Are Dynamic Prices Sufficient?

Harvard Electricity Policy Group

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Agenda

1. Conditions for Dynamic Pricing Sufficiency
2. Toward Dynamic Pricing Sufficiency
3. Case Study: Smart Non-Residential Rate Design
4. Takeaways

1 Conditions for Dynamic Pricing Sufficiency

Dynamic Prices can be Sufficient if:

1. LMP and CRR exist down to the feeder
2. Free entry and exit on the distribution system
3. Utility has the opportunity to be revenue adequate
4. Political tolerance for scarcity pricing exists

Barriers to Dynamic Pricing Keep It from Being Sufficient Today in Most Places

1. Distribution system over-built (analog tech)
2. Structural change massive (digital tech)
3. Barriers to entry on the distribution system
4. Embedded cost recovery
5. Political tolerance for scarcity pricing low in many places

2 Toward Dynamic Pricing Sufficiency

Bonbright Principles Still Useful for Example:

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

Borenstein Framing Useful but Not Sufficient

1. Rely on dynamic pricing as much as we can: short run marginal cost pricing that reflects all environmental externalities and full scarcity pricing
2. Achieve revenue adequacy achieved with true-ups that reflect State equity goals

Some Proposed Principles that Move Toward Dynamic Pricing Becoming Sufficient

1. Rely on time-varying pricing as much as possible with short AND long run marginal costs as guideposts
2. Remove barriers to entry on distribution system
3. Attend to specific sources of cost that lay outside of time-varying cost causation
4. Attend to revenue adequacy without distorting price signals
5. Attend to infrastructure investment that leads to dynamic pricing becoming sufficient

3 Case Study: Smart Non-Residential Rate Design in California

Traditional Rate for Large Commercial Customers is Flawed

Typical Structure:

Customer Charge: **$100/month**

Demand Charge: **$10/kW**

Energy Charge: **$0.10/kWh**

Typical Bills for Two Large Customers with this Rate Design

Supermarket (83% LF)	
Customer Charge:	$ 100
300 kW Demand:	$ 3,000
180,000 kWh:	$18,000
Total:	$21,100
Average:	**$.117/kWh**

Office Tower (35% LF)	
Customer Charge:	$ 100
300 kW Demand:	$ 3,000
75,000 kWh:	$ 7,500
Total:	$10,600
Average:	**$.141/kWh**

BUT: For both customers, at ANY hour except their highest use (non-coincident peak) hour, the incremental price for electricity is $0.10/kWh.

What's the Problem?

Customer Charge: $100/month

Demand Charge: $10/kW

Not Linked to System Peak but peak is a primary source of cost causation

Energy Charge: $0.10/kWh

Not Time-Differentiated but time of use is a primary source of cost causation

The Following Sub-sections Present Principles that Improve on Current Design by Addressing Several Specific Principles

