RAP Energy solutions for a changing world

UTILITY OF THE FUTURE AND THE CHANGING TIDE OF REGULATION

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Presented by

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The Regulatory Assistance Project (RAP)

We are a global, non-profit team of experts focused on the long-term economic and environmental sustainability of the power and natural gas sectors, providing assistance to government officials on a broad range of energy and environmental issues.

About RAP – US

RAP provides technical and policy support at the federal, state and regional levels, advising utility and air regulators and their staffs, legislators, governors, other officials and national organizations.

We help states achieve ambitious energy efficiency and renewable energy targets and we provide tailored analysis and recommendations on topics such as ratemaking, smart grid, decoupling and clean energy resources. RAP publishes papers on emerging regulatory issues and we conduct state-by-state research that tracks policy implementation.

Utility of the Future

Some states have begun to re-examine their traditional utility models and to consider regulatory changes that address the intersection of customer options and new the emergence of new technologies and choices.

- New York – Reforming the Energy Vision (REV)
- California – New Docket on distribution planning, solar emphasis
- Hawaii – Fast deployment of distributed generation, faster than regulatory response
- Other States – Adopted or considering decoupling, energy efficiency standards, new tariff designs, Distributed Generation policies

What's On the Horizon?

Convergence of multiple events:

- Customer empowerment
- New Technologies and Competitive Service Offerings

This leads to (in absence of any policy or structural response):

- Reduction in utility sales and hence revenues
- Potential rate responsibility shifts and equity questions

This is pitted against:

- Public interest in low carbon energy solutions
- While grid resilience becomes increasingly important in the wake of *severe climate*

What's On the Horizon? Self-Assessment

- Consideration of the role of the utility in light of emerging competitive technologies
- Consideration of the role of regulation – Should we move to a performance-based standard?
- Public policy considerations that:
  - Advance energy policies that reduce carbon footprint
  - Take into account equity considerations:
    - Utility Revenue Needs
    - Economic Incentives for Distributed Energy Resources (DER)
    - Protecting Non-DER customers from a greater burden for utility lost revenues

Topics To Be Discussed

- New Business Models
  - Performance-based regulation
  - Decoupling
- Impact of growing distributed generation on utilities and customers
  - And impact on business model and regulation
- Rate Design considerations

Power Sector of the Future

Potential New Business Models

Utility Business Models

Options Include:

- Traditional vertically integrated utility model
- Recent (last 15 years) deregulated model for generation
- Distribution utility as competitive service provider
- Distribution utility acting as a distribution system operator
- Variations of the above

Future Utility Business Models

The increased deployment of customer/distributed energy resources (DER) is the harbinger of change. Many new models will emerge, some more rapidly than others. What is certain is that these models will need to be flexible, to evolve through an iterative process and adapt to change. None out of the gate will be exactly right.

Traditional Vertically Integrated Model

- Presumes little change, BAU
- Slow development of energy efficiency, demand response, distributed generation
- Continued reliance on utility centralized plant
- Consideration of Clean Power Plan (111d) impacts on capacity may result in more DER – potential catalyst for change

Deregulated Model for Generation

- Generation separated from distribution function either functionally, corporately, or through total divestiture
- Wholesale and/or retail competition for generation services full or partial retail competition
- Competitively bid default rate for non-choice customers

Deregulated Model for Generation: What do we have to say about innovation?

- Lessons learned to transfer to new distribution business models:
  - Total separation of regulated entity from competitive entity
  - Codes of Conduct
  - Fair and reasonable operating agreements between utility and independent competitive entities:
    - Terms of Surety Bonds, letters of Credit
    - Terms of Interface with utility
  - Access to customer data
  - Access by retail competitor to customer bill to provide information
  - Compensation for shared services between utility and affiliate
- Goal is to Ensure a fully competitive marketplace so as to not create a future deregulated monopoly that can control prices for services rendered

Distribution Utility as Competitive Service Provider

Distribution Utility competes with independent companies to provide a variety of services:

- Energy Efficiency
- Distributed Generation
- Demand Response Services
- Advanced Energy Management through data and metering
- Rate options for load management
- Other?

  - Integration of Electric and Communications system delivery

Example: Utility Ownership/Management of DG Solar

Utility-owned DG Solar

Virtual Power Plant Operator

Regulators can:

- Allow IOUs to recover costs of investment in DG
- Encourage IOUs to include distributed solar in capacity expansion plans

Utilities gain:

- Increased customer participation
- Experience with DG
- Ability to target locations where DG can support the grid

Regulators can:

- Allow IOUs to recover costs of investments in smart grid and other technologies that support high penetration of DG
- Restructure rates to allow utilities to gain revenue from the provision of system management

Utilities gain:

- Clearly defined role into future
- Clear revenue stream

Source: NREL

Examples

Utility-owned DG Solar

Duke Energy installed DG solar on offices, warehouses, schools and manufacturing facilities in North Carolina.

Duke owns the systems and pays landowners annual rental fee.

Source: NREL

Virtual Power Plant Operator

Arizona Public Service is conducting the Flagstaff Community Power Project.

APS installed and owns DG solar on homes and schools to create a high DG scenario. Utility is testing smart grid technologies and learning how to maximize system performance.

Distribution Utility as Competitive Service Provider

Considerations:

- Goal of distribution utility as service provider is the potential to make up for lost revenues from customer DER
- Caveat – Arms length, fair competitive market policy objectives may lead to corporate separation or at a minimum, functional separation
- Issue – If a separate affiliate is created within a corporate holding company, how does that help the distribution utility's lost revenue problem if each corporate affiliate must rise and fall based on its own successes?

Models Requiring Utility Subsidiaries

Utility investment in 3rd Party Leasing

- Utility invests in 3rd party solar leasing companies
- Utility provides customer connections and name recognition
- Utility owns assets and recovers investment costs and rate of return
- 3rd party provider compensated for development and maintenance
- Utility includes the DG as a supply in resource planning

Example: PG&E has tax equity financing agreements with Solar City and Sun Run.

Value-Added Consulting Services

Utilities provide customers with comprehensive energy consulting and services, including:

- Energy efficiency
- Distributed generation
- Demand-side management
- Connection with vendors
- Coordination/site-management
- On-bill financing
- Energy education

Distribution Utility as a Distribution System Operator

- Utility grid used as the highway for delivery of services
- Distribution Utility functions as the master conductor for services from independent service provider to the customer
- Distribution utility collects tolls for the use of its system in bi-directional or one-directional transactions

Power Sector of the Future:

Performance-Based Regulation

Consideration of the Role of Regulation: Performance Based Regulation

All regulation is incentive regulation. An important skill for regulators is to understand what incentives are created by any particular regulatory scheme and to design a scheme that best serves the desired objectives.

