240 |
| AJ Danboise, Inc. | 31015 Grand River ave. | Farmington Hills | MI | 48336 |
| AKA Electric | 13525 Imlay City Rd. | Capac | MI | 48014 |
| AKT Peerless Environmental and Energy Services | 22725 Orchard Lake Rd. | Farmington | MI | 48336 |
| Al Jo Electric | 2644 Elsinore | Waterford | MI | 48328 |
| Al Walters Heating | 59 Ecorse | Ypsilanti | MI | 48198 |
| Al Walters Heating & Air Conditioning, Inc | 59 Ecorse Road | Ypsilanti | MI | 48198 |
| Aladdin Electric Inc. | 4809 James McDivitt | Jackson | MI | 49201 |
| Aladdin Heating & Cooling | 26969 Ryan Rd. | Warren | MI | 48091 |
| ALADDIN HEATING AND COOLING | 26969 Ryan Rd | Warren | MI | 48091 |
| Albert Heating & Cooling Inc | 676 E 3 Mile | Sault Ste Marie | MI | 49783 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| ALERT HEATING AND COOLING, INC. | 3971 Fort St. | Lincoln Park | MI | 48146 |
| All American Electric | 31110 Fairfield | Warren | MI | 48088 |
| All American Handyman Services, LLC | PO Box 1942 | Belleville | MI | 48112 |
| All City Electric Contractors Inc. | 26233 Grand River Avenue | Redford | MI | 48240 |
| All Electric Inc. | 27044 Haverhill Dr. | Warren | MI | 48092 |
| All Green Plus, LLC | 24419 Sorrentino Ct. | Clinton Township | MI | 48035 |
| ALL IN ONE PLUMBING & HEATING | 965 E. Commerce Dr. | Traverse City | MI | 49685 |
| ALL NATURAL CLEANING & SERVICES LLC. | 4830 Fox reek East #115 | Clarkston | MI | 48346 |
| ALL PRO PLUMBING AND HEATING INC | 292 Main St. | Coopersville | MI | 49426 |
| All Seasons Insulation of Michigan | 1819 East Airport Road | Midland | MI | 48642 |
| All Seasons Signs & Lighting Inc | 3547 Miller Rd | Mussey | MI | 48014 |
| ALL SEASONS SIGNS & LIGHTING, INC. | 3547 Miller | Mussey Twp | MI | 48014 |
| All Star Comfort Solutions, LLC | P.O. Box 186 | Allendale | MI | 49401 |
| All State Electric Co., Inc. | 4401 Fletcher | Wayne | MI | 48184 |
| All State Electric Inc | 4401 Fletcher St | Wayne | MI | 48184 |
| All Type Electrical Construction | 1785 Rock Rd. | Commerce Twp | MI | 48390 |
| All-City Refrigeration | 32425 W 8 Mile | Livonia | MI | 48152 |
| Allegiance Inc. | 5108 Oawwensa Blvd. | Clarkston | MI | 48348 |
| ALLEN ELECTRIC SUPPLY CO | 31750 Plymouth Rd | Livonia | MI | 48150 |
| Allen Electric Supply Company | 31750 Plymouth Road | Livonia | MI | 48151 |
| Allen Home Improvement | 780 W 8 Mile Rd | Ferndale | MI | 48220 |
| Allendale Heating Company Inc. | 11672 60th - POB 296 | Allendale | MI | 49401 |
| Alliance Energy Solutions | 11S Hurley Rd. Suite 3F | Oxford | CT | 06478 |
| Alliance for Environmental Sustainability | 947 Wealthy St SE | Grand Rapids | MI | 49506 |
| Alliance Heating & Cooling | 20800 Hubbell St | Oak Park | MI | 48237 |
| Alliance Laundry System | P.O. Box 990 Shepard St. | Ripon | WI | 54971 |
| ALLIANCE MECHANICAL | 20800 Hubbell | Oak PArk | MI | 48237 |
| ALLIED BUILDING SERVICE COMPANY OF DETROIT, INC. | 1801 Howard St | Detroit | MI | 48216 |
| ALLIED ELECTRIC SUPPLY CO. | 23820 Telegraph | Southfield | MI | 48033 |
| Allied Electric Supply Company | 23820 Telegraph Rd. | Southfield | MI | 48033 |
| ALLIED MECHANICAL SERVICES INC. | 3380 HIGHLAND DRIVE | HUDSONVILLE | MI | 49426 |
| All-in-One Electric | 790 St. John Blvd. | Lincoln Park | MI | 48146 |
| ALLSTATE ENERGY SOLUTIONS LLC | 21348 Telegraph Rd | Southfield | MI | 48033 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| All-State Energy Solutions LLC | 4120 W. Maple Road | Bloomfield Hills | MI | 48301 |
| AllState Energy Solutions, LLC | 6632 Telegraph Rd, Ste 199 | Bloomfield Hills | MI | 48301 |
| ALLTRADE BUILDING COMPANY | 110 W. St. Clair | Romeo | MI | 48065 |
| Alltype Electric | 1785 Rock Rd | Walled Lake | MI | 48390 |
| ALPERS INSULATION L.L.C. | 345 E. Welch Ct. | Traverse City | MI | 49686 |
| Alpha Electric Inc | 39349 Mound Rd | Sterling Heights | MI | 48310 |
| Altech Mechanical | 7885 Jackson Road | Ann Arbor | MI | 48106 |
| ALTECH MECHANICAL SERVICE, LLC | 7885 Jackson Rd., Suite 4 | Ann Arbor | MI | 48103 |
| Alternative Energy Services, LLC | 4170 Navarra Ct | White Lake | MI | 48383 |
| Alternative Lighting Solutions, LLC | 44048 North Oaks Court | Sterling Heights | MI | 48314 |
| ALUMALIGHT | PO Box 944 | Birmingham | MI | 48012 |
| Alvons Electric Inc. | 35353 Brighton Dr. | Sterling Heights | MI | 48310 |
| Amber Electric Inc | 7785 Frampton Dr. | Washington | MI | 48095 |
| AmbiRad Limited | 12910 Ford Dr | Fishers | IN | 46038 |
| Ameresco | 28800 Orchard Lake Road, Suite 220 | Farminton Hills | MI | 48334 |
| AMERESCO, INC. | 28800 Orchard Lake Road, Suite 220 | Farmington Hills | MI | 48334 |
| Amerian Electrical Service | 578 Sumpter Rd. | Belleville | MI | 48111 |
| American Discount Heating & Cooling Inc. | 29566 W 9 Mile Rd | Farmington Hills | MI | 48336 |
| AMERICAN ECO ENERGY | 6140 Taylor Drive | Flint | MI | 48507 |
| American Energy | 1834 Melvin | Livonia | MI | 48152 |
| AMERICAN ENERGY CONSERVATION SERVICES | 38270 Radde St. | Clinton Twp. | MI | 48036 |
| American Energy Solutions, Inc. | 10601 Mission Road, Suite 210 | Leawood | KS | 66206 |
| American Glass Tinting | 35 W Hunters Creek Rd | Lapeer | MI | 48446 |
| AMERICAN INFRARED, LLC. | 8844 Bethel Church Rd. | Saline | MI | 48176 |
| American Mechanical Services of West MI Inc. | 7815 E Apple Ave | Muskegon | MI | 49442 |
| American Mechanical Services of West Michigan Inc. | 7815 Apple Ave. | Muskegon | MI | 49442 |
| AMerican Performance Heating & Cooling, LLC | 47317 Destiny | Paw Paw | MI | 49079 |
| American Temperature Service, Inc. | 46101 Grand River | Novi | MI | 48374 |
| American Wall Systems Inc. | 4222 Nicholson Rd. | Flowerville | MI | 48836 |
| America's Green Line | 400 Monroe St., Suite 480 | Detroit | MI | 48226 |
| AMISTEE AIR DUCT CLEANING & INSULATION | 44485 Grand River Ave | Novi | MI | 48375 |
| Anchor Bay Communications LLC | 46348 Community Center Dr. | Chesterfield | MI | 48047 |
| Anchor Custom Duct Work | 1666 Kile Rd. | Metamora | MI | 48455 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Anchor Staffing Agency | 27035 Plymouth Rd. | Redford | MI | 48239 |
| ANDERSON PLUMBING AND HEATING CO. | 13568 Nine Mile Rd. | Kaleva | MI | 49645 |
| Andy J Egan Co | 2001 Waldorf NW | Grand Rapids | MI | 49544 |
| ANDY'S STATEWIDE HEATING & COOLING | 4828 Joslyn Rd. | Orion | MI | 48359 |
| Angeline and Associates Architects | 113 East Ann Street | Ann Arbor | MI | 48104 |
| Anmardom LLC | 2136 Wildflower Lane | Milford | MI | 48390 |
| ANN ARBOR ARCHITECTS COLLABORATIVE | 210 East Huron Street | Ann Arbor | MI | 48104 |
| Answer Heating & Cooling Inc | 8490 Midland Road | Freeland | MI | 48623 |
| Anthony International | 12391 Montero Ave | Sylmar | CA | 91342 |
| Antler Construction | 5055 Belleville Road | Canton | MI | 48188 |
| Anything Electric | 5320 Van Dyke | Almont | MI | 48003 |
| Anything Electrical Services | 4074 Chapman | Sterling Heights | MI | 48310 |
| Anytime Inc. | 44291 Ryan Road | Sterling Heights | MI | 48314 |
| A-OK Cooling & Heating Corp. | 16700 13 Mile Rd. | Roseville | MI | 48066 |
| A-OK PLUMBING AND HEATING, INC | 11825 Morgan | Plymouth | MI | 48170 |
| Aorenalin Electric | 6177 Brambleberry Lane | Howell | MI | 48855 |
| Apex Electric | 14465 Fruitwood | Washington Twp | MI | 48094 |
| Apex Electrical Systems Incorporated | PO Box 558 | Davison | MI | 48423 |
| APPLEGATE HOME COMFORT | 1096 Highview Drive | Webberville | MI | 48892 |
| APPLIED ECOLOGIC | 306 Thomas St. | Holly | MI | 48442 |
| APPLIED ENERGY SOLUTIONS - PETOSKEY | 5002 Pickerel Lake Rd | Petoskey | MI | 49770 |
| APPLIED ENERGY SOLUTIONS - TRAVERSE CITY | 5363 Harris Rd | Traverse City | MI | 49684 |
| Applied Energy Solutions LLC | 5363 Harris Road | Traverse City | MI | 49684 |
| APPLIED HANDLING, INC. | 15200 Century Drive | Dearborn | MI | 48121 |
| ARBOR INSULATION | 3250 W. Liberty Road | Ann Arbor | MI | 48103 |
| ARCTIC AIR, INC. | 4918 Fernlee Ave. | Royal Oak | MI | 48073 |
| Arctic Inc. Heating & Cooling | P.O. Box 181 | Lowell | MI | 49331 |
| ARCTIC INSULATION CO. OF MICHIGAN | 654 Junction | Plymouth | MI | 48170 |
| Armock Mechanical | 745 S. State | Sparta | MI | 49345 |
| Armock Mechanical Contractors | 745 S State St | Sparta | MI | 49345 |
| Arms & Cole | 363 S Airport Rd W | Traverse City | MI | 49686 |
| Arnold Electric | 337 Hailees Place | Lapeer | MI | 48446 |
| Arrow Heating & Air Conditioning, Inc. | 8055 Hamerich Ave. SW | Byron Center | MI | 49315 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| ARROW HEATING & COOLING SERVICE, INC. | 30289 Little Mack Ave. | Roseville | MI | 48066 |
| Arrow Roofing | 520 Wellington | Traverse City | MI | 49686 |
| Arrow Roofing & Supply Inc. | 3453 Eastern SE | Wyoming | MI | 49508 |
| Arrow Service Group | 90 Ely St | Binghamton | NY | 13904 |
| ARTHUR W. CROOKS PLUMBING & HEATING, INC. | 7 Grand Blvd. | Battle Creek | MI | 49014 |
| ASG | 90 Ely St. | Binghamton | NY | 13904 |
| Ashcott Electrical Inc | 11800 Whitemore Lake Road Suite C | Whitmore Lake | MI | 48189 |
| ASHCOTT ELECTRICAL, INC. | 11236 Lemen Rd. Suite C | Whitmore Lake | MI | 48189 |
| Aspen Heating and Cooling | 4131 W. Michigan Ave. | Jackson | MI | 49202 |
| Associated Construction Services Corp. | 28525 Beck Road Suite 118 | Wixom | MI | 48393 |
| ASSURED COMFORT HEATING & COOLING, INC. | 1275 Holton | Muskegon | MI | 49445 |
| ASTRUM SOLAR | 39555 Orchard Hill Place, Suite 600 PMO 6143 | Novi | MI | 48375 |
| ATI Group | 3419 Pierson Place | Flushing | MI | 48433 |
| ATKINSON ENERGY SOLUTIONS LLC | 1670 E. Hurd | Monroe | MI | 48126 |
| Atlas Appraisal and Home Weatherization, LLC | PO Box 32 | Prescott | MI | 48756 |
| Atmosphere Control, LLC | P.O. Box 468 | Hesperia | MI | 49421 |
| ATS | 8200 S. Akron St., Ste 111 | Centennial | CO | 80112 |
| ATTIC INSULATION & VENTILATION PRO'S | 51300 Overhill Road | Shelby Township | MI | 48316 |
| Auch Construction | 734 South Paddock | Pontiac | MI | 48341 |
| Austin Supply, Inc. | 1666 Northern Star Drive | Traverse City | MI | 49696 |
| Automated Building Control Systems, Inc. | 13119 Ripley Road | Linden | MI | 48451 |
| Automated Control Systems Inc. | 25188 Seeley Road | Novi | MI | 48375 |
| Automated Control Systems, Inc. | 25168 Seeley Rd. | Novi | MI | 48375 |
| Automated Logic Corporation | 1025 Cobb Place Blvd | Kennesaw | GA | 30144 |
| Automation Electric Controls, Inc. | 20759 Osmus St | Farmington Hills | MI | 48336 |
| Avetria Lighting | 150 Peyerk Court | Romeo | MI | 48065 |
| AXIS ALTERNATIVE TECHNOLOGIES | 6301 Frank N Dot Court, Suite 2 | Lansing | MI | 48917 |
| A-Z Electrical Services Inc | 1406 Forest Bay Dr | Waterford | MI | 48328 |
| B & B Electric | P.O. Box 674 | Goodrich | MI | 48438 |
| B & B MECHANICAL SERVICES, LLC | 8475 Sparta Line Road | Sparta | MI | 49345 |
| B & C Ten Air HVAC Systems Inc. | 41441 Eleven Mile Rd | Novi | MI | 48375 |
| B & D Electirc Inc. | 7606 Northport Dr. | Lansing | MI | 48917 |
| B & D Heating and Cooling, Inc. | 1148 North Van Dyke | Bad Axe | MI | 48413 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| B & D MECHANICAL | 52420 Stuck Rd. | Marcellus | MI | 49067 |
| B & G Pluming & Heating | 6561 US41 South | Marquette | MI | 49855 |
| B & T Electric Inc. | 5506 Gratiot Ave | St. Clair | MI | 48079 |
| B & T ELECTRIC, INC. | 5506 Gratiot Rd. | St. Clair | MI | 48079 |
| B & V Electric Co. | 8943 Quail Court/17401 East Ten Mile Road | Plymouth Township/ Eastpoint | MI | 48170 |
| B & V Mechanical | 400 32nd Street SE | Wyoming | MI | 49548 |
| B and P Electric, LLC | 27964 Southpointe | Grosse Ile | MI | 48138 |
| B&C TEN AIR HVAC SYSTEMS, INC. | 41441 Eleven Mile Rd. | Novi | MI | 48375 |
| BALLARD'S PLUMBING AND HEATING | P.O. Box E | Petoskey | MI | 49770 |
| Ballfrey & Johnston | 7431 W. 8 Mile | Detroit | MI | 48221 |
| BanahCorp | P.O. Box 300400 | Drayton Plains | MI | 48330 |
| BARIL PLG, HTG, & CLG INC. | 2917 Ashmun St. | Sault Ste. Marie | MI | 49783 |
| Barton Malow | 26500 American Drive | Southfield | MI | 48034 |
| Bass (Building Automated Systems & Services) | 6260 18 1/2 Mile Rd | Sterling Heights | MI | 48314 |
| Bass Controls | 6260 18 1/2 Mile Road | Sterling Hts | MI | 48314 |
| BAUMANN AND DEGROOT, INC | 116 E Lakewood Blvd | Holland | MI | 49424 |
| BAY CONTROLS, LLC. | 6528 Weatherfield Ct. | Maumee | OH | 43537 |
| Bay View Electric | 12230 Dixie | Redford | MI | 48239 |
| BAYVIEW ELECTRIC COMPANY, LLC | 12230 Dixie Street | Redford | MI | 48239 |
| BD ENERGY SAVER INC | 27925 Arlington Drive | Southfield | MI | 48076 |
| BDT Light Source | 31659 Glendale | Livonia | MI | 48150 |
| BDT LIGHTSOURCE | 26677 W Tweleve Mile | Southfield | MI | 48034 |
| Beal, Inc. | 221 Felch St | Ann Arbor | MI | 48103 |
| BEATY BROTHERS, INC. | 19305 Elwell | Belleville | MI | 48111 |
| Beautiful Basements | 22517 Telegraph Road | Southfield | MI | 48033 |
| Beckering Advisor, Inc. | 650 44th Street SE | Grand Rapids | MI | 49548 |
| Bei Mechanical | 504 Snapdragon | Dewitt | MI | 48820 |
| Bekaert Corporation | 1395 S. Marietta Pkwy, Suite 708 | Marietta | GA | 30067 |
| Bel-Aire Heating & Air Conditioning | 781 Lenox | Portage | MI | 49024 |
| Bel-Aire Htg & A/C | 1435 Century Sw | Grand Rapids | MI | 49503 |
| Belco Industries | 9138 W. Belding Rd. | Belding | MI | 48809 |
| Bell & Son's | 26514 W. Seven Mile Road | Redford | MI | 48240 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Bel-Mac Contractors LLC | 5364 General Squire | Dryden | MI | 48428 |
| Bennett & Dent Heating & Cooling | 205 Himes | Wyoming | MI | 49508 |
| Bensman Light Source | 27766 W. 12 Mile | Southfield | MI | 48034 |
| Berbiglia Associates | 36400 West 12 Mile Road | Farmington Hills | MI | 48331 |
| Berbiglia Associates Inc. | 36400 West 12 Mile Rd. | Farmington Hills | MI | 48331 |
| Berger & King Inc. | 1912 Ludington | Escanaba | MI | 49829 |
| Bert Blain HVAC | 1618 128 Ave. | Hopkins | MI | 49328 |
| Bertacci Inc. | 899 Woodlea St | Birmingham | MI | 48009 |
| Best Aire LLC | 3648 Rockland Circle | Millbury | OH | 43447 |
| Best Heating | 607 Railroad Ave | Norway | MI | 49870 |
| BEST HEATING & AIR CONDITIONING INC | 607 Railroad Avenue | Norway | MI | 49870 |
| Best Lights, Inc | 100 Park Dr | Troy | MI | 48083 |
| BEST LIGHTS, INC. | 100 Park | Troy | MI | 48083 |
| BESTECH ENERGY SYSTEMS | 6386 Hartland Rd. | Fenton | MI | 48430 |
| BETA Design Architects and Engineers | 70 Lonia Avenue SW Suite 400 | Grand Rapids | MI | 49503 |
| Better World Builders | 315 Prospect St., | Kalamazoo | MI | 49006 |
| Beyerlein Electric | 1680 S. Bradleyville Rd. | Reese | MI | 48757 |
| BFG Supply Co. | 14500 Kinsman Rd. | Buron | OH | 44021 |
| BGI BRIGHT GREEN | 116 Clair | Mount Clemens | MI | 48043 |
| BIC | 26711 Woodward Ave Suite 307 | Huntington Woods | MI | 48070 |
| Big A Electric | 1461 Elias | Westland | MI | 48186 |
| Bill Elwood Inc | 46870 Middle Brook Dr | Macomb | MI | 48044 |
| BILLY ELECTRIC, INC. | 3807 19th Ave. N | Escanaba | MI | 49829 |
| Binford Electric | 2221 Dorothea | Berkley | MI | 48072 |
| Binski Electric | 4902 Smith Creek Rd. | Kimball | MI | 48074 |
| Bishop Heating & Air Conditioning | 2150 E. Laketon Ave | Muskegon | MI | 49442 |
| BISHOP HEATING CO. | 2150 E. Laketon | Muskegon | MI | 49442 |
| BJORN JOHNSON MECHANICAL HEATING REFRIGERATION | N6010 Hwy M95 | Iron Mountain | MI | 49801 |
| BLAGEC BROTHERS, INC. | 114 Chestnut Street | Kingsford | MI | 49802 |
| Blake Lord Associates Inc. | 237 West Palatine Rd. | Palatine | IL | 60067 |
| BLAKESLEE & SON, INC. | 198 Northland Drive N.E. | Rockford | MI | 49341 |
| Blakeslee and Son, Inc. | 198 Northland Drive | Rockford | MI | 49341 |
| Blank Electric | 3647 W. Washington Street | Snover | MI | 48472 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| BLANKET INSULATION | 21676 Melrose Avenue | Southfield | MI | 48075 |
| Blessing Company | 122 East Grand Blanc Road | Grand Blanc | MI | 48439 |
| Blessing Company Plumbing Heating & Air Conditioning | 122 E. Grand Blanc Rd. | Grand Blanc | MI | 48439 |
| BLI Lighting | 15275 Minnetonka Blvd | Minnetonka | MN | 55245 |
| B-Line Electric Inc. | 21457 31 Mile Rd. | Ray | MI | 48096 |
| Bloom General Contracting | 25601 W 8 Mile Rd | Redford | MI | 48240 |
| Bloom Roofing Systems Inc | 12238 Emerson Drive | Brighton | MI | 48116 |
| BLOOMFIELD STAIRS AND REMODELING, INC. | 4433 Bunker | West Bloomfield | MI | 48323 |
| Bloxsom Roofing and Siding Company | 3733 Blair Town Hall Road | Traverse City | MI | 48684 |
| Blue Lighting Illumination and Design | 2223 NW Cameo Lane | Ankeny | IA | 50023 |
| Blue Ray Mechanical Inc. | 22606 John R Rd. | Hazel Park | MI | 48030 |
| Blue Star Energy | 363 W. Erie St., Suite 700W | Chicago | IL | 60654 |
| Blue Water Boiler | 7557 Markel Rd | Fair Haven | MI | 48023 |
| BLUECOLT LIGHTING | 1630 Timber Trail | Ann Arbor | MI | 48103 |
| Bluestone Energy Services LLC | 136 Longwater Drive, Ste. 103 | Norwell | MA | 02061 |
| Bluestone Energy Services, LTD | 136 Longwater Dr. Suite 103 | Norwell | MA | 02061 |
| BML Building Maintenance LLC | 33275 Boulder Dr. | North Ridgeville | OH | 44039 |
| B-N-S ELCTRIC, INC. | 860 Livernois | Ferndale | MI | 48220 |
| Boat Town Electric | 31713 South River Rd. | Harrison Twp. | MI | 48045 |
| Bob Beckett | 1382 Ruffner Avenue | Birmingham | MI | 48009 |
| BOB'S SHEET METAL HEATING & AIR COND. INC. | 1001 Ethel Avenue P.O. Box 368 | Hancock | MI | 49930 |
| Bogart Construction Inc. | 3686 Squires Place | Howell | MI | 48855 |
| BOGROFF HEATING & COOLING, INC. | 2917 N. 47 Rd. | Manton | MI | 49663 |
| Boilers and More Co Inc | 5884 LaComb Road | Alpena | MI | 49707 |
| Bolt Electrical Contracting Inc | 2240 Boldt | Dearborn | MI | 48124 |
| Bonds Electric, Inc. | 610 W. Michigan Ave. | Ypsilanti | MI | 48197 |
| Boone & Darr | P.O. Box 1718 | Ann Arbor | MI | 48106 |
| Boonstra Electric | 675 Milford Meadows | Milford | MI | 48381 |
| BOTTOMLINE ENERGY SOLUTIONS. LLC | 2229 Apsley Boulevard | Toledo | OH | 43617 |
| BOVA Electric | 2124 Park Place Dr. | Walled Lake | MI | 48390 |
| Bozeks Heating & Cooling LLC | 2148 Hartwick Lane | Howell | MI | 48855 |
| BRAKEMAN PRODUCTS INC. | 27390 Wellington | Franklin | MI | 48025 |
| Brandle Roofing and Sheet Metal | 3400 Centennial Drive | Midland | MI | 48642 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Brandon Electric Inc. | 1650 E. Auburn Rd. | Rochester Hills | MI | 48307 |
| Brasile Electric | 45576 Keding | Utica | MI | 48317 |
| Bratcher Electric Inc | 35728 Van Born | Wayne | MI | 48184 |
| BRATIC ENTERPRISE LLC | 1316 E 4th Street | Royal Oak | MI | 48067 |
| Braun Electric Company, LLC | 1271 Purdy Lane | Howell | MI | 48843 |
| Brehob Corp. | 1441 Combermere Drive | Troy | MI | 48083 |
| Brennan Electrical Contractors, Inc. | 1352 A Combermere Drive | Troy | MI | 48083 |
| Brian Bowerman | 850 Barn Swallow Lane | Milan | MI | 48160 |
| Briarwood Heating & Cooling | 46851 Dequindre | Rochester Hills | MI | 48307 |
| Bri-Car Roofing and Sheetmetal | 4597 S Garfield Rd. | Auburn | MI | 48611 |
| Bright Green Ideas | 116 Clair st | Mt Clemens | MI | 48043 |
| Bright Green Systems | 3914 McKinley | Dearborn Heights | MI | 48125 |
| Bright Light Electric | 2625 W Longlake Rd | W Bloomfield | MI | 48323 |
| Bright Power Solutions | 45100 Sterritt, Ste.106 | Utica | MI | 48317 |
| BRIGHT POWER SOLUTIONS, INC. | 45100 Sterritt St, Ste 106 | Utica | MI | 48317 |
| BRIGHT SIDE INC. | 7501 Triangle | Sterling Heights | MI | 48314 |
| BRILLIANT LIGHTING ALTERNATIVES, LLC | 146 Turtle Trace | Pinckney | MI | 48169 |
| BRIO Development | PO Box 399 | Milford | MI | 48381 |
| Broder & Sachse Real Estate Services, LLC | 260 E Brown St. | Birmingham | MI | 48009 |
| BROOKLYN INSULATION | 134 Nottingham Dr | Brooklyn | MI | 49230 |
| Brothers Services Group, Inc. | 3390 Porter | Ann Arbor | MI | 48103 |
| Brovo Lighting, LLC | 706 Front St | Louisville | CO | 80027 |
| BROWN-SCHROEDER & CO. | 225 E. Hudson Ave | Royal Oak | MI | 48067 |
| Brown-Schroeder and Co Inc | 4321 Delemere Ct. | Royal Oak | MI | 48073 |
| Bruce Rees Electric | 5766 Ewalt Rd | Imlay City | MI | 48444 |
| Bryan Wisniewsky | 2650 Trautner Drive | Saginaw | MI | 48603 |
| BUDS HEATING & COOLING | 4643 Middle St. | Columbiaville | MI | 48421 |
| BUILDER SERVICES GROUP, INC | 3030 Sangra Ave SW#101 | Grandville | MI | 49418 |
| Building Complete Maintenance | 595 Forest Suite 5B | Plymouth | MI | 48170 |
| Building Inspection Services | 25430 Westmoreland | Farmington Hills | MI | 48336 |
| BUILDING PERFORMANCE BY DESIGN, INC | 2051 S Huron Rd | Kawkawlin | MI | 48631 |
| BUILDING PERFORMANCE SOLUTIONS INC | 28115 Dohran Dr | Warren | MI | 48088 |
| BUILDING PERFORMANCE TESTING AND ANALYSIS, LLC | 31120 Sheridan | Beverly Hills | MI | 48025 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| BUILDING SCIENCE ENERGY SERVICES | PO Box 234 | Sparta | MI | 49345 |
| Bulldog Boiler Rentals Inc. | 1641 Caniff | Hamtramck | MI | 48212 |
| Bulldog Electric Company | 48959 Celeste | Chesterfield Twp. | MI | 48051 |
| BurCon Services Inc | 12526 Velp Ave | Green Bay | WI | 54313 |
| Burt Realty Co. | 23821 Hazen | Southfield | MI | 48033 |
| BURTON AND SONS INC | 32900 Manor Park | Garden City | MI | 48135 |
| C & C Building Automation Company, Inc. | 390 Swift Ave., Suite 22 | South San Fransisco | CA | 94080 |
| C & G Electric | 7183 24 Mile Road | Shelby Township | MI | 48316 |
| C & J Electrical | 32728 West 8 Mile Road | Farmington | MI | 48336 |
| C & J ELECTRICAL SERVICES | 32728 W. Eight Mile Rd. | Farmington | MI | 48336 |
| C & S SERVICES LLC | 2056 Davison RD. | Lapeer | MI | 48446 |
| C & T Electrical Contractors | 24248 Leatham | Eastpointe | MI | 48021 |
| C.G.E. Electrical Service | 26617 Grand River Rd. | Redford | MI | 48240 |
| Cable Energy | P.O. Box 730 | Fair Haven | MI | 48079 |
| Cable Energy, LLC | 7423 Broadbridge Rd | Marine City | MI | 48039 |
| CADENA HEATING AND COOLING, LLC | 2686 Fairbrook Drive | Jenison | MI | 49428 |
| CAE Construction | 5817 Thornaby | Waterford | MI | 48329 |
| Calhoun-Ayers Plumbing & Heating, Inc. | 4740 N. Peterson Rd. | Ludington | MI | 49431 |
| Caliber Electric | 50577 Jim DR | Chesterfield | MI | 48047 |
| Calo Plumbing | 830 Pleasant | Boyne City | MI | 49712 |
| Calumet Building Group, LTD | 5761 N. Hawkeye CT., SW | Grand Rapids | MI | 49509 |
| Calverley Heating & Cooling | 24321 John R Rd. | Hazel Park | MI | 48030 |
| CAMPBELL THERMOGRAPHY LLC | 1059 Shady Oaks Dr | Ann Arbor | MI | 48103 |
| CAMPBELL, INC | 1077 James L Hart Parkway | Yspilanti | MI | 48198 |
| Canfield Plumbing & Heating | 411 E Main | Lowell | MI | 49331 |
| Caniff Electric Supply | 2001 Caniff Ave | Hamtramck | MI | 48212 |
| Canton Construction Corp | 5914 N Lotz Rd | Canton | MI | 48187 |
| CAPITAL CONSTRUCTION GROUP, LLC | 343 Daubony Dr. | Brighton | MI | 48114 |
| Capitol Light | 270 Locust St | Hartford | CT | 06114 |
| CAPPY HEATING & AIR CONDITIONING | 12551 Globe St | Livonia | MI | 48150 |
| CARBON CREDIT ENVIRONMENTAL SERVICES | 440 Burroughs St. | Detroit | MI | 48202 |
| CARBON CREDIT ENVIRONMENTAL SERVICES, INC | 13040 Merriman Rd, Suite 300 | Livonia | MI | 48150 |
| Carms Electric Company | 16130 Cleophus Ave | Allen Park | MI | 48101 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| CARPENTERGUY | 1600 Longshore | Ann Arbor | MI | 48105 |
| Carrier Coproration | 39205 Country Club Dr. | Farmington Hils | MI | 48331 |
| Casa De Santiago, LLC | 240 Chene St. | Detroit | MI | 48207 |
| CASCADE RENEWABLE ENERGY | 3400 Innovation Court | Grand Rapids | MI | 49512 |
| Cas-Harbert Energy Solutions | 5937 McFarland Dr | Plano | TX | 75093 |
| CAT Electric | 55176 Hagen Drive | Shelby Township | MI | 48315 |
| Catalyst Management Group | 148 West Walton Blvd | Pontiac | MI | 48340 |
| Catalyst Management Group/CMG Construction Div | 10 W Pike Street | Pontiac | MI | 48342 |
| Catalyst Management Group/CMG Construction Div. | 10 W. pike Street | Pontiac | MI | 48342 |
| Catalyst-Partners | 502 2nd St. NW | Grand Rapids | MI | 49504 |
| CBRE, Inc. | 400 Renaissance Center Suite 2500 | Detroit | MI | 48243 |
| CCD Construction | 72340 Russ Rd | Richmond | MI | 48326 |
| CCG LED Solutions | 917 A.E.C Drive | Wood Dale | IL | 60191 |
| CCT CONTRACTING & ASSOC. LLC | 16662 Robson | Detroit | MI | 48235 |
| CDC Energy Consultants LLC | 28905 Grayfield Drive | Farmington Hills | MI | 48336 |
| CDC ENERGY CONSULTANTS, LLC | 28905 Grayfield Dr | Farmington Hills | MI | 48336 |
| CEC COMBUSTION SERVICES GROUP | 11699 Brookpark Road | Cleveland | OH | 44130 |
| CEC Electric | PO Box 224 | Durand | MI | 48429 |
| Cedar Heating & Cooling | P.O. Box 339 | Cedar Spring | MI | 49319 |
| Cedar Valley Enterprises | 7704 W. Akron Road | Fairgrove | MI | 48753 |
| CEI Electric | 3140 Ruler Drive | Commerce Township | MI | 48390 |
| Center Line Electric, Inc | 26554 Lawrence | Center Line | MI | 48015 |
| Center State Electric | 3388 N. Elms Rd. | Flushing | MI | 48433 |
| CentiMark Corporation | 38750 Ford Road | Westland | MI | 48185 |
| Certified Electric Inc | 7974 Lochlin Dr, Suite B1 | Brighton | MI | 48116 |
| Certified Temperature Innovations | 3107 Custre Rd. | Carsonville | MI | 48419 |
| Chamberlin Power, LLC | 7975 E Dale Lane | Scottsdale | AZ | 85266 |
| Charge Electric, Inc. | 24 Frank Lloyd Wright Drive | Ann Arbor | MI | 48106 |
| Chelsea Lumber Company | 1 Old Barn Circle | Chelsea | MI | 48118 |
| Chevron Energy Solutions | 4040 Embassy Parkway, Suite 270 | Akron | OH | 44333 |
| CHOICE WINDOWS & SIDING INC. | 6623 Middlebelt | Garden City | MI | 48135 |
| Choproeep Co. | 5311 N. Kedzie Ave. | Chicago | IL | 60625 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Chris Carr Mechanical | 2360 N. Amber Rd. | Scottville | MI | 49454 |
| Christman Company | 38701 Seven Mile Rd, Suite 435 | Livonia | MI | 48152 |
| CHUCK HOUK, INC. | 205 2nd St. | Ludington | MI | 49431 |
| CI Engineering Solutions | 4460 Rivergate Dr. | Clinton Twsp | MI | 48038 |
| Ciamillo Heating and Cooling | 24913 Schoenherr | Warren | MI | 48089 |
| Cimate Control Heating & Air Conditioning | 173 S. 168th Ave. | Holland | MI | 49426 |
| Circle Heating & Cooling Co | 17945 Allen Road | Melvindale | MI | 48122 |
| CISCO | 4565 Hermen St. S.W. | Grand Rapids | MI | 49509 |
| City Creations Inc | 17170 Hubbell Ave | Detroit | MI | 48235 |
| City Electric Supply | 727 W Ellsworth Rd. | Ann Arbor | MI | 48108 |
| City of Trenton | 1431 West Rd | Trenton | MI | 48183 |
| CJ Mirror Lighting Systems | 7434 Augusta Dr | Washington | MI | 48094 |
| CKGP /PW & Associates, Inc. | 989 Chicago Rd. | Troy | MI | 48083 |
| Clark Building Company | 8451 Stout Avenue | Warren | MI | 48083 |
| Clark Construction Company | 3535 Moores River Dr. | Lansing | MI | 48901 |
| CLARK'S CONSTRUCTION CO. | 18109 Livernois | Detroit | MI | 48221 |
| Classic Haeting and Cooling, Inc. | 106 McLean Dr. | Romeo | MI | 48065 |
| CLAYTON S. EBY BUILDING SERVICES, INC | P.O. Box1800 | Alanson | MI | 49706 |
| CLEAN ENERGY COALITION | 924 N. Main, Suite 2 | Ann Arbor | MI | 48104 |
| Clean Light Green Light | 24501 N. River Rd. | Mt. Clemens | MI | 48043 |
| Clear Electric | 134 Brown Street | St. Clair | MI | 48079 |
| Clear Energy Contracting | 438 E. Millsap Road, Suite 200 | Fayetteville | AR | 72703 |
| CLEAR FORTRESS WINDOW FILM, LLC | 1246 Edenbrook Court | Wixom | MI | 48393 |
| CLEAR WATER POOL AND SPA, INC | 11844 Hubbard, Suite D | Livonia | MI | 48150 |
| CLEMENTS ELECTRIC INC. | 204 S. Dean | Bay City | MI | 48706 |
| CLIMATE CONTROL HEATING AND COOLING | 4865 Oslund Rd | Mancelona | MI | 49659 |
| Climate Technology | 42692 Proctor Rd. | Canton | MI | 481811 |
| CLIMATEPRO HEATING & COOLING | 16500 Hemlock Drive | Spring Lake | MI | 49456 |
| CLOR LIGHTING GROUP | 18524 Mack Ave. | Grosse Pointe Farms | MI | 48236 |
| Clor Lighting Group LLC | 18524 Mack Ave | Grosse Pointe Farms | MI | 48236 |
| CLS Facility Services | 35350 Curtis Blvd., Suite 200 | Eastlake | OH | 44095 |
| CLS Mechanical, Inc. | 3201 W. Grand Ledge Hwy P.O. Box 0077 | Mulliken | MI | 48861 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| CMC Plumbing, Heating & Cooling | 4907 Leafdale | Royal Oak | MI | 48073 |
| CMR Mechanical, LLC | 3611 Central Street | Dexter | MI | 48130 |
| CNS Electric Co. | 1118 Millard Ave. | Royal Oak | MI | 48073 |
| COASTLINE POWER & LIGHTING, LLC | 8859 Dixie HWY | Fair Haven | MI | 48023 |
| Cobblestone Park | 10509 Cobblestone Blvd | Davison | MI | 48423 |
| Cobra Electrical Services | 1361 Bradley | Troy | MI | 48085 |
| COCHRANE SUPPLY & ENGINEERING | 30303 Stephenson Hwy | Madison Heights | MI | 48071 |
| Coffee Electric Inc. | 7246 Shenandoah | Allen Park | MI | 48101 |
| Coffey Electric | 9612 Beardslee | Perry | MI | 48872 |
| Coleman Hines | 20830 N Tatum Boulevard #330 | Phoenix | MI | 85050 |
| Colter Precision | 10051 East Highland Rd. Siote 29-261 | Howell | MI | 48843 |
| Colville Electric Co LLC | 15210 Toepfer Dr | Eastpointe | MI | 48021 |
| COMAU INC. | 21000 Telegraph Road | Southfield | MI | 48033 |
| Comfort 1 Heating & AC | 200 5th St. | Michigan Center | MI | 49254 |
| COMFORT 1 HEATING & AIR CONDITIONING | 200 5th Street | Michigan Center | MI | 49254 |
| Comfort A/C & Heating Co. | 15373 S. Telegraph Rd. | Monroe | MI | 48161 |
| COMFORT CONTROL HEATING & COOLING | 10470 Pennycress Ln | Mattawan | MI | 49071 |
| Comfort Electric | 4651 Fenwick Dr | Warren | MI | 48092 |
| Comfort First Heating & Cooling | 3375 N Waverly Rd. | Lansing | MI | 48906 |
| Comfort Zone Energy Savings | 10807 West "J" Avenue | Kalamazoo | MI | 49009 |
| COMFORT ZONE INSULATION, LLC | 18835 Toledo Hwy | Brownstown | MI | 48193 |
| COMMERCIAL BUILDING & RETROFIT, INC. | 100 Park Dr. | Troy | MI | 48083 |
| Commercial Contracting Corporation | 4260 North Atlantic Blvd | Auburn Hills | MI | 48326 |
| Commercial Maintenance & Supply Inc. | 3777 Chestnut Court | Oakland Township | MI | 48363 |
| COMPETITIVE LIGHTING INC. | 35034 Automation Dr. | Clinton Twp. | MI | 48035 |
| Complete Inspections | 2900 Canyonside Ct | Grand Rapids | MI | 49525 |
| COMPUTER ENVIRONMENTS, INC | 34147 Schoolcraft Road | Livonia | MI | 48150 |
| Computer Sciences Corporation | 6000 17 Mile Rd. | Sterling Hts | MI | 48310 |
| CONDOR HEATING & COOLING SPECIALISTS, INC. | 4065 Otis Ave. | Warren | MI | 48091 |
| ConEdison Solutions | 3101 W. Dr. Martin Luther King Jr. Blvd # 110 | Tampa | FL | 33607 |
| Conlon Installations Inc. | 30014 Rosebriar | St Clair Shores | MI | 48082 |
| Conserva Electric Supply Inc | 40350 Grand River Ave | Novi | MI | 48375 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| CONSERVABUILDERS | 45031 Grand River | Novi | MI | 48375 |
| Construction Services Management | 45144 Sheri Dr | Macomb | MI | 48044 |
| CONSTRUCTIONAL REMODELING | 18144 North Lauren Drive | Clinton Township | MI | 48038 |
| Conti Corporation | 6417 Center Dr. | Sterling Heights | MI | 48312 |
| Conti Electric | 6417 Center Drive | Sterling Heights | MI | 48312 |
| CONTINUUM SERVICES | One Towne Square, Suite 1600 | Southfield | MI | 48076 |
| Continuum Services LLC | One Towne Square, Suite 1680 | Southfield | MI | 48076 |
| Contract Electric Company | 19646 Coral Gables | Southfield | MI | 48076 |
| Contractors Building Supply | 16880 Front Street | Copemish | MI | 49625 |
| CONTROL COOLING & HEATING | 1256 Kalamazoo S.E. | Grand Rapids | MI | 49507 |
| Control Logic of Michigan | 3395 Kraft Ave. SE | Grand Rapids | MI | 49512 |
| Control Rite Inc | 6503 Arrow Road | Sterling Hts | MI | 48314 |
| Controlled Temperature, Inc | 1897 Best Drive | Walled Lake | MI | 48390 |
| Control-Net LLC | PO Box 2092 | Kalamazoo | MI | 49003 |
| Conus Electric LLC | 967 Belle River Road | East China | MI | 48054 |
| CooLED | P.O. Box 907 | Traverse City | MI | 49685 |
| Cooper Electric | 425 E Huron | Vassar | MI | 48768 |
| COOPER MECHANICAL SERVICES | 7900 Meade St | Montague | MI | 49437 |
| Coral Performance Lighting | 11464 Bailey Dr. NE | Lowell | MI | 49331 |
| Corby Energy Services Inc. | 6001 Schooner Drive | Belleville | MI | 48111 |
| Core Consulting Group | 2573 Palm Dale Dr. | Grandville | MI | 49418 |
| Core Design Group | 47448 Pontiac Trail, Suite 304 | Wixom | MI | 48393 |
| Cornerstone Design, Inc. | 310 Depot St., Ste 2 | Ann Arbor | MI | 48104 |
| Corr Energy Consulting | 3925 Klais Dr. | Clarkston | MI | 48348 |
| Corrigan Construction | 775 N 2nd St | Brighton | MI | 48116 |
| Cotton Insulation, Inc | 5180 West River Dr | Comstock Park | MI | 49321 |
| Country Electric Inc. | 7283 O'Neil | Howell | MI | 48855 |
| COUNTRYSIDE HEATING & COOLING, INC. | 8691 West Olive Rd. | West Olive | MI | 49460 |
| County Electric, LLC | 815 N. Locust St. | Ottawa | OH | 45875 |
| County Line Electric | 10601 N. County Line Highway | Milan | MI | 48160 |
| Cox Electric | 3484 Hadley Rd. PO Box 259 | Hadley | MI | 48440 |
| CPH | 130 E. Ainsley | Hale | MI | 48739 |
| CQR Contracting | 53796 Pine Creek Ct. | Shelby Township | MI | 48316 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| CR Meyer | 1717 N 26th Street | Escanaba | MI | 49829 |
| CRAFT ELECTRIC, INC. | 112 W. Porter St. | Jackson | MI | 49202 |
| Crampton Electric Company, Inc. | PO Box 380 | Fowlerville | MI | 48836 |
| C-Ray Enterprises, LLC | 1740 Hollywood Ave | Grosse Pointe Woods | MI | 48236 |
| C-Ray Industrial Lighting | 1740 Hollywood | Grosse Pointe Woods | MI | 48236 |
| Creative Rebuilding Company | 1015 Rodd Street | Midland | MI | 48640 |
| CRESIT ENERGY | 4082 Biddle Ave | Wyandotte | MI | 48192 |
| CRESIT ENERGY, LLC | 4082 Biddle Ave. | Wyandotte | MI | 48192 |
| CRG ELECTRIC LLC | 18203 Boyd | Belleville | MI | 48111 |
| Crook Electric Co | 20729 Sunnydale St | Farmington Hills | MI | 48336 |
| CROOK ELECTRIC CO. | G145 Millett Ave | Sterling Heights | MI | 48312 |
| Crown Enterprises, Inc. | 12225 Stephens Rd. | Warren | MI | 48089 |
| CROWN HEATING | 24521 W. McNichols | Detroit | MI | 48219 |
| Crystal Electric Co. LLC | 51464 Oro Drive | Shelby Township | MI | 48315 |
| CRYSTAL VALLEY HEATING & COOLING | 7682 N. 126th Ave. | Hart | MI | 49420 |
| CSM Mechanical | 7400 Hickory Valley Drive | Fenton | MI | 48430 |
| CT0 Builders, Inc. | PO Box 361 | Hugo | MN | 55038 |
| CTI and Associates, Inc. | 51331 W. Pontiac Trail | Wixom | MI | 48393 |
| CTI Buildings & Maintenance Group | 12225 Stevens Road | Warren | MI | 48089 |
| CTI Mechanical Contractors, Inc. | 14910 6 1/2 Mile Rd. | Battle Creek | MI | 49014 |
| CTRL Systems | 1004 Littlestown Pike, Suite H | Westminster | MD | 21157 |
| Cunningham-Limp | 39300 W Twelve Mile Rd, #200 | Farmington Hills | MI | 48331 |
| Current Designs | 2237 General Motors Road | Milford | MI | 48380 |
| Current Electric- Now Munson Electric | 2685 Platt | Ann Arbor | MI | 48104 |
| Current Solutions Inc. | 51244 Danview Technology Ct. | Shelby Township | MI | 48316 |
| Custom Built | 2037 W. Grand Blvd, Suite C | Okemos | MI | 48864 |
| CUSTOM CLIMATE SYSTEMS, INC. | 9146 Horseshoe Ct. | Dexter | MI | 48130 |
| Custom Enclosures | 1030 Elmsford | Clawson | MI | 48017 |
| Custom Home Insulation, Inc. | 3306 Brighton Rd. | Howell | MI | 48843 |
| CUSTOM SHEET METAL & HEATING | 9444 N. US 31 | Free Soil | MI | 49411 |
| CUSTOM TEMPERATURE CONTROL INC. | 158 S. Rochester Road | Clawson | MI | 48017 |
| D & B Electric Co. | 33125 Louise Ave | Clinton Township | MI | 48035 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| D & G Heating & Cooling | 19140 Farmington Road | Livonia | MI | 48152 |
| D & G Heating and Cooling co. | 19140 Farmington Rd. | Livonia | MI | 48152 |
| D & L PLUMBING, HEATING, AND AIR CONDITIONING | 1512 N Stephenson Ave, PO Box 159 | Iron Mountain | MI | 49801 |
| D & R Builders Heating & Cooling | 936 Turtle Rd. | Mason | MI | 48854 |
| D & R ENERGY SERVICES, INC. | PO Box 1013 | Brighton | MI | 48116 |
| D & W Mechanical | 1266 Industry Dr Ste A | Traverse City | MI | 49686 |
| D&W MECHANICAL | 1266 Industry Dr. Suite A | Traverse City | MI | 48696 |
| D. BRENT ASSOCIATES, INC. | P.O. Box 64 | Oxford | MI | 48371 |
| D. J. Conley Associates | 2694 Elliott Ave. | Troy | MI | 48079 |
| D.J. Conley | 2694 Elliott Avenue | Troy | MI | 48083 |
| D.J. Maltese | 888 N.Mill St. | Plymouth | MI | 48170 |
| D/A MECHANICAL, LLC | 1128 Eureka Rd. | Wyandotte | MI | 48192 |
| D3 Distributors LLC | 5430 Gatewood Drive | Sterling Heights | MI | 48310 |
| DA Electric | 1144 Eureka Rd. | Wyandotte | MI | 48192 |
| DA Mechanical, LLC | 1128 Eureka Road | Wyandotte | MI | 48192 |
| Daddy's Toyshop Inc | 3190 W Doumgington | Snover | WI | 48472 |
| Dalstra Roofing Inc. | 616-363-3271 | Grand Rapids | MI | 49525 |
| Damian Farrell Design Group. PLLC | 3011 Miller Rd. | Ann Arbor | MI | 48103 |
| Dan Jordan Electric | 51895 Chesterfield Rd. | Chesterfield | MI | 48051 |
| Dan Wood Plumbing & Heating | 40400 Grand River Suite F | Novi | MI | 48375 |
| Dana Energy Savers, Inc | 37809 Groesbeck Hwy | Clinton Twp | MI | 48036 |
| Danboise Mechanical Inc | 31625 Grand River Avenue | Farmington | MI | 48336 |
| Daniel Electric | 3000 Auburn | Auburn Hills | MI | 48326 |
| Dart Construction Company | 4008 E 8 Mile Rd | Detroit | MI | 48234 |
| Dave Frey and Son | 42010 Koppernick #106 | Canton | MI | 48187 |
| Dave Lamb Heating & Air Conditioning, Inc. | 409 E. Caroline | Trenton | MI | 48430 |
| Dave Lamb Heating and AC | 409 E Caroline St. | Fenton | MI | 48430 |
| Dave's Electric | 478S Dixie Highway, Suite A | Waterford | MI | 48329 |
| Dave's Electrical Services | 5279 Dixie Hwy | Waterford | MI | 48329 |
| David Dermer Electric | 14470 Vernon St | Oak Park | MI | 48237 |
| DAVID F. DAVIDSON | 9498 Silverside Drive | South Lyon | MI | 48178 |
| DAVID SCHMITTOU - BUILDER | 27577 Hanover | Westland | MI | 48186 |
| David's Heating and Cooling, Inc | PO Box 2742 | Southfield | MI | 48037 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Davis Designer Homes, Inc. | 22239 Roberts Rd. | Northville | MI | 48167 |
| Davis Heating & Cooling | 10831 Capital | Oak Park | MI | 48237 |
| DAVIS RESIDENTIAL HEATING & COOLING, INC. | 23440 Beverly | Oak Park | MI | 48237 |
| DC ILLUMINATIONS | 2655 Orchard Lake Rd. Suite 127 | Sylvan Lake | MI | 48320 |
| DC Illuminations Inc | 2655 Orchard Lake Road Suite 127 | Sylvan Lake | MI | 48320 |
| De Weerd & Van Dyke, Inc. | 3790 Chicago Dr. | Hudsonville | MI | 49426 |
| Dealer Lighting | 9719 Cedar Island Road | White Lake | MI | 48386 |
| Dean Boiler Inc | 1824 3 Mile Rd NW | Grand Rapids | MI | 49544 |
| DEAN BOILER, INC. | 1824 Three Mile Rd NW | Grand Rapids | MI | 49544 |
| Dean Electric, Inc. | 1575 W. Hamlin Rd. | Rochester Hills | MI | 48309 |
| DE-CAL, Inc. | 24659 Schoenherr | Warren | MI | 48089 |
| Dee Cramer Inc. | 4221 E. Baldwin Rd. | Holly | MI | 48442 |
| Deere Electric Inc. | 10684 Cason Highway | Tecumseh | MI | 49286 |
| Dehondt Electric | 7457 21 Mile Road | Sterling Hts | MI | 48317 |
| Deisler Electric Inc. | P.O. Box 126 | Durand | MI | 48429 |
| Del Ozone | 833 Mill Rd. | Pleasantville | NJ | 08232 |
| DELOOF BUILDERS L.L.C | 7509 West S Ave | Schoolcraft | MI | 49087 |
| Delta Electric Services | 5556 Allen Road | Allen Park | MI | 48101 |
| Delta Industrial | 51825 Gratiot Ave | Chesterfield | MI | 48051 |
| Delta Roofing | 6601 Pineherst | Dearborn | MI | 48126 |
| DELTA STAR ELECTRICAL CONTRACTING CO., INC. | 1532 Lakewood Dr. | Troy | MI | 48083 |
| Delta Temp | 500 Ajax | Madison Heights | MI | 48071 |
| DeLux Electric, Inc. | 32711 N. River Road | Harrison Twp. | MI | 48045 |
| Demand Electric | 5250 Lackie Rd. | Kinde | MI | 48445 |
| DENKEN ENGINEERED ELECTRIC, INC. | 1439 E. 11 Mile Rd. | Madison Heights | MI | 48071 |
| Denmark Heating & Cooling, Inc | 2280 N Hix | Westland | MI | 48185 |
| Dennis Electric LLC | 8375 Linden | Fenton | MI | 48430 |
| Dennis Jaworski Electric | 11840 Ina Drive P59 | Sterling Heights | MI | 48312 |
| Denny's Heating, Cooling & Refrigeration | 3166 Martin Rd | Commerce Twp | MI | 48390 |
| Denver Electric | P.O. Box 210670 | Auburn Hills | MI | 48321 |
| Dependable Heating & Cooling, Inc. | 2302 Wadhams Rd. | Kimball | MI | 48074 |
| Desert in Alaska Corp | 11402 Schaefer Hwy. | Detroit | MI | 48227 |
| Design Comfort | 5977 Brighton Pines Court | Howell | MI | 48843 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Designer Electric | 25123 Kingshire Rd | Southfield | MI | 48076 |
| Detroit Electrical Services | 1924 Rosa Parks Blvd. | Detroit | MI | 48216 |
| DETROIT SPRAY FOAM | 36189 Schoenherr | Sterling Heights | MI | 48312 |
| Devine Electrical Inc | 9569 W. Grand River | Fowerlville | MI | 48836 |
| DeWeerd Heating & Air Conditioning | 212 W. Superior St. | Wayland | MI | 49348 |
| DG Furi Electric | 22400 Rosedale St. | St Clair Shores | MI | 48080 |
| DH Redmond | 4905 Whipple Lake rd. | Clarkston | MI | 48348 |
| Diamond Environmental Solutions Inc | 10335 Cedarcrest Rd | Whitmore Lake | MI | 48189 |
| Diamond-J Enterprises | 4005 Five Mile Creek Rd | Harbor Springs | MI | 49740 |
| Dickson Schutt | 22016 Rosedale | St. Clair Shores | MI | 48080 |
| DiClemente Siegel Design Inc. | 28105 Greenfield Road | Lincoln Park | MI | 48076 |
| Diekema Hamann Engineering | 15 Ionia SW, Suite 330 | Grand Rapids | MI | 49503 |
| DILLON ENERGY SERVICES | 22100 Greater Mack Avenue | St. Clair Shores | MI | 48080 |
| Dillon Energy Services, Inc | 22100 Greater Mack Avenue, Suite 1 | St. Clair Shores | MI | 48080 |
| Dirkse Electric | 3038 Wakefield | Berkley | MI | 48072 |
| Distinctive Group Inc | 759 Construction CT Suite 2 | Zeeland | MI | 49464 |
| DIVERSIFIED HEATING & COOLING, INC. | 20789 Parker Street | Farmington Hills | MI | 48336 |
| Diversified Mechanical Services, Inc. | 844 W. River Center Drive | Comstock Park | MI | 49321 |
| DMS Electric, LLC | 1380 Ross Lane | Rochester | MI | 48306 |
| DONS HVAC | 5655 Main Street | Wells | MI | 49894 |
| DON'S HVAC INC | 5655 Main Street PO Box 389 | Wells | MI | 49894 |
| Doorr Heating & Cooling, Inc. | 989 S. Isabela | Mt. Pleasant | MI | 48858 |
| Doty Mechanical, Inc. - Heating, Cooling, and Geothermal | 615 S. Waverly Rd. | Lansing | MI | 48917 |
| Double D. Electric | 14180 Twin School Hwy | Millersburg | MI | 49759 |
| DOUGLAS ELECTRIC CO. | 759 Grove | Wynadotte | MI | 48192 |
| Douglas Electric Company | 759 Grove St | Wyandotte | MI | 48192 |
| DOVETAIL SOLAR AND WIND | 6551 White Pines Dr. | Brighton | MI | 48116 |
| Downriver Energy Auditing | 3414 15th | Wyandotte | MI | 48192 |
| Downriver Granite | 2876 Fifth Street | Trenton | MI | 48183 |
| Downriver Mechanical LLC | 7594 Weddel | Taylor | MI | 48180 |
| Dr. Energy Saver - Lansing | 2505 South Waverly Hwy | Lansing | MI | 48911 |
| DRAFT STOP ENERGY & INSULATION LLC | 1905 St. Clair St. | St. Clair | MI | 48079 |
| Dresseler Mechanical Inc. | 2051 Enterprise St at Indus | Marquette | MI | 49855 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| DROESE CONSTRUCTION INC. | 1309 West C. St. | Iron Mountain | MI | 49801 |
| DRU INSULTION | 1835 Crestline | Rochester | MI | 48307 |
| DTE Energy | 15600 19 Mile Rd | Clinton Twp | MI | 48038 |
| Duke Manufacturing | 2305 N. Broadway | St. Louis | MO | 63102 |
| Dunrite Heating & Cooling Systems Inc. | 26421 Plymouth Rd. | Redford | MI | 48239 |
| Durant Mechanical & Electrical Contractors, LLC | 16814 Hamilton | Detroit | MI | 48203 |
| Durant Plumbing & Heating Inc. | 7470 E. M-115 | Cadillac | MI | 49601 |
| Durant Plumbing and Heating, Inc. | 7470 E. M-115 | Cadillac | MI | 49601 |
| Durr Ecoclean, Inc. | 1350 Van Camp Rd | Bowling Green | OH | 43402 |
| Durr Systems Incorporated | 40600 Plymouth Rd. | Plymouth | MI | 48170 |
| Durr Systems, Inc | 40600 Plymouth Rd | Plymouth | MI | 48170 |
| DWELLTECH SOLUTIONS | 959 Wealthy Street | Grand Rapids | MI | 49506 |
| Dyer & DeWeerd Heating & Cooling | 1140 Jackson St | Grand Haven | MI | 49417 |
| Dyna-Brite Lighting | 630 Hamilton Ave | Nashville | TN | 37203 |
| Dynaelectric of Michigan | 25701 Commerce Dr | Madison Heights | MI | 48071 |
| Dynalectric Michigan (Shambaugh & Son LP) | 25710 Commerce Dr. | Madison Heights | MI | 48071 |
| Dynalectric of Michigan | 1743 Maplelawn | Troy | MI | 48084 |
| Dynamic Installations & Services | 17911 Deering | Livonia | MI | 48152 |
| Dynesco | 1901 NE, 162 Ave - Suite D105 | Vancouver | WA | 98694 |
| DZI Construction Services Inc | 8405 Andersonville Rd Suite F | Clarkston | MI | 48346 |
| E. Gilbert & Sons | 45887 Mound Road | Utica | MI | 48317 |
| E.L. ELECTRICAL CONTRACTING | 140 Engelwood Suite C | Orion | MI | 48359 |
| Eagle Electric | 1807 Samoset | Royal Oak | MI | 48073 |
| EAGLE MECHANICAL | 2512 W. Eason Dr | Howell | MI | 48855 |
| Earthwell Energy | 4443 Old Springfield Road | Vandalia | OH | 45377 |
| East Muskegon Roofing & Sheet Metal | 1665 Holton Road | Muskegon | MI | 49445 |
| Eastern Power & Lighting | 26341 Bryhoward | Madision Heights | MI | 48030 |
| Eastman Fire Protection Inc. | 1450 Souter | Troy | MI | 48083 |
| EASTVIEW CONSTRUCTION LLC | 415 Virginia Lane | Algonac | MI | 48001 |
| Eastwood Electric Inc. | 1195 Chicago Rd. | Troy | MI | 48083 |
| EATON CORPORATION | 40200 Grand River Ave. | Novi | MI | 48375 |
| Eaton Electric, INC. | 360 E. Maple Road, Suite H | Troy | MI | 48083 |
| Ebuild LLC | 23200 Sherman | Oak Park | MI | 48237 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Eckler Electric | 23900 Orchard Lake, Ste. 30 | Farmington | MI | 48336 |
| Eco Engineering, LLC | 11815 Highway Drive Suite 600 | Cincinnati | OH | 45241 |
| Eco Lighting | 5598 Northcrest Village Dr. | Clarkston | MI | 48346 |
| ECO PARKING LIGHTS | 9084 Technology Dr. Suite 300 | Fishers | IN | 46038 |
| ECOfficient Solutions, LLC | 25095 Firwood | Warren | MI | 48089 |
| Ecogate, Inc. | 5669 Whitnall Highway | North Hollywood | CA | 91601 |
| EcoGreen Energy Slutions, Inc. | 51194 Romeo Plank Road #206 | Macomb | MI | 48042 |
| Eco-Green-Energy LLC | 17401 E 10 Mile Rd | Eastpointe | MI | 48021 |
| Eco-Green-Energy, LLC | 44 Lakecrest Lane | Grosse Pointe Farms | MI | 48236 |
| EcoSunWind | c/o 800 LaPrairie | Ferndale | MI | 48220 |
| ECOTELLIGENT HOMES | 37728 Hills Tech Drive | Farmington Hills | MI | 48331 |
| Ecotelligent Homes LLC | 35289 Edythe Drive | Farmington Hills | MI | 48331 |
| Ecova, Inc. | PO Box 2443 | Spokane | WA | 99210 |
| Eco-Wise Living | PO Box 87342 | Canton | MI | 48187 |
| ECS Electric, INC | 47131 Ryan Road | Shelby Township | MI | 48317 |
| Ed Haass Sales Co. | 7311 Brighton Rd. | Brighton | MI | 48116 |
| ED HAASS SALES COMPANY | PO Box 778 | Brighton | MI | 48118 |
| Edge Electric LLC | 44039 N. Grosebeck Hwy. | Clinton Township | MI | 48036 |
| Edgewood Electric | 1225 Spartan Street | Madison Heights | MI | 48071 |
| EDI, A Shealy Company | 1515 S. Clarkson Street | Charlotte | NC | 28208 |
| Edmon Electrical | 42338 Stanton Drive | Sterling Heights | MI | 48314 |
| EDSS | 7892 W. Grand River Ave | Brighton | MI | 48114 |
| EELS LLC | 19151 Birmingham St. | Roseville | MI | 48066 |
| EFFECTIVE ENERGY SOLUTIONS | 56860 McKenzi Lane | South Lyon | MI | 48178 |
| Efficient Lighting Consultants | 31 Pecks Lane | Newtown | CT | 6470 |
| Efficient NRG Consultants | 521 McCarthy | Howell | MI | 48843 |
| Ehlers Heating & Air Conditioning | 30885 Eight Mile Rd | Livonia | MI | 48152 |
| EL Electric | 140 Engelwood Drive | Lake Orion | MI | 48359 |
| ELECTREX | 41775 Production Drive | Harrison Township | MI | 48045 |
| Electrex Co., Inc. | 41775 Production Drive | Harrison Twp | MI | 48045 |
| Electric One | 1027 Rosa Park Blvd. | Detroit | MI | 48216 |
| Electric Power & Design, Inc. | 18840 Woodworth | Redford | MI | 48240 |
| Electrica | 2555 Emmons | Rochester Hills | MI | 48307 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Electrical & Controls | 4977 Stoney Creek Drive | Kenockee | MI | 48006 |
| Electrical Eagle Co. | 17322 Cambridge | Southfield | MI | 48076 |
| Electrical Maintenance Corporation | 1671 Juiper Dr | Conklin | MI | 49403 |
| Electrical Management Company | 2741 Belsam Way | Sterling Heights | MI | 48314 |
| Electrical Repair Service | 42049 Brookview Ct. | Canton | MI | 48188 |
| Electrical Services Plus | 2550 Irish Road | Ida | MI | 48140 |
| Electrical Systems, Inc | 50413 Central Industrial Drive | Shelby Township | MI | 48315 |
| ELECTRO-MATIC PRODUCTS, INC. | 23409 Industrial Park Ct. | Farmington Hills | MI | 48335 |
| Electroserve | 119 Stonebridge Ct. | Ortonville | MI | 48462 |
| Electrotec Contracting Inc | 46582 Erb Dr | Macomb | MI | 48042 |
| Eliminator Lightings | 1039 Belle River Woods Blvd | East China | MI | 48054 |
| Elite Electric | 3760 Bay City Forrestville Rd | Ubly | MI | 48475 |
| Elite Indoor Comfort, Inc. | 2971 N. Horseshoe Dr. | Grandville | MI | 49418 |
| Elliot Food Equipment | 2224 West Willow St. | Lansing | MI | 48917 |
| Elliott Electric | 30124 Beverly Rd. | Romulus | MI | 48174 |
| EMC, LLC | 11100 Wayzata Blvd. Suite 170 | Minneapolis | MN | 55305 |
| EMI (Electrical Materials Incorporated) | 44262 Phoenix Drive | Sterling Heights | MI | 48314 |
| Empire Electric Supply | 3575 Vinewood | Detroit | MI | 48208 |
| Empire Supply | 11273 Country Lane | Pinckney | MI | 48169 |
| Empowerment Energy Analysts | PO Box 253 | Maple City | MI | 49664 |
| ENERGEN ELECTRIC, LLC | 3327 Grindley Park | Dearborn | MI | 48124 |
| Energen Electrical LLC | PO Box 2066 | Dearborn | MI | 48124 |
| ENERGY & BUILDING PERFORMANCE LLC | 124 W. Church St. | Clinton | MI | 49236 |
| Energy Auditors, LLC | 6615 Laken Avenue | Imlay City | MI | 48444 |
| Energy Chek | 4150 Western Pleasure | Milford | MI | 48381 |
| Energy Conservation & Supply Inc. | 55 Washington Street Suite 302A | Brooklyn | NY | 11201 |
| ENERGY CONTROL & DESIGN, INC. | 3137 North Roemer Road | Appleton | WI | 54911 |
| Energy Control and Design INC | 3137 Romer Road | Appleton | WI | 54911 |
| Energy Control Equipment | 407 Synder Ave. PO Box 2569 | Ann Arbor | MI | 48106 |
| Energy Control Solutions | P.O. Box 605 | Richmond | MI | 48062 |
| Energy Design Service Systems (EDSS) | 7892 W. Grand River | Brighton | MI | 48116 |
| ENERGY EFFICIENT CONSTRUCTION CO., INC. | 3829 West Road | Trenton | MI | 48183 |
| Energy Efficient Inc. | 800 W Main St. | Kersey | PA | 15846 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Energy Efficient Lighting Solutions/ DBA EEIS LLC | 19151 Birmingham St | Roseville | MI | 48055 |
| Energy Electric Services | 4220 Whitebirch | West Bloomfield | MI | 48323 |
| Energy Eyes, Inc. | 7492 Holborn Trail | West Bloomfield | MI | 48322 |
| Energy Logic Inc. | P.O. Box 204 | Dennisport | MA | 02639 |
| Energy Management Lighting Consultants, LLC | 1550 LaFollette St. | Fennimore | WI | 53809 |
| Energy Management Solutions Inc. | 7935 Stone Creek Dr. Suite 140 | Chanhassen | MN | 55317 |
| Energy Management Systems | 450 E. 96th Street., Suite 150 | Indianapolis | IN | 46240 |
| ENERGY MANAGEMENT SYSTEMS LLC | 27 S, Manitou Ave. | Clawson | MI | 48017 |
| ENERGY MATTERS | 10505 E Cherry Bend Rd | Traverse City | MI | 49684 |
| ENERGY OPTIMIZATION INC. | 34150 Hunters Row | Farmington Hills | MI | 48331 |
| Energy Performance Partners, LLC | 930 Wright Ave. | Toledo | OH | 43609 |
| Energy Preservation Company | 214 Mill Street | Davison | MI | 48423 |
| Energy Products | 6550 Sims Drive | Sterling Heights | MI | 48313 |
| Energy Recovery Systems | 3779 5 Mile Rd. | Grand Rapids | MI | 49525 |
| Energy Recovery Systems, LLC | 14901 32 Mile Rd. | Romeo | MI | 48065 |
| Energy Saving Services | 3025 Emerald Drive | Kalamazoo | MI | 49001 |
| ENERGY SAVING SYSTEMS OF MICHIGAN, INC. | 2430 N. Dort Hwy | Flint | MI | 48506 |
| Energy Savings Solutions | 20900 NE 30 Ave., Ste. 800 | Aventura | FL | 33180 |
| ENERGY SCIENCES RESOURCES PARTNERS, LLC | 725 South Adams Road, Suite 252 | Birmingham | MI | 48009 |
| Energy Sciences, LLC | 725 S. Adams, Suite 252 | Birmingham | MI | 48009 |
| Energy Services Group LLC | P.O. Box 671 | Marion | CT | 06444 |
| Energy Solutions Enterprises | 6830 Highland Rd. | White Lake | MI | 48383 |
| ENERGY SOLUTIONS OF MICHIGAN | PO Box 237 | Folwer | MI | 48835 |
| Energy Systems Analysts | 313 Main Ave. NE | Hickory | NC | 28601 |
| Energy Systems Group | 7804 Francis Court, Suite 210 | Lansing | MI | 48917 |
| Energy Systems RUS | 22120 Rougemont | Southfield | MI | 48034 |
| ENERGY WISE AMERICA | 4340 Redwood Hwy #50 | San Rafael | CA | 94903 |
| Energy Wise America Inc. | 143 Cady Center | Northville | MI | 48167 |
| ENERGYCHEK | 5511 W 56th Avenue Ste. 210 | Arvada | CO | 80002 |
| ENERSOL LLC | PO Box 111 | Whitaker | MI | 48190 |
| EnerSys | 29895 Hudson Drive | Novi | MI | 48377 |
| EnerTemp Inc. | 3961 Eastern SE | Grand Rapids | MI | 49508 |
| ENGELSMA HEATING & A/C | 237 Steele NW Suite A | Grand Rapids | MI | 49534 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Engineered Comfort Systems, Inc | 14280 Allen Rd | Taylor | MI | 48180 |
| Engineering Electric | 23701 Marlow | Oak Park | MI | 48237 |
| Enpulse Energy Conservation, Inc | 13736 Glenrio Drive | Sterling Heights | MI | 48313 |
| Enviro Comfort Inc. | 4235A 14 Mile Rd | Rockford | MI | 48341 |
| Environmental Glass | 12335 Stark Road | Livonia | MI | 48150 |
| ENVIRONMENTAL TECHNOLOGY RESOURCES, INC | 4465 Oak Pointe Dr | Brighton | MI | 48116 |
| ENVIRONMENTAL TECHNOLOGY RESOURCES, INC. | 4465 Oak Pointe Dr. | Brighton | MI | 48116 |
| Enviro-Tight Services | 6650 Maple Dr | Clarkston | MI | 48346 |
| Envision Electric Contracting LLC | 12450 Universal Drive | Taylor | MI | 48180 |
| Envy Homes, Inc | 6615 Laken Ave | Imlay City | MI | 48444 |
| EOS SOLUTIONS CORP. | 400 Water Street | Rochester | MI | 48307 |
| Erco Worldwide | 302 The Eas Mall, Suite 200 | Toronto | ON | M9B6C 7 |
| ERV EHLERS COMPANY | 30885 Eight Mile Rd. | Livonia | MI | 48152 |
| ESI ENERGY CONSULTANTS | 8840 Barnes Road | Portland | MI | 48875 |
| Esko Roofing and Sheet Metal | 14000 Simone | Shelby Township | MI | 48315 |
| E-SOLAR-WIND-DEPOT, LLC | 121N. State St. | Caro | MI | 48723 |
| Esper Electric | 7775 N. 6th Street | Kalamazoo | MI | 49009 |
| Etgar Company Inc. | 22920 Lasher Rd. | Southfield | MI | 48033 |
| Evangelista Corporation | 55800 Grand River | New Huson | MI | 48165 |
| EVANS CONTRACTING | 00283 Peck Road | Boyne City | MI | 49712 |
| EVERGREEN ENERGY SAVERS LLC. | 7357 Steinbach Rd | Manchester | MI | 48158 |
| Evergreen Marketing Incorporated | 44262 Phoenix Dr | Sterling Heights | MI | 48314 |
| Everkold Refrigeration | 11877 Belden Ct. | Livonia | MI | 48150 |
| Excel Automation LLC | 2967 Nationwide Parkway, Unit #1 | Burnswick | OH | 44212 |
| Excel Lighting & Electrical Supply Co. | 2667 E. 8 Mile Rd. | Warren | MI | 48091 |
| Excell Electric | 35050 Mound Rd | Sterling Heights | MI | 48310 |
| Executive Electric and Building Service | 7724 Pontiac Lake Road | Waterford | MI | 48327 |
| EXECUTIVE HEATING & COOLING, INC | 51330 Oro Drive | Shelby Twp | MI | 48315 |
| Expert Energy Management LLC | 4248 Chicago Rd | Warren | MI | 48092 |
| Expert Heating and Cooling, Inc | 21811 Allen Road | Woodhaven | MI | 48183 |
| EXPERT MECHANICAL SERVICE, INC | 542 Biddle | Wyandotte | MI | 48192 |
| Expert Mechanical Service, Inc. | 542 Biddle Ave. | Wyandotte | MI | 48192 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Extreme Electrical Contracting, Inc. | P.O. Box 300674 | Waterford | MI | 48330 |
| E-Z Electric, Inc. | 16665 Racho Blvd | Taylor | MI | 48180 |
| F.A.S. | 4269 S. Wayne Road | Wayne | MI | 48184 |
| F.D. Hayes Electric | 2301 Beal Ave. | Lansing | MI | 48910 |
| FACILITIES PERFORMANCE SERVICES | 836 Alan Drive | Lake Orion | MI | 48362 |
| Facilities Resource Group | 3404 Busch Dr. Suite E | Grandville | MI | 49418 |
| Facility Maintenance and Construction of Michigan, LLC | 901 S. Brandt Rd, Suite 100 | Groveland | MI | 48462 |
| Facility Management Partners | 320 Martin Street, Ste. 140 | Birmingham | MI | 48009 |
| Facility Solutions Group | 8203 A North Lamar | Austin | TX | 78753 |
| Fairborn Equipment Company of Ohio, Inc. | P.O Box 123 | Upper Sandusky | OH | 43351 |
| Fairfax Electric Services, Inc | 25447 Ecorse Rd | Taylor | MI | 48180 |
| FAIRFAX ELECTRICAL SERVICES, INC. | 25447 Ecorse Rd. | Taylor | MI | 48180 |
| Fairlane Electric | 8476 Nightingale | Dearborn Hts | MI | 48127 |
| Fallert Heating and Cooling | 10075 Colonial Industrial Dr. | South Lyon | MI | 48178 |
| Fallon Electric Inc. | 65291 Dequindre Road | Oakland | MI | 48363 |
| Family Contracting & Maintenance | 23400 Thornton | Clinton Township | MI | 48035 |
| Family Heating & Cooling & Electrical, Inc | 30210 Ford Rd | Garden City | MI | 48135 |
| FAMILY HEATING & COOLING CO. INC. | 2852 DM Drive | Gaylord | MI | 49735 |
| FAMILY HEATING AND COOLING | 519 West 2nd St | Gaylord | MI | 49735 |
| FARMERS INSULATION, INC. | 1373 Jewett Ave. | An Arbor | MI | 48104 |
| Fast Furnace Co. | 42026 Hayes | Belleville | MI | 48111 |
| Father and Son Construction | 5032 Rochester Road Suite 100 | Troy | MI | 48085 |
| Faudie Architecture | 2430 Rochester Ct. | Troy | MI | 48083 |
| FC Washington & Sons | 510 Harper Ave | Detroit | MI | 48202 |
| Ferenczy and Associates | 850 Mooerville | Milan | MI | 48160 |
| Ferndale Electric Company, Inc. | 915 E. Drayton | Ferndale | MI | 48220 |
| Ferriby Electric | 1560 Pug Rd. | St. Clair | MI | 48079 |
| FiberClass Contracting | 47220 Cartier Dr | Wixom | MI | 48393 |
| FIERROHVAC INC. | P.O. Box 668 | Boyne City | MI | 49712 |
| Fine Line Electric, Inc. | 3071 N. Dixie Highway | Pompano Beach | FL | 33064 |
| Finley Construction | 8995 Schrepfer Rd | Howell | MI | 48855 |
| First Choice Electric, Inc. | PO Box 4045 | Centerline | MI | 48015 |
| FIRST CHOICE HEATING & COOLING | 1020 Silver Lake Rd. | Fenton | MI | 48430 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| First Contracting Incorporated | 701 South Main | Ovid | MI | 48866 |
| First Electrical Company | 24659 Rosland | Eastpoint | MI | 48021 |
| Fishbeck, Thompson, Carr & Huber, Inc. | 39255 Country Club Dr., STE B25 | Farmington Hills | MI | 48331 |
| Fisher Electric | 38425 Morovian | Clinton Twp. | MI | 48036 |
| Fisher Roofing co. Inc | 5471Sylvania St. | dearborn Heights | MI | 48125 |
| Five & Security Technologies | 31551 Groesbeck Hwy. | Fraser | MI | 48026 |
| Five Star Electric | 48762 Salt River Drive | Chesterfield Twp | MI | 48047 |
| Flame Heating, Cooling and Electrical | 2200 Eleven Mile Rd | Warren | MI | 48091 |
| Flo-Aire Heating & Cooling, Inc. | 15761 Eureka Rd. | Southgate | MI | 48195 |
| Floor Heat Company | 3120 Spanish Oak | Lansing | MI | 48911 |
| FOAMSULATE, LLC | 20374 Brookwood St | Dearborn Heights | MI | 48127 |
| FOIL-RITE CORP. | 10750 Lewis Rd. | Vanderbilt | MI | 49795 |
| FORESTAR ELECTRIC, INC. | 1964 Viola Drive | Ortonville | MI | 48462 |
| FORSTROM'S HEATING SERVICE, INC. | 445 Sterling St. | Kingsford | MI | 49802 |
| Foster Contracting | 69245 Burke Drive | Richmond | MI | 48062 |
| Frank Rewold and Son, Inc | 333 East Second St | Rochester | MI | 48307 |
| Franke Foodservice Systems Inc | 800 Aviation Pkwy | Smyrna | TN | 37167 |
| FRANKLIN HOLWERDA CO. | 2509 29th St. SW | Wyoming | MI | 49519 |
| Franklin Holwerda Company | 2509 29th St. | Wyoming | MI | 49519 |
| Frasard Electrci | 22717 Harper Ave. | St. Clair Shores | MI | 48080 |
| Frazer Mechanical | 8494 N. 3 Lane | Gladstone | MI | 49837 |
| Fred Garner Electric | 6200 25 Mile Rd. | Shelby Twp. | MI | 48316 |
| Free Hold Enterprises, LLC | 5119 Highland Rd #315 | Waterford | MI | 48327 |
| FREE HOLD ENTERPRIZES | 5115 Highland Rd. #315 | Waterford | MI | 48327 |
| FridgeWize | 2520 S. Grand Avenue, Suite 112 | Glenwood Springs | CO | 81601 |
| Friedman | 645 Griswold, Ste. 1300 | Detroit | MI | 48226 |
| Frigitek | 407 Snyder Avenue | Ann Arbor | MI | 48106 |
| FRONTIER HEATING AND COOLING | 9790 Cherry Valley Rd. | Caledonia | MI | 49316 |
| Frost Heating and Cooling, Inc. | 737 Durkee St. P.O. Box 400 | Nashville | MI | 49073 |
| Frost Properties | 3151 Miller Drive | Sears | MI | 49679 |
| Fuel Conservation Consultants LLC | 25140 Lahser Road #141 | Southfield | MI | 48033 |
| Fuelling Electric Inc. | 3675 Auburn Rd. | Shelby Twp. | MI | 48317 |
| Full Service Insulation | 7734 Pleasant Manor Dr. | Waterford | MI | 48327 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| FULL SPECTRUM SOLUTIONS | 2021 Wellworth Ave | Jackson | MI | 49203 |
| Full Spectrum Solutions, Inc | 712 E South St | Jackson | MI | 49203 |
| Fuller Heating | 777 S Wagner | Ann Arbor | MI | 48103 |
| Future Energy Group, LLC | 39425 Garfield Road, Suite 27 | Clinton Township | MI | 48038 |
| G & B Electric Inc. | 830 Orchard | Ferndale | MI | 48220 |
| G & G Electric | 3220 Country Ln | Caro | MI | 48723 |
| G & J Heating | 48380 9 Mile Rd | Novi | MI | 48374 |
| G & S Mechanical | 2736 N Johnson Rd | Weidman | MI | 48893 |
| G & S Technologies | 700 Snowmass Dr. | Rochester Hills | MI | 48309 |
| G & W Refrigeration | 3015 Brooks Road | Muskegon | MI | 49444 |
| G E Insulation Co | 965 East Saginaw Road | Midland | MI | 48657 |
| G.A. Frisch Inc | 1831 Austin Dr. | Troy | MI | 48083 |
| G.E. INSULATION CO. | 965 E. Saginaw Rd. | Sanford | MI | 48657 |
| Gallagher-Kaiser Corporation | 13710 Mt. Elliott | Detroit | MI | 48212 |
| Gardner Electric Inc. | 2918 N. Connecticut | Royal Oak | MI | 48073 |
| Garland Construction | 44899 Centre Ct. | Clinton Township | MI | 48038 |
| Garr Electric | 33755 Riviera | Fraser | MI | 48026 |
| Garrett Electric | 180 W. Church Street | Lake Orion | MI | 48362 |
| GARY CHAFFEE | 310 W. Giles Rd. | Muskegon | MI | 49445 |
| Gary L. Smith, Inc. | 2691 John R. Rd | Troy | MI | 48083 |
| GASSER BUSH ASSOCIATES | 30984 Industrial | Livonia | MI | 48150 |
| Gateway Refrigeration Inc. | 2176 E Herrick Rd | Clare | MI | 48617 |
| GAUTHIER HEATING & COOLING LLC | 5401 N US-23 | Black River | MI | 48721 |
| GE Lighting | 2 Towne Sq 5 | Southfield | MI | 48076 |
| Gee & Missler, Inc. | 744 Vinewood | Wyandotte | MI | 48192 |
| GEM, Inc | 6842 Commodore | Walbridge | OH | 43465 |
| Gemini Electric | 48605 Structural Drive | Chesterfield | MI | 48051 |
| Genco LLC | 16043 23 Mile Rd | Macomb | MI | 48042 |
| GENEEZ WINDOW FACTORY | 23110 Sherwood Rd. | Warren | MI | 48091 |
| General Heating & Cooling | 1530 Monroe | Grand Rapids | MI | 49505 |
| General Supply & Services, Inc. | 684 Robbins Dr. | Troy | MI | 48083 |
| G-Energy LLC | PO Box 848 | Jenison | MI | 49429 |
| Genesee Refrigeration, Inc. | G- 3375 E. Bristol Rd | Burton | MI | 48529 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| GEOFURNACE HEATING & COOLING, LLC | 886 US 31 South | Traverse City | MI | 49684 |
| GEO-RENEW SYSTEMS, INC. | 3045 Grange Hall Rd. Siute 7 | Holly | MI | 48442 |
| George Auch Construction Management | 735 S Paddock Street | Pontiac | MI | 48341 |
| George Pastor & Sons Construction | 34018 Beacon | Livonia | MI | 48150 |
| Gerald Schlaf Associates, Inc. PC. | 1132 Lakeview | Wolverine Lake | MI | 48390 |
| Gexpro | 2 Towne Square | Southfield | MI | 48076 |
| Giffin, Inc. | 1900 Brown Rd. | Auburn Hills | MI | 48326 |
| Gilbane Building Co. | 1365 Cass, Room 1218 | Detroit | MI | 48226 |
| Gillette Heating | 172 S M-33 | West Branch | MI | 48661 |
| Gillis Electric Inc. | 34133 Schoolcraft Rd. | Livonia | MI | 48150 |
| GIROUX HEATING & COOLING | 1524 Mack Ave. Suite 204 | Grosse Pointe Park | MI | 48236 |
| GIROUX HEATING AND COOLING | 15324 Mack Avenue | Grosse Pointe Park | MI | 48230 |
| GJ Perelli Company | 222 E Merill Suite 101 | Birmingham | MI | 48009 |
| Glastender | 5400 N. Michigan Road | Saginaw | MI | 48604 |
| Glenn Lamb Electric | P.O. Box 319 | Metamora | MI | 48455 |
| Glenn Parker Electric | PO Box 83 | Romeo | MI | 48065 |
| GLG Electric, Inc. | 3429 Cero Drive | Sterling Heights | MI | 48310 |
| GLOBAL ENVIRONMENTAL ENGINEERING, INC. | P.O. Box 352, 129 Bridge Street | Elk Rapids | MI | 49629 |
| Global Green Energy Solutions | 7794 Boardwalk Rd. | Brighton | MI | 48116 |
| Global Induction Lighting | 35 Highview Crescent | Toronto | ON | M6H2Y 3 |
| Glover Electric | P.O. Box 708 | Fowlerville | MI | 48836 |
| GMB Architecture & Engineering | 85 East Eighth Street, Ste. 200 | Holland | MI | 49423 |
| GO GREEN ENERGY CONSULTING | 400 Galleria Officentre, Suite 555 | Southfield | MI | 48034 |
| Godwin Plumbing | 3703 South Division | Grand Rapids | MI | 49548 |
| Goldberg Electric | 1012 S Campbell | Royal Oak | MI | 48067 |
| Goldstar Products | 21680 Coolidge Highway | Oak Park | MI | 48237 |
| Goodman | 1215 Polaris Parkway #160 | Columbus | OH | 43240 |
| Goodman Co. LP - Amanda PTAC | 3911 Johnson Avenue | Western Springs | IL | 60558 |
| Goyette Mechanical Co. | 3842 Gorey Ave. | Flint | MI | 48506 |
| Grainger | 455 Knightbridge Pkwy | Lincolnshire | IL | 60069-361 |
| Grainger Lighting Services | 61 Mattaluck Heights Rd. | Waterbury | CT | 06705 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Grand Traverse Contstruction | 5050 Sawyer Woods Drive | Traverse City | MI | 49684 |
| Grand Valley Automation Inc. | 4275 Spartan Industrial | Grandville | MI | 49418 |
| GRAND VALLEY AUTOMATION, INC. | 4275 Spartan Industrial Drive | Grandville | MI | 49418 |
| Granger Construction | 6267 Aurelius Road | Lansing | MI | 48911 |
| Grant Plumbing & Heating, Inc. | 121 S. Front St. P.O. Box 396 | Grant | MI | 49327 |
| Grantham Building and Remodeling | 801 Baxter St | Petosky | MI | 49770 |
| Grapids Heating & Cooling Inc | 429 Covell Ave NW | Grand Rapids | MI | 49504 |
| GRAYBAR ELECTRIC | 8350 Haggerty | Belleville | MI | 48111 |
| Graye Electrical Services, Inc | 12257 market St | Livonia | MI | 48150 |
| Great Dane Heating and Air Conditioning | 36611 Gratiot Ave | Clinton Township | MI | 48035 |
| GREAT LAKES CONCRETE PRODUCTS | 4555 134th Ave | Hamilton | MI | 49419 |
| Great Lakes Critical Power & Cooling | 13576 S. Horrell Rd. | Fenton | MI | 48430 |
| Great Lakes Detroit | 13506 Helen Street | Detroit | MI | 48212 |
| Great Lakes Electric | 9646 Marine City Hwy | Casco | MI | 48064 |
| GREAT LAKES ENERGY SERVICE, INC | P.O. Box 79 | DeWitt | MI | 48820 |
| GREAT LAKES ENERGY SOLUTIONS, LLC | 4947 Davis Court | Troy | MI | 48085 |
| Great Lakes Home Performance LLC | PO Box 992 | East Lansing | MI | 48826 |
| GREAT LAKES HYSAVE, INC. | P.O. Box 1061 | Troy | MI | 48099 |
| Great Lakes Insulation | 9114 West G Ave | Kalamazoo | MI | 49009 |
| Great Lakes Lighting | 13506 Helen St. | Detroit | MI | 48212 |
| Great Lakes Mechanical | 3800 Maple | Dearborn | MI | 48126 |
| GREAT LAKES PLUMBING & HEATING | 2111 E. Mitchell Rd. | Petoskey | MI | 49770 |
| Great Lakes Power and Equipment | 13500 Helen St. | Detroit | MI | 48212 |
| GREAT LAKES PUMP & SUPPLY CO. | 1075 Naughton | Troy | MI | 48083 |
| Great Lakes Superior Walls | 4555 134th Street | Hamilton | MI | 49419 |
| Great Lakes Systems | 2283 Port Sheldon Ct. | Jenison | MI | 49428 |
| GRecon, Inc | 39300 W Twelve Mile Rd, #160 | Farmington Hills | MI | 48331 |
| Green Builders Plus | 22218 Ford Rd. | Dearborn Heights | MI | 48127 |
| Green Building Services pllc | 6443 Inkster Rd, Suite 170a | Bloomfield | MI | 48301 |
| GREEN CONSULTING SERVICES, LLC | 18640 Mack Avenue, PO Box 361298 | Grosse Pointe | MI | 48236 |
| GREEN ELECTRICAL SUPPLY, LLC | 2355 Arizona Court | Rochester Hills | MI | 48309 |
| GREEN ENERGY SOLUTIONS | P.O. Box 612 | Cedarville | MI | 49719 |
| Green Energy Systems LLC | 35209 Cricklewood Dr. | New Baltimore | MI | 48047 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Green Home Energy | 7805 Cooley Lake Road, Suite 500 | West Bloomfield | MI | 48324 |
| Green Ideas Group | 529 Ontario Ave | Sheboygan | WI | 53081 |
| Green Path Energy Solutions | 15751 Frankfort | Detroit | MI | 48224 |
| Green Power Sources, LLC | 7974 lochlin | Brighton | MI | 48116 |
| GREEN POWER SOURCES, LLC | 7974 Lochlin Drive Suite B4 | Brighton | MI | 48116 |
| GREEN PROFESSOR | 11852 Diehl Dr | Sterling Heights | MI | 48313 |
| Green Team Coalition | 6845 Cedarbrook Dr. | Bloomfield Hills | MI | 48301 |
| Greenalysis | 3180 Long Lane | White Lake | MI | 48383 |
| GREENE SOLUTIONS, LLC | 640 Livingston Ave. NE #1 | Grand Rapids | MI | 49503 |
| GREENER BUILDING MECHANICAL INC. | 10971 2 Mile Rd | Lowell | MI | 49331 |
| GREENERE LLC | 8382 Hardwood Dr. | Jennison | MI | 49428 |
| Greenergy Partners LLC | 28243 Beck Rd Suite B9 | Wixom | MI | 48393 |
| GreenFit Homes | 343 S. Union St. | Sparta | MI | 49345 |
| GREENSPARK ENERGY SOLUTIONS | 1889 Maple Avenue, Suite E11 | Evanston | MI | 60201 |
| Greentech Energy Services | 122 E. Kings Highway | Mapleshade | NJ | 08052 |
| GREENWIRE SYSTEMS, LLC | 29488 Woodward Ave.. Suite 107 | Royal Oak | MI | 48073 |
| GREFFEN SYSTEMS, INCORPORATED | 394 Settlement Lane | Alpharetta | GA | 30004 |
| Greg's Electric Company Inc. | 6326 Marsh Rd. | Marine City | MI | 48039 |
| Griffin Hileman Real Estate Solutions | 2200 N. Canton Center Rd., Suite 140 | Canton | MI | 48187 |
| Griffin International LLC | 46430 Continental Dr. Ste A | Chesterfield | MI | 48047 |
| Griffiths Mechanical, inc. | 1250 E. Chicago Rd. | Jonesville | MI | 49250 |
| Groom Energy Solutions | 96 Swampscott Rd | Salem | MA | 1970 |
| GROOM ENERGY SOLUTIONS, INC. | 96 Swampscott Rd. Unit 6 | Salem | MA | 01970 |
| GROOM ENERGY SOLUTIONS, LLC. | 96 Swampscott Rd. | Salem | MA | 01970 |
| Gross Electric | 2232 S. Industrial | Ann Arbor | MI | 48104 |
| GT Electric | 10608 Bunton | Willis | MI | 48191 |
| GUARDIAN ENVIRONMENTAL SERVICES | 34400 Glendale | Livonia | MI | 48150 |
| Guardian Environmental Services, Inc. | 34400 Glendale Avenue | Livonia | MI | 48150 |
| Guerriero Enterprises, LLC | PO Box 42 | Allen Park | MI | 48101 |
| Gunnels Electric, Inc. | 13626 Tuscola Road | Clio | MI | 48420 |
| H & AL Electric | 7332 Plainfield | Dearborn Heights | MI | 48127 |
| H & B PLUMBING & HEATING, INC. | 9611 N. Straits Highway | Cheboygan | MI | 49721 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| H & B Plumbing and Heating, Inc. | 9611 N. Straights Hwy. | Cheboygan | MI | 486041 048 |
| H VANHECK HTG & COOLING | 6655 Burlingame SW | Byron Center | MI | 49315 |
| H. G. Mechanical | 10368 Carmer | Fenton | MI | 48430 |
| Haddix Electric | 5729 Allen Rd. | Allen Park | MI | 48101 |
| Haggards Plumbing & Heating | 06238 US 31 South | Charlevoix | MI | 49720 |
| Haggard's Plumbing & Heating | 06238 U.S. 31 South | Charlevoix | MI | 49720 |
| Haisma Heating & Cooling, Inc. | 5514 Alpine | Constock Park | MI | 49321 |
| Haley Mechanical | 1535 Baker Road | Dexter | MI | 48130 |
| Hamilton & Sons | 711 Rustic Village | Lake Orion | MI | 48362 |
| Handyman & More, Inc. | 3941 Brighton Rd | Howell | MI | 48843 |
| HANKWITZ HEATING AND COOLING, LLC | 609 S. Washington Ave. | Ludington | MI | 49431 |
| HANSONS WINDOW & CONSTRUCTION, INC. | 977 E. 14 Mile Rd. | Troy | MI | 48083 |
| Harley Ellis Devereaux | 26913 NW Highway Suite 200 | Southfield | MI | 48033 |
| Harper Electric | 6920 Jackson Road | Ann Arbor | MI | 48103 |
| HARRELL BUILDING CO. | 3983 M-15 | Clarkston | MI | 48348 |
| Harris Lighting | 4035 Reynolds Boulevard | Green Cove Springs | FL | 32043 |
| Harrison French & Associates, LTD. | 809 Southwest "A" Street | Bentonville | AR | 72712 |
| Hartford & Ratliff Co. | 32708 W. Eight Mile Road | Farmington | MI | 48336 |
| HARTLAND ELECTRIC LLC | P.O. Box 704 | Hartland | MI | 48353 |
| Hartland Electric, LLC | PO Box 704 | Hartland | MI | 48353 |
| Hass Factory Outlet - A Division of Gerotech Inc. | 29220 Commerce Drive | Flat Rock | MI | 48134 |
| Hatlen Heating and Cooling | 11865 Stoney Ridge | Brightong | MI | 48114 |
| Hattis Constrution Inc. | 14895 Almount | Allenon | MI | 48065 |
| Havel | 5128 W. 79th St. | Indianapolis | IN | 46268 |
| Havtech Corporation | 9505 Berger Road | Columbia | MD | 21046 |
| HCR | 29122 Haggerty Rd. | Novi | MI | 48377 |
| Hearthside Heating, Inc. | 30207 John R. | Madison Heights | MI | 48071 |
| Heat Seeker's Inc | 12825 Outer Drive East | Detroit | MI | 48224 |
| Heatcraft Heating & Cooling Inc. | 14940 Hercheval St. | Grosse Pointe Park | MI | 48215 |
| HEATH HEATING & COOLING OF WEST MICHIGAN, LLC | 4140 Anthony Court | Dorr | MI | 49323 |
| HEATING PLUS COOLING LTD | 291 Minnesota | Troy | MI | 48083 |
| Heating Plus Cooling, LTD | 1701 E McNichols Rd | Detroit | MI | 48203 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| HEB Enterprises Inc. | 26711 Woodward Ave. | Huntington Hills | MI | 48070 |
| HECO INC | 3509 South Burdick Street | Kalamazoo | MI | 49001 |
| Heights Heating and Cooling | 2083 Pontiac Road | Auburn Hills | MI | 48326 |
| Heileman's Electric | 49936 Fuller Ct. | Plymouth | MI | 48170 |
| Heinanen Engineering, Inc | 27611 Schoolcraft Road | Livonia | MI | 48150 |
| Helder Construction | 4535 84th Street | Caledonia | MI | 49316 |
| Heller Electric Inc. | 6591 Swan Creek Rd | Ira Township | MI | 48023 |
| Helm Electric, Inc. | PO Box 282 | Frankenmuth | MI | 48734 |
| HENDRICKS HEATING & AIR CONDITIONING | 1724 Chicago Dr. S.W. | Wyoming | MI | 49519 |
| Henry J. Ware, Inc. | 8754 Sawmill Pt | Barbeau | MI | 49710 |
| HERRICK PLUMBING & HEATING | 1334 E. Huron (US-23) | East Tawas | MI | 48730 |
| Higgins Development Partners, Inc. | 985 Michigan Ave. | Detroit | MI | 48226 |
| High Lighting Service Company | 24725 Curie St. | Warren | MI | 48091 |
| Highgate Electric Inc. | 29318-A Lorie Lane | Wixom | MI | 48393 |
| HighPointe Electric Inc. | 8113 Belmont Ave., Suite B | Belmont | MI | 49306 |
| HIRDES HEATING, COOLING & REFRIGERATION | 1586 Ridgecrest Dr. | Zeeland | MI | 49464 |
| Hirst Electric Co. | 2326 Brooklyn Road | Jackson | MI | 49203 |
| Hirst Electric Company | 2326 Brooklyn Rd. | Jackson | MI | 49203 |
| HITACHI AC VARIABLE SPEED DRIVES | 50 Prospect Ave. | Tarrytown | NY | 10591 |
| Hi-Tech Environments, Inc. | 1890 Crooks Rd | Troy | MI | 48084 |
| HM White | 12855 Burt Road | Detroit | MI | 48223 |
| Hobby Lobby | 7707 S.W. 44th Street | Oklahoma City | OK | 73179 |
| Hoffman Electric | 4185 Windiate Park Drive | Waterford | MI | 48329 |
| Holiday Heating | 1914 Kenmore | Grosse Pointe Woods | MI | 48236 |
| HOLLAND HEATING AND COOLING, INC. | 9160 Lapeer Rd. | Davision | MI | 48423 |
| Holland's Floral & Gifts | 308 S. Main St. | Rochester | MI | 48307 |
| Holley Mechanical Insulation, Inc. | 33985 Harper Suite 304 | Clinton Twp. | MI | 48035 |
| HOLLINGSHEAD BUILDERS | 120 N. Main Strret | Evart | MI | 49631 |
| HOME ADJUSTMENTS LLC | 18530 Mack Ave. Suite 466 | Grosse Pointe Farms | MI | 48236 |
| Home Center Warehouse | 848 US-31 South | Traverse City | MI | 49684 |
| Home Comfort Show Room Inc. | 2120 Ludington Street | Escanaba | MI | 49829 |
| Home Comfort Solutions | 3435 W US Hwy 12 | Clinton | MI | 49236 |
| HOME ENERGY ANSWERS | 13271 Nelva Rose | Coopersville | MI | 49404 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Home Energy Audits | 862 Eagles Nest Ct | Mason | MI | 48854 |
| Home Energy Counseling Inc | 4473 Bunker Ave. | West Bloomfield | MI | 48323 |
| HOME ENERGY ED | 3656 Auburn Ave. NE | Grand Rapids | MI | 49525 |
| Home Energy Inspections.com | 2755 Blackberry Lane NE | Grand Rapids | MI | 49525 |
| HOME EVALUATION SERVICES | 5099 US 41 South, Suite 3 | Marquette | MI | 49855 |
| Home Front Lighting Inc. | 4683 Park Dr., Ste. B | Carlsbad | CA | 92008 |
| HOME REPAIR SERVICES OF KENT COUNTY | 1100 S. Division ave | Grand Rapids | MI | 49507 |
| HOME SERVICE CORP | 2810 Oakwood Blvd | Melvindale | MI | 48122 |
| HOMESPACE AUDITING LLC | 14465 Doebler Drive | Shelby Township | MI | 48315 |
| HOMESPEC ADVANCED BASEMENTS | 840 Minion | Ypsilanti | MI | 48198 |
| HomeVest Energy | 1565 Northern Star Dr. | Traverse City | MI | 49684 |
| HOMEVEST ENERGY LLC | 5060 Highland Dr. | Traverse City | MI | 49684 |
| Honeywell International Inc. | 49116 Wixom Tech Dr | Wixom | MI | 48393 |
| Hoover Electric | 2123 W. Eight Mile Road | Detroit | MI | 48203 |
| HOOVER ELECTRIC INC. | 2123 W. 8 Mile Rd. | Detroit | MI | 48203 |
| Hopp Electric Inc. | 720 W Industrial Dr., Suite 100 | Chelsea | MI | 48118 |
| Horizon Heating & Cooling | 117 Maple St. | Delton | MI | 49046 |
| Hoshizaki America | 618 Hwy 74 South | Peachtree City | GA | 30269 |
| Hot Watt Solar, LLC | 37861 Townhall | Harrison Twp. | MI | 48045 |
| Hot Watt Solar, LLC | 37861 Townhall | Harrison Township | MI | 48045 |
| HOTLINE ELECTRIC INC | 32361 Edward | Madison Heights | MI | 48071 |
| Hotz Development | 20752 Ryan Rd. | Warren | MI | 48091 |
| HOWARDS HEATING & COOLING, LLC | 6475 Main St. | Cass Clty | MI | 48726 |
| HP Electric, LLC | 7853 Thunderbay Dr. | Pinckney | MI | 48169 |
| Hudsonville Heating and Cooling, LLC | 3658 -1 Chicago Dr. | Hudsonville | MI | 49426 |
| Hudsonville-Steigmeyer Heating & Cooling LLC | 3151 Broadway Ave SW | Grandville | MI | 49418 |
| Hullmark Homes, Inc | 5720 Furlong CT, NE | Belmont | MI | 49306 |
| Hulst Heating & Cooling | 709 Alles Drive SW | Byron Center | MI | 49315 |
| HULST HEATING & COOLING, INC. | 709 Alles Dr. | Byron Center | MI | 49315 |
| Hunter Electric | 6375 Genaw Rd | Algonac | MI | 48001 |
| Huron Valley Electric | 425 Jackson Plaza | Ann Arbor | MI | 48103 |
| Hurst Mechanical | 5800 Safety Drive | Belmont | MI | 49306 |
| HUSSMANN REFRIGERATION | 27475 Meadowbrook | Novi | MI | 48377 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Hussmann Services Corporation | 890 Remington Blvd | Bolingbrook | IL | 60440 |
| Hutchinson's Electric Inc. | 5828 Dixie Hwy | Waterford | MI | 48329 |
| Hutzel Plumbing & Heating Co. | 2311 S. Industrial Highway | Ann Arbor | MI | 48104 |
| Hybra Energy Corp | 765 Duell Rd. | Traverse City | MI | 49686 |
| I.E.A. LLC | 1255 Lake Shore Blvd | Lake Orion | MI | 48362 |
| IB ELECTRIC INC | 5280 Reuter | Dearborn | MI | 48126 |
| Ideal Contracting, LLC | 2525 Clack Street | Detroit | MI | 48209 |
| IDEAL HOME SERVICES | 5572 S. Betsie River Rd. | Interlochen | MI | 49643 |
| Illumetek Corp. | PO Box 1147 | Cuyahoga Falls | OH | 44223 |
| Impact Energy Management | 2865 Boardwalk Drive | Ann Arbor | MI | 48104 |
| IMPACT ENERGY MANAGEMENT, LLC | 2865 Boardwalk Dr | Ann Arbor | MI | 48104 |
| INC Electric | 14301 Meyers | Detroit | MI | 48227 |
| INDEPENDENT ENERGY | 17 W. First St. | Monroe | MI | 48161 |
| Indoor Air Quality Heating and Cooling LLC | 624 Scott View Dr. | Comstock Park | MI | 49321 |
| Indoor Climate Solutions | 6757 Cascade Rd. Unit#242 | Grand Rapids | MI | 49546 |
| Indoor Comfort | 416 W, Huron | Ann Arbor | MI | 48103 |
| Indoor Energy Solutions | 6757 Cascade Rd. Unit 47 | Grand Rapids | MI | 49546 |
| INDUSTRIAL AND COMMERCIAL LED LIGHTING INC. | 757 West Main St. Suite 250 | Flushing | MI | 48433 |
| Industrial Electric | 574 East Milwaukee St | Detroit | MI | 48226 |
| Industrial Electric Co of Detroit, Inc | 275 E Milwaukee | Detroit | MI | 48202 |
| Industrial Energy Services, Inc | 6309 DaLisa Rd | Milton | FL | 32583 |
| Industrial Mechanical | 3555 Whitfield | Waterford | MI | 48329 |
| Industrial Technology Services, LLC | PO Box 452 / 648 St Andrews | St. Clair | MI | 48079 |
| INFINITI ENERGY & ENVIRONMENTAL, INC. | 65 Cadillac Square; Suite 2815 | Detroit | MI | 48226 |
| Infrared Energy Analysis | 920 Loyola St | Ann Arbor | MI | 48103 |
| INFRARED THERMAL IMAGING SERVICES, INC | 14600 LaBelle St | Oak Park | MI | 48237 |
| INGELL REFRIGERATION AIR CONDITIONING, INC. | 1115 Fourth Street | Port Huron | MI | 48060 |
| Ingenuity IEQ | 3600 Centennial Drive | Midland | MI | 48652 |
| Ingersoll Rand Company | 13551 Merriman Road | Livonia | MI | 48150 |
| INNCOM International, Inc. | 277 West Main Street | Niantic | CT | 06357 |
| Innovation Electric LLC | 16425 Erin St | Fraser | MI | 48026 |
| Innovation Electrical Company | 2940 Newberry Rd | Waterford | MI | 48329 |
| Innovative Corporate Interiors | 32384 Edward | Madison Heights | MI | 48071 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Innovative Design Build Services | 9837 Colwell | Allen Park | MI | 48101 |
| Innovative Electric LLC | 12543 Foley Rd. | Emmett | MI | 48022 |
| Innovative Engineered Solutions Inc | 17001 19 Mile Rd., Ste.3 | Clinton Township | MI | 48038 |
| INNOVATIVE REMODELING, LLC | 6132 Hyde Park | Romulus | MI | 48174 |
| Inside Out Construction | 15100 Keel St. | Plymouth | MI | 48170 |
| In-Sight Mechanical LLC. | 2033 Fawn Ave. | Middleville | MI | 49333 |
| Insight Technology LLC | 18472 Mack Ave | Grosse Pointe Farms | MI | 48236 |
| Inspired Green | 223 South Bridge Street | Grand Ledge | MI | 48837 |
| INSPIRED MARKETING, LLC | 223 S Bridge St | Grand Ledge | MI | 48837 |
| INST-I-GLASS OF BRIGHTON | 2237 Cheltenham | Toledo | OH | 43606 |
| INSULATION & ENVIRONMENTAL SERVICES INC. | 3156 3 Mile Rd NW | Grand Rapids | MI | 49544 |
| Insulation & Environmental Services, Inc. | 3156 Three Mile Road | Grand Rapids | MI | 49544 |
| INSULATION MAN, INC. | 22381 Starks Drive | Clinton Township | MI | 48038 |
| inSync Lighting | 1475 Harvard Dr. | Kankakee | IL | 60901 |
| Integrated Design Solutions | 1441 W. Long Lake, Ste. 200 | Troy | MI | 48098 |
| Integrated Design Solutions (IDS) | 888 W. Big Beaver, Ste. 200 | Troy | MI | 48084 |
| INTEGRITY CONTRACTORS INC | 750 Hazelwood St | Detroit | MI | 48202 |
| Interior Development Group | 22485 Moorgate | Novi | MI | 48374 |
| Interior Partnership Group | 1332 Anderson Road | Clawson | MI | 48017 |
| INTERIOR PARTNERSHIP GROUP, INC. | 1332 Anderson Rd. | Clawson | MI | 48017 |
| INTERNATIONAL RADIANT, INC. | 959 East Whitcomb | Madison Heights | MI | 48071 |
| Ironwood Construction | 3250 Woods Way | Petoskey | MI | 49770 |
| IXL Glass | 33480 Giftos Dr. | Clinton Township | MI | 48035 |
| J & D Electric, Inc. | 1578 Metamora Drive | Metamora | MI | 48455 |
| J & J Electric, Inc. | 25162 Mound Road | Warren | MI | 48091 |
| J & J Electrical Maintenance Inc. | 1864 Mason | Highland | MI | 48356 |
| J & J Refrigeration Co., Inc. | 7170 Dixie Highway | Clarkston | MI | 48346 |
| J & K Communications Inc. | 21745 W. 8 Mile Rd. | Detroit | MI | 48219 |
| J GOODS PLUMBING AND HEATING, LLC | 7 Glen Meadows | Marquette | MI | 49855 |
| J Mac Electric | 7222 Fairwood | Dearborn Heights | MI | 48127 |
| J NORMAN COMPANY LLC | 1160 Trowbridge Dr | Alpena | MI | 49707 |
| J Norman Company, LLC | 1160 Trowbridge | Alpena | MI | 49707 |
| J&K Electric | 4251 McDowell Rd | Lapeer | MI | 48446 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| J&M Service & Equipment Co. | 16100 Port Sheldon Street | West Olive | MI | 49460 |
| J. E. JOHNSON CONTRACTING, INC. | 1550 E. Virginia D. | Midland | MI | 49642 |
| J. Gallagher Contracting LLC | 615 Orchard Dr. | Northville | MI | 48167 |
| J. RANCK ELECTRIC, INC. | 1993 Grover Parkway | Mount Pleasant | MI | 48858 |
| J. Simon & Sons | 3773 12 Mile | Berkley | MI | 48239 |
| J.B.L Electric | 241 Rose Briar | Rochester | MI | 48307 |
| J.D. Stratton Electric, Inc. | 2360 W. Carriage Hill Dr. | Traverse City | MI | 49686 |
| J.E. BICKEL, LLC | 2634 Popple Lane | Howell | MI | 48855 |
| J.E. Johnson | PO Box 1863 | Midland | MI | 48641 |
| J.F Cavanaugh Co. | 20750 Sunnydale | Farmington Hills | MI | 48336 |
| J.L. Anderson Associates | 4167 Grandwood Circle | St. Joseph | MI | 49085 |
| J.O. GALLOUP | 130 North Helmer Rd. | Battle Creek | MI | 49015 |
| J.S. Vig Construction Company | 16650 Racho Road | Taylor | MI | 48180 |
| Jack Flood Light | 29800 Little Mack | Roseville | MI | 48066 |
| Jack's Heating and Cooling | 1820 W Caro Road | Caro | MI | 48723 |
| Jacobson Heating & Cooling | 3303 Eastern SE | Grand Rapids | MI | 49508 |
| JAG Electric LC | 1250 W. Vassar Rd | Reese | MI | 48757 |
| JAKSA HEATING & COOLING SERVICES | 4873 Klam Rd. | Columbiaville | MI | 48421 |
| JAMES ANDERSON BUILDERS | 3766 West Briar Ridge Dr | Maple City | MI | 49664 |
| JAMES KNOX HEATING & A/C | 5999 Dollar Rd. | Belleville | MI | 48111 |
| James R Gailey Electrical Services | 27440 Park Court | Madison Heights | MI | 48071 |
| JARVIS PROPERTY RESTORATION | 41800 Executive Drive | Harrison Township | MI | 48045 |
| JAYZ Inc. | 22751 Dequindre Rd. | Hazel Park | MI | 48030 |
| JB Electrical Company | 6070 Wall Street | Sterling Heights | MI | 48312 |
| JC Beal Construction Inc | 221 Ferch Street | Ann Arbor | MI | 48103 |
| JC Electric LLC | P.O. Box 146 | St. Johns | MI | 48879 |
| JCI | 2875 High Meadow Circle | Auburn Hills | MI | 48326 |
| JE Johnson, Inc. | P.O. Box 1863 | Midland | MI | 48641 |
| JEFF BREWER MECHANICAL | 2609 Breezeway St. | North Branch | MI | 48401 |
| JEFF DOERR HVAC, INC, | 8815 Midstate Dr. | Mecosta | MI | 49332 |
| Jeff Rinke Electric | 4977 Stoney Creek Dr | Kenockee | MI | 48006 |
| Jeff Squires | 1456 West Hazelhurst | Ferndale | MI | 48220 |
| JEM Electric Service | 3825 Newark Rd | Attica | MI | 48412 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Jenkins Construction, Inc. | 985 E. Jefferson Ave., Suite 300 | Detroit | MI | 48207 |
| JEROME ELECTRIC INC | 370 List Street | Frankenmuth | MI | 48734 |
| Jerry & Sons Electric, LLC | 11261 Patty Ann Lane | Bruce | MI | 48065 |
| Jerry P Kelly Electric | 18004 Eastland | Roseville | MI | 48066 |
| Jet Electric Company | 21333 Hilltop | Southfield | MI | 48033 |
| JG SOLUTIONS LLC | 47470 Saltz Rd. | Canton | MI | 48187 |
| JG Squared, Inc. | 18600 Old US 12 | Chelsea | MI | 48118 |
| Jim Poole Electric Inc | 13838 Neal Road | Davisburg | MI | 48350 |
| Jim Watts Heating & Cooling, Inc. | 3112 Columbus Ave. | Royal Oak | MI | 48073 |
| Jim Willneff | 20133 Finley | Clinton Twp | MI | 48038 |
| Jim's Electric | 2119 Kingston Drive | Pinckney | MI | 48169 |
| JL Green Contracting | 13401 E 8 Mile Rd | Warren | MI | 48089 |
| Joe Pizik Electric, Inc. | 375 Oliver | Troy | MI | 48084 |
| JOE'S HEATING & COOLING | 9160 Greenfield | Detroit | MI | 48228 |
| JOHN BAKER SALES, LLC | P.O. Box 2096 | Riverview | MI | 48193 |
| JOHN CLEVELAND SIDING, LLC | 1494 Ferndale Ave, SW | Grand Rapids | MI | 49534 |
| John E. Green Company | 1125 N. Cedar St. | Mason | MI | 48854 |
| John R Glass | 26733 John R Rd. | Madison Heights | MI | 48071 |
| Johnson & Wood LLC | 2130 E. Hemphill Rd. | Burton | MI | 48529 |
| Johnson Controls - York Midwest | 32975 Capital Ave. | Livonia | MI | 48150 |
| Johnson Controls Inc | 1935 S Industrial Hwy | Ann Arbor | MI | 48104 |
| Johnson Thermol Temp Inc | 58540 Van Dyke Suite 5 | Washington | MI | 48094 |
| Johnstone Company | 1666 Northern Star Dr | Traverse City | MI | 49686 |
| Johny's Electric | 32428 Dequindre | Warren | MI | 48203 |
| Jon Coffer Contracting | 4306 Potts Dr. | Dexter | MI | 48130 |
| Jonathon Short | 8590 Swan Creek Rd. | Newport | MI | 48166 |
| Jones Lang LaSalle Americas, Inc. | 35000 West Warren | Westland | MI | 48185 |
| Jordan Building Group, LLC | 2018 Cedar St., Suite B-2 | Holt | MI | 48842 |
| Jos Development Group, LLC | 2360 Orchard Lake # 110 | Sylvan Lake | MI | 48320 |
| Joseph M. Day Company | PO Box 1372 | Saginaw | MI | 48605 |
| Joseph Sarkody Electric | 13231 Tecumseh | Redford | MI | 48239 |
| Joule Electrical Contracting LLC | 20605 32 Mile Rd. | Armada | MI | 48085 |
| JP Controls | PO Box 752 | Douglas | MI | 49406 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| JP Heating of Northern Mi | 1830 Dickerson Rd. | Gaylord | MI | 49735 |
| JP Heating of Northern Michigan, LLC | 1830 Dickerson Rd | Gaylord | MI | 49734 |
| J-Power | 2218 Scott lake Rd | Waterford | MI | 48328 |
| JRM Enterprises | 7473 Calkins | Flint | MI | 48532 |
| J's Electric Company | 11195 Sugden Lake road | White Lake | MI | 48386 |
| J's Maintenance Service | PO Box 972906 | Ypsilanti | MI | 48197 |
| JST DEVELOPMENT LLC | 32530 Prescott | Romulus | MI | 48174 |
| JTK Electric LLC | 1019 Midland Blvd | Royal Oak | MI | 48073 |
| Julian H.V.A.C/R. | 3563 N. Manistee River Road | Frederic | MI | 48733 |
| Juodikis Electric | 44950 W Eleven Mile Rd. | Novi | MI | 48375 |
| Jurzysta Electric | PO Box 94072 | Washington | MI | 48047 |
| K & D Industrial Services | 2962 Venture Rd. | Midland | MI | 48640 |
| K & J Electric, Inc. | 7219 East Highland Rd. | Howell | MI | 48843 |
| K & S Ventures Inc | 2767 Grant Rd | Rochester Hills | MI | 48309 |
| K & S Ventures, Inc | 2767 Grant Rd. | Rochester Hills | MI | 48309 |
| K&E Elecrtric | 3450 Lapeer Road | Port Huron | MI | 48060 |
| K.T Group, Inc. | 245 Aspinwall | Troy | MI | 48098 |
| K.T. GROUP, INC | 5214 Breeze Hill Place | Troy | MI | 48098 |
| K/E Electric | 35101 Schoolcraft | Livonia | MI | 48150 |
| Kalsbeek Plumbing | 4132 Hall St. SW | Grand Rapids | MI | 49534 |
| Kanduit Electrical Services | 12910 Rolling Brook Court | Sterling Heights | MI | 48313 |
| KAPA CONSTRUCTION CO., LLC. | 672 Hartland | Troy | MI | 48083 |
| KAPA CONSTRUCTION COMPANY | 672 Hartland Drive | Troy | MI | 48083 |
| KARASIEWICZ CONSTRUCTION INC. | 9280 Wolven Ave | Rockford | MI | 49341 |
| Katie Crooks, Inc. | 20882 Harper Ave. | Harper Woods | MI | 48225 |
| KDL Home Energy Inspections, LLC | 1111 Orion Rd. | Lake Orion | MI | 48362 |
| KE2 THERM SOLUTIONS | 209 Lange Drive | Washington | MO | 63090 |
| Kearns Brothers Inc | 2000 Telegraph | Dearborn | MI | 48128 |
| Keen Technical Solutions LLC | PO Box 2109 | Traverse City | MI | 49685 |
| KEEN TECHNICAL SOLUTIONS, LLC | 800 Cottageview Dr. Suite 1042 | Traverse City | MI | 49684 |
| KEENTECHNICAL SOLUTIONS | 6288 Lake Waldon Drive | Clarkston | MI | 48346 |
| KEI Electrical Contractors | 35350 Stanley Drive | Sterling Heights | MI | 48312 |
| KELLEY & SONS HEATING & COOLING, INC. | P.O. Box 230249 | Fair Haven | MI | 48023 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Kelley Brothers LC | 37100 Amrhein Rd | Livonia | MI | 48150 |
| KEN DAVID ELECTRIC, INC. | 3195 Christy Way South #8 | Saginaw | MI | 48603 |
| KENCO ENERGY SERVICES | 7273 Tucker Rd. | Holly | MI | 48442 |
| Kendall Electric | 7633 Ianac | Lansing | MI | 48917 |
| Kendall Electric Inc. | 832 Scribner Avenue NW | Grand Rapids | MI | 49504 |
| Kentwood PLBG. And HTG., Inc. | 3411 32nd Street S.E | Grand Rapids | MI | 49512 |
| Kerry's Testing Service | 45180 Handford Rd. | Canton | MI | 48187 |
| Kevin's Electric LLC | 6485 Perryville | Holly | MI | 48442 |
| KGR Services | 4004 Kraft Rd. | Fort Gratiot | MI | 48059 |
| Kidder Heating | 13233West Michigan, | Marshall | MI | 49068 |
| Kilavock Industriies LLC | P.O. Box 8018 | Bloomfield Hills | MI | 48302 |
| Kimberly LED Lighting | 6783 Oakhurst Ridge | Clarkston | MI | 48348 |
| Kincaid Electric Inc. of Ubly | 2521 E Atwater Rd | Ubly | MI | 48475 |
| Kingscott | 229 East Michigan, Suite 335 | Kalamazoo | MI | 49007 |
| KJK Mechanical | 2666 Leonard | Maine | MI | 49435 |
| KL Electric LLP | PO Box 1694 | Warren | MI | 48306 |
| Klein Electric and Lighting | 33050 Industrial | Livonia | MI | 48150 |
| KMETZ HEATING & COOLING LLC | 23760 Harper | Saint Clair Shores | MI | 48080 |
| Koch & White Heating/Cooling | 2608 W. Liberty | Ann Arbor | MI | 48103 |
| Kors Engineering Company Inc. | 2805 Pontiac Lake Rd. Suite 2B | Waterford | MI | 48328 |
| Kosin's Glass LLC | 222 W Grand River | Howell | MI | 48843 |
| Kost Contracting | 8000 Wilson Hwy | Grand Ledge | MI | 48837 |
| KOTZ HEATING & AIR CONDITIONING | 5405 Perry | Waterford | MI | 48329 |
| Kraft Electric | 13793 Towering Oaks | Shelby Township | MI | 48315 |
| Krane Heating and Cooling | 1042 Benstein Suite 102 | Farmington Hills | MI | 48390 |
| Kroll Furnace Co, Inc. | 5820 Balsam Dr | Hudsonville | MI | 49428 |
| Kropf Mechanical Service Co | 33792 Capitol | Livonia | MI | 48150 |
| Krystal Services | 1262 Crest Haven | Howell | MI | 48823 |
| Kuchenmeister Lighting & Electrical Supply | 295 SB Gratiot | Mt. Clemens | MI | 48043 |
| Kurt Mason Custom Laminate & Trim | 622 Lochaven | Waterford | MI | 48327 |
| Kurt's Electric | 11067 E Mt. Morris Rd | Davison | MI | 48446 |
| KUYPER INVESTMENT ASSOCIATES, LLC | 707 Merrimac Rd. | Canton | MI | 48188 |
| KW Efficiency | 141 West Patrick St. | Frederick | MD | 21701 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| L. Marson Tile & Marble | 3978 Lake Oaks Dr. | Commerce Twp | MI | 48382 |
| L.D. HEATING & COOLING | 718 S. Weldon Rd | Beulah | MI | 49617 |
| LaBelle Electric Services, Inc. | 24546 21 Mile Rd | Macomb Twp. | MI | 48042 |
| Laibe Electric / Innovative Lighting | 404 N. Byrne Rd. | Toledo | OH | 43607 |
| Lake Pointe Electric | 6293 14 Mile Rd. | Sterling Hts | MI | 48313 |
| LAKE POINTE ELECTRICAL | 9864 East Grand River Suite 110-250 | Brighton | MI | 48843 |
| Lakeshore Improvements LLC | 7825 Big Gulley Rd. | Palms | MI | 48465 |
| Lakeside Energy Solutions, Inc | 40675 Woodside Dr | Clinton Township | MI | 48038 |
| LAKESIDE SERVICE COMPANY | 4367 S. Old US Hwy 23 | Brighton | MI | 48114 |
| Lakewood Construction | 11253 James St | Holland | MI | 49423 |
| Lamp Solutions | 12090 Farmington Rd | Livonia | MI | 48150 |
| Lamphear Service Company | 3933 56th St SW | Grandville | MI | 49418 |
| Lance McCleary | 135 Haines Ave. | New Lenox | IL | 60451 |
| Lane Valente | 20 Keyland Court | Bohemia | NY | 11716 |
| Langerak Roof Systems | 4266 Corporate Exchange Drive, PO Box 85 | Hudsonville | MI | 49426 |
| LANGERAK ROOF SYSTEMS, INC | 4266 Corporate Exchange Drive, P.O. Box 85 | Hudsonville | MI | 49426 |
| LARKE PLBG-HTG- AIR COND INC. | 5639 S Scenic Dr | Sault Ste Marie | MI | 49783 |
| Larry & Bryan Electric Inc. | PO Box 183639 | Shelby | MI | 48318 |
| Larry Tundo | 35450 Seville | Clinton Twp | MI | 48035 |
| LaSalle Electric Supply | 34073 Schoolcraft | Livonia | MI | 48151 |
| Lascko Plumbing & Mechanical | 375 Bayou | Muskegon | MI | 49442 |
| Lausman Homes | 1112 S Lapeer Rd | Lapeer | MI | 48446 |
| LD Heating & Cooling | 718 S. Weldon Rd. | Beulah | MI | 49617 |
| Learning Consultants, Inc.. | 17601 James Couzens | Detroit | MI | 48235 |
| Lecom, Inc. | 30200 Groesbeck Hwy | Roseville | MI | 48066 |
| LED Lighting Inc. | 106 Decatur Drive | Cement City | MI | 49233 |
| LED Low Lights | 9378 Lisa St. | Romulus | MI | 48174 |
| Lee & Associates | 1230 E Square Lake Road | Bloomfield Hills | MI | 48304 |
| Lee Contracting | 631 Oakland Ave | Pontiac | MI | 48342 |
| Lee Industrial Contracting | 631 Oakland Avenue | Pontiac | MI | 48342 |
| Lee Kitson Builder, Inc | 2300 Three Mile Road NE | Grand Rapids | MI | 49505 |
| LENNOX INDUSTRIES | 1384 Piedmont Dr. | Troy | MI | 48083 |
| Lennox Industries Inc. | 7201 Milton Lane | Plano | TX | 75025 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Lepore Construction | 4436 Eleanor | Troy | MI | 48098 |
| Leslie Electric Company | 85 Oakland Ave | Pontiac | MI | 48342 |
| LEVITON MANUFACTURING COMPANY | 9501 Buckingham | White Lake | MI | 48386 |
| Lexicon Plastic Corporation | 50679 Design Lane | Shelby Township | MI | 48315 |
| Liberty Total Comfort | 25550 Grand River Ave. | Redford | MI | 48240 |
| Light Bridge LED | 25121 Ford Road | Dearborn | MI | 48128 |
| Light Source Unlimited | 980 Corporate Woods Pkwy | Vernon Hills | IL | 60061 |
| Lighthouse Lighting & Design LLC | 20497 Mack Ave | Grosse Pointe Woods | MI | 48236 |
| LIGHTING ENERGY CONSULTANT | 152 E. Siena Heights Dr. | Adrian | MI | 49221 |
| Lighting Resources of Michigan, Inc. | 1323 Knollcrest Circle | Bloomfield Hills | MI | 48304 |
| LIGHTING SERVICES, INC. | 9001 Dutton Drive | Twinsburg | OH | 44087 |
| Lighting Supply Company | 10651 Northend Ave | Ferndale | MI | 48220 |
| LIGHTINGPLUS, INC | 735 Longfellow Dr. | Troy | MI | 48085 |
| LIMBACH COMPANY LLC | 926 Featherstone Road | Pontiac | MI | 48342 |
| Lime Energy | 1280 Landmeier Rd | Elk Grove Village | IL | 60007 |
| Linc Mechanical, LLC | 37695 Interchange Dr | Farmington Hills | MI | 48335 |
| Lindhout Associates Architects | 10465 Citation Drive | Brighton | MI | 48116 |
| LINNIE'S HOME REPAIR SERVICES | 1010 Eastern Ave. S.E. | Grand Rapids | MI | 49507 |
| Lipten Company LLC | 28054 Center Oaks Court | Wixom | MI | 48390 |
| Lite Electric | 51475 Milano, Ste. A | Macomb | MI | 48042 |
| Lites Plus, Inc. | 227 Maple St. | Portland | MI | 48875 |
| Livewire Electric Company | 2631 Clivedon Road | Howell | MI | 48843 |
| LOAD SIDE ELECTRIC CO. | 7081 Edwards | Belleville | MI | 48111 |
| Loc Heating and Cooling | 2346 Byron Shores Dr. SW | Byron Center | MI | 49315 |
| Lodestar Construction Inc | 333 North Park NW | Grand Rapids | MI | 49544 |
| Loeb Lighting Services | 906 Burr Ave | Columbus | OH | 43212 |
| Long Mechanical | 190 E. Main Street | Northville | MI | 48167 |
| Lortle Plumbing & Heating | 44 Superior Ave. | Crystal Falls | MI | 49920 |
| Lou's Electric | 2266 Arcadia Estates Dr. | Attica | MI | 48412 |
| LSI | 2462 Dixboro Rd. | Ann Arbor | MI | 48105 |
| LSI Industries | 10000 Alliance Road | Cincinnati | OH | 45242 |
| LTN Technologies LMC | 1140 Dresden Dr | Hoffman Estates | IL | 60195 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| LUCINDA ENTERPRISES | 27 Beardsley Rd. P.O. Box 507 | Ionia | MI | 48846 |
| Lucky's Heating &Cooling | 18315 Fort Street | Riverview | MI | 48193 |
| LUMASMART | 15809 Claire St. | Macomb | MI | 48042 |
| LumaSmart Technology | 15809 Claire Court | Macomb Township | MI | 48042 |
| Lumecon | 23107 Commerce Drive | Farmington Hills | MI | 48335 |
| LUMECON LLC | 23107 Commerce Dr. | Farmington Hills | MI | 48335 |
| Lumerica | 25171 Dequindre Rd. | Madison Heights | MI | 48071 |
| Lumond Lighting Inc | 29567 Hickey | Chesterfield | MI | 48051 |
| LUNA CONSTRUCTION SERVICES, LLC | 6069 Northridge Hills Dr. | Brighton | MI | 48116 |
| Lutz Roofing | 4721 22 Mile Rd | Shelby Township | MI | 48317 |
| Lyon Mechanical | 30100 South Hills Rd. | New Hudson | MI | 48165 |
| M & M Plumbing - Heating - A/C | 3646 S. Straits Hwy | Indian River | MI | 49749 |
| M & M Power | 4322 Blue Bird | Commerce Twp | MI | 48382 |
| M L Bailey Electric Co., LLC | 4591 Skelton Rd. | Columbiaville | MI | 48421 |
| M S Electric | 16277 Hubbard | Livonia | MI | 48154 |
| M&M Plumbing, Heating, Cooling, Inc | 3464 S Straits Hwy | Indian River | MI | 49749 |
| M.E.M. Construction & Contracting, Inc. | 62 West Sheffield Ave. | Pontiac | MI | 48340 |
| Macatawa Radiant Inc. | 10702 Chicago Drive | Zeeland | MI | 49464 |
| MACDONALD ELECTRIC | 59195 Francy Lane | South Lyon | MI | 48178 |
| MacGregor Plumbing and Heating, Inc | 235 Franklin Park | Harbor Springs | MI | 48740 |
| MacMillan Associates Inc. | 714 east Midland St. | Bay City | MI | 48706 |
| Macson Electric , LLC | 34054 James J Pompa | Fraser | MI | 48026 |
| Maderas Home Improvement | 4473 4th St. | Ecorse | MI | 48229 |
| MADISON ELECTRIC COMPANY | 31855 Van Dyke Ave. | Warren | MI | 48093 |
| Madison Electric Supply | 31855 Van Dyke | Warren | MI | 48093 |
| MADLAKE, INC. | 10169 Colonial Industrial Drive | South Lyon | MI | 48178 |
| Magnum Electric Supply Company | 2116 Cartier St. | Flint | MI | 48504 |
| MAINSTREAM ENERGY SOLUTIONS. LLC | 2300 E. Rattalee Lake Rd. | Holly | MI | 48442 |
| Maintenance Technology Corporation | P.O. Box 944 | Birmingham | MI | 48012 |
| MAINTENANCE TECHNOLOGY LLC | 1307 E MAPLE, SUITE D | Troy | MI | 48083 |
| Mall City Mechanical Inc | 3325 3 Mile Rd. NW | Grand Rapids | MI | 49534 |
| MALL CITY MECHNICAL INC | 3325 3 Mile Rd NW | Grand Rapids | MI | 49534 |
| Manufacturing and Maintenance Engineering Inc | PO Box 507 | Grosse Ile | MI | 48138 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| MARATHON ELECTRIC MOTOR COMPANY | 100 E. Randolph St. P.O. Box 8003 | Wausau | WI | 54402 |
| Marble Mechanical Services LLC | 1221 Bowers #2109 | Birmingham | MI | 48012 |
| MAREK MECHANICAL LLC | 8101 Harding St. | Center Line | MI | 48015 |
| Mark Lannen Construction LLC | 743 Oakridge Drive | Jackson | MI | 49203 |
| Mark V Investments, Inc. | 32100 Telegraph Rd., Ste. 209 | Bingham Farms | MI | 48025 |
| Markee Electric | 2410 Kansas Ave | Flint | MI | 48506 |
| Mark's Electric Company | 35176 Valley Forge DR. | Farmington Hills | MI | 48331 |
| Marshall E. Campbell | 2975 Lapeer | Port Huron | MI | 48060 |
| Marshall E. Campbell Co. | 2975 Lapeer Rd. | Port Huron | MI | 48060 |
| Marshall E. Campbell Company | 2975 Lapeer Road | Port Huron | MI | 48060 |
| MARSHALL RYERSON COMPANY | 7440 Lime Hollow Dr SE | Grand Rapids | MI | 49546 |
| MARTECH ENTERPRISE LLC | 3176 W. Clay Rd. | Rothbury | MI | 49452 |
| Maryland Electric Co. Inc. | 33651 Giftos | Clinton Township | MI | 48035 |
| MAS Electrical Service Inc. | 32940 Capital Ave. | Livonia | MI | 48150 |
| Masco Contractor Services | 47167 Cartier Ct. | Wixom | MI | 48393 |
| MASCO HOME SERVICES | 21001 Van Born Rd. | Taylor | MI | 48180 |
| MAST HEATING AND COMMERCIAL REFRIGERATION, INC. | 355 Royal Park Dr. | Zeeland | MI | 49464 |
| Mastercraft Heating & Cooling | 26641 Grand River | Redford | MI | 48240 |
| MASTERCRAFT HEATING & COOLING, INC. | 26641 Grand River Ave. | Redford | MI | 48240 |
| Matheson Heating & Air Conditioning, Inc. | 4307 South Commerce Rd. | Commerce Twp. | MI | 48382 |
| Mattawan Mechanical Services LLC | 28895 Red Arrow Hwy | Paw Paw | MI | 49079 |
| Matthew J. DiGiovanni LLC | 1435 Berkshire | Grosse Pointe Park | MI | 48230 |
| MAUDER HVAC | 30080 Bradner Rd. | Northwood | OH | 43619 |
| Maurer Electric Inc | 28 Westland Dr | Bad Axe | MI | 48413 |
| Maurer Electric Inc. | 81 Westland Dr. | Bad Axe | MI | 48413 |
| MAURER HEATING & COOLING CO. | 203 S. Water St. | Owosso | MI | 48867 |
| Maxim Services LLC | 6550 North Guion Road | Indianapolis | IN | 46268 |
| MB Maintenance | 5800 Hartwell | Dearborn | MI | 48126 |
| MBM Construction Co. | 1310 W. Breen Avenue | Kingsford | MI | 49802 |
| MC Lighting | 8959 Tyler Blvd | Mentor | OH | 44060 |
| McCarthy & Smith (Construction Manager) | 24317 Indoplex Circle | Farmington Hills | MI | 48335 |
| McChesney Electric, Inc. | 22036 Woodward Avenue | Ferndale | MI | 48220 |
| MCCURDY MECHANICAL, LLC | 4910 Sanford Dr. | Sterling Heights | MI | 48310 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| McGrath, Inc. | 401 E. Sharon Ave. | Houghton | MI | 49931 |
| MCGUIRE HEATING & COOLING, INC. | 6333 W. Main St. | Weidman | MI | 48893 |
| MCKENZIE ELECTRIC | 9222 26 Mile Rd. | Casco | MI | 48064 |
| MCMI Controls | 6540 Diplomat Drive | Sterling Heights | MI | 48314 |
| MCNAUGHTON - MCKAY ELECTRIC | 1357 E. Lincoln Avenue | Madison Heights | MI | 48071 |
| MCNAUGHTON-MCKAY ELECTRIC | 1357 E Lincoln Ave | Madison Heights | MI | 48071 |
| McNaughton-McKay Electric Company | 1011 E. Fifth Street | Flint | MI | 48503 |
| McNulty Electric Inc. | 7060 S. Lakeshore Rd. | Lexington | MI | 48450 |
| McPhee Electric & Telecommunications, Inc. | PO Box 263 | Potterville | MI | 48876 |
| MCS Lighting, LLC | 25107 Dequindre | Madison Heights | MI | 48071 |
| McSweeney Electric | 29365 Wall St. | Wixom | MI | 48393 |
| Meadowbrook Electric Inc. | P.O. Box 81637 | Rochester | MI | 48308 |
| MEADOWLARK BUILDERS | 711 Fountain St. | Ann Arbor | MI | 48103 |
| Meadowlark Energy Efficiency LLC | 3250 West Liberty Road | Ann Arbor | MI | 48103 |
| MEADOWLARK ENERGY LLC | 3250 W. Liberty | Ann Arbor | MI | 48103 |
| MECHANICAL COMFORT, INC | 1100 Owendale Bldg D | Troy | MI | 48083 |
| MECHANICAL CONTRACTING SERVICES | 2111 E Mitchell Rd. | Petoskey | MI | 49770 |
| Mechanical Controls & Maintenance, Inc | 6540 Diplomat Dr | Sterling Heights | MI | 48314 |
| Mechanical Design & Installation | 47924 West Road | Wixom | MI | 48393 |
| MECHANICAL ELECTRICAL ENGINEERING CONSULTANTS, PC | 1415 Goldsmith | Plymouth | MI | 48170 |
| Mechanical Energy Systems | 8130 Canton Center Rd | Canton | MI | 48187 |
| Mechanical Heating & Cooling | 20916 Van Born Rd. | Dearborn Heights | MI | 48125 |
| MECHANICAL HEATING & COOLING INC. | 6192 N Telegraph Rd | Dearborn Heights | MI | 48127 |
| Mechanical Heating And Cooling | 6192 North Telegraph | Dearborn Heights | MI | 48127 |
| MECHANICAL HEATING AND COOLING, INC | 6192 N. Telegraph Rd | Dearborn Heights | MI | 48127 |
| Mechanical Services LLC | 6380 Green Road | Fenton | MI | 48430 |
| Mechanical Systems & Services (MSS) | 1201 S. Graham Street | Charlotte | NC | 28203 |
| MEDLER ELECTRIC COMPANY | 2155 Redman Drive | Alma | MI | 48801 |
| MEEKHOF ELECTRIC | 5194 37th Ave | Hudsonville | MI | 49426 |
| Megahertz, LLC | 28233 Ecorse Rd. | Romulus | MI | 48174 |
| MEGTEC Systems, Inc. | 830 Prosper Road, PO BOX 5030 | DePere | WI | 54115 |
| MEM Construction | 62 West Sheffield | Pontiac | MI | 48340 |
| Memtech, Inc. | 9033 General Dr. | Plymouth | MI | 48170 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Merc Electric | 31130 Leotta | Fraser | MI | 48026 |
| Merchandising Equipment & Supply | 2039 Walker Ct. | Grand Rapids | MI | 49544 |
| Meridian Plumbing HVAC & Remodeling | 1999 E. Saginaw Hwy | Lansing | MI | 48823 |
| MERLO ENERGY | 1987 Concept Drive | Warren | MI | 48091 |
| Merrit Electric | 5190 Branto Dr. NE | Rockford | MI | 49341 |
| Messinian Properties LLC | 1025 S Washington Ave | Royal Oak | MI | 48067 |
| Metro Air, Inc. | 6689 Orchard Lake Rd, Suite 320 | West Bloomfield | MI | 48322 |
| Metro Climate Control | 25122 Jefferson Ave | St. Clair Shores | MI | 48081 |
| Metro Contracting | 25017 Dequindre Suite 100 | Madison Heights | MI | 48071 |
| Metro Design & Build | 20031 Carlysle | Dearborn | MI | 48124 |
| Metro Electric | 8981 Winter Cove | Commerce Township | MI | 48382 |
| Metro Electric Engineering | 110 East Pond Drive | Romeo | MI | 48065 |
| METRO ELECTRICAL SYSTEMS, INC. | 10266 Lapeer Road, Ste. 105 | Davison | MI | 48423 |
| Metro Environmental, Inc | 22656 Fifteen Mile Rd | Clinton Twp | MI | 48035 |
| Metro One Contracting | 50344 Vinecrest | Chesterfield Twp. | MI | 48047 |
| Metro Shores Construction | 30830 Jefferson Ave | St Clair Shores | MI | 48082 |
| Metro Tech | 1355 Remington Rd. Suite C | Schaumburg | IL | 60173 |
| Metropolitan Air Compresser Co., Inc | 29191 Grosebeck Hwy | Roseville | MI | 48066 |
| Metropolitan Air Compressor Co, Inc. | 29191 Groesbeck Hwy | Roseville | MI | 48066 |
| Meyer Electric, Inc | P.O. Box 667 | Owosso | MI | 48867 |
| Mezher HVAC | 7639 Payne | Dearborn | MI | 48126 |
| MFREP.COM | 20704 Country Club | Harper Woods | MI | 48225 |
| MG Plumbing & Mechanical | 419 Mountana Avenue | Gladstone | MI | 49837 |
| MI HEAT LLC | 7543 F.W. Moore Hwy | Casco | MI | 48064 |
| MI Mechanical North LLC | 2395 S Mission View Dr. | Suttons Bay | MI | 49682 |
| MI PROPERTY PROGRAM | 3600 Edgewood Park | Commerce | MI | 48382 |
| Michigan Air Solutions | 4511 Clay Ave SW | Grand Rapids | MI | 49548 |
| Michigan Chandelier Company | 20855 Telegraph | Southfield | MI | 48033 |
| Michigan Climate Control, Inc. | 35375 Groesbeck Hwy | Clinton Twp | MI | 48035 |
| Michigan Electric LLC | 3855 Kiefer Ave | Warren | MI | 48091 |
| Michigan Electrical Services | 280 Prospect Street | Romeo | MI | 48065 |
| MICHIGAN ENERGY SAVINGS | 144 Whistling Pines Lane NW | Sparta | MI | 49345 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Michigan Energy Service Company | P.O. Box 481 | Jenison | MI | 49429 |
| Michigan Energy Services | 8445 Main st. | Whittmore Lake | MI | 48129 |
| Michigan Energy Services - WB | 2479 S M-76 | West Branch | MI | 48661 |
| Michigan Energy Services Inc | 8445 Main Street | Whitmore Lake | MI | 48189 |
| Michigan Glass Coatings | 1120 Doris Rd | Auburn Hills | MI | 48326 |
| Michigan Glass Coatings, Inc. | 1120 Doris Road | Auburn Hills | MI | 48326 |
| Michigan Green | 1215 Ludington Ave | Escanaba | MI | 49829 |
| Michigan Green Space LLC | 201 S Mill | South Lyon | MI | 48178 |
| Michigan Greenspace | 201 S. Mill St. | South Lyon | MI | 48178 |
| Michigan Industrial Controls, Inc. | 2402 Gratiot Ave | Port Huron | MI | 48060 |
| Michigan Infrared, LLC | 8670 Pellett Dr. | Whitmore Lake | MI | 48189 |
| Michigan Interfaith Power & Light | 138 Goodell St | Wyandotte | MI | 48192 |
| Michigan Lighting Solution | 32329 Miltion | Madison Heights | MI | 48071 |
| Michigan Lighting Systems | 3055 Hilton Ste A | Ferndale | MI | 48220 |
| Michigan Mechanical Insulation | 38900 West Ten Mile Road | Farmington Hills | MI | 48335 |
| Michigan Mechanical Services | 25445 Brest Road | Taylor | MI | 48180 |
| Michigan Metro Tech | 1355 Remington Rd., Suite C | Schaumburg | IL | 60173 |
| Michigan Power Systems | 21745 W 8 Mile Rd | Detroit | MI | 48219 |
| Michigan Refrigeration & Mechanical | 4100 Cedar Commercial Dr | Cedar Springs | MI | 49319 |
| MICHIGAN SOLAR POWER, INC. | 191 Presidio Drive | Ortonville | MI | 48462 |
| Michigan Solar Solutions, LLC | 509 Sherbrooke | Commerce Township | MI | 48382 |
| Michigan Spray Booth | 11211 e. 9 mile | Warren | MI | 48089 |
| Michigan Steam Equipment | 28200 Orchard Lake Rd. Suite 109 | Farmington Hills | MI | 48334 |
| Mics Lighting | 38794 Lakeshore Dr | Harrison Township | MI | 48045 |
| Mid Michigan Community Action Agency | 1574 E Washington Rd PO Box 768 | Farwell | MI | 48622 |
| MID MICHIGAN SOLAR | 522 S. Franklin Ave. | Flint | MI | 48503 |
| MidWest Electric | PO Box 279 | Millington | MI | 48746 |
| MIDWEST ENERGY CONNECTION, LLC: | 1412 Forest Dr. | Portage | MI | 49002 |
| Midwest Energy Group | 5688 East ML Ave Box 2587 | Kalamazoo | MI | 49003 |
| Midwest Energy Group LLC | 5688 E ML Ave | Kalamazoo | MI | 49003 |
| Midwest Illumination Inc. | 8405 Andersonville Road Suite C | Clarkston | MI | 48346 |
| Midwest Insulating Foam & Fireproofing Co., LLC | 6881 Springfield Ave. | Hudsonville | MI | 49426 |
| MIDWEST LIGHTING SERVICES, LLC | P.O. Box 135 | Griffith | IN | 46319 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| MIDWEST WINDOW | 7741 S. Division Ave. | Grand Rapids | MI | 49548 |
| MIKE GENSON PLUMBING, INC. | 182 E. Livingston Road | Highland | MI | 48357 |
| Mike Hamilton Electric | 27 Park St. | Oxford | MI | 48371 |
| Mike Hastie | 21124 Carlysle | Dearborn | MI | 48124 |
| Mike Schreiber | 53224 Joann Marie Dr. | Chesterfield | MI | 48047 |
| Mike's Heating & Cooling, Inc. | 46028 Van Dyke | Shelby Twp. | MI | 48317 |
| Milestone Electrical | 2452 Lindell Rd | Sterling Heights | MI | 48310 |
| Miller Heating & Cooling | 6311 East Joy Rd. | Ann Arbor | MI | 48105 |
| Miller Sage | 300 Quality Way | Holly | MI | 48442 |
| Miller-Boldt, Inc. | 42826 Mound Road | Sterling Heights | MI | 48314 |
| MING SCIENTIFIC, LLC | 2142 Pontiac Rd, No 104 | Auburn Hills | MI | 48326 |
| Minkler Electric | 959 E. Huron | Vassar | MI | 48768 |
| Miror Lighting Inc. | 14647 W. 95th Street | Lenexa | KS | 66215 |
| MISTER GREEN ENERGY LLC | 30308 Wedgewood Circle | Roseville | MI | 48066 |
| Mitchell Electric | 10395 Clark Rd. | Davison | MI | 48423 |
| Mittelman Heating and Cooling | 15938 Jennete | Southfield | MI | 48075 |
| MLG Electric, LLC | 13335 15 Mile | Sterling Heights | MI | 48312 |
| MLG Hardware LLC | 33643 Mulvey | Fraiser | MI | 48026 |
| MNC Professional Service LLC | 72 Pinewood | White Lake | MI | 48386 |
| M-N-M Products | 1130 Rial Lake Rd | Howell | MI | 48843 |
| Mode Development, Inc | 38700 Van Dyke Suite 200 | Sterling Heights | MI | 48312 |
| Molino Electric | 3162 Palmetto Ct. | Trenton | MI | 48183 |
| Monarch Welding & Engineering, Inc. | 519 W. Hackley Ave | Muskegon | MI | 49444 |
| Monroe Infrared Technology, Inc | 52226 Concorde Dr | Shelby Twp | MI | 48315 |
| Monroe Plumbing and Heating | 506 Copper St P.O. Box 307 | Monroe | MI | 48161 |
| Monte Electric LLC | 46231 Sugarbush Road | Chesterfield | MI | 48047 |
| Moore Brothers Plumbing, Heating & Cooling LLC | 15870 Schaefer | Detroit | MI | 48227 |
| Moore Mechanical | 12760 Honor Hwy | Honor | MI | 49635 |
| Moote Electrical, Inc. | 490 S. Opdyke Road | Pontiac | MI | 48341 |
| MORONI HEATING & AIR CONDITIONING, INC. | 2094 Tobys Rd. | Niagara | WI | 54151 |
| Morris Electric INC | 11600 Delta Drive | Fowlerville | MI | 48836 |
| Mosher, Dolan, Cataldo & Kelly Commerical | 735 Forest Suite 200 | Birmingham | MI | 48009 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Moshier & Son Electric | PO Box 81694 | Rochester | MI | 483308 |
| MOTOR CITY ELECTRIC CO. | 9440 Grinnell St. | Detroit | MI | 48213 |
| MPG Electric | 3341 Stonewood | Sterling Heights | MI | 48312 |
| MPH Contracting Inc. | 34 Barry St. SE | Brand Rapids | MI | 49548 |
| MPH, INC./ MILLER PLUMBING HEATING & A.C. | 1021 River Ave. | Iron Mountain | MI | 49801 |
| Mr. Heat | 4744 Interlake | Oscoda | MI | 48750 |
| MR. HEAT & COOL | 880 E Bard Rd. | Muskegon | MI | 49445 |
| MS GREEN CONSTRUCTION | 1342 N. Main Street Suite 5 | Ann Arbor | MI | 48104 |
| Ms. Green Construction | 1342 N. Main., Suite 5 | Ann Arbor | MI | 48103 |
| MSP Construction | 4396 E75 Lane | Bark River | MI | 49807 |
| MT. PLEASANT HEATING & AC | 502 Industrial | Mt. Pleasant | MI | 48858 |
| Mt. Pleasant Heating & Air Conditioning | 502 Industrial Avenue | Mt. Pleasant | MI | 48858 |
| MTI Energy Management | 7627 Park Place | Brighton | MI | 48116 |
| MUELLER HEATING AND COOLING, INC. | 94 E. Apple Ave. | Muskegon | MI | 49442 |
| MULLIGAN HEATING INC. | 9260 Elizabeth Lake Rd. | White Lake | MI | 48386 |
| Multi-Phase Contracting Inc | 31600 Harper | Clinton Twp | MI | 48035 |
| Mulvanny G2 Architecture | 110 112th Avenue NE Suite 500 | Bellevue | WA | 98004 |
| Munro Electric Co., Inc. | 48590 Downing Street | Wixom | MI | 48393 |
| Murray Lighting and Electrical Supply Co. | 10227 W. 8 Mile Rd. | Detroit | MI | 48221 |
| Muskegon Oceana Comm Action Partnership | 1170 W Southern Ave | Muskegon | MI | 49441 |
| Mutual Electric | 1260 Rickett Rd | Brighton | MI | 48116 |
| MW Morss Roofing, Inc | 15423 Oakwood Dr | Romulus | MI | 48174 |
| MXENERGY WIZARD. | 39555 Orchard Hill Place Suite 600 | Novi | MI | 48375 |
| Myers Lighting | 28815 Grobbel | Warren | MI | 48092 |
| MYRON ZUCKER INC | 36825 Metro Court | Sterling Heights | MI | 48312 |
| N Wasserstrom & Sons | 2300 Lockbourne Rd | Columbus | OH | 43207 |
| Nadia's Service, Inc. | 6314 Kendal | Dearborn | MI | 48126 |
| National Electrical | 22193 Spitzley St. | Clinton Twp | MI | 48035 |
| National Energy Control, Inc. | 423 W. Wyoming Ave. | Cincinnati | OH | 45215 |
| National Energy Services, Inc. | 250 Hembree Park Drive, Suite 114 | Roswell | GA | 30076 |
| NATIONAL HEATING CO., INC. | 23660 Grand River Ave. | Detroit | MI | 48219 |
| National Retrofitting Group LLC | 130 S. Jefferson | Chicago | IL | 60661 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Nationwide Construction | 33079 Garfield Ste 253 | Fraser | MI | 48026 |
| Nationwide Equipment Inc. | 37131 Highlite | Sterling Heights | MI | 48310 |
| Naugle Plumbing & Heating Inc. | 1108 W. Chicago Blvd. | Tecumseh | MI | 49286 |
| Nederman | 102 Transit Avenue | Thomasville | NC | 27361-0429 |
| NELSON TRANE | 5335 Hill 23 Drive | Flint | MI | 48507 |
| Nemer Property Group, Inc | PO Box 70 | Southfield | MI | 48037 |
| Nevilles Electric Service | 678 Front Street, Suie 135 | Grand Rapids | MI | 49504 |
| New Electric | 6475 19 1/2 Mile | Sterling Hts | MI | 48314 |
| New England Energy Management, Inc. | 5 Shelter Rock Rd. | Danbury | CT | 06810 |
| New Harvest Homes, Inc. | 453 East Marshall | Ferndale | MI | 48220 |
| NEW HORIZON HEATING AND COOLING LLC | 117 Maple Street | Delton | MI | 49046 |
| New Tech Electric | 24840 Belton Lane | Dearborn Heights | MI | 48127 |
| New Tech Electric LLC | 24840 Belton | Dearborn Heights | MI | 48127 |
| New Way Electric, Inc. | 79779 North Avenue | Armada | MI | 48005 |
| NEWMAN CONSULTING GROUP, LLC | 6600 Valley Spring Rd. | Bloomfield Hills | MI | 48301 |
| NexRev, Inc. | 601 Development Drive | Plano | TX | 75074 |
| NEXTEK WEST, INC. | 461 Burroughs Street | Detroit | MI | 48202 |
| Nihil Ultra Corporation | 55 E. Long Lake Rd. #424 | Troy | MI | 48085 |
| NLMS, Inc. | PO Box 178, 340 South Union St. | Bethel | OH | 45106 |
| NOLA (New Orleans Lighting Alternative) | 3750 Pinegrove Avenue | Fort Gratiot | MI | 48059 |
| North Electric Supply, Inc | 1290 North Opdyke Road | Auburn Hills | MI | 48326 |
| North Point Electric | 10077 Colonial Industrial Dr. | South Lyon | MI | 48178 |
| North Star Mechanical, Inc. | 50650 Corporate Drive | Shelby Twp | MI | 48315 |
| Northern Boiler | 2025 Latimer Dr. | Muskegon | MI | 49442 |
| Northern Equities Management Company | 39000 Country Club Dr. | Farmington Hills | MI | 48331 |
| NORTHERN INSULATION LLC | 1620 8th Ave S. | Escanaba | MI | 49829 |
| NORTHERN LIGHTS MECH INC. | 2500 Wiersma | Cedar Springs | MI | 49319 |
| NORTHERN MICHIGAN ENERGY | 8450 Channel Rd. | Petoskey | MI | 49770 |
| Northern Michigan Energy Auditors, LLC | 1152 E Traverse Lake Rd | Cedar | MI | 49621 |
| Northern Pizza Equipment Inc. | 8020 Grand St. | Dexter | MI | 48130 |
| Northside Heating Cooling & Refrigeration | 2175 Reigler Rd. | N. Muskegon | MI | 48445 |
| NORTHSIDE HEATING, COOLING & REFRIGERATION, INC | 2175 Riegler | Muskegon | MI | 49445 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Northstar Refrigeration | 50650 Corporate Dr. Suite A | Shelby Twp | MI | 48315 |
| Northwest Kent Mechanical | 4095 16 Mile Rd | Cedar Springs | MI | 49319 |
| NORTHWEST MECHANICAL INC | 8315 US Highway 31 | Alanson | MI | 49706 |
| NORTHWOODS ENERGY | 8129 Ferry Rd. | East Jordan | MI | 49727 |
| Norton Mechanical | 4956 Clemson Drive | Sterling Heights | MI | 48313 |
| NOVA CABLE | 110 1/2N. Third | Grand Haven | MI | 49417 |
| NOVA Consultants Inc. | 21580 Novi Road | Novi | MI | 48375 |
| NOVA CONSULTANTS, INC | 21580 Novi Road, Suite 300 | Novi | MI | 48375 |
| NOVA ELECTRICAL INC | 12325 Nixon | Riverview | MI | 48193 |
| Novaks Construction | 3620 Van Dyke | Almont | MI | 48003 |
| Novaspect Process Management | N992 Quality Drive | Greenville | WI | 54942 |
| Novatec | 222 East Thomas Avenue | Balitmore | MD | 21225 |
| Novi Insulation, Inc | 23660 Industrial Park Drive | Farmington Hills | MI | 48335 |
| NPY Electrical | 3734 Coton Drive | Fort Gratiot | MI | 48059 |
| NRG Patrol | 46036 Michigan Avenue Suite 225 | Canton | MI | 48188 |
| NRG Patrol LLC | 46036 Michigan Ave Suite 225 | Canton | MI | 48188 |
| Nudell Architects | 31690 W Twelve Mile | Farmington Hills | MI | 48334 |
| Nuechterlein Electric, Inc. | 304 List St. | Frankenmuth | MI | 48734 |
| OAK ELECTRIC SERVICE | 5492 Dixie Hwy | Waterford | MI | 48329 |
| Oak Electric Service Inc. | 5492 Dixie Hwy Suite 1 & 2 | Waterford | MI | 48329 |
| Oakley Heating & Cooling | 7538 Currie Rd. | Northville | MI | 48168 |
| Obertron Electronic Manufacturing | 10098 M-52 | Manchester | MI | 48158 |
| O'BRIEN CONSTRUCTION AND ENERGY SOLUTIONS | 1735 Highwood East | Pontiac | MI | 48340 |
| O'Donnell Electric | 8262 Woods Trail | Whitmore Lake | MI | 48189 |
| OEO Energy Solutions | 143 East Main Street | Lake Zurich | IL | 60047 |
| Office Maintenance Services Inc. | 2214 Red Maple | Troy | MI | 48098 |
| Oliver Electric, LLC | 10770 Gloria Greer Lane | Holly | MI | 48442 |
| Oliver/Hatcher Construction | 27333 Meadowbrook Rd., Ste. 100 | Novi | MI | 48377 |
| Olympos Electric | 4173 Vassar Dr. | Troy | MI | 48085 |
| O'Mara Plumbing, Heating & Cooling | 208 S. Kidd St. | Ionia | MI | 48846 |
| O'MARA PLUMBING, HEATING & COOLING, INC. | 208 Kid St. | Ionia | MI | 48846 |
| Omega Development Corporation | 24663 Mound Road | Warren | MI | 48091 |
| Omega Electric | 24784 Hathaway St. | Farmington Hills | MI | 48335 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| OMEGA Productive Services | 2100 Coe Court | Auburn Hills | MI | 48326 |
| On The Mark Contractors | 7340 Camelot Drive | West Bloomfield | MI | 48322 |
| Optimum Lighting, LLC | 500-C Alexander Avenue | Henderson | NC | 25736 |
| Orchard Hill Mechanical Co. | PO Box 557 | Casnovia | MI | 49318 |
| Ore Creek Development | 10315 Grand River Rd., Suite 101 | Brighton | MI | 48116 |
| ORION ENERGY SYSTEMS, INC. | 2210 Woodland Drive | Manitowoc | WI | 54220 |
| ORTON REFRIGERATION & HEATING LLC | 5466 Clifford Rd | Clifford | MI | 48727 |
| OSC Inc. | 6789 Fish Lake Road | North Branch | MI | 48461 |
| OSCAR W. LARSON COMPANY | 10100 Dixie Highway | Clarkston | MI | 48348 |
| OSG Energy | PO Box 71 | Ada | MI | 49301 |
| Osier & Sons Electric | 41227 S I-94 Service Drive | Belleville | MI | 48111 |
| OSIER & SONS ELECTRIC, LLC | 41227 I-94 S. Service Dr. | Belleville | MI | 48111 |
| Ott Electric | 3170 Edgewood Park Dr | Commerce Twp | MI | 48382 |
| OTTO A TRZOS CO. INC | 3101 Orchard Lake Rd | Keego Harbor | MI | 48320 |
| Otto A. Trzos Co., Inc | 3101 Orchard Lake Rd. | Keego Harbor | MI | 48320 |
| Outdoor Link, Inc. | 3058 Leeman Ferry Rd. SW | Huntsville | AL | 35801 |
| Owens Landscaping | 38167 Abruzzi | Westland | MI | 48185 |
| Oxford Electric Systems | 5 South Glaspie Unit E | Oxford | MI | 48371 |
| OXFORD PLUMBING AND HEATING LLC/AIR-VAC FURNACE CO. | 153 S. Washington St. | Oxford | MI | 48371 |
| OYK Construction | 26300 Telegraph Rd, Suite 100 | Southfield | MI | 48033 |
| OZ ENERGY OPTIMIZATION, LLC | 30130 Bristol Lane | Bingham Farms | MI | 48025 |
| P & R Electrical Contractors | 412 Ruff Dr. | Monroe | MI | 48162 |
| P & W Construction LLC | 33064 Benson Drive | Westland | MI | 48185 |
| P D Insulation | 1475 Cedar Valley Rd. | Petoskey | MI | 49770 |
| P&M Lighting Co. | 1921 Hilton Road | Ferndale | MI | 48220 |
| P.S.R. | 129 South St. | Belleville | MI | 48111 |
| PACECONTROLS LLC | 4747 S. Broad Street, Bldg 101, Suite 220 | Philadelphia | PA | 19112 |
| Paddington Farms, Inc. | 2820 N. Lima Ctr. Rd. | Dexter | MI | 48130 |
| PANTERA DRYWALL, INC. | 240 E. Ludington | Farwell | MI | 48622 |
| PARADIGM ENERGY SERVICES | 11195 Essex Rd | Ellsworth | MI | 49729 |
| Paragon Electrical Construction | 6514 Hatchery Rd., | Waterford | MI | 48327 |
| Parker-Arntz Plumbing & Heating Inc. | 6319 S. Greenville Road | Greenville | MI | 48838 |
| Parkway Electric & Communications LLC | 11952 James St. | Holland | MI | 49424 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Pat Walters & Sons | 636 S Mansfield | Ypsilanti | MI | 48197 |
| Patti Electric Inc. | 131 McLean Drive | Bruce Twp. | MI | 48065 |
| Patton Mechanical LLC | 13394 B Lime Lake Dr. | Sparta | MI | 49345 |
| Paul Thomas Construction | 54 Smith | Mt. Clemens | MI | 48043 |
| Paulsen Heating & Cooling Inc. | 221 North Mercant | Fremont | MI | 49412 |
| PAULSEN HEATING AND COOLING, INC. | 221 N Merchant | Fremont | MI | 49412 |
| Payton Electrical Services | 22724 Power Rd | Farmington | MI | 48336 |
| Pells Radio Appliance & TV | 415 N. Mitchell | Cadillac | MI | 49601 |
| Peninsula Electrical LLC | 4200 Cross Rd | White Lake | MI | 48386 |
| Peninsula Insulation Co. | 839 N. Al Moses Road | Lake City | MI | 49651 |
| PENNING PLUMBING & HEATING, INC. | 584 44th St. SE. | Grand Rapids | MI | 49548 |
| Perceptive Industries, Inc. | 951 Industrial Parkway | Plainwell | MI | 49080 |
| Perfect Touch | 3383 Elder | West Bloomfield | MI | 48324 |
| Performa Inc | 124 N Broadway | De Pere | WI | 54115 |
| Performance Engineering Group, Inc | 32995 Industrial Rd | Livonia | MI | 48150 |
| Performance Engineering Group, Inc. | 32995 Industrial Road | Livonia | MI | 48150 |
| PES GROUP | 615 Griswold-STE 805 | Detroit | MI | 48226 |
| Peter Basso Associates | 5145 Livernois Road | Troy | MI | 48098 |
| PETER BASSO ASSOCIATES, INC. | 5145 Livernois | Troy | MI | 48098 |
| Peterson Electric, Inc | 25524 John R | Madison Heights | MI | 48071 |
| Pete's Heating & Cooling, Inc. | 12070 Farmington Road | Livonia | MI | 48150-1726 |
| PG Electric | 1421 Walnut | Dearborn | MI | 48124 |
| PHASE LINER OF MICHIGAN, INC. | 3175 Christy Way | Saginaw | MI | 48603 |
| PHASE LOGIC, INC. | 3089 E. Bristol Rd. Suite One C | Burton | MI | 48529 |
| Phenomenal Electric Service | 2624 Rhodes | Troy | MI | 48083 |
| PHEONIX UBER RENEWAL | 3984 Cabaret Tr | Saginaw | MI | 48603 |
| Philips Lightolier | 540 N. Lapeer Rd. #389 | Orion Township | MI | 48362 |
| Philips Optimum | 754 Southwick Ave | Clayton | NC | 27527 |
| Phillip Boose Builders | 4281 Smith Rd. | Lambertville | MI | 48144 |
| Phillips Service Industries | 11878 Hubbard | Livonia | MI | 48150 |
| Phillips Sign & Lighting Inc. | 40920 Executive DR | Harrison Twp | MI | 48045 |
| PHIL'S CONSTRUCTION CO. | 1425 Fox Ave. | Ferndale | MI | 48220 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| PHIL'S PLUMBING & HEATING, INC. | 751 N. Van Dyke | Bad Axe | MI | 48413 |
| Phoenix Contractors, Inc | 2111 Golfside | Ypsilanti | MI | 48197 |
| Phoenix Environmental, Inc. | 11042 Hi Tech Drive | Whitmore Lake | MI | 48189 |
| Phoenix Home Perfomance | 3984 Cabaret Trail | Saginaw | MI | 48603 |
| PHOENIX HOME PERFORMANCE | 3984 Cabaret Tr. | Saginaw | MI | 48603 |
| Phoenix Lighting Services Inc. | 26617 Grand River | Redford | MI | 48240 |
| Phoenix Refrigeration, Inc. | 29333 Lorie Lane | Wixom | MI | 48393 |
| PHOENIX UBER RENEWAL | 12770 Fairlane | Livonia | MI | 48150 |
| Pico-Brewing Systems | 8383 Geddes Rd. | Ypsilanti | MI | 48198 |
| Pilot Heating & Cooling | 14486 Edmeer Dr. | Holland | MI | 49424 |
| Platinum Electric | 50631 Wing St. | Shelby Township | MI | 48315 |
| Pleasant Valley Construction Company | PO Box 3133 | Independence | OH | 44131 |
| Pleune Service Company | 750 Himes SE | Grand Rapids | MI | 49548 |
| Plumb Crazy Plumbing LLC | 9915 N. Shay Town Rd. | Mulliken | MI | 48861 |
| Plus 1 Electric | 17194 Parkside | Detroit | MI | 48221 |
| PM ENVIRONMENTAL, INC. | 4080 West Eleven Mile Rd. | Berkley | MI | 48072 |
| Polaris Plate Heat Exchangers, LLC | 28 May St. | Edison | NJ | 48382 |
| Porter & Heckman Energy Solutions | 3056 Davison Road | Lapeer | MI | 48446 |
| Porter & Heckman Inc | 3056 Davison Rd | Lapeer | MI | 48446 |
| Posen Construction, Inc | 7991 Hartwick | Detroit | MI | 48211 |
| Postill Electric Inc. | 4300 E. Range Ct. | St. Clair | MI | 48079 |
| Power Control Systems, Inc. | 2861 W. Jolly Rd, Ste C | Okemos | MI | 48864 |
| Power Correction Technology Inc. | 1448 Avon Circle West | Rochester Hills | MI | 48309 |
| Power Distribution Center | 10617 McCabe Rd | Brighton | MI | 48116 |
| Power Point Electrical Contracting LLC | 3298 Eona Jane | Auburn Hills | MI | 48340 |
| Power Smart | 14944 Yorkshire | Southgate | MI | 48195 |
| Powerhouse Retail Services | 812 S. Crowley Rd., STE A | Crowley | TX | 76035 |
| Powerline Electric | PO Box 300044 | Waterford | MI | 48330 |
| Powur of Citizenre | 3862 Steiner | Trenton | MI | 48183 |
| PRACTICAL POWER INC. | P.O. Box 80048 | Rochester | MI | 48308 |
| Practical Power, llc | 6875 Rochester Rd. Suite 200 | Rochester Hills | MI | 48306 |
| Precision Climate Services | 10750 Culver Road | Brighton | MI | 48114 |
| Precision Electrical Contracting Inc | 26220 Grand River Ave | Redford | MI | 48240 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Precision Heating and Cooling, Inc. | 4786 W. River Dr. | Comstock Park | MI | 49321 |
| Precision Plumbing & Heating Systems Inc. | 2829 Cass Rd | Traverse City | MI | 49684 |
| PREDICTIVE SERVICE | 25200 Chagrin Blvd. Suite 300 | Beachwood | OH | 44122 |
| Premeau Construction Inc. | 904 W. Baraga Ave. | Marquette | MI | 49855 |
| PREMIER / SPECTRUM SALES GROUP | 720 Madison St. | Jackson | MI | 49202 |
| PREMIER HEATING & COOLING | 205 Second Street | Ludington | MI | 49431 |
| Premier Refrigeration Co. | 6650 Highland Rd, Suite 310 | Waterford | MI | 48327 |
| PREMIER ROOFING & EXTERIORS, LLC. | 3090 Pine Ave. S. W. | Grandville | MI | 49418 |
| Premium Air | 1051 Naughton | Troy | MI | 48083 |
| Premium Electric Company | 2550 Hilton Road | Ferndale | MI | 48220 |
| PREMIUM ELECTRIC COMPANY, INC. | 2550 Hilton | Ferndale | MI | 48220 |
| PREMIUM SERVICES, INC | 21765 Melrose Ave. | Southfield | MI | 48075 |
| Premium Services, Inc. | 21765 Melrose Ave | Southfield | MI | 48075 |
| Pressures and Pipes Inc | 143 W Sherman Blvd | Muskegon | MI | 49444 |
| Primary Electric | PO Box 398 | Grayling | MI | 49738 |
| Prime Electrical Services | 19215 W. 8 Mile Rd. | Detroit | MI | 48219 |
| Pro Energy Consultants | 2516 Pamela | Ann Arbor | MI | 48103 |
| Pro Energy Consultants - Howell | 1104 Burns Street | Howell | MI | 48843 |
| Pro Environmental, Inc. | 10134 6th Street, Suite K | Rancho Cucamonga | CA | 91730 |
| Pro Lighting | 12581 E. Grand River | Brighton | MI | 48116 |
| Pro Refrigeration, Inc. | P.O. Box 1528 | Auburn | WA | 98071 |
| Process Engineering & Equipment Company | 571 6 Mile Road NW | Comstock Park | MI | 49321 |
| Production Electric | 440 Parkdale | Rochester | MI | 48307 |
| PROENERGY CONSULTANTS OF SHELBY TWP., INC. | 14485 Doebler Drive | Shelby Township | MI | 48315 |
| Professional Air Services, Inc | P.O. Box 715 | Hamburg | MI | 48139 |
| Professional Engineering Services, Inc (PES) | 220 Bagely Ave, Suite 930 | Detroit | MI | 48226 |
| Professional Pump and Irrigation Service | 27962 East Broadway St. | Moline | OH | 43465 |
| Professional Renovation Services | 700 Welch | Commerce Township | MI | 48390 |
| Pro-Green Solutions | 119 S. Washington Street Suite 4 | Oxford | MI | 48371 |
| Progressive AE | 1811 4 Mile Rd | Grand Rapids | MI | 49525 |
| Progressive Heating Cooling & Refrigeration Inc. | 1375 E. Main Street | Lowell | MI | 49331 |
| Progressive Home Improvement | 453 North Wildwood | Westland | MI | 48227 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Prominent Design & Build, Inc. | 3738 Lansing Ave. | Jackson | MI | 49202 |
| PROPERTY FACTS HOME & ENERGY INSPECTIONS, LLC | 9350 Colony Farm Ct | Plymouth | MI | 48170 |
| PROPERTY FACTS HOME AND ENERGY INSPECTIONS | 9350 Colony Farms Ct | Plymouth | MI | 48170 |
| Protech Lighting | 17281 Shinnecock | Macomb | MI | 48042 |
| Pro-Tech Lighting Inc. | 1695 E. Maple | Troy | MI | 48083 |
| Protek Electrical Contracting | 325 E. Huron St | Milford | MI | 48381 |
| Pumford Construction, Inc. | 1674 Champagne Dr. N. | Saginaw | MI | 48604 |
| Pumps & Systems Incorporated | 6256 N Telegraph | Dearborn Heights | MI | 48127 |
| Purcell Group | 1658 Wilmington Ct | Rochester Hills | MI | 48309 |
| Pure Eco Environmental Solutions | 2895 Chestnut Run Dr | Bloomfield Hills | MI | 48302 |
| Pzarka Enterprises | 5941 Mabley Hill | Fenton | MI | 48430 |
| Q-Electric | 53257 Mound Rd | Shelby Township | MI | 48316 |
| Quade Inc. | 44001 Phoenix Dr. | Sterling Hgts. | MI | 48314 |
| Quality Air Heating & Cooling, Inc. | 3395 Kraft Ave SE | Grand Rapids | MI | 49512 |
| Quality Crafters Inc | 47233 Giamongan Drive | Novi | MI | 48374 |
| QUALITY HEATING AND COOLING, INC. | 38291 Schoolcraft Rd. Suite 101 | Livonia | MI | 48150 |
| QUALITY INSULATION INC. | P.O. Box 473 | Gladwin | MI | 48624 |
| Quality Stainless | 1150 E. 11 Mile Rd | Madison Heights | MI | 48071 |
| QUIKWATER | 8939 W. 21st Street | Sand Springs | OK | 74063 |
| R & A Heating and Cooling | 275 Biltmore Blvd. | Troy | MI | 48084 |
| R & A Mechanical | 6150 Lake Montcalm Rd. | Six Lakes | MI | 48886 |
| R & D Mechanical Systems, Inc. | 39111 W. Six Mile Rd. | Livonia | MI | 48152 |
| R & J Electric | 18383 Cheval Dr. | Clinton Township | MI | 48038 |
| R & K HEATING & COOLING CO., INC. | 981 Getty | Muskegon | MI | 49442 |
| R & R DRYWALL & INSULATION, INC. | 586 Industrial Dr. | Clare | MI | 48617 |
| R & R Drywall and Insulation, Inc. | 586 Industrial Drive | Clare | MI | 48617 |
| R B Miller | 2764 W. Lake Dr. | Kimball | MI | 48074 |
| R ENERGY SERVICES, INC. | 767 Whittier Ct. | Saline | MI | 48176 |
| R&L HEATING & COOLING INC | 21159 Goddard | Taylor | MI | 48180 |
| R. A. LEE ELECTRIC, INC. | 263 W. Montcalm | Pontiac | MI | 48342 |
| R. A. Rice Electric Co. | 17185 Wyoming | Detroit | MI | 48221 |
| R. L. Deppmann | 20929 Bridge | Southfield | MI | 48033 |
| R. Wadsworth Co. | 13730 Brookside Dr. | Sterling Heights | MI | 48313 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| R. WHITMAN SERVICE | 4384 Rifle River Trail | Prescott | MI | 48756 |
| R.B. & Sons Electric | 1951 Larchwood | Troy | MI | 48083 |
| R.C. Ford Assoc. Inc. | 2462 Dixboro | Ann Arbor | MI | 48105 |
| R.C. Schmidt & Sons | 52057 Sierra Dr. | Chesterfield | MI | 48047 |
| R.E. Fraley Company, Inc | 1715 N. River Road #27 | Saint Clair | MI | 48079 |
| R.O.I WEATHERIZATION | 532 Saint Joseph St. | Lake Leelanau | MI | 49653 |
| R.W. Mercer Co. | 4585 Executive Drive | Portage | MI | 49002 |
| RA Mechanical | 4617 N. Grand River | Lansing | MI | 48906 |
| Rader Electric | P.O. Box 638 | Walled Lake | MI | 48390 |
| RADIANT ENERGY SYSTEMS | 29757 Anthony Dr. | Wixom | MI | 48393 |
| Radiant Energy Systems, Inc | 29757 Anthony Dr | Wixom | MI | 48393 |
| Rand Construction | 1270 Rickett Road | Brighton | MI | 48116 |
| Randazzo Mechanical Heating & Cooling | 51113 Industrial Drive | Macomb | MI | 48042 |
| Randazzo Mechanical Heating and Cooling | 51113 Industrial Dr | Macomb | MI | 48042 |
| Randy Charbineau Electric | 637 Orange St. | Wyandotte | MI | 48192 |
| RAPID ROOFING | 5700 S. Sheldon | Canton | MI | 48188 |
| RASMUSSEN LLC | 2914 3 Mile Rd | Walker | MI | 49534 |
| Rauhorn Electric, Inc. | 17171 23 Mile Rd. | Macomb | MI | 48042 |
| Rausch Electric | 1546 Meisner Rd. | East China | MI | 48054 |
| Ray Electric | 25673 Meadowbrook | Novi | MI | 48375 |
| Raymer Electric LLC | 10829 Bigelow Rd. | Davisburg | MI | 48350 |
| RC Ford Associates Inc. | 2462 Dixboro Rd | Ann Arbor | MI | 48105 |
| RC Mechanical Services Inc | PO Box 51277 | Livonia | MI | 48151 |
| RCI Electric Co. | 32733 Folsom Rd. | Farmington Hills | MI | 48336 |
| RD Electric Inc. | 8161 Burning Bush Rd. | Grosse Ile | MI | 48138 |
| Real Electric Inc. | 533 S. Oakwood Blvd. | Detroit | MI | 48217 |
| Recess King | 1175 J. Street | Waterford | MI | 48327 |
| Reckingers Heating & Cooling | 2050 Monroe Blvd | Dearborn | MI | 48124 |
| Re-Construction Inc | 17250 Redford | Detroit | MI | 48219 |
| REDCO FOODSERVICE EQUIPMENT | 5145 S Emmer Drive | New Berlin | WI | 53151 |
| REDCO FOODSERVICE EQUIPMENT, LLC | 5145 S. Emmer Drive | New Berlin | WI | 53151 |
| Redd Electric | P.O. Box 509 | Almont | MI | 48003 |
| Redmon Heating | 3736 28th St SW | Grandville | MI | 49418 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| REDMON HEATING AND COOLING INC | 3736 28th St. SW | Grandville | MI | 49418 |
| Refrigeration Engineering Inc. | 27475 Meadowbrook Rd. | Novi | MI | 48377 |
| Regency Lighting | 9261 Jordan Ave. | Chatsworth | CA | 91311 |
| REI Hussmann | 3123 Wilson Drive | Grand Rapids | MI | 49534 |
| Reliable Electric Services | 3040 Wakefield | Canton | MI | 48188 |
| Reliable Electrical | 4930 Livernois | Detroit | MI | 48210 |
| Reliable Energy Savings, Inc | 44487 Oak Forest Dr | Northville | MI | 48168 |
| RELIABLE RELAMPING | 6459 Nash Hwy | Saranac | MI | 48881 |
| Reliable Relamping Inc | 6459 Nash Hwy | Sarnac | MI | 48881 |
| Relume Technologies, Inc. | 925 N. Lapeer Rd., Ste. B | Oxford | MI | 48371 |
| Remi Sound | 5318 Wild Daisy Ct. | Clarkston | MI | 48346 |
| Renewable Energy Solutions LLC | 17700 Garvey Rd. | Chelsea | MI | 48118 |
| RENEWAL BY ANDERSEN | 307720 Amrhein Rd | Livonia | MI | 48336 |
| Renton Electric | 4614 Fernlee | Royal Oak | MI | 48073 |
| Resource Mechanical Insulation | 47461 Clipper Street | Plymouth | MI | 48170 |
| Restaurant Lighting Concepts, LLC | 209 Oak Ridge Drive | Taylorsville | KY | 40071 |
| RETAF | 32401 W 8 Mile Rd | Livonia | MI | 48152 |
| RETIRED ENGINEER TECHNICAL ASSISTANCE FOUNDATION | 32401 West Eight Mile Road | Livonia | MI | 48152 |
| Retro-Tech Systems, Inc | 2974 Aspen Lane | Bloomfield Hills | MI | 48302 |
| Reveal Inspections | 1520 Marie | Westland | MI | 48186 |
| Reynolds Electric | 21048 Gloede | Wareen | MI | 48088 |
| RHAC Heating & Cooling Co. | 15615 Markese Ave. | Allen Park | MI | 48101 |
| RHINO CONSTRUCTION | 215 Irwin St. | Brooklyn | MI | 49230 |
| RHM Fluid Power, Imc. | 375 Manufacturers Dr. | Westland | MI | 48186 |
| Rich & Howell Plumbing | 1580 Cheston St. | Muskegon | MI | 49442 |
| Rich Osterman Electric | 34865 Groesbeck Hwy | Clinton Twp | MI | 48035 |
| RICH OSTERMAN ELECTRIC COMPANY INC. | 34865 Groesbeck Hwy. | Clinton Twp. | MI | 48035 |
| Richer's Refrigeration & Air Conditioning | 2803 Danforth Road | Escanaba | MI | 49829 |
| Rick Buckman | 28004 Gladstone | St. Clair Shores | MI | 48081 |
| Rick's Electric Inc. | PO Box 578 | Oxford | MI | 48371 |
| RICKY'S HEATING | 12255 Coster Rd. | Fife Lake | MI | 49633 |
| Riney Electric Inc. | 1459 Fort St. | Wyandotte | MI | 48192 |
| Rite Electric | 3060 W. 11 Mile Rd | Southfield | MI | 48072 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Riteway Plumbing & Heating Inc. | 2083 Walker Ct NW | Grand Rapids | MI | 49544 |
| RITE-WAY PLUMBING & HEATING, INC. | 2083 Walker Court NW | Grand Rapids | MI | 49544 |
| River City Mechanical | 5325 Six Mile Ct. NW | Comstock Park | MI | 49321 |
| Riverside Construction Company | PO Box 506 | Stephenson | MI | 49887 |
| Riverside Electrical Services | P.O. Box 343 | Trenton | MI | 48183 |
| Rizzolobrown & Novak Architects | 122 S. Main suite 290 | Ann Arbor | MI | 48104 |
| RJV Solutions, LLC | 2301 W. Big Beaver, Suite 900 | Troy | MI | 48084 |
| RLM Environmental Services | 39340 Country Club Dr. | Farmington | MI | 48331 |
| RLM Global | 28850 Cabot Drive Suite 900 | Novi | MI | 48377 |
| RMR Associates LLC | 35555 Garfield, Ste. 1 | Clinton Twp. | MI | 48035 |
| RMS Electrical | 34173 Serone | Chesterfield Twp. | MI | 48047 |
| Robert D. Lakin | 11571 Aspen | Plymouth Twp | MI | 48170 |
| Robert J. Dunn | 3033 Harrison | Trenton | MI | 48183 |
| ROBERTSON MORRISON INC | 4721 Runway Blvd | Ann Arbor | MI | 48108 |
| Robin Aire Heating and Cooling, Inc. | 28930 Wall St. | Wixom | MI | 48393 |
| Rock Electrical, Inc. | P.O. Box 627 | Clarkston | MI | 48347 |
| ROCKWELL AUTOMATION | 1121 - 133rd Avenie | Wayland | MI | 49348 |
| ROG Mechanical | 300 River Place 5350-12 | Detroit | MI | 48236 |
| Rogers Electric | 2050 Marconi Drive, Suite 200 | Alpharetta | GA | 30005 |
| Rogers Electric Company | 12745 Prospect St. | Dearborn | MI | 48126 |
| ROI Energy Solutions Corp. | 3480 Burning Bush | Bloomfield Hills | MI | 48301 |
| Rolly Electrical Service, Inc. | 1215 E. Lincoln | Royal Oak | MI | 48067 |
| Romanoff Electric | 5570 Enterprise Blvd. | Toledo | OH | 48131 |
| Ron Bond Electric | 15126 Oldham | Taylor | MI | 48181 |
| Roncelli Inc. | 6471 Metro Parkway | Sterling Heights | MI | 48312 |
| Roof Restoration Technologies | 671 E Long Lake | Bloomfield Hills | MI | 48304 |
| Roseville Heating & Cooling | 32314 Utica Rd | Fraser | MI | 48026 |
| Rosol Electric LLC | 39853 Coronation | Canton | MI | 48188 |
| Roth Bros, Inc | 3847 Crum Rd | Youngstown | OH | 44515 |
| Rowley Electrical Co., Inc. | 28875 Westfield | Livonia | MI | 48150 |
| Royal Radiant Heat. Inc. | 2477 Van Ommen Dr. | Holland | MI | 49424 |
| Royal Roofing Company | 245 Brown Rd | Orion | MI | 48359 |
| RSM Management, LLC | PO Box 772 | Bloomfield Hills | MI | 48303 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| RUBYSCAN OF MICHIGAN, LLC | 20700 Civic Center Drive, Suite 170 | Southfield | MI | 48076 |
| Russell Electric | 1605 S. Range Road | St, Clair | MI | 48079 |
| RUSSELL PLUMBING AND HEATING | 114 E Fairplains ST | Greenville | MI | 48838 |
| RUSTIN BUILDERS | 2068 Jamestown SE | Grand Rapids | MI | 49508 |
| R-VALUE CONCRETE STRUCTURES | 3203 Eckert Rd | Freeport | MI | 49325 |
| Ryan Electric | 11431 Hanford Dr. | Warren | MI | 48093 |
| S & M HEATING SALES CO. | 23262 Telegraph Rd. | Southfield | MI | 48033 |
| S & S Electric | 720 Tucker Lane | Howell | MI | 48855 |
| S. B. Heatring & Air Conditioning, Inc. | 3704 Keewahdin Rd. | Fort Gratiot | MI | 48059 |
| S.B.O. Power Tech | 11408 E. 12 Mile | Warren | MI | 48093 |
| S.E. MICHIGAN ENERGY AUDITORS | 1007 Bedford Rd. | Grosse Pointe Park | MI | 48230 |
| S4i LLC | 5555 Corporate Exchange Court SE | Grand Rapids | MI | 49512 |
| Sable Electric | 23130 Masonic | St. Clair Shores | MI | 48082 |
| Sachse Construction | 260 E. Brown Street, Suite 200 | Birmingham | MI | 48009 |
| Sadler Electric | 27423 Harper Ave. | St. Clair Shores | MI | 48081 |
| SAFETY KING AIR DUCT CLEANING AND SEALING | 50000 Ryan Road | Utica | MI | 48317 |
| SAFETY ONE ELECTRIC COMPANY | 20935 Country Club | Harper Woods | MI | 48225 |
| SAIC Energy, Environment and Infrastructure, LLC | 60 E Plato Blvd, Ste 300 | St. Paul | MN | 55107 |
| Salinger Electric | 1755 E. Maple Road | Troy | MI | 48083 |
| Salt River Electric, Inc. | 4860 County Line Rd | Lenox | MI | 48048 |
| Sam's Electric | 34940 Hunter Ave. | Westland | MI | 48185 |
| Sand Beach Electric | 5765 Sand Beach Rd. | Harbor Beach | MI | 48441 |
| Saturn Electric | 321 South St | Rochester | MI | 48307 |
| Sauriol Bohde Wagner Architects & Assoc. Inc. | 46869 Garfield | Macomb | MI | 48044 |
| SAWYER ENGINEERING INC. | 4090 Chicago Dr. | Hudsonville | MI | 49426 |
| Schaafsma Heating & Cooling | 25 North Park St | Grand Rapids | MI | 49544 |
| Schaafsma Heating and Cooling | 25 North Park | Grand Rapids | MI | 49544 |
| Schafer Construction | 150 N. First Street | Brighton | MI | 48116 |
| Schaub's Insulation, LLC | 160 E River Rd | North Muskegon | MI | 49445 |
| Scheid Plumbing, Heating & Cooling Inc. | 990 Industrial Park Dr. | Whitehall | MI | 49461 |
| Schena Roofing & Sheet Metal | 28299 Kehrig Drive | Chesterfield | MI | 48047 |
| Schneider Electric | 30442 Esperanza | Rancho Santa Margarita | CA | 92688 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Schroeder Store Fixtures | 1731 Allendale Dr | Saginaw | MI | 48638 |
| Schumacher Electric Inc. | 3690 Hickory Rim | Ortonville | MI | 48462 |
| Schwank, USA, Inc | 2 Schwank Way | Waynesboro | GA | 30830 |
| SCR-TEK | 4759 Cannonsburg Rd. | Belmont | MI | 49306 |
| SD Associates | 7700 Second Ave, 3rd Floor | Detroit | MI | 48202 |
| SeaDrain Land Development LLC | 10400 NE 2nd Street 112 | Bellevue | WA | 98004 |
| Seal Tech Insulation | 12501 Lake Pointe Pass | Belleville | MI | 48111 |
| SEAMAN'S A/C & REFRIGERATION | 2510 Oak Industrial Dr. NE | Grand Rapids | MI | 49505 |
| Seay Lighting Associates, LLC | 40 East Main Street | Neward | DE | 19711 |
| Sebesta Brothers Electric Inc. | 51644 Oro Dr. | Shelby Twp. | MI | 48315 |
| Sedlacek Plumbing & Heating | 3825 Vance Rd. | Traverse City | MI | 49689 |
| SEED HOMES, LLC | 20954 Mapleridge Avenue | Southfield | MI | 48075 |
| SELECT SOLAR & GENERATOR | 1250 Stewart Drive | Ypsilanti | MI | 48198 |
| Selective Heating & Cooling, Inc. | 29301 Garrison Rd. | Wixom | MI | 48393 |
| Senior's Heating & Cooling | 333 E. Welch St Suite A | Traverse City | MI | 49686 |
| Seniors Heating and Cooling | 333 E. Welch St. Suite A | Traverse City | MI | 49686 |
| SERENE COMFORT HEATING, COOLING AND REFRIGERATION | 4037 Morningdale | Troy | MI | 48085 |
| Sergio Juarez | 5115 Baldwin Rd. | Hudsonville | MI | 49426 |
| Serr Electrical, Inc. | 21040 E 12 Mile Rd | St. Clair Shores | MI | 48081 |
| Servant Properties | PO Box 871280 | Canton | MI | 48187 |
| Service Electric Company, Inc. | 3421 S. Hadley Rd. | Ortonville | MI | 48462 |
| Service Electric of Michigan LLC | 3867 South Old US 23 | Brighton | MI | 48114 |
| Service Electric Supply Inc. | 15424 Oakwood Dr. | Romulus | MI | 48174 |
| Service Lamp Corp | 152 E. Siena Heights Drive | Adrian | MI | 49221 |
| Service Pro LLC | 44300 Grand River Ave | Novi | MI | 48375 |
| Service Tech's Direct Inc | 5150 Short St | Muskegon | MI | 49444 |
| Servidyne Systems LLC | 1945 The Exchange, Suite 325 | Atlanta | GA | 30339 |
| SES | 6095 E. 15 Mile Rd | Sterling Heights | MI | 48312 |
| SGS Electrical Services | 41760 Independence Dr | Novi | MI | 48377 |
| SHAFERS HEATING & COOLING, INC. | 1361 Leonard Ave. | Grand Rapids | MI | 49505 |
| SHARON'S HEATING AND AIR CONDITIONING, INC. | 31776 Cowan Rd. | Westland | MI | 48185 |
| Shawn Construction & Managment Co. | 13980 Farmington Rd | Livonia | MI | 48154 |
| SHELTON HEATING & COOLING | 18436 180th Ave P.O. Box 251 | Tustin | MI | 49688 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Sheren Plumbing & Heating | 3801 Rennie School Rd | Traverse City | MI | 49685 |
| SHEREN PLUMBING AND HEATING, INC.; | 3801 Rennie School Rd. | Traverse City | MI | 49684 |
| Sherman Clark | 18293 Jamestown Circle | Northville Twp. | MI | 48168 |
| Shiflett Electric Inc. | P.O Box 778 | Flint | MI | 48501 |
| Shirkey Electric Co., Inc | 1570 Michigan | Marysville | MI | 48040 |
| Shoreview Electric Co. | 37839 Groesbeck Hwy. | Clinton Twp. | MI | 48036 |
| SHW Group | 2338 Coolidge Hwy | Berkley | MI | 48072 |
| Sideline Electric | 7838 Marsh Rd. | Cottrellville | MI | 48039 |
| Siemens Industry | 4547 Commerce Center Dr. | Plymouth | MI | 48170 |
| SIEMENS INDUSTRY, INC | 45470 Commerce Center Drive | Plymouth Township | MI | 48170 |
| Siemens Industry, Inc. | 21741 Melrose Ave | Southfield | MI | 48075 |
| Sierra Electric | 12355 Country Creek Dr. | Goodrich | MI | 48438 |
| Siga Green Technologies | 4661 Oakwright Dr. | Ada | MI | 49301 |
| SIGMA GREEN ENERGY, LLC | 14521 Garfield Ave | Lakewood | OH | 44107 |
| SIGMA LUMINOUS LLC | 32027 Industrial Rd. | Livonia | MI | 48150 |
| Sign Fabricators | 43984 Groesbeck Highway | Clinton Township | MI | 48036 |
| Signature Electric LLC | 74451 Van Dyke | Bruce Township | MI | 48065 |
| Signature Lighting Systems | 28525 Beck Rd. Unit # 116 | Wixom | MI | 48393 |
| Silver Star Contracting, LLC | 1801 Howard Street | Detroit | MI | 48216 |
| SIR HOME IMPROVEMENTS | 12849 US 131 Hwy | Schoolcraft | MI | 49087 |
| Site Controls LLC | 7004 Bee Caves Rd, Bldg 2 | Austin | TX | 78746 |
| Siwek Construction | 5020 Pilgrim Road | Flint | MI | 48507 |
| SK Mechanical | 1500 John A Papalas | Lincoln Park | MI | 48146 |
| Skanska | 26100 American Dr. Suite 200 | Southfield | MI | 48034 |
| SKL PROCESS SOLUTIONS | P.O.Box 587 | Grass Lake | MI | 49240 |
| SKOOG HEATING AND COOLING | 307 South James Street | Ludington | MI | 49431 |
| Sky Electric | 885 A Whitney Dr | Lapeer | MI | 48446 |
| Sky Electric, Inc. | 865 A Whitney Drive | Lapeer | MI | 48446 |
| SKYLINE ELECTRICAL CONTRACTING COMPANY | 22755 Kelly Road | Eastpointe | MI | 48021 |
| Skyline Management Co. | 2380 St. Francis Drive | Ann Arbor | MI | 48103 |
| Skyway Electric LLC | 55449 Belle Lane | Macomb | MI | 48042 |
| SLASOR HEATING & COOLING, INC. | 33504 Five Mile Rd. | Livonia | MI | 48154 |
| Slifco Electric Co | 1904 Woodslee | Troy | MI | 48083 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| SMART LIGHTING SOLUTIONS | 54491 Nottingham | Shelby TWP | MI | 48315 |
| Smart Watt Energy, Inc. | 400 Mason Rd. | Fairport | NY | 14450 |
| Smashray Ltd. | 5862 Walnut Springs Blvd. | Sylvania | OH | 43560 |
| SNA LLC | 588 E. Rich St. | Columbus | OH | 43215 |
| SOLAR WINDS POWER SYSTEMS, LLC | 2421 Applelane Drive | Kalamazoo | MI | 49008 |
| SOLAR WORKS LLC | 8895 Kearney Road | Whitmore Lake | MI | 48189 |
| SOLARFRAMEWORKS | 765 Moss St. | Golden | CO | 80401 |
| SOLEY HEATING & AIR CONDITIONING INC. | 32582 Grosebeck Hwy. | Fraser | MI | 48026 |
| SOLTMAN HEATING & COOLING INC | 8650 W Nine Mile Rd | Oak Park | MI | 48237 |
| Soltman Heating & Cooling, Inc. | 8650 W. 9 Mile Rd | Oak Park | MI | 48237 |
| SONORAS ELECTRIC | 7720 Mentel Rd. | Newport | MI | 48166 |
| Sorensen Gross Construction Services | 3407 Torrey Road | Flint | MI | 48507 |
| Source One LED | 3150 Thorncrest Dr. S.E. | Grand Rapids | MI | 49546 |
| Source Refrigeration | 326 Paseo Reyes Dr | St. Augustine | FL | 32095 |
| Southern Michigan Heating & A/C Company Inc. | 1508 First St. | Jackson | MI | 49203 |
| Southern Michigan Heating and A/C Company | 1508 First St | Jackson | MI | 49203 |
| Southpoint Solutions | 9374 Old Bailes Rd | Fort Mill | SC | 29707 |
| SPARK BUILDING ENERGY SOLUTIONS LLC | 32401 8 Mile Rd. | Livonia | MI | 48152 |
| Sparks Electric | 46710 Ryan Rd | Utica | MI | 48317 |
| Spartan Electric Services | 6121 Green Rd. | Haslett | MI | 48840 |
| Spartan Insulation | 24644 M-43 | Mattawan | MI | 49071 |
| Spartan Renovation, LLC | 407 E Fort St, Suite 400 | Detroit | MI | 48226 |
| Spectro International, LLC | 7280 Northwind Court | Clarkston | MI | 48346 |
| Spectron Denken Electric | 31400 Kendall, Suite A | Fraser | MI | 48026 |
| Spectrum Group Technologies | 17800 Woodward Ave, Suite 230 | Detroit | MI | 48203 |
| Speed - Tech Equipment | 3364 Quincy Street | Hudsonville | MI | 49426 |
| Speedwrench, Inc. | 3365 Quincy | Hudsonville | MI | 49426 |
| Spina Electric | 26801 Groesbeck Hwy | Warren | MI | 48089 |
| Spink Insulation | 320 Fairview | Horton | MI | 49246 |
| Springfield Inc | 6509 M-37 | Kingsley | MI | 49649 |
| SRF Enterprises, Inc. | 29595 Ardmore | Farmington | MI | 48334 |
| SRI ENERGY, LLC | 24371 Catherine Industrial Drive Suite 231 | Novi | MI | 48375 |
| ST. MICHAELS ELECTRICAL ENGINEERING SERVICES & DISTRIBUTION | 7500 Intervale Ave. | Detroit | MI | 48238 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Staelgraeve Turner Electric, Inc. | 1138 Huber Drive | Monroe | MI | 48162 |
| Stafford Smith, Inc. | 3414 South Burdick | Kalamazoo | MI | 49001 |
| STARPAK GROUP | 3003 Miller Rd. | Ann Arbor | MI | 48103 |
| Staybright Electric | 609 Ken Ridge Drive | Middletown | OH | 45042 |
| Stay-Lite Lighting, Inc. | W233 N2800 Roundy Cirlcle West Suite 100 | Pewaukee | WI | 53072 |
| Steele Electric LLC | 9527 Cedargrove Rd | Clarkston | MI | 48348 |
| Stein Electric Company Inc. | PO Box 820 | Manchester | MI | 48158 |
| Stempian and Associates | 29895 Greenfield Road | Southfield | MI | 48076 |
| Stenco Construction | 12741 Farmington Road | Livonia | MI | 48126 |
| Stephenson Electric | PO Box 610841 | Port Huron | MI | 48060 |
| Sterling Electric | 13321 Cloverlawn | Sterling Heights | MI | 48089 |
| STERLING HEATING & AIR CONDITIONING INC | 42760 Mound Rd | Sterling Heights | MI | 48314 |
| Steve Leader Electric | 1799 Richmond | Lincoln Park | MI | 48146 |
| Stevens Architects, LLC | 209 Huron Ave., Suite 1 | Port Huron | MI | 48060 |
| Steve's Electrical Services | 41760 Independence | Novi | MI | 48377 |
| Stewart Electric Inc. | 3192 Hadley Rd. | Metamora | MI | 48455 |
| STEWART ENVIRONMENTAL SERVICE | 4511 Delemere | Royal Oak | MI | 48073 |
| STIENSTRA HEATING AND COOLING, LLC | 6559 Rollingview Drive | Hudsonville | MI | 49426 |
| Stony Creek Services | 445 Joe Hall Drive | Ypsilanti | MI | 48197 |
| Straits Lighting Co. | 37000 Grand River, Ste. 370 | Farmington Hills | MI | 48335 |
| Strategic Energy Solutions | 4000 W. Eleven Mile Rd. | Berkley | MI | 48072 |
| Strategic Energy Solutions, Inc | 4000 West Eleven Mile Rd | Berkley | MI | 48072 |
| Strategic Equipment & Supply Company | P.O. Box 535427 | Atlanta | GA | 30353 |
| Streamline Enterprises | 4171 Legion Dr | Lansing | MI | 48854 |
| Streetscape , LLC | 4645 N Walton Blvd | Waterford | MI | 48239 |
| Striko Dynarad | 501 E. Roosevelt Ave. | Zeeland | MI | 49464 |
| Stroyko Construction Group, Inc. | 3045 Pheasant Run East Dr | Wixom | MI | 48393 |
| STUART MECHNICAL, LLC | 260 East Brown Street, Suite 200 | Birmingham | MI | 48009 |
| Styl-Rite Development Co. | 29445 Beck Rd, Suite A206 | Wixom | MI | 48393 |
| Suburban Electric, Inc. | 33197 W. Jefferson | Brownstown | MI | 48173 |
| Suburban Heating & Cooling, inc. | 33539 Plymouth Rd. | Livonia | MI | 48150 |
| Suburban Insulation Co., Inc. | 8000 Boardwalk | Brighton | MI | 48116 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Suburban Mech | 500 8th St. | Kalamazoo | MI | 49019 |
| Sugden Electric | 46920 7 Mile Rd. | Northville | MI | 48107 |
| Summit Electric, Inc. | 2544 Acacia Dr | Troy | MI | 48083 |
| Summit Mechanical Inc. | 5527 Gratiot | St. Clair Twp. | MI | 48079 |
| Summit Properties | 6445 Citation Drive Suite C | Clarkston | MI | 48346 |
| Sun Control Inc. | 1145 Hickory Mills Rd. | Hurricane | WV | 25526 |
| Sun Energy Enterprises, LLC | 32232 Schoolcraft, Ste C-3 | Livonia | MI | 48150 |
| Sun Shade Window Tinting | 23310 Van Dyke | Warren | MI | 48089 |
| Sunlite Heating & Cooling | 2784 Longmeadow | Trenton | MI | 48183 |
| SUNLITE HEATING AND COOLING INC | 2784 Longmeadow Dr. | Trenton | MI | 48183 |
| SUNRAY INDUSTRIES | 4076 Commerce Drive | Flushing | MI | 48133 |
| Sunrise Electric Inc. | 4629 Edwards Rd. | Harbor Beach | MI | 48441 |
| SUNRISE ENERGY MANAGEMENT LLC | P.O. BOX 605 | Dearborn Heights | MI | 48127 |
| SUNRISE INC | 5615 S. Beech Daly St. | Dearborn Hgts. | MI | 48125 |
| Superior Comfort Heating & Cooling | 27518 Telegraph Road | Flat Rock | MI | 48134 |
| Superior Construction & Home Improvement, Inc | 3354 Grindley Park | Dearborn | MI | 48124 |
| Superior Electric Company of Greater Detroit | 10280 Capital St | Oak Park | MI | 48237 |
| Superior Electric Great Lakes Company | 264 Executive Drive | Troy | MI | 48083 |
| Superior Heating & Cooling, Inc. | 8015 Gratiot Ave | Columbus Township | MI | 48063 |
| SUPERIOR INSULATION, INC. | 34857 Brush St | Wayne | MI | 48184 |
| Superior Mechanical of Charlevoix LLC | 09472 Maple Grove Rd. | Charlevoix | MI | 49720 |
| Superior Plumbing & Heating, Inc. | 5316 Highland Rd. | Waterford | MI | 48327 |
| Superior Power and Lighting Inc. | 5430 Washburn rd | Goodrich | MI | 48438 |
| Superior Spray Solution LLC | 5045 Plymouth Road | Ann Arbor | MI | 48105 |
| Superior Wall Foam | 624 South Wilson Rd | Boyne City | MI | 49712 |
| SUPERIOR WINDOW CO. | 2709 Fort | Wyandotte | MI | 48192 |
| SUR ENERGY, LLC | 221 Buena Vista Ave. | Ann Arbor | MI | 48103 |
| Sustainable Energy Management | 815 E. 4th St. | Royal Oak | MI | 48067 |
| SUSTAINABLE ENERGY WORKS | 140 Mill Street | Gahanna | OH | 43230 |
| Sustainable Energy Works LLC | 140 Mill St. | Gahanna | OH | 43230 |
| SUSTAINABLE ENVIRONMENTAL SERVICES | 8728 Winderness Trail | Traverse City | MI | 49684 |
| SVB Electric Inc | 5707 Skylite Ln. | Shelby Twp | MI | 48316 |
| Sylvania | 1948 Prestwick Road | Grosse Pointe Woods | MI | 48236 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Sylvania (Osram) | 100 Endicott Street | Danvers | MA | 01923 |
| Sylvania Lighting Services | 3323 SE Fairway E | Stuart | FL | 34997 |
| SYNERGY | 200 Fridberg PKWY, Suite 3010 | Westborough | MA | 01581 |
| SYNERGY CONSTRUCTION GROUP | 1800 Star-Batt Drive | Rochester Hills | MI | 48309 |
| Synergy Consulting Engineers | 6250 Jupiter Ave NE | Belmont | MI | 49306 |
| Synergy Electric LLC | 3818 Hillcrest Dr. | Highland | MI | 48356 |
| Synergy Group Inc. | 39400 Woodward Ave, Suite 190 | Bloomfield Hills | MI | 48304 |
| Synergy Investments | 200 Friberg Parkway., Suite 3010 | Westborough | MA | 01581 |
| SYSTECORE INC. | 5975 Dixie Hwy. | Saginaw | MI | 48601 |
| System Power Inc | 21179 W. 8 Mile Rd | Southfield | MI | 48076 |
| Systemp Corporation | 3909 Industrial Dr. | Rochester Hills | MI | 48309 |
| Szudera Insulation Co | 344 Commerce Ave. SW, Ste. 2 | Grand Rapids | MI | 49503 |
| T L W | 5075 Irwin Dr. | Holly | MI | 48442 |
| T Morceri Electric & Sons Electric | 23212 Detour | St Clair Shores | MI | 48082 |
| T.H. EIFERT LLC | 3320 West St. Joseph ST. | Lansing | MI | 48917 |
| T.H. Eifert Mechanical Contractors | 3302 West St. Joseph | Lansing | MI | 48917 |
| T.H. Marsh | 32121 Woodward Ave. Suite 300 | Royal Oak | MI | 48073 |
| T.J. AIR HEATING AND COOLING LLC | 46550 Middle Brook Dr. | Macomb | MI | 48044 |
| Tacoma Heating & Cooling LLC | 4095 Riley St | Hudsonville | MI | 49426 |
| Tailor Made Windows & Doors | 24460 Gratiot Ave | Eastpointe | MI | 48021 |
| Tailor Made Windows Inc | 24460 Gratiot | Eastpointe | MI | 48021 |
| Talbot Corporation | 11887 Belden Ct | Livonia | MI | 48150 |
| TAMOU'S ELECTRICAL CONTRACTING | 3012 Farmdale | Sterling Heights | MI | 48134 |
| Tanner Plumbing & Heating Inc. | 900 South State Street | Hart | MI | 49420 |
| Target Construction | P.O. Box J | Cedar Springs | MI | 49319 |
| Target One | 44405 ThunderBay | Clinton Twp. | MI | 48038 |
| Tarnow Doors Inc | 23701 Halsted Rd | Farminton Hills | MI | 48322 |
| Tartan Energy | 4425 Fernlee | Royal Oak | MI | 48073 |
| Taylor Electric | 6200 Conway | Chelsea | MI | 48118 |
| TB Wired Electrical Service LLC | 9361 Farmington Rd. | Livonia | MI | 48150 |
| TCB Electrical Contracting | 7142 Timberland Trail | West Bloomfield | MI | 48322 |
| TCS MICHIGAN | 1311 Ann Arbor | Plymouth | MI | 48170 |
| Team Facilities Inc/Danboise Mechanical | PO Box 484 | Bloomfield Hills | MI | 48303 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Tech Electric | 1785 Rock Road | Commerce | MI | 48390 |
| TECH IV HEATING - COOLING | 37895 Groesbeck Hwy | Clinton Twp. | MI | 48036 |
| Tech Mechanical | 1490 Highwood East | Pontiac | MI | 48340 |
| Tech Mechanical, Inc. | 1490 E. Highwood | Pontiac | MI | 48340 |
| Technical Consumer Products Inc | 23465 Forest Road North | New Boston | MI | 48164 |
| Technical Energy Performance Group | 56595 Byron Commerce Drive | Byron Center | MI | 49315 |
| Technical Energy Solutions | 8535 Byron Commerce Drive | Byron Center | MI | 49315 |
| TECHNICAL ENERGY SOLUTIONS, INC | 8535 Byron Commerce Dr. Ste A | Byron Center | MI | 49315 |
| Tedd's Electric | 5790 Emmett Road | Emmett | MI | 48022 |
| T-Electric | 28597 Thames Ct. | Chesterfield | MI | 48047 |
| Temp Control Services | 1311 Ann Arbor Rd. | Plymouth | MI | 48170 |
| Temp Solutions | 41739 Joy Rd | Canton | MI | 48187 |
| Temperature Control Heating | 4105 7th Street | Wyandotte | MI | 48192 |
| Temperature Control, Inc. | 1623 Northern Star Dr. | Traverse City | MI | 49686 |
| Temperature Services Inc. | 37107 Schoolcraft | Livonia | MI | 48150 |
| TEMPLETON BUILDING COMPANY | 735 Forest Ave., Suite 204 | Birmingham | MI | 48009 |
| Templin Heating and Cooling LLC | 9033 Rockland Suite 100 | Redford | MI | 48239 |
| Tenesis LLC | 226 Hank Hollow Dr. | Bartlett | IL | 60103 |
| Terry's Heating-Cooling, LLC | 683 Industrial Park Dr. | Shelby | MI | 49455 |
| TESLA ENERGY EFFICINECY LLC | 26226 Beechwood Dr. SE | Grand Rapids | MI | 49506 |
| The Alliance for Environmental Sustainability | 947 Wealthy SE | Grand Rapids | MI | 49506 |
| The Farmer Group | 35 W. Huron St. Suite 10 North | Pontiac | MI | 48342 |
| THE GREEN PANEL, INC. | 4023 South Old US 23, Suite 109 | Brighton | MI | 48114 |
| The Heating & Cooling Guys LLC | 33115 Richard O Street | Sterling Heights | MI | 48310 |
| The Hinman Company | 2851 Charlevoix Drive, Suite 208 | Grand Rapids | MI | 49546 |
| The Home Examiner, LLC | 259 Morris Ave SE | Grand Rapids | MI | 49503 |
| THE HOME INSPECTOR GENERAL | 2753 108th St SW | Byron Center | MI | 49315 |
| The HouseProfessor | 11852 Diehl Drive | Sterling Heights | MI | 48313 |
| The Installers | 257 Sunset Drive | Dowling | MI | 49050 |
| The Lighthouse | 1595 West Rd. | Trenton | MI | 48183 |
| The Lighting Corner | 4269 Chicago Dr. | Grandville | MI | 49418 |
| The Monahan Company | 21321 Kelly Road | Eastpointe | MI | 48021 |
| The Northview Group LLC | 5743 Metamora Road | Metamora | MI | 48455 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| The Ozone Company, LLC | 4639 Treichel Street | Madison | WI | 53718 |
| The Retrofit Companies | 3855 Hwy 14 West | Owatonna | MN | 55060 |
| The Roxbury Group | 535 Griswold Suite 2650 | Detroit | MI | 48226 |
| THE SOLAR SOURCE, INC | 20200 Stephens | St.. Clair Shores | MI | 48080 |
| The Wesserstrom Company | 477 South Front St. | Columbus | OH | 43215 |
| THEBOLT ELECTRICAL SERVICES LLC | 454 E. Monroe Street | Dundee | MI | 48131 |
| Thermal Dynamic Resources | PO Box 401525 | Redford | MI | 48111 |
| THERMAL IMAGING CONSULTANTS, INC | 27927 Ponchartrain | Harrison Township | MI | 48045 |
| Thermal Netics | 3955 Pinnacle Ct | Auburn Hills | MI | 48326 |
| Thermal Sleuth | 114 N. Court Ave. | Gaylord | MI | 49735 |
| Thermal Wall Construction | P.O. Box 506 | Armada | MI | 48005 |
| THERMALNETICS | 3955 Pinnacle Court | Auburn Hills | MI | 48326 |
| Thermatool Corp | 31 Commerce Street | East Haven | CT | 06512 |
| Thermo Source, LLC | 2360 Orchard Lake Rd, Suite 105 | Sylvan Lake | MI | 48320 |
| Thermolock North | 16880 Front St, PO Box 7 | Copemish | MI | 49625 |
| Thierica Equipment Corporation | 3147 N. Wilson Ct. | Grand Rapids | MI | 49534 |
| THORNTON AND GROOMS | 24565 Hallwood Court | Farmington Hills | MI | 48335 |
| Thornton and Grooms Plumbing, Heating & cooling | 1728 W. Maple | Birmingham | MI | 48009 |
| THUMB COOLING & HEATING, LLC | 5599 Pochert Road | Port Hope | MI | 48468 |
| Tichenor Inc. | 637 West Michigan Ave. | Battle Creek | MI | 49037 |
| Tiesto Energy Systems | 229 W. Wisconsin Ave., #101 | Milkwaukee | WI | 53202 |
| TiKi Inc | 1004 Montrose | Royal Oak | MI | 48073 |
| Tim Bollin Electric | 2722 Pineview Trail | Brighton Township | MI | 48114 |
| Timberlynn Lighting | PO Box 128 | Geneseo | IL | 61254 |
| Timothy Novak, DBA | 28717 Grant | St. Clair | MI | 48081 |
| TINPIN ENERGY CONSULTING | 25170 Circle Dr | Southfield | MI | 48075 |
| TMC Electric, LLC | 47210 Condor Ave. | Shelby Twp | MI | 48317 |
| TMI Compressed Air | 2626 Sanford Ave. SW | Granville | MI | 49418 |
| TNT Electric Inc. | PO Box 530100 | Livonia | MI | 48153 |
| TODD SPINK CONSTRUCTION, INC. | 215 Dino Drive | Ann Arbor | MI | 48103 |
| TODD'S PLUMBING AND HEATING INC. | 282 S 5th St | Rogers City | MI | 49779 |
| Tom Carlisle | 30305 Whittier | Madison Heights | MI | 48071 |
| Tony's Refrigeration, Heating & Air Conditioning, Inc. | 9809 Dixie Hwy P.O. Box 258 | Anchorville | MI | 48004 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| TOP NOTCH MECHANICAL INC. | P.O. Box 301150 | Waterford | MI | 48330 |
| Total Comfort Resource, LLC | 3584 Fairlanes Ave. Suite A | Grandville | MI | 49418 |
| Total Energy Concepts Inc./ B.E.S | 22229 Apsley Blvd. | Toledo | OH | 43617 |
| Total Energy Solutions, LLC | 176 Crescent Rd | Waterford | MI | 48327 |
| Total Solutions | 661 Airport Blvd Suite 5 | Ann Arbor | MI | 48108 |
| TOTAL SOLUTIONS- DIV OF CAMPBELL INC | 1077 James Hart PKWY | Ypsilanti | MI | 48198 |
| Towler Electric | P.O. Box 970840 | Ypsilanti | MI | 48197 |
| Town & Country Electric Inc. of Bay City | 2998 N. Euclid Ave. | Bay City | MI | 48706 |
| Town Center Electric, Inc | 21297 Hilltop St | Southfield | MI | 48033 |
| TOWN CENTER ELECTRIC, INC. | 21297 Hilltop Street | Southfield | MI | 48033 |
| Trademark Electrical Contractors | 9299 Becker | Allen Park | MI | 48101 |
| Trademark Services LLC | 4306 Olivia Avenue | Royal Oak | MI | 48073 |
| Trane Commercial Systems | 5005 Corporate Exchange Blvd | Grand Rapids | MI | 49512 |
| Trane West Michigan | 1903 Marquette | Muskegon | MI | 49442 |
| Tri Star Electrical, LLC | 3415 Rafferty Dr. | Howell | MI | 48843 |
| Triangle Associates | 3769 Three Mile Road | Grand Rapids | MI | 49534 |
| Triangle Electric | 29787 Stephenson Highway | Madison Heights | MI | 48071 |
| Tri-County Construction | 37637 Five Mile Road | Livonia | MI | 48154 |
| Trigger Chain | 53579 Wolf Dr | Shelby Twp | MI | 48316 |
| Trillium Energy Solutions | 35 W. Huron, Suite 10N | Pontiac | MI | 48342 |
| Tri-Master, Inc. | PO Box 550 | Fenton | MI | 48430 |
| TRINITY GREEN ENERGY SOLUTIONS | 6301 Frank N Dot Ct. Suite 2 | Lansing | MI | 48917 |
| TRI-PUPS, INC. | 25580 Farmbrook | Southfield | MI | 48034 |
| Tru Exteriors Inc | 305 S Saginaw | Sterling | MI | 48659 |
| TRU-CRAFT CONST. INC | 8550 Crofoot Rd. | Fowelerville | MI | 48336 |
| Tru-Craft Construction Inc. | 8550 Crofoot Road | Fowlerville | MI | 48836 |
| Truxell Electric | 29117 5 Mile Rd. | Livonia | MI | 48154 |
| TRUXELL ELECTRIC CORP. | 29117 Five Mile Rd | Livonia | MI | 48154 |
| TS Electrical | 8556 Hendrie | Huntington Woods | MI | 48070 |
| Turner Construction | 535 Griswold, Ste. 200 | Detroit | MI | 48226 |
| Turtle Island Wind and Solar, LLC | 8467 Smith Rd. | Berrien Center | MI | 49100 |
| Tuson Electric, Inc. | PO Box 331 | Lake Orion | MI | 48361 |
| Tyler Deal | 1197 Penniman | Plymouth | MI | 48170 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Tyrrell Electric | 56808 Grand River Avenue | New Hudson | MI | 48165 |
| TYRRELL ELECTRIC, INC. | 56808 Grand River Ave. Suite 3 | New Hudson | MI | 48165 |
| U Muss We Fuss | 45306 Spring Drive | Canton | MI | 48187 |
| U.S. ENERGY ENGINEERS | 2960 Lucerne Drive. S.E. - Suite 150 | Grand Rapids | MI | 49546 |
| UNCONVENTIONAL SOLUTIONS, INC | 527 Union St | Milford | MI | 48381 |
| Unico Commercial Corporation | 11125 Clark Rd. | Davisburg | MI | 48350 |
| Unified Electric | 1530 McDonbald | Bad Axe | MI | 48413 |
| UNITED HEATING AND COOLING CO | 4004 E Eight Mile Rd | Detroit | MI | 48234 |
| UNITED STATES ELEMENTAL ENERGY SOLAR, INC | 29488 Woodward Ave. Suite 347 | Royal Oak | MI | 48073 |
| United States Lighting | 37849 Vine Street | Willoughby | OH | 44094 |
| United Temperature Services, Inc | 8919 Middlebelt Rd | Livonia | MI | 48150 |
| Universal Coin Laundry Machinery, Inc. | 30301 Woodward Ave., Ste. 230 | Royal Oak | MI | 48073 |
| UNIVERSAL LAUNDRY MACHINERY | 38700 Webb Drive | Westland | MI | 48185 |
| Universal Roofing | Po Box 339 | Linwood | MI | 48634 |
| UR Energy, Inc. | 91 Clinton Rd. Bldg. 2D | Fairfield | NJ | 07004 |
| Urban Options / Northern Options | 405 Grove Street | East Lansing | MI | 48823 |
| US Signs | 2220 San Jacinto Boulevard #365 | Denton | TX | 76205 |
| USZTAN LLC | 261 Collier | Auburn hills | MI | 48326 |
| Utilities Dynamics, Inc. | 6910 Lovelaceville Rd. | Paducah | KY | 42001 |
| Utilities Instrumentation Service | PO Box 981123 | Ypsilanti | MI | 48198 |
| Utilities Instrumentation Services | 306 N River St, PO Box 981123 | Ypsilanti | MI | 48198 |
| Utility Savers USA | 7300 Carter Road | Jackson | MI | 49283 |
| Utility Services Assessments | 2849 Windside Ct. | Ann Arbor | MI | 48103 |
| Valley Mechanical, Inc. | W6106 Oak Crest Drive | Norway | MI | 49870 |
| Van Buren Electric | 141 N. Mill Street | Plymouth | MI | 48170 |
| Van Dyke Building Services LLC | 46130 Van Dyke | Shelby Twp. | MI | 48317 |
| Van Dyken Mechanical Inc | 4275 Spartan Industrial Dr. | Grandville | MI | 49418 |
| Van Wert Electric | 6050 N. Seymore Rd | Flushing | MI | 48433 |
| Vander Hyde Mechanical | 1058 Scribner Ave., NW. | Grand Rapids | MI | 49504 |
| VANDER HYDE MECHANICAL, INC. | 1058 Scribner Ave. NW | Grand Rapids | MI | 49504 |
| VanderPloeg & Lanning Service | 921 47th Street SW | Grand Rapids | MI | 49509 |
| VANDERPLOEG AND LANNING HEATING & COOLING | 921 47th St. SW | Wyoming | MI | 49509 |
| Vanguard | PO Box 767 | Howell | MI | 48844 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| VANTAURA ENERGY SERVICES | 4039 40th Street SE Suite 4 | Grand Rapids | MI | 49512 |
| VARO ENGINEERS, INC. | 2751 Tuller Parkway | Dublin | OH | 43017 |
| Varton Heating & Cooling, LLC | 47033 Glastonbury Dr | Canton | MI | 48188 |
| VDB Mechanical | 11445 Pontaluna Rd. | Coopersville | MI | 49404 |
| Venture Electric | 42732 Merrill | Sterling Hts | MI | 48314 |
| VerWys Home Improvement LLC | 3266 Briggs Blvd., NE | Grand Rapids | MI | 49525 |
| Victory Electrical Services | 111 Peyerk CT | Romeo | MI | 48065 |
| Vierson Boiler | 3700 Patterson Ave SE | Grand Rapids | MI | 49512 |
| Vita Electrical LLC | 21031 Cooper Drive | Macomb Township | MI | 48044 |
| Vlad Electric | 18832 Dalby St | Redford | MI | 48240 |
| Volt Electric Services | 170 Marci Lane | Commerce TWP | MI | 48382 |
| Voltron Power LLC | 5674 Aylesbury | Waterford | MI | 48327 |
| Voss Lighting | 3854 Broadmoor Avenue SE, Ste 106 | Grand Rapids | MI | 49512 |
| Vredevoogd Heating & Cooling, Inc. | 3047 Sangra | Grandville | MI | 49418 |
| Vriesland Growers Coop | 4529 48th Ave | Hudsonville | MI | 49426 |
| W. Smith Refrigeration, Inc. | 1152 S. Getty St. | Muskegon | MI | 49442 |
| W. W. FAIRBAIRN & SONS INC | 7537 Burr Ave | Alanson | MI | 49706 |
| W.D. PARTNERS | 7007 Discovery Blvd. | Dublin | OH | 43017 |
| W.D.M. Enterprise | 2615 Cleveland Avenue | Marinette | WI | 54143 |
| W.J. Electrical Inc. | 12910 Rolling Brook Ct | Sterling Heights | MI | 48313 |
| W.J. O'NEIL CO | 35457 Industrial | Livonia | MI | 48150 |
| W.M. Electric | 32361 Craftsbury | Farmington Hills | MI | 48334 |
| W.R. Mangement Inc | 2854 Serra Drive | Sterling Heights | MI | 48310 |
| Waatti and Son's Electric | 58914 Romeo Plank Road | Ray Township | MI | 48096 |
| Walbridge | 5800 N. Ann Arbor Road | Dundee | MI | 48131 |
| WALKER-MILLER ENERGY SERVICES LLC | 440 Burroughs Suite 517 | Detroit | MI | 48202 |
| WALKER'S HEATING & COOLING INC | 15921 West 8 Mile Rd | Detroit | MI | 48235 |
| Wallside Windows Inc. | 27000 W. Trolley Industrial Drive | Taylor | MI | 48180 |
| Walsh/Lipten, A Joint Venture | 3011 West Grand Blvd. #2300 | Detroit | MI | 48202 |
| Walters & Hemming, Inc. | 421 W. Front St. | Traverse city | MI | 49684 |
| Walt's Electric Inc. | 24273 Hayes | Eastpointe | MI | 48201 |
| WANKO ELECTRIC INC. | 7965 Kinsington Court, Suite A-1 | Brighton | MI | 48116 |
| Wanko Electric, Inc. | 7965 Kensington Court, Ste A | Brighton | MI | 48116 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Warehouse Management Co | 12660 Greenfield | Detroit | MI | 48227 |
| WASKE ELECTRIC | 6989 Twin Creek Dr. | Millington | MI | 48746 |
| WaterFurnace International, Inc. | 9000 Conservation Way | Fort Wayne | IN | 46809 |
| Watson Brothers Company | 325 Court Street | Port Huron | MI | 48060 |
| Watson Electric | 6894 Sharpe Road | Fowlerville | MI | 48836 |
| Waugs Electrical Service | 22001 Colgate St. | Farmington Hills | MI | 48336 |
| WEATHER GARD WINDOW CO., INC. | 14350 West 8 Mile Rd. | Oak Park | MI | 48237 |
| Weatherwise Foam Insulation | 3627 Pickett Rd. | Parma | MI | 49269 |
| Webb Mechanical and Electrical Contractors | 12681 Delta Drive | Taylor | MI | 48180 |
| WEER ENERGY SOLUTIONS | 21828 Van Born rd, | Dearborn | MI | 48127 |
| Weinkauf Plumbing & Heating, Inc. | 1411 M 32 West | Alpena | MI | 49707 |
| Weinkauf Plumbing and Heating | 1411 M-32 West | Alpena | MI | 49707 |
| WELLHOME | 7500 Holland Road | Taylor | MI | 48180 |
| Werth Electric, Inc. | 2145 La Forset | Aplena | MI | 49707 |
| WESCO | 33162 Sterling Ponds | Sterling Heights | MI | 48312 |
| WEST CLIMATE CONTROL, INC. | 4309 US 131 South | Petoskey | MI | 49770 |
| West Electric, Inc. | 3406 Torrey | Flint | MI | 48507 |
| West Michigan Energy Auditors LLC | 709 Marietta NE | Grand Rapids | MI | 49505 |
| WEST MICHIGAN GLASS BLOCK, INC | 2131 Martindale SW | Wyoming | MI | 49509 |
| West Michigan Heating & Air Conditioning Services | 3640 Highland Drive | Hudsonville | MI | 49426 |
| Western Mechanical Contractors, Inc. | 22630 Fifteen Mile Rd. | Clinton Twp | MI | 48035 |
| WESTON SOLUTIONS INC | 600 East Lakeshore Dr | Houghton | MI | 49931 |
| Westside Solutions, Inc. | 303 North Rose Street, Suite 340 | Kalamazoo | MI | 49007 |
| WHIPPLE ELECTRIC INC | 14800 BURR ST | TAYLOR | MI | 48180 |
| WHIPPO BROTHERS, INC. | P.O. Box 712 | Charlevoix | MI | 49720 |
| White Construction | 1120 W. Baltimore | Detroit | MI | 48202 |
| White Lion | 12215 Carol Ave. | Warren | MI | 48093 |
| WHOLESALE ELECTRIC SUPPLY | 705 E Midland Street | Bay City | MI | 48706 |
| Wholesale Lighting LLC | 5242 Angola Rd. | Toledo | OH | 43615 |
| Wiedenbach-Brown Co., Inc. | 315 Norwood Park South | Norwood | MA | 02062 |
| Willaim A. Kibbe Associates, Inc. | 1475 S. Washington Ave. | Saginaw | MI | 48601 |
| Williams Heating-Cooling, Inc. | 116 W. Main St. P.O. Box 140 | Elsie | MI | 48831 |
| WILLIAMS REFRIGERATION & HEATING, INC | 27332 Van Dyke | Warren | MI | 48093 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Wilson Construction Co. | 4005 Forest Point Dr. | Muskegon | MI | 49441 |
| Wilson Heating, Cooling,Plumbing & Electrical, Inc. | 405 W. Main | Ionia | MI | 48846 |
| Wiltec Technologies, Inc | 4201 Varsity Drive | Ann Arbor | MI | 48108 |
| Wiltse Electric Service, Inc. | 1146 Camelot Drive | Pinckney | MI | 48169 |
| Wimsatt Building Materials | 36340 Van Born Rd | Wayne | MI | 48184 |
| WINDOW PLUS INC. | 6490 E, Ten Mile | Center Line | MI | 48105 |
| Wing Construction | 8149 Millis Rd | Shelby Township | MI | 48317 |
| Winkle Electric LLC | 2024 Cypress | Wyoming | MI | 49519 |
| Wire Works Electrical Contracting LLC | 28206 Roy Street | St. Clair Shores | MI | 48086 |
| Wiring Solutions Electric Inc. | 1463 Rochester Road | Oakland | MI | 48363 |
| Wise Heating & Cooling | 2268 S. M-76 | West Branch | MI | 48661 |
| Withers Heating & Cooling Inc. | 49011 Gratiot Ave. | Chesterfield | MI | 48051 |
| WLS Electric LLC | PO Box 715 | Union Lake | MI | 48387 |
| Wm F Nelson Electric Inc. | 111 Hoyt Street | Saginaw | MI | 48607 |
| Wolgast Corporation | 4835 Towne Centre, Suite 203 | Saginaw | MI | 48604 |
| WOLVERINE BUILDING GROUP | 4045 Barden | Grand Rapids | MI | 49544 |
| Woodland Facility Supply | 50773 Pontiac Trail | Wixom | MI | 48393 |
| Worthington Steel | 11700 Worthington Drive | Taylor | MI | 48187 |
| Wright Choice Electric | 5226 Piper Lane Rd | Ubly | MI | 48475 |
| Wright Electrical Contracting Inc. | 22439 Louise | St. Clair Shores | MI | 48081 |
| WTI Services | 13576 South Horrell Road | Fenton | MI | 48430 |
| Wyatt Electrical Contractors | 631 E Michigan Ave. | Grass Lake | MI | 49240 |
| Xavier, Inc | PO Box 510884 | Livonia | MI | 48154 |
| Xpert Solutions LLC | 1259 28th SW | Grand Rapids | MI | 49509 |
| X-Treme Mobile Repair | 46445 Continental Dr | Chesterfield | MI | 48047 |
| YAROCH ELECTRIC LLC | 7209 Cardinal Street | Clay TWP | MI | 48001 |
| Yaroch Electric, LLC | 7209 Cardinal Street | Clay Township | MI | 48001 |
| YELLOWLITE, INC. | 5755 Granger Road Suite 750 | Independence | OH | 44131 |
| York International | 5005 York Drive | Norman | OK | 73069 |
| Yorkshire Construction | 3434 Russel | Detroit | MI | 48211 |
| You Name It #1 | 22484 Gascony | East Pointe | MI | 48021 |
| Ziehm Brothers Electric | 29265 Grandview | Harrison Twp | MI | 48045 |
| ZILKA HEATING & COOLING INC | 2595 Orchard Lake Rd | Sylvan Lake | MI | 48320 |