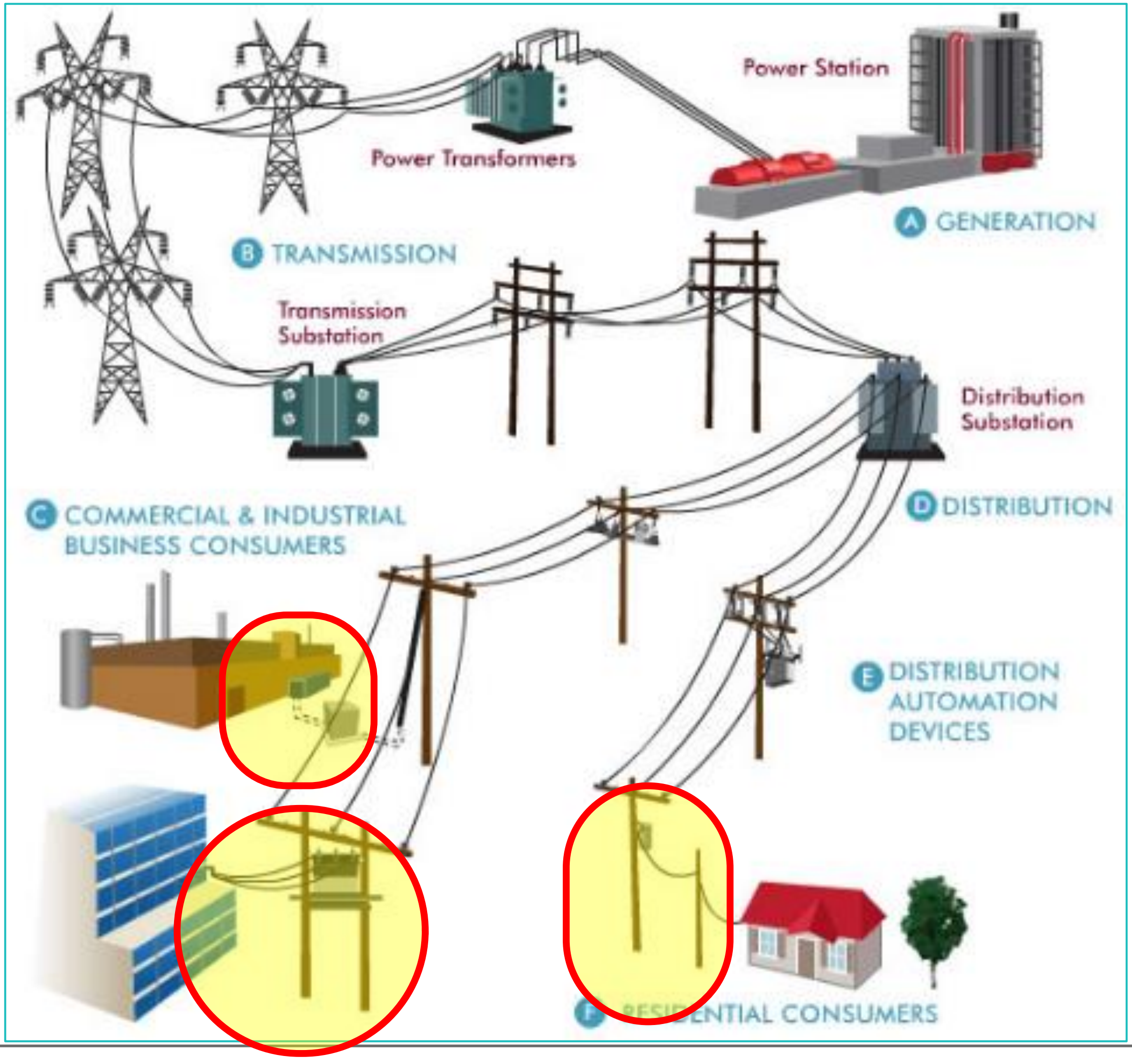
3a Match Fixed & NC Demand Charges Specifically to Cost Causation

NR Principle 1

- Service drop, metering, and billing costs should be recovered in a customer fixed charge

- Final transformer is a customer-specific cost
  - Note: this is different from residential class

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



Site Infrastructure Charge varies by Capacity of Facility

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

3b Reward Load Diversity

NR Principle 2.1

- De-emphasize NCP demand charges except as noted in NR Principle 1

- All shared generation and transmission capacity costs should be reflected in system-wide time-varying rates so that diversity benefits are equitably rewarded

Load Diversity Between School and Church Means they Share Facilities and Thus Should Share Costs

