RAP® Energy solutions for a changing world

Time-of-Use Rates
Methods, Experience, Results

Utah Public Service Commission
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Richard Sedano, John Shenot, and Jim Lazar

The Regulatory Assistance Project (RAP)®

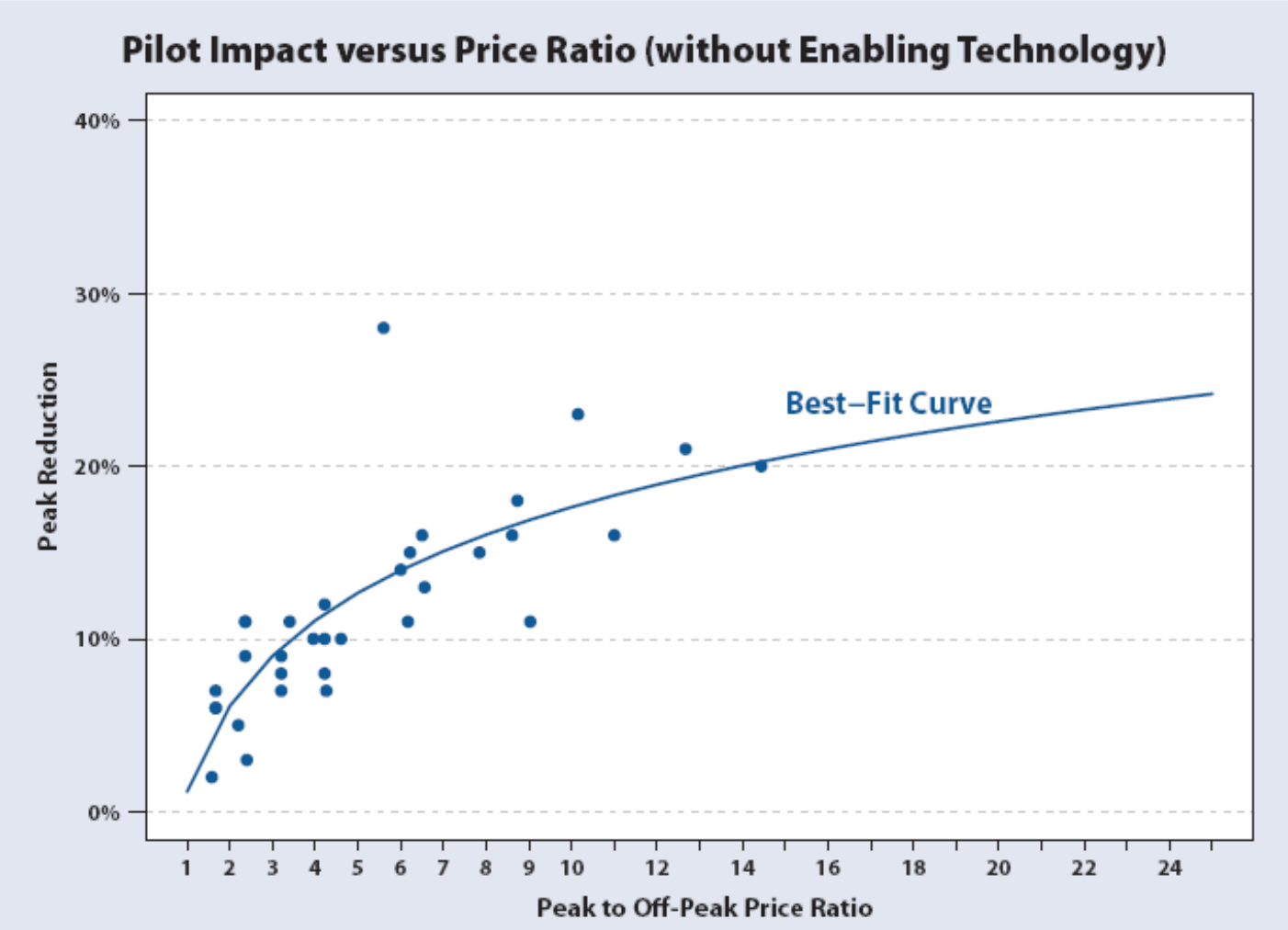
Agenda

- Why Consider TOU Rates
- Types of TOU Rates (with and without AMI)
- How to Select TOU Periods
- Expected Uptake and Results
- Incorporating TOU with Inclining Blocks
- Peak Time Rebates: An Alternative
- Communicating with Consumers
- Thinking Ahead: California and Hawaii

