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Smart Non-Residential Rate Design

RAP Webinar

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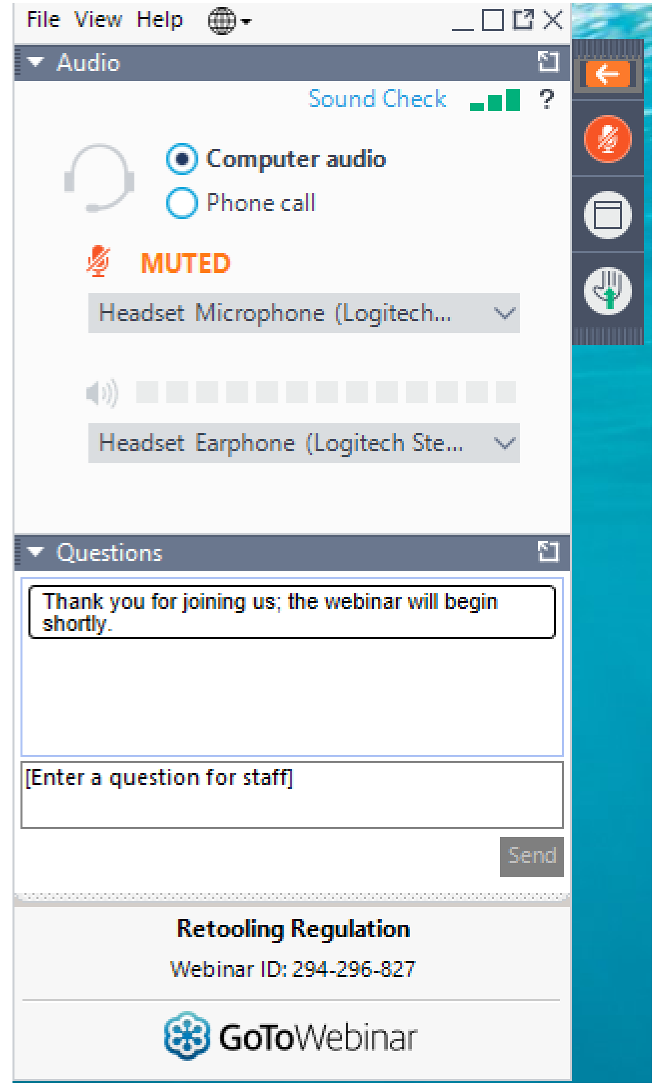
Questions?

Please send questions through the Questions pane



Our experts

Dr. Carl Linvill

Jim Lazar

Examples of Large NR Customers

Key Terms for NR Rate Design:

- **Non-Coincident Peak (NCP)** Demand: A customer's highest usage during the month.

- **Coincident Peak (CP)** Demand: A customer's usage at the time of the system maximum usage.

Problems & Solutions

Problem #1: Most non-residential rates do not align customer rates with system costs

Problem #2: Technological change and the emergence of DERs make improvement necessary

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Solution #1: Non-Coincident Peak Demand Charges should be lower

Solution #2: Time-of-Use Rate Design reflects system costs better than coincident peak demand charges

1 Problem #1: Most Non-Residential (NR) Rates do not Align Customer Rates with System Costs

A Typical Rate for Large NR Customers

Customer Charge:	\$100/month
Demand Charge:	\$10/kW
Energy Charge:	\$0.10/kWh

Rate design should make the choices the customer makes to minimize their own bill consistent with the choices they would make to minimize system costs.

What’s The Problem?