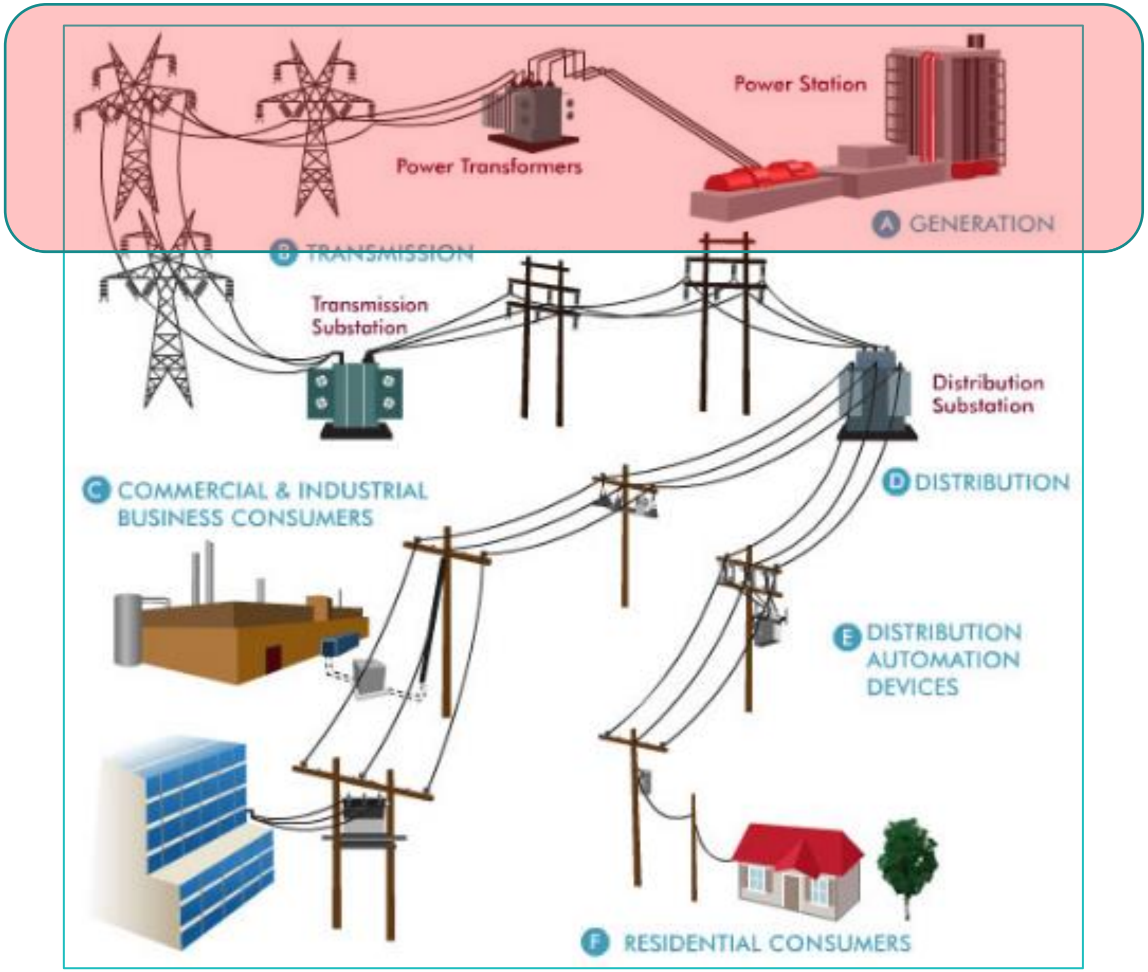
Hours	System Peak	Church	School	Mini-Mart	Total
Weekday 9-4	Mid-Peak	5	45	50	100
Weekday 4-8	On-Peak	5	15	50	70
Nights	Off-Peak	5	5	50	60
Weekend	Off-Peak	45	5	50	100
NCP		45	45	50	140
%		32%	32%	36%	
CP		5	15	50	70
%		7%	21%	71%	