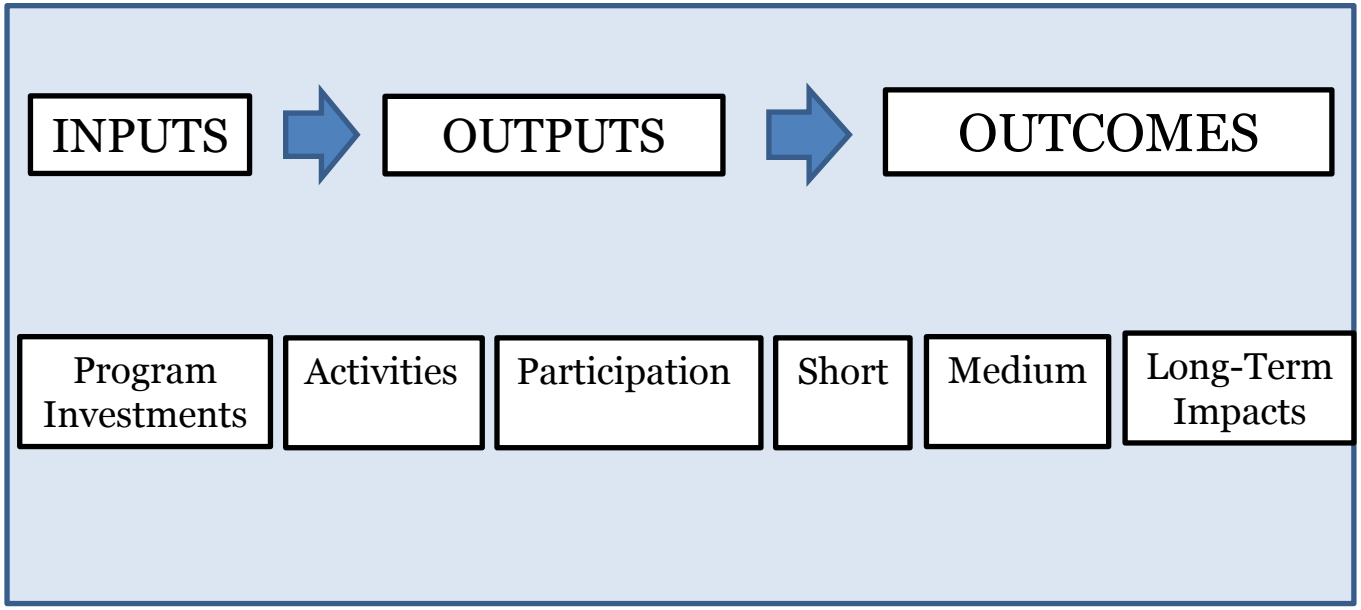
Alternative Ratemaking: Performance Based Regulation

- Used to provide an incentive or reward to the utility for performing in a public policy direction
  - Not necessarily consistent with current utility business plan (*we would like to see that convergence in the future)*
- Different approaches for the regulator seeking to change utility behavior:
  - Price-cap mechanisms set a trajectory for prices, leaving the firm to find economies;
  - Revenue-cap mechanisms that seek to provide predictable revenues independent of sales volumes;
  - Others are tied to specific metrics of service quality, reliability, and environmental performance, etc.
  - Penalties and bonuses (Rate of Return)

Alternative Ratemaking: Performance Based Regulation

- Shift from a strictly investment-plus return on capital framework to one that encourages behavioral changes.
- Create metrics that measure and reward desired performance that motives management to innovate, control costs, or otherwise improve outcomes.
- Performance incentives can flow through to employee compensation plans, as corporate incentives do now, as an example of a mechanism to make performance incentives meaningful.
- Provides more rational allocation between risks and rewards.
- Performance goals and associated metrics could be structured over a period of time and include milestones toward the achievement of certain longer-term objectives

Alternative Ratemaking: Performance Based Rates



- Inputs – What is used to do the work
- Outputs – What is delivered or produced
- Outcomes – What we wish to achieve
- Impacts – What long-term results are desired.

Alternative Ratemaking: Performance Based Regulation

Dimensions of Performance include:

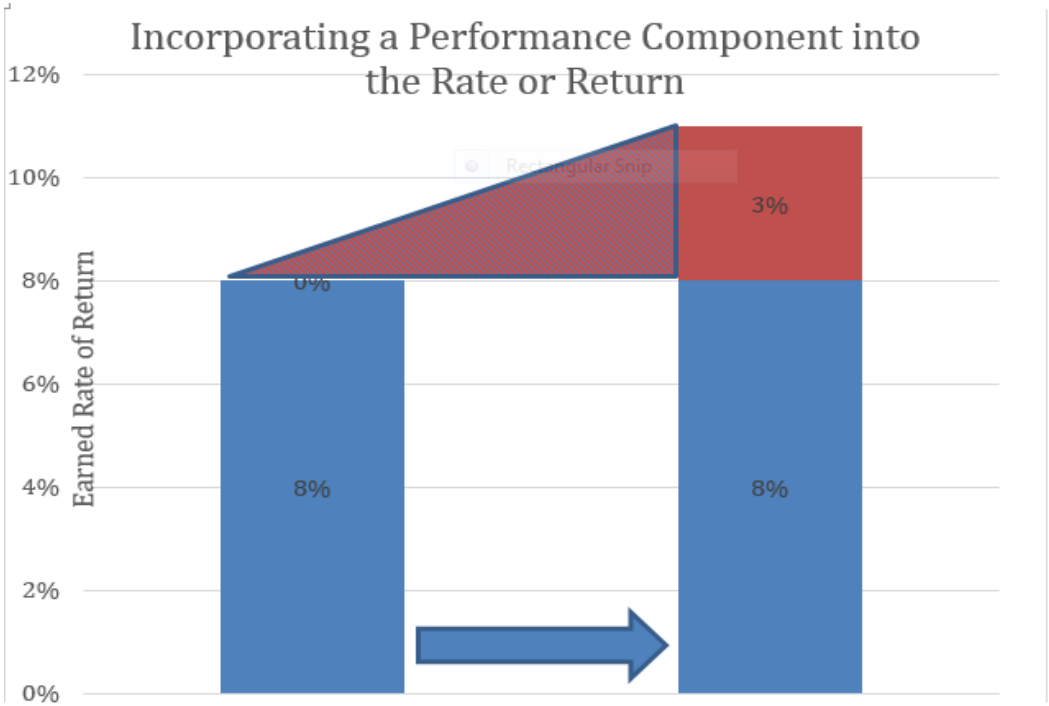
- Reliability
- Safety
- Customer Satisfaction
- Financial Health
- Cost Containment – economic efficiencies
- Plant Performance
- Innovation
- Asset Management
- Encouraging Investment in Distributed Generation and Energy Efficiency

A regulatory proceeding with public participation can develop the dimensions most applicable to the timeframe and circumstances

Alternative Ratemaking: Performance Based Regulation

One idea for a financial model

- A zero-based approach
- Normally allowed return consistent with compliance-based performance
- Higher return available for increasing, exemplary level of measured performance



Example of a Performance Regulation Methodology

Rate of Return Calculation Under Performance Incentive Regulation

Performance Incentive Regulation			
	Ratio	Allowed Cost	Weighted Cost
Debt	50%	7%	3.50%
Equity	50%		
Minimum Return	50%	7%	3.50%
Performance Return	50%	0% - 6%	0 - 3%
Combined ROE		7% - 13%	3.5% - 6.5%
Overall Allowed Return			7.0% - 10.0%

"Overall Allowed Return" is equivalent to Weighted average cost of capital

Power Sector of the Future:

Decoupling

Decoupling as a Regulatory Tool

Decoupling can accomplish the following:

- Eliminate the throughput incentive so that the utility is indifferent to reductions in sales
- Provides a method of adjusting utility rates (prices) between rate cases to account for changes in sales volumes. Most decoupling mechanisms contain a method to update allowed revenues for customer growth and/or attrition factors
- Allows utility to focus on performance which can provide additional incentives
- Useful foundation for other reforms

Decoupling

- Decoupling is designed to address the throughput incentive by breaking the link between utility sales and revenue.
- The Commission in a rate case proceeding determines the distribution revenue requirements which become the basis for determining the revenue the utility will receive in rates.
- Decoupling enables a rate design that continues to send forward looking price signals through volumetric charges and does not burden rate design with the challenge of producing adequate revenue.

