

RATE DESIGN IN A HIGH DER ENVIRONMENT

A Way Forward

PRESENTED TO
MEDSIS Rate Design Workshop

PRESENTED BY
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THE **Brattle** GROUP



Agenda

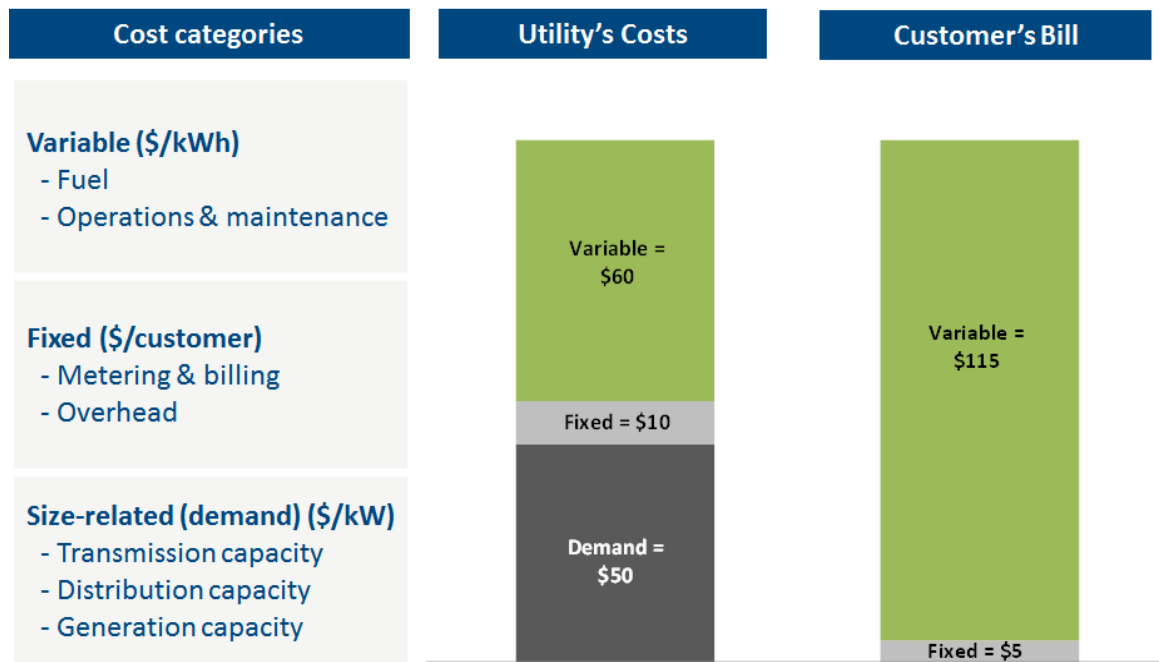
Searching for the Ideal Rate Design

Implementations of Alternative Rate Designs

Concluding Thoughts

Across the US, residential rates and costs are misaligned for most utilities

Illustrative Example Delivery Revenues vs. Costs (Residential)



Source: The Brattle Group

Why is this important?

- Delivery costs are mainly fixed and demand related, but a significant portion of delivery revenue is recovered through volumetric charges
- It is critical to shift delivery rate design to a more cost-based rate structure to drive efficient customer behavior

A rate design revolution is all but inevitable

Several factors exacerbate the problems caused by volumetric rates

- Falling load factors, driven by rising peak loads and falling sales
- DERs will continue to exacerbate the mismatch between revenue and costs among residential customers

Regulatory directive

- Push for increased DER penetration, greater customer choice, and greater system efficiency

Changing customer needs

- Seamless integration of technologies with the grid (at least) at the same level of reliability they have today
- Expect customized and personalized rate options

Rates are the means by which costs are assessed on customers

In a competitive market, economic efficiency is maximized because prices end up equaling marginal cost

