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Memorandum

From the office of
Commissioner Andy Tobin
Arizona Corporation Commission
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TO: Docket Control

DATE: August 4th, 2016

FROM: Commissioner Andy Tobin's Office

SUBJECT: Docket No. # E-00000J-16-0257

Attached please find Dan Cross - Call presentation entitled "Doing Rate Design Better" for the Reducing System Peak Demand Costs Workshop on August 4, 2016.

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CERTIFICATION OF SERVICE

On this 4th day of August, 2016, the foregoing document was filed with Docket Control as a correspondence from Commissioner Andy Tobin, and copies of the foregoing were mailed on behalf of Commissioner Andy Tobin to the following who have not consented to email service. On this date or as soon as possible thereafter, the Commission's eDocket program will automatically email a link to the foregoing to the following who have consented to email service.

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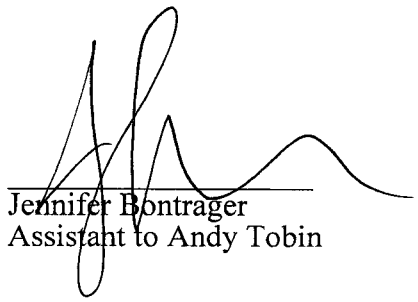
By: 
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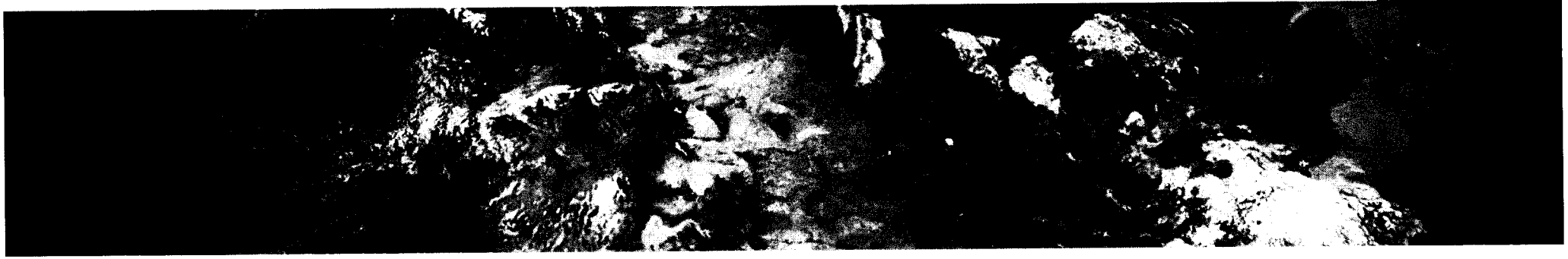
Doing Rate Design Better

Findings from RMI's *A Review of Alternative Rate Designs*

Dan Cross-Call | August 4, 2016

Workshop on Reducing Peak System Costs | Phoenix, AZ



Agenda

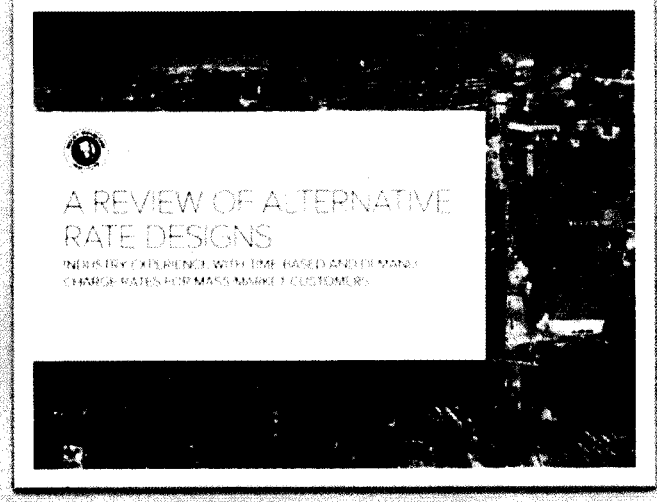
1. The Need for Better Rate Design
2. *Findings*: Time-Based Rates
3. *Findings*: Demand Charge Rates
4. Applying These Findings

A Review of Alternative Rate Designs

Industry Experience with Time-based and Demand Charge Rates for Mass-Market Customers

May 2016

By Aman Chitkara, Dan Cross-Call, Becky Li, James Sherwood

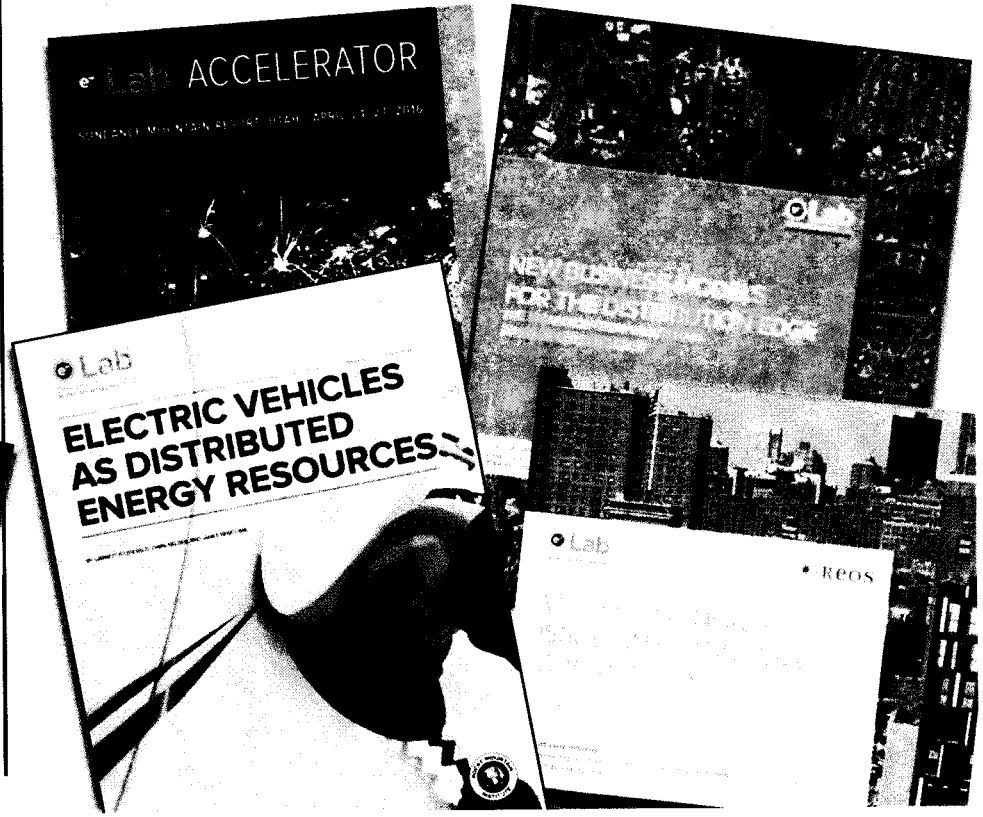


rmi.org/alternative_rate_designs

About RMI and e-Lab

Rocky Mountain Institute works across industries on challenging energy issues to drive the efficient and restorative use of resources with market-based approaches

e-Lab brings together leading electricity sector actors to solve regulatory, business, and economic barriers to the deployment of distributed resources

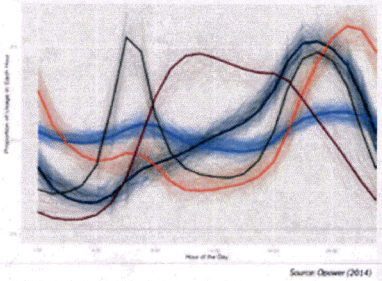


1 The Need for Better Rate Design

RMI transforms global energy use to create a clean, prosperous, and secure future.