# Energy Efficiency Contractors

| COMPANY NAME | STREET | CITY | STATE | ZIP |
|---|---|---|---|---|
| Zimmer Roofing & Construction | 133 Runnels Street | Port Huron | MI | 48060 |
| ZON LED | PO Box 85 | Romeo | MI | 48065 |
| Zook Farm Equipment | 7980 Pratt Lake Rd | Alto | MI | 49302 |
| Zouhiar Kokaz | 39275 Geneva | Farmington Hills | MI | 48333 |

# Supporters - Businesses

| Business Name |
| --- |
| 3rd Day Farm |
| 5 Lakes Energy |
| A Z Electric Service Inc. |
| A3C Collaborative Architecture |
| Accelerated Knowledge |
| Accurate Energy Audits |
| Advanced Appraisal |
| Advanced Energy Group |
| Afternoon Delight |
| AIA Architecture |
| Amberjack Construction |
| American Renewable Energy Builders, Inc. |
| Anderson, Eckstein & Westrick, Inc. |
| Antelope Antiques |
| Arait Engineering Group |
| Arbor Brewing Company |
| Arbor Insulation |
| Archiopolis Architects, LLC |
| Art Cats Gallery |
| Aventura Business Consulting |
| Avissa Salon and Spa |
| Ayse's Cafe |
| Bernco, Inc. |
| Best Results Builders |
| Blue Chip Technologies |
| Blue Haven Healing Arts |
| Blue Terra Energy, LLC |
| Blumer Portraiture |
| Bonz & Thongz |
| Bratic Enterprises, LLC |
| Brauer Productions, Inc. |
| Brewery Vivant |
| BrightBridge Studios, LLC |
| Burke E. Porter Machinery Company |
| Bwana Design and Photography |
| Bygone Basics |
| Byrum and Fisk Advocacy Communications |
| CA Green Designs |
| Cass Cafe |
| CCT Contracting and Associates |
| Cedar River Properties |
| Celeste Allen Novak Architect |
| Cherry Republic |
| Chicory Cafe |
| Chris' Therapeutic Touch |
| City Green Environmental, LLC |

# Supporters - Businesses

| Business Name |
| --- |
| Civil Construction |
| Classic Landscape, Ltd.. |
| Clean Green Energy, LLC |
| ClinCorp Group, LLC |
| Clockwork Logic Software |
| CMF Marketing, LLC |
| Cogeneration Consultants |
| Communication Solutions |
| Comprehensive Vision Center, PC |
| Condor Piping, Inc. |
| ConTech Sales Group, LLC |
| Continuity-antique.vintage.renewed. |
| Contractors Building Supply, Inc. |
| Corner Brewery |
| County Hermitage B&B |
| Creative Foam Corporation |
| Creative Solutions with Lynn |
| Crook Electric Company |
| Daniels Realty Group, LLC |
| Danotek Motion Technologies |
| Del Zoppo Electric Co |
| Detroit Community Investment, Inc. |
| Detroit Construction Services Group |
| Detroit Talent Hub |
| Digital Garage Studios |
| Digital Technology Solutions |
| Distributed Power |
| DK Industrial Services |
| Dokka Fasteners, Inc. |
| Door to Door Organics |
| Dyas Construction |
| Dynamic Conveyor |
| Earth Smart Environmental Solutions, LLC |
| Earthmovers of Midland LLC |
| Easy Green Shop |
| Eco-Building Products |
| EcoRock Consulting, LLC |
| Ecotelligent Homes |
| EcoTrek Fitness |
| Edible Grande Traverse |
| Element Electric, Inc. |
| Elixer Vitae |
| Energyflex |
| Envigor Design |
| Environmental Compliance Office Inc. |
| Environmental Waste & Recovery Service, Inc. |

# Supporters - Businesses

| Business Name |
| --- |
| Essence Restaurant Group |
| EverGreen Energy Savers, LLC |
| Evolution Electric Vehicle Systems |
| Factory Service Specialists |
| Fantasee Lighting |
| Finance Outsource Associates |
| FlexSys Inc. |
| Flight Path Creative |
| FLOW for water |
| Fountain Investment Group |
| Four Elements Energy, Inc. |
| Fusco Weatherization Services |
| Gaia Cafe |
| Gearbox Express |
| G-Energy, LLC |
| GenPoint Energy, LLC |
| Georgios Pizza |
| Go Green Energy Consulting |
| Great Lakes Heavy Haul |
| Green Arrow Enterprises, LLC |
| Green Building Automation |
| Green Earth Coatings LLC |
| Green Energy Solution Technologies, LLC |
| Green Team Coalition, LLC |
| GreeningDetroit.com |
| GrownFolk.us |
| Growth Capital Network |
| Gunnels Technology Inc. |
| Hancock & Associates |
| Harvest Homes Realty, Inc. |
| Healthy Jones |
| Higher Grounds Trading Company |
| Homeland Builders of Michigan |
| Hot Watt Solar, LLC. |
| Howard & Howard Attorneys, PLLC |
| HughesRR, Inc. |
| Human Resources Strategy |
| IES, LLC |
| iLike Media Group, LLC. |
| Illuminart Inc. |
| Image Design, LLC |
| Improvements by Stephen Lundy |
| Infrared Energy Analysis |
| Infuz Ltd. |
| Inovateus Solar |
| InstaCote, Inc |

# Supporters - Businesses

| Business Name |
| --- |
| Irenes Myomassology Institute |
| Iron Mike's Welding & Fabricating |
| Ivy Tech Energy Technology |
| J & J Service-Energy Specialists |
| J.D. Stratton Electric |
| Jados Media |
| Janis-Shunta Insurance |
| Joyful Noise Daycare |
| JS Vig Construction |
| Kelly Tinker Architects |
| Kinetik Partners |
| King Outdoor Adventures, LLC |
| KLA Development |
| Kokosing Construction Co./Durocher Marine Division |
| Krios Consulting |
| La Belle Maison |
| Lake Effect Energy Corporation |
| Lakeshore Digital Signage & Media |
| Laughing Tree Bakery |
| LEAP LLC |
| Lemonjello's Coffee |
| Light of Day Organic Teas |
| Link2Technology |
| Low's Cleaning Service |
| LUMA Resources |
| M.G. Walsh & Associates, Attorneys |
| Mackerel Sky Gallery |
| Mainline Plumbing |
| Major Cement Paving |
| Maple Moon Farm |
| Martin Rots |
| Matrix Metalcraft, Inc. |
| Meadow Management, Inc |
| Meadowlark Builders |
| Meadowlark Energy |
| Mechanical Energy Systems |
| Media 1 |
| Metro Ag Services, Inc. |
| MetroDelivery |
| MetroSweep Services, LLC |
| MIAT-Institute of Technology |
| Michigan Cleanup Projects |
| Michigan Land Use Institute |
| Michigan Solar & Wind Power Solutions |
| Midwest Renewable Energy, LLC |
| Midwest Solar Aggregation Group |

# Supporters - Businesses

| Business Name |
| --- |
| Millennium Planet, LLC |
| Monahan-Ide Construction, LLC |
| Moore Brothers Electric Co |
| Muskegon Local |
| MVP Engineering, PLC |
| Naman Group Inc |
| Nan's Merle Norman Salon |
| Nelson Charters |
| Net Owl Media |
| Netchey Construction |
| Network Infrastructure Consulting Services, LLC |
| Nordman Sustainability Solutions, LLC |
| Nova Development Group of Detroit, LLC |
| NOVI Energy |
| Obsideo Energy, LLC |
| Olson, Bxdok & Howard |
| Omni Remodeling |
| On the Rocks |
| Oob Marketing |
| Organic Lawn, Inc. |
| Organic Waste Systems |
| Orisol Energy |
| Oryana Natural Foods Market |
| Pacitto & Forest Construction Co. |
| Paradigm Energy Services |
| Paradise Garden Landscaping Inc. |
| Park Avenue Consultants Inc |
| Patriot Solar |
| Payne Mechanical Inc. |
| People's Food Cooperative |
| Performance Ninja |
| Phelps Accounting |
| Phervor: Creative Agency |
| Phoenix Home Performance |
| Piast Institute |
| Plamondon Shoes |
| PNH Consulting Group, LLC |
| Power Panel, Inc. |
| Precise Manufacturing Inc |
| Principia, LLC |
| Progressive AE |
| Property Management, LLC |
| Pure Eco Environmental Solutions |
| Ragha Systems, LLC |
| Rainforest Salon, LLC |
| Ramos Auto Body |

# Supporters - Businesses

| Business Name |
| --- |
| Raven's Child |
| Redbelly Board Shop |
| RelyLocal Muskegon |
| Renewable Services |
| Renovo Power Systems, LLC |
| Resource Restoration Inc. |
| Revel |
| Rising Star Wellness Center |
| Rivet Entertainment |
| RLS Energy |
| Rose Justian, LMSW |
| Rose's Express |
| Rubies Hair & Skincare Salon |
| Rudy Pelota Insurance Agency |
| Run Amok Promotions |
| Russ Cesarz Design & Build, Inc. |
| Russell Design Inc |
| S & S Building Company LLC |
| S.U.R Energy |
| Scottish Inn |
| Self Reliant Energy Company |
| Seven Steps Up, LLC |
| Shorts Brewing Co. |
| Siam Cuisine |
| Solar Winds Power Systems, LLC |
| Solar Works |
| SolidFuel Sales, LLC |
| Song Bird Cafe |
| Spark Building Energy Solutions LLC |
| SPM Windpower, LLC |
| SRI Energy, LLC |
| SSA Soft, LLC |
| Standale Lumber and Interiors |
| Stargate HVAC Services |
| STE Construction Services, Inc. |
| Sterling Corporation |
| Sterling Investment Properties, LLC |
| Stone Road Eco Farm |
| Strain Electric Co |
| Straub Pettitt Yaste Architects |
| Sun Water Food |
| Sunstructures Architects |
| Sustainable Energy Financing |
| Sustainable Environmental Services |
| Sustainable Home Consultants, LLC |
| Sustainable Systems, Inc. |

# Supporters - Businesses

| Business Name |
| --- |
| Sustainable TC |
| Sweetwater Local Foods Market |
| T&N Services Inc |
| T&T Builders |
| Terrestrial Media LLC |
| The Blackbird |
| The Center for Mindfulness in Northern Michigan |
| The Coffee House |
| The Crystal Lake Catering Co. |
| The Dailey Company |
| The Orbit Room |
| The Places You Go |
| The Wine Sellers |
| The-Digital-Sun Group, LLC |
| Thermo Manufacturing |
| This Child's Life |
| Thrive Net Zero Collaborative |
| TnT Consulting Group |
| Trattoria Stella |
| Traverse Visual |
| Treehuggers |
| Tri-Star Industries |
| U.S. Construction Research |
| Urban Ashes |
| Usztan, LLC |
| Vesta Building Industries, LLC |
| Viability Energy, LLC |
| Viridity! Design |
| Voltage Electric Inc. |
| Wallington Construction Company |
| Wastenotbiz, LLC |
| Weaver General Contracting, LLC |
| Weer Energy Solutions |
| Wellspring Energy |
| Whitehead Propertiies, LLC |
| Wild Bird Center |
| Will Lent Horseshoe Company |
| Windemuller Inc. |
| Wings of Wonder |
| Woodland Designs |
| Woodland Wind, LLC |
| Yoga for Health Education |
| Your Plate or Mine |
| Ypsi Daisy Green Cleaning |
| ZeroTrashTalk |
| Zerwell Energy Corp. |

# Supporters - Businesses

| Business Name |
| --- |
| Zingermans |
| Zingerman's Bakehouse |
| Zingerman's Candy Manufactory |
| Zingerman's Creamery |
| ZingTrain |

# Supporters - Organizations

| Organization Name |
| --- |
| Amalgamated Transit Union (ATU) |
| American Federation of Teachers Michigan (AFT) |
| American Wind Energy Association |
| Ann Arbor Democratic Party |
| Ann Arbor Energy Commission |
| Asthma & Allergy Foundation of America- Michigan Chapter |
| Central Michigan University Student Environmental Alliance |
| Cheboygan County Democratic Party |
| Christian Coalition |
| Clean Water Action |
| Communications Workers of America District 4 (CWA) |
| ConservAmerica |
| Detroiters Working for Environmental Justice |
| East Michigan Environmental Action Council |
| EnviroDems (University of Michigan) |
| Environment & Social Concerns Committee, Ann Arbor Friends Meeting |
| Environmental Issues Commission (University of Michigan) |
| Fresh Energy |
| Great Lakes Renewable Energy Association |
| Greenpeace (Michigan State University) |
| Greenpeace (Northern Michigan University) |
| Ingham County Democratic Party |
| Interfaith Council for Peace and Justice |
| International Union of Operating Engineers Local 324 (IUOE) |
| Justice and Peace Task Force- Grand Rapids Plymouth UCC |
| Kalamazoo County Democratic Party |
| League of Women Voters of Michigan |
| Macomb County Democratic Committee |
| Michigan AFSCME Council 25 |
| Michigan Association for Justice |
| Michigan Capital Area Coalition of Labor Union Women |
| Michigan Education Association |
| Michigan Environmental Council (MEC) |
| Michigan Federation of College Democrats (MFCD) |
| Michigan Interfaith Power and Light |
| Michigan Land Use Institute |
| Michigan League of Conservation Voters |
| Michigan National Organization for Women |
| Michigan Nurses Association |
| Michigan State University College Democrats |
| Michigan State University Sierra Student Coalition |
| Michigan Student Sustainability Coalition |
| Moms Clean Air Force |
| Muskegon County Democratic Party |
| NAACP |
| National Wildlife Federation |

# Supporters - Organizations

| Organization Name |
| --- |
| Natural Resources Defense Council |
| North Oakland Democratic Club |
| Northern Michigan Environmental Action Council (NMEAC) |
| Northville Democratic Club |
| Oakland County Democratic Party |
| Oceana County Democratic Party |
| Ottawa County Democratic Party |
| Plymouth Democratic Club |
| Royal Oak Democratic Club |
| Service Employees International Union Michigan State Council (SEIU) |
| Sheet Metal Workers International Association Locals 292 and 80 (SMWIA) |
| Sierra Club |
| Southeast Michigan Regional Energy Office |
| Student Environmental Alliance (Central Michigan University) |
| Students for a Sustainable Earth (Western Michigan University) |
| Students for Clean Energy (University of Michigan) |
| Troy Democratic Club |
| Unitarian Universalist Congregation of Grand Traverse |
| United Auto Workers (UAW) |
| United Food and Commercial Workers Locals 876 and 951 (UFCW) |
| United Steelworkers District 2 (USW) |
| University of Michigan EnviroDems |
| University of Michigan Environmental Issues Commission |
| University of Michigan Students for Clean Energy |
| USGBC Detroit Regional Chapter |
| USGBC West Michigan Chapter |
| Voices for Earth Justice |
| Vote Solar |
| Washtenaw County Democratic Party |
| West Michigan Environmental Action Council |
| Western Michigan University Students for a Sustainable Earth |
| Young Evangelicals for Climate Action |

# Supporters - Officials

| Official Name | Official Position |
|---|---|
| Barb Byrum | State Representative |
| Bill Clinton | Former U.S. President |
| Branden Dyer | Charlotte Council Member |
| Christopher Taylor | Ann Arbor City Council Member |
| Conan Smith | Washtenaw County Commissioner |
| Craig Covey | Oakland County Commissioner |
| Dave Coulter | Ferndale Mayor |
| David Bonior | Former U.S. Congressman |
| Dayne Walling | Flint Mayor |
| Debbie Stabenow | U.S. Senator |
| Felicia Brabec | Washtenaw County Commissioner |
| Gary McGillivray | Oakland County Commisioner |
| Gary Nelund | City of Norton Shores Mayor |
| George Heartwell | Grand Rapids Mayor |
| Janis Bobrin | Washtenaw County Water Resources Commissioner |
| Jeff Irwin | State Representative |
| Jody Washington | Lansing City Council Member |
| John Hieftje | Ann Arbor Mayor |
| Leah Gunn | Washtenaw County Commissioner |
| Nathan Triplett | East Lansing Mayor Pro Tem |
| Patrick Lindemann | Ingham County Drain Commissioner |
| Penelope Tsernoglou | Ingham County Commissioner |
| Rashida Tlaib | State Representative |
| Ronnie Peterson | Washtenaw County Commissioner |
| Sabra Briere | Ann Arbor City Council member |
| Stephen Kunselman | Ann Arbor City Council Member |
| Susan M Lumley | City of Roosevelt Park Mayor |
| Toni Moceri | Macomb County Commissioner |
| Virg Bernero | Lansing Mayor |
| Wesley Prater | Washtenaw County Commissioner |
| Yousef Rabhi | Washtenaw County Commissioner |

# Supporters - Faith Leaders

| Faith Leader Name | Faith Leader Organization |
|---|---|
| Bishop John Schieicher- Evangelical Lutheran | North and West Michigan Synod, Lansing |
| Bishop Thomas Gumbleton- Catholic | St. Hillary Parish, Detroit |
| Bob Milstein | Temple Beth Emeth, Reform Judaism, Ann Arbor |
| Dr. Veenan K. Kulkarni | Ann Arbor Christian Reformed Church, Ann Arbor |
| Imam Achmat Salie- Muslim | American Muslim Diversity Center, Sterling Heights |
| Janet Wright- Quaker | Ann Arbor Friends Meeting, Ann Arbor |
| Nancy Seubert and Sarah Nash- Roman Catholic | Sisters, Servants of the Immaculate Heart of Mary |
| Nigel Berry-Christian | Ann Arbor Vineyard Church, Ann Arbor |
| Pastor Ian Reed Twiss- Episcopal and Lutheran | Holy Faith Church, Saline |
| Pastor Julianne Smeck | St. Mark Lutheran Church, Ypsilanti |
| Paul Carson- Methodist | Dixboro United Methodist Church, Ann Arbor |
| Rabbi Ariana Silverman- Reform Judaism | Temple Kol Ami, West Bloomfield |
| Rabbi Norm Roman- Reform Judaism | Temple Kol Ami, West Bloomfield |
| Rabbi Michael Zimmerman- Reconstructionist Judaism | Kehillat Israel, Lansing |
| Rev. Barb McRae- Presbyterian U.S.A. | Sisters, Servants of the Immaculate Heart of Mary |
| Rev. Brooke Pickrell- Presbyterian | Northside Presbyterian, Ann Arbor |
| Rev. Charles Morris- Roman Catholic | St. Christopher Parish, Detroit |
| Rev. Chibuzor Ozor | Ann Arbor Mennonite Church, Ann Arbor |
| Rev. Chris Richards- Congregational Church | Pine Hill Congregational Church, West Bloomfield |
| Rev. D. Alexander Bullock - Baptist | Greater St. Matthew Baptist, Highland Park |
| Rev. David Hurst- United Methodist | Sisters, Servants of the Immaculate Heart of Mary |
| Rev. Dr. Leia Huyck- Unitarian Universalist | Unitarian Universalist Congregation of Grand Traverse |
| Rev. Elizabeth Hoban- United Church of Christ | Congregational Church of Birmingham, Bloomfield Hills |
| Rev. Haju Sunim- Zen Buddhist | |
| Rev. Joseph Summers- Episcopal | Church of Incarnation, Ann Arbor |
| Rev. Judith Mayo, United Methodist | |
| Rev. Ken Wilson-Evangelical Christian | Vineyard Church, Ann Arbor |
| Rev. Lela Iduna- Centers of Light | Sisters, Servants of the Immaculate Heart of Mary |
| Rev. Louise Ott- United Church of Christ | Congregational Church of Birmingham, Bloomfield Hills |
| Rev. Marguerite Allen | St. John - St. Luke United Church of Chirst |
| Rev. Mark Evens- Unitarian Universalist | First Unitarian Universalist Congregation of Ann Arbor |
| Rev. Paul Versluis- Mennonite | Shalom Community Church, Ann Arbor |
| Rev. Peggy Garrigues- United Methodist | Clawson UMC, Clawson |
| Rev. Peter Boeve- Presbyterian | 1st Presbyterian Church, Saline |
| Rev. Ralph Brown | Hope United Church of Christ, Fraser |
| Rev. Rich Peacock- United Methodist | First Baptist Church of Ann Arbor, Ann Arbor |
| Rev. RJ Hronek- United Church of Christ | United Church of Wayland, Wayland |
| Rev. Robert Roth, Chaplain- Wesley Foundation | 1st United Methodist Church, Ann Arbor |
| Rev. Roger Pohl | United Church of Christ, Ypsilanti |
| Rev. Russell Fuller, Disciples of Christ | |
| Rev. Selena Lucas- Centers of Light | Sisters, Servants of the Immaculate Heart of Mary |
| Rev. Stacy Simpson Duke- Baptist | First Baptist Church of Ann Arbor, Ann Arbor |
| Rev. Terry Gallagher, Prophetic Integrity Team | Michigan Conference United Church of Christ |
| Rev. Terry Gallagher-United Church of Christ | Sacred Conversations on Justice-Trenton |
| Rev. Tim Larson- Evangelical Lutheran | Peace Lutheran, Southfield |
| Rev. Vern Hoffman-Reformed Church of America | Hope Reformed/Micah Center, Grand Rapids |

## Supporters - Faith Leaders

| Faith Leader Name | Faith Leader Organization |
|---|---|
| Rev. Viktor Trotskyy, Russian Orthodox | Assumption of the Virgin Mary, Ferndale |
| Rev. Wallace Gilbert Jr.- Baptist | Greater Christ Baptist Church, Detroit |
| Rev. Evans McGowan-Presbyterian | First Presbyterian Church of Ann Arbor, Ann Arbor |
| Senior Pastor Marcia Fairrow | Grace United Church of Christ, Grosse Point |
| Student Rabbi, Aura Ahuvia- Reconstructionist | Ann Arbor Reconstructionist Havurah, Ann Arbor |
| The Rev. Reid Hamilton, Chaplain | Canterbury House |
| The Very Rev. Daniel Richards- Episcopal Christian | Episcopal Church, Traverse City |

# Supporters - Individuals

| Individual Name | Individual City |
|---|---|
| Adam Lawrence | Mount Pleasant |
| Alex Citron | Southfield |
| Alex Graeff | Grand Rapids |
| Alexandria Idziak | Royal Oak |
| Alice Van Zoeren | Burdickville |
| Alison Heins | Traverse City |
| Amanda Kik | Bellaire |
| Amanda Shunta | Norton Shores |
| Amanda Weissert | Muskegon |
| Amber McCurtis | Oakland |
| Amy Kinney | Traverse City |
| Amy Tennis | Traverse City |
| Andrea Paine | Ann Arbor |
| Andy Price | Ann Arbor |
| Angela Gavan | Grand Rapids |
| Ann Rogers | Traverse City |
| Ann Swaney | Old Mission |
| Ann Woiwode | Lansing |
| Anna Bachman | Traverse City |
| Anna Norris | Traverse City |
| Anne Gothard | Lake City |
| Anne Honhart | Birmingham |
| Anthony Offak | Royal Oak |
| Anthony Reetz | Kalamazoo |
| April Carlson | Flint |
| Art Toy | Lawrence |
| Arthur Mohr | Bloomfield |
| Arthur Thomas | Harrisville |
| Ashley G. Zytowski | Troy |
| Athen Moore | New York |
| Barbara Bloomer | Traverse City |
| Barbara DiVizio | Dearborn |
| Barbara Schneider | Maple City |
| Barry Klecka | Norton Shores |
| Bernard Hanchett | Traverse City |
| Bernard Sheff | Eaton Rapids |
| Beryl Striewski | Traverse City |
| Beth Wallace | Ann Arbor |
| Bethann Glidden | Kalamazoo |
| Betsey Emdin | Traverse City |
| Betty Carnes | Norton Shores |
| Betty M Borough | Traverse City |
| Beverly J. Christensen Cedar | |
| Bill Latka | raverse City |
| Bill Palladino | raverse City |
| Bill Wells | Northport |

# Supporters - Individuals

| Individual Name | Individual City |
|---|---|
| Bob Brown | Buckley |
| Bob Gothard | Lake City |
| Bob Otwell | Traverse City |
| Bob Prud'homme | Ferndale |
| Bob Scholl Honor | |
| Bobby Afton | Newaygo |
| Bonnie Mathias | Traverse City |
| Brad Kik | Bellaire |
| Bradley Belrose | Ada |
| Branden Dyer | Charlotte |
| Brandon Knight | Highland Park |
| Brenda Anttila | |
| Brennen Thompson | Dearborn Heights mi. |
| Brian Buysse | raverse City |
| Brian Lydic | Ann Arbor |
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| Celeste McCray | Detroit |
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| Charlie Weaver | Kalkaska |
| Charlie Wunsch | Traverse City |
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| Cheryl Cannaday | Kalamazoo |
| Chris Bazzett | Traverse City |
| Chris Bzdok Traverse City | |
| Christi Bardenhagen | Lake Leelanau |
| Christine M. Ruback | Montague |
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| Christopher Reader | Grand Rapids |
| Chrysteen Moelter-Gray | Grand Haven |
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| Cindy Rebman Traverse City | |
| Cindy Sawyer | Commerce Township |
| Cindy Sawyer | Commerce Twp. |
| Clifford Ostling | Traverse City |

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| Corinne McGue | Stevensville |
| Craig Sherwood | Atlanta |
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| Dale Scheiern | Cedar |
| Dan Marcin | Ann Arbor |
| Dan McKeen Fife | Lake |
| Dan O'Neil | Traverse City |
| Daniel Marbury | Traverse City |
| Daniel Parnell McCarter | |
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| Danielle Ostafinski | Grand Rapids |
| Darlene | Traverse City |
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| David Glenn | Hawks |
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| David Krumlauf | Cedar |
| David Kunhardt | |
| David Locher | Monroe |
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| Debra Rowe | Farmington Hills |
| Dennis Hough | Battle Creek |
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| Dorthea Thomas | Detroit |
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| Doug Kelbaugh | Ann Arbor |
| Douglas Bedell | Traverse City |
| Douglas LaForest | Cedar |

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| Dr. Suzanne Sorkin | |
| Drew Buschholz | Traverse City |
| Ebru Uras | Ann Arbor |
| Eileen Van Linn TIKAL | Grand Haven |
| Eklo Kossi Nogbe | HoHoe |
| Elizabeth Bizer | |
| Elizabeth Spitz | Plymouth |
| Emily Springsteen | Sheridan |
| Emma DeCenso | |
| Eric Douglas | |
| Eric Justian | Muskegon |
| Erica Canfield | Traverse City |
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| Erika Shenk-Tessin Traverse City | |
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| Flossie Byrd | Detroit |
| Francisco Rodriguez | Miami Gardens |
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| Gabriel Talaga | raverse City |
| Gaia Kile | Ann Arbor |
| Gail Masselink | |
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| Gary Bardenhagen | Lake Leelanau |
| Gary Howe | Traverse City |
| Gary Maveal | Chelsea |
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| Guy Plamondon | Traverse City |
| Hannelore Frederick | Copemish |
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| Harry Dovletian | Dearborn Heights |
| Heather Miller | Alden |
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| Helen Wells | Northport |

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| James Russell | Traverse City |
| Jan Ebersole | Chesterfield |
| Jan Wright | Ypsilanti |
| Jane & Price Watts | Traverse City |
| Jane Watts | Traverse City |
| Janet Pytleski | Rochester Hills |
| Janice Best | |
| Jared Bigler | Vernal |
| Jason Clark | Clinton Township |
| Jay Letzgus | Port Huron |
| Jean Hartman | Marlette |
| Jean Hiscock | Kalamazoo |
| Jean King | Grand Haven |
| Jean Veenema-Birky | Glenn |
| Jeff Gaines | Northville |
| Jeff Grossklaus | Grand Blanc |
| Jeff Toonen | Marquette |
| Jeffery Brooke | Grand Rapids |
| Jeffery Jordan | Beulah |
| Jeffrey Salisbury | Wayland |
| Jennifer Payne | Traverse City |
| Jennifer Sawyer | Mussey twp |
| Jennifer Schaap | Petoskey |
| Jerry Beasley | Traverse City |
| Jerry Jehle | Beulah |
| Jerry Micham | West Bloomfield |
| Jerry VanSpronsen | |
| Jessica Stephenson | Traverse City |
| Jill and Richard Claybour | Frankfort |
| Jim Barnes | Frankfort |
| Jim Carruthers | Traverse City |
| Jim Dulzo | Beulah |
| Jim Head | |
| Jim Horrocks | Traverse City |

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|---|---|
| Jim Hughes | East Lansing |
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| Jim Mora | Lansing |
| Jim Olson | Traverse City |
| Jim Sluyter | Traverse City |
| Jo Anne Beemon Charlevoix | |
| Joan Sheard | Traverse City |
| Joan Wolfe | Frankfort |
| JoAnn Render | |
| Joanne Robb | Traverse City |
| Jodee Taylor | Kingsley |
| Jodi Simpson | Traverse City |
| Jodie Legg | |
| Joe Fletcher | Grand Rapids |
| Joe Szuszwalak Jr. | Kalamazoo |
| Joel Gaff | Jr. |
| Johanna Miller | Glen Arbor |
| John Bachman | Traverse City |
| John Birdsong | Traverse City |
| John Chahbazi | Flushing |
| John Hardy | Traverse City |
| John Hoffmann | Traverse City |
| John Moellers | |
| John Nelson | Traverse City |
| John Ort | Traverse City |
| John P Wright | Mt. Pleasant |
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| John Steves | St. Joseph |
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| Karen Franseen | Bellaire |
| Karen McDiarmid | Farmington |
| Karen Puffer | South Boardman |
| Karl Love | Traverse City |
| Kate Bassett | Harbor Springs |
| Kate Evans | Traverse City |
| Kate Gallup | Leelanau |
| Kate Madigan | Traverse City |
| Kate Scheuermann | Grand Rapids |
| Kathe Gardenias | |
| Katherine Ross | Beulah |
| Katherine Schindler | Ann Arbor |
| Katherine Trachsel | |
| Kathie Scott | Traverse City |
| Kathleen Hoagg | Traverse City |
| Kathleen Kasdorf | Traverse City |
| Kathleen Prentice | Traverse City |
| Kathryn Gray | Holland |
| Kathryn Thostenson | |
| Kathy Guest | |
| Katianna Morawitz | Beulah |
| Katie Davis | |
| Kaylee Milanowski | Grand Rapids |
| Kayleigh Marlin | |
| Kelsey Kuhn | Interlochen |
| Ken Hurlin | Glen Arbor |
| Khalil Barakat | Dearborn |
| Kim Easter | Ann Arbor |
| Kim Gyr | Empire |
| Kim Rosseter | Troy |
| Kirk Leader | Fraser |
| Kris Caterino | |
| Kristen Talaga | Traverse City |
| Kristin Sulecki | Traverse City |
| Kristine Diaz | Holly |
| Kriya Townsend | Kingsley |
| Kurt Facknitz | Sterling Heights |
| Laura Bowman | Dexter |
| Laura Otwell | Traverse City |
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| Lee Williams | Traverse City |
| Len Franseen | Bellaire |
| Leslie Garrison | Ann Arbor |
| Liesl Eichler Clark | Howell |
| Linda Jury | De Witt |
| Linda Reens | |
| Lindi Milner | Thompsonville |
| Lindsey Rice | Escanaba |
| Lisa Danto | Suttons Bay |
| Lisa Marshall Bashert | Ypsilanti |
| Liz Bruning | Traverse City |
| Liz Kirkwood | Traverse City |
| Logan Chadde | Ann Arbor |
| Lois Bahle | Suttons Bay |
| Lori and Gregory Boothroyd | Traverse City |
| Lori Hansen | Glen arbor |
| Lori Heinz | Muskegon |
| Lori Rodgers | |
| Louise Edje | Inkster |
| Lucky McKeen | Fife Lake |
| Luisa Schumacher | East Lansing |
| Lynette Grimes | Benzonia |
| Lynette Lucker | Stevensville |
| Lynn Hartung | Waterford |
| Madeline Smith | Ann Arbor |
| Maja Bombaugh LaForest | Traverse City |
| Mara Cunningham | |
| Marda Chahbazi | Flushing |
| Margaret Kauffman | Traverse City |
| Margaret Von Walthausen | Traverse City |
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| Marilyn Landis | |
| Marissa Luna | Lansing |
| Marjie Rich | Traverse City |
| Marjorie Rundell | Traverse City |
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| Mark Gustafson | Traverse City |
| Mark Johnson | Port Huron |
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| Marshal Evans | Muskegon |
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| Martin Chirgwin | Traverse City |

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| Mary Lou McGue | Traverse City |
| Mary O'Neil | Traverse City |
| Mary Valentine | Muskegon |
| Mary Van Valin | Traverse City |
| Matt Eggers | |
| Matt Miller | Kingsley |
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| Maura Brennan | Traverse City |
| Maureen Charbonneau | Traverse City |
| Maureen Smyth | Traverse City |
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| Melissa Bernardi | Clarkston |
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| Michael Robold | Traverse City |
| Michael Ross | Beulah |
| Michael Schutz | Belleville |
| Michele Cannaert | Elberta |
| Michele Howard Traverse City | |
| Michele York | Shelby Twp |
| Mike Davis | Traverse City |
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| Mo Charbonneau | Traverse City |
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| Nancie Thole | Interlochen |
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| Nayyirah Shariff | Flint |
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| Nick Babic | |
| Nicolette Ledbury | Kalamazoo |
| Noor Ahmad | West Bloomfield |
| Nora Reid-LeZotte | Kalamazoo |
| Norman Kjome Suttons Bay | |
| Norman Wheeler | Empire |

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|---|---|
| Pam Jackson | Commerce Township |
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| Pat Timmons | Traverse City |
| Patricia Cantrell | Beulah |
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| Patricia Edgerton | Kalamazoo |
| Patricia Odernheimer | Hessel |
| Patricia Roberts | Portage |
| Patty Gillis | Southfield |
| Paul Danielson | Traverse City |
| Paul Dobrowolski | Saline |
| Paula Thompson | Ossineke |
| Peggy Stranthof | Fremont |
| Penelope A. Ort | Traverse City |
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| Philip Micklin | Kalamazoo |
| Phillip Brown | Detroit |
| Pinkie Hoffmann | Traverse City |
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| Price Watts | Traverse City |
| R. Gary Deavel | Traverse City |
| Rachel Long | Ypsilanti |
| Rachel Zegerius | Grand Haven |
| Raid George | Redford |
| Ralph Von Walthausen Traverse City | |
| Randy Smith | Williamsburg |
| Randy Volz | Linden |
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| Ray Bresnahan | Lansing |
| Raymond Corpuz | Ypsilanti |
| Raymond Raczkowski | |
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| Rebecca Somsel | Traverse City |
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| Richard Gilman | Kalamazoo |
| Richard Hendricks | Beulah |
| Richard Medlock | |
| Richard Miller | Traverse City |

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|---|---|
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| Robert A Mills | Beverly Hills |
| Robert DeBoef | Richland |
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| Rose Justian | Norton Shores |
| Rosia Anderson Murphy | Flint |
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| Scott Busz | |
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| Scott Howard | Traverse City |
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| Stephanie Cepak | |
| Stephanie Glidden | Lansing |
| Stephanie Walton | Traverse City |
| Steve Cousins | Traverse City |

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| Susan Beeler | Traverse City |
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| Tara Ward | Traverse City |
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| Tina Smith | Kalamazoo |
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| Tom Drayton | Traverse City |
| Tom Fisher | Oxford |
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| Tom Teachout | |
| Tom Turner | Wixom |
| Tracey Easthope | Ann Arbor |
| Tricia Neville | Westland |
| Trina Spence | Lake Ann |
| Trish Collier | |
| Valerie Mann | Saline |
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| Wanda Hayes Eichler | Pigeon |
| Wayne Appleyard | Grass Lake |
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| William J. Westerman | Holland |
| William Mathias | Traverse City |
| William Saenz | |

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| Zachary Sonoga | Dearborn |

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# MUSKEGON-OCEANA COMMUNITY ACTION PARTNERSHIP

1170 W. Southern Avenue
Muskegon, Michigan 49441
(231) 725-9499
Fax (231) 722-1959

February 25, 2013

**Re: Michigan Energy Public Forums- Comments**

I'd like to take this time to address the panel about the importance of including energy conservation in any statewide plan on energy policy; specifically, providing weatherization as a conservation measure-reducing usage while other energy alternatives are being developed.

I represent one Community Action Agency, working in Muskegon and Oceana Counties. But I am speaking as part of a network of 30 CAPs statewide focused on serving the low-income community in Michigan. MO-CAP was established in 1964, and began weatherizing homes in the early 1970's. Since that time our small Agency has weatherized over 10,000 homes. We have seen the program grow from a "caulk and seal holes you see" to a mature industry with a strong reliance on the physics of building science.

A large reason for the maturing of the program was the stimulus funding received by the network through the American Recovery and Reinvestment Act. We at MO-CAP, a small agency, geared up and provided weatherization services to nearly 1000 homes in the 3 year ARRA funding cycle. We went from doing about 60 homes a year to doing over 300 homes a year in a matter of months. At an average annual savings of $400 a year per home we put more than $400,000 into the pockets of these home owners, in addition to the millions of ARRA dollars invested on local suppliers and contractors. The home owners spend that money at local merchants for food, transportation, entertainment and the like instead of on fuel and electricity. That money is turning into a long term investment in Michigan's economy.

At the end of ARRA, weatherization funding was expected to return to pre-stimulus levels. It came as a surprise to the entire network when we discovered the programs were going to receive only 40% of the money allocated prior to 2008. Weatherization is in jeopardy but there is something the state can do to insure this successful program continues to provide energy conservation and education to our citizens. Michigan receives an annual allocation for the Low Income Home Energy Assistance Program (LIHEAP) from the US Dept. of Health and Human Services. These funds are used to provide emergency assistance to low income families to prevent utility company shut-offs. Part of the funding is used to support the Weatherization Assistance Program (WAP), based on the fact that weatherization can and does provide utility assistance by reducing consumption over the long term. The 2012 state LIHEAP plan allows for up to 15% of LIHEAP funding going to the WAP with the remaining 85% used for one time payments.

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NAT-37933-1

Allocating LIHEAP funds to weatherization needs to be a part of the Governor's energy plan! If that 15% is used in the WAP, it will be invested in local communities and it will lower energy consumption over the long term. The network will install simple measures like insulation, sealing air leaks, or upgrading appliances and lights. The savings realized will continue much longer that one month utility payment. The measures installed return at least their costs in energy savings for the life of the measure. The money spent goes to local business where the materials used in the work are purchased and it goes to local contractors who hire the workers to do the installation.

The Weatherization Assistance Program is a priority in the State LIHEAP plan. 15% of the total LIHEAP allocation is all it would take. We can invest those funds in a way that shows a return each and every year while still providing the one time emergency payments that prevent utility shut offs. As a network and as an individual agency providing WAP services we ask that the governor plan that the full amount of funding be sent to the people of the state in a way that will insure long term benefits for all of Michigan.

Thank you.

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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Karen Fifelski

**Affiliation (if any):** _____

**Phone:** 269-793-3306

**Email:** karenfifelski@yahoo.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic** fracking

**(Please specify):** _____

**Requested time to speak:** ✓ **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

I want to thank you for this time to offer our ideas and concerns on Michigan's energy policies.

As you know Michigan currently gets nearly 60% of its energy from coal imported from other states. There are almost 30 other states that have stronger renewable energy and energy efficiency goals than Michigan.

In the past few years there has been a strong focus on natural gas with a push to lease the mineral rights on all of our state lands, which is already being drilled using the controversial practice called horizontal hydraulic fracturing to produce gas/oil. Many of the citizens in Michigan and other states feel that gas or oil obtained by using the practice horizontal hydraulic fracturing or another name is high volume slickwater horizontal fracking.- is NOT CLEAN energy.

Although we have been fracking in Mi some 50 years this newer process raises many concerns

The millions of gallons of fresh water used during this practice is injected with toxic chemicals –such as copper, lead, benzene, formaldehyde and naphthalene , which in turn contaminates those millions of gallons of water. That water can never return to our aquifers.