Customer Charge: $100/month

Demand Charge: $10/kW

Not Linked To System Peak

Energy Charge: $0.10/kWh

Not Time-Differentiated

2 Problem #2: Technical Change and the Emergence of DERs Make Improvement Necessary

Bonbright Principles Still Useful

1. Fair
2. Simple
3. Unambiguous
4. Revenue adequacy
5. Proxy for what competition would provide

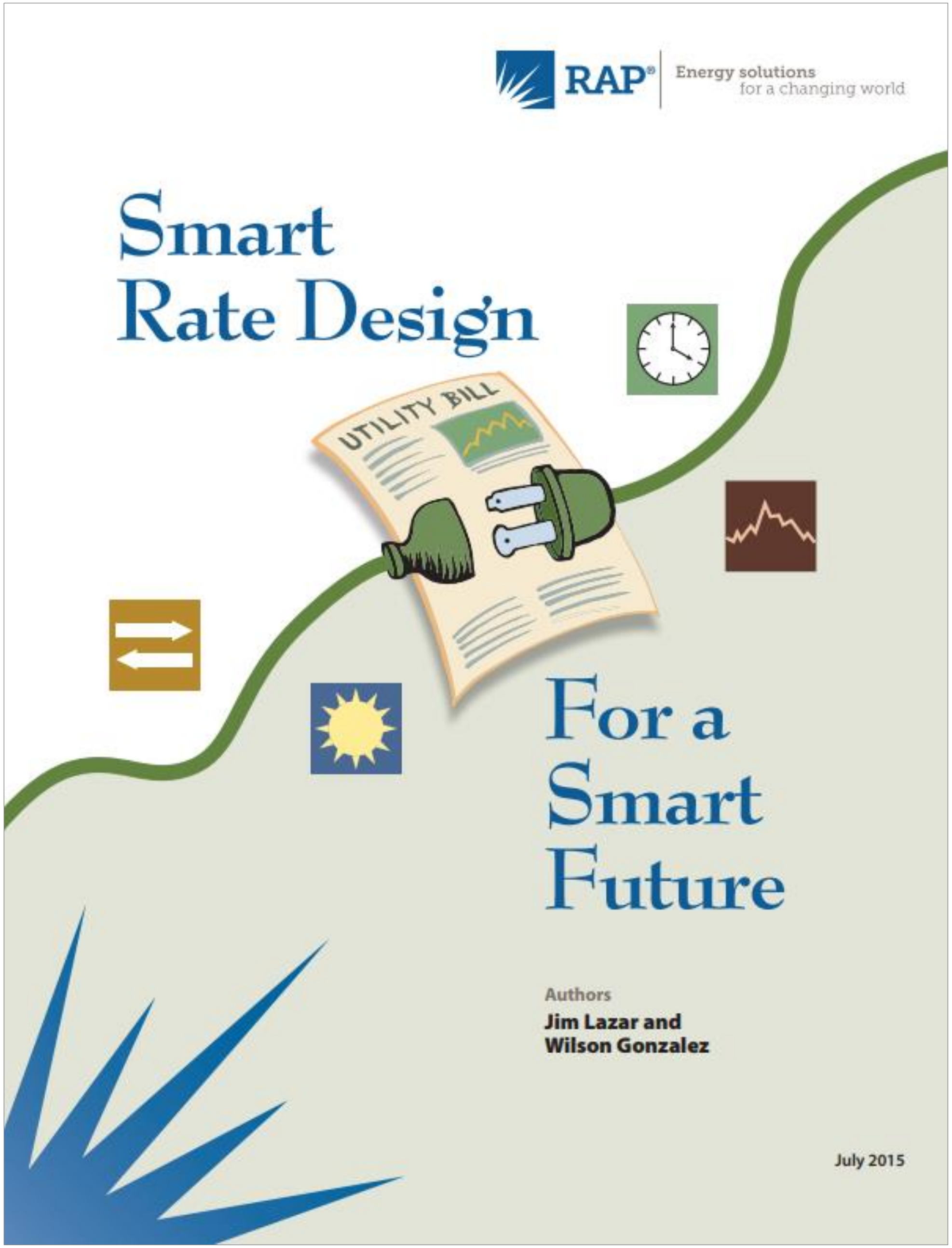
Technologies Affect What is Possible and Necessary

Smart Grid Makes Better Rate Design Possible

DERs make Better Rate Designs Necessary:

- Wind and Solar
- Storage Technologies
- EVs

RAP has Described How Technological Change And the Emergence of DERs Affect Residential Rate Design