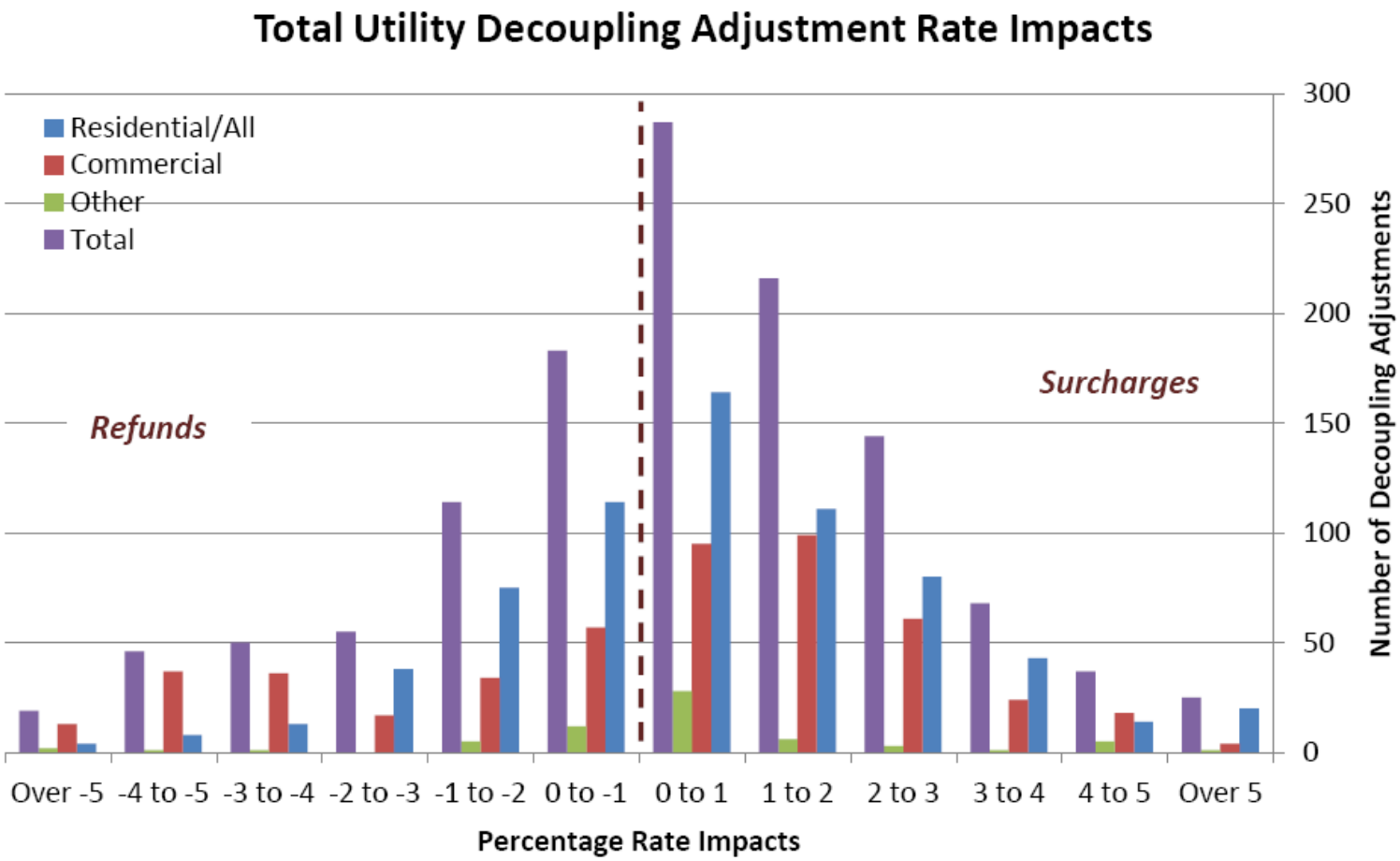
Decoupling

- Periodically, the utility's authorized revenue requirements are measured against actual revenues
- Rates are then reconciled to allow the utility to recover (positive or negative) the difference between revenues authorized and revenues received
- Other forecasted revenue changes can be recognized and included in the mechanism

How Decoupling Works

Periodic Decoupling Calculation	
From the Rate Case	
Target Revenues	$10,000,000
Test Year Unit Sales	100,000,000
Price	$0.10000
Post Rate Case Calculation	
Actual Unit Sales	99,500,000
Required Total Price	$0.1005025
Decoupling Price "Adjustment"	$0.0005025

Decoupling Rate Adjustments Have Generally Been Very Small



How Changes in Sales Affect Earnings: Why Decoupling Matters

	Revenue Change		Impact on Earnings		
% Change in Sales	Pre-tax	After-tax	Net Earnings	% Change	Actual ROE
5.00%	$9,047,538	$5,880,900	$15,780,900	59.40%	17.53%
4.00%	$7,238,031	$4,704,720	$14,604,720	47.52%	16.23%
3.00%	$5,428,523	$3,528,540	$13,428,540	35.64%	14.92%
2.00%	$3,619,015	$2,352,360	$12,252,360	23.76%	13.61%
1.00%	$1,809,508	$1,176,180	$11,076,180	11.88%	12.31%
0.00%	$0	$0	$9,900,000	**0.00%**	11.00%
-1.00%	-$1,809,508	-$1,176,180	$8,723,820	**-11.88%**	9.69%
-2.00%	-$3,619,015	-$2,352,360	$7,547,640	**-23.76%**	8.39%
-3.00%	-$5,428,523	-$3,528,540	$6,371,460	**-35.64%**	7.08%
-4.00%	-$7,238,031	-$4,704,720	$5,195,280	**-47.52%**	5.77%
-5.00%	-$9,047,538	-$5,880,900	$4,019,100	**-59.40%**	4.47%

Power Sector of the Future:

Impact of Growing Distributed Generation on Utilities and Customers

Background on the Debate

Rapid growth in distributed solar has led to increased attention

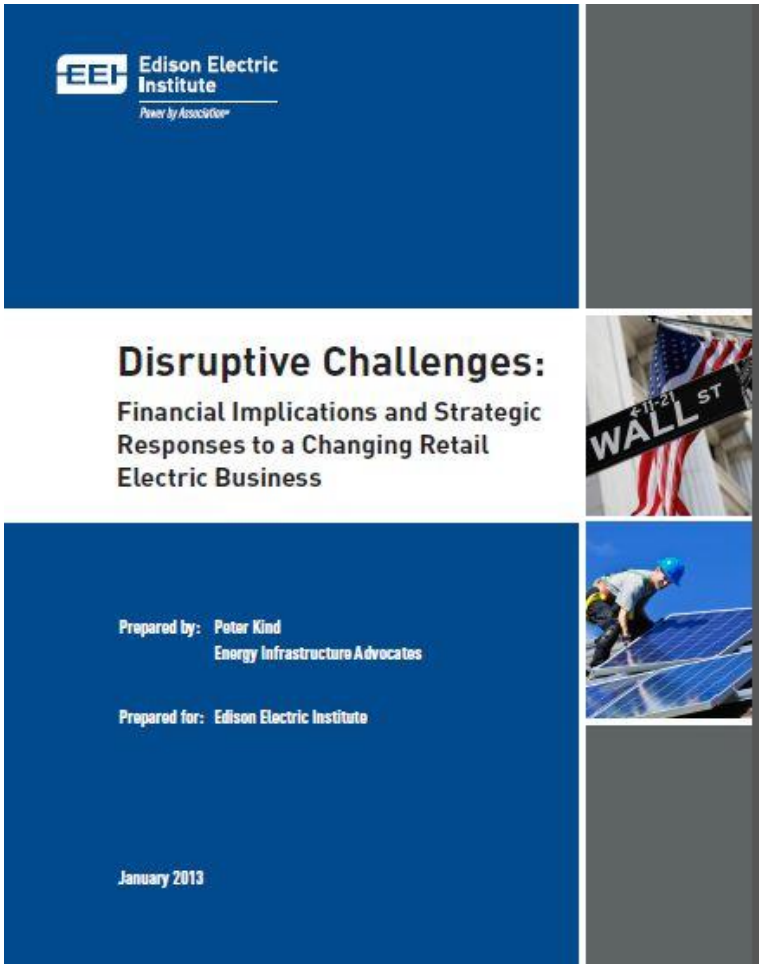
Utilities concerned that:

- DG reduces utility revenues and undermines traditional utility business models
- the fixed cost of maintaining the grid is spread across fewer customers and fewer kWh sales
- Utility mission may be changing, but changes are not yet defined
- cost shifts are occurring among solar and other customers

Solar industry concerned that:

- Policy regulation and rate changes will under-value solar generation and hinder the solar market

Source: NREL



Background on the Debate

Rapid growth in distributed solar has led to increased attention

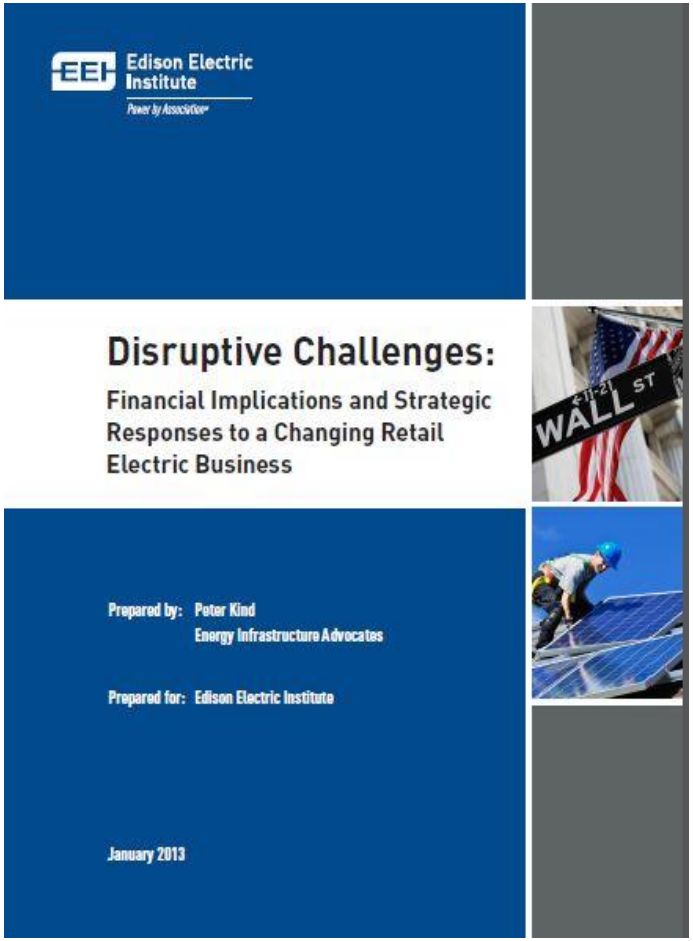
Consumers concerned that:

- DG reduces utility revenues and the lost revenue shortfall will be borne by non-DG customers
- Cost shifts are occurring between solar and non-solar customers and other participant/non-participants
- Impact on and opportunity for low income/fixed income customers.
- Fair access to energy services and resources and fair access to grid and information

Innovators and New Market Entrants concerned that:

- They have a pathway to the market either in cooperation with the utility or enabled by it.

Source: NREL



Framing the Debate

- More and more customers are choosing to install Distributed Generation (DG)
- Consequently utility sales and revenues are declining from what they otherwise would have been
  - In most places, there is no absolute decline yet, but such situations are increasingly possible over time
- Many Commissions are wrestling with how to address pricing for net-metered customers in a fair and equitable manner.
  - In only a few places is this question urgent, most places have time

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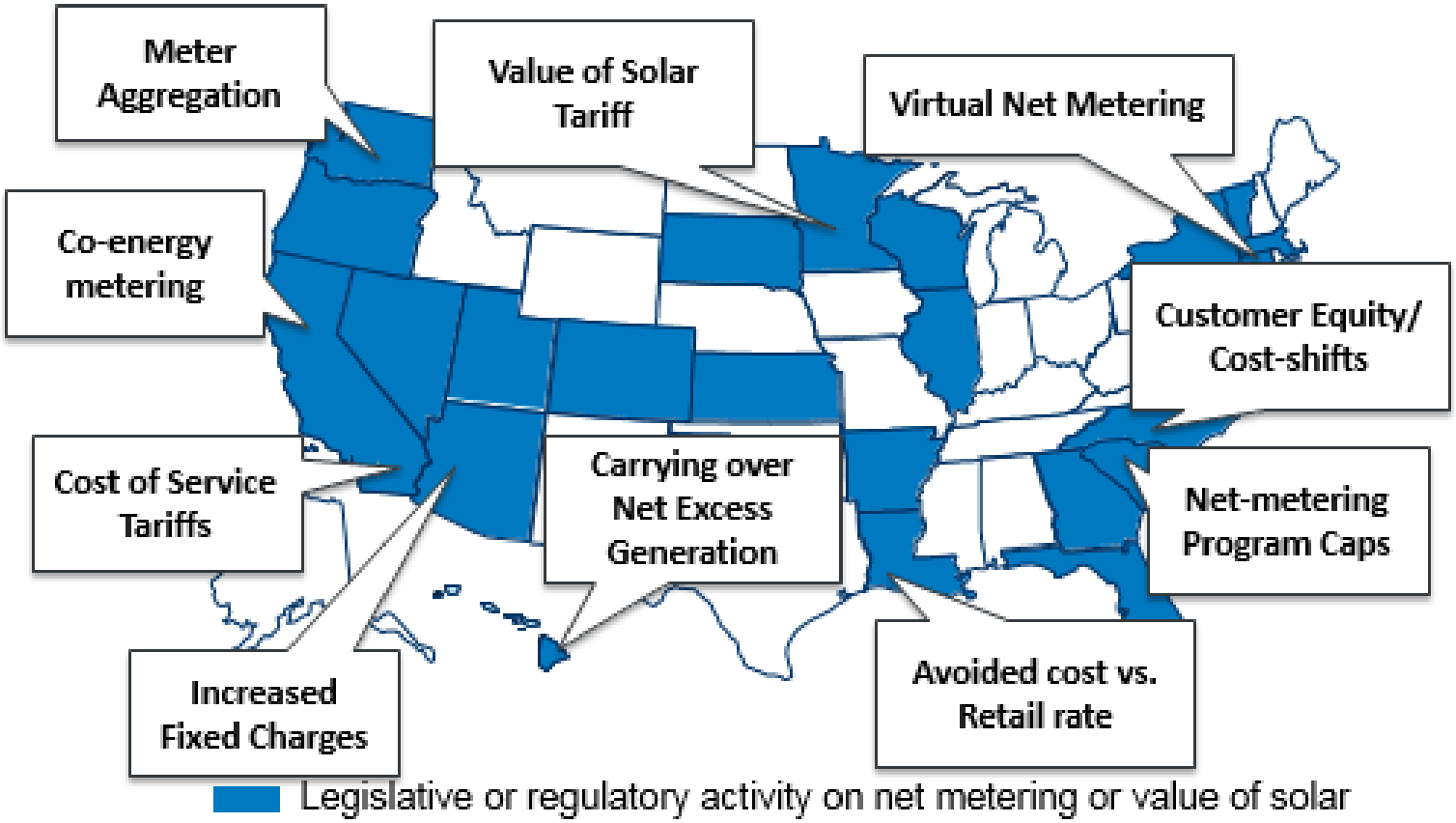
A Variety of Discussion Topics

