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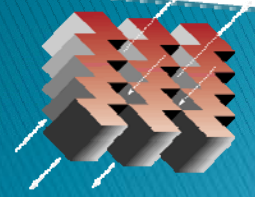
Michigan Energy Measures Database

Michigan Collaborative
December 7, 2009



ARCHITECTURAL ENERGY CORPORATION

Integrated Engineered Solutions

Franklin energy

cost effective energy solutions

Agenda

- Introductions & Objective of Meeting
- Overview MEMD
- Non Weather Sensitive Measures
- Weather Sensitive Measures
- Discussion how to use the data in the state

Objectives of MEMD

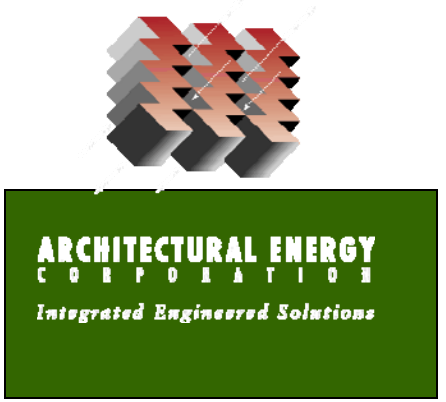
- Provide you with accurate information on potential technologies or measures that could be used in an energy efficiency program and for IRP planning
- Customize measures for your weather and loads
- Allows for consistent application of information across state for energy efficiency planning and goal measurement
- Avoids duplication of efforts among utilities
- Allows for consistency of assumptions
- Good documentation for regulatory review

Key Terms

- *Michigan Energy Measures Database* – Database supplied by MMP as basis for initial calculations and potential for programs
- *Deemed Measures* – When state policy makers decide to adopt those calculations for the upcoming program year. It is important that this is a forward look and then adjusted based on evaluation for the upcoming year.
- *Weather Sensitive Measures* – measures that are affected directly by weather and impacts need to be simulated based on that weather.
- *Non Weather Sensitive Measures* – all other measures not impacted directly by weather.

Two Parts to Library

- Non Weather Sensitive Measures
- Weather Sensitive Measures



What is NOT in MEMD

- Measures that have large variability of application where use patterns and applications will vary – Custom
- Measures that are new to market with unproven savings and costs
- MEMD does not include technical or market potential it is only the engineering savings opportunity based on a single installation

Non Weather Sensitive Measures

George Roemer

Franklin Energy Services

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Non Weather Sensitive Data

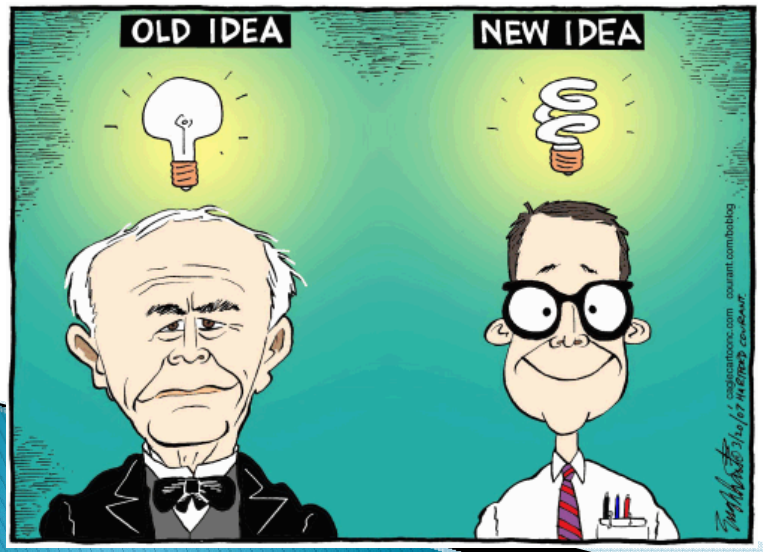
- Process of measure selection, evaluation, and documentation
- Summary of measures
- Sample specifics for a few measures

Process of Measure Selection Evaluation, and Documentation

- Identified measures
- Determined baselines
- Calculated savings
- Estimated incremental costs, measure lives
- Documented in written text and spreadsheets for support

Identified Measures

- Review of major incentive programs around country, based on our experience – WI, MN, NY, CA, OR, Duke Midwest
- Review recommendations of energy organizations – CEE, ACEEE, ENERGY STAR, etc.