Smart Rate Design Principles

- **Principle #1:** A customer should be allowed to connect to the grid for no more than the cost of connecting to the grid.
- **Principle #2:** Customers should pay for power supply and the grid in proportion to how much they use, and when they use it.
- **Principle #3:** Customers delivering power to the grid should receive full and fair value –- no more and no less.

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DECEMBER 2017

Smart Non-Residential Rate Design

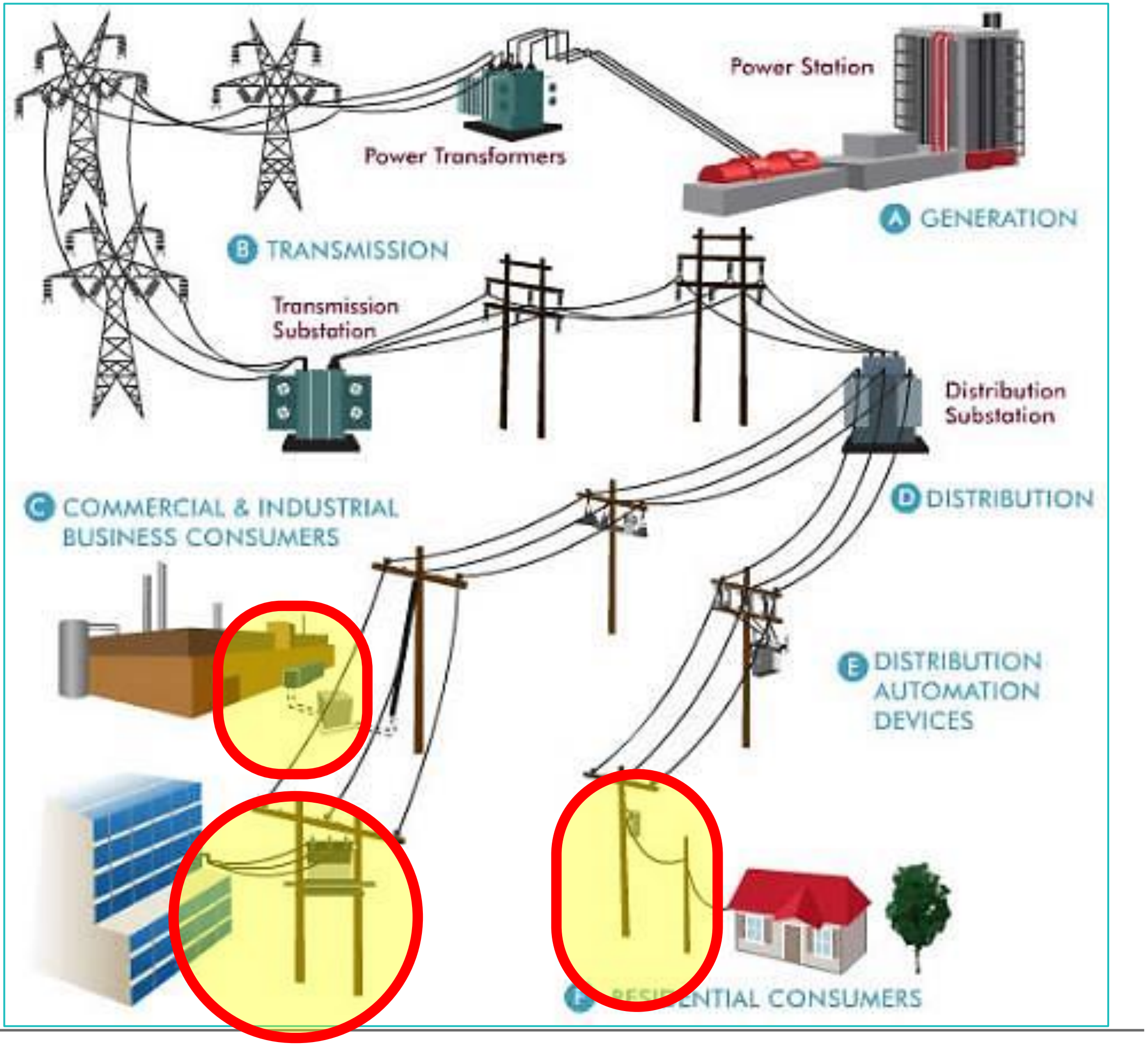
Optimizing Rates for Equity, Integration, and DER Deployment