3c Establish Price Signals that Address Peak Demand and Convey System Costs

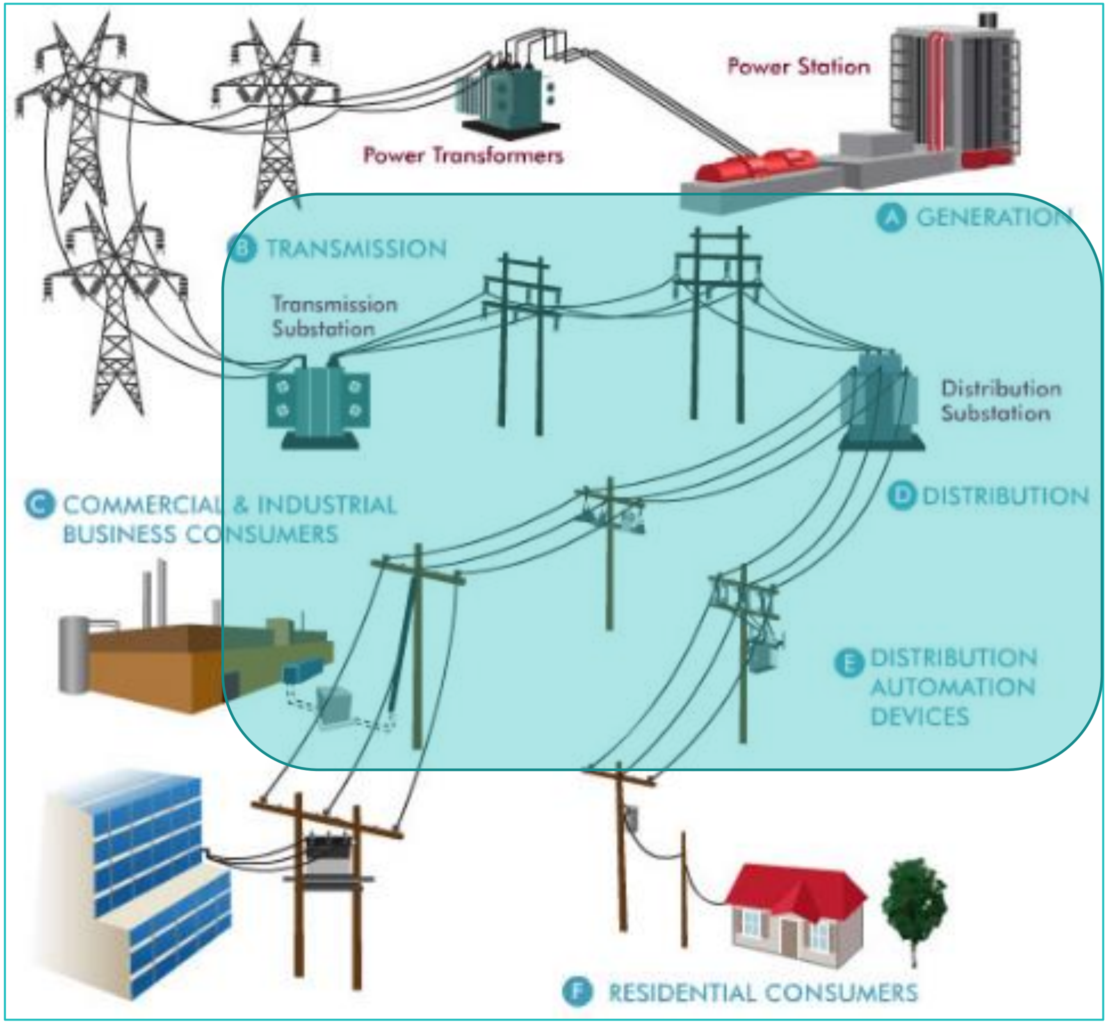
NR Principle 2.2

- **Shift shared distribution network revenue requirements into regional or nodal time-varying rates (i.e., NOT demand charges)**