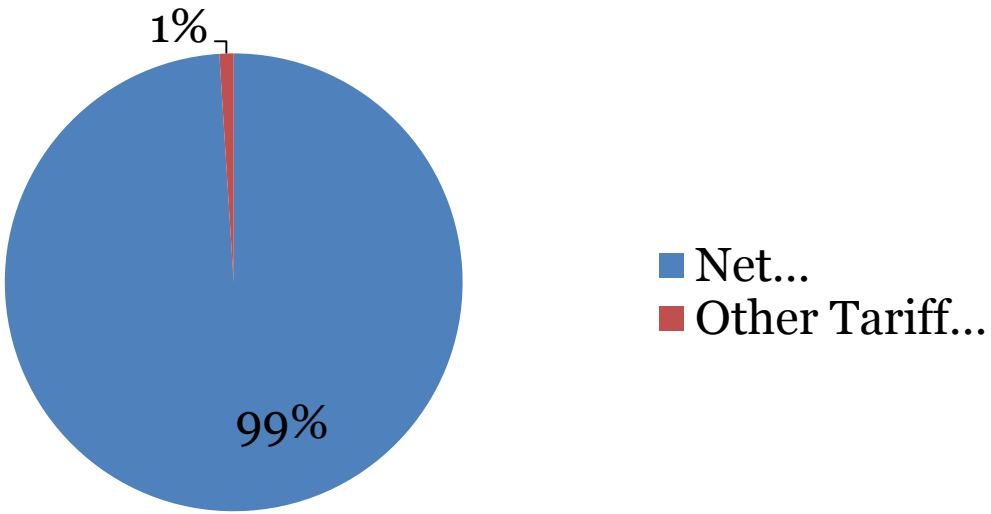


Source: NREL

Net-Metering

Net-metering is a mechanism under which the utility nets the electricity produced from a customer's system with the electricity the customer purchases from the utility with compensation set at the full retail rate.

Almost All Grid-connected PV Systems are Net Metered



Source: Solar Electric Power Association (2012)

A Variety of Discussion Topics

Net-metering

- What sources should qualify?
- What should the site cap be?
- What method should be used to calculate the installed capacity and the system cap?
- At what rate should net excess generation be credited?
- Should excess generation carry over year-to-year or expire at the end of the year?
- How can Time-of-Use rates be combined with net metering?
- Is meter aggregation (Community Net Metering) allowed/required?
- Is Virtual Net Metering allowed/required?
- Are income class issues addressed?
- are utility distribution planning/investment adjustments useful/needed?

Source: NREL

A Variety of Discussion Topics

Cost-shifts / Lost Revenue

- Is there a cost-shift from solar to non-solar customers? How large? How to address? Or is the system value of DER positive?
- What is the impact of distributed PV on utility revenues?
- Should fixed charges be increased to cover infrastructure costs? Should they apply to only self-generators or to all customers, with corresponding reduction in volumetric rates?
- What other rate structures can address the cost-shift and lost revenue issue?

Value of Solar Tariff

- What value categories should be included in a value of solar tariff?
- What value should each cost and benefit be assigned?
- How should a value of solar program be designed?

Source: NREL

Business Models for Distributed Solar

New utility business models may address utility concerns about lost revenues/cost-shifts.

Common Business Models

- Customer-owned
- 3rd party leasing
- Community and utility-led "solar gardens"

Innovative Business Models

- Utility-owned DG solar
- Virtual power plant operator
- Utility partnership/investment in 3rd party leasing companies (this one is actually fairly common)
- Value added consulting services
- Energy services utility model

**See the full report for more description of each of these business model options. Source: NREL.*

Distributed Generation as a Grid Resource

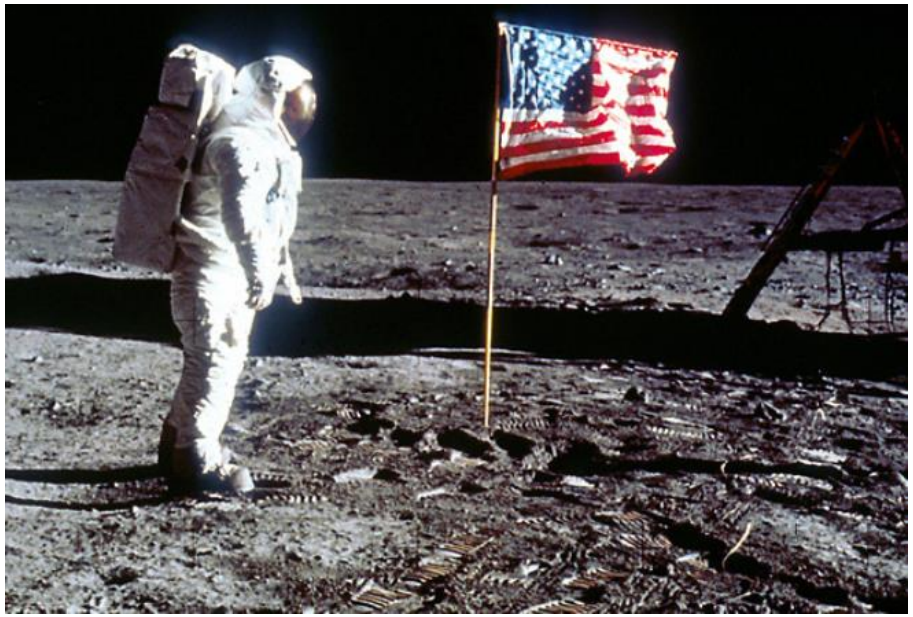
Can Distributed Generation be utilized as a grid enhancement?

- Competitively bid alternative in congested areas
- Considered as a least-cost option as compared with infrastructure upgrades
- Source of energy, capacity, ancillary services
- Analogous to an Integrated Resource Plan, but on the distribution side: integrated distribution system planning
- Promotes strategic deployment of DG, microgrids, zero net energy

Alternatives to Net Metering

- Infant Industry Subsidy
- Value of Solar Tariff (VOST)
- Higher Customer Charge
- Special Charge for PV Customers
- Demand Charge
- Directional Pricing

Infant Industry Subsidies



Are potential cross-subsidies a significant problem?