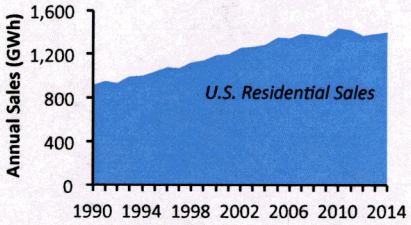
The rate design landscape is rapidly evolving

EVOLVING TRENDS



Diversity of load profiles is increasing

New technology is increasing capabilities

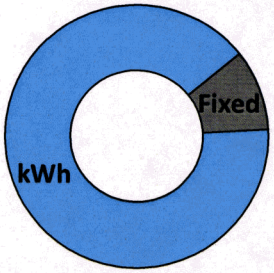


Electricity demand growth is flattening

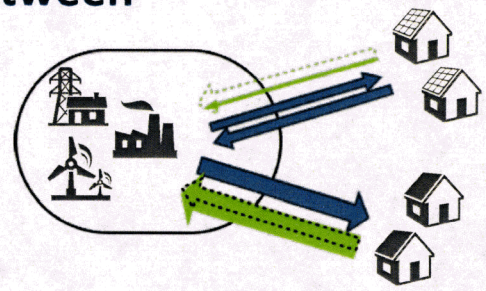
IMPLICATIONS FOR RATE DESIGN

Current price signals are inadequate

The existing rate design toolkit is limited



There is growing misalignment between costs and rates

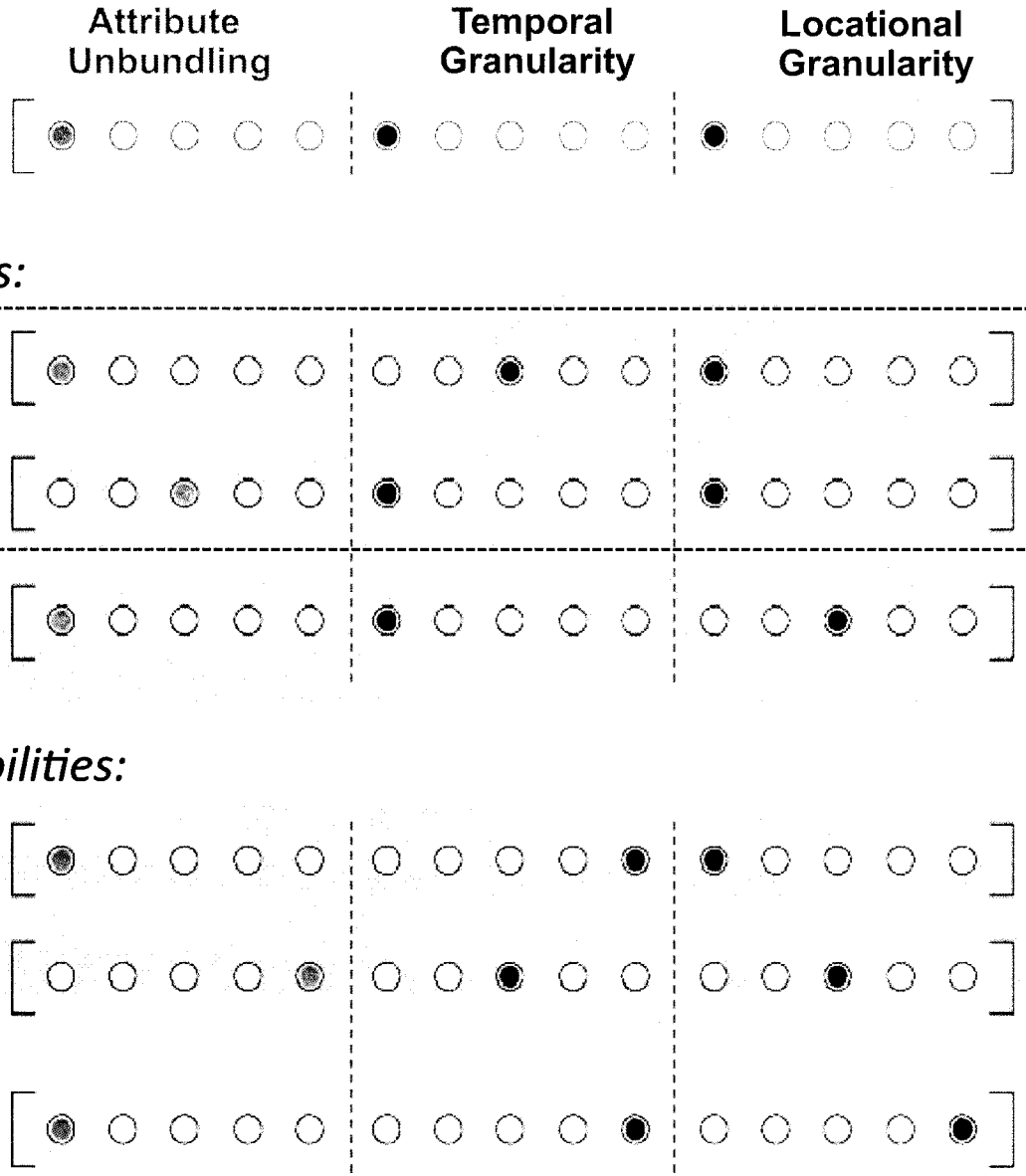


Rate design can help meet changing customer and system needs

Rate design can change to better reflect the dimensions of benefits and costs along three continuums:

- **Attribute Continuum**—from a single bundled rate to unbundle and separately price the various sources of benefit and cost (e.g., energy, capacity, etc.).
- **Temporal Continuum**—from unchanging flat rates to include time-differentiated prices that reflect benefits and costs that vary by time.
- **Locational Continuum**—from standard, system-wide values to prices that reflect site-specific benefits and costs.

A number of different approaches are available



Source: *Rate Design for the Distribution Edge, RMI, 2014*

Critical questions remain regarding the application of alternative rates

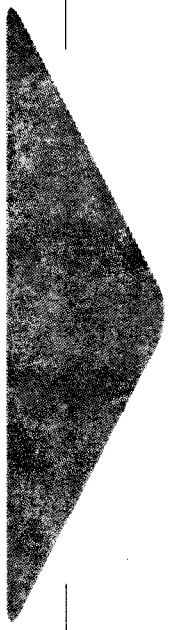
OUR FOCUS

Two most-prominent types of alternative rates:

1. *Time-based rates*
2. *Demand charge rates*

KEY QUESTIONS

- What design choices are most important?
- What magnitude of impact is possible?
- What might prevent successful implementation?
- What knowledge gaps exist?



OBJECTIVES

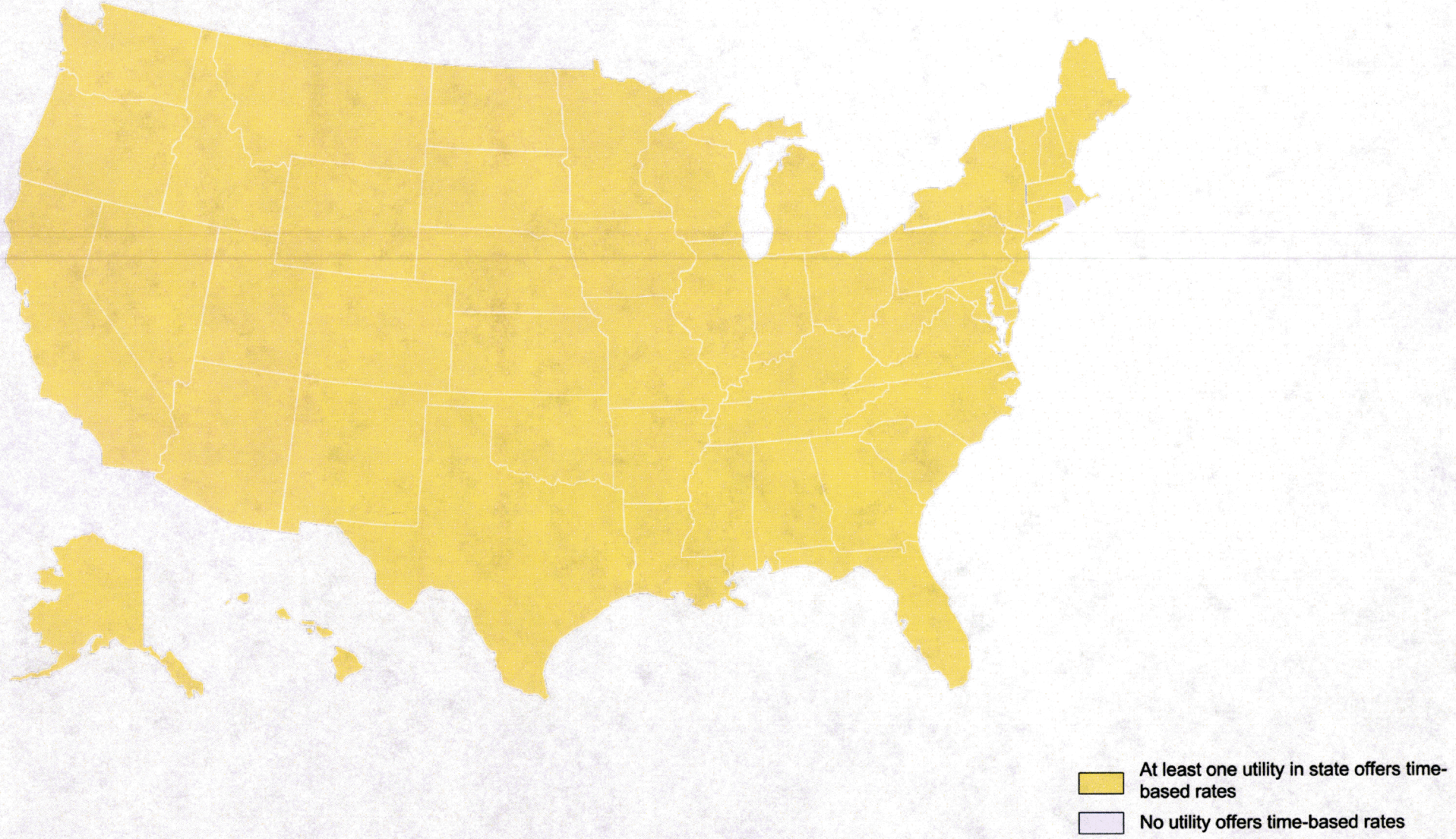
- Provide a structure for evaluating alternative rates
- Identify major design choices and options
- Determine choices that maximize desired outcomes
- Highlight areas where further study is needed