I have been under the impression that horizontal hydraulic fracturing used 3-5 million gallons of water for each frack, but was surprised to see permits issued from the DEQ to ENCANA – a Canadian company already drilling in Michigan, that permits the use of 16,000,000 gallons of our fresh water for the drilling/fracturing of a single well and 21,000,000 million gallons for another well. Again, this water will not return to our aquifers. Because of the toxic chemicals used in the process, it will be disposed of in injection wells. Michigan currently has over 800 injection wells.

Since we are responsible for the almost 20% of the worlds fresh water, can we really afford to continue these practices.

Air pollution is also a problem using this process. There is release of excess methane, benzene, hexane, and volatile organic compounds during the well completion stage. It is well know that methane is a green house gas that is 20X more potent than carbon dioxide. In 2011 A duke University Study showed evidence that methane contamination was 17x higher in water wells nearer hydrofraking sites.

~~Since~~ Horizontal hydraulic fracturing is exempt from the Clean Water Act, Clean Air Act, Superfund Act and the Michigan Water Withdrawal rules that were enacted to protect public health and environment. ~~the oil and gas companies by~~ The federal government and our state has basically given them the go ahead, there are little to no protections for the public.

I ask that ~~the~~ any exemption~~s~~ and ~~subsidies~~ incentives provided to the gas and oil companies be taken away and used to develop renewable sources of energy.

I ask that at the very least you put a moratorium on the process of horizontal hydraulic fracturing in Michigan until the EPA has revealed the results of the study they are currently conducting and there has been a study on the environmental impacts of this process.

I ask that Michigan step into the future and pursue and encourage renewable energy to keep Michigan PURE and protect our water and air.

Karen Fifelski

LARA
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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Glenn Freeman

**Affiliation (if any):** Union of Concerned Scientists

**Phone:** 616-235-0284

**Email:** glenn@ogreogress.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ✓ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ✓ **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

Early in the year 2013 I did my part as an individual to help reduce the use of non-Michigan-based fossil fuels while at the same time helping Michigan's economy. I purchased a Ford hybrid vehicle. But one individual can only do so much. Our elected leaders need to pick up the slack and listen to the wishes of the people who actually voted them into office, not the 1% who paid for their election advertisements. Almost 60 percent of our electricity is produced from coal and all of it is imported from other states. We spend $1.7 billion dollars a year to import that coal. This has got to change fast and our elected leaders, not the free-market or corporations, have the ability to legislate such changes swiftly.

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GOVERNOR

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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** HARVEY M. GENDLER M.D.

**Affiliation (if any):** CRRM

**Phone:** 616 433 8574

**Email:** GENDLERH@SBCGLOBAL.NET

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. X Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. X Other Additional Energy Topic

(Please specify): FRACKING

**Requested time to speak:** ____ < 5 minutes X 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

1 page attached

My name is Harvey Gendler. I am a retired MD.

Is it worth risking our fresh ground water, the air we breathe and roads we drive on for an energy source that may last 20 to 30 years when renewable energy is clean and available now if we push its development?

We won't need further natural gas development here in the USA for years with what we have now. Drilling wells isn't even profitable for domestic consumption.

The gas companies want to export the gas to Europe or China where they can get better pricing and make a quick buck.

Dr. Ingraffea, a retired geological engineer, states that the drilling is 98.5% safe. (That is 1.5 accidents per 100 wells.) This is taken from industry records. If you drill hundreds of thousands of wells, that represents a lot of accidents.

Aquifers are relatively shallow and highly interconnected. There is preliminary evidence that drilling has contaminated aquifers in western states.

Drilling puts a 2 to 4 mile defect in the earth's crust that will be there indefinitely. The hole and plug have to stay reliably intact forever and forever is a very long time!

We need to test well sites and cattle for toxins before, during and after drilling and look for associated diseases. There is a large gap in our knowledge and almost nothing being done to collect further data. When the industry says there is no evidence of cause and effect on the population, it is because there is little reliable data.

Methane escape is a sure byproduct of drilling and methane is 25 times more potent as a global warming substance than carbon dioxide. There is no mandate that released methane must be captured and used commercially. Now there is large wasteful burn off of gas (called flaring).

The north polar icecap is almost gone, about 50 years ahead of predicted schedule. Continued melting and warming will release tons of methane and CO2 from the icepack and the continental shelf, accelerating global warming. It is time to look down the road several hundred years, not just around the corner for instant profits.

The same mentality that put tons of oil in the Gulf of Mexico and dumped tons of tar sands oil sludge into the Kalamazoo River is driving the gas industry. (Both sites still have plenty of residual in spite of the attempted cleanup.) The gas industry is already guilty of collusion on previous mineral rights bidding. I don't trust anything they say or do. They should be contributing to an environmental fund to clean up their many sites after the gas and oil gold rush is over.

I think we are heading for a huge global disaster and fracking will hasten its arrival.

There will be draught, famine, weather catastrophes from global warming and it will put one quarter of our population under water. It is already happening!

We need a moratorium on fracking until current research can provide data on the risks.

We must demand renewable energy be developed as fast as possible.

Thank you.

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STEVE BAKKAL, DIRECTOR

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Eric Justian

**Affiliation (if any):** West Michigan Jobs Group

**Phone:** 231 903-5032

**Email:** ejustian@gmail.com

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

I'd like to thank the Governor for coming to our neighborhood, and for giving citizens a chance to speak about Michigan's energy future. I will be addressing question number #13.

My name is Eric Justian. I am from Muskegon, Michigan.

I am president of the West Michigan Jobs Group, a non-profit organization in West Michigan working to strengthen independent businesses and lure sustainable industries to the West Michigan area. We've gained national media attention for West Michigan through our cash mobs which build public awareness of independently owned businesses, and we organized thousands of West Michigan voices in favor of renewable energy which helped area businesses lure a 150 MW wind farm proposal to Muskegon County.

Our goal is to do whatever we can as citizens and businesses to help diversify Michigan's economy, because a greater diversification of industries will create a more buoyant and durable economy going forward. That's a major reason we support a 25% renewable energy standard.

Our economy is growing again and our unemployment is dropping. And that's great news. However, the University of Michigan's 60th annual economic outlook concluded that most of our gains are from a resurgent auto industry. It's fantastic to see our auto manufacturers growing. But we are still overly dependent on a single industry. That should worry Michiganders who have lived through the state's economic freefall for most of the 21st century. Our jobs and economy are too vulnerable to a market slow down in a single sector.

We need to diversify. Because Michigan should never go through that again, where our friends and family are losing their jobs in huge numbers, and our kids and grandkids, our future innovators, have to leave Michigan to find work and start families elsewhere. We need to diversify into responsible and growing industries.

That's why Michigan should increase the renewable energy standard to 25%, and do it in such a way as to use as many Michigan companies as possible, supporting the current and future businesses that can supply the growing global demand for renewable energy and put Michigan to work.

The Public Service Commission reports that the 10% renewable energy standard is working. Our clean energy sector supports 20,500 jobs, and generates $5 billion in annual economic activity, and we're prepared to grow.

I see it happening in my own community. West Michigan Jobs Group had a renewable energy booth at Bike Time, a huge motorcycle rally attended by over 100,000 people in 2012, and we talked to dozens of folks from West Michigan who make a living because of the renewable energy sector: Engineers, fabricators, electricians, steel workers, crane operators, drivers, solar panel installers. One guy in his early 20s talked to us about his job at Energetx. That's one more young man who can start a family and make a living here in Michigan. That is what we need. Let's buy from him. Let's diversify into more of the energy supply that strengthens the innovative companies that hire people like him.

The Lake Winds Energy Park alone added almost $10 million in economic activity for Mason County and Michigan, while three of DTE's wind farms will contribute $150 million in economic activity. And the energy they generate will keep more of Michigan's dollars in Michigan.

Each year we send 1.7 billion dollars out of our state to import 100% of our coal for our power plants. Renewable energy reduces the need for coal purchases and keeps more of that money here in the Michigan economy.

Increasing Michigan's renewable energy standard to 25% will directly benefit our communities and our businesses, and it will put people to work just like the 10% renewable energy standard has. And while some folks may lament that Michigan hasn't moved toward renewable energy as fast as most US states, I like to look on the bright side. With nearly 30 US states having a higher renewable energy standard than Michigan, we have a huge pool of data and precedent to show that it works, that it can be done, and that it should be done. It reliably produces affordable power. These are well tested waters, and it's time Michigan increase its use of renewable energy and support Michigan's entry into the renewable energy manufacturing and service industry.

Let's get those businesses going, and put people to work making clean, Michigan made energy.

Thank you for giving me and the rest of us here the time to talk about Michigan's energy future.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Shirley Kallio

**Affiliation (if any):** CRRM Citizens for Responsible Resource Management

**Phone:** 874-7571

**Email:** _____

**Topics you wish to address today:**

a. X Renewable Energy Portfolio Standards

b. X Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** ____ < 5 minutes X 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

1 page attached

As stewards of 20% of the world's fresh water, we should be in the forefront of its protection. Instead, we seem poised to put volume and purity of that precious resource at risk with full exploitation of the new technologies in play with high volume hydraulic fracturing.

Yet there is abundant and growing evidence elsewhere in this country that current extraction practices exceed current ability to control risk to land, air and water, and accelerate – rather than slow down – contributions to already high greenhouse gas emissions into the atmosphere.

Prudence – especially in the face of market glut -- dictates moratorium pending future development of sufficient safeguards. What is to be gained by extracting more oil and gas if we destroy ourselves in the process?

We are told by reputable scientists that the survival of a tolerable planet is dependent on leaving 80% of known reserves in the ground – a wrenchingly difficult change of course from business as usual.

But we must make that change. Here in Michigan we can achieve far greater efficiencies – which we know and have experienced to be the cheapest form of energy – and we can and are beginning to supply ourselves abundantly with wind generation. Solar is gaining, costs are dropping dramatically, and sun generation, given its chance, will take its place as equal contributor in the state's portfolio. We have only to look to Germany, a country with comparable sun exposure to our own, as testimony to that possibility.

Let us find the courage to confront the crisis honestly and respond boldly to the responsibility our knowledge imposes upon us.

Shirley Kallio
6260 Greeley Ave. NE
Rockford, MI 49341

submissions can be made through end of April

leave in coal

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## Michigan Energy Public Forum Statement Card

If you wish to speak today, please complete the following:

Name: Wayne Kiel (Keel)

Affiliation (if any): _____

Phone: 616-836-1440

Email: Wayne.Kiel@gmail.com

Topics you wish to address today:

a. ✓ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ✓ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

Requested time to speak: ✓ < 5 minutes ____ 5 minutes

Please leave a copy of any written or electronic materials at the welcome center.

Wayne Kiel
Blueberry Heritage Farms
13871 Blair St.
Holland, MI 49424

LADIES AND GENTLEMAN

My name is Wayne Kiel I own and operate Blueberry Heritage Farms. I put up a 7.2 k system up in the spring of 2010 it was operational may 31 of 2010. The cost of that was $6.32 per watt installed before incentives of a 30 percent tax break the final cost was $4.43 and that system is in consumers program where they have a 12 year contract .

My wife and I are so pleased with the success of that system I applied and received a reap grant for a 20 K system in 2012 for my main farm at the corner of US. 31 AND 13871 Blair Street Holland Mi. This is a ground mount system with one axis racking to track the sun. This was purchased in July and erected in late December and operational Jan 5 2013. The cost of this system was $2.50 per watt before the 25 percent reap grant so the net cost is $1.875 PER WATT PLUS YOU HAVE A 30 PERCENT FEDERAL TAX CREDIT WHICH SHOULD PUT THE COST AROUND $1.60 PER WATT.

The racking design is by Solar Tilt, LLC a Michigan based company. The panels were sold to me by a Michigan base company called SEF. At that price you are producing power for less than grid prices. Today with PV prices 34% LESS THAN when I purchased PV in 2012 my cost of putting up the same system before incentives would be $1.90 to $2.00 per watt include incentives the cost would be $1.35 per approximately. The racking design is so simple any one can put it up. I was able to set the poles install the racks and the panels myself. I hired an electrician to wire the inverters and the panels and connect it to the grid for consumers.

I am here to attest that not only is solar a viable choice for making power but it is a cost effective choice according to all the calculations I am producing power at parity with grid already. I would have put up a bigger system at my farming operation but after 20 k Consumers will not pay true net metering.

I believe the public service commission should raise that to 100 k to allow for farms to offset their power bill. I want to say the state of Michigan has a chance of creating real jobs and expanding their green initiative but right now there are other states with more aggressive programs leaving Michigan behind.

I would like to recognize four Michigan based companies that were instrumental in helping me put a solar system in for 1.87 per watt SEF BASED out of Holland, POWER BY SUN based out of Spring Lake , Butler Electric based out of Standale and Solar Tilt the racking manufacturer based out of Holland. This is the way to create jobs in Michigan.

In conclusion when I hear someone tell me it cost $5.00 per watt to install solar I don't know what planet they're from but they're not from planet earth because I did it for $1.87 and today I can do it for $1.35 with incentives.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Kurt Krueger

**Affiliation (if any):** Martin Marietta

**Phone:** 231-510-0798

**Email:** Kurt.Krueger@MartinMarietta.com

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** X **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

MPSC and LARA distort the effect of PA295 on employment in Michigan

MPSC and LARA claim green jobs are boosting the economy. They are wrong.

PA295 requires the MPSC to issue a report that describes its impact on employment in this state. Please note the wording. It says impact on employment in the state. It doesn't instruct the PSC to just count jobs related to specific wind projects. It doesn't instruct the PSC to call local officials and ask how they like the property tax revenue. It requires them to describe the impact on the state. This means both the positive and negative impacts. Unfortunately their report only considers the positive half of the economic equation. They count the impacts caused by the spending of billions on renewable energy but fail to consider the negative impacts caused by having to pay for these projects. Let me repeat, they are not counting the negative impacts caused by having to pay for these projects. There is no free lunch. Someone has to pay the cost and that someone is you me and all the other ratepayers and tax payers in this state.

I am the plant manager of a large manufacturing facility located in Northern Mi. We compete in a challenging global marketplace against competitors that have much lower raw material and labor costs. We remain competitive by being efficient and productive. Energy is a significant part of our overall manufacturing cost so when the price of electricity goes up we become less competitive and less profitable. When we are less profitable we hire fewer people, buy fewer supplies and provide less return to our investors. There are thousands of employers like mine and individuals like me in this state who contribute to the economy but yet are not included in the PSC/LARA jobs estimate. Let me repeat, the ratepayers of this state are not included in the PSC's jobs estimate! We are the ones paying for PA295 yet the impacts on us are given no consideration.

As any first year economics student can attest high energy costs hurt economic growth and when government mandates the use of high cost and inefficient forms of energy the result is slower economic growth. There can be no other outcome. It is simple economics. Our PSC is wrong when they perpetuate the myth that PA295 is fueling economic growth. When we spend 12 billion dollars on wind turbines we are just diverting 12 billion from other economic activity. PA295 is merely transferring money from the pockets of ratepayers into the pockets of wind developers and Utilities. There is no net gain. In fact there is a net loss because the end result is higher energy bills that will continue for decades. Companies like mine will experience lower growth, lower profits and lower employment. This is bad for Michigan and bad for ratepayers.

MPSC also makes the claim that this is an investment in Michigan. This is incorrect. We the ratepayers and citizens of this state are not the ones making the investment. It is the wind developers that are making the investment and it is the wind developers earning the ROI. The ratepayers do not own any of these projects and are not earning an ROI. For us this is nothing more than an expense. Our only role is to pay for it all with interest.

Please ask yourself are we better off spending billions on wind turbines or should we spend this money on new roads, better schools or better yet lower utility bills? We cannot afford everything. Choices need to be made. Wind is a poor choice. The benefits to the environment are limited, the cost is high and in the end we will be stuck with an intermittent source of power that requires at least 90% backup. I cannot imagine a bigger waste of money.

Kurt Krueger

I have a B.S. in chemical engineering, an MBA and thirty years of manufacturing experience. I have also done extensive research into the costs of wind power. I am the plant manager of Martin Marietta Magnesia Specialties located in Manistee Mi. My plant is the world's largest synthetic magnesia production facility and remains competitive in the global market due to 160 dedicated and talented full time employees.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Tim Kumbier

**Affiliation (if any):** GLREA

**Phone:** 734-255-7953

**Email:** tkumbier@aol.com

**Topics you wish to address today:**

a. ✓ Renewable Energy ~~Portfolio Standards~~

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** ✓ < 5 minutes ____ 5 minutes

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**Renewables in the context of Governor Snyder's Pillars and Foundation**

**Affordability**

- Cost of fuel = $0 (wind, solar, geothermal, etc.)
- Cost of fuel predictable, i.e. certain, over time
- Up-front costs steadily improving as volume builds
- Levelized cost of energy steadily improving

**Reliability**

- Fuel source is dependable—independent of politics, economic cycles, supplier leverage, global conflict, etc.
- Generation is diversified—portfolio of type, location, size, etc. mitigates risk

**Environment**

- No extraction impact
- No emissions or spent fuel

**Adaptability**

- Size—add capacity in smaller "chunks"
- Speed—add capacity more quickly

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Sara Simmonds on Behalf of Adam London

**Affiliation (if any):** Kent County Health Dept.

**Phone:** 616.632.6277 (Adam London)

**Email:** adam.london@kentcountymi.gov

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

# KENT COUNTY HEALTH DEPARTMENT

700 FULLER N.E.
GRAND RAPIDS, MICHIGAN 49503-1918
PH: 616-632-7100
1-888-515-1300
FAX: 616-632-7083

Adam London
*Administrative Health Officer*

February 25, 2013

The Kent County Health Department appreciates the efforts of the Governor, the MI Air MI Health Coalition, and others to address energy needs and to protect our air quality statewide. Those of us in West Michigan are all too familiar with Ozone action days and high concentrations of particulate matter in our air. As public health professionals, we understand the risk that these pollutants pose to our community. Asthma, cardiopulmonary stress, and lung cancer are just a few of the adverse outcomes associated with exposure to air pollution. These are serious issues which impact the health of Kent County citizens today and will also play a major role in determining what type of place Kent County is in the future.

We also recognize that energy policy and air pollution are complicated subjects. There are many causes and complicating factors involved in this matter. We commend all involved for their work trying to sort through these factors and identifying effective strategies for addressing energy needs while protecting public health. We also encourage all involved to consider, and carefully weigh, the possibility of unintended negative public health consequences resulting from well-intentioned policy decisions. As we all understand, the health of a community is also strongly linked to the health of the local economy. Any proposals which hold the potential for economic or environmental harm should be scrutinized very carefully.

Thank you, once again, for your work on this very important topic. The Kent County Health Department looks forward to working with you to make our region a healthier place to live, work, and play.

Sincerely,

Adam London, RS, MPA
Administrative Health Officer
Kent County Health Department
(616) 632-7266

(*) Slides

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**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** MIKE LINSEA (Lindsay)

**Affiliation (if any):** SOLAR WINDS

**Phone:** 616 635 7855

**Email:** MGLINSEA@MEI.NET

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ✓ **Other Additional Energy Topic**

**(Please specify):** SOLAR WORK IN WEST MICHIGAN

**Requested time to speak:** ____ **< 5 minutes** ____ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

(*) Powerpoint (Solar [illegible]) preloaded on laptop

Solar Winds

POWER SYSTEMS, LLC

Solar Winds

POWER SYSTEMS, LLC

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**If you wish to speak today, please complete the following:**

**Name:** Jill Marcusse

**Affiliation (if any):** Sierra Club

**Phone:** 616-301-2481

**Email:** jjmarcusse@att.net

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** Fracking

**Requested time to speak:** 1 **< 5 minutes** ___ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

**My Mouth is Dry**

For water untainted
By force or chemicals
Nitrates or undisclosed fracking agents

For water that tastes of the ground
Not what we've poured on it, plowed into it
Rammed through it

I thirst for
Water huge as the Great Lakes
Powerful as an artesian well
Peaceful as a creek through cowslips

In the energy arena, fracking is Michigan's most urgent issue. We need a moratorium on fracking. We cannot ignore the dire environmental , economic and human health issues that are becoming known from other states, counties and communities that have been seriously comprised by fracking.

Clean energy does not contain a platform for using undisclosed carceogenic chemicals and millions of gallons of water that then becomes contaimanted. Water is Michigan's most valuable resource. It is our responsibility, our obligation to protect.

Our public lands are being leased to frackers I find that outrageous. It must stop.

Our governor prides himself on being a businessman. Fracking is not good business. It is short-sighted. What looks like quick easy money, will prove costly in the long run. Our agriculture and our recreational industry, rely on uncontaimented water and land.

Pure Michigan---it must be more than a marketing slogan. Pure Michigan—it's-our obligation, our responsibility.

Jill Marousse
Grand Rapids

Cecile Pineda's astonishing anatomy of the Fukushima Daiichi nuclear disaster is an alarming cry from the heart that echoes the best work of Rachel Carson, Marilyn Robinson, and Helen Caldicott. This book is a revelation, and a searing denunciation of the worldwide nuclear energy industry. You will never get a better description of what actually happened (and is still going on) at Japan's Fukushima power plants after the March 2011 earthquake and tsunami.

Pineda defies a world media blackout in her minutely detailed, day-by-day exposé of what amounts to humanity's death wish. It has taken great courage and immense research for the author to trace the fallout from our planet's most recent, and seminal, nuclear catastrophe.

*Devil's Tango* is a call for us to wake up, inform ourselves, and resist. The author is a poet, an artist, and a disciplined investigative reporter who writes with the searing urgency of a mother desperate to save her own child. "Nuclear energy equals murder...." That is the message of this memoir written with boundless energy, even humor, and passionate resolve. *Devil's Tango* contains everything you always wanted to know about Fukushima, Chernobyl, Three Mile Island, and nuclear energy in general but were afraid to ask. It is a work of a conscience truly in touch with, and deeply concerned about, humanity.

—John Nichols, author of *The Sterile Cuckoo, The Milagro Beanfield War, An American Child Supreme: The Education of a Liberation Ecologist*, et al.

Pineda's cinematic memoir evokes layer on layer of what it means to be human as we face (and avoid) the magnitude of the Fukushima Daiichi nuclear crisis. We ride along, day by day, as her wide-ranging intellect struggles to come to grips with the planet-altering implications of worldwide nuclear technology. Pineda's theatrical genius converts this cerebral premise into kinetic, visceral experiences—doors spring open into inner and outer worlds full of motion, rhythm, shadow and light, warmth, touch, closeness. The vastness of galaxies and the particularity of our lives.

Pineda's inner dialogue paints a fractured panorama of history, art, ideas—the fragile, ecstatic, peculiar works of humans. This is a book to savor slowly and/or stay up all night reading, a book to quote, share with friends, and tuck into a time capsule for future beings who wonder whatever happened here.

—Barbara George, founder of Women's Energy Matters

WingsPress
*Fine multicultural literature since 1975.*
www.wingspress.com
Distributed by Independent Publishers Group

Award-winning author & excellent speaker Pineda in Grand Rapids 12:15 noon Thurs, March 14 at Aquinas Wage Ballrin Also watch GRTV ch. 25 speaking Oct April 2013

ALSO at 2:30 at RAYBROOK MANOR (south off Burton - west of EAST BELTLINE)

DEVIL'S TANGO

PINEDA

*... and a searing denunciation of the worldwide nucle... energy industry ... a minutely detailed, day-by-day exposé of what amounts ... humanity's death wish.* —John Nichols

*Profound, quirky, laugh-out-loud funny at times, and utterly terrifying, Pi... challenges us to join her in waking ourselves out of denial. Read it if you da... it if you care.* —Jacqueline Cabasso, Director, Western States Legal Fou...

*One of the most important and required reads this year. . . . An unremitt... courageous if not prophetic voice.* —Jeff Biggers, *Huffington Post*

# DEVIL'S TANGO

## How I Learned the Fukushima Step by Step

# CECILE PINEDA

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STEVE BAKKAL, DIRECTOR

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Charlie Muller

**Affiliation (if any):** _____

**Phone:** 231-873-9820

**Email:** charlie@laughingtreebakery.com

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

Good afternoon Mr. governor, and fellow Michiganders. My name is Charles Muller and I live in Oceana County with my wife and children where we own a small homestead and operate our business, Laughing Tree Brick Oven Bakery, which specializes in artisan breads made with many Michigan grown ingredients. I grew up in Grand Rapids and attended the University of Michigan's business school where I studied economics. After graduating from Michigan I served for two years as a Peace Corps volunteer in Mali, West Africa.

My wife and I moved to our property eight years ago with a commitment to living sustainably. Over the years we built a house out of recycled materials, established a large garden, and built our bakery adjacent to our home. The motto for our bakery is 'small good things matter' and our small, good enterprise has sustained us financially now for several years. I'm proud to say that we meet the majority of our home and business electric needs with a 1000 watt solar panel array. We installed these panels on a financial shoestring before we even built our house and without any tax credit incentives. Our system is living proof that solar electricity works well here in our beautiful state. I am pleased with its performance and pleased that we have remained true to our values in this arena. Clean energy is important to us because we are concerned that our childrens' future includes the economic externalities of clean water, clean air, and weather patterns that are semi-predictable. We do not want to leave future generations bereft of the very basic resources they'll need for true economic security and prosperity.

My vision for Michigan's energy future is based, not only on my own experience with solar electricity, but also on the example of inspiring people I've met over the years. I understand the concerns of those who propose that an investment in renewable energy will somehow burden ratepayers and businesses in the state, but I have seen over and again that creative people find ways to make given technologies work to their advantage.

While living in Mali I was inspired by the toys children in our neighborhood would create out of wires they found in the local dump. I am similarly inspired by a country like Germany, which has figured out how to make renewable energy pay off collectively. I am inspired by the example of Solar Ypsi, which is responsible for outfitting businesses and the city government of Ypsilanti, Michigan with solar electricity. I am inspired by mayor Heartwell, who has challenged his municipality to run off of 100% renewable energy within a few years. I am inspired by Torreson Marina in Muskegon for making their solar electricity available for public consumption. Finally, I am inspired every time I open the fridge in my home and turn on the mixer in our bakery which are both powered by the sun.

In conclusion, it is my hope that our homestead serve as an example of what is possible at the state level. We are a state vast in the resource of smart, visionary people. Why can't we produce the majority of our residential power with solar and the rest with wind. Why can't we be the state that is the light to the country, THE example and the LEADER of renewable energy production. And why can't we be the state that manufactures the parts to serve the worlds growing demand for clean energy. I invite you sir to innovate with me and with those who want to come home and plug in their hybrid to an electric grid powered by limitless clean energy. Thank you.

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Nicholas Occhipinti (ocki pin tee)

**Affiliation (if any):** West MI Environmental Action Council

**Phone:** _____

**Email:** Noccipinti@wmeac.org

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. X **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

Chairman Quackenbush, Director Bakkal

Hi, My name is Nicholas Occhipinti. I am the Policy Director at the West Michigan Environmental Action Council – WMEAC for short.

WMEAC has been a non-profit environmental education and advocacy organization since 1968 based here in Grand Rapids. We're focused on Building Sustainable Communities and Protecting Water Resources.

[Pause] NEW COAL – 133 mwH → 107/MWH ; WIND + EE STILL CHEAPER

*"The best source of new energy is the energy we can save every day. We must explore new business models that reward energy savings, especially for utilities and ultimately the customers. We must expand the suite of voluntary programs, mandates, and fiscal incentives for greater benefits of energy efficiency."*

SLOW SLOW

-Those are not my own words. I lifted them from a letter from the U.S. Chamber of Commerce to the President and Congress. Energy efficiency policies and programs have broad support; they can and should be unifying.

Energy efficiency represents the least expensive, least risky, load matching, and most quickly deployable resource to meet energy demand. Reducing the need for new power plants and energy during peak times will improve public health as well as the ecological health of our Great Lakes.

[Pause]
In this conversation WMEAC is asking citizens and decision makers to reconceive of our buildings and existing energy infrastructure as a new source of energy - to be tapped and mined similar to oil and gas wells and coal mines. "We should treat investments in energy efficiency in essentially the same manner as investments for generation, transmission, and distribution."

Energy efficiency programs are already active in West Michigan. WMEAC is working with the BetterBuildings program – a collaboration of multiple units of government and the private sector to audit and retrofit 2,000 homes before it concludes this summer.

But these efforts represent just the tip of the iceberg. For example, WMEAC is working with the City of Holland and interested citizens on a number of energy task forces with the goal of piloting community-wide energy labeling and efficiency improvements as called for in Holland's world-class Community Energy Plan. More, energy contractors in West Michigan and across the state are experimenting to find new customers, decrease paperwork, and lower costs.

Particularly interesting are emerging models that finance energy audits and retrofits directly on utility bills – paid for from the savings of the newly installed efficiency improvements.

This innovative model, known as On-Bill Finance or Pay as You Save, addresses several of the major barriers to energy efficiency and will encourage more and deeper retrofits. Opportunity Costs, Risk, Transaction costs, and the landlord-tenant dilemma

Notable On-Bill financing programs include: Kansas's How$mart program, the City of Portland Housing Bureau, Clean Energy Works Oregon, and the Electric Cooperatives of South Carolina's Rural Energy Savings Program

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STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** BARB OLSON

**Affiliation (if any):** _____

**Phone:** 616.877.4251

**Email:** barbaraannolson@yahoo.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** Clean Energy Importance

**Requested time to speak:** ✓ **< 5 minutes** ___ **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

"just the facts!"

Governor Snyder (and all present),

Thank you for the opportunity to weigh in on such a timely and important matter that affects us all present today but even more importantly, the children and future inhabitants of this planet. Because my main point that I personally want to emphasize and remind all present here today is that the decisions that are made by the people in power in this state will show a ripple effect that will be felt all over this planet now and continuing into the future for many years to come. Just like the effects our planet is now feeling through climate change that were enacted by previous persons in power in good faith but with little foresight on environmental impact.

I would like to see the State of Michigan lead the nation in clean energy production. Electricity from coal is not the correct choice for Michigan. It will never be clean. High Volume Hydraulic Fracking will never be clean either and also is not the correct choice for Michigan. HVHF is being protested in sites all over this country and the negative health effects associated with hydro-fracking are being examined at state and federal levels as we speak. Governor Cuomo of New York State has (as you are probably aware of) agreed to postpone their hydro-fracking plans so that states Department of Health can examine the issue "before" investing money into a process that turns into the next Chernobyl Nuclear disaster, the next Exon-Valdez nature disaster, the next BP Gulf of Mexico ecosystem destroyer, the next Kalamazoo River pipeline leak failure. The list is endless of people in power making decisions that have hurt humans and ruined this planet.

So, I am just asking you to please give careful consideration to the proponents that are presenting evidence for solar, wind and alternative energy production. I am asking you to listen intently to the arguments that come from the environmental folks and give weight to their knowledge and experience. I would love to say in the near future that this state leads the nation in Green Energy Production and Blue Water recreation. That this state can exemplify a model of "Green Energy and Blue Waters" .
And to the people here who are still pushing for dirty, outdated energy creation; your grandchildren will appreciate your joining us to work for a cleaner, more beautiful earth then the dismal scenario that faces this planet if we stay the present course.

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STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** THOM PETERSON

**Affiliation (if any):** _____

**Phone:** 616 846 8875

**Email:** thompete@gmail.com

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. ✓ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** ____ < 5 minutes ✓ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

Dir. Bakkal
Chair. Quackenbush

– **Grand Haven resident Thom Peterson**
– testimony, Monday, February 25, 2013

e mgt + e acctg since 1978

**"Michigan's renewable energy and energy efficiency policies are creating jobs for Michigan workers and sparking investment in communities across our great state. Michigan is now ready to take the next step and become a regional leader in clean energy manufacturing and technology, but we must have a long-term energy plan in place to make that happen."**

The governor's Energy & Environment remarks and the decision to hold these forums across the state are welcomed by those of us who see a need to act now to respond to the reality of climate change.

There are advocates of particular approaches, as well as opponents of particular approaches, who will be stating their cases . I don't think it is the role of the MPSC or the State Energy Office to gather all of these remarks, go behind closed doors, and judge these ideas.

Rather your role ought to be to design a process for all concerned to make their cases to one another, to hear each other out in a rational decision-making process based on the **Integrated Resource Planning model**. It has been done before in our state, (the Michigan Electricity Options Study, MEOS, completed in 1987) and we can benefit greatly by reviewing not just the results of this previous effort, but also the format & processes designed for this intensive and in-depth effort of multiple stakeholders.

- This is my primary request to you today—don't re-invent the wheel, but jump-start the plan by starting with the serious study of this previous **IRP** effort.

Secondly, one key element of the earlier MEOS assumptions was the principle of lowest life-cycle cost. If we choose to apply this principle

now, energy efficiency, as an important component of demand management, will reveal itself to be our first choice. We know this already, we should agree on how life-cycle costs are fairly determined, and proceed.

The questions on the website looked like a final exam in a graduate class in Energy & Public Policy. They seemed most interested in evaluating efforts thus far. It is unclear to me how the energy efficiency program promulgated by MPSC and the utility companies are actually fulfilling the mandates of PA295. I hereby request the documents that explain how energy reduction targets are drawn up, and how the results are measured or calculated.

- I believe that somewhere along the line we need to have actual measurements of energy efficiency in residential, commercial and institutional buildings, and would propose as a standard one that I have used for thirty years: namely BTUs per square foot per degree-day (**btu/sf/dd**). The resultant number accounts for variations in building size and weather from year to year, helping to isolate differences in consumption that can be attributed to better insulation or higher efficiency motors, pumps, furnaces, boilers, etc. Let's build a state-wide database of real results to inform our subsequent policy decisions.

I think every building owner ought to pay attention to this—just like drivers ought to know whether their cars get 25 or 55 mpg—but lacking that, there ought to be some analysis done of some participants' results from utility efficiency programs. By this I mean follow-up comparisons of electricity and natural gas consumption for a period of at least two years after efficiency measures have been performed. These case studies need not involve 100% of participants, but a decent-sized sample should provide program managers, as well as home & business owners, regulators, and utilities with good information as to what works, and how well it works.

Thom Peterson, 12134 112th Ave., Grand Haven MI 49417

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**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Nicolas Pietrangelo (Peet nan gello)

**Affiliation (if any):** Power By Sun / Pisatsolar / Harding Energy

**Phone:** 616-502-0827

**Email:** pattonydoc@yahoo.com

**Topics you wish to address today:**

a. ✓ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ✓ Other Additional Energy Topic

(Please specify): Building As Powerplant / Energy storage Photovoltaics

**Requested time to speak:** ____ < 5 minutes ___ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

2/25/2013 (1)

TO: Mich Energy Policy Forum

FROM: Nicolas Pietrangelo Power By SUN/Pisat solar
616-502-0827 batterydoc@yahoo.com Harding Energy

Background: Mention P. wage!

- Multiple solar cell Projects with Different P.V. Technologies N. America, Europe, Africa Installations for 30 yrs
- Adv. Batteries for Approx 25 yrs in Both Manufacturing & Marketing of These Technologies into the worldwide Markets (Storage Handing Energy)

Basis: State of Mich has Limited Requirements for Renewable Technologies Along with Very Limited State incentives. It has Been Demonstrated over & over where states/Countries Have Strong incentives for Renewable Technologies (feed-in-Tarifs etc. etc.) Manufacturing, Sales & installation of Those Technologies Flourish. Examples Abound Germany, Japan, N.J. Calif. etc.

¶ To Date Mich has touted itself As "The Perfect Place" for Green Energy Manufacturing, Largely in Part Because of its' Many Manufacturing Talents.

Sadly, this Hype has not come true.
Frankly, I hate to say it, But it has
Been a Real Disaster!!
Examples Stand out in Many fields
such As Advanced Battery Manufacturing (Lithium)
Specificially A123/LGChemical/JCI-Saft
to name a few. Billions of $$ have
Been spent to Jumpstart this Industry
to Align with the Auto Industry, with
Little to No Results. Chevy volt & Nissan
leaf sales show this. The successful NiMH has been lost to Japan & Germany
on the side of solar cells Manufacturing
with Much State input (Tax Abatements
& Money) Huge P.V. factories of United
Solar in Auburn Hills & Greenville
Are Now Schuttered, As the Solar Industry,
Although challenged, Grows yearly,
@ double Digit Rates worldwide!!
without Adequate Incentives for P.V.
System owners (feed-in-Tariffs/Tax Incentives)
very few P.V. systems of This Particular
Technology were Installed in Mich.
And yes After Installing P.V. now within
Mich, Much to the Suprise of Many, P.V.
works very well in Mich.
A Classic Ex. of This is the P.V. system
on Manec, Muskegon Mich, Installed Circa 2002/2003
Never Touched Producing on Avg. 12% of The Power to
(Per Month) the Bldg. Now in 11th yr 1/2 Roof & older P.V. Technology!!

Boeing 787 Disasters!

30 G.W. one yr
100 G.W. Installed

These "Great Expectations" for the State were to Have supported MANY New JOBS (Politicians love JOB CREATION), support A Potentially growing tax Base of highly Skilled workers & SALVAGE A MAJOR BRAIN DRAIN of young Students graduating from the State supported Universities!

Other MAJOR fallouts to the States' well Being have Been (AS Mentioned) the Success of NiMH Battery technology involved in The Gasoline-Hybrids Best Exemplified By The Toyota Prius - 3rd Highest selling CAR IN The WORLD. NiMH controlled By JAPAN & GERMANY AND include the Relative Success of WIND FARMS IN The State (Ludington, Bebe etc.). I SAY limited Because the VAST MAJORITY of These WIND FARMS' Towers, WIND MACHINES, Construction, TRANSPORTATION etc. ORIGINATED out of State with Little to no IMPACT from Mich MANUFACTURING!! ONCE AGAIN LARGE SUMS of $$ were INVOLVED in these WIND FARMS chasing Federal INCENTIVES of 2.2¢ per Kwatt-hr. for WIND generated Electricity.

A few suggestions going forward:

BAH. in Bldg for solar
- Bosch
- solarcity
- Tesla
- others

(A) Pay Critical Attention to Electrical Storage Technologies. Storage is Absolutely Necessary for Renewables' inconsistancy. Pump Storage Ludington, Failed BAH. Tech. Successful BAH. Technology. Explore other new Storage Technologies like Thermal fracking Driven By solar/wind.

(B) Pay Attention to Multiple working P.V. Installations in The State which Prove Beyond A Shadow of Doubt P.V. works in Mich. There Are MANY P.V. Power is @ or Below grid costs @ Parity! Wrong Info out there Parity @ 2020.

(C) Ex of B Above. State Supported G.V.S.U./MARC Muskegon, Mich. working Nicely No Maintainence Since 2002/2003. Supply on Avg./per Month/ 12% of Buildings' Electrical Requirements. MARC "Building as Powerplant" Beacon to the world.

(D) Appreciate The Magnitude of P.V. Installations 100 G.W. worldwide (70 Nukes) 30 G.W. Just Last yr. 2012 (20 Nukes)

(E) Listen to Input from Entrepreneurs in The field putting solar systems in place. Politicians & Policy makers All too often Are out of Touch with what is Happening. P.V. Along Pricing (Crystalline) has gone Down (-)34% Alone in 2012, and still decreasing Start to Think outside The Utility Box of Det. Edison/ Consumers Power

(F) follow the Successful Incentive Programs. GERMANY for Ex in Dec 2011 Installed (3) GigaWatts - one month That's (2 nuke plants). Miti in JAPAN After Fukiema 10-12 Billion ¥¥ for food-in- incentives for P.V.

(G) watch Closely Raw Materials for So Much of Renewables & Hybrid Electrics. Copper/cobalt/Nickel of U.P. Mines Critical Raw Materials Critical Raw Materials for Batteries Magnets Rare Earths (Great western Technologies Troy, Mich)

(H) watch closely Technologies from Mich. Like Phase change Memory (Micron/Intel) used for Data Storage in Smart Meters

TECH TUESDAY

# Wanted: A better battery

You Had it Nich NiMH You gave it up!!

## WHAT'S HOLDING ENERGY TECHNOLOGY BACK? AN INEFFICIENT, 200-YEAR-OLD INVENTION

By Seth Borenstein
Associated Press

As 21st-Century technology strains to become ever faster, cleaner and cheaper, an invention from more than 200 years ago keeps holding it back. It's why electric cars aren't clogging the roads and why Boeing's new ultra-efficient 787 Dreamliners aren't flying high.

And chances are you have this little invention next to you right now and probably have cursed it recently: the infernal battery.

Boeing is the first company to make extensive use in an airliner of technology's most advanced battery — lithium ion. But a Jan. 7 battery fire aboard a Dreamliner in Boston, followed by a similar meltdown in Japan, led authorities around the world to ground the fleet, highlighting a longstanding safety problem that engineers have struggled with.

In 2006 and 2007, more than 46 million cell phone batteries and 10 million laptop batteries — all lithium ion — were recalled because of the risk of overheating, short-circuiting and exploding. Additional safety features have been installed since then on lithium ion batteries used in consumer electronics.

As for the electric car industry, lithium ion batteries have proved to have two major drawbacks: They are costly, and they do not allow automobiles to go far enough between rechargings. A123, a maker of lithium ion batteries for electric cars, went bankrupt last year because of poor demand and high costs after receiving a $249-million federal grant.

**LITHIUM ION BATTERIES**, which store more energy at a higher voltage and a lighter weight than earlier types, represent the most recent jump in battery technology. And that took place nearly a quarter-century ago.

"We need to leapfrog the engineering of making of batteries," said Lawrence Berkeley National Lab battery scientist Vince Battaglia. "We've got to find the next big thing."

But none of the 10 experts who talked to the Associated Press said they know what that big thing will be yet, or when it will come.

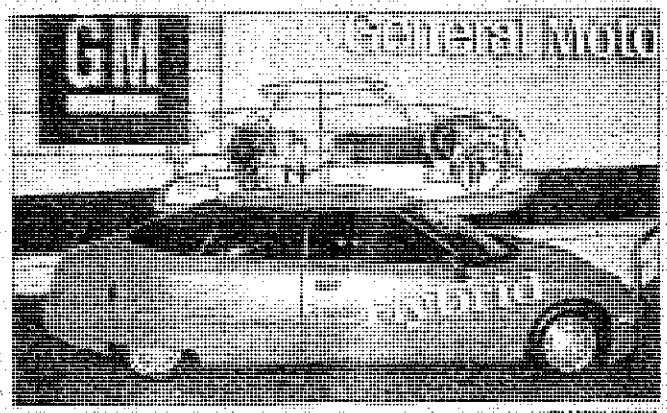
"If you crack it ... it'll change the world," said Carnegie Mellon University materials science professor Jay Whitacre.

Batteries are so crucial to a greener energy future that the Obama administration has spent more than $2 billion to jump-start the advanced battery industry, including setting up what some experts say is a mini-Manhattan Project for batteries.

To make the next breakthrough, researchers will have to master complex chemistry, expensive manufacturing, detailed engineering, a variety of different materials, lengthy testing, stringent safety standards and giant cost problems. It involves dealing with liquids and solids, metals and organic chemicals, and things that are in between, said Glenn Amatucci, director of the Energy Storage Research Group at Rutgers University.

ASSOCIATED PRESS

In a 1940 photo, German mechanic F. Hans tests the battery on his electrically driven bicycle. The bike motor was powered by an 8-volt 60-amp battery.




General Motors unveils the EV1 Parallel Hybrid vehicle at the North American International Auto Show in Detroit in January 1998.

**"WE'RE DEALING WITH** a system that you can imagine is almost alive. It's almost breathing," Amatucci said. "Trying to understand what's happening within these batteries is incredibly complex."

One reason the battery is the slowpoke of the high-tech highway is that it has conflicting functions. Its primary job is to store energy. But it's also supposed to discharge power, lots of it, quickly. Those two jobs are at odds with each other.

"If you want high storage, you can't get high power," said M. Stanley Whittingham, director of the Northeast Center for Chemical Energy Storage. "People are expecting more than what's possible."

On the commercial market, lithium ion batteries are generally small enough to fit into cell phones. But to power bigger items — from a Prius to a 787 — they get grouped together, increasing the juice they store and provide. That also increases the safety risk, experts say. The lithium ion battery that caught fire in a Boeing 787 weighed 63 pounds and was 19 inches long.

"You can't get around the fundamental thing is that lithium ion batteries are stuffed full of flammable liquid," Whitacre said.

**EXPERTS SAY LITHIUM** ion batteries are more dangerous because their electrolyte, the liquid that allows ions to move among electrodes in the battery, is more flammable than the substance in older-type batteries. Those older types include the lead-acid batteries in most cars and the nickel cadmium batteries in video equipment and power tools.

Still, MIT materials science and engineering professor Gerbrand Ceder and others said the safety problems can be fixed.

Change doesn't come often in the battery field.

"The big advances in battery technology happen rarely. It's been more than 200 years and we have maybe five different successful rechargeable batteries," said George Blomgren, a former senior technology researcher at Eveready and now a private battery consultant. "It's frustrating."

Alessandro Volta — for whom the volt is named — invented the first useful battery in 1800. That was long before other breakthrongh inventions like the internal combustion engine, telephone, car, airplane, transistor, computer and Internet. But all of those developments have seemed to evolve faster than the simple battery.

The lead-acid car battery "has been around for 150 years more or less," Whitacre said. "This is a remarkable testament to first how robust that chemistry is and how difficult change is."

# AMC series OK'd for incentives

## Drama 'Low Winter Sun' will film in Detroit this spring and summer

By Julie Hinds

Michigan on nearly double that amount of episodes.

The "Low Winter Sun" pilot filmed in Detroit last September.

Based on a 2006 miniseries from Great Britain, "Low Winter Sun" will explore

best-series Emmy, and it went on to win best drama fo years in a row.

The debut of "Low Winter Sun" has yet to be sche uled. The first season will include 10 episodes.

The news is encouraging to a local film commun hoping for a busier year than 2012.

"It gives a lot of our people work and provides it ov the months for our members," said Calvin Hazelbak business representative for IATSE Local 38, which re resents many local crew jobs.

BASF
The Chemical Company

# BASF acquires Ovonic Battery Company, the global leader in NiMH battery technology

2012-02-14
P-12-140

**ISELIN, NJ, February 14, 2012** – BASF today announced that it has acquired Ovonic Battery Company, a wholly owned subsidiary of Energy Conversion Devices Inc. (NASDAQ: ENER).

Based in Rochester Hills, Mich., Ovonic is the global leader in Nickel-Metalhydride (NiMH) battery technology, including the production of cathode active materials (CAMs) for this battery type. The company also has a battery materials research facility in Troy, Mich.

Ovonic is the inventor of the NiMH technology as it is used today, and has a patent portfolio of 97 U.S. and international patents and patent applications in this field. All major producers of NiMH batteries are currently working under license from Ovonic.

As part of BASF, Ovonic will be managed under BASF's new global business unit "Battery Materials," which was launched on Jan. 1, 2012, to integrate the company's current and future battery materials-related activities within a single operating unit managed by its Catalysts division, based in Iselin, N.J.

"Our acquisition of Ovonic provides BASF with an immediate leadership position in NiMH battery technology, as well as long-established commercial relationships with the world's major battery manufacturers," said Ralf Meixner, Senior Vice President of BASF's Battery Materials business. "In addition, Ovonic's proven research expertise provides a strong complement to the broad range of battery materials development activities we currently have underway within BASF."

"We are very pleased to join BASF's Battery Materials business," said Michael Fetcenko, President of Ovonic Battery Company. "BASF's expertise in materials science and processing technology is a tremendous resource and these synergies will accelerate Ovonic's development of advanced NiMH solutions for consumer, vehicle and smart grid energy storage."

In addition to its current activities in electrolyte formulations and Li-ion cathode materials development, BASF is exploring next-generation battery materials concepts, including lithium-sulfur technologies now in early stage development with partner Sion Power, in which BASF recently invested $50 million to take an equity ownership stake.

As a result of these initiatives, BASF is building up a broad coverage of battery materials technology to drive the future of electromobility, supporting its long-term objective of becoming the leading provider of functional materials and components to serve cell and battery manufacturers worldwide.

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Ovonic Battery Company, Inc. (OBC) is the inventor, developer and worldwide licensor of NiMH battery technology. Not only does OBC manufacture battery cathode materials for sale to licenses, but it continues to innovate advanced materials to expand markets for NiMH batteries in consumer, vehicle and stationary fields of use. Through its innovative R&D, OBC has established a proprietary position applicable to cathode materials for lithium-ion batteries and to next generation batteries such as very high energy MH-Air (Proton-ion) batteries.

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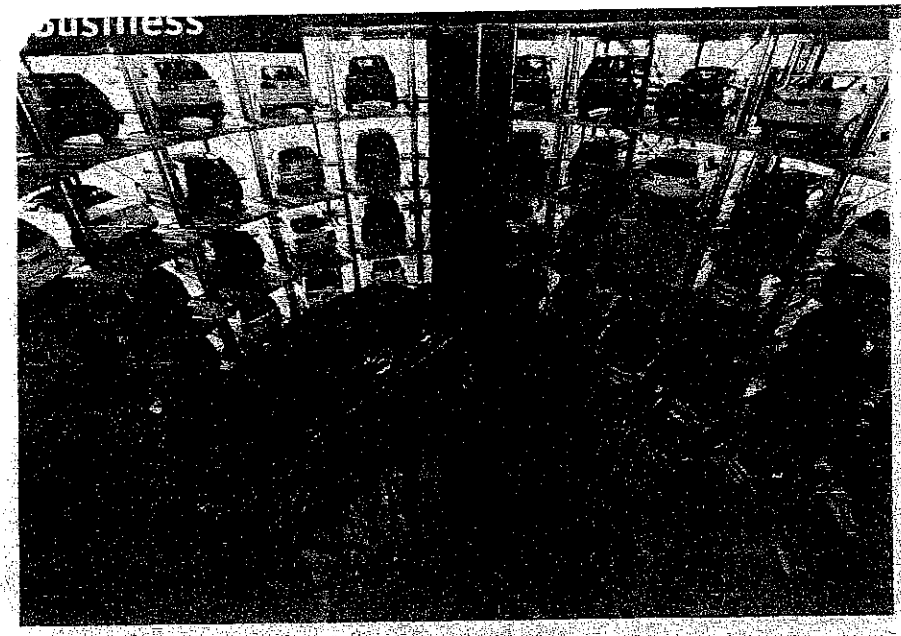

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Volkswagen

# VW conquers the world

Circa 2018 Where Does G.M. End Up? Behind VW & Toyota

BERLIN

**Germany's biggest carmaker is leaving rivals in the dust**

WHEN Ferdinand Piëch arrived as Volkswagen's chief executive in 1993, things looked dire. The carmaker was overspending, overmanned and inefficient, and had lost its reputation for quality. How things have changed: last year the VW group's profits more than doubled, to a record €18.9 billion ($23.8 billion). As other European volume carmakers seek to close factories and cut jobs, VW is seizing market share in Europe, booming in China and staging a comeback in America. It plans to spend €76 billion on new models and new factories by 2016. Its global workforce is more than half a million, and growing.

It took years for Mr Piëch—now chairman, but still with his hands firmly on the wheel—to tame VW's menagerie of semi-independent brands and get to grips with its global empire of factories. He has been a ruthless hirer and firer of executives: only last month Karl-Thomas Neumann was removed as head of VW's Chinese operations, supposedly for his disappointing performance, despite the juicy profits VW is making in China. Mr Neumann had been talked of as a possible successor to the chief executive, Martin Winterkorn.

Mr Piëch is a grandson of Ferdinand Porsche, who founded VW after Hitler called in 1934 for the creation of a cheap "people's car", a Volkswagen. The Piëch-Porsche clan controls both VW and Porsche, a sports-car maker that is now being folded into VW after the failure of an overambitious and highly leveraged reverse takeover. On July 4th VW agreed to buy the 50.1% of Porsche it does not yet own for €4.46 billion.

VW is also buying Ducati, a maker of fancy motorbikes, and consolidating MAN and Scania, two lorrymakers, into its commercial-vehicles division. Yet still the firm remains hungry. It has long coveted Alfa Romeo, a premium-car division of Fiat, and is rumoured to be eyeing up Navistar, an American lorrymaker. Mr Winterkorn nevertheless dismisses the suggestion that the group is getting unmanageably big.

Mr Piëch's plan was for VW to become the world's biggest carmaker by volume by 2018. Last year, however, as Toyota struggled with the aftermath of Japan's tsunami and GM floundered in Europe, VW reached its goal seven years early (see chart, next page), if you do not count Subaru, Toyota's distant affiliate, or GM's Wuling joint venture in China, which mainly makes Chinese-branded cars.

The 8.5m vehicles VW made last year cover all corners: Volkswagen, Skoda and SEAT in the mass market; Audi in premium cars; Porsche, Bugatti and Lamborghini in sports cars; Bentley at the luxury end; plus various commercial-vehicle brands. Most (SEAT excepted) are firing on all cylinders. IHS Automotive, a forecaster, expects VW easily to beat its target of 11m sales by 2018.

Fierce competition and regulatory pressure to develop alternative-fuel cars are forcing other makers to seek cost-sharing partnerships. Toyota and BMW are teaming up on low-carbon technologies. GM's Opel division in Europe is joining Peugeot-Citroën to make smaller cars. Daimler is edging towards a threesome with the Renault-Nissan alliance. Sergio Marchionne, the boss of Fiat and Chrysler, recently suggested merging several European makers to create "another Volkswagen".

Volkswagen has been better than its rivals at reducing the number of common "platforms" that its cars are built on. This allows it to offer a fabulous variety of brands and styles while slashing manufacturing costs. The next stage, launched this year, is a versatile platform codenamed MQB, which will underpin the VW Golf, Audi A3, Skoda Octavia and SEAT Leon, in all their variations.

**Wolfsburg's lone wolf**

VW's size means it seldom needs partnerships with rivals, says Mr Winterkorn. Perhaps this is just as well. Judging by its botched hook-up with Suzuki, a mid-sized Japanese maker, VW is not much good at romance. Suzuki's boss, Osamu Suzuki, has filed for divorce and is taking VW to arbitration to force it to sell its 19.9% stake in Suzuki. Among other things, he has complained of being treated like a subsidiary, rather than a partner. VW had hoped to develop cheap cars for emerging markets with Suzuki, which is big in India. Now it must do so alone, at considerable cost.

In many of the 26 countries where VW has factories, it has been around long enough to be seen as a domestic firm, so protectionists usually leave it alone. The founding family's controlling shareholding, and a blocking stake held by the state of Lower Saxony, where VW is headquartered, allow it to resist short-term pressures to pull out of any market that turns difficult. Rivals envy the stability this brings, especially just now, says Mr Winterkorn.

VW can cope with a collapse of the ↦

European car market. Others must make deep cuts—or perhaps even, in the case of GM (which has lost $16 billion in Europe since 1999) and Ford (which gave warning on June 28th of deepening losses there), pull out of the continent altogether.

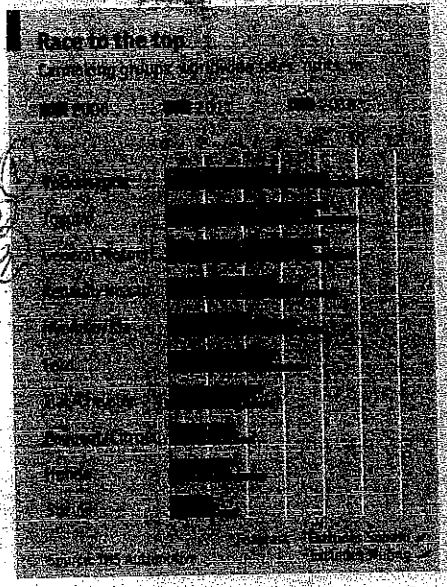
VW bet on China nearly 30 years ago. Now it is the world's biggest car market and VW has 18% of it, through two joint ventures. They sell 2m vehicles a year and plan to double this by 2018. A glut of cheap cars is hurting prices in China but VW's premium models are doing well: the group's share of its Chinese ventures' profits rose from €1.9 billion in 2010 to €2.6 billion last year. VW has long been big in Brazil (market share: 22%), and is expanding fast in Russia (9%). The weakest BRIC in its wall is India, where its share is less than 5%. Suzuki, whose affiliate Maruti Suzuki has almost 50% of the Indian market, should have been the perfect partner there.

The "Beetlemania" that VW enjoyed in America in the 1960s, when its Beetle was the pioneer of smaller, cheaper cars, faded in the 1970s. Decades of weak sales and losses ensued. VW closed its Pennsylvania factory in 1988 because the cars it made were lousy. It tried importing from Mexico but couldn't make this pay. Now, with a big new plant in Chattanooga, Tennessee, a revamped dealer network and the successful launch of the new Jetta, a family saloon, VW is back on a roll in America. Its sales there rose by 23% last year to 444,000, and its aim of selling 1m cars by 2018 looks achievable. However, VW's quality ratings in America remain well below average, according to surveys by J.D. Power.

Like BMW, another admired German carmaker, VW seems to have succeeded because it is run by petrolheads. Mr Piëch's passion for engineering pervades the group. He is the strategist; Mr Winterkorn the get-things-done guy. Hans-Dieter Pötsch, the chief financial officer, has helped a lot by controlling costs, says Max Warburton of Sanford C. Bernstein, an investment bank. VW's other chiefs enjoy considerable freedom—unless they incur the chairman's wrath.

For all VW's success, it is rare to hear people outside the firm praising the "Volkswagen Way" as they once lauded the "Toyota Production System". VW has ignored Toyota's obsession with the production line, says Mr Warburton, and concentrated on saving costs through parts-sharing between models. It has managed to preserve a culture of permanent innovation and a willingness to take risks. If there is a Volkswagen Way, it is to be determined, diligent and attentive to detail, with a glint of ruthlessness.

Still, plenty could go wrong. Toyota captured the top spot from GM in 2008, only to stumble on quality as it rushed for quanti-




Sprawl and loss of focus are another risk. Take the SEAT brand, for instance, which lost €225m last year. What is it for? Mr Winterkorn describes it as VW's "sporty, design-oriented" brand for young people. But how does SEAT's new Toledo, which VW describes as "a practical, top-quality and affordable car for the whole family", fit that image? If VW already has one brand too many, SEAT is it.

An earlier growth spurt, during Mr Piëch's time as chief executive, led to VW's brands churning out lots of competing models while overlooking popular new trends, such as the "compact multipurpose vehicle" pioneered by Renault with its Scenic. Upper-end Volkswagens and Skodas are now competing with lower-end Audis. SEATs, Skodas and VWs have different images but much in common under the hood. Relying on buyers' brand loyalty has worked so far, but for how long? Procter & Gamble, which is to toiletries what VW is to cars, stumbled after "taking on every competitor in every category in every region of the world at once," as an analyst put it in *The Economist* last week. That seems to be what VW is doing now.

VW is so big in China that it would be vulnerable to a downturn there. Likewise in Brazil, where its Chinese rivals are starting to encroach. And VW has a closer challenger in its rear-view mirror: Hyundai-Kia, which is pushing upmarket while continuing to churn out small, good-value motors. It has around half of its home market in South Korea, is ahead of VW with a 9% share in America and is making inroads in Europe and emerging markets. And unlike VW, it does not have a profusion of brands to support.

If the euro falls apart, VW's German factories will suddenly find their costs denominated in expensive Deutschmarks. That cosy relationship with Lower Saxony (whose blocking stake the European Commission is seeking to remove) might become a burden if VW needed to make swift cuts to maintain profitability. If circumstances require a change of direction, the monoculture at the top of VW may react slowly. With so many executives close to retirement—Mr Piëch is 75 and Mr Winterkorn 65—succession is another worry.

However, such problems are hypothetical. As VW drives relentlessly towards world domination, Bernstein's Mr Warburton says that Mr Piëch "will go down in history as an automotive legend, in the same class as Gottlieb Daimler, Henry Ford and Kiichiro Toyoda." ■

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GERMANY Does with
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Memory Chips

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The Economist

**Technology Quarterly: Q3 2012**
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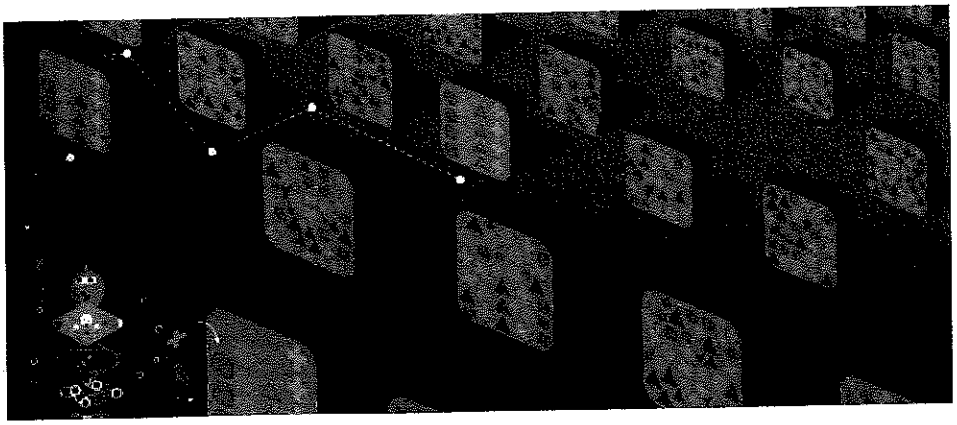
**Phase-change memory**

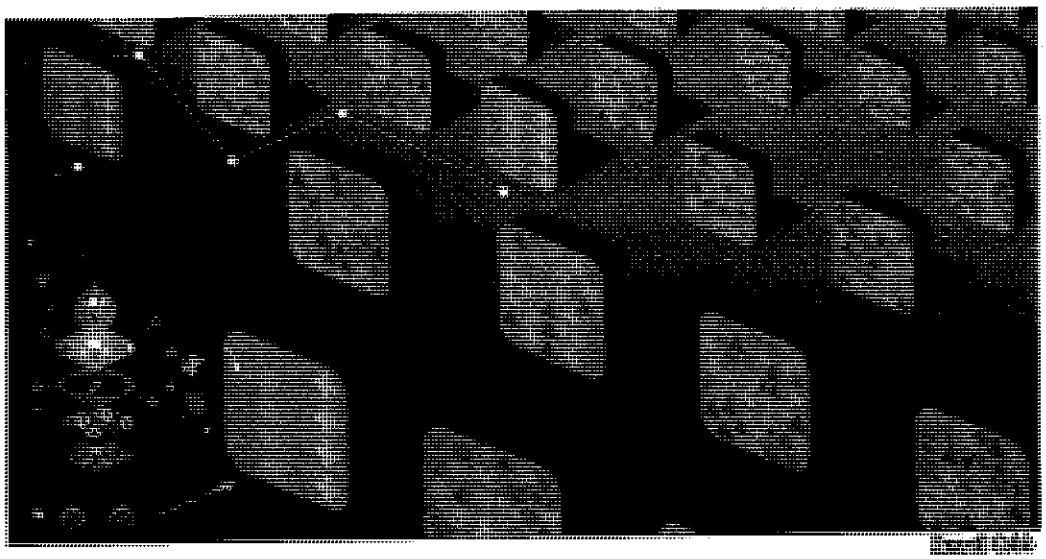
# Altered states

## Computing: Phase-change memory chips, an emerging storage technology, could soon dethrone flash memory in smartphones, cameras and laptops

Sep 1st 2012 | from the print edition



AS EVERY parent knows, a tidy bedroom is very different from a messy



AS EVERY parent knows, a tidy bedroom is very different from a messy one. The number of items in the room may be exactly the same, but the difference between orderly and disorderly arrangements is immediately apparent. Now imagine a house with millions of rooms, each of which is either tidy or messy. A robot in the house can inspect each room to see which state it is in. It can also turn a tidy room into a messy one (by throwing things on the floor at random) and a messy room into a tidy one (by tidying it up). This, in essence, is how a new class of memory chip works. It is called "phase-change memory" and, like the flash memory that provides storage in mobile phones, cameras and some laptops, it can retain information even when the power is switched off. But it promises to be smaller and faster than flash, and will probably be storing your photos, music and messages within a few years.

The technology relies, as its name suggests, on special substances called phase-change materials (PCMs). These are materials, such as salt hydrates, that are capable of storing and releasing large amounts of energy when they move from a solid to a liquid state and back again. Traditionally they have been used in cooling systems and, more recently, in solar-thermal power stations, where they store heat during the day that can be released to generate power at night. But for memory devices it is not their thermal properties that make PCMs so attractive. Instead it is their ability to switch from a disorderly (or amorphous) state to an orderly (or crystalline) one very quickly. PCM memory chips rely on glass-like materials called chalcogenides, typically made of a mixture of germanium, antimony and tellurium.

Technology Quarterly

Reprints

Phase Change Memory
Developed in Mich. ENER/OVONYX
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Each cell in the memory chip consists of a region of chalcogenide sandwiched between two electrodes (see diagram). The bottom electrode is a resistor that heats up when a current passes through it. Delivering a gentle pulse of electrical energy to the cell turns on this tiny heater and causes the chalcogenide to melt. As it cools it forms an orderly, crystalline structure. This state corresponds to the memory cell storing a "1". Applying a shorter, stronger pulse of energy to the cell melts the chalcogenide but does not allow crystals to form as it cools. Instead, the region of the material above the bottom electrode assumes a disorderly, amorphous state, corresponding to the cell storing a "0". The amorphous state has a higher electrical resistance than the crystalline state, allowing the value stored in the cell to be determined. (For this reason PCM memory is sometimes called "resistive memory", and its individual cells are sometimes referred to as "memristors".)

You may already be relying on chalcogenides to store data without realising it, because they are used in re-writeable optical storage, such as CD-RW and DVD-RW discs. Bursts of energy from a laser put tiny regions of the material into amorphous or crystalline states to store information. The amorphous state reflects light less effectively than the crystalline state, allowing the data to be read back again. The technology has, in other words, already proved that it can work. Now companies like Micron Technology, Samsung and SK Hynix—the three giants of digital storage—are applying it inside memory chips. The technology has worked well in the laboratory for some time, and has been used in a handful of specialist applications since 2007. But it is moving towards the mainstream consumer market. Micron started selling its first PCM-based memory chips for mobile phones in July, offering 512-megabit and one-gigabit storage capacity.

**Thanks for the memories**

PCM memory chips have several advantages over flash memory, which works by trapping electrons in an enclosure called a "floating gate", built on top of a modified form of transistor. The value stored in each cell is 1 or 0, depending on whether the enclosure is full or empty. But writing to individual flash-memory cells involves erasing an entire region of neighbouring cells first. This is not necessary with PCM memory, which makes it much faster, says Paolo Giuseppe Cappelletti, who is in charge of Micron's PCM memory project at Agrate Brianza in Italy. Indeed, some prototype PCM memory devices can store and retrieve data 100 times faster than flash memory, says Evangelos Eleftheriou, head of storage technologies at IBM's Zurich Research Laboratory in Switzerland. Another benefit of PCM memory is that it is extremely durable, capable of being written and rewritten at least 10m times. Flash memory, by contrast, wears out after a few thousand rewrite cycles, because of the high voltages that are required to shepherd electrons in and out of the floating-gate enclosure. Accordingly, flash memory needs special controllers to keep track of which parts of the chip have become unreliable, so they can be avoided. This increases the cost and complexity of flash, and slows it down.

"As well as dethroning flash, phase-change memory could lead to a radical shift in computer design."

In addition, PCM offers greater potential for future miniaturisation than flash. As flash-memory cells get smaller and devices become denser, the number of electrons held in the floating gate decreases. Because the number of electrons is finite, there will soon come a point at which this design cannot be shrunk any further, says Tom Eby, the head of Micron's embedded solutions group. "We need a fundamentally different approach," he says. Last year a group led by Eric Pop at the University of Illinois, Urbana-Champaign, demonstrated how a prototype PCM memory cell could be made that was just 10 nanometres across, bridging a gap between two carbon-nanotube electrodes. The research, published in the journal *Science*, also showed marked improvements in energy consumption compared with flash.

PCM- in SMART Meters made in China!!

Besides many other applications!!

George

ttp://www.micron.com/about/blogs/2013/january/paying-our-dues

# Paying Our Dues" Paid off with PCM

Paolo Cappelletti | January 21, 2013 | All Products

> "I commend Micron for being able to put silicon down and show volume production of PCM. This blows naysayers away—of which I was one—and shows that the technology can work. It also drives home the lesson that you must pay your dues in terms of development and production time—including the ability to work around a variety of issues like thermal disturb—to achieve a good, production-ready, innovative design."
>
> - Alan Niebel, CEO of Web-Feet Research

In December, we announced our second phase change memory (PCM) product, a 512Mb part made with our proprietary 45nm PCM technology, and confirmed we're shipping high volumes of our first PCM product, the 1Gb part, to Nokia.

It doesn't happen very often that a radically new technology starts to play a significant role in the highly competitive memory field. The last time that happened was the introduction of NAND Flash more than 10 years ago, and 10 years prior to that, the introduction of NOR Flash.

Web-Feet Research CEO Alan Nieble, who definitely has a long experience with and deep understanding of memory, especially nonvolatile memory, has recognized that we are at an inflection point in the history of long-awaited emerging technologies. He commended Micron for making it happen with PCM.

But Alan has captured an important point—it is always true that "you must pay your dues in terms of development and production time," even when progressing from one node to the next node on a memory roadmap. But when it's time to move from an evolutionary innovation to a revolutionary innovation, the dues are far higher.

It's radical change of paradigm. As far as discontinuity, the distance of PCM from any conventional nonvolatile memory is orders of magnitude larger than, for instance, the gap between NOR Flash and NAND Flash, or between planar NAND and 3D NAND.

For more than 40 years, engineers and designers have been playing with electronic devices, charge storage, potential barriers, electric fields, and electrical capacitances. The 10 years Micron has spent on phase change memory was invested in learning how to work with thermal devices, phase transition, latent heat, heat diffusion, and thermal capacitances. We basically had to change our mindset—from electronic engineering to phonon engineering.

And...we made it!

That we can now produce PCM in high volumes, with industry-standard yield, high performance, and high reliability, is thanks to the huge effort and the long hours our engineers spent digging into material properties, physical mechanisms, and process details to build a solid understanding that could be translated into design and manufacturing skills.

You are perfectly right, Alan—we had to pay our own dues! But we're proud that we reached the finish line first.

**Intel's Low Cost Game Changer**
by Ashraf Eassa
Investors in US equities tend to focus on products and services that they can easily "see" in action. It's easy to invest in a company like **Verizon** (VZ) or **AT&T** (T) because many of us likely fork over a substantial sum of money to them each month to fund the Android phone that we got with that 2-year contract. Until the PC growth hit a snag, it was easy to pull the trigger on shares of **Intel** (INTC) because, quite frankly, the fat dividend, coupled with "Intel Inside" most of our computers made it seem like a no-brainer safe equity. **read more »**

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# Intel's Low Cost Game Changer

February 4, 2013 by: Ashraf Eassa | about: INTC

**Disclosure:** I am long INTC. **(More...)**

Investors in US equities tend to focus on products and services that they can easily "see" in action. It's easy to invest in a company like **Verizon** (VZ) or **AT&T** (T) because many of us likely fork over a substantial sum of money to them each month to fund the Android phone that we got with that 2-year contract. Until the PC growth hit a snag, it was easy to pull the trigger on shares of **Intel** (INTC) because, quite frankly, the fat dividend, coupled with "Intel Inside" most of our computers made it seem like a no-brainer safe equity.

However, with PC sales in a slump (that may or may not be temporary), and with Intel's fairly limited visibility in US-based tablets and smartphones (due to a lack of an 'obvious' design win that everyone can see as of yet), it

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**Design Article**

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Micron ships phase-change memory

Peter Clarke

12/12/2012 6:09 AM EST

LONDON – Memory chip vendor Micron Technology Inc. has backfilled its range of 45-nm phase-change memory (PCM), which it says is shipping in "high volume" to Nokia, as reported by *EE Times* in November.

P.C.M.

Micron (Boise, Idaho) has announced it has been shipping 45-nm 1-Gbit PCM multchip package to Nokia for use in the their phones for some time and is now sampling a 512-Mbit PCM plus 512-Mbit LPDDR2 MCP. Nokia is using Micron's PCM solution to enrich the functionality of "select devices" in its portfolio, Mic

At the time of the Electronica exhibition *EE Times* Micron will ship tens of millions of units of 1-Gbit I couple of cell phone design wins (see ***Micron ph*** the Nokia Asha phone (see **www.nokia.com/glob**

"Nokia has always found ways to provide innovati globe, and Micron's PCM for mobile enables us tc smartphones," said Dirk Didascalou, senior vice p statement issued by Micron. "Micron is a trusted s strong user experience with a number of feature a

Micron said its PCM can speed up boot time for n development and boost performance with its oven components are being targeted at mobile phones tablet computers, the company said.

Micron's 45nm PCM solution is currently targeted enhanced capabilities, with a future roadmap aime tablets.

Mich. Support of Medical Devices ???



# s Michigan a hotbed for medical devices?

Lights, camera... BUSINESS JOURNAL STAFF

r years now, part of the nantra associated with ne medical industry in the rand Rapids region has een the goal of turning Iichigan into an important in the U.S. for medical de- anufacturing. Medical de- re seen as a hopeful diver- on of the Wolverine State's acturing sector.

have we achieved that dis- n?

eally, according to **Todd** n of Rose Technologies, ll medical device contract acturer in GR.

ere's not really much (med- device) manufacturing in Michigan. Outside of Stryk- re's not much going on (in gan)," he added, "other than o in Ann Arbor. And ATEK."

EK Medical Group's plant is R's southwest side, although ompany had been headquar- in Minneapolis. "Had been," se a little over a year ago, K was acquired by Vention cal in Massachusetts.

assachusetts is, in fact, one e real medical device manu- ring hotspots in the U.S., ac- ng to Grimm. He also ranks neapolis at the top, along with ornia, Texas and Florida.

2007, the West Michigan ical Device Consortium was device and services industry, and Rose was one of the original seven members. Grimm said the company is no longer a member.

**It's about Time**

Sumba, Indonesia; Malmo, Sweden; Guca, Serbian Dragacevo; South Island, New Zealand — and Grand Rapids, Mich. Yep, you read that right. Grand Rapids sits among these cities on Time Magazine's list of Five Festive Events You Won't Want to Miss in 2013. And why should the world be flocking to good old River City? ArtPrize, of course!

The magazine says of ArtPrize: "The world's most lucrative art competition isn't in New York City or Hong Kong but in Grand Rapids — a Michigan city better known for Rust Belt decline than edgy painting and photography. Founded in 2009 by **Rick DeVos** — heir to the Amway fortune — the annual ArtPrize (Sept. 18 to Oct. 6) will distribute some $560,000 to its 2013 winners, chosen by both a professional jury and the votes of the more than 400,000 visitors who will arrive to view the work."

It's interesting to note the other cities don't receive the same backhanded compliment reserved for Grand Rapids. But, no matter, GR is on the list. Yet another feather to add to city's growing "list making" the Rust-Belters in us talking, but don't the other four sound a wee bit stuffy?

**Social status**

Get ready for the tourists. For the sixth year in a row, Michigan.org took the honor of most visited state tourism website in the country. That's right, Michigan beat out Florida — only by a mere 1 million more virtual visits. Let's hope that number translates in some way to actual visits.

The site attracted 8.8 million web visits in 2012. Consumers used the site an average of 24,000 times per day, and it garnered an average of 14,000 click-throughs per day to other Michigan tourism industry sites — that's 5.3 million per year. Yes, **Tim Allen** has a silken voice on those Pure Michigan ads, but that can't be the only reason for the traffic.

The good news doesn't stop there. Turns out Michigan also is quite the social butterfly. Pure Michigan's social media presence is the best in the country among all destination-marketing organizations, according to Think Social Media. And, the U.S. Travel Association awarded Michigan a 2012 Mercury Award for Best Use of Social Media among all destination-marketing organizations in the nation.

photo. Leading those other states with 15,000 followers and more than 115,000 photos since July with the hashtag #PureMichigan, the state is quite the socialite.

**It's showtime!**

Who says manufacturing is dead (or even boring)?

A collaborative partnership created by The Right Place/MMTC-West Manufacturers Council and the Kent Intermediate School District, has opened registration for Kent County high school students to join the 2013 Discover Manufacturing Today — Video Challenge.

Students will be represented by teams of no more than six and challenged to create a video that is at least 60 seconds but not longer than 3 minutes in length. Videos showcase a partnered manufacturer in the area and capture the skills needed to be successful in a manufacturing career, the environment of manufacturing, and opportunities for growth and professional development for students.

The intent of the program is to change the misperception most students, parents and others have about career choices in manufacturing. It also will allow local manufacturers to showcase their facilities and help students understand the skills they will need to be successful in various types of manufacturing careers.

The idea for Discover Manufacturing Today – Video Challenge began when members of the Manufacturers Council realized they wanted to step in and help the next generation of West Michigan's workforce.

"The misperceptions around manufacturing are keeping students from considering it for a career," said **Jay Dunwell**, chair- fastest growing sectors in West Michigan."

Teams will interview a manufacturer and explore the high-tech nature of modern manufacturing, and discuss the skills that employers seek. Students also will learn about the challenges faced by businesses as they search for skilled workers, and to gain an understanding of what they can do to develop the required skills.

"West Michigan is proving that manufacturing will lead again in our region," said **Birgit Klohs**, president and CEO of The Right Place. "The demand for skilled manufacturers is ever present and we encourage current and future generations to keep an open mind when thinking about a career in manufacturing."

Area businesses such as Amway are supporting the Video Challenge. Other businesses that have seen the value in changing the current misperceptions are the local manufacturers themselves. Several companies have volunteered to mentor and partner with the students to create the videos and share insight into their growing businesses, including: ADAC Automotive, Davidson Plyforms, Wolverine Coil Spring, Flexco, GR Spring and Stamping, Autocam, Terryberry and Rapid-Line.

Deadline for video entries is 5 p.m., Feb. 27. For more information visit www.discover-manufacturing.com.

Videos will be judged by the Manufacturers Council followed by a screening premiere on April 16 at Celebration Cinema, where attendees will watch the winning videos on a big screen in the theater. The public will be able to participate as certain prizes will be awarded to teams based on the

and US Airways would be the world's largest airline.

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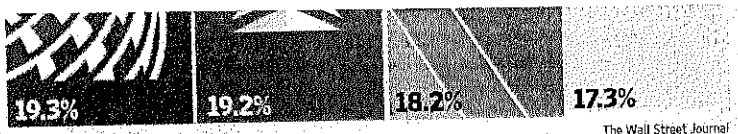



*Southwest includes subsidiary AirTran Airways.
Source: Innovata LLC

The Wall Street Journal

earnings before interest, taxes, depreciation and amortization. He said that with those titles removed the value of the company's magazine assets would be between $2.4 and $2.9 billion.

Time Inc. has struggled in the past several years amid an indus-

opinion on its own.

News that Time Warner was exploring a Time Inc. deal was reported earlier Wednesday by its own Fortune magazine.

The deal talks come as the broader magazine industry, like

*Please turn to the next page*

Wall St. Journal

# Paid By a Federal Grant, Workers Played Board Games

By Ryan Tracy

WASHINGTON—The Obama administration's electric car efforts took another hit on Wednesday after a federal inspection found a South Korean advanced battery maker never scaled up U.S. production despite receiving $142 million in federal grants.

A Holland, Mich., factory owned by **LG Chem Ltd.**, part of **LG** Corp., was half-funded by a government grant and estimated to add some 440 jobs building battery cells for **General Motors** Co.'s Chevrolet Volt and other vehicles.

When demand for the plant's batteries didn't meet expectations, the company filled orders with cells made at a factory in South Korea, leaving the Michigan plant largely idle, according to the report by the Department of Energy's Inspector General, Gregory Friedman.

LG Chem said in a statement that production delays at the Michigan facility were "market-driven," adding that it is "developing specific plans for the start of production." The company said it regretted that it applied for reimbursement for "employment costs that were not allowed" under its U.S. grant.

The inspector general said that to avoid layoffs at the factory LG Chem paid idle workers $1.6 million in the third quarter of last year, about half of which was covered by its U.S. grant, even though there was nothing for them to do. The workers played board games, watched movies, and volunteered at local animal shelters during regular work hours, Mr. Friedman said. LG Chem has since paid back the government's share of those charges.

"Until the shift in production takes place or some alternative use for the plant is developed, U.S. taxpayers will receive little direct benefit from a plant for which they provided up to half of the funding," Mr. Friedman said in his report.

In 2010, Mr. Obama attended the plant's groundbreaking and said such grants would "unleash private sector growth" and called the factory "a symbol of where America is going." The facility today has about 150 workers, some of whom are hourly employees and are furloughed one week a month.

LG Chem is the latest of several recipients of federal funds, including solar panel maker

Solyndra LLC, that haven't panned out. Solyndra filed for bankruptcy in 2011. The inspection report on the Electric Drive Vehicle Battery and Component Manufacturing Initiative grant came a day after President Barack Obama lauded U.S. efforts to invest in alternative energy.

"Four years ago, other countries dominated the clean energy market and the jobs that came with it. And we've begun to change that," Mr. Obama said in Tuesday's State of the Union address.

The DOE initiative that funded LG Chem's factory in total provided about $2 billion in grants to more than two dozen companies building advanced batters and other components for hybrid and electric cars.

Another recipient, **A123 Systems** Inc., got about $250 million in federal funds for plants in Michigan. It filed for bankruptcy in October and its automotive assets have been sold to a Chinese auto-parts firm. The new owner is expected to continue operating in the U.S.

The Department of Energy's deputy assistant secretary in charge of the grant program, Kathleen Hogan, said in a written response to Wednesday's report that the funding for LG Chem was part of an effort to "continue to grow the manufacturing sector in the United States." She said the electric vehicle industry "hasn't grown quite as quickly as expected," but will become "an enormously valuable and growing market."

Mr. Friedman's report said that while LG Chem had said it planned to move battery production to Michigan from South Korea, there was no explicit requirement for it to do so in order to receive federal funds. The company built three of five planned production lines, but underestimated labor costs—apparently unaware of a requirement that it pay prevailing wages—and no longer has enough grant money to complete production.

*—Jeff Bennett contributed to this article.*

Mich support of Lithium Tech Industry Summit???

# Euro's Gain Brings Corporate Pain as Exports Suffer

By Deborah Ball

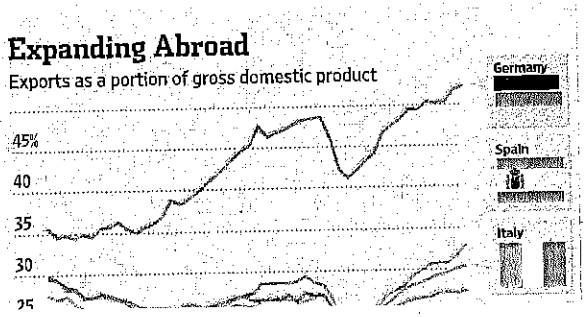
The euro's recent strength is dimming a rare bright spot for European companies: exports.

With their home markets locked in a protracted downturn, European companies over the past few years have sought relief abroad. Exports have soared, making up 35% of national output in Spain pean companies are squirming. A stronger currency makes a country's exports more expensive abroad—and thus less competitive—and reduces profit when it is brought back home.

The pain from the euro's gain has been spread unevenly, exposing a divide in which German companies are better able to adjust than those in France and Italy. Companies with the option will raise prices or cut costs. euro's rise, which has climbed as the Continent's economy has stabilized and fears have receded that its common currency would break up. Officials from the Group of 20 nations are expected to discuss what some label a burgeoning currency war when they meet in Moscow at the end of the week.

Northeast Italy's **Veneta Cucine** SpA highlights the bind for southern European companies. market-research experts to serve clients that order thousands of kitchens. The company also has slashed costs. But the strong euro is eroding that hard work, hurting Veneta Cucine's sales.

"We have worked a lot on our cost structure," said owner Denise Archiutti. "But we suffer from this lack of competitiveness in Italy, from our financing costs, to our cost of labor here. It penalizes us a lot."



Lithium Battery??



MARKETPLA

Getty Images

Super Bowl Draws Third-Biggest Audience

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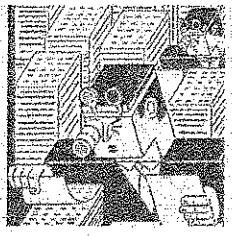

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THE WALL STREET JOURNAL.

# 787 Fires Still a Mystery

*Investigators Struggle to Discern Root Cause of Dreamliner's Burning Batteries*

By Andy Pasztor
And Jon Ostrower

Despite talk of progress, investigators still don't know what caused the dangerous Dreamliner mishaps.

As the probe of burning batteries aboard **Boeing** Co.'s 787 jets stretches into its second month, an international team of air-accident sleuths remains stumped about the underlying cause, according to people familiar with the details.

This has fueled pessimism about how quickly the planes can resume flying. Still, federal aviation regulators are leaning toward approving flight tests, perhaps within the next few days, say people familiar with the matter.

Investigative activity remains intense, and a breakthrough could still come. But in the past few days, industry and government officials familiar with the probes on both sides of the Pacific have stressed the lack of progress. At a recent Department of Transportation briefing, according to one of these officials, government experts acknowledged "they may not be any closer to identifying root cause than they were" at the start of the National Transportation Safety Board's high-profile investigation.

After painstakingly dissecting a number of batteries, examining associated electronic parts, and analyzing information from flight-data records, NTSB experts and their Japanese counterparts haven't been able to pinpoint any specific component, automated subsystem or software application that appears to offer hope of finding answers.

With no apparent, clear-cut theory, investigators are now delving into additional parts of the plane's electrical grid. They also are seeking help from technical experts outside the aviation industry, including scientists and electronics engineers from the U.S. Navy and Department of Energy.

Meanwhile, Boeing said it "has submitted an application to conduct test flights and it is currently under evaluation by the FAA." A spokeswoman for the Federal Aviation Administration confirmed Monday that the request is under review.

The initial probe began Jan. 7 after a lithium-ion battery aboard a **Japan Airlines** Co. 787 parked at Boston's Logan International Airport ruptured and burst into flames. Nine days later, an **All Nippon Airways** Co. Dreamliner on a domestic flight made an emergency landing and evacuation due to an overheating battery, prompting swift worldwide grounding of Boeing's flagship jets.

Initially, some involved with the investigation hoped finding a solution might take mere days. Now airlines and others are bracing for a delay that could stretch additional weeks, or even months. Barring a breakthrough, some pessimists predict that designing and installing a new battery system could take as long as a year.

**United Continental Holdings** Inc. has slotted in other planes for its 787 routes through late February, and Japan Airlines has

*Please turn to the next page*

Brazil: The Social Media Capital of the Universe

Logos and Brands

RPORATE NEWS

# on Brands Up

## ·ships Under One Name Nationally

ıtoNation name would appear by June on most of its dealerships.

me change to customers in Florida and other markets. ; will drill it into people's " says AutoNation Presi- Mike Maroone, whose fam- nded the South Florida ship group that was one of ation's first acquisitions. aroone says he long advo- the switch to one brand. Nation isn't putting its on its luxury dealerships. will do business under ; like Mercedes-Benz of auderdale.)

oNation's chief marketing ; Greg Revelle, hired from website Expedia.com, says vantages of using a single will multiply over the long With 15 names, he says,

manage inventory and set vehicle prices across the company.

Mr. Jackson—and AutoNation's largest shareholder, financier Edward S. Lampert's **ESL Investments**, Inc.—are betting the "coast to coast" retail chain approach will click with consumers who use the Internet to gather information and are less tolerant of the type of sales tactics that Mr. Jackson compares to "a game of three-card Monte on 42nd Street."

Mr. Jackson's competitors, including rival dealer groups such as **Group 1 Automotive** Inc. and **Penske Automotive Group** Inc., have pointedly not done away with long-established local dealership names they acquired.

AutoNation's Mr. Jackson told

# *Dreamliner Probe Teams Are Baffled*

*Continued from the prior page*

postponed the start—originally scheduled for the end of this month—of a new Tokyo-to-Helsinki route using the Dreamliner.

A spokeswoman for NTSB on Friday said "our investigators are moving swiftly and we are making progress," but she declined to elaborate. The FAA's press office also declined to comment.

The NTSB has said it found short-circuits and evidence of uncontrolled overheating inside the fire-ravaged battery of the Japan Airlines 787. But what they still can't decipher is cause and effect.

"The short circuit, the fire, these are all symptoms that something is wrong," Deborah Hersman, the safety board's chairman, told reporters late last month. "These events should not happen as far as [the] design of the airplane."

Boeing has assigned hundreds of its own technical staff to work with the loosely coordinated U.S. and Japanese probes. The company's efforts using simulators to recreate battery-system malfunctions on the ground haven't provided significant new leads, according to one person close to the effort. Analysis of battery operating trends before the planes were grounded hasn't yielded major findings either, according to others closely tracking that data.

Boeing spokesman Marc Birtel says the company is "working

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34% of sales. The company, based in Matthews, N.C., attributed the pinched margins, in part, to clothing and other nonessential products that didn't sell during the holidays.

The sharp consumer pullback leading up to the holidays intensified competition as retailers across the board slashed prices to attract shoppers. Customers seemed to be hanging on to their money as long as they could, buying only when they absolutely had to, Dollar General Chief Executive Rick Dreiling told investors in December.

"It's as if there are more days than there are dollars" for these shoppers, Mr. Dreiling said.

Dollar General's same-store sales increased 4% in the third quarter ended Nov. 2, compared with a 6% increase a year ago. The Goodlettsville, Tenn., company said margins might be pressured in the current quarter as it advertises more and lowers prices on some food and household items to spur sales. The chain also said it would start selling cigarettes this year, which it said could pinch gross profit margins.

The company declined to comment on whether dollar stores' expansion plans are contributing to softer results.

Dollar Tree, based in Chesapeake, Va., expects sales to be flat to up mid-single digits in the current quarter compared with a 7.3% rise a year ago. The company reports fiscal fourth-quarter results Feb. 27.

"We continue to see long-term opportunities for sustained, profitable growth," said Timothy Reid, vice president of investor relations at Dollar Tree.

tingency plans, according to people familiar with those options. One possible interim fix Boeing engineers have considered would place the 63-pound battery inside a containment box that would both protect nearby equipment and vent smoke overboard in the event of a failure, according to one person familiar with the proposal.

Boeing faces an uphill battle to get such a system approved, however, because federal investigators have sketched out a zero-tolerance approach when it comes to aircraft fires. So far, FAA officials have balked at engaging in any detailed discussions of potential interim fixes, according to people familiar with the matter, until experts succeed in recreating battery malfunctions under laboratory conditions.

If the probes linger and pressure builds to get the planes back in the air, regulatory precedent could work in Boeing's favor. FAA safety rules account for fan blades of a jet engine possibly failing under extremely rare circumstances, but the casing that surrounds the front of the engine must contain all internal parts that break off without damaging the rest of the aircraft.

Regulators' consideration of approving flight tests highlights the lack of progress so far from various ground testing, according to people familiar with the matter. The flight tests, these people said, are basically intended to recreate certain conditions to help explain what happened to make the battery-systems go haywire. The anticipated green light for testing won't affect the current status of passenger flights.

The flight-test request was initially reported by the Seattle Times.

# elp From State Banks

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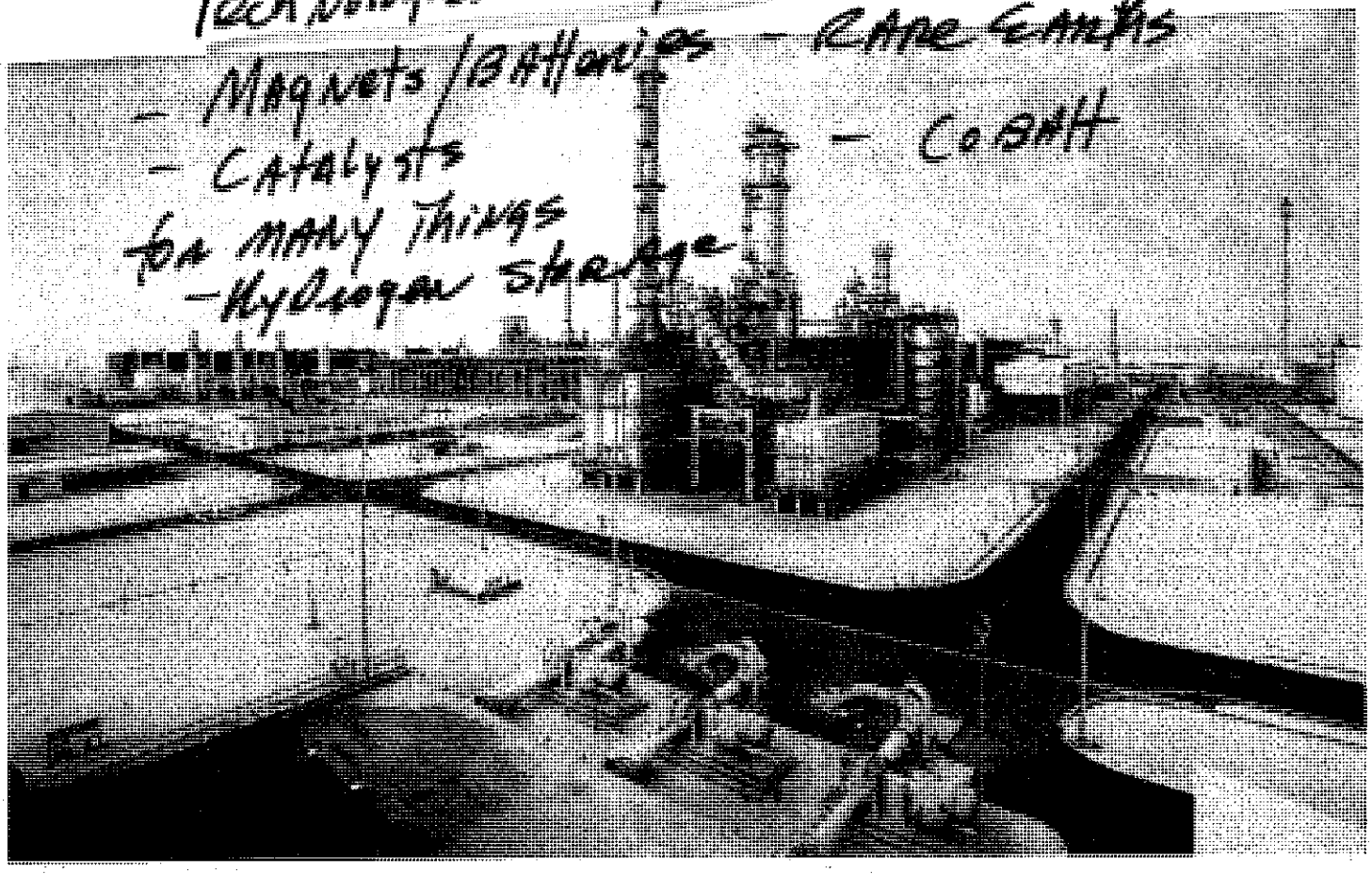
firms combined, according to data from the local government, although even in the good years the company's tax bill was dwarfed by what it received in government subsidies, according to the com-

remain uncertain. In the first half of 2012 it received orders for two new ships with a combined contract value of $55.6 million, down from 24 ships in the same period a year earlier

Great Western Technologies – Troy, Mich
– Magnets/Batteries – Rare Earths
– Catalysts – Cobalt
for many things
– Hydrogen storage



The refinery in Qatar where natural gas is turned into clean-burning liquid fuels and chemical products. The company plans a similar plar

# A Big, and Risky, Energy Bet

## Wagering $14 Billion That 1920s Technology Is Ready to Turn a Profit

By JOHN M. BRODER and CLIFFORD KRAUSS

RAS LAFFAN INDUSTRIAL CITY, Qatar — The compact assembly of towers, tubes and tanks that make up the Oryx natural gas processing plant is almost lost in a vast petrochemical complex that rises here like a hazy mirage from a vast ocean of sand.

But what is occurring at Oryx is a particular kind of alchemy that has tantalized scientists for nearly a century with prospects of transforming the energy landscape. Sasol, a chemical and synthetic fuels company based in South Africa, is converting natural gas to diesel fuel using a variation of a technology developed by German scientists in the 1920s.

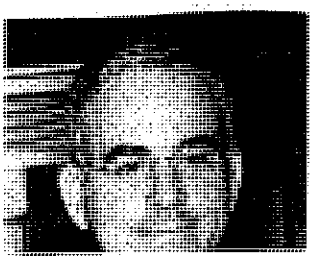
Performing such chemical wizardry is exceedingly costly. But executives at Sasol and a partner, Qatar's state-owned oil company, are betting that natural gas, which is abundant here, will become the dominant global fuel source over the next 50 years, oil will become scarcer and more expensive and global demand for transport fuels will gr

Sasol executives say the compa strongly in the promise of this techn month, it announced plans to spend u to build the first gas-to-liquids plant States, in Louisiana, supported by mo lion in state incentives. A shale drillin region in the last five years has proc cheap gas, and the executives say Sas supply to make diesel and other refin competitive prices.

Marjo Louw, president of Sasol Q his company can produce diesel fu

Continued on Page 11

# 2 Ex-Hedge Fund Traders Are Found Guilty in Insider Tradi



By PETER LATTMAN and WILLIAM ALDEN

Two former hedge fund managers were found guilty on Monday of fraud and conspiracy, the latest convictions in the government's campaign to eliminate illegal conduct on Wall Street trading floors.

After two full days of deliberations, a jury convicted Anthony Chiasson, a co-founder of Level Global Investors, and Todd Newman, a former portfolio manager at Diamondback Capital Management. The

Both Mr. Chiasson and Mr faced as the jury foreman anno dict. After it was read, Mr. Nev chair; Mr. Chiasson stared blan Sullivan, the judge presiding ov tencing for April 19. Until then, t

Reid H. Weingarten, a law 39, said his client would appeal. lawyer for Mr. Newman, 48, decl

Juries in Federal District

# Big, and Risky, Bet on Profits in Turning Natural Gas to Liquid Fuels

*From First Business Page*

cleaner, costs less and creates less greenhouse gas pollution than fuel derived from crude oil.

"We believe the planets are aligned for G.T.L.," Mr. Louw said during a recent tour of the Oryx plant. "Other players — much bigger players — will follow."

Perhaps. So far, however, the record for converting gas to liquids is spotty.

The newest and largest plant in operation, Royal Dutch Shell's giant Pearl plant, also in Qatar, cost the leviathan sum of $19 billion, more than three times its original projected cost, and has been plagued with unexpected maintenance problems. BP and ConocoPhillips built and briefly operated demonstration plants in Alaska and Oklahoma, but stopped short of full development of the technology. Exxon Mobil and ConocoPhillips announced plans to build giant plants in Qatar, but backed out, putting their capital instead into terminals to export liquefied natural gas.

Today only a handful of gas-to-liquids plants operate commercially, in Malaysia, South Africa and Qatar. Together they produce only a bit more than 200,000 barrels of fuels and lubricants a day — equivalent to less than 1 percent of global diesel demand.

"The reason you see so few G.T.L. plants is the economics are challenged at best," said William M. Colton, Exxon Mobil's vice president of corporate strategic planning. "We do not see it being a relevant source of fuels over the next 20 years."

Many analysts and industry insiders say the technology makes sense only when oil and gas supplies and prices are far out of balance, as they are today in Qatar and the United States. When oil and gas come into alignment, gas-to-liquids ventures will become white elephants, these skeptics say. Environmentalists also say that the huge energy inputs required to transform natural gas into diesel or other fuels negate any greenhouse gas benefits.

Until recently, the method used to convert natural gas or coal to liquid fuel — known as the Fischer-Tropsch process after the Germans who invented it — had been used only by pariah nations desperate for transportation fuels when they had little or no oil available. For decades, South Africa defended its system of apartheid from international oil embargoes by producing synthetic oil from its rich coal resources. Nazi Germany did the same to fuel its military machine in World War II.

But with North Africa and the Middle East chronically unstable and natural gas cheap and plentiful in the United States, some say the technology is now an enticing option to produce various fuels without importing a drop of oil.

Shell may soon announce a tentative site for a gas-to-liquids plant on the Gulf Coast of the United States. Given what the company learned from its Qatar plant, executives say it would reduce costs in any new one by using different types of valves and alloys.

But Ken Lawrence, Shell's vice president for investor relations in North America, said the company was still two years away from a final decision on an American plant.

That leaves Sasol in the forefront of the gas-to-liquids effort.

Sasol is building a gas-to-liquids plant in Uzbekistan with the Malaysian oil company Petronas. It is working with Chevron to build another plant in Nigeria. The company says that a plan to build a plant in Canada has been shelved until after the Louisiana project, which could cost $11 billion to $14 billion, the largest single investment proposed in the state.

"It can be a game-changer," David Constable, Sasol's chief executive, said in an interview. He said the United States was a logical place for gas-to-liquids to take off because of the availability of cheap gas, the proximity of large markets and the availability of trained labor, modern industrial shops and friendly state governments along the Gulf Coast.

The American plant will build on knowledge the company acquired at the Oryx plant in Qatar.

The heart of the Oryx plant is a pair of 164-foot reactor towers that contain a patented system for transforming purified natural gas into so-called long-chain carbon compounds that can be refined into liquid fuels.

"Gas bubbles up through a cobalt slurry bed, and out comes the good stuff — the sellable products," said Etienne Rademeyer, chief operations officer at the Oryx plant.

The process is challenging and complex. First a synthetic gas is made from pure oxygen and methane, the main component of natural gas, which is cleansed of sulfur, metals and other impurities, under intense pressure and heat. Then the synthetic gas is put in giant reactors that make a synthetic crude through the Fischer-Tropsch process. The process essentially forces heated synthetic gas to react with a catalyst, typically cobalt, to convert into a liquid hydrocarbon. Finally that liquid is refined into one fuel or another.

The process is far more complex than that at a typical refinery, so the plant is much more expensive to build and operate. Alfred Luaces, a refining specialist at the consultancy IHS, said a conventional oil refinery could be built for $50,000 per barrel of capacity, less than half of what Sasol says it is willing to spend on the proposed Louisiana plant.

The plant here is a maze of refining towers, reactors, evaporators, pipes and storage tanks. It employs about 120 workers from more than 30 countries to produce about 32,000 barrels of liquid fuel a day, less than a third of the amount it hopes to produce in Louisiana.

Rick Manner, a vice president at consultancy KBC Advanced Technologies who has contributed to gas-to-liquids studies for Sasol and other companies, estimated that the projects must keep capital costs at $100,000 for every barrel a day of production capacity to be worthwhile economically at current prices of about $100 a barrel for oil and $4 per thousand cubic feet for natural gas.

By that formula, Shell needed to cap costs at its plant in Qatar, which can make up to 140,000 barrels a day, at $14 billion. Instead, the project has cost at least $19 billion, which suggests that it will need a sustained crude price of about $125 a barrel, or lower natural gas prices, to be economic, Mr. Manner said. "There's not a big future in it," he said.

Shell executives said they could make money in Qatar, though they would not be more specific except to estimate that the Pearl plant, including its adjoining liquefied natural gas facility, can generate $4 billion in annual cash flow from operations at an oil price of $70 a barrel, which determines at what price the refined products can be sold. "It's a good solid project," said Marvin E. Odum, president of Shell Oil Company. "We're very pleased with it."

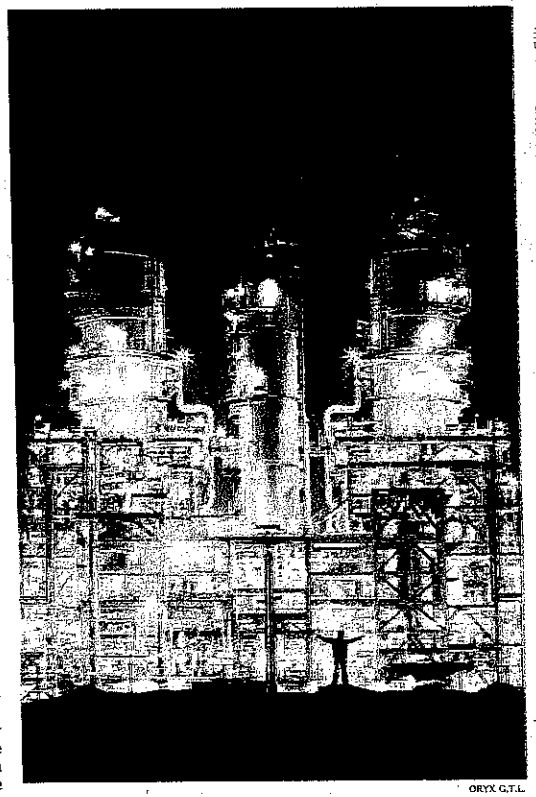
Mr. Louw, Sasol's Qatar president, said that the Oryx plant was designed to be profitable with oil at $25 a barrel. That implies a very low long-term price for the natural gas feedstock. He would not specify what Sasol pays its Qatari partner for gas, but he said it was "not zero."

Outside gas-rich Qatar, natural gas and diesel prices can be unpredictable, and if enough companies build gas-to-liquids plants or find other uses for natural gas, gas prices could rise with demand.

And environmental concerns exist. A 2008 Carnegie Mellon study estimated that plants in Qatar and Malaysia produced fuels that generated 20 to 25 percent more carbon emissions than conventional petroleum-based liquid fuels because the production process consumed so much energy.

"We're not talking about an environmental solution to the carbon problem," said Simon Mui, a scientist at the Natural Resources Defense Council. "G.T.L. will likely make the problem worse, unless the industry adopts effective safeguards on drilling and additional pollution controls on these refineries. Those are big ifs."

*John M. Broder reported from Ras Laffan Industrial City, Qatar, and Clifford Krauss from Houston.*



ORYX G.T.L.

The Sasol plant in Qatar makes 32,000 barrels of liquid fuels daily. Experts say the economics of the process are challenged.

JOHN BRODER/THE NEW YORK TIMES

Marjo Louw, the president of Sasol Qatar, at its Oryx gas-to-liquids complex in Ras Laffan Industrial City, Qatar.

**Chemical wizardry turns natural gas to diesel fuel, but not inexpensively.**

**'We believe the planets are aligned' for gas-to-liquid, a Sasol official said.**

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## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Art Plefka (Do not speak) SC

**Affiliation (if any):** _____

**Phone:** 231-894-2428

**Email:** aplewka-2000@yahoo.com

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. X **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

# Michigan Energy Forum 2013

I'll begin by addressing Energy Efficiency Question #7 by way of describing my home. I'm pleased to tell you that it is highly efficient. It uses a direct gain solar approach. Insulated window quilts reduce heat loss at night. Super insulation and thermal mass in the floor and around the wood stove create a warm living space without blowers or pumps. A tankless heater efficiently supplies endless hot water. I should mention here that the only one I could find was made in Japan. This unique home was built thirty years ago and these applications have paid for themselves many times over. My home has a very small carbon footprint which has helped protect our Great Lakes and resulted in cleaner and healthier air as well.

So why is this home still so unique? Obviously, the systems described are exceedingly simple. However, it takes science and political will to promote energy efficiency. The energy tax credit program that I took advantage of was discontinued. Over the ensuing years there have been sporadic efforts made to pay lip service to green technology. Unfortunately,much of our technological expertise and the jobs it created moved to China and Germany in order to find a consistent market supported by forward looking government policies.

This fact gets at Renewable Energy Question #13. Consider also that Michigan is falling behind the thirty or so states that have stronger renewable energy goals than we have. The Michigan Public Services Commission reports that investments in renewable energy have touched communities all around the state. I'm proud to say that one of the largest, if still not the largest, in the state is the solar array at Torresen Marine in Muskegon County. The jobs created during this project were much needed. Unfortunately, the company running the project was from Chicago,the installer was an Indiana firm and the Schuten solar panels are made in Germany, a country with fewer sunny days than we average here in Michigan.

The Michigan Public Services Commission supports my belief that we should have more in state participants on such projects from top to bottom. Their report states, "Michigan has the potential to become a regional leader in the development and manufacturing of renewable energy systems, building on the state's engineering expertise, modernized machining, and investment in renewable energy in coming years".

Not only will a strong renewable energy program create new jobs but it will help wean us off of our dependence on coal. I was surprised to learn that despite our advantageous location for wind generated power we still generate nearly 60% of our electricity from coal, all of which must be imported from other states; a decision that drains some $1.7 billion a year from our economy.

Though I myself am retired, like many parents I have a personal stake in an expanding green job market. I'm encouraged to learn that this sector added over 20,000 new jobs and that its $5 billion in annual economic activity could be a significant part of a brighter economic future. A future that could provide an avenue for my son and daughter, who left to find jobs, to return to Michigan. A future that helps protect this planet which we borrow from our grandchildren.

My vision of Michigan's energy future is not clouded because of technological challenges. We continue to produce the same type of talented, creative professionals that we've always been known for. The political part of the picture will come into focus when we see the results of this process. In the meantime, I have a growing confidence that the voters in this state are getting a clearer and clearer vision of what their elected officials truly value, not by listening to what they say but by watching what they do.

Art Plewka
(231) 894-2428
aplewka_2000@yahoo.com
Topic: b
Time: < 5 minutes

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STATE OF MICHIGAN

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MICHIGAN PUBLIC SERVICE COMMISSION
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MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Colleen Plummer

**Affiliation (if any):** P.O.W.E.R. – C.A.R.R.E. of Mason County

**Phone:** 616-402-1205

**Email:** Protia@yahoo.com

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ✓ Other Additional Energy Topic

(Please specify): Community exclusion – Lack of Oversite

**Requested time to speak:** ____ < 5 minutes ____ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

Good Afternoon to you too!
Appreciate your timely response to the deficit of speaking opportunities at this past Monday's meeting at Grand Valley. Over all, I found that meeting to be very good. Many varied ideas & possibilities for Michigan's Energy future.The meetings are an excellent idea IF the information is truly used to achieve a "responsible cutting edge"solution & not just benefiting a particular segment of our business community/people. We need to be leaders again! I've been to many hearings/meetings commissioned by the State of Michigan in the past 6 yrs.I was also at all of the meetings that the wind energy facilitator Scandia Wind presented.Somebody isn't doing there homework.When the lake-based turbine issue arose three years, two presentations were given. Venues were high school theaters.Capacity of 200+. each. Full-No standing room. Senator Hansen can attest to this. That was only the lake based issue. A venue in a rural area. At your meeting it was mentioned that they only had a few people show for the meeting in Lansing. Not surprising, that is where the big ideas come from. They do not have to live daily with all of their own laws they impost. I noticed the venues that are near to recent, potential and pending wind factory parks drawing hundreds of people. Please secure a proper venue for future presentations? Your opportunities to speak were handled poorly. People who signed almost an hour before the program began were left out. A woman, a college professor fresh off a European trip, fact finding mission on alternative energy was left out. Why? I too was screened out of the process, tho a woman I walked in with & had signed just before me to speak, was one of the first 20 speakers? She was from Grand Rapids. You had a meeting a week ago in Lansing, 45 minutes from Grand Rapids. Why are these venues so close? Why did I notice Holland, Muskegon and Grand Rapids speakers given preferential treatment over those who have to drive long distances because we never have a venue placed in or near our community?Muskegon would be a reasonable compromise. Were good enough to host the blight and the ill heath effects, but forgotten after the fact? What kind of government does that? I was 20 minutes late for the meeting. Why? I attempted to park in 4 parking lots with signs that read parking for staff, students and visitors. After entering the four, we had to take time to leave with traffic and lights impeding us. I did learned from that! Finally ended up at a lot under the expressway parking illegally due to 0 parking spaces left.Being in business for the past 34 yrs. I understand one can plan but sometimes it just doesn't work. I appreciate that. But, if people are paying attention you should know and understand the seriousness of this issue and the passion that accompanies it. I will take advantage of submitting information on this website, but something most metro people are missing is this.Citizens, living with Lansings grand ideas, planning OUR future in the rural communities need to understand the negative impact of their decisions.The very people who are using the energy & those making the components etc for the chosen energies need to hear us. I had that opportunity taken, as did the college professor. We have been ridiculed, our businesses targeted, attacked in the media & on the internet. Why? For asking for better setbacks in Mason County to ensure our basic health safety and welfare that you and others take for granted? We wanted the same or greater setbacks that the the turbine manufacturer Vesta set in their own safety manual to ensure the safety of their employees.(taken off-line once they knew we had it) Our lives have less value than their employees? Before you move forward you must understand the past & correct any mistakes if there are any. Who doesn't want a cleaner planet? But, disrespecting the health safety & welfare of those affected & dividing communities is a problem. If something has to be put in an area where people live then buy them out. What is being done to date is just dishonest and cruel. WE are the unintended collateral damage of Lansings ideas. WE are being ignored. Might seem like strong accusations, but true.We taped the truth. Collusion, conflict of interest, to many to mention here. On that I will close. I do appreciate the efforts of Gov. Snyder.They have greatly improved over Granholms past stacked meeting and skewed presentations. May we have a state that protects the health safety and welfare of ALL Michigan residents?Thank you..

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MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Charles Rop

**Affiliation (if any):** University of Toledo

**Phone:** 616 7060516

**Email:** Crop@utoledo.edu

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ✓ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): Industrial Wind Turbines have no place in MI

**Requested time to speak:** ✓ < 5 minutes ___ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

I left a Letter at the welcome center. If it is misplaced, please email.

2/25/2013
3086 Belle Meadow Dr.
Byron Center, MI 49315 Crop@utoledo.edu

Governor Snyder and Michigan Public Service Commission Chairmen Quackenbush and Bakkal
RE: Governor's Energy Forum, GVSU, Grand Rapids, MI

Dear Governor Snyder,
Thank you for requesting public comments on Michigan's energy future. I talked to you during your election campaign in Grand Haven about the exemplary Pure Michigan Campaign that focuses on our 17.7billion dollar tourist industry and preserving and protecting our natural world.

Especially in the 21st century, we need to learn from our history and remember white pine forests, open spaces, and pristine wetlands destroyed through hubris and greed. I am a passionate supporter of wise and cutting-edge alternative energy sources. But rushing ahead unwisely can be extremely dangerous and can have long-lasting negative affects on our quality of life, our natural environment, and perhaps especially our increasingly important blue water economy that gives Pure Michigan meaning.

I was ambivalent about large wind turbines until about two years ago. I saw them as interesting and rather elegant. I still think they are appropriate in the right places. Now, after reading the science and much of the related scholarship, I have come to the conclusion that placing industrial wind farms in Michigan is unwise and short-sighted.

Tourists come to our state to fly fish, relax on the beach, hike our trails, ski, sail blue water, visit sleepy harbor towns, enjoy our remaining open spaces and watch world-class sunrises and sunsets. They will not come more than once if our horizons are cluttered with lights of industrial machines, our morning peace disturbed by fog warning devices and our special sleepy tourist towns cluttered with industrial facilities and the infrastructure supporting giant machines.

The following is a brief list of well-known problems with large, industrial-scale wind facilities on land and in water. The empirical scientific evidence for these problems is becoming clearer and more convincing every day. For the sake of brevity, I provide only a small sample of important references here. Scholarly literature reviews that are complete, accurate, objective, and can withstand the test of rigorous peer review are especially useful and reliable. Studies funded by vested interests or personal bias are not included here and should not be considered.

1) Industrial wind turbines harm property values.

A recent study by Heintzelman & Tuttle (2011) of 11,369 property transactions over 9 years in Northern New York explored the effects of wind facilities on property values. The authors state that "wind facilities significantly reduce property values"(p.2) and that a home 0.5 miles away results in a 10.87%-17.77% decline in sales price and "At a distance of 1 mile we see declines in value of between 7.73% and 14.87% (p.26).

2) Industrial wind turbines harm human health and peace of mind.

Pierpont (2009) discovered "Wind Turbine Syndrome," the result of relentless low frequency noise from turbines. In addition, Carmen & Horner (2011) recently reviewed the relevant literature and concluded that "no further (wind) projects should be approved in proximity to humans until human health studies are conducted to determine setbacks and noise levels that will ensure the health and welfare of all exposed individuals."(2). These researchers conclude that "Studies that do not pose a risk of adverse health effects in humans are scientifically incorrect"(11)

"Acknowledged adverse health effects include: annoyance, stress, sleep disturbance, headache, tinnitus, ear pressure, dizziness, vertigo, nausea, visual blurring, tachycardia, irritability, problems with concentration and memory, and panic episodes associated with sensations of internal pulsation or quivering when awake or asleep. Other adverse impacts include reduced well-being, degraded living conditions, and adverse societal and economic impacts. These adverse impacts culminate in expressions of a loss of fairness and social justice." (11)

3) Industrial wind turbines pose significant environmental harm.

Any "green" alternative energy source must do more good than harm and all industries, utilities, and individuals must be held accountable under the law. Relevant laws include the Endangered Species Act, Migratory Bird Treaty Act, the Bald and the Golden Eagle Protection Act (FWS White Paper, 2008). I believe that following the law must not be voluntary.

*Birds*

Simple high-school geometry shows wind turbine blades travel more than 200 miles per hour at their ends even with moderate winds. This makes them bird-killing machines. The National Research Council, and The Fish and Wildlife Service state that "large numbers" of birds are killed by wind turbines. Eagles and other raptors are especially vulnerable. Michigan is in the middle of the Mississippi Flyway, one of the world's most important migratory bird pathways.

The American Bird Conservancy has a very good position statement on wind development. Please see: http://www.abcbirds.org/abcprograms/policy/collisions/wind_farms.html

No one actually knows how many birds are being killed in Michigan by large wind machines now in operation. No further development of turbines should be allowed until we know.

*Bats and other mammals*:

The American Society of Mammalogists issued a strong position statement on industrial wind turbines. They claim that entire populations of already stressed and endangered bats might be eliminated if turbines are placed improperly. In Michigan, Indiana bat (Miotis sodalist) is a federally protected endangered species. The evening bat (Nycticeius humeralis) is also at risk. Bats are already in extreme pressure already by disease, pesticides and other environmental threats. Bats are vital for insect control and are important contributors to the food web. We can't sacrifice them for short-term gains of industrial energy development.

In addition to killing bats, wind "farms" or "parks" fragment Habitat by clear cutting, road building and installation of infrastructure. Mammals, snakes and other wildlife abandon areas where turbines are installed. Clear cutting kills endangered and protected plants.

*Invasive species*

Especially off shore in our Great Lakes, large wind machine development would be disastrous. These large machines would require unimagimable amounts of concrete in their foundations. These foundations will encourage growth of invasives such as gobies, quagga mussels, and invasive plants. The foundations of these large machines will effect the ecology of the lakes in ways we can't imagine.

*Fish*

There is evidence that low frequency sound and under-water transmission lines will releasing electromagnetic energy will affect the behavior of fish, especially migratory fish like the endangered lake sturgeon (Gannon, 2006).

*Conclusion*

We must wean ourselves from our dependency on coal. However, there are much more elegant solutions than large wind machines in Michigan that will actually benefit residents, tourists, and our natural environment. No solution should be funded by hubris and greed. The environmental benefits of any solution must far outweigh the costs.

I challenge Governor Snyder to make Michigan a leader and national example in wise alternative energy solutions. The technology is here and new technologies are being developed every day. We can learn how. We just need the will and a little imagination.

Thank you for considering this. Please do not hesitate to contact me for further discussion.
Charles J. Rop, Ph.D.

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MEMORANDUM

TO: Interested Persons ~

FROM: Terry Black, proje~ b~r
Michigan Electricity bptions S udy

SUBJECT: Michigan Electricity Options Study (MEOS) Reports

On October 22, 1987 the results of the Michigan Electricity Options Study (MEOS) were released. The Study examined the cost, contribution and other key characteristics of a wide range of options and option combinations to meet electricity needs under various future demand scenarios.

Attached for your information is a complete list of the reports prepared in conjunction with the Study. These reports are available at the cost of printing and mailing, and multiple copies can be ordered.

## A. Summary of the MEOS Project

Unprecedented in its broad scope and cooperative nature, the ME OS Project involved about 200 participants from more than 90 organizations--electric utility companies, commercial and industrial users, business associations,
environmental organizations, universities, consumer groups and state government. All of the major stakeholders in our electricity system helped both to frame the Study and to assure that its results were credible, useful and reasonably balanced. That participants were able to agree on so much is a tribute to the strength of their commitment to producing the data and tools required to assure a least-cost, reliable power supply for Michigan's future.

Among the Study's more important contributions to rutur e electric resource planning are the following:

- It provides for the first time a comprehensive description of Michigan's existing electricity system, current electricity usage, major supply- and demand-side options, and analyses of resource alternatives under various constraints and assumptions about the future.

- It indicates the major economic and environmental consequences of choosing different resource strategies for meeting future needs.

- It shows that the capital investments and total economic costs of different resource strategies will vary by hundreds of millions of dollars by the year 2005.

- It demonstrates that the costs of electric resource options can vary from as little as one-half cent per kilowatt-hour of electricity generated (or saved) to over ten cents per killowatt-hour, with the least expensive options being conservation and efficiency, cogeneration, refurbishment of existing plants and power purchases.

- It shows that extending the Ii ves of current generating plants could provide over 4,400 megawatts of capacity over the next 20 years (the equivalent of 6-8 new, medium-size power plants), cogeneration and renewable fuels could provide over 800 megawatts of capacity, and conservation and load management programs could provide over 2,000 megawatts of capacity equivalency.

- It suggests that average electricity rates in the Detroit Edison/Consumers Power region could be reduced by more than 20 percent during the next two decades (in real, non-inflated dollars) under current assumptions about demand growth and future fuel prices.

- And, it provides the basic information, analyses and tools needed by electric utilities and business customers to make cost-effective electric resource decisions for the future.

## Guide to MEOS Reports

Three levels of detail are presented in the various MEOS reports. Overviews of study results are presented in the Executive Summary and Final Report. The Executive Summary covers the Study's principal conclusions and highlights of key information about the options studied and scenarios analyzed. The Final Report contains more details of the options studied, the scenario analyses, and the study's methods and tools. It also summarizes the results of the six MEOS Work Groups' analyses.

The second level of detail is presented in the six Work Group reports which cover the information gathered, analyses performed and conclusions reached by each of the Work Groups. These reports also contain the principal results of the work of the various consultants that were contracted to undertake detailed analytical studies for the Work Groups.

The third level of detail includes the contractor/consultant reports. These reports are the most detailed and technical, and they tend to be highly specific in focus.

In considering which reports may be useful, it is important to realize that some of the same information is covered at each type of report. If you are uncertain as to the level of detail in which you may be interested, it may be
useful to start with the more general--the Final Report--followed by Work Group reports and then the contractor reports.

# Preface

Early in 1984 the Michigan Department of Commerce's Energy Administration (EA) was asked by Governor James Blanchard to assist public policy makers in analyzing future electric power needs and options. After reviewing the information available at that time, the EA concluded (1) that Michigan had many options for meeting future power needs, (2) that the costs of various options differed significantly, and (3) that Michigan's primary focus should shift from determining exactly when new capacity will be needed to what is the least expensive ~ to provide that capacity at a given level of reliability.

The July 1984 EA report clearly documented the need for comprehensive integrated resource assessment in Michigan. Making such assessments requires the development of a quantitative modeling structure that will accommodate the various demand- and supply-side data needed for comparing resource options. In addition, it requires a relatively comprehensive cost analysis of Michigan's resource alternatives. Thus, the EA report recommended that a detailed study be performed by the Department of Commerce in cooperation with utility companies, customer groups and other stakeholders regarding the feasibility, cost and long-term economics of the various options for meeting Michigan's future electric power needs.

In 1985, at the direction of the Governor, the Commerce Department invited the input and cooperation of all the major electricity stakeholders in framing a comprehensive study of resource options. As a result, the Michigan Electricity Options Study (MEOS) was initiated to generate the information and analyses required to assist utility planners, state regulators and other interested parties in making economically sound judgments regarding the potential contribution of various resource options for meeting Michigan's uncertain electricity needs over the next 20 years.

Given the scope of the Study, it was necessary to divide the work among six working groups.

Work Group # I examined options for improving the existing generating, transmission and distribution system and for extending the life of existing power plants.

Work Group #2 examined the potential for demand management options, including peak load management and energy efficiency and conservation alternatives.

Work Group #3 investigated the potential for non-utility power production, including cogeneration and alternative fuels.

Work Group #4 examined new utility power plant options and alternative options for completing Midland.

Work Group #5 prepared a series of baseline electricity peak load and sales estimates for use by the Work Groups and Project Management in developing MEOS demand and sales growth assumptions. And,

Work Group #6 served Project Management in a technical advisory role with principal responsibility for developing project-wide assumptions, assisting with the integration of the results produced by other Work Groups, and coordinating the modeling work needed to develop the integrated resource analysis portion of the Study.

A management consultant, ICF Incorporated, was hired to help coordinate the overall Study effort, resolve technical problems, and assist with the integration of the final results through the development and use of an Integrated Planning Model (IPM). Several other contractors were employed to assist the various Work Groups, providing needed expertise and additional resources to complete the work in a timely and efficient manner.

As part of the broader MEOS effort, this Work Group Report is designed to provide important information for utility planners, customer groups, state regulators and other electricity stakeholders. It is written for readers who are interested in the information, assumptions and analyses underlying the integrated analysis framework used in the MEOS for analyzing electricity resource options available to meet Michigan's future electricity needs.

# Figure 1-1
# Michigan Electricity Options Study Approach

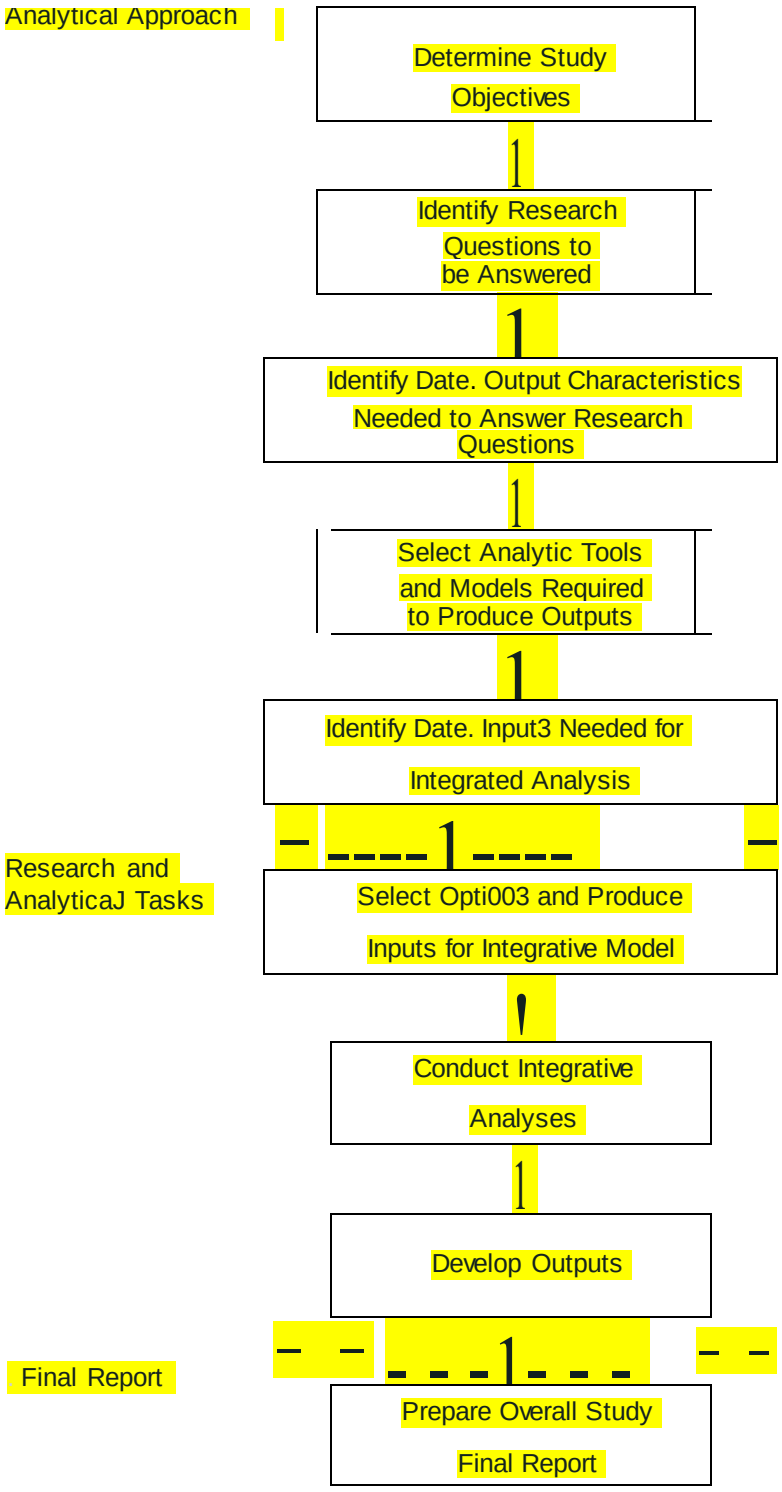


Table 1-1: Work Group #6 Work Tasks

Tasks

Assessment Phase

| | |
|---|---|
| 1. Prepare a list of tasks and time table for Work Group #6. | Work Plan Subgroup |
| 2. Review and assess existing planning approaches, methods and models that might be available to analyze the options, their costs and ability to satisfy the anticipated range of demand. | |
| 3. Propose research questions to be answered by the study and recommend parameters (scope) and criteria for screening options to analyze. | Work Group #6 |
| 4. Request from each Work Group a list of the key characteristics for each option, plus the assumptions and input variables needed to complete their respective analyses. Request reporting format ideas from other Work Groups. | Models Subgroup and Work Group # |
| 5. Assist with the preparation of "a description of the information (or output variables) needed to answer research questions. | Work Group #6 |
| 6. Review the integrated planning tools, models and methods proposed to be selected and/or developed to produce the information (or output variables) needed to answer the research questions. | Models Subgroup and Work Group :: |
| 7. Evaluate and advise Project Management on the assumptions and data proposed by reF to be used in the models to produce the information (or output variables) needed. | Models Subgroup and Work Group :: |
| 8. Advise Project consultant on modifying methods and models as needed. | Work Group #6 |
| 9. Review proposed model modifications and modified models. | Models Subgroup<br>Models Subgroup |

Table 1-1 Continued

Tasks

Assessment Phase

10. Review and advise Project Management regarding the preliminary data compiled by Work Groups and rCF for preliminary test.

11. Assist rCF in performing a preliminary integration test.

12. Assist Project Management in developing an approach to environmental cost assessment.

Research Phase

13. Review revisions of the integrated models and data, and advise Project Management regarding quality of products.

Integration Phase

14. Advise rCF regard~ng integrated analyses and review preliminary work products.

Recommendation Phase

15. Assist in the formulation of recommendations and review draft reports prepared by Project Management

Final Review Phase

16. Review proposed Final Report to Advisory Committee.

17. Review documentation prepared by rCF on tools, models, methods and data for future use.

Models Subgroup

Models Subgroup

Environmental
Subgroup

Models Subgroup

Work Group ~6

Work Group ~6

Work Group #6

Work Group ~S

Also, in its early efforts to assist in developing the scope and overall research structure of the Study, the Work Group was instrumental in developing research questions and identifying the analytical tasks that needed to be completed to answer the research questions. (See Table 1-2, Proposed Research Questions.)
The proposed research questions were divided into three categories:

- Analysis of Options by Work Groups #1-#4
- Electricity Demand by Work Group #5
- Integration Analysis by Work Group #6

2. **Assumptions Development**

While Work Group #5 and Project Management were primarily responsible for developing the economic, electric sales, demand, financial and fuel price assumptions, Work Group #6 provided review and recommendations to Project Management regarding those assumptions. Work Group #6 also provided the environmental and regulatory assumptions used by the Work Groups *in* their options analysis.

At Project Management's request, rather than establishing an electric sales and demand forecast per se, the Work Group reached agreement on two reference demand scenarios=Cases A and B, for both demand and sales. The reference cases took into account preliminary Work Group #5 sector projections, as well as other forecasts of Michigan electricity demand in formulating its assumptions. In addition, the integrated planning analysis provided for wide-ranging sensitivity analyses to be conducted for each of the cases. (See Chapter III for further details of Work Group #6's role in the development of key assumptions.)

Since the principal objective of the Study was to develop and illustrate applications Of integrative planning tools, a demand scenario approach was considered the most appropriate one to pursue. This would avert a potentially controversial, protracted and expensive effort to produce a forecast. It was generally felt by both Project Management and Work Group #6 that better project resource allocation would result from this decision.

3. **Inter-Work Group Consistency**

The membership structure of Work Group #6 was helpful in assuring that inter-Work Group consistency was achieved. Each of the Work Group Coordinators was a member of this Work Group, and therefore, Feedback to and from each of the Work Groups was facilitated by the Coordinators.

Some of the Work Group #6 activities were directly related to the consistency effort. Early in the Project, the Work Group's Models Subgroup developed a set of screening criteria, which provided each Work Group with guidelines on which options to study. This provided some consistency in deciding how options were to be culled out for detailed consideration (See Figure 1-2, Criteria For Screening Options.)

The Work Group also assisted Project Management by reviewing each of the Work Groups' Final Report Executive Summaries during the final phase of the Study.

Table I-2: Michigan Electricity Options Study
Proposed Research Questions

**Analysis of Options by Work Groups #1- #4**

1. What criteria should be used to determine which resource options are to be analyzed? (first-level screening)

2. What are the technical and achievable potential contributions of each option? (kW, kWh, availability profile)

3. What will be the owning and operating costs for each resource option? (cents/kWh, dollars/kW)

4. What is the time schedule for achieving the achievable potential?

5. What are the other key characteristics and impacts (environmental, societal, legal, regulatory, etc.) of each option that cannot be stated in dollar terms?

6. What will affect the key characteristics of each option?

7. What are the uncertainty and probability distributions of the key characteristics of each option?

8. How can the uncertainty of key characteristics be reduced or mitigated through risk management strategies?

**Electricity Demand by Work Group #5**

1. What is the likely range of electrical energy (kWh) and peak demand (kW) needs and resulting load shapes for each year from 1985-2005?

2. How is electricity used by end-use?

3. Wha t are the impacts of electricity and fuel prices and economic growth on electrical energy, peak demand and load shapes?

4. What are the likelihoods (probability distributions) of electrical energy, peak demand and load shape forecasts?

**Integration Analysis bv Work Group #6 and Project Management**

1. What criteria should be used to determine which options are to be evaluated? (second-level screening)

2. What criteria should be sued to determine which combinations of options are to be evaluated? (third-level screening)

3. What are the owning and operating costs for each option and each option combination for each demand scenario?

**Table 1-2 Continued**

4. What are the quantifiable environmental, societal, legal, regulatory and other costs of each option and each option combination for each demand scenario? (both total dollars and cents/kWh and dollars/kW)

5. What are the non-quantifiable key characteristics and impacts (environmental, societal, legal, regulatory, etc.) of each option and for each option combination for each demand scenario?

6. What is the price of electricity for each option combination for each demand scenario?

7. What are the uncertainties and probability distributions of the key characteristics of each option and option combination for each demand scenario?

8. How will each combination of options perform with respect to risk management strategies to reduce or mitigate the uncertainty of key characteristics.

9. What combinations of options are "most desirable" based on both the quantifiable and non-quantifiable costs of each option for each demand scenario? (fourth-level screening)

10. What implementation strategies would be required and appropriate to achieve each desirable combination of options?

11. What is the economic impact of "over" or "under" providing electricity resource options?

Figure 1-2

## MICHIGAN ELECTRICITY OPTIONS STUDY
## CRITERIA FOR SCREENING OPTIONS

### Firs~-Level Screening Criteria by WG's #1-Q4

Which Options to Study

(P~ss/Fail)

1. Minimum potential contributions in kW and kWh .•
2. Technology is commercially available by 1987.
3. Maximum cost per kW and per kWh .•
4. Likely to meet or can achieve current regulatory standards.

### Second-Level Screening Criteria by WG 06 & PH

Which Options to Evaluate (Pass/Fail)

1. Minimum potential contributions in kW and kWh.
2. ~4Ximum costs per kW and per kwh.
3. Meets or can achieve current regulatory standards.