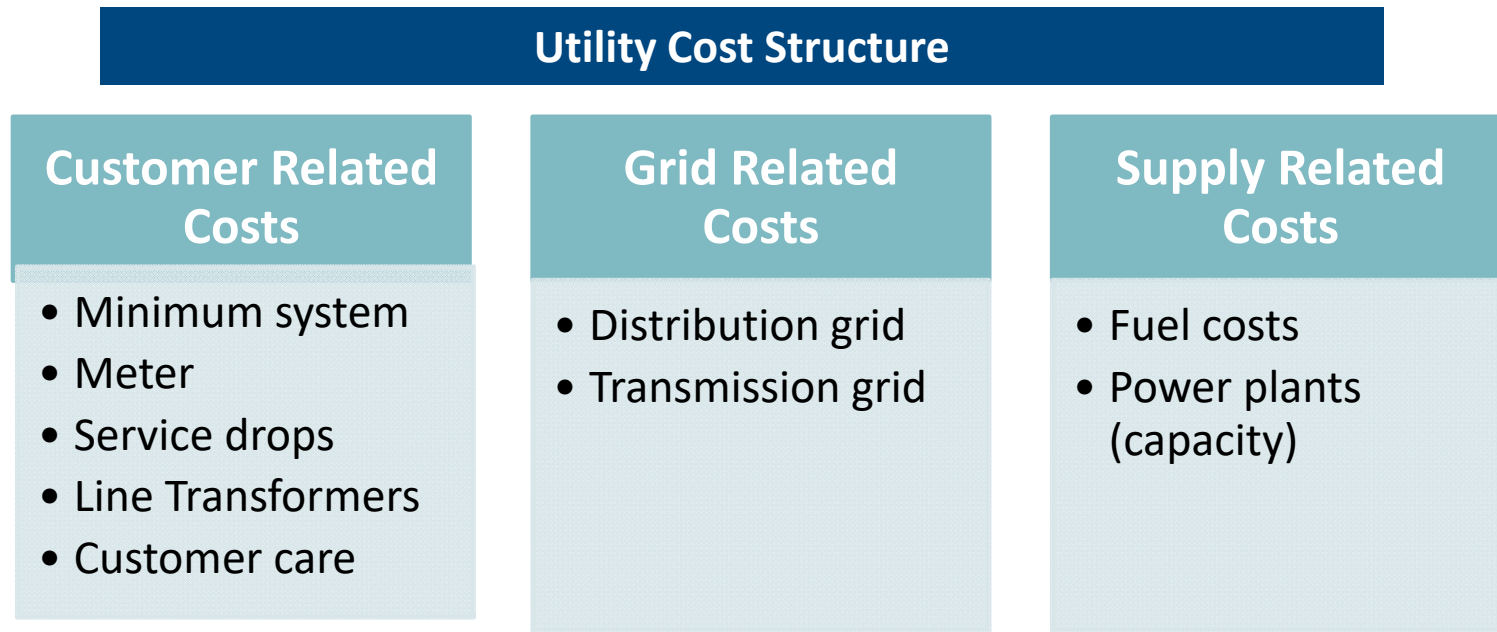
- However, electric utilities are regulated monopolies and do not face a competitive market
- In a regulated space, rates are designed to approximate a competitive market outcome. This maximizes the distribution of economic welfare to producers and consumers
- Therefore, rates of a regulated monopoly should be cost-based

The premise of cost-based rates is discussed in the seminal work by James Bonbright (Principles of Public Utility Rates)

Rate Design Principles

Principles	Objective
1. Cost Causation	<ul style="list-style-type: none">• Rates should reflect cost causation, including embedded costs, long-run marginal and future costs
2. Encourage Outcomes	<ul style="list-style-type: none">• Rates should encourage desired market and policy outcomes in a technology neutral manner
3. Policy Transparency	<ul style="list-style-type: none">• Incentives should be explicit and transparent, and should support policy goals
4. Decision-making	<ul style="list-style-type: none">• Rates should encourage economically efficient and market-enabled decision-making in a technology neutral manner.
5. Fair Value	<ul style="list-style-type: none">• Customers and utility should both be paid the fair value for the grid services they provide
6. Customer Orientation	<ul style="list-style-type: none">• Rates should be practical, understandable and promote choice
7. Stability	<ul style="list-style-type: none">• Customer bills should be relatively stable
8. Access	<ul style="list-style-type: none">• Electricity should remain affordable and accessible for vulnerable sub populations
9. Gradualism	<ul style="list-style-type: none">• Rate changes should be implemented in a manner which would not cause any large bill impacts
10. Economic Sustainability	<ul style="list-style-type: none">• Rate design should reflect a long-term approach to price signals and remain neutral to any particular technology or business cycle

The utility cost structure has three primary components



Current residential delivery rates typically have two components to recover a multitude of utility service costs: fixed charges and volumetric rates

A five-part rate would reflect costs accurately

A Fully Cost-Based Rate			
	Fixed Cost (\$/month)	Demand Charge (\$/kW-month)	Volumetric Charge (\$/kWh)
Distribution	✓	✓	
Transmission		✓	
Generation		✓	✓

An ideal rate structure would attribute a separate charge to address each of the cost categories

However, as much as rates should promote economic efficiency and equity, the changes in rate regimes should be implemented gradually and the complexity of the rates should be balanced against their likely customer understanding