This research is constrained to a subset of all possible time-based and demand charge rates:

- **Mass-market customers** (residential and small commercial)
- **Rates for consumption** (i.e., no direct attention to compensation for DG)
- **Common variations of each rate design type**
- **Impact on three primary desired outcomes:**
  - Total energy consumption
  - Peak load reduction
  - Customer acceptance

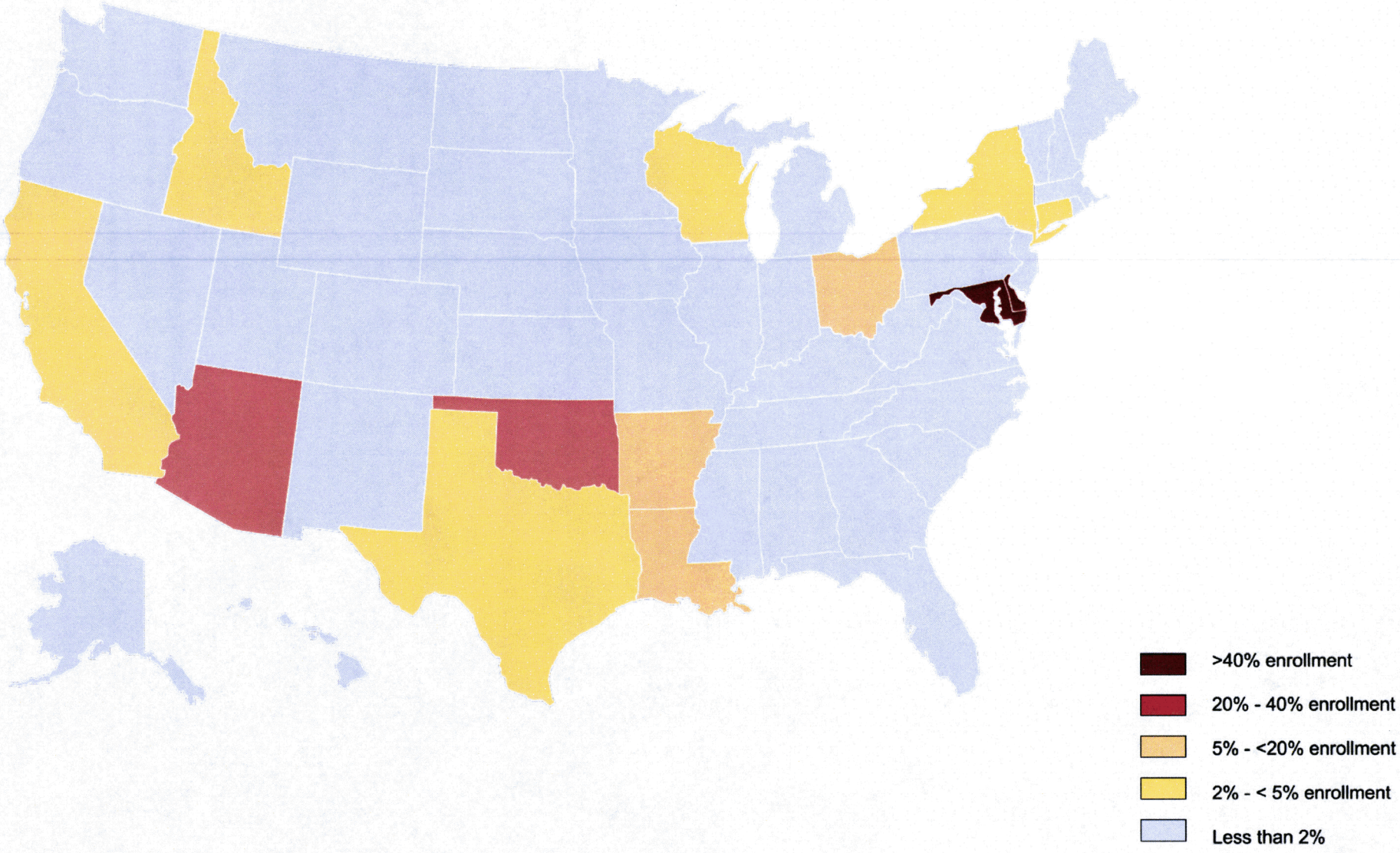
2 *Findings:* Time-Based Rates

There is significant experience in the US with time-based rates...



Source: *EIA Form – 861, 2014*

...however, enrollment rates are fairly low in most states

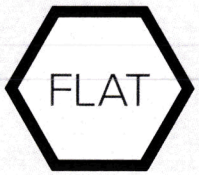


Source: *EIA Form – 861, 2014*

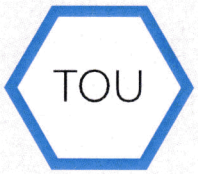
There are several types of time-based rates