Carl Linvill, PhD, Jim Lazar, Max Dupuy, Jessica Shipley, and Donna Brutkoski

Report prepared at the request of the California PUC

3 Solution #1: NCP Demand Charges should be Lower

Costs that Vary with Customer NCP: Final Line Transformer and Service Drop



Site Infrastructure Charge

Customer Type	NCP Demand	$/kW	Site Infrastructure Charge
Small Retail or Office	20 kW	$2	$40/month
Supermarket	300 kW	$2	$600/month
Office Tower	600 kW	$2	$1,200/month
Suburban Shopping Mall	2,000 kW	$2	$4,000/month

Load Diversity Between School and Church

Weekday 4-8 PM	On-Peak	5	15	20
Weekday 9-4	Mid-Peak	5	45	50
Nights	Off-Peak	5	5	10
Weekend Day	Off-Peak	45	5	50

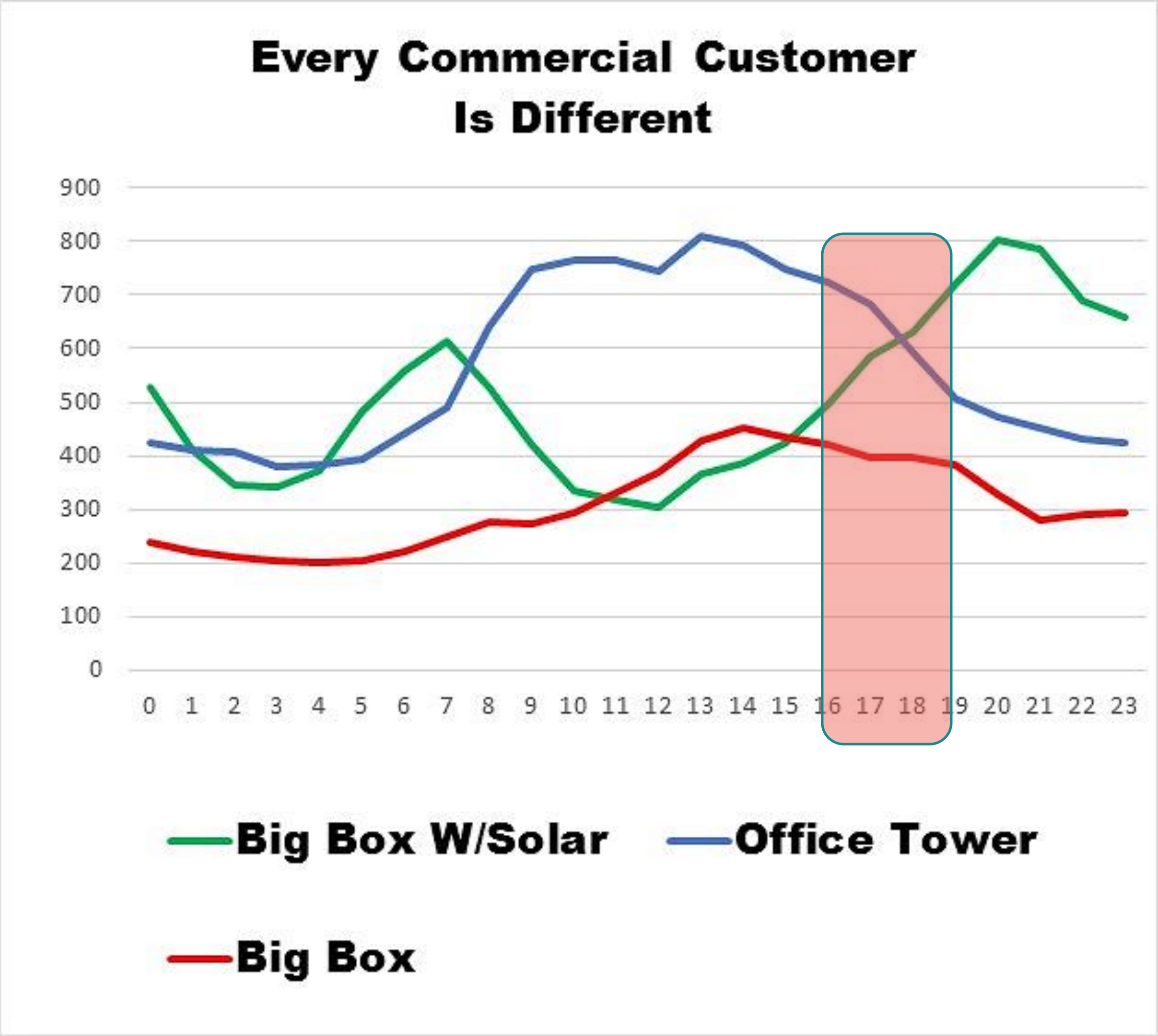
Church and School Demands Are Low During System Peak

NCP Demand Charges fail to Reward Load Diversity

- Limit NCP Peak demand charges to site infrastructure.
- All shared generation and transmission capacity costs should be reflected in system-wide time-varying rates so that diversity benefits are equitably rewarded.