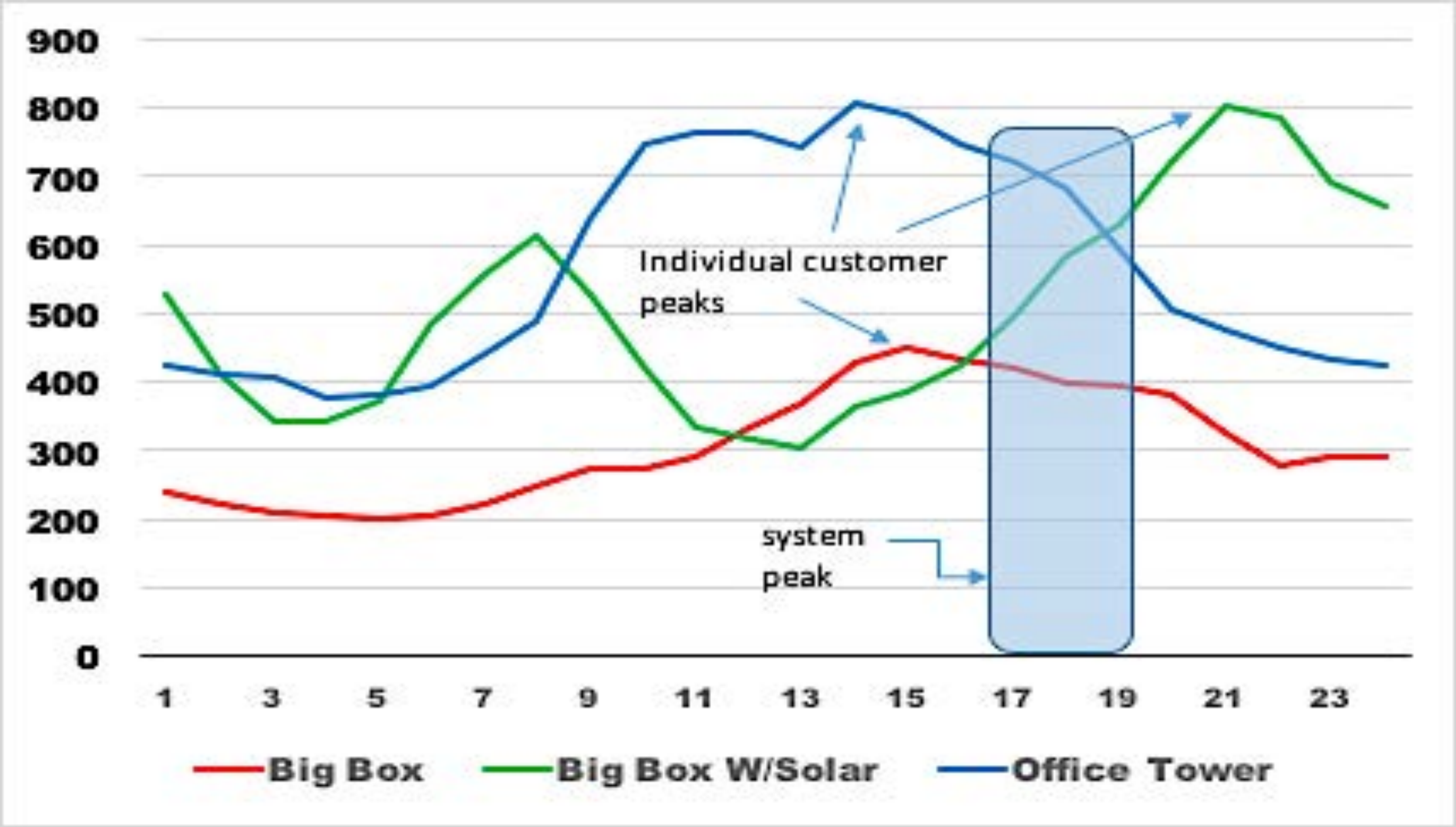
Costs that Vary with System TOU Loads: Generation and Bulk Transmission