Base Structures

Foundation of any time-based volumetric rate



Flat Volumetric



Time-of-Use

Real-Time Pricing

Modification Mechanisms

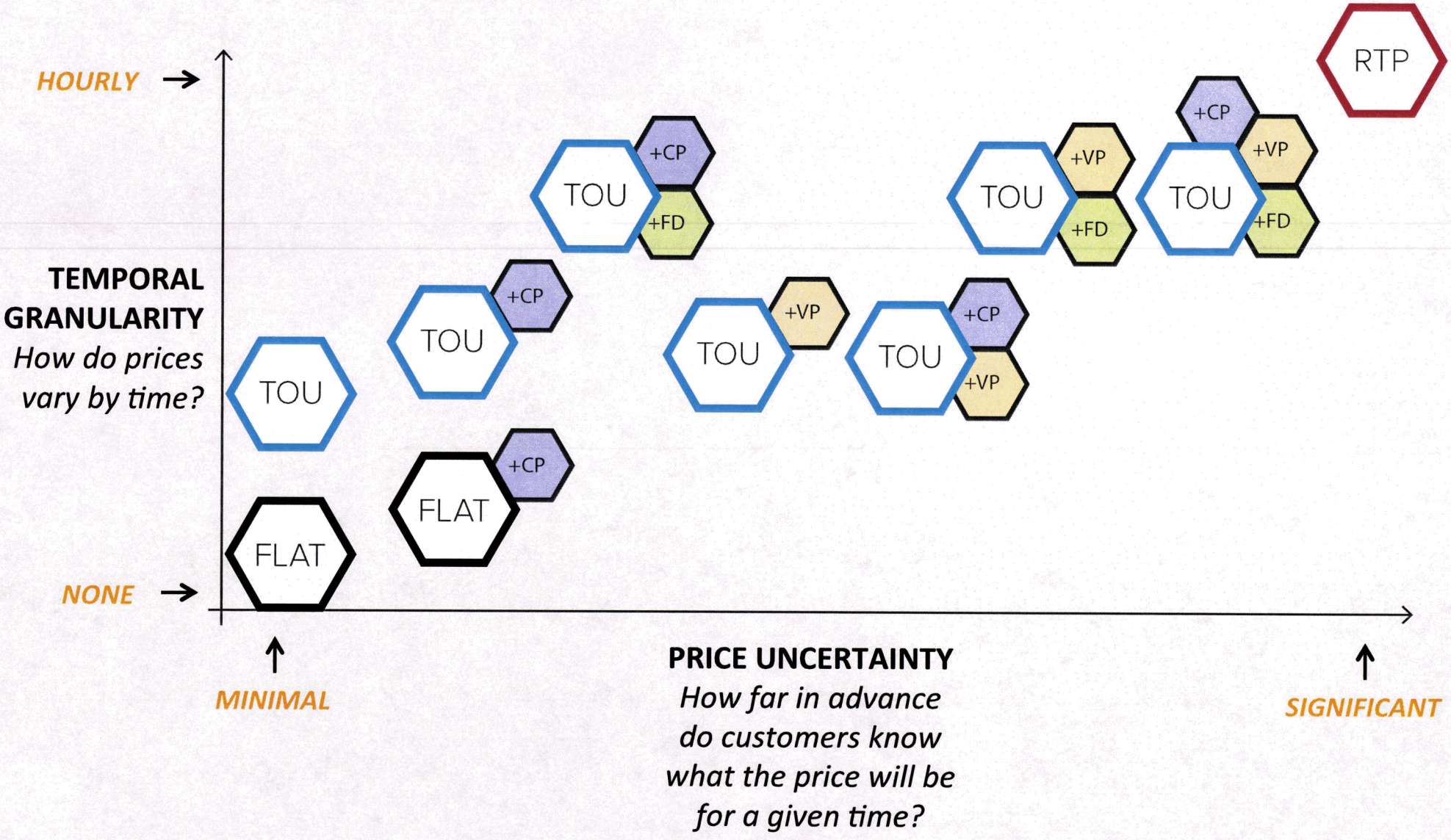
Can be added to a base structure to increase sophistication

Critical Peak

Variable Peak

Flexible Duration

These types of rates have different characteristics



Well-designed time-based rates can reduce peak consumption without compromising customer acceptance

Range of Findings:

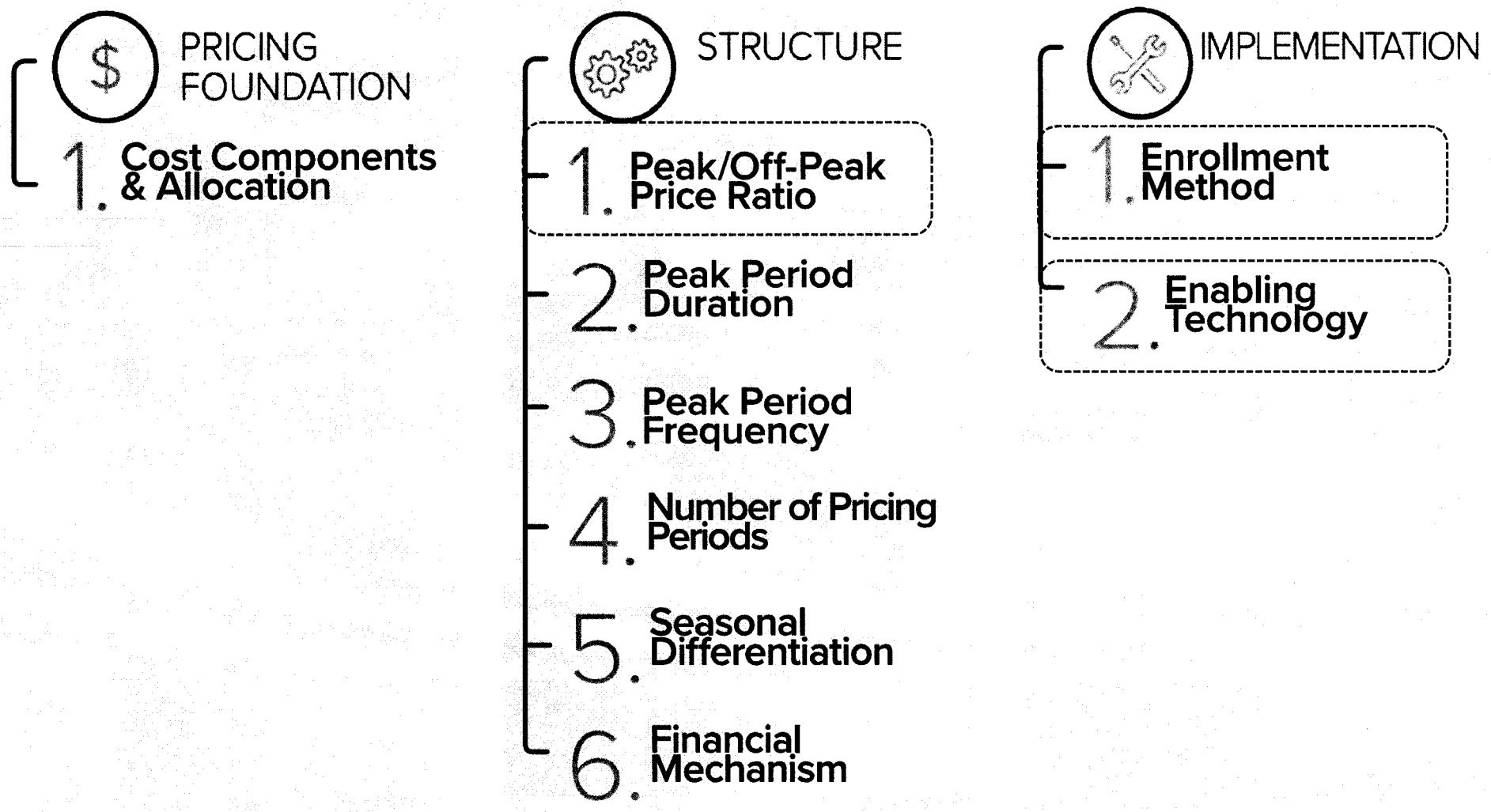
Compared to demand-charge rates, impacts of time-based rates have been studied much more extensively.

- **Reduction in Total Energy Consumption:** *0 – 10%*
- **Customer Peak Load Reduction:** *0 – 50%*
- **Customer Acceptance:** *6 – 98% enrollment, 63 – 98% retention*

Yet, Impact of time-based rates can vary widely.

- Variation is influenced by various design choices.
- Also require thoughtful marketing and customer education to be effective.

Nine dimensions must be defined for any time-based rate



Structure
Peak/Off-Peak Price Ratio

The POPP ratio is a key determinant of how impactful a rate will be

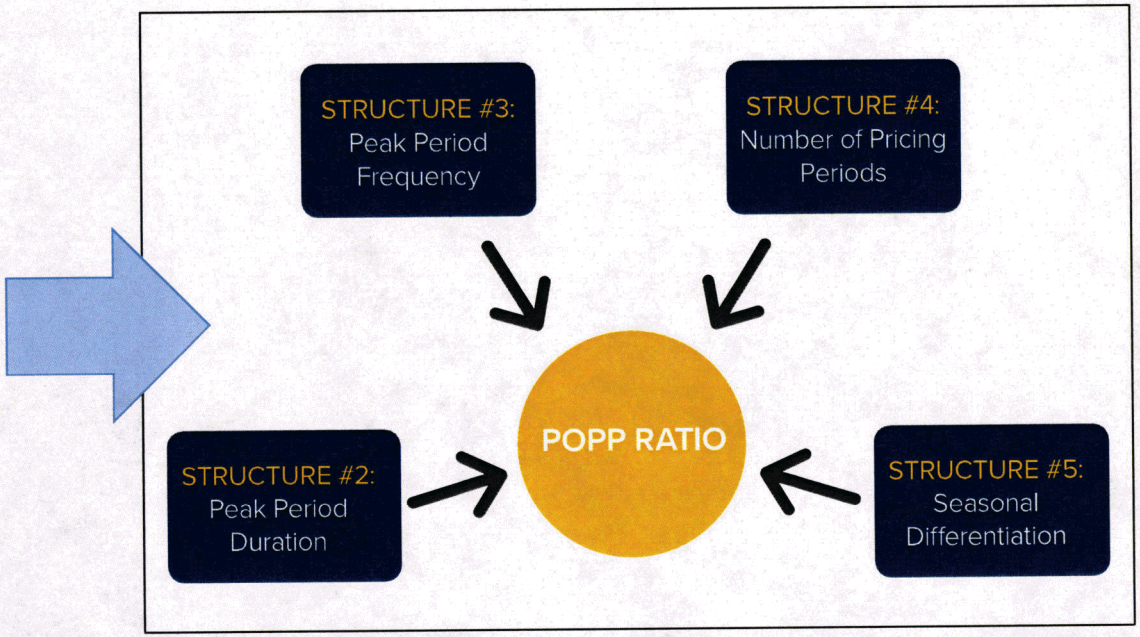
OPTIONS

POPP ratios vary widely in practice, and differ depending on the structure:

- *Basic Time-Based Rates*: 1:1 → 7:1.
- *Modified Time-Based Rates*: 4:1→ 20:1, including CP modifications.

IMPORTANT CONSIDERATIONS

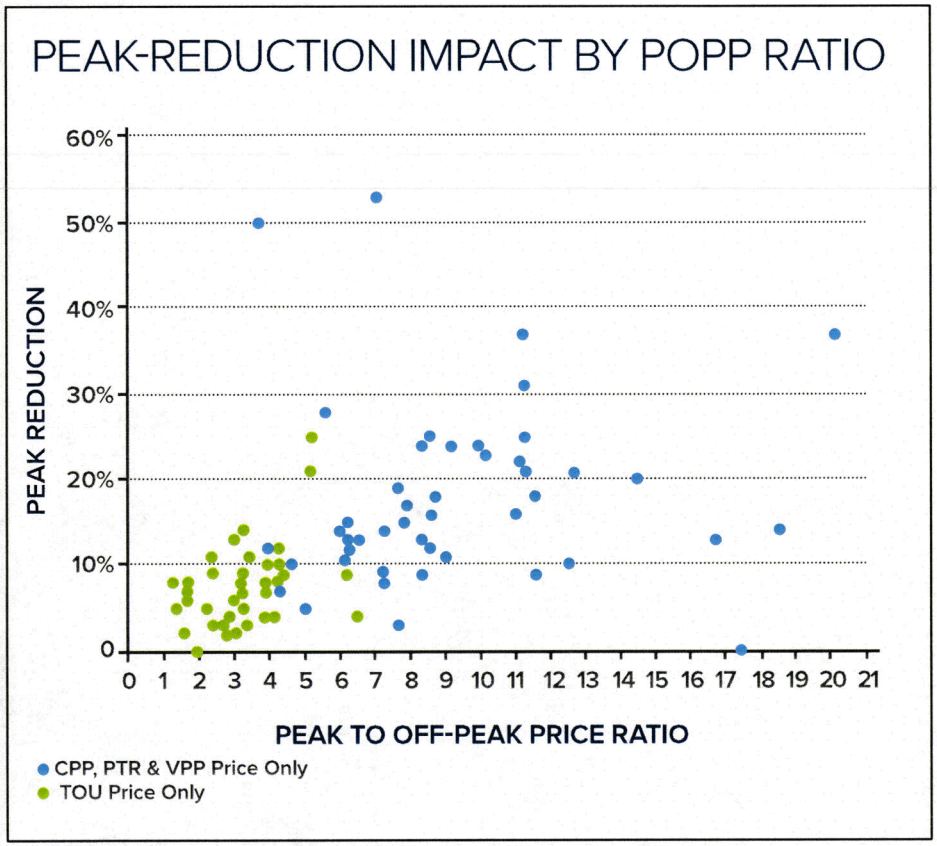
- The POPP ratio is a function of four input dimensions
- To set an appropriate ratio, all dimensions should be considered in balance with each other



Structure
Peak/Off-Peak Price Ratio

IMPACT ON OUTCOMES

Empirical studies show that **higher POPP ratios tend to produce larger reductions** in on-peak consumption...



... But less evidence is available to definitively evaluate impact of POPP ratios on **total energy consumption** and **customer acceptance**

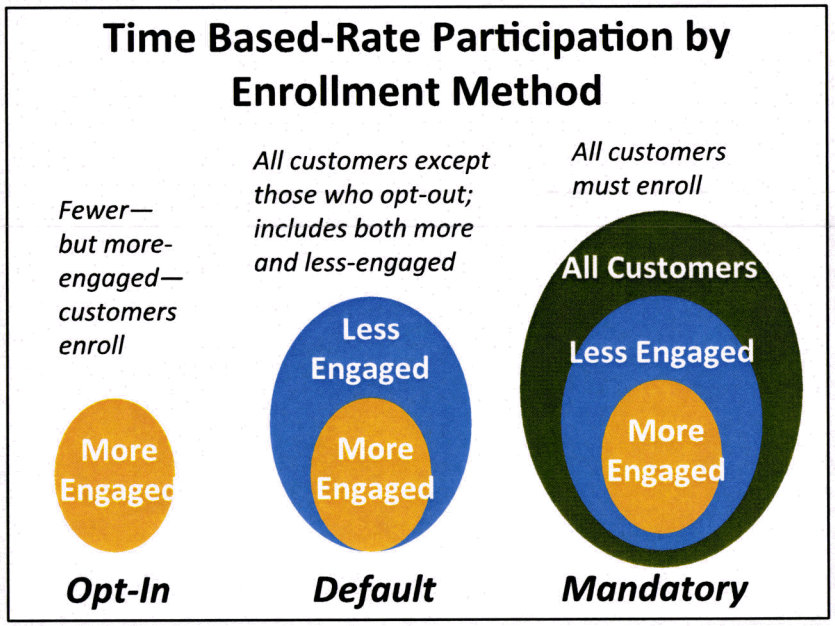
Chart Source: *The Brattle Group*

Implementation
Enrollment Mechanism

The choice of enrollment mechanism influences the uptake of the rate

OPTIONS

1. **Opt-in**, where customers can choose to participate but are otherwise not enrolled.
2. **Opt-out**, where customers are enrolled by default but have the option to switch to another rate.
3. **Mandatory**, where all customers must take service on the rate.



IMPORTANT CONSIDERATIONS

- Opt-*in* rates can be used to test new rate designs, or reach "early adopter" customers
- Opt-*out* rates need to be supported with customer education and effective program design
- Mandatory rates should be considered only with proven rate designs that are well-understood by customers

Implementation
Enrollment Mechanism

IMPACT ON OUTCOMES

Customer Acceptance

Opt-out rates can garner 3 to 5 times higher participation than opt-in, while having somewhat lower retention rates

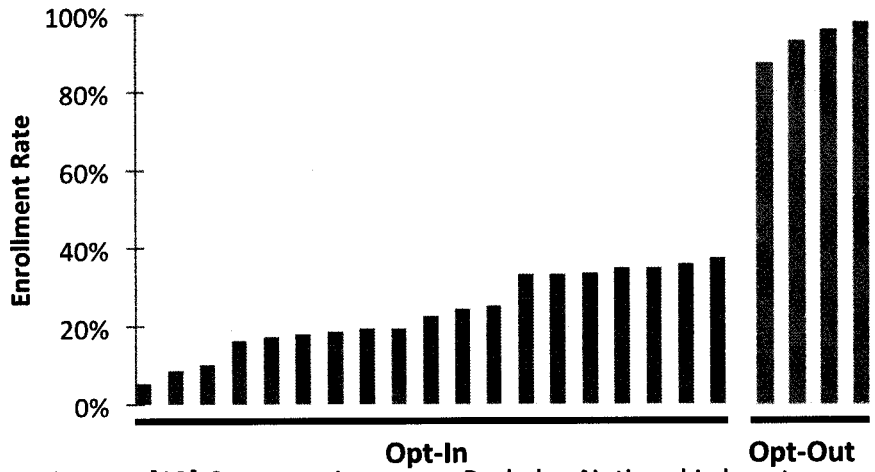
- **Opt-In Methods**

  Enrollment of 6–38%, with an average of 24%.