4 **Solution #2:** Time Of Use Rate Design Reflects System Costs Better Than Coincident Peak Demand Charges

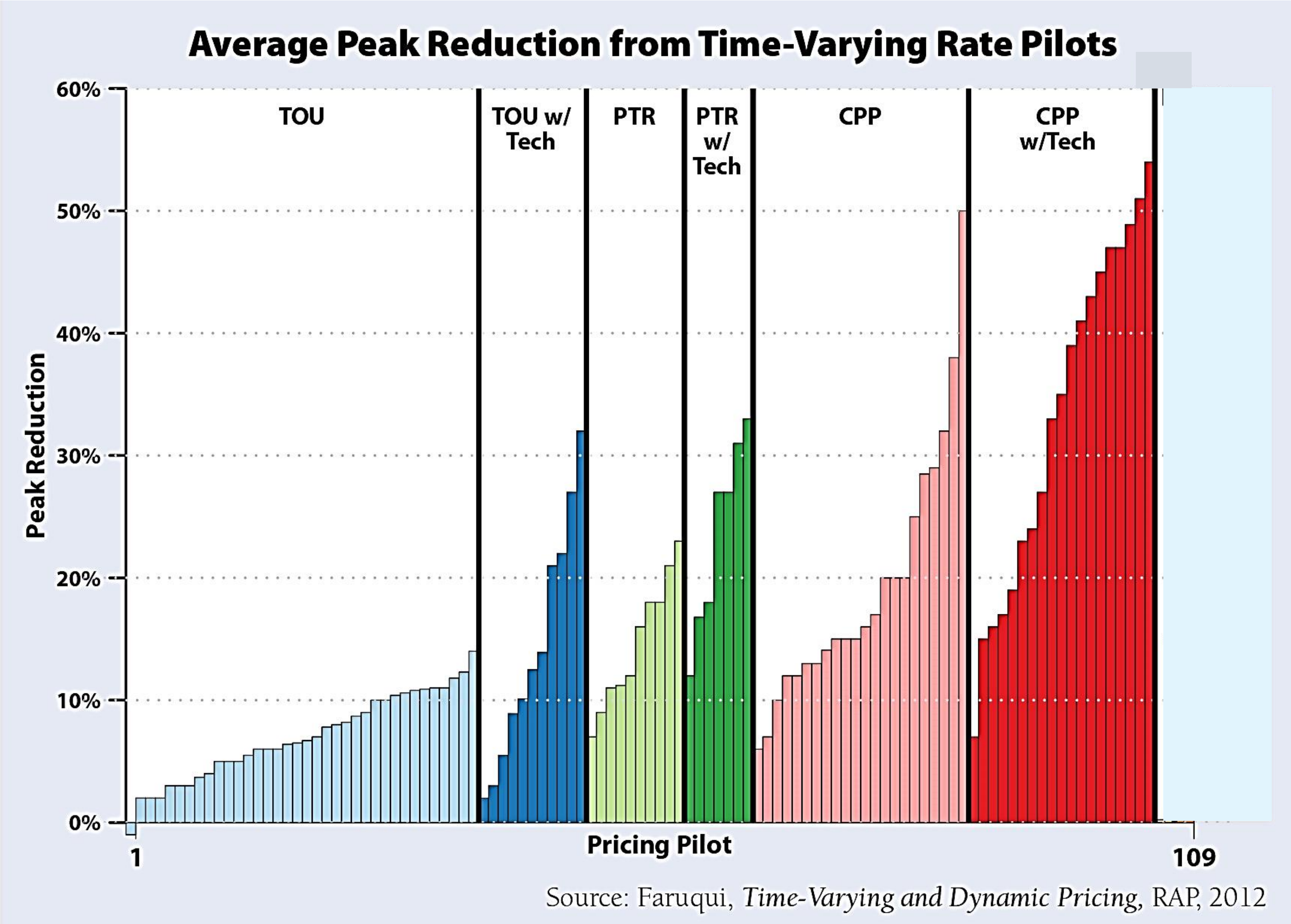
Three Actual Large Commercial Customers



None of the customers peak at the time of the system peak

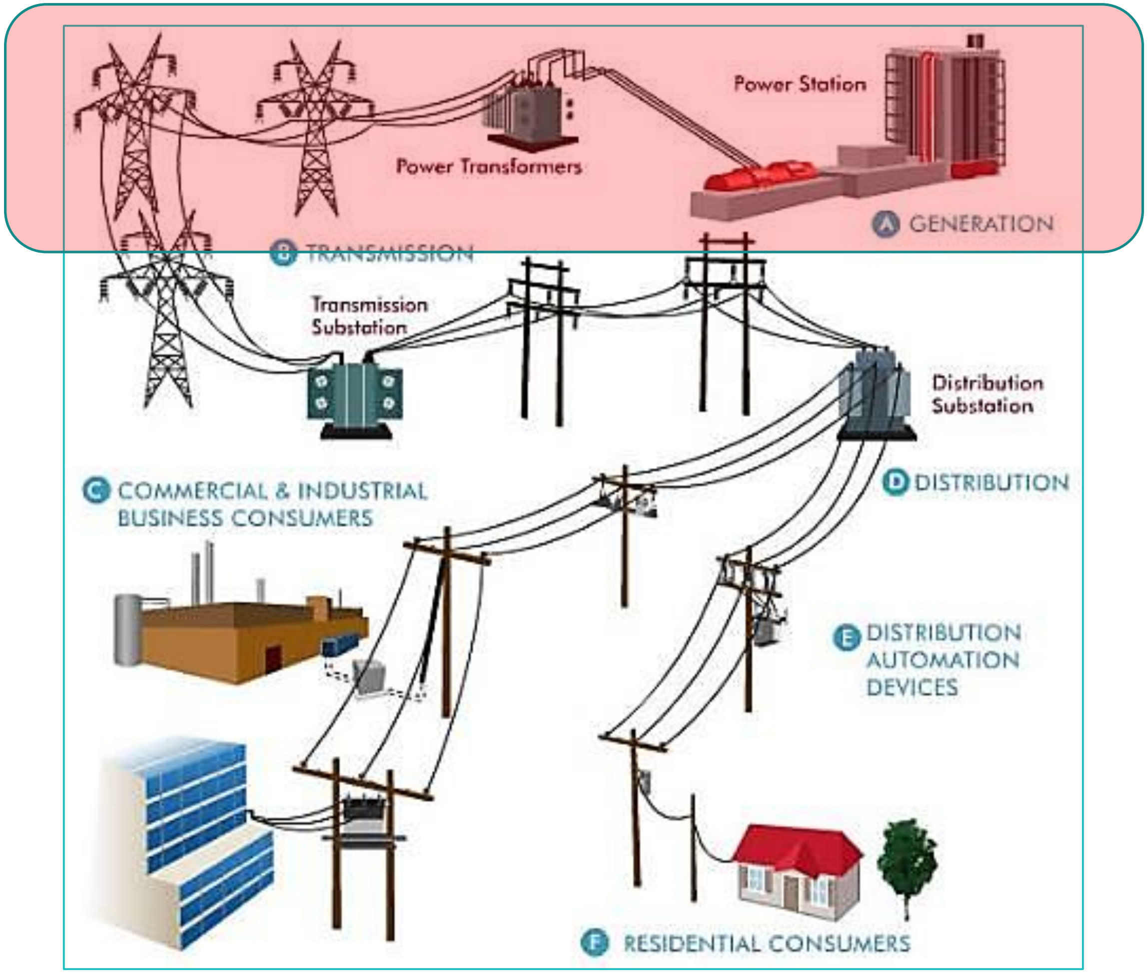
Rate Designs That Address Peak Demand

- Well-designed Time of Use Prices (TOU)
- Critical Peak Price (CPP)
- Peak Time Rebates
- Transparent Real Time Prices (RTP)
- Weak: Coincident Peak Demand Charges