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Identified Baselines

- Review recommendations of energy organizations – CEE, ACEEE, ENERGY STAR, etc.
- Review of programs currently administering
- Review of code/energy standards – ASHRAE Energy Star, other
- Some baselines may be adjusted based on local markets as you get your own evaluation data, but you have the foundation assumption as start

Savings Calculation

- Standard engineering calculations
- Spreadsheet analysis – allows flexibility
- Calculations from established organizations
- Assumptions based on actual field observations and experience with other programs

Cost Estimation

- DEER database
- Means cost data
- Review of current projects in programs administering – Focus on Energy WI

Summary of Measures – C&I

Lighting
- Fluorescent
- High Bay
- Controls
- LEDs

Motors and Pumps

Appliances

Grocery

Process

DHW

Renewable

Summary of Measures – Residential

Lighting

- CFLs
- LEDs

Appliances

Pool Pumps and Control

Renewable

- Solar DHW
- PhotoVoltaics

Measures Summary Spreadsheet

- New Data Fall 09\Master Measure Database Michigan 112509.xlsx

Sample Measure Calculations

FES- L1 T8 Replacing T12s and T12HOs

Assumptions												
Demonstration Operating Hours	**3,680**											
Energy Efficient Installation T 8 w/Electronic Ballast	Energy Efficient System Wattage	Energy Efficient Initial Lumens	Energy Efficient Mean** Lumens	Standard Installation T12 w/Magnetic Ballast	Standard System Wattage	Standard Initial Lumens	Standard Mean** Lumens	Differential Mean** Lumens	delta P Lumens Mean**	Watts Savings	kW Savings	Energy Savings kWh/yr
T8 - 17W -2' 1 Lamp - Electronic	20	1,325	1,260	T12 - 20W -2' 1 Lamp - Magnetic	27.5	1,200	1,150	110	10%	7.5	0.008	28
T8 - 17W -2' 2 Lamp - Electronic	33	2650	2520	T12 - 20W -2' 2 Lamp - Magnetic	43	2,400	2,300	220	10%	9.5	0.010	35
T8 - 17W -2' 3 Lamp - Electronic	48	3975	3780	T12 - 20W -2' 3 Lamp - Magnetic	68	3,600	3,450	330	10%	20	0.020	74
T8 - 17W -2' 4 Lamp - Electronic	63	5300	5040	T12 - 20W -2' 4 Lamp - Magnetic	85	4,800	4,600	440	10%	22	0.022	81
T8 - 25W -3' 1 Lamp - Electronic	26	2080	1970	T12 - 30W -3' 1 Lamp - Magnetic	37	2,200	1,910	60	3%	11	0.011	40
T8 - 25W -3' 2 Lamp - Electronic	43	4160	3940	T12 - 30W -3' 2 Lamp - Magnetic	53	4,400	3,820	120	3%	10	0.010	37
T8 - 25W -3' 3 Lamp - Electronic	78	6240	5910	T12 - 30W -3' 3 Lamp - Magnetic	90	6,600	5,730	180	3%	12	0.012	44
T8 - 25W -3' 4 Lamp - Electronic	86	8320	7880	T12 - 30W -3' 4 Lamp - Magnetic	106	8,800	7,640	240	3%	20	0.020	74
T8 32W - 4' 1 Lamp - Electronic	30	2,800	2,660	T12- 34W - 4' 1 Lamp - Magnetic	44	2,650	2,280	380	17%	14	0.014	52
T8 32W - 4' 2 Lamp - Electronic	60	5,600	5,320	T12- 34W - 4' 2 Lamp - Magnetic	77	5,300	4,560	760	17%	17	0.017	63
T8 32W - 4' 3 Lamp - Electronic	88	8,400	7,980	T12- 34W - 4' 3 Lamp - Magnetic	120	7,950	6,840	1,140	17%	32	0.032	118
T8- 32W - 4' 4 Lamp - Electronic	112	11,200	10,640	T12- 34W - 4' 4 Lamp - Magnetic	150	10,600	9,120	1,520	17%	38	0.038	140
T8 - 59W - 8' 1 Lamp - Electronic	58	5,800	5,500	T12 - 60W - 8' 1 Lamp - Magnetic	69	5,500	5,060	440	9%	11	0.011	40
T8 - 59W - 8' 2 Lamp - Electronic	112	11,600	11,000	T12 - 60W - 8' 2 Lamp - Magnetic	132	11,000	10,120	880	9%	20	0.020	74
T8 - 86W - 8' 1 Lamp - HO - Electronic	80	8,000	7,600	T12 - 95W - 8' 1 Lamp - Magnetic - HO	105	8,000	6,950	650	9%	25	0.025	92
T8 - 86W - 8' 2 Lamp - HO - Electronic	160	16,000	15,200	T12 - 95W - 8' 2 Lamp - Magnetic - HO	210	16,000	13,900	1,300	9%	50	0.050	184
Low Watt T8	28	2,750	2,585	32 W T8	32	2,800	2,660	(75)	-3%	4	0.004	15