- Some level of cross-subsidy is normal and even desired
  - Customer classes, not individual rates
  - Undue discrimination is bad
- At low penetration levels, these lost revenues are extremely small compared to the revenue requirement
- But as deployment grows, at some point this could become a problem

Potential Cross-Subsidies

If value of PV < volumetric charges:

- Other customers subsidize PV customers
- Under-recovery of utility's fixed costs
- Upward pressure on rates (cross subsidy)
- Reduced utility shareholder returns

If value of PV > volumetric charges:

PV customers subsidize other customers

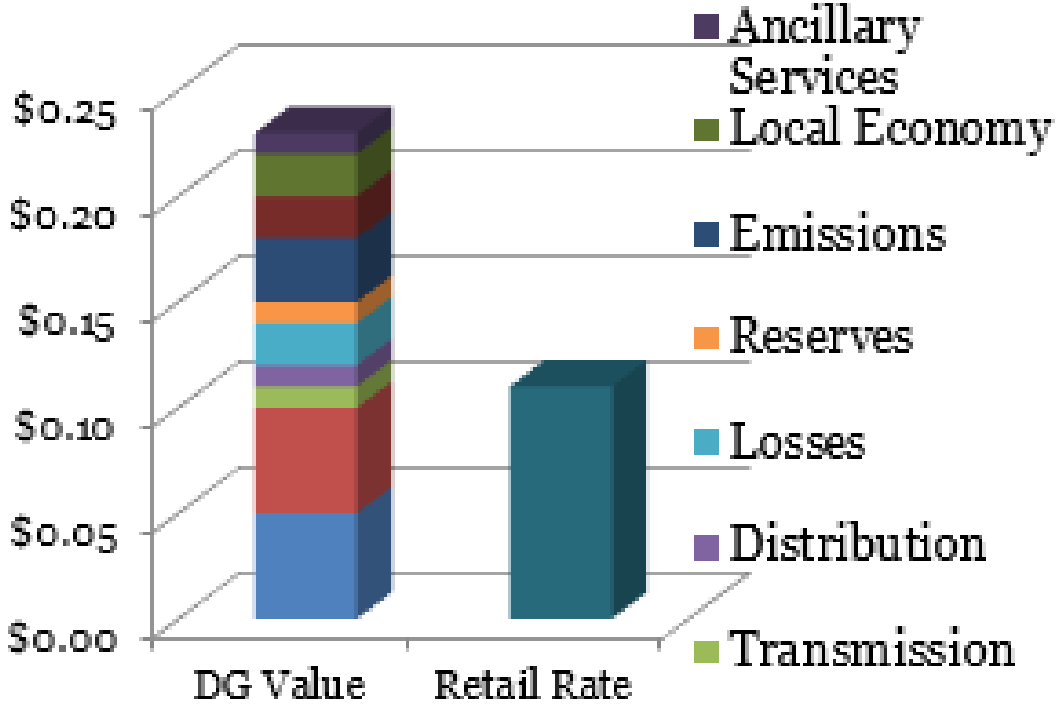
Suppresses PV deployment from societal value

Utility effects may still require attention

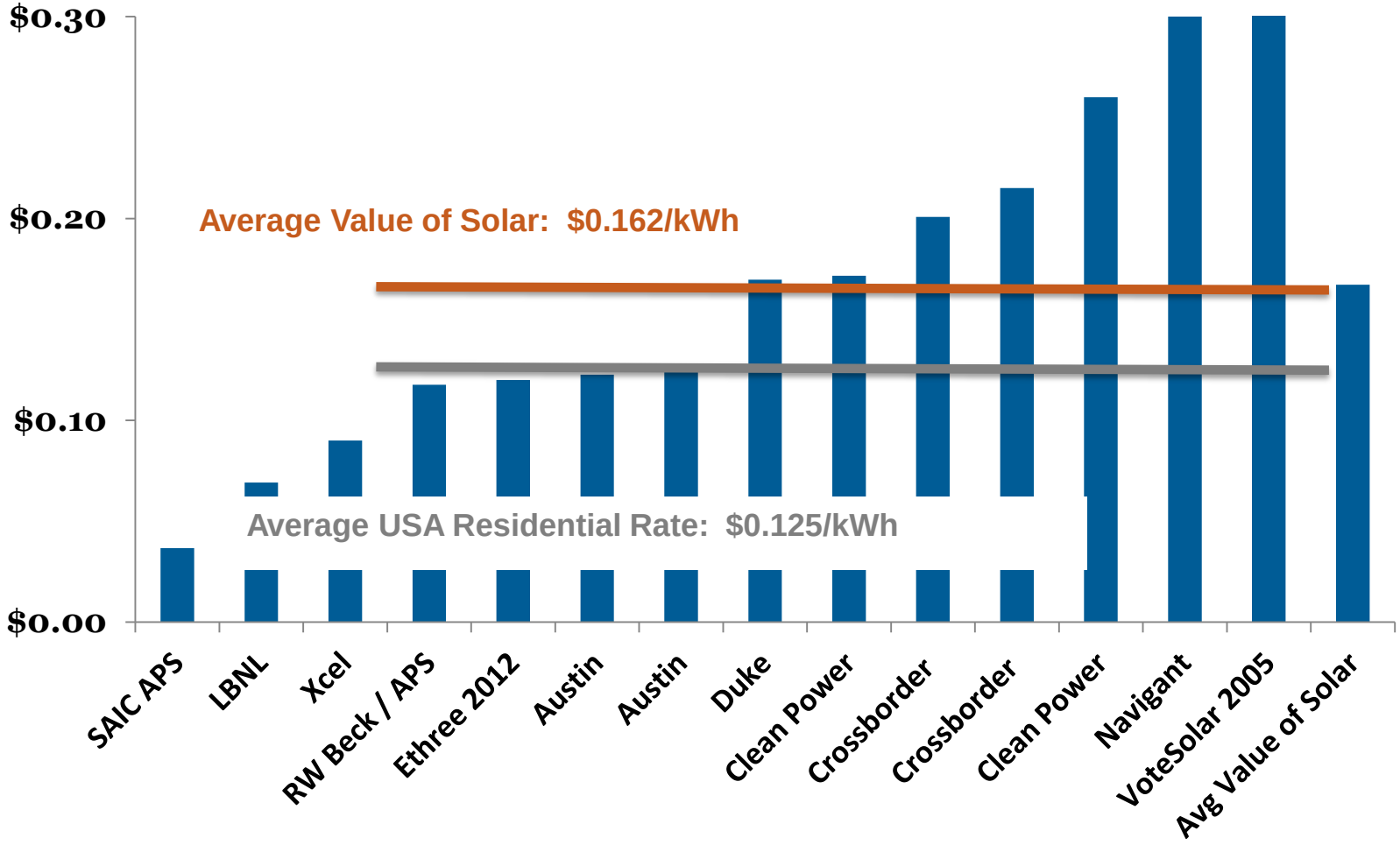
Value of Solar Tariff (VOST)

Recognize all values of solar:

- Renewable
- New Resource
- Delivered to System
- Environmental
- Fuel Cost Risk
- Price Suppression



Value of Solar Tariff – RMI Study



Directional Pricing

Directional Pricing Example		
Customer Charge	Billing and Collection	$5.00/month
Distribution Charge	All Delivery Costs	$0.05/kWh
Power Supply (either direction)		
• On-Peak	Peak and Baseload	$0.15/kWh
• Off-Peak	Baseload Only	$0.08/kWh

May be appropriate for high-cost utilities, where current rate is > value of solar.