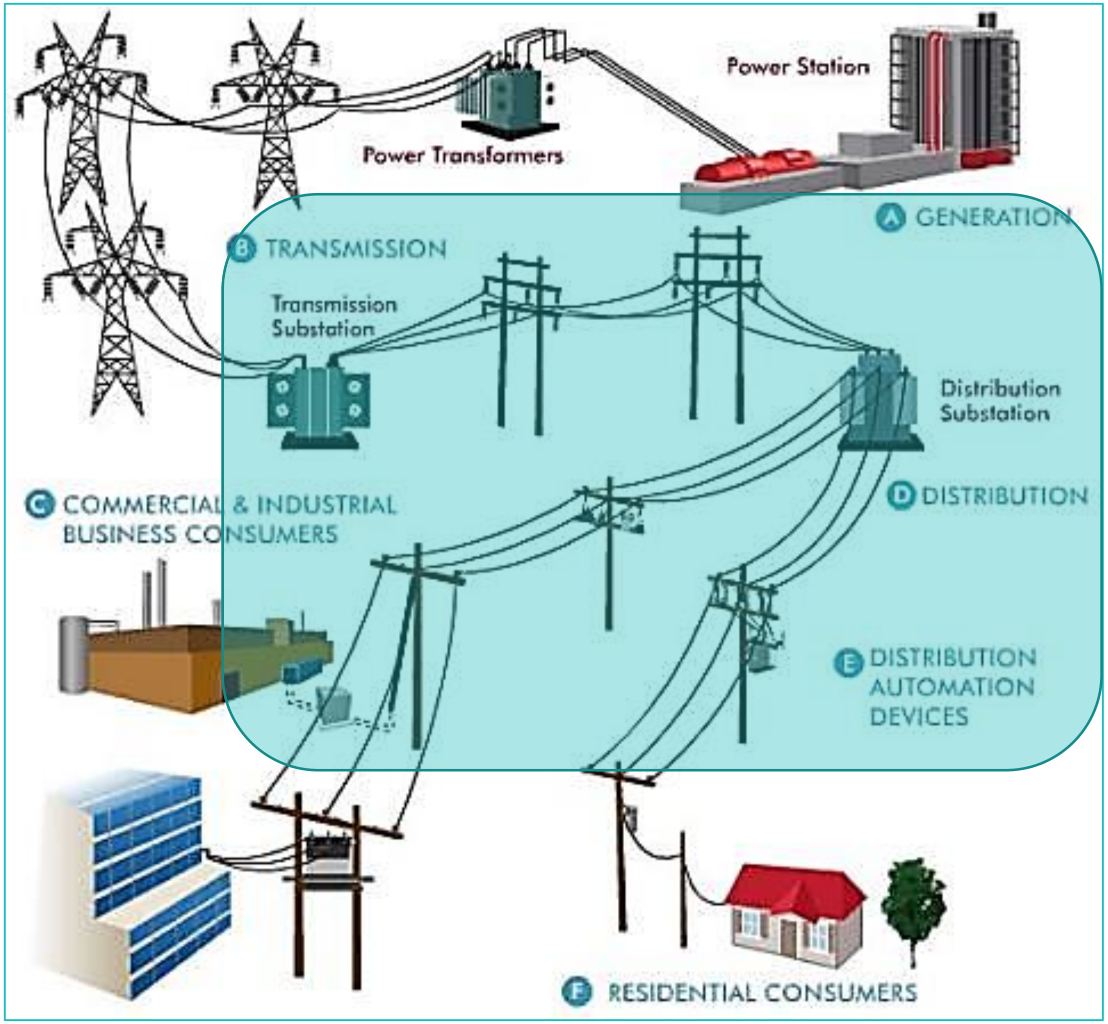


Average Peak Reduction from Time-Varying Rate Pilots
60%
50%
40%
30%
20%
10%
0%
Peak Reduction
TOU
TOU w/ Tech
PTR
PTR w/ Tech
CPP
CPP w/Tech
1
Pricing Pilot
109
Source: Faruqui, *Time-Varying and Dynamic Pricing*, RAP, 2012

Costs that Vary with System TOU Loads: Generation and Bulk Transmission



Costs that Vary with Nodal TOU Loads: Network Transmission and Distribution



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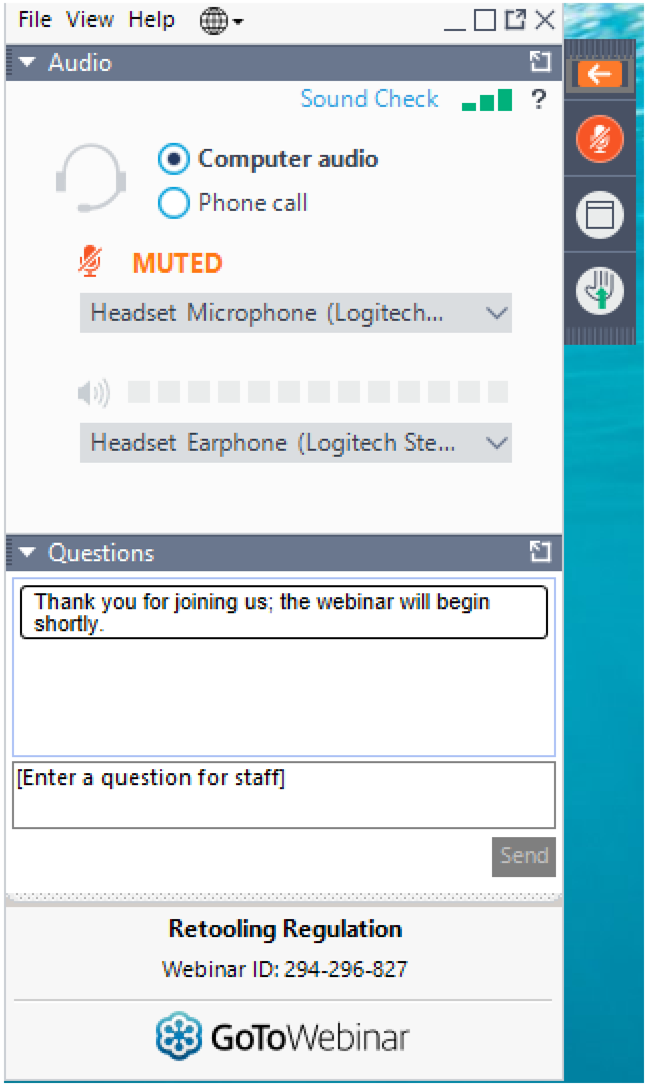


Rate design should make the choices the customer makes to minimize their own bill

consistent with the choices they would make to minimize system costs.

Rates should Promote Beneficial DER Adoption and Operation

- Investment is already happening
- Time-varying rates align customer use with system benefits

TOU rates with a CPP encourage beneficial DER operation

- Recognizes the system benefit of sharing infrastructure capacity
- Sends price signals for all hours, with a strong signal deterring use in highest stress hours
- Encourages electric vehicle charging during off-peak and shoulder hours
- Encourages use of air conditioning controls, ice storage and batteries to flex use away from stress periods toward surplus periods

5 An Illustrative Rate Design that Promotes Alignment

What Does Utility Non-Residential Rate Design Actually Look Like?

- We examined:
  - Customer charges
  - Demand charges (Distribution and Generation)
  - Volumetric rates
  - Time of use rates
  - Seasonal rates

Antiquated Example Rate #1
(a real utility in the U.S.)

Customer Charge	**$/Month**	**$ 209.00**
Demand Charge	**$/kW**	**$ 21.35**
Energy Charge	**$/kWh**	**$ 0.050**

- Demand charge is based on NCP demand.
- Energy Charge is not time-differentiated

Better: Example Rate #2 Georgia Power TOU-GS-10

Customer Charge	$/Month	$ 209.00
Demand Charge		
On-Peak	$/kW	$ 15.66
Maximum Peak	$/kW	$ 5.23
Energy Charge		
On-Peak	$/kWh	$ 0.122
Shoulder Peak	$/kWh	$ 0.063
Off-Peak	$/kWh	$ 0.024

- Higher coincident-peak demand charge.
- 5 hour window
- Steep TOU energy rate.