Sample Measure Details

FES – L1 – Replace T12 or T12HOs Fixtures with T8 or T8HO Fixtures

Technology Description

For this technology, we evaluated the replacement of energy efficient T12 lamps and T12 fixtures with magnetic ballasts with T8 lamps and T8 fixtures with electronic ballasts.

Methodology and Assumptions

A standard spreadsheet analysis was developed to evaluate the use of T8 lamps and fixtures with electronic ballasts versus the use of energy efficient T12 lamps and fixtures with magnetic ballasts. Also evaluated was the replacement of T12 HO lamps and fixtures with T8HO lamps and fixtures.

Key assumptions for both scenarios:

- Cost estimates include material costs only. Fixture replacement as well as fixture retrofit costs are provided. Installation costs and potential maintenance savings are not included.
- Secondary impacts for heating and cooling were not evaluated.
- Information regarding lamp and system wattages, lumens, and material pricing was developed from a combination of lighting suppliers and industrial supply houses.
- Potential lighting replacement scenarios were evaluated based on mean lumens. Lumen is the measure of the amount of light a lamp produces. Initial lumens are the lamps' approximate light output after 100 hours of operation, while mean lumens measures the light output at 40% of its rated life. A true measure of a lamps' efficacy is how well it maintains its' light output over time.

Results Summary

The results of the analysis are shown in FES – L1 T8 Replacement of T12s.

- Standard 2' T8 17 watt lamps with electronic ballasts can be used to replace standard 2' T12 20 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations, with an average 10% increase in mean lumen output.
- Standard 4' T12 34 watt lamps with magnetic ballasts can be replaced by 4' T8 lamps with 28, 30, or 32 watt lamps with electronic ballasts on a one-for-one replacement schedule for 1, 2, 3 and 4 lamp configurations. Utilizing T8 28 watt lamps yield an average 13% increase in mean lumens output, the T8 30 watt lamps yield an average 16% increases in mean lumens output, while the T8 32 watt lamps yield an average 17% increase in mean lumens output.
- Standard 8' T8 59 watt lamps with electronic ballasts can be used to replace standard 8' T12 60 watt lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 9% increase in mean lumen output. Although replacing T12 60W 8' 1 and 2 lamp configurations with respective T8 59W 8' 1 and 2 lamp configurations is an energy efficient solution, it isn't very cost effective. A more cost effective option would be to replace T12 60W 8' 1 lamp fixtures with T8 32 W 4'2 lamp fixtures and to replace T12 60W 8' 2 lamp fixtures with T8 32 W 4' 4 lamp fixtures. This option results in a 5% increase in mean lumen output.
- Standard 8' T8 86 watt HO lamps with electronic ballasts can be used to replace standard 8' T12 95 watt HO lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 9% increase in mean lumen output.
- Standard 2' T8 32W watt U-Bend lamps with electronic ballasts can be used to replace standard 2' T12 34 watt U-Bend lamps with magnetic ballasts on a one-for-one replacement schedule for 1 and 2 lamp configurations, with an average 12% increase in mean lumen output.

Requirements For Application

Incentives require a one-for-one replacement of F40T12, F34T12 or F96T12 lamp and ballast systems with new F32T8 or F96 T8 lamp and electronic ballast systems.

Measure Life

Fixture and ballast life data range from 10 to 16 years, we recommend 10 years.