### Third-Level Screening Criteria by ~G U6 & PH

Which Option Combinations to Evaluate

1. Balances supply and demand (energy and peak) with specified levels of reliability.
2. Cost per kW and per kWh.
3. Meets specified environmental and regulatory performance standards.

*Levels to be determined by each work group.

# II. Model Development and Implementation

A. Model Development

Assisting in the selection of an "Integrated Planning Model" was a function assigned to Work Group #6. Project Management, with Work Group #6's advice, was responsible for defining the type of model that would best serve the goals of the MEOS Project. It was determined that part of this process should be to conduct a preliminary review of a number of available planning models, in order to provide the Work Group with a basis for making a recommendation on model selection and to begin the education of those members of Work Group #6 who were not experts in the field of modeling. The Work Group identified planning models used by the following entities for review: the Northwest Power Planning Council, Bonneville Power Administration, Electric Power Research Institute, Detroit Edison, Consumers Power, Virginia Public Service Commission, the State of California and the State of Wisconsin.

It was agreed that the model(s) chosen should incorporate the following characteristics: flexibility, ease of use, and the ability to develop both near-term and long-term cost projections. Because of the complexity and importance of the modeling responsibilities, Work Group #6 established the Models Subgroup.
The initial function of the Subgroup was to review the available planning models and make recommendations to Work Group #6 as to which would best meet the needs of the Project.

Preliminary work of the Models Subgroup involved the review of a number of models, including:

- "HELM," a load/resource model used to examine end-use by sector.
- "WASP," a production costing model developed for the International Atomic Energy Agency. WASP (Wein Automatic System Planning Model) can be used to find the optimal generation expansion policy for an electric system.
- EPRI's "Over/Under Capacity Planning Model," a model that performs risk analysis in conjunction with system analysis. It considers demand uncertainty, measures trade-offs between having adequate/Inadequate energy and determines construction programs yielding minimum total cost to the customer.
- EPRI's "LMSTM," a load management strategy testing model:
- "OGP-FSP," Optimum Generation Planning--Financial Simulation Program developed by General Electric, a capacity planning model which uses a linear programming approach. The Financial Simulation Program is a simplified corporate model which uses the output from OGP to generate financial statements.
- "MAREL," Multi-Area Reliability Computer Program, a model which estimates generation system reliability on an interconnected system.

- "PROMOD," a production costing program which was developed by Energy Management Associates. PROMOD uses an equivalent load approach to estimate the generation dispatch and resulting fuel and production costs.

- "PROJANAL," a model developed by Detroit Edison which provides levelized bus bar costs for proposed generating units.

The selection of ICF as Project Consultant in October 1985 accelerated the model selection process. Preliminary model review work by the Models Subgroup, reflecting the ideas and thoughts behind the model selection process, was embodied in the MEOS "Draft Model Primer." This document, combined with continued input from the Subgroup, provided Work Group #6 with the necessary information to make a final recommendation on model selection.

ICF and the Models Subgroup defined the MEOS Project requirements which needed to be met by the planning model chosen. The key requirement of the modeling framework for MEOS was that "production costing" and "resource planning" be incorporated into the model. The model would need to consider the variable costs of a full range of electricity options, along with plant and transmission system operating characteristics and constraints (availability of generation units and transmission equipment, minimum turndown and demand-side option performance), in determining the least-cost dispatch which would meet projected load requirements, i.e., a "production costing" model. However, the model would also need to consider the full costs (capital and other fixed costs, as well as the variable costs) of new electricity resource options in making capacity planning or demand-side decisions to satisfy future load requirements, i.e., a "resource planning" model.

Decisions to add new utility capacity, demand-side management options or non-utility supply options to the system have to be made in tandem with present and future dispatching decisions. Capacity 'planning decisions also have to be made based on the expected demand for electricity and the available options for meeting capacity requirements over time. Dispatching decisions depend on the hourly demand for electricity and conversely on the resource option decisions made. Ideally, the modeling framework should not only integrate the alternative electricity options and scenario assumptions being developed by the Work Groups, but also integrate "resource option" and "production costing" considerations as well.

The types of models available to meet the requirements of the MEOS Project as set forth by the subgroup and ICF were then reviewed. Models cannot be easily characterized as a certain type or in a specific category because they are often hybrid in nature, using different decision rules and structures within the same model. However, there are certain general model types or attributes which are useful characterizations:

Optimization Models--These are models which are specifically designed to determine a "best" solution or solutions (in the sense of a minimum or maximum of some objective function) given a specific objective or set of objectives and a set of solution constraints. Generally, an objective function is expressed as an equation to minimize costs or maximize revenues. In the case of electricity resource planning, an optimization model would develop a "least-cost" electricity plan subject to a detailed set of cost and financial assumptions, environmental and other constraints. Optimization models which reflect standard engineering or economic relationships use a long series of linear equations that serve as constraints. For example, total electricity generation from all power plants or other resource options less distribution losses would be required to equal sales demand (less imported power). All of these equations are solved simultaneously to determine a "least-cost" solution.

Optimization models are very suitable for problems in which decisions are based on economic, financial or other analytical relationships. They are less suitable when behavior cannot be explained on the basis of economic or other statistical relationships. They also require a great deal of data and information in order to solve problems accurately, and they can take a great deal of computation time.

2. Simulation Models--differ from optimization models in that rather than determining a "least-cost" or "best" solution given a long series of economic and engineering relationships, these models solve to meet a limited set of conditions or requirements with a large portion of the decisions regarding resource options and future events already predetermined and treated as specific inputs to the model. In the case of electricity option considerations, a simulation model might operate or dispatch an electricity power system subject to a fixed capacity expansion or resource plan with a given set of dispatch rules specified by the user. Generally, many, if not all, of the resource decisions are specified by the user in a simulation model.

Simulation models are suitable when relationships are so complex that analytical solutions are not possible or practical, or when "least-cost" behavior, other financial rules or statistical relationships do not apply. They also provide detailed outputs with much less computation time. Simulation models are often used in very large scale macroeconomic forecasting efforts. However, they usually do not provide least-cost economic solutions, which are extremely useful to policy makers or managers wanting to explore the implications of specific policies, regulations or financing restrictions on the types of strategies to be pursued.

3. Large-Scale Integrated Models--are models which are really several models or modules linked together. These models are used to satisfy several objectives and they provide very different types of outputs. Benefit-cost models are examples of large-scale integrated models which measure benefit and cost outputs separately and in some cases try to optimize on both criteria. The models can be "optimization" or "simulation," or structured as a combination of both. Various modules can also be simple accounting models. That *is,* outputs are based on simple relationships between forecast variables and outputs. For example, sulfur *dioxide* emissions might simply be equal to a factor such as an emissions rate times forecast fuel consumption.

A number of resource planning models were reviewed that were available and potentially useful in providing an integrated analytical framework for evaluating alternative resource decisions. These models differed across a number of attributes, some more important than others. The major component of an integrated modeling framework is the resource planning component. The structure, approach and sophistication of this model is most important when comparing models. Most of the other models are ancillary to the major functions of the integrated framework, typically providing information to report writers or preprocessors of data.

Executive Summary--Environmental Subgroup of Work Group #6
Environmental Assessment of Electricity Resource Options
Michigan Electricity Options Study

October 1987

A key component of MEOS was to determine the environmental output levels, impacts and, for one case study the financial costs of selected electricity resource options' environmental characteristics (e.g., S02 emissions). It was the goal of the environmental assessment to assist with the MEOS integrative analysis of resource options through environmental data collection and environmental analysis of both the individual options and the option scenarios.

An Environmental Subgroup of Work Group #6 was formed to assist in meeting this goal. The Subgroup was comprised of representatives from the Public Service Commission, utilities, environmental advocates and the Michigan Department of Natural Resources.

The Subgroup undertook five separate tasks:

1. Review the environmental data provided by the Work Groups on each resource option for validity, consistency and reasonableness.

2. Provide an approach to incorporating environmental assessment into the MEOS analytical framework, including methodology development.

3. Identify key environmental characteristics and output levels not covered by the Work Groups for selected stages of electricity production or demand modification.

4. Assess the environmental impacts of the electricity resource options analyzed by the Work Groups and the MEOS resource scenarios.

5. Evaluate and recommend methods of environmental cost assessment (dollar valuation) and provide an example to test the methodology.

Efforts on each of these tasks resulted in three major accomplishments. First, the data base on the environmental characteristics of electricity resource options in Michigan is the most comprehensive compiled to date. Second, methodologies have been developed which provide a first step towards reaching the goal of providing decision-makers and the public with understandable information to assess some of the environmental consequences of particular courses of action. Finally, major issues
of environmental concern and analysis with respect to electricity generation and conservation have been identified and consolidated to provide a focus for future research needs.

## Key Parameters and Limitations

Key parameters were established in the initiation of this effort which provided a focus for the research. These key parameters also limited the scope of analysis undertaken.

The first of these parameters was to focus data collection only on environmental characteristics that have impacts within the geographic boundaries of Michigan and that occur at the point of conversion for the different technologies--i.e., the on-site characteristics of either the conversion of energy into electricity or the conservation of electricity (including the waste disposal of on-site by-products). Second, environmental characteristics have been collected for normal operation of the electricity options. Accidental or unusual discharges or other characteristics were not included. Third, the MEOS analysis was generic in nature and did not include site-specific factors (such as the effects of water discharges on the receiving environment)--important in assessing environmental impacts of particular courses of action.

As a result of these decisions regarding the focus of this initial assessment, the MEOS environmental analysis has a number of limitations. First, the characteristics provided and analysis conducted is heavily oriented towards air emissions and, to a lesser extent, solid waste. Second, because site-specific factors were not included and because of the difficulty of capturing the environmental effects of demand-side and dispersed options, the data on environmental characteristics across technology options is neither equivalent nor complete.

Third, neither the environmental assessment nor the general MEOS effort attempted to incorporate a net energy balance approach to determining the effects of resource extraction and conversion or resource depletion.

And, finally, time, resources and the state of current knowledge did not permit a full economic valuation of all the environmental characteristics for all the resource options so that a full comparison of societal costs could be made.

**Findings**

1. The reliance on life extension of existing utility power plants for meeting a substantial portion of future capacity addition needs (4,400 MW over the analysis period) will result in the maintenance of current emission values. The Integrated Planning Model (IPM) sensitivity run which excluded life extension as an option resulted in emission reductions in the ranges of 22 percent for S02' II percent for $NO_x$' 8 percent for TSP and 4 percent solid waste reductions in 2005, but increased cumulative capital investment requirements of almost 37 percent and increased the net present value of 20 years' annualized costs from the base case by 7 percent.
2. The calculated relationship of S02 and $NO_x$ emissions to deposition on receptors yielded four primary results. First, the major receptor of Michigan emissions is Michigan. Second, the major source of emissions received by Ontario is Ontario. Third, Michigan has been contributing a significant part (20 percent) of its own sulfur deposition but relatively little (4 percent) of the deposition in the critical areas of the Northeast (New York and southern Ontario). Fourth, a new coal-fired plant (700 MW, 70 percent capacity factor, 10,000 Btu/kWh, 0.6 lbs. S02/MMBtu)
satisfying NSPS requirements will add very little to the existing Michigan and New York/Southern Ontario sulfate deposition patterns, (0.19 percent and 0.04 percent, respectively).

3. In the higher demand growth _ sensitivity case for the Broad Options Scenario, air emissions in 2005 will increase from 1985 levels by 135,000 tons (25 percent) for S02' 144,600 tons (42 percent) for $NO_x$ and 7,000 tons (28 percent) for TSP. Air emissions will generally have increased back to pre-1980 levels by 2005. Only the Reduced Environmental Impact Scenario is able to hold down sulfur dioxide emission levels during the 1985-2005 period. In the high demand (Case A doubled) sensitivity runs for all scenarios, there is a substantial increase in solid waste generation by
2005, ranging from 2.3 to 3.9 million tons per year, or approximately 23 to 39 percent of the current total for the state's solid waste generation.

4. At the lower demand growth (Case B) cases of the IPM runs, the increases in environmental outputs are small under all scenarios. Furthermore, scenarios that promote renewable and conservation options are more effective in reducing environmental outputs when load growth is low. This occurs because, at the higher growth rates, these resources reach saturation levels before supply and demand are matched. At the lower growth rates, the relative contribution of demand-side options to the additional capacity needs is higher.

5. There is no change in indoor air quality in any of the scenarios because no retrofit weatherization was selected. If, however, in future iterations of the IPM such retrofits are selected, the weatherization of existing electrically-heated homes in Michigan will have impacts (small, but not negligible) on indoor air quality and human health if control technologies, such as air-to-air heat exchangers, are not employed. However, only 5 percent of Michigan homes are heated electrically at the present time, and it is expected that relatively few new homes will be heated with electricity.

6. Initial assessments indicate that outdoor air, water and land pollution resulting from manufacture of weatherization materials is negligible compared to the environmental effects of generating the displaced power from conventional sources.

7. Michigan's production of carbon dioxide through the combustion of foss il fuels to generate electricity is about 3.1 percent of the U.S. total carbon dioxide production from such combustion. By comparison, Michigan's population is 3.7 percent of the U.S. total population.

Recommenda tions

While the initial MEOS environmental assessment resulted in some important findings and accomplishments, it should be viewed as only a beginn ing. As such, the following recommendations have been compiled by the Environmental Subgroup to provide focus and direction to future efforts.

1. Data collection on the environmental characteristics of electricity options should be expanded for future resource assessments in order to more adequately detail the outputs associated with all the technology options--supply-side, demand-side and dispersed.

2. Continue to develop methodologies which can incorporate site-specific characteristics into a generic planning model. Specifically, incorporate a generic site characteristics in the data collection of technology options and, when data are available, establish a computer model which maintains the flexibility to incorporate new or different (a) electricity options, (b) design, operating and environmental characteristics, (c) resources at risk, and (d) impacts.

3. Develop a simple methodology to attribute the environmental characteristics of demand-side and dispersed options to that portion of the option related to electrical generation or conservation.

4. Develop a method by which important parameters of electrical production or conservation (i.e., net energy balance, manufacturing of equipment, fuel cycle impacts, accidental discharges) can be fairly accounted for in the environmental assessment of electricity resource options. This method would need to include consideration of the regional percentage of production, the boundaries for such an expanded analysis, and the application of this analysis to the technologies being examined and the integrated analysis of MEOS.

5. Continue to utilize the IPM to determine the amount of emission reduction achieved through the selection of alternative options and the retrofitting of existing resources, and the cost of such alternatives.

6. Research on the correlation between emissions, acidic deposition, and health and ecosystem impacts should continue to be examined. When such data become available and applicable, the correlations should be quantified to provide a better measure of the value received for making emission reductions.

7. Although an economic valuation methodology for environmental characteristics/impacts was developed and sample calculations were modeled, there was insufficient agreement on the data and data economic values to permit an analysis of cost impacts. Such a methodology would be useful in providing more detailed comparisons of specific courses of action--information that is not available through the identification and quantification of option environmental characteristics. However, additional research, discussion and, finally, agreement on the data and data economic values must occur in order for the methodology to be useful in integrated resource planning.

# PREFACE

Early in 1984 the Michigan Department of Commerce's Energy Administration (EA) was asked by Governor James J. Blanchard to assist public policy makers in analyzing Michigan's future electric power needs and options. After reviewing the information available at that time, the EA concluded (1) that Michigan had many supply- and demand-side options for meeting future power needs, (2) that the costs of various resource options differed significantly, and (3) that Michigan's primary focus should shift from determining exactly when new capacity would be needed to what is the least expensive way to meet electricity needs at a given level of reliability.

The 1984 EA report clearly documented the need for a comprehensive and integrated approach to resource assessment in Michigan. Making such assessments requires the development of a quantitative analytic structure that takes account of the extensive data and assumptions needed for comparing resource options. In addition, it requires a relatively comprehensive technology and cost analysis of Michigan's resource alternatives. Thus, the EA report recommended that a detailed study be performed by the Department of Commerce in cooperation with utility companies, customer groups and other stakeholders regarding the feasibility, costs and long-term economics of the various options for meeting Michigan's future electric power needs.

In 1985, at the Governor's direction, the Commerce Department invited the participation of Michigan's major electricity stakeholders in framing a comprehensive study of resource options. As a result, the Michigan Electricity Options Study (MEOS) was initiated to generate the information and analyses required to assist utility planners, state regulators and other interested parties in making economically sound judgments regarding the potential contribution of various resource options for meeting Michigan's uncertain electricity needs over the next 20 years.

The MEOS initiative is a joint private and public sector research effort to identify and analyze the costs and potential contributions of the major demand-side and supply-side electric resource options available to Michigan. It also represents a cooperative effort to strengthen and broaden Michigan's electric resource planning capabilities. Unprecedented in its broad scope and cooperative nature, the Study has involved nearly 200 participants from over 90 organizations, including state government, electric utility companies, commercial and industrial users, business associations, universities, environmental organizations, and consumer and other interest groups.

While representatives of numerous agencies, organizations and companies participated in this study and helped to frame its approach, the assumptions, conclusions, findings, and recommendations do not represent the official positions of any of the participants. Project assumptions and, ultimately, its findings, conclusions and recommendations, reflect substantial agreement but not full consensus among project participants.

# I. INTRODUCTION TO THE MEOS PROJECT

The 1984 Energy Administration study of Michigan's future electricity needs and options reflected broad public concerns regarding the costs and availability of competitive power supply in the 1990's and beyond. In response to the Study, Governor Blanchard initiated an effort to ensure an adequate, reliable, and cost-effective future electricity supply for the state. One of the major components of the initiative was completion of a comprehensive assessment of available electricity resource options. This report presents the findings of the Michigan Electricity Options Study (MEOS), which was initiated in the spring of 1985 to accomplish that assessment.

## MAJOR PROJECT GOALS

The MEOS represents a cooperative effort to strengthen and broaden electric resource planning capabilities in Michigan. Its primary purpose was to develop and make available for use within the state the tools and expertise required to perform integrated assessments of electricity resource options. **Integrated assessment** means the analysis and comparison of the planning trade-offs related to a wide range of resource options based upon consideration of a variety of important option characteristics. These characteristics include cost, potential (for reducing electric demand or increasing generation capacity), reliability, environmental impacts, and socioeconomic effects. **Resource options** means devices or equipment used to generate or transmit electricity to utility customers, devices or equipment used by businesses or individuals to generate electricity for their own needs, and conservation and load management programs sponsored by utilities or government agencies which increase the efficiency or change the patterns of electricity use by customers.

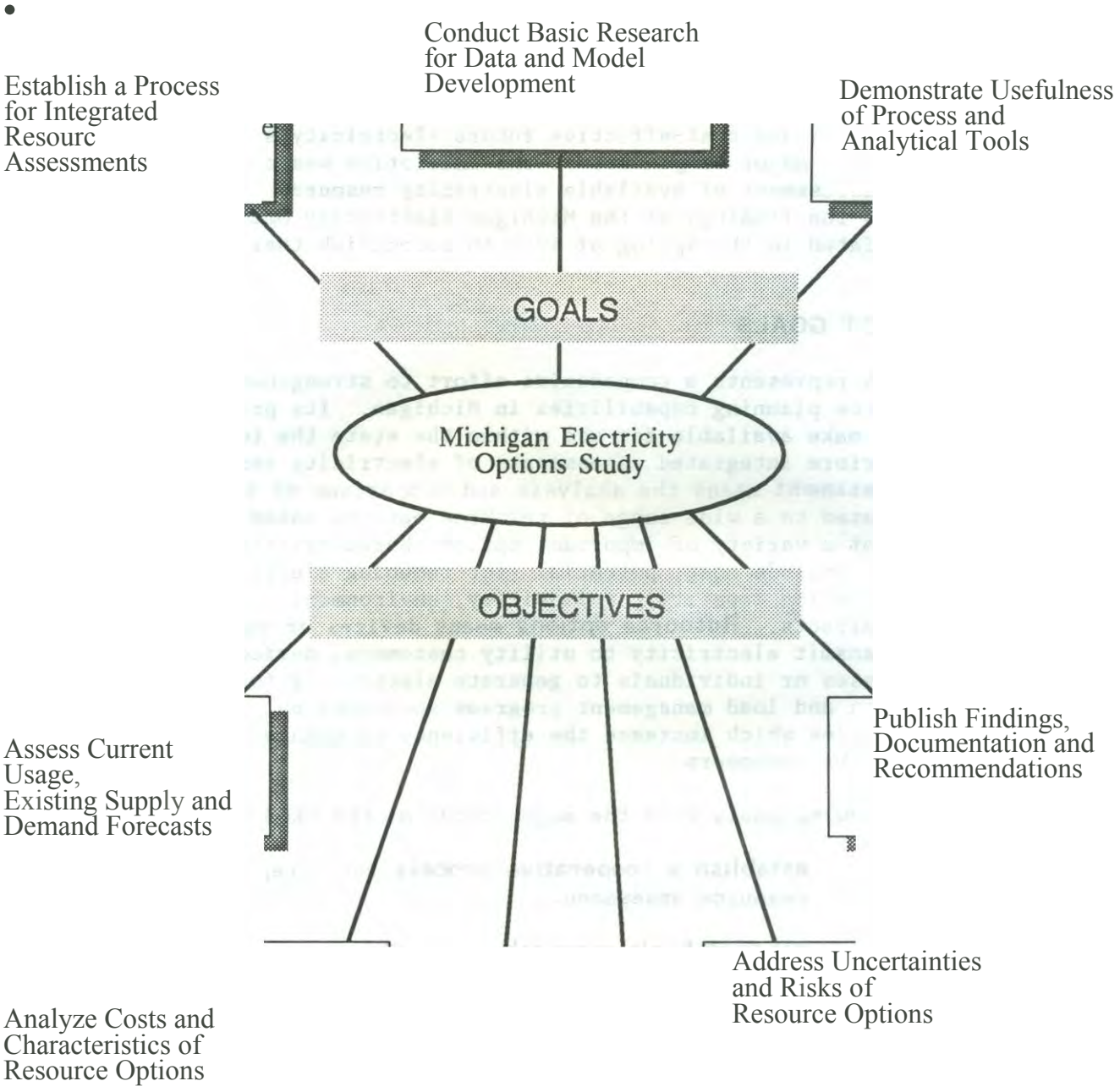
The following goals were the major focus of the MEOS Project:

- **establish a cooperative process** for integrated resource assessment,
- **conduct basic research** to develop essential data and models, and
- **demonstrate the usefulness** of the integrative process, data and models in planning to meet Michigan's future electricity needs.

**Establishing a cooperative process** for integrated resource assessment was important because it permitted the project to draw upon the knowledge, skills and perspectives of many different organizations and individuals who have a stake in Michigan's electricity future. An important product of the process has been the interactions and communications among the parties and the education of all participants about the concerns of other stakeholders in utility planning. In addition, a framework was developed which can be used to provide objective analyses of and insights about utility planning issues.

Figure 1

# Major Project Goals and Objectives



**Basic research** was conducted to provide the data, methods and models required to make the analytic framework useful. Alternative methods and models designed to perform cost and technology assessments were reviewed, and the tools best suited to Michigan and its perspective on electricity planning were selected. Data was gathered and assumptions were developed to provide inputs for the methods and models. Because the data bases necessary to perform comprehensive resource assessment were not available within the state, a substantial portion of the in-kind and monetary resources devoted to MEOS was allocated to data development. Although significant progress was made in this area, project resource and time limitations prevented the development of all of the information needed for a totally comprehensive assessment of option characteristics and impacts.

The other major goal of MEOS was to **demonstrate the usefulness** of the process, data and models to perform integrated resource assessments under a variety of assumptions and different planning perspectives. Resource scenarios were developed for analysis to illustrate the quality of the project's information and analytic techniques, as well as to provide insights regarding the relative costs, potential contributions, environmental impacts, and risks associated with various options and option combinations. The results of this demonstration could be used to develop resource planning strategies for the state and to set a research agenda for improving and refining the assessment process.

## PROJECT OBJECTIVES

The project's basic goals gave rise to six specific objectives:

(1) assess the state's current electricity usage, existing power supply system, and forecasts of future electricity demand;

(2) analyze the costs and other characteristics of resource options now available to Michigan;

(3) develop a "least-cost" approach to resource assessment;

(4) examine the trade-offs between minimizing costs and meeting other important planning objectives;

(5) address the uncertainties and risks associated with alternative planning decisions; and

(6) make MEOS information and tools available to parties interested in the utility planning process.

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# Readying Michigan to Make Good Energy Decisions

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**If you wish to speak today, please complete the following:**

**Name:** KRAIG SCHULTZ

**Affiliation (if any):** COMMUNITY OF GRAND HAVEN, MI

**Phone:** (616) 540-7027

**Email:** KRAIG@SCHULTZENGINEERING.US

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

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**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

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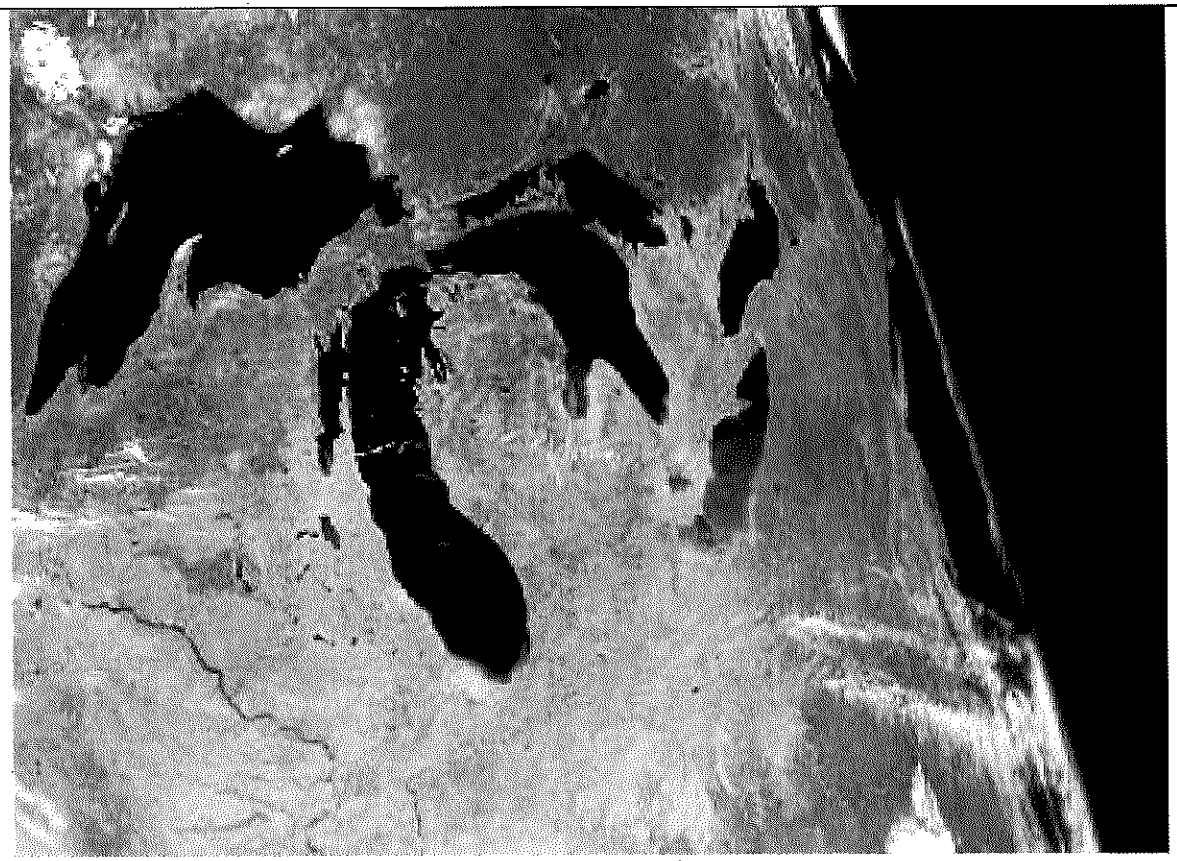


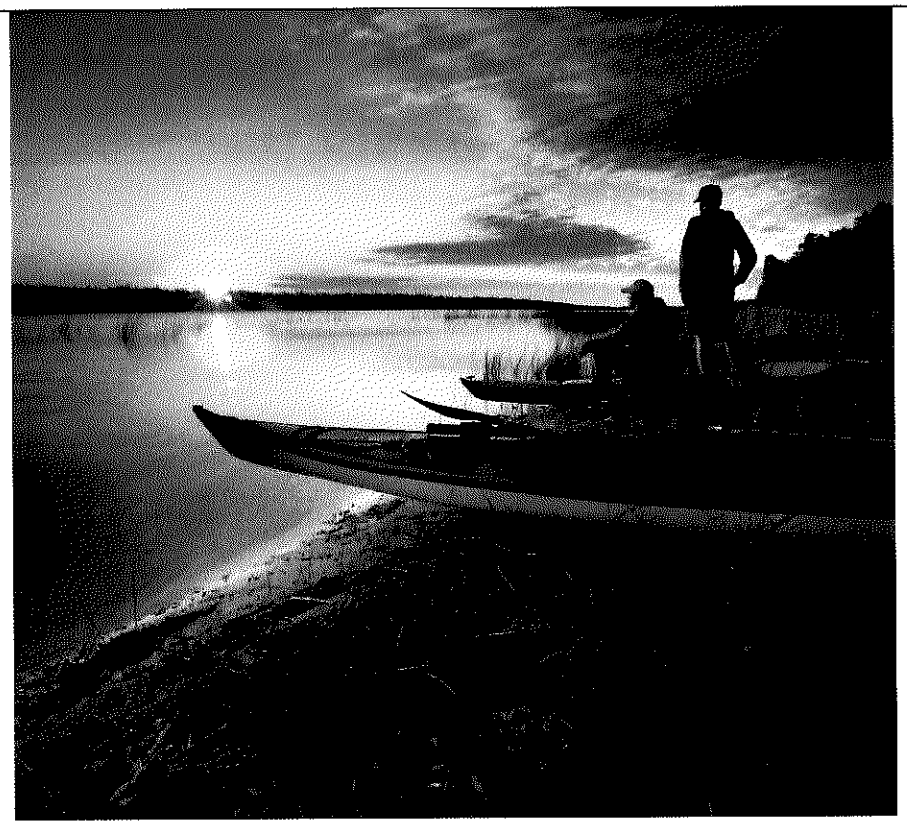
"We do not inherit the earth from our ancestors, we borrow it from our children."

We are the stewards of this land.
Are we protecting it and keeping it healthy for our Children?

#4 Craig Schultz

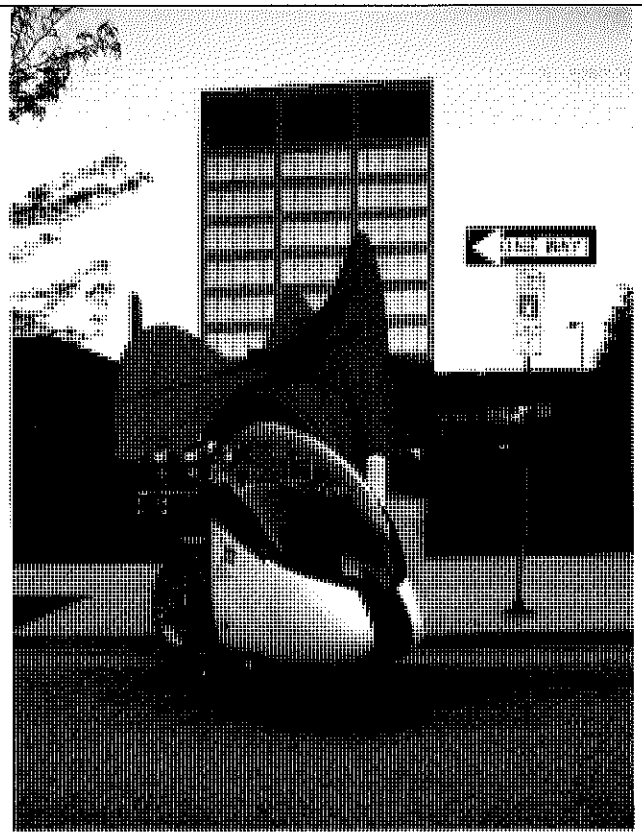
Enbridge's Oil Pipeline Breach Near Kalamazoo, MI

OUR LEGACY?



Clean, Pure Michigan

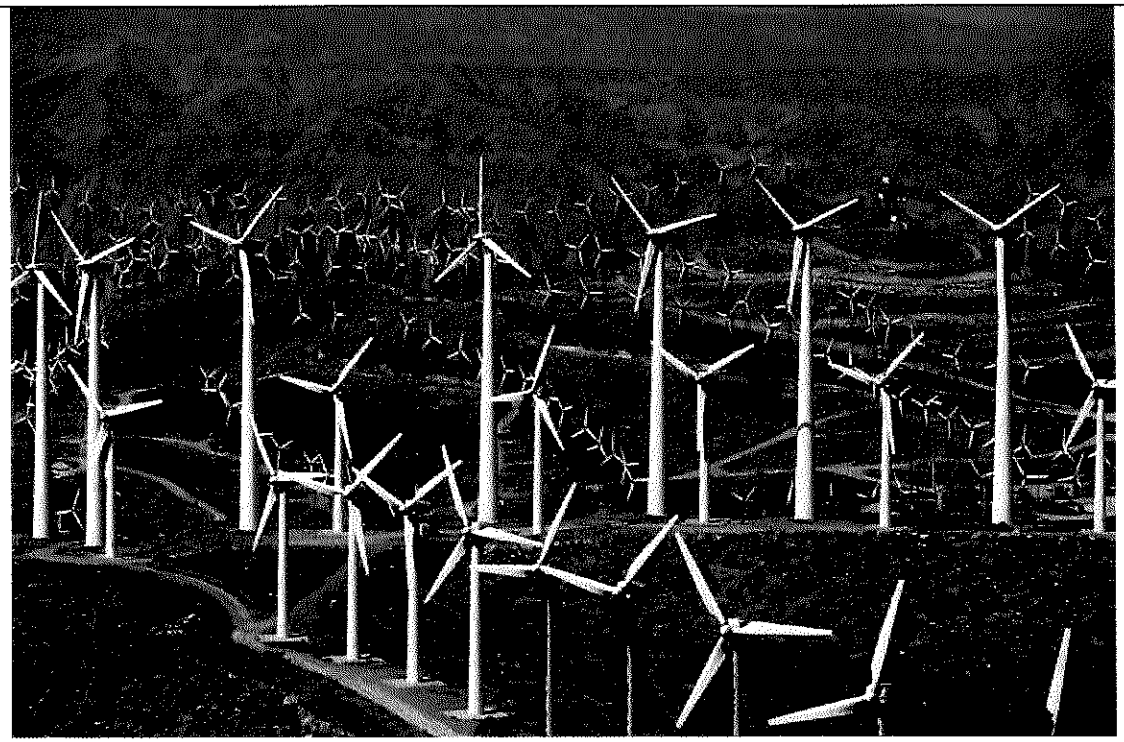
Is our Energy Production Polluting our Land, Or MAKING IT CLEANER?



300 MPGe over last 6,000 Miles
Built in a Barn by Michigan Public School Graduate

Efficiency by DESIGN

WE MUST DESIGN CLEANNESS INTO ENERGY PRODUCTION.



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In 2012, Wind Power in Michigan is less expensive to install than Coal!

BAD NEWS!
641 Wind Turbines = 978 MW
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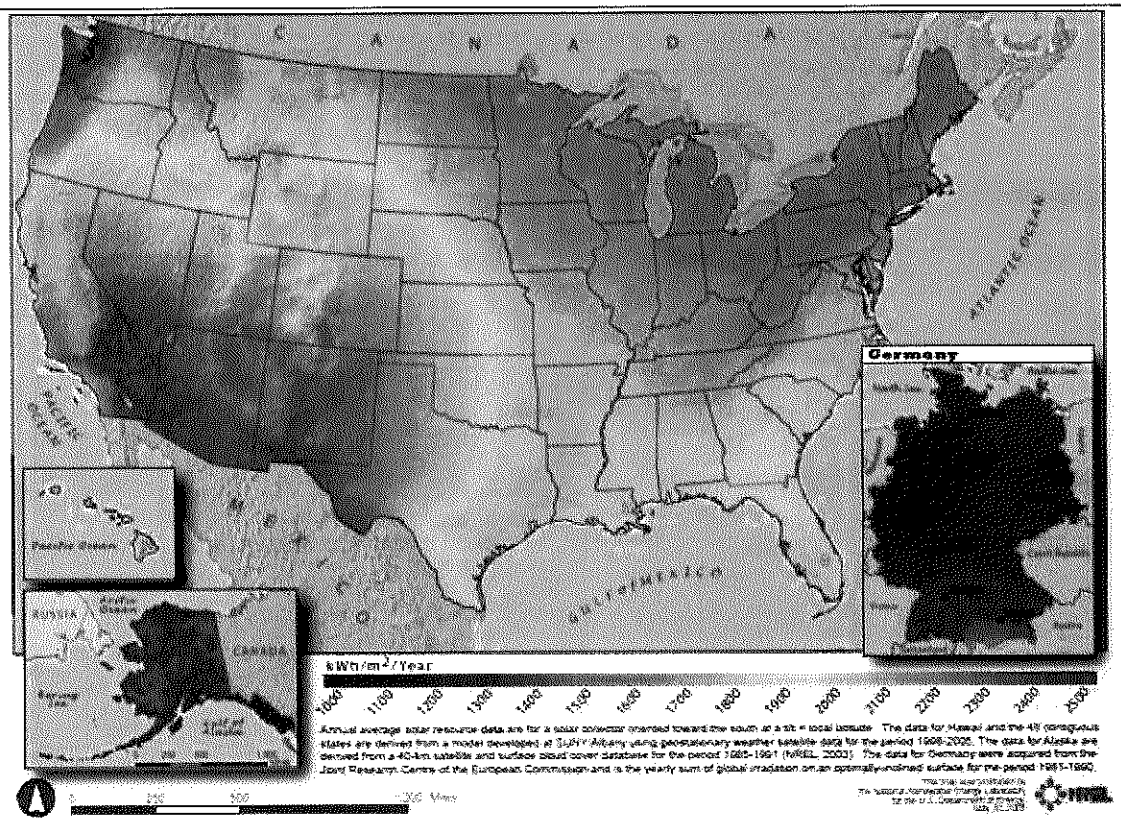
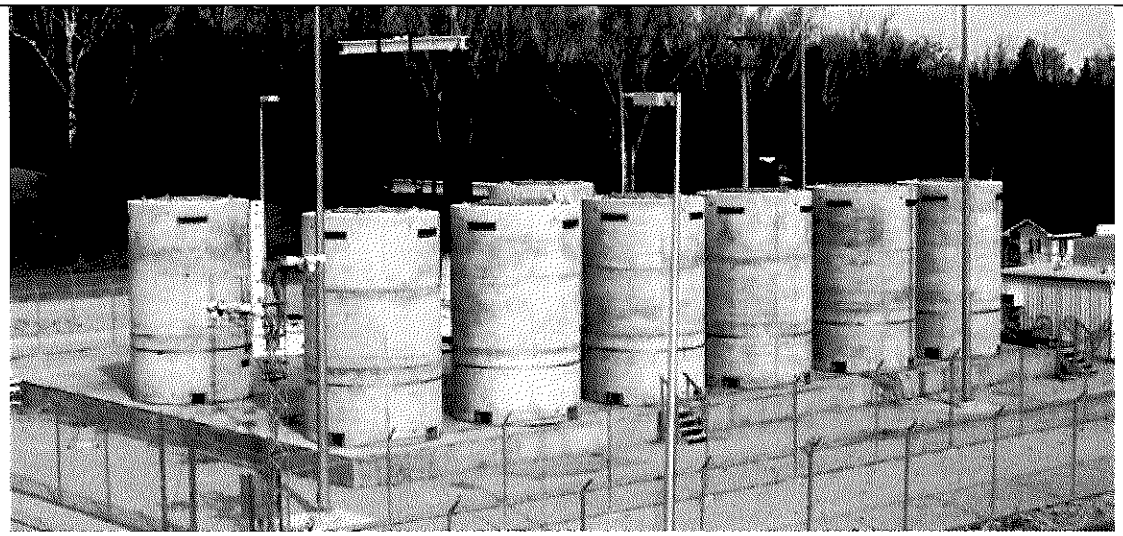



Germany Gets about as Much Sun at ALASKA
Yet, is producing 40% of its Electricity with SOLAR!

Why? Feed-In Tariffs, Guaranteed Grid Access



ENERGY STORAGE MYTHS

High Level Nuclear Dry Cask Storage at Big Rock Point,
Traverse City, Michigan.

Safe storage for 10,000 YEARS+ !?
Who says we can't store energy over night?

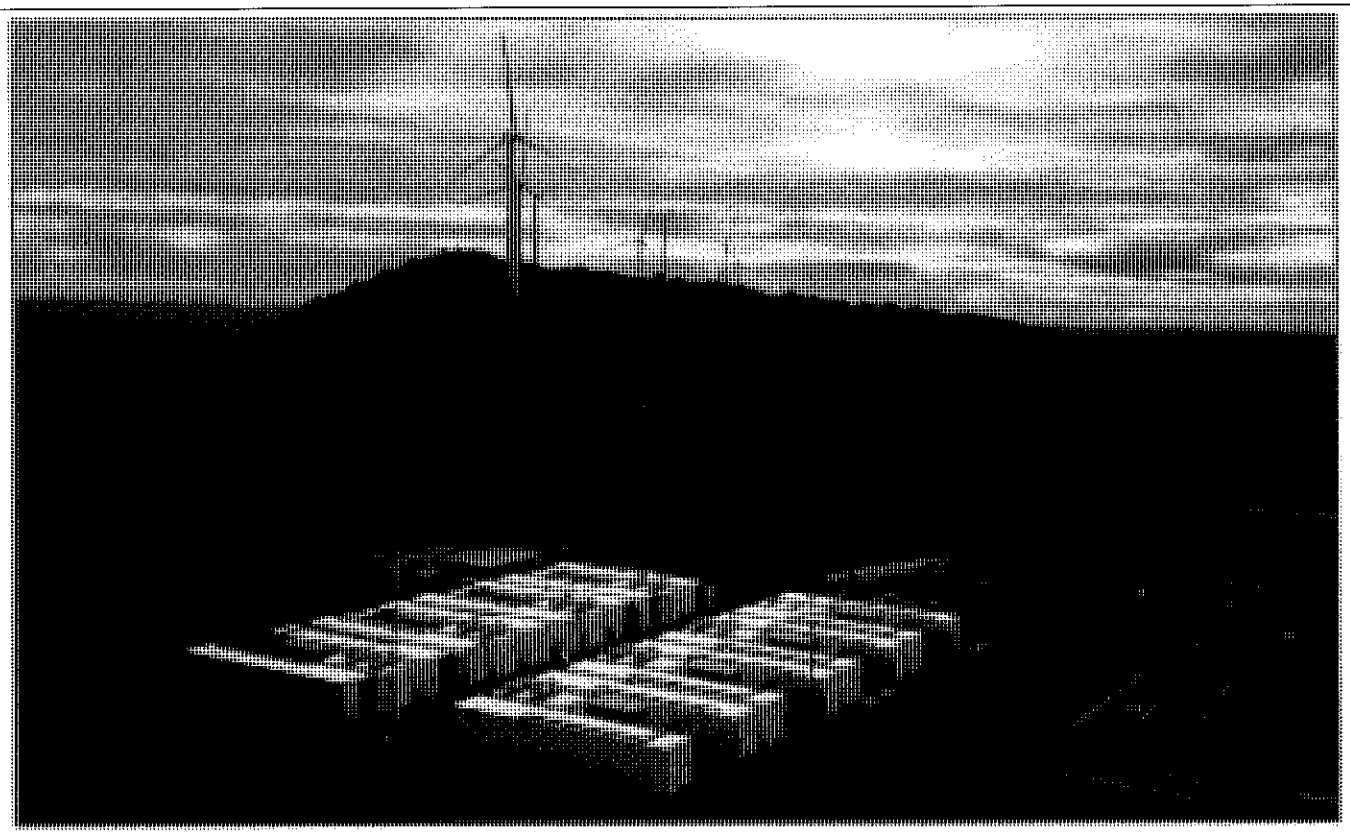


**Photo courtesy of AES Storage**

A123 GRID STORAGE SYSTEM.
Up to 4 MWh Capacity Per Trailer

The Ultimate GRID STORAGE SYSTEM
Battery Electric Cars with Grid Access

We're Building them TODAY!

In Summary,

I recommend that we phase out Coal, Nuclear and Natural Gas as existing plants reach the end of their lives, and that we replace them with clean, and less costly renewable sources like wind and solar. We also must focus on reducing consumption by improving efficiency's of our cars and buildings.

1. In 2012, Wind Power in Michigan is less expensive to install than Coal today!
2. Use Germany's success with Solar as a template to grow our Solar Industry
    a. Legislate Feed-In Tariffs with 20 year contracts
    b. Guaranteed grid access
    c. Streamline paper work for Solar Installations
3. Develop a standard to allow Electric Vehicles to function as Grid Storage Systems
4. Encourage Michigan Battery Producers to support Grid Storage Applications.
5. Heighten Focus on Legislation to set higher standards for Efficiency's in Buildings and Cars
6. Continue to make legislation that sets extremely high standards for clean environment

To solve our problems we must all be involved and active in doing the work that needs to be done to prepare for a healthy future.

The role of our policy makers is to set high standards for what is best for the entire community in the long run. We must not seek to just please our immediate constituency.

Thank You, Kraig Schultz, www.SchultzEngineering.US, 616-540-7027

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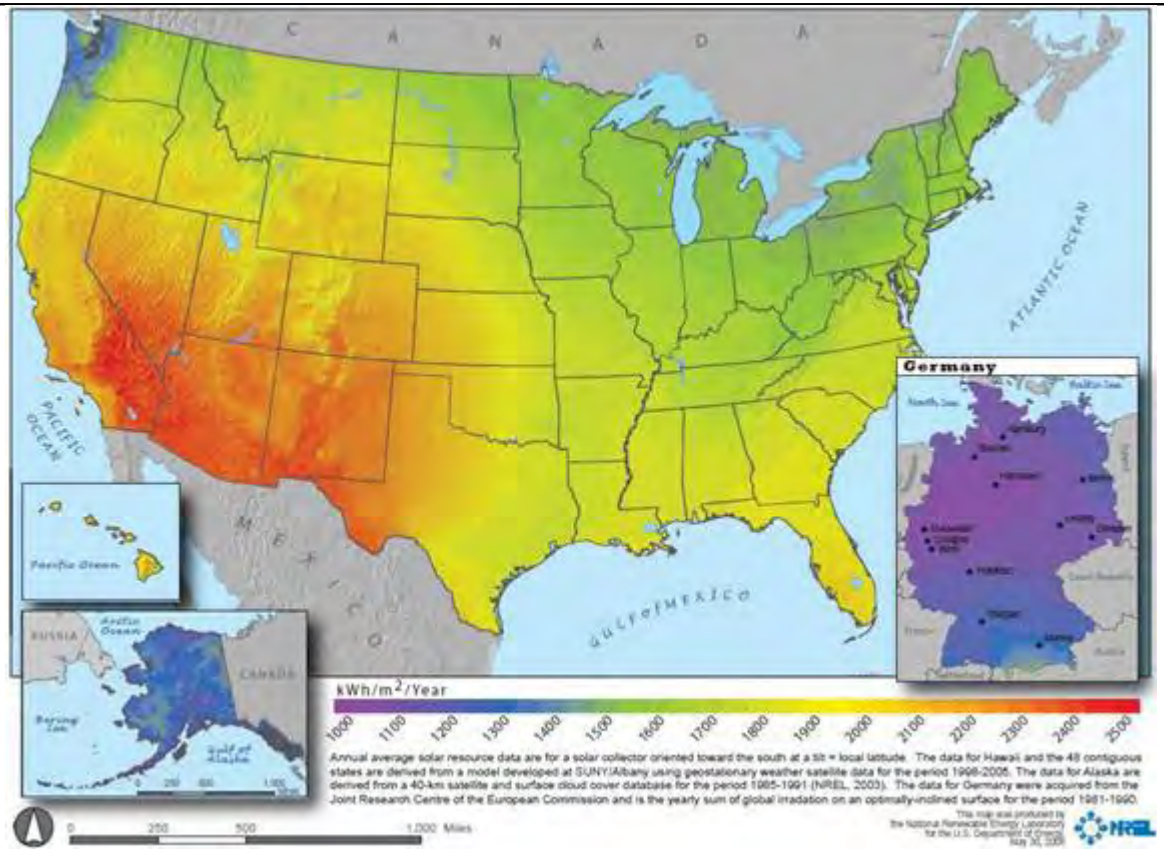


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POWERPOINT ON MEMORY STICK

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** CARY SHINELDECKER

**Affiliation (if any):** _____

**Phone:** 231-510-5128

**Email:** pdi@carrinter.net

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** WIND TURBINE SITING

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

# Clean Energy and Dirty Gag Clauses

By Cary Shineldecker

**Wind Energy claims to be clean, free, and impact free. The industry trade associations tout talking points repeated at nauseam by its trusting followers, but here is the fine print.**

**Consumers Energy Lake Winds Energy Park, Riverton and Summit Townships, Mason County, Michigan**- *Grantor shall at no time: (i) take any action to in any manner attempt to wholly or partially prevent, or otherwise to in any manner oppose, the granting, regranting, issuance, re-issuance, renewal or extension of any regulatory, administrative or other governmental or quasi-governmental permits, licenses, authorizations or other approvals, of any kind or nature and whether federal, state or local, that Grantee may at any time seek in connection with the construction, operation, use, maintenance, repair, renewal, repowering, upgrading, improvement, inspection, removal or replacement of any Wind Farm Facilities on the Easement Premises or on any Other Wind Farm Site; or (ii) bring any lawsuit, complaint or other action before any court, administrative or regulatory agency or other governmental or quasi-governmental body seeking in any manner enjoin ar otherwise restrain, in whole or in part, the construction, operation, use maintenance, repair, renewal, re-powering, upgrading, improvement, inspection, removal or replacement of any wind Farm Facilities on the Easement Premises or an any Other Wind Farm Site.* *(Source FOIA, LWEP Permit Application, 2011)*

**Heritage Sustainable Energy, of Traverse City, Mich.** Heritage, which is best known for its nearly 2,000-acre Stoney Corners Wind Farm Project near McBain, Mich.
*"...Lessee shall have a non-exclusive easement over and across said property for audio, visual, view, light, noise, vibration, air turbulence, wake, electromagnetic, electrical, and radio frequency interference, and any other effects attributable to Lessee's operations." The lease further stipulates: "Lessor waives ony claim with regard to any such interference or effects."*
*(Source www.dailypress.net, Wind turbines in Garden's future, November 22, 2010, By Ashley Hoholik)*

**Canadian Hydro Developers, Inc., Ontario** *"The Transferror hereby transfers, sells, grants, and conveys to the Transferee, to use and enjoy for the benefit of the Tronsferee, the right, liberty, privilege, and free and unencumbered easement in perpetuity" "for the right and privilege to permit heat, sound, vibration, shadow, flickering of light, noise (including grey noise) or any other adverse effect or combination thereof resulting directly or indirectly from the operation of the Transferee's wind turbine facilities" "The Transferor further acknowledges and agrees that the operation""may offect the living environment of the Transferor and that the Transferee will not be responsible or liable for, of and from any of the Transferror's complaints, claims, demands, costs and expenses arising from any direct, indirect or consequential damages arising out of a complaint, claim, action or cause of action"* *(Source- Windaction.org, CASE STUDY: Diminution in Value, Wind Turbine Analysis, September, 2012 by Ben Lansink, AACI, P.App, MRIC)*

The Wind Industry knows these impacts exist, and that they make such a vigorous effort to restrict the rights of the landowners whom they sign contracts with and silence them!

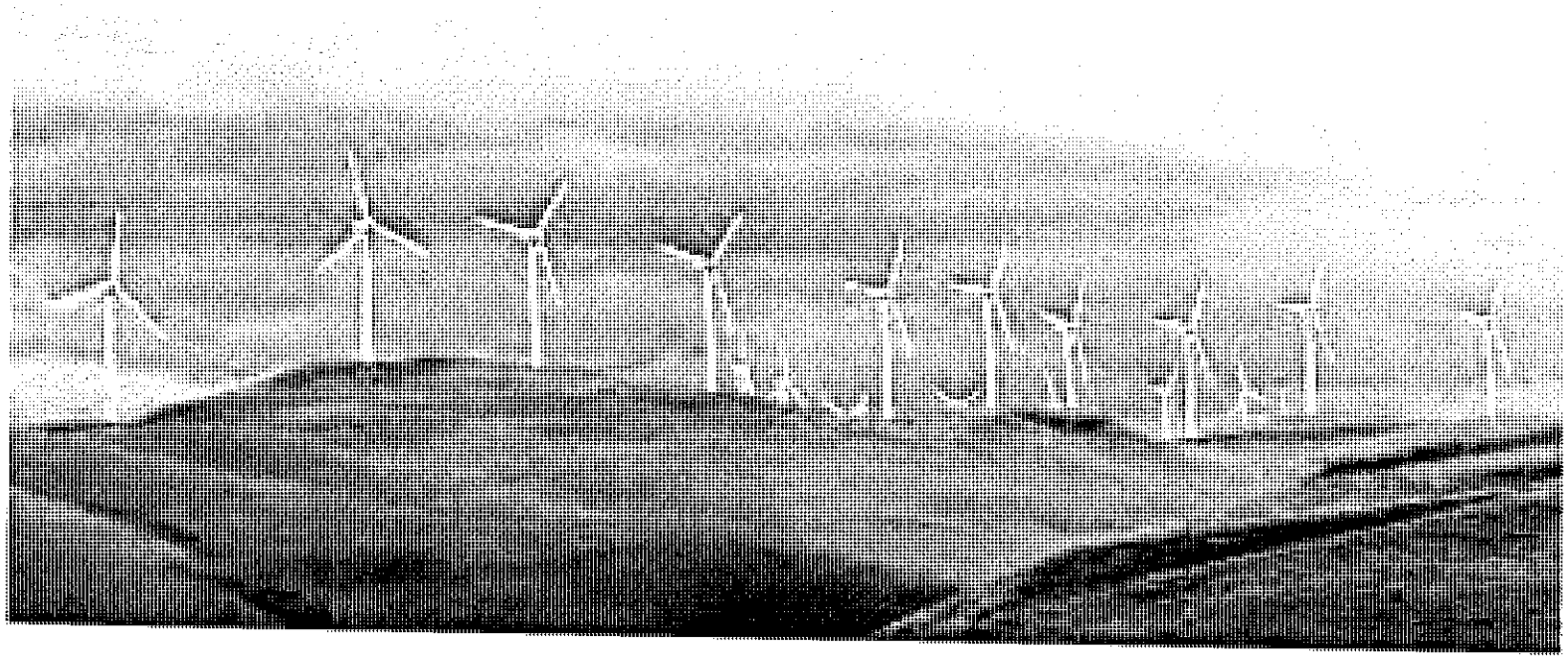
The Wind Industry knows they are harming people, and that is why they have Gag clauses in good neighbor agreements.

The Wind Industry knows the impacts and it is NOW time to hold them accountable.

The Michigan Public Service Commission dissolved the Health and Technical Workgroup with Co-Chairs Dr. Jerry Punch, Audiology, MSU and Dr. Ken Rosenman, Occupational Epidemiology, MSU, because of the pressure put on my John Sarver, Great Lakes Renewable Energy Association and others, because the honorable health professionals supported Health, Safety, and Welfare to be the cornerstone of Industrial Turbine Siting in Michigan.

It is time that Michigan become civilized and treat its citizens with the dignity that they deserve.

# STOP DESTROYING LIVES!



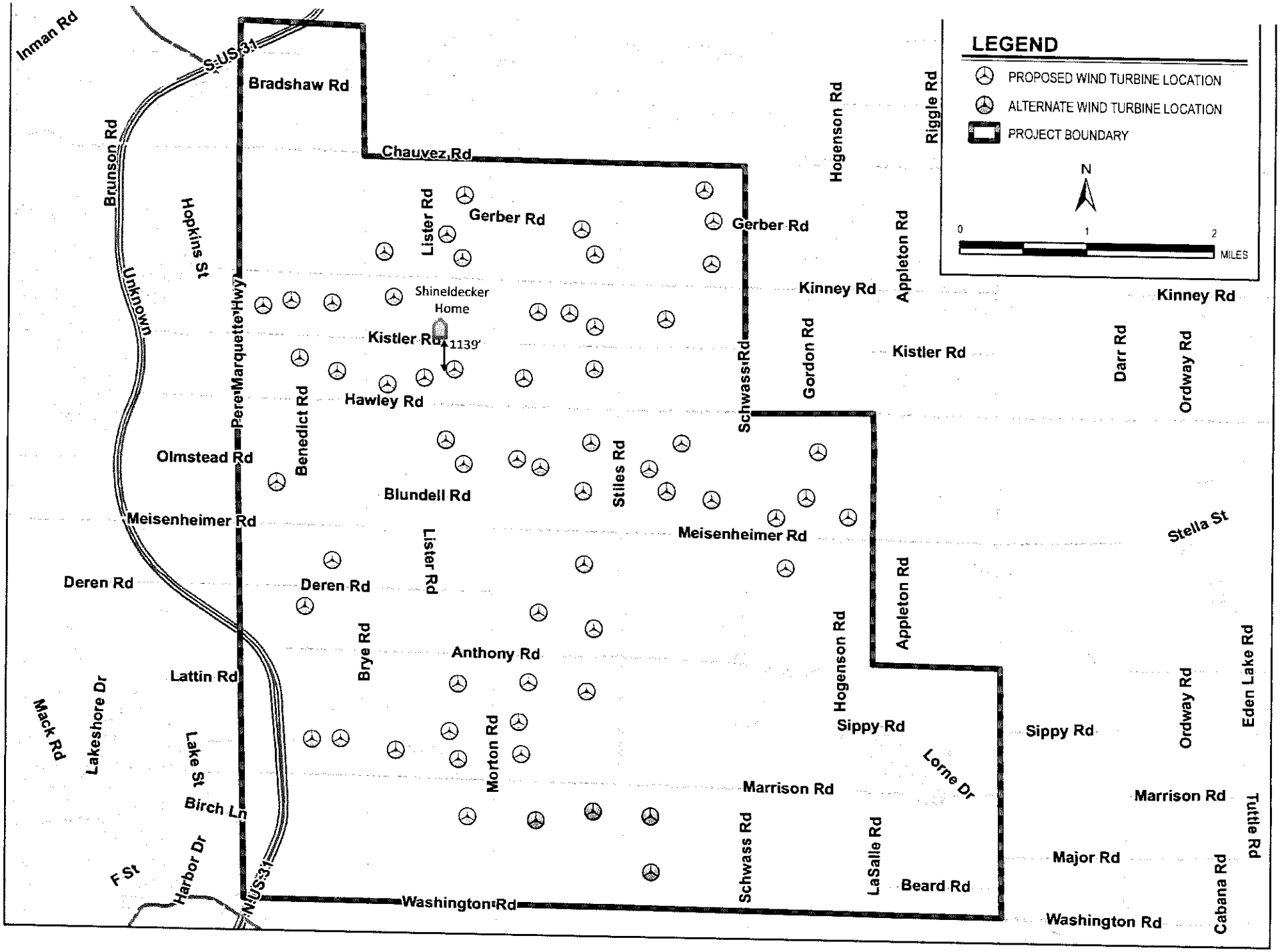
# Michigan's Energy Future
# How Does Wind Siting Make Sense?

Presenter

Mr. Cary Shineldecker

Audience Participation and Questions- Please Show Hands When Asked. Thank You!

- How many audience members support the idea of Michigan pursuing renewable energy?
- How many audience members believe renewable energy creates a meaningful amount of jobs?
- How many audience members make at least some share of their yearly income from renewables?
- How many audience members are being compensated in some way to participate in today's forum?
- How many audience members have been to 1 or more industrial wind developments?
- How many audience members live within 50 miles of an industrial wind development?
- How many audience members live within 10 miles of an industrial wind development?
- How many audience members within 1 mile of an industrial wind development?
- How many audience members live within ½ mile of an industrial wind turbine?
- How many audience members live within ½ mile of 5 industrial wind turbines?
- How many audience members live within 1 ½ miles of 25 or more industrial wind turbines?


LEGEND
PROPOSED WIND TURBINE LOCATION
ALTERNATE WIND TURBINE LOCATION
PROJECT BOUNDARY
N
0
1
2
MILES
Inman Rd
S US 31
Bradshaw Rd
Chauvez Rd
Brunson Rd
Hopkins St
Unknown
Pere Marquette Hwy
Lister Rd
Gerber Rd
Gerber Rd
Shineldecker Home
Kistler Rd
1139'
Hawley Rd
Benedict Rd
Olmstead Rd
Blundell Rd
Stiles Rd
Schwass Rd
Gordon Rd
Hogenson Rd
Riggle Rd
Appleton Rd
Kinney Rd
Kinney Rd
Kistler Rd
Darr Rd
Ordway Rd
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Stella St
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Lister Rd
Brye Rd
Anthony Rd
Appleton Rd
Hogenson Rd
Lattin Rd
Mack Rd
Lakeshore Dr
Lake St
Birch Ln
Morton Rd
Sippy Rd
Sippy Rd
Ordway Rd
Eden Lake Rd
Lorne Dr
Marrison Rd
Marrison Rd
Tuttle Rd
F St
Harbor Dr
N US 31
Schwass Rd
LaSalle Rd
Beard Rd
Major Rd
Cabana Rd
Washington Rd
Washington Rd

Shineldecker's Home, Ludington, MI

Impacts to my family

- Sleep Disturbance/Sleep Deprivation
- Tinnitus
- Ear Pressure
- Continual Head Aches
- Migraine Headaches
- Anxiety
- Routine awakenings (10 per night)
- Heart Racing out of dead sleep
- Grinding Teeth / Loose Teeth
- Depression
- Turbines heard inside bedroom
- Low Frequency Felt throughout body
- Home Unable to Sell in 2 years on market
- Loss of enjoyment of home and property
- Pets Impacted

- ***We are ready to abandon our home! The single biggest investment of our lifetime!***

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**If you wish to speak today, please complete the following:**

**Name:** KELLY SLIKKERS (Slick-ers)

**Affiliation (if any):** ENERGETX COMPOSITES

**Phone:** (616) 218-3390

**Email:** KSLIKKERS@ENERGETXCOMPOSITES.COM

**Topics you wish to address today:**

a. ✓ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** ✓ < 5 minutes ____ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

My name is Kelly Slikkers and I am Vice President of Business Development and a founding member of Energetx Composites based in Holland, Michigan.

Energetx Composites was founded in 2008 as a diversification effort from our sister company, S2 Yachts. S2 Yachts is a luxury yacht manufacturer that has been located in Holland for its entire 50 year history.

Energetx Composites was created to capitalize on our long-standing history of composite manufacturing excellence and expertise. We wanted to bring the same manufacturing systems used in the boat manufacturing industry to industries such as wind energy, mass transportation and defense. To date, wind energy has been the primary focus for Energetx. We are currently manufacturing our first 45.3 meter wind turbine blade. At almost 150 feet it is a large scale, utility sized turbine blade. We have already provided other composite components to various wind energy OEMs throughout the United States.

In addition to making parts for the wind energy industry, we have manufactured all composite bus bodies for a hybrid bus OEM. We have built weather buoys for marine applications. We are working on a composite housing which utilizes solar panels for off-grid applications. We are looking for other applications of this "made in Michigan" skill set. The overarching goal for Energetx Composites is to provide a stable work environment for our employees and to bring new, innovative products and technologies to market.

Like the yachting industry, the wind energy market is one that fluctuates in response to both economic and policy initiatives. In Michigan, we feel fortunate to be in a State where there is comprehensive renewable energy legislation in place. We firmly believe that much of the growth that we are seeing at Energetx can be directly attributed to Public Act 295 passed in 2008. Over the last 2 years, we have hired over 100 team members ranging from highly technical engineering positions to manufacturing positions making the parts. We have plans to hire many more within the ensuing months.

PA 295 ~~had~~ is having a significant impact on our business because Detroit Edison and Consumers Energy have advocated for Michigan based content in their wind projects. Private project developers have also advocated for Michigan based content. This has allowed our organization to meet with the primary supply chain decision makers from nearly every leading wind energy OEM in the market today. These discussions have led to commercial agreements that will result in production and hiring in Holland, Michigan.

While this legislation has been a tremendous driver for our organization, it has also created a ripple effect through our own supply chain. Energetx has contracted with 70+ different Michigan companies over the last three years that have supplied product to us This number will continue to grow as we see an increase in orders and thus production. From Maslo Fabrication in Hamilton, MI to Kerr Pump and Supply in Detroit, MI, we rely on the great work and expertise in other Michigan communities – both large and small. You may only see one company here in front of you, but in reality we represent dozens and dozens of Michigan companies and Michigan jobs.

We all know that Michigan's economy has been hit hard over the last several years. However,, diversifying our economy, just like our internal diversification, will undoubtedly enable our State to thrive and bring new talent into Michigan as opposed to watching it leave. Public Act 295 and the legislation to expand on this beginning effort can be an important driver for helping to grow new industries like the renewable energy sector, in this State.

Thank you once again for allowing me to speak with you today and I look forward to continue playing a role in ensuring that Michigan keeps its place as the premiere manufacturing center for the world.

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**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Robert Stegmier

**Affiliation (if any):** Izaak Walton League of America

**Phone:** 614-481-5497 Citizen for Responsible Resource Managment

**Email:** rstegmier@ameritech.net

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. X **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** Global Warming

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

+ 1 form attached

Governor Snyder, Energy Forum 2-25 2013

I Thank the Governor for this opportunity to have input on Michigan energy policy.

My name is Robert Stegmier from Rockford. I am a Notional Director of the IWLA a conservation group established in 1922 with the goal of defending our soil air woods waters and wildlife. I have been an active member since 1952.

I have three goals on energy for the Governor today all predicated on the serious problem facing all beings on earth "Global Warming" and the part energy has to play in it.

First the Governors needs to get a moratorium on the slick water Fracking process which unreversably pollutes millions upon millions of gallons of good water with each Fracking procedure. I believe this time of action violates the intent of the Great Lakes Compact.

Unfortunately Michigan has to dubious honor of having the current highest Fracking job with one well near Kalkaska with over 21 million gallons. This pad with two other wells on it has polluted over 45 millions of water. To me and many citizens of Michigan this is an unconscionable act.

This can be stopped and I believe the Governor has to responsibility to get a Moratorium in place.

My second goal for the Governor is to get established the next renewable energy goal set. That could be 25% by 2025 or 35% 3035 either are very attainable goals without the necessity of putting any windmills in any of the Great Lakes.

My third goal is for the Governor to accomplish these two goals by the fourth of July this year, or sooner.

Thanks you again for giving me this opportunity to speak and I offer my assistance in any way to accomplish these goals.

Beginning in mid-February and continuing until the end of April, Governor Snyder will be sponsoring a series of Energy Forums across the state of Michigan. These forums will be used to shape Michigan's energy future, and the governor wants to hear from you. Two forums will be in West Michigan, one in **Grand Rapids Monday, Feb. 25** and another in **Kalamazoo Monday, March 18**.

To help jumpstart the forums a web site has been launched to inform the public about the process and gather information. The website contains multiple avenues for public input. There are two overall questions about energy policy, as well as three topic areas with more specific questions - Renewable Energy, Energy Efficiency, and Electric Choice.
Your contribution is needed because Governor Snyder will use public input to make his recommendations for Michigan's energy future. This process will inform policy makers as they enact

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Joshua Van Camp

**Affiliation (if any):** NRC

**Phone:** 517-443-5935

**Email:** jvancamp@tc3net.com

**Topics you wish to address today:**

a. X Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. ___ Other Additional Energy Topic

(Please specify): _____

**Requested time to speak:** ____ < 5 minutes  X 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

Josh Van Camp - IICC

"Good afternoon.

My name is Joshua VanCamp, director of the IICC, and I am here to discuss the need for a little common sense and honesty with regard to the cost of renewable energy. I believe if we are going to have an effective energy policy the public needs to be provided complete and honest information.

Unfortunately our Public Service Commission (PSC) is not providing the public with the accurate information we deserve. Here are just a few examples of where the PSC has let us down.

Example #1

Let me start with a simple example. I ask all of you to read your next power bill. On it you will see the following statement.

*"For the average Michigan residential customer, renewable energy is expected to avoid $3.90 per month of new coal-fired generation costs."*

This is an absolutely false statement. I would guess that everyone here today understands that wind is an intermittent source of energy and as such is not a substitute for a fossil fuel plant. Wind is only capable of <u>supplementing</u> conventional generation. It is not a <u>substitute</u> for conventional generation.

U.S. Energy Information Administration

And the EIA concurs:

> *"The duty cycle for intermittent renewable resources, wind and solar, is not operator controlled, but dependent on the weather or solar cycle (that is, sunrise/sunset) and so will not necessarily correspond to operator dispatched duty cycles. As a result, their levelized costs are* ***not directly comparable to those for other technologies*** *(even where the average annual capacity factor may be similar)and therefore are shown in separate sections within the table."*

This is elementary information that informed people understand yet this false statement continues to appear on our bills every month. MISO places the capacity value of wind at 8% yet the statement on our power bills assumes a one for one substitution of wind for new coal plants. This is not only misleading it is absolutely false. If we are to have an honest discussion about energy policy we need to start by providing ratepayers with honest information. A good start would be for our PSC to remove this false statement from our bills and replace it with a statement that describes the full and complete <u>cost</u> of renewable energy.

Example #2

Our PSC has routinely understated the cost of wind energy thereby distorting the whole discussion of renewable energy. The PSC's cost estimate ignores the PTC, ignores the section 1603 grants, ignores the Michigan incentive credits, ignores the billions that will be spent for new transmission lines, ignores the cost of integrating wind into the grid, ignores the negative efficiency impacts wind has on existing conventional sources and ignores the low value of wind power. All of these costs are real and need to be included in the cost of wind. Unfortunately our PSC has chosen to ignore those costs and is hiding them from ratepayers.

Example #3

PA295 assumes wind will displace coal generation. While this may happen to some small degree it is much more likely that wind will displace natural gas generation not coal. The environmental impacts of gas are much lower than those of coal yet PA295 continues to require a bogus substitution of wind for coal in their calculations. This is wrong and distorts the fair and honest dialogue that this subject requires.

The bottom line is that if we are to have an effective Energy policy our PSC needs to provide Michigan ratepayers with accurate information about the true costs and impacts of wind energy. Any energy policy is only as good as the foundation upon which is built. If this foundation is one of false information and industry propaganda then we will have a failure in which the utilities and multinational wind companies profit at the expense of ratepayers. It is up to our PSC and our elected officials to ensure we have a policy that is based upon facts and serves the citizens of Michigan not the wind companies.

U.S. Energy Information Administration

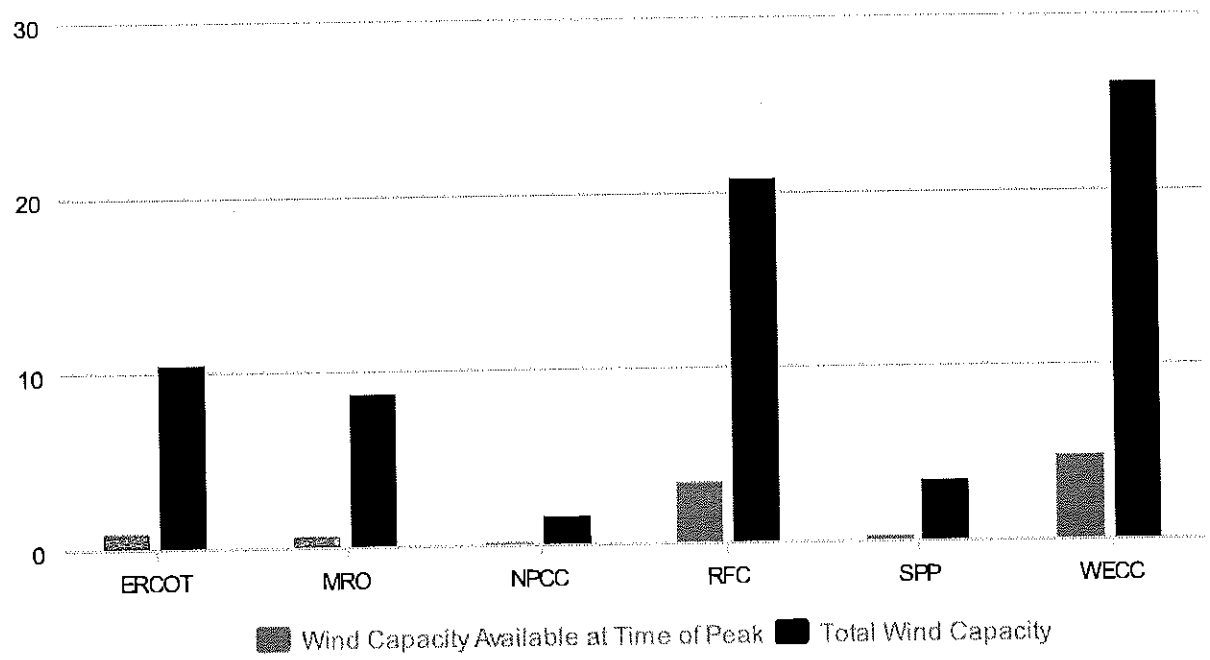
# Today in Energy

May 13, 2011

## Electricity resource planners credit only a fraction of potential wind capacity

**Industry projections of wind capacity by NERC region, 2019**

gigawatts (GW)




**Source:** U.S. Energy Information Administration, Form EIA-411, Coordinated Bulk Electric Supply and Demand Program Report

**Note:** All projections were reported to EIA by electric power system planners during 2010, with a base year of 2009. Projections are reported for the time of summer peak demand. Capacities are given by NERC region (U.S. portion only; see map). FRCC has no existing or planned wind capacity; wind capacity projected for SERC is very small.

Earlier editions of Today in Energy discussed the intermittent nature of wind generation (March 22, 2011) and the challenges it poses for electric power system operators (March 25, 2011) as the Nation's wind capacity rapidly increases. Today's story describes how electric power system planners treat wind generators, recognizing that the wind necessary to achieve a turbine's full generating capacity may not be available at the time of peak electric demand. In their long-range projections, planners count only a fraction of the nameplate capacity by "derating" a plant's capacity (i.e. applying a discount factor to it).

Electric power system planners forecast the demand for electricity at the time of the peak, and then identify existing and potential generating resources needed to satisfy that demand, plus enough additional resources to provide a comfortable reserve margin. The goal is to minimize the costs associated with new capacity investments while ensuring reliability for customers.

Capacity resource planners handle intermittent generation like wind differently from other generation[1]. Because of its unpredictable nature, planners reduce the amount wind contributes to the capacity needed to ensure reliability. Different

Independent Statistics & Analysis
U.S. Energy Information Administration

July 2012

# Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012

This paper presents average levelized costs for generating technologies that are brought on line in 2017[1] as represented in the National Energy Modeling System (NEMS) for the *Annual Energy Outlook 2012* (AEO2012) reference case.[2]

Levelized cost is often cited as a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatthour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating levelized costs include overnight capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.[3] The importance of the factors varies among the technologies. For technologies such as solar and wind generation that have no fuel costs and relatively small O&M costs, the levelized cost changes in rough proportion to the estimated overnight capital cost of generation capacity. For technologies with significant fuel cost, both fuel cost and overnight cost estimates significantly affect the levelized cost. The availability of various incentives, including state or federal tax credits, can also impact the calculation of levelized cost. The values shown in the tables below do not incorporate any such incentives[4]. As with any projection, there is uncertainty about all of these factors and their values can vary regionally and across time as technologies evolve.

It is important to note that, while levelized costs are a convenient summary measure of the overall competiveness of different generating technologies, actual plant investment decisions are affected by the specific technological and regional characteristics of a project, which involve numerous other considerations. The ***projected utilization rate***, which depends on the load shape and the existing resource mix in an area where additional capacity is needed, is one such factor. The ***existing resource mix*** in a region can directly affect the economic viability of a new investment through its effect on the economics surrounding the displacement of existing resources. For example, a wind resource that would primarily displace existing natural gas generation will usually have a different value than one that would displace existing coal generation.

[1] 2017 is shown because the long lead time needed for some technologies means that the plant could not be brought on line prior to 2017 unless it was already under construction.

[2] The full report is available at http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf.

[3] The specific assumptions for each of these factors are given in the *Assumptions to the Annual Energy Outlook*, available at http://www.eia.doe.gov/oiaf/aeo/index.html.

[4] These results do not include targeted tax credits such as the production or investment tax credit available for some technologies. Costs are estimated using tax depreciation schedules consistent with current law, which vary by technology.

A related factor is the ***capacity value,*** which depends on both the existing capacity mix and load characteristics in a region. Since load must be balanced on a continuous basis, units whose output can be varied to follow demand (dispatchable technologies) generally have more value to a system than less flexible units (non-dispatchable technologies) or those whose operation is tied to the availability of an intermittent resource. The levelized costs for dispatchable and nondispatchable technologies are listed separately in Tables 1 and 2, because caution should be used when comparing them to one another.

Policy-related factors, such as investment or production tax credits for specified generation sources, can also impact investment decisions. Finally, although levelized cost calculations are generally made using an assumed set of capital and operating costs, the inherent uncertainty about future fuel prices and future policies, may cause plant owners or investors who finance plants to place a value on ***portfolio diversification***. While EIA considers all of these factors in its analysis of technology choice in the electricity sector, these concepts are not well represented in the context of levelized cost figures

The levelized cost shown for each utility-scale generation technology in the tables below are calculated based on a 30-year cost recovery period, using a real after tax weighted average cost of capital (WACC) of 6.8 percent. However, in the AEO2012 reference case a 3-percentage point increase in the cost of capital is added when evaluating investments in greenhouse gas (GHG) intensive technologies like coal-fired power and coal-to-liquids (CTL) plants without carbon control and sequestration (CCS). While the 3-percentage point adjustment is somewhat arbitrary, in levelized cost terms its impact is similar to that of an emissions fee of $15 per metric ton of carbon dioxide ($CO_2$) when investing in a new coal plant without CCS, similar to the costs used by utilities and regulators in their resource planning. The adjustment should not be seen as an increase in the actual cost of financing, but rather as representing the implicit hurdle being added to GHG-intensive projects to account for the possibility they may eventually have to purchase allowances or invest in other GHG emission-reducing projects that offset their emissions. As a result, the levelized capital costs of coal-fired plants without CCS are higher than would otherwise be expected.

Some technologies, notably solar photovoltaic (PV), are used in both utility-scale plants and distributed end-use residential and commercial applications. As noted above, the levelized cost calculations presented in the tables apply only to utility-scale use of those technologies.

In the tables below, the levelized cost for each technology is evaluated based on the capacity factor indicated, which generally corresponds to the high end of its likely utilization range. Simple combustion turbines (conventional or advanced technology) that are typically used for peak load duty cycles are evaluated at a 30-percent capacity factor. The duty cycle for intermittent renewable resources, wind and solar, is not operator controlled, but dependent on the weather or solar cycle (that is, sunrise/sunset) and so will not necessarily correspond to operator dispatched duty cycles. As a result, their levelized costs are not directly comparable to those for other technologies (even where the average annual capacity factor may be similar) and therefore are shown in separate sections within the table. The capacity factors shown for

solar, wind, and hydroelectric resources are simple averages of the capacity factor for the marginal site in each region. These capacity factors can vary significantly by region and can represent resources that may or may not get built in EIA capacity projections. These capacity factors should not be interpreted as representing EIA's estimate or projection of the gross generating potential of resources actually projected to be built.

As mentioned above, the costs shown in Table 1 are national averages. However, there is significant local variation in costs based on local labor markets and the cost and availability of fuel or energy resources such as windy sites (Table 2). For example, levelized wind costs for incremental capacity coming on line in 2017 range from $77/MWh in the region with the best available resources in 2017 to $112/MWh in regions where the best sites have been claimed by 2017. Costs shown for wind may include additional costs associated with transmission upgrades needed to access remote resources, as well as other factors that markets may or may not internalize into the market price for wind power.

## Table 1. Estimated Levelized Cost of New Generation Resources, 2017

| | | U.S. Average Levelized Costs (2010 $/megawatthour) for Plants Entering Service in 2017 | | | | |
|---|---|---|---|---|---|---|
| **Plant Type** | **Capacity Factor (%)** | **Levelized Capital Cost** | **Fixed O&M** | **Variable O&M (including fuel)** | **Transmission Investment** | **Total System Levelized Cost** |
| **Dispatchable Technologies** | | | | | | |
| Conventional Coal | 85 | 64.9 | 4.0 | 27.5 | 1.2 | 97.7 |
| Advanced Coal | 85 | 74.1 | 6.6 | 29.1 | 1.2 | 110.9 |
| Advanced Coal with CCS | 85 | 91.8 | 9.3 | 36.4 | 1.2 | 138.8 |
| Natural Gas-fired | | | | | | |
| Conventional Combined Cycle | 87 | 17.2 | 1.9 | 45.8 | 1.2 | 66.1 |
| Advanced Combined Cycle | 87 | 17.5 | 1.9 | 42.4 | 1.2 | 63.1 |
| Advanced CC with CC5 | 87 | 34.3 | 4.0 | 50.6 | 1.2 | 90.1 |
| Conventional Combustion Turbine | 30 | 45.3 | 2.7 | 76.4 | 3.6 | 127.9 |
| Advanced Combustion Turbine | 30 | 31.0 | 2.6 | 64.7 | 3.6 | 101.8 |
| Advanced Nuclear | 90 | 87.5 | 11.3 | 11.6 | 1.1 | 111.4 |
| Geothermal | 91 | 75.1 | 11.9 | 9.6 | 1.5 | 98.2 |
| Biomass | 83 | 56.0 | 13.8 | 44.3 | 1.3 | 115.4 |
| **Non-Dispatchable Technologies** | | | | | | |
| Wind | 33 | 82.5 | 9.8 | 0.0 | 3.8 | 96.0 |
| Solar PV[1] | 25 | 140.7 | 7.7 | 0.0 | 4.3 | 152.7 |
| Solar Thermal | 20 | 195.6 | 40.1 | 0.0 | 6.3 | 242.0 |
| Hydro[2] | 53 | 76.9 | 4.0 | 6.0 | 2.1 | 88.9 |

*[1] Costs are expressed in terms of net AC power available to the grid for the installed capacity.*

*[2] As modeled, hydro is assumed to have seasonal storage so that it can be dispatched within a season, but overall operation is limited by resources available by site and season.*

*Note: These results do not include targeted tax credits such as the production or investment tax credit available for some technologies, which could significantly affect the levelized cost estimate. For example,new solar thermal and PV plants are eligible to receive a 30-percent investment tax credit on capital expenditures if placed in service before the end of 2016, and 10 percent thereafter. New wind, geothermal, biomass, hydroelectric, and landfill gas plants are eligible to receive either: (1) a $22 per MWh ($11 per MWh for technologies other than wind, geothermal and closed-loop biomass) inflation-adjusted production tax credit over the plant's first ten years of service or (2) a 30-percent investment tax credit, if placed in service before the end of 2013 (or 2012, for wind only).*

*Source: U.S. Energy Information Administrotion, Annual Energy Outlook 2012, June 2012, DOE/EIA-0383(2012)*

Table 2. Regional Variation in Levelized Cost of New Generation Resources, 2017

| Plant Type | Range for Total System Levelized Costs (2010 $/megawatthour) for Plants Entering Service in 2017 | | |
|---|---|---|---|
| | Minimum | Average | Maximum |
| **Dispatchable Technologies** | | | |
| Conventional Coal | 90.5 | 97.7 | 114.3 |
| Advanced Coal | 102.5 | 110.9 | 124.0 |
| Advanced Coal with CC5 | 127.7 | 138.8 | 158.2 |
| Natural Gas-fired | | | |
| Conventional Combined Cycle | 59.5 | 66.1 | 81.0 |
| Advanced Combined Cycle | 56.8 | 63.1 | 76.4 |
| Advanced CC with CC5 | 80.1 | 90.1 | 108.5 |
| Conventional Combustion Turbine | 91.9 | 127.9 | 152.4 |
| Advanced Combustion Turbine | 77.7 | 101.8 | 122.6 |
| Advanced Nuclear | 107.2 | 111.4 | 118.7 |
| Geothermal | 84.0 | 98.2 | 112.0 |
| Biomass | 97.8 | 115.4 | 136.7 |
| **Non-Dispatchable Technologies** | | | |
| Wind | 77.0 | 96.0 | 112.2 |
| Solar PV[1] | 119.0 | 152.7 | 238.8 |
| Solar Thermal | 176.1 | 242.0 | 386.2 |
| Hydro[2] | 57.8 | 88.9 | 147.6 |

*[1] Costs are expressed in terms of net AC power available to the grid for the installed capacity.*

*[2] As modeled, hydro is assumed to have seasonal storage so that it can be dispatched within a season, but overall operation is limited by resources available by site and season.*

*Source: U.S. Energy Information Administration, Annual Energy Outlook 2012, June 2012, DOE/EIA-0383(2012)*

(4) Slides

LICENSING AND REGULATORY AFFAIRS
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PURE MICHIGAN
Energy Office

DEPARTMENT OF LICENSING & REGULATORY AFFAIRS
MICHIGAN PUBLIC SERVICE COMMISSION
JOHN D. QUACKENBUSH, CHAIRMAN

RICK SNYDER
GOVERNOR

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** Kim Walton

**Affiliation (if any):** GVSU

Name: Kim Walton

Michigan Alternative Renewable Energy Center, Grand Valley State Univ.

616-331-6907

waltonk@gvsu.edu

Topics A. Renewable Energy Standards

5 minutes

# Welcome to

MICHIGAN
ALTERNATIVE & RENEWABLE ENERGY
CENTER (MAREC)

**Kim Walton**
Program Director for MAREC/GVSU

# So you've heard MI doesn't have good solar!

**Grand Rapids, MI**

WBAN NO. 94860

Solar Radi

| Tilt (°) | | Year |
|---|---|---|
| 0 | Average<br>Min/Max | 3.8<br>3.6/4.0 |
| Latitude -15 | Average<br>Min/Max | 4.3<br>4.0/4.5 |
| Latitude | Average<br>Min/Max | 4.2<br>4.0/4.5 |
| Latitude +15 | Average<br>Min/Max | 4.0<br>3.8/4.3 |
| 90 | Average<br>Min/Max | 2.9<br>2.7/3.1 |

**Miami, FL**

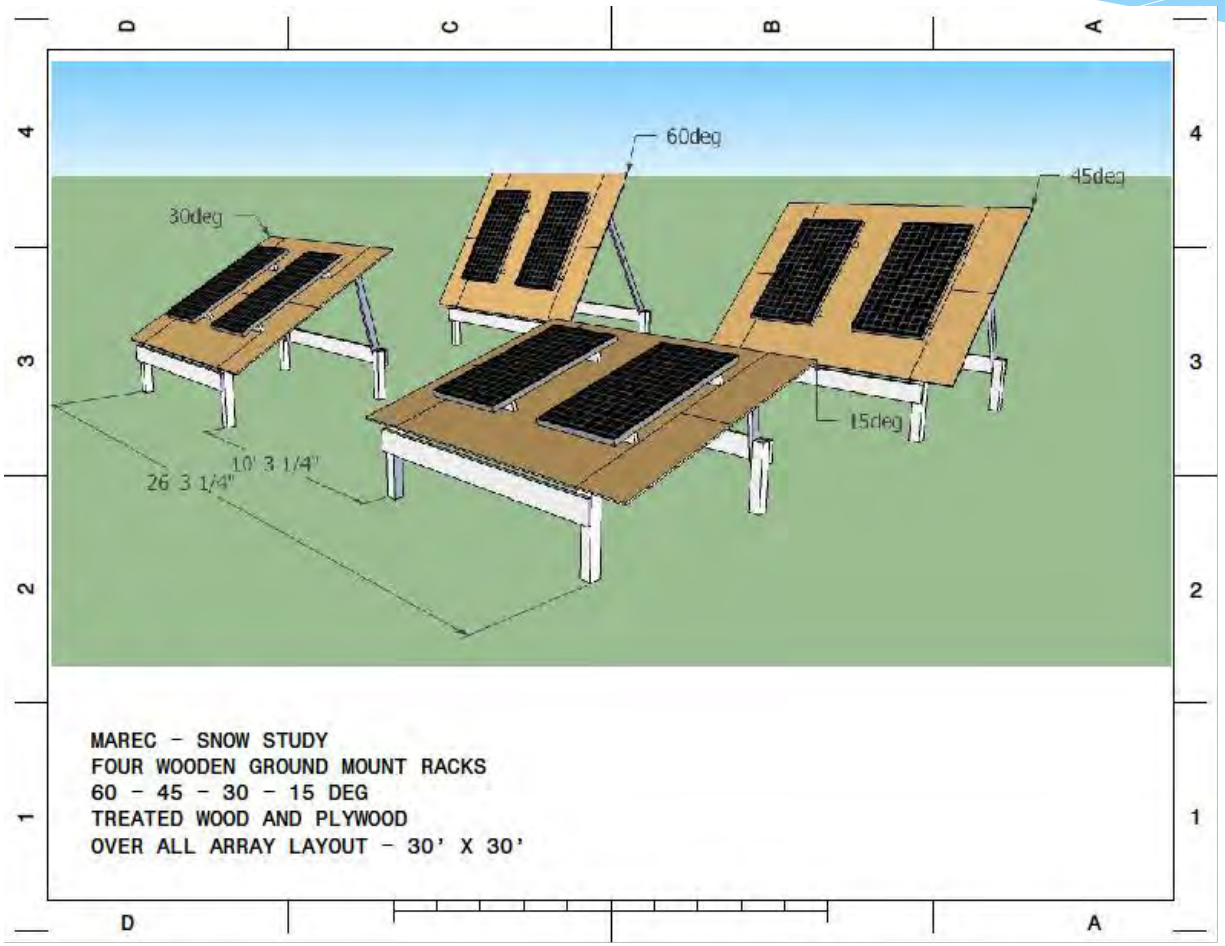
WBAN NO. 12839

| Year |
|---|
| 4.8<br>4.5/5.1 |
| 5.1<br>4.8/5.4 |
| 5.2<br>4.8/5.5 |
| 5.1<br>4.7/5.4 |
| 3.0<br>2.7/3.1 |

* O-Degrees -MI gets 79% of Miami Fl's solar Radiation (Panels Laying flat)
* 90 Degrees –MI gets 97% of Miami Fl's solar Radiation (Panels up right)
* Set at Latitude - MI gets 81% of Miami Fl's solar Radiation
* Set at Latitude -15 degrees - MI gets 84% of Miami Fl's solar Radiation

Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

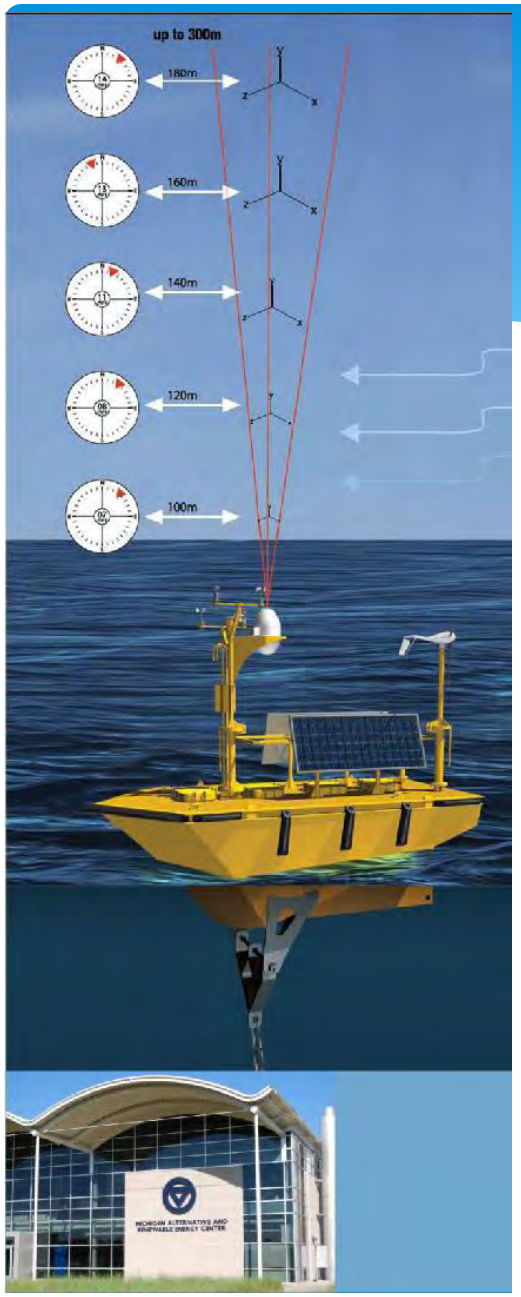
# Key Project Goals




Quantify Michigan's Micro Climates

Assess the benefits of renewable energy technology on working class families

Work with the Great Lakes Renewable Energy Association to build off the 3.5 million dollar grant money, to help local businesses.




# Wind

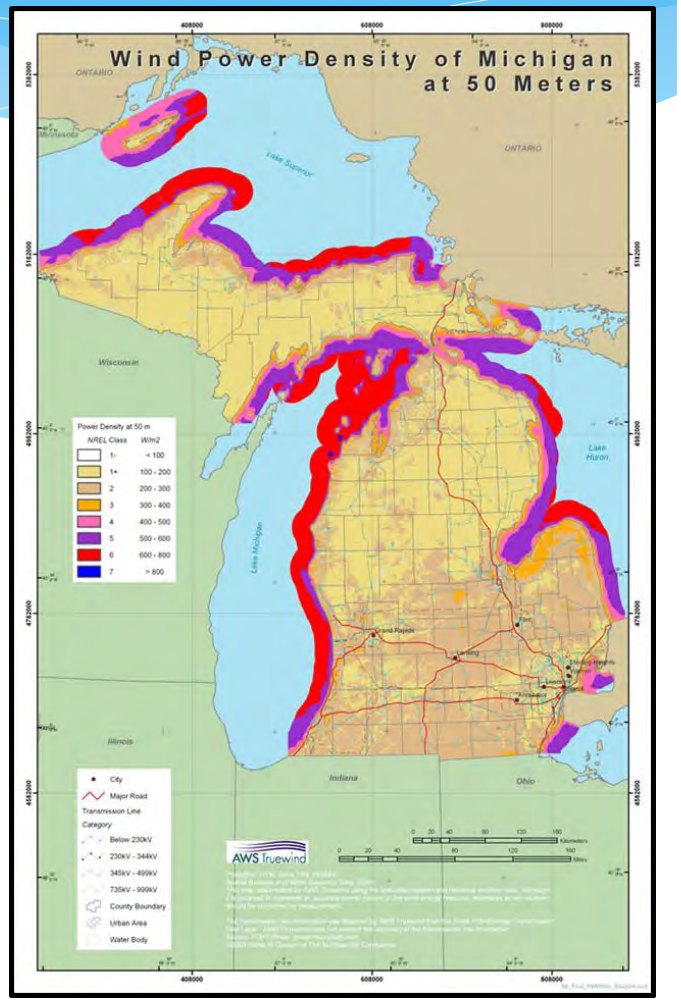
## Key Project Goals

- To collect and analyze wind data essential to the consideration of future wind industry development on the Great Lakes
- To develop real-time / hub-height offshore wind data called for by prior Great Lakes wind assessment studies (2004 & 2009)
- To validate the use of laser pulse (LIDAR) technology on a mobile platform as a viable wind assessment technology
- Goal to advance the knowledge of bird and bat ecology over the Great Lakes

# Summary

Michigan has a good start on renewable energy usage and the businesses to support these technologies are here.

We need to keep moving forward



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GOVERNOR

MICHIGAN ECONOMIC DEVELOPMENT CORPORATION
MICHIGAN ENERGY OFFICE
STEVE BAKKAL, DIRECTOR

# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** Elizabeth E. Wheatley Ph.D.

**Affiliation (if any):** Grand Valley State University

**Phone:** (231) 894-9591 Dept of Sociology

**Email:** wheatlee@gvsu.edu

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** Deleterious impacts of wind energy on human health

**Requested time to speak:** ____ **< 5 minutes** X **5 minutes**

**Please leave a copy of any written or electronic materials at the welcome center.**

GRAND VALLEY STATE UNIVERSITY
www.gvsu.edu
Elizabeth E. Wheatley, Ph.D.
Associate Professor of Sociology

2165 Au Sable Hall
1 Campus Dr.

Ofc: 616/331-3434
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E-mail: wheatlee@gvsu.edu

**Michigan Public Service Commission**

**Grand Valley State University**

**Grand Rapids**

**February 25, 2013**

My name is Elizabeth Wheatley and I am an Associate Professor of Sociology here at Grand Valley State University. I work on the Allendale campus, teaching courses in the sociology of health medicine and illness, health and social inequalities, and social problems. My training is in medical sociology, and my research addresses the politics of disease as well as health and social justice movements. I am an ethnographer. My research involves going into the field in order to learn from people, first hand, about their experiences, in order to document those experiences, through interviews and observations of those I study.

I began addressing industrial wind energy in both my teaching and research in spring 2010. In October 2010, I attended the First International Symposium on the Global Wind Industry and Adverse Health Effects, held in Picton Ontario. There, I met leading experts of North America, the UK, and Australia from fields of medicine, epidemiology, acoustics, and law, whose work investigates impacts of poorly sited industrial wind energy on citizens living close to turbines.

In summer, 2012, I began an industrial wind turbine tour, whose purpose is to document the experiences of citizens living in the footprint areas of large scale industrial wind installations. My research has taken me through rural areas of Michigan, Ontario, New York, Massachusetts and Maine, where large scale industrial wind turbine installations are sited. I visited, and interviewed citizens inhabiting the footprint areas of those projects.

In September and October 2012, I travelled to South Australia, Victoria Australia and the North island of New Zealand, touring industrial wind installations, and interviewing those living amidst the turbines. Routinely, I was housed and fed by those I interviewed, both in North America, and down under. Such generosity defrays the costs of my research, which is self-financed in its entirety, while enabling me to get a first-hand experience of what it's like to live among the turbines.

To this point, I've visited 26 existent industrial wind projects and I've carried out over 200 interviews, lasting between one and eight hours. I've also travelled to many more locations where battles are raging over proposed wind energy developments. My work is ongoing and I am writing a book. I plan to conduct further research in New England, the upper Midwest and the UK in the not-so-distant future. I've confined my research to the English-speaking world, not only to eliminate the need for an interpreter, but also because some of the most heated fights

over wind energy are taking place in specific regions of North America, the United Kingdom and Australia.

Based on my work to date, I can state, unequivocally, that despite the popular appeal of wind energy as a "clean" "green" and "eco-friendly" energy source, the lived experience of wind energy is far more dubious. My ethnographic observations and interviews document widespread physical and social suffering of residents living amidst industrial wind turbines and an expanding network of citizens engaged in struggles for health and social justice.

Given the format of this meeting, my presentation of findings is necessarily brief. I would be pleased to elaborate in some other forum should there be an interest.

**What are people complaining about?: Sleep Loss, Exhaustion and Fatigue**

People are losing sleep because the turbines are loud. People are suffering from sleep loss and sleep deprivation. In every location I visited, there are widespread violations of noise limit ordinances, some of them egregious, and little or nothing is being done to make wind companies comply with the law.

People are getting sick from sleep deprivation and exposure to low frequency noise and infra-noise. In some cases, people are getting sick from exposure to unusual electrical phenomena, which some researchers interpret as dirty electricity or electrical pollution.

People are waking up in the middle of the night because of the loud noise of the turbines. Some are waking up in a panic state. Some are waking up with bodily organs vibrating in synch with the rhythmic swoosh of the turbine blades. Some are waking up with tingling sensations in their forearms, and quivering in their lips. Many describe a pattern, intensity and frequency of migraine headaches, which they never had before. A lot of the same people describe suffering from dizziness, nausea and vertigo. Ear pressure, ear pain and ringing in the ears are ubiquitous problems among wind project residents.

Dozens of those I interviewed described episodes of vertigo that began only after the turbines went online. One woman at the Maple Ridge Wind Project near Lowville, New York had to spend two weeks in bed after turbines went on line. She had never experienced vertigo before. The woman is in her twenties.

Another man in Thamesville, Southwestern Ontario who works as a roofer also suffered from episodes of vertigo after the turbines went on line. His home is situated beside an eight-turbine array of 2.5MW 494 foot Vestas. Because he works in roofing, his dizziness and spells of vertigo are considerable hazards on the job. Both he and his son have had to stop projects in their tracks on days when either one, or both of them, has spinning sensations that make climbing around on rooftops, life threatening. All four members of this family experience vertigo since the turbines went online. They also experience an alarming number of electrical surges in their

home after the turbines became operational. They have had several appliances destroyed by the surges. The wind company denies that the turbines have anything to do with their physical symptoms or electrical surges, but the family is convinced that a connection exists.

**Home Abandonments and Lost Jobs** Enbridge

Bill, in Kincardine Ontario also began developing vertigo with increasing frequency since the turbines went on line. He has been unable to work, and forced to stay in bed, motionless, for a week at a time. The vertigo has become so disabling that he was forced to abandon his home. Bill had no trouble sleeping amidst the turbines. The nearest one to his home was 1.7 kilometers away. But a dizzying array of 110 gargantuan turbines surrounds his home in all directions. He's convinced that he is being bombarded, from all sides, by sub-audible, low-frequency noise, which penetrates solid structures and affects inner-ear physiology, and hence vestibular function. Unfortunately for Bill, as well as residents of Michigan, the low frequency component of wind turbines noise is unregulated and unmonitored in most places where industrial turbines are spinning.

**Job Loss: Norma, Nikki, Jerrod, Neil, Susan**

Perhaps the most tragically impacted Kincardine, Ontario resident I interviewed was Norma, who told me she lost her home, as well as her job, as a consequence of the turbines surrounding her home. Norma describes the noise they emit as "pure torture," which made her life a "living hell."

Enbridge

After the turbines became operational, Norma suffered from increasingly frequent, and severe, migraine headaches. She also had pressure and pain in her ears, and a sharp pain at the back of her head. She also experienced vertigo and nausea with increasing frequency. Her weight loss became so severe that she got down to just 98 pounds. Norma also suffered from cognitive iinpairments and found it increasingly difficult to form sentences, recall words, and to craft email messages. These impairments made it increasingly difficult for Norma to perform her duties as a faculty member at the university where she worked. She was forced to resign from her position.

Norma was one of many rural Ontario residents who lost their job after turbines arrived. Nikki, who lives in Southwestern Ontario, just north of the shores of Lake Erie, lost her job because her performance fell so dramatically after some 200 turbines surrounding her home became operational. Nikki had worked for the provincial government, monitoring workplace noise levels to protect workers' health. Despite laws limiting the noise of turbines to 45 dba at the receptor site (center of the home) Nikki measured levels as high as 68 dba in her home on bad winter nights when the wind was blowing. Field personnel from the minister of the environment came to her home at their convenience, in summer months when the wind wasn't blowing, typicallyat mid day, assuring her there were no violations of the noise limit.

Nikki's suffered from headaches, nausea and vertigo. She also experienced unusual vibrations in bodily cavities, including her pelvic area, which movied in synch with the swishing of the turbine blades. Nikki's husband, Jerrod was a construction worker before the turbines went on line. After the turbines began spinning, Jerrod had more and more difficulty sleeping. He insisted, "once you hear them, you're screwed." Totally exhausted from sleep deprivation, Jerrod fell from a ladder on a construction site, and suffered an injury that rendered him incapable of working.

Before the turbines went online Nikki and Jerrod were a happily married, twenty-something, dual-career couple with two young children. They were living their dream in a beautiful home near the shores of Lake Erie. The intrusion of a couple hundred gargantuan electricity generators in the fields surrounding their home have left them sleep-deprived, exhausted, jobless and without any income. They can no longer pay the mortgage on their home. Nikki insisted "nobody is going to want to live in the middle of two hundred industrial wind turbines."

**Losing Work in Massachusetts**

Just three turbines dot the landscape of Falmouth, on Cape Cod, in Massachusetts. But number of families have been enduring ill effects from the noise and vibration of these poorly-sited, electricity-generating machines. Two of the people I interviewed in Falmouth insist they lost their livelihoods as a result of the turbines. And one also lost her home.

Neil, an independent contractor, was grossing one million dollars in revenues annually in his construction business before the three turbine array got erected alarmingly close to his home. Both Neil and his wife became ill after the turbines went online. They suffered from sleep deprivation, exhaustion, and headaches. Neil also found it difficult to concentrate. He became incapable of carrying out the calculations needed to complete bids for potential work projects. Exhausted, depressed, and with constant headaches, Neil's work has dropped off radically since the turbines arrived. He earned just $30,000 in the year prior to the my interview. He attributes his loss of income and physical and mental incapacitation to the turbines, which funnel noise audible and low frequency noise, and infranoise, directly toward his home.

Susan lives just down the street from Neil. She, too, was a successful entrepreneur before turbines came to town. She did flower arrangements for weddings, in a home-based business, netting about $80,000 a year. Susan grew the flowers on her property and did all the arrangements herself. It was her lifelong dream to have her own business and hers was highly successful during the summer months on Cape Cod.

I met Susan in the nursing home where her mother resided since Susan no longer tolerates being in her home. Susan describes her home as acoustically toxic from the turbines. Hers is the home where Stephen Ambrose and Rob Rand carried out the McPherson Report. They too, got sick while taking acoustical measures in Susan's home.

After turbines went online, Susan became sick from headaches, dizziness, vertigo, and loss of balance. One day she lost her balance and fell flat on her face onto the sidewalk in her back garden, losing several of her front teeth. Like Norma in Ontario, Susan suffered from cognitive impairments that made it increasingly difficult for her to complete flower arrangements for weddings. Over time she was rendered incapable of doing the work. At roughly the same time she shut down her business, Susan abandoned her home. She could no longer inhabit it because its acoustical properties from turbine exposure were making her sick. At the time of the interview, Susan hoped she could sell the property to somebody who would not have to live in the house, such as a landscape supply company. Susan lost her business, her health, her home and a very large portion of the equity she had built up in her home, thanks to the three spinning turbines that the town of Falmouth placed beside a residential neighborhood, ridiculously close to homes.

**Concluding Thoughts**

Sleep lost, jobs lost, and even homes lost. This pattern kept presenting itself everywhere I went on the tour: Ontario, New York, Massachusetts, Maine, South Australia, Victoria Australia, and New Zealand. And then there are the suicides; those that came to fruition and those that were contemplated.

How much sleep will be lost in Michigan because of poorly-placed turbines? How much loss of previously good health? How many jobs will be lost as a consequence of compromised capacities, physical illness, and disability among formerly healthy, fully-functioning, able-bodies, home-owners?

How many homes will be lost after being rendered acoustically toxic by the spinning generators placed in adjacent fields? How much suicidal ideation will take place in Michigan? How many people in Michigan will consider taking their own lives as a consequence of the devastation, desperation, hopelessness, despair and depression that is all too common among victims of Big Wind?

Michigan must put a stop to the misguided and irresponsible policies that are harming human health. Setback distances in Michigan, like those of New York, are the most permissive in the world. These distances are designed to promote profits for the wind industry, rather than protect the health and welfare of citizens.

**Concluding Remarks**

My research is sociological and ethnographic. I document citizens' perspectives on their experiences, rather than clinical medical accounts of their conditions. For your edification, I'm submitting hard copies of peer-reviewed and published research documenting the adverse health impacts of audible noise pollution as well as low frequency noise and infra-noise, emitted by

industrial wind turbines. A recent court testimony of Australia physician, Sarah Laurie, and the documents submitted along with her testimony, should be of particular interest.

**I'll conclude with three suggestions:**

First, before jumping on the bandwagon of believers who think that Industrial Wind Energy is Clean, Green and Eco-Friendly, I advise taking a long walk out of the suburbs and cities, to the nearest industrial wind development in a rural area that has been colonized by a colossal fleet of turbines that are actually spinning and generating electricity. Speak with the residents of the footprint area of that project, focusing, in particular, on those who receive no remuneration for living amidst the turbines. These "non-participating neighbors" have not signed contracts with wind companies, so they are not bound, by contract, to refrain from speaking openly about their experiences. Non-participating neighbors will tell you the truth about wind energy.

Second, before jumping on the bandwagon of believers who think that wind energy creates jobs, remember the stories I've shared today. These are stories of sleep loss, health loss, job loss, and even home loss, as a consequence of poorly-sited industrial wind turbines. Jobs gained for any given wind project are often temporary: these include construction jobs or road crews whose signs tell people to slow down or get out of the way of the five hundred footers coming through. Many jobs are filled by folks from out of state and all are heavily subsidized by taxpayers.

Third, recognize that the worst atrocities of the wind industry have been facilitated and enabled by governments that subsidize and mandate wind energy production, while streamlining the permitting process for developers. These same governments collude with wind energy companies by neglecting to monitor or regulate noise limit violations, which took place at every project I visited. Citizens suffer, not only as a consequence of corporate greed, but also because governments are siding with global corporate giants, rather than citizens in their communities.

Our best bet for safeguarding Michigan from misguided wind development is to keep decision-making in the hands of local communities. Citizens deserve a choice and voice in matters pertaining to the zoning of wind energy in their communities.

Most importantly, we must have energy policy that is based on legitimate science and empirical evidence, rather than the talking points of the wind industry, its lobbies, or "expert" consultants. Just as wind companies have caught the subsidy-chasing bug, academics and the institutes that house them, around the world, are chasing grants made available by governments (e.g., The U.S. Department of Energy) with agendas to promote "renewables" by any means necessary. The efforts of academics such as these are less directed toward seeking and disseminating truth than in chasing and securing grant money that is available by putting a particular spin on the "reality" of renewables. The spin they generate on wind energy is a farce and a scam. I suspect that Governor Snyder is far too smart to believe it. Thank you.

**IN THE VICTORIAN CIVIL AND ADMINISTRATIVE APPEALS TRIBUNAL**
**Planning and Environment List**

No 2910 of 2012

**BETWEEN**

**CHERRY TREE WIND FARM PTY LTD**
Applicant

and

**MITCHELL SHIRE COUNCIL**
First Respondent

and

**TRAWOOL VALLEY-WHITEHEADS CREEK LANDSCAPE GUARDIANS INC**
Second Respondent

and

**ORS**
Respondents

**STATEMENT OF DR Sarah Elisabeth Laurie, CEO Waubra Foundation**

**STATEMENT OF DR SARAH ELISABETH LAURIE**

1. My name is Dr Sarah Elisabeth Laurie, and I reside in the mid north of South Australia. I was asked to submit a statement by concerned community members.

2. I am a trained rural general practitioner, and practiced clinical medicine in rural and remote areas after completing my undergraduate medical degree at Flinders University in 1994, a Bachelor of Medicine, and a Bachelor of Surgery (BMBS).

3. I subsequently completed postgraduate training, obtaining both a Fellowship of the Royal Australian College of General Practitioners, and a Fellowship of the Australian College of Remote and Rural Medicine.

4. I was asked to become an examiner for the Royal Australian College of General Practitioners, and did so in 2001. I was also a member of state council of the South Australian branch of the Australian Medical Association.

5. In 2002 I left clinical practice because of a serious medical illness requiring urgent surgery, and initially I retained my registration to continue clinical practice.

6. I was subsequently unable for personal health reasons to return to work as a clinical practitioner, because of a combination of health issues and extended family caring responsibilities including young children and frail elderly parents in law, so I chose not to renew my medical registration in 2004 until I was in a position to resume clinical practice.

7. I fully intend to return to clinical medicine in the future, however I am currently unregistered.

8. I have never been deregistered. I was informed by a resident living in the vicinity of the proposed Cherry Tree wind development that an Infigen employee had told them I was deregistered, but when challenged by the resident they changed their story.

9. I currently work in a voluntary capacity as the CEO of the Waubra Foundation.

10. The Foundation's postal address is PO Box 7112 Banyule LPO, Victoria 3804 and my phone number is 0439 865 914.

11. The foundation was established in March 2010, by the former chairman of the National Stroke Foundation, Mr Peter Mitchell, AM, after he recognised the need for urgent research to investigate the reported adverse health effects being experienced and reported to Victorian Health authorities by residents near wind turbines at Waubra.

12. At Mr Mitchell's request, I joined the Foundation initially as Medical Director in July 2010. My title was subsequently changed to Chief Executive Officer to better reflect my role.

13. The Objectives of the Waubra Foundation are attached as Annexure 1.

14. Our current directors in addition to Mr Peter Mitchell as Chairman, and myself as CEO, include Justice Clive Tadgell, formerly a Judge of the Victorian Supreme Court, the Hon Dr Michael Wooldridge, former Federal Health Minister, Mr Tony Hodgson AM, and Ms Kathy Russell, an economist and manager in a health service, who started visiting, supporting, and advocating for sick residents impacted by industrial wind turbine developments in Victoria in **June 2008**.

15. All the directors donate their time pro bono. Our activities are completely funded by concerned citizens, mostly residing in rural areas, who are appalled at the

current situation and the lack of action by all the relevant responsible authorities to address the growing public health problems associated with unsafely sited and poorly regulated noise polluting wind turbine and other developments.

16. The Waubra Foundation is frequently described in the media and by wind developers as an "anti wind" organisation, and I am personally regularly described as being "anti wind". Both assertions are untrue. For example, it is on the public record that I supported my children, then aged 4, in their march in a "Get Up rally" holding a wind turbine, supporting wind energy, in Adelaide in 2008.

17. The Waubra Foundation is primarily concerned about the adverse impacts of industrial noise on human health, with particular focus on sound and vibration in the infrasound and low frequency ranges, ie below 200 Hz.

18. Since we commenced our work with initial concerns about poorly sited large industrial wind turbines, we have been approached by, and provided assistance to, a range of people impacted by different sources of infrasound and low frequency sound and vibration energy in both urban and rural environments.

19. Rural noise sources have included gasfired power stations (eg Pt Campbell, Victoria, Uranquinty, NSW), mining activities (eg coal mines in the upper Hunter region, NSW) and compressors used in CSG operations (eg Tara, QLD).

20. Urban sources include the low frequency noise emissions from large compressor attached to a Veterinary Building at the University of Melbourne, which was affecting the health of some of the nearby residents living in an adjoining suburb of Parkville. The Parkville Resident's association submitted to the Federal

Senate Inquiry into the Social and Economic Impact of Rural Wind Farms, and I have attached their submission as Annexure 2.

21. As a result of my work in this area of public health, I have been asked to provide evidence at the two Australian Federal Senate inquiries, which investigated this issue of wind turbine noise, and I have also given evidence in and for other legal proceedings and parliamentary or government inquiries, both in Australia and in Canada.

22. My own interest in this little understood area of public health was first stimulated in March/April 2010 by learning about a proposed wind turbine development near my home.

23. That proposal has now been dropped by the wind developer, but my professional concern about the serious nature of the health problems, the way sick residents are being universally ignored by health, planning and noise pollution authorities, and the lack of specific scientific knowledge about safe exposure doses for certain sound frequencies remains, hence my ongoing work with the Waubra Foundation.

24. Dr Amanda Harry, a rural General Practitioner from Cornwall in the United Kingdom was the first Medical practitioner I am aware of who reported adverse health effects being experienced by neighbours to wind turbines. Dr Harry conducted a survey of her patients living near wind developments in 2003. Her study is attached as annexure 3.

25. Dr Harry's additional experience and post graduate qualifications in the fields of Ear Nose and Throat disorders, and the multidisciplinary assistance she received from a physicist with expertise in the field of infrasound and low frequency

noise, together with the seriousness of some of the reported symptoms made me very concerned after reading her study that there was indeed a real problem for some neighbours of industrial wind turbines.

26. It became clear with further reading that in the subsequent years since Dr Harry's study there had been little systematic population health data collection by clinical researchers. There was no information on the full spectrum of acoustic frequency exposures inside people's homes, and very little research about the adverse health effects of chronic exposure to this sound and vibration energy from wind turbines specifically. There were, however, plenty of adverse health reports from sick residents, including reports of home abandonment, both in Australia and internationally.

27. I resolved to do what I could to ensure such research was urgently conducted, in order to ensure that future planning decisions for the siting of wind developments were better informed by science.

28. The release by the Australian National Health and Medical Research Council's Rapid Review in July 2010 into this issue did nothing to allay my concerns, indeed a glance at the list of references in that document made me even more concerned, as there was an abundance of wind industry generated literature, some of which purported to be independent, but key authoritative documents and studies on low frequency noise, sleep deprivation at its consequences and the impacts of environmental noise were nowhere to be seen. This Rapid Review document has since been extensively criticised nationally and internationally, and the NHMRC are currently conducting another review.

29. The CEO of the NHMRC has since admitted during oral testimony on March 31st 2011 at the first Federal Senate Inquiry that *"we do not say that there are no ill effects"*, a position which the judges in a court case in Ontario agreed with in July 2011, when they found that "*This case has successfully shown that the debate should not be simplified to one about whether wind turbines can cause harm to humans. The evidence presented to the Tribunal demonstrates that they can, if facilities are placed too close to residents*"

    (Environmental Review Tribunal, Case Nos.: 10-121/10-122 Erickson v. Director, Ministry of the Environment, Dated this 18th day of July, 2011 by Jerry V. DeMarco, Panel Chair and Paul Muldoon, Vice-Chair, http://www.ert.gov.on.ca/english/decisions/index.htm.)

30. It was at this time when the NHMRC released their Rapid Review in July 2010, that I was first approached by Mr Peter Mitchell to work with the organisation he had established a few months earlier, initially called the Waubra Disease Foundation, as that was the name the Victorian Press were using at the time to describe the symptoms.

31. When I first became aware of the proposed wind development near my own home, I also sought the advice of acousticians with experience of wind turbine noise working in Australia and internationally, in order to determine whether or not based on current acoustic knowledge my family and I would have a problem.

32. I learnt from them and others of work which had already been carried out in Australia, New Zealand, the US, the UK and in Europe. Those acousticians included Professor Colin Hansen, from Adelaide University, and Dr Bob Thorne, from Noise Measurement Services based in Brisbane, also associated at the time with Massey University in New Zealand. It was not reassuring.

33. I also spoke with some of the residents whom Waubra Foundation director Kathy Russell, or Dr Thorne or Professor Hansen had previously been in contact with, and I was subsequently contacted by other residents who requested I visit their communities to share my growing knowledge of the problems with them.

34. I attended the first Symposium into the Adverse Health Effects of wind turbines held in Ontario in October 2010, to learn as much as I could about the problems from other scientists, health professionals and acousticians interested in the area, and also from the sick residents who also attended this symposium from the US and Canada. My husband and neighbours funded this trip.

35. During this trip I met with numerous Canadian families, who all described the identical range but individually different symptoms and health problems in the characteristic pattern of worsening with increasing exposure but improving when they moved away, to those I had been previously told about in Australia, particularly by residents at the Toora and Waubra wind developments.

36. All the residents I spoke to had the identical patterns of being symptom free prior to the start up of the adjacent wind project, subsequently developing symptoms which correlated with exposure to operating wind turbines and wind direction. Their symptoms varied between members of the same household, but the pattern was consistent in that their individual symptoms worsened over time with ongoing exposure, and improved when away from their homes.

37. Some of these Canadian families had been forced to leave their homes, and some had spent time in motels, paid for by the wind developers. Some had signed confidentiality agreements, prohibiting them from speaking publicly about their

health problems. I had previously been told of this practice of silencing sick people in Australia at Toora and Waubra.

38. I also met with a public health doctor at the Grey Bruce Health Unit who had publicly expressed her concerns about what was happening to rural residents living near wind developments in Ontario, Dr Hazel Lynn. Dr Lynn chose to speak out about her concerns despite the Chief Health Officer of Ontario, Dr Arline King, issuing a report, widely used by the wind industry, which essentially denied there was any evidence of a health problem from wind turbine noise.

39. Dr King has recently been subpoenaed to attend court in Ontario to explain how she came to her stated position, as it has emerged that numerous Ontario families had sent detailed reports to her department advising her of the serious nature of their health problems, and that field officers in the Ministry of the Environment, responsible for noise pollution regulation from the wind turbines, had also made their concerns clear to more senior government officials.

40. I visited Toora in South Gippsland in October 2010, and met with Dr David Iser, an experienced and highly regarded rural medical practitioner who was the first Australian medical practitioner to speak publicly of his concerns and conduct his own research locally at Toora in 2003/4, based on Dr Amanda Harry's initial survey.

41. Dr Iser first raised his concerns in 2004 about his longstanding patients' new symptoms, which coincided with the commencement of operation of the Toora wind development, with the Victorian Government and the Victorian Health authorities. I have attached his letters to then government ministers, his survey questionnaire and other material at annexure 4.

42. It is clear from information submitted to parliamentary inquiries and from media reports out in the public domain both in Australia and internationally that the identical range of adverse health problems resulting from exposure to operating wind turbines have been reported by residents and concerned health and acoustics professionals for a number of years **prior to** my own awareness of the problems and active involvement in advocating for research, which commenced relatively recently in July 2010.

43. The wind industry and some public health academics with no clinical experience in this area, frequently assert in Australia that the symptoms being reported are caused by the "nocebo" effect, by which they mean the Waubra Foundation's ongoing community education program about the reported symptoms and problems being reported by residents impacted by infrasound and low frequency nose from a number of sources, which they also refer to as "scaremongering".

44. There is no research evidence collected from rural residents living near wind developments in Australia or anywhere else in the world to support this assertion that the symptoms reported by these sick residents are **caused** by knowledge about the reported health problems.

45. There is, however, human and animal research in the fields of infrasound and low frequency noise, which provide direct empirical experimental evidence that both infrasound and low frequency noise can cause a range of physiological stress effects and symptoms, many of which are also being reported by wind turbine residents. Sound in those frequencies is now being measured inside the homes of sick people, and preliminary data is showing direct correlation between certain frequencies and specific symptoms.

46. One useful literature review detailing research into infrasound was conducted in 2001 by the United States National Institute of Environmental Health Sciences, with the title " Infrasound – Brief Review of toxicological Literature". It is attached as annexure 5. Some of the animal studies listed show evidence of a physiological stress response, although generally the doses of infrasound are higher than those extremely limited data sets of full spectrum acoustic measurements inside and outside homes at existing wind developments, but the exposure durations are very short, in comparison to living 24/7 for 25 years beside a wind turbine development. The report makes it clear that there are significant knowledge gaps with respect to chronic exposure to infrasound at lower "doses" particularly, stating: *"Examples of critical data gaps include a lack of high quality long-term experimental studies of infrasound, and inadequate characterization of environmental infrasound and accompanying higher frequency sound levels in community settings*"

47. The second relevant literature review was conducted in 2003 by Dr Geoffrey Leventhall, for the Department of Food, Environment and Rural Affairs, with the title "Review of Published Research on Low Frequency Noise and its Affects". This review contains some very useful information about the then known physiological stress connections with low frequency noise exposure, one example given is of measured cortisol elevation in sleeping children exposed to truck low frequency noise, and confirms that wind turbines were known in 2003 to be a source of infrasound and low frequency noise. The review is attached as annexure 6.

48. There is also plenty of evidence that the reporting of symptoms for many residents at wind developments in Victoria such as Toora, Waubra and Cape

Bridgewater **preceded the establishment of the Waubra Foundation**. In the case of Dr David Iser's patients at Toora the time elapsed is some 6 years, and similarly Dr Amanda Harry's patients in her survey from the UK, which immediately preceded Dr Iser's work.

49. With respect to the impact of the Toora wind development on its neighbours, I have been advised by Dr Iser that a number of his severely affected patients left the district, having been bought out by the wind development operator at the time.

50. These former Toora residents are now restricted from talking publicly about their health problems, because of a confidentiality clause in their agreement with the wind developer.

51. I have also been advised that some homes at Toora were relocated or bulldozed, and that in these homes, residents had reported seeing vibrations in their cups of tea and glasses of water. Acousticians I work with tell me this is evidence of sound frequencies well below 200 Hz, in the infrasound and low frequency noise ranges being present within the homes. One of the homes where this vibration was reported at Toora, was subsequently bulldozed by the wind development owner, after the home was purchased from the sick resident.

52. I was advised the law firm used by the sick residents from Toora to negotiate with the wind development owner was Slater and Gordon. The use of confidentiality agreements under these circumstances was confirmed by Mr James Higgins, the General Manager of Slater and Gordon, in a letter to the Australian newspaper dated 4th May, 2011. In that letter, Mr Higgins stated the following: *"We have acted for landowners who have been affected by the*

*operation of nearby windfarms"*. Higgins went on to state that *"Any confidentiality clauses associated with some compensation claims have not been made at our direction. Such clauses are required by the wind farm operators and are typically required in these types of settlements."*

53. I am concerned about the inevitability of serious adverse health impacts of this particular proposed Cherry Tree wind development on many of the neighbours, over the lifetime of the project, based on my knowledge of the adverse sleep and other health impacts of large wind turbines sited in close proximity to homes, in similar terrain, reported publicly in the media and in formal government inquiries, and privately to me by residents at numerous wind developments both in Australia and internationally.

54. Characteristic symptoms such as the "repetitive night time waking in a panicked state" or waking up exhausted for no obvious reason, correlating with wind and weather conditions consistently observed by the resident and acousticians to correlate with this pattern of sleep disturbance, have been reported out to 10km from existing wind developments such as at Waterloo in South Australia, where the larger 3MW VESTAS V90 wind turbines have been used. I understand wind turbines larger and more powerful than these are proposed for Cherry Tree Wind Development.

55. Community noise impact surveys have been carried out by two Australian concerned rural citizens following some disturbing results obtained from a similar population noise impact survey carried out by a Masters student from Adelaide University, Zhenhua Wang, at Waterloo.

56. Mr Wang surveyed all households within 5km of wind turbines at the Waterloo wind development, and found that over 50% of residents who responded were moderately or very affected by the wind turbine noise, with 38% stating they had adverse health effects including sleep deprivation and headaches. 75 surveys were distributed, and 48 returned, given a 64% response rate, which I am told by researchers who have published in this area that this is considered a very good response rate for this type of study.

57. Mr Wang was awarded his degree on the basis of this research, but unfortunately the original masters dissertation has not ever been made publicly available, for reasons which have never been explained to the participating residents of Waterloo by either Mr Wang or Adelaide University. The briefing summary written by Mr Wang is attached as annexure 7.

58. This study by Mr Wang is the only one of its kind in the world, which has looked at the impact of larger wind turbines such as the VESTAS 3MW on a rural population.

59. Mrs Mary Morris from Waterloo repeated Frank Wang's survey questionnaire out to 10km in the same location, and found that the adverse noise and sleep impacts for some people extended out beyond 5km to 10km.

60. Mrs Morris is a 5th generation farmer in the area and knew of people including wind turbine hosts who were reporting their health and sleep was affected by the wind turbines at Waterloo, and in particular Mrs Morris knew of people well beyond 5km who were also having problems who were not included in Mr Wang's study. Mrs Morris's survey report is attached as annexure 8.

61. Mrs Patina Schneider repeated a similar community noise impact survey out to 7.5km from 2MW wind turbines at Cullerin Range in New South Wales, and found that at that distance, after nearly four years of operation, 76% of households reported sleep disturbance due to the wind turbines (71% survey response rate). Mrs Schneider's survey report is attached as annexure 9.

62. This important work by both Mrs Morris and Mrs Schneider will no doubt be dismissed by the wind industry and its advocates as biased, as both women are impacted by proposed wind developments. However they cannot be dismissed quite so easily when these surveys are considered along with the evidence from many rural residents to two Federal senate inquiries, two state inquiries (NSW and SA), the results of Frank Wang's survey, and the lack of publicly available completed and published peer reviewed university research which proves that their survey data is wrong or invalid.

63. This evidence from the residents near large wind turbines reporting sleep problems out to greater distances with larger wind turbines is supported by acoustic evidence from Professors Moller and Pedersen's peer reviewed published research paper from 2011 which demonstrated that the size of the turbine is related to the amount of low frequency noise generated, and the consequent "annoyance" for the neighbours. Acoustic engineers have historically called sleep disturbance and a range of other symptoms known by them to be associated with low frequency noise "annoyance". Professor Moller stated that *"The relative amount of low-frequency noise is higher for large turbines (2.3–3.6 MW) than for small turbines (≤ 2 MW), and the difference is statistically significant."* That paper is attached as annexure 10.

64. I have now listened to detailed symptom reports from over one hundred and twenty rural residents in Australia affected by operating wind turbines, and have a good understanding of the range of pathology, the individual variability in expression of symptoms, and the pattern of inevitable deterioration with ongoing exposure once people become sensitised.

65. My knowledge has also been informed by discussions with some of the treating health practitioners, being general practitioners, sleep physicians, psychologists, occupational physicians, and researchers and acoustic colleagues working in this area internationally in both clinical practice and research, and from my knowledge of the relevant research literature.

66. The symptoms reported to me by residents exposed to wind turbines primarily include symptoms related to acute and chronic sleep deprivation and its consequences, symptoms of acute and chronic physiological and psychological stress, and symptoms of vestibular disorders.

67. US epidemiologist Professor Carl Phillips has noted the connection with stress related disorders in his peer reviewed published paper on the subject, titled "Properly Interpreting the Epidemiological Evidence about the Health Effects of Industrial wind turbines on Nearby Residents" which is attached as annexure 11.

68. In the abstract of that paper, Professor Phillips states : *"There is overwhelming evidence that wind turbines cause serious health problems in nearby residents, usually stress-disorder type diseases, at a nontrivial rate. The bulk of the evidence takes the form of thousands of adverse event reports. There is also a small amount of systematically-gathered data. The adverse event reports provide compelling evidence of the seriousness of the problems and of causation in this case because of their volume, the ease of observing exposure and outcome*

*incidence, and case-crossover data. Proponents of turbines have sought to deny these problems by making a collection of contradictory claims including that the evidence does not "count", the outcomes are not "real" diseases, the outcomes are the victims' own fault, and that acoustical models cannot explain why there are health problems so the problems must not exist. These claims appeared to have swayed many non-expert observers, though they are easily debunked. Moreover, though the failure of models to explain the observed problems does not deny the problems, it does mean that we do not know what, other than kilometers of distance, could sufficiently mitigate the effects. There has been no policy analysis that justifies imposing these effects on local residents. The attempts to deny the evidence cannot be seen as honest scientific disagreement, and represent either gross incompetence or intentional bias"*

69. In addition to symptoms and consequences of sleep deprivation, stress and vestibular disorders, residents also consistently report that some of their pre-existing medical and psychiatric conditions worsen with exposure to operating wind turbines, but improve when either the turbines stop turning, when the wind is in a different direction, or when they are away from their home and not exposed to other sources of infrasound and low frequency noise.

70. Given the extensive and longstanding peer reviewed published clinical research detailing the known interconnections and associations between chronic sleep deprivation, stress and numerous clinical disorders including ischemic heart disease, hypertension, diabetes, immune suppression resulting in increased infections and malignancies (cancers), depression, and anxiety, this observation of these particular preexisting symptoms and health problems worsening with exposure to wind turbine noise is not surprising to clinicians and mental health

professionals when they understand the way infrasound and low frequency noise, regardless of the source of the noise, are known to affect health via the physiological and psychological stress pathways.

71. When that wind turbine related noise pollution is occurring at night, and people are reporting their sleep is disturbed, even if the precise causative low frequencies are not known, the adverse health consequences from this widely reported sleep disturbance from exposure to operating wind turbines are well known, predictable, and inevitable. It is no surprise this is now being reflected in some of the emerging research literature where data is being collected from sick residents.

72. A relatively recent meta analysis of the impact of chronic sleep deprivation on cardiovascular disease, published in the European Heart Journal in February 2011 is attached as annexure 12. That meta analysis states "*Lack of sleep exerts deleterious effects on a variety of systems with detectable changes in metabolic, endocrine, and immune pathways. Too little or too much sleep are associated with adverse health outcomes, including total mortality, type 2 diabetes, hypertension, and respiratory disorders, obesity in both children and adults and poor self-rated health*"

73. A review of the widely damaging impact of chronic stress on health by a leading researcher in this area, Bruce McEwen, was published in the New England Journal of Medicine in 1998, and since 1998 the evidence continues to mount about the deleterious effect of chronic stress on physical and mental health and well being. That review is attached as annexure 13.

74. This characteristic pattern of symptoms varying directly with exposure to operating wind turbines is entirely consistent with reports from rural residents exposed to operating industrial wind turbines around the world, and is consistent with the recent clinical and acoustic reports from my health and acoustic colleagues, particularly from the following: Dr Nina Pierpont, American Paediatrician, Dr Robert McMurtry, (former Dean of the Medical and Dental School of Western Ontario), Ms Carmen Krogh, a retired senior Pharmacist from Health Canada who has conducted extensive field research in Ontario, and acousticians such as Dr Bob Thorne, Mr Steven Cooper, Mr Rob Rand and Mr Stephen Ambrose from Maine, USA, and Mr Rick James, from Michigan.

75. Dr Bob McMurtry has published a peer reviewed paper with a proposed Case Definition, to extend the work started by our clinical colleagues Drs Harry, Iser, and Pierpont, and to take into account the additional knowledge from his interviews with many affected residents in Ontario, Canada and his experience watching their symptoms progressively deteriorate with ongoing exposure. That paper is attached at annexure 14.

76. I have learnt that what acousticians call "annoyance" medical practitioners listening to the same reported symptoms described by the residents may describe as "serious clinical pathology", particularly in the case of sleep and stress related symptoms if the effects are cumulative. Dr Nina Pierpont also identified this issue some years earlier.

77. As medical practitioners are not acousticians it is not surprising that using terms such as "annoyance" has resulted in continuing ignorance amongst our medical colleagues about what is meant by the term "annoyance" in the acoustic research literature, if they have time to read these papers.

78. Currently, the groups of medical practitioners who may have some awareness of the problems with infrasound and low frequency noise exposure are those working in the military, the aviation industry, occupational physicians looking after workers exposed occupationally to low frequency noise and vibration, and ear nose and throat specialists who look after patients with vestibular disorders.

79. Rural General Practitioners are the first to see these patients affected by operating wind turbines, and it is my observation that they rarely have any knowledge or specific training in this field of medicine, as it is not a core part of our work, unlike occupational physicians or ear nose and throat specialists. Rural doctors are often extremely busy, and if they are part of a large medical practice they may only see one or two patients living near wind turbines who are experiencing problems, so may be unaware of the relevant body of knowledge which does exist, even though it is limited.

80. Closer collaboration and communication between knowledgeable and industry independent health and acoustic professionals locally and internationally, as well as the work of neurophysiologists such as Professor Alec Salt from Washington State University, is now helping to overcome these communication and conceptual barriers between acousticians and health practitioners to better understand the range and severity of health problems the residents are reporting, and their connections with exposure to operating wind turbines or other sources of infrasound and low frequency noise and vibration.

81. The evidence of the suspected direct causal relationships between specific low frequency emissions from the wind turbines and specific symptoms has recently strengthened with the case study reported by Associate Professor Con Doolan in

November 2011, in a paper titled "Characterisation of noise in homes affected by wind turbine noise".

82. Acoustic and "annoyance" data with a scale for severity of symptoms was collected from a resident and inside their home 2.5km from turbines at the Waterloo wind development in South Australia. It was found that symptoms of "annoyance" were related in time and severity to the presence and "dose" of specific low frequency sound energy present at the time the resident perceived and reported the symptoms.

83. The data collection in this case study was limited in its collection of infrasound frequencies, as it did not include frequencies between 0 – 10 Hz because the acoustic equipment used did not have that capacity to detect and record those frequencies. However with respect to the frequencies between 10 – 30 Hz, the following was stated ""*Measurements taken in a single resident's home near a wind farm show an increase in the overall mean Z (unweighted) and C weighted sound level with Annoyance rating. No increase was, however, observed in the mean A weighted sound level and this is due to the majority of the acoustic energy being contained in the lower frequencies. In particular, the energy levels within the 10-30 Hz band were observed to increase with Annoyance rating.*"

84. The resident was unaware of the acoustic emissions at the time, and so was "blinded" to the acoustic results. This study is attached as annexure 15.