Sacramento Rate Design
NR Best of Class

Customer Charge	$108/month	
Site Infrastructure Charge	$3.80/kW/month	
Super Peak Demand Charge Summer weekdays 2-7 PM	$7.65/kW	
Energy Charge	Summer	Winter
Super Peak	$0.20	N/A
On-Peak	$0.137	$0.104
Off-Peak	$0.109	$0.083

Sacramento Rate Design
NR Best of Class

Customer Charge	$108/month	
Site Infrastructure Charge	$3.80/kW/month	
Super Peak Demand Charge	$7.65/kW	
Energy Charge	Summer	Winter
Super Peak	$0.20	N/A
On-Peak	$0.137	$0.104
Off-Peak	$0.109	$0.083

We made two changes:

1) Convert the super-peak demand charge to a critical peak energy charge, applied to specific hours of system stress;
2) Add a super-off-peak rate, to encourage consumption when energy is unusually abundant and market prices are near zero.

Illustrative Future Non-Residential Rate Design

	Production	Transmission	Distribution	Total	Unit
Metering, Billing			$100.00	$100.00	Month
Site Infrastructure Charge			$2/kW	$2/kW	kW
Summer On-Peak	$0.140	$0.020	$0.040	$0.20	kWh
Summer/Winter Mid-Peak	$0.100	$0.015	$0.035	$0.15	kWh
Summer/Winter Off-Peak	$0.070	$0.010	$0.020	$0.10	kWh
Super Off-Peak	$0.030	$0.010	$0.010	$0.05	kWh
Critical Peak	Maximum 50 hours per year			$0.75	kWh

Illustrative Future Non-Residential Rate Design

		Distribution		Unit
Metering, Billing		$100.00		Month
Site Infrastructure Charge		$2/kW		kW
Summer On-Peak		$0.040		kWh
Summer/Winter Mid-Peak		$0.035		kWh
Summer/Winter Off-Peak		$0.020		kWh
Super Off-Peak		$0.010		kWh
Critical Peak	Maximum 50 hours per year			kWh

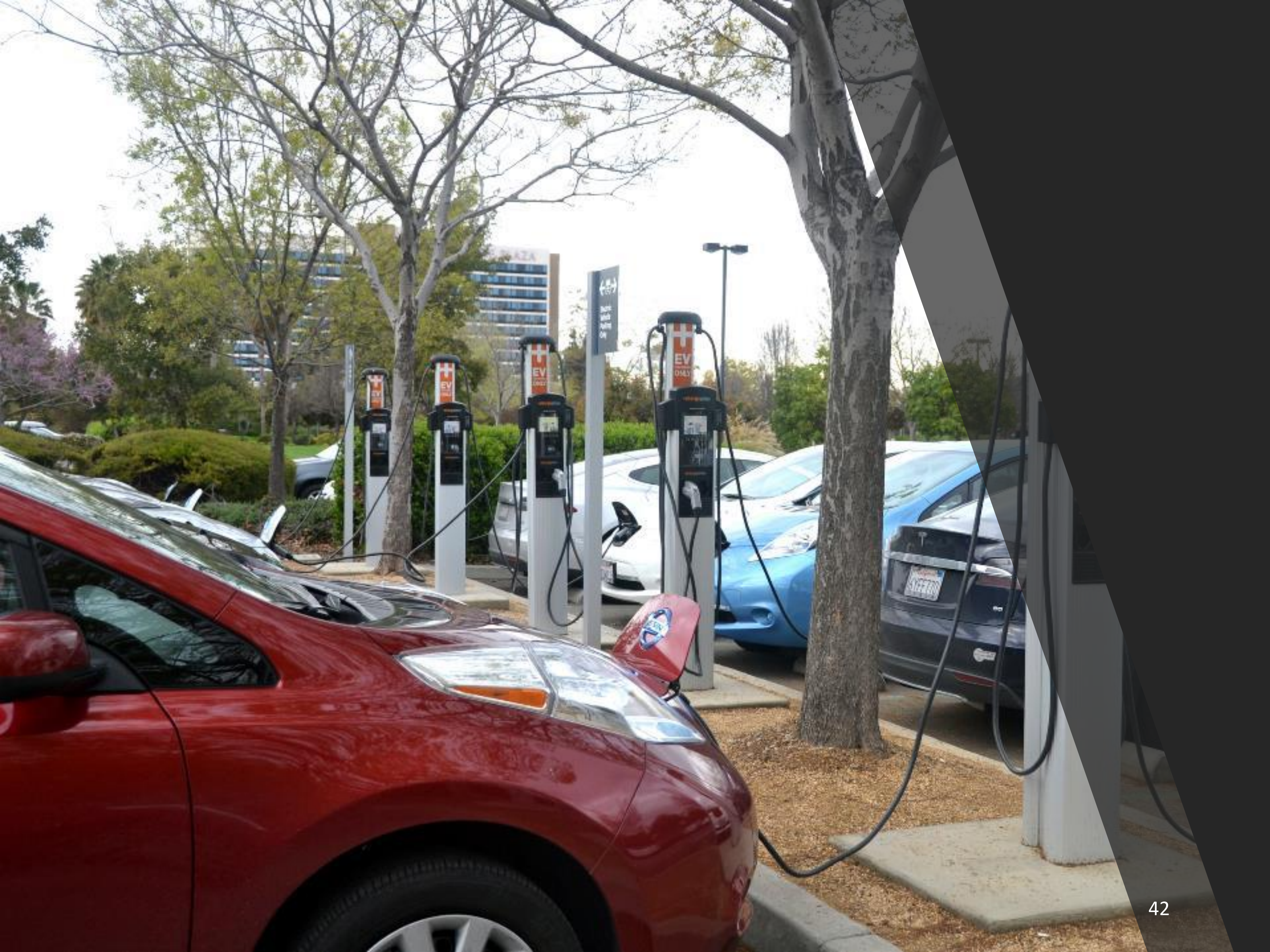
Restructured State

Optional Dynamic/Real-Time Pricing

- An energy cost component, charged on a per kWh basis, that fluctuates hourly
- Tied to locational marginal prices
- Transmission, distribution, and residual generation costs would be collected in TOU rates