A three-part rate would provide a good approximation to the five-part rate

1. **Customer charge (\$/month)** designed to recover “customer-related” fixed costs
2. **Demand charges (\$/kW-month)** designed to recover costs of providing capacity. It can be designed to have two components based on the fixed vs. variable cost nature of the capacity
 - A non-coincident peak demand charge for being connected 24/7 to the grid
 - A coincident peak demand charge for using the capacity
3. **Energy charge (\$/kWh)** designed to recover the variable costs of generating electricity

Source: Alliance to Save Energy, “Forging a Path to the Modern Grid” (February 2018)

Behavioral economics tells us that customers have diverse preferences

Market research studies and surveys undertaken in the context of time-based pricing pilots reveal valuable insights on customer preferences

Some want the lowest price

- They are willing to be flexible in the manner in which they use electricity

Some want to lock in a guaranteed bill

- They are willing to pay a premium for peace-of-mind

Many others are in between these two bookends

- Some might want a guaranteed bill but may be willing to lower usage if rebates are offered for reducing demand during peak periods
- Others may wish to subscribe to a given level of demand

All customers want choice but *they only want what they want*

Alternative Rate Designs I

Rate Design	Main Features	Other Considerations
1- Demand Charges	<ul style="list-style-type: none">• Reflects delivery related cost-causation• Typically require interval meters• Ideally would have two components: CP and NCP demand	<ul style="list-style-type: none">• Several options are available for measuring demand (NCP is most common)• In some cases, billing demand is measured during the peak window
2- TOU Rates	<ul style="list-style-type: none">• TOU periods are determined based on system or local load conditions• May have seasonal definitions	<ul style="list-style-type: none">• As the peak shifts towards later in the day, it becomes more effective in recovering demand related costs
3- Dynamic Pricing	<ul style="list-style-type: none">• Typically declared based on wholesale system conditions, although there are variations based on local conditions	<ul style="list-style-type: none">• CPP can be defined as a demand charge or a kWh charge• Event day charge may vary across events (VPP)
4- Increased Fixed Charge	<ul style="list-style-type: none">• Reflects fixed costs of serving customers• Most fixed charges do not include all customer costs; some utilities increase fixed costs to cover all customer related costs and some demand related costs	<ul style="list-style-type: none">• May have a larger negative impact on low usage customers• May temper conservation incentives• Easier to manage from customer experience perspective