85. The improved understanding of the physiology behind the inner ear's response to infrasound and low frequency noise has been greatly assisted by the work of physiologist Professor Alec Salt and his colleagues from Washington State University.

86. A recent paper presented by Professor Salt in August 2012 in New York, titled "Perception-based protection from low-frequency sounds may not be enough" showed that the inner ear of mammals is much more responsive to sound frequencies below 20 Hz than previously thought, especially where there is little concurrent sound present in higher frequencies. Professor Salt has suggested that based on his research, thresholds of safe exposure for infrasound such as is emitted by industrial wind turbines may be much lower than has historically been assumed by many acousticians to be safe, based on historic perception thresholds. That paper is attached as annexure 16.

87. British acoustician Dr Malcolm Swinbanks shares Professor Salt's concerns about the inadequacy of the current perception thresholds to protect health. At the same New York Conference, Dr Swinbanks referred to a paper from Chinese researchers in 2004, demonstrating that in an experimental situation, infrasound resulted in both physiological changes (blood pressure elevation and increase in heart rate) and symptoms such as nausea, at levels which were below the current perception threshold used to assert that levels below that threshold were "safe" and did not cause those physiological effects. This is confirmatory experimental evidence from almost 10 years ago that these perception thresholds were not appropriate and needed to be much lower. Both the Swinbanks paper and the Chinese research paper are attached as annexures 17 and 18.

88. An acoustic environment full of infrasound and low frequency sound energy but without much concurrent audible noise is precisely the scenario in quiet rural environments inside well insulated homes in the vicinity of wind developments with large industrial wind turbines operating. When it is also understood that infrasound and low frequency noise sound energy is far more penetrating and

attenuates far more slowly than audible sound, it helps explain why some people are reporting the characteristic sleep disturbance and vibration symptoms related to infrasound and low frequency noise energy on occasions out to 10km from the nearest wind turbine.

89. One such home was measured by Australian acoustician Steven Cooper, who recorded the characteristic wind turbine acoustic signature in a home 8km from the nearest 3MW wind turbine in Waterloo in South Australia, where the residents experience some of the characteristic symptoms, including sleep disturbance. That data is at figure 10 in attachment 19, in a paper by Steven Cooper with the title : "Are wind farms too close to communities".

90. I know the occupant of that house well. The resident in that home has changed from being an ardent wind turbine supporter, who worked on the initial wind turbine development at Waterloo, to deciding to forego the income from 6 turbines himself as he doesn't want the symptoms for his family to worsen, and nor does he want to harm the health of his neighbours.

91. The acoustic survey performed at the home in Falmouth, Massachusetts by Robert Rand and Stephen Ambrose, and first reported in December 2011 in the document titled "Bruce McPherson Infrasound and Low Frequency Noise Study" also provided useful information with respect to the difference in the acoustic environment inside and outside the home while the wind turbine was operating. The document is attached at annexure 20.

92. Rand and Ambrose found that taking concurrent full spectrum acoustic measurements revealed that there was far more energy in the infrasound and low frequency noise section of the sound spectra inside the home than outside, and

likened the inside of the home to being like being within an acoustic drum, because of the way the lower frequencies resonated.

93. Rand and Ambrose also found, unexpectedly, that they both became ill with the identical pattern of symptoms characteristic of exposure to operating wind turbines, and had to get out of the house in order to obtain relief from the symptoms. Both took some time to recover from just three days exposure. The Falmouth resident has since abandoned her home because of deteriorating health. Rand is now sensitised, and reports the symptoms he experienced at the Shirley wind project in December 2012 in his report at annexure 23 (see below).

94. Further evidence of the role of infrasound between 0 – 10 Hz may be playing in the direct generation of symptoms such as nausea and headaches has come from the results of a recent acoustic survey at the Shirley wind project, Wisconsin. There was clear evidence of infrasound at 0.7 Hz and its harmonics, emitted by the operating wind turbines, generated as the blade passes the tower, called the "blade pass frequency". The joint report of the four acousticians, and the reports by Dr Paul Schomer and Mr Rob Rand are attached as annexures 21, 22 and 23.

95. On the basis of the data collected, four firms of acousticians including those working for wind developers and those working for sick residents as well as a very senior member of the acoustics profession in America who has worked for both wind developers and residents (Dr Paul Schomer) signed a common report, which amongst other things stated the following: "*The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that*

*wind turbine levels are magnitudes below the threshold of hearing at low frequencies".*

96. Thus there is very recent empirical acoustic survey data, from the US and Australia, which clearly demonstrates that wind turbines emit sound in frequencies below those currently being measured by the usage of dBA, which have the potential to cause symptoms in some people, and the potential to cause harm to health from the cumulative sleep deprivation effects alone, long described as the most prevalent "annoyance" let alone symptoms induced by physiological or psychological stress, or vestibular disorders.

97. The current practice by wind developers and noise regulatory authorities of relying solely on dBA for noise impact predictions and noise measurements has therefore been demonstrated to be inadequate, as dBA will not measure either the infrasound frequencies (0 – 20 Hz) or low frequency noise (20 – 200 Hz), and as Associate Professor Con Doolan has shown, reported annoyance bears no relationship to dBA, but *"the energy levels within the 10-30 Hz band were observed to increase with Annoyance rating".*

98. Both infrasound and low frequency noise frequency ranges are considered by these acousticians and others including scientists and health professionals working in the field to be implicated in directly causing the pathology and symptoms being reported by the sick residents, on the basis of current knowledge and research.

99. There is general agreement amongst acousticians, health professionals and other researchers independent of the wind industry with direct personal knowledge of the problems reported by the residents that further multidisciplinary research is

urgently required in order to determine human safety dose response curves, both for acute short term exposures and longer term exposures relating to infrasound, low frequency noise and vibration emissions from these wind turbines. This is particularly important given the reported and observed deterioration of the physical and mental health of residents with ongoing exposure to operating wind turbines, once they have developed initial symptoms of exposure.

100. This deterioration in health with ongoing exposure to infrasound and low frequency noise has been reported for 10 years. It was noted by Dr Leventhall, in his previously mentioned 2003 report to the UK Government's DEFRA (annexure 6).

101. On page 60, in his concluding remarks, Leventhall stated "*There is no doubt that some humans exposed to infrasound experience abnormal ear, CNS (central nervous system) and resonance induced symptoms that are real and stressful. If this is not recognised by investigators or their treating physicians, and properly addressed with understanding and sympathy, a psychological reaction will follow and the patient's problems will be compounded. Most subjects may be reassured that there will be no serious consequences to their health from infrasound exposure, and if further exposure is avoided they may expect to become symptom free.*"

102. Evidence showing the deterioration in people's health over time by comparing pre exposure status with post exposure status has not yet been collected in a systematic way at any wind development, so there is little comparative data, with the exception of Dr Nina Pierpont's peer reviewed study, which clearly showed deterioration in those residents, which ceased when they removed themselves from exposure by leaving their homes.

103. The Waubra Foundation urged staff in the Victorian Department of Health to start collecting this pre exposure health data prior to Hepburn Wind's turbines commencing operation at Leonard's Hill, and subsequently from AGL/Meridian Energy's Macarthur wind development turbines commencing operation recently, but according to the residents the Victorian Department of Health have not done so. Some residents are ensuring their own family doctor does a thorough pre construction health check, documenting their health status prior to the start up of the wind project in their area.

104. Residents at both these newer wind developments have publicly and privately reported serious health problems and some have reported temporary (in the case of Macarthur) or even permanent home abandonment (in the case of Hepburn Wind) for symptom relief.

105. The wind turbines at Macarthur are the largest in Australia, being VESTAS V112's, and are not yet properly commissioned. Yet already the characteristic symptoms of the typical repetitive sleep disturbance and body vibrations, have been reported to me by families who live out to six kilometres away from the nearest wind turbine, some of whom have also spoken out in the media. For some, the symptoms started within days of first being exposed, consistent with the reports from residents and other clinicians from elsewhere in Australia and internationally.

106. Dr Bob Thorne's recent self-funded study submitted to both the recent Federal Senate inquiry into proposed legislation to better regulate "excessive noise from wind farms" and for peer review prior to publication in an international journal, has provided vital information about the health status of individuals who have lived near 2 Victorian wind developments for over two years. Some of those

individuals were forced to leave their homes, some permanently, because of the seriousness of the health problems, which they developed with exposure to operating wind turbines.

107. Dr Thorne's study is unique, in that it combined acoustic measurements at certain homes, with collection of clinical data using standardised validated questionnaires. This had not been done previously, and gives some idea of acoustic exposures inside the homes, however Dr Thorne was unable to collect frequencies down to the blade pass frequency level such as were collected in the Wisconsin study.

108. The questionnaires chosen by Dr Thorne were based on those used in two previous peer reviewed published studies, being work of Dr Daniel Shepherd et al, published in October 2011, and Dr Michael Nissenbaum et al, published in October 2012, attached as annexures 24 and 25.

109. Dr Thorne's data confirmed the previous findings from both studies above with respect to the existence of significantly disturbed sleep in neighbouring residents, using an internationally recognised sleep quality questionnaire called the Pittsburgh Sleep Quality Index. Dr Thorne's study is attached, at annexure 26.

110. Dr Thorne's results replicated Dr Nissenbaum's findings of mental health problems in residents exposed to wind turbines. The scores were extremely low, indicating that in these people, there was a very disturbing level of mental health pathology, which is precisely what the residents have been reporting themselves. The wind turbines in all three studies mentioned above were much smaller than those proposed for Cherry Tree Wind Development, meaning that the distance of

effect will be much greater should the Cherry Tree wind development be approved.

111. In addition, when the health of individuals in Dr Thorne's recent case series exposed to wind turbines was compared to data collected from patients hospitalised for depression, the health of the turbine exposed group was noticeably worse on every indicator of health, including domains of physical, mental, social and environmental.

112. Hospital inpatients generally have the worst scores on these indicators, indicating the seriousness of the pathology being experienced by these wind turbine exposed residents, which is consistent with their adverse health event reports and the reports of their clinicians.

113. The pattern of onset of symptoms is variable for each individual, even within the same household with apparently similar exposures. Reports of changes in their health from rural families in Australia to me directly are consistent with the clinical findings of medical practitioners such as Dr Nina Pierpont (USA), Dr Amanda Harry (UK) and Dr McMurtry (Canada). This is to be expected with any disease process in a population, but also because of the known individual variation with respect to perception of sound.

114. Predictors of increased risk of developing symptoms with exposure to operating wind turbines were identified by American Paediatrician Dr Nina Pierpont in her peer reviewed, case series, cross over study published in 2009. Dr Pierpont collected data documenting health status and medical problems for individuals prior to exposure to operating wind turbines, followed by a detailed clinical history of symptoms while exposed, followed by a detailed clinical history of

symptoms when people reduced their exposure to operating wind turbines by leaving their homes. A clear pattern of symptoms relating to exposure to operating wind turbines was evident.

115. The predisposing risk factors identified by Dr Pierpont include having a pre existing problem with motion sickness, inner ear pathology, or a clinical history of migraines. The elderly and the very young appear also appear to be more vulnerable to developing symptoms early. Dr Pierpont's findings are consistent with the clinical reports I have been given by Australian residents, and invariably those who reported a rapid onset of symptoms with early exposure fitted into one of the five groups mentioned above (child, elderly, motion sickness, migraines or inner ear pathology).

116. Dr Geoffrey Leventhall, the acoustic consultant often used by the wind industry, has acknowledged Dr Pierpont's contribution in this area of identifying people susceptible to the effects of "environmental noise" whilst giving evidence under oath in Canada (personal communication with Eric Gillespie, Ontario Lawyer).

117. One of Dr Nina Pierpont's Peer Reviewers for her study was Dr Owen Black, a senior Otolaryngologist (Ear Nose and Throat Specialist) with extensive experience of treating vestibular disorders and knowledge of pathology related to low frequency noise exposure from his work with the American Navy and with NASA. Dr Owen Black's affidavit for a court case from 2009 in the USA is attached as annexure 27.

118. Over time with ongoing exposure the symptoms worsen in each individual. This worsening of symptoms with ongoing exposure to low frequency noise, was also

reported by Dr Geoffrey Leventhall, in his report to the UK Department of Environment Food, and Rural Affairs, in 2003.

119. There is no evidence that people habituate or "get used to" the effects, rather the clinical evidence is that people do not habituate, rather they deteriorate until they remove themselves from exposure after which many of their symptoms and health problems start to improve. This is consistent with the pattern identified by multiple clinicians and acousticians previously mentioned.

120. It is consistently reported by the residents that the longer the period of exposure, the longer it takes for their symptoms to improve with cessation of exposure.

121. By far the most commonly reported problem by the residents is repetitive sleep disturbance, resulting in cumulative sleep deprivation and consequent exhaustion with ongoing exposure to operating wind turbines. The significance of this problem has been confirmed in the peer reviewed published studies of Dr Daniel Shepherd, and Dr Michael Nissenbaum, and in the recently completed study of residents at two Victorian wind developments by Dr Bob Thorne, previously mentioned.

122. The sleep disturbance can be many times in the same night, and is reported by the residents to be related to wind direction, with the worst experiences being reported to be when the residents are downwind from the operating wind turbines, and particularly bad in certain homes on those nights where they are downwind of a line of wind turbines.

123. Some residents also report experiencing an effect when they are upwind from the wind turbines. Acoustic field measurements performed by Mr Steven Cooper

have confirmed the presence of the characteristic wind turbine signature with infrasound and low frequency noise components upwind of the turbines.

124. Many residents report not being able to see or hear the wind turbines when they wake up with the characteristic symptoms, especially if they are at a considerable distance from the wind turbines. However in my experience from staying and visiting these people, their predictions from inside their homes, about turbine operation and even wind direction, solely on the basis of the symptoms they have at a particular time, when they cannot see or hear the turbines, are remarkably accurate.

125. Some residents report being woken by the audible wind turbine noise on occasions, particularly on nights with cold night air, which acousticians report is consistent with what they describe as the "temperature inversion effect" where audible noise in quiet rural areas is noted by residents to travel for greater distances.

126. I am aware that the World Health Organisation recognises sleep disturbance as an adverse health effect. In its Night-time noise guidelines for Europe (2009) it states at pXII that *"sleep is a biological necessity and disturbed sleep is associated with a number of adverse impacts on health"*. The guidelines go on to state that: *"While noise-induced sleep disturbance is viewed as a health problem in itself (environmental insomnia), it also leads to further consequences for health and wellbeing"*. One example of a consequence is the previously mentioned links between cardiovascular disease and chronic sleep deprivation, which were confirmed by Professor Capuccio's meta analysis, previously mentioned and attached as annexure 12.

127. The Federal Senate of the Commonwealth Parliament made numerous recommendations in June 2011 for urgent multidisciplinary research to be conducted into wind turbine noise and adverse health effects, which included the measurement of sound frequencies inside affected resident's homes.

128. The Waubra foundation has long advocated that a precautionary distance of 10km must be adopted for new turbine developments, especially those planning to use the larger wind turbines, on the basis of clinical reports of sleep deprivation out to that distance at existing wind developments, until this research is conducted. Our Explicit Cautionary Notice is attached at annexure 28.

129. The evidence since we issued our Explicit Cautionary Notice in June 2011 has continued to mount that there are serious concerns, and that infrasound and low frequency noise are implicated directly in causation of these health problems.

130. In May 2012 the Waubra Foundation called for the full acoustic spectrum to be measured at all wind developments, with our Acoustic Pollution Guideline Requirements document attached as annexure 29.

131. The recent findings in Australia at Waterloo and the United States at the Shirley wind project now make that imperative at all existing and future wind developments, as part of ongoing monitoring in addition to the required research. It is our firm position that such acoustic monitoring results must be mandatory, transparent, out in the public domain, and available in real time to all parties.

132. I believe that the research recommended by the Federal Senate in June 2011 must be performed before any more turbines are constructed within 10km of human habitation.

133. I have not found any scientific or other evidence to show that a 2 km turbine setback from homes, such as currently exists in Victoria, is enough to protect people from low frequency noise and infrasound, especially from the larger wind turbines increasingly being used by the wind industry, indeed experienced acousticians such as Professor Phillip Dickinson with nearly 60 years experience have suggested 5 – 10 km would be more appropriate. He stated at the conclusion of a recent paper which heavily criticised the New Zealand standard and restated the importance of sleep, "*One easy solution for solving the noise problem and protecting public health, is a ruling that no wind farm sound emission shall exceed 30 dB ($L_{Aeq,10mins}$) at any residence, nor exceed 20 dB ($L_{Aeq,10mins}$) in total in the frequency bands 31.5 to 125 Hz. A very simple way of achieving this, and of eliminating the need for any further involvement by the territorial authority, would be to make a ruling that no wind farm shall be situated less than say 5 to 10 kilometres away from any residence unless the occupant agrees in writing for this condition to be waived*". The paper is attached as annexure 30.

134. There are valid concerns expressed by acousticians and clinicians, on the basis of clinical and resident adverse health event reports, population noise impact surveys and acoustic measurements, that even with the current limited knowledge, the buffer distances from larger industrial wind turbines need to be much greater than 2 km, in order to protect the health and amenity of residents who are hosts as well as neighbours, and their family members who may be in the particularly at risk groups such as babies, young children, noise sensitive individuals such as those with brain injuries, autism spectrum disorders, and the elderly.

135. This proposal should therefore be rejected on the basis of its potential to cause serious adverse health effects from sleep disturbance alone, to a great number of people.

136. The proposed industrial wind turbine development should be rejected until the developer can prove with independently conducted peer reviewed scientific, acoustic and medical research that its industrial wind development will not cause harm to the health of rural people living and working nearby, through chronic cumulative exposure to unsafe levels of low frequency noise and infrasound emitted from the industrial wind turbines proposed, over the life of the project.

Dr Sarah Elisabeth Laurie
CEO Waubra Foundation

signed and submitted to VCAT 14th January, 2013

List of links to annexures listed in this statement

1. Waubra Foundation Objectives (view at www.waubrafoundation.com.au)
2. Submission by the Parkville Residents association to the Federal Senate inquiry, submission number 389, submitted by Mr Gerry Noonan (http://www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=clac_ctte/completed_inquiries/2010-13/impact_rural_wind_farms/index.htm
3. Dr Amanda Harry "Wind Turbines, Noise and Health" https://www.wind-watch.org/documents/wind-turbines-noise-and-health/
4. Dr David Iser's survey results and letters to government officials https://www.wind-watch.org/documents/toora-wind-farm-health-effects-survey-2004/
5. National Institute of environmental health sciences Literature Review 2001 https://www.wind-watch.org/documents/infrasound-brief-review-of-toxicological-literature/
6. Leventhall et al, 2003 report for UK Department of Environment, Food and Rural Affairs (DEFRA) https://www.wind-watch.org/documents/review-of-published-research-on-low-frequency-noise-and-its-effects/
7. Briefing summary, Zhenhua Wang, first attachment at the following link: https://www.wind-watch.org/news/2012/07/18/open-letter-to-the-premier-of-south-australia-re-new-survey-at-waterloo-wind-farm/
8. Morris, M Waterloo Survey, attachments two and three at the following link: https://www.wind-watch.org/news/2012/07/18/open-letter-to-the-premier-of-south-australia-re-new-survey-at-waterloo-wind-farm/
9. Schneider, P Cullerin Range Survey, https://www.wind-watch.org/documents/cullerin-range-wind-farm-survey-august-2012/
10. Professor Moller & Professor Pedersen, 2011 Journal of the Acoustic Society of America "Low frequency noise from large wind turbines" https://www.wind-watch.org/documents/low-frequency-noise-from-large-wind-turbines-2/
11. Professor Carl Phillips, "Properly interpreting the epidemiological evidence about the health effects of industrial wind turbines on nearby residents" 2011 https://www.wind-watch.org/documents/properly-interpreting-the-epidemiologic-evidence-about-the-health-effects-of-industrial-wind-turbines-on-nearby-residents/
12. Capuccio et al February 2011 " sleep duration predicts cardiovascular outcomes: a systematic review and meta analysis of prospective studies" http://eurheartj.oxfordjournals.org/content/early/2011/02/03/eurheartj.ehr007.full
13. McEwen, Bruce, "Protective and Damaging Effects of Stress Mediators" NEJM 1998, 338:171-179
14. McMurtry, R "Toward a Case Definition of Adverse Health Effects in the Environs of Industrial Wind Turbines: Facilitating a Clinical Diagnosis" accessible via https://www.wind-watch.org/documents/wind-turbine-noise-and-health-special-issue-of-bulletin-of-science-technology-society/
15. Nobbs, B Doolan C, and Moreau D "Characterisation of noise in homes affected by wind turbine noise" 2012 https://www.wind-watch.org/documents/characterisation-of-noise-in-homes-affected-by-wind-turbine-noise/

16. Salt, A et al "Perception based protection from low frequency sounds may not be enough" 2012 https://www.wind-watch.org/documents/perception-based-protection-from-low-frequency-sounds-may-not-be-enough/
17. Swinbanks, M "Numerical simulation of infrasound perception, with reference to reported laboratory effects" 2012 https://www.wind-watch.org/documents/numerical-simulation-of-infrasound-perception/
18. Qibai et al, "An investigation on the Physiological and Psychological effects of infrasound on persons" 2004 https://www.wind-watch.org/documents/an-investigation-on-the-physiological-and-psychological-effects-of-infrasound-on-persons/
19. Cooper, Steven "Are wind farms too close to communities?" 2012 https://www.wind-watch.org/documents/are-wind-farms-too-close-to-communities/
20. Ambrose, S & Rand, R "Bruce McPherson Infrasound and Low frequency noise study" December, 2011 https://www.wind-watch.org/documents/bruce-mcpherson-infrasound-and-low-frequency-noise-study/
21. Walker, B, Hessler G, Hessler, D, Rand R and Schomer, P December 2012 joint report "Cooperative Measurement survey and analysis of low frequency and infrasound at the Shirley wind Farm" https://www.wind-watch.org/documents/cooperative-measurement-survey-and-analysis-of-low-frequency-and-infrasound-at-the-shirley-wind-farm/
22. Schomer, P appendix D access via above weblink
23. Rand, R appendix C access via above weblink
24. Shepherd, D et al "Evaluating the impact of wind turbine noise on health related quality of life" October 2011 https://www.wind-watch.org/documents/evaluating-the-impact-of-wind-turbine-noise-on-health-related-quality-of-life/
25. Nissenbaum, M, Hanning, C and Aramini, J "Effects of industrial wind turbine noise on sleep and health" October 2012 https://www.wind-watch.org/documents/effects-of-industrial-wind-turbine-noise-on-sleep-and-health/
26. Thorne, R "Wind Farm Generated Noise and Adverse health Effects" November 2012, https://www.wind-watch.org/documents/wind-farm-generated-noise-and-adverse-health-effects/
27. Black, Owen MD, neurotologist Affidavit 2009 download as first attachment of the document at the following weblink: https://www.wind-watch.org/documents/list-of-symptoms-and-medical-problems/
28. Waubra Foundation's Explicit Cautionary Notice, June 2011, https://www.wind-watch.org/documents/explicit-cautionary-notice-to-those-responsible-for-wind-turbine-siting-decisions/
29. Waubra Foundation's Acoustic Pollution Assessment Requirements, May 2012 https://www.wind-watch.org/documents/wind-turbine-acoustic-pollution-assessment-requirements/
30. Dickinson, Professor P "Pragmatic view of a wind turbine noise standard" https://www.wind-watch.org/documents/pragmatic-view-of-a-wind-turbine-noise-standard/

Additional material referenced and tabled during oral evidence given by Dr Laurie during the VCAT Hearing in Melbourne, Australia on 7th & 8th February, 2013

- Documents obtained under FOI from Victorian Department of Health, confirming complaints were received from Victorian residents in 2009. This is prior to the establishment of the Waubra Foundation in 2010, and is evidence that the problems were in existence before any publicity generated by the foundation (ie the nocebo "diagnosis" is erroneous).
- Dr Sandy Reider MD testimony to the Vermont Legislature http://www.windturbinesyndrome.com/2013/acoustic-trauma-produced-by-large-wind-turbines-is-real-and-significant-sandy-reider-md-vermont/?var=cna
- Submission from Dr Wayne Spring, Ballarat Sleep Physician to second Australian federal senate inquiry http://www.windturbinesyndrome.com/2012/sleep-specialist-physician-treats-patients-with-wind-turbine-syndrome-australia/?var=cna
- Submission from Dr Andja Mitric Andjic, Rural GP and wind turbine refugee (formerly a neighbour of Hepburn Wind's "community" wind turbines) to second Australian Federal senate inquiry http://www.windturbinesyndrome.com/2012/there-is-something-horribly-wrong-with-wind-turbine-technology-says-physician-driven-out-of-her-home-australia/?var=cna
- Submission from Mr Peter Trask, Psychologist to second Australian Federal senate inquiry http://www.windturbinesyndrome.com/2012/wind-turbine-syndrome-is-real-reports-clinical-psychologist-australia/?var=cna
- Response to a question on notice by Dr Michael Nissenbaum, to the second Federal Senate inquiry, concerning the use of "nocebo". The document can be downloaded from http://docs.wind-watch.org/Nissenbaum-Nocebo-senate-inquiry-11-22-2012.pdf
- Article written for the Copenhagen Post, by former High court judge Peter Roerdam, . https://www.wind-watch.org/news/2012/11/16/the-myth-of-denmark-as-a-corruption-free-country/
- Wisconsin town Council association's call for a moratorium https://www.wind-watch.org/documents/resolution-adopted-by-the-board-of-directors-of-wisconsin-towns-association/
- Brown County Health Board http://www.windturbinesyndrome.com/2012/board-of-health-asks-state-for-emergency-financial-relocation-assistance-for-wind-turbine-syndrome-victims-wisconsin/
- Farboud et al "Wind turbine Syndrome: Fact or Fiction?" Review article in Journal of Otology and Laryngology, 2013 https://www.wind-watch.org/documents/wind-turbine-syndrome-fact-or-fiction-2/
- Dr Owen Black's CV from http://www.legacyhealth.org/en/for-health-professionals/legacy-research-institute/our-scientists/f-owen-black-md-facs.aspx
- Dr Nina Pierpont's study "Wind Turbine Syndrome, A report on a Natural Experiment" 2009 K Selected Books
- Notes made for the VCAT Commissioners concerning the application of the Bradford Hill Criteria of Causation to the symptoms being reported by people exposed to operating wind turbines (see following pages).

## NOTES FOR COMMISSIONERS
## RE APPLICATION OF BRADFORD HILL CRITERIA OF CAUSATION

Comments on the 9 criteria are made below, with reference to comments by the authors in the following article, quoted in italics where relevant:

http://neuro.psychiatryonline.org/article.aspx?articleid=101454
Special Article | August 01, 2001
Applying Bradford Hill's Criteria for Causation to Neuropsychiatry: Challenges and Opportunities
**Robert van Reekum, M.D., F.R.C.P.C.; David L. Streiner, Ph.D., C.Psych.; David K. Conn, M.B., F.R.C.P.C.**
*The Journal of Neuropsychiatry and Clinical Neurosciences 2001;13:318-325.*
10.1176/appi.neuropsych.13.3.318

### 1. Strength of the Association

*"Clearly if condition A causes outcome B, then it must be that A and B can be demonstrably associated with each other. The association has to be strong enough to be judged clinically significant by the reader of the argument. This is a necessary, but not sufficient, criterion in establishing an argument of causation. "*

Studies with adequate control populations will help investigate this. (Dr Daniel Shepherd & Dr Michael Nissenbaum's studies have started this process at a population level).

**The most compelling information comes from individual exposure information in those who are affected.**
"case cross over" designs – where people are exposed and have symptoms, then they reduce their exposure and the symptoms go away, but return when they are reexposed. Dr Sandy Reider gives a very good description of this in his statement to the Vermont legislature.

Dr Nina Pierpont's case series cross over study is the most rigorously collected data of this type, and is very detailed. Her contribution to the knowledge of vestibular disorders and the relationship with clinical symptoms being reported is respected amongst those ENT specialists who are (or were) leaders in the world in this very poorly understood area of clinical medicine (eg Dr Owen Black). Increasingly acousticians are also starting to publicly recognise her contribution. Professor Leventhall has admitted under oath in Canada that he acknowledged she had identified groups in the population who seem more susceptible to developing problems (eg inner ear disorders, migraines, and motion sickness, as well as the extremes of age)

### 2. Consistency of the Evidence

The effects on SLEEP are consistent. People are describing waking up repetitively in an anxious frightened panicked state. They often say they do not hear the turbines at the time (see Dr Reider's statement for an excellent clinical description). Some just describe waking up tired, for no reason. Children who previously slept well have poor sleep, with (for example) babies waking up repetitively screaming where they never did this before, and never do it when away from their homes, or when the turbines are not turning. This then disturbs their parent's sleep. The accumulated effects of this over time lead to a myriad of health problems.

The inability to stop the noise and vibration and the lack of control over that in itself leads to significant psychological stress, anger, and often depression in people, as well as anxiety about whether or not they are going to get a good night's sleep. People become focused on the weather forecast, and plan their lives around which way the wind is coming from, making plans to he away from home if the

wind is coming from a certain direction because they know they will get symptoms on those days. This inevitably affects many other aspects of their lives – their work, family entertaining, ability to have guests to stay etc etc.

Once people are sensitised to ILFN, they then notice other sources of ILFN may give them the symptoms (especially tinnitus). Other sources have included large air conditioners (eg court buildings in Adelaide, aeroplanes, and smaller compressors from home air conditioners)
The range of symptoms are consistent within an individual, but there is variable expression of them in different people, which is entirely to be expected if they result from chronic stress. Chronic stress will affect a multitude of different body systems in a variety of different ways, known to clinical medicine since 1998 (Bruce McEwen's paper).

## 3. Specificity

*This criterion stems from old beliefs related to a one-disease, one-outcome model of illness. Clearly this criterion does not hold even for infectious diseases or toxin exposures, in which multiple pathogens may produce the same set of symptoms, or in which a single pathogen may produce a number of outcomes. E. coli may produce urinary tract infections as well as infections of the gastrointestinal system, and both of these types of infections may also be produced by a number of other pathogens. Similar concerns limit the validity of this criterion in neuropsychiatry; that is, if specificity can be demonstrated, then this is additional support for causation,* ***but if specificity is lacking, then this in no way detracts from the argument of causation.***

## 4. Temporal Sequence

*Clearly if A is causing B, then A should necessarily occur prior to B.*

***As with all health-related research, the only way to be certain about the temporal sequence is to conduct prospective studies, in which the samples are studied (for presence of the outcome) prior to the onset of the putative causative agent and then followed over time after the insult.***

## 5. Biological Gradient

*Is there a dose response effect?* The clinical symptoms being reported suggest there is. It needs to be properly investigated, which Professor Con Doolan has started to do with some case studies from Waterloo.

Con Doolan's research suggests there is a dose response effect in the reported case, and in the other data he has collected. I know the residents who are subjects in those studies and their symptoms and pattern of symptoms are characteristic of people exposed to operating wind turbines who have an effect.

## 6. Biologic Rationale

*Is it biologically plausible?*

Salt's work, and the work discussed in the NIEHS infrasound toxicology suggest the underlying mechanisms of the effects being observed in humans.

- Alerting mechanism – especially in quiet background noise environments
- Qibai and Shi – infrasound stimulation leads to sympathetic nervous system stimulation with elevated heart rate and blood pressure in many of the subjects. Individual variation is consistent with what we are seeing in the field. They also reported nausea, tiredness and "fretfulness".

- In Qibai and Shi, the infrasound dose is BELOW the audible perception threshold (see Swinbanks work)
- NIEHS toxicology studies show three effects:

1. Physiological stress – release of adrenaline and cortisol with exposure to infrasound
2. Sequential tissue damage eg to myocardium (heart muscle) with sequential sacrifices with ongoing exposure – tissue damage gets worse with ongoing exposure but resolves with cessation
3. Oxidative stress is a biological mechanism – confirmed with study number 58 Dadali

What dose is required to do this?
Over what period of time? There is clinical evidence of a cumulative exposure effect – worse over time. Dr Bob Thorne's data from Victorian wind developments captured the "snapshot" after 2 years exposure and the results confirm my clinical impressions and that of their doctors – these people are sick.

## 7. Coherence

*Is this consistent with what we already know?*
*As with the biologic rationale criterion, if this criterion is met, then it is supportive of an argument of causation; if not, then we may simply not yet know enough, or we may need to revisit that which we think we know.*

## 8. Experimental Evidence

***Experimental evidence is the most compelling evidence of causation.*** *If it can be shown that experimentally (ideally randomly) inducing the causative agent consistently produces the outcome, at greater rates than in a nonexposed control sample, this is clear and compelling evidence of causation.* ***However, it is obvious that such evidence will be rare in neuropsychiatry, as it is grossly unethical to induce most forms of brain dysfunction experimentally in humans. Experimental approaches are often applied to nonhuman species, but this practice is also increasingly considered to raise ethical concerns.***

WHAT ABOUT THE ETHICS OF USING THIS TECHNOLOGY, NOT INVESTIGATING WHAT IS GOING ON DESPITE THE MANY SERIOUS COMPLAINTS, BY RESIDENTS AND BY SOME OF THEIR TREATING DOCTORS?

## 9. Analogous Evidence

*This approach takes the form of thinking that if some condition similar to A causes an outcome similar to B, then this is evidence that A causes B.*

We know what sleep deprivation does to people

We know what chronic stress does to people.

Both stress and serious cumulative sleep disturbance are being reported by people living near wind turbines, as are the resultant conditions.

This is further supportive evidence that the wind turbines are causing these symptoms.

The precise noise and vibration frequencies which are causing these symptoms in people, especially the episodes of night time waking in a panicked state, and the body vibrations are yet to be precisely determined. We do not know what doses acutely will induce this effect, nor do we know what doses will do this once people are sensitised. The concern is that we do not know what the SAFE Exposure cumulative dose is for adults AND particularly young children.

However given that these are being reported by residents out to 10km from Waterloo for example, our suspicion is that it will be the frequencies below 200 Hz which are responsihle. These are well known to travel longer distances than the audible noise which attenuates far more rapidly. Salt's experimental work suggests that the effect of this sound energy in locations where there is very little ambient noise, is much greater physiologically than has been previously understood.

Large turbines emit more LFN proportionately (Moller & Pedersen's paper) so you would expect a greater effect out to greater distances as the turbines increase in height. That is what we are already seeing out at Macarthur, (VESTAS V112's) where symptoms such as sleep disturbance are being reported already out to 6 – 7 km, and that development has not even been officially commissioned.

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Reg. No. A0054185H
ABN: 65 801 147 788

22nd November, 2012

Senator Doug Cameron
Chair
Senate Inquiry into "Excessive Noise from Wind farms Bill"

Dear Senator Cameron,

**RE: List of symptoms and medical problems**

As requested by you, I have provided details of the range of symptoms and health problems which have been reported to me by residents living near industrial wind turbines, which the residents and in some instances their treating doctors have told me are new since the wind development commenced operating, and which correlate with exposure to the operating wind development. I have also provided details of those conditions which the residents or their treating doctors have told me worsen with such exposure to operating wind turbines – ie the health conditions or symptoms were preexisting prior to the wind development commencing, but they consistently worsen with exposure and IMPROVE back to baseline when the resident is away from the turbines.

This pattern has been consistently reported by residents and some of their treating doctors in residents exposed to operating wind turbines, and is consistent with the existing peer reviewed published medical and acoustic research in related areas of the known adverse health impacts of low frequency noise, infrasound and vibration, including animal experiments, many of which occurred over 10 years ago. It is also consistent with existing clinical and research knowledge of vestibular disorders, neurophysiology, psychiatry, endocrinology, sleep medicine, and various other related fields of clinical medicine.

I have also attached a number of key papers and literature reviews listing relevant empirical research relating to infrasound, low frequency noise and vibration and their effect on human and animal health, or on the effects of sleep deprivation and stress on health. Most of these were available prior to July 2010, when the NHMRC Rapid Review on the subject was published, but were not included in that Rapid Review. Others have been published subsequently.

Yours sincerely

Dr Sarah Laurie,

CEO Waubra Foundation

## THE RANGE OF CLINICAL PATHOLOGY and SYMPTOMS REPORTED DIRECTLY TO THE WAUBRA FOUNDATION WITH EXPOSURE TO OPERATING WIND TURBINES and some other sources of INFRASOUND AND LOW FREQUENCY NOISE AND VIBRATION (ILFN & V)

### CLINICAL FRAMEWORK

The considerable range of clinical pathology and symptoms reported by sick residents and their treating doctors is best understood in the way clinicians assess symptoms with respect to the pattern of reported symptoms, the category of clinical specialty or body system they relate to, and how the symptoms and problems change over time with cumulative exposure. Only the pathology and symptoms reported directly to me is included in this list. Most of my information has come from residents in Australia. It is included only when I have been satisfied that it appears to be correlating with the operating wind turbines (or other sources of ILFN & V) ie there is a clear and consistent pattern in the resident's account of the symptoms or observations which consistently varies with exposure, or is unmistakably linked to it if it was a discrete episode of illness, or where there is relevant research which supports the linking of the symptom or described problem with ILFN & V.

I am aware that other trained medical practitioners who have taken first hand clinical histories from sick residents, such as Professor Robert McMurtry, and Dr Nina Pierpont, have had other pathology reported directly to them, which may not be listed here. There is nothing inconsistent with that, rather it is to be expected when the range of expression of this pathology in each individual is so varied. It is the PATTERN of exposure resulting in new or worsening symptoms, correlating with exposure to operating wind turbines or ILFN & V from other sources, which is the common link.

For the purposes of understanding which pathophysiological processes might be involved, these reported symptoms and problems have been divided into acute and chronic pathology. Because of the considerable complexity and range of information required to put the symptoms into the context of current clinical knowledge, I have first provided some background information.

### ACUTE EXPOSURE SYMPTOMS

These include but are not limited to:

**Symptoms of VESTIBULAR DISORDERS**

These were investigated and described in considerable detail in a group of residents living near wind turbines from locations around the world by American Paediatrician Dr Nina Pierpont MD PhD, and given the name of "wind turbine syndrome". Other rural medical practitioners had collected data some years earlier, including Dr Amanda Harry (UK) and Dr David Iser (Australia). This cluster of symptoms was known previously to medical researchers and clinicians working in the fields of inner ear diseases, disorders of balance, and Meniere's disease, and is grouped together by clinicians as "vestibular disorders". Internationally acknowledged researchers who have worked in this field include Dr Owen Black MD. I have attached an affadavit written by Dr Black in 2009 which places Dr Pierpont's work in this context. Dr Black was one of a number of expert peers who reviewed her work. The continued assertion that her work is not "peer reviewed" is untrue.

Dr Pierpont connected the pattern of symptoms described to her by sick residents, to the symptoms known to acousticians with existing knowledge and research in this field of low frequency noise exposure, and recognized that vestibular disorders were the basis of much of the symptomatology being reported by these residents. These symptoms and their correlation with exposure to low frequency noise are also well known to some

occupational physicians and also to acousticians, such as Professor Geoffrey Leventhall, and Dr Malcolm Swinbanks, both from the United Kingdom.

Professor Leventhall has stated he is well aware of these symptoms and their connection to exposure to low frequency noise, and the precise quote from his court evidence and its source is listed in my attached letter to Professor Simon Chapman (also accessible at http://www.wind-watch.org/documents/letter-from-sarah-laurie-to-simon-chapman/ ). Also attached is the table from page 49 of Leventhall's 2003 DEFRA literature review, listing the symptoms identified in a case control study in 2000 identifying identical symptoms which were reported by residents to occur in response to LFN exposure. This DEFRA document is the same document which I highlighted in my oral evidence to the Senate inquiry as a serious omission from the NHMRC's Rapid Review of 2010, and can be accessed at http://www.wind-watch.org/documents/review-of-published-research-on-low-frequency-noise-and-its-effects/ ).

Dr Malcolm Swinbank's comments in a recent letter (at http://www.wind-watch.org/documents/infrasound-from-wind-turbines-letter-from-malcolm-swinbanks/ ) are reproduced below:

> "I would comment that I first became aware of the physical effects of infrasound when working extensively on site with an industrial gas turbine in 1980. I identified specific aspects which were closely related to some symptoms of sea-sickness with which I was very familiar, being a keen offshore sailor. Thus I did not doubt that infrasound under some circumstances can cause adverse effects, and the relationship to sea-sickness implied that there was probably some interaction with the balance mechanisms of the inner ear. So the more recent work of Dr Nina Pierpont did not strike me as heresy – rather, it endorsed an opinion that I had formed from my own direct, first-hand experience in an entirely different context, almost 30 years earlier."

Dr Swinbanks is not the only acoustician to have developed symptoms of low frequency noise exposure whilst working in an environment measuring ILFN. Robert Rand and Stephen Ambrose had the same experience whiles measuring the full acoustic spectrum inside a home in Falmouth, USA over three days. They have both since stated it took days to weeks to recover from the experience. (http://www.wind-watch.org/documents/bruce-mcpherson-infrasound-and-low-frequency-noise-study/ )

**Symptoms of Acute Sympathetic Nervous System Stimulation,** or activation of the fight / flight response These include symptoms such as a tachycardia (rapid pulse), hypertension (high blood pressure), anxiety, and other rare pathologies related to acute elevations of circulating adrenaline, a stress hormone. These include specifically Tako Tsubo Heart Attacks, and Acute Hypertensive crises, both of which are reported to be occurring in the presence of known ILFN but **in the absence of the usual clinical precursors**. Such a precursor includes a sudden stressful traumatic event in the case of Tako Tsubo Heart Attacks (death of a close relative is the usual example cited) and an underlying tumour of the adrenal gland called a phaeochromocytoma in the case of an acute hypertensive crisis.

As Dr Pierpont and others have pointed out, there is overlap and connections between these two groups of acute pathologies and symptoms, which is grounded in the known science. Vestibular disorders which stimulate the fight flight response or as Professor Salt has called it "the alerting mechanism", (http://www.wind-watch.org/documents/perception-based-protection-from-low-frequency-sounds-may-not-be-enough/ ) will inevitably lead to a physiological fight /flight response as a consequence.

Dr Swinbanks has also recently highlighted the research by a Chinese team from 2004, (http://www.wind-watch.org/documents/an-investigation-on-the-physiological-and-psychological-effects-of-infrasound-on-persons/ ) showing that infrasound exposure in humans in a laboratory situation for a very short period of time, causes increases in heart rate and blood pressure as well as symptoms such as nausea, which confirms the coexistence of the physiological sympathetic nervous system stimulatory effect and the vestibular disorder symptoms (nausea). The link to Dr Swinbank's paper placing this important Chinese research in its correct

context was presented to the Inter Noise conference in New York in August 2012 downloadable at http://www.wind-watch.org/documents/numerical-simulation-of-infrasound-perception/ )

## CHRONIC CUMULATIVE EXPOSURE SYMPTOMS / PROBLEMS

### Consequences of Cumulative Sleep deprivation

The commonest reported symptom or problem by residents is disturbed sleep. Sometimes residents report hearing the audible noise of the turbines when they are woken, but other times they cannot hear the turbines and report a characteristic pattern of "waking suddenly in a panicked state". This can occur when they cannot see the turbines, (they are asleep!) cannot hear them, and have no way of knowing at the time inside their home whether the turbines are operating. This can happen numerous times each night, and correlates with wind direction and certain weather conditions which acousticians confirm are likely to enhance the perception of sound energy.

Being in a well insulated home can make the symptoms including sleep disturbance worse, which fits with the research evidence of Professor Alec Salt, confirming that the inner ear responds very differently when there is predominantly low frequency sound energy present, which can result in stimulation of the "alerting mechanism" of the brain. It fits with the acoustical survey data collected by Rand and Ambrose in the USA (http://www.wind-watch.org/documents/bruce-mcpherson-infrasound-and-low-frequency-noise-study/ ) and at multiple locations in Australia by Steven Cooper, where the acoustic profile inside a well insulated home can be quite different to that obtained concurrently outside the home. This is why internal home measurements of the full acoustic spectrum are so important – external measurements do NOT reflect the actual experienced ILFN exposures inside the home, and cannot be used as a substitute.

This identical pattern of sleep disturbance, and on occasions perception of vibration through the bed, has been reported by residents living near wind turbines and also by those living near coal mining activities in the Upper Hunter, where the mine was at least 5km away through a hill. Independent acoustic measurements taken at multiple locations near wind turbines and coal mining confirmed the presence of sound frequencies below 200 Hz, regardless of the source of the sound energy. These residents consistently report that their sleep pattern improves on those occasions when there is no sound energy from the source of ILFN & V, or when they are away from their homes.

The cumulative effects of sleep deprivation are very well known to clinical medicine, and result in both new disorders and exacerbation of existing conditions, regardless of the cause of that sleep disturbance. Conditions include mental health disorders (depression, anxiety), metabolic conditions such as diabetes, cardiovascular pathologies such as hypertension, ischemic heart disease, and impaired immunity leading to increased infections and in the long term malignancies (cancers). A recent meta analysis by Professor Capuccio from Warwick University provides a useful summary of the importance of sleep with respect to cardiovascular health, and is attached.

### Consequences of Chronic Stress

**Physiological stress**

The known connections from established research between low frequency noise exposure and cortisol, an important stress hormone, were outlined by Professor Leventhall in his 2003 Literature review for the UK Department of Food and Rural Affairs (DEFRA) in section 10. The existence of a relationship between physiological stress and LFN exposure is therefore established, as it is in animal studies listed in the National Institute of Environmental health sciences (NIEHS) Literature review of 2001, (see http://www.wind-watch.org/documents/infrasound-brief-review-of-toxicological-literature/ ) where animal studies showed elevated cortisol and adrenaline with exposure to infrasound in experimental studies. Both these documents are attached. Neither was referenced in the NHMRC Rapid Review of 2010. Professor Leventhall was aware that wind turbines emitted both low frequency noise and infrasound, from work done by Frits Van Den Berg

and presented at a conference in Maastricht in 2004 (as pointed out by Dr Malcolm Swinbanks at http://www.wind-watch.org/documents/infrasound-from-wind-turbines-letter-from-malcolm-swinbanks/ ).

Research is required to determine precisely what acute and chronic exposures and which frequencies are inducing these physiological stress responses in humans exposed to ILFN & V from a variety of sources including wind turbines. The clinical observations suggest that the dose response curves are much lower than acousticians have historically assumed, and that they may in fact decrease over time with cumulative exposure, because of sensitization or decreased tolerance for the same level of low frequency sound energy over time. Professor Salt's work using an animal model has shown that sound energy below the audible threshold can still be perceived, and this requires urgent research with human subjects, with acoustic monitoring concurrently with sleep and physiological monitoring.

**Psychological stress**

Professor Leventhall recognized the negative psychological impact on people adversely impacted by low frequency noise who were disbelieved or misdiagnosed. This ADDITIONAL psychological stress has been consistently reported to me by sick residents in Australia, and was reported to others prior to my involvement which commenced in July 2010. Perjorative descriptors have been used to describe these sick and vulnerable residents by wind developers and their supporters, and has contributed greatly to this damaging psychological effect, known as "victim blaming". It has been further magnified by some of the media reporting and on line blogs, where it is still common for sick, desperate and vulnerable people to be described as jealous, NIMBY's, or brainwashed by anti wind turbine advocates, with no empirical research evidence to support these psychologically damaging assertions. For those people driven out of their homes, off their farms, too sick or too tired to work safely and productively this is particularly difficult. This psychological damage is compounded when their pleas for help fall on deaf ears within the health and noise regulatory authorities.

**Combined effect of both physiological and psychological stress**

The combined effect of both physiological and psychological stress is well known to clinical medicine to be catastrophic for maintenance of good physical and mental health over the long term. Almost every body system will be adversely affected, based on longstanding and more recent clinical research. Just a few examples are given below:

Recent neurobiological research has shown that childhood trauma and consequent stress can result in a lifelong increased risk of developing depression, thought to be at least partly because the hippocampus in those circumstances may never grow to its full capacity to release hormones such as brain derived neurogenic factor, known as BDNF. The effect of chronic exposure to wind turbine noise is unclear, in children or in adults, but given the known connections between ILFN exposure and stress, it is likely that chronic stress plays a significant role in the longer term. Dr Pierpont, herself a practicing Paediatrician, has documented clear evidence of adverse effects on the health and development of the children in her study when exposed to operating wind turbines. Similar reports are emerging from concerned parents around the world, magnified if the children have disorders such as epilepsy, autism, and other conditions with known noise sensitivity. The account of the Dutch parent with a son with autism in submission number 29 to this inquiry is one such example.

Cardiovascular health is well known to be adversely impacted by chronic stress, as is the immune system, and is associated with increased risk of infections and malignancies (cancers). Evidence for a stress effect is further supported by night time salivary cortisol results which have been shown to be elevated in some residents chronically exposed to wind turbines, but when the turbines are off for a period of time the cortisol test has been repeated and shown to be normal (residents in the US, and in Ontario).

Bruce McEwen is an Australian researcher at the Rockefeller Institute in the USA in the field of stress, and in a review article in the New England Journal of Medicine in 1998 (attached) he described what happens when the

body's defences are overwhelmed because of chronic stress. He described the "rapid aging effect" observed in rats subjected to experimental conditions designed to elicit a stress response. The same "rapid aging effect" is being observed in residents living for any significant length of time, near wind turbines. Consistently the residents report improvement in their individual symptoms when they are not exposed to the ILFN & V. The longer the period of time of exposure, the longer the time to recovery back to baseline. Some people report they never attain their previous good health, and have residual health problems related to the exposure to ILFN & V even when they have been away for some years, despite an initial improvement and partial recovery.

**Tissue pathology**

The possibility of tissue pathology resulting from prolonged ILFN & V exposure has been investigated by researchers including the US military (vibration from helicopters being recognized as a potential risk to the health of unborn children, from studies of the effect of chronic vibration on chicken embryos, resulting in a ban on pregnant female helicopter pilots flying in certain rotary bladed helicopters (Shannon et al, attached, 1994). There are animal studies in the NIEHS Literature Review of 2001 (downloadable at http://www.wind-watch.org/documents/infrasound-brief-review-of-toxicological-literature/ ), eg abstract number 58 by Dadali et al, where focal organ damage was reported in rats exposed to infrasound regularly each day for 60 days. What Dadali et al found was that the rats given antioxidants showed much less focal organ damage in a variety of organs including brain, kidney, liver and testes than the rats not given that intervention. This suggests that oxidative stress may be one of the mechanisms of tissue damage from chronic exposure to infrasound.

There is also the work of Professor Mariana Alves Pereira, Dr Nuno Castelo Branco and their team, over a period of approximately 30 years in Portugal, identifying and investigating a range of reported tissue damage in people predominantly with occupational exposure to ILFN & V in the aviation industry. The pathology described included thickened collagen in blood vessels, pericardium, and altered tissues in a variety of organs including brains and lungs. Recently, identical pericardial and heart valve pathology to that described by the Portuguese researchers has been independently identified in a Taiwanese research group of aviation workers. There are also reports from residents in Germany with long term exposure to relatively small wind turbines that the characteristic cardiac valve and pericardial thickening has been identified on their recent echocardiography investigations. It has been asserted by some that this is a "Portuguese phenomena" but the emerging clinical and research evidence would suggest otherwise.

**SYMPTOM/PROBLEM LIST**

**ACUTE**

**Vestibular dysfunction/disorder** (first 12 also listed by Dr Owen Black MD in his attached affadavit)

- Sleep disturbance
- Headache, including migraines
- Tinnitus
- ear pressure (often described as painful)
- Balance problems, dizziness
- Vertigo
- Nausea
- Visual blurring
- Irritability
- Problems with concentration and memory
- Panic episodes
- Tachycardia (fast heart rate)

**Acute Sympathetic Nervous System Stimulation**

- Tachycardia (fast heart rate)
- Arrythmias, which residents might describe as palpitations
- Hypertension (High blood pressure) which has been reported by some residents to be considered unstable by their treating doctor or cardiologist, and to vary in response to exposure to operating wind turbines.

  The following three conditions are rare, but important to mention.
- Tako Tsubo heart attack (adrenaline surge related) in the absence of the usual acute emotional stressor (eg death of close relation) but closely correlating with exposure to operating wind turbines (2 sites in Australia), or to ILFN & V from coal mining in the upper Hunter in NSW, and also reported in Ontario with exposure to industrial wind turbines.
- Acute Hypertensive Crisis (Australia, Ontario) in absence of adrenal tumour (usual cause),
- Crescendo angina (the best description of this came from a couple in Germany who were stuck in a vehicle on an autobahn near large industrial wind turbines, but the same has been reported in Australia by a resident subsequently advised verbally by his cardiologist never to go back home)

**Other (some of these have a chronic exposure component but manifest with acute symptoms)**

- Episodes of sensation of body vibration (specifically lips, chest cavity and abdomen)
- Episodes of intense anger (reported in workers as well as residents, also noted to a much lesser extent with short exposure to ILFN in experimental research in 1997 by Professor Leventhall in an office occupational setting)
- Bleeding from ear drum following intense and painful sensation of ear pressure
- Deteriorating hearing (confirmed sometimes with audiological assessment)
- Menstrual irregularities in women marked by heavy bleeding and noticeable hormonal cycle changes.
- Significantly decreased ability to "multi task" impacting noticeably on resident's ability to perform usual tasks
- Noticeable difficulties with mental arithmetic, when previously able to calculate easily
- Hyperacusis – extreme sensitivity to "normal" sounds which in some circumstances has persisted for over 6 years after removal from the exposure to ILFN.
- Disorders of thyroid metabolism which stabilize when away from ILFN

**CHRONIC**

**Sleep disturbance & its consequences**

- the sleep disturbance itself has been attributed by residents to the following (which they report does NOT happen when they are not exposed to operating wind turbines, and correlates with wind direction and weather conditions on the nights when they are affected in this way):
  - audible noise of the turbines (especially if their home is not well insulated, or the windows are open to cool it at night, and they live close to the turbines)
  - waking at night in the characteristic "panicked" state (many living further away who report this symptom say they cannot see or hear the turbines at the time they wake up)
  - violent and disturbing dreams in adults and children, which can happen repeatedly over the same night
  - increased need to urinate, sometimes as often as every 10 minutes for a period of up to one hour (sometimes this affects numerous people in the house at once)
  - bedwetting in children reported by parents to be previously "dry" at night for some years

- **known clinical consequences of repetitive sleep disturbance/deprivation**
  - cardiovascular disorders, including hypertension, ischemic heart disease, angina
  - diabetes
  - mental health disorders such as depression and anxiety

- impaired immunity, leading to increased acute and chronic infections, and in the longer term malignancies (cancers).
- fatigue related work impairment and accidents. This is a serious issue for rural communities and farms, where workplace injury is already a significant problem
- fatigue driving heavy vehicles and school buses – thus a concern for the safety of the wider rural community as well
- fatigue in workers such as health care workers (Australia), air traffic controllers (USA), well known to lead to impaired judgment which will detrimentally impact on the safety of the wider community, **in addition** to personal health problems for those individuals)

**Combined Stress (Psychological and Physiological) and its consequences**

- repetitive physiological stress as well as major acutely stressful event have both been linked with post traumatic stress disorder (PTSD). There are residents who have reported to me that symptoms of their pre existing PTSD (eg resulting from Vietnam War experiences or childhood sexual abuse) is triggered with exposure to operating wind turbines. Helicopter noise, and blast noise and vibration from mining has also been reported by other clinicians as triggers. All these are known sources of ILFN & V. There are also reports of people who develop PTSD after exposure to operating wind turbines, with ongoing problems 7 years after they moved away (bought out and silenced by the wind developer). This is a research area needing further investigation, and the connections between PTSD, vestibular disorders and ILFN exposure from other sources are currently being investigated in the USA under Professor Carey Balaban, an acknowledged world expert in this field, who also reviewed Dr Pierpont's work.
- Stress is an acknowledged long term contributor to dental disease via a number of mechanisms including impaired immunity and a dry mouth. Increased severity of dental infections has certainly been reported by some residents living near turbines who report this as one of a number of problems.
- Other illnesses either caused by or exacerbated by chronic stress have been well documented in peer reviewed published research literature for many years, and are being reported by these residents. Some overlap with those listed above for sleep disturbance, which is itself a source of stress. They include the following:
    - cardiovascular disorders, including hypertension, ischemic heart disease, angina, and transient ischemic attacks
    - diabetes
    - mental health disorders such as depression and anxiety, often severe
    - impaired immunity, (elevated cortisol being one component) leading to increased acute and chronic infections, delayed healing, and in the longer term malignancies (cancers). Chronic sinusitis is commonly reported by some residents with longer term exposure, either as a new condition or a worsening of preexisting sinusitis.
    - disrupted human fertility and hormonal cycles
    - exacerbation of pre existing inflammatory disorders, including arthritis, asthma, inflammatory bowel disease, SLE (Lupus), or the development of new inflammatory conditions which coincides with exposure to ILFN & V

**Tissue damage**

The items below have been reported to me from Germany in residents exposed for over 10 years

- Pericardial thickening
- Mitral and tricuspid valve thickening
- Characteristic mouth ulcers described in Vibroacoustic disease

The pathology is identical to that described in workers and others studied by the Portuguese researchers who first described VAD or vibroacoustic disease, (see http://www.wind-watch.org/documents/vibroacoustic-disease-biological-effects-of-infrasound-and-low-frequency-noise-explained-by-mechanotransduction-cellular-

signalling/ ) now being diagnosed in others including most recently Taiwanese aviation workers (Chao et al, http://docs.wind-watch.org/chao.html ).

Finally, there are growing concerns about the potential for fetal abnormalities with increasing exposures to larger wind turbines and therefore more ILFN and V. These fetal abnormalities are being reported by some farmers in their stock (cattle, sheep) at rates which are noticeably increased for them since wind turbines commenced operating. The farmers who disclosed this keep accurate records of their stock numbers and problems, and were clear in their reports. The aetiological agent is not clear, and no one is systematically collecting this data, as with human health.

There is research evidence indicating concerns about the impact of vibration on embryos (referred to previously). Vibration is being reported by some of the residents, living near wind turbines and living near coal mines in the Upper Hunter. The vibration from wind turbines is also reported by institutions with seismic arrays, which are part of a worldwide network to detect nuclear explosions. The characteristic acoustic signature is being detected significant distances away from such institutions in Scotland and Germany. Links to those pieces of research are at: http://www.wind-watch.org/documents/inaudible-noise-of-wind-turbines/ , http://www.wind-watch.org/documents/microseismic-and-infrasound-monitoring-of-low-frequency-noise-and-vibrations-from-windfarms/ , and there is research done in New Zealand by Dr Bob Thorne and colleagues measuring seismic energy from larger 3MW V90 VESTAS wind turbines reported to be disturbing residents, at http://www.wind-watch.org/documents/seismic-effect-on-residents-from-3-mw-wind-turbines/ .

The long term impact of chronic exposure to such low "dose" of vibration is unknown. It is my impression, however, that where a resident is reporting the perception of vibration, the resident's health appears to be negatively impacted more rapidly, even when compared to others living in the same home.

**All of the above problems listed have the characteristic pattern of improving partially or completely when the turbines are off, or when the residents are away from their homes. Some residents also report subsequently being affected by other sources of ILFN, such as when flying, or when exposed to LFN from heating and cooling (air conditioning) compressors, which is to be expected, as they have become "sensitized" to LFN. This phenomena of "sensitization" was noted by Professor Leventhall in 2003, where he also made it clear that if people moved away from the sources of the LFN their condition improved. What is being observed is that many sick people who do not or cannot move away, deteriorate with cumulative exposure.**

Finally, in response to a direct question in the senate inquiry from Senator Cameron as to whether or not I had ever claimed there have been deaths as a result of exposure to operating wind turbines, I answered I have not made such claims, which is true.

**However, it is clear that some of the conditions being reported are potentially life threatening, in particular the acute cardiovascular pathology, and the serious mental health problems. I am aware of emerging concerns from Ontario about identical issues.**

I have had phone calls and emails from desperately sick people, who are being ignored by all the relevant responsible health and noise regulatory authorities, and who are or have been acutely suicidal or who tell me they have made suicide pacts if things do not change for them, particularly if they cannot "get away from the noise and vibration, and get a decent night's sleep". Country people are resilient, stoic, and used to dealing with all manner of hardship. They are not complainers. They describe what is going on as "torture".

**Please do not ignore the suffering of these people.**

**Dr Sarah Laurie, CEO Waubra Foundation**

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Attachments:

1. Affadavit of Dr Owen Black, MD, May 2009, De Kalb County, Illinois
2. Letter to Professor Chapman http://www.wind-watch.org/documents/letter-from-sarah-laurie-to-simon-chapman/
3. Table on page 49 of Leventhall DEFRA Literature Review 2003 (reproduced from http://www.wind-watch.org/documents/review-of-published-research-on-low-frequency-noise-and-its-effects/ )
4. Leventhall et al, DEFRA Literature Review, 2003 http://www.wind-watch.org/documents/review-of-published-research-on-low-frequency-noise-and-its-effects/
5. NIEHS Literature Review, 2001 (http://www.wind-watch.org/documents/infrasound-brief-review-of-toxicological-literature/ )
6. Capuccio, F et al, "Sleep Duration predicts cardiovascular outcomes: a systemic review and meta-analysis of prospective studies" European Heart Journal (2011) 32, 1484-1492
7. McEwen,B "Protective and Damaging Effects of Stress Mediators" New England Journal of Medicine, 1998, 338 171 - 179
8. Shannon et al, October 1994 "Effect of Vibration and Frequency Amplitude on developing chicken Embryos" US Army Aeromedical Research Laboratory, Fort Rucker, Alabama
9. Alves Pereira et al, 2007 http://www.wind-watch.org/documents/vibroacoustic-disease-biological-effects-of-infrasound-and-low-frequency-noise-explained-by-mechanotransduction-cellular-signalling/

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# Readying Michigan to Make Good Energy Decisions

## Michigan Energy Public Forum Statement Card

**If you wish to speak today, please complete the following:**

**Name:** DOUGLAS G. WOOD

**Affiliation (if any):** KENT COUNTY DEPT. PUBLIC WORKS

**Phone:** 616 336 3532

**Email:** doug.wood@kentcountymi.gov

**Topics you wish to address today:**

a. X **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. ___ **Other Additional Energy Topic**

**(Please specify):** _____

**Requested time to speak:** X **< 5 minutes** ___ **5 minutes**

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DOUGLAS G.WOOD
Director

# Board of Public Works

**Michigan Energy Public Forum**
**February 25, 2013**

Chairman Quackenbush and Director Bakkal, thank you for the opportunity to present testimony on this important issue. My name is Douglas Wood and I am the Director of Public Works for Kent County. The Public Works Department provides solid waste management services and water and sewer system construction, inspection, and maintenance under contract with some local units of government. The county owns an Energy from Waste facility that represents one of the major components in Kent County's solid waste management system. The commercial operation began February 1, 1990 and processes 625 tons per day of municipal solid waste, generating up to 18 megawatts of electricity. Waste is delivered to the facility from Grand Rapids and five surrounding cities: East Grand Rapids, Grandville, Kentwood, Walker, and Wyoming. In 2007, the Facility was designated a Michigan Voluntary Protection Program (MVPP) Star Facility and was accepted into the Michigan Clean Corporate Citizen (C3) Program in 2006.

Despite much of the advanced nations of the world moving away from landfilling, Michigan continues to landfill millions of tons of Municipal Solid Waste (MSW) every year. In fiscal year 2012 alone, Michigan landfilled 14.8 million tons of MSW, with over 3 million of those tons coming from out of state. Many countries and other US states have come to take the view that MSW is actually a resource, and can be used as a fuel to produce clean, renewable energy. As Michigan revisits its Renewable Portfolio Standard, the use of MSW as a resource can be a key factor in meeting the state's goals.

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Energy from Waste (EfW), sometimes referred to as Waste To Energy or Resource Recovery, is a state of the art process that safely converts MSW into renewable electricity. The process takes MSW and transfers it to a combustion chamber where it is combusted at high temperatures and reduced to 10% of its original volume. The heat generated from the combustion chambers heats water in steel tubes. That water is converted to steam and run through a turbine that continuously generates renewable electricity. All gases are collected, filtered and cleaned before being released safely into the atmosphere. The remaining ash is run through a metal recovery system that recovers tons of metal for recycling.

Passed in 2008, Michigan's Renewable Portfolio Standard (Public Act 295) (RPS) calls for 10% of the state's energy production to be from renewable sources by 2015. However, in the State's RPS, only the existing EfW facilities qualify for Renewable Energy Credits. Any new EfW facilities would not qualify. From a solid waste management perspective, this state policy is perversely encouraging landfilling over the more environmentally superior EfW. From an energy policy perspective, the state policy is not supporting the clean, in state, renewable energy production that supports in state jobs and reduces GHG emissions. There are several reasons why Michigan should allow new or expanded EfW facilities to qualify for the state's RPS.

EfW represents an environmentally superior alternative to landfills. While many modern landfills have a gas recovery system that produces electricity, these systems' energy efficiency is extremely low compared to EfW. The average existing EfW facility generates *nine times* more power per ton of waste while the newest EfW facilities can generate as much as *fourteen times* more power. This comparison was done using the exact same fuel, garbage. Furthermore, landfills are one of the largest sources of manmade methane (a GHG 25 times as potent as carbon dioxide over a 100 year time frame), and only a portion of that methane is collected and converted into electricity. The rest of it escapes directly into the atmosphere. While EfW facilities are "one of the cleanest sources of electricity" according to the US

As the state struggles to replace the jobs lost in recent years, a new EfW facility can provide a significant number of green jobs. This infrastructure is capital intensive, has a 3 year construction cycle, and generates almost 1000 direct and indirect jobs during the construction phase in addition to good, long-term jobs during the life of the plant.

Thank you again for this opportunity. For the reasons above, it is critical that as the state expands the RPS, so that EfW be included in that expansion.

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**Michigan Energy Public Forum Statement Card**

**If you wish to speak today, please complete the following:**

**Name:** DAN ZIMMER

**Affiliation (if any):** 5.5 KW GRID TIED NET METERED SOLAR SYSTEM OWNER

**Phone:** 616 399 8987

**Email:** twoinwestolive@aol.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** ENERGY FUTURE

**Requested time to speak:** X **< 5 minutes** ___ **5 minutes**

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**Mr. Daniel Zimmer**
8180 156th Ave.
West Olive, MI 49460-9531

I would like to speak to the energy future. I am owner of a 5.5Kw, grid tied, net metered solar system. Looking for safety and certainty after the 2008 financial collapse, my wife and I made decision to invest in solar and in May 2011 installed solar system. To date our system has produced 12,479 kw and reduced carbon emissions by 21,213 pounds. Pragmatists look beyond the world as it is. Looking beyond the current monolithic status qou, the energy future I see includes homes, farms and small businesses with solar. With progressive political will and policy that respects capitalism, the private ownership to the means of production. Policy that gives citizens a place at the energy production table. A future when citizen participation is encouraged and embraced by policy, and viewed as a cornerstone to problem solving. A future when solar PV is as common as a boat, swimming pool or jet ski. Policy that recognizes solar PV can integrate and support the grid, providing peak solar output when peak demand for air conditioning and commercial refrigeration are the greatest. Policy that considers and values the return on investment in solar, the carbon reduction, curbing global warming and providing alternative to the current 2 dominate power utility producers. Policy that provides liquidity for SREC,s solar renewable energy credits earned, as the architecture for srec's in Michigan is non existant. My confidence that the sun will shine outweighs the trust I have in Washington or Lansing to secure a renewable, sustainable energy future. With the responsibility of changing the status quo comes the assurred certainty of offending those who have worked so hard to preserve it.
The time for action is now, the future demands it of us.

Mr. Daniel Zimmer
8180 156th Ave.
West Olive, MI 49460-9531

# "Reflections of the Mind"

**Artist: Dan Zimmer**
**Venue: GRid70**

**What value does art have to society? If art is the product of creativity and the question is rephrased to ask, what value does creativity have to society? Modern creativity yields innovation. Creativity is the unseen force that sees the world not as it is, but rather how we envision it. Thought is the only reality and creativity can change thought and in like kind, changes reality. Always remember whether you think you can, or you think you cannot, in both instances you are correct. Transformation is always possible, so long as we dwell in possibilities. My recent transformation has been installing Solar Panels to convert sunshine into electricity and also utilizing the Chevy Volt vehicle to reduce oil dependence. The Solar Panels go hand in hand with the Volt. I like to say, "we have a car that runs on sunshine". The dawn of a new era is on the horizon that is equal to the transition from "Horse and Buggy" to the "Horseless Carriage". A transition from oil dependant to electric assisted transportation. A world where electric "means of production" are no longer a centralized top down function, but a diverse integrated decentralized backyard and rooftop endeavor. A world in which worth and value is not determined by square feet of living space, but rather by carbon footprint. The difference between getting somewhere and nowhere is the courage to make a start.**

**Thank you for viewing "Reflections of the Mind" and enjoy the rest of Artprize.**

**Thanks Again,**
**Dan**

**Mr. Daniel Zimmer**
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**If you wish to speak today, please complete the following:**

**Name:** Tim Lundgren

**Affiliation (if any):** Varnum

**Phone:** 616-336-6750

**Email:** TJLundgren@varnumlaw.com

**Topics you wish to address today:**

a. ___ **Renewable Energy Portfolio Standards**

b. ___ **Energy Optimization / Efficiency Standards**

c. ___ **Electric Choice**

d. X **Other Additional Energy Topic**

**(Please specify):** Standby rates

**Requested time to speak:** X **< 5 minutes** ___ **5 minutes**

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## READYING MICHIGAN TO MAKE ENERGY DECISIONS

**Michigan Energy Public Forum Grand Rapids**
**Monday, February 25, 2013**

Tim Lundgren

Good afternoon.

I am here to enter a statement and data on behalf of Bruce Goodman, of the Varnum law firm, who was unable to attend today because he is at the ARPA-E Conference in Washington, D.C. reviewing the next generation of clean energy innovation being sponsored and spurred by the Department of Energy.

The issue on which Bruce is submitting data is standby utility tariffs within the state of Michigan. Standby rates are utility charges to customers who own their own electric generation to compensate the utility for providing backup service for that generation. Although the charge and the concept is not in and of itself a problem, the level at which standby rates have been set in Michigan have been an impediment to energy innovation. The utilities' current standby rates do not properly reflect the true cost of standby service.

The result of inflated standby rates is that self-generation projects that otherwise would add to the economic competitiveness of Michigan's economy have not gone forward.

Stated very simply, the standby rates being charged by Michigan utilities must be revised, reduced, and appropriately set. This is a job for the Michigan Public Service Commission and is well within its regulatory authority. A regulatory case should be commenced immediately to investigate and reset standby rates within the state of Michigan to make them simple, fair, and encouraging for self-generation.

In support of this position, the following nine reports are being submitted today as data for consideration.

- ***Removing Barriers to a Greater Use of Distributed Renewable Energy***, by John Sarver, Executive Director, Great Lakes Renewable Energy Association (GLREA), 10/5/12.

- ***Electric Utility Standby Rates: Updates for Today and Tomorrow***, by Tom Stanton, Principal Researcher, National Regulatory Research Institute, and formerly of the Michigan Public Service Commission, July 2012.

- ***Rate Structures for Customers with Onsite Generation: Practice and Innovation***, by L. Johnston and K. Takahashi, Synapse Energy Economics; F. Weston and C. Murray, Regulatory Assistance Project, National Renewable Energy Laboratory (NREL), December 2005.

- ***Are Standby Rates Ever Justified? The Case Against Electric Utility Standby Charges as a Response to On-Site Generation,*** by Sean Casten, President and CEO of Turbosteam Corporation, *The Electric Journal*, copyright 2003.

- ***About the Standby Rate Estimator***, by Pace Energy and Climate Center for the New York State Energy Research and Development Authority.

- ***Are US Utility Standby Rates Inhibiting Diffusion of Customer-Owned Generating Systems?*** by Jerry Jackson, Texas A&M University, August 2006.

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- ***Standby Rate Design: Current Issues and Possible Innovations***, by A.J. Goulding and Serkan Bahceci, London Economics International, LLC, November 2006.

- ***Standby Rates for Customer-Sited Resources,*** by U.S. Environmental Protection Agency, Office of Atmospheric Programs, Climate Protection Partnerships Division, December 2009.

Thank you.

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**Email:** TJLundgren@varnumlaw.com

**Topics you wish to address today:**

a. ___ Renewable Energy Portfolio Standards

b. ___ Energy Optimization / Efficiency Standards

c. ___ Electric Choice

d. X Other Additional Energy Topic

(Please specify): Standby rates

**Requested time to speak:** X < 5 minutes ___ 5 minutes

**Please leave a copy of any written or electronic materials at the welcome center.**

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Thank you.

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# Removing Barriers to a Greater Use of Distributed Renewable Energy

## Comments by the Great Lakes Renewable Energy Assoc.

### Background

Michigan has ample renewable energy resources that can help our state become more self-reliant, cleaner, and less vulnerable to volatile fossil fuel prices. Michigan has 120 companies (4,000 jobs) already in the wind energy industry and 121 companies (6,300 jobs) in the solar energy industry. There are hundreds of other companies that are well positioned to diversify into renewable energy.

While the Renewable Portfolio Standard has led to the development of commercial wind farms in Michigan and true net metering has encouraged residential installations of small solar and wind energy systems, there are still significant barriers to a greater use of distributed renewable energy in Michigan. Significant reductions in the cost of photovoltaic systems and a greater availability of small wind systems provide real opportunities for Michigan's economy and environment if regulatory and institutional barriers can be reduced.

While these comments focus on distributed renewable energy systems, it should be mentioned that GLREA believes in efficiency first and the utility energy optimization programs complement solar and wind energy systems and should be expanded. It should also be noted that while the development of commercial wind farms has been a success story in most Michigan communities, there are communities that are enacting restrictive zoning ordinances. It would be helpful if state agencies were more proactive in informing local officials and planners about wind zoning and siting best practices.

### Financial Incentives

"Weak incentives for solar" was the highest ranking barrier to a greater use of renewable energy in a recent survey of GLREA business members. Detroit Edison and Consumers Energy photovoltaic (PV) pilots have been helpful in providing incentives for PV systems, but they are limited and undependable, i.e. homeowners and businesses never know if they will win the "lottery" or if funding limits will be reached. There are more incentive requests than program budgets can accommodate. Expanded and extended program pilots would not eliminate, but would reduce this barrier.

### Permitting

The recent survey of GLREA business members identified a number of barriers related to permitting. Four of the top ten barriers related to permitting: inconsistent policies, inspectors' unfamiliarity with solar and wind systems, inconsistent fees, and inconsistent forms. GLREA is revising its PV training program for electrical inspectors and will seek financial support to make this available. Inconsistent policies, fees, and forms could be

addressed by the Bureau of Construction Codes and Michigan Energy Office leading an effort to work with local permitting authorities to develop consistency wherever possible. GLREA can assist in this effort.

Property Taxes

The recent survey on barriers identified "property taxes based on system cost" as the third highest ranking barrier. If residential solar and wind systems are taxed at installed cost, homeowners will not be able to invest in the systems. The increase in property taxes would be higher than the dollar value of the electricity produced by a solar or wind system. This is a significant risk for homeowners and discourages installations. One solution to this barrier, implemented in many other states, is to exempt smaller renewable energy systems from property taxes. Another solution is to tax systems based on the value of energy produced, i.e. a revenue approach. Ann Arbor is already using this approach. A State policy is needed to make it statewide.

Net Metering Limitations

True net metering, i.e. credits on utility bills at the retail rate, is now limited to 20 kW. This works well for the residential sector, but we are missing some very good opportunities for schools and farmers. Modified net metering, i.e. credits at the generation rate, goes to 150 kW. Legislation permitting true net metering for schools and farmers up to 150 kW would provide significant incentives to two very important target audiences.

Community Solar

There are a number of groups who, even if they want to, cannot purchase photovoltaic systems for practical reasons. Renters do not own their buildings. Many homeowners do not have good sites, e.g. too much shading, building orientation is not good, etc. Community Solar can provide a means to allow those interested to participate in a "community" system. A large system that can meets the needs of many persons is placed in a good location for solar energy and interested persons make an investment in the system and receive "solar credits" on their personal utility bills based on their share of the electric production of the community solar system. Existing net metering legislation and rules do not make this possible. New Community Solar legislation could expand the opportunities for purchasing photovoltaic systems.

None of these modest proposals would require state expenditures or have significant economic impacts on utilities, but they would make a difference in reducing the existing barriers to a greater use of distributed renewable energy in Michigan.

Comments Prepared By
John Sarver
Executive Director, GLREA
10/5/12

# Are Standby Rates Ever Justified? The Case Against Electric Utility Standby Charges as a Response to On-Site Generation

*Standby rates are not only unnecessary, but actually stand in direct opposition to the public interest. To allow utilities to apply standby rates to distributed generators is economically beneficial to the utility in question, but economically disadvantageous to society as a whole.*

*Sean Casten*

**can Casten** *is President and CEO of Turbosteam Corporation, a 17-year-old developer of "heat-first" ogeneration projects headquartered Turners Falls, Massachusetts. He is also the Policy Chair of the Northeast CHP Initiative, a public/private partnership dedicated to encouraging the adoption of mbined heat and power generation in the northeastern U.S.*

## I. Introduction

In recent years, the call for standby tariffs in electric utility rate structures has escalated as a response to the growing penetration of distributed generation (DG) on the utility grid. Though intended to ensure that the public benefit is not compromised, their actual effect has been—and will be—to increase the total cost of electricity to all power consumers.

This article outlines the economic basis for this argument and is intended to provide policymakers[1] with a tool to assess the full economic impacts of standby electric rates. While this article is focused on standby rates—wherein customers pay a flat monthly charge for potential, rather than actual, power provided—its logic applies equally to any rate component that tends to reduce the dependence of electric bills on variable electricity consumption and increase their dependence on fixed monthly charges.[2]

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This article will show that the counter-arguments in support of standby rates all fail for one or more of the following reasons:

1. A failure to include load growth in cost-recovery projections;
2. A failure to apply actuarial mathematics to the utility infrastructure, and;
3. A failure to design rates that maximize social—as opposed to utility—financial benefit.

## II. Why Standby Rates?

To appreciate the cause for these failures, one must start by understanding the utility argument for standby rates, all of which boil down to the following two propositions.

### A. Compensation to recover the costs of providing peak power

To a substantial degree, utilities' costs tend to scale with peak demand (kW) rather than annual electricity sales (kWh), since the former sets the size and maintenance needs for the most capital-intensive components of their traditionally configured system (central generating plants, transmission/distribution wires, substations, etc.). However, utility revenues tend to scale with electricity sales, on a kWh basis. As such, it has been claimed that the addition of a distributed generator will reduce utility revenues, but not significantly impact their costs, since it is assumed that the utility still must maintain peak service in the event of a generator outage. Utilities have thus argued that existing rate structures must be altered to correct this changing pattern of consumption.

### B. Prevent cross-subsidization of non-DG customers

In this case, it is claimed that since utility profit margins are compromised by DG, the utility must be "made whole," or else be forced to raise rates to all other customers. Should this happen, non-DG customers will in essence be forced to pay for their neighbors' actions. Regardless of the economic accuracy of these assertions, these arguments create political and emotional arguments for the implementation of standby rates that are often extremely difficult for policymakers to effectively counter.

*The underlying presupposition of all standby rates—that customers receive benefits from the utility system, but deliver no benefits in return—is categorically false for customers who install DG.*

Both of these arguments are fatally flawed, but for subtly different reasons:

- The first fails to include the statistical realities of the electric grid and thereby overstates the actual revenue impact of an individual distributed generator on the much larger utility.
- The second fails to take into account the financial benefits that DG creates, which are often well in excess of their costs.
- Both arguments fail to account for the steady growth in electricity consumption, which creates an ongoing demand both for new wires *and* enhanced utilization of existing utility assets.

In short, ***the underlying presupposition of all standby rates is that customers receive benefits from the utility system, but deliver no benefits in return.*** This supposition is categorically false for customers who install DG. These customers can be shown to be directly responsible for an array of benefits that accrue both to their utility and to the society at large. In ignoring these benefits, standby rates thus overcharge DG customers for electric power *and* bring about financial penalties to our national economy by preventing the more widespread adoption of DG technology.

To understand why this is the case, let's take a closer look at each of the arguments in favor of standby rates as outlined above.

## III. The Case Against Peak Power Cost Recovery

Like all businesses, electric utilities are obliged to charge for


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calculate the aggregate financial impact of a given DG installation on a given utility, which is best illustrated by example. Suppose that a 100 kW DG unit is installed. The actual reduction in utility resource utilization will be:

100 kW
X The distributed generator's coincident peak with the utility (expressed as a percent)
X The statistical likelihood of an outage, inclusive of all DG units that directly impact the asset in question.

These values can be calculated easily—and will always be less than the rated power of the generator. To categorically apply a standby rate to the entire peak power output of the generator is thus to overcompensate the utility for the services they provide.

## IV. The Case Against Cross-Subsidization

Public utility commissions are—as their title suggests—tasked with regulating utilities in a manner that will deliver the maximum public benefit. While the fiscal health of a utility is *sometimes* a good proxy for the public benefit (e.g., a bankrupt utility cannot be reasonably expected to provide reliable electric power), this is not universally true. In fact, there are a broad number of social benefits—financial and otherwise—which accrue to society at large, but not to the regulated utility.

Many of these benefits can be generally classified as market externalities, which are notoriously difficult to monetize under any condition (reductions in air emissions, reductions in greenhouse gas emissions, reduced vulnerability to terrorist attacks, etc.). While policymakers are well advised to factor these into their planning processes, it is admittedly difficult to do so. However, there are many financial benefits delivered by distributed power generation that are easy to calculate but exceeding difficult to recover under existing utility regulation. Broadly speaking, ***these benefits arise in any instance where the distributed generator reduces the total cost of delivered electricity.*** So long as utilities rates are set under traditional cost-plus protocols, any actions that reduce utility costs also reduce utility revenues. (Note that society still realizes fiscal benefit from these measures—after all, it is the electricity consumer who ultimately benefits from any reduction in the cost of delivered electricity.)

Among the classes of financial benefits which can thus be delivered—and calculated—by distributed generation are the following:

- Any measures that increase the efficiency of power generation. If a customer generates electricity at twice the efficiency of the local utility, they will only have to purchase half as much fuel and realize immediate fiscal savings. However, if the utility invests in the same measure, they will be forced to pass these savings along to their customer, and show no net improvement in their financial position.

**Table 1:** Marginal Costs to Serve New Load by Upgrading T&D Network

| Grid Component | U.S. Average Cost ($/kW) |
|---|---|
| Transmission | $540 |
| Substation | $39–211 |
| Distribution | $720 |
| Total | $1,299–$1,471 |

- Any measures that reduce the need for additional construction of transmission and distribution assets will offset (on average) over $1,300/kW of DG capacity installed.[5] This is shown in **Table 1.**[6] Society clearly benefits from such avoided investment, but the utility only realizes a reduced basis for cost-plus rate making (and hence reduced revenues).

With many DG technologies—engines, steam turbines, gas turbines, etc.—already available at installed costs of less than $1,300/kW, it thus becomes abundantly clear that distributed generation is in many cases the cheapest way to deliver future load growth.[7] The obvious implication is that from a public policy perspective, it is in society's best interests to enhance the economics of DG—as opposed to the economics of the utilities


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simply "when?" Installation of end-user-sited generation does not render utility investments useless—it simply buys the utility critically needed time before they will have to upgrade the capacity of those investments.

This reality sets a very real "shelf-life" on the economic relevance of standby rate structures which (to the author's knowledge) has yet to be factored into any approved standby tariff. Unless one expects DG penetration to outpace future load growth, the entire concept of "stranded assets" thus becomes a misnomer. "Temporarily idled assets?" Perhaps—but certainly not stranded. As **Table 3** shows, we would require a national DG penetration of almost *13 GW per year* over the next 20 years simply to keep pace with the growth in electricity consumption.[10] Any penetration short of this level will have to be accompanied by a commensurate increase in transmission and distribution (T&D) construction—and thus with the steady overutilization of those (supposedly) stranded assets.

In other words, unless one expects these extraordinarily high levels of DG penetration to materialize in the very near future, there is no credible argument that can be made in support of standby rates. Rather than asking the question "can the utility afford to allow DG on their networks?" we should be asking "given our constrained electric distribution system, how can we best facilitate the spread of DG?" Standby rates—which reduce the economic viability of DG investments—are thus clearly a step in the wrong direction.

In fact, any measures that prevent the adoption of DG may also stand in opposition to the financial interests of the utility. To understand why, recognize that the trends shown in Figure 2 imply a steady aging of the installed base. This means that utilities' revenues are increasingly being earned on assets that have already been paid down. By deferring the need to invest in new assets, DG will thus increase the marginal profitability of utilities by allowing them to steadily increase that fraction of their revenue that is earned through fully amortized investments. By contrast, if we take actions that block the spread of DG, we will soon force utilities to make massive investments in the electricity T&D infrastructure, which would almost certainly lead to rising electricity rates to all consumers.[11]

Given these trends it is quite reasonable to assert that absent strong corrective action, we are on a crash course for disaster. There is no hyperbole intended by this statement. As reserve margins have fallen, we have steadily reduced our ability to move electric power into those places where it is most needed. Recent blackouts in Chicago, California, and New York City have all been caused not by a lack of generation, but by a lack of T&D capacity. In Chicago alone, the 800 deaths that directly resulted from power outages make this a larger social disaster than the Oklahoma City bombing, Northridge earthquake, and TWA Flight 800 crash *combined*.[12] This is a public policy disaster of the first order—and one which we have yet made no measurable effort to resolve.

In this context, policymakers should be doing everything in

**Table 3:** Actual Annual DG Penetration Required to Idle Utility Assets, 2003–2023

| Region | Annual DG Installations Required to Idle Utility Assets, 2003–2023 (MW/year) |
|---|---|
| New England | 281 |
| Middle Atlantic | 703 |
| East North Central | 1,719 |
| West North Central | 879 |
| South Atlantic | 3,311 |
| East South Central | 1,167 |
| West South Central | 1,807 |
| Mountain | 1,157 |
| Pacific | 1,946 |
| Total U.S. | 12,970 |


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Having made this case, it is worth noting that there are undoubtedly a number of exceptional cases in which case a DG investment will lead to significant stranded assets (e.g., if a customer installs DG immediately after a utility makes an investment in a large distribution capacity upgrade specifically for that customer's facility). However, this is an argument for allowing exceptions to existing tariffs—not for designing tariffs for exceptional circumstances.

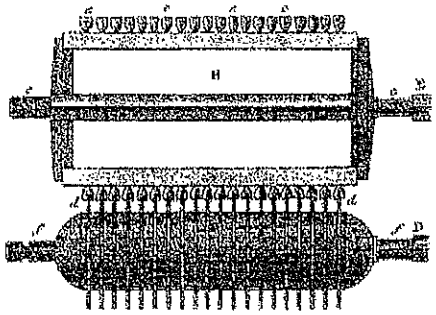
With the 20-year (and counting) trends all pointing in the wrong direction, the time has come for wholesale changes in the way that we regulate—and price—electric power. When the status quo equates to increasing line losses and falling reliability, our best course of action is to change the status quo—not to add standby rates that will serve only to keep it in place.■

Endnotes:

1. This term is used generically throughout this article to refer to public utility commissions and legislators—all of whom have a direct role to play in the regulation of monopoly utilities.

2. This includes demand ratchets, increasing customer charges as well as many blatantly anti-competitive rate elements like aptly named "customer retention discounts" approved by the Hawaii PUC or "load retention tariff" proposed by Commonwealth Edison.- Gary Nakarado (National Renewable Energy Laboratory), via personal correspondence, provided information on "customer retention rates" and other more egregious examples of anti-competitive rate-making by utilities and rate commissions. Among the examples he has identified are the following:

- *Colorado:* Public Serv. Co. v. Trigen-Nations Energy Co., No. 98SA103, Supreme Court of Colorado, 982 P.2d 316; 1999 Colo. LEXIS 616; 1999 Colo. J. C.A.R. 3901, June 28, 1999, Decided.
- *Hawaii:* Report Submitted to the Legislature Pursuant to S.C.R. 98, S.D. 2 Requesting a Consideration of the



Feasibility of Opening a Public Utilities Commission Docket Relating to Standby Charges and Customer Retention Discounts, State of Hawaii Public Utilities Commission, Dec. 2002.

- *Illinois:* Citizens Util. Bd. v. Illinois Commerce Comm'n, 275 Ill. App. 3d 329.

3. A grid with $n$ interconnected generators will have a reliability of $1 - X$ percent$^n$, where $X$ is the probability of an unplanned outage on any individual generator at any given time. Most DG technologies have reliabilities of 95 percent or higher, meaning that just 5 interconnected generators will have a system reliability of 1–5 percent$^5$, or 99.99997 percent. By comparison, the U.S. electric grid has an aggregate reliability of approximately 99.99 percent.

4. To take just two examples, photovoltaics produce peak power only during mid-day, and many combined heat and power plants produce peak power during times of peak thermal demand without regard for relative electric consumption.

5. It is worth noting that the lion's share of this avoided expense arises on the downstream end of the T&D system, as these are the investments that will be most directly impacted by any individual DG user.

6. Arthur D. Little, *Preliminary Assessment of Battery Energy Storage and Fuel Cell Applications in Building Applications*, Final Report to National Energy Technology Laboratory, Aug. 2, 2000.

7. Thomas R. Casten and Martin Collins, *Optimizing Future Heat and Power Generation*, COGENERATION AND ON-SITE POWER PRODUCTION, Nov./Dec. 2002, 3 (6).

8. Department of Energy, Energy Information Administration, ANN. ENERGY OUTLOOK 2000, Washington DC, 2000.

9. Eric Hirst, *Transmission Planning for a New Era*, Jan. 2002, available on Web at http://www.ehirst.com/PDF/TXPlanning102.PDF.

10. Calculated simply as the growth in electricity consumption shown in Table 2 converted into MW based on a 6,000 hour operating year. Actual penetration requirements would be slightly higher than that shown here due to utility backup requirements (see Casten and Collins, *supra* note 7, for a more rigorous calculation).

11. Eric Hirst has estimated that simply to maintain a transmission (e.g., exclusive of distribution) reserve margin consistent with 1999 levels will require an investment of $56 billion from 2000 to 09, at a cost of approximately $1,000/kW of delivered service. (Hirst, *supra* note 9.) It is unrealistic to expect utilities to make these investments without also filing for a formal rate case to increase the electric rates paid by all consumers.

12. Eric Kleinenberg, HEAT WAVE: A SOCIAL AUTOPSY OF DISASTER IN CHICAGO (Chicago: University of Chicago Press, 2002).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# About the Standby Rate Estimator

## Introduction

To further encourage the use of combined heat and power ("CHP") in New York State, the New York State Energy Research and Development Authority ("NYSERDA") has contracted with the Pace Energy and Climate Center to develop a Standby Rate Estimator ("Estimator") and Standby Rate Manual ("Manual") to help businesses analyze the energy bill impacts of deploying an onsite CHP system. CHP, which utilizes both the heat and electric power output from small generation systems situated on an energy user's premises, dramatically improves energy and environmental performance over traditional electricity supply approaches consisting of central station generating plants and transmission and distribution systems. Economic benefits include paybacks that in some cases can be as short as two years, improved power quality and improved reliability. The environmental importance of CHP is made evident by the fact that total system efficiencies can reach 80% and more in contrast to usual power plant efficiency of about 30%. Each unit of fossil fuel input can be employed for useful cooling, heating and power with only a fraction of the waste and resulting pollution inherent in separately provided cooling, heating and power configurations. Responding to the benefits of CHP, businesses are increasingly investigating the feasibility of building their own CHP systems.

Because a CHP system generally cannot meet the entire electric needs of a facility due to insufficient electric capacity, scheduled maintenance shutdowns or unscheduled outages, developers of CHP systems must provide for back-up or supplemental power supply. Basically there are two alternative means to provide for backup generation capacity (1). One alternative is to build sufficient redundant capacity such that if one generating unit cannot operate, another will be available to take its place. The problem with this approach is that it is very costly; the redundant capacity will rarely be used and since the capital costs must be spread over relatively few kWh the cost per kWh will be very high. For the same reason developers generally do not build sufficient capacity to meet peak load, since the increment of capacity designed solely to meet peak demand will rarely be used.

The second alternative is to rely upon the local distribution utility to serve the balance of the customer's electric needs, and to pay what are called standby rates to make sure that the utility has capacity available when needed. Standby rates are the charges levied by the local utility for supplemental, backup and maintenance power provided to customers utilizing CHP and other distributed generation ("DG") plants (2).

The New York Public Service Commission ("Commission") has approved standby rates for all of the State's major electric distribution utilities applicable to customers utilizing CHP (3). As discussed in more detail below, the standby rates collect the costs of providing standby service on a per kW basis through "as-used demand" charges and "contract demand" charges as opposed to through per kWh charges reflecting energy consumption. The Commission recognized that depending upon their load patterns some customers would pay higher electric charges under the standby rates than under their otherwise applicable rates and, therefore, provided for an optional phase-in of the standby rates. For the major electric distribution utilities other than National Grid, whose standby rates had been previously determined by the Commission, the Commission also provided an optional exemption from the standby rates for certain on-site generation using an "eligible designated technology" defined as including fuels cells, wind, solar thermal, photovoltaics, sustainably-managed biomass, tidal, geothermal, methane waste and CHP systems of less than 1 MW that meet certain efficiency and environmental criteria (4). In order to be eligible for the designated technology exemption, the on-site generation must enter service by May 31, 2006, (though the Commission is currently considering an extension of this deadline).

Under certain circumstances standby rates can result in significantly higher utility bills than the otherwise applicable rates and can, in fact, be determinative of the economic viability of CHP projects. The benefits to a customer of using on-site generation instead of paying its local utility for energy may be considerably diminished, however; when the customer pays to generate its own energy on-site and also has to pay, at the same time, the utility for standing ready to provide that same power. Complicating the problem for developers of potential CHP systems, standby rates are complex and it is difficult to accurately estimate the standby rates that will be incurred if a CHP system is built. The inability to determine standby charges quickly, accurately and inexpensively could be a major decision barrier for owners and facility managers of smaller customers, a serious problem since small commercial and institutional facilities constitute the majority of the remaining technical potential for CHP in New York State (5).

## About This Manual and Estimator

Responding to the needs for transparency and for easily accessible and understandable information about possible standby charges, this Manual describes a new web-accessible and interactive Standby Rate Estimator that makes it possible for users to estimate the standby charges that would be incurred if a CHP system were built. It also allows users to see whether the Standby Tariff will result in total charges in excess of the charges they would incur under otherwise applicable rates. In addition, users are able to compare the delivery charges (total bills without commodity charges) they would be billed under the Standby Tariff to those they would incur under otherwise applicable rates. In certain cases, described in this Manual, a user might be able to obtain an exemption from the Standby Tariff and the Estimator will help the user determine whether to seek such an exemption. In addition, the standby charge derived through use of the Estimator can be input into already available programs that analyze the economics of installing a CHP system to obtain a more complete analysis than would otherwise be possible.

This Manual begins with an introduction to standby rates. It includes a discussion of the rationale for the rates, a description of their impact on customers and a summary description of tariff mechanics. The Manual next provides an introduction to the Estimator, describing its purpose; necessary inputs and where to find them; inevitable uncertainties when using the Estimator; and a walk-through example of how to take advantage of the Estimator. The Manual concludes with a glossary of terms, a compendium of links to utility standby tariffs for all New York State distribution companies and contact information for each of the distribution companies.

Both the Estimator and the Manual focus on Consolidated Edison at this time, with revised versions of both the Estimator and the Manual planned to include the recently revised National Grid standby tariff.

## Standby Rates

### Background and Rationale

Standby rates are tariffs designed to recover the costs incurred by electric distribution utilities to provide service to those customers that use a utility's transmission and distribution system for only a portion of their electric energy requirements. They recover the costs of standby service, which includes:

- *backup service* in case a customer's on-site generation is not operational for some reason and the customer must return to utility service;
- *maintenance service* in case the customer must return to utility service during routine testing and upkeep of the CHP system; and
- *supplemental service* which provides the difference between a customer's total load and its installed on-site generation.

For ratemaking purposes in New York, there is no recognized distinction between these three situations in which the customer may require partial service from the utility.

In order to provide standby and supplemental service, utilities must invest in sufficient distribution and transmission capacity to provide power to standby rate customers when that power is requested. In addition, the utility or another energy supplier must have sufficient generating capacity available to meet the customer's request for power. The distribution and transmission capacity must be appropriately sized to meet the maximum demand that the customer is expected to impose on the utility system.

Since the investment necessary to provide standby service is determined by the maximum demand imposed by a particular customer on the system, rather than by the amount of energy used over the course of a month (or other billing period), the Commission has determined that standby rates should recover the cost of service through per kilowatt (kW) "fixed" demand charges rather than per kilowatt-hour (kWh) volumetric charges based upon energy consumption.

Under standby rate guidelines established in 2001, New York utilities recover the cost of standby service through three distinct charges: *customer charges, contract demand charges, and daily as used demand charges.*

The customer charge is designed to recover certain fixed costs, costs that do not vary with energy use or demand, such as metering expenses and administrative costs. The customer charge shows up on the customer's bill as a fixed monthly charge. Every customer in a given rate class pays the same customer charge, regardless of the site's electric load or usage.

The contract demand charge by contrast, varies according to total site demand, to reflect the fact that utility investment is positively correlated with customer demand. Contract demand represents a customer's maximum potential demand. Customers pay the contract demand regardless of whether their actual demand approaches this level. (In this way, the contract demand charge is a lot like a "bucket" of minutes on a mobile phone contract - you pay this charge whether or not you use the minutes.) As explained in Opinion No. 01-4, "contract demand charges are the more appropriate vehicle for recovering charges that are relatively specific to the individual customer, in the sense that the utility incurs such costs to provide "local" transmission and distribution facilities necessitated by that customer's peak demand..." (6)

The daily as-used demand charge also varies by usage, but the charge is assessed based upon the customer's actual metered demand (in kW) during peak-hour periods. Although some standard service classes are subject to demand charges for use at night, the daily as-used demand charges do not reflect night-time use. As explained by the Commission, "As-used demand charges, on the other hand, are the preferred means of cost recovery for facilities that are needed to meet system peaks and therefore are "shared" among numerous customers rather than "local" to the individual customer."

## Unresolved Issues

Standby rates for Con Edison were set by the Commission following lengthy negotiations and litigation over the term of a settlement proposal submitted by some of the parties in the utility's standby rate case. A similar process occurred for the other major electric distribution utilities in the state, with the result that all of the utilities have fairly similar standby rates. However, development of standby rates for National Grid predated the standby rate cases of the other utilities and the National Grid rates differ from the other utilities in important respects. Significant changes to National Grid's rates were approved by the Commission on April 28, 2006.

Standby rate design remains a controversial and hotly debated issue in New York State, and indeed across the country. Important questions remain as to the proper allocation of costs between the contract demand charge and the daily as-used demand charge, whether it is

appropriate to recover supplemental service together with standby service and whether the standby rates properly recognize the benefits CHP provides to system reliability, diversity of supply and the ability to avoid investment in otherwise necessary distribution, transmission and generation plant. The scope of this Manual is limited to understanding the implications of the existing standby rates for potential CHP systems; it does not attempt to explore the intricacies of standby rate design.

### Impact on Customers

*How will standby rates affect my bill?*

The impact of standby rates on customers will depend upon the specific customer's load profile. High-load factor customers (i.e., those whose demand is relatively flat and whose average demand is a high percentage of their peak demand), may benefit from standby rates since they do not have demand spikes that would incur high contract demand charges relative to typical daily demands. Furthermore, their high energy usage would result in much higher bills if standby rates recovered revenues based upon number of kilowatt-hours used as opposed to peak demand. Low-load factor customers, those whose average demand is a low percentage of their peak demand, would more likely to be hurt by a standby tariff since their relatively low volumes combined with demand spikes makes them losers under a tariff design that recovers costs based upon demand rather than energy use. Low-load factor customers who peak during off-peak periods, however, may benefit since their peak will not be captured in the daily as used demand charge.

Figure 1 illustrates a typical high-load factor customer's use of energy. Customers will relatively little weather sensitive load, such as industrial customer using energy for manufacturing, might have this type of energy usage.

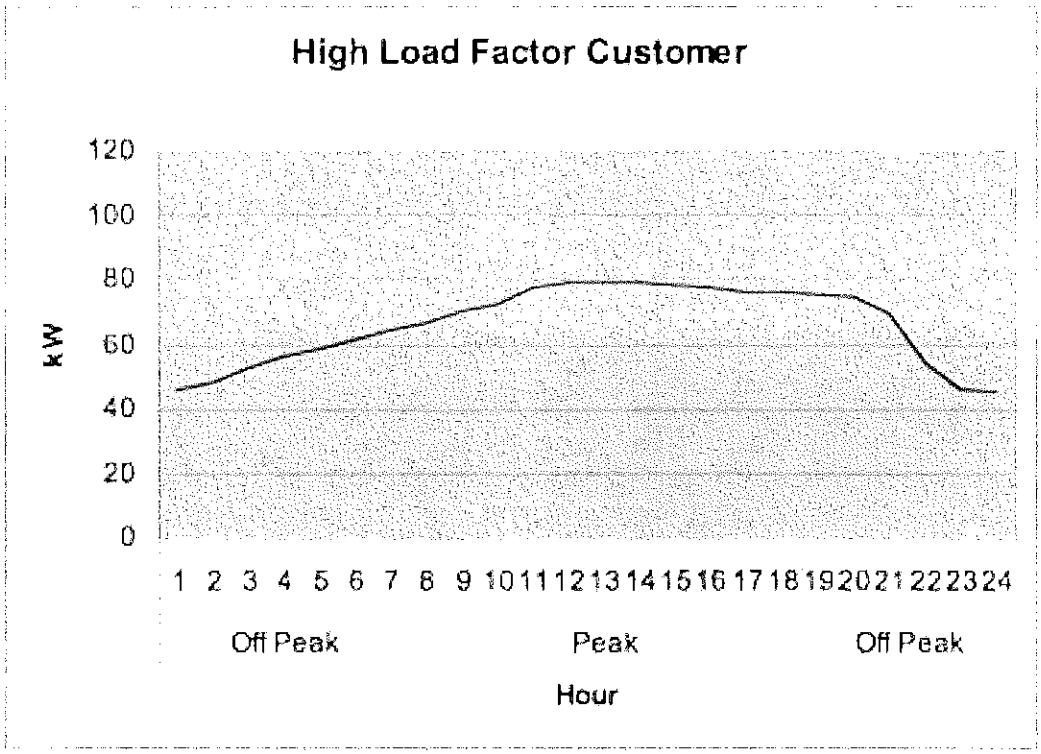
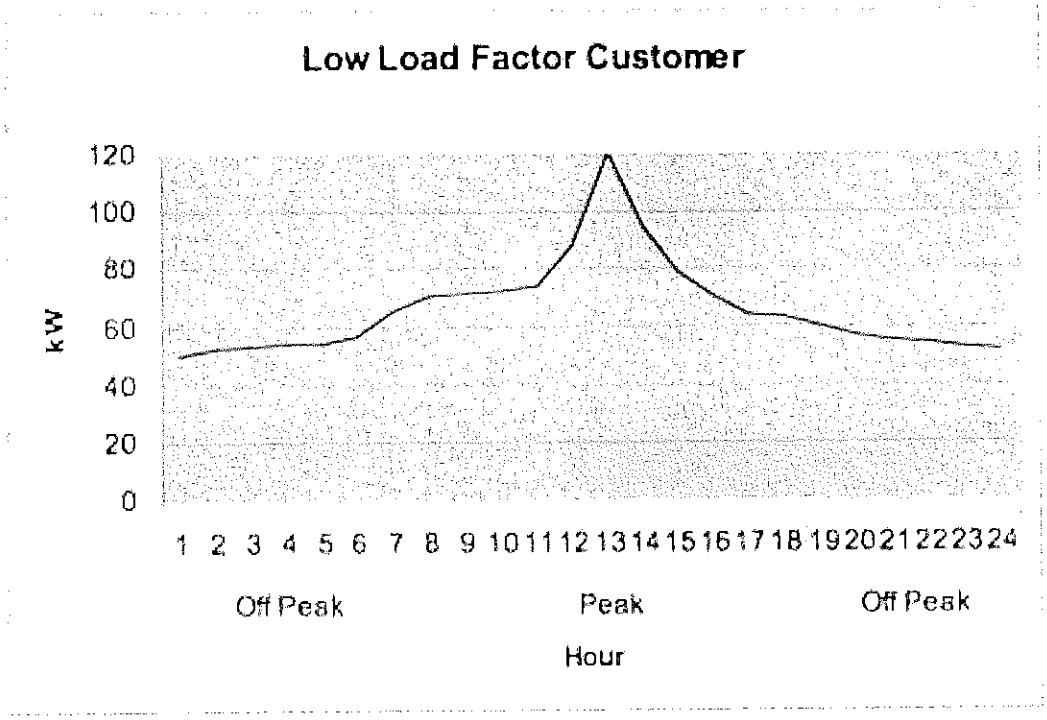
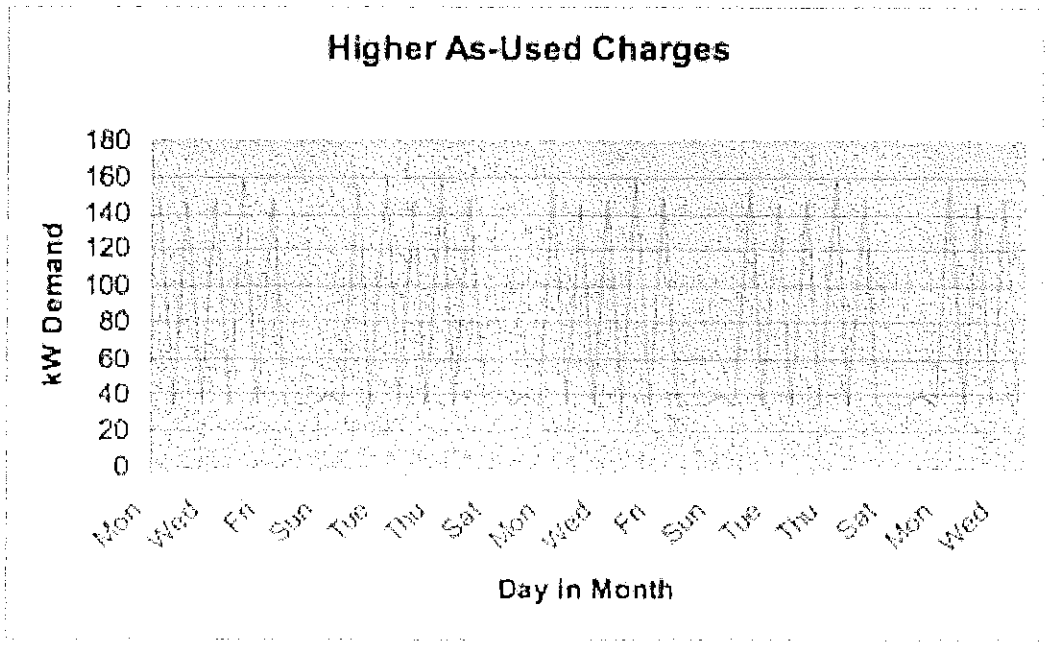


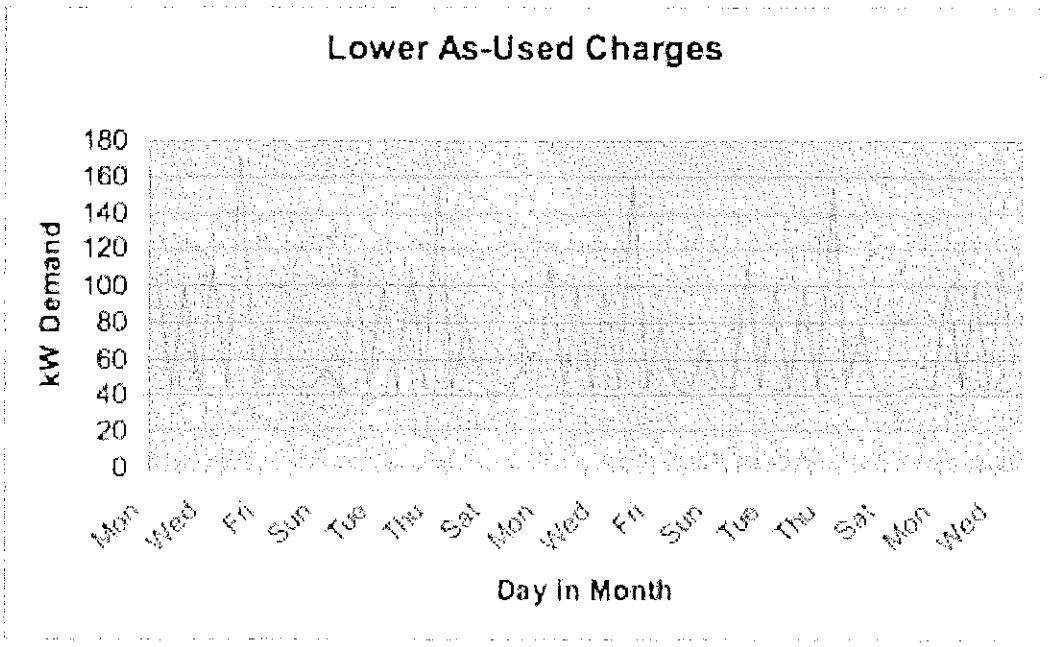
Figure 2, by contrast, shows a low-load factor customer with peak demand that is considerably higher than its average demand. Note that in the two examples, both customers use the same total kWh through the day; the difference is the timing and degree of their peak demands. Low-load factor customers could be commercial customers with highly weather-sensitive load or multi-family buildings, although the latter might have peaks somewhat later during the on-peak period. Low-load factor customers with peak demand during off-peak hours, for example a steel mill that starts its manufacturing processes before on-peak hours begin, would have a similar looking curve, but the peak would be far to the left.




In addition to load factor, a similar but distinct characteristic that influences a customer's standby delivery charges is how often the customer achieves a high kW demand "spike" at least once in a day. Since the daily as-used demand charge is set daily, a high fifteen minute demand will impose the same delivery charge as if that same level of demand were maintained for several hours. The Estimator uses a ratio, called the "Average Demand Discount Factor" to estimate this consumption characteristic.

One important difference between load factor and this demand characteristic is that as-used demand charges are established only on peak. Furthermore, since the as-used demand charges are set daily, they are not affected disproportionately by a monthly peak; at most the peak day contributes one daily peak demand of the twenty or so peak days in a month. Figures 3 and 4 illustrate how the as-used demand components of a customer's bill are related to the average of peak daily demands, not the monthly peak. Also note that the high as-used charge customer imposes lower weekend demand, but because weekends are not peak days, those days do not contribute to the standby as-used demand charges.




In those cases where the standby tariff results in an increase in utility bills compared to the bills that would have been received under the otherwise applicable service classification, the financial benefits of investing in CHP will obviously be decreased. To the extent a customer's payback period is significantly lengthened because of the impact of the standby tariff, the customers may have to choose between forgoing the opportunity to build a CHP system or building redundant capacity. Since building redundant capacity will increase the cost of energy per kWh, the reliability benefits would then have to be weighed very carefully against the costs of such a system.

There are significant reliability benefits to redundant capacity in addition to avoiding standby tariffs, since customers will be indifferent to distribution utility power quality problems and outages; however, the costs of the increased reliability will be too high for many customers.

Customers should consider various alternatives to reduce their contract demand and daily as-used demand charges such as, if feasible, shifting load from on-peak to off-peak periods as well as technology sizing options. Users of the Standby Estimator should consider running various sensitivities with different loads and different size CHP systems.

The Estimator is designed to move the question of how significant the standby tariff will be from a theoretical discussion to an approximation of what the actual impact will be on specific users. In fact, that's the only impact that most readers of this Manual will care about.

## Summary Description of Tariff

Customers supplying some, or all, of their own electric load in parallel with their local utility's electric system are subject to their utility's standby tariff. This section of the Manual describes Con Edison's standby tariffs; most of the other distribution utilities in the State have similar tariffs. It is essential that customers considering the installation of CHP examine (or have their consultants examine) the tariffs of the specific company serving the location of their potential facility. Citations to specific sections of the Con Ed tariffs are included in the body of this report. Links to the tariffs of other companies can be found in Links at the end of this Manual.

Customers in Con Edison's territory are subject to tariff SC-14A (the "Standby Tariff"). The Standby Tariff can be found at http://www.coned.com/documents/ra/ra-sc14.pdf. Key elements of the Standby Tariff are:

## Applicability

*Would the standby rates apply to the CHP system I'm thinking about building?*

The Standby Tariff is generally applicable to service used to "replace and or supplement the power and energy ordinarily generated by a Customer by means of a private generating facility on the premises..."(8) The main exceptions are for very small systems, renewable systems, and high efficiency CHP less than 1 MW, discussed in a response to a question below.

*How do I know which standby rates would apply to me?*

The precise rates the consumer is charged are determined by the customer's "service classification". A customer's service classification will be the same whether or not the customer has an onsite generation facility and will be based on both the nature of the customer site (e.g., residential, commercial, industrial) and the level of the customer's demand. a.(9)

*Am I eligible for an exemption so that I wouldn't have to pay the standby rate?*

The Standby Tariff includes exemptions allowing certain customers to be billed under the otherwise applicable rate rather than the Standby Tariff.

1. Customers whose on-site generation has a total nameplate rating equal to no more than 15 percent of the maximum potential demand served from all sources.
2. Customers who would receive service under Service Classifications No. 1-RA, 2-RA, 7-RA or the energy-only rate of Service Classification No. 12-RA if they did not have on-site power, the common element being that the rates do not bill for demand.
3. Customers with a contract demand of less than 50 kW, provided, however, that customers who are not eligible for service under the above two exemptions may opt-in to the Standby Tariff by providing advance notice to Con Ed.(10)

*Are there certain technologies that are exempted from the standby rate?*

To encourage clean and renewable energy technologies, the Commission provided an optional exemption from the standby rates for certain on-site generation using an "eligible designated technology" including:

- fuels cells
- wind
- solar thermal
- photovoltaics
- sustainably-managed biomass
- tidal
- geothermal
- methane waste and
- CHP systems of less than 1 MW that meet certain size, efficiency and environmental criteria including an annual overall fuel efficiency of at least 60 percent.

To be eligible for the designated technology exemption, the customer must have a Contract Demand (explained in next section) of 50 kW or greater and on-site generation having a total nameplate capacity equal to or more than 15 percent of the maximum potential demand from all sources.

In order to be eligible for the designated technology exemption, the on-site generation must enter service by May 31, 2009.

*If I am going to be subject to the Standby Tariff, does it take effect immediately or can it be phased in?*

The Standby Tariff will be phased in except for those customers who affirmatively elect to be billed at the full Standby Tariff rate. Customers who opt to phase-in application of the Standby Tariff could have had their bills calculated at the otherwise applicable rate until 2008; for the next year at the otherwise applicable rate plus 25% of any difference between bills calculated at Standby Tariff rates and the otherwise applicable rate; increasing another 25% each of the next three years (11).

*I am eligible for an exemption to the standby rate. How do I know whether it is advantageous to opt out of this rate?*

The Estimator will provide an estimate of whether a customer is better off on the standby rate or the otherwise applicable rate. Before actually opting out of the exemption, a customer should work with its own consultant or in-house expert to confirm that its bills will be lower under the standby rate than the otherwise applicable rate.

## Contract Demand

*What is the contract demand and why does it matter?*

Contract Demand, for purposes of the Standby Tariff, is a customer's maximum potential demand, expressed in kW.(12) The Contract Demand is important because it helps to determine whether the Standby Tariff is applicable; if it is applicable, the Contract Demand becomes a critically important factor determining how high a customer's bill will be.

*Who determines the contract demand?*

A customer may establish its Customer Demand, but if it fails to do so in its application for service the utility will establish the Contract Demand for the customer (13). Whoever establishes the Contract Demand, if it is exceeded at any time by the maximum monthly demand, that maximum monthly demand becomes the new Contract Demand (14).

A customer who chooses its own Contract Demand is permitted to revise the Contract Demand downward once every 12 months; however, the new Contract Demand cannot be set at a level that is lower than the maximum demand during the previous 12 months unless the Customer provides an engineering analysis demonstrating equipment changes supporting the lower demand (15).

*What happens if I set my contract demand too low?*

There may be a temptation to set a low contract demand on the grounds that this will minimize overall standby charges. However, setting too low a demand can result in significant surcharges. Exceeding a customer selected Contract Demand by more than 10 percent but less than 20 percent will result in a surcharge equal to 12 times the sum of the monthly demand charges for the demand in excess of the Contract Demand. If the monthly maximum demand exceeds the Contract Demand by 20 percent or more, the surcharge will be equal to 24 times the sum of the monthly Contract Demand charges for the excess demand with provision for waiver (16). Of course, setting too high a Contract Demand would be counterproductive, since it would increase demand charges unnecessarily and could undermine the economics of a project.

*What if the utility sets my contract demand?*

Where the utility sets the contract demand (17) , there are no penalties if the Contract Demand is exceeded (18). The customer has the opportunity establish its own Contract Demand if it doesn't like that established by the utility, but doing so makes the customer subject to the surcharges described above (19). Since customers can be penalized for setting too low a Contract Demand charge by having to pay the surcharge described above, and are effectively penalized for setting too high a Demand Charge by paying unnecessarily high rates, there is an obvious advantage to letting the utility set the contract demand, assuming the utility itself does not set the Contract Demand too high. It is therefore recommended that users work closely with their system design consultant so that whoever sets the Contract Demand, sets it at the appropriate level.

*What are Daily As-Used Demand Charges?*

In addition to the Contract Demand charge, customers are also required to pay a daily as-used demand charge. The daily as-used demand charge, as its name suggests, is a per kW charge calculated on a daily basis and based upon peak demand during the peak weekday hours, as described below. Customers can reduce their daily as-used demand charges by shifting load off-peak.

## Tariff Mechanics

*What are the key elements of the Standby Tariff?*

Rates under the Standby Tariff vary depending upon the otherwise applicable service classification, but all include the same basic elements:

- **Monthly Customer Charge** - a fixed amount that does not vary based upon usage;
- **Delivery Service Contract Demand Charge** - per kW of Contract Demand (as described above);
- **As-used Daily Delivery Service Demand Charge** (Period 1) - per kW of daily peak demand during Monday - Friday hours between 8 am and 6 pm;
- **As-used Daily Delivery Service Demand Charge** (Period 2) - per kW of daily peak demand during Monday - Friday hours between 8 am and 10 pm. (20)

*Do the Standby Tariff charges vary by season?*

The Standby Tariff has higher rates during the billing period June-September than the other months of the year, to reflect higher costs incurred during the summer when peak demand imposes higher costs on the electric system. During the non-summer months the Period 1 charge disappears for all customers, since the rate is designed to reflect the higher costs incurred during the system peaks that almost always occur on summer weekdays. In addition, during the non-summer months Period 2 rates decrease for most customers (21).

*Are there any other charges collected by the Standby Tariff?*

Rates under the Standby Tariff also include recovery of various other charges and adjustments including:

- the Monthly Adjustment Clause ("MAC") - The MAC is authorized by the PSC as a mechanism for Con Edison to recover a variety of supply related and other charges related to its operations. All Con Edison delivery customers pay the MAC, whether or not they are full service customers or buy commodity energy through an ESCO. The MAC is imposed as a fixed addition to the customer charge and a per kW addition to the contract demand charge and as-used daily demand charges.

- System Benefit Charge - a small surcharge to support public benefits programs such as energy efficiency investment and research and development.

- Renewable Portfolio Standard Charge - to support statewide procurement targets for energy generated from renewable energy sources and other charges and other charges and adjustments included in each customer's otherwise applicable rates (22).

## Key Design and Operational Issues

*Will the Standby Tariff affect how I operate a CHP unit?*

The Standby Tariff provides important incentives for customers to minimize their Contract Demand both to avoid paying higher demand charges and to avoid paying surcharges if they exceed their self-selected Contract Demand levels. For example, customers will have a powerful incentive to avoid using Con Ed supplied electricity during shoulder periods (weekday evenings) if buying energy from Con Ed would result in a new maximum monthly demand, even if Con Ed energy is otherwise cheaper to purchase than the cost of self-generating.

Similarly, the Standby Tariff provides an incentive for customers to shift load off-peak in order to reduce their daily as-used demand charges even if the daily peaks do not threaten to exceed the Contract Demand level.

In addition, customers will have to make every effort to avoid system maintenance during the summer billing months in order to avoid a new maximum monthly demand.

As set forth above, the exception for designated technologies is scheduled to expire on May 31, 2009, so there is a powerful incentive to commence operation of on-site generation before that date for those customers with relatively low-load factors. While the designated technology exception is available for a variety of clean and renewable technologies listed above in the Applicability Section, customers operating CHP systems that want to take advantage of the exception have a special set of design and operational issues. Since CHP units must obtain an annual overall fuel efficiency of 60 percent in order to avoid the standby charge, customers owning such systems have to avoid generating electricity without also using the thermal energy that is generated at the same time. While it might be tempting to run the CHP system at times when it would be cost-effective to generate electricity but there is no thermal load, doing so will reduce overall fuel efficiency and could jeopardize eligibility for the designated technology exception. Complicating matters, in some cases it might be beneficial to run the CHP system without thermal load, since with a high enough load factor the standby tariff would not result in higher overall rates and, therefore, there would be no reason to plan operations so as to obtain the fuel efficiency level necessary for the exception. Customers must carefully consider, with the help of consultants if they do not have in-house expertise, whether it makes sense to try to obtain the designated technology exception.

There are, unfortunately, some operational issues that could unavoidably lead to higher demand charges. If a utility outage, even a momentary system trip, leads to a spike in a customer's demand, the customer has to pay the resulting charges (and possibly surcharges) even though the underlying problem originated with the utility.

Proper analysis of the design and key operational issue impacts on energy use and demand will be essential in order to provide reasonable inputs for use in the Estimator.

# The Estimator

## Purpose

The Estimator is a new web-accessible and interactive tool that makes it possible for users to estimate the utility charges that would be incurred if a CHP system or other on-site generation system were built compared to the charges that would otherwise be incurred absent such a system. The Estimator fully incorporates the costs that result from the applicability of the Standby Tariff rather than the rate that would otherwise apply absent the on-site generation system. The Estimator provides the type of transparent, easily accessible and understandable information about the impact of possible standby charges that is necessary for developers/utility customers considering the possibility of building on-site generation. Unless the new on-site generation will provide all of a customer's electrical needs and include sufficient redundancy to permit the customer to isolate itself from the electrical grid, the customer will need to rely upon it's local electric distribution utility for backup electricity. If it does so, it will have to pay standby rates and should consider the impact of the Standby Tariff on the economics of the on-site generation it is considering.

The Estimator will only generate an approximation of the user's expected energy and demand costs, with and without a contemplated CHP unit, based upon user provided site-specific load data (e.g. service territory, service class, monthly kWh and highest kW), system data (e.g. technology and nameplate capacity) and energy cost data (e.g., cost of fuel inputs for CHP unit and costs of energy if purchased from electric distribution utility or other supplier). Since the Estimator will only provided estimated costs, it is not intended to provide the level of precision necessary to make a fully informed decision regarding the economic viability of a new CHP or other on-site generation system. Rather, the Estimator is only intended to provide information that will help a user make a preliminary build/no build decision, decide whether to seek an exemption from application of the Standby Tariff and to determine whether it makes sense to further investigate the economics of building a CHP system.

A potential CHP installation may provide cost savings despite an increase in utility tariff charges. Furthermore, some CHP installations offer many benefits such as improved power quality and reliability, and thus may be justified even if the impact of standby rates is relatively high. If it does make sense to proceed further, the user should consult a professional to fully investigate the cost effectiveness of a new CHP system.

The Estimator does not address the issue of interconnection charges. Interconnection charges are described in the Standby Tariff (23), but are site-specific costs that are beyond the scope of the Estimator and the Manual. Interconnection charges are an important capital cost that must be included in the economic analysis of a potential new CHP system.

## How to Use the Standby Rate Estimator (SRE)

This section describes the materials the user must have available to utilize the SRE. It then describes critical uncertainties that will impact use of the SRE. Finally, the section includes a walk-through of the SRE illustrating how it works given a set of assumed facts.

*What data is necessary to use the Estimator?*

The customer will need to have available at least:

- one and preferably three years of electric bills;
- nameplate capacity and technology of the CHP unit that is being considered and its projected in-service date;
- knowledge of the CHP system's technical efficiency (for purposes of considering whether the Designated Technology exemption is available).

*Where do I find my delivery costs?*

The delivery costs are the costs of moving energy from the utility's transmission system through its distribution system to the customer's electrical load as recovered through the Standby Tariff or the otherwise applicable rate. Since the SRE estimates the difference between bills calculated using the Standby Tariff and the otherwise applicable rate and since the SRE is based upon the otherwise applicable rate, it is essential that a SRE user know the otherwise applicable rate. That rate can be obtained by referring to a past bill or by calling Con Edison at 1-800-343-4646.

*Do I have to provide information about my energy costs?*

As to energy costs, the customer is free to purchase energy from any of the Energy Service Companies (frequently referred to as "ESCOs") serving the State or from its local electric distribution utility. The Standby Tariff notes that standby customers may purchase electricity from Con Edison at the company's Market Supply Charge (frequently referred to as the "MSC") and Adjustment Factor, with such charges assessed on both a per kWh and a per KW basis (24). The Standby Tariff also notes that in most cases a customer will be assumed to be purchasing its energy supply from Con Edison, unless an ESCO enrolls the customer in the retail access program or Con Edison receives notice from the customer that it has a non-Con Edison source of supply (25).

The Estimator will use default estimates for commodity prices based upon Con Edison's MSC and Adjustment factor. If the user plans to purchase energy from an ESCO and knows that the ESCOs rate design differs from that of the distribution utility, ESCO specific data would be helpful. The more precise the fuel price data, the more accurate the projection of CHP generation and generation costs and, also, the more accurate the demand derived by the Estimator for use in the calculation of the Standby Tariff. It is, of course, impossible to precisely estimate next year's fuel prices (much less next month's), so the Estimator's results are inherently inexact.

*Why do I need three years of old bills?*

Past consumption is critical information, so the user should have the last three years worth of bills available. While one year will be sufficient in most cases, additional years are helpful to ensure that usage during the previous year is likely to recur. The user should consider the possibility of any significant changes in consumption patterns that result in changed overall consumption or consumption patterns such as moving usage from a higher-priced billing period to a lesser-priced period or vice versa. For example, if demand for a user's product is expected to vary significantly from the past, with a resulting change in demand, information about anticipated consumption should be provided. Unusually hot or mild summers may also cause significant annual differences for customers with high air conditioning load.

## Glossary of Terms

**Annual overall fuel efficiency** - A measure of total energy efficiency calculated by dividing combined useful thermal and electric output by the potential energy of the fuel burned, used for determining qualification as an "eligible designated technology."

**As-used demand charges** - A per kW charge calculated on a daily basis and based upon peak demand during the peak weekday hours.

**Backup service** - Distribution utility provided service in case a customer's on-site generation is not operational for some reason.

**Combined heat and power** - Generally, the use of a single fuel source to provide both steam or other thermal energy for industrial or commercial production or process and to generate electricity.

**Contract demand** - For purposes of the Standby Tariff, a customer's maximum potential demand expressed in kW.

**DMS** - Con Edison's Demand Monitoring Software, described at http://www.coned.com/sales/business/demandmonitoringsoftware.asp.

**Eligible designated technology** - Clean and renewable on-site generation energy technologies, eligible for an optional exemption from the standby rates including: fuel cells; wind; solar thermal; photovoltaics; sustainably-managed biomass; tidal; geothermal; methane waste; and CHP systems of less than 1 MW that meet certain size, efficiency and environmental criteria including an annual overall fuel efficiency of at least 60 percent.

**Energy Service Companies (ESCOs)** - For purposes of this Manual, companies providing energy to end-users in competition with local distribution companies.

**High-tension service** - Service provided at a primary nominal voltage of; 4 kV, 13 kV, 27 kV or 33 kV. The Customer provides primary switchgear and power transformers to isolate the Customer's service from the Company system.

**High-load factor customers** - Customers whose demand is relatively flat and whose average demand is a high percentage of their peak demand.

**Interconnection charges** - Site-specific charges that on-site generators must pay to be electrically interconnected with the distribution system.

**Low tension service** - Service at 600V or below.

**Low-load factor customers** - Customers whose average demand is a low percentage of their peak demand.

**Maintenance service** - Distribution utility provided service in case the customer must return to utility service during routine testing and upkeep of the CHP system.

**Market Supply Charge (MSC)** - The MAC is as a monthly pass-through of energy costs purchased through the wholesale energy market, authorized by the New York State Public Service Commission (PSC) and assessed only on those who purchase energy from Con Edison.

**Monthly Adjustment Clause ("MAC")** - The MAC is authorized by the PSC as a mechanism for Con Edison to recover a variety of supply related and other charges related to its operations. All Con Edison delivery customers pay the MAC, whether or not they are full service customers or buy commodity energy through an ESCO.

**Monthly Customer Charge** - According to the PSC's glossary, "The charge to a customer which is designed to compensate the utility for the costs it incurs as a result of that customer's subscription to utility service, irrespective of the customer's eventual demand or energy use. For example, metering costs, including the cost of this meter and the cost of mutual reading, are components which contribute to the customer charge."

**Nameplate rating** - The full-load continuous rating of a generator under specified conditions as designated by the manufacturer. The net output of some generators will be less than the full-load continuous rating because of the "parasitic" load necessary to operate the generator.

**Otherwise applicable rate** - The rate that would be applicable if a customer were not subject to the standby tariff.

**Parasitic Load** - Electricity necessary to operate a generator, e.g. gas compressors for microturbine.

**Power quality** - Temporal variations in the characteristics of the power that an individual customer sees at its service panel.

**Renewable Portfolio Standard Charge** - A small surcharge authorized by the PSC to support statewide procurement targets for energy generated from renewable energy sources.

**Supplemental power** - Distribution utility provided service that provides the difference between a customer's total load and its installed on-site generation.

**Systems Benefit Charge** - A small surcharge authorized by the PSC to support public benefits programs such as energy efficiency investment and research and development.

# Links

## Utility Standby Tariffs for All NY Electric Distribution Company Standby Tariffs

### Consolidated Edison

Main Rates- http://www.coned.com/rates/
Standard Tariff- http://www.coned.com/documents/elec-sched1.htm
Standby- http://www.coned.com/documents/ra/ra-sc14.pdf
Tariff Name, Notes- SC 14-RA
Steam Tariff- coned.com/rates/default.asp#i_steam

### Natl. Grid / Niagara Mohawk

Main Rates- http://www.nationalgridus.com/niagaramohawk/business/rates/rates.asp
Standard Tariff- http://www.nationalgridus.com/niagaramohawk/non_html/rates_psc207.pdf
Standby- http://www.nationalgridus.com/niagaramohawk/non_html/rates_psc207.pdf
(see PDFp. 672 of 788) Tariff Name, Notes- SC-7

### RG&E

Main Rates- http://www.rge.com/rgeweb/webcontent.nsf/doc/PriceTariffs
Standard Tariff- http://www.rge.com/rgeweb/webcontent.nsf/doc/PriceTariffsGasElec19
Standby- http://www.rge.com/rgeweb/webcontent.nsf/Lookup/PSC19=237_250/$file/PSC19=237_250.pdf
Tariff Name, Notes- SC No. 14

### Central Hudson

Main Rates- www2.dps.state.ny.us/ETS/search/search.cfm
Standard Tariff- www2.dps.state.ny.us/ETS/search/search.cfm (Search on ETS)
Standby- www2.dps.state.ny.us/ETS/display_files/4276054.pdf PDF p. 33 of 112; Leaf 272
Tariff Name, Notes- SC 14 (use PSC's ETS system)

### Orange and Rockland

Main Rates- http://www.oru.com/aboutoru/tariffsandregulatorydocuments/
Standard Tariff- Pick service class from list on
http://www.oru.com/aboutoru/tariffsandregulatorydocuments/newyork/scheduleforelectricservice.html
Standby- http://www.oru.com/documents/tariffsandregulatorydocuments/ny/electrictariff/electricSC25.pdf
Tariff Name, Notes- SC 25

### NYSEG

Main Rates- http://www.nyseg.com/nysegweb/webcontent.nsf/doc/PriceTariffs
Standard Tariff- http://www.nyseg.com/nysegweb/webcontent.nsf/Lookup/120v41/$file/120v41.pdf
Standby- http://www.nyseg.com/nysegweb/webcontent.nsf/Lookup/120v41/$file/120v41.pdf
(see PDF p. 310 of 448)
Tariff Name, Notes- SC NO. 11

**PSC tariff site:**
www2.dps.state.ny.us/ETS/home/index.cfm

# Contact Information for NY Electric Distribution Companies

Utility Contact Info: http://www.dps.state.ny.us/electricu.html

### Consolidated Edison

4 Irving Place
New York NY 10003
(212) 460-2386

### Natl. Grid / Niagara Mohawk

300 Erie Blvd. West
Syracuse NY 13202
(315) 474-1511

### RG&E

89 East Avenue
Rochester NY 14649-0001
(716) 546-2700

### Central Hudson

284 South Avenue
Poughkeepsie, NY 12601-4879
(914) 452-2000

### Orange and Rockland

One Blue Hill Plaza
Pearl River NY 10965-3104
(845) 352-6000

### NYSEG

P.O. Box 3287
Ithaca, NY 14852-3287
(607) 762-7200

## Footnotes

1. Insufficient capacity could more accurately be considered supplemental load, but is treated the same as backup generation since it is treated the same way for billing purposes. To maximize total efficiency, it is usually recommended that CHP be sized to serve thermal needs first, with electric output envisaged as a free additional output.

2. Future references to CHP generally also apply to DG and other on-site generation.

3. Order[s] Establishing Standby Rates, in Case 02-E-1108, Central Hudson Gas & Electric Corporation (issued December 4, 2003); Case 02-E-0551, Rochester Gas & Electric Corporation (issued July 29, 2003); Cases 02-E-0780 and 02-E-0781, Orange & Rockland Utilities, Inc. and Consolidated Edison Company of New York, Inc. (issued July 29, 2003); and Case 02-E-0779, New York State Electric & Gas Corporation (issued July 30, 2003). National Grid's standby rates were set as part of the utility's general rate proceeding in Case 01-E-0075, Niagara Mohawk Power Corporation - Merger and Rate Plan, Opinion No. 01-6 (issued December 3, 2001).

4. National Grid's standby tariff provides an exemption for Environmentally 5. CHP Market Potential for New York State, prepared by Energy Nexus and the Pace Energy Project for NYSERDA, October 2002.

6. Cases 02-E-0780 and 02-E-0781, Order Establishing Electric Standby Rates (issued July 29, 2003).

7. Id.

8. Standby Tariff P.S.C. No. 2 - Retail Access, Fourth Revised Leaf No. 135. The Standby Tariff is also applicable to station use by a wholesale generator, a use not described in this manual, but is not applicable where service is provided under Rider R of the Full Service Schedule. The Standby Tariff is generally applicable to SC 12 customers (Multiple Dwelling Space Heating) with demand meters, but is not applicable to a limited number of "energy-only" customers on that tariff. The SC 12 "energy-only" customers, therefore, should not use the Estimator. The Estimator incorporates for SC-12 the rates applicable "Where the Customer is Billed for both Energy and Demand," not the (relatively rare) case "Where the Customer is Billed for Energy Only."

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# Are US utility standby rates inhibiting diffusion of customer-owned generating systems?