- **Opt-Out Methods**

  Enrollment of 87–98%, with an average of 93%.

Enrollment Rates in Utility Programs, by Method



Charts Source: [12] Courtesy: Lawrence Berkeley National Laboratory

Peak Reduction

Per-Capita Impacts

Opt-in customers tend to be more engaged:

- **Basic Time-Based Rates:**
  - 12% reduction from opt-in vs. 6% for opt-out rates,
  - 8% for opt-in rates and 0% for opt-out.
- **Modified Time-Based Rates** (e.g. critical peak pricing)
  - 25% for opt-in rates vs. 14% for opt-out.

Aggregate Impacts

- Opt-out rates can achieve much greater *total* customer response

Implementation
Enabling Technology

Certain enabling technology can boost the impact of time-based rates

OPTIONS

- ***Passive enabling technology*** **-** includes in-home displays and other technologies that convey signals without taking action, e.g., actual price, price level, or other price indicator.
- ***Active enabling technology*** **-** includes programmable controllable thermostats (PCTs) and other devices that automatically modulate customer load in response to price or other signals.

IMPORTANT CONSIDERATIONS

- Not all enabling technology is created equal
- Important equity considerations around customers who are more/less likely to adopt enabling technology

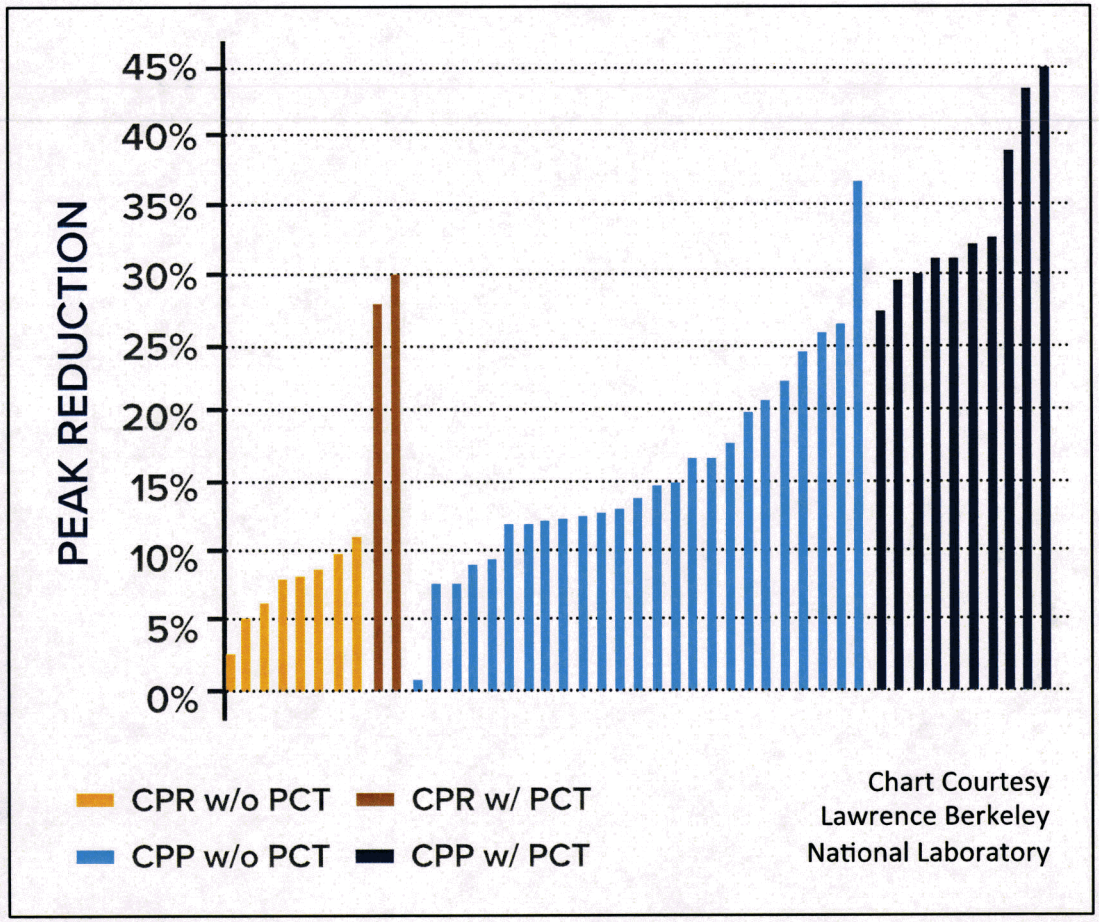
Implementation
Enabling Technology

IMPACT ON OUTCOMES

Peak Reduction:

- **Passive Technology:**
  - In-home displays improved peak reduction by 1–15 percentage points in one utility program.
  - IHDs had no effect on demand reduction in another study.
- **Active Technology:**
  - A study across 45 modified time based-rate pilots found programmable, controllable thermostats improved peak reduction by 10–20 percentage points.

Peak Reduction with and without Enabling Tech
(on modified Time-Based Rates)



Time-based rates from SMUD and OG&E illustrate how good design principles can result in desired outcomes

	SMUD Smart Pricing Pilot *(Basic TOU Rate)* TOU	OG&E Smart Study TOGETHER - *(TOU with VP and CP modifications)* TOU +CP +VP
Design Choices*		
Peak to Off-Peak Price Ratio	1.1:1 (Winter) 2.6:1 (Summer)	TOU/VP: 2.5:1 to 10.2:1 Critical peak: 10.2:1
Peak Period Duration	3 hours	TOU/VP: 5 hours Critical peak: 2–8 hours
Peak Period Frequency	Weekdays	Capped at 120 hours/year for CP events
Number of Pricing Periods	2	Summer: 2 (+CP) Winter: 1 (+CP)
Seasonal Differentiation	2 seasons	2 seasons
Financial Mechanism	Price-based	Price-based
Enrollment Method	Default	Opt-In
Enabling Technology	IHDs offered	PCTs offered
Impacts		
Customer Peak-Load Reduction	6%	21%
Reduction in Energy Consumption	1.3%	No Data Available
Customer Acceptance	Enrollment: 98% Retention: 91%	Enrollment: 18% (of *all* residential customers) Retention: 97%

3 *Findings:* Demand Charges

RMI transforms global energy use to create a clean, prosperous, and secure future.

There are two distinct types of demand charge structures

Ex Post

- Customers charged based on peak demand in the previous billing period(s)
- Can provide a continuous price signal to limit peak consumption
- U.S., Australia

Examples:

Black Hills Energy

aps

DUKE ENERGY®

Ex Ante

- Customers billed based on a preselected level of peak service capacity
- Once the demand limit is selected the charge is effectively fixed
- Spain, Italy, France, Indonesia

Examples:

CITY OF BURBANK Water and Power Since 1913

RED ELÉCTRICA DE ESPAÑA

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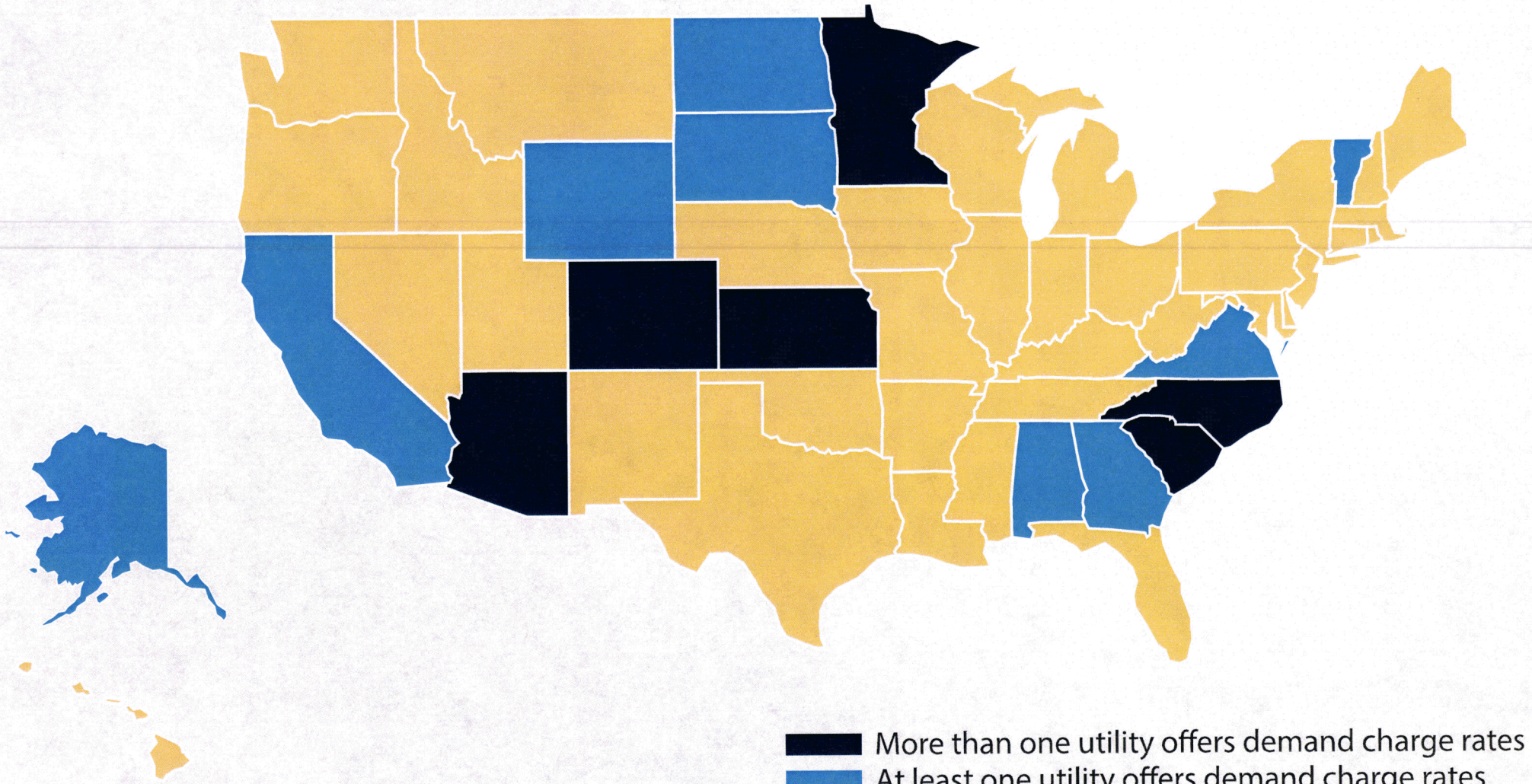
A relatively small number of US utilities currently offer residential demand charges



Source: *A Review of Alternative Rate Designs, RMI, 2016*

What impact have existing residential demand charges had?

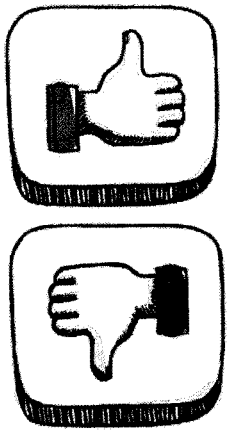
There has been limited dissemination of studies showing the impacts of residential demand charges on desired outcomes:

- **Reduction in Total Energy Consumption:** *Unclear*
- **Customer Peak Load Reduction:** *Unclear*
- **Customer Acceptance:** *1–10% enrollment, unclear retention*

Still, there are many assertions for what demand charges can (or can't) do.

Proponents argue:

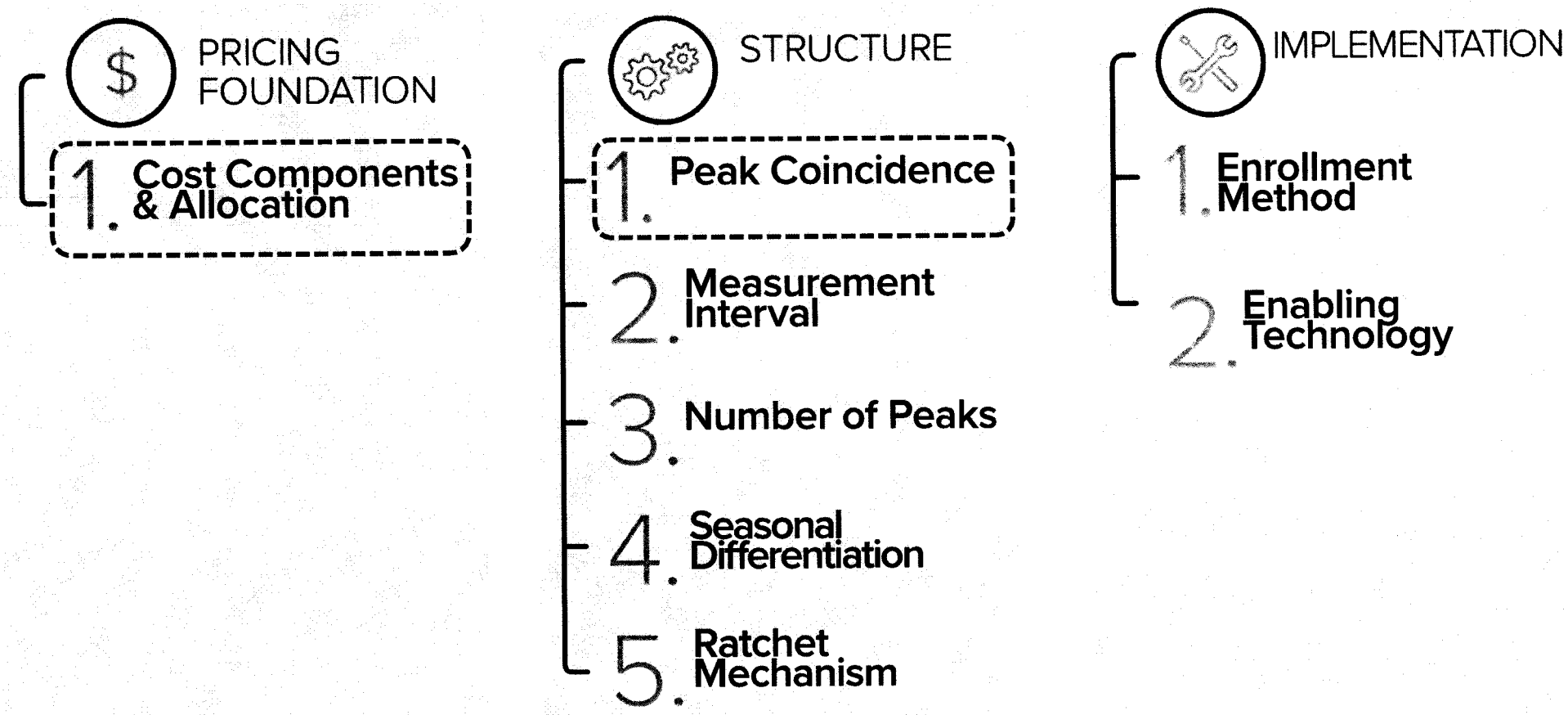
- Demand charges can help with cost recovery better than other approaches
- Demand charges send price signals that better reflect cost causation



Opponents argue:

- Customers don't understand how to manage their power demand
- Customer financial impacts may be punitive or regressive
- Demand charges limit the incentive for energy efficiency

Eight specific design choices are key to the efficacy of any demand charge rate



Source: *A Review of Alternative Rate Designs, RMI, 2016*

Pricing Foundation
Cost Components

Certain cost components may be more appropriately recovered through a demand charge than through volumetric and customer charges...

...but there are different schools of thought on the appropriate way to do this.

IMPORTANT CONSIDERATIONS

1. **Is the magnitude of the cost component driven by customer peak demand?**

   Costs driven by customer peak demand may include building, operating, and maintaining capacity, but many other costs are unrelated.

2. **Is the cost component best recovered through demand, volumetric, or customer charges?**

   Shifting variable and fixed costs into demand charges may help hedge against uncertainty in volumetric sales but it's important that the rate remain actionable for customers.