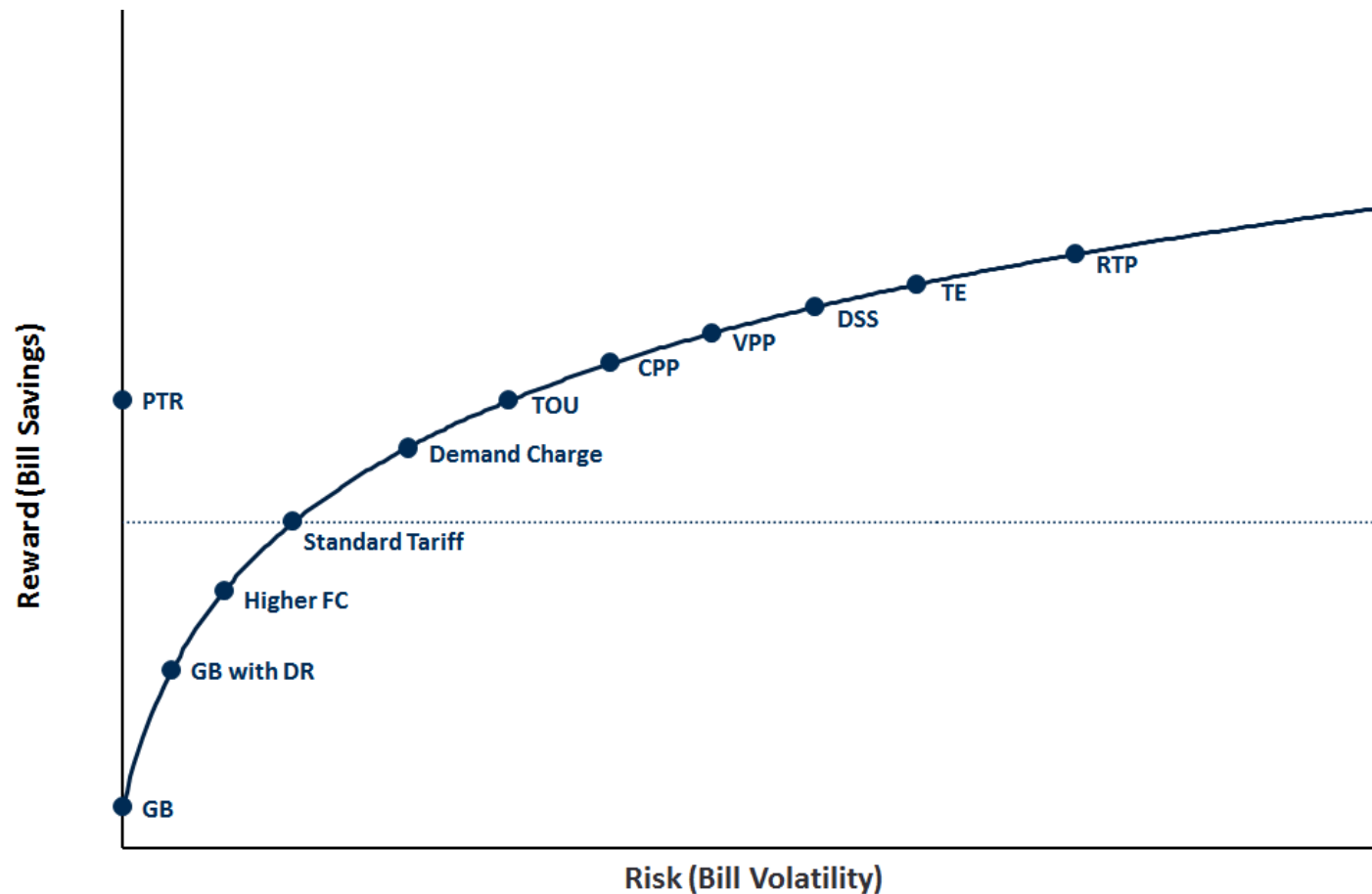
Alternative Rate Designs II

Rate Design	Main Features	Other Considerations
5- Minimum Bill	<ul style="list-style-type: none"> Ensures that each customer makes a minimum level of contribution to cost recovery regardless of their consumption May negatively impact low usage customers 	<ul style="list-style-type: none"> Minimum level of consumption needs to be determined
6- Demand Subscription	<ul style="list-style-type: none"> Fixed delivery charge based on kW usage subscription level Single charge for all delivery costs Additional charge for excess demand 	<ul style="list-style-type: none"> Customers may choose subscription levels or they are defaulted based on historic consumption levels Variations around demand measurement
7- Grid Access Charge	<ul style="list-style-type: none"> Charge per kW of solar generating capacity Ensure that solar customers contribute to the recovery of delivery costs regardless of their net consumption 	<ul style="list-style-type: none"> Need to determine the basis of grid access charge (inverter rating, max net demand) Need a technology specific access charge
8- Stand-by Rates	<ul style="list-style-type: none"> No volumetric charges included Customer charge, contract demand charge, daily as-used demand charge 	<ul style="list-style-type: none"> Which costs to include in contract demand vs. as-used demand? Measurement of as-used demand Additional charge for actual demand that exceed the contract demand

Alternative Rate Designs III

Rate Design	Main Features	Other Considerations
9- Green Tariff	<ul style="list-style-type: none">• Allows large commercial and industrial customers with a preference for renewable energy to contract with the utility• Involves negotiating a PPA or buying renewable generation at market prices	<ul style="list-style-type: none">• Many Fortune 500 companies have corporate sustainability goals• Green tariffs may open up new partnership and marketing opportunities with C&I customers
10- Guaranteed Bill	<ul style="list-style-type: none">• No volumetric charges• Provides customers with a flat bill option that has little or zero risk from month-to-month	<ul style="list-style-type: none">• Limits any energy efficiency or demand response opportunities
11- Transactive Energy	<ul style="list-style-type: none">• Experimental rate option for households or businesses that would like to trade energy between each other• Useful for customers with on-site generation and limited storage capabilities	<ul style="list-style-type: none">• Mostly experimental

These create an efficient pricing frontier,
and customers can pick where they want
to lie on the frontier



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Variable Peak Pricing in Oklahoma

OGE rolled out a dynamic pricing rate coupled with a smart thermostat to its residential customers a few years ago

- “Smart Hours” features variable peak pricing, or four levels of peak pricing depending on what day type it happens to be (Low, Standard, High, Critical)
- There are fixed summer and winter peak hours
- Prices during peak hours vary depending on system conditions, and are communicated by 5:00pm the previous day. Critical periods can be communicated with as little as two hours notice
- The expectation is that there would be 10 Low price days, 30 Standard price days, 36 High price days, and 10 Critical price days in a typical year.
- Is also offered to Small GS customers whose annual demand is less than 10 kW or less than 400 kW with a load factor of less than 25%