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**Abstract**

New, small-scale electric generation technologies permit utility customers to generate some of their own electric power and to utilize waste heat for space heating and other applications at the building site. This combined heat and power (CHP) characteristic can provide significant energy-cost savings. However, most current US utility regulations leave CHP standby rate specification largely to utility discretion resulting in claims by CHP advocates that excessive standby rates are significantly reducing CHP-related savings and inhibiting CHP diffusion. The impacts of standby rates on the adoption of CHP are difficult to determine; however, because of the characteristically slow nature of new technology diffusion. This study develops an agent-based microsimulation model of CHP technology choice using cellular automata to represent new technology information dispersion and knowledge acquisition. Applying the model as an $n$-factorial experiment quantifies the impacts of standby rates on CHP technologies under alternative diffusion paths. Analysis of a sample utility indicates that, regardless of the likely diffusion process, reducing standby rates to reflect the cost of serving a large number of small, spatially clustered CHP systems significantly increases the adoption of these technologies.
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*Keywords:* Distributed generation; Agent-based model; New technology

## 1. Introduction

While large combined heat and power (CHP) systems have been used for decades in industrial, hospital and university applications, recent technology innovations permit smaller utility customers to self-generate all or a portion of their own electricity onsite and to apply waste heat from the generation process for thermal uses such as space heating, water heating, and air conditioning. For customers with appropriate hourly electric and thermal loads, overall CHP system efficiency can reach 85 percent compared to a maximum of about 50 percent for the most efficient central utility generation plants and about 33 percent for the average US utility generation plant.[1] CHP systems improve the efficiency of the entire electric generation system, reduce emissions and can provide substantial reductions in utility customer energy costs.

Currently, the primary US market for new small-scale CHP technologies is the commercial sector. A 2000 US Department of Energy study found 74 Gigawatts (GW) of technically feasible potential[2] for commercial sector CHP system installations representing about 12 percent of total electric utility-owned capacity in the year 2000.

Recent standardization of utility interconnection requirements, remote monitoring/control and guaranteed service contracts are a few recent CHP market innovations that facilitate CHP installations. Emission control technologies guarantee compliance with the most stringent local requirements while CHP systems can provide improved power quality and reliability compared to grid-delivered power.

In spite of these developments, existing small US commercial sector systems probably number no more than

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[1]Overall system efficiency is the percent of generation energy input delivered as useful energy to the final user. See DOE, 2000, 2002 and 2003 for a description of CHP technologies, markets and case studies.

[2]Technically feasible potential includes installations where a majority of waste heat can be utilized with limited changes in existing building thermal energy systems (e.g., space heating).

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several thousand (Jackson, 2005; DOE, 2000) and while that number is increasing (Prabhu, 2002; NECHPI, 2005), CHP systems appear to be making only modest inroads in the market (NECHPI, 2005).

CHP proponents frequently identify high standby (or backup) rates, charged by the local utility when CHP systems are unexpectedly unavailable, as one of the primary reasons for the slow adoption of CHP systems (Jimison et al., 2004; Casten, 2003). A recent addition to the literature (Firestone and Marnay, 2005) confirms the important impact of standby rates in six New York utility service areas.

While utilities are required to determine standby electric rates based on cost, this process is complicated and sometimes inconsistent with no agreed-upon methodology. For example, state regulatory agencies require revenue neutrality[3] in designing standby rates; however, crediting CHP customers for fixed cost savings associated with generation and distribution would automatically increase the allocation of additional fixed costs to non-standby customers. On the other hand, the Federal Energy Regulatory Commission (FERC), directs utilities to incorporate utility savings associated with intermittent demands in standby rate design. Consequently, utilities typically have considerable discretion in setting standby rates for incremental service required if the utility customer's CHP-generating system is not operating.[4] This rate-setting flexibility puts utilities in the position of regulating competition from their own customers.[5] Furthermore, revenue reductions resulting from cost-based standby rates have an exaggerated impact on profits for investor-owned utilities (Weston, 2000; Moskovitz, 2000, Regulatory Assistance Project, 2000) and create rate pressure for publicly owned utilities.[6]

An equally compelling argument, however, can be made that the slow adoption of CHP is characteristic of new technology diffusion and a long-recognized reluctance of firms to invest in energy-saving investments (Jaffe and Stavins, 1994; Jaffe et al., 2001; DeCanio, 1998).[7]

The extent to which CHP diffusion is limited by current regulatory practices as opposed to reflecting traditional new technology diffusion has important policy implications for the $239 billion US electric industry. CHP systems can potentially offer a significant opportunity to improve energy efficiency and reduce emissions. Encouraging this resource through policy initiatives; however, requires understanding the nature of current impediments, if any, to the adoption of CHP technologies.

Unfortunately, lack of utility CHP data, nonstandard interconnection fees, revisions in standby rates over time, complicated nonlinear electric rate structures that differ by utility and many other data difficulties prevent statistical tests of these hypotheses.

The objective of this study is to develop an agent-based microsimulation model of new CHP technology diffusion that permits analysis of utility standby-rate setting practices on the adoption of these new technologies. The remainder of this paper is organized as follows: The next section provides a brief review of relevant literature. Section 3 describes the conceptual model and Section 4 presents an empirical model specification. Section 5 describes analysis results. The final section provides a summary.

## 2. Relevant literature

Empirically assessing the impacts of standby rates on the diffusion of new CHP technologies requires a model structure that can represent (1) detailed CHP technology characteristics, (2) individual agent hourly electric and thermal energy use heterogeneity, (3) agent decision criteria heterogeneity, (4) detailed non-linear utility rate structures and (5) the endogenous spread of information among agents and agent knowledge accumulation.

The agent-based model developed in this study extends traditional economic microsimulation-modeling to accomplish these tasks by including bounded rational agent investment behavior and an agent-based process to represent agent interactions and the dissemination of new technology information. Relevant literature antecedents and modeling considerations are described in the remainder of this section.

### 2.1. Microsimulation models

Microsimulation approaches have been applied to accommodate the first four modeling issues above in

[3]Once rates are set, revenue neutrality requires any change in the rate for a single rate class to have no impact on revenue requirements of other rate classes.

[4]Standby rates differ by utility primarily in "demand" charges (charges for the maximum 15-min kW use in the month). Most utilities apply "ratchet" clauses that bill demand based on the maximum kW in the previous year. Standard non-CHP demand charges typically range from $6 to $9 per kW. Utilities who strive for revenue neutrality set standby rate demand charges as close to standard demand charges as possible so that even one unplanned 15-min system downtime in the year will recover lost revenue. One utility, in recent years, set standby rates at more than double the standard rate, which could have conceivably increased revenue from CHP customers (LIPA, 2001). More recent standby rate setting practices appear to set standby demand rates at approximately 50 percent of full demand charges using a combination of capacity and use charges (e.g, LIPA, 2004).

[5]Each utility is regulated by one or more agencies in its own state. Consequently, this description includes some generalization. The local distribution utility designs and applies standby rates and remains regulated in all US states.

[6]Adoption of CHP technologies also reduces the utility's generation, transmission and distribution assets relative to a world without CHP. In addition to the Averech-Johnson effect, which explains over-investment in capital by regulated firms, a larger asset base reduces the relative impacts of random negative influences on revenue such as weather and economic fluctuations.

[7]Lee (2003) and others argue that customer-sited generation yields limited value relative to attributes of grid-provided power and is likely to serve only niche applications. As indicated in a later section, the analytical approach developed in this study accommodates CHP attribute values as positive and negative costs relative to grid power.

energy sector applications since the early 1980s. (Goett and Mcfadden, 1982; Jackson, 1986, and Jackson, 1994). US state energy agencies and utilities have used these models to analyze and forecast the impacts of detailed conservation technologies and energy policies in both residential and commercial sectors. Microsimulation models represent the individual behavior of a sample of agents with the ability to expand the results to determine impacts of population segments as well as the entire population. The ability to forecast and evaluate policies for any subset of the sample of agents provides policymakers with a consistent, comprehensive framework for ex ante evaluation of social and economic policies.[8]

CHP Microsimulation modeling applications have been less robust. Most studies have addressed only technical potential (DOE, 2000) or have used arbitrary investment criteria (e.g., a 10-year payback requirement, DOE, 2002), historical trends (CEC, 1999) and heuristic aggregate representations (NYSERDA, 2002) to evaluate the CHP market. While these CHP potential estimates provide insight on long-run upper-bound estimates of potential CHP penetration and energy savings, they are not useful in assessing utility standby rate impacts.

### 2.2. Modeling agent CHP investment behavior

CHP technologies provide an opportunity to reduce energy services cost by generating a portion of the building's electricity use and applying waste heat to supplement space heating and other thermal building requirements previously fueled with natural gas or oil. CHP systems are typically integrated in existing space heating, water heating, air conditioning, and other energy systems and do not require early replacement of existing energy-using capital.

Virtually all empirical analyses of actual energy-related investments have found significantly larger implied discount rates than can be explained by extending traditional investment theory to include uncertainty with respect to future fuel prices and equipment performance, unrepresented transaction costs, the option value of delaying the investments and other factors. The difference between observed implicit discount rates and financing costs has given rise to the so-called "energy paradox" (Shama, 1983) which remains a critical unresolved issue in energy and environmental analysis (Jaffe and Stavins, 1994; DeCanio, 1998).

The energy paradox is especially difficult to explain as part of cost-minimizing behavior of firms,[9] particularly larger firms that presumably apply more sophisticated investment criteria when considering energy-saving investments. A recent analysis of energy-savings investments in industrial firms (Anderson and Newell, 2002) found that even after detailed onsite engineering studies and cost-benefit analysis, which presumably minimized information cost and reduced uncertainty with respect to expected savings, firms still exhibit an average implicit discount rate of 75 percent.

A good deal of evidence indicates that firms do, in fact, use criteria for energy saving and similar capital investments other than net present value or equivalent investment analysis. A variety of previous studies have reported payback analysis as the predominant decision criterion used by firms in considering energy-related investments (Anderson and Newell, 2002; Lefley et al., 2003; Koomey, 1990, Kulakowski, 1999; Muller et al., 1995; DOE, 1996). Related empirical evidence is provided in a study by Lefley et al. (2003) that found 84 percent of financial decision makers in large companies use payback analysis alone or in combination with other investment criteria when considering advanced manufacturing technologies (i.e., computer-controlled processes).

The fact that this group of decision makers, who are undoubtedly aware of more sophisticated investment analysis techniques, chose to use payback analysis is consistent with a bounded rationality (Simon, 1955) view of decision makers applying simpler decision rules when faced with complicated investment decisions. Nelson and Winter (1982) extended this view to include procedural rationality based on firm-level learning over time and the use of procedural rules to provide decision-making continuity.

Minimizing model estimation and forecast error is especially important in policy modeling applications; consequently, agent CHP purchase decisions in this study are based on individual payback criterion. That is, CHP investment occurs when:

$$\text{Initial Cost}/\text{Annual Savings} < \text{PBR}, \tag{1}$$

where Initial Cost is equipment and installation cost of a CHP system, Annual Savings is the annual savings in energy bills minus operating, maintenance and CHP fuel costs, and PBR = payback criterion applied by the decision-maker (years).

The standard practice of applying a fixed corporate-specific payback requirement to individual energy-savings investments (Kulakowski, 1999) implies that a knowledge threshold is achieved prior to the final application of the payback analysis. Otherwise, decision-makers would use different payback requirements to accommodate varying levels of uncertainty or information available concerning the individual investments. The cellular automata process described in the next section is used to represent CHP information dissemination and agent knowledge acquisition.

Since nearly all CHP utility customers have grid power, even during unexpected CHP downtimes, the value of CHP

[8]Microsimulation models were originally suggested by Orcutt (1957). See O'Donoghue (2001) for a survey of dynamic microsimulation modeling applications.

[9]Most energy-saving investment studies focus on residential investments in energy saving equipment. Ten studies of residential investments documented in Train (1985) have an average implicit rate of 66 percent.

attributes relative to grid attributes are incorporated as components of costs in the payback Eq. (1). Many of these cost components (e.g., maintenance costs) have been quantified in previous studies (e.g., DOE, 2002).

### 2.3. Information diffusion and knowledge acquisition with agent-based cellular automata

Microsimulation models can be extended to accommodate the fifth requirement mentioned above (endogenous spread of information among agents and agent knowledge accumulation) by incorporating endogenously determined agent-to-agent interactions and an agent knowledge accumulation process. Agent-based models are increasingly being used to explore micro foundations of many areas in economics and other disciplines (Tesfatsion, 2003; Dawid, 2006).

The dispersion of new technology information is recognized as a critical component in all models of new technology diffusion. Most theoretical and empirical models evaluate new technology penetration from an aggregate perspective. For instance Griliches' (1957) classic model represents the spread of information as if it were a disease spreading through the population. The seminal Bass (1969) model reflects a sigmoid curve with, among other parameters, a coefficient of imitation reflecting interpersonal communication or social contagion.

Agent-based models permit a more detailed and a potentially richer representation of the dynamics of information dispersion. The endogenous spread of new technology information from agent to agent is also consistent with a contagion process that, at an agent level, can be represented with as cellular automata (CA) process. Developed in the late 1940s by Stanislaw Ulam and John von Neuman as a model of self-reproducing systems, CA has been studied and used extensively in disciplines ranging from computer science to transportation planning. A cellular automation consists of discretely identified spatially arranged cells, each of which is characterized by a state of nature. The system evolves dynamically over time according to rules that define state changes for the individual cells based on exogenous influences and changes of state in other cells within a neighborhood. CA structures provide an intuitive mechanism to represent the spread of information from agent to agent and agent knowledge accumulation. Current CA applications in agent-based technology diffusion models tend to apply relatively aggregate and abstract characterizations of information-related cell states (Berger, 2001) or focus on theoretical and methodological issues of the CA process itself (Strang and Macy, 2001, Goldenberg et al., 2001). The model in this study extends these previous applications by applying a CA process to a microsimulation sample of individual agents to model the dissemination of new CHP technology information from one agent to another and to model agent knowledge acquisition which eventually results in the initiation of a purchase decision.

## 3. The conceptual model and a test of the standby-rate hypothesis

### 3.1. Model process

The model developed in this study simulates CHP investment decisions of each agent in a sample of commercial, institutional and government establishments. Hourly electricity, space heating, air conditioning and water heating energy uses, a payback requirement and availability of in-house energy expertise uniquely characterize each of these microeconomic agents.

Each agent's potential CHP system reflects an optimized CHP design that sizes generator capacity (kW) and waste heat applications based on the individual agent's hourly electric, thermal space heating, water heating and air conditioning demands.[10] The resulting system is characterized by an initial cost, annual maintenance cost, natural gas cost and other operating costs. Annual CHP benefits included avoided electricity costs and avoided natural gas costs (now provided by waste heat).

Agents consider CHP investment only when they acquire a threshold level of CHP knowledge. Each agent in the model originally begins with a state of ignorance concerning the new CHP technologies. A cellular automata (CA) process is used to model information dissemination and knowledge accumulation.

Each agent's accumulation of knowledge is a function of the level of its onsite energy-engineering expertise and exposure to sales/CHP installation information. The CA process moves each agent through individual states of a knowledge acquisition process towards a knowledge threshold. Once the threshold is reached, the agent considers CHP as an energy savings investment comparable to other energy-saving investments.

Sales contacts are targeted to agents in individual business segments that provide the greatest CHP potential savings based on segment averages. Agents are identified as belonging to neighborhoods consisting of agents of similar size in the same business segment (see Table 1). Business type segmentation is specified with respect to information flows that occur within similar industries. This specification is consistent with industry associations organized by business type (e.g., American Hospital Association, American Restaurant Association). The number of agents comprising a neighborhood within a business category is parameterized as part of the study analysis.

Larger agents, measured by number of employees, are contacted first. This representation reflects actual target marketing currently conducted by CHP suppliers. Sales

[10]Optimization of engineering system design may seem incompatible with a payback criterion that is "non-optimal" in a traditional investment sense. The first represents good engineering and design practice while the second represents, at least from the perspective of the firm making the investment, good investment strategy for uncertain energy-saving investments.

Table 1
Sample agent characteristics

| | Population | Sample | Square feet | Peak kW | Employees | Annual kWh | Weekly operating hours | % Onsite energy manager |
|---|---|---|---|---|---|---|---|---|
| Office | 2174 | 285 | 59,190 | 280 | 208 | 1,074,213 | 71 | 17.8 |
| Retail | 2306 | 73 | 17,046 | 61 | 14 | 232,756 | 79 | 11.5 |
| Shopping mall | 443 | 77 | 88,081 | 263 | 94 | 1,054,580 | 85 | 4.6 |
| Grocery | 1589 | 87 | 12,631 | 135 | 31 | 684,768 | 121 | 0.5 |
| Warehouse | 53 | 29 | 60,418 | 217 | 35 | 839,038 | 81 | 5.7 |
| Refrig. warehouse | 875 | 111 | 88,011 | 179 | 68 | 816,752 | 73 | 2.7 |
| Assembly | 526 | 70 | 39,329 | 162 | 40 | 507,819 | 85 | 2.9 |
| School | 943 | 107 | 54,774 | 146 | 102 | 348,455 | 55 | 3.6 |
| Restaurant | 2180 | 88 | 6592 | 79 | 31 | 301,230 | 97 | 0.7 |
| Health | 321 | 156 | 98,028 | 468 | 355 | 2,120,003 | 168 | 26.2 |
| Hotel | 246 | 63 | 37,669 | 180 | 22 | 674,236 | 166 | 13.2 |
| Religious | 113 | 17 | 29,777 | 56 | 42 | 153,867 | 64 | 0 |
| College | 139 | 93 | 76,475 | 311 | 102 | 1,181,173 | 88 | 13.8 |
| Federal | 108 | 75 | 49,130 | 274 | 95 | 1,025,806 | 98 | 7 |
| State and local | 801 | 177 | 51,341 | 195 | 75 | 777,352 | 94 | 5.2 |
| Other | 95 | 41 | 45,916 | 426 | 103 | 1,651,263 | 104 | 7 |

Population data reflects the number of utility customers in the population by business type. Entries in the sample column represent the number of utility customers in the sample. All other data items are averages for the appropriate business categories. Both sample and population reflect commercial sector electric customers in the LIPA service area with average daytime hourly electricity use greater than 20 kW.

contacts to agents with onsite energy engineering capabilities result in immediate attainment of the knowledge threshold and a purchase decision using the agent's hourly energy use data and payback requirement. Agents with no onsite energy management expertise are moved a single step in the knowledge acquisition process as the result of each sales contact. Additional sales contacts move agents to the next knowledge acquisition state, up to one level below the threshold. The observation of a neighbor's CHP installation is required for an agent with no onsite expertise to reach the purchase decision threshold.

Each agent's knowledge state increases with the installation of a CHP system in its neighborhood defined by the same business type and similar size. The impact of a CHP system installation results in an endogenously determined "spread" of the technology to other agents in the same neighborhood. These "observed" technology installations are the last step in knowledge acquisition required by agents with no onsite engineering expertise.

The following three CA parameters define the diffusion dynamics described above: (1) the number of knowledge states, $k$, required to reach the threshold level, (2) the number of agents in a neighborhood, $p$, and (3) the number of sales contacts per year, $s$.

### 3.2. Evaluating aggregate diffusion impacts

The question addressed in this analysis is: To what extent can discriminatory standby rates reduce the diffusion of CHP technologies? While standby rates set at levels greater than the cost of providing intermittent CHP-related service undoubtedly reduce economic efficiency and energy cost savings associated with CHP systems and inhibit CHP diffusion, it is not clear how important this factor is, especially in comparison to other inefficiencies and problems that exist in the regulated electric utility industry.[11]

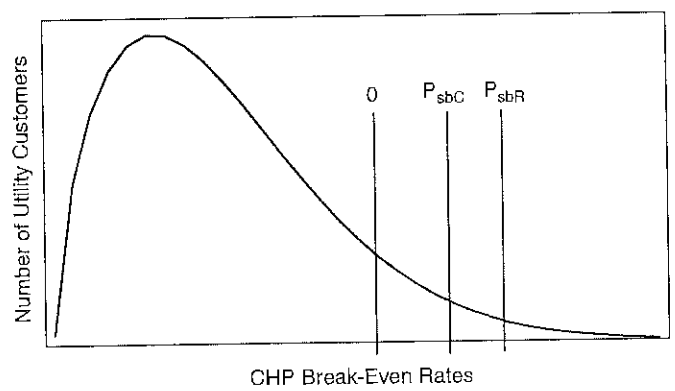


Fig. 1. Population distribution, $f(x)$, of CHP standby break-even rates.

The potential diffusion impact of an inflated standby rate based on maintaining utility revenue, $P_{sbR}$, is illustrated in Fig. 1 where the population distribution of CHP standby break-even rates is shown along with a cost-based standby rate, $P_{sbC}$ and a standby rate of 0. The distribution of utility customer energy use characteristics yields a distribution of break-even rates that is approximately lognormal with utility customers to the right of any standby rate achieving positive annualized CHP savings (or a positive net present value). Utility customers to the left of 0 require a subsidy to achieve positive annualized savings. We assume in this representation that the break-even population distribution, $f(x)$, represents all of the economic factors associated with a CHP investment except the

[11]For example, US Costs of the August 2003 Northeast blackout have been estimated at between $7 billion and $10 billion (ICF Consulting, 2003).

standby rate and that the capital recovery factor in this representation reflects a social discount rate. It follows that $D(P_{sbR}) = \int_{P_{sbR}}^{\infty} f(x)\,dx$ is the long run maximum economically efficient adoption of CHP technologies under the current rate, $D(P_{sbC}) = \int_{P_{sbC}}^{\infty} f(x)\,dx$ is adoption under a cost-based standby rate and $D(0) = \int_0^{\infty} f(x)\,dx$ is adoption with no standby rate. Additionally, $D(0) > D(P_{sbC}) > D(P_{sbR})$ . These economic potential estimates provide an upper-bound estimate of potential CHP penetration and energy savings in the long run; however, they do not reveal the dynamics of new technology diffusion required to compute the present value of costs and benefits. Since the diffusion of new CHP technologies could conceivably take a decade or two, diffusion dynamics can have a significant impact on discounted cost/benefit analysis.

CHP market diffusion is a product of the maximum economic potential $D(.)$ and, $\gamma$, the fraction of economic potential achieved as a function of agent population characteristics, $\alpha$ (including hourly energy use, payback requirements, and CHP system characteristics), time, $t$, the standby rate, $P_{sb}$, and the three CA diffusion parameters defined in the previous section: $k$, $p$ and $s$. That is

$$\mu(\alpha, t, P_{sb}, k, p, s) = \gamma(\alpha, t, P_{sb}, k, p, s)D(P_{sb}) = \gamma(\alpha, t, P_{sb}, k, p, s)\int_{Psb}^{\infty} f(x)\,dx, \quad (2)$$

where $\mu(t, P_{sb1}, k, p, s) > \mu(t, P_{sb2}, k, p, s)$ $\gamma$ when $P_{sb1} < P_{sb2}$ and $\gamma(t, P_{sb1}, k, p, s) > \gamma(t, P_{sb2}, k, p, s) \leqslant 1.0$.

The impact of excessive standby rates at period t in the forecast horizon, given a current standby rate $P_{sbR}$ , a cost-based rate $P_{sbC}$, and diffusion parameters $k$, $p$, $s$, is

$$\mu(\alpha, t, P_{sbC}, k, p, s) - \mu(\alpha, t, P_{sbR}, k, p, s) \quad (3)$$

represented as the vertical distance between the two curves shown in Figs. 2 and 3. Fig. 3 shows a scenario with an alternative set of diffusion parameters $k$, $p$, $s$ (2).

The total direct economic cost imposed on CHP utility customers and potential CHP customers (EC) is the

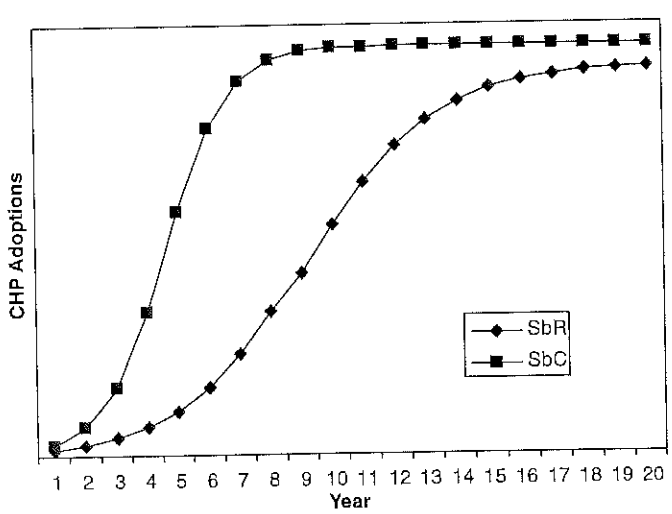


Fig. 2. Diffusion process d1.

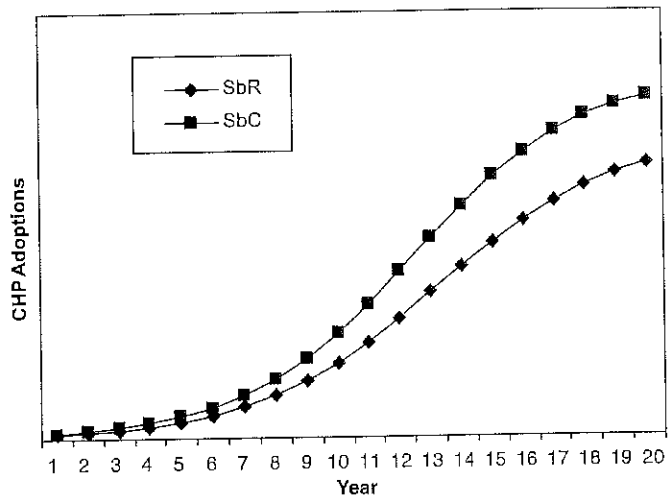


Fig. 3. Diffusion process d2.

difference in the present value of the energy cost savings under current standby rate $P_{sbR}$ , and cost-based rate $P_{sbC}$, given as

$$EC(T) = \int_0^T [\pi(\alpha, t, P_{sbC}, k, p, s)\mu(\alpha, t, P_{sbC}, k, p, s)] - (\alpha, t, P_{sbR}, k, p, s)\mu(\alpha, t, P_{sbR}, k, p, s)]e^{rt}\,dt, \quad (4)$$

where $\pi$ (.) is the average system energy cost savings and $r$ is the social discount rate.

These two figures illustrate that the economic costs associated with excessive standby rates depend critically on the underlying diffusion process. The reasonably speedy diffusion in Fig. 1 shows a significant impact while the diffusion process in Fig. 2 shows a much smaller total impact because most savings occur in future years that are discounted more heavily.

The model developed in this study provides ex ante forecasts of market diffusion, $\mu$ ($\alpha$, $t$, $P_{sbC}$, $k$, $p$, $s$), and discounted energy cost savings, EC($T$), as the sum of individual agent technology installations. The difference in the current standby rate and cost-based standby rate scenarios depends on standby rates ($P_{sbR}$, $P_{sbC}$) and the CA diffusion parameters, $k$, $p$, $s$.

The following section describes the methodology used in this study to isolate the impact of standby rates from impacts of the diffusion parameters as part of a formal hypothesis test.

### 3.3. Testing the standby-rate hypothesis

Since values for elements of the CA parameter vector, $k$, $p$, $s$ are unknown in this ex ante application, we approach the quantitative analysis as a field experiment. Our experimental units or subjects are actual commercial utility customers in a study area who accumulate knowledge required to make a CHP investment decision according to the CA process defined by the $k$, $p$, $s$ parameter vector. The

response variable is the discounted cost of excessive standby rates. A factorial experimental design identifies $n$ treatment combinations of the parameter values that can be applied with the agent-based microsimulation model. For each parameter vector associated with one of the $n$ treatments, the model is simulated once with the current standby rate $P_{sbR}$ and once with a cost-based rate $P_{sbC}$ to determine net diffusion impacts of excessive standby rates as indicated in (3) and (4).

In the spirit of an experimental approach, we specify a null hypothesis, $H_0$: Differences between current standby rates and cost-based rates result in no significant costs to utility customers. If all $n$ experimental treatments show insignificant impacts the null hypothesis cannot be rejected. If treatment results are mixed, the analysis must turn to an exploration of circumstances represented by CA parameter vector values that lead to significant costs.

On the other hand, if all $n$ treatments show significant diffusion impacts, $H_0$ can be rejected indicating significant standby rate impacts on CHP diffusion in the study area. In this case the $n$ quantitative results will provide empirical estimates of the likely range of costs.

As with other experiments, the validity of the results depends on the design of the experiment and the extent to which the experimental treatments isolate the relationship of interest. In this case, the specification of the CA process $\gamma$ must be consistent with actual information dissemination and knowledge accumulation and the $k$, $p$, $s$ parameters must map CHP diffusion, $\mu$, onto all reasonable empirical representations.

## 4. Empirical model specification, input data and parameters

### 4.1. Application area

Inter-utility variations in rate structures, natural gas prices and utility customer heterogeneity in electric and thermal load profiles require utility-specific analysis of CHP diffusion. The Long Island Power Authority (LIPA) utility service area was selected as the application area for this study. LIPA is a New York state authority that was created to close the Shoreham Nuclear Power Plant. LIPA took over LILCO, the Long Island utility that owned Shoreham, in 1998 and now operates Long Island's retail electric system. As a public entity, LIPA does not earn profits; however, it and other public electric utilities, apply the same principles as investor-owned utilities in operating their systems and designing customer rates. The service area includes most of Long Island and serves a population of 2.8 million (Long Island Power Authority, 2004). LIPA is a "load pocket" with limited transmission capacity onto the island. LIPA faces high marginal distribution costs, chronic generating capacity shortfalls, reliability difficulties, and moderate economic growth. LIPA could potentially realize significant benefits from a more decentralized energy delivery system.

### 4.2. CHP systems

Natural gas engine-driven systems, the most common CHP system, are sized for each agent to provide optimal outputs of electricity and thermal loads according to each facility's whole building hourly electric loads, air conditioning hourly electric loads and hourly thermal loads for domestic water heating and space heating. All data on CHP systems was taken from a US Department of Energy (DOE, 2002) study and included total installed cost, operating and maintenance costs, air conditioning operating, maintenance and equipment costs and efficiency characteristics for a variety of system sizes.

Agent valuation of grid attributes relative to CHP attributes not included in the CHP cost items above should be added to these costs. For instance, extended warranties would provide an additional cost. Similarly, an agent's valuation of improved power quality would reflect a negative cost. No quantitative information exists on the valuation of these items; consequently, only the costs included in the DOE, 2002 study are used to compute CHP system costs. However, two alternative simulations are included in the analysis to test the sensitivity of analysis results to increased CHP cost estimates.

### 4.3. Utility customer data

Utility customer survey data from the US Department of Energy's Commercial Buildings Energy Consumption Surveys (CBECS) for 1992 and 1995 were used to develop a sample of buildings representing commercial utility customers, or agents, on Long Island. Data were pooled, and a proportional poststratification using US Commerce Department (County Business Patterns, 2000) county-level data on establishments by employee size categories was used to develop a sample of 1549 buildings reflecting the population of commercial buildings on Long Island potentially suitable for CHP technologies.[12] Characteristics of the customer sample are presented in Table 1.

The one item missing from the CBECS-based agent sample data is an investment criterion. Values for this missing data item were imputed for each agent record using survey results for 2400 Arkansas commercial sector utility customers. The 1994 Arkansas survey asked a question designed to elicit the willingness of decision makers to trade off future savings for current investments. The average payback requirement of this sample is 1.5 years, consistent with the 1.4 year firm average reported in Anderson and Newell (2002). Values for the missing CBECS payback variables were developed with a "nearest-neighbor" imputation approach that makes a random draw from

[12]Commercial utility customers were considered potential adopters only if they used more than an average of 20 kW for each hour during the day. This size includes office, retail and other commercial buildings larger than about 10,000 square feet along with most high electric intensity establishments such as restaurants and grocery/convenience stores.

the Arkansas survey responses in a neighborhood defined by the agent's business type and size as measured by the number of employees. Since each agent, $i$, in the microsimulation sample reflects an additional $w_i$ agents in the population determined by the weight associated with that agent, an additional $w_i$ agents are generated for each of the 1549 original agents. Each agent in the $w_i$ subset is identical except that payback requirements are determined with random draws from appropriate neighborhoods in the Arkansas survey. This process provides 12,912 agents for the microsimulation process.

### 4.4. Rebound effect

Agents who adopt CHP systems realize energy cost savings equivalent to that provided by an increase in equipment efficiency, resulting in increases in energy consumption. This efficiency-related response, or "rebound" effect, is generally assumed to be similar in total impact to the short-run price elasticity (Greening and Difiglio, 2000). The commercial building energy services rebound elasticity is estimated to be −0.15 in the US Department of Energy's NEMS model (DOE, 2004). This rebound price impact is applied as a partial-adjustment process with a short-run (1st year) elasticity of −0.075 and a long-run elasticity of −0.15. This adjustment reduces CHP energy cost savings.

### 4.5. Utility rates

The LIPA Large General Service (LGS) and Standby rate class schedules (Long Island Power Authority, 2004) were applied to model electricity costs for each of the agents. Basic LGS rates are differentiated by season with charges of \$0.0928/kWh and \$9.99/kW in the summer (June–September) and \$0.0779/kWh and \$8.88/kW in the winter (January–May and October–December). The demand charge (\$/kW) is based on the maximum electricity use in any 15-min period in the month. The standby charge is composed of both "contract" and "as needed" charges with a total charge of \$4.92/kW applied to the maximum 15-min demand charge occurring in the current or previous eleven months.[13] A 2004 natural gas price of \$8.30 per million Btu was used in the analysis.[14]

The number of LIPA commercial utility customers is assumed to grow by 1 percent per year over the forecast horizon. This rate of growth is consistent with the 2-percent rate of electricity use growth in the commercial sector reported in the LIPA Energy plan.[15] A sample of new agents is developed for each forecast year. The new construction sample is composed of recently constructed buildings from the original survey data weighted to reflect the appropriate number of new utility customers.

### 4.6. Alternative cost-based standby rates

Under the baseline scenario presented in the next section, the average CHP system size is 92 kW (about 15 times the peak kW use of an average residence). The small size of new CHP systems, the random nature of likely unexpected CHP downtimes and spatial clustering of commercial establishments permits a probabilistic approach to determining the cost of providing unexpected energy and demand services to CHP service during unexpected systems downtimes.

Most CHP prime mover specifications report average downtimes of less than 10 percent. By scheduling required maintenance during off-peak periods, unanticipated interruptions should be no more than 10 percent during periods where capacity limits are approached, consequently, an estimate of least cost backup rate schedule for widely-distributed small CHP systems is specified as 10 percent of the standard large general service demand charge plus standard energy charges for kWh use to cover variable costs. Resulting \$0.999/kW summer and \$0.888/kW winter peak demand rates are substantially less than the current LIPA rates of \$4.92/kW. One important distinction between these rates is that the probabilistically determined rates require a sufficient (future) population of CHP systems to take advantage of the random nature of unexpected outages while the LIPA rate is an attempt to reflect costs given the current population of CHP systems. A "chicken and egg" problem exists here with CHP advocates arguing that long-run system cost optimization can be achieved only with current pricing that represents these longer-run conditions. Not surprisingly, utilities are more concerned with immediate revenue and revenue neutrality issues. The long-run standby rate argument is appropriate only if these rates result in the kind of clustered, small CHP population characteristics assumed above.

The issue of long-run system cost optimization mentioned above is a reminder that appropriate standby rate design should take into account all of the costs and benefits associated with CHP systems including avoided transmission and distribution costs, emissions reductions and grid stability. The methodology developed in this study can be extended to incorporate these items; however, their consideration is beyond the scope of the current study. The focus at this time examines the impact of the difference

[13]The "as needed" demand charge of \$2.46 is applied to actual maximum kW use during an interruption in CHP service; however, the twelve month "ratchet clause" insures that one unanticipated 15-min CHP outage will trigger this charge for an entire year.

[14]2004 prices are used in this study as reasonable representations of longer-term natural gas prices based on current Department of Energy Mid-term forecasts. Additionally, the primary focus of this study is on the impacts of standby demand charges, which are not tied to natural gas prices.

[15]Commercial sector electricity demand increases over time as a result of new commercial construction and increases in electricity intensity over time, primarily caused by increased use of computer, office and other miscellaneous equipment (Jackson, 1986, 1994).

Table 2
CHP adoption summary results[a]

| | Adopters | Simulation year CHP kW capacity | Current LIPA rates | | | Cost-based rates | | | Difference |
|---|---|---|---|---|---|---|---|---|---|
| | | | Annual CHP savings (million $) | Adopters | CHP kW capacity | Annual CHP savings (million $) | Adopters | CHP kW capacity | Annual CHP savings (million $) |
| *Baseline scenario* | | | | | | | | | |
| 5 | 14 | 47,869 | 86 | 419 | 169,838 | 212 | 405 | 121969 | 126 |
| 10 | 84 | 92,218 | 146 | 1962 | 260,662 | 313 | 1878 | 168444 | 167 |
| 15 | 526 | 163,551 | 212 | 2664 | 276,039 | 331 | 2138 | 112488 | 119 |
| 20 | 782 | 176,746 | 274 | 2806 | 276,289 | 356 | 2024 | 99543 | 82 |
| 25 | 913 | 178,167 | 289 | 3012 | 276,213 | 384 | 2099 | 98046 | 95 |
| *Alternative scenario* 1 | | | | | | | | | |
| 5 | 3 | 17,651 | 23 | 130 | 76,812 | 110 | 127 | 59161 | 87 |
| 10 | 20 | 57,042 | 99 | 470 | 167,464 | 220 | 450 | 110422 | 121 |
| 15 | 32 | 69,362 | 118 | 818 | 198,023 | 259 | 786 | 128661 | 141 |
| 20 | 40 | 72,773 | 124 | 1156 | 210,103 | 283 | 1116 | 137330 | 159 |
| 25 | 43 | 75,120 | 129 | 1324 | 212,161 | 295 | 1281 | 137041 | 166 |
| *Alternative scenario* 2 | | | | | | | | | |
| 5 | 2 | 14,708 | 25 | 93 | 64,750 | 83 | 91 | 50042 | 58 |
| 10 | 4 | 32,048 | 57 | 181 | 101,991 | 147 | 177 | 69943 | 90 |
| 15 | 17 | 50,707 | 93 | 255 | 127,697 | 191 | 238 | 76990 | 98 |
| 20 | 23 | 56,320 | 101 | 290 | 132,431 | 197 | 267 | 76111 | 96 |
| 25 | 25 | 58,014 | 103 | 308 | 133,502 | 202 | 283 | 75488 | 99 |

Cellular automata parameters for alternative forecasts

| | Baseline | Alt 1 | Alt 2 |
|---|---|---|---|
| Knowledge levels | 5 | 8 | 12 |
| Neighborhood size | 80 | 40 | 20 |
| Increase in sales contacts (%) | 50 | 10 | 0 |

Cellular automata parameters values used in factorial experimental design

| | |
|---|---|
| Knowledge levels | 2, 5, 8, 12 |
| Neighborhood size | 20, 40, 80, 100, 200 |
| Increase in sales contacts (%) | 100, 50, 10, 0 |

[a]LIPA LGS electricity rates for 2004 include demand charges of $9.99/kW summer (June–September) and $8.88/kW winter and energy charges of $0.0928/KWh and $0.0779/KWh summer and winter, respectively. Standby demand charges are $4.92/kW according to the current tariff and $0.999/kW summer and $0.888/kW winter for the cost-based rates.

between the current LIPA standby rate and a long-run cost-based CHP rate[16] with respect to the diffusion of CHP technologies.

## 5. Analysis results

The experimental design used to "net-out" the impact of alternative standby rates includes four knowledge levels, five neighborhood sizes and four annual percentage increases in sales contacts to describe possible empirical representations of information dissemination and knowledge accumulation for a total of 80 experimental treatments (See Table 2). Experiment results indicate that the $4.00/kw/month differential between current standby rates and the cost-based estimate of cost of service have a significant impact on CHP diffusion and utility customer energy costs.

Results of three of the experimental treatments are included in this section. A "most likely" baseline scenario was selected to reflect the general utility industry view of a slow (20 year) market penetration scenario, given current standby rate specifications. Diffusion paths with slower penetration showed the smallest cost impacts; consequently, results of the slowest penetration treatment considered feasible are included to show the most limited impact. An additional forecast with a diffusion path between the baseline and the slowest diffusion path is presented to illustrate results between the moderate and the slowest case.

The baseline CA specification required agents to pass through five stages of knowledge accumulation and sales contacts were allowed to grow at a rate of up to fifty percent per year. Neighborhoods included eighty agents closest in total employment within the same business

[16]The long-run rate is defined as reflecting the system cost of providing generation and distribution capacity to a sizeable number of appropriately clustered CHPcustomers.

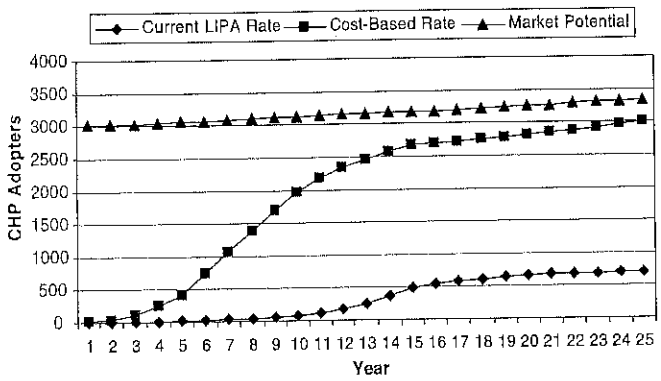


Fig. 4. Number of utility customer adopters—baseline scenario.

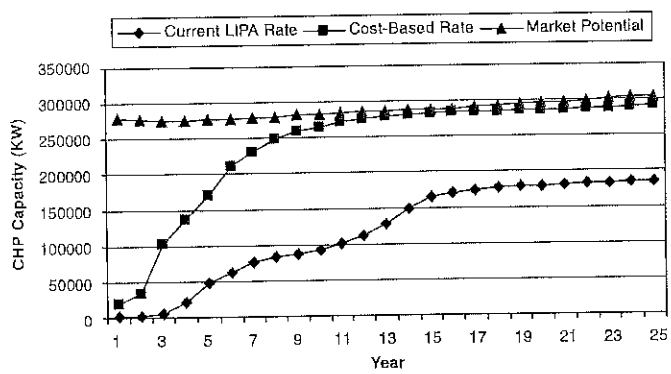


Fig. 5. CHP generating capacity—baseline scenario.

category. The model was run with current LIPA standby rates and cost-based rates described in the previous section. The resulting forecasts are shown in Figs. 4 and 5. The "current LIPA rate" series shows the diffusion of the number of CHP systems and the diffusion of CHP kW capacity (total avoided central plant kW of all CHP systems) under current LIPA standby rates for a 25 year horizon. Approximately 20 years are required for CHP technologies to approach their asymptotic values under current LIPA standby rates.[17] CHP capacity increases more rapidly than number of installations because early adopters tend to have larger facilities. Greater new technology adoption by larger firms has been noted in previous studies and attributed to many factors[18]; however, the impact of sales activity targeted to larger customers and the higher proportion of large customers with onsite energy engineering expertise are sufficient here to provide similar empirical results.

The "cost-based LIPA rate" series show number and kW capacity of CHP systems under the cost-based rate described above. The difference between the "current LIPA rate" and "cost-based LIPA rate" series shows the impact of excessive standby rates (relative to the long-run cost-based rates). These model forecasts indicate that switching to cost-based rates would generate an additional 115,000 kW of customer-generated power by the fourth year. This capacity is comparable to the size of a small central generating plant and is accompanied by an approximately equal amount of heat energy supplied for space heating, water heating and other thermal loads rather than being exhausted to the environment. The difference between the current and the cost-based standby rate scenarios increases to approximately 170,000 kW in year nine.

The "market potential" series in the figures shows CHP installations that would be installed if all utility customer agents immediately reached the knowledge threshold required to make a purchase decision.[19] This market potential is considerably smaller than the "technical potential" measures used in most studies because agents in the current model adopt CHP systems only if the payback meets each agent's criterion, which, as indicated earlier varies across agents with an average of about 1.5 years. By comparison, the DOE, 2002 study used a 10-year payback criterion to evaluate CHP potential. Under current LIPA rates, about 28 percent of potential sites, representing approximately 60 percent of potential CHP kW capacity, undertake a CHP installation in the 25-year forecast. Under this diffusion path most smaller agents are not "found" by sales targeting activities and do not have sufficient knowledge to initiate the purchase process themselves. Under the cost-based standby rates most of the market potential is realized (90 percent of potential sites representing 96 percent of potential CHP capacity).

Evaluating energy and cost impacts for slower and less complete diffusion scenarios also shows significant standby rate impacts as indicated by the two pairs of curves in Fig. 6 (the area between the current and cost-based rates for each alternative scenario shows the rate impact). Neighborhood size and rate of increase in sales contacts were reduced and number of sales contacts required to reach the knowledge threshold was increased to provide slower diffusion paths (see Table 2). These parameter changes substantially reduced the total adoption of CHP technologies. Under the slowest diffusion scenario, an average of one system adoption occurs per year through the forecast period with only the largest, and most profitable, project undertaken. About 20 percent of the potential kW capacity is actually achieved.

[17]These are technically not asymptotic values because the stock of agents grows each year; consequently, all of the series have an upward trend over time.

[18]Easier access to capital markets, better financing rates, and more sophisticated decision-making have been identified in previous analysis. Sales targeting large customers is an obvious supplier profit-maximizing strategy that has been observed in the CHP market (Jackson, 2005).

[19]By way of reference, this maximum market potential is a relatively small fraction (10 percent) of total LIPA commercial customer kW capacity requirements.

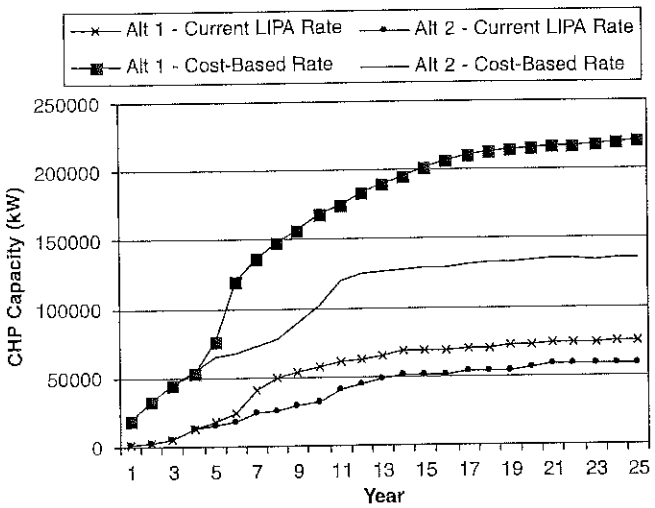


Fig. 6. CHP generating capacity—alternative CHP diffusion scenarios.

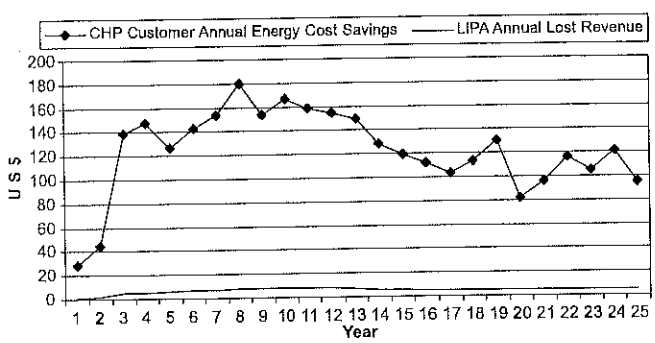


Fig. 7. CHP customer energy cost savings and LIPA lost revenue.

Fig. 7 shows baseline energy cost savings for CHP customers along with utility revenue losses resulting with a cost-based rate. Utility customer savings reach an annual peak of $180 million (US) while LIPA utility losses are no more than $8.3 million. The discounted annual savings in utility customer energy costs is $ 2137 million over the 25 year period while utility lost revenue is $ 99 million. That is, revenue neutrality could be achieved and still provide a net savings to utility customer of $ 2038 million with a cost-based rate.

The results of all 80 simulations show that diffusion impacts are less with a slower diffusion process. Fig. 6 shows that the slowest diffusion treatment results in 70,000 kW of unachieved CHP capacity. The discounted utility customer annual savings in this minimum impact scenario show is $ 1361 million over the 25 year period while utility lost revenue is $ 51 million.

One of the most interesting findings of this agent-based analysis is that the application of current LIPA standby rates is likely to keep the population of CHP customers small enough to limit the "neighborhood" information dissemination and knowledge acquisition impacts and to prevent the achievement of a sufficient number of clustered CHP applications required to take advantage of the probabilistic nature of unexpected CHP downtimes. However, when standby rates are specified to reflect the advantages of a large number of clustered applications, the adoption required to match this premise is likely to be achieved.

These and similar results from all 80 experimental treatments determined with the factorial experimental design indicate that regardless of the diffusion process excessive standby rates, relative to their long-run cost-based values, can be expected to have a significant impact on the diffusion of CHP technologies, to limit the value of the random nature of unexpected CHP downtimes to the utility system and to impose considerable costs on customers who would have adopted these technologies.

To examine sensitivity of the results to increased initial CHP costs reflecting agent valuation of grid attributes and other factors, DOE (2002) cost estimates were increased in two alternative simulations. An initial system cost increase of 20 percent reduced the number of systems to 75 percent and the total kW CHP capacity to 84 percent of the baseline. Initial system cost increase of 40 percent reduced the number of systems to 52 percent and the total kW CHP capacity to 66 percent of the baseline. These results indicate that any reasonable agent valuation of grid attributes will not change the analysis conclusions.

It also should be noted that CHP-related distribution system and emissions benefits have not been included in this analysis; monetization of these benefits in the form of incentives to CHP customers would increase the CHP diffusion and capacity contributions beyond the baseline results.

## 6. Summary and conclusions

The extent to which combined heat and power (CHP) technolgy diffusion is limited by current regulatory practices as opposed to reflecting traditional new technology diffusion and energy-related investment patterns has important policy implications. CHP systems can potentially offer a significant opportunity to improve energy efficiency and reduce emissions.

This study develops and applies a new analytical framework to separate the impacts of standby rates from the diffusion process. The modeling methodology extends microsimulation techniques to include endogenous agent interaction with a cellular automata process that reflects the dissemination of new technology information and the accumulation of knowledge required to consider the purchase of these technologies. By viewing each simulation of the model as an experimental treatment where alternative values of neighborhood size, knowledge levels and sales activity are developed with a factorial experimental design, the analysis is able to systematically separate the impacts of standby rate differentials from the underlying diffusion process for alternative diffusion paths.

The Long Island Power Authority (LIPA) service area was selected to conduct an example analysis. Results for the LIPA study area find that excessive current standby rates can be expected to significantly reduce the diffusion of new CHP technologies regardless of diffusion dynamics. Total additional costs attributable to excessive standby rates are estimated to be $2.1 billion over 25 years under a baseline scenario and $1.4 billion under the least costly alternative diffusion scenario examined in the study.

Similarity in relationships between the LIPA study area and utility service areas in California and the Northeastern states suggests that analyses of these service areas are likely to show similar results with the following important policy implications. Standby rates designed to achieve immediate utility rate revenue neutrality or to reflect immediate, rather than longer run, distribution benefits are likely to limit the diffusion of CHP systems to such an extent that customer and utility system benefits of a large number of spatially clustered small systems are never realized. The costs of these shortsighted rate design objectives are substantial both in terms of electric system efficiency and energy costs for potential CHP customers.

## Acknowledgments

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# Electric Utility Standby Rates: Updates for Today and Tomorrow

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Any inaccuracies, mistakes, or omissions are my responsibility. Comments, corrections, and recommendations for future work are welcome and can be submitted to:

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# Executive Summary

A standby rate is paid by an electric utility customer who is served in part by on-site generation and in part by services delivered through the electric grid. Such customers are sometimes referred to as *partial requirements service customers*, and the associated tariffs are sometimes called *partial requirements service tariffs*. Customers pay standby charges so that, in the event of an outage of the customer's on-site generator, either planned or unplanned, the customer has the guaranteed ability and the right to purchase power to replace what would normally be self-generated. Customers pay standby charges either to a utility company, according to the terms and conditions of an approved standby tariff; or to a competitive service provider under a contractually determined or market-price-determined rate. A customer-generator still has to pay for their use of local distribution facilities, however, even if they buy power from an alternative energy supplier. The federal Public Utility Regulatory Policy Act (PURPA, 18 CFR § 292.305) requires utilities to provide certain services, including standby service, to customers with Qualifying Facilities.[1] The rates, terms, and conditions of such service are generally set by state public utility regulatory commissions.[2]

Standby rates have often been contentious. US DOE (2007, p. 8-6) offers this concise overview of the long-standing standby rates debate:

> The installation of DG reduces utility power sales revenues, may cause the utility to incur costs for power purchases or losses on power sales for power expected to be used by the DG customer, reduces rate revenue from non-power related charges in rates (such as "wires" charges and general and administrative expenses included in a kWh rate), and so on. These costs would shift to other, non-DG customers if the utility did not recover them specifically from DG customers. This constitutes a subsidy of DG customers by other rate payers. By the same token, DG systems provide potential benefits to the utility and, by extension, other ratepayers… . Accordingly, DG customers feel they are subsidizing the utility and other ratepayers.

This characterization, though, highlights the dangers of over-generalizing. Whether a subsidy or cross-subsidy occurs depends on the long-run marginal costs of providing the different utility services in question. It should also be noted that the same general concerns apply to energy-efficiency improvements and that the associated costs can differ widely depending on the specific location and mode of operation of a DG system. In addition, customer bills for those utility services depend on the details of rate design, including standby rate design.

Distributed generation (DG) advocates have sought minimal standby rates, based on the premise that DG installations provide grid benefits in the form of deferred or permanent

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[1] 18CFR §292.303(b) *Obligation to sell to qualifying facilities*. Each electric utility shall sell to any qualifying facility… energy and capacity requested by the qualifying facility.

[2] PURPA applies to some utilities that are not regulated by state public utility commissions. Examples include some municipal (city-owned) utilities and cooperative (member-owned) utilities. *See* US DOE, 2009, *List of covered electric utilities*.

reductions in the need for utility-provided generation, transmission, and distribution capacity. Utilities and others have argued that the theoretical benefits from DG are insubstantial, if not immaterial or even chimerical if located in an unsuitable area or operated erratically, and that low standby rates can result in DG customers avoiding payments to cover infrastructure costs associated with backup generation and wires services and thus raise rates for non-participating customers.

The utility concern regarding infrastructure charges is especially acute for most residential and small commercial customers whose rates do not include fixed demand (i.e., kW) charges, but rather have all but a small portion of their charges (i.e., monthly customer-service charges, nominally covering only metering and billing costs) expressed as volumetric (kWh) fees. Standby rates do not always apply to small customers, however. Net metering statutes often prohibit standby charges, and standby rates are sometimes designed only for large customers.

This paper reviews current practices for standby tariffs and presents options and recommendations about how to determine an appropriate standby rate, reflecting differences among generators (such as size and type of generator) and how the generators are regularly operated, and particularly exploring and reporting on differences between vertically integrated monopoly and competitive electricity markets. But standby rate design needs to be evaluated in the context of overall rate design. Standby charges vary, as they should, depending on overall rate design and on the regular service rate the customer is on.

The paper makes two major recommendations: (1) Existing standby rates can and should be modeled, using pro forma estimates of charges under a variety of scenarios and supplemented by case studies of actual customers; and (2) data should be gathered and analyzed about the classes of DG customers—both those paying standby charges and also any who are exempted—to assess accurately the present and future utility-system costs and benefits associated with DG installations. The first type of modeling is needed to determine how close the rates come to meeting their design expectations and how the rates affect DG-customer economics. The second type will better assess the relationship between DG installations and utility-system costs. Depending on the modeling results, standby rates can be adjusted to most accurately reflect the costs and benefits associated with DG installations and operations.

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## I. Introduction

Utility standby rates are common, if not ubiquitous. As more and varied types of distributed generation (DG) seek to interconnect with the electric grid, standby rates take on increasing importance. In a 2005 report, Johnston et al. (p. iii) introduced the subject:

> Customers with onsite generation typically remain connected with the grid to meet electrical needs that exceed the capacity of their DG facilities and to ensure, through diversity of supply, the reliability of their electric service in the event that their units are not available because of maintenance or some other reason. Grid-supplied service to these "partial requirements" customers comes in many forms—standby (or backup), scheduled maintenance, and supplemental—and, as the deployment of DG systems has increased, the urgency of resolving the difficult questions about their rates and rate structures has become more acute.
>
> What does it cost the electric system to provide standby service for partial-requirements customers, and how should these costs be recovered? What are the benefits of DG to the system? How should standby rates be designed to reflect these benefits and encourage customers to maximize the value of DG for themselves and the system? The decisions made today will have long-term strategic consequences. [fn omitted]

What is noteworthy, almost eight years after publication of Johnston et al.'s report, is the extent to which these same questions still remain unanswered. This paper reviews the current status of standby tariffs and presents options about how to determine an appropriate standby rate.

Under the Public Utilities Regulatory Policy Act (PURPA) regulations (18 CFR § 292.305), some utilities are required to provide supplementary, backup, maintenance, and interruptible power to a "qualifying cogeneration facility or… small power facility" ("QF"). This requirement was first established with the initial passage of PURPA in 1978 and was amended in 2005. An alternative provided by the 2005 amendment is that a utility's obligation can be terminated by the Federal Energy Regulatory Commission (FERC), at the utility's request, if FERC determines that:

> Competing retail electric suppliers are willing and able to sell and deliver electric energy to the qualifying cogeneration facility or qualifying small power production facility; and (2) The electric utility is not required by State law to sell electric energy in its service territory. (18 CFR § 292.312 and FERC Order 688, 71 FR 64372, Nov. 1, 2006; 71 FR 75662, Dec. 18, 2006).

If FERC does terminate a utility's obligation, however, to date the determination has been applicable only to generators larger than 20 MW in net capacity. The rebuttable presumption is that smaller generators might "not have non-discriminatory access to markets." Thus, FERC has determined that a utility's obligations remain in effect "for all QFs with a net

capacity of 20 MW or smaller… ." FERC treats this as a rebuttable presumption, subject to a "showing that a small QF does in fact have nondiscriminatory access to the relevant market."[3]

These four different services—supplementary, backup, maintenance, and interruptible power—are often grouped together in a single utility tariff, typically called a *standby tariff*.[4] Standby tariffs establish the rates, terms, and conditions of service by which a self-generating customer secures ongoing eligibility to obtain utility services when needed.

PURPA Section 305 states, in part:

> (c) Rates for sales of back-up and maintenance power. The rate for sales of back-up power or maintenance power:
>
> (1) Shall not be based upon an assumption (unless supported by factual data) that forced outages or other reductions in electric output by all qualifying facilities on an electric utility's system will occur simultaneously, or during the system peak, or both; and
>
> (2) Shall take into account the extent to which scheduled outages of the qualifying facilities can be usefully coordinated with scheduled outages of the utility's facilities.

The design and setting of standby rates has often been contentious. As Hurd (2009, pp. 240-241) explains:

> [M]ost parties agree that there should be a standby rate structure based on cost causation principles, meaning the rate should allow the utilities to recover all costs that the distributed generation customers impose on the system but nothing more. There is considerable disagreement, however, as to what costs and benefits the distributed generation project actually imposes on the distribution system. Also, the parties dispute how and to what extent such costs and benefits should be incorporated into the standby rate structure. … Utility providers and distributed generation advocates vastly disagree over the factors that should be included in the standby rates. [footnotes omitted]

The gist of the contentious issues has always been:

- Participating customers (and the manufacturers and developers of DG facilities who serve the customers) generally favor standby rates that do not defer or prevent establishing DG facilities that would otherwise be fully economical, but for the existence of standby charges. In addition, DG advocates are concerned, as US DOE (2007, p. 8-8) notes, that standby rates too often "impose disproportionate costs on

---

[3] FERC, 2007, RM06-10-001, Order No. 688-A, pp. 53, 59.

[4] A fifth service called economic replacement power is offered by some utilities. This is a variation of supplementary and interruptible power. A utility can offer to produce and deliver electricity when it costs less than the on-site resource. (*See* Regulatory Assistance Project and ICF International, 2009, p. 5).

the customer for facilities that are only rarely used."

- Participating customers desire cost-based, flexible rates that give options for determining the quantities and qualities of their purchases of standby services.

- Non-participating customers and utility shareholders do not want to subsidize participating customers. Their general point of view is that if standby rates are too low, participating customers will utilize utility resources without adequately compensating the utility.

- Depending on the incentives and market structure present, an electric utility might seek to prevent bypass, which represents the loss of sales and diminished revenues associated with customer self-generation. Utilities sometimes also explicitly seek to prevent uneconomic bypass.[5]

- Again, depending on the incentives and market structure present, natural gas utilities could support minimal electric utility standby rates because on-site generation using gas-fired equipment often represents an opportunity for increased gas utility sales.

- A variety of social interests can also play a role. Lower standby charges would generally serve to promote goals such as diversifying electric generating resources, helping to meet renewable energy portfolio standards, or providing another type of customer choice in competitive electricity services.[6] Higher standby charges would generally help to prevent uneconomic bypass and ensure that utility capital resources will be more fully utilized.

The areas of contention often center on analysis of the costs and benefits associated with DG installation and operation. For example, DG advocates expect that utility capital costs will be reduced, while utilities typically expect the opposite. Utilities sometimes acknowledge that DG installations could result in temporary distribution system deferrals, but utilities also point out that customers with DG systems have no obligation to serve. If a customer decides to discontinue DG operations at any time, the utility could theoretically be unable to serve the full loads in that area, or at a minimum costs could increase and reliability be reduced. Absent detailed analysis of large numbers of DG installations over a sufficiently long time, it is practically impossible to know just where the truth lies in such different perspectives. Nevertheless, rate structures do affect DG deployment decisions and DG operations, and listed utilities are required by PURPA to offer standby rates. Therefore, standby rate decisions need to be made based on the best available information.

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[5] *Uneconomic bypass* refers to the situation in which a customer's alternative source of on-site generation has a marginal cost that is lower than the customer's avoided utility rate but higher than the utility's marginal cost. *See* Rose, 1996.

[6] *See*, for example: National Action Plan for Energy Efficiency, 2008, pp. 2-14, D-6; and US EPA Combined Heat and Power Partnership, 2008.

## II. What's New? Why Revisit Standby Rates Today?

Several reasons exist for reviewing standby tariffs now. These include: (a) increasing energy efficiency; (b) reducing negative environmental impacts associated with electricity production and use; (c) supporting other DG-promoting policies; and (d) achieving the benefits of smarter-grid implementation.

Energy efficiency is an important goal for ratemaking. As The Regulatory Assistance Project (RAP) and ICF International (2009, p. 5) explain:

> [B]etter rate designs… give customers a strong incentive to use electric service most efficiently, to minimize the costs they impose on the system, and to avoid charges when service is not taken.

DG frequently contributes to higher energy efficiency, for three major reasons.[7] One is that line losses are reduced when electricity is generated at or near the point of end use. Second, the large quantities of heat usually associated with electricity production can be put to good use in customer facilities. Energy that would otherwise be dissipated as waste heat, when produced at a central power plant far from loads, frequently can provide useful space or water heating and cooling or industrial-process heat when generated at or near customer end-use facilities. The ready ability to use the waste heat from electricity production for on-site end uses, or to use otherwise-wasted thermal energy to produce electricity can often result in a doubling of the total efficiency of converting the energy inherent in a fuel to useful purposes, compared to the separate production of electricity in a central utility plant and thermal energy in on-site facilities.[8] In addition, DG can provide practical opportunities for generating and using direct-current (DC) energy on site without converting it to or from alternating current (AC), which can also lead to efficiency improvements.[9] Third, customers who utilize on-site generation often demonstrate increased interest in their energy uses and costs. They often invest in higher-efficiency end-use equipment as a means of reducing their capital investments in on-site generation and are at least somewhat more likely to manage their loads in ways that maximize their use of on-site generation and reduce their use of utility grid resources. They are also likely to be early adopters who will utilize other technologies to reduce their energy costs, including, for example, electrical and thermal energy storage, automated energy-management systems, and automated demand response.

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[7] Lovins et al. (2002) detail dozens of specific mechanisms by which distributed energy resources can help to achieve higher efficiency and thus higher economic value.

[8] The combined generation of electricity and thermal energy in a cogeneration or combined heat and power (CHP) facility can be accomplished in either sequence. Systems that generate electricity first and then use thermal energy are called *topping cycles*, and systems that generate thermal energy first and then use what would otherwise have been wasted heat to generate electricity are called *bottoming cycles*. *See* http://www.epa.gov/chp/documents/faq.pdf.

[9] Galvin and Yeager, 2009, pp. 93, 95. *See also* http://www.emergealliance.org/.

New and emerging environmental regulations covering air emissions, wastes, and water use and discharge are also producing changes in the electricity industry, especially the steam electric power generating industry.[10] This includes some changes that will eventually lend support to different types of DG. For example, stricter air quality requirements will generally support no-emissions (i.e., geothermal, hydro, solar, and wind) and low-emissions (e.g., high-efficiency natural gas and some bio-fueled) electric generators. Also, a US EPA-proposed rulemaking could change the way that stationary emergency backup generators are regulated for national emissions standards for hazardous air pollutants under the Clean Air Act, to allow for their use in peak shaving and both emergency and non-emergency demand response.[11] Another example is the expected US EPA rule that would require major industrial and commercial boilers to utilize maximum available control technology (MACT) to reduce hazardous air pollutant emissions.[12]

Some states and the federal government are also implementing a variety of policies that specifically support DG. These include, for example, special treatment of or separate requirements for DG in state renewable portfolio standards and financial incentives, including property tax exemptions in some states.[13] At the federal level, FERC has approved standard interconnection agreements and procedures for large and small generators, and has established rules governing the sale of ancillary services in transmission markets. For the success of such policies, just and reasonable standby rates serve a modest supporting role, along with just and reasonable PURPA buyback rates, interconnection and net metering policies, and competitive bidding or other policies supporting a utility's procurement of new electric power generation.

Also important are the multiple ways that technologies enabling a smarter electric grid are expected to support the more widespread use of DG. Smarter-grid infrastructure will enable higher efficiency and better utilization of grid resources by facilitating the control and blending of DG system output with demand subscriptions, load management, demand response,[14] and

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[10] *See* http://www.epa.gov/lawsregs/sectors/electric.html and http://water.epa.gov/scitech/wastetech/guide/steam_index.cfm. *See also* Regulatory Assistance Project, 2003a and 2003b.

[11] 40 CFR Part 63, Docket No. EPA-HQ-OAR-2008-0708, http://www.epa.gov/ttn/oarpg/t3/fr_notices/rice_neshap_recon_prop_052212.pdf.

[12] *See* http://www.epa.gov/ttn/atw/boiler/boilerpg.html.

[13] *See* DSIRE, 2012b; http://www.epa.gov/chp/state-policy/; and US EPA Combined Heat and Power Partnership, 2008.

[14] Load management and demand response are not always consistently defined. *Load management* usually implies utility control of certain end use equipment, as a means of managing peak loads. Examples include interruptible water heaters and air conditioners. *Demand response* usually implies consumer responses to price signals, with higher prices reflecting peak load periods. Demand response can be automated, but is usually distinguished from utility-directed load management by remaining under customer control.

electric and thermal storage. Smarter-grid controls, combined with time-varying pricing and near-real-time communications will further facilitate multiple operating options for variable output, baseload, intermediate, peaking, and emergency-backup DG. This multiplicity of options leads to questions of whether and how to: (a) alter standby tariffs based on the different modes of DG operation, and (b) offer choices so that standby services can be tailored to meet various customers' specific operational needs. The bottom line is that system operators need to deploy a wide array of tools to provide customers with economic incentives to encourage DG operations that produce the best supports for the electric grid as a whole.

Another important reason to review standby rates now is the near-term abundance and low cost of U.S. and North American natural gas resources. With natural gas presently under intense focus as a fuel of choice for electricity generation, it is important to consider using this valuable fossil fuel most efficiently. Use in distributed combined heat and power (CHP) systems makes sense, because such systems can offer up to 90% efficiency in the conversion of fuel energy to useful electricity plus thermal energy. It would be counterproductive if excessive standby charges were to prevent the development of otherwise economical, high-efficiency CHP.

Lastly, it is important to recognize that DG equipment is frequently small scale, modular, and subject to technological improvements and cost reductions associated with economies of manufacturing. Many DG technologies are continuing to improve in efficiency, reliability, and cost-effectiveness, making DG increasingly attractive to consumers.[15] And, at least in some applications, DG is already or soon could be a low-cost resource for meeting electric-utility system needs.

A most important question is whether current utility standby tariffs, given the total rate picture including the utility parent tariffs, distort the costs and benefits of DG operations, in ways that affect the customer's or utility's selection of technologies or operating strategies.

Rates that accurately compensate DG resources for the time value of capacity and energy produced will help signal DG developers and managers about how to most economically operate their systems. In theory, both the benefits and costs associated with DG resources should be reflected in tariffs. For example, DG operators deserve fair compensation for the value of the utility system benefits they produce and deliver, including capacity, energy, and ancillary services. At a minimum, when a DG system is operating it reduces the need for an equivalent amount of generation, plus line losses and spinning reserves (Lovins et al., 2002, pp. 201-207). At a maximum, DG is theoretically capable of producing a broad array of utility system benefits, but these benefits depend upon pricing structures that optimize DG operation for the grid and customer. US DOE (2007, p. v) concludes:

> Calculating DG benefits is complicated, and ultimately requires a complete dataset of site-specific operational characteristics and circumstances. This renders the possibility of utilizing a single, comprehensive analysis tool, model, or methodology to estimate national or regional benefits of DG highly improbable. However, methodologies exist for

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[15] *See*, for example: Colatat, 2009; Hoffman and Molinski, 2009; Lins, 2010; National Research Council, 2010, pp. 172-180.

accurately evaluating "local" costs and benefits (such as DG to support a distribution feeder). It is also possible to develop comprehensive methods for aggregating local DG costs and benefits for substations, local utility service areas, states, regional transmission organizations, and the nation as a whole.

In earlier studies of standby rates, Fox-Penner (1990) found that decisions about whether to invest in on-site generation were dominated by the influences of rate designs. Ferrey (2000) questioned whether standby charges were not exit fees in disguise, designed to prevent customers from installing and operating self-generation equipment. Jackson (2007) modeled the potential impacts of standby rates on customer adoption of combined heat and power systems. He concluded that standby rates were acting as a barrier to adoption and that an appropriate goal would be "reducing standby rates to reflect the cost of serving a large number of small, spatially clustered [combined heat and power (CHP)] systems..." (Jackson, 2007, p. 1896). More recently, and in a similar vein, Basu, Chowdhury et al. (2011) questioned whether "standby rates are a barometer of a state's general receptivity to DG, meaning that states with 'good' standby rates have more DG and states with 'bad' standby rates less DG."

Another reason for reviewing standby rates now is that DG is generally becoming more attractive to larger numbers of potential customers. Several DG technologies are continuing to improve in reliability and efficiency, and manufacturing improvements are gradually reducing equipment costs, thus leading to growing DG markets. In addition, the variety of aforementioned state and federal policies produce incentives for and heighten interest in DG. As the numbers of customers using DG technologies and the diversity of DG applications increase, standby costs and benefits change, too, based on the increasing populations of and load diversity among standby customers. The increased variability in customers' use of standby resources ought to be reflected in rates.

A decade ago, Morrison (2003, p. 76) found that the actuarial mathematics needed to calculate the costs associated with providing standby service were lacking; not enough was known about DG technology performance and operating characteristics to determine accurately the risks of unexpected outages, let alone unexpected outages during peak load conditions. Johnston et al. (2005, p. iv) also lamented the general lack of data and analysis available to support standby rate design. A pertinent question for today is whether that circumstance still exists. Are adequate data available or readily obtainable, to provide the actuarial evidence needed to determine appropriate, accurate standby rates? Or if such data are not already available, will they become available soon as smarter-grid systems are deployed in more utility service territories? If so, what recommendations might commissions follow in the near term, to ensure that the relevant data will be collected and made available?

Finally, PURPA was amended by the Energy Policy Act of 2005 to add the new requirement in Section 305(c) (18 CFR § 292.305(c)), that rates take into account the diversity of self-generators and the variability and timing of "forced outages or reductions in electric output by all qualifying facilities." Long before the PURPA amendments passed in 2005, Berry reported (1989, p. 479) that "standby charges are not explicitly based on the probability of outages and do not reflect... the costs of providing standby service." If states have not already done so, existing standby rates should be reviewed to make sure this 2005 PURPA requirement is met.

## III. Understanding Standby Charges

This part of the paper lists the main categories and components of standby charges and describes the major goals that are important to consider when designing standby rates.

By way of introduction, standby service customers are called *partial-requirements customers*. These customers provide some of their requirements using their on-site generators and purchase the remainder under a stand-alone standby tariff or contract, or through a combination of some standard-service utility tariff or contract in conjunction with a standby tariff or contract. Partial-requirements customers still purchase delivery service from a utility, even if they buy energy from a competitive supplier. They are differentiated from full-service customers who buy all of their electricity services from a utility, or obtain delivery services from a utility and all their energy from a competitive electricity service provider. Designing standby rates basically involves analyzing the costs of providing partial (as compared to full requirements) service and then designing rates to collect the revenue requirement associated with those costs.[16] These issues are much the same in all rate design, but complexities and difficulties are added when analyzing partial requirements services, because of the lack of *a priori* knowledge about the timing and duration of DG unplanned outages.

When reviewing standby rate design, though, keep in mind that standby rates depend to a large extent on full service rate design. Partial-requirements customers typically receive some service from a standard utility tariff designed for full-service customers, which this paper calls a "parent" tariff. Thus, some details that are present in some standby tariffs could be found in a utility's full service tariffs, and vice versa.

### A. Major categories and components of standby rates

Firestone, Marnay, and Maribu (2006, pp. 5-6) explain the three main categories of standby charges:

- *Fixed charges ($/month)* are invariant fees. They are intended to cover infrastructure supply and delivery costs required by the customer regardless of the customer's monthly use of energy and capacity demands.

- *Volumetric charges ($/kWh)* are in proportion to energy consumed and may fluctuate by time of day within the month. They cover the variable costs of producing electricity, such as fuel charges and variable maintenance expenses. Volumetric charges can be metered as a flat tariff, as time-of-use (TOU) with a different price during on-peak and off-peak periods, or as real-time pricing (RTP) with a different price each hour.

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[16] For further explanation of standby rate design issues, *see*: Berry (1989); Gordon, Olson, and Nieto (2006); and Morrison (2003).

• *Demand charges ($/kW)* are levied on the maximum power used during a specified time range, such as over the on-peak hours of a month, regardless of the duration or frequency of that level of consumption. Demand charges are intended to collect the fixed costs of infrastructure shared with other customers in proportion to the capacity each requires.[17]

Fixed charges generally reflect costs that are associated with customer service and do not vary depending on customer usage. This typically includes charges for metering and billing, and for the utility's customer service facilities and personnel. A pertinent question for standby rates is whether standby customers should pay the same as full service customers, or a higher charge to reflect the additional complexities involved in their metering and billing. It is not uncommon for customers to be directly charged for the metering equipment and sometimes meter reading and billing for their on-site generator(s), in addition to the parent tariff charges for metering and billing.

Demand charges are often used to collect infrastructure costs associated with power-supply (generation) capacity and distribution (delivery) service capacity. The same power-supply resources can be used to provide standby service to multiple standby customers, because it is unlikely that all the generators for which standby service is reserved will fail simultaneously. Consequently, the demand charges for power-supply capacity should be lower than the demand charges for power-supply capacity contained in a standard tariff. The distribution system must be constructed to serve the maximum demand. Some localized capacity additions may be delayed and some existing localized capacity could be stranded. Some variable costs may be reduced due to reduced losses, and some variable costs could increase due to the need to remove labor saving devices that are not compatible with localized generation. Consequently, demand charges for distribution service cannot be significantly reduced.

Power-supply-resource and distribution-resource costs that are a function of capacity are commonly recovered with energy charges when the cost of demand metering is prohibitive. Historically, that has been the case for most residential and small commercial customers. This complicates the design of standby charges, because some mechanism is required in standby chares for recovering distribution fixed charges (which remain relatively unchanged by the installation of onsite generation). The typical full-service rate that collects infrastructure costs using volumetric charges must be replaced by some mechanism to collect infrastructure costs on significantly reduced energy deliveries.

Many other details are typically included in standby tariffs. They include, for example: the circumstances under which standby customers will take (and pay for) service under the utility's standard tariff for similarly situated customers who do not have on-site generation; differentiating among standby, backup, supplemental, and maintenance service; differentiating based on the size, type, and normal operations of on-site generators; provisions for DG metering and interconnection; compensation for electricity a DG customer sells to the utility or a wholesale market participant; liability and indemnification provisions; how minimum monthly

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[17] Demand charges are sometimes also used to collect charges for delivery facilities that are built to serve only a single customer.

charges will be determined; details about how demand charges will be determined, including the applications of demand ratchets;[18] and provisions for dispute resolution.

Several of these issues can be and sometimes are included in a utility's standard parent tariffs, and could be considered misplaced if they do appear in standby tariffs. Examples include interconnection rules and procedures, compensation for electricity sales, liability and indemnification provisions, and provisions for dispute resolution.

## B. Major goals for standby rate design

The goals for the design of standby rates are generally the same as for all rate design. Those goals, first articulated by James Bonbright in 1961, emphasize, among other things, economic efficiency, fairness, simplicity, and transparency.[19] To these, standby rate designers might add promoting efficiency and electric system reliability and standardizing markets. It is important to understand that these goals sometimes conflict with one another, and it is no simple matter to determine the optimum rate design that will maximize achievement of all these goals.[20] This part of the report reviews these goals and how they relate to standby rate design.

### 1. Economic efficiency

Economic efficiency basically means setting prices so that they are closely related to marginal costs. Economic efficiency also supports the premise that standby charges should not discourage on-site generation that is fully economical and cost-effective but for the inclusion of standby charges (Firestone, Marnay, and Maribu, 2006, pp. 14-15).

Hurd (2009, p. 952) describes "the ideal standby rate":

> The ideal standby rate design should incorporate cost causation principles. Specifically, the rates should be neither a barrier to new distributed generation projects nor a subsidy to standby customers by requiring non-standby customers to cover costs through increased rates. A standby policy should adhere to the central principle of requiring standby customers to cover any costs that they impose on the distribution system, while allowing them to recover for any benefit *actually* conferred. [footnote omitted, emphasis in original].

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[18] *Demand ratchets* are a method of establishing the level of demand that a customer must pay for through a demand charge. The ratchet sets the level of demand for computing a customer's monthly demand charge equal to the highest level of demand (kW) utilized at any point during a preceding time period (e.g., one year) (Edison Electric Institute, 2005).

[19] For a concise review of Bonbright's principles, *see* US DOE, 2007, p. 8-4.

[20] For a primer about basic rate design, *see* RAP and ICF International, Dec 2009, Appendix B.

The question of what constitutes a subsidy is more difficult than it first appears. Subsidy is an economic concept; consumers are *subsidized* when the price they pay is less than the long-run marginal cost of producing the good or service they receive. Cost shifting between different ratepayer groups does not necessarily equate to cross-subsidies. It is possible that a utility will receive less revenue from a participating standby customer than from a similarly situated customer without a DG installation. However, as an economic principle, if the participant's standby rates are above long-run marginal cost, their cost savings is not a subsidy *per se*. In that case, non-participating customers may have a legitimate complaint about fairness, but not about subsidy. Another complication, sometimes directly relevant to DG systems, is that existing prices do not incorporate charges to account for negative environmental externalities. Should the externalities be construed as a subsidy for traditional electric generation? Determining whether subsidies are present in standby rates is beyond the scope of this paper, but the modeling recommended in this paper (see Part V) should go a long way towards exploring that question in more detail.

Berry (1989, pp. 477-481) listed some of the foundational principles for designing standby charges to reflect the costs associated with providing the service. One important aspect is the probability of each standby customer using backup service on-peak. Another is the probably of a population of standby customers using backup service on-peak and the coincidence of that population's supply and demand compared to the utility service territory as a whole. A third is the actual use of standby service, with lower charges for lower use and higher charges for higher use, for both individual customers and for the entire class of standby customers. Berry (1989, p. 477) also explained how standby charges are conceptually similar to avoided costs and further noted that avoided costs vary depending on the "time of day, season of the year, interruptibility of power, and other factors."

### 2. Fairness

*Fairness* means making rates just and reasonable for both customers and utilities. Among other things, that means that the rates are as low as they can be while still enabling the utility to collect revenues sufficient to cover its costs and attract capital. One of the objectives for fairness in ratemaking is revenue sufficiency, meaning that the total amount collected by the standby tariff will be equal to the total revenues the utility requires to provide the service.

One example of fairness is applying cost-causation principles to assign costs to differently situated customers. Morrison (2003) points out that customers without DG would subsidize customers with DG, if the latter did not pay for the benefits they receive by virtue of being interconnected with the grid.

Another aspect of fairness is treating benefits and costs symmetrically, giving customers credit for the benefits they provide to the utility system under terms and conditions that are similar to those used to assign costs to the same customers. Jackson (2007, p. 1903) recommends, "[A]ppropriate standby rate design should take into account all of the costs and benefits associated with CHP systems… ." RAP and ICF International (2009, p. 2) outline the kinds of benefits to be considered:

The many benefits accrue both to the owners of the onsite resources—through cost savings from avoided purchases of grid-supplied power, improved reliability, reduced thermal (e.g., boiler) energy consumption, and lower overall energy costs—and to the electric system as a whole—through reduced demands for power, avoided investments in generation and delivery capacity, improved operational efficiencies, increased system reliability, and lower total system energy consumption, costs, and emissions.

Yet another example of fairness is in assigning benefits and costs to all the various services that together comprise the full relationship between a utility and a self-generating customer. In addition to standby tariffs, these can include: the rates, terms and conditions of standard utility service; DG interconnection rules and standards; net metering rules; rates for interruptible loads; and rates for energy storage, load-management, demand response, and ancillary services.

Meeting this goal also implies fairness to both individual partial-requirements customers and to the class(es) of such customers. It can be important to consider tariff variations based on, for example, the regular operations of the on-site generating equipment and the timing and duration of outages. A relevant example is establishing financial penalties for non-compliance with specific tariff provisions, rather than allowing a single non-compliance episode to result in a cancellation of a customer's right to obtain standby service.[21]

### 3. Simplicity and transparency

Achieving simplicity and transparency in standby rate design is not easy, but it is a goal that deserves ongoing attention. Simplicity means making the rates easy to understand and administer, and transparency means designing the rates so that prospective users can most easily estimate what their charges will be, based on a few known cost determinants.

Ideally, standby service prices will precisely reflect the costs associated with each component of utility service: generation, transmission, distribution, and customer service (such as billing and metering). Complexity exists due to the desirability of assigning direct versus joint or common costs, and accurately assigning cost responsibility for peak-demand versus total usage of generation, transmission, and distribution (Conkling, 2011, pp. 72-77). Disaggregating all the various cost components, though, can make the rate structure highly complex and confusing. Particular examples are the complexities of applying standby rates to customers hosting more than one on-site generator, and even multiple generators that use different technologies with different operating characteristics.[22]

It should also be noted that leaving details to be determined by the utility conflicts with the goal of transparency. One prominent example is the workings of reserve capacity and

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[21] Examples can be seen in standby tariffs from PPL Electric Utilities (2004-2011, p. 10C) and Pacific Gas and Electric (2009-2012, Sheet 12).

[22] *See*, for example, Pacific Gas & Electric (2009-2012, Sheet 13).

demand ratchets, where some tariffs leave decisions to the utility's discretion.[23] It is preferable for the tariff itself to be clear and complete. If a utility will determine certain charges, though, then at a minimum the customer should be able to (a) request and obtain the utility's determination in a timely basis, and (b) understand how changes to the utility's determination, if any, will be triggered and decided.

At any rate, tension is likely between the goals of economic efficiency and simplicity and transparency. The more costs are differentiated and tariffs designed to accurately collect charges for each cost component, the more complex the resulting tariff. Ideally, the customer (or at least the customer's agent) will be able to understand, and thereby anticipate and accurately estimate, the customer's liabilities under the standby rate. For better or worse, utility rates are often already too complex for average customers to correctly model. Various efforts are underway, however, to help consumers with this task.[24]

### 4. Promoting efficiency and reliability

Rate structures can have significant impact on the economics of distributed generation, as noted by US DOE (2007, pp. 8-1–8-2), Firestone, Marnay, and Maribu (2006, pp. 10, 14-15) and RAP and ICF International (2009, p. 2). Based on the different ways in which standby rates can be designed to assign costs to fixed versus variable charges, the tariffs can affect the amount of cost savings that results when a customer reduces their grid-purchases. Thus, the tariffs can affect the customer's selection of on-site generation type, size, and operating strategy. RAP and ICF International (2009, p. 17) explain:

> Rate designs that have a reasonable balance between energy and demand or reservation charges will naturally be more amenable to the broad policy goal of encouraging clean, efficient DG. Rate designs that reward reliable operation can encourage the development of a diversified, more reliable electric grid. The review of tariffs and operation on peak in this report suggests that the more favorable rate designs share common and central characteristics: they are designed to give customers a strong incentive to use electric service most efficiently, to minimize the costs they impose on the system, and to avoid charges when service is not taken. Put another way, they reward customers for maintaining and operating their onsite generation.

Another aspect of efficiency and reliability can be the relationship between standby rates and the various other government policies intended to support DG. Policy makers and interest groups sometimes favor the idea of tilting standby rates higher or lower.[25] Grace, Donovan, and

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[23] *See*, for example, Pacific Gas & Electric (2009-2012, Sheet 8).

[24] Prominent examples include the Green Button initiative (http://energy.gov/articles/green-button-data-more-power-you) and many software products from Clean Power Research (http://www.cleanpower.com/products/) and the National Renewable Energy Laboratory (http://www.nrel.gov/applying_technologies/models_tools.html).

[25] *See* DSIRE, 2012b, for several examples of state policies favoring solar and distributed generation (DG) technologies.

Melnick (2011) use the term "tilt" to describe policies intended to favor certain technologies. Johnston et al. (2005, pp. iv, v) describe these as "policy overlays." For example, in several states net metering customers are exempted from paying standby charges.

However, Hurd (2009, p. 956) concludes that standby rates, per se, should not be used to tilt DG policies in any particular direction. He states, "Standby rates are an inappropriate method of spurring new distributed generation… ." Hurd recommends that means other than standby rate tilting should be used to provide incentives for DG. For example, he recommends grants, low interest loans, and tax credits. "Proper incentives," Hurd opines, "will promote new distributed generation and raise penetration to levels sufficient to provide measurable benefits."

### 5. Market standardization

Another important goal for standby tariffs can be to standardize markets. The greater the differences in DG tariffs between utilities, states, and regional transmission operating regions, the more difficult it is for the suppliers of distributed generation to successfully market their equipment and services. This same concern applies to energy efficiency products and services, and is widely recognized in the design of utility programs that acknowledge the goal of standardization to help consumers, equipment vendors, and retailers. Thus, an appropriate goal that a commission might consider is the extent to which standby rates in its jurisdiction can be made as similar as practical for all regulated utilities in the state. However, unless the base rates for full service customers are similarly designed from utility to utility, it will prove difficult to design similar standby service rates.

Another important example of market standardization is making partial-requirements rate designs as similar as practical to full-requirements rates. Meeting this goal might include, for example, assigning power factor charges in the same manner and offering the same choices for time-of-use or real-time rates to both full- and partial-requirements customers.[26] This is not to imply that the charges will be the same, but only that they will be calculated in the same manner.

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[26] As an example, NStar Electric (2006, pp. 2, 3, 6) utilizes the customer's standard rate schedule for determining several charges.

## IV. The Current Situation

This part of the report looks at standby tariffs for utilities in a dozen states. The tariffs selected for review do not represent any kind of scientific sample. The survey includes some of the largest utilities in the country.[27] States were selected to include broad geographic diversity and both regulated and restructured electric industries (EIA, 2010).

Tariffs were reviewed from Alliant Energy (Wisconsin Power and Light); Arizona Public Service; Connecticut Light & Power; Consolidated Edison (New York); Consumers Energy (Michigan); Detroit Edison (Michigan); Georgia Power; Hawaii Electric; NStar Electric (Boston Edison); Pacific Gas and Electric (California); Pacific Power (Oregon); Portland General Electric (Oregon); and PPL Electric (Pennsylvania).

The purpose is not to identify an ideal standby tariff. Rather, it is to seek out and relate examples that illustrate important principles in standby rate designs, identify a range of responses to key regulatory issues, and provide references to those features found in specific tariffs so that anyone grappling with similar issues can easily find examples to serve as a guide. The topics include:

- capacity levels and demand ratchets;
- scheduled versus unscheduled use of power;
- time-varying rates;
- metering and billing;
- minimum monthly charges;
- compensation for generation and ancillary services that DG supplies to the grid;
- specific generator types or sizes;
- liability and insurance requirements;
- dispute resolution;
- wires-only companies; and
- other DG tariff provisions.

What follows in the remainder of Part IV is a brief discussion of each issue, with examples drawn from the tariffs reviewed for this study, including general guidance about tariff details that are most likely to support achieving the five major goals identified in Part III.

### A. Capacity levels and demand ratchets

The methods that standby tariffs use to assign capacity levels and demand ratchets vary widely among US utilities. Some companies define standby demands based on metered

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[27] *See also* US DOE, 2007, pp. 8-9–8-34 for a review of DG ratemaking issues, focusing on California, New York, Oregon, and Minnesota, but also drawing examples from many other states.

maximum demand ratchets that cover the current and preceding 11 billing months. These include Alliant Energy (2002-2005, Sheet 7.29) and Connecticut Light & Power (2006, pp. 1-2). Arizona Public Service (2007-2010, p. 3) sets a new total contract demand with any increase, and the increase remains in effect "for the term of the contract, unless superseded by subsequent increases… ."

At Alliant, standby reservation demand is set based on the size of the customer's generating unit(s).

Other companies allow customers more latitude in determining standby service capacity. The gist of these options is to allow customers to set their standby capacity and then manage their use of on-site generation and supplemental capacity to best meet their needs. By managing energy use during times when on-site capacity is unavailable, customers can reduce their total capacity below what would otherwise be the simple sum of their on-site generating capacity plus supplemental service (typically the parent rate) demand ratchet. For example:

- Consolidated Edison (2011-2012, Leaf 164–Leaf167) sets demand charges based on a contract demand delivery charge plus an as-used daily demand delivery charge. New standby customers can request a specific quantity of contract demand which the company can then "reasonably adjust" or the contract demand will be "reasonably determined through the company's engineering analysis… ." If the customer decides the contract demand and then actual demand exceeds the contract demand by 10% or more, then the customer will owe a surcharge (penalty) for the excess capacity. Consolidated Edison (2011-2012, Leaf 161) also exempts from standby-demand charges customers whose on-site generator(s) provides not more than 15% of the customer's maximum demand and customers with contract demand less than 50 kW.

- Detroit Edison (2012, Sheet D-73.00) subtracts a continuously adjusting standby capacity from maximum annual site demand to set parent tariff maximum annual demand, so that the customer's total demand for distribution charges is effectively the sum of standby capacity plus supplemental demand. Detroit Edison offers an optional pricing method for power supply charges, which uses the real-time Midwest Independent [Transmission] System Operator (MISO) market-based pricing mechanism.

- Georgia Power (2012, p. 2) defines standby power demand in a billing period as the "the maximum metered demand measured during the time standby service is being taken, less the maximum metered demand during the time intervals in the billing period (or the most recent month) when standby service is not being taken." Georgia Power (2012, p. 2) also adjusts parent tariff demand, in three steps, depending on the total duration of standby service a customer requires over the course of a year. In that way, the more the customer uses standby service, the less credit the customer receives in this calculation for their non-standby service billing demand.

- Pacific Gas and Electric (2009-2012, Sheet 8) allows the customer to make the initial determination of reservation capacity, and then makes "adjustments as warranted"

consistent with specific criteria. In addition, for customers whose loads regularly exceed their on-site generating capacity, reservation capacity takes into account the number, size, and outage diversity of the customer's generating unit(s), and "any reduction of customer load commensurate with [on-site] generator capacity outages."

- Pacific Gas and Electric (2009-2012, Sheet 7) also allows customers to receive standby service under a "physical assurance" contract. Under this type of standby service, the customer's load must "automatically and instantaneously drop in an amount equal to the energy shortfall arising from a reduction in the on-site generator's output." Customers fulfilling the physical assurance performance requirements do not pay a reservation charge for the amount of capacity designated.

- Pacific Power (2011-2012, p. 2) bases its charges on a combination of on-peak demand (measured at 15-minute intervals), plus baseline demand reflecting the expected operations of the customers DG unit(s), and a facility capacity reflecting the "two greatest non-zero monthly demands" over the past year.

### B. Scheduled versus unscheduled use of power

Many standby rates include provisions for scheduling the use of power during planned maintenance periods. In addition, some standby tariffs allow customers to purchase economic replacement power, which means the utility offers to produce and deliver electricity when it costs less than the generation from the customer's on-site resource (RAP and ICF International, 2009, p. 5). These are examples of scheduled uses that typically cost less than unscheduled use during unplanned outages. Often, standby-demand charges are waived for scheduled maintenance power. The logic for this exemption is that the utility has sufficient opportunity to plan for providing maintenance power, so that it is not actually providing that service in a standby mode.

Unscheduled uses are either explicitly for standby service when a customer's generator has an unplanned outage, or for supplemental service that is typically billed under a parent tariff. Supplemental service is what the customer regularly needs, during normal DG operation, because the DG unit(s) do not always provide all the energy that the customer demands.

For maintenance service, Alliant (Sheet 7.728) requires "written notice 3 months in advance... for generators... less than 25 megawatts and 9 months for all other generators" and limits maintenance to "a 6-week period per generator per year." Alliant can also require generators larger than 25 MW to defer maintenance. Arizona Public Service (2007-2010, p. 3) limits maintenance to 30 days per unit per year, which must be scheduled during non-summer months with 90 days' advance notice to the utility so that the utility can coordinate with its scheduled maintenance. Detroit Edison (2012, Sheet D-79.00) requires customers to schedule a year at a time. Hawaii Electric (2008-2012, Sheets 75H-I) limits customers to not more than 300 hours of on-peak scheduled maintenance service in a year, and requires requests in writing four weeks in advance; for off-peak scheduled maintenance, there is no maximum limit and requests need be only two weeks in advance. PPL (2004-2011, p. 1) allows maintenance power use not

more than 70-days per year, to be scheduled during "March 16 to May 31, and September 16 to November 30," with 60-day prior notice in writing.

Detroit Edison (2012, Sheet D-73.00), Georgia Power (2012a, pp. 1, 3), and NStar Electric (2006, p. 7) have options for interruptible, non-firm standby service. That is a lower-cost option for unscheduled service, because it gives the utility a right to interrupt service if system demands require it. Detroit Edison waives daily demand charges if the customer's standby service is interrupted. For its interruptible standby service, NStar Electric charges a monthly standby customer charge and then bills all of the customer's scheduled usage on the parent tariff.

Consolidated Edison (2011-2012, Leaf 78) allows customers to use on-site generators to provide emergency power without contracting for standby service, but self-generated emergency power can be used only during company outages. The logic is that this is an unscheduled use that does not require any standby service from the utility.

### C. Time-varying rates

Utilities that offer time-of-use or other time-varying rates usually offer similar options for standby customers. Examples include Georgia Power (2012, p. 2), Consumers Energy (2012, p. D-43.00), and Pacific Gas and Electric ((2009-2012, Sheet 1). Time-varying rates for service have the potential to encourage customers to operate DG equipment so that it produces the most system benefits. Being able to use economic replacement power is one example.

Consumers Energy (2012, p. D-43.00) has a standby energy charge provision based on the MISO locational marginal price.

Pacific Gas & Electric (2009-2012, Sheet 1) has special offerings for DG customers who take service under time-of-use rates. Those customers pay time-of-use meter charges but are exempted from paying standby reservation charges.

### D. Metering and billing

It is common for utilities to charge customers with DG some metering or metering and billing charges in excess of the charges for customers without DG. Examples include Connecticut Light & Power (2006, p. 2), Consolidated Edison (2011-2012, Leaf 160), Detroit Edison, and Pacific Gas and Electric. These provisions are to measure the generator output, rather than the energy and demand the utility supplies the customer. This provides the utility with detailed information about the operations of the DG unit(s). In some tariffs, standby charges depend on the amount of capacity being used during times when the customer's generating unit(s) are out of service, in which case the data about DG unit(s) operation is required.

Alliant Energy (1987-2007, Sheet 7.76; 1997-2003, Sheet 7.81) allows its customers to pay for their additional metering and service facilities, including financing cost, over a period not to exceed two years.

Detroit Edison requires standby customers to have demand metering on generation, inflow, and outflow, if applicable. Detroit Edison (2012, Sheet D-74.00) will provide standby customers with monthly data reports on load and generation, upon request, for a charge of $10 per meter per month.

Pacific Gas and Electric (2009-2012, Sheets 2, 5) requires an extra time-of-use meter charge for customers with reservation capacity less than 500 kW. Pacific Gas and Electric customers are normally metered on 15-minute intervals, but if customer use is "intermittent or subject to severe fluctuations" (including also special provisions for welding loads), shorter time intervals may be used.

It is also fairly common for utilities to require real-time communications capabilities between DG units and the company's operations center.

Alliant (2002-2005, Sheet 7.291) requires the customer to notify the company "immediately" if they require standby power and the expected duration of their need. The customer is further directed to "record the date and time of the beginning and end of each time period of standby service use, and send such recording to the Company within 24 hours of the end of that standby use period." However, the company, at its discretion, "may require that Company-owned metering be installed to monitor each of the customer's electric generating units."

Connecticut Light & Power Co. (2006, pp. 2-3) requires each generating unit to be separately metered, "on a measured time-of-use basis." In addition, customers must provide either a dedicated analog phone line or another "mutually agreed communication technology" to allow continuous remote communication access by the utility.

Pacific Power (2011-2012, p. 5) requires company-approved interval metering and meter communications to be in place prior to initiation of service, including metering that measures the net quantity and direction of flow at the point of delivery and total generator output.

As an alternative, Georgia Power (2012a, pp. 1, 3) requires customers to notify the company about the customer's use of standby service. The customer must notify the company within 24 hours of taking firm back-up service, and within 24 hours of the end of each billing period the customer must provide to the company a log of all generating equipment down-time. If that log is not provided, the utility will assume that the customer's generating equipment was down during the entire billing period.

### E. Minimum monthly charges

Like most utility tariffs, standby tariffs usually specify minimum monthly charges. That is good practice and supports the goal of providing transparency. Minimum monthly charges establish a practical hurdle rate for DG economics, though. Modeling of minimum charges will provide all parties with a clear picture of the minimum size and performance that an on-site generator would need to meet, in order to result in customer cost savings. Examples include:

- Alliant (1994-2005, Sheet 7.672), where the "minimum monthly bill is the applicable customer charge and customer demand charge plus the standby demand charge."

- Detroit Edison, where minimum bills include the applicable customer charge, a standby generation reservation fee, and a charge for delivery. Both the standby generation fee and delivery charge are based on a continuously adjusting standby contract capacity, designed to set standby contract capacity as close as practical to the actual operating level of the generation. Detroit Edison also sets a maximum charge for primary voltage standby demand charges. That charge is designed to limit demand charges to the levels that would have been paid (neglecting ratchets) for the standby demands under the standard primary service tariff offered by the company.

- Georgia Power (2012, p. 2), which includes a customer charge of $184.00 per month, plus $1.57/kW firm standby reserve charge and $1.27/kW local facilities charge.

- Pacific Gas and Electric (2009-2012, Sheet 5), which treats its customer charge as a minimum for residential DG customers, stating, "Residential customers will pay a Customer Charge only in months when the Customer Charge exceeds the customer's [standby service] bill… ."

### F. Compensation for generation and ancillary services that DG supplies

This is not a standby issue, *per se*, but it is included in the discussion here because it is an important consideration for DG economics and because it is sometimes included in standby tariffs themselves; standby tariffs sometimes include provisions for the compensation customers will receive for delivering energy to the utility or for sales to the wholesale market, if one is available. As US DOE explains (2009, p. 8-17), the price paid for DG output will impact economic viability and the lack of a fair price will act as an "impediment or barrier" to development. Prices paid for DG output are determined by a variety of compensation mechanisms. The most common ones include variations of net metering,[28] sales to utilities under some definition of avoided cost, and sales to wholesale markets at market-based prices (US DOE, 2009, pp. 8-17–8-25).

In states where there are active wholesale markets, it is not uncommon for customers to be compensated based on wholesale market prices. For example, Consumers Energy (2012, p. D-44.00) provides for either negotiated energy purchases, or for purchases bought at the MISO real-time LMP, less an administrative charge of $0.005/kWh. And, for small DG producers,

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[28] Net metering options presently exist for at least some utility customers in 46 states and the District of Columbia (DSIRE, 2012a). Most programs allow customers to net their energy purchases and deliveries in each billing period, at least until their net usage reaches zero. If the customer produces and delivers more energy than what they consume from the utility in a billing period, however, the state programs differ in the way that customers are compensated for excess generation delivered to utilities. Some programs effectively donate excess generation to the utility, with no customer compensation.

<100 kW generators at a single location for specific technologies and renewable resources, Detroit Edison (2008d) will pay its top incremental cost – either monthly average, time-of-day monthly average, or hourly, depending on the customer's generation meter type.

Compensation based on area wholesale market prices can be understood as an approach that is aimed at fairly allocating risks to both participating and non-participating customers. That approach does offer limited predictability, though, and therefore heightens DG developer risk and reduces transparency compared to fixed-price offerings.

### G. Specific generator types or sizes

Many utility tariffs exempt specific generator types or sizes from standby charges. Such provisions are sometimes included in standby tariffs, but they may instead be included in other DG tariffs, net metering programs, and the like. These are examples of promotional policies. They can also be seen as examples of policies intending to serve the goal of simplicity, by waiving standby charges for small DG, where the cost of determining and collecting standby charges could outweigh the revenues received.

For example, Consolidated Edison (2011-2012, Leaf 161 and Leaf 162) exempts customers whose on-site generator(s) provide no more than 15% of their demand, and allows exemptions for specific generating technologies if installed and operating by May 31, 2015. The latter constitutes a promotional rate for "fuel cells, wind, solar thermal, photovoltaics, sustainably-managed biomass, tidal, geothermal, or methane waste, or… small, efficient types of combined heat and power generation that do not exceed 1 MW of capacity in aggregate… ." Also, Consolidated Edison customers with standby contract demand less than 50 kW can choose whether or not to take standby service.

Detroit Edison (2009) exempts from standby charges net metering sites with capacity no greater than150 kW.

Similarly, California regulated utilities exempt certain qualifying distributed energy resources from standby charges. Pacific Gas and Electric's standby tariff (2009-2012, Sheet 1) exempts solar generation participating in the company's net metering tariffs or less than or equal to 1 MW, and either not selling power or making only incidental export of power. Detroit Edison (2008d) has a separate tariff, Rider DG, which exempts selected renewable and other small generators (<100 kW).

Pacific Power (2011-2012, p. 1) exempts customers with DG under 1 MW, who are instead served "under the applicable general service tariff."

Portland General Electric (2007-2012a, Sheet 75-1) exempts customers with DG under 2 MW.

## H. Liability and insurance requirements

Standby service and other DG tariffs also frequently include provisions regarding liabilities and indemnification for the utility and customer and insurance requirements for customers. These provisions are sometimes found in other DG tariffs, or in state statutes, rather than in standby rate tariffs.

Network for New Energy Choices (2011, pp. 20-21) and Thornton and Monroy (2011, p. 4815) both caution against overly-strict and one-sided requirements that protect only the utility and not the customer. They claim that overreaching in liability and insurance requirements can act as a barrier to DG adoption. Thornton and Monroy point out that utilities worry about being forced to pay for any damages, "because they have 'deep pockets'." However, Network for New Energy Choices (2011, p. 21) explains:

> [T]o the authors' knowledge there has never been a documented case of a small, net-metered system causing electrical failure or creating potential personal injury or property damage liabilities for a utility. Renewable energy technologies manufactured and installed in compliance with technical interconnection guidelines significantly reduce the risk of potential safety issues.
>
> Excessive insurance requirements only serve to discourage customers from investing… . Requiring customer-sited generators – especially those with relatively small DG systems – to obtain and maintain million-dollar insurance policies is impractical, because the high premiums will likely exceed the economic benefits… ."

Detroit Edison (2012, Sheet D-67.00) requires customers with larger DG units to carry "comprehensive general liability insurance in the amount of $2.5 million per occurrence, with the Company named as an additional insured." For smaller (<100 kW) systems, however, Detroit Edison (2008d, Sheet D-97.00) simply cautions, "The customer is advised to consult its insurers and insurance policies regarding the existence of coverage for on-site distributed generation resources."

Detroit Edison's standby tariff (2012, Sheet D-67.00) also includes an indemnification provision that applies equally to the company and customer.

## I. Wires-only companies

States with unbundled electricity rates typically have standby tariffs that have separate charges for wires (delivery) service and generation (energy and power) service. Customers buying electricity through the competitive market still have to pay for distribution service (delivery) from the utility, so there are usually standby rates for the wires-only service. In these situations, the customer can purchase generation standby service from a competitive market supplier, the default service provider, or the open, competitive spot market. Energy charges for competitive spot-market generation service vary depending on the time and location of use and do not include any explicitly differentiated capacity component.

It is also common in states with unbundled rates for standby service wires charges to be differentiated by service voltage, based on the same cost-of-service studies that determine distribution charges for full-service customers. Examples include Detroit Edison (2012, Sheet D-72.00) and Pacific Gas and Electric (2009-2012, Sheets 2-3). However, there is no reason why rates cannot be unbundled in states with hybrid[29] or vertically integrated markets. RAP and ICF International (2009, p. B-4) report:

> [T]he structure of the electric industry in a state might affect the nature of partial requirements service, like that of full requirements service. If multiple competitive suppliers provide generation services, distribution utilities will provide only delivery service and regulatory interest in standby will be, accordingly, restricted to that component of service. Restructuring accelerated the movement to unbundled pricing for the various components of service (i.e., separate prices for the differentiable elements of service—generation, transmission, and distribution), but nothing about vertically integrated industry structures prevents a similar unbundling of rates. Unbundling makes the nature of costs more transparent and, if done properly, greatly reduces or even eliminates the potential for the cross-subsidization of one service by another.

In some restructured states, the utility offers to purchase for customers standby service from the open market. Alliant (1987-2007, Sheet 7.721) and Detroit Edison (2012, Sheet D-72.00, 2008a, Sheet D-80.00, 2008b, Sheet D-83, and 2008d, Sheet D-97.00) both offer such options. Detroit Edison adds a per-kWh administration charge for that service. In New York, standby customers can choose their energy supplier, with rates set by bilateral contract. If the customer specifies default service from the utility, then the utility will procure the standby service from the competitive market.[30]

Consolidated Edison's standby tariff (2011-2012, Leaf 169) also has a provision for negotiated rates, which includes a requirement for the company to "respond with either an offer or a written explanation for rejection" within 60 days of receiving a customer's application for a negotiated rate agreement.

### J. Other DG tariff provisions

US DOE (2007) reports on two other kinds of DG tariff provisions: (1) special natural gas rates for fueling DG systems; and (2) DG disincentive rates, also known as deferral rates and frequently taking the form of special contracts between a utility and an individual customer.

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[29] Michigan's electricity market is a hybrid, with regulated utilities providing both distribution and generation service, most transmission under independent ownership, and a portion of customers able to buy generation service from competitive suppliers. *See* http://www.michigan.gov/mpsc/0,4639,7-159-16377_17111---,00.html.

[30] Personal communications with Edward B. Kear, On-Site Power Team Leader, New York State Energy Research and Development Authority, 30 May 2012.

The basis for special natural gas rates (US DOE, 2007, pp. 8-15–8-16) is that in regulated natural gas markets customers fueling their DG units with gas would otherwise have to pay retail residential or commercial prices for their fuel. As US DOE explains,

> Distributed generation systems use considerably more fuel than a home or office furnace, and these higher volumes and load factors justify lower unit costs for natural gas than comparable non-DG customers. ... In many instances, the difference between wholesale and retail rates are sufficient to eliminate any financial savings the project may have generated... .

US DOE (DOE 2007, p. 8-16) cites New York and New Jersey as states where natural gas utilities offer special wholesale rates for customers with DG units.

Also, US DOE (2007, p. 8-18) describes DG disincentive rates, stating that "utilities and regulators have historically allowed co-generation deferral rates to actively discourage DG." U.S. DOE states (2009, p. 8-24):

> Under state retail regulation, utilities typically request approval from state commissions to offer deferral rates to customers that would otherwise generate locally for some portion of supply. Approval is needed because offering a price break to an individual customer means that the customer would be paying rates that are less than those paid by other, like customers; the state regulatory commission determines whether the legal criteria that would justify a deviation from tariffs have been met. Any reduction in sales means that, all else being equal, the remaining customers in the rate class will be asked to pay a larger share of class-related costs to cover the portion no longer paid by the selected customer. It is up to regulators to determine whether there are any, or a sufficient level of, net system benefits to justify the discounted rates.

US DOE recommends (2009, pp. 8-24–8-25) that commissions consider DG deployment "in the context of least-cost provision of service... [and] allow pricing flexibility in low-cost areas of the distribution system only if the utility increases rates in high-cost areas." This implies a fine-tuning of the cost-causation principle to reflect differential costs in specific areas of a utility service territory. US DOE further recommends that the issue of utility lost revenues associated with DG be dealt with separately, by considering "performance-based regulation (PBR), sharing of savings between [the] utility and customer DG, [and] de-averaging buy-back rates for DG." Other mechanisms that can help address utility lost revenues include decoupling and lost revenue adjustment mechanisms.

As a final note, Detroit Edison (2008c), Hawaiian Electric (2008-2012, Sheet 75E) and Portland General Electric (2007) have tariffs that compensate customers for dispatchable standby generation. These tariffs are not directly related to standby service, but similar variations could be applied to standby service customers in the future. Both Detroit Edison and Portland General Electric contracts for this service are for customers with at least 250 kW of generation at a single location and its contracts are arranged through bilateral negotiations. Portland General Electric's tariff (2007, Sheet 200-1) requires that the utility will fuel, maintain, and test the generators so that the utility can be assured that the generators will respond when called upon. Also, Georgia

Power (2012b) reports providing standby generators to Johnson & Johnson, which the utility "maintains, tests, and dispatches… in case of emergencies."

## V. Going Forward

A recommended approach for addressing standby tariffs in the near future is to obtain and analyze pricing structures and data about the current situation and use that analysis to determine whether changes are warranted. Data would be analyzed for two major purposes: (1) modeling the effects on individual customers to assess fairness and ascertain whether the rates are promoting efficiency and reliability; and (2) evaluating standby tariffs from the standpoint of economic efficiency. The first type of analysis will model how standby charges are presently affecting the economics of individual DG system installations. The second will investigate broader classes of DG customers, by utility (and, perhaps later by state and region), to check on progress and understand in more detail how standby rates, terms, and conditions of service are affecting DG markets. Based on such analysis, rates can be adjusted, if necessary, to align them with the goals of economic efficiency, fairness, simplicity and transparency, promoting efficiency and reliability, and market standardization (*see* Part III.B.)

The first type of analysis can employ both theoretical modeling and actual, case-study reviews of customer experiences with standby tariffs. RAP and ICF International (2009) and Firestone, Marnay, and Maribu (2006) provide examples of the requisite kinds of modeling. A micro-computer software model that is at least partially applicable to this effort, Distributed Energy Resources Customer Adoption Model (DER-CAM), is readily accessible from Lawrence Berkeley National Laboratory. Firestone, Marnay, and Maribu (2006) use the DER-CAM model for their analysis.[31]

Kear recommends modeling standby charges for a customer with on-site generation, pretending that the generator never operates over the course of a year.[32] The purpose would be to see, for a standby customer purchasing 100% of its requirements from the utility, how its bill would compare to a similarly situated full-requirements customer (who does not have on-site generation and similarly purchases all requirements from the utility). In theory, under a reasonable standby rate the annual charges would be close to the same in these two circumstances.

Similarly, for a partial-requirements customer whose on-site generator produces 100% of its annual needs, the charge should be close to the minimum charge for a similarly situated full-requirements customer. Modeling usage in between these extremes, at 25%, 50%, and 75% self-

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[31] *See* http://der.lbl.gov/der-cam. The website already indexes several DER-CAM case study reports. In addition, a forthcoming report (RAP and Brubaker & Associates, in press) will include spreadsheet modeling of standby rates for proxy industrial customers of regulated utilities in up to five states. This report analyzes standby tariffs and their efficacy for various CHP system sizes under several outage scenarios, recommends potential tariff improvements, and summarizes best practices.

[32] Personal communications with Edward B. Kear, On-Site Power Team Leader, New York State Energy Research and Development Authority, 30 May 2012.

supply for example, should help to demonstrate how well the standby charges track customer usage of standby services.

RAP and ICF International (2009, p. 9) recommend standby rate designs that allow customers to avoid approximately 90% or more of the full retail rate charges, for each kilowatt-hour of energy generated and used on-site. That implies limiting fixed monthly charges and demand charges so that they are a modest percentage of total standby charges, and assigning more standby costs to volumetric charges, including, if appropriate, as-used demand charges. Such cost allocations to the various rate components will have different effects on customers with on-site generators, depending on the nature of their operations. Modeling will help demonstrate the cost avoidance for various customers. Customer-specific case studies can be employed, using actual billing data to verify the models and reveal important patterns among standby service users. Customers with efficiently managed and well-maintained on-site generation should see higher percentage cost reductions. And, rates that achieve this recommended goal can be evaluated to determine whether the resulting revenues are sufficient to meet the goal of economic efficiency.

In addition to modeling the effects of standby rates on individual customers, it is important to obtain and analyze system-wide data. Some relevant data are available from public sources,[33] but presently only utilities have access to much or all of the data necessary to evaluate standby rates.[34] Commissions can request and obtain from utilities the kinds of data necessary to evaluate standby tariffs, either on a case-by-case basis as needed to support periodic analysis, in regularly scheduled reports, or both.

What kinds of data are necessary to evaluate standby rates? The general purpose for the data collection and analysis should be to compare the theoretical basis for standby rates to actual experience and enable refining standby rates as needed to keep them reasonably accurate. Of course the costs of data collection, analysis, reporting, and evaluation need to be considered in light of the likely benefits. Bear in mind, though, that there are costs associated with inaccurate standby charges; negative results can be either too little DG installed and operated—leading to higher total system costs for all utility customers—or too much, including at least some uneconomical systems, possibly leading to cross-subsidization by non-participating customers

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[33] Examples of publicly available data sources related to standby rates include a database of combined heat and power installations (www.eea-inc.com/chpdata/), net metering program data (www.eia.gov/todayinenergy/index.cfm?tg= net metering and www.eia.gov/renewable/annual/greenpricing/), and information about PURPA QFs (www.eia.gov/electricity/data.cfm#gencapacity, www.eia.gov/cneaf/electricity/page/eia826.html, and www.eia.gov/cneaf/electricity/page/eia861.html, Files 5 and 6). Some relevant data on power purchases from QFs is also published in annual reports from major electric utilities (Form No. 1) to the Federal Energy Regulatory Commission (FERC). However, some of this data is reported and made publicly available only after substantial time lags and none of it is explicitly geared towards analyzing and understanding standby rates.

[34] *See* Kassakian and Schmalensee, 2011, p. 177, for a cogent discussion of the information asymmetry between utilities and regulators.

and higher costs for all customers. Therefore, at least modest efforts to gather and analyze the relevant system-wide data appear worthwhile.

Demographic information about the numbers and types of customers using on-site generation, along with the size and types of generators in use, is a starting point.[35] Then, as much as is practical, it is important to try to obtain data about how much standby service was used, when, and for what purposes. Evaluators should consider the various billing determinants, and then explore how the utility can aggregate the relevant data and make them available for analysis. Commissions should consider having these data available for analysis so that they can be aggregated for review by customer type (e.g., residential, commercial, industrial), generator type, generator size, and geographic location. Some tariffs differentiate between standby, supplemental, and maintenance service, in which case collecting and reporting each type of use is warranted. Since some standby tariffs are associated with interconnection rules that apply contractual terms regarding liability, indemnification, and insurance, data collection and reporting about any circumstances that result in those contractual terms being brought into play is also warranted. Also, since many states exempt net metering customers or other specific types of on-site generation from standby charges, data about those customers' uses of utility service can be relevant to understanding whether such exemptions are resulting in cross-subsidization by non-participating customers.

In addition, in states with competitive markets for retail electricity service there is a need to review usage patterns and costs for partial-requirements customers who receive generation service from competitive suppliers, as opposed to regulated utilities. In theory, if the non-wires benefits of DG are sufficient to support fully cost-effective installations, then competitive suppliers might offer DG services as a means of differentiating themselves in the market. To date, however, it does not appear that any data are publicly available about the numbers or types of customers served by both DG and competitive suppliers; nor is there any analysis of this class of customers (assuming such a class exists), which would be useful in analyzing their use of standby wires-only services and contributions towards wires-service infrastructure. This analysis of standby use by partial-requirements customers who receive generation service from competitive suppliers could be needed, if any meaningful numbers of such customers exist, in order to establish accurate standby rates for wires-only service.

From the outset, the underlying theory for standby rates is that standby customers do impose costs on utilities, due to the nature of full-service rate structures that recover at least some, if not most, infrastructure (that is, non-fuel and operating) costs through volumetric charges and explicitly because of the utility's need to produce and make available for use back-up resources for the supply of generation, transmission, and distribution necessary to serve standby customers when called upon.

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[35] Of course, care must be taken to protect the customer's right to privacy. It is important to protect customer-specific data from release without the customer's prior authorization. In some circumstances, it can be desirable to ask for customer permission, on an opt-in basis, for legitimate investigators who agree not to reveal customer-specific information to contact customers for survey purposes. Utilities providing data can easily remove or redact any customer-identification information.

Kassakian and Schmalensee (2011, Chapter 8) are critical of rate structures that recover most costs through variable (kWh) charges and little through fixed (kW) charges. These researchers (2011, p. 111) conclude, "[C]urrent rules allow customers with DG to avoid paying their share of fixed network costs." They also note that DG customers on increasing-block electricity tariffs can sometimes avoid the highest-priced energy, using their on-site generated power to replace high-price service while still taking advantage of a grid connection to obtain low-price energy. It should be noted, though, that Kassakian and Schmalensee's critique is not exclusively focused on standby rates. The situation with respect to DG is fundamentally no different from changes in customer usage that result from energy efficiency measures. Also, most large customer tariffs already include demand charges that address this issue. Still, Kassakian and Schmalensee propose a general change in ratemaking to address all customers' contributions to fixed costs. They say (2011, p. 175):

> Recovering a substantial portion of distribution and transmission network costs through volumetric kilowatt-hour-based rates distorts both utility and customer incentives and over time may create implicit cross-subsidies across subsets of customers. ... [A]lternatives to volumetric charges are needed to mitigate distortions common to most utility rate structures, and we recommend that fixed transmission and distribution network charges be recovered largely through customer-level fixed charges. ...

This highlights the long-standing dispute between advocates of straight fixed-variable rate design apparently supported by Kassakian and Schmalensee versus volumetric charges that provide price signals that more directly encourage consumers to reduce their energy usage (see Boonin, 2008). A counterpoint to the proposal for fixed charges is that costs are fixed only at a given point in time and for some specific duration. In the long run, all costs are variable. +++

On the other hand, Kassakian and Schmalensee (2011, p. 181) also recognize a counterpoint, which is that risk aversion "may make utilities excessively cautious." They explain:

> [E]arly adopters of new technologies and systems may end up incurring costs that are avoided in later adoptions through learning spillovers from early experiences. These considerations may bias investment toward the mature technologies and assets that are familiar to utilities and regulators. Such conservatism may dramatically retard the adoption of technologies to modernize the grid, even when deployment of those technologies is likely to be the most cost-effective path to accommodate the policy goals impressed on the system... . [footnote omitted]

This observation suggests that some policy intervention can be needed to counterbalance utility conservatism and ensure opportunities for customers to be early adopters of emerging cost-effective technologies, like DG.

Paradoxically, the more a utility needs new capacity, the more benefit is provided by DG customers. This means that the same analysis that supports higher estimates of standby costs could also lead to the opposite conclusion, that customers installing DG units are helping the utility avoid future expansion costs and thus reducing total system costs. Plus, the more DG

customers there are, the more they can be considered as providing back-up generation service for one another, not requiring the utility to supply back-up generation. Jackson (2007, p. 1898) explains:

> The small size of new CHP systems, the random nature of likely unexpected CHP downtimes and spatial clustering of commercial establishments permits a probabilistic approach to determining the cost of providing unexpected energy and demand services to CHP service during unexpected systems downtimes.
>
> Most CHP prime mover specifications report average downtimes of less than 10 percent. By scheduling required maintenance during off-peak periods, unanticipated interruptions should be no more than 10 percent during periods where capacity limits are approached, consequently, an estimate of least cost backup rate schedule for widely distributed small CHP systems is specified as 10 percent of the standard large general service demand charge plus standard energy charges for kWh use to cover variable costs. ... One important distinction between these rates is that the probabilistically determined rates require a sufficient (future) population of CHP systems to take advantage of the random nature of unexpected outages... .
>
> A "chicken and egg" problem exists here with CHP advocates arguing that long-run system cost optimization can be achieved only with current pricing that represents these longer-run conditions. Not surprisingly, utilities are more concerned with immediate revenue and revenue neutrality issues. The long-run standby rate argument is appropriate only if these rates result in the kind of clustered, small CHP population characteristics assumed above.

The probability of multiple DG systems requiring standby service at the same time, and of that time occurring on-peak, is generally based on multiplication of the individual probabilities, reflecting the general independence of DG outages. The probability of simultaneous, on-peak outages drops quickly as the total population of DG units increases (Lovins et al., 2002, pp. 181-185; Hoff, 1997, pp. 51-52). To be sure, some DG outages are correlated. For example, solar generators depend on the availability of solar radiation and wind generators depend on wind availability. Just as with central station generators, groups of DG systems can be affected simultaneously by problems with fuel availability, technical problems, and equipment failures. The probability of multiple DG system failures occurring simultaneously rapidly approaches zero, though, as the total number of generators and variety of technologies in the population increases. And, as the average size of generator in the total DG population is reduced, the quantity of power at risk in any simultaneous outage of multiple generators also rapidly approaches zero. Thus, an acute need for standby rate modeling is to periodically true-up standby capacity charges and evaluate the capacity-related benefits the class of DG customers provides, based on actual experience. Data from DG customer billing determinants should reveal details about the timing, durations, and quantities of standby generation service being produced and provided by the utility.

Benefits at the distribution service level are not as easy to ascertain and quantify. Unless it happens that multiple DG units are installed in a particular area of a utility's service territory, it

is less likely that obvious, measurable benefits will accrue from the standpoint of avoided distribution system costs. This is not to say that such benefits are non-existent. The benefits depend on the types and modes of operation of the DG units and on qualities of each distribution circuit. Lovins et al. (2002, pp. 107-274) identify many sources of potential value in the realms of utility system planning, construction, and operation. Many of those benefits are difficult to model and quantify, however, compared to the relative ease of calculating the value of a population of DG in supporting a broad portfolio of generating resources. Plus, the detailed modeling of utility costs by substation and distribution circuit has not frequently been available for review by anyone outside of the utility's own operational staff.

As DG installations proliferate, however (along with other customer options for load management, demand-response, energy efficiency, and so forth), commissions might consider working with utilities to make sure relevant information is being analyzed on a location-specific basis. There are always likely to be some particular locations where DG could combine with other distributed energy resources to help defer or avoid needed distribution system upgrades. Commissions might ensure that the analysis by location is made publicly available, helping customers and developers to know where on the utility system distributed resources can reduce costs and conversely where it could be expensive for the utility system to install DG. Commissions might also bear in mind the capabilities of advanced metering infrastructure, as noted by Kassakian and Schmalensee (2011, p. 191-92), for gathering detailed locational, time-of-use, and time-of-production data for customers with on-site DG systems. As Hurd (2009, p. 956) proposes, once sufficient distributed resources exist on some individual circuits, "standby rate structures can be re-assessed in light of the new benefits." Smarter-grid implementation provides opportunities for such assessments to be conducted at low incremental cost.

If enough of these resources are concentrated in specific locations, then benefits will accrue in terms of avoided costs throughout the utility system, including distribution, transmission, and generation. Part of the impetus for FERC Order 1000 is to make sure that utility transmission planning takes into account the geographic distribution of resources, and the potential ability of options like load management, demand-response, energy efficiency, and DG to produce and deliver cost-effective non-transmission alternatives.[36] Thus, states might usefully consider how the planning requirements under FERC Order 1000 could create opportunities for utilities to gather and make public more detailed information about the costs and benefits associated with specific distributed resources in specific locations, which would also be useful for evaluating standby tariffs.

Relying on accurate aggregated data about DG customers' locations and the timing of their energy usage, on-site production, and use of standby resources, a thorough evaluation of standby charges can be completed. Such studies could then be informed by data about the costs associated with the utility services caused by the class(es) of partial-requirements customers, and the benefits, if any, that their DG operations provide to the utility system. As standby rate

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[36] *See* http://www.ferc.gov/industries/electric/indus-act/trans-plan.asp, http://www.ferc.gov/whats-new/comm-meet/2011/072111/E-6.pdf, and http://www.ferc.gov/EventCalendar/Files/20111109080800-MIT_Afternoon_Class_Lecture_11-4-11.pdf. Related issues are also discussed in Stanton, 2012.

experience grows and evaluations produce useful information about DG costs and benefits, model tariff principles can be identified for states with each major type of market structure (e.g., vertically-integrated regulated monopoly states, versus restructured states with competitive service options, both with and without access to RTOs).

## VI. Conclusions

Standby rates are only one factor that enters into considerations about DG investments. Customers will consider the entire economic picture, including all financial incentives; financing costs; their avoided cost of energy and capacity; DG system reliability, including warranty provisions and performance guarantees; environmental costs and benefits, including compliance with environmental regulations; and any other specific benefits, such as increased reliability and improved power quality, that the customer associates with the production and use of on-site generation. However, there is at least anecdotal evidence that in many locations in the U.S. standby rates are at least one of the deciding factors in DG deployment decisions. Excessive standby charges can have a chilling effect, deterring DG system developers from focusing efforts in those areas and discouraging customers from investigating DG options.

As outlined at the beginning of this paper, there are several reasons why the time is now ripe to reconsider and refine standby rates and their associated pricing structures. These include: (a) new and pending environmental regulations that are likely to increase the value of certain DG technologies; (b) smarter-grid infrastructure deployment that should simplify the collection of data necessary to evaluate standby rates; (c) the low price of natural gas; and (d) technological improvements and cost reductions that are making DG simultaneously more attractive to more customers and more capable of producing and delivering low-cost utility system benefits. There is also an added impetus in markets where ancillary services markets can add value to DG operations.

In addition, an array of federal, state, and sometimes local government incentives are presently increasing market attention to many selected DG technologies. Colatat (2009, p. 141) urges caution in applying learning-curve and technological-evolution principles indiscriminately, however. He recommends close attention to a variety of market dynamics, because, he says, "[I]t helps to focus...attention on more surgical interventions and provides alternatives to brute force intervention like offering larger and larger incentives." From this perspective, it is important for commissions to make sure that standby rates do not produce unintended subsidies. Commissions can also, at least to some extent, help ensure—either through direct commission action or by helping to inform other policy makers—that other market incentives are carefully targeted to produce the best long-term results for system efficiency and reliability.

Thornton and Monroy (2011, p. 4816) hold out California as a "role model" for solving problems and reducing barriers to DG. As these researchers note, California has developed a DG strategic plan (Tomashefsky, Marks, and Larson, 2002). California also provides a comprehensive on-line Distributed Energy Resource Guide,[37] where, Thornton and Monroy (2011, p. 4817) note,

> potential DG operators can find information on everything related to DG in California, including technology, research, example installations, economics analysis, state incentives, interconnection standards, permitting requirements, regulatory activity, and strategic planning.

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[37] *See* http://www.energy.ca.gov/distgen/

Taken as a whole, this all means the time is ripe to reconsider standby rates and refine them as necessary, so that they do not inadvertently either restrict the growth of cost-effective DG or promote uneconomic bypass. Setting accurate standby rates will play a supporting role in ongoing efforts towards the low-cost provision of safe and reliable electricity for all customers.

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# Rate Structures for Customers With Onsite Generation: Practice and Innovation

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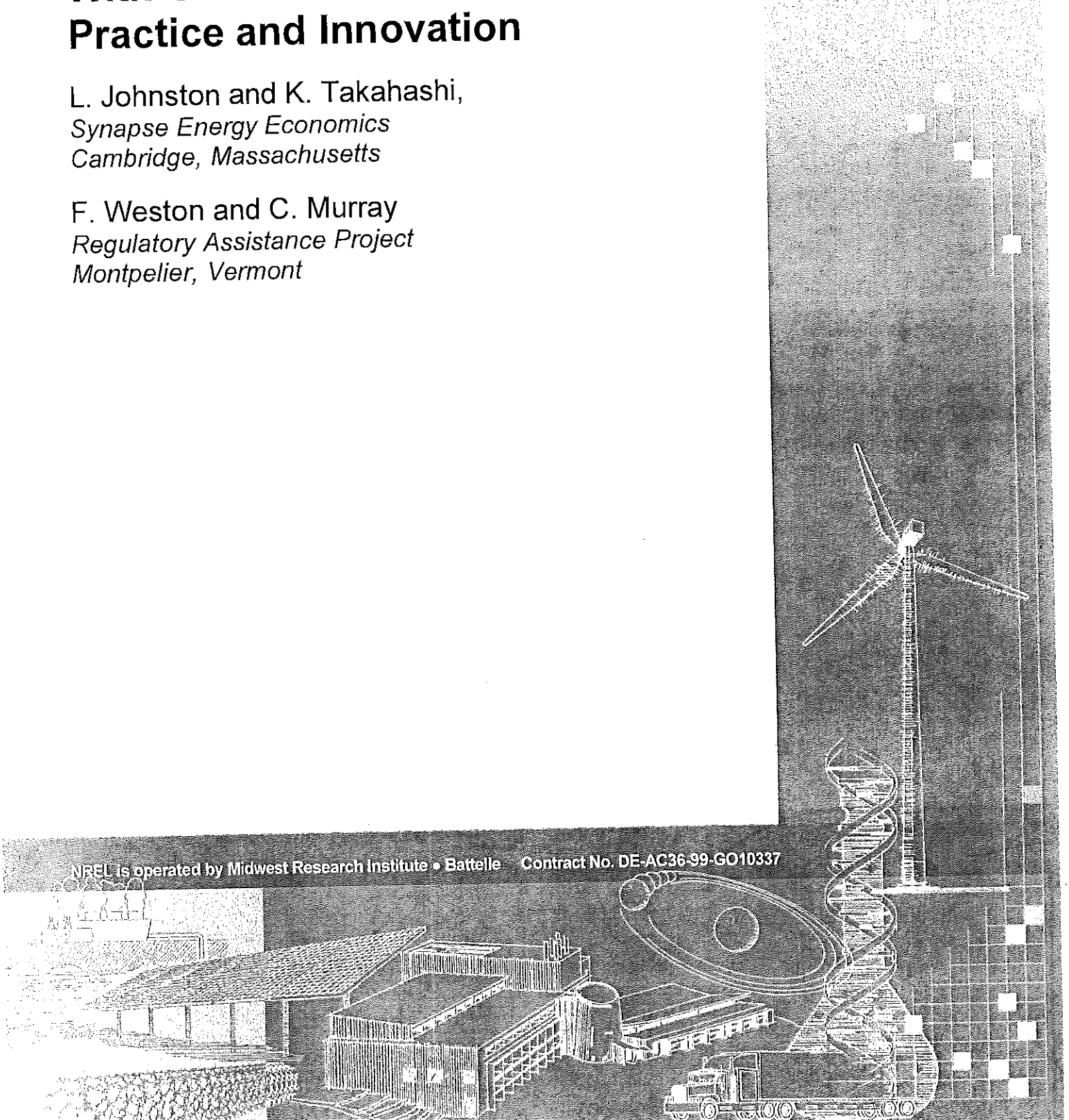

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## Executive Summary

In the late 1990s, widespread publicity surrounded the commercial introduction of microturbines, and new market developments appeared likely to vastly increase the deployment of distributed generation (DG). In this environment, state and federal policymakers began to address the challenges that were preventing DG from becoming an integral part of the traditional transmission and distribution grid. The expectation was that more and more commercial and industrial users of electricity would use onsite generation, often in combined heat and power configurations. Although the actual scale of DG deployment has not met these hopes—and current natural gas prices are making the future more uncertain—there have been significant increases in DG installations in the past decade.

Customers with onsite generation typically remain connected with the grid to meet electrical needs that exceed the capacity of their DG facilities and to ensure, through diversity of supply, the reliability of their electric service in the event that their units are not available because of maintenance or some other reason. Grid-supplied service to these "partial requirements" customers comes in many forms—standby (or backup), scheduled maintenance, and supplemental—and, as the deployment of DG systems has increased, the urgency of resolving the difficult questions about their rates and rate structures has become more acute.[1]

What does it cost the electric system to provide standby service for partial-requirements customers, and how should these costs be recovered? What are the benefits of DG to the system? How should standby rates be designed to reflect these benefits and encourage customers to maximize the value of DG for themselves and the system? The decisions made today will have long-term strategic consequences.

California and a handful of other states have begun, as part of broader efforts to diversify and improve the efficiency and environmental performance of their electric systems, to develop ratemaking policies for standby service for customers with onsite DG. Recognizing that innovation and good public policy do not always proclaim themselves, Synapse Energy Economics and the Regulatory Assistance Project, under a contract with the California Energy Commission (CEC) and the National Renewable Energy Laboratory (NREL), undertook a survey of state policies on rates for partial-requirements customers.

[1] Historically, customer-sited generation was usually big enough to warrant special regulatory consideration (rules or tariffs for multi-megawatt cogeneration or "qualifying facilities" under the Public Utilities Regulatory Policy Act proceedings) or special contracts (sometimes combined with economic development rates), or alternatively, it was small and rare enough to be ignored. However, technological advances have begun to change the markets for DG and, as the potential for deployment grows, the DG industry, customers, and regulators are looking for new policy tools to facilitate this transformation.

The survey investigated a dozen or so states. These varied both in geography and the structures of their electric industries. By reviewing regulatory proceedings, tariffs, publications, and interviews, the researchers identified a number of approaches to standby and associated rates—many promising but some that are perhaps not—that deserve policymakers' attention if they are to promote the deployment of cost-effective DG in their states.

The final judgments, however, are more limited. The researchers did not examine the cost bases of the rate structures. (Indeed, in most cases, there were none). Also, they did not test the cost-effectiveness of hypothetical DG installations against different tariffs; this was beyond the scope of this work. Even so, important findings and insights can be drawn from the survey.