Initial One-Time Costs

A summary of costs are shown in FES – L1 T8 Replacement of T12s.

Residential CFL Savings

Savings rely on recent program evaluations for key assumptions

- CFL wattages and weighting, Glacier 2008 – Weighting analysis produces 52.5W avg savings
- Annual Hours, KEMA-XENERGY 2005
  Annual hours = 2.3 hours/day

Residential CFL Savings

- Per PA Consulting/Focus on Energy 2008

  2.3 hours/day more applicable to Direct Installation with more low use fixtures retrofit
- Nexus 2004 long term logging study shows 2.7 hours/day

  Using 2.7 hours/day with 0.85 realization rate give 2.3 hours/day

Residential CFL Savings

- Savings estimate of 44.1 kWh is justified using the conservative 2.3 hours/day with no realization rate
- Savings estimate of 44.1 kWh is also justified using a reasonable 2.7 hours/day assumption with a 0.85 realization rate

Weather Sensitive Measures

Pete Jacobs
Architectural Energy Corporation/Building Metrics

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Building Types and Vintages

- Single Family Residential (with and without basement)
  - Old, poorly insulated (1950s)
  - Existing, average insulation (1980s building codes)
  - New (minimally compliant with IECC 2004)
- Manufactured Homes
  - Pre 1978
  - 1978 – 1994 (HUD standards)
  - 1995 and newer
- Commercial
  - Existing vintage only
  - Ten different building types

Commercial Building Types

- Assembly
- Fast Food Restaurant
- Full Service Restaurant
- Grocery
- Large Office
- Large Retail
- Light Industrial
- Primary School
- Small Office
- Small Retail

General Approach

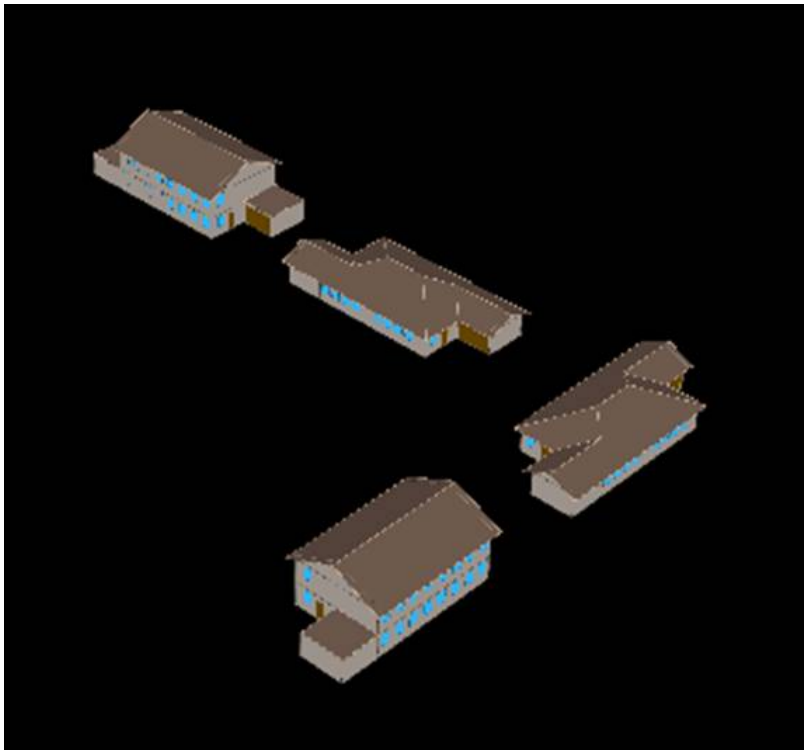
Residential and Commercial Buildings

- DOE-2 simulations of prototypical buildings
- Prototypes derived from California Database for Energy Efficiency Resources (DEER) study
- Modifications to prototypes according to common design practices in Michigan
- EIA - RECS and CBECS used to help define prototypes
- DOE-2.2 used for all but grocery stores
- Groceries used DOE-2.2R
- Same calculation “engine” as eQUEST