Some 130,000 customers out of 650,000 are on that rate today; they control their thermostat setting, not OGE

- Average peak load has dropped by ~40%
- Average bill savings amount to ~20% of the customer's bill

Peak Time Rebates in Maryland

Both BGE and PHI offer peak time rebates of \$1.25/kWh to their customers in Maryland (~ 2 million households), and bid in the load reductions into the PJM market

At BGE, about 80% of its customers have taken advantage of the rebates and saved \$40 million in utility bills since the program began in 2013

The average percent impact across all hours and events for SER rebate earning customers was %15.3 for 2017 and 14.2% for 2016

The Maryland Commission has authorized new pilots for testing the response of customers to time-of-use rates

TOU Rates in Ontario (Canada)

For the past five years, some 90% of Ontario's 4 million residential customers have been buying their energy through a regulated supply option, which features a three-period TOU rate

- They have reduced their peak demand by ~3%, based on a three-year analysis that we carried out for the IESO

Knowing the limitations of TOU rates, the Ontario Energy Board (OEB) has authorized dynamic pricing pilots that would allow those rates to be offered as supplements to the TOU rates

The OEB has ruled that distribution charges will be collected through a fixed charge

- The Texas PUC is watching the developments with interest

Critical Peak Pricing in California

PG&E offers CPP programs (SmartRate and Peak Day Pricing) to both residential and C&I customers

- Peak to off-peak price ratio of approximately of 3:1 and 4:1 for residential and C&I customers, respectively
- 14 events called in 2017 and 12 events called in 2016 (max of 15 per year)
- Standard trigger point: 98 degree average temperature in service territory

Similarly, Southern California Edison offers a CPP program to both residential and C&I customers

Instead of CPP, SDG&E offers a more widely enrolled PTR program

In some jurisdictions, cost-based tariffs are already the default tariff

Spain offers real-time pricing as the default regulated supply option and about half of all customers have elected to stay on it

Ontario (Canada) has made TOU tariffs the default supply option

- The rates vary seasonally and feature three periods
- Some 90% of customers are on that tariff

California is planning to roll out TOU tariffs to all residential customers by 2019

- A pilot to test default deployment has been implemented

Demand charges

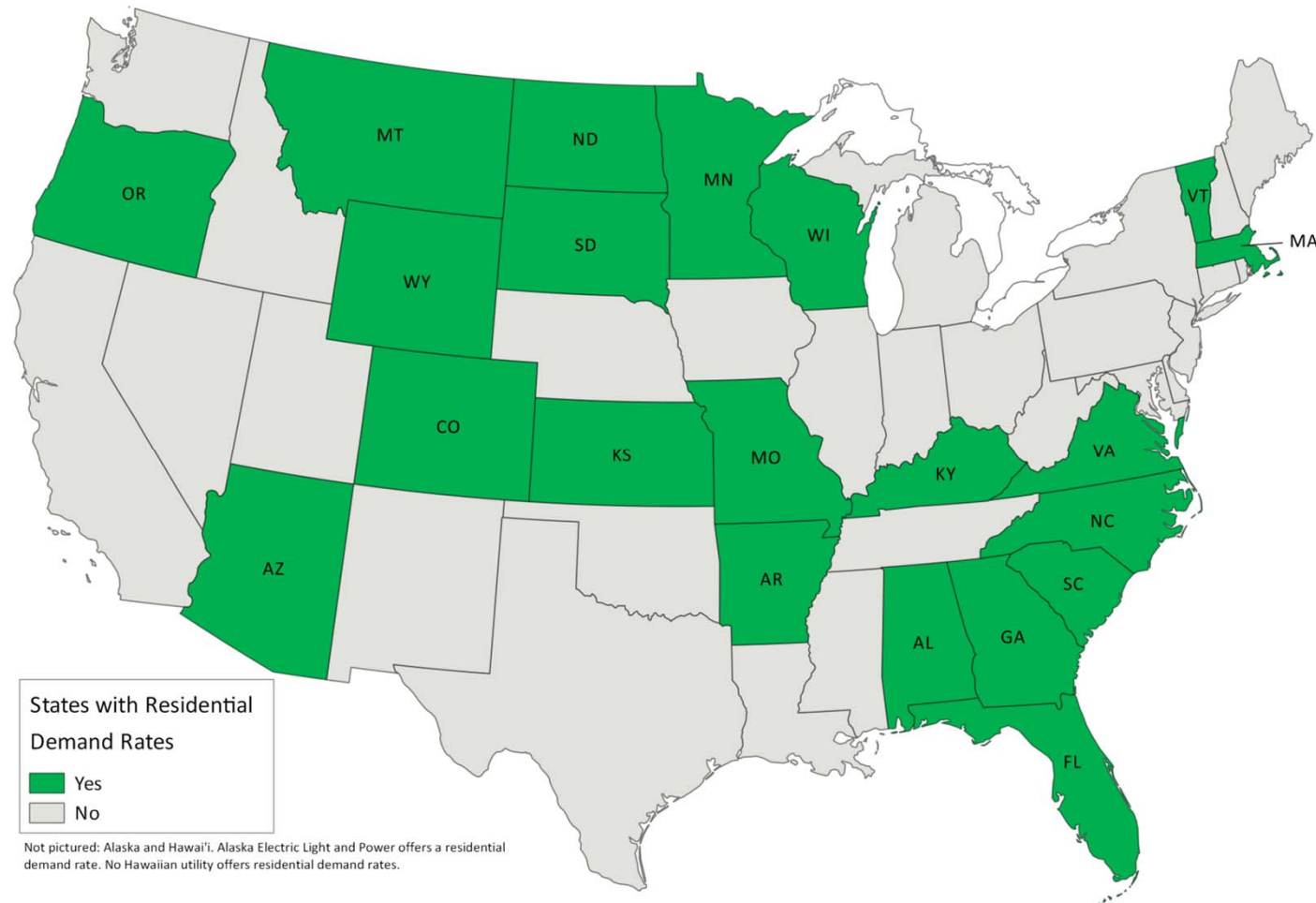
Capacity charges based on the size of the connection are mandatory for residential customers in France, Italy, and Spain