Illustration of Alternative Rate Designs

Type of Charge	Unit / Usage	Typical Current Residential Tariff	Option 1 Fixed Monthly Charge	Option 2: Demand Charge	Option 3: Bidirectional Distribution Charge
Monthly Fixed Charge:	$/Month	$ 5.00	$ 35.00	$ 5.00	$ 5.00
Demand Charge	$/kW/Month		$ -	$ 3.00	$ -
Distribution Charge	$/kWh		$ -	$ -	$ 0.03
Off-Peak Energy	$/kWh	$ 0.145	$ 0.08	$ 0.08	$ 0.08
On-Peak Energy	$/kWh	$ 0.145	$ 0.15	$ 0.15	$ 0.15
Average Customer Bill					
Fixed Charge	Per Customer	$ 5.00	$ 35.00	$ 5.00	$ 5.00
Demand Charge	10 kW Demand	$ -	$ -	$ 30.00	$ -
Distribution Charge	1,000 kwh total energy	$ -	$ -	$ -	$ 30.00
Off-Peak Energy	500 kWh on-peak	$ 72.50	$ 40.00	$ 40.00	$ 40.00
On-Peak Energy	500 kWh off-peak	$ 72.50	$ 75.00	$ 75.00	$ 75.00
		$ 150.00	$ 150.00	$ 150.00	$ 150.00

Each alternative produces $150/month from a customer using 1,000 kWh/month

Breakdown of Hypothetical PV Customer Bill

Rate Element		Typical Current Residential Tariff		Option 1 Fixed Monthly Charge		Option 2: Demand Charge		Option 3: Bidirectional Distribution Charge
Fixed Charge		$ 5.00		$ 35.00		$ 5.00		$ 5.00
Demand Charge		$ -		$ -		$ 30.00		$ -
Distribution Charge		$ -		$ -		$ -		$ 30.00
Off-Peak Energy		$ 72.50		$ 40.00		$ 40.00		$ 40.00
On-Peak Energy		$ (72.50)		$ (75.00)		$ (75.00)		$ (75.00)
Total Bill:		$ 5.00						
Total Distribution Service:		$ 5.00		$ 35.00		$ 35.00		$ 35.00

Assumptions: 10 kW maximum demand; 1,000 kWh total consumption, 50% on-peak; 1,000 kWh total on-site production. 500 kWh imported from grid off-peak; 500 kwh exported to grid on-peak

Guiding Principles for Fair PV Tariffs

- PV customer should pay utility fair value for services provided by grid connection
- Utility should pay PV customer fair value for services provided by PV
- Rate design should be no more complicated than necessary
- Address any desired incentives and the impact of lost revenues separately
- Account for low income customer impacts

Power Sector of the Future:

Rate Design Considerations

Typical Residential Rate Structures

Monthly Bill =

Fixed service charge (e.g. $6.75/month)

+

Volumetric charges (e.g., 8.000 cents/kWh)*

*NOTE: Volumetric charges may vary by time of day or season

Higher Customer Charge

Customer Charge	$5.00	↑	$20.00
Energy Charge	$0.12	↓	$0.09
Change in Price/kWh			-25%
Predicted Change in Usage			+5%

- Does not recognize value of solar, particularly on lower-cost utilities.
- Recognizes elasticity of electricity.

Other Considerations with High Customer Charges

- Does not promote conservation
- Increases the payback on energy efficiency investments
- Results in low usage customers (often low-income) subsidizing high usage customers (often higher income)
- Impact on utility investments – If the Volumetric Charge is less than the Long Run Marginal Cost, then customers will behave as if their incremental usage has less of a cost effect than it does. This can result in greater customer usage which means utilities need to invest in more facilities, hence raising rates.
- High customer charges may hasten customers exiting the grid, rather than maintaining a connection to it, which further exacerbates the situation.

Special Charge for PV Customers

Tied to estimated additional costs for voltage regulators and other grid investments to accommodate PV.

- Arizona: $0.90/kW of panel size (adopted)
- Hawaii: $16/month (proposed)

Residential Demand Charge (or panel size charge)

- Customer pays based on size of connection to grid.
- If recovering ONLY transformer cost and additional costs to accommodate solar, may be cost-based.
- Does not recognize value of solar.

Concerns with Residential Subscription Demand Charges

- Small appliances add up to significant demand;
- Only run a few minutes each;
- Multiple customers per transformer;
- Essential to measure demand on an 1-hour or 2-hour basis.

Directional Pricing

Directional Pricing Example		
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Power Supply (either direction)		
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May be appropriate for high-cost utilities, where current rate is > value of solar.

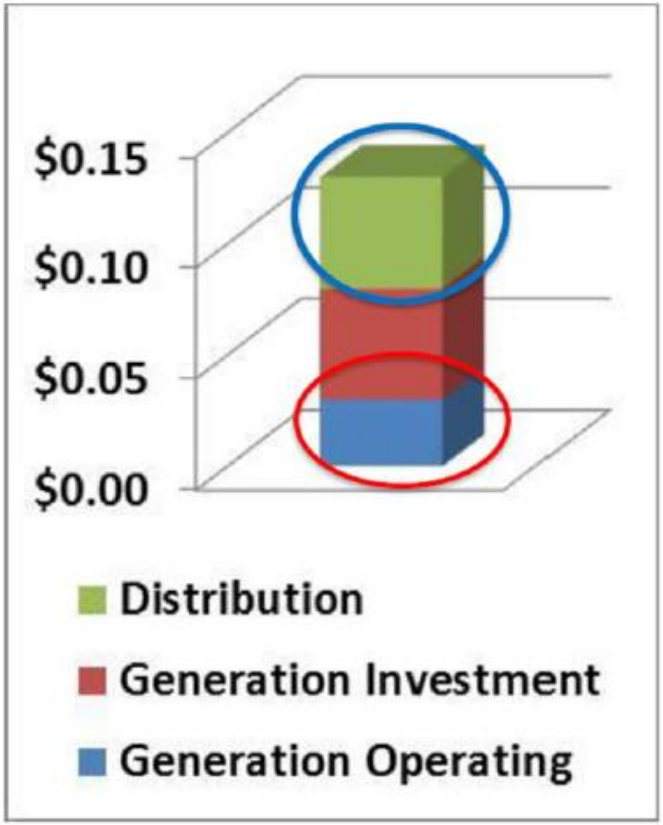
Common Utility Advocate View

Embedded Cost Perspective

- **Only the short-run avoided operating cost should be credited.**
- **At minimum, customer should pay distribution costs.**

DG customer "uses" the grid and should pay for it;

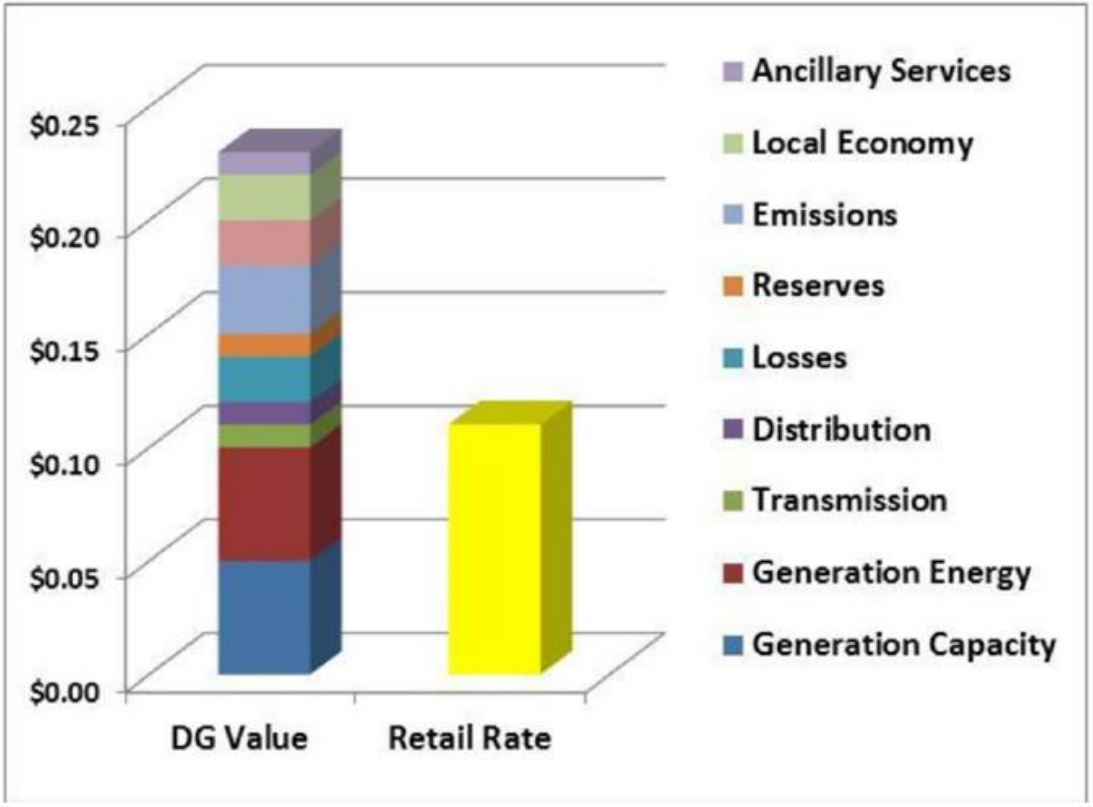
Solution: High monthly fixed charges for grid service.