Among the key findings are:

- An array of rate-related options is available to states, and is under development by states, that are pursuing DG as a resource in the electric system.
- States have implemented a variety of approaches for determining an individual customer's load for standby rates, developing service offerings that permit customers to choose service appropriate to their circumstances, incorporating analysis of diversity and probability in cost allocation, and creating DG performance incentives that align rates with cost causation.
- States may consider a "policy overlay," in which state policy goals are allowed to shape rate treatment. In this vein, states can use performance-based revenue cap regulation to break the link between a utility's profitability and volumetric sales and thus avoid a financial disincentive to enable customer-sited DG.
- States can, and have, adopted exemptions from standby rates as well as incentives to encourage DG deployment.
- Options for further development include increasing the proportion of costs collected through volumetric rates in recognition of the long-term volumetric nature of costs that appear fixed in the short-term (such as some infrastructure costs) and developing favorable treatment for DG resources that meet threshold environmental criteria. Many states have explicit policy goals of fostering customer-sited DG as an integral part of a customer's electricity service.
- States justify their policy goals through the individual customer benefits of having DG as a viable service choice and anticipated system benefits of a proliferation of customer-sited DG installations.
- Unfortunately, the available data and analysis of costs, system benefits, and power system integration details make the development of standby service options and associated rates difficult and somewhat rough when compared with earlier visions of an electric sector transformed through the integration of distributed resources.

- Fortunately, utilities, customers, the private sector, and policymakers are gaining valuable experience and undertaking an array of research projects that will permit an increasingly sophisticated approach to developing standby rates for customers with onsite DG. California is one of the leaders—both in the development of regulatory policy to integrate DG and other distributed energy resources as components of the electric system and in research that will inform improvements in rate treatment and other policies.
- Developing innovative ratemaking for customers with onsite DG will require further exploration, evaluation, and understanding of cost causation issues and policy overlays. DG customers, utilities, and other stakeholders will benefit immensely from coordination among state policies to reduce policy conflicts, confusion, and costs.

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## Introduction

Distributed generation (DG) has become a focus of technological and policy innovation over the past decade. Included within the broader category of distributed energy resources (DER), which includes combined heat and power (CHP) technologies, DG is "modular electric generation or storage located near the point of use."[2]

DG is now widely regarded as an important, though relatively small, component of the nation's electric system. Customers view it as a means to otherwise unattainable reliability and as a cost-reducing and efficiency-enhancing energy resource. System operators are increasingly seeking to integrate DG for its real-time operation and reliability properties. Distribution utilities see it, in certain instances, as a meaningful alternative to new investment in poles and wires. Advocates tout its environmental attributes. And many policymakers speak of it as an essential element of a diversified, resilient, and least-cost electric portfolio.

However, as is the case for all popular new ideas, the achievement of such benefits can be difficult and is often contingent on circumstances. Against these expectations for DG are arrayed real challenges that belie the promise and raise costs. These challenges include interconnection and interoperability with the grid, emissions, safety, and (of interest here) the availability and cost of grid-supplied power.

DG can provide real benefits to the electric system, but capturing those benefits depends, in some measure, on appropriate policy treatment by utility and environmental regulators—treatment that deals with grid interconnection requirements, dispatch rules, siting, emissions standards, and equally importantly, the rates of standby (or backup) services desired by DG owners.[3]

A good deal of work has already been done at the state and national levels to address the interconnection, emissions, and wholesale market issues concerning DG. In several states, attention has now turned to the question of standby service—how pricing can encourage or discourage deployment of clean DG resources and what policy options are available to satisfy the sometimes competing objectives of, among others, fairness, revenue sufficiency, and promotion of environmentally sustainable DG systems throughout the US electric grid.

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2 Department of Energy (DOE) definition found at http://www.eren.doe.gov/distributedpower/whatis_main.html in 2002:

> Distributed systems include biomass-based generators, combustion turbines, concentrating solar power and photovoltaic systems, fuel cells, wind turbines, microturbines, engines/generator sets, and storage and control technologies. Distributed resources can either be grid-connected or operate independently of the grid. Those connected to the grid are typically interfaced at the distribution system. In contrast to large, central-station power plants, distributed power systems typically range from less than a kilowatt (kW) to tens of megawatts (MW) in size.

3 In this report, the term *distributed generation* and its acronym, *DG*, mean all customer-sited, non-emergency generation, whether configured in a CHP mode or not.

On behalf of the California Energy Commission (CEC) and under a contract with the National Renewable Energy Laboratory (NREL), Synapse Energy Economics and the Regulatory Assistance Project surveyed state policies on standby rates for customer-sited DG systems.[4] The purpose of this study is to identify the suite of ratemaking policies that will best support the deployment of clean DG systems when balanced against other legitimate objectives—such as equity, economic efficiency, and cost recovery—of setting utility rates. The study constitutes one element of research under the CEC Distributed Energy Resources Integration Program.

## 1.1. Key Questions for the Project

This study, though intended to inform discussion of DG ratemaking throughout the country, is driven in large part from ongoing work in California. The California 2003 Energy Action Plan (EAP) stated that it developed an approach sensitive to the implications of energy policy on global climate change and the environment generally.[5] One of the six goals of the plan was to promote customer- and utility-owned DG. The plan stated that DG could enhance reliability and provide high-quality power and that the state was promoting and encouraging clean and renewable customer- and utility-owned DG.

Some of the tasks for DG development included:

- Promoting small, clean DG at load centers
- Determining how to hold DG customers responsible for costs associated with power purchases by the Department of Water Resources
- Determining the system benefits of DG and related costs
- Enabling DG participation in the renewable portfolio standard
- Standardizing DG definitions across agencies to promote coordination
- Collaborating with the California Air Resources Board to integrate air quality and energy policies.

California's Energy Action Plan II, adopted in October 2005, identifies the DG-related achievements and efforts in progress resulting from the implementation of the first EAP.[6] It also contains additional DG-related goals that build on the efforts of 2003.

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4 This study does not address net-metering policies. A great deal of attention has already been given to net-metering arrangements, and they are in place in many states. The resources of this project are dedicated to enhancing the understanding of standby rate policies, which are not as pervasive.

5 The EAP was adopted in April and May of 2003. California Public Utilities Commission commissioners Lynch and Wood did not sign the EAP because they believed it reached conclusions that should more appropriately be reached through regulatory proceedings. The EAP was a collaborative effort among the CEC, the California Public Utilities Commission, and the now-dissolved Consumer Power and Conservation Financing Authority.

6 California Public Utilities Commission and California Energy Commission, *Energy Action Plan II: Implementation Roadmap for Energy Policies*, October 2005.

In its Order Instituting Rulemaking Regarding Policies, Procedures, and Incentives for Distributed Generation and Distributed Energy Resources (R.04-03-017), the California Public Utilities Commission (CPUC) identified other issues. Among them are questions pertaining to:

- The temporal and geographic characteristics of DG and how best to reflect those in rates
- The quantification of costs and benefits of DG
- Appropriate rate design
- Consistency with other state policies.

In more detail, the CPUC is striving to answer questions such as:

- Are there examples of cost-benefit methods that are informative?
- Do other states use avoided-cost determinations for energy efficiency in DG cost-benefit analysis?
- What positive and negative aspects of DG additions need to be monetized?
- Are there specific approaches to DG and net metering cost-benefit analyses that could be informative to California?
- How can standby rates reflect and incorporate temporal and geographic characteristics of DG?
- Can standby rates provide aggressive energy peak demand reduction? If so, how?
- Are there examples of tariffs that provide recognition of, and compensation for, distribution deferral?
- How can rates and tariffs reflect reduced grid use by DG customers?
- Are standby charges and reserve requirements properly assessed and applied to DG projects?
- Have other states established separate customer classes to encompass DG installations and contain net costs and benefits within each class?
- Could tariffs or rates be crafted to provide better retail price transparency to DG? Could participation costs be reduced? Could the full range of DG participate?
- What are practices regarding metering requirements?
- How can standby rates be aligned with air quality and environmental goals?

Although these questions are far broader than the limited focus of this paper, many served as the basis for questions pursued in the survey and interviews.

## 1.2. Study Methods

This report is based on a series of state surveys and interviews conducted during the second half of 2004 and the first half of 2005. The researchers began by surveying a sample of states that are diverse in geography and electric sector structure and varied in their approaches to DG and rate design. In particular, they looked at states that have conducted or begun regulatory proceedings on DG rate policies in which the full range of issues were or are under consideration and also at states that, by not taking action, have, in effect, adopted *de facto* policies worthy of examination (for their virtues as well as their vices). It was beyond the scope of this work to survey the standby rates and policies of every state, or even most states, in the union.

The researchers reviewed regulatory decisions, tariffs, legislation, and other policy documents in Arizona, California, Indiana, Massachusetts, Minnesota, New York, Oregon, Rhode Island, Texas, and Vermont. Those with ongoing or completed DG ratemaking proceedings are New York, Texas, California, Massachusetts, and Minnesota. Others are examining ratemaking issues in one way or another but not in a general proceeding. This group consists of Oregon, Rhode Island, Vermont, Arizona, and Indiana. In most cases, the researchers found a tariff element or methodological approach to the rates that was of particular interest—an intriguing new twist on an older theme. In one or two instances, they came across features that caught their attention for their apparent antagonism to customer-sited resources and thus warranted a closer look. In all cases, what they discovered gave them a greater appreciation for the complexity of the issue.

The surveys provided an understanding of the status of ratemaking treatment for DG and enabled the researchers to identify important issues and various policy responses to them. They followed the surveys with interviews of more than 30 people with professional interest in the issue. These included staff of public utilities commissions (PUCs), DG developers, and engine manufacturers as well as utility officials, representatives of trade organizations, advocates, consultants, and other experts from across the country. They found general agreement on the benefits and opportunities for customer-sited generation but, in the details, a diversity of opinion that, in some respects, does not seem capable of being reconciled. Like most controversies in the electric industry, the debate centers on the essential questions of costs, benefits, cost allocation, and the structure of prices.

## 2. Current Rate Design Practices for Partial-Requirements Customers

With the installation of onsite generation, a customer will rarely go entirely "off grid." Grid-supplied power retains value in a number of ways. For example, in a typical installation, the DG is sized to serve less than the total load at the customer site. A facility with an average load of 25 kW that installs a 10-kW DG system to provide higher-reliability service for "critical" loads will require 15 kW in addition. But even a facility with onsite capacity sufficient to meet all of its demand will want or need to take power from the grid at times.

This may be done to:

- Serve needs in excess of that supplied by the DG system on average, to meet short-term or seasonal peaks, or, in certain cases, to serve the momentary need for increased power associated with DG start-up
- Supply power during scheduled outages of the DG system, most often for maintenance
- Supply power during unscheduled outages because of equipment failure, loss of fuel supplies, or other problems
- Purchase power at prices below the operating cost of the DG system, typically during off-peak periods when the local system is in surplus.

The term *standby rate* is often used as shorthand for the full set of retail products that customers with onsite, non-emergency generation (whom this paper refers to as "partial-requirements customers") typically desire. Reasonable and nondiscriminatory standby rates for certain customers were first required under the Public Utilities Regulatory Policy Act of 1978. Most of the states reviewed for this report (e.g., utilities in Minnesota, Texas, Arizona, and Indiana) distinguish among three types of service in their tariffs: supplemental, backup, and maintenance. Some tariffs (e.g., those of Narragansett Electric in Rhode Island and Tucson Electric Power in Arizona) differentiate only between backup/standby service and supplemental service.

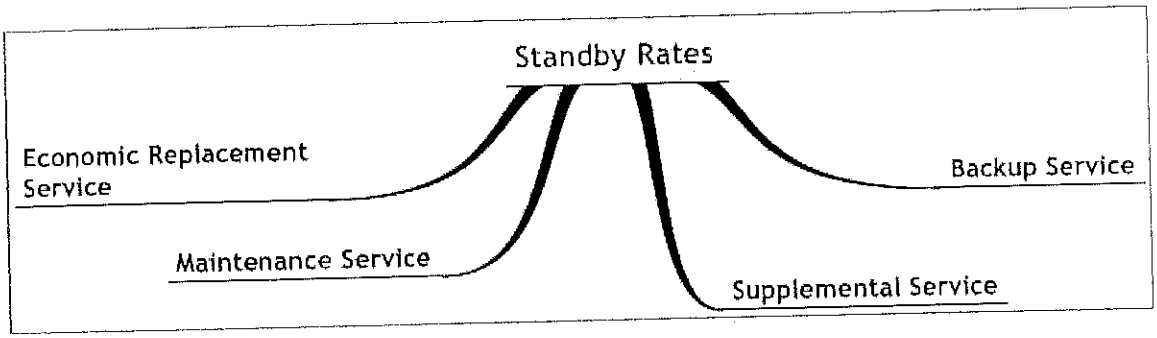


**Figure 1. Basic services for partial-requirements customers**

The following are the basic services for partial-requirements customers as defined in this report:

1. Backup service
   Backup service, also called "standby service," serves a customer load that would otherwise be served by onsite generation during unscheduled outages of the onsite generation.
2. Supplemental service
   Supplemental service is for customers whose onsite generation does not meet all of their needs. In most cases (and as in Oregon), it is provided under the otherwise-applicable full requirements tariff.
3. Scheduled maintenance service
   Scheduled maintenance service is taken when a customer's onsite generation is due to be out of service for checkup and repair. In general, because this service can be scheduled for non-peak times, it is deemed to impose few marginal costs on the utility's system, so tariffs are typically structured to exempt the customer from capacity-related costs (e.g., reservation charges or ratchets for either generation or delivery).
4. Economic replacement power
   Some utilities offer economic replacement power, or electricity at times when the cost of producing and delivering it are less than that of the onsite source.

Although not all states, utilities, or tariffs reviewed make these distinctions in the same way, these terms do, for the most part, appropriately describe the range of services typically offered.[7]

Electric industry restructuring and the unbundling of the system has, in some states, added a complicating layer to rate design. Whereas the prices of vertically integrated utilities often are all-inclusive of generation, transmission, and distribution charges, the separation of these functions in restructured states has led to the parallel separation of charges for them. This can cause confusion when comparing different rate elements and, in particular, their ratchet elements and exemptions.

## 2.1. Costs of Partial-Requirements Service

PUCs and electric companies approach partial-requirements service in much the same way as they do full service. That is, standby tariffs typically reflect the traditional function and allocation of costs according to their relationship to changes in demand for energy and capacity. The costs that a partial-requirements customer imposes on the system are described, for the most part, along the same dimensions and in the same terms as the costs that any other customer might cause. These are (1) generation, transmission, distribution, and customer and (2) fixed and variable, dedicated and shared, and embedded and marginal costs.

[7] Customers with onsite generation intended only for use in the event of an electric system interruption or failure are full-requirements customers and, for rate design purposes, are treated no differently than customers without onsite generation. Consequently, customers with emergency onsite generation are not a focus of this report.

Interestingly, little detailed analysis has been performed on the nature and types of costs imposed on the grid for standby service or on the benefits that DG bestows in return.[8] In fact, the lack of specific cost analysis of the effects of DG installations on distribution systems is emerging as one of the stumbling blocks in the design of DG-specific cost-based standby tariffs. Inferences, of course, can be drawn from the design of tariffs, and one is not surprised to see that the implied characteristics of DG costs are those of the electric system generally. In New York, Massachusetts, and Oregon, utilities used existing cost-of-service studies to determine DG standby rates. The availability, or lack, of specific cost analysis has been cited as a concern in a number of jurisdictions.

### *2.1.1. General Cost Categories*

It bears repeating that electricity is a product that, on the one hand, must be available on demand and, on the other, can only be produced when demanded. Out of the combination of these unusual legal and physical properties flow the complex questions of cost causation that make rate design so vexing at times. At a rarefied level of generalization, the problems and their solutions can be easily described. Partial-requirements customers, like other customers, demand services that require use of the various components of the electric system—generation, transmission, and distribution—and a customer's share of these costs depends on a host of factors, including customer peak demand, coincidence of customer demand with relevant peaks (such as system, transmission, and local facilities), and load factors. Debate arises when discussion turns from the general to the specific: Do—and, if so, how do—the usage characteristics of individual or groups of partial-requirements customers differ from those of other customer classes, and are those differences accompanied by measurably different costs (or costs avoided) that then justify alternative rate treatment?

#### *2.1.1.1. Generation*

Partial-requirements customers call on the grid to supply electricity for a variety of needs, such as during an unscheduled outage of their onsite generation, when their onsite generation has scheduled maintenance performed, and for loads in excess of those served by the onsite facility. This paper is interested primarily in the first instance because it is the unpredictable nature of demand for backup service that creates its cost conundrum. The second and third cases also raise cost questions, but they are, for the most part, less controversially resolved. It is unexpected demand for which the utility (or default service provider or some other entity) must have in reserve some amount of generation capacity, and it is the probability and timing of that demand that determine both the amount and cost of the capacity.

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[8] California is the exception. Cost-of-service analyses by its utilities have returned useful information, and recently, the studies performed under the CEC's Public Interest Energy Research program have revealed significant system benefits from strategically deployed DG. The Massachusetts DG Collaborative will take up issues associated with the costs and benefits of DG installations during the second half of 2005.

The need for generation (and reserves) is causally related to system peak demand, which is the sum of the diversified demands of all customers on a system. It is called *diversified demand* because it may be (and often is) that any one customer's individual peak does not occur at the same time as the system peak. A customer's contribution to the need for generation capacity, therefore, is not defined by his own peak but rather by his demand at the time of system peak, i.e., his "coincident peak." One can imagine that the probabilities of calls for standby service at the time of system peak differ wildly among partial-requirements customers—in the same way that the load profiles of full-requirements customers in a particular rate class differ—but when taken as a whole, they render a usage pattern that is, for the utility, both predictable and manageable.

#### *2.1.1.2. Transmission*

Transmission serves a variety of needs. Like generation, it is configured to reliably serve overall system peak. Ideally, the system is designed to do so in the most economic manner possible and to assure that electricity can flow from generators to loads, meet minimum reliability standards, and minimize congestion.[9] It has other values as well:

1. It enables system operators to optimize the operations of the grid
2. It facilitates bulk transactions that lower overall power costs
3. In dedicated deployments, it connects remote generation to demand.[10]

Although for ratemaking purposes, transmission might bear a strong resemblance to generation (its capacity is driven by peak demand, but it also serves energy needs), in reality, it is often priced in ways that do not fully reflect its cost drivers (e.g., postage-stamp pricing that does not account for congestion). Typically, transmission costs are included in the delivered price of generation and, thus, in retail prices, are covered in the charges for generation capacity and energy.

#### *2.1.1.3. Distribution*

Regulatory and utility practice has traditionally seen distribution investment as driven by two causes: customers and demand. Customer-related costs are those incurred to serve individual customers—for example, the costs of meters, service drops, and some transformers (even whole substations for large customers)—and are either shared among them (as a function of numbers of customers in each class) or allocated to each directly. Costs incurred to meet peaks loads—where and when they occur can vary wildly across the lower-voltage network—are deemed demand-related and are allocated according to customers' contribution.

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9 Implicit here is the recognition that transmission needs, like those of generation and distribution, can be met in a variety of ways. The least-cost solution to a transmission problem might not be to string additional wires but rather to invest in end-use energy efficiency, DG, or other forms of demand response. Under certain circumstances, the various components of the electric system can act as substitutes for one another. See Brown, M., and Sedano, R. "Electricity Transmission: A Primer." National Council on Electricity Policy, www.ncouncil.org. Denver. National Conference of State Legislatures, June 2004. In rate design, then, it is an asset's function, not its form, that determines how its costs are categorized and allocated.

10 National Association of Electric Utility Commissioners. *Electric Utility Cost Allocation Manual.* Washington, DC: January 1992; pp. 69–85, 127–135.

There are two general types of demand-related distribution costs: local (or "dedicated") and shared. Local facilities costs are attributed exclusively or nearly exclusively to a single customer, and shared facilities costs are those costs incurred to meet the coincident peak demand of customers on a particular part of the system. The determination of whether particular facilities are dedicated or shared—and, if shared, the appropriate allocations of costs among customers—is critical to the setting of rates for both full- and partial-requirements customers. The allocations could, conceivably, vary from circuit to circuit. Although these are demand-related costs, they are not related to system demand, and consequently, customer class non-coincident peaks and individual customer maximum demands are typically used to allocate them. The weightings of the allocation factors are affected by the diversity of customer loads on the nearby circuits and facilities; as one moves closer to an individual customer, diversity in customer load diminishes and costs can be more directly assigned to each customer.[11] It is in these allocations that challenge and controversy lie.[12]

### 2.1.2. Types of Costs

#### 2.1.2.1. Fixed and Variable Costs

Fixed costs do not—in the short run, at least—vary with demand.[13] In standby tariffs, these appear in fixed, recurring customer charges and sometimes in local facilities charges and reservation fees. Monthly (or daily) customer charges cover the costs of facilities and services—e.g., line extensions (or drops), meters, and account administration—that are dedicated to the customer only and whose need and size are not linked to variations in usage (although these naturally affect the original sizing of facilities).

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11 National Association of Regulatory Utility Commissioners. *Electric Utility Cost Allocation Manual.* pp. 86–101, 136–146.

12 Not surprisingly, determining the allocation between these two costs for standby rates was one of the most controversial issues among stakeholders in New York. Utilities in New York established a contract demand charge for local facilities costs and an on-peak, daily as-used demand charge for shared facilities costs. More specifically, a contract demand charge in New York is based on a customer's potential maximum electric load, which is typically determined by the utility and set yearly. The as-used demand charge is charged during daytime (e.g., from 8 a.m. to 10 p.m.) and for the daily standby service demand (kW) a customer uses.

13 Whether a cost is fixed is, for economists, a debate over the distinction between the short run (in which productive capacity cannot be altered) and the long run (in which all factors of production are variable). The arguments in favor of pricing electric utility services to reflect the long-term cost characteristics of the system are, in the authors' view, persuasive. See:

- Bonbright, J.C. *Principles of Public Utility Rates.* Public Utilities Reports Inc. New York: Columbia University Press, 1960; pp. 300–304, 317–336, 396.
- Boiteaux, M. "Peak-Load Pricing." *Journal of Business of the University of Chicago*; Vol. 30, 1960 (translated by H.W. Izzard); p. 165–167. (This is an update of the author's earlier paper "La Tarification des demandes en pointe: application de la théorie de la vente au coût marginal." *Revue générale de l'électricité* ; Vol.58, 1949.)
- Kahn, A.E. *The Economics of Regulation*, Vol. I. Cambridge, MA: The MIT Press, 1988; pp. 71–87.
- Bonbright, J.C.; Danielsen, A.L.; Kamerschen, D.R. *Principles of Public Utility Rates.* Arlington, VA: Public Utilities Reports Inc., 1988; pp. 467–468.

That said, the long-standing tradition in utility rate-making that treats certain minimum customer costs as, in essence, fixed and unavoidable has a practical appeal that will not be challenged here.

The variable costs of standby service are, as they are for fully tariffed service, energy- and demand-related. Ultimately, customers demand electricity to provide end-user services—such as lighting, refrigeration, cooling, and information processing—that they value. In this context, demand for electricity can be seen as driven altogether by the need for energy because it is kilowatt-hours, not kilowatts, that animate their end-uses. However, energy-producing and energy-transporting facilities are sized to meet peak coincident demand on the relevant system, and a customer's contribution to that peak can be measured and billed.[14]

Local facilities charges cover the costs of those components of the distribution and, in certain cases, transmission network that, but for the customer, would be unnecessary. Rates for shared facilities (if differentiated from local) pay for those portions of the distribution system that serve multiple customers and whose sizing reflects load diversity on the system. Both costs, as described above, are largely driven by peak demand (of individuals and groups) and, thus, are usually allocated on a per-kilowatt basis. Because demand is variable, a customer's contribution to peak is variable. However, once built, local and shared facilities are, for the most part, fixed and long-lived. In this, rate-making confronts at once the problem of historic ("embedded") cost recovery and economically efficient pricing because, in most cases, both the short- and long-run costs of new distribution investment are likely to be less than the historic costs.[15] Determining the share of these costs allocable to DG customers and the degree to which those costs are avoidable—i.e., How does the presence of onsite generation change, if at all, the cost-causative properties of the customer's need for shared local facilities?—is among the more challenging aspects of setting standby rates.

The demand for generation and transmission capacity is likewise variable, and these services are allocated and traded on a per-kilowatt basis. To what degree has the utility incurred capacity costs to serve the partial-requirements customer? How do the diversity of overall demand on the system and the probability of a call for standby service affect cost allocation?

#### *2.1.2.2. Incremental and Embedded Costs*

There is no need to revisit the arguments that favor, or disfavor, incremental cost-based or market-based pricing structures to embedded-cost ones. The long history of utility case law and ratemaking practice in this country has, more or less, settled the issue. Simply put, providers of monopoly utility services are to be given a reasonable opportunity to recover their investments dedicated to public service and to earn a fair rate of return on those investments.

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[14] As a practical matter of metering and rate design, the customer's non-coincident peak demand typically is measured and billed. To the extent that the class average customer's usage corresponds to the overall system load profile, this approach to pricing is effective. As metering and billing technologies advance, new approaches, such as critical peak and real-time pricing, can provide more economically efficient prices (notwithstanding external costs).

[15] In the absence of capacity constraints (an important caveat), short-run marginal distribution costs are close to zero. In the long run, marginal costs will depend on growth on the circuit and the timing of replacement of existing facilities. (The farther into the future the costs are expected to be incurred, the more they are discounted in today's dollars.)

For ratemaking, this has been interpreted as requiring that prices be sufficient to cover the prudent historic, or embedded, costs of service.[16] This prerequisite, however, has not constrained rate design to average cost prices, and much of the second half of the 20th century has been marked by regulatory and utility endeavors to develop rate structures that reflect marginal costs for marginal consumption while prices for customers' less elastic demand are adjusted to ensure against over- or under-collection of the embedded cost of service. In standby rates, this often manifests itself in embedded cost pricing for the fixed-cost components of service and some manner of marginal cost pricing (e.g., seasonal or time-of-use, in the short or long run) for the variable. There is, of course, no hard-and-fast rule about this.

## 2.2. Basic Elements of Rate Design

In their general characteristics, the rates for partial-requirements customers look the same as those for full-requirements customers. The same components of the network provide the two services, so standby and related rates are typically broken out along the traditional lines suggested by the preceding discussion. There are fixed, recurring customer charges; demand charges for capacity (generation, transmission, and distribution, bundled or unbundled) that may or may not vary with demand; and energy charges for the actual amounts of electricity purchased.[17] The following subsections provide a general description of the components of rates and rate design.

### *2.2.1. Customer Charges*

Customer charges are monthly or daily fixed, recurring charges that are typically intended to recover the costs of metering, billing, and service drop facilities and which must be paid regardless of whether any electric service is taken. In this sense, they can be seen as a kind of access fee.

### *2.2.2. Demand Charges*

As described above, the electric system is designed to meet a variety of peak loads: that of the system as a whole, those of customers served by discrete parts of the network, and those of individual customers. The costs of capacity can be included in per-kilowatt-hour energy charges, as they often are for lower-volume residential and small commercial consumers. But for larger-volume users, standard practice is to separate the charges for capacity and energy.

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16 State utility regulators today rely on the historic (accounting) costs of investments, rather than their market value, to calculate utility rate bases (i.e., assets for the provision of the public service) for a variety of reasons, such as the reliability of the numbers, the stability of the resultant prices, and the difficulty of determining the market value of the assets. Regulators are not, however, required to approach rate base valuation in this manner. If there are alternative approaches that yield a better end result, they are acceptable under the law. *Federal Power Commission v. Hope Natural Gas Co.*, 320 U.S. 591 (1944) and *Duquesne Light Company v. Barasch*, 488 U.S. 299 (1989).

17 This discussion operates on the assumption that partial-requirements customers have, by and large, demands of sufficient size to warrant, or require, the taking of service under differentiated demand and energy rates (sometimes referred to as "two-part rates") rather than under all-inclusive energy rates (as most low-volume residential and small commercial customers do). In their surveys, the researchers did not find any one-part standby rates.

Capacity, or demand, charges are a means of allocating and recovering the costs of the capacity, measured in kilowatts, to serve those peaks. They are deemed to give the larger users stronger incentives to manage their peak demand most efficiently and thus minimize the investment in fixed facilities that the utility must make on their behalf. Given that such facilities are long-lived and unvarying with demand for energy in the short run, capacity charges are often "ratcheted" by some multiplier of customer peak demand for a specified number of months after the incurrence of that peak.[18]

Ratchets have the effect of turning a fee (the product of the rate and monthly peak) that would otherwise vary with changes in demand into something more of a fixed charge that locks a customer into a minimum monthly payment for the duration of the ratchet. Although there is a certain logic behind ratchets (i.e., the linking of customer charges to the longer-term nature of the capacity obligations incurred by the utility), they can constitute financial barriers for customers that seek alternative and more efficient means of meeting their energy needs.

#### *2.2.2.1. Distribution*

Distribution system investment is driven by a combination of factors. For dedicated facilities, it is a customer's non-coincident peak demand, and for shared facilities, it is the coincident peak demand of the customers served. Although the costs are separable, they are typically combined within one demand charge (or set of charges) for distribution service and priced on a per-kilowatt-month basis. Simplicity is one reason for this. The lack of a metering and data management capability that measures both customer coincident and non-coincident peaks on discrete sections of the distribution system is another. A third reason is that, although the occurrence of coincident peaks is highly variable, for the purposes of distribution planning and investment, timing is less important than magnitude.

The distribution demand charge is multiplied by the customer's billing demand, which is one (or some variation) of several quantities: the customer's monthly non-coincident peak demand, its maximum potential demand, or an agreed-upon contract demand (usually accompanied by the customer's promise not to exceed it). Not all utilities offer these options; each has its own approach.

It is in the computation of rates that the art and science of rate design combine. Dedicated facilities must be sized to serve the maximum demand a customer will impose, and non-coincident demand (or contract or maximum potential) is the appropriate measure for this. Costs for the facilities can be expressed on a unit (per-kilowatt) basis, which for all intents and purposes will comprise this portion of the distribution rate. However, when it comes to shared facilities, this measure is, at best, a proxy for the customer's contribution to coincident demand. Customer class load data will reveal a generalized relationship between a customer's peak demand and its share of coincident peak, and from this adjustment, factors can be computed and applied to the unitized costs for shared facilities to calculate this part of the overall distribution rate.

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[18] A typical ratchet calls for the customer to be billed, in each of the 11 months following its peak demand, for either 80% of that peak demand or the peak in that month, whichever is greater. If a higher peak occurs, that new demand forms the basis of a new ratchet, which then extends for the following 11 months.

#### 2.2.2.2. *Generation*

Rates for generation are separated into demand and energy charges. Demand charges are designed to recover the costs for capacity that were incurred to serve a customer or, more accurately, a customer class. Because generation needs are driven primarily by system coincident peak, it is a customer's contribution to that coincident peak that should determine its cost responsibility. But, as with distribution, a customer's contribution to coincident peak (in this case, system peak, not local area peak) is neither readily measured nor, for rate design generally, a practical necessity. In designing rates, generation demand charges are adjusted to reflect the relationship of class coincident peak with the average customer's non-coincident peak, so customer bills calculated on the basis of non-coincident peak will cover costs that are, in reality, associated with coincident peak.

Each customer class imposes unique demands on the system, and the tariffs drawn up to reflect these differing characteristics provide, in effect, different services suited to the needs of the classes. Similarly, partial-requirements customers can be seen as a class of customers. Their needs for generation services, at least for that portion of their loads that are served primarily by their onsite generation, differ (presumably) from those of full-requirements customers, and so do the cost impacts. A standard tariff element for standby service is the reservation fee, which ostensibly covers the costs of the capacity that the utility must have entitlements to if it is to cover the call for unscheduled service, even if it is never made. Typically, it is applied against monthly billing demand (contract, maximum potential, or ratcheted) and, therefore, looks very much like a fixed recurring fee that accords a customer the right to take standby service. What matters most under this scheme is the per-kilowatt reservation charge. If it approximates the generation component of the otherwise-applicable full-requirements tariff and makes no provision for the probability that the service will not be needed, it is likely to result in total costs that will render most onsite generation projects uneconomic.[19]

A variation on the reservation charge is a fee for contingency reserves, the amount of operating reserves that must be available to meet load in the event that the customer unexpectedly takes energy from the grid (i.e., when its onsite generation suffers an unscheduled outage). This approach imposes on the customer the same obligation that other load-serving entities have—namely, sufficient operating reserves to cover the load in cases of an unplanned outage of any of the resources serving that load.

#### 2.2.2.3. *Transmission*

In most rate structures, transmission costs are included bundled demand charges or are included in generation demand charges. Some tariffs, such as PGE's (Oregon) partial-requirements service, set separate demand charges for transmission service.[20]

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[19] Whether this will be the case depends on the relationship between the capital and operating costs of the DG system and the demand and energy costs of grid-supplied power.

[20] Transmission charges for PGE's partial-requirements customers are the same as those paid by full-requirements customers.

### 2.2.3. Energy Charges

Energy is priced on a per-kilowatt-hour basis. Full-requirements customers purchase energy at tariffed rates. They may be differentiated by time of use, season, block, or some other means. The same may be true for standby service. More likely, however, are energy rates that are in some manner tied to short-term wholesale market prices. In addition, there may be additions or surcharges to cover related operational costs and risks.

### 2.2.4. Other Charges

A number of other charges may be applicable to partial-requirements customers. They are not the focus of this study, but they should not go unacknowledged, as they may have significant effects on the economics of onsite generation.

#### 2.2.4.1. Interconnection

Interconnecting customers with onsite generation with the grid imposes additional costs. The Texas Interconnection Manual states that all distribution customers shall pay the costs of distribution interconnection, including any needed distribution system upgrades. DG customers may pay for interconnection studies, line extensions, and equipment specific to their installation. In Arizona, Tucson Electric Power requires customers to pay, in advance, the estimated interconnection construction costs. The customer receives a refund of up to 40% of the revenue associated with such facilities for each of the first 5 years of metered use; this is capped at a maximum equal to the advance. The customer must furnish, install, and maintain "incremental non-distribution or non-transmission system" equipment at its own expense. The tariffs also include a provision for the customer to pay incremental interconnection costs if its 15-minute billing demand in a month or its maximum 15-minute billing demand in the previous 23 months exceeds the maximum contract demand, when such billing demand requires the company to expand facilities.[21]

#### 2.2.4.2. Costs of Studies

In several jurisdictions, customers may be charged for studies to determine the effect of their load and generation on the power system. For example, in Minnesota customers are eligible for credits for avoided distributed costs and avoided line losses. However, to receive these credits, a customer must fund a study by the utility to determine whether its load and generation profiles justify the credits. In Texas, the PUC's DG manual states that customers are responsible for the cost of a variety of studies pertaining to DG installations. These study costs can be quite high for a DG owner.

[21] This is, in effect, a severe financial penalty for failing to maintain one's demand below an agreed-on level and worthy of including in a discussion of using contracts and penalties to affect customer peak demand. This is an alternative to physical assurance.

#### 2.2.4.3. *Metering Costs*

States and tariffs have different approaches to metering, but in general, a customer must, at its own cost, install one or more meters that meet specific standards. Tucson Electric Power requires "appropriate interval metering equipment." California utilities also have specific metering requirements for DG customers. For example, PG&E Schedule S includes a time-of-use meter charge, a non-firm meter charge, and a load profile meter charge. New York requires interval metering for customers whose DG is more than 50 kW. The New York Public Service Commission's Standby Rate Guidelines requires interval metering for all customers with contract demands at or more than 50 kW to implement its rate design policy, which includes a daily "as-used demand charge" on the basis of daily customer demand during peak system times.[22]

## 2.3. Features of Tariffs for Partial-Requirements Service

In general, tariffs for standby service differ from their full-requirements equivalents not in general features but rather in the rate levels themselves, their applicability, the means by which they are assessed, and, often, their exemptions.

### *2.3.1. Applicability*

The policies and tariffs reviewed reveal a variety of approaches for determining the characteristics that affect the nature of standby service. Some customer-specific characteristics, such as customer size, affect charges. In addition, some characteristics of the service that the customer requests, such as season and time of use or size of the customer's load for standby service, affect charges.

#### 2.3.1.1. *Customer Size*

Like other tariffs, many DG standby tariffs vary according to the size of the customer. In some instances, customer size determines eligibility for, or exemptions from (see "Exemptions" below), standby service. In Minnesota, the legislature directed the PUC to undertake proceedings to investigate interconnection and tariffs for natural gas-fired or renewable DG up to 10 MW; DG facilities of 60 kW or less are exempt from paying standby charges.[23] Similarly, the Texas PUC restricts interconnection of onsite DG to units 10 MW or less. However, renewable DG that does not export to the grid is considered "energy efficiency;" therefore, customers with renewable DG may avoid interconnection costs that other DG customers would incur. In New York, the standby tariffs of the investor-owned utilities (IOUs) do not apply to either non-demand-metered standby customers or standby customers whose contract demand is less than 50 kW.[24]

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22 New York Public Service Commission. *Opinion No. 01-4, Opinion and Order Approving Guidelines for the Design of Standby Service Rates.* Oct. 26, 2001; p. 9.

23 Minnesota Statute 216B.1611. The commission's order in Docket No. E-999/CI-01-1023 states that backup generation is beyond the scope of the proceeding. "In the Matter of Establishing Generic Standards for Utility Tariffs for Interconnection and Operation of Distributed Generation Facilities under Minnesota Laws 2001, Chapter 212." Sept. 28, 2004. http://www.puc.state.mn.us/docs/orders/04-0131.pdf.

24 Actually, they have the option of taking service under the tariffs or being exempted from them. Presumably, one's choice will depend on whether it is less expensive to take service under the otherwise applicable tariffs, which itself will be a function of the performance characteristics of the onsite facility.

In other instances, a customer's size determines what charges it is assessed, with tariffs reflecting different charges for customers of different sizes. In Indianapolis Power and Light Co.'s territory, large customers must take backup service in increments of 100 kW, with a minimum contracted amount of 500 kW. Smaller customers take backup, maintenance, and supplemental service under their otherwise-applicable tariffs. Indiana Michigan Power Co. (an AEP company) also has minimum contract demands for small and large customers. In Arizona, the tariffs of Tucson Electric Power Co. and Arizona Public Service (APS) recognize three size categories.

#### *2.3.1.2. DG Technologies*

In certain instances, the technology of the onsite generation determines whether rate elements apply to a customer's usage. Regulators and utilities in some states recognize that cleaner, lower-emitting DG technologies, especially renewables, will provide significant public benefits. To encourage use of the preferred technologies or fuels, some states offer special rate treatment, primarily in the form of tariff exemptions. (See the section on exemptions for details.) These policies are usually found in states in which complementary actions in support of renewables (e.g., portfolio standards and system benefits funds) have been taken.

### *2.3.2. Time*

Rates for partial-requirements customers are often differentiated by the timing of demand for service. Demands in seasonal and daily peak periods are accompanied by higher-than-average rates that reflect the time-dependent drivers of the underlying costs.

#### *2.3.2.1. Seasonality*

Some states and utilities assess charges that depend on the season. In its guidelines, the Minnesota PUC states that tariffs should reflect, to the extent practical, seasonal variations in costs. The NSTAR settlement, for example, sets higher distribution demand charges for the summer peak season than for the non-peak period. The same is true for Consolidated Edison (Con Edison) and Orange and Rockland Utilities (O&R) in New York. Con Edison has a standby rate category, the monthly adjustment clause, that adjusts prices for loads on the system in different periods. The monthly adjustment clause is an additional charge per kilowatt during a certain period and is applied to the customer charge, the contract demand charge, and the as-used, daily contract demand charge. O&R does not have a monthly adjustment clause, but it provides seasonally differentiated, as-used, daily contract demand charges. Other utilities, including those in Arizona and California, also vary standby rates by season.

#### *2.3.2.2. Time of Use*

Although some tariffs reflect only seasonal periods, other policies and tariffs include greater specificity as to time of use. In its guidelines, the Minnesota PUC states that tariffs should reflect, to the extent practical, time-of-use variations. APS tariffs have different rates for each season for on-peak and off-peak energy use. Similarly, utilities in California have tariffs that distinguish between peak and off-peak periods (e.g., PG&E's Schedule S). IOUs in New York also have time-differentiated standby rates. New York utilities have an as-used, daily demand charge as one component of standby rates. This charge is applied only to peak hours, which start at 7 a.m. or 8 a.m. and end around 10 p.m. or 11 p.m. Monday through Friday.

### 2.3.3. Service Characteristics

#### 2.3.3.1. Type of Service

As noted at the beginning of this chapter, partial-requirements customers make use, most often, of three types of service: backup, supplemental, and scheduled maintenance. Some utilities add economic replacement power to the menu. Supplemental service is, in most cases, simply electric service provided under the full-requirements tariff that would otherwise apply to the customer. Although for ratemaking it presents the same questions about cost causation and allocation, they are unrelated to the manner and extent to which the customer's onsite generation is operated and therefore do not merit special attention here. Scheduled maintenance, because dispatchable, can be managed to not contribute to the need for capacity and, consequently, can be priced to cover the variable short-run costs of energy and delivery.

The differentiations among these services are, in certain instances, less clear than this brief description suggests. Utilities in Arizona, for example, differentiate between standby and supplemental service not on the basis of the onsite generation's maximum capacity (or some other agreed-upon method of determining what portion of the customer's load is served by the onsite facility) but rather on the basis of the generation's operating characteristics. Tucson Electric Power uses a methodology called the partial-requirements usage percentage to determine, in part, whether a customer takes service under the standby tariff or the supplemental tariff. This method, in effect, ensures that a customer can rely on backup power only for a small number of hours per billing period. Otherwise, the customer must use the higher-cost supplemental service.[25] In contrast, the New York Public Service Commission (PSC) does not distinguish among these categories of service on the grounds that the costs of building and maintaining distribution facilities for standby customers do not differ according to the portion of the customer's load served by DG or whether an outage is scheduled or unscheduled.[26]

Finally, some tariffs set out separate charges for reactive power. Reactive power is the power in electric fields that is developed when transmitting alternating current power, and it affects and is affected by equipment that relies on magnetic fields for the production of induced electric currents (e.g., motors, transformers, pumps, and air conditioning).[27]

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25 The partial-requirements usage percentage is the ratio of backup energy purchased to the product of billing demand for standby service and hours in the billing period. If the partial-requirements usage percentage exceeds 5% in a period, the customer's energy charge is converted to the supplemental service energy charge for all kilowatt-hours in excess of the 5%. APS has a similar standby tariff, which also makes the availability of standby service subject to achievement of a minimum capacity factor (18-month rolling average) for the customer DG of 75%.

26 New York Public Service Commission. *Opinion and Order Approving Guidelines for the Design of Standby Service Rates, Opinion No. 01-4.* Oct. 26, 2001; p. 21–22. Also see the commission's order of July 29, 2003, in cases 02-E-0780 and 02-E-0781, page 21–22 of Attachment A – The Joint Proposal by Con Edison and Orange & Rockland.

27 Brown and Sedano. *Electricity Transmission: A Primer.* pp. 35, 64. For example, New York State Electric and Gas Corp. (NYSE&G) charges standby customers $0.00095 per reactive kilovolt-ampere hours. Niagara Mohawk Power Corp. establishes two different charges ($0.85 for one customer and $1.02 for another customer class) for each chargeable reactive kilovolt-ampere of lagging reactive demand (Service Classification No. 7, Leaf No. 106 and 106A).

#### 2.3.3.2. *Firm and Non-Firm Service*

Some tariffs provide a choice between firm and non-firm (or interruptible) service. In Oregon, if low-cost power is available, PGE is free to offer it to DG customers on an interruptible basis. It is called "economic replacement power," and it is intended to displace onsite generation when it is cost-effective to do so. Such "generation displacement" rates are not uncommon. In Vermont, they are available on a special contract basis; there are, however, no separate standby tariffs for DG owners in the state. Customers with onsite generation take standby service under the applicable full requirements tariffs or, in at least one case, under special contract.

Interruptible economic replacement power is not available for unscheduled standby service, but, in several states at least, there are options for non-firm standby service, which is to say that it will only be provided if it is available (i.e., if it imposes no incremental capacity costs on the supplier). In Minnesota, the PUC guidelines for serving partial-requirements customers provide for different treatment of firm service customers and non-firm service customers. Non-firm service customers do not incur reservation charges for generation capacity or energy or for transmission charges, but there is no discount for distribution services. Firm service customers must pay reservation charges for generation, capacity, transmission, and distribution. In 1985, the Indiana PUC identified interruptible service as one of the service options that utilities should offer customers. The NSTAR settlement in Massachusetts provides a non-firm service option to customers. Terms of interruption are negotiated on a case-by-case basis between the distribution company and the customer.

### 2.3.4. *Critical Tariff Provisions: Billing Determinants*

How the components of a tariff are applied, the mechanics of billing, vary from state to state. Chief among the key tariff provisions are those that determine the level of billing demand because this invariably has the largest effect on a partial-requirements customer's monthly bill. Also important are provisions that offer exemptions and set performance or technology requirements.

#### 2.3.4.1. *Billing Demand*

In some jurisdictions, tariffs contain provisions for setting bounds on the standby service for which a customer may contract rather than simply requiring that a customer's billing demand for standby service be determined by the capacity of its DG installation (on the assumption that it will always, or only, be needed at system peak times) or by a measurement of non-coincident peak demand within a given period. These provisions include mechanisms to ensure the customer relies on the utility for only a portion of its load, recognize the diversity of DG installations on the distribution system, and limit the hours during which the customer can request certain services. Accounting for reliability of the customer's DG installation is also factored into certain tariffs, as discussed in the section on DG performance.

Utilities have a variety of methods for determining a partial-requirements customer's billing demand, and different billing demands are used for different service components (e.g., dedicated and shared distribution facilities, transmission, and generation). Some tariffs tie portions of a customer's billing demand to its non-coincident peak demand (e.g., to cover the costs of dedicated facilities) and other portions to demand coincident with daily peak periods of usage (e.g., Rhode Island, Texas, Minnesota, and Oregon). Some of these demand charges are levied on a daily or monthly as-used basis; others are ratcheted. For example, under Tucson Electric Power's tariffs, billing demand is tied to the greater of the maximum 15-minute demand in a month or in 23 months. In New York, billing demand is not differentiated among backup, supplemental, and maintenance service, and it is tied to the customer's maximum potential demand or customer-nominated demand. In either case, customers have a chance to change their billing demand once every 12 months if they can demonstrate real load reductions (such as through removal of equipment or the installation of energy-efficiency equipment) based on an engineering analysis submitted to the utility. NSTAR in Massachusetts, pursuant to its recent settlement, provides standby and supplemental service to most partial-requirements customers. NSTAR's billing demand for backup service is tied to the generating capability of the customer's DG units.

In Indiana, the 1985 rules governing provision of service to qualifying facilities state:

> ... a rate for backup and maintenance power shall not presume (unless supported by factual data) that a forced outage or other reduction in the electrical output of each qualifying facility on the electric utility's system will occur simultaneously or during the system peak, or both, and may take into account the extent to which a scheduled outage of the qualifying facility can be usefully coordinated with a scheduled outage of the utility's facility.[28]

As a result, for example, Northern Indiana Public Service Co. ties billing demand to the higher of the customer's highest billing determinant in a month or 80% of the highest billing determinant in the past 11 months.

In Texas, where transmission and distribution utilities (TDUs) have no tariffs specifically for DG standby service, customers are charged under full tariffs for the power they take from the grid and are subject to demand ratchet provisions. There does not appear to be an option for customers to nominate specified levels of service. However, retail electric providers may design rates to be attractive to larger customers with onsite DG.[29]

Some utilities allow the customer to set bounds on the reservation. In Minnesota, the PUC specifically states that customers are not obliged to buy standby service. It notes, however, that if such service is not purchased, it may not be available.

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[28] 170 IAC 4-4.1-5(b).

[29] What is important to note here is that, in Texas, TDUs do not charge retail rates to end-use customers. Instead, the TDU charges the retail electric provider for the delivery services it provides, and the retail electric provider is free to recover those costs from its retail customers however it chooses, and is able, to do so.

### 2.3.4.2. *Level of Billing Demand and Physical Assurance*

Several of the tariffs reviewed provide options for determining the level of a customer's demand. In some instances, billing demand can be utility-nominated or customer-nominated. Some policies provide the option of using "physical assurance" to limit standby service to a specified portion of the customer's load.[30] These options allow the customer greater flexibility in defining the level of service it needs and, thus, gives it additional means of controlling its costs of service.

Some tariffs allow the customer to determine a specific capacity for standby service. For example, Pacific Gas and Electric (PG&E) in California allows customers to specify desired levels of "physical assurance." In its guidelines, the Minnesota PUC states that a customer is not obliged to purchase standby service for the full capacity of its DG, but it requires a guarantee that the facility will not take more than its contracted demand level. The PUC also states that a "physical assurance" option for customers that elect not to take standby service should be offered; however, the details of the option are worked out in individual utility tariff proceedings. The settlement on Narragansett Electric's rates in Rhode Island provides that a customer may configure its system, with the agreement of the Company, to effect a lower demand determination.

In New York, utility standby tariffs give customers the option of setting their own level of contract demand. This option includes a ratchet and strict financial penalties for exceeding the level.[31] For example, in Con Edison's and O&R's service territory, if the excess is 10%–20%, the penalty will be 12 times the applicable contract demand charges for the excess demand.[32] If the excess is more than 20%, the penalty will be 24 times the applicable contract demand charges for the excess demand.[33] Other New York utilities charge penalties for excess even less than 10%.[34]

The NSTAR settlement in Massachusetts allows customers to nominate a contract demand level. The customer nomination, to be memorialized in a special contract that includes penalties for exceeding the contract demand level, can be rejected by the company and must be approved by the PUC.

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30 The California PUC adopted the following definition of "physical assurance":

> ... the application of devices and equipment that interrupt a distributed generation customer's normal load when distributed generation does not perform as contracted. An equal amount of customer load to the distributed generation capacity would be interrupted to prevent adverse consequences to the distribution system and to other customers.

CPUC. *Decision No. 03-02-068 Order Instituting Rulemaking into Distributed Generation.* Rulemaking No. 99-10-025, Feb. 27, 2003.

31 Harsh penalties for exceeding a customer-nominated level of contract demand deter many customers from nominating their contract demand level (personal contact with Chris Young on Dec. 13, 2004).

32 New York Public Service Commission. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates.* July 29, 2003; p. 11; Attachment A, Joint Proposal by Con Ed and O&R, p. 4; O&R's service classification No. 25, leaf No. 133; Con Edison's service classification No. 14-RA, leaf No. 139.

33 *Id.*

34 See O&R SC No. 25; Con Edison SC No. 14-RA; RG&E SC No. 14; Central Hudson SC No. 14; NYSE&G SC No. 11; and Niagara Mohawk SC No. 7.

In Minnesota, the PUC determined that the monthly reservation fee for generation should be based on a percentage of the planned reserve margin times the tariffed rate. This is similar to the PGE approach in Oregon. PGE calculates reserved capacity for the purpose of determining a customer's contingency reserves obligation (see the description in a later section). The Minnesota PUC declined to provide a discount on T&D costs for firm service customers.

#### *2.3.4.3. Determination of Specific Hours for Standby Service*

To limit the use of standby service and give owners of onsite generation a strong incentive to maintain and operate their facilities, APS allows its customers to identify specific periods and hours of a month when standby service will be required. APS sets a floor for the minimum number of designated standby service hours.[35] This option is only for customers whose standby service requirements are less than 3 MW. If a customer takes standby service during non-designated hours more than two times in any rolling 12-month period, the customer is deemed to require standby service in all hours of the month for the next 3 months.

#### *2.3.4.4. Performance*

Some tariffs include minimum performance requirements, which can make load associated with DG installations more predictable. If the DG installation does not meet the requirements, the customer can be assessed stiff financial penalties or made ineligible for certain services. Capacity factor is one metric that affects the charges. For example, APS DG customers must maintain a 75% capacity factor over a rolling 18-month period; otherwise, APS assesses a significantly higher monthly reservation charge (Tariff E-55 and E-52). APS states that the purpose of this requirement is to address "substandard operational performance" of DG installations.[36] The calculation of capacity factor under APS's tariffs allows for the possibility that a customer will not require standby service to replace the full output of its DG installation. Under APS's tariffs, monthly reservation charges (dollars per kilowatt of contract standby capacity) decrease as the onsite resource's capacity factor increases to 80%–95%.

In New York, small, efficient CHP units are exempt from standby demand rates if they meet certain performance criteria, specifically:

1. A unit's annual overall efficiency shall be greater than or equal to 60% HHV of the fuel input.
2. A minimum of 20% of the annual energy output of the unit will serve a thermal load.
3. Nitrogen oxide emissions shall not exceed 4.4 lbs/MWh.
4. The facility has a capacity of 1 MW or less, and it serves no more than 100% of the customer's maximum potential demand.[37]

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[35] Under Tariff E-55, it is 365 designated standby service hours /month. Under Tariff E-52, it is 280 designated standby service hours /month.

[36] See, e.g., Tariff E-55, Section VIII.

[37] New York Public Service Commission. *Order Directing Modifications to Standby Service Tariffs, Case 02-E-0551 et. al.* Jan. 23, 2004; pp. 10–13.

Power factor, a complex measure of power quality and the need for reactive power, is also considered in some tariffs. For example, Tucson Electric Power customers receive a discount or are subject to an additional charge for each 1% variation from 90%, up to a maximum discount.[38] Although applicable only to qualifying facilities under the Public Utilities Regulatory Policy Act, under Northern Indiana Public Service's tariff, a customer's billing demand is the same as its billing determinant if the qualifying facility has a power factor of 85% or more.

#### *2.3.4.5. Exemptions*

Some states have policies or guidelines for exempting customers with onsite generation from rates for certain components (generally one or another of the demand charges) of partial-requirements service. Typically, there are two kinds of eligibility for the exemptions: size and technology.

Examples of exemptions based on the size (in kilowatts) of the onsite facility include:

- The Minnesota PUC requires that facilities of 60 kW or less be exempt from the payment of reservation fees.[39]
- Under the PGE settlement in Oregon, the first 1,000 kW of load served by onsite generation is exempt from demand charges for contingency reserves.
- In Texas, onsite generation of 10 MW or less is exempt from stranded cost charges.
- In New York, there is a "small customer exemption" from contract demand charges if the onsite facility is 50 kW or less or if it serves no more than 15% of onsite load.[40]
- Under the June 2004 settlement in Massachusetts, NSTAR exempts from its delivery (distribution) charges:
    - Any onsite generation between 250 kW and 1,000 kW that serves less than 30% of a customer's overall load
    - Onsite generation with a nameplate capacity of 250 kW or less
    - Onsite generation that would be operational as of Dec. 31, 2004 (Dec. 31, 2005, for certain public schools that had binding financial commitments in place as of Dec. 31, 2004).[41]

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38 Tucson Electric Power Tariffs PRS-10, 13, and 14.

39 The PUC's policy guidelines also state that the reservation rate shall be "equal to the percentage of the planned reserve margin of the utility times the applicable capacity tariffed rates." This would then be multiplied by the number of kilowatts of load to be served in the event of an unscheduled outage of the onsite generation to produce a monthly total reservation charge.

40 Customers have the option of signing up for the exemptions, and there are limits to them. Depending on the utility, they will no longer be available after specified dates (mid-2006 or early 2007) or after a specified number of customers sign up.

41 Massachusetts Department of Telecommunications and Energy. *Investigation by the Department of Telecommunications and Energy on Its Own Motion as to the Propriety of Rates and Charges—NSTAR Electric*. Docket 03-121, at 17. July 23, 2004.

Regulators and utilities in some states recognize that cleaner, less-emitting DG technologies, especially renewables, will provide significant public benefits. Because of these public benefits, some states offer special treatment for specific technologies and fuels. For example:

- Under the Massachusetts NSTAR settlement, all onsite generation that qualifies as "renewable energy technologies" under state law is exempt from standby delivery charges.[42]
- In New York, "designated technologies" (which include fuel cells, wind turbines, solar thermal installations, photovoltaics, and sustainably managed biomass, tidal, geothermal, and methane waste facilities) are exempt from contract demand and daily as-used demand charges.[43] They must have come online on or after July 29, 2003.[44]
- In Rhode Island, "eligible renewable energy resources" up to an aggregate statewide cap of 3 MW are exempt from distribution demand charges for standby service.

### *2.3.5. Other Tariff Provisions: Public Purpose Programs and Stranded Costs*

A number of states generate revenue for public purpose programs (e.g., energy-efficiency, renewables, and low-income assistance programs) or, in some cases of electric sector restructuring, stranded cost recovery through charges that are separate from the rates paid for electricity itself.[45] These charges are typically set on unit bases—per kilowatt-hour or per kilowatt—and, thus, as one's consumption rises and falls, so does one's contributions to these purposes. In certain states, stranded costs charges are assessed against all electricity production, both onsite and grid-supplied, so there is no avoiding them by the installation of DG. Although one might conclude that, as a general matter, such unavoidable charges should not affect DG cost-effectiveness relative to grid power (unless they are applied disproportionately to standby service), whether this is true will depend on the specifics of each case.

In Texas, DG customers cannot avoid payment of stranded cost recovery charges by installing DG. In contrast, Rhode Island does not have any exit fees. Massachusetts law stipulates that DG customers are exempt from exit fees if they (1) operate or purchase electricity from DG units of 60 kW or less (i.e., the capacity eligible for net metering) and (2) notify the distribution company and DTE, at least 6 months in advance, of plans to install or purchase electricity from onsite renewable energy technologies, fuel cells, or cogeneration (of at least 50% efficiency).[46] However, in both cases, if the total revenue reduction because such customers leave the system during a 3-year period exceeds more than 10% of annual revenue, such customers are subject to exit fees.

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42 *Ibid.*

43 New York Public Service Commission, *Order Establishing Electric Standby Rates, Case 02-E-0780 et. al.*, July 29, 2003.

44 New York Public Service Commission. *Order Directing Modifications to Standby Service Tariffs, Case 02-E-0551et. al.* Jan. 23, 2004; p. 6. CHP has to meet specified efficiency and emissions standards. Also, in Niagara Mohawk's service territory, the criteria for designated technologies are slightly different and stricter. See Niagara Mohawk tariff SC No. 7 on Leaf No. 102B.

45 "Stranded costs" represent the above-market value of utility investments that, through restructuring, may no longer be recoverable in electric rates.

46 Massachusetts General Laws c. 164, § 1G(g).

In New York, the PSC stated in comments on its restructuring rules that exit fees would be prohibited; however, it allowed Niagara Mohawk to charge exit fees:

> ... to discourage total bypass of the company's retail distribution services and charges where such bypass is not economic from society's standpoint and to prevent the shifting of the company's transition costs to other stakeholders ... .

as it anticipated would occur in such circumstances.[47]

However, the company may not charge exit fees "if a self-generating customer completely isolates itself from the Niagara Mohawk system or if its electricity is supplied by an on-site third party that installed its generating capacity after January 1, 2000 and serves only a single customer."[48]

### 2.4. Summary of Partial-Requirements Service Practices in Selected States

A number of states have taken steps to address the rate design and utility revenue issues associated with standby service for customers with DG. Table 1 offers brief descriptions of interesting features (whether good or ill) of tariffs for partial-requirements customers, policy guidelines for such tariffs, and proposals for new tariffs in several states that are taking steps to promote deployment of efficient DG.

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[47] Energy and Environmental Analysis. "Regulatory Requirements Database for Small Electric Generators – NY Section." Available at http://www.eea-inc.com/rrdb/DGRegProject/States/NY.html.

[48] *Id.*

# Table 1. Summary Matrix of Selected States and Utilities

| State | Subject | Regulatory and Industry Structure | Applicability | Rate Design for Partial Requirements Service | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Stand-By Service | | | | |
| | | | | Service | Customer Charges | Distribution Charges | Generation Capacity Charges | Energy Charges |
| NY | Investor-owned utilities | The electric sector has been restructured. Delivery service is provided by regulated distribution companies. Electricity is supplied by competitive or default service providers. | Partial requirements customers with on-site generation of 50 kW. Some existing customers and all customers with renewable technologies have exemption an phase-in options. | Delivery only | Fixed monthly fee | 1. Monthly per-kW charge to cover costs of local facilities, applied to potential maximum load or customer-nominate contract level. 2. Daily as-used per-kW charge to cover costs of shared facilities, applied to peak demand during specified daily peak hours. | NA. | NA. Stand-by energy is provided by competitive or default service providers. |
| MA | NSTAR | The electric sector has been restructured. Delivery service is provided by regulated distribution companies. Electricity is supplied by competitive or default service providers. | To all partial requirements customers. | Delivery only | Fixed monthly fee | Monthly per-kW charge, seasonally differentiated. Contract demand negotiated or set equal to generator capacity. 100% ratchet. | NA. | NA. Stand-by energy is provided by competitive or default service providers. |
| OR | PGE | The electric sector has been restructured. Delivery service is provided by regulated distribution companies. Electricity is supplied by competitive or default service providers. | To all partial requirements customers. | Delivery and generation (contingency reserves and energy) | Fixed monthly fee | 1. Ratcheted monthly charge per kW of peak demand, to cover dedicated facilities. 2. Monthly as-used charge per kW of highest demand during on-peak hours in the month, to cover shared facilities. | Monthly per-kW spinning and supplemental reserve charges, assessed against load to be served during unscheduled outage (nameplate capacity of on-site generation or negotiated load) | Priced at hourly market rates per kWh, adjusted for wheeling, risk, and losses. |
| CA | | The electric sector was restructured; however direct retail access was suspended in September 2001. Electricity is supplied by regulated utilities unless a customer had a contract in place prior to the suspension date. | Partial requirements customers that do not qualify for size and/or technology exemptions | Delivery only. | Fixed monthly fee | 1. Ratcheted monthly reservation charge reflecting distribution infrastructure costs that don't vary with usage. 2. Volumetric rate based on actual usage that includes variable distribution costs including peak demand-related costs. | Utilities directed to develop an "electricity procurement rate option" to ensure generation capacity charges not bundled in standby rates. | Utilities directed to develop an "electricity procurement rate option" to ensure energy charges not bundled in standby rates. |
| HI | County of Maui proposal for MECO | Vertically integrated utility | To all partial requirements customers. | Delivery and generation | Fixed monthly fee | Yearly charge per kW of stand-by load to cover 50% of T&D costs (can include ancillary services provided at all times). | Daily as-used charge per kW of demand, to cover remaining demand-related costs. As an option, "best efforts" service, under which stand-by service is provided only if capacity is available. | Charge per kWh to cover variable costs of supplying energy. |

### 2.4.1. California

The State of California has multiple policies that apply to facets of ratemaking for DG and CHP. The policies address standby charges and exit fees for a variety of DG types. Overall, the policies are designed to encourage the installation of clean, customer-sited DG by giving favorable rate treatment to technologies that meet specified performance standards.

The CPUC has a policy on backup and standby rates for DG. In October 1999, the CPUC initiated a rulemaking on DG, R.99-10-025. The purpose of the rulemaking was to develop specific policies and rules to facilitate the deployment of DG in California. The policy goals for the rates portion of the proceeding were:

1. To provide for fair cost allocation among customers
2. To allow the utility adequate cost recovery while minimizing costs to customers
3. To facilitate customer-side DG deployment
4. To send proper price signals to prospective purchasers of DG.[49]

The commission issued its Interim Decision Adopting Standby Rate Design Policies, D.01-07-027, on July 12, 2001.[50] This decision provided general policy guidelines and guidance regarding standby rate design for DG and CHP. The commission adopted the decision on an interim basis in recognition of the possibility that other policy decisions and events in the electric sector might necessitate changes to the rate design policy.[51]

In its decision, the commission determined that "most of the distribution system costs to serve standby customers appear to be fixed in nature."[52] These fixed costs include facilities-related costs such as poles and wires, which are independent of usage in the short term. The commission also recognized that certain infrastructure costs are variable, such as substation capacity and transformation costs. However, the record was not sufficient to specify which costs are fixed and which are variable.[53] Although the distinction is hard to draw based on available information, the commission stated that both types would be low for a customer that provides "physical assurance" (the immediate reduction of all or part of the load served by the customer's generation when that generation is not operating).[54]

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49 CPUC. *ALJ Scoping Ruling, R.99-10-025*. April 14, 2000.

50 CPUC. *Decision 01-07-027, Interim Decision Adopting Rate Design Policies, R.99-10-025*. July 12, 2001.

51 *Id.*, p. 5.

52 *Id.*, p. 57.

53 *Id.*, p. 58.

54 *Id.*, p. 58.

Accordingly, a customer should be able to contract with a utility for a specified capacity for which it will provide physical assurance.[55] The customer "should not pay standby charges designed to recover the fixed costs associated with distribution service for the amount of capacity it provides to the utility with physical assurance."[56] The commission determined that financial penalties would not be sufficient to enable customers to enjoy reduced standby rates.

The commission distinguished among three types of standby service—supplemental, backup, and maintenance—and stated that standby rates should reflect the different costs associated with these types of service. Supplemental service, which supplies the portion of a customer's load that is not regularly supplied by the DG unit, is no different from full-requirements service and should be priced according to the customer's otherwise-applicable tariff.[57] The commission characterized backup and maintenance service as intermittent services. The commission concluded that backup demand, which is by nature unanticipated, results in higher costs than maintenance service, which can be scheduled in advance to avoid peak demand times. Although the commission recognized that diversity of DG installations on a distribution circuit can affect distribution costs, the record was insufficient to determine the degree of diversity that exists today. The commission directed electric utilities to provide information about diversity in their standby rate filings.

Because of its goal of cost-based rates, the commission rejected proposals for usage-only standby rates as well as reservation fee-only rates.[58] The CPUC provided utilities the option, but not the obligation, to provide interruptible service or non-firm standby rates. The CPUC determined that rates should be based on embedded costs rather than incremental costs. The commission adopted the Independent Clean Energy Tariff (ICE-T) that exempts from any new or additional demand, standby, customer, minimum monthly, and interconnection charges any solar generating facility up to 1 MW that does not export power to the grid and is ineligible for net metering. The CPUC directed utilities to file standby rates within 60 days; however, the commission subsequently directed utilities to file standby rates within their next general rate case.[59]

In 2001, the California legislature established a short-term policy pertaining to standby charges for onsite generation. The policy exempted most onsite generators 5 MW or smaller that went into operation between May 1, 2001, and June 1, 2003, from standby charges for at least 10 years.[60] Diesel generators are not eligible for the exemption.

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55 The CPUC defines "physical assurance" as "the application of devices and equipment that interrupt a distributed generation customer's normal load when the distributed generation does not operate." D.01-07-027. July 12, 2001; p. 79.

56 CPUC. *Decision 01-07-027, Interim Decision Adopting Rate Design Policies, R.99-10-025.* July 12, 2001; p. 81.

57 *Id.*, page 60.

58 *Id.*, p. 64ff.

59 CPUC. *Decision 02-09-037.* Sept. 20, 2002.

60 To obtain the exemption, the onsite generator must be 5 MW or smaller, use a fuel other than diesel, comply with emissions standards established by the California State Air Resources Board, and meet other criteria. Gas-fired generators that do not operate in a CHP application must commence commercial

The commission extended the exemption in D. 03-04-060 "The Standby Charge Exemption" in Rulemaking (R.) 99-10-025 on April 17, 2003. This decision extended a waiver of standby charges for two categories of DG sized 5 MW or smaller:

1. Renewables and CHP (as defined in D. 02-10-062) installed between May 2001 and Dec. 31, 2004
2. Ultra-clean DG units [as defined in PUC Code 352.2(a)] installed between Jan. 1, 2003, and Dec. 31, 2005.

Pursuant to this decision, the above resources would be served under the same rates as customers with similar load profiles that do not install DG. The commission has also exempted certain DG customers from paying exit fees or "cost responsibility surcharges." In April 2003, the CPUC created an exemption for certain DG resources based on their emissions characteristics.[61]

All three regulated electric companies have filed general rate cases. The CPUC approved San Diego Gas and Electric's Settlement of Rate Design Window issues in D.04-04-042, April 22, 2004. The commission approved Southern California Edison's settlement of revenue requirement allocation and rate design in D.05-03-022, March 17, 2005. PG&E submitted a settlement in Phase 2 of its general rate case (A. 04-06-024) on May 13, 2005. The commission is currently considering that settlement.[62]

### *2.4.2. Massachusetts*

In June 2002, the Massachusetts Department of Telecommunications and Energy (DTE) opened Docket DTE 02-38, an investigation into regulatory policies for DG. The scope of the investigation was broad, but among the key issues were:

> ... (1) the development of interconnection standards and practices that do not threaten the reliability or safety of existing distribution systems, but also do not present undue barriers to the installation of distributed generation; (2) the appropriate method for the calculation of standby or backup rates and other charges associated with the installation of distributed generation; and (3) the appropriate role of distributed generation in distribution company resource planning.[63]

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operation no later than Sept. 1, 2002. The specific requirements are set out in Section 351.1 of the California Public Utilities Code. The legislation is SB X1 28 (Stats 2001, Chap. 12).

61 CPUC. Opinion on Cost Responsibility Surcharge Mechanisms for Customer Generation Departing Load, R.02-01-011. April 3, 2003.

62 California Public Utilities Roadmap. September 2005.

63 Docket DTE 02-38, *Investigation by the Department of Telecommunications and Energy on its own Motion into Distributed Generation.* Order of June 13, 2002; p. 2.

The docket focused primarily on interconnection issues. In January 2004, NSTAR Electric—which serves Boston, Cambridge, and other areas in eastern Massachusetts—filed its own standby tariffs for large- and medium-sized commercial and industrial customers with onsite generation. This filing triggered Docket DTE 02-121. A month later, in an order on interconnection in DTE 02-38, the DTE stated that, in the NSTAR standby rate case, it would consider, among other things:

> ... whether: (1) a distribution company should recover its costs through fixed or variable charges; (2) standby rates should reflect embedded or incremental costs; and (3) a distribution company should offer firm and non-firm standby service.[64]

On June 4, 2004, NSTAR, the Massachusetts Division of Energy Resources, and other interested parties submitted a joint motion for approval of settlement agreement and an offer of settlement agreement ("settlement").[65] The settlement resolved outstanding issues among the signatories and proposed a set of standby rates for NSTAR. It was approved by the DTE a month later,[66] and the rates went into effect in August 2004.

The electric industry in Massachusetts was restructured in the late 1990s, and the state's distribution companies no longer provide integrated generation and delivery services. NSTAR's standby tariff is for delivery service only; energy is purchased from default service or competitive providers. In defending the settlement, NSTAR stated that the proposed rates were based on the same cost-of-service study that was used to establish the current rate schedules for all other classes of service. The company argued this was appropriate.

> Because the distribution company must construct its circuits to be of sufficient size to meet the peak load of the internal requirements of all customers (including those with self-generation in the event the self-generation is not available), the Company builds its distribution system no differently to serve its continuous-load customers or customers with self-generation. Accordingly, the Company designed its proposed standby rates to reflect the same level of cost recovery for standby service based upon the same cost-of-service study as is reflected by the otherwise applicable continuous-service rate schedules.[67]

The DTE accepted these arguments and approved the settlement. No study was performed to test the premise that the delivery cost characteristics of partial-requirements customers are indistinguishable from those of full-requirements customers.[68]

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64 Massachusetts DTE. Docket D.T.E. 02-38-B. Order of February 24, 2004; p. 37–38.

65 Joint Motion for Approval of Settlement Agreement and the Settlement Agreement entered into by Boston Edison Company, Cambridge. Available at http://www.mass.gov/dte/catalog/7206.htm.

66 Docket DTE 03-121. Order of July 23, 2004.

67 Docket DTE 03-121, Reply Comments of NSTAR Electric on the Settlement Agreement. June 18, 2004; p. 15 (citations to the record omitted).

68 Docket DTE 03-121. Order of July 23, 2004; p. 38–39.

NSTAR's tariff for customers with onsite generation has two basic components. The first is firm standby delivery service with two charges: a fixed monthly customer charge (equal to that in the otherwise-applicable tariff) and a recurring contract demand charge. The second is supplemental delivery service. It covers that portion of the customer's load not served by onsite generation, and it is taken under the otherwise-applicable tariff, which makes use of a monthly as-used demand charge. No scheduled maintenance service is offered.

The contract demand charges are set "equal to the generating capability or the expected output of the Customer's Generation Unit(s), but shall not exceed the Customer's maximum internal load."[69] Although there are conditions under which the contract demand increases or decreases (e.g., it is set at the maximum actual output of the generation in that month or the 11 months preceding), the general requirement is, in effect, a 100% ratchet.[70] In contrast, there is no ratchet under the corresponding tariff for full-requirements customers (Rate G-3); instead, charges are assessed against each month's peak demand as it occurs in specified hours of the day (i.e., morning to evening on weekdays).[71] The standby contract demand charges, like the full-requirements demand charges, vary by season. They are higher during the peak summer months of June through September.[72]

As an alternative to company-determined contract demand, a customer may ask to negotiate a special contract under which the customer can specify, or "nominate," the level of its contract demand. There is no guarantee the request will be granted, however. If a contract is signed, it must be filed with and approved by the DTE. If the customer and the company cannot reach an agreement, the customer is free to file a petition with the DTE.[73]

There is also a non-firm service alternative to firm standby. Non-firm service is provided as an option upon request by a customer through a separate contract that specifies terms of interruption. In this service, standby service is provided when local distribution capacity is available. When distribution capacity is not available, the customer under this service must forego or interrupt its demand for standby service. NSTAR will bill the customer:

> ... the monthly standby customer charge and the demand and energy charges under the otherwise applicable rate schedule on an "as-used" basis for any distribution service actually taken.[74]

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69 DTE 03-121, "Rate Per Month" section in *Compliance Filing Tariffs*. July 29.

70 This is, presumably, one reason no scheduled maintenance service is offered. The tariff assumes there are no distribution capacity costs to be avoided through the scheduling of delivery at off-peak times. Another is that, because NSTAR does not provide generation services, there is no low-cost, off-peak energy to offer either.

71 The absence of a ratchet for full-requirements customers has two effects. The first is that it spares customers a year-long financial penalty for a spike in their demand. The second is that it encourages them to shift loads to off-peak periods.

72 Docket DTE 03-121, Reply Comments of NSTAR Electric on the Settlement Agreement. June 18, 2004; p. 6.

73 Docket DTE 03-121, *Compliance Filing Tariffs*. July 29, 2004.

74 *Id.*

Customers with specified types of onsite generation are exempt from the new standby tariff and will take service under the applicable full-requirements tariff. This includes:

- Onsite generation whose capacity is less than or equal to 250 kW
- A combination of onsite generation units whose aggregate capacity is 251–1,000 kW and that serve less than 30% of the customer's internal electric load
- Renewable technologies as defined in Massachusetts law, with the exception of certain fuel cell units that primarily use natural gas
- Any onsite generation that came online before January 2005 and any public school-sited generation that comes on line before January 2006.[75]

Table 2 provides the prices for firm standby service under NSTAR's Rate SB-3.

**Table 2. NSTAR Rate SB-3 (Delivery Only)**

| Customer Charge, per Month | As Per Applicable Rate Schedule | |
|---|---|---|
| Monthly Distribution Charge, per kW | October–May | June–September |
| Contract Demand <1,000 kW | $ 3.58 | $ 6.65 |
| Contract Demand ≥1,000 kW | $ 5.02 | $ 9.33 |
| Transmission | No charge | |
| Transition | No charge | |

Massachusetts Electric Co., a National Grid company, does not have a separate tariff for standby service. Customers with onsite generation take service under the tariffs that would otherwise be applicable to them. Western Massachusetts Electric Co. (WMECO), a subsidiary of Northeast Utilities, does have a standby tariff. In its general features, it resembles that of NSTAR: It provides for firm backup and supplemental delivery services. WMECO's firm backup service is notable in that its demand charges are applied on a monthly as-used basis (i.e., not ratcheted). The rate, however, is not available to new applicants after Sept. 17, 1999. The absence of a replacement tariff indicates that new customers receive backup service under the applicable full-requirements tariff.[76]

[75] *Id.*

[76] WMECO Schedule PR.

### 2.4.3. New York

The PSC of New York has used a combination of generic proceedings and utility-specific proceedings to develop its policies. The PSC adopted interconnection standards for small DG units in 1999.[77] In 1999, the PSC opened a generic proceeding in response to complaints from independent power producers that standby rates were unduly high and should instead be cost-based using a uniform method across the utilities in New York. The commission approved Guidelines for the Design of Standby Service Rates, which established state-wide guidelines on the design of standby rates, on Oct. 26, 2001.[78]

Subsequently, the commission approved "joint proposals" for standby tariffs in compliance with the Standby Rate Guidelines from six electric companies in 2002 and 2003.[79] On Jan. 23, 2004, the commission refined its policies on the phase-in period for DG to shift to full standby service rates and DG criteria related to exemption from standby rates in utility-specific proceedings.[80] Standby tariffs established by all utilities are now approved by the commission.

The PSC has also been investigating issues associated with integrating DG into distribution system planning. In Case 00-E-0005 – Proceeding on Motion of the Commission to Examine Costs, Benefits, and Rates Regarding Distributed Generation, the commission directed utilities to conduct a 3-year pilot program starting in 2001.[81]

In May 2003, the commission initiated another DG-related proceeding, Case 03-E-0640.[82] This proceeding investigates whether current electric delivery tariffs present disincentives to DG, renewable technologies, or energy efficiency. The commission seeks to align current rate incentives and delivery rate structures with policy goals—such as the promotion of energy conservation, renewable energy, and DG—that it has pursued over decades.

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77 New York PSC. *Opinion No. 99-13, Case 94-E-0952, Competitive Opportunities for Electric Service.* Dec. 31, 1999.

78 New York PSC. *Case 99-E-1470, Opinion No. 01-04, Opinion and Order Approving Guidelines for the Design of Standby Service Rates.* Oct. 26, 2001.

79 New York PSC.

- *Case 02-E-0551, supra, Order Establishing Electric Standby Rates.* July 29, 2003.
- *Case 02-E-0779, supra, Order Establishing Electric Standby Rates.* July 30, 2003.
- *Case 02-E-0780, et al., supra, Order Establishing Electric Standby Rate.* July 29, 2003.
- *Case 02-E-1108, supra, Order Establishing Electric Standby Rates.* Dec. 4, 2003.

80 New York PSC. *Order Directing Modifications to Standby Service Tariffs.* Cases 02-E-0551 et. al. Jan. 23, 2004.

81 New York Public Service Commission, Case 00-E-0005, Opinion No. 01-5, *Opinion and Order Approving Pilot Program For Use of Distributed Generation in the Utility Distribution System Planning Process,* October 26, 2001.

82 New York PSC. *Case 03-E-640, Order Instituting Proceeding, Proceeding on Motion of Commission to Investigate Potential Electric Delivery Rate Disincentive Against the Promotion of Energy Efficiency, Renewable Energy, and Distributed Generation.* May 2, 2003.

Three of the most interesting aspects of standby tariffs in New York are the:

- Design of standby rates (fixed contract demand charge and as-used daily demand) and rejection of establishing supplemental and maintenance charges
- Standby rate applicability and exemption and phase-in policies for certain DG customers
- Treatment of revenue loss and gains associated with DG installation.

The guidelines state that standby rates must reflect the cost of serving the standby customer and "should provide neither a barrier nor an unwarranted incentive" to DG customers.[83] New York IOU's did not conduct new cost-of-service studies to establish standby tariffs; instead, New York IOUs set their standby tariffs based on recent cost-of-service studies. The commission determined that:

> ... [p]ending appropriate cost of service analyses, costs now allocated to each standard service classification ... serve as the basis for the design of class-specific, revenue-neutral, standby service delivery charges.[84]

Although several stakeholders argued that benefits of DG, such as low emissions and reduced line congestion, should be considered in standby rates, the commission determined that public policy values or benefits to utilities from DG were extraneous to the development of standby delivery rates and should be considered and applied, if appropriate, in the context of a utility's distribution planning process.[85] Nevertheless, the commission approved exemption and phase-in policies for small DG as well as renewable energy-based DG to recognize the benefits of those DG units (see description below). Further, the commission later argued that "the economic 'benefits' of reduced or avoided utility delivery system costs are reflected in the standby rates" in the form of on-peak, as-used demand charges that reflect "the lower cost responsibility of standby customers for service classification coincident peak loads."[86]

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83 New York PSC. *Opinion No. 01-4, Opinion and Order Approving Guidelines for the Design of Standby Service Rates*. Oct. 26, 2001; p. 11.

84 *Id.;* Appendix A, p. 2.

85 New York PSC. *Opinion No. 01-04*. Oct. 26, 2001; p. 27

86 *Id.*, p. 11.

Standby rates in New York include a customer charge; a fixed, contract demand charge; and a variable, daily as-used demand charge. Standby costs are recovered through per-kilowatt charges based on the standby customer's demand "because the local costs of providing delivery service correlate with the size of the facilities needed to meet the generating customer's maximum demand for delivery service."[87] The contract demand charge recovers the costs of local facilities that are "attributed exclusively or nearly exclusively to the customer involved."[88] Costs associated with "shared" facilities are recovered through a daily as-used demand charge, which applies to the customer's daily maximum metered demand that occurs during the utility's system peak periods.[89]

Table 3 shows examples of this allocation by four IOUs as presented in their joint proposals. It is important to note that several stakeholders complained that the percentage currently set for shared facilities is still too small and the amount of fixed, contract demand charge is too high.

**Table 3. Percent of Contract Demand/Percent of As-Used Demand for Utilities in New York**

| Utilities | System Facilities | Secondary Customers | Primary Customers | Substation Customers | Transmission Customers |
|---|---|---|---|---|---|
| O&R Standby Service | Secondary | 100%/0% | | | |
| | Primary | 50%/50% | 75%/25% | | |
| | Substation | 0%/100% | 50%/50% | | |
| | Transmission | 0%/100% | 0%/100% | 25%/75% | 25%/75% |
| Con Edison Standby Service | Secondary | 75%/25%* | | | |
| | Primary | 25%/75%* | 75%/25% | 100%/0%** | |
| | Substation | 0%/100% | 50%/50% | 100%/0%** | |
| | Transmission | 0%/100% | 0%/100% | 25%/75%** | |
| NYSE&G Standby Service | Secondary | 100%/0% | | | |
| | Primary | 75%/25% | 75%/25% | | |
| | Substation | 25%/75% | 50%/50% | 75%/25% | |
| | Transmission | 0%/100% | 15%/85% | 15%/85% | 15%/85% |
| Central Hudson Standby Service | Secondary | 100%/0% | | | |
| | Primary | 75%/25% | 90%/10% | | |
| | Substation | 50%/50% | 75%/25% | 90%/10% | |
| | Transmission | 0%/100% | 9%/91% | 7%/93% | 10%/90% |

*Con Edison has a larger percentage in the shared facilities than other utilities. This is because its jurisdiction has more secondary network distribution systems (in which a large number of customers share a distribution system) than other jurisdictions.[90]
**Includes only 138-kV facilities for "138 kV and above" customers

87 *Id.*, p. 12.

88 *Id.*, p. 13.

89 *Id.*, Appendix A. p. 4.

90 Personal contact with Chris Young at Pace Energy Project on Dec. 1, 2004.

Customers can either set the contract demand level themselves or accept the contract demand level determined by their utility. The contract demand level includes a ratchet regardless of which party sets the customer's contract demand.[91] If the utility sets the contract demand level, customers do not pay a surcharge when their demand exceeds it. However, at least one company requires customers to notify the company of installation or removal of equipment that could change demand significantly (e.g., more than 12.5%).[92] Customers who set the contract demand level and subsequently exceed it incur a significant penalty. In the case of Con Edison and O&R, if the excess is 10%–20%, the penalty is 12 times the applicable contract demand charges for the excess demand.[93] If the excess is more than 20%, the penalty is 24 times the applicable contract demand charges for the excess demand.[94] Other utilities charge penalties for excess even less than 10%.[95] Customers who set their contract level can reduce it once every 12 months if they can demonstrate that:

> ... electricity-consuming equipment is removed or abandoned in place, or permanent energy efficiency or load limiter equipment is installed, based on an engineering analysis submitted to the utility.[96]

The contract demand level by the utility will be the customer's maximum total demand that reflects all sources, including the utility's system and DG units. This contract demand will be adjusted upward or downward if there is any permanent change to the customer's electrical load because of changes in equipment. This adjustment is made by the utility's engineering analysis and information the customer provides. Customers and a utility may enter into an individually negotiated agreement under certain conditions (such as economic isolation from the grid, physical isolation from the grid, or sale of 90% to the market or a third party), provided that the negotiated agreement provides a reasonable contribution to the recovery of fixed costs.[97]

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91 New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 11, Attachment A, pp. 4–5.

92 NYSE&G, SC 11, Leaf 290.

93 New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 11; Attachment A, p. 4; O&R's service classification No. 25, leaf No. 133; Con Edison's service classification No. 14-RA, leaf No. 139.

94 Ibid.

95 See O&R SC No. 25, Con Edison SC No. 14-RA, RG&E SC No. 14, Central Hudson SC No. 14, NYSE&G SC No. 11,Niagara Mohawk SC No. 7.

96 New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 11; Attachment A, Joint Proposal by Con Edison and O&R, p. 5. Also see the tariffs mentioned above. Note that Niagara Mohawk's standby tariff does not specify how to demonstrate the reduced contract demand.

97 Quote from Con Edison's service classification No. 14-RA, leaf No. 180 C; the same rules can be found in all IOUs' standby tariffs mentioned above.

The commission does not differentiate, as others do, among types of standby service for partial-requirements customers. The commission denied a proposal for a split rate containing a supplemental charge and a backup charge on the ground that:

> ... [t]he Guidelines provide cost-based delivery service rates that apply to the entire delivery service taken by a customer with an OSG regardless of whether the OSG serves all or only a portion of that customer's load.[98]

The commission rejected Niagara Mohawk's proposal to establish additional charges for scheduled maintenance because it reasoned that the cost of building and maintaining delivery facilities does not vary according to whether an outage is scheduled or unscheduled. Otherwise, the commission stated, "adequate energy supply, including a customer's discretionary importation of lower cost off-peak energy during a scheduled outage, cannot be delivered."[99] Customers with a DG unit larger than 1 MW are still required to notify the utility of its annual schedule of planned maintenance outages.

The commission has approved exemption and phase-in provisions for small customers and clean DG technologies. The commission agreed to approve the exemption and phase-in policies proposed by various stakeholders because:

1. There are possible public benefits associated with diverse generating technologies.
2. Exemptions and phase-in policies are in non-cost criteria and adjuncts to the cost-based rate design.
3. The standby rate guideline presupposes that remedial action may be taken "if justified upon a party's showing that a standby rate unintentionally creates 'a barrier' to OSG."[100]
4. Such policies can "safeguard against unduly harsh impacts on the affected customers or industries during the initial transition to standby rates."[101]

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98 New York PSC. *Opinion No. 01-4*. Oct. 26, 2001; p. 21–22. Also see New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 11; Attachment A, Joint Proposal by Con Edison and O&R, pp. 21–22.

99 New York PSC. *Case 01-E-1847, Order Clarifying Prior Order and Directing Tariff Modifications*. Jan. 13, 2003; p. 12.

100 New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 17.

101 *Ibid.*

Customers with demand metering and a contract demand less than 50 kW, as well as all non-demand metered customers, can be exempt from standby tariffs in New York.[102] However, most utilities provide a time limit and customer number limit for new, small, non-demand metered customers to be exempted from standby rates. The commission and utilities will review the effect of exemptions at the periods when such limits are reached and may discontinue the exemptions.[103]

**Table 4. Time Limit and Customer Limit for Small Customer Exemption in New York**

| | Time Limit | Customer Limit |
|---|---|---|
| Con Edison[104] | May 31, 2006 | 15,000 customers |
| O&R[105] | May 31, 2006 | 1,500 customers |
| NYSE&G[106] | Jan. 1, 2007 | 200 customers on east of Total East or 250 customers on west of Total East |
| RG&E[107] | Jan. 1, 2007 | 150 customers |
| Central Hudson[108] | A review is initiated in Case 02-E-0780/1 | 100 customers |

Furthermore, all IOUs except Niagara Mohawk provided an exemption to standby customers whose onsite generation provides no more than 15 % of the customer's maximum potential demand.[109] In the case of Niagara Mohawk's standby tariff, customers with onsite generation that provides less than 15% of their maximum potential demand must pay contract demand charges according to the nameplate capacity of the generation.[110]

Existing OSG customers have the option of an 8-year phase-in to the full standby rates or paying the full standby rates as of the date the rates take effect. Existing OSG customers are defined as customers whose OSG facility had achieved certain milestones by January 2003.[111]

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102 New York PSC. *Opinion No. 01-4*. Oct. 26, 2001; p. 9.

103 Although several tariffs mention utilities will discontinue exemptions at a certain time, the commission mentions in the Standby Rate Orders that it and utilities will examine the effects of the exemption and determine whether to discontinue it.

104 New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates*. July 29, 2003; p. 19.

105 *Ibid.*

106 O&R SC No. 25, leaf No. 137.

107 NYSE&G SC No. 11, leaf No. 294.1.

108 Central Hudson SC No. 14, leaf No. 272.1.

109 O&R SC No. 25, leaf No. 137; Con Edison SC No. 14-RA, leaf No. 174; RG&E SC No. 14, leaf No. 237; Central Hudson SC No. 14, leaf No. 272; NYSE&G SC No. 11, leaf No. 282.

110 Niagara Mohawk SC No. 7, leaf No. 106-J.

111 New York PSC. *Order Directing Modifications to Standby Service Tariffs, Cases 02-E-0551 et. al.* Jan. 23, 2004; p. 4.

Customers with "designated technologies" have three options:

1. Exemption from standby charges if they entered service after June 29, 2003, and before May 1, 2006
2. An 8-year phase-in
3. A move to the new standby charges.

Designated technologies are generally fuel cells, wind turbines, solar thermal installations, photovoltaics, and sustainably managed biomass, tidal, geothermal, or methane waste units.[112] In addition to these renewable energy technologies, designated technologies include small, efficient CHP that meets certain efficiency, emissions, and capacity criteria.[113]

The commission's decisions include provisions for addressing revenue losses and gains resulting from the standby rates. For example, the most recent order by the commission on Central Hudson's standby rates, issued December 2004, contains the following provision for allocating gains and losses between shareholders and customers:

> In any 12 month period ending June 30 in which the algebraic sum of the monthly net differences exceeds $75,000, the amount above $75,000 will be treated as shown in the table below [where the return on equity (ROE) is "post-sharing" under the existing rate plan].[114]

**Table 5. Allocation of Gains and Losses – Central Hudson, New York**

| | ROE Less Than 11.3% | ROE 11.3%–14.0% | ROE greater than 14.0% |
|---|---|---|---|
| Standby Revenue Gain | 100% of gain to shareholders | 50% to shareholders, 50% to customers | 100% of gain to customers |
| Standby Revenue Loss | 100% recovery from customers | 50% recovery from customers, 50% borne by shareholders | 100% borne by shareholders |

[112] New York PSC. *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates.* July 29, 2003; Attachment A, Joint Proposal by Con Edison and Orange & Rockland Utilities, p. 11.

[113] New York PSC. *Order Directing Modifications to Standby Service Tariffs, Cases 02-E-0551 et. al.* Jan. 23, 2004.

[114] See page 9 of the joint proposal by Central Hudson under Case 02-E-1108.

### 2.4.4. Oregon

In 2004, the Oregon Public Utility Commission approved a settlement on Portland General Electric Co.'s (PGE's) tariffs for partial-requirements customers. In the wake of the state's industry restructuring, Oregon's electric rates have been fully unbundled. Generation, transmission, and distribution services are all priced separately, and each generates revenues to cover its full embedded costs of service.

Under the settlement, partial-requirements customers, like all others, pay the full charges for distribution investments dedicated solely to them. These are recovered in a monthly per-kilowatt demand charge assessed against what is called "facility capacity," which is the average of the two greatest non-zero monthly demands established during the 12-month period that includes and ends with the current billing month. (The minimum facility capacity is the customer's demand for grid—i.e., supplemental—power when the onsite generator is operating.) The costs of shared distribution and transmission facilities are paid according to the probability of the average customer in the large non-residential class causing new investment. These, too, are recovered in monthly per-kilowatt demand charges, but they differ in that they are assessed against the customer's on-peak monthly demand (which may or may not equal facility capacity). Peak hours are between 6 a.m. and 10 p.m. Monday through Saturday.[115] With one small (one penny) exception for the shared distribution facilities charges, the several T&D fees are essentially the same for partial- as for full-requirements customers.[116]

Where the PGE settlement is innovative is in its treatment of standby generation capacity. The load served by the onsite generation is treated in the same manner as any other load on the system, which, under Oregon rules, is obligated to have (or contract for) its share of contingency reserves. The onsite generation is, in effect, both contributing to and deriving benefits from the system's overall reserve margin. The PGE tariff differentiates between two types of contingency reserves: the spinning reserves needed to instantaneously serve the load that is exposed when the onsite generation fails and the supplemental (or "10-minute") reserves that will come online shortly thereafter.

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[115] Shared T&D costs that are covered in monthly, rather than daily, as-used demand charges were not uncontroversial. Arguments in favor of daily as-used demand charges, as in New York, were made, but PUC staff did not believe there were sufficient numbers of or diversity among customers with onsite generation to justify such a rate design. (Communication with Lisa Schwartz, Oregon PUC staff, Feb. 11, 2005.

[116] PGE schedules 75 and 83; pre-filed testimony of Ted Drennan and Lisa Schwartz, Oregon PUC Docket UE-158, June 28, 2004. The one difference between the partial- and full-requirements T&D charges is the calculation of monthly demand. The partial-requirements tariff uses the highest monthly on-peak demand, whereas the full-requirements tariff simply uses the highest monthly demand. *Id.*

Under the new rates (a similar pricing package is under development by PacifiCorp, the state's largest IOU), the partial-requirements customer must pay or contract for contingency reserves equal to 7% (3.5% each for spinning and supplemental reserves) of the "reserve capacity" (i.e., either the nameplate capacity of the onsite unit or, in the alternative, of the load it does not want to lose in case of an unscheduled outage). (If the customer is able to shed load at the time its unit goes down, it will be able to reduce the contingency reserves it must carry).

To simplify billing, the monthly demand fees for the two reserves are equal to 3.5% of their full cost. There are separate charges for the two types of reserves, but the charges are the same. All but the first 1,000 kW of reserved capacity required for customers with onsite generation is subject to the contingency reserve charges. The charges for the contingency reserves are multiplied by the reserve capacity. Mathematically the effect of this approach is the same as multiplying the full charges for the reserves by 3.5% of the needed capacity. If the customer so chooses, it may forego purchasing contingency reserves from PGE and, instead, purchase them from other providers in the market.

The actual energy received under unscheduled service is priced at an indexed hourly wholesale price that is adjusted for wheeling, risk (to compensate PGE for any differences between the actual and indexed prices), and losses.

Electric needs in excess of the demand served by the onsite generator are provided under the applicable full-requirements tariff. Maintenance service is also available for up to 744 hours per year. It must be scheduled at least 30 days in advance. The timing and demand will determine whether incremental monthly as-used T&D charges will be incurred.

The effect of the PGE rate design is to give the partial-requirements customer a strong financial incentive to operate its onsite generation, particularly during on-peak times. The energy charges and the charges for shared T&D facilities—significant portions of the cost of standby service—are avoidable through the reliable operation of the onsite generation. The costs of dedicated distribution facilities and contingency reserves are, in effect, access fees and, as they cannot be avoided by the full-requirements customer, neither can they be by the partial.[117]

[117] We note, however, that the method by which revenues to cover the costs of contingency reserves are collected from partial-requirements customers differs from that for full. Whereas partial-requirements customers pay monthly demand charges for contingency reserves, the cost of contingency reserves for full-requirements customers is included in their energy prices. (Communication with Lisa Schwartz, Oregon PUC staff, Feb. 11 2005.)

**Table 6. PGE Schedule 75, Partial-Requirements Service**

| | Delivery Voltage | | |
|---|---|---|---|
| | **Secondary** | **Primary** | **Sub-Transmission** |
| Basic Monthly Charge | | | |
| Single-Phase Service | $20.00 | | |
| Three-Phase Service | $25.00 | $150.00 | $500.00 |
| Transmission & Related Services | | | |
| Per Kilowatt of Monthly Demand | $0.78 | $0.78 | $0.78 |
| Distribution Charges The Sum of the Following, per Month: | | | |
| Per Kilowatt of Facility Capacity | $2.27 | $1.65 | $0.32 |
| Per Kilowatt of Monthly Demand | | | |
| First 30 kW | $0.56 | $1.90 | $1.06 |
| More Than 30 kW | $1.90 | $1.90 | $1.06 |
| Generation Contingency Reserves | | | |
| Spinning Reserves Per Kilowatt of Reserved Capacity >1,000 kW | $0.234 | $0.234 | $0.234 |
| Supplemental Reserves Per Kilowatt of Reserved Capacity >1,000 kW | $0.234 | $0.234 | $0.234 |
| System Usage Charge Per Kilowatt-Hour | $0.00485 | $0.00354 | $0.00257 |
| Energy Charge | | | |
| Baseline Energy | Per Schedule 83 | | |
| Scheduled Maintenance, Max 744 Hrs/ Calendar Year | Daily or Monthly Fixed, per Schedule 83 | | |
| Unscheduled | Dow Jones Mid-Columbia Hourly Firm Electricity Price Index, plus wheeling charges and a $0.003/kWh recovery charge, and adjusted for losses | | |

### 2.4.5. Hawaii

The Hawaii PUC is in the midst of an investigation into DG and the policy actions it can take to promote the cost-effective deployment of such resources. Among the issues being tackled is ratemaking for partial-requirements customers. Of particular interest in the proceeding (briefs have been filed, and a decision is pending) is the proposal of the County of Maui (COM). COM has urged the PUC to establish cost-based standby rates that recover a small portion of the bundled (generation, transmission, and distribution) demand-related costs of standby resources through a yearly (or monthly) demand charge and the majority of those costs through a daily demand charge incurred when standby service is actually used. Variable costs would be recovered in a time-of-use energy charge. This approach is intended to fairly allocate the cost of standby resources among the many standby customers who can share the standby resources and capture the diversity benefits (i.e., the low probability of simultaneous or peak-coincident unscheduled outages) that they provide.[118]

COM argued, citing evidence provided by Hawaii Electric Co. (HECO, operating as Maui Electric Co. on that island), that it is flawed logic that holds that DG requires grid backup of equal capacity. Rather, contended COM, a well-developed DG industry, with tens or even hundreds of installations in a service territory, would require that each partial-requirements customer pay for only a small share of the total backup capacity held by the utility. Evidence in the record showed that the forced outage rate for CHP systems in HECO's territory is on the order of 5%. Consequently, COM argued that reserves equal to only 5% of the aggregate nameplate capacity (or firm standby load)[119] of all the partial-requirements customers need be held by the utility and that, therefore, each DG customer need only cover its share of the costs of that reserve.[120] The logic, the same as that underpinning the contingency reserves element of the PGE (Oregon) tariff (as well as any utility's own reserve planning), is that not every DG customer will suffer simultaneous failures, and therefore, the utility needs only a fraction of the total DG capacity in reserve to provide reliable service. This is the diversity benefit.[121]

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118 County of Maui. *Brief, Docket 03-0371, In re Instituting a Proceeding to Investigate Distributed Generation in Hawaii.* March 7, 2005; p. 24

119 By "firm," COM means the load that a customer would expect to be served by the utility during an unscheduled outage of the onsite generation, regardless of when it occurs.

120 In addition, there would be scheduled outages for planned maintenance. COM proposed that the standby tariff require coordination of scheduled outages during off-peak times. In this way, the utility need only provide enough capacity to serve the expected forced outages at any point in time. COM Brief p. 26.

121 *Id.*, pp. 26–27. COM notes that there is also diversity at the transmission and distribution level and that it is a function of the number of partial-requirements customers served by a single transmission or distribution line. Pricing for these elements of standby service may need to be geographically differentiated given variations in numbers of DG customers and the sizes of individual backup loads.

COM proposed two options for standby service. The first was "firm" service, with the utility expected to plan for the statistical diversity of demand created by unexpected outages of DG systems. Given the assumption of a 5% forced outage rate on average, rates would be set so that each customer would pay for about 5% of the costs of the capacity used to provide backup service. Under COM's proposal, a small portion of this would be recovered through a monthly "reservation fee" per kilowatt of standby load (or nameplate capacity of the onsite generator) and the balance through daily as-used demand charges. Energy would be priced to recover the variable costs of production.

Specifically, the firm service would consist of:

- A capacity reservation charge

  This is a dollars-per-kilowatt-per-year charge that covers the costs of being connected to the utility, including net transmission and distribution capacity costs, that are customer-specific. This can include ancillary services that the utility provides at all times, such as spinning reserves. This should reflect the expectation that DG systems will bring transmission and distribution system benefits. It should be higher for customers served at secondary voltage than for those served at higher voltages. (COM recommended that, at least to start, this charge be set at 50% of the transmission and distribution charges already set in tariffs and thereby acknowledged that DG provides T & D diversity benefits.)

- An as-used daily standby demand charge

  This dollars-per-kilowatt-per-day charge covers the cost of the reserved generating capacity (calculated to reflect the diversity of the population of DG, as described above) that the customer actually uses. A customer that uses standby service 100 days per year pays five times as much under this approach as one that uses standby service only 20 days per year. Each standby customer therefore bears the cost of standby capacity in proportion to how often he uses it. This should be lower on days of the week and months of the year when demand is lower, and the utility does not need to reserve any otherwise-unneeded capacity to serve the diversified needs of standby customers (thus giving customers an incentive to schedule maintenance at such times).

- A standby energy charge.

  This is a dollars-per-kilowatt-hour charge that recovers the variable cost of the energy used by the standby customer. In New York, this is a real-time energy charge based on power pool dispatch conditions. In Hawaii, it would most logically be a time-of-use energy charge that is adjusted monthly for fuel costs.[122]

[122] Rebuttal testimony of Jim Lazar on behalf of the County of Maui. *Docket 03-0371, In re Instituting a Proceeding to Investigate Distributed Generation in Hawaii*. October 2004; pp. 18–21.

This rate design would:

1. Ensure that the utility fully recovered the costs of standby capacity without double-charging multiple customers for the same capacity
2. Provide an incentive for DG customers to schedule such things as oil changes at night or on weekends by allowing them to avoid a portion of the fixed standby costs
3. Ensure that those customers that use standby service many hours of the year make a larger contribution to the capacity costs than standby customers that take service only a few hours per year
4. Ensure that all standby power users pay the utility for the variable costs of their service.

The following is an example of the rate structure for firm service as COM proposed.[123]

**Table 7. Illustrative Firm Standby Rate for Maui Electric Company**

| | | |
|---|---|---|
| Standby Reservation Charge: (50% of T&D Cost) | $/kW/year | $32.88 |
| As-Used Monday–Friday Daily Standby Demand Charge (100% of Remaining Demand-Related Costs/200 days/year) | $/kW/day | $0.98 |
| As-Used Saturday–Sunday Standby Demand Charge | $/kW/day | $0.49 |
| Standby Energy Charge (Computed Monthly Based on Current Fuel and Other Variable Energy Costs) | $/kWh | Monthly Variable Energy Costs |

The second option was "best efforts" service, under which the utility provides service if it has generating capacity available. This service would be appropriate for loads that could be curtailed if necessary. Because the utility would not need to plan resources to serve a best efforts customer, there is no additional capacity cost required to make the service available. Even so, COM did not assert that the "best efforts" customer avoid capacity charges altogether. It argued instead that long-standing principles of ratemaking hold that any customer that uses utility capacity, at any hour, should make some contribution toward its costs. The reasoning is that the capacity has value to the customer, irrespective of its use at off-peak times, for which the customer should be willing to pay.[124]

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[123] *Id.*, p. 22.

[124] We add that this is especially true with respect to capacity whose costs were in part incurred to serve not peak demand but energy needs in other hours of the year (i.e., that portion of the cost that is in excess of the minimum cost of capacity). In support of its argument, COM cited Garfield and Lovejoy (Public Utility Economics. 1964; p. 163) and quoted Dr. Henry Herz, National Association of Regulatory Utility Commissioners Cost Allocation Committee: "All utility customers should contribute to capacity costs. The longer the period of time that a particular service pre-empts the use of capacity, the greater should be the amount of capacity costs allocated to that service. Service that can be restricted by the utility should be allocated less in demand cost as the degree of restriction increases." Rebuttal testimony of Jim Lazar, p. 24.

COM described such customers as "hitchhikers." It held that, as a matter of value and fairness, they should pay some portion of the costs of capacity they are using, even if their usage is not driving incremental investment. COM proposed that best efforts standby service be assessed one-fourth of the capacity cost assessed to a firm standby customer.[125]

In response to testimony of utility witnesses, COM suggested, in its brief, an alternative rate design that would meet the essential objectives of its original (and still preferred) proposal but would require only minimum changes to existing full-requirements tariffs (HECO Schedules J and P). This would have the advantage of simplicity because customers are familiar with the basic rate structure.

The COM alternative consisted of the following elements:

- A demand reservation charge equal to the Schedule J and P monthly demand charges

  These schedules recover a large portion (about one-third) of the fixed costs in energy charges, so they satisfy the goal of recovering only a portion of fixed costs in the (largely) unavoidable standby reservation charge. In addition, the demand ratchet should not apply, thereby giving partial-requirements customers a strong incentive to avoid standby service.

- Time-of-use energy charges designed to recover the remaining demand-related costs

  These time-of-use charges would replace HECO's "load factor" (in this case, declining) block rates. Under these rates, the majority of the demand-related costs should be recovered during the on-peak and mid-peak periods. A smaller portion would be recovered during the off-peak period.

- Time-of-use energy charges to recover the variable costs of service.[126]

COM argued that, like the original proposal, this rate design would ensure that those customers who cause a need for standby facilities (i.e., those increasing the utility's daytime loads) would pay the costs of those facilities. It would also ensure that the many customers sharing the standby facilities would also share their costs because each customer would pay for standby service on the days it uses it.

COM provided the following example of how the Schedule P rate could be converted: [127]

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[125] *Id.*, pp. 28–30.

[126] COM Brief, pp. 30–33.

[127] *Id.*, p. 32.

**Table 8. Alternative Standby Rate Design for Maui Electric Company**

| Schedule P Rate Elements | Schedule P Rates (HECO, 2003) | Standby/TOU Rate Elements | Standby/TOU Rates |
|---|---|---|---|
| Demand Charge | $9.50 | Demand Reservation Charge | $9.50 |
| First 200 kWh/kW | $0.072 | On-Peak kilowatt-hours | $0.095[128] |
| Next 200 kWh/kW | $0.064 | Mid-Peak kilowatt-hours | $0.064 |
| More Than 400 kWh/kW | $0.061 | Off-Peak kilowatt-hours | $0.061 |
| Energy | TOU charges/kWh | Energy | TOU Charges/ kilowatt-hour |

COM also recommended that, if this alternative rate design is to be adopted, it be modified for a "best efforts" option. COM suggested that the same rate structure be used for best efforts service but that the demand reservation charge be reduced to one-half of the otherwise-applicable charge. The TOU energy-per-kilowatt charges would remain the same, as would the variable charges for energy. Under this approach, best efforts customers will impose no fixed costs on the utility but will contribute significantly to cost recovery of fixed costs. This will benefit non-participating ratepayers because these charges are used to offset costs that would otherwise be recovered from full-requirements service customers.[129]

[128] The on-peak charge is higher than the current charge for the first 200 kWh/kW because there are only approximately 90 on-peak hours per month (4 hours/day Monday–Friday). Because the same demand-related costs must be collected in a smaller number of hours, the rate must be higher.

[129] COM Brief, p. 33. COM also urged the Hawaii PUC to develop and implement a performance-based ratemaking mechanism as an alternative to traditional cost-of-service regulation, with the aim of breaking the link between utility sales and profits and thereby removing the utility's strong financial incentive to oppose deployment of customer-sited resources such as DG and end-use energy efficiency.

Pre-filed testimony of Jim Lazar on behalf of the County of Maui. *Docket 03-0371, In re Instituting a Proceeding to Investigate Distributed Generation in Hawaii.* July 2004; pp. 94–97.

# 3. Policy Issues

It might be flippant after 30 pages describing the arcana of electric utility rate design as it applies to customers with onsite generation to say that the debate, ultimately, comes down to money, but it would not be untrue. Across the states, the essential features of standby rates are the same, and what matters are the mechanics of their application and, more to the point, their absolute levels. The economics of DG are straightforward enough (setting aside reliability and other, less-quantifiable customer benefits): An installation will be cost-effective when it can displace grid-supplied service for less, *including the costs of standby*, than the cost of grid power.[130]

This does not diminish the import of a rate design. Rates structures can have profound effects on behavior—both of utilities and their customers—and the exercise should not be lightly dismissed. This review has revealed key areas of economic and policy debate that affect the outcome to this question. This chapter summarizes them and offers recommendations to address them.

## 3.1. DG Cost Causation

The question of cost causation—What are the nature and magnitude of the utility costs to serve partial-requirements customers?—is a fundamental debate among DG proponents, utilities, and regulators. Advocates argue that DG reduces demands on the system, improves overall reliability, and avoids new investment and operational costs. Utilities assert that DG has little or no effect on system planning and investment, particularly in the distribution system near the customer, where facilities still have to be sized to serve the customer's highest instantaneous loads, even if the frequency of their occurrence has been reduced by onsite generation.

There appears to be little dispute that the distribution facilities deployed to serve a single customer, sized to serve the potential maximum load of the customer, should be paid for by that customer.[131] Difficulty begins with shared facilities—wires, poles, transformers, and substations—that serve more than one customer. Traditional allocation methods rely on class contributions to coincident peak adjusted for, among other things, the mix of classes in areas of the system. How the standby requirements of customers with onsite generation affect the underlying costs defies easy generalization, particularly when there is not a significant penetration of DG on a system (or area of it).

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130 Of course, a significant market niche for DG is supplying a particular kind of service—i.e., redundant DG to supply extremely reliable power—not available from the grid. Renewable energy is another product with a perceived quality that may not compete directly with grid power on the basis of price.

131 Although the exceptions might be argued to swallow the rule, one of the oft-spoken principles of sound ratemaking is that the "cost causer should pay." The principle has the advantage of not only appearing fair on its face but also of avoiding the perverse results that can occur when the actor does not bear the cost responsibility for his actions—i.e., consumption of the good or service far in excess of what might be deemed economically efficient (assuming that all costs, internal and external, are reflected in price).

The argument that, in the aggregate, the load profiles of partial-requirements customers are reasonably similar to those of other customers in their classes has weight, although it may be more relevant with respect to facilities (e.g., transmission and central-station generation) whose characteristics are only marginally affected by the presence of customer-sited generation (i.e., benefiting more fully from the overall diversity of the system).[132] If so, what can one conclude about how rates should be set for DG customers? If they are no different from others of their class, though without DG, should they not pay the same rates? This, however, could subject them to ratchets—costly by virtue of the lower load factors of DG customers—and, moreover, fails to account for any benefits (such as avoided costs and improved reliability) that DG provides.

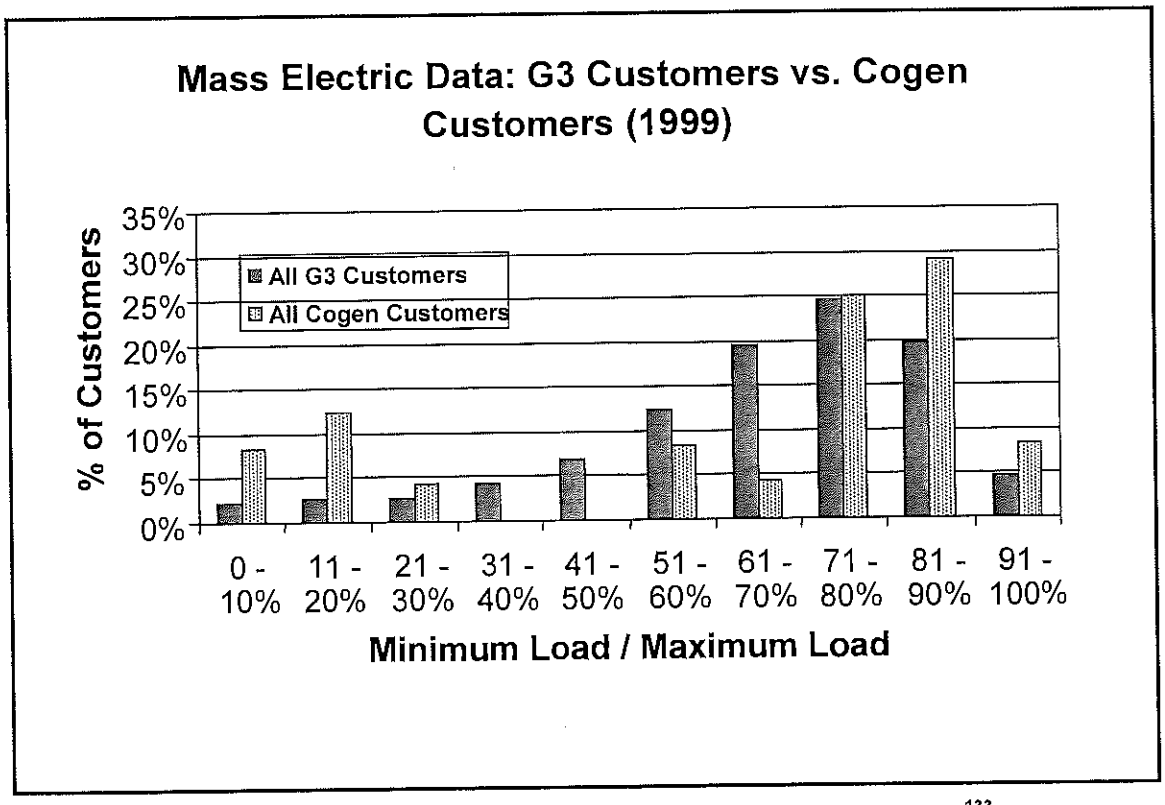


**Figure 2. Class G3 customers versus cogeneration customers[133]**

The debate about the cost-causative and cost-avoiding properties of onsite generation will not resolve itself easily without more empirical evidence on the performance of DG and its effects on the operations of, and investment in, the system. Even so, until such data are available, the probabilities of cost-causing and cost-saving events can be estimated for the purposes of ratemaking.

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132 This is, for instance, the logic implicit in the PGE standby rate design.

133 Casten, S. "NSTAR Proposed Standby Rate for Onsite Generators in MA Update on DTE Filing 03-121." Presentation to the Northeast Energy Commerce Association, 11th Annual Energy Conference. Boxborough, Mass., May 17, 2004.

### 3.2. DG Benefits

Traditionally, in the setting of fair and equitable rates for electric service, attention is given primarily to the costs incurred to provide the service because it is not generally the case that the taking of the service yields immediate and direct benefits (i.e., positive externalities) to other users of the grid.[134] However, customer-sited distributed resources have the potential to provide benefits to the system—through sales of excess energy to the grid, downward pressure on market prices, reduced loadings on stressed lines and substations, deferral or avoidance of distribution and transmission upgrades, diversity benefits, and the provision of reliability services—and, where those services are not in some manner valued and traded, it may be appropriate to recognize and credit them against the costs that standby prices cover.

Although the benefits of DG have been generally acknowledged by policymakers, methods for accounting for those benefits, in ratemaking as well as planning, are not yet well developed (with the exception of work conducted in California).[135] Nevertheless, many states provide exemptions or other favorable rate treatments based on anticipated benefits. These exemptions or special treatments are essentially a policy overlay on tariffs and justified by the broad expectation of public benefits, even though these benefits have not been quantified. Some states have also developed mechanisms for considering benefits for deferral of distribution system upgrades. One example of such an approach is de-averaged distribution credits or reduced charges for DG/CHP that defers or avoids higher-cost network investments in stressed, high-cost areas.

In its rulemaking on DG, the CPUC considers the question of a distribution-level diversity factor to set standby rates, and it notes stakeholder acceptance of the concept, though with utility admonitions that such factors accurately reflect DG's contribution to the utility's avoidance of distribution upgrades.[136]

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[134] For example, increased access to the telecommunications network (i.e., universal service) is seen as an overall benefit because it increases the number of people and businesses with which any one user can connect. Insofar as increased use of electricity is positively correlated with improved public health and safety, education, income, and a more stable society, it too provides external benefits. But this perspective is somewhat more narrowly constrained here. Also, some might argue that, insofar as increases in sales decrease the share per kilowatt-hour of fixed costs that customers must pay, greater use reduces costs, and all consumers benefit. The researchers do not find the argument persuasive, however. Increased demand, in fact, increases total costs—in the short run, by increasing fuel costs and, in the long run, by increasing capital investment. Moreover, to the degree that that incremental demand for energy service is not met in the most economically efficient manner, it is a misallocation of society's resources that could be put to more valued use elsewhere.

[135] The researchers note that NREL funded the following: Iannucci, Cibulka, Eyer, and Pupp. DER Benefits Analysis Studies: Final Report. NREL/SR-620-34636. Golden, CO: National Renewable Energy Laboratory, September 2003. This report contains summaries of multiple reports assessing benefits of distributed energy resources. See also California Energy Commission. *PIER Project 500-01-039, Optimal Portfolio Methodology for Assessing Distributed Energy Resources Benefits for the EnergynetSM.* There have been a number of other studies on the benefits of DG, but typically, they have not focused on the ratemaking implications of their findings. See, e.g., Kosanovic, Dragoljub, and Beebe. *System-Wide Economic Benefits of Distributed Generation in the New England Energy Market.* Center for Energy Efficiency and Renewable Energy, University of Massachusetts, Amherst, February 2005.

[136] CPUC. *Order Instituting Rulemaking into Distributed Generation*, R. 99-10-025, D. 01-07-027. July 12, 2001; page 14.

In its guidelines on standby rates for DG, the Minnesota PUC took a fairly broad approach to valuing and providing credit for benefits of DG. It stated that:

> Credits should be given to a DG customer if the installation of a DG facility reduces the utility's costs of providing the service. These lower costs could be generation, transmission, or distribution related costs.[137]

In particular, the Minnesota PUC created options for:

- Distribution credits based on the utility's avoided cost

  The utilities were directed to name substations or feeders that were identified through the regular planning process as potential candidates for distribution credits. Although a customer must fund the initial study pertaining to its own DG installation, the utility will fund a more in-depth study if the initial study shows that the specific DG installation holds promise.
- Line loss credits as determined through a customer-funded utility study
- Renewable credits when a DG installation allows the utility to avoid the purchase of "green power" elsewhere
- Emission credits when a DG installation allows the utility to capture the value of an emission credit in a tradable emission program.

The Minnesota PUC also stated, somewhat inexplicably, that DG should not be eligible for any "additional diversity credits."[138]

The Texas DG manual, Section 4.3, discusses the cost benefit effects of DG and describes, in many cases, how to calculate them. The manual lists costs and benefits for the TDU and for the customer as well as other costs and benefits.

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137 *In the Matter of Establishing Generic Standards for Utility Tariffs for Interconnection and Operation of Distributed Generation Facilities Under Minnesota Laws 2001.* Chapter 212, Appendix 6. Sept. 28, 2004. http://www.puc.state.mn.us/docs/orders/04-0131.pdf.

138 Minnesota PUC. *Docket No. E-999/CI-0101023 in re Establishing DG Standards.* Order of Sept. 28, 2004, Attachment 6. If calculated correctly, credits for avoided generation, transmission, and distribution costs should reflect the diversity benefits of DG. Although it is not clear what the Minnesota PUC means by additional diversity benefits, it is possible that it is referring here to other considerations such as fuel diversity. (The lion's share of the nation's DG is fired by natural gas.)

In Rhode Island, Massachusetts, and New York, utility tariffs have taken fairly broad-brush approaches to recognizing certain benefits of DG. Legislation in Rhode Island allows the PUC to discount backup service distribution rates in cases in which the public interest justifies the price reductions. Consideration of the public interest can include reduced environmental effects, increased energy efficiency, reduced transmission losses and congestion, and effects on electric system reliability. Lost revenue because of these discounts must be accounted for and recovered in rates assessed on all customers. The legislation further provided that the PUC may permit or require discounted backup distribution service rates to encourage economically efficient cogeneration or small power production projects.[139] Although the settlement with Narragansett Electric does not provide specific discounts associated with these factors, the settlement does include an exemption for renewable resources. According to the settlement, customers who install onsite non-emergency generating units powered by eligible renewable energy resources, as defined in 2004 R.I. Pub. Laws 205 and up to an aggregate nameplate capacity of 3 MW for all customers having installed such generation, shall be exempt from the backup rates.

In Massachusetts, the NSTAR settlement took a slightly different and much less specific approach. The approved standby tariffs exempt small DG units and most renewable DG technologies from standby tariffs because of the public benefits renewable technologies provide and because the financial effects that both types of technologies pose on distribution service were deemed to be relatively small. In addition, the settlement reduced the standby rates approximately 15% below tariffs initially proposed in recognition of the public benefits provided by these technologies.

Several states use exemptions from standby rates as a means of promoting the deployment of preferred resources types. California provides several exemptions:

- DG, 5 MW and less, that meets certain fuel and environmental criteria is exempt from standby charges.
- Solar generation of up to 1 MW that does not export to the grid is exempt from any additional charges.
- Other specified DG is exempt from exit fees or "cost responsibility surcharges."

In New York, customers with "designated technologies"—fuel cells, solar thermal installations, photovoltaics, and sustainably managed biomass, tidal, geothermal, and methane waste units as well as eligible CHP—that come online on or after July 29, 2003, must choose from three pricing options:

- Exemption from standby charges if they enter service by May 31, 2006
- An 8-year phase-in of standby charges
- Taking standby service under the new charges immediately.

[139] Rhode Island Title 39, Public Utilities and Carriers, § 39-2-1.4, Reasonable Backup or Supplemental Rates. Effective Jan. 1, 2005.

The New York PSC also allows standby rate exemptions to small DG and clean DG technologies (including CHP), or the standby rates can be phased in gradually. In its standby rate guidelines, the PSC stated that:

> ... extraneous factors sought by various parties, such as public policy values or benefits to utilities from DG ... do not belong in the development of standby delivery rates.[140]

The commission also said that "such factors should be considered and applied, if appropriate, in the context of a utility's distribution planning process."[141] However, later, the commission approved the exemptions and phase-in policies that stakeholders proposed.

- The commission acknowledged the possible public benefits of the diverse generating technologies.
- Exemptions and phase-in policies are recognized in non-cost criteria and adjuncts to the cost-based rate design.
- The standby rate guidelines presuppose that remedial action may be taken "if justified upon a party's showing that a standby rate unintentionally creates 'a barrier' to [onsite generation]."[142]
- Such policies can "safeguard against unduly harsh impacts on the affected customers or industries during the initial transition to standby rates."[143]

However, it is important to note that there are time and customer limits to the New York exemptions policy. When either of the limits is met, utilities and the commission review the effect and the effectiveness of the policy and determine whether to terminate it. In Texas, renewable energy DG technologies that do not export to the grid are considered "energy efficiency."

### 3.3. Rate Design Issues

Another issue concerns properly reflecting DG's benefits in rates. Cost-of-service studies that properly analyze the effects of DG customers on the system (in effect, that treat them as their own class) should identify the costs they impose on the system and the costs they avoid, and the rates (or credits) that emerge should likewise reflect those puts and takes. In the absence of such studies, reliance on existing rates, adjusted for expected effects, is a second-best solution. But even with cost studies in hand, much judgment is needed because the study methods themselves may be prisoners of the assumptions underpinning them.

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140 New York PSC. *Opinion No. 01-4.* Oct. 26, 2001; p. 27.

141 *Id.*, p. 27

142 New York PSC, *Case 02-E-0780 et. al., Order Establishing Electric Standby Rates.* July 29, 2003; p. 17.

143 *Id.*

Key issues in rate design for standby and related rates include:

- *Bundled or Unbundled Rates*

  The first question is how far to unbundle rates. This may depend, in part, on the status of the electric sector in a state—but not necessarily. The rates for the various services—generation, transmission, and distribution—of vertically integrated utilities can be separated (as they are, for example, in Oregon). The issue is one of value. What does such unbundling achieve? Do the differentiated rates positively affect the efficiency with which customers use the grid? Do the individual rates fully and fairly compensate the utility for the service provided?

- *Demand and Energy Charges*

  Although it is maximum instantaneous peak demand on a system or subsystem that determines its size, or capacity, it does not necessarily follow that the service that the system provides—e.g., generation or delivery—should be priced on a capacity, or demand-related (per-kilowatt), basis. For low-volume customers, primarily residential and small commercial, energy rates inclusive of capacity costs are the norm. The question for designers of standby rates is whether kilowatt rates produce the desired effects (behavioral and financial). The proposal currently in Hawaii, in which a significant portion of demand-driven costs would be collected in kilowatt-hour rates (which are avoidable if no standby service is taken), offers an alternative approach that is worth considering.

- *Ratchets*

  Without ratchets, per-kilowatt charges, such as "per kilowatt-hour," can be avoided or reduced by reductions in demand. A ratchet, depending on its size and duration, has the effect of placing relatively more emphasis on the peaks of demand. Although this is salutary in the sense that the fixed investment of a utility system has historically been driven by peak demands, it also has costs. By moving to a more capacity-driven rate structure, the resulting rates may reduce to some degree a customer's incentive to take more general, cost-effective, energy-saving steps. Some DG customers see ratchets as excessive charges for facilities that are only occasionally used. From the utility's perspective, a ratchet is simply a mechanism to allocate capacity-based charges to the cost-causer. This, of course, is only true to the extent that customer peaks correlate with the relevant system peak (generation, local distribution, etc.) to which the demand charges apply. Diversity of loads on circuits and substations should lead to a reduced need for ratchets—but to what degree remains to be seen. The objective for rate designers and their regulators is to find ways to assure reasonable cost recovery for utilities while providing strong cost-saving incentives for customers.

- *Generation Held in Reserve*

  For utilities that provide both standby delivery and generation services, there remains the question of how to charge partial-requirements customers for generation services. Although the general premise that a customer should pay for the generation capacity actually held on his behalf is widely accepted, the issue for partial-requirements customers is how that capacity—which serves standby, not full, requirements—should be determined. The key factor in the calculation is the likelihood that a partial requirements customer will need backup power at a time of system peak. What are the increased costs incurred because the DG customer and others of the class are interconnected with the system? What are the real implications for a utility's reserve requirements of a customer or customer class whose likelihood of drawing power during times of peak or other capacity constraint is measurably less than that of full-requirements customers? The argument that the potential for a DG facility to go off-line during a system peak is such that the utility must have in reserve enough capacity to meet the customer's full load seems unreasonable in light of the probabilities, especially in those cases in which there are more than one DG customer. The diversity of standby loads should be recognized, as it is for all other loads, in the setting of standby generation service. In Oregon, for example, this is achieved through the assignment of, in effect, the same probabilities of unscheduled outages to onsite generators as to central-station units, in that the tariffs require DG customers to maintain the same level of contingency reserves that other load-serving entities must have.[144]

[144] PGE's full-requirements customers do not pay separate demand charges for contingency reserves like partial-requirements customers do. The full-requirements customers do, nevertheless, pay for the contingency reserves held on their behalf. The charges for these reserves are included in the energy rates they pay.

# 4. Policy Recommendations

Throughout the state surveys and interviews with stakeholders, rate design for customers with onsite generation raised two broad sets of issues. The first involved ensuring that rates appropriately reflect the services that DG customers desire and that the costs associated with those services are recovered. The second concerned state policy, specifically governmental action in support of DG as an important element of customer choice, power system resilience, portfolio diversity, and clean generation supply.

The first set of issues requires the determination of how customers with onsite generation are different in their service needs from full-service customers, how they are the same, and how these factors affect ratemaking and design. For example, customers with onsite generation, by definition, do not purchase electricity from the utility to meet their full electrical demand. This can justify some differences in treatment for generation service, distribution service, and transmission service. However, the extent to which it does depends heavily on the degree to which these services are dedicated to the partial-requirements customer or are shared among some set, or sets, of customers. Many of the recent regulatory efforts in this matter have focused on determining the nature of service required or requested by DG customers, quantifying important determinants of that service request, and identifying the costs associated with the service. As discussed in more detail below, issues in this category involve determining whether to differentiate among standby, supplemental, and maintenance service; whether and how to enable customers to limit the demand they place on the utility's system; what costs and benefits DG customers create on the utility's system,[145] and whether the diversity and other benefits of DG installations can and, if so, should be somehow incorporated into tariff structures.

The second set of issues comprises an array of approaches that serve a broad set of policy goals beyond those of traditional ratemaking, at least as narrowly construed.[146] These can be characterized as a policy overlay, whereby a state establishes certain rate policies that are driven by broader goals such as environmental improvement, new technology development, the widening of customer choice, or the inter-class and inter-temporal shifting of revenue burdens in pursuit of long-term cost reductions or greater equity. In these instances, such rate treatments are justified by the ends they are intended to achieve rather than by the narrow application of ratemaking rules aimed solely at allocating costs according to their causes.[147]

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[145] Note that it is important in this context to differentiate between costs and benefits on the utility's system (such as reduced losses, reduced peak load, delayed infrastructure expenditures, and fuel and resource diversity) and costs and benefits to society as a whole (such as reduced emissions, effects on energy markets generally, and secondary economic benefits).

[146] As set out, for example, in Bonbright. Of course, policy goals have been inherent in the fabric of utility ratemaking. It started with the most basic assumption of policymakers in the 19th and 20th centuries that price-averaging made it possible for more customers to take service and thus increased the overall public good. "Utility service for all" remains a goal of public policy, but philosophies on how best to price it continue to evolve.

[147] This is not to say that such ratemaking is in any way cut-and-dried. A significant portion of electric utility costs are, in fact, "joint and common," the allocation of which economic theory offers little guidance.

This research revealed numerous examples in each of these areas that are worthy of further exploration and development.

## 4.1. Cost Causation

When a customer installs DG to supply a portion of its electrical load, the DG may substantially change the customer's load profile and the nature of utility service required for it. Such an installation may reduce, during many hours, the customer's grid-supplied electrical load. However, the possibility remains that during outages of the onsite generation, the customer's need for electricity from the grid will increase. Even so, it may not necessarily follow that DG customers have load profiles that are more costly to serve than those of customers without DG. In part, this is a question of the costs under consideration—distribution only, or generation and transmission, too?—and, in part, it has to do with the timing and duration of the customer's calls for unscheduled service. Does a particular kind of usage merit separate treatment under the tariffs, and, if so, how can rates be best structured to recover the costs of that service?

For the system as a whole, the better approach involves measuring or estimating the actual effect on the system because of the behavior of the group as a whole—in this case, customers with DG. That is, the coincidence of the group's actual or estimated aggregate (diversified) demand with the relevant system peaks should determine its share of the capacity costs (whether generation, transmission, or distribution), and the duration and timing of its demand for energy (in the case of vertically integrated utilities and load-serving entities) should drive its energy costs. With respect to specific and unique costs associated with the demands of individual customers—i.e., those for dedicated and local facilities designed (either entirely or substantially) to serve the peak demands of the individual customer—these may properly be charged directly to the individual customer, or not, depending on other policy objectives in the jurisdiction. One of the challenges of rate design for DG customers is identifying the billing determinants that best reflect the costs incurred to serve those customers.

### *4.1.1. Innovation and Regulator Willingness To Innovate*

Addressing and accommodating a new application or technology, such as the relatively new demand for customer-sited DG, often requires innovation and change on the part of customers, utilities, and regulators so that the *status quo ante* is not inappropriately advantaged to the detriment of the overall public good. This sort of innovation can be difficult for regulators, who are often bound by custom and precedent. The general inclination of commissions to base their decisions on precedent, to be consistent with long-standing policies, in some ways leads to small increments of change rather than an overhaul of ratemaking approaches. Even more powerful can be the axioms and assumptions, implicit or explicit, contained in that body of knowledge that evolved in the context of regulating natural monopolies in essential services.[148]

[148] For example, even progressive regulatory bodies have often allowed incumbent utilities to provide "special" discount rates to large customers considering cogeneration alternatives based on the idea that loss of the customer, by definition, would lead to increased rates for others. Not only is this not true in times of increasing demand, but it also has the unintended side effect of inhibiting increases in the overall efficiency of the nation's electrical system, which has remained at a dismal 33% for decades. Nakarado,

As a result, one of the challenges for state public utility commissions is determining to what extent established costing principles, and traditional ratemaking principles and precedents, are applicable in designing rates for DG customers. Additional information and data that emerge from research targeted at understanding specific DG installations and interaction with the electrical grid and utility systems will assist in determining how established costing principles can be applied and will facilitate and substantiate appropriate change and innovation in ratemaking for such customers.

### *4.1.2. Continue Analysis of Existing DG Installations and Rate Treatments*

The first step in refining existing rate treatments and developing useful new approaches must be to ensure a thorough understanding of what is already in place. This report has primarily presented a survey of standby rate options for customers with DG. More detailed analysis is an important next step.

Many states, utilities, customers, and affected parties are grappling with the complex issues associated with the potential power system innovation offered by customer-sited DG installations. In honing policies designed to tap the promise of DG, states should initiate and continue efforts to better understand real DG installations in the field. Foremost among these efforts would be monitoring and measuring DG performance in the field, gathering more detailed load data for customers who install DG as well as those who do not, and assessing various DG technologies in specific states to inform policy questions surrounding least-cost DG options. In parallel with the attention to DG installations, states should pursue more detailed analyses of specific rate structures, using well-defined criteria for judgment. Examples of evaluation criteria include economic efficiency, minimization of cost shifting, consistency with cost causation principles, consistency with state policy goals (including energy, environmental, and economic), and acceptability to stakeholders.

### *4.1.3. Develop Mechanisms for Individual Customers to Determine Their Load*

One of the key billing determinants in ratemaking is customer load. One of the simplest ways to address this issue for DG customers is to assume the customer's entire load served by DG could be shifted to the utility grid at any time, including during peak times. Some utilities (such as NSTAR in Massachusetts) have, in fact, based rates on just such an assumption by applying demand charges at the nameplate rating of the DG system. However, this type of assumption can lead to high demand ratchets for standby service that are not consistent with the way DG is likely to operate.

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G.; Thomas, H. "Combined Heat and Power, Revisited." *Public Utilities Fortnightly*, Vol. 141, No. 16. September 2003.

One alternative being explored in California is a method for customers to limit the demand that they shift to the utility grid. This limitation would take the form of "physical assurance," in which a customer would permit the installation of technical devices that would instantaneously shed load in the event of a DG outage. Although the main driver behind such a provision is to prevent DG customers from creating a strain on the system during system peak, it also provides the technical basis for limiting or avoiding certain tariff elements or charges. Recent research by Southern California Edison has indicated that physical assurance is not necessary during all hours. In fact, such measures would be necessary only during a few hours of the year when the utility's distribution system must operate above 400 A—about 200 hours, or 2.2% of total annual hours.[149] Although many states have included provisions for physical assurance to limit a customer's demand, none have progressed as far as California in developing and defining the concept.

### 4.1.4. Develop Service Offerings for Individual Customers

Another alternative proposed in Hawaii is the concept of "best efforts" service, or non-premium service. The concept is to design service so the customer does not create any requirement for the utility to invest in any generation or transmission plant or equipment to provide standby service. The proponent of this approach (the COM) believes it could remove any basis for the as-used daily standby demand charge altogether; however, it recognizes that a precept of regulation is that any customer using system capacity, at any hour, should help pay for the cost of that capacity. Therefore, at least a nominal as-used demand charge could apply to best efforts standby service. For example, one-third of the normal standby demand charge (both standby reservation charge and as-used daily standby demand charge) could apply to best-efforts customers.

Customers with non-critical loads—such as industrial customers with process energy requirements or resort hotels that can interrupt service to their water features, laundry, and other noncritical loads—could choose best efforts service up to the level of those loads. If the customer's DG unit failed when the utility was not under stress, it would place that load on the utility and contribute financially to the cost of that capacity. If the utility were under stress at that particular hour or day, the load would go unserved until the utility's reserve margin recovered or the DG unit was again available. Because the probability of the failure of the customer's DG system at the same time the utility system is under stress is quite low, this might be a reasonable choice for some customers. To the extent that they choose this option, it would provide a contribution to the utility's fixed costs without actually imposing any corresponding cost on the utility. The utility's other customers would be made better off by the receipt of this revenue. One issue to resolve is how to ensure that the customer is not served during peak periods on the system. This would mostly likely require physical assurance.