Demand charges are being offered by more than 30 utilities in the United States, including a few rural cooperatives

- APS, Black Hills Power, Georgia Power, OG&E are among IOUs offering voluntary demand charges for residential customers
- Eversource, Salt River Project, NV Energy, and Westar Energy have filed applications to make demand charges the mandatory tariff for DER customers
 - Salt River Project in Arizona, a municipally owned system, has instituted a mandatory tariff for DG customers

Residential Demand Charges in the U.S.

22 states are offering demand charges to residential customers



Is there an ideal rate design for DER customers? I

Rate design for DER customers should adhere to the same rate design principles that would apply to mass market customers in general

It is difficult to find the “ideal rate design” that would hit the mark on all ten principles

- To the extent that certain principles have a larger weight compared to others in a given jurisdiction, that should help with the determination of the ideal rate design given the circumstances

Is there an ideal rate design for DER customers? II

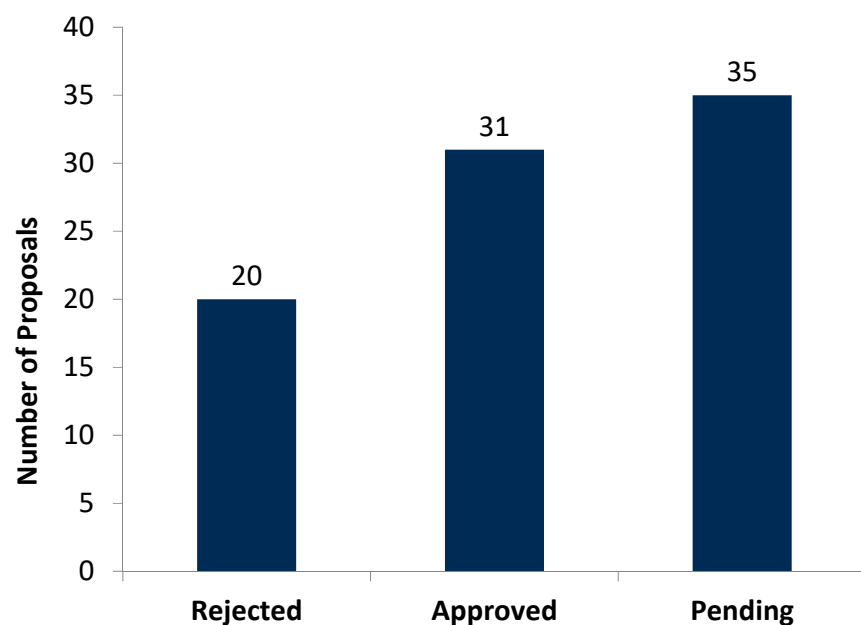
High priority rate design principles

- *Cost-based rates* lead to economically efficient outcomes and remove hidden subsidies that may lead to over/under consumption of electricity or over/under investment in certain technologies
 - Volumetric delivery rates are not cost based and lead to cross-subsidies between DG and non-DG customers
 - Inclining block rates are not cost based and lead to larger customers subsidizing smaller customers
- *Economic sustainability* ensures that rates convey efficient price signals in a technology neutral manner
- *Customer orientation* ensures that the rates are understandable and promote choice
 - Customer education is an essential driver of customer orientation