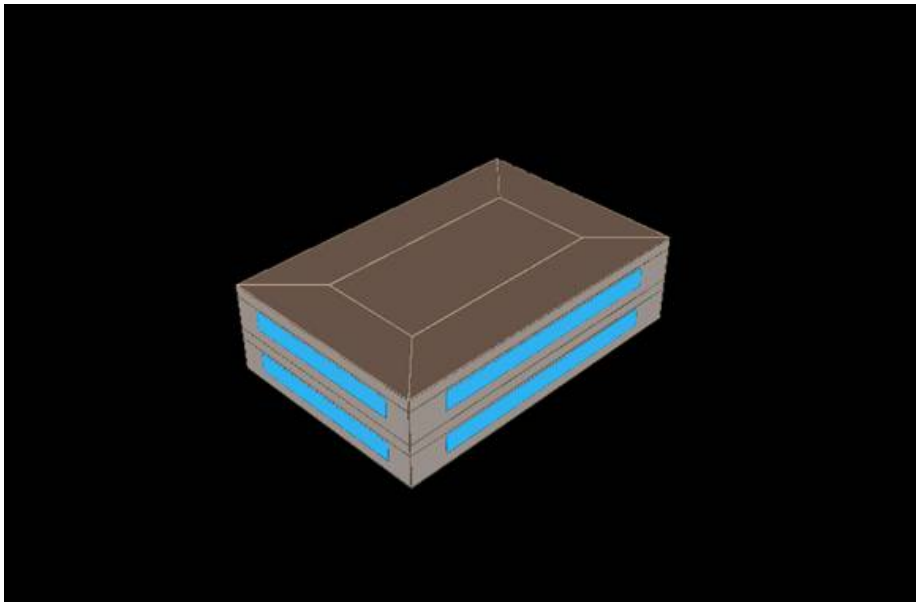
Locations and Climate Data

- Simulations driven by long term average weather data (TMY3)
  - Alpena
  - Detroit Airport
  - Lansing
  - Muskegon
  - Saginaw
  - Sault Ste Marie
  - Traverse City

Prototypes



Single Family Detached Residential



Small Office Prototype

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Residential Measures

- Air-Conditioners and Heat Pumps
- Wall Insulation
- Roof Insulation
- Floor Insulation
- Crawlspace Insulation/Basement Insulation
- Replacement Windows
- Duct Insulation
- Duct Leakage
- HVAC Tuneup
- Setback Thermostat
- ECM Motor
- AC Desuperheater to Hot Water
- Ceiling Fans
- Infiltration Reduction
- Heat Recovery

Small Commercial Building Measures

- Packaged AC and heat pumps
  - Size ranges
- PTAC and PTHP
- Ground source heat pump
- Water loop heat pump
- Sleeve AC
- Economizer
- Setback thermostat
- Tuneup
- High performance glazing
- Window film

Built-Up System Measures

- Chillers
- Chilled water reset
- VFD air handler fan
- VFD chilled water pumps

Refrigeration Measures

- Efficient Condenser
- Floating head pressure control
- Night covers on open cases
- Anti-sweat heater controls

Modeling Approach

- Define baseline building characteristics
  - Building type
  - Vintage
- Size HVAC system for each building/vintage combination
- Establish measure efficiency characteristics
- Simulate energy savings
- Compile results
  - Summer peak kW savings
  - Annual energy (kWh and kBtu) savings
  - Load shapes

Weather Sensitive Summary Spreadsheet

- How to use the spreadsheet
  - Adjust weather zones
  - Choose building types or vintages
  - Residential do mix of heating system types
  - Commercial do ventilation mix if needed
- However all the data for all existing types are in the database. I recommend that you use the actual data when reporting projects to help with evaluation but use weighted averages for goal measurement.

Report

- Describes building types and assumptions used for base energy use development.

Typical Results

- Results reported by building type, vintage and climate zone
- Normalized by tons, SF, etc.
- Measure life, measure costs, installation costs provided

HVAC Measure Assumptions

- Normal replacement – baseline is standard efficiency new equipment
- Combination of EPACT and ASHRAE 90.1 baselines
- Average performance characteristics for each SEER category

How to Best Use the Data

- Used for upfront program planning
- Cost effectiveness modeling
- Support Documentation
- Reasonableness checks on savings assumed and applications

Also Needs Updated Periodically

- Note that you need to update and verify periodically – annually preferred but no more than two years
  - Evaluation findings – hours and actual make up of building types
  - Baselines change and Technology change