Comparison of Three Rates: Consequences for NR EV Adoption

	Antiquated Rate	Coincident Peak Demand Charge	Smart Rate
Demand Charge	$10/kW	$10/kW	$2/kW
Demand Measurement	NCP	4 PM - 8 PM	Site Infrastructure
Energy	$0.12/kWh	$0.12/kWh	$.05 - $.75/kWh
Energy Measurement	No TOU	No TOU	TOU


EV

Smart Rate => Workplace EV Charging

	Antiquated Rate	Coincident Peak Demand Charge	Smart Rate
Demand Charge	$10/kW	$10/kW	$2/kW
Demand Measurement	NCP	4 PM - 8 PM	Site Infrastructure
Energy	$0.12/kWh	$0.12/kWh	$.05 - $.75/kWh
Energy Measurement	No TOU	No TOU	TOU

Electric Vehicle Charging Cost Per Month 6.6 kW 250 kWh

NCP Demand	$ 66.00		$ 13.20
CP Demand		$ -	
Energy	$ 30.00	$ 30.00	$ 12.50
Total	$ 96.00	$ 30.00	$ 25.70
Average $/kWh	$ 0.384	$ 0.120	$ 0.103

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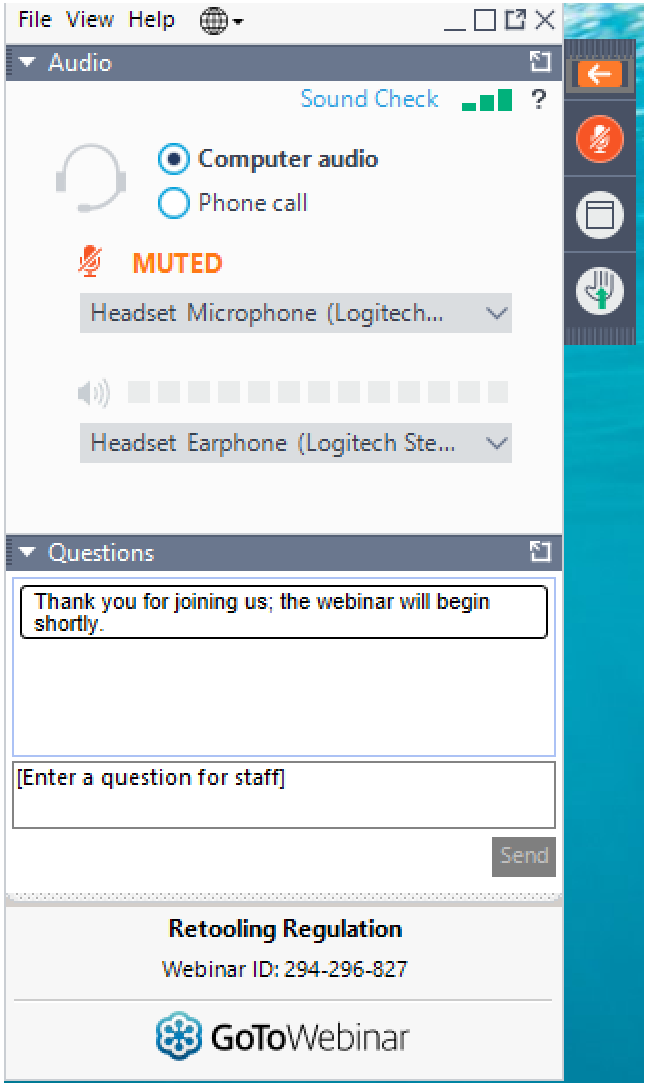

Takeaways

Rate design should make the choices the customer makes to minimize their own bill

consistent with the choices they would make to minimize system costs.

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Problem #2: Technological change and the emergence of DERs make improvement necessary

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Solution #1: Non-Coincident Peak Demand Charges should be lower

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Illustrative Future Non-Residental Rate Design

Table ES-1. Proposed Illustrative Rate Design for Non-Residential Consumers

	Production	Transmission	Distribution	Total	Unit
Metering, Billing			$100.00	$100.00	Month
Site Infrastructure Charge			$2/kW	$2/kW	kW
Summer On-Peak	$0.140	$0.020	$0.040	$0.20	kWh
Summer/Winter Mid-Peak	$0.100	$0.015	$0.035	$0.15	kWh
Summer/Winter Off-Peak	$0.070	$0.010	$0.020	$0.10	kWh
Super Off-Peak	$0.030	$0.010	$0.010	$0.05	kWh
Critical Peak	Maximum 50 hours per year			$0.75	kWh

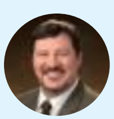
Resources from RAP

- Smart Rate Design for a Smart Future
- Designing Tariffs for Distributed Generation Customers
- Designing Distributed Generation Tariffs Well
- Rate Design Where Advanced Metering Infrastructure Has Not Been Fully Deployed
- Time-Varying and Dynamic Rate Design
- Use Great Caution in the Design of Residential Demand Charges
- Standby Rates for Combined Heat and Power Systems
- Standby Rates for Customer-Sited Resources: Issues, Considerations and the Elements of Model Tariffs

About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org



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