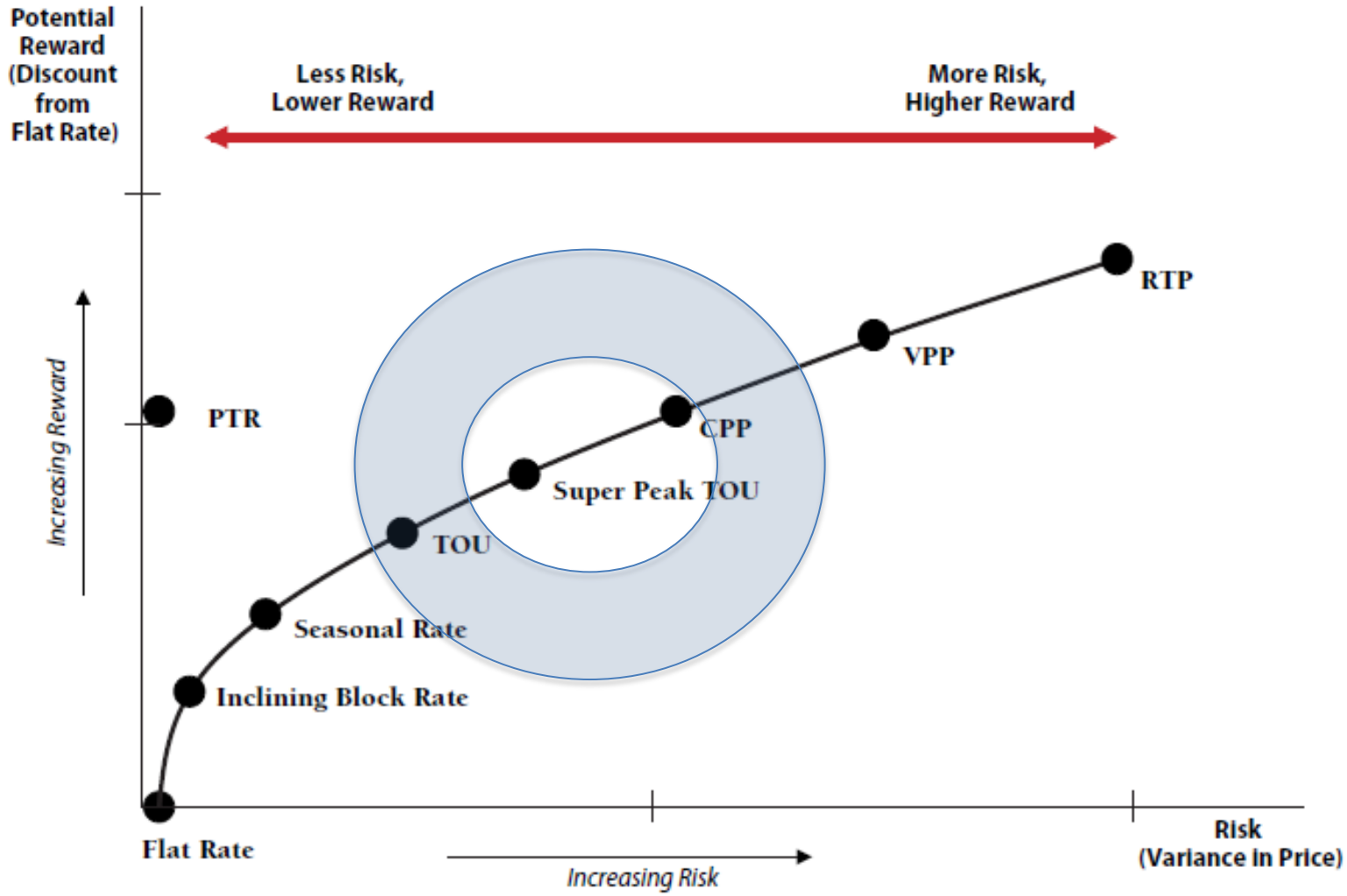
Common DG Advocacy View

Marginal Cost Perspective:

- Value of distributed resource is greater than the than retail rate;
- Net-metering results in subsidy **to** the grid from innovators.



Dynamic Pricing



Example Residential Critical Peak Rate

Portland General Electric (Oregon)	
Customer Charge	$9.00
Off-Peak $/kWh	$0.0916
On-Peak $/kWh	$0.1166
Critical Peak $/kWh	$0.4335

Critical Peak Maximum: 4 hours per day; 10 days per year

Conclusions

- DER is impacting many spheres of regulation and can be embraced as a valuable tool or treated as a disruption to a well-functioning grid (but note that to some extent it will happen)
- As a tool DER can:
  - Be the purveyor of low cost, clean options
  - Allow customers to manage their energy better
  - Step in as a low-cost grid enhancement to strengthen reliability
  - Provide an alternative to central station fossil fuel generation
  - Stimulate innovation at the customers' premises
- Treated as a disruption it can:
  - Produce regressive rate designs such those with high customer charges
  - Hinder the development of low-cost clean alternatives.
  - Place interested customers in conflict with their utility company in perpetuity

Related RAP Publications

- **Regulatory Considerations Associated with the Expanded Adoption of Distributed Solar** (2013) http://www.raponline.org/document/download/id/6891
- **Energy Efficiency Cost-Effectiveness Screening** (2012) www.raponline.org/document/download/id/6149
- **US Experience with Efficiency As a Transmission and Distribution System Resource,** (2012) www.raponline.org/document/download/id/XXXX
- **Preparing for EPA Regulations** (2011) www.raponline.org/document/download/id/919
- **Incorporating Environmental Costs in Electric Rates** (2011) www.raponline.org/document/download/id/4670
- **Clean First: Aligning Power Sector Regulation With Environmental and Climate Goals** www.raponline.org/document/download/id/12
- **Integrating Energy and Environmental Policy** (2013) www.raponline.org/document/download/id/6352

Valuation Resources

- RAP, *Full Value of Energy Efficiency*, Lazar & Colburn (September 2013)
  - http://www.raponline.org/document/download/id/6739
- Rocky Mountain Institute (RMI), *A Review of Solar PV Benefit & Cost Studies, 2nd Edition* (September 2013)
  - http://www.rmi.org/Knowledge-Center/Library/2013-13_eLab - DER Benefit Cost Deck_2nd Edition_130903
- Interstate Renewable Energy Council (IREC), *A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation* (October 2013)
  - http://www.irecusa.org/wp-content/uploads/2013/10/IREC_Rabago_Regulators-Guidebook-to-Assessing-Benefits-and-Costs-of-DSG.pdf

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

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