Pricing Foundation
Cost Components

Approaches boil down to three options:

1. Narrow Demand Charges

Include only a customer's service drop and share of the line transformer

2. Broad Demand Charges

Also include other capacity-related distribution costs

3. Extensive Demand Charges

Include all costs for system infrastructure built to meet peak demand

COST COMPONENTS	APPROACH		
	NARROW DEMAND CHARGE	BROAD DEMAND CHARGE	EXTENSIVE DEMAND CHARGE
Customer Meter*	✘	✘	✘
Service Drop and Transformer	✔	✔	✔
Other Marginal Distribution- Capacity Costs	✘	✔	✔
Marginal Transmission-Capacity Costs	✘	✘	✔
Marginal Generation-Capacity Costs	✘	✘	✔

✔ *Include* ✘ *Exclude*

Structure
Peak Coincidence

Many existing demand charges are based on the customer's noncoincident peak demand, but alternative options may better reflect cost causation.

OPTIONS

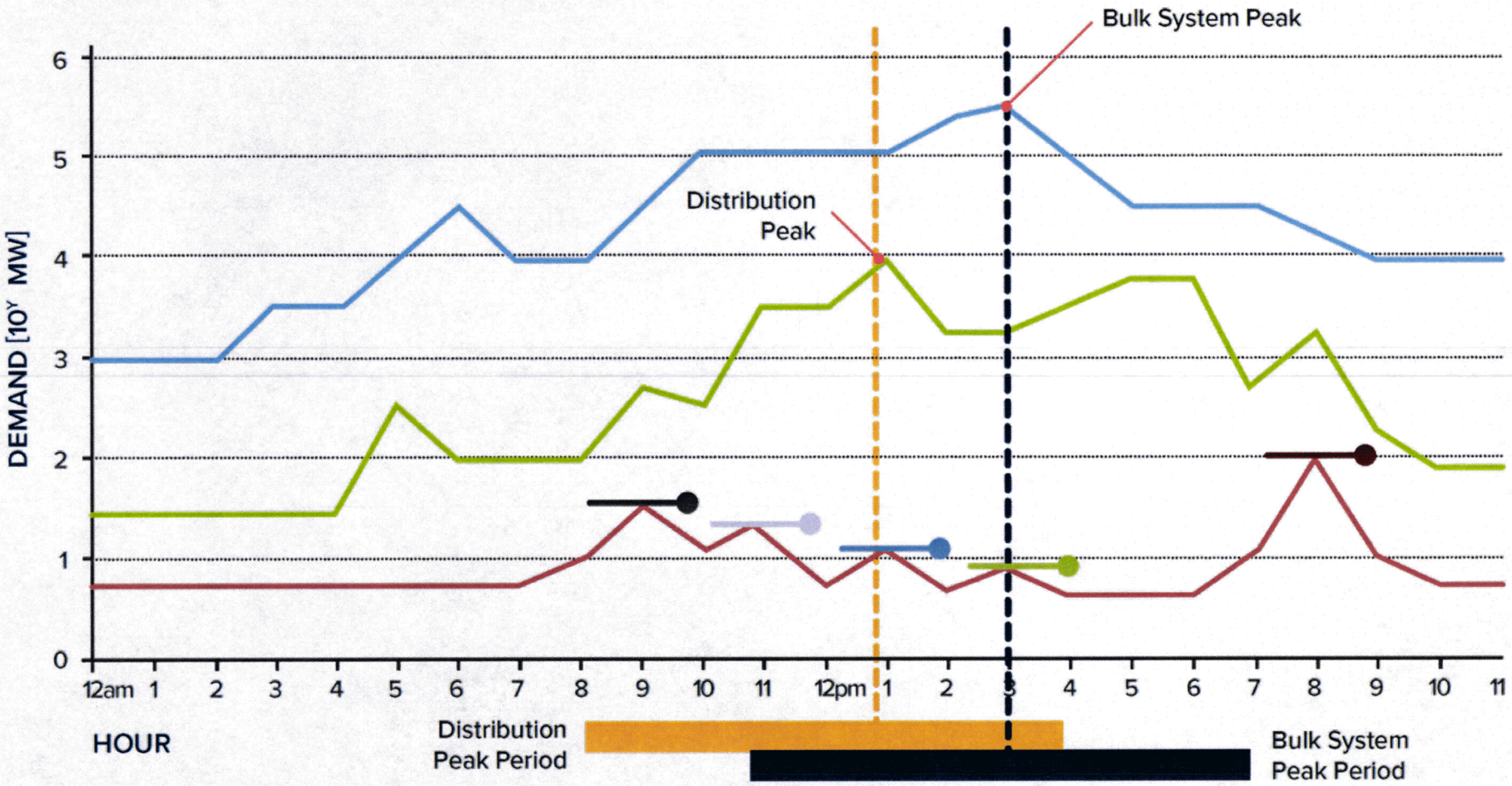
1. **Noncoincident peak**—customer's maximum demand any time in a billing period

2. **Coincident peak**—customer's peak demand at the time of the system peak

   –*When is the timing of peak established?*
   - ***Ex ante***—predetermined peak period (selected to coincide with system peak)
   - ***Ex post***—time when system peak actually occurs

   –*What level of the system determines the peak?*
   - **Distribution system**—only the portion of the system local to the customer
   - **Bulk system**—includes loading on the utility's entire power system

Structure
Peak Coincidence



Legend

- Bulk System Load
- Distribution System Load
- Customer Load

Customer's Billed Demand

- Noncoincident peak
- Coincident peak: ex ante, bulk system
- Coincident peak: ex ante, distribution system
- Coincident peak: ex post, distribution system
- Coincident peak: ex post, bulk system

4 Applying These Findings

RMI transforms global energy use to create a clean, prosperous, and secure future.

Strong price signals combined with customer-oriented design can produce measurable reductions in peak load

While all design dimensions are important to consider, specific choices are key achieving peak reduction with alternative rates:

Time-based rates

- *Financial mechanism*, *POPP ratio, enrollment method,* and *enabling technology* determine whether the rate enables customer response

Demand charges

- *Cost components & allocation* and *peak coincidence* can determine whether the rate sends accurate price signals about system costs
- Other structural dimensions—*measurement interval*, *number of periods*, and *ratchet mechanism*—influence whether the rate enables customer response

Moving Forward

- Apply this framework in designing and reviewing new and existing rates
- Make rate design objectives transparent, then draw from proven best practice to achieve desired results

Time-based rates have a proven track record; the experience with demand charges is more limited

There is more historical experience with time-based rates to draw upon

- Can continue to improve our understanding of impacts, but there is sufficient evidence to move forward with broader rollout of time-based rates

Insufficient empirical evidence is available on the impacts of demand charges

- To address stakeholder concerns, need to prove whether demand charges are viable

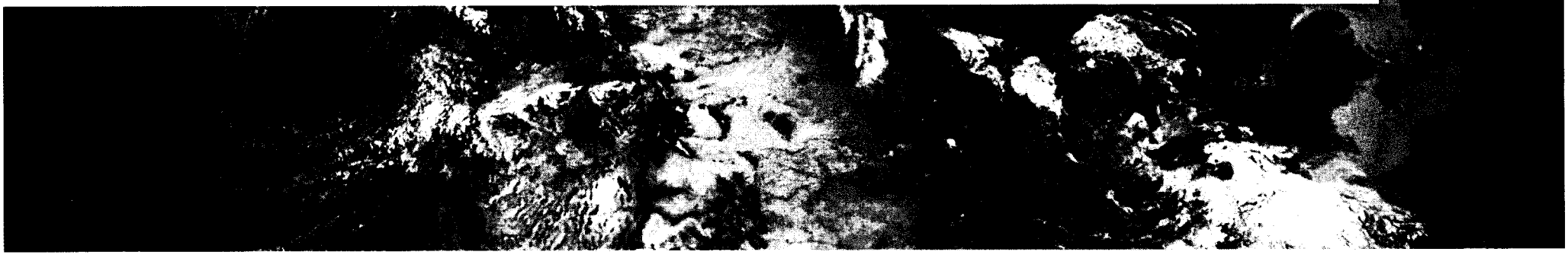
Moving Forward

- ***Time-based rates***:
  - Improve existing opt-*in* rates
  - Test and implement opt-*out* rates
  - Publicly report findings and data
- ***Demand charges***:
  - Conduct pilots to gain understanding of impacts
  - Publicly report findings and data

Thank You

Download the report, *A Review of Alternative Rate Designs,* at rmi.org/alternative_rate_designs

www.rmi.org

Contact: Dan Cross-Call | dcrosscall@rmi.org

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