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



Three Actual Large Commercial Customers

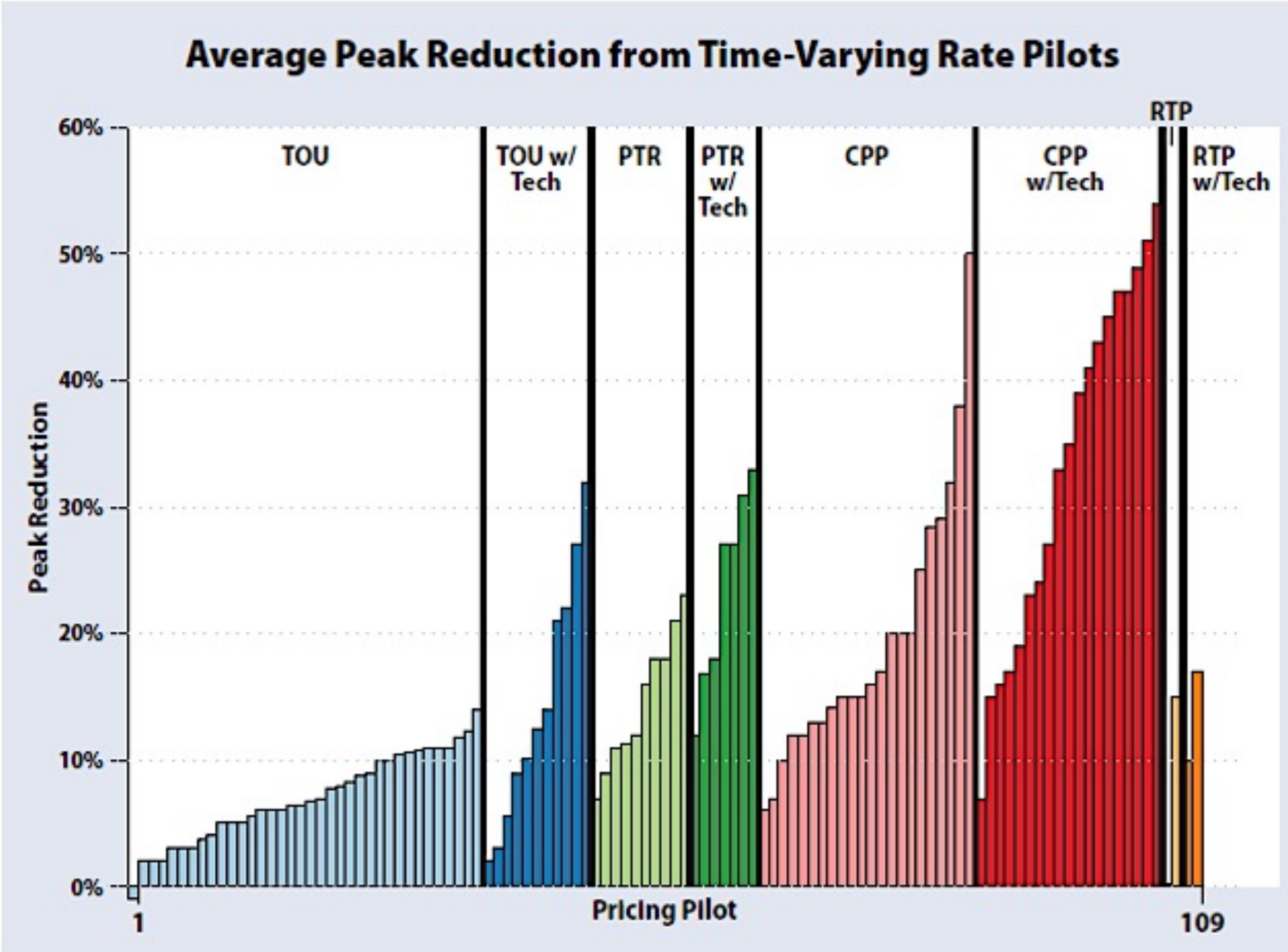


NR Principles 2.3 & 2.4

- NR Principle 2.3: Consider short-run marginal cost pricing signals and long-run marginal cost pricing signals
- NR Principle 2.4: Time-varying rates should align incentives for controllable load, customer generation, and storage dispatch with electric system needs

Rate Designs that Address Peak Demand

- Preferred System Pricing:
  - A Critical Peak Price and Well-Designed Time of Use Prices
  - Transparent Real Time Prices (where available)
- Preferred Distribution System Peak Pricing:
  - Distribution System Congestion Credits
- Less Preferred:
  - 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
RTP
RTP w/Tech
Pricing Pilot
1
109