[149] Dossey, T. *Integrating Customer-Operated Distributed Generation Into Distribution Planning.* Southern California Edison presentation to the California Energy Commission DER Integration Workshop. Sacramento, CA; May 4, 2005.

### *4.1.5. Incorporate Diversity and Probability Analysis Into Cost Assignment*

Physical assurance pertains to limiting the individual customer's demand on the utility system during certain key periods. Other promising approaches relate to analyzing and reflecting the combined effect of multiple DG customers on a portion of the distribution system. In concept, the probability of any one DG system failing at a time of system peak is low because outages at a DG unit would be random rather than tied to the factors driving system peak. The probability that many such systems will simultaneously fail at a time of system peak is even lower, therefore—particularly if the DG systems are technologically and fuel-diverse.[150] Finally, the probability that a DG customer's peak demand will coincide with system peak is even lower than it is with a full-requirements customer—again because outages would be random rather than tied to customer consumption patterns. Consequently, the standby capacity (shared delivery and generation) that each DG customer should be responsible for will, depending on the number and nature of the deployments, be relatively small (some fraction of the nameplate capacity of the onsite system). It seems clear that, as a matter of both fairness and electric system economics, it is inappropriate to allocate costs on the assumption that all DG units will fail at the same time.

Rate structures can be informed by probabilistic analysis of when DG will be on, how it will be used, and how multiple DG installations on a portion of the distribution system will affect the necessary capacity for that distribution system. For diversity to exist in sufficient depth to warrant the favorable adjustment to cost assignment, there should be:

1. Sufficient numbers of installations
2. Sufficient technical and, possibly, fuel-diversity (e.g., not all systems subject to the same failures)
3. Sufficient peak diversity (e.g., systems are not all dependent on sunshine, and, thus, have different outage patterns).

With sufficient diversity, generation capacity charges could be set so that each DG customer contributes a portion of the cost of owning and maintaining the capacity that collectively provides service to all DG customers in proportion to how much and how often the individual customers use that standby capacity. Where there will be many DG customers, and because DG systems are not all expected to be out of service simultaneously, it is necessary for the utility to have only a fraction of the combined DG capacity available in reserve to meet the standby needs of these customers. One does this the same way one estimates the capacity needed to serve firm customers. First, one looks at the combined individual loads of the individual customers on the system. Second, one looks at the probability, or "coincidence," that these loads will occur at the same time. Finally, one measures this coincidence of loads against the other loads on the system to determine if additional capacity is necessary.

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[150] The value of fuel diversity depends on the nature of the fuel and its delivery system. Systems that use natural gas delivered through a fixed network of pipes bear the risk of common supply disruptions. A large proportion of DG systems fueled in this fashion may, in fact, present a higher probability of failure on peak and thus increase, not decrease, the overall cost and reliability effects on the system. This, like many other questions raised in this report, requires further analysis before reasoned judgment can be made.

As discussed in the body of this paper, Oregon has adopted a version of this approach in its treatment of generation capacity charges for DG customers. In Oregon, PGE includes a provision for contingency reserves for generation. The idea is, in effect, to treat DG/CHP like any other generator on the system.[151]

The CEC is funding many analyses that will provide useful data on issues associated with the integration of DG into utility systems and diversity of DG on the system. These include:

- FOCUS PIER contracts monitoring commercially installed DG for grid interaction
- San Francisco DER test bed site monitoring and analysis of the effects of DER on two San Francisco distribution system feeders
- An optimal portfolio methodology for assessing DG benefits for the Energynet
- The distributed utility integration test
- The evaluation of policy effects on project economic viability.[152]

### *4.1.6. Incorporate DG Into Distribution System Planning*

There is growing interest in identifying how DG can be incorporated into distribution system planning. Several states—including California, Vermont, New York, and Massachusetts—and individual utilities—such as Detroit Edison in Michigan and Conectiv Power Delivery in New Jersey—are exploring this approach.[153]

In a paper for NREL, the Regulatory Assistance Project determined that, because of the high variation from *average* cost that characterizes the different areas of a distribution system, it is not just the high average-cost utilities that might effectively use DG. For a low average-cost utility, although very short-duration deferrals would be unlikely to generate enough savings to justify DG, projects that obviate for longer periods the construction of new facilities might very well produce enough savings to make DG the economic choice from the utility's perspective when compared with a "wires and transformers" alternative.[154]

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151 More precisely, it is to treat the load served by the DG the same as any other load on the system—namely, to assign to that load its share of system's reserves that are held to ensure reliable service.

152 Presentations to the California Energy Commission DER Integration Workshop. Sacramento, CA: May 3–4, 2005:

- Prabhu, E. *Forging a Consensus on Utility System Integration, CEC PIER Contracts*
- Moss, S.; Price, S. *San Francisco as a Distributed Energy Resource "Test-Bed" Site*
- Evans, P. *Optimal Portfolio Methodology for Assessing Distributed Energy Resource Benefits for the Energynet*
- Horgan, S. *Distributed Utility Integration Test*
- Provol, S. *Evaluation of Policy Impacts on the Economic Viability of California Based DG/CHP from a Project Owner's Perspective.*

153 Massachusetts Technology Collaborative; Navigant Consulting. Massachusetts Distributed Generation Collaborative Annual Report 2005. May 31, 2005. This source includes a detailed discussion of the integration of DG into distribution system planning at pages 122–150.

154 Moskovitz et al. *State Electricity Regulatory Policy and Distributed Resources: Distribution System Cost Methodologies for Distributed Generation.* NREL/SR-560-32500. Golden, CO: National Renewable Energy Laboratory, October 2002.

The Electric Power Research Institute DER Public/Private Partnership is undertaking a collaborative stakeholder approach to identify methods for incorporating DER into distribution planning when it brings value. Through this process, stakeholders have resolved difficult issues, including how a distribution company can identify the value of deferring distribution upgrades. The stakeholders have agreed that a utility can disclose a market reference price based on the carrying cost of capital for distribution deferrals.[155]

Averaged distribution prices mask the wide geographic variation in distribution costs within an individual distribution company's service territory. One option is for the company to charge different customers different rates based on where they are on the distribution system, or de-averaging rates. Utility regulators have found this sort of de-averaging of rates to be unacceptable because it is hostile to the application of the traditional regulatory principles of equity, simplicity, and ease of administration. But there are practical alternatives to the de-averaging of distribution rates These are de-averaged distribution *credits* and distributed resource development zones.[156] A de-averaged distribution credit would allow a utility, as well as a DG customer, to benefit from the cost reduction associated with installation of DG in high-cost areas of the network, which thereby defers incremental distribution system investment.

> The term "de-averaged credits" is shorthand for a family of related policy options that provide cost-effective economic incentives to concentrate distributed resources in high-cost areas. Distributed resource development zones, for example, would designate geographic areas and set a standard credit for all qualifying distributed resources located in an area. A distribution value bidding scheme could be used to invite competitive proposals from distributed resource vendors. The amount of the credit requested in the bids would be one of the criteria used to select the winning distributed resources.[157]

Detroit Edison, an investor-owned, vertically integrated utility (a subsidiary of DTE Energy) has been taking a proactive approach for incorporating DG into the distribution planning process. Detroit Edison sees DG as one of the viable solutions for distribution planning. It also regards DG as "one way of delivering just-in-time and 'right-sized' capacity to resolve smaller short falls while minimizing the initial capital outlay."

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155 Petrill, E. *Shaping a California DER Procurement Through Stakeholder Collaboration.* Presentation to the California Energy Commission DER Integration Workshop. Sacramento, CA; May 3, 2005.

156 Moskovitz et al. *State Electricity Policy and Distributed Resources: Distributed Resource Distribution Credit Pilot Programs—Revealing the Value to Consumers and Vendors.* NREL/SR-560-32499. Golden, CO: National Renewable Energy Laboratory, October 2002.

157 *Id.*, p. 5.

The company considers DG in three areas of distribution planning: (1) internal to the distribution circuit, (2) at the substation, and (3) in an island mode for maintenance purposes. It is also partnering with customers on overloaded circuits and installing DG on such customer sites. Costs and benefits of such DG projects are shared with customers, and the onsite generation is owned and monitored by the company. For most DG applications, Detroit Edison has installed diesel and natural gas combustion engines. However, for technology demonstration purposes, it has installed alternative technologies such as fuel cells, photovoltaics, and flow batteries.[158]

The diversity and probability analysis discussed in the previous section is critical to fully evaluate the ability of DG to fulfill a role in utility resource planning.

### *4.1.7. Performance Incentives To Shape Customer Behavior*

One option available to utilities is to design rates in a fashion that encourages customers to operate their DG as much as possible. This is available to utilities, which might seek to align a customer's incentives with minimization of impact on the distribution system, as well as regulatory bodies, which might seek to achieve other policy goals.

In Arizona, one utility charges higher reservation capacity charges to customers whose onsite generation does not maintain a 75% or better capacity factor. Another utility in the state provides a discount or charges a penalty based on the DG customer's power factor (a measure of power quality and the need for reactive power). But there are issues associated with this type of approach, including the treatment of DG operators that choose to run on an economic dispatch basis (i.e., shutting down during off-peak periods to take advantage of lower off-peak utility prices) and the possible correlation of higher DG capacity factors with lower load factors for utility-provided power, which affects cost separation between generation and distribution capacity cost avoidance versus displaced energy valuation.

Another option has been proposed in Hawaii. An unbundled rate for standby service would separate the customer-specific costs of connecting a customer with the utility grid from the costs of joint production and transmission facilities used by multiple customers. The customer would pay a fixed annual fee for the connection to the system (a "capacity reservation" payment) and a variable amount for actual standby service, depending on how much and how often the customer actually requires standby service. With this approach, a customer that used standby service very little (and therefore did not cause the utility to invest in facilities to provide standby service) would pay much less than one who relied on the utility frequently. It would provide an incentive for customers to install reliable equipment and maintain that equipment while ensuring that customers using standby service frequently fairly compensate the utility for providing firm year-round service.

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[158] Asgeirsson, H.; Seguin, R. "DG Comes to Detroit Edison." *Transmission & Distribution World*; October 2002. Available at http://tdworld.com/mag/power_dg_comes_detroit/.

Asgeirsson, H. "Detroit Edison Distributed Resources Utility Applications and Case Studies." Presentation at IEEE Power Engineering Society General Meeting; June 9, 2004.

Proponents of this approach believe that a rate that bundled the full annual costs of standby service for hundreds of days per year into a fixed fee that applies regardless of the frequency of standby use would be an inappropriate standby rate design. A customer that uses standby service frequently should pay a much higher cost than one who seldom requires service simply because the latter customer can "share" standby facilities with many more customers and should be allowed to share the cost of those facilities with other customers that use them.

One variant of this approach shows up in APS's tariff, which allows a customer to identify specific periods and hours of a month during which standby service is required. If a customer uses standby service during non-designated hours more than two times in any rolling 12-month period, the customer is deemed to require standby service in all hours of the month for the next 3 months. This provision provides a significant financial disincentive to use service from the utility in any but the customer's designated hours.

The converse of this approach is to penalize poor generation performance (or higher demand than anticipated). For example, in New York, utility standby tariffs give customers the option to set their own levels of contract demand; this option includes a ratchet and strict financial penalties. For example, in the O&R and Con Edison service territories, the penalty for a 10%–20% excess demand is *12* times the applicable demand charge for the excess demand. When demand exceeds the customer-nominated demand level by more than 20%, the penalty is *24* times the applicable contract demand charge for the excess.

### 4.2. Policy Overlay

The previous section addressed issues associated with identifying the services that DG customers request and designing rates to properly recover the costs of those services. In many states, DG ratemaking is being taken up as part a broader effort to develop a set of state policies to promote DG and capture its expected economic, environmental, and reliability benefits for customers, utilities, and society as a whole. These anticipated benefits go beyond a strict evaluation of electric system costs and benefits of a customer's individual installation. State regulatory agencies may want to design rate treatments to affirmatively promote distributed resources, including clean DG.

A recent report summarizes the mix of direct customer and dispersed societal benefits of DER, of which DG is a subset:

> The benefits associated with DER installations are often significant and numerous. They almost always provide tangible economic benefits, such as energy savings or transmission and distribution upgrade deferrals, as well as intangible benefits, such as power quality improvements that lengthen maintenance or repair intervals for power equipment. Also, the benefits routinely are dispersed among end users, utilities, and the public. For instance, an end user may use the DER to reduce peak demand and save money due to lower demand charges. Reduced end user peak demand, in turn, may lower a distribution system peak load such that upgrades are deferred or avoided. This could benefit other consumers by providing them with higher reliability and power quality as well as avoiding their cost share of a distribution system upgrade. In this example, the costs of the DER may be born by the end user, but that user reaps only a share of the benefits.[159]

In this context, many states will grapple with the following question: Do long-term system benefits and non-participant benefits justify any cost shifting—including exemptions from certain charges, favorable treatment for DG customers, or incursion of short-term costs to obtain anticipated long-term benefits?[160] A state can pursue several options for providing explicit rate treatment in recognition of the dispersed benefits associated with DG. In contrast, some states may determine that rates should be cost-based and that it will pursue other policy objectives through non-rate policies, such as distribution system planning.[161]

### *4.2.1. Align Utility Revenue Collection Incentive With Public Policy Goals*

Provisions for utility cost recovery through regulated rates generally contain strong incentives that affect a utility's attitude toward customer installation of DER, including DG and energy efficiency, on the customer side of the meter. Traditionally, utility cost recovery ties utility profits to sales of kilowatt-hours. Thus, a utility's profitability is tied directly to its sales volume, which creates a disincentive to reduce sales (e.g., through energy efficiency or customer-sited DG) and an associated incentive to increase sales.

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159 Poore et al. *Connecting Distributed Energy Resources to the Grid: Their Benefits to the DER Owner/Customer, Other Customers, the Utility, and Society.* ORNL/TM-2001/290. 2001, p. 13.

160 The term "cost shifting" is used in the context of utility rate design to mean the allocation of particular costs of service to a class or classes of customers other than those that can credibly be argued to, in fact, cause those costs. Because the question of cost causation is, in many instances, debatable and other, non-economic bases on which to allocate costs must be relied on, it is probably more accurate to speak of the shifting of "revenue responsibilities."

161 The New York Public Service Commission has taken this approach and will incorporate consideration of broader benefits into distribution system planning rather than modifying rate treatment. *New York Public Service Commission Opinion 01-04.* Oct. 26, 2001, page 27.

Because sales can often be increased in the short term with little or no increase in fixed costs, the profit margin on these sales is very large and constitutes a very powerful financial incentive for behavior that is inimical to improvements in the overall efficiency of the economy. Performance-based ratemaking that breaks the link between sales and profits can theoretically overcome a utility's natural disincentive to support customer load reductions (whether through efficiency or DER).[162]

There are two primary forms of performance-based ratemaking: price caps and revenue caps. Revenue caps are by far the better approach for breaking any link between installation of DG on the customer side of the meter and erosion of a utility's revenue. Under a revenue cap, the utility's revenues are fixed over a certain time period (typically 3–5 years). Because the revenues are fixed, the utility is indifferent, from a revenue perspective, to a customer's installation of DG. Under price cap regulation, where prices are fixed over a specified period of time, the utility's profits are still tied to sales volume, and the utility's profits are affected by reduced sales.

Similar in intent yet different in results is a "lost base revenue approach," which can be used to address a utility's disincentive to reduce throughput. Under this approach, a utility is essentially "made whole" for base revenue lost because of reduced sales corresponding to customer installation of DG. Although it compensates the utility for reduced sales, the lost revenue approach does not remove the utility's financial incentive to increase sales. This approach permits a targeted response to a specific initiative such as the installation of DG; however, it does not address incentives that affect other forms of DER such as energy efficiency.

### *4.2.2. Support Policy Goals With Explicit Exemptions and Incentives*

The simplest kind of policy overlay is a state exemption of desirable DG installations from certain rate components. Previous sections of this paper presented several examples of this. Such favorable treatment for DER can thus provide a "jump start" to the resource. In some instances, this approach can be justified for consistency with other state policies that support clean energy technologies—particularly those that also receive support from state energy funds, thus lowering the cost to the state. Failure to give the exemptions means that the state has policies in place that may, in fact, counteract one another. The exemption can be tied to the date of the DG installation (e.g., as a transitional policy to encourage DG), the resource type (e.g., as a spur for certain types of installations), or to the emissions profile of the DG (e.g., to encourage "clean" DG). Many states are already providing exemptions for customers with DG resources that meet state-established criteria of size limits and technology specifications.

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[162] The Regulatory Assistance Project has written extensively on the subject of performance-based regulation, including approaches to "revenue decoupling." See the Web site at www.raponline.org for multiple publications on performance-based regulation.

As with exemptions, specific incentives can be a policy overlay to cost-based rates for DG customers. A recent paper from E2I discusses various types of incentive programs for DER, including ratepayer-funded direct payments to DG customers that install certain types of DG.[163] The costs and benefits of DG are different from the perspective of the individual customer, distribution and bulk power utilities, utility regulators, and other state policy leaders. Developing appropriate incentives requires careful evaluation of the cost-effectiveness of different options from a variety of perspectives. Although generic costs and benefits of DG installations are widely discussed, the development of specific incentives requires an assessment of the real value associated with specific installations within a real context of location on the delivery system, applicable tariffs, and other state policies. A regulatory agency or legislative body must take into account any potential shifts in class revenues burdens associated with any policy of exemptions or incentives.

### *4.2.3. Develop Volumetric Rates to Shape Customer Behavior*

In many jurisdictions, utilities are favoring, and commissions are approving, recovery of higher proportions of distribution-related costs in fixed charges. The argument for this kind of pricing is that distribution costs are fixed rather than variable with energy consumption. Although this may be true in the short term, it is not in the long term. A long-term view of the distribution system justifies a different cost treatment. Although distribution facilities, like generation and transmission, must be sized to meet instantaneous peak demand, it is nevertheless the case that customers demand energy—and it is changes in the timing and amounts of that demand that drive investment in distribution system upgrades and expansion.

When distribution system costs are recovered in large proportion through fixed costs, customers have no financial incentive to modify their behavior by reducing their energy consumption. Historically, distribution system costs have been recovered through volumetric rates (both per-kilowatt-hour and per-kilowatt), and there is no reason to deviate from the practice. Such rates have the virtue of causing those who consume more to bear a higher proportion of costs and give an incentive to them to cost effectively manage their consumption.[164] Revenue-cap performance-based regulation with volumetric rates would ensure distribution companies fixed revenues while providing customers with incentives to modify their consumption.[165]

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[163] *A Framework for Developing Collaborative DER Programs: Working Tools for Stakeholders.* A report of the E2I Distributed Energy Resources Public/Private Partnership. 1011026. Palo Alto, California: E2I, 2004.

[164] For a fuller treatment of this issue, see Weston, F. *Charging for Distribution Utility Services: Issues in Rate Design.* The Regulatory Assistance Project, December 2001.

[165] Customer reductions in grid-supplied electricity, for whatever reason (DG, end-use efficiency, etc.) are likely to have greater short-term effects on the utility's revenues in cases in which rates recover a significant share of T&D costs through energy-based volumetric rates thau in cases in which these costs are recovered through demand charges. In some cases, the customer bill reductions will exceed the short-run avoided costs (there will be a temporal mismatch between the bill savings and the capacity savings), and regulators may need to take remedial actions. Revenue-cap performance-based regulation, in fact, addresses this problem directly as it insulates the utility's bottom line from the effects from changes in sales.

### 4.2.4. Tie Rate Treatment to Emissions Threshold or Efficiency Threshold

To spur the installation of clean DG, a state can tie rate treatment to attainment of a specific emissions threshold. For example, a public utility commission, working with the state environmental agency, could determine that DG installations that meet an air quality-based emissions threshold should receive favorable treatment because they are consistent with the state's environmental policy goals. This sort of policy overlay uses a tool within one state agency's jurisdiction to reinforce another state policy.

A similar approach would determine that CHP applications that meet a certain efficiency standard could receive more favorable treatment than less-efficient applications or, conversely, that less-efficient applications should be required to pay higher rates than more-efficient ones. This sort of treatment would be an explicit decision by the state that greater efficiency in CHP applications justifies the more favorable rate treatment.

### 4.2.5. Strive for Coordination Among, and Consistency Within, State Policies

Many DG customers expressed frustration with inconsistencies among state policies pertaining to DG as well as with the unpredictability of state policies pertaining to DG. For example, customers stated that agency procedures that include long lead times for issuing permits or that included changes and revisions to standards conflict with a state's policy of supporting or encouraging DG installations. Furthermore, they indicated that when state regulations—such as emissions requirements—change, it makes a customer's cost-benefit analysis difficult. Better coordination among the rules of state agencies would facilitate DG adoption by customers. Without coordinated and consistent policies and without policy stability, it is difficult for customers to determine the cost-effectiveness of an installation.

Ideally, within a state, there would be a high-level commitment to the development of DG to meet state policy goals, and that commitment would translate into a mandate for all state agencies to review their policies and procedures to ensure they are consistent with the goal of increasing the penetration of, for example, clean, customer-sited DG. California is one state that has a high-level mandate for the introduction of DG, and it has developed an on-going coordination framework through the Distributed Energy Resources Web site. Even so, customers still find hurdles associated with conflicting and changing state policies. Massachusetts has an ongoing multi-stakeholder collaborative process; however, the state has not made a high-level commitment to DG. Having a DG champion within a state government can make a significant contribution to the development of effective and coordinated state policies.

Beyond policy coordination, it is important that there be coordination and consistency of data collection regarding the operation and performance of DG. Such data collection will assist state agencies in evaluating the success of implementation of policies and in further refining policies to achieve intended outcomes.

### *4.2.6. A Word on Carbon Policy*

One of the policy drivers behind certain state policies on DG is the anticipation that increased penetration of clean DG will improve the environmental footprint of the electric system. State policy leaders desire to integrate energy and environmental policy because DG is widely perceived as providing significant potential for meeting economic and environmental policy goals. One of the most straightforward ways to ensure that energy and environmental policies are integrated would be to adopt a state-wide or nation-wide policy on carbon emissions. Carbon taxes and carbon cap-and-trade systems are comprehensive policies that could create incentives for efficient CHP, and clean DG, if a program took a broad look at all resources.

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**14. ABSTRACT** *(Maximum 200 Words)*
Recognizing that innovation and good public policy do not always proclaim themselves, Synapse Energy Economics and the Regulatory Assistance Project, under a contract with the California Energy Commission (CEC) and the National Renewable Energy Laboratory (NREL), undertook a survey of state policies on rates for partial-requirements customers with onsite distributed generation. The survey investigated a dozen or so states. These varied in geography and the structures of their electric industries. By reviewing regulatory proceedings, tariffs, publications, and interviews, the researchers identified a number of approaches to standby and associated rates—many promising but some that are perhaps not—that deserve policymakers' attention if they are to promote the deployment of cost-effective DG in their states.

**15. SUBJECT TERMS**
distributed generation; DG; distributed energy resources; DER; interconnection; partial-requirements customers; tariffs; regulatory; National Renewable Energy Laboratory; NREL

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# The Legal Case against Standby Rates

*Under rates approved by many state commissions, on-site investments are blocked and/or dis-incentivized by policies that place the interest of utility shareholders before the interests of the public.*

*Sean Casten and Myra Karegianes*

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One of the most pervasive barriers to the deployment of clean, low-cost electricity is the prevalence of rate structures that penalize locally sited generation. By blocking the deployment of local power, these rate elements raise the cost of electricity, decrease system reliability, and unnecessarily increase the pollution associated with power generation. They are also incompatible with modern utility law.

## I. Background

A grid with multiple local generators provides reliable service with less generation and transmission capacity than one that relies on remote, central generation, saving ratepayer capital. Local generation also enables lower on-peak grid loads, reducing system losses and the need for expensive marginal generation sources.

Typical local generation is available over 95 percent of the time,[1] with approximately half of the outages due to planned maintenance. The remaining 2.5 percent outage rate is random and could occur during the local utility's peak demand, but the 2.5 percent maintenance outage rate can be scheduled during periods of low load on the local grid.[2]

Thus, there is a 97.5 percent probability that the local

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generation will be operating during local grid peak and reduce the need for grid wires and generation, as compared to a 2.5 percent probability that the grid will need to supply the load during peak. A grid with multiple local generators therefore provides reliable service with less generation and transmission capacity than one that relies on remote, central generation, saving ratepayer capital. Local generation also enables lower on-peak grid loads, reducing system losses and the need for expensive marginal generation sources.

Despite such benefits, rates developed for on-site generators focus almost exclusively on the costs needed for backup during those rare 2.5-percent-probability events. Ignoring the benefits that accrue during the remaining 97.5 percent of the time creates a windfall for utility investors at the expense of their customer base.[3] Why?

## II. Typical Standby Rate Design

In theory, electricity prices ought to serve both as a means for utilities to recover their costs and as an incentive for consumers to use power efficiently. In practice, conventional rate structures often make a kilowatt-hour of conservation much less valuable – on a cent/kWh basis – than a kilowatt-hour of consumption. From declining-block pricing schedules to demand ratchets, a host of rate elements insulate utility shareholders from the downside risks of sales volatility – and thereby lower the economic incentive for efficiency. In so doing, these rate structures implicitly shield regulated utilities from competitive market discipline. The anti-competitive consequences are seen most starkly in standby rates, where the economic disincentive to reduce purchases from the utility is applied selectively to those customers who elect to source their electricity from a competitive, on-site generator.

*Despite the benefits, rates for on-site generators focus almost exclusively on the costs needed for backup.*

While standby rates vary, the most common replaces a variable energy charge ($/kWh) with a demand charge ($/kW) calculated on a rated generator's output. As a result, customers considering an on-site generator in order to save $/kWh fees find those savings offset by increased $/kW payments to their electric utility.

The first and often most glaring flaw in these rates is one of simple logic. Rate-making theory says that rates should – to the extent possible – be based on marginal costs, the better to ensure economically optimal decision making by electricity consumers. But consider the signal sent by conventional standby rates: If a customer increases her electricity consumption, utility revenues rise through kWh sales – but if that same customer decreases her load by using an on-site generator, utility revenues remain essentially flat as $/kW fees offset falling kWh demand. This result is consistent with marginal-cost rate making theories only if utility cost structures magically shift from fixed to variable when consumption increases. Of course they do not, so these rates fail even the most cursory considerations of rate-payer equity.

These logical failings of standby rates have been detailed by one of the authors elsewhere,[4] as have the adverse policy consequences of the regulatory paradigm from which these rates derive.[5,6]

Yet comparably little has been written to counter the assertions by regulated utilities that – policy consequences notwithstanding – utility commissioners are legally obliged to approve those rate elements. While these arguments vary from rate case to rate case, they can be broadly generalized as follows: Utility monopoly franchises provide a guaranteed recovery of commission-approved costs. Ergo, according to these arguments, any reduction in utility

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returns caused by competitive power sources constitutes a "takings violation" under the Fourteenth Amendment. Since commissioners are understandably reluctant to approve rates that might face constitutional challenge, these utility arguments have tended to prevail.[7] But at the same time, it is reasonable to wonder why we are legally obliged to oppose technologies that lower the cost of power, reduce greenhouse gas emissions, and facilitate a more competitive and resilient U.S. electric grid.

This article has been written to refute the assertion that utilities have a constitutional right to cost recovery where that cost recovery comes at the expense of the consumer interest. We urge state and federal utility commissions to counter those claims not with policy – which sadly has little place in the resource-constrained environment of the modern rate case – but rather with direct citation of those federal cases that have considered the appropriate way to balance the interests of utility shareholders and utility customers in the face of declining utility revenues and competitive sources of supply.

## III. Case Histories

We explore three cases that form the basis of modern ratemaking law as it applies to adjustments in revenue recovery in the wake of declining utility sales:[8] *Federal Power Commission v. Hope Natural Gas*,[9] *Market Street Railway v. Railroad Commission*,[10] and *Public Service Company of Indiana, Inc. v. Federal Energy Regulatory Commission*.[11] Collectively, these cases provide ample legal framework to challenge most standby rates and to help commissioners reconcile the good of the consumer with the financial desires of regulated utilities.

*This article has been written to refute the assertion that utilities have a constitutional right to cost recovery where that cost recovery comes at the expense of the consumer interest.*

### A. Federal Power Commission v. Hope Natural Gas

On its face, *Hope* simply reviewed the best way to calculate total capital costs for the purposes of determining appropriate rates from regulated commodities. However, its scope and precedent were much larger, going to the heart of the regulatory compact and the need for regulators to balance the conflict between shareholders and the public interest that is innate to all regulated monopolies. By exposing this conflict, *Hope* directed regulators to consider the broader public interest when crafting rates.

Questions about the appropriate way to quantify utility capital costs had risen to the Supreme Court in multiple cases before 1944. In the 1898 case *Smyth v. Ames*,[12] the Court said that capital costs should be determined

> ... upon the basis of what it would cost to duplicate the property at the present time.[13]

This approach theoretically ensured that technological innovation would always lead to lower costs, even if affected utilities did not embrace new, lower-cost approaches. Regulated utilities, however, contested the ruling, arguing that their obligations to the public service often compelled them to make capital investments based on urgent public needs and, thus, that a purely "replacement cost methodology" could encourage a conservative approach to capital deployment that conflicted with the public interest. These arguments prevailed in the 1923 case *Southwestern Bell Tel Co. v. Public Service Company of Missouri et al*,[14] when the Court overruled *Smyth* and said that utilities could earn returns on

> ... capital prudently invested in the utility ...[15]

By shifting from a replacement-cost to a prudent-cost methodology, *Missouri* lowered the capital risks associated with the utility enterprise, but it provided no quantitative way for

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a utility regulator to ensure fiscal discipline. Prudence is, after all, in the eye of the beholder.

When the *Hope* case reached the Supreme Court in 1944, the time was ripe to develop a more solid foundation for future rates that would not be subject to subsequent modification.

The Court quickly rejected the absolutism of earlier decisions, but did so in such a way that has direct relevance to today's standby rate design when they held not only that the Constitution does not prescribe any one ratemaking methodology, but also that *there is no constitutional guarantee of recovery for utility costs*. In the Court's words:

> ... [r]ate-making is indeed but one species of price-fixing. The fixing of prices, like other applications of the police power, may reduce the value of the property which is being regulated. But the fact that the value is reduced does not mean that the regulation is invalid.[16]

Citing its decision in Federal Power Commission v. Natural Gas Pipeline Co.[17] the Court stated:

> ... the Commission was not bound to the use of any single formula or combination of formulae in determining rates... Under the statutory standard of 'just and reasonable' it is the result reached not the method employed which is controlling. It is not theory but the impact of the rate order which counts.[18]

This finding raises the obvious question as to what "impacts" ought to factor into rate design. The Court was not proscriptive on this point, except to note generally that rate setting:

> ... involves a balancing of the investor and the consumer interests.... [and] regulation does not insure that the business shall produce net revenues.[19]

In this specific instance, the justices found that the interests of investors had already been met, and further price increases were not warranted by this need for balance. Commenting on existing rates, the Court stated:

> ... [r]ates which enable the company to operate successfully, to maintain its financial integrity, to attract capital, and to compensate its investors for the risks assumed certainly cannot be condemned as invalid...[20]

*The Court rejected the absolutism of earlier decisions, but did so in such a way that has direct relevance to today's standby rate design.*

### B. Application to modern standby rates

*Hope* clearly establishes a framework within which commissioners could justify a consumer interest that must be satisfied even if that satisfaction does not allow for the recovery of utility capital at the same rate contemplated in an earlier rate case. Indeed, by contemplating the potential for negative "net revenues," the decision allows for the consumer interest to trump even when utility returns are non-existent. Further, while not explicitly contemplated in the case, the decision suggests that the consumer interest might include not only the cost of utility services, but also its reliability and environmental consequences. On all of these grounds, *Hope* provides a solid framework to challenge standby rates through specific references to the public benefits that accrue from cleaner, cheaper, privately owned generation.

*Hope* also makes it quite clear that the interests of investors and consumers are not perfectly aligned. This clarity is of particular relevance to standby rates, which are typically framed as if the conflict between these two interest groups does not exist. Regulated utilities often argue that absent a standby rate, they will be compelled to raise other rates, creating an apparent conflation of their interests with those of their customers. This argument is politically crafty, but – as *Hope* makes clear – financially dubious, as well as worthy of much greater vigilance than is found in many standby rate proceedings.[21]

However, we should be clear that while *Hope* provides a

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framework within which utility returns might be reduced in the name of the public interest, it does not provide a specific precedent for same. This precedent would come a year later in *Market Street*.

### C. Market Street Railway v. Railroad Commission

*Market Street* took *Hope* a step further by explicitly recognizing the beneficial effects of unfettered economic forces *external* to the regulated enterprise. It also strongly suggested that utility rates should not exist solely to protect utility shareholders from those same market forces.

In this particular case, the Court considered the appropriateness of a rate increase to a San Francisco cable car line that had suffered steadily decreasing customer use due (among other things) to the advent of the automobile. This situation is interesting in the context of standby rates, which exist solely to increase utility revenues in order to make up for those lost to competition. Where a strict interpretation of *Hope* argues that standby rates are at best overstated, a similarly strict interpretation of *Market Street* implies that all standby rates should be eliminated in the name of the public interest.

Prior to the case, the state railroad commission reduced the rates of a San Francisco street car utility company. The utility asserted that this reduction deprived it of its property without due process and was contrary to the Fourteenth Amendment – precisely the same argument advanced by modern electric utilities to justify standby rates. This case, therefore, deserves careful review.

In concluding that there was no due process violation, the Court held:

> ... it may be safely generalized that the due process clause never has been held by this Court to require a commission to fix rates on the present reproduction value of something no one would presently want to reproduce, or on the historical valuation of a property whose history and current financial statements showed the value no longer to exist, or on an investment after it has vanished, even if once prudently made, or to maintain the credit of a concern whose securities already are impaired. The due process clause has been applied to prevent governmental destruction of existing economic values. It has not and cannot be applied to insure values or to restore values that have been lost by the operation of economic forces.[22]

*The Market Street case strongly suggested that utility rates should not exist solely to protect utility shareholders from market forces.*

Under the facts of *Market Street*, the Supreme Court found that the utility company's investment was economically impaired and its earnings abilities reduced by competition from alternative forms of transportation, such as the automobile and other bus lines. In noting that:

> ... no responsible person would think of reproducing the present plant, consisting in substantial part of cable cars and obsolete equipment,[23]

the Court implicitly acknowledges the market-constraining impacts of regulated utilities and that utility shareholder interests in the recovery of past investments cannot be allowed to interfere with economic progress. The benefits of economic progress that accrue to consumers, even at the expense of utility shareholders, thus emerge from *Market Street* as a part of the "balancing of investor and consumer interests" provided by *Hope*.

### D. Application to modern standby rates

When an *unregulated* monopoly can use price controls to prevent competitors from entering its market or to prevent the arrival of competitive technologies, it is understood to be contrary to the public interest and no shortage of legislation has been crafted to protect against this abuse of market power. When a *regulated* monopoly seeks the same ends, however, it pursues this path through commission-approved rates that are not subject to antitrust legislation. In *Market*

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*Street*, the Court acknowledges the adverse consequences of such action, and it provides a legal basis for utility commissions that seek to protect consumers from this form of abuse.

But perhaps the most interesting question that *Market Street* raises with respect to standby rates is whether a "responsible person" would reproduce the electric grid in its current configuration. Rigorous analysis of capital deployment by regulated U.S. utilities over the past three decades shows that utilities have consistently failed to deploy the most cost-effective technologies to serve new load.[24] Moreover, this work concludes that the most cost-effective investments have been local on-site generators. These installations by unregulated market participants are precisely the competition from which regulated utilities seek protection through standby rates.

Unregulated consumers install on-site power – even after taking into account higher costs-of-capital and no rate-payer guaranteed recovery – because such generators provide their owners with lower electricity costs than utilities can provide. Thus, standby rates block precisely the same "economic forces" that led the Court to condemn the rates sought by the streetcar utility in *Market Street*. Most – if not all – standby electric rates presently in effect could be overturned on the same grounds.

### E. Public Service Company of Indiana, Inc. v. Federal Energy Regulatory Commission

Our final review is of a case that stipulates the acceptable range within which different customers can be charged different rates. By the Court's principles, virtually every standby rate in the country can be deemed unduly discriminatory.

Why do we have regulated monopolies? At core, because we believe certain public benefits would not otherwise be realized in an unregulated market. Alfred Kahn, former chairman of the Civil Aviation Administration, Federal Communications Commission, and New York Public Service Commission, pointed out as much when he described one of the challenges of deregulatory processes as follows:

> ... [utilities have a] corollary goal of preserving those distorted, cross-subsidizing rate structures... [and] regulators and incumbents alike attempt to preserve the artificially elevated prices needed to finance cross-subsidies.[25]

From low-income housing support to rural electrification, it is widely understood that a goal of regulation is to provide discriminatory rate treatment to disparate customers. However, it is also understood that this motivation conflicts with the "cost-causer pays" principles associated with economic efficiency. The 1935 Federal Power Act sought to distinguish between these two conflicting motivations with the word "undue:"

> No public utility shall... (1) make or grant any undue preference or advantage to any person or subject any person to any undue prejudice or disadvantage, or (2) maintain any unreasonable difference in rates, charges, service, facilities, or in any other respect, either as between localities or as between classes of service.

So when does good prejudice become undue prejudice? Clarity on this question would not arrive for another 43 years, in the form of the 7th Circuit Court's 1978 decision in *Public Service Company of Indiana*.[26]

The case consolidated five appeals from the Federal Power Commission's[27] (FPC's) prior approval of wholesale power rates the Indiana electric utility could charge its wholesale customers. Specifically, the Court was asked to consider whether the increases passed along to five municipal customers were "just and reasonable," and whether the large disparity between those

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rate increases was "unduly discriminatory," as those terms were defined in the 1935 Federal Power Act. The appeal was based in part on the city of Frankfort's contention that its higher rate was unduly discriminatory.

The Court, quoting *St. Michaels Util. Comm'n v. FPC*,[28] first acknowledged that price differentials between customers are not *per se* unduly discriminatory, because

> ... [d]ifferences in rates are justified where they are predicated upon differences in facts.[29]

The Court found that these "facts" were not established since the FPC had not conducted the analysis necessary to refute Frankfort's claims.[30] The Court's framework, as noted below, is that once a customer shows a disparity in rates, the utility must justify the specific rate differences and the commission must analyze whether the facts of a particular case justify the difference in treatment.

> [A]ll that [a customer] was required to do was show that a substantial disparity in rates existed between customers of the same class. It then became incumbent on [the utility] to justify that disparity on the basis of factual differences. The [commission]... must show not only that factual differences justify some rate differences, but also that the factual differences justify the specific rate differences permitted.[31]

The Court went on to consider the definition of the qualifier "undue" in the FPA's prohibition of undue discrimination, first by noting that:

> ... the difference between the rates charged to Frankfort and the other cities may be excessively discriminatory. That conclusion does not require, *a fortiori*, the conclusion that the rates are unduly discriminatory. ... The purpose behind section 205(b) [of the Federal Power Act] is the protection of

> the consumer's interest ... and the purpose behind section 206 [of the Federal Power Act] is the protection of the public interest. Discriminatory rates that are inconsistent with the interests of a consumer need not be inconsistent with the public interest.[32]

Thus, by implication, a rate is not unduly discriminatory unless it is contrary to the public (as opposed to a specific consumer's) interest. The Court then outlined a test driven by a consideration of the impacts on so-called "similarly situated" consumers.

> In our view the anti-discrimination policy in section 205(b) is violated in a case such as this where one consumer has its rates raised significantly above what other similarly-situated consumers are paying. In such a case, the lone consumer would be placed in an unjustifiably non-competitive position, and thus should have recourse to the FPC under section 205(b). Section 206's ban on [undue] discrimination may be breached in a case where one customer is afforded, without any factual justification, a contract rate that is significantly lower than the pre-existing rates for all other members of the class.[33]

This decision suggests two clear tests for undue discrimination. First, the class must be defined under which differential rate treatment is sought. Second, the factually justified cost characteristics of that class must be compared to those of similarly situated customers. Absent a demonstration that there is either a unique definable class, or that this class has differentiable cost characteristics, one would necessarily conclude that differential rate treatment between those classes is unduly discriminatory.

We are aware of only one standby rate case that has even applied this test, much less accepted or rejected a standby rate on its conclusions. But that case is instructive. The 2003 standby rate case filed by NSTAR in Massachusetts[34] was opposed by a large coalition of industrials, manufacturers, and on-site generation developers, which mounted a vigorous refutation of the facts presented by the utility. The analysis mirrored an informal review done for MassElectric in 1999. In both instances, the load

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characteristics of customers with on-site generation *as a class* were compared to other, similarly situated customers in the same rate classification who did not have on-site generation. The explicit purpose of the analysis was to test whether the utility's assertion that the reduction in sales caused by on-site generation led to a class-differentiable impact on the utility's fixed-cost recovery. The class-specific nature of the analysis is critical, since no two customers have identical load profiles. Changing rates because a specific customer's kWh usage falls after she installs an on-site generator is unduly discriminatory unless such charges are equally applied to other customers whose kWh usage falls in a similar manner but for other reasons (e.g., more efficient motors, shifting manufacturing schedules, etc.). Of course, differential rate treatment would be justified if all customers with on-site generation were to show loads that are demonstrably "peakier" than other similarly situated customers.

The reviews found no statistically significant difference between the two Massachusetts populations. Thus, under the principles established in *Public Service Company of Indiana*, the application of a standby rate in this instance would have been unduly discriminatory.[35]

But this case is the exception. Most standby rates are justified simply because a *specific* customer will purchase fewer kWh after she installs an on-site generator, rather than any consideration of those customers as a class. Such customer-specific analyses not only fail to perform the "similarly situated" test, but also fail to demonstrate that the requested rates are justified by "factual differences" in the load

characteristics of the affected class.

We acknowledge that in many instances – including the Massachusetts example cited above – the resulting rates are approved in spite of (or in lieu of) the factual analysis urged by *Public Service Company of Indiana* (e.g., by settlement external to formal Commission vote). These settlements are politically tempting, especially given the charged nature of many standby rate cases. However, they are chronically prone to faulty outcomes due to the inequity of resources between the utility and other parties. More perniciously, most of the parties who realize negative consequences from the standby rate are not parties to the settlement, significantly biasing the settlement process in favor of utility shareholders.[36] For example, industrials that have not yet considered on-site generation will find themselves with less economic incentive to make those future investments if a standby rate is approved – but they have no obvious reason to participate (or even to be aware of the need to participate) in most rate cases. In addition, manufacturers of on-site generation equipment often have operations in multiple utility jurisdictions and cannot afford to engage in every rate case in every state in which they operate. Even in the rare instance where all sides are amply represented, many commissions accept settlements that are not enjoined by all intervening parties, thus allowing for the appearance of agreement in situations where the majority of the affected parties disagree.[37]

This inherent inequity argues against settlement processes in standby rate proceedings, and it highlights the need for commissions to assess facts and "balance investor and consumer interests." Settled rates, in short, are rife for partial and/or faulty factual analysis.

## IV. Conclusions

The U.S. electric system is in desperate need of economic and environmental reform, but neither is possible without rate and/or regulatory change. We face increasing bottlenecks in the

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transmission grid, as well as capacity constraints in the coal and nuclear fleet that has long formed the low-cost, baseload floor on power prices. Having used up the reserve margin built into the coal fleet before the Clean Air Act was passed, new coal facilities will be drastically more expensive – and even more so if legislators enact carbon restraints. Meanwhile, the Clean Air Interstate Rule, Clean Air Mercury Rule, and the recent Supreme Court ruling in *Environmental Defense et al. v. Duke Energy Corp. et al.*[38] have forced existing coal plants either to comply with the Clean Air Act (mandating more capital and less fuel efficiency) or to shut down. All of these trends are conspiring to drive up the cost of electric power, as recent rate filings attest.

Despite these macro trends, the political reality is that the public holds present slate of elected officials accountable when rate increases come, even if the underlying causes were many electoral cycles in the making. Legislators in Maryland and California know this far too well. Commissioners and governors throughout the nation, therefore, are looking for ways to blunt the political fallout of the seemingly inevitable rate increases.

On-site generation may not be able to reverse these big trends completely, but it at least moves in the right direction. It eases the burden on constrained distribution grids. It reduces the need for more inefficient (and dirty) central power. By generating at or near the load, it both reduces distribution losses and enhances overall system reliability. And when it is installed by unregulated actors (as virtually all of it, to date, has been), on-site generation achieves these benefits without burdening ratepayers.

Yet under rates approved by many state commissions, these

on-site investments are blocked and/or dis-incentivized by policies that place the interest of utility shareholders before the interests of the public. Although the policy arguments for greater deployment of these technologies are no longer debated by anyone without a financial interest in the status quo, narrow, legalistic arguments too often have favored utility cost recovery. Those arguments, fortunately, are refutable, and it is our hope that this review of relevant court cases helps commissioners do so.■

**Endnotes:**

1. Energy and Environmental Analysis, *Distributed Generation Operational Reliability and Availability Database*, Arlington, VA, Jan. 2004. Prepared for Oak Ridge National Laboratory under ORNL Subcontract No. 400021456. This database is a compilation of actual, in-field data from the installed fleet of distributed generators.

2. While these maintenance outages can be scheduled to occur during off-peak times, it bears noting that many standby rate structures are based on 12-month ratchets and thus provide no differential incentive for local generator owners/operators to schedule their outage around grid needs. Thus, notwithstanding this article's larger conclusions, those standby rate tariffs that have been passed by state commissions can often provide no incentive for affected customers to operate their generators in way that would create maximum grid benefit.

3. Readers interested in more statistically rigorous analysis of local generation's impact on the grid are encouraged to review "Electric Power Systems Under Stress: An Evaluation of Centralized Versus Distributed System Architectures," the Ph.D. thesis of Hisham Zerriffi (Carnegie Mellon University, Engineering and Public Policy Department, 2004).

4. Sean Casten, *Are Standby Rates Ever Justified? The Case Against Electric Utility Standby Charges as a Response to On-Site Generation,"* ELEC. J., May 2003.

5. Thomas Casten and Sean Casten, *Transforming Electricity*, NORTHEAST MIDWEST ECON. REV., Nov./Dec. 2001, at 3–7.

6. Sean Casten, *Five Aces and a Winking Dealer*, STRAT. PLANNING FOR ENERGY AND ENV'T., 23:2, Fall 2003, at 61–80.

7. Indeed, this is precisely the logic that led the restructured states to allow "stranded cost" recovery for utility assets that were not expected to be competitive once exposed to market forces.

8. Although the cases cited herein are federal cases, the utility regulatory rate setting theories, including the concepts of "just and reasonable," "prudent costs," "undue

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discrimination," and others are universally accepted and can be found in state statutes and/or state case law.

9. 320 U.S. 591 (1944).

10. 324 U.S. 548 (1945).

11. 575 F.2d 1204 (7th Cir. 1978).

12. 169 U.S. 466 (1898).

13. *Id.*, at 549.

14. 262 U.S. 276 (1923).

15. 262 U.S., at 310.

16. 320 U.S., at 602.

17. 315 U.S. 575 (1942).

18. 320 U.S., at 602.

19. *Id.*, at 602.

20. *Id.*, at 605.

21. This would not be the last time that the Court rebuffed utility assertions that their shareholder interests were consistent with those of their customers. In the *Public Service Company of Indiana* case discussed later in this document, the Court comes close to ridiculing this assertion when they write that "It is somewhat incongruous for [the utility] to argue as to the best interests of [its customer]. It nonetheless has helped to make a persuasive showing that that [customer] might be injured by the rate disparity... While our decision potentially lowering the rates charged to [the customer] is not what [the utility] has requested, it should at least assuage its concerns about [their customer]." (575 F.2d 1204 (7th Cir. 1978)_.

\22. 324 U.S., at 567.

23. *Id.*, at 564.

24. Benjamin K. Sovacool and Marilyn Brown, Eds., ENERGY AND AMERICAN SOCIETY: THIRTEEN MYTHS. (Springer, 2007).

25. Kahn, Alfred E., *Lessons from Deregulation: Telecommunications and Airlines after the Crunch*, AEI-Brookings Joint Center for Regulatory Studies, Washington, 2004, available at http://www.aei-brookings.org/publications/abstract.php?pid=400.

26. 575 F.2d 1204 (7th Cir. 1978).

27. The FPC was renamed the Federal Energy Regulatory Commission in the interval between the initial dispute and the decision in 1978.

28. 377 F. 2d 912, 915 (4th Cir. 1967).

29. 575 F.2d, at 1208.

30. Ironically, the FPC suggested that this analysis was Frankfort's responsibility.

31. 575 F.2d, at 1210.

32. *Id.*, at 1211.

33. *Id.*

34. MA DTE 03-121.

35. Ironically, in the case of the 1999 informal analysis the conclusion was that Mass Electric could not justify the imposition of standby charges because of the similarly situated test, but in the NSTAR case, the Commission approved a rate by settlement rather than make a decision on the facts of the case. While this speaks volumes about the politics of rate cases – and utilities' ability to steer outcomes accordingly – the case record is still worth the time to review for the way it thoroughly dismantles all arguments in favor of the standby rate. Sean Casten was an intervenor and active participant in the DTE 03-121 proceeding.

36. It is axiomatic that all interests of utility shareholders will be represented in a standby rate case, but all interests of affected non-utility businesses and consumers will not be. Thus, a simple tabulating of the votes in a settlement is always prone to be overly biased in favor of utility shareholder interests.

37. This is what occurred in the Massachusetts case, where the affected industrials and large DG manufacturers who represented the majority of the affected kWh – but the minority of the intervening parties – were not party to the settlement. There are noteworthy state-specific efforts to address this particular failing, such as in Illinois, where settlements must be joined by all intervening parties in order to be accepted. However, even this approach does not address the inequities faced by parties who were unable or unwilling to intervene in the case.

38. 549 U.S. (2007).

*New coal facilities will be drastically more expensive – and even more so if legislators enact carbon restraints.*

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# I. Introduction

When examined from the perspective of traditional ratesetting criteria, such as efficient capital allocation and incentive compatibility, standby rate design in North America could be greatly improved if techniques borrowed from the insurance industry were applied. Alternatively, taking the view that standby rates are a form of an option also provides meaningful insight. Although these topics have been explored to some degree in the *Electricity Journal* and elsewhere,[1] we believe that a better framework is warranted. Even when existing standby rate designs are examined on the traditional basis of revenue sufficiency, reliability, and cost causation, there are several inconsistencies. The impact on revenue sufficiency is poorly estimated; the potential risks to reliability, and the assumptions used to determine cost causation by customers on standby rates are exaggerated. We suggest adoption of standby rates based on insurance pricing principles and development of "as available" standby rates. If necessary, the insurance approach can be simplified through use of a menu of insurance options.

## A. What are standby rates?

Distributed generation (DG) makes the issue of standby rates increasingly important, as standby service is a key component of DG economics. DG can be defined as small (less than 5 MW) generation of various technologies designed primarily to reduce or eliminate customer grid usage during certain periods. It may or may not rely on net metering, supplying power in excess of host needs into the distribution grid in return for a discount on host power bills, but it is not designed for wholesale generation sales or to supply power to the high voltage transmission grid.

Depending on the load shape of its host, a DG resource may supply all or part of the host's load. During such periods, the host may be off-grid entirely. However, when the DG resource needs to be removed from service for maintenance, is on a forced outage, or is unable to run due to lack of fuel availability, the host needs to obtain power from alternative resources, mainly the distribution grid. When the host relies on the grid in lieu of DG resources, it must pay for such usage. The rates that the host pays under such circumstances are referred to as *standby rates*. In this paper, we are focused solely on the rates that the distribution utility charges to provide such standby service. In practice and in theory, rates for such standby service generally include some form of a reservation or fixed charge, a volumetric charge when used, and an additional charge for the cost of the energy transmitted. This latter charge would incorporate all upstream charges, such as transmission charges, ancillary services, and system and market operator charges.

A distribution utility operating under a standard cost-of-service regime may be incentivized to discourage DG. This is not solely based on the fact that it may earn less under the volumetric portion of its tariff if DG becomes widely established. It also reflects the Averch-Johnson effect,[2] in which utilities may due to the nature of cost-of-service regimes seek to over-capitalize their networks. If the primary source of earnings growth is the ability to increase capital investments, burgeoning DG investment may make it more difficult for the distribution utility to achieve its own financial objectives. Under such circumstances, utilities are likely to advocate for tariffs rates which, while ostensibly designed with revenue sufficiency and cost causation in mind, actually serve as a barrier to most forms of DG. This is in no way intended to suggest that all forms of DG are necessarily "good" (as we define the term, leading to an increase in social welfare), but rather to highlight the fact that utilities currently have an embedded incentive to discourage DG.

## B. Typical current stakeholder positions

There tend to be two diametrically opposed positions when it comes to the design of standby rates: a traditional regulated utility approach, which argues that "standby" customers should be treated no differently than a normal low load factor demand customer (i.e. charged the fixed portion of the standard applicable rate, and the volumetric portion of the rate only when not using DG), and the DG advocates approach, which is to minimize or eliminate fixed charges and have minimal volumetric rates. Neither view is consistent with fundamental economic principles.


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### 1. *Utility views*

Utilities make several arguments with regards to the design of standby rates. First, they argue that they have an "obligation to serve" and must configure their system in a fashion that would allow every customer, after being connected, to be served with the expected degree of reliability implicit in the utility's tariff. Even if we accept this argument in determining cost causation, some form of probability analysis needs to be carried out. Distribution rates are not designed under the assumption that every possible light fixture and electric appliance is on at the same time. Likewise standby rates cannot be designed with the view that all DG resources will be off at peak hours, or even that a single resource will be off at the exact moment when no additional capacity is available.

The "obligation to serve" argument bears further scrutiny. Utilities have for many years in many jurisdictions offered large customers "interruptible" service. Such rates could be considered a voluntary election on the part of customers to relax the utility's obligation to serve. It is possible to offer a similar "as available" standby service, which would mean that the utility would be allowed to exclude or assign a lower weighting to such customers from peak load calculations for system planning purposes. This would then provide a justification for reducing estimates of cost causation for "as available" standby customers, and in turn for reducing the corresponding standby rates.

Second, utilities also argue that DG resources, which serve existing load, result in lost revenues under a volumetric rate design. The point is a consideration for a lost revenue adjustment mechanism (LRAM), rather than the design of stand-by rates. Utilities also express concerns regarding the potential for cross-subsidization. While such concerns may be valid, and indeed drive consideration of the potential for rate arbitrage, the potential for cross subsidization goes both ways: highly reliable DG systems which pay a high fixed monthly charge relative to their capacity are essentially cross subsidizing other customers, because such DG systems are paying for distribution capacity that they are not using.

### 2. *DG proponent views*

DG proponents note that DG competes against the delivered cost of electricity. High standby rates erode DG's competitive advantage, and in extreme cases force DG to compete based on wholesale generation prices rather than on a delivered basis. Applying standard delivery rates to DG and simply forcing the DG customer to pay the full fixed portion of the standard delivery rate does not reflect the real impact a standby customer has on the overall system. Put another way, such rates would not provide an accurate representation of cost causation for the standby customer.

However, DG proponents often take the opposite tack: that they should be allowed to avoid the fixed charge entirely, and pay only the volumetric rate associated with the standard delivery rates. This is also inappropriate, as in such cases utilities are likely to under-recover the true system impact of the customer. This is not to say that a volumetric-only standby rate cannot be designed. It does mean, however, that the standby rate if volumetric only should reflect a pro rata allocation of any fixed costs which the utility incurs on behalf of standby customers, plus a moderate convenience charge.

DG advocates will also highlight the potential positive externalities which arise from installation. These can include greater overall system reliability, avoided or delayed investment in strengthening the distribution grid, and increased price responsive load as DG owners become familiar with hourly costs. Advocates will further argue that the benefits of such positive externalities need to be factored in to the design of standby rates.

While it is true that failure to account for positive externalities may lead to an economically inefficient level of investment in DG, it is not clear that the value of these positive externalities is as high as proponents claim, or that the design of standby rates is an appropriate mechanism for providing compensation for them. DG does have several disadvantages over central generating stations. It is generally more expensive per unit of output to address emissions, noise, and other issues associated with DG; as such, negative externalities may also exist associated with DG. Gas-fired DG imposes strains on the gas distribution grid; while these strains should be reflected in the design of rates within the gas distribution tariff, we need to recognize that in some cases the delayed network investments have merely been shifted from one type of network to another.


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A number of other mechanisms exist to compensate DG resources for perceived positive externalities. These include allowing them to qualify for clean or renewable energy credits (RECs), a range of tax incentives which vary across jurisdictions, and direct grants and subsidized loan programs. On congested systems, locational credits may also be used to incentivize location of DG in areas with it is most needed. Given that this is the case, it is sensible and appropriate to focus the design of standby rates far more narrowly. A standby rate is a service; providing that service has a cost; that cost needs to be appropriately reflected in the rate. Using the design of standby rates to accomplish broader policy objectives may result in unintended consequences, either with regards to revenue sufficiency for the utility or overall system design if DG resources proliferate in areas of the system where they are inappropriate. Refinements in standby rate design which better reflect the operational characteristics of DG may help to remove barriers to DG without distorting overall rate designs, which would otherwise be a risk if positive externalities are factored in.

## II. Current practices in US regarding standby rates

Distribution standby rates across US more or less follow the same structure; however, the levels of standby rates charged vary significantly. A monthly fixed charge (variously called a customer charge or monthly charge) is attributed towards distribution utility's recovery of customer related administrative costs. A demand charge (variously called as facilities charge, reservation charge, or contract charge), which is generally levied per kW of either maximum expected demand or contracted capacity, is intended to recover the facilities cost, and a volumetric charge per kWh of energy supplied by the grid, which is time-varying in some jurisdictions and on-peak in others, is charged to ensure cost recovery of distribution assets.

**Table 1. Summary of distribution standby charges for various utilities in the US**

| | Monthly customer charge ($/month) | Contract demand charge | On-peak demand charge |
|---|---|---|---|
| California (PG&E) | $0.46719 per meter per day | $0.06684 per kWh | $0.82 per kW (!) |
| Maryland (BGE) | $750 | $0.00456 per kWh | $2.33 per kW (*) |
| Massachusetts (NSTAR) | $90 | $4.2 per kVA (#) | - |
| Minnesota (OTPCO) | $120 | $5.22 per kW per month | $0.37 per kW per day |
| New York (NYSEG) | $41.61 | $4.89 per kW | $0.1876 per kW per day |
| Oregon (PacifiCorp) | $230 | $0.65 per kW (^) | $1.32 per kW |

(#) For contract demand >= 1,000 kVA and replacement demand >= 100 kVA
(*) This is the contracted capability charge, not on-peak demand charge
(!) This is the reservation charge, not on-peak demand charge
(^) This is the facilities charge and kW amount is given by the customer's baseline demand

*Sources: PG&E, BGE, NSTAR, OTPCO, NYSEG, and PacifiCorp. Massachusetts rates are for large industrial and commercial customers; all other rates are for primary voltage customers.*

Table 1 presents the summary of standby rates for primary voltage customers charged by six utilities in the US. Looking across the country, there appears to be no standard practice with regards to how standby rates are set. Second, none of the jurisdictions takes a systematic approach to evaluating the probability of outages and basing pricing on this basis. Third, none provide a framework in which different resources can choose the degree of insurance they want based on their own expectations of future outages and abilities to bear a portion of the costs at that time.

## III. Possible innovations

In designing standby rates, regulators need to move away from the "one size fits all" mentality. They also need to incorporate a sound probability-based approach into rate design. Such an approach will be an innovation relative to standard approach of starting with a static revenue requirement and dividing by expected volumes balanced by true-up accounts. By reinterpreting the obligation to serve, refining the approach to cost causation, and allowing for a greater diversity of rate designs, regulators can remove inappropriate barriers to DG which arise through poorly designed rates. Regulators tend to become imprisoned by the principles of traditional ratemaking. In fact, the services provided by electricity networks have a range of analogues in competitive markets. We can


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use pricing principles from other markets to guide design of rates in regulated industries. With regards to standby electricity distribution service, two broad categories of services are most relevant: those priced as options, and those priced as insurance. In fact, these categories overlap substantially.

### A. Real options approach

We can think of standby distribution service as an option, in which the customer has the right, but not the obligation, to call on distribution service when needed. Indeed, for those standby customers operating in unbundled markets, it is likely necessary for them to procure standby distribution services separately from standby generation services. In such cases, they can choose to either pay whatever the hourly wholesale price of generation is at the time in which they use it, or they can choose to hedge by purchasing call options. The call options will have a premium (the price paid to purchase the right embodied in the option), a strike price (the price for generation to be paid if the option is exercised), and an exercise period (the time during which the option can be exercised).

Stand-by distribution rates fit the options framework, because they are characterized by intermittent usage, and are contingent on the operating performance of the on-site generation and expected all-in price of power (energy plus distribution and transmission charges).[3] The DG owner would be the "buyer" of the option from the distribution utility. The DG owner would be acquiring the right, but not the obligation, to use the distribution utility's services over an agreed period of time. To secure this right, the DG owner would pay the distribution utility a premium. That premium would be equivalent to the fixed charge for distribution services. The strike price which the DG owner would pay the distribution utility if and when it exercises its option would be a proxy for the variable rate tariff. The options contract would also dictate the terms by which the DG owner could exercise his right (i.e., the frequency of use and notice period, etc.).

However, the standard approach for valuing an option requires some modification for distribution standby service. Option pricing relies on wholesale price volatility, current market prices, and the relationship between the strike price and the market price to determine the value of the premium. An option can be structured for less "marketable" services too. Common approaches to option pricing rely heavily on the availability of market indicators for the price of the underlying asset or service, in this respect, the cost of distribution services, in order to establish the future value of that service and the volatility of that future value. Generally, there is an inverse relationship between the size of the premium paid and the extent to which the strike price exceeds market price. Premium prices also increase the greater the time remaining until the end of the exercise period. Due to the lack of volatility in the price for distribution services (at least within regulatory periods), a standard option pricing approach could result in a relatively low premium being attached to standby service.

The options premium would be set consistent with the fixed costs of having available capacity to service the DG, *adjusted* for the expectation of exercise (how frequently the DG owner uses the distribution services). The strike price should be set consistent with the actual unit costs of providing distribution services.[4] At the same time, the adjustment for probability of use should lower the option premium (the fixed charge) substantially, eradicating the often cited economic obstacles for DG interconnection. A high strike price vis-à-vis the options premium should also align the incentives of DG with the distribution utility; both parties are seeking to minimize the use of the distribution grid.

The options premium for DG customers will be lower than the fixed charge for permanently interconnected customers of the distribution utility in recognition of the usage-adjusted impact of the DG on the distribution utility's cost. Differentiated fixed rates for DG versus permanently interconnected customers are also consistent with economic principles and cost causation. If the standard higher fixed charges discourages a segment of customers (e.g., DG customers) from taking service, this could create sub-optimal utilization of the distribution network. On the basis of the elasticity of different consumers and given the objective of optimizing utilization of services and distribution revenues, Ramsey Pricing principles[5] suggest that DG consumers should have a smaller fixed charge than other (i.e., permanently interconnected) customers.

The conceptual methodology is generally flexible enough to also apply to various formulations of DG, including both DG that use the grid continuously for a small portion of their peak load and DG that use the grid intermittently for their entire load when internal resources are on outage.

### B. Insurance approach

While options pricing principles have some relevance for the design of standby distribution rates, insurance pricing may provide an even better model. When individuals and companies buy insurance, they also pay a premium; in this case, an amount which in case of certain specified events allows them to make a claim against an insurance company. As with options, the size of the premium varies depending on the length of the period for which the coverage is active. Premium size also varies by the amount of the potential claim that could be made against the insurance company, and the amount of the loss which the customer agrees to absorb, otherwise known as the deductible. Again, similar to an option, the size of the premium is also influenced by probability of exercise, or in insurance, the probability of making a claim. The reason that wholesale price volatility and the distance between the market price and strike price are important for options pricing are that these in turn affect the probability of exercise. Consequently, insurance premiums are priced based on reams of historical data to determine the probability of loss, as well as on characteristics specific to the insured.

Pricing of insurance can be complex. First, the probability of occurrence is not fixed and can be affected by the insured party. A fully insured party has no incentives to drive carefully or lock the doors when going out, a phenomenon known as *moral hazard* or hidden action problem in economic literature. Insurance companies thus seldom assume 100% of the risk. Insurance companies align the incentives of the insured with their own by adding a variable component (the deductible) to the fixed component (the premium) of the price in insurance contracts. The deductible is meant to create incentives for the insured party to provide the effort, which is usually costly, to lower the probability of the occurrence.

Pricing standby service can be described as an insurance problem: consumers with installed generators are the insured parties; the utility providing backup power is the insurer. Standby service may be easier to price than some other insurance products. When it comes to distributed generation (DG), the *adverse selection* problem (only the poorest risks choose to be insured) may be less of a problem.[6] The types of installed generators are easily distinguishable by simple inspection and the technology and specifications are known to the utility; the price of the insurance can thus be clearly matched to the degree of outage probability.

The probabilities of different classes of generators going off-line can be very effectively calculated and the corresponding stand-by rates can be offered: given a significant number of consumers with generators - making the law of large numbers applicable - the "actuarially fair" stand-by rates are calculated by multiplying the probability of a specific type of generator going off-line and the cost of providing backup power. The important point is that the uncertainty faced by a utility is easier to assess than the uncertainty faced by insurance companies in their quite complicated markets.

An insurance-based approach to establishing stand-by rates has four steps:

- determine the cost of providing service to the customer were they not to be using standby service;
- identify the outage probability during peak periods for the DG units placed in service at the customer site;
- assess the administrative costs of providing standby service; and
- allow the customer to select the degree of exposure to volumetric charges.

None of these steps is particularly difficult to implement. The cost of service to the customer, were standby service not in place, should be simply the existing rate schedule embodied in the tariff for that particular customer. When DG is installed, the outage probability should be based on the specifications of the manufacturer. Each year, this outage probability would be updated based on the actual performance of the particular unit.[7]

To determine a customer specific revenue requirement associated with a stand-by rate, we would first calculate the total annual revenue we would have expected to receive from the customer were DG not in place. This would mean examining the existing fixed versus volumetric split in the tariff, estimating the customer's annual



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consumption without DG, and determining the total revenue that would be received. We would then also identify the administrative costs associated with putting in place standby services. Such costs would likely be based on the information technology costs of setting up an interactive website which would automatically make the above calculations to provide a customer with a rate quote. They would also include the costs during initial installation of the DG resource with verifying that the equipment the customer actually installed matched what the customer claimed to have installed. However, these latter costs could be separated into a DG connection charge, rather than being part of the standby rate.

**Table 2. Indicative example of probability-based approach**

$$CC = DOCC \times OP \times 5\%$$
$$MFC = (DOCC \times OP + CC) / 12$$
$$VR = DOCC \times OP / (DGICAP \times OP \times 8760)$$
$$MVC = VR \times 115\%$$

where

| | |
|---|---|
| DOCC: | Demand-only customer costs at specified load factor |
| OP: | Outage probability |
| DGICAP: | DG installed capacity |
| CC: | Convenience charge |
| MFC: | Maximum monthly fixed charge |
| VR: | Volumetric rate for charging against bank |
| MVC: | Maximum volumetric charge |

Once the customer specific revenue requirement has been determined, it would be multiplied by the outage probability to determine a net annual revenue requirement. This would be found by multiplying the total customer specific revenue requirement times the outage probability. Next, the customer would be allowed to specify how they paid the revenue requirement. Customers could choose to pay only the monthly administrative charge, and a volumetric rate based on a pro rata allocation of their customer-specific revenue requirement, with a convenience charge added on top; the volumetric rate would only be paid when distribution services were actually used. Note that even were the customer to choose a high volumetric rate arrangement, it would still need to pay the initial connection charge; this initial connection charge would also include some form of convenience fee to provide the utility with an incentive to connect DG.[8] Or customers could choose to pay a higher fixed monthly charge, which would serve as a "bank" against which the volumetric rates would be charged. Customers choosing to pay the full customer-specific revenue requirement divided by twelve each month would not be required to pay the added convenience charge when the volumetric rates were charged, and could be offered some discount.

Critics of the insurance approach are likely to claim that it would entail substantial administrative costs and would be difficult to set up. We find such claims unconvincing. At a time when we can shop for most insurance products online, receive quotes in seconds, and purchase such products without ever seeing a live human being, setting up an insurance-based standby rate regime is not a particularly intricate task. Furthermore, unlike insurance companies, who must rely on information from third party sources about ongoing driving records, lifestyles, and so forth, the utility can monitor directly how well or poorly a particular DG resource is performing. The utility should be able to track exactly when a DG resource is or is not operating, and develop direct knowledge of how that resource is performing. For poorly performing resources, outage probabilities can be updated quarterly rather than annually, and a corresponding adjustment made in the rates. Insurance companies use claims histories to make similar adjustments, and to notify customers accordingly.

Interestingly, an insurance-based approach using an outage probability methodology provides powerful incentives to the utility to connect additional DG resources to the grid. If we assume that the outage probability of any individual DG unit is largely independent from that of another DG unit (particularly if these units are at dispersed locations), the outage probability of the entire fleet of DG resources is likely to be lower than the outage probability of any individual unit. This provides the utility with the potential to earn additional revenue over and

above its revenue requirement as new DG resources are added. If the utility is allowed to retain some or all of this revenue, it in effect has the ability to earn extra profits from new DG connections. While it may still be necessary to impose performance standards on utilities with regards to the speed with which they respond to requests for standby connections, allowing the utility to earn extra profits on DG may help to overcome some of the embedded inertia in utility organizations with regards to facilitating DG.

### C. Menu approach

While the insurance approach is perhaps the best crafted way to handle standby rates for DG, an alternative would be to provide for a menu of standby rates which the customer could choose from. This menu would assume particular levels of reliability for the DG resource. Customers would pick the rate schedule which they thought best matched the reliability of their machine. Customers would face penalties when they relied on standby service for more than the number of hours that were specified under the rate schedule chosen. An "as available" rate could also be designed; for this rate, the customer would be unable to use the grid during superpeak periods and at any point where a system emergency was expected to be announced. Pricing for as available service would be significantly lower than other types of service, because in fact the utility need not incorporate as available service when designing the system to meet peak needs.

This type of pricing structure is similar to that used by some cell phone companies, where customers pay a fixed price for a total number of minutes of system usage; high volumetric rates are charged for usage thereafter. Under this structure, plans would be based on the expected amount of peak system usage. Customers would chose plans based on specified expected outage levels – for example, 5%, 15%, 25%, and 45%. Monthly fixed charges would be based on the customer specific monthly revenue requirement times the expected outage level chosen. For volumes used in excess of the allowed amount, the volumetric charge would be based on the overall customer class revenue requirement when calculated on a non-standby basis divided by customer class expected volumes plus a sliding scale penalty charge which increased in inverse proportion to the expected outage level (i.e., as the selected outage level decreased and usage exceeded that selection, penalties would increase). These volumetric penalty charges would be specified in advance in the standby tariff; rates in the tariff would thus consist of a monthly charge at the specified outage level and the penalty volumetric charge for excess system usage. Alternatively, customers could specify that they did not wish to take service beyond the amount that they had specified through their choice of rate.

**Table 3. Indicative example of a menu approach to standby service**

| demand-only commercial customer charge | DG system characteristics |
|---|---|
| $7.80 monthly fixed charge | 100 kW system installed |
| $0.08 volumetric charge | 7.00% convenience charge on 15% fixed |
| 70% customer load factor | 3.50% convenience charge on 25% fixed |
| $4,095.80 monthly network bill without DG | 15.00% convenience charge on volumetric only |
| | 15.00% *or* 25% outage probability |

| | fixed | volumetric | monthly bills 10,950 kWh | monthly bills 18,250 kWh |
|---|---|---|---|---|
| "as available" service | - | $0.080 per kWh | $876.00 | $1,460.00 |
| max 15% fixed service | $438.38 | $0.020 per kWh up to 10,950 kWh then max volumetric | $657.38 | $1,419.92 |
| max 25% fixed service | $913.13 | $0.010 per kWh up to 18,250 kWh then max volumetric | $1,022.63 | $1,095.63 |
| max volumetric | - | $0.104 per kWh | $1,143.82 | $1,906.36 |

*note: connection charge for "as available" service would be same as for demand-only customers*

The advantage of the menu approach is that it shifts the burden of determining the most appropriate rate structure to the consumer. While we do not believe that the insurance-based approach would be difficult to implement, the menu approach would likely have somewhat lower administrative costs. Like the insurance approach, it does provide incentives to the utility, provided outage probabilities are truly independent across different DG installations. To the extent that the options in the menu approach are not continuous, customers will likely choose an outage probability higher than that which matches their equipment; this may also provide



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additional revenues to the utility relative to the insurance approach. However, this does mean that customers will end up paying more in standby rates under the menu approach than in the insurance-based approach, as they will be forced to purchase more coverage than they actually need.

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## Endnotes:

[1] See Casten, S. "Are Standby Rates Ever Justified? The Case Against Electric Utility Standby Charges as a Response to On-Site Generation," *The Electricity Journal*, Volume 16, Issue 4, May 2003, Pages 58-65. Casten, S. "Rebuttal: How Far We Have to Go," *The Electricity Journal*, Volume 16, Issue 8, October 2003, Pages 81-84. Morrison, J. "Why We Need Standby Rates for On-Site Generation," *The Electricity Journal*, Volume 16, Issue 8, October 2003, Pages 74-80. Parmesano, H. "Standby Service to Distributed Generation Projects: The Wrong Tool for Subsidies," *The Electricity Journal*, Volume 16, Issue 8, October 2003, Pages 85-92. Parmesano, H. "Standby Rates Issue is More Nuanced than Authors Let on," *The Electricity Journal*, Volume 16, Issue 9, November 2003, Pages 3-4. Switzer, S. "On-Site Generation and Pricing Policies for a Local Distribution Company: A Utility Line is Used and Useful Even if It's Not in Use," *The Electricity Journal*, Volume 17, Issue 6, July 2004, Pages 30-38.

[2] Averch, Harvey and Johnson, Leland. "Behavior of the Firm Under Regulatory Constraints". *American Economic Review*, 1962, Vol. 52, pp. 1053-1069.

[3] If all-in price of power via the distribution grid is lower than DG production costs, the economic decision would be to use the services of the distribution utility (and transmission provider) and buy power externally rather than to self-generate.

[4] The strike price does not need to be a fixed number. It can be calculated based on a reference rate (for example, based on an index if there are different costs to service depending on time of use). Indeed, since the economic decision-making for a DG owner on whether or not to use the distribution grid is a function of all-in costs (distribution, transmission, and energy), it is also possible to have the strike price reflect the average bundled cost of the service, as measured at agreed-upon intervals during the life of a contract (which is similar in pricing structure to an Asian option).

[5] At its most basic, Ramsey pricing concept stipulates that in order to maximize social welfare, monopoly prices above marginal cost (especially the fixed cost component thereof) should be set as a function of the elasticity of demand for the different products by consumers. *See* Frank Ramsey. "A Contribution to the Theory of Taxation," *Economic Journal*, March 1927.

[6] Adverse selection is a complication due to the asymmetric information in the market. The insurer has access to only averages within a region, within age groups, income levels, types of insured property, etc. The individual characteristics of the insured are almost always private information. If only the actuarially fair premium, based on the averages is offered, only the "bad" types of consumers with higher probabilities of occurrences will be attracted to the insurance contract, and the "good" types of consumers will be forced out. One solution is to differentiate the types of consumers as much as possible and then offer different types of incentive compatible contracts, carefully designed so that each type of consumer willingly chooses the contract intended for her type.

[7] We would suggest using a weighted average approach, in which N=the number of years the unit has been in service, E=expected life of the unit, M=manufacturer's stated unit reliability, and A=actual unit reliability during peak periods since commencing operations. Thus, outage probability would be calculated as OP=(E-N*M+N*A)/E. When N is greater than 0.5*E,


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then A only would be used. Note that by limiting calculation of A to peak periods, we are in effect incentivizing the DG owner to manage outages so that they occur during offpeak periods.

[8] We recommend that the utility be allowed to retain all convenience fees associated with the standby rates, provided the utilities meet established standards in the speed with which they process the standby connection. Convenience fees should be capped at not more than 5% of the overall expected annual revenues at the specified outage rate. As noted elsewhere in the paper, retaining some part of the standby fee as additional profit helps overcome utility inertia with regards to DG.


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# STANDBY RATES FOR CUSTOMER-SITED RESOURCES

## ISSUES, CONSIDERATIONS, AND THE ELEMENTS OF MODEL TARIFFS

U.S. Environmental Protection Agency
Office of Atmospheric Programs
Climate Protection Partnerships Division
1200 Pennsylvania Ave., NW
Washington, DC 20460

**December 2009**

Final Report

Developed by the Combined Heat and Power Partnership

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## List of Acronyms and Abbreviations

| | |
|---|---|
| CHP | combined heat and power |
| DG | distributed generation |
| FERC | Federal Energy Regulatory Commission |
| kW | kilowatt |
| kWh | kilowatt-hour |
| MW | megawatt |

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# 1: Executive Summary

With increased interest in efficient, clean, customer-sited resources comes increased interest in the regulatory policies that affect their deployment. The economic viability of clean, distributed generation (DG) and, in particular, combined heat and power (CHP) facilities, heavily depends on the regulatory policies that determine how they are treated by the electricity network. This paper focuses on one of those policies: the structure of prices for standby service. The report identifies approaches that, given the costs and benefits of DG, provide appropriate savings to the clean, DG system owner and appropriate cost recovery to the utility.

The review of selected rate tariffs suggests that the better rate designs share common and central characteristics: they are designed to give customers a strong incentive to use electric service most efficiently, to minimize the costs they impose on the system, and to avoid charges when service is not taken. This means that they reward customers for maintaining and operating their onsite generation. Specifically, these tariffs are marked by some or all of the following features:

- Contract demand or reservation charges are small in relation to the variable charges for peak demand and energy.
- Peak demand charges are not ratcheted or, at worst, have 30-day ratchets (that is, there are no more than monthly as-used demand charges).
- Energy-based charges to collect capacity costs would seem to offer the greatest promise in this regard, but utilities and their regulators do not appear to be prepared to entirely abandon some form of peak demand charge. As such, daily as-used demand charges are the next best solution, but how a particular rate is structured along these lines will depend on the levels of the various rate elements.
- The rate structure yields a significant retail rate savings per kilowatt-hour (kWh) produced on site instead of purchased from the grid. This depends not only on the standby tariff itself, but also on the level and structure of the otherwise applicable full requirements tariff (e.g., the tariff that would apply in the absence of DG).

These findings are consistent with the understanding that the economics of onsite generation are based on reduced electricity purchases, and these reduced purchases must benefit the customer to make DG viable. Importantly, they also serve to remind regulators of the need to pay close attention to ensure that the design of partial requirement rate structures captures the economic and environmental benefits of reduced energy consumption. These examples also suggest that such rates can apply to DG while also fairly compensating utilities for the services they provide to onsite generators.

# 2: Introduction

Interest in clean, customer-sited,[1] non-emergency generation, in particular CHP systems,[2] continues to grow as appreciation likewise grows for the value that these resources can provide. The many benefits accrue both to the owners of the onsite resources—through cost savings from avoided purchases of grid-supplied power, improved reliability, reduced thermal (e.g., boiler) energy consumption, and lower overall energy costs—and to the electric system as a whole—through reduced demands for power, avoided investments in generation and delivery capacity, improved operational efficiencies, increased system reliability, and lower total system energy consumption, costs, and emissions.

With these benefits in mind, policy-makers, utility representatives, and system operators have begun to address the challenges of integrating these systems into the electric transmission and distribution networks. Much work has been done at the state and federal levels to develop and standardize technical and regulatory rules for interconnection of the onsite generator to the electric grid. Today, if interconnection remains a barrier to onsite generation, it is likely the result of a state's failure to adopt appropriate rules, and not the consequence of unresolved technological or operational challenges.

Customers primarily install onsite generation in an attempt to reduce their overall energy costs. Onsite generation typically reduces the amount of electricity purchased while increasing onsite capital and fuel costs. The decision to generate one's own power balances additional capital, fuel, and maintenance expenses with a decrease in the amount and therefore the cost of purchased power. CHP further enhances the customer economics because of additional savings from combining thermal and electric generation into one process. In general, CHP is most efficient, and cost effective, when it is sized to match the thermal loads of the facility and operates an extended number of hours on an annual basis. Electric rate structures, particularly standby and backup rates, can have a significant impact on CHP economics by affecting the amount of actual savings resulting from reduced electricity purchases from the grid. As such, tariffs can affect prime mover selection, system sizing, and operating strategy. Not all tariffs result in the most efficient system design or operating strategy.

Although an increasing number of states have begun to address the question of whether the lack of appropriate statewide rules on retail tariffs might also present a barrier to onsite generation, there is little evidence of a standard approach. States are innovating, and there are now several approaches to the design of rate structures for DG that warrant closer analysis.

This paper identifies the elements of rate structures that will appropriately charge customers with DG for the services they take, without creating economic barriers to DG. The degree to which customers' charges are adjusted under a certain tariff by generating their own electricity from DG will determine whether or not this is the case. These rates should also fairly compensate the utility for the costs of serving customers with DG in order to protect other customers from being charged unfairly high rates. This avoidance of cross-subsidization cannot, in the absence of company-specific cost data, be directly judged. The analyses in this paper presume that rates that are in effect or proposed by utilities are meeting cost-recovery (or revenue-burden) goals.

# 3: Electric Rate Structures and Economics of Distributed Generation

This section provides a brief primer on the basics of electric service and rate design to provide a context for the later discussions of standby rates. While this discussion applies to rate design generally, this paper focuses on rate structures for customers that are most likely to be suited to onsite generation—that is, high-volume commercial and industrial users for whom DG capacity would be at least 200 kilowatts (kW), but more likely 500 kW and greater.[3] Appendix B provides a more detailed discussion of these topics.

## 3.1 Elements of Electricity Rates

Electricity rates have three main components: customer charges, demand charges, and energy charges. There could, of course, be other charges as well, such as taxes or special assessments, but for the purposes of this paper, these can be ignored.[4]

The **customer charge** is a fixed, recurring charge (monthly or daily), typically intended to cover the constant costs of metering, billing, and service drop facilities, which must be recovered by the utility even if no electric service is taken. In this sense, it can be seen as a flat fee that provides access to the grid.

**Energy charges** are the charges for consumption of the electricity commodity applied on a per-kWh basis. Customers purchase energy at the tariffed rates or from third-party suppliers at negotiated rates; they may be differentiated by time-of-use, by season, by consumption block, or by some other means.[5] In addition, there may be adders or surcharges to cover related costs and risks of operation. In some cases, there may be multiple commodity charges associated with different categories of usage charges. For example, higher energy charges might apply during on-peak time periods as opposed to off-peak time periods, or the energy charge might decrease as more energy is purchased, in a declining block structure. For residential and small commercial rates, energy charges may be the only category of rates. However, larger facility rates (e.g., commercial and industrial) typically include both energy and demand charges.

**Demand charges** are based on the peak electricity demand (kW) during a given period, typically 1 month. Demand charges are used to recover the capital costs of the capacity necessary to meet customers' peak loads. Capacity is measured in kW or megawatts (MW), and it represents the ability of a facility (or the grid in the aggregate) to deliver the service desired at any instant. Because the electric service is to be provided on demand, the system must be designed to meet a variety of peak loads: that of the system as a whole, those of customers served by individual parts of the network, and those of individual customers. The costs of capacity can be included in per-kWh energy charges, as they often are for lower volume residential and small commercial consumers. For larger volume users, standard practice is to separate the charges for capacity and energy.

Demand charges are a means of allocating and recovering the costs of the capacity, measured and priced in dollars per kW per time period, to serve those peaks. They are deemed to give the

larger utility users stronger incentives to manage their peak demand most efficiently, thus minimizing the investment in physical infrastructure that the utility must make on the customers' behalf. This incentive is further promoted by the common use of ratchets, which apply a peak demand value to the bill for anywhere from several months to a year after its occurrence.[6] Ratchets turn a fee that would otherwise vary with changes in demand into something more like a fixed charge that locks a customer into a minimum monthly payment for the duration of the ratchet. Although there is a certain logic behind ratchets—i.e., they link customer charges to the longer term nature of the capacity obligations of the utility—they nevertheless can be a financial barrier for customers looking for more efficient means of meeting their energy needs (even as they have the effect of lowering the cost of off-peak power).[7]

Most large customer electric rates include both an energy and a demand component. The relative level of each is determined by the characteristics of the local grid, supply mix, and other local market factors. The significance of the two components for a customer depends heavily on the customer's load factor. The load factor is the total energy consumption divided by the peak demand multiplied by the number of hours in the month. If the customer always consumed the same amount of electricity every hour of the month, then the demand would never change and the load factor would be 100 percent. This is an advantageous situation for the utility because its facilities are always being fully utilized. In this case, there would be little need to apply a demand charge, because demand and energy charges are fully linked.

If the demand is highly variable, then the load factor can be much less than 100 percent. In this case, there can be brief periods when supply facilities are heavily used, and long periods when consumption is much lower. In this situation, a utility would want to apply a demand charge to recover the costs of supplying the peak capacity that is not recovered by the lower level of consumption during nonpeak times. Because this load profile is in some respect related to the underlying operations of the customer, it might be appropriate for the customer to provide payment in this structure or alternatively to be driven by this structure to modify their operation to improve their load factor.

## 3.2 Standby Service

Customers who receive all of their electricity from the utility or via the grid are known as "full requirements" customers. Their electricity is provided under rates that are primarily some mix of the components discussed above. Customers with onsite generation typically require a different set of services, which includes continuing electricity service for the portion of usage that is not provided by the onsite generator, as well as service for periods of scheduled or unscheduled outages. "Partial requirements" is the more precise name for *standby* or *backup* service: the set of retail electric products that customers with onsite, non-emergency generation typically desire. This service could be a tariff that replaces the standard full requirements tariff or an additional tariff that applies on top of the standard tariff for certain special types of service. Many of the utilities that provide these services distinguish in their tariffs among three types of partial requirements service: supplemental, backup, and maintenance. Some differentiate only between standby and supplemental. In this report, we recognize the following as the most common components of service for partial requirements customers:

- **Supplemental Service.** Supplemental service provides additional electricity supply for customers whose onsite generation does not meet all of their needs. In many cases it is provided under the otherwise applicable full requirements tariff.

- **Backup Service.** Backup or standby service supports a customer's load that would otherwise be served by DG, during unscheduled outages of the onsite generation.[8]

- **Scheduled Maintenance Service.** Scheduled maintenance service is taken when the customer's DG is due to be out of service for routine maintenance and repairs. In general, because this service can be scheduled for nonpeak times, it is considered to create few additional or marginal costs to the utility's system, and tariffs are typically structured to exempt the customer from capacity-related costs (e.g., reservation charges or ratchets, for either generation or delivery).

- **Economic Replacement Power.** Some utilities offer economic replacement power—electricity at times when the cost of producing and delivering it is below that of the onsite source.

Electric industry restructuring and the unbundling of the electric system's components (generation, distribution, transmission, etc.) has, in some states, added complexity to rate design (i.e., the Federal Energy Regulatory Commission's [FERC's] no action policy on states if deregulated). Whereas the electricity prices of vertically integrated utilities that have not been unbundled often include generation, transmission, and distribution charges, the separation of these functions in restructured states has also led to a separation of the charges for them. This can cause some confusion when comparing different rate elements and, in particular, their ratchets and exemptions. In general, in a restructured state the question of partial requirements service is limited to the remaining monopoly services that are only provided by the local incumbent utility—distribution and, in certain cases, transmission—but there might also be default service offerings for energy charges.

## 3.3 The Economics of Distributed Generation

As noted above, the basic economic underpinning of a DG system is a tradeoff between reduced electricity purchases and the increased capital and operating costs for the DG system. The facility operator invests in capital equipment and must pay operating and fuel costs. These costs must be offset by reduced electricity purchases for the system to be economical. For a CHP system, there are also increased efficiency and operating cost savings because of the combined generation of thermal and electric energy. At this level, there is a simple economic tradeoff between savings from reduced electricity consumption and the cost of additional fuel for onsite generation and levelized cost of increased capital investment.

The complication with respect to electricity rates comes when reduced consumption does not result in reduced electricity bills. This can result depending on the structure of the tariff—electric rate demand versus energy charges. Because DG reduces the purchase of energy (kWh), a rate that includes only a commodity charge would provide the most direct recognition of the benefit of the DG system. An 80 percent reduction in energy purchased would result in an 80 percent reduction in electricity cost.

Although the reduced consumption theoretically translates into a commensurate reduction in demand, in reality, every system has some number of planned or unplanned outages during the year, during which facility demand can reach the non-DG level. Thus, if the rate has only a demand charge and no energy charge, an outage would cause the facility to reach its peak demand during the month for a brief period, causing the DG system to achieve no savings at all in that month. If the rate has an annual ratchet, the one outage would cause the system to forgo any savings for the entire year.

Under these circumstances, the profile and timing of outages can be a major determinant of DG cost and system economics. Unplanned outages might be extremely rare and might not coincide with other system outages. Planned outages can be scheduled for off-peak hours when they place minimum stress on grid facilities. Thus, determining the appropriate rate structure of DG facilities requires a different analysis than that applied to conventional facilities. The rates applied to DG facilities can be many different combinations of standard, supplemental service, standby, emergency, and economic replacement rates. One cannot identify a unique structure that fits all customer and market characteristics; however, the goal of this paper is to identify basic structures that provide appropriate savings to DG facilities and appropriate cost recovery to utilities, recognizing the costs and benefits of DG.

# 4: Tariff Designs, Supplemental Service, and Economics of Distributed Generation Systems

Evaluating the economic effect of rate design on DG systems requires a detailed assessment of the time-dependent effect of both components of the rate structure. This section employs such a detailed assessment to evaluate the effect of partial requirements charges on a prototype DG (CHP) facility and to identify beneficial rate structures. This section discusses three tariffs, and Appendix A describes two additional examples.

## 4.1 Analytical Approach

The subsections that follow identify and analyze several approaches to standby rates using actual tariffs. This analysis compares annual bills of a DG customer with specified usage and production characteristics against the bills that the customer would otherwise pay as a full requirements customer. In each example, it is assumed that customers are billed monthly. Because the purpose of these analyses is to determine only the annual electric bill savings that a DG system would yield under the various tariffs given specified load and operating characteristics, the economics of the DG system were not being evaluated, so no attempt to characterize its costs and its thermal energy benefits was made.

The tariffs were evaluated for a mid-sized (5 MW) CHP project with characteristics summarized in Table 1.

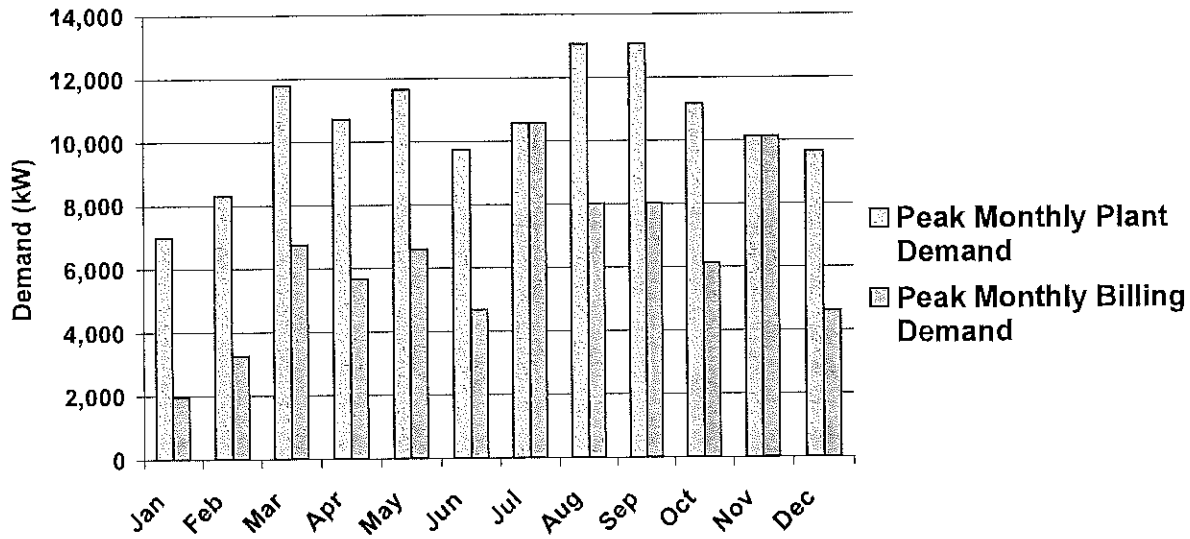
Table 1. Prototype CHP Facility

| Plant Consumption Details | | |
|---|---|---|
| Operating hours | 8,760 | |
| Annual power consumption, kWh | 92,762,451 | |
| Peak demand, kW | 13,000 | |
| **CHP System** | | |
| Prime mover | | Gas Turbine CHP |
| CHP electric capacity, kW | | 5,000 |
| System availability, % | | 98% |
| System hours of operation | | 8,616 |
| **Electric Consumption** | **Base System** | **Gas Turbine CHP** |
| Purchased power, kWh | 92,762,451 | 49,273,191 |
| Generated power, kWh | | 43,489,260 |

The modeled DG customer has a peak annual demand of 13,000 kW and annual consumption of 92,762,451 kWh. The peak demand is set in August. As shown in Figure 1, the 5,000 kW CHP system is baseloaded and provides about 47 percent of the customer's annual power needs.

In order to evaluate the impact of outages on savings under different tariff structures, the CHP system was assumed to experience unplanned outages during 2 months out of the year. As shown in Figure 1, the CHP system reduces the customer's monthly peak billing demand by 5,000 kW, except during July and November when the outages occurred. In these months, the peak billing demand is equal to the total demand of the facility.

**Figure 1. Prototype Demand Profile**




The rate impacts for the system for each tariff were calculated for each month of the year for the DG and non-DG cases. A spreadsheet tool was developed to calculate these monthly values and summarize them for the year. The tool calculated several annual average cost figures based on the total energy consumption. The first is the average cost per kWh for grid-supplied electricity under the full requirements tariff. This was calculated as the annual bill divided by the annual electricity consumption or purchases. The second is the average cost per kWh for grid-supplied electricity under the partial requirements tariff. This is the annual utility bill divided by the annual electricity purchases. Next, the tool calculated the value, per kWh, of the avoided grid-supplied electricity. This was calculated as the bill savings divided by the avoided consumption (or generation).

Last, the tool compared the value of the avoided purchases with the value of the full requirements electricity on a per-kWh basis. This avoided cost percentage is an important concept for evaluating the treatment of onsite generation by partial requirement tariff structures. One of the key economic values of onsite generation[9] is the displacement of purchased electricity and the avoidance of those costs. Ideally, the reduction in electricity price should be commensurate with the reduction in purchased electricity. If the onsite system reduces consumption by 80 percent, the cost of electricity purchases would also be reduced by 80 percent. The economics are severely impacted if partial requirements rates are structured so that only a small portion of the electricity price can be avoided. The higher the ratio of avoided costs

to the full retail average price, the higher the user's savings. As an evaluation measure, partial requirement rate tariffs that result in avoided costs that are above 90 percent of the full service retail rate percentage generally provide adequate savings to support onsite generation.

## 4.2 Example 1—Portland General Electric

The first example is the Portland General Electric partial tariff 75, summarized in Table 2, as compared with the full requirements tariff 89. The rate is a fairly standard structure with customer, demand, and energy charges. A critical feature, however, is that this rate has monthly as-used on-peak demand charges (i.e., no ratchet). Thus, the assumed outages only affect the demand charge in that month and do not reduce the savings in other months.[10]

**Table 2. Portland General Electric Tariff Provisions**

| Unbundled Service for Partial and Full Requirements Customers (>1 MW) With Monthly As-Used Demand Charges Portland General Electric | | |
|---|---|---|
| | Full Requirements Rate 89 | Partial Requirements Rate 75 |
| **Part 1: Customer charge** | | |
| Customer charge | $150/month | $150/month |
| **Part 2: Transmission charges** | | |
| On-peak demand | $0.70/kW-month | $0.70/kW-month |
| **Part 3: Distribution charges** | | |
| Sum of A + B | | |
| A. Facility capacity | | |
| First 1,000 MW | $1.90/kW-month | $1.90/kW-month |
| Over 1,000 MW | $0.57/kW-month | $0.57/kW-month |
| B. On-peak demand | $2.01/kW-month | $2.01/kW-month |
| **Part 4: Generation charges** | | |
| Generation contingency reserves | | |
| Sum of A + B | | |
| A. Spinning (>2,000 kW) | N/A | $0.2340/kW-month |
| B. Supplemental (>2,000 kW) | N/A | $0.2340/kW-month |
| System usage charge | $0.0039/kWh | $0.0039/kWh |
| Energy charge | Wholesale market price/kWh | |
| Average on/off peak | $0.0626/kWh | $0.0626/kWh |

Source: Portland General Electric, Rate 75 (partial requirements) and Rate 89 (full).

The partial requirements tariff is in most respects the same as the full requirements tariff. The primary difference is a contingency reserve and a spinning reserve charge applied to the onsite generator capacity. These contract demand charges are fixed, but their rates are low enough that they do not significantly change the electricity cost for the CHP system. Table 3 shows the breakdown of costs for the fuel requirements and partial requirements cases. There are three key elements:

- The first thing to notice is that the energy charges constitute more than 90 percent of the total cost in both cases. Because DG affects energy consumption, this is an initial indicator that these rates will be favorable for DG economics.
- Second, as mentioned above, this rate does not have a demand ratchet, so the outages do not have an exaggerated effect on the cost.
- Finally, the standby demand charges, though fixed, are only a $28,000 adder compared with the $3-million savings provided by the CHP systems.

Overall, the cost savings are more than 97 percent of the electricity savings, indicating that the tariff does a good job of recognizing the value of DG.[11]

**Table 3. Portland General Electric Cost Comparison**

| Comparative Annual Bills | Full Requirements | Partial Requirements |
|---|---|---|
| Purchased electricity, kWh | 92,762,451 | 49,273,191 |
| Facilities charges | $1,800 | $1,800 |
| Distribution on-peak demand charges | $255,056 | $153,601 |
| Facility capacity demand charges | $105,404 | $88,289 |
| Transmission on-peak demand charges | $88,826 | $53,493 |
| Standby demand charges | $0 | $28,347 |
| Energy charges | $6,170,439 | $3,277,589 |
| **Total electric charges** | **$6,621,524** | **$3,603,120** |
| | | |
| Average rate for purchased power | $0.0714 | $0.0731 |
| Average avoided rate | N/A | $0.0694 |
| | | |
| **Average avoided rate as a percentage of average retail service rate** | **97.2%** | |

Source: EPA analysis using Portland General Electric tariff.

This rate structure illustrates a number of rate design features that could be appropriate for large users, whether full or partial requirements:

- Transmission, distribution, and generation charges are separated and, within these categories, the rates are further unbundled as justified by their cost characteristics.

- The customer charge, transmission rate, and distribution rates are the same for full and partial requirements customers.[12] This might also be true of the generation rates, but it could depend on the existence of competitive alternatives.

- The charges might differ, depending on the voltage level at which service is taken (i.e., secondary, primary, sub-transmission).

- The customer charge is typically a fixed, periodic (daily or monthly) charge. It should cover at most the costs of metering, billing, and customer service that do not vary with usage. It goes without saying that charges should not be duplicative—for example, a partial requirements customer should not pay a customer charge for standby service and a second one for supplemental service.

- The transmission charge is applied to kW of monthly on-peak demand (no ratchet).

- There are two categories of distribution charges, one for dedicated facilities and a second for shared facilities.

The facilities (or contract demand) charge is a per-kW fee applied to the customer's maximum noncoincident peak demand (or contractually agreed-on maximum) of required capacity for dedicated facilities, subject to an 11-month ratchet or similar mechanism.

The charge for shared facilities is also a per-kW fee, but applied to the customer's maximum monthly demand during the on-peak periods (e.g., 8 a.m. to 11 p.m.).

The generation charges cover the costs of generation capacity necessary to serve unplanned outages of the DG. These per-kW charges can be calculated in one of two ways, in recognition of the DG's diversity benefits (they should, theoretically at least, yield the same result):

1. As a function of the probability of the occurrence of an unplanned outage coinciding with a system peak or other times of capacity constraint (e.g., when other units are suffering unplanned outages). The ratchet will depend in part on the nature of wholesale capacity and energy markets and the obligations of participants. At most, a ratchet should reflect the timing and duration of capacity purchase requirements, but should also be reflective of the other uses to which that capacity can also be put (i.e., the diversity of the loads it will serve).

2. As a share of the contingency reserves required to serve load in the event of an unplanned outage.[13] Energy charges are rendered in dollars per kWh and can be differentiated by time (on-peak, off-peak, season, hourly) to reflect the variable costs of production or a market-based approach.

## 4.3 Example 2—Orange & Rockland

Orange & Rockland is an investor-owned utility in New York State. Table 4 summarizes Orange & Rockland's standby service tariff SC-25, as compared with its full requirements tariff SC-9. A unique feature of this standby service tariff is that all service—both that needed to serve the customer when its onsite generation is offline (i.e., standby) and that needed to serve the customer's demand in excess of the capacity of its onsite generation (i.e., supplemental)—is taken under the partial requirements tariff. This means that the contract demand charge applies to the customer's total maximum demand, not merely that portion necessary to backing up its generator. In this respect it differs from other tariffs with daily as-used demand charges (for instance, see Appendix A, which describes the Hawaiian Electric standby tariff). Note, however, that a customer has the option to segregate a portion of its load so it might indeed be billed under the applicable full requirements tariff.

As suggested earlier, a monthly demand charge is, in effect, a daily demand charge with a 30-day ratchet. An alternative to a monthly demand charge for shared facilities is a daily as-used, on-peak demand charge. It reduces the costs of partial requirements service for those customers whose need for backup is infrequent, providing incentive for increased onsite generation. In its other aspects, this type of rate design looks very much like the previous design.

Table 4. Orange & Rockland Tariff Summary

| Unbundled Service for Full and Partial Requirements Customers (>1 MW) With Daily As-Used Demand Charges Orange & Rockland | | |
|---|---|---|
| | Full Requirements SC-9 | Partial Requirements SC-25 |
| Part 1: Customer charge | | |
| Customer charge | $450/month | $371/month |
| Part 2: Delivery charges, demand | | |
| A. Period A | $9.89/kW-month | |
| B. Period B | $4.64/kW-month | |
| As-used demand charge | | |
| Daily summer as-used | | $0.4210/kW-month |
| Daily non-summer as-used | | $0.2769/kW-month |
| Part 3: Delivery charges, energy | | |
| Period A, all kWh | $0.01103/kWh | |
| Period B, all kWh | $0.01103/kWh | |
| Period C, all kWh | $0.0041/kWh | |
| Standby | | |
| Contract demand charge | | $3.09/kW-month |
| Part 4: Energy, commodity | Energy, ancillary service, capacity at wholesale market prices | |
| Commodity charge | $0.0795/kWh | $0.0795/kWh |

Source: Orange & Rockland, general service Tariff SC-9 and standby service Tariff SC-25.

Table 5 shows the calculated cost for the conventional and CHP systems under Orange & Rockland's two tariffs. As in the previous example, the energy charges predominate, though not as much, accounting for slightly more than 80 percent of the total cost. The contract demand charges and delivery charges in the partial requirements tariff are much higher than in the previous example, accounting for almost $1 million. However, these charges are in lieu of higher demand and delivery charges included under the full requirements tariffs, so the result is a net savings. The reduction in cost is more than 95 percent of the reduction in consumption, again showing a good recognition of the value of DG in the tariff. The key factors again are a tariff dominated by energy charges, no demand ratchet, and, in this case, standby charges that replace rather than add to the demand and delivery charges in the full services tariff.

Table 5. **Orange & Rockland Cost Comparison**

| Comparative Annual Bills | Full Requirements | Partial Requirements |
|---|---|---|
| Purchased electricity, kWh | 92,762,451 | 49,273,191 |
| Facilities charges | $5,398 | $4,457 |
| Delivery demand charges | $832,744 | $0 |
| Delivery energy (usage) charges | $667,311 | $0 |
| Contract demand charges | $0 | $484,880 |
| Daily as-used demand charges | $0 | $489,961 |
| Commodity energy charges | $7,374,615 | $3,917,219 |
| **Total electric charges** | **$8,880,068** | **$4,896,518** |
| | | |
| Average rate for purchased power | $0.0957 | $0.0994 |
| Average avoided rate | N/A | $0.0916 |
| | | |
| **Average avoided rate as a percentage of average retail service rate** | **95.69%** | |

Source: EPA analysis using Orange & Rockland tariff.

## 4.4 Example 3—NSTAR

NSTAR has a standby rate design that calls for contract demand charges only; there are no variable demand charges, either monthly or daily. Table 6 summarizes NSTAR's partial requirements SB-T2 rate, as compared with its full requirements T2 tariff.

Table 6. **NSTAR Tariff Summary**

| Unbundled Service for Full and Partial Requirements Customers (>14,000 Volts)<br>Contract Demand Charges for Partial Requirements<br>Monthly As-Used Demand Charges for Full Requirements<br>NSTAR | | |
|---|---|---|
| | **Full Requirements** Rate T2 | **Partial Requirements** Rate SB-T2 |
| **Part 1: Customer charge** | | |
| Customer charge | $375/month | $375/month |
| **Part 2: Distribution charges, demand** | | |
| Summer peak | $19.5/kW-month | $19.5/kW-month |
| Winter peak | $11.03/kW-month | $11.03/kW-month |
| Energy charge | $0.01371/kWh | $0.01371/kWh |
| Transmission charges, demand | | |
| Summer | $4.50/kW-month | $4.50/kW-month |
| **Part 3: Other charges, standby** | | |
| Summer contract demand | | $14.67/kW-month |
| Winter contract demand | | $8.75/kW-month |
| **Part 4: Energy, commodity** | | |
| Default service, all kWh | $0.11678/kWh | $0.11678/kWh |

Source: NSTAR, Rate SB-T2 for partial requirements customers and Rate T2 for full.

Table 7 summarizes the cost analysis for this NSTAR example. The energy charge is the largest cost component, but it represents only 70–75 percent of the total, which is lower than in the previous examples. This suggests a less favorable outcome for DG; however, there is no demand ratchet. The standby charge is a contract demand charge, and, as such, it cannot be reduced through the generation of more power. It therefore represents an unavoidable cost which is larger than in the previous examples, accounting for more than 7 percent of the total electricity cost in the DG case compared with $6 million in savings. This accounts for a large part of the difference between the average retail rate before DG and the average avoidable rate.

Table 7. NSTAR Cost Summary

| Comparative Annual Bills | Full Requirements | Partial Requirements |
|---|---|---|
| Purchased electricity, kWh | 92,762,451 | 49,273,191 |
| Facilities charges | $4,500 | $4,500 |
| Distribution demand charges | $1,793,221 | $954,125 |
| Standby/contract demand charges | $0 | $649,512 |
| Transmission demand charges | $571,021 | $298,456 |
| Distribution energy charges | $1,271,773 | $675,535 |
| Commodity energy charges | $10,832,799 | $5,754,123 |
| **Total electric charges** | **$14,473,315** | **$8,336,252** |
| | | |
| Average rate for purchased power | $0.1560 | $0.1692 |
| Average avoided rate | N/A | $0.1411 |
| | | |
| **Average avoided rate as a percentage of average retail service rate** | **90.44%** | |

Source: EPA analysis using NSTAR tariff.

# 5: Conclusions

A host of factors will affect increased investment in efficient, clean DG. These factors include the costs of the onsite DG systems and the costs (e.g., the rates) for partial requirements electricity service. Rate designs that have a reasonable balance between energy and demand or reservation charges will naturally be more amenable to the broad policy goal of encouraging clean, efficient DG. Rate designs that reward reliable operation can encourage the development of a diversified, more reliable electric grid. The review of tariffs and operation on peak in this report suggests that the more favorable rate designs share common and central characteristics: they are designed to give customers a strong incentive to use electric service most efficiently, to minimize the costs they impose on the system, and to avoid charges when service is not taken. Put another way, they reward customers for maintaining and operating their onsite generation. Specifically, they are marked by some or all of the following features:

- Contract demand or reservation charges are small in relation to the variable charges for peak demand and energy.
- Peak demand charges are not ratcheted or, at worst, have 30-day ratchets (that is, there are no more than monthly as-used demand charges).
- Energy-based charges to collect capacity costs would seem to offer the greatest promise in this regard, but utilities and their regulators do not appear to be prepared to entirely abandon some form of peak demand charge. As such, daily as-used demand charges are the next best solution, but how a particular rate is structured along these lines will depend (as the first bullet mentions) on the levels of the various rate elements.
- The rate structure yields a high value of retail rate savings per kWh produced on site instead of purchased from the grid. This depends not only on the standby tariff itself, but also on the level and structure of the otherwise applicable full requirements tariff.

These findings are consistent with the understanding that the economics of onsite generation are based on reduced electricity purchases, and these reduced purchases must benefit the customer to make DG viable. Importantly, they also serve to remind regulators of the need to pay close attention to ensuring that the design of partial requirement rate structures captures the economic and environmental benefits of reduced energy consumption. These examples also suggest that such rates can apply to DG while also fairly compensating utilities for the services they provide to onsite generators.

# 6: Notes

1 There are a variety of terms and associated acronyms for customer-sited generation, some of which are synonyms and some of which refer to subsets of others: for example, DG, onsite generation, and CHP systems. For simplicity's sake, we use the catch-all term "DG" here because our analyses are concerned only with utility rates and not with the costs and benefits of different kinds of onsite facilities. The generic system that we model in the analyses is a high-capacity factor CHP system slightly more than 5 MW in size.

2 EPA's Combined Heat and Power Partnership defines CHP as follows: "CHP, also known as cogeneration, is an efficient, clean, and reliable approach to generating power and thermal energy from a single fuel source."

3 Energy and Environmental Analysis, an ICF International Company, maintains a Combined Heat and Power Installation Database that contains data on CHP units in each state. The database can be accessed at <http://www.eea-inc.com/chpdata/States/MT.html>.

4 Of course, how these other charges are calculated (e.g., as a function of demand or energy or according to some other measure) will be relevant to whether they pose barriers to DG and can be avoided.

5 Some tariffs define their consumption blocks in terms of kWh per kW of demand, thus relating usage directly to levels of demand.

6 A typical ratchet calls for billing the customer, in each of the 11 months following their peak demand, for a share of that peak demand or the peak in that month, whichever is greater. If a higher peak occurs, that new demand forms the basis of a new ratchet, which then extends for the following 11 months, unless it too is surpassed. To the extent that generation and delivery charges are unbundled, the computation and application of the charges and ratchets can differ. In the case of generation, the demand charge should be a function of the customer's contribution to system (i.e., coincident) peak, whereas for delivery it will be a function of the customer's noncoincident peak and its contribution to the need for dedicated and shared facilities.

7 The tension with ratchets lies in precisely this circumstance. Onsite generation systems, particularly CHP systems with higher capacity factors, save energy, but depending on the nature of their outages, they might have less of an impact on the need for grid-supplied capacity (both generation and delivery). Whether this is the case depends on the probabilities and timing of outages and the overall load shapes of the relevant customer classes and the system as a whole. A relatively diverse system should have less of a need for longer-duration charges. Some standby tariffs allow for the conversion of the historical ratchet into the level of contract or reservation demand, which further exacerbates the challenges for the customer in making the case for DG work.

8 At least one utility—Detroit Edison—calls the service that it provides to customers with onsite generators "backup," even if the customer sheds load to compensate for the unplanned outage (see the discussion in Section III.C. on physical assurance). Similarly, all service taken by an Orange & Rockland DG customer is supplied under the partial requirements tariff; "standby" is not differentiated from "supplemental" service.

9 There are additional economic values provided by onsite generation, including increased reliability and, in the case of CHP applications, reduced fuel use for onsite thermal needs.

10 This example assumes that this customer is on a calendar month billing cycle. Other simplifying assumptions having to do with the market price for the energy commodity were also made.

11 This is the consequence of a simplifying assumption in which the generation energy charges that partial requirements customers pay are the same as those paid by the full requirements customer. This is not the case in practice. Whereas the partial requirements customer pays for its generation contingency reserves separately from the energy it uses, the full requirements customer pays an energy rate that already includes the cost of the contingency reserves. By using the same energy commodity charge for both customers, we have slightly

overstated the cost of partial requirements service, though not significantly enough to affect the central conclusions.

[12] This assumes that the distribution- and transmission-level diversity benefits (or losses) provided by DG customers do not significantly differ from those of full requirements customers. If they do, regulators might want to set rates that better reflect those impacts.

[13] Mathematically, the differences between the two methods are as follows. In the first instance, the amount of load to be served in the case of an outage is discounted by the probability of that outage occurring on peak. Then applied to that discounted demand is a price per kW for the generation needed to cover it. In the second case, it is the cost of the system's generation reserves that is discounted (that is, it is shared among all customer classes according to their contributions to system peak) and is then applied to the total kW that a customer is expected to incur during an unplanned outage.

# Appendix A: Additional Analyses of Specific Standby Tariffs

## A.1 Hawaiian Electric Company—Unbundled Rates and Daily Demand Charges

This is an additional example of a standby rate that makes use of daily as-used demand charges. Hawaiian Electric Company, serving an island, is faced with particularly high costs. Its rates are provided in Table 8.

Table 8. Hawaiian Electric Company Tariff Summary

| Unbundled Service for Full and Partial Requirements Customers (>1 MW) With Daily As-Used Demand Charges Hawaiian Electric Company | | |
|---|---|---|
| | Full Requirements Rate PS | Partial Requirements Rate SS |
| Part 1: Customer charge | | |
| Customer charge | $230/month | $230/month |
| Part 2: Delivery charges, demand | | |
| Sum of A + B | | |
| A. Reservation demand charge* | | $7.26/kW-month |
| B. As-used demand charge | | $0.66/kW-day |
| First 500 kW of billing demand | $10.00/kW-month | |
| Next 1,000 kW of billing demand | $9.50/kW-month | |
| Over 1,500 kW of billing demand | $8.50/kW-month | |
| Part 3: Delivery charges, energy | | |
| All kWh | | $0.124/kWh |
| First 200 kWh/month per kW of billing demand** | $0.072087 | |
| Next 200 kWh/month per kW of billing demand | $0.064104 | |
| Over 400 kWh/month per kW of billing demand | $0.061010 | |
| Part 4: Energy, commodity | $0.15/kWh | $0.15/kWh |

Source: Hawaiian Electric Company, full requirements Rate PS and partial requirements Rate SS.

*Note that, unlike the Orange & Rockland contract demand charge, Hawaiian Electric Company's reservation demand charge applies only to the amount of demand associated with backup service (e.g.,

the nameplate capacity of the onsite generation or a contractually agreed-on demand). Any demand in excess of that amount is paid for under the otherwise applicable full requirements tariff.

**Energy charges in kWh/month per kW of billing demand denote a declining block structure where the number of kWh under each block rate is a function of the monthly kW billing demand.

The standby rate customer, as in the other examples discussed in this report, will avoid the purchase of 47 percent of its grid-supplied energy, and the customer will reduce its utility bill by 42 percent. The average cost of a grid-supplied kWh under the partial requirements tariff is approximately 5 percent greater than under full requirements. The value of the average avoided kWh is 94.3 percent of the average retail rate.

Of interest is the fairly high per-kWh charge ($0.124/kWh) for delivering energy to the partial requirements customer when the DG is offline. A similar charge is not imposed on full requirements customers, but they pay delivery demand charges that range from 17 percent to 37 percent higher than partial requirements customers. An energy-based delivery charge is, as a general matter, a preferred approach to standby rate design, in that it gives the customer a strong and direct incentive to ensure that their DG is properly maintained and operating. In this example, the delivery charge constitutes a relatively small portion of the total annual bill (approximately $90,000) because the onsite generation operates at a fairly high capacity factor. But, for a less well-performing DG system, this charge could be much larger. This tariff, in effect, shifts part of the revenue burden for partial requirements customers from an unavoidable delivery demand charge to a "pay as you go" energy charge. This, in combination with the daily as-used demand charge, enables the 42 percent reduction in the customer's annual bill and results in the fairly high value of avoided retail purchases. Obviously, even a rate structure that makes use of avoidable charges might still impose relatively high bills on the customer with DG, if the recurring charges (customer and reservation or contract demand charges) are themselves set at disproportionately high levels. What matters are the relative shares of the total bill to which the various rate elements contribute.

## A.2 Consolidated Edison—Daily As-Used Demand Charges

This analysis shows the full and partial requirements tariffs of an additional New York utility, Consolidated Edison. Table 9 compares this utility's full and partial requirements tariffs.

Table 9. Consolidated Edison Tariff Summary

| Unbundled Service for Full and Partial Requirements Customers (>1.5 MW) With Daily As-Used Demand Charges Consolidated Edison | | |
|---|---|---|
| | Full Requirements Tariff SC-9, Rate II | Partial Requirements Tariff SC-14RA |
| Part 1: Customer charge | | |
| Customer charge | $0 | $908 |
| Part 2: Delivery charges, demand | | |
| June–September: sum of A + B + C | | |
| A. M–F, 8 a.m.–6 p.m. | $5.86/kW-month | |
| B. M–F, 8 a.m.–10 p.m. | $11.09/kW-month | |
| C. All days, all hours | $10.94/kW-month | $5.41/kW-month |
| All other months: sum of B + C | | |
| B. M–F, 8 a.m.–10 p.m. | $8.14/kW-month | |
| C. All days, all hours | $3.54/kW-month | |
| Part 3: Delivery charges, as-used demand | | |
| 8 a.m.–6 p.m., Jun–Sept | | $0.3423/kW-day |
| 8 a.m.–10 p.m., Jun–Sept | | $0.6910/kW-day |
| 8 a.m.–10 p.m., other months | | $0.5200/kW-day |
| Part 4: Delivery charges, energy | | |
| M–F, 8 a.m.–10 p.m. | $0.0058/kWh | |
| All other hours/days | $0.0058/kWh | |
| Part 5: System benefits charges, energy | | |
| All hours/days | $0.0018/kWh | $0.0018/kWh |
| Part 6: Energy, commodity | Energy, ancillary service, capacity at wholesale market prices | |

Source: Consolidated Edison, partial requirements tariff SC-14RA and full requirements tariff SC-9, Rate II.

The partial requirements customer, in keeping with the other examples, will avoid the purchase of 47 percent of its grid-supplied energy, and will reduce its utility bill by 43.7 percent. The average cost of a grid-supplied kWh under the partial requirements tariff is 6 percent greater than that under full requirements. The value of the average avoided kWh is 93.2 percent of the average retail rate.

# Appendix B: Principles of Rate Design

## B.1 Basic Principles of Rate Design

There are two broad, fundamental justifications for governmental oversight of the utility sector. The first is the widely held belief that this sector's outputs are essential to the well-being of society—its households and businesses. The second is that its technological and economic features are such that a single firm often can serve the overall demand for its output at a lower total cost than can any combination of more than one firm. Competition cannot thrive under these conditions and, eventually, all firms but one exit the market. This is called "natural monopoly," and, like monopoly power in general, it gives the surviving firm the power to restrict output and set prices at levels higher than are economically justified. Economic regulation is seen then as the necessary and explicit public or governmental intervention into a market to achieve a public policy or social objective that the market fails to accomplish on its own.

In light of the economic and public welfare characteristics of utilities, certain purposes for price regulation emerge. They can be generalized in the two goals of *economic efficiency* and *fairness* (or equity), which can then be further broken down as follows:

- **Economic efficiency**. Because electric utilities generally do not operate in competitive markets that would impose cost discipline on them, regulation must fulfill that function. To achieve this objective, regulation sets rates that reflect, to the greatest extent possible, the long-run marginal costs of production.[1]

- **Fair prices** for consumers and investors. Price regulation is intended to guard against the reaping of unjustifiably high profits (called economic "rents"), while still enabling the utility to generate enough revenue to cover necessary expenses and investment and to provide a reasonable return on that investment. Prices should also be fair to competitive providers or, more accurately, the competitive process. They should also minimize any distortional effects on the economy—changes in how the economy and customers would act if there were perfect competition with no regulation and no monopoly.

- **Non-discriminatory access** to service for all consumers.

- **Adequate quality and reliability**. Because electricity is an essential service, reliability is critically important.

- **Other stated public policy objectives** (e.g., environmental protection, universal service, low-income support, energy efficiency) (Bonbright, 1961, pp. 25–41; Pierce, 1999, p.11; Kahn, 1988, Vol. I, pp. 20–25, 69–70, and Vol. II, pp. 243–246).

For goods and services that competitive markets can provide, the markets by themselves will go a long way toward meeting these goals.[2] Thus, it can be said that economic regulation is intended to achieve outcomes that competition, if it were possible in the market for electricity, would otherwise achieve (Kahn, 1988, Vol. I, p. 17; Bonbright, 1961, p. 372; Pierce, 1999, pp. 2, 47–48, 94–95). Also, prices in regulated industries naturally affect prices in competitive ones, and

vice versa, and therefore affect the overall efficiency of the economy—all the more reason to adopt utility rate designs that most closely resemble price structures in competitive markets and therefore do not create excessive distortionary effects on the economy.

The general goals of economic regulation inform the rate design process. More specifically, the object is to set economically efficient and fair prices, while simultaneously giving the regulated firm a reasonable opportunity to recover its legitimate costs of providing service—including return of, and on, its investment.

The particular problem faced by regulators in this exercise is that the legitimate historical (accounting or "embedded") costs that a utility incurs are to be recovered in rates, but these costs may only bear a passing resemblance to the marginal costs—what a customer must pay to receive one more unit of energy—that form the basis of economically efficient prices. The need to cover historical costs, set economically efficient prices, and then meet other objectives of regulation requires careful judgment. James Bonbright (1961) dedicated five chapters and 120 pages to the subject, beginning with a catalogue of the several and sometimes competing objectives of rate design. It remains today the comprehensive compilation on which regulators rely. Paraphrased, Bonbright's principles are (Bonbright, 1961, p. 291):

### Revenue-Related Objectives:

- Rates should yield the total revenue requirement.
- Rates should provide predictable and stable revenues.
- Rates themselves should be stable and predictable.

### Cost-Related Objectives:

- Rates should be set so as to promote economically efficient consumption, where the well-being of both the utilities and consumers is maximized, given the restraints (static efficiency).
- Rates should reflect the present and future private and social costs and benefits of providing service (i.e., all internalities and externalities).
- Rates should be apportioned fairly among customers and customer classes.
- Undue discrimination should be avoided.
- Rates should promote innovation in supply and demand (dynamic efficiency).

### Practical Considerations:

- Rates should be simple, certain, payable conveniently, understandable, acceptable to the public, and easily administered.

on the operating characteristics of the generation, which system operators and utilities argue is far less understood than proponents contend. One way to deal with this issue, at least in the early years of a new standby rate structure, is to make the tariff optional—that is, give customers the choice of taking service under the standby tariff or under the otherwise applicable full requirements tariff. Customers will choose the tariff that better serves their needs and reduces their costs more. While this may result in a lower aggregate level of revenues for the utility from these customers, it will reveal a good deal about the performance that customers expect from their machines and might indeed offer a better allocation of the risks between them.[7]

## B.2 Pricing the Components of Electric Service

Rate designers differentiate the major components of the system according to the drivers of their costs—i.e., according to the functions of the system. Three broad categories of costs emerge from this approach—generation, transmission, and distribution—which can be separately priced as consumer understanding and administrative simplicity allow. Where the benefits of changes in usage caused by more complex rate designs are not enough to justify the added metering and billing costs to support such rates, the pricing elements are combined and aggregated into simpler energy-only or energy and demand charges.

We note here that the structure of the electric industry in a state might affect the nature of partial requirements service, like that of full requirements service. If multiple competitive suppliers provide generation services, distribution utilities will provide only delivery service and regulatory interest in standby will be, accordingly, restricted to that component of service. Restructuring accelerated the movement to unbundled pricing for the various components of service (i.e., separate prices for the differentiable elements of service—generation, transmission, and distribution), but nothing about vertically integrated industry structures prevents a similar unbundling of rates. Unbundling makes the nature of costs more transparent and, if done properly, greatly reduces or even eliminates the potential for the cross-subsidization of one service by another.

Generation consists of energy and capacity costs. Energy is the cost to actually produce kWh—that is, variable (or marginal) cost. Primarily this is the cost of fuel, but often there are variable operations and maintenance costs that are not incurred if the unit does not run. Capacity is the cost of the plant—or, more precisely, of the ability to generate power—for the period of the purchase (hour, day, month, year).[8] As described above, capacity is typically expressed in per-kW terms, but it can also be expressed in energy terms (per kWh) given assumptions about a plant's operating characteristics.

The amount of generation that a system needs is a function of its overall peak demand. Only that amount necessary to meet peak (and reserves—otherwise unused capacity to maintain reliability in case of unplanned outages) should be acquired; any more would be wasteful and any less would, without remedial action, jeopardize system reliability. This means that it is a customer's or, more accurately, a customer class's full or partial requirement, contribution to the system (or coincident) peak that determines its responsibility for the costs of the required generation capacity. Insofar as the load-serving entity (i.e., the utility or competitive service provider) knows generally when peaks will occur, time-differentiated pricing can be designed to reflect the expected costs of peak demand, and this will go a long way toward fairly allocating the costs of

capacity among users, capturing the benefits of demand response, and capturing load diversity from the different power generation sources.[9]

Each customer class imposes unique demands on the system, and the tariffs drawn up to reflect those different characteristics provide, in effect, different services suited to the needs of the classes. To the extent that the usage characteristics of partial requirements customers, and the costs associated with that usage, are demonstrably different from those of related full requirements customers, such customers can be seen as constituting a different class. Whether, from the perspective of DG customers, being treated as a separate class is good or bad (that is, less or more costly) depends on, among other things, the average load factor (the ratio of average electric load to peak load) of the group and its contribution to system peak. If the load factors of DG customers are for the most part better than those of other customers in the relevant full requirements service class, then the non-DG customers are benefiting from the inclusion of DG owners in the class.[10] Or it might be the other way around. But either way, a detailed cost of service study—using reliable data on the operational characteristics of DG systems—will be needed to inform the regulators' decision about how to treat these customers.

A standard practice in the design of standby tariffs is to impose more than one type of demand charge. The first is the reservation or contract demand charge, which ostensibly covers the costs of the capacity that the utility must have access to in order to cover a call for unscheduled service, even if that call is never made. Typically, the reservation charge is applied against monthly billing demand (contract, maximum potential, or ratcheted), and therefore looks very much like an unavoidable, fixed, recurring fee that gives a customer the right to take standby service.[11] The contract demand is often based on the net capacity of the onsite generator or some negotiated or specified portion of that capacity. The next charge is a usage-related demand charge, which is applied against demand associated with standby service actually taken. This charge is often a monthly, or sometimes daily, price per kW used and, in the absence of a ratchet, is referred to as "as-used." This charge is generally linked to the costs of shared facilities, which can vary insofar as the plant can be redeployed (used to serve other demands).[12]

A variation on the reservation charge is a fee for contingency reserves, the amount of operating reserves that must be available to meet load in the event that the customer unexpectedly takes energy from the grid—that is, when its onsite generation suffers an unscheduled outage. Under this approach the customer has the same obligations that other load serving entities have: namely, entitlement to sufficient operating reserves to cover the load in cases of an unplanned outage of any of the resources serving that load. Because the probabilities of two or more generating facilities (whether central station or customer-sited) suffering an unplanned outage simultaneously and, in particular, at the time of a system peak, are less than 100 percent, the amount of resources to be held in reserve is correspondingly less than the full potential load that they might be called on to serve. This is the effect of diversity, and it greatly reduces the amount of excess capacity that the system must have to maintain a given level of reliability.

A combination of factors drives investment in the distribution system. For facilities dedicated to the customer, a customer's noncoincident peak demand (i.e., maximum demand, regardless of when it occurs) drives investment, and for facilities shared among distribution customers (e.g., substations, feeders, etc.), the driving force is coincident peak demand of the customers they serve. Though the costs are separable, they are typically combined within one demand charge (or

set of charges) for distribution service, priced on a per-kW-month basis. Simplicity is one reason for this. Another is the lack of a metering and data management capability that measures both customer coincident and noncoincident peaks on discrete sections of the distribution system—although advances in metering technology are changing this.

The distribution demand charge is multiplied by the customer's billing demand, which is one of several quantities (or some variation on them): the customer's monthly noncoincident peak demand, its maximum potential demand, or an agreed-on contract demand. For partial requirements customers, the negotiated contract demand might be accompanied by the customer's promise not to exceed it (accompanied by special load-limiting facilities to make good the guarantee), a feature sometimes referred to as "physical assurance."[13] Not all utilities offer these options; each has its own approach.

If avoidability of charges is a key determinant of whether a rate structure is beneficial to DG, then the design of demand charges—specifically, their ratchets—becomes a focus of analysis. Ratchets are most painful to customers with relatively low load factors—i.e., low ratios of actual usage (in kWh in a period) to maximum potential usage (the product of peak demand and hours in the period). They require the customer to pay a fee related to a significant fraction of their peak demand in periods when their demand does not approach their peak. A customer with relatively high load factors is less affected by the ratchet the closer its periodic demands are to its peak, and so the fees it pays are not much different from those it would pay without the ratchet. Either way, of course, it is worth examining the justification for the ratchet to determine if it is related to the nature of the costs incurred and if the capacity whose costs it covers is indeed unable to be put to alternative uses. This is another way of looking at the question of diversity, the measure of the coincidence of customer demands. The more diverse a system (or part of a system) is, the less impact the peak demand of any one customer or set of customers has on the overall peak of the system. Conversely, the greater the degree of coincidence in customer demands, the less diverse the system's load.

A number of utilities have eliminated multi-month ratchets for distribution service. Portland General Electric assesses distribution demand charges on the basis of the customer's peak in the month; each month's costs are determined separately and are unrelated to any previous month's demand.[14] Rochester Gas & Electric, Orange & Rockland, and other New York utilities use daily on-peak only (as-used) demand charges.

Transmission costs tend to be less problematic than generation and distribution costs if only because they are typically a small portion of the bill. Transmission investments are shared facilities and, depending on the size of the facilities in question, are characterized by greater diversity than much of the distribution system. Because transmission, like distribution, is driven by the relevant peak demand, it is priced on a per-kW (or per-MW) basis. In many restructured states, transmission charges are typically included in the prices of competitive generation suppliers, not the prices of the distribution company.

## B.3 Notes

1 The economics literature in support of this statement is extensive. (See, for example, Kahn, 1998, Chapters 3 and 4, and Bonbright, 1961, p. 318.) This is not to say that it is not appropriate, in certain circumstances, to set prices at short-run marginal cost, for instance when variable costs (e.g., the price of fuel) exceed the long-run marginal cost. In that event, consumers undervalue the good and use more of it than is economically justified, and the utility loses money. Some regulatory economists argue that the converse is also true—that when capacity is surplus, it is economically inefficient to charge greater than variable operating cost. We would say, however, that this argument might have more appeal if all the costs of production, including the external costs (e.g., environmental damage costs), were included in the price.

2 This is not to say that competitive markets will, by themselves, satisfy all, or fully any, of the welfare-enhancing objectives that a society embraces. Transaction costs, externalities, lack of information, and the preexisting distribution of wealth and income—to name a few factors—all affect the operations of markets in ways that often call for some form of governmental intervention into the market for the benefit of the public overall. Content labeling; performance requirements; health standards; labor, anti-trust and anti-discrimination laws; and financial requirements are all examples of government actions taken to assure that other highly valued outcomes (such as equity) are achieved.

3 Moreover, they are virtually unknown in competitive markets. One does not pay a toll, for example, to enter a grocery store. The relatively few instances of such fees in nonregulated markets (e.g., cellular telephone service) can be seen as exercises of some degree of market power and, perhaps more importantly, as symptomatic of an industry in which capacity (bandwidth) is plentiful and inexpensive, and the marginal costs of usage (in both the short and long runs) are very low. This is not the case in the electric industry.

4 Indeed, early designs for competitive wholesale markets called only for energy pricing.

5 For example, Arizona Public Service Corporation sets a minimum number of hours per month at which standby service will be provided at base prices. Failure to stay at or below the minimum will result in penalty charges. In addition, the onsite generation must maintain a 75 percent capacity factor, based on a rolling 18-month average. The onsite generation is also subject to penalties for failure to do so. Tucson Electric Power's standby tariff works in a similar fashion.

6 California is one state where this option is available.

7 New York and Hawaii have both taken this approach, although in New York the option was available only to customers who had onsite generation as of January 2003.

8 As a matter of economic theory, price should equal the *marginal* cost of the good, because that describes the value to society of the resources that production of the good requires. As a matter of law, the rates of regulated monopolies must be sufficient to cover actual expenditures that are deemed prudent and used and useful. These are referred to as historical or embedded costs. The problem is that utilities are natural monopolies and the economics of their industries, unlike those of competitive markets, do not drive their embedded costs per unit to equal their marginal costs; in the long run, their embedded costs will exceed their marginal costs. Worse yet, as monopolies, the profit-maximization imperative would cause them to set prices at levels that exceed their embedded costs. Regulation is intended to prevent that outcome and to ensure only the recovery of their embedded costs. Rate design aims, to the extent possible, to set rates that reflect marginal costs, adjusted as appropriate to generate revenues sufficient to cover embedded costs.

9 An individual customer's contribution to coincident peak is not, given traditional metering technologies, easily measured, nor is it, for rate design generally, a practical necessity. Advances in metering infrastructure are enabling more dynamic rate structures, including real-time pricing, which reveal hourly (or even shorter duration) changes in wholesale market prices for power. Early experience with these new technologies and prices has demonstrated that customer demand response, especially where made possible by automated systems (e.g., the shutting down of one's air conditioning when a specified price trigger is hit), can be predictable and

significant. Technologies of this sort and the dynamic rate designs they support can have the effect of allocating costs more directly to those who cause them and, conversely, can more directly reward those who are able to avoid them.

[10] This, of course, is true of all rate structures as a general matter: the nature of average-cost ratemaking is that customers with load factors that are below average pay less than what might be described as their "full share" of the class's total cost of service, and the customers with better-than-average load factors pay more than their share. And it is also true of pricing in competitive industries as well: the standard rate for delivery of a package by Federal Express doesn't vary by distance. The customers who cost less to serve than the average cover some part of the costs of those who cost more than the average to serve.

[11] What matters most under this scheme is the level of the per-kW reservation charge. If that level approximates the generation component of the otherwise applicable full requirements tariff and makes no provision for the probability that the service will be needed, it may result in total costs to the customer that will render most onsite generation projects uneconomic. Whether this will be the case depends on the relationship between (1) the capital and operating costs of the DG system and (2) the demand and energy costs of grid-supplied power.

[12] In this discussion, we haven't differentiated between the rates of vertically integrated utilities (those that are monopoly providers of generation, transmission, and distribution services) and delivery-only utilities. The general description of typical standby rate designs applies to both, but in the case of delivery-only service the charges would of course not include any generation costs.

[13] California is one state where this option is available. In Rulemaking 99-10-025 (1999), the state's public utilities commission defined physical assurance "as the application of devices and equipment that interrupt a DG customer's normal load when DG does not operate." The California Clean DG Coalition has since argued that a utility's ability to refuse service should not be unconditional, but should instead be limited to specified circumstances such as times of local distribution system peaks.

[14] This, in effect, is a demand charge with a maximum 31-day ratchet.

# Appendix C: References

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