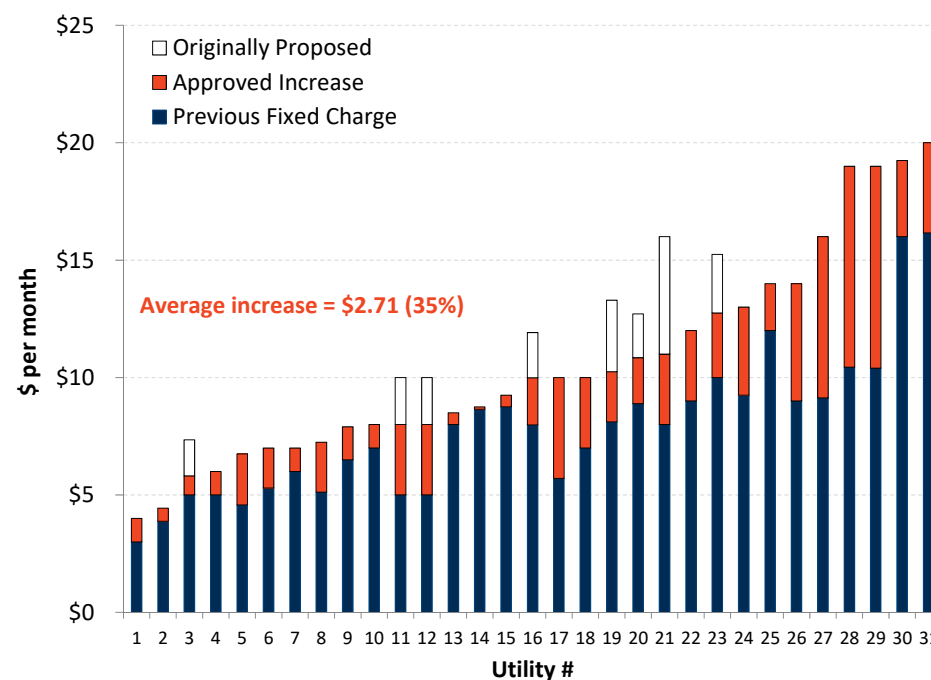
There is a desire to move Fixed Charges closer to fixed costs

Many utilities have proposed to increase the fixed charge, with varying degrees of success

Recent Proposals to Increase Fixed Charge



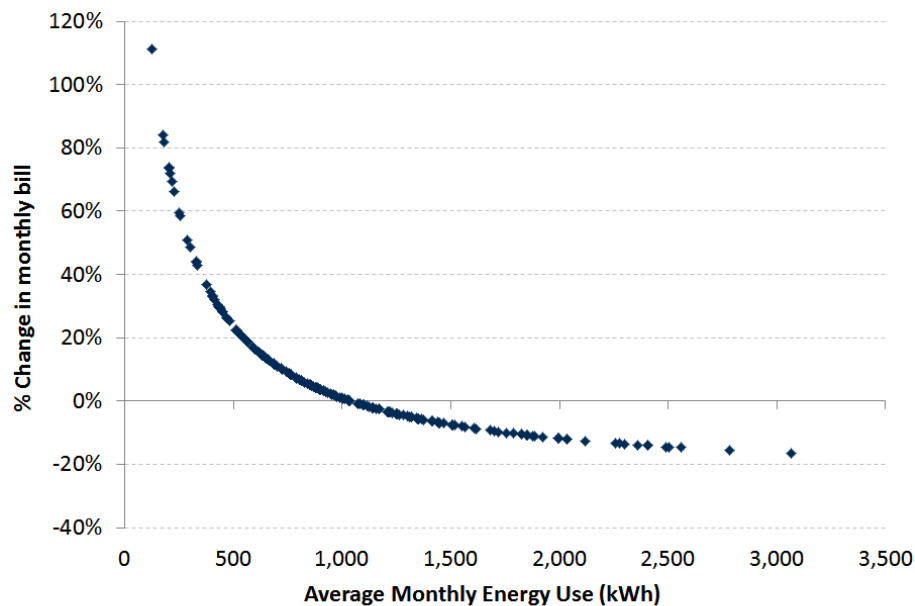
Amount of Approved Increase



Data sources: NC Clean Energy, "The 50 States of Solar," Q2 2015. Supplemented with review of additional utility rate filings.