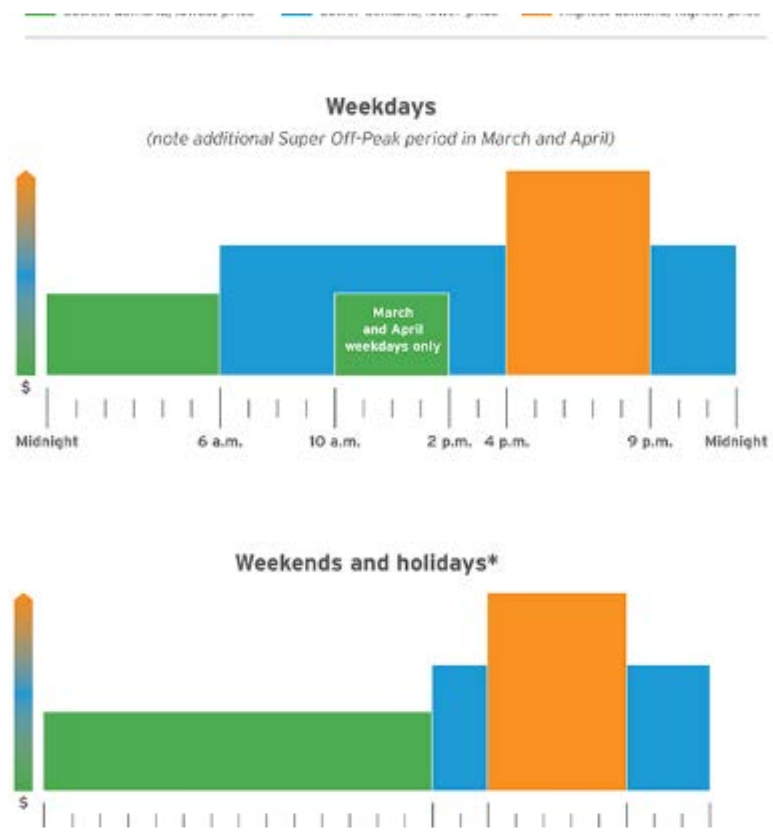
Reasons to Prefer Time-Varying Rates over Demand Charges

- More equitable cost recovery
- Reduce peak demand(s)
- Provide price signal for electric vehicle charging during off-peak and shoulder hours
- Provide price signal for air conditioning controls, water heater controls or ice storage
- Provide price signal for beneficial use of on-site storage

SDG&E New TOU Rates: A Big Improvement

On-peak period moved to early evening

Super off-peak period attractive for EV charging, ice-storage A/C and other controllable loads



3d Additional Considerations for a Model Tariff

NR Principle 2.5

- Simple default tariff
- Optional tariffs with more granular elements

What Utility Tariff Best Exemplifies Our Principles?

- We looked at about 20 utilities from around the country and a couple of international examples
- We looked at:
  - Customer charges
  - Demand charges (Distribution and Generation)
  - Volumetric rates
  - Time of use rates
  - Seasonal rates

Sacramento Rate Design NR Best of Class among Existing Designs Examined

Summer weekdays 2-7 PM		
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

Sacramento Rate Design NR Best of Class, but We Suggest Two Improvements

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

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

And We Recommend an Optional Real-Time Pricing Tariff

- A wholesale 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

NR Principle 2.6

- **Optimal non-residential rate design will evolve as technology and system operations mature**
- **Opportunities to revisit rate design should occur regularly**

4 Takeaways

Pricing Principles that Position Dynamic Pricing to be Sufficient when Systems, Business Models and Regulation Matures include:

- Ensure Revenue Adequacy without Distorting Prices
- Match Fixed & NC Demand Charges Specifically to Cost Causation: Customer Specific Costs
- Reward Load Diversity
- Establish Price Signals that Convey System Costs at All Hours of the Year, including Peak Demand
- Include an Optional Real Time Pricing Tariff
- Remove Barriers to Entry

Resources

- Smart Non-Residential Rate Design

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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