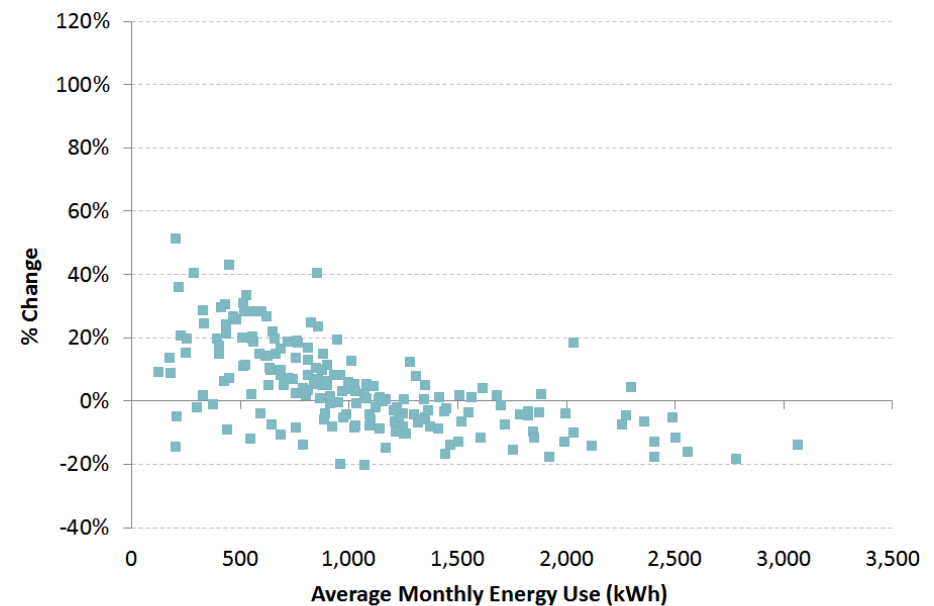
While increased fixed charges raise bills for small customers, demand charges do not

With Increased Fixed Charge



Note: The three-part rate includes a monthly fixed charge of \$10, an energy charge of \$0.077/kWh, and a demand charge of \$6/kW. The revenue-neutral two-part rate includes a monthly fixed charge of \$40 and an energy charge of \$0.083/kWh.

New Demand Charge



Note: The three-part rate includes a monthly fixed charge of \$10, an energy charge of \$0.060/kWh, and a demand charge of \$9/kW. The revenue-neutral two-part rate includes a monthly fixed charge of \$40 and an energy charge of \$0.083/kWh.

- Correlation between bill impact and customer size is stronger with increased fixed charge.
- Whether small customers are low income customers is another question entirely...

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Concluding Thoughts I

Volumetric rates do not provide efficient or equitable price signals to residential customers

- They create cross-subsides between customers with different load factors and in particular between customers with DG and those without DG
- The problem will become more pronounced as DG penetration grows

Choice of appropriate mass market rate design should not be decided solely on customer bill impacts

- Bill impacts can inform the pace of change
- The principles of cost causation and economic sustainability should be given priority

Concluding Thoughts II

For electric delivery service, the combination of a fixed customer charge and a demand charge best align revenues and costs and provide customers with the appropriate price signals. Demand charge can be:

- A combination of non-coincident peak and coincident peak demand charges; or
- Time-differentiated demand charges

There are many ways in which to make the transition

- Phase in rate reform with initial focus on DG customers
- Seek stakeholder input
- Educate customers

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Dr. Sanem Sergici is a Principal in The Brattle Group's Boston, MA office specializing in program design, evaluation, and big data analytics in the areas of energy efficiency, demand response, smart grid and innovative pricing. She regularly supports electric utilities, regulators, law firms, and technology firms in their strategic and regulatory questions related to retail rate design and grid modernization investments.

Dr. Sergici has been at the forefront of the design and impact analysis of innovative retail pricing, enabling technology, and behavior-based energy efficiency pilots and programs in North America. She has led numerous studies in these areas that were instrumental in regulatory approvals of Advanced Metering Infrastructure (AMI) investments and smart rate offerings for electricity customers. She also has significant expertise in development of load forecasting models; ratemaking for electric utilities; and energy litigation. Most recently, in the context of the New York Reforming the Energy Vision (NYREV) Initiative, Dr. Sergici studied the incentives required for and the impacts of incorporating large quantities of Distributed Energy Resources (DERs) including energy efficiency, demand response, and solar PVs in New York.

Dr. Sergici is a frequent presenter on the economic analysis of DERs and regularly publishes in academic and industry journals. She received her Ph.D. in Applied Economics from Northeastern University in the fields of applied econometrics and industrial organization. She received her M.A. in Economics from Northeastern University, and B.S. in Economics from Middle East Technical University (METU), Ankara, Turkey.

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