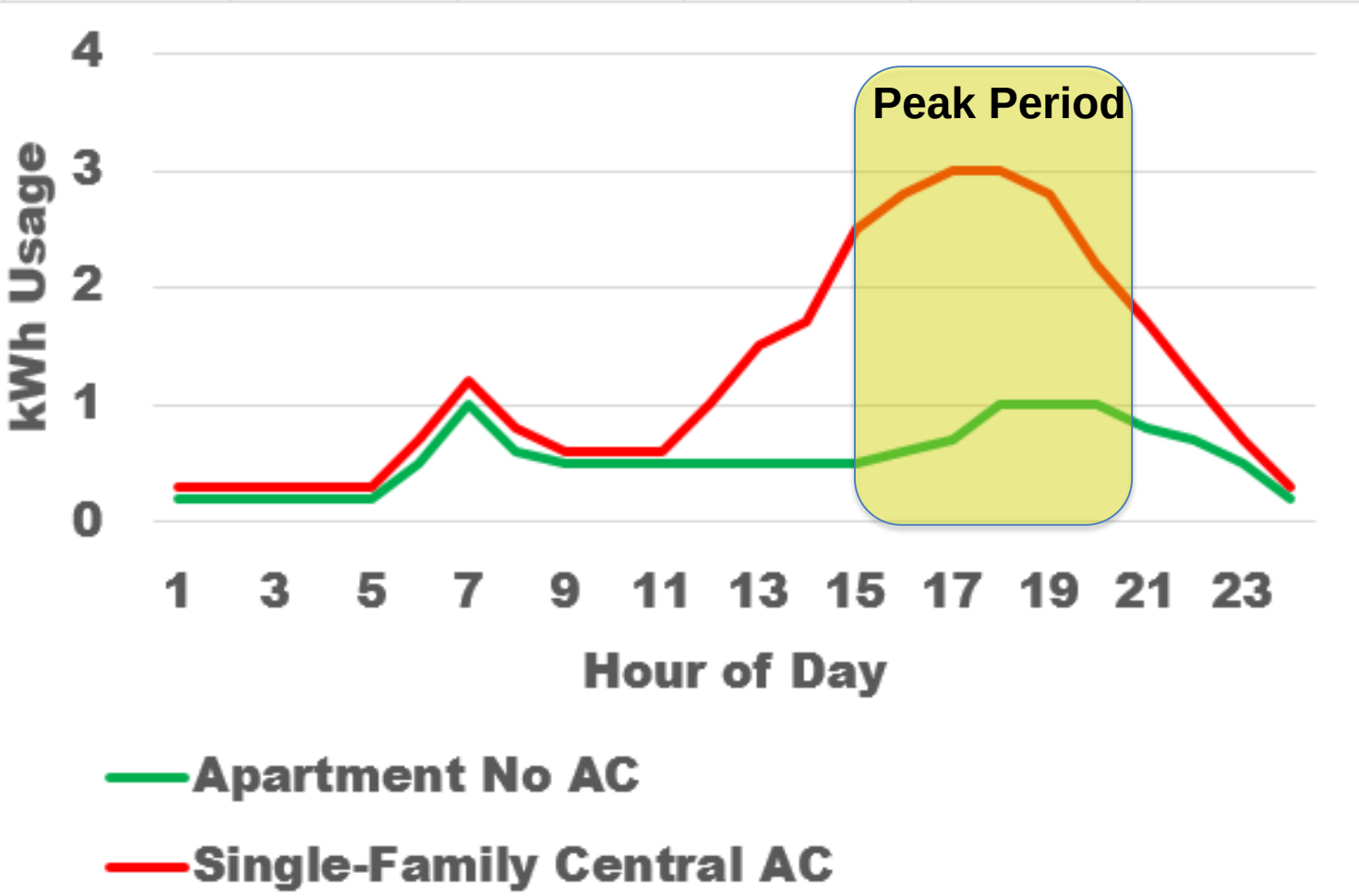
Why Consider TOU?

- Peak load (and cost) reduction
- Equity between customers
- Equitable treatment of solar
  - Reduction of load during high-cost hours
  - Augmentation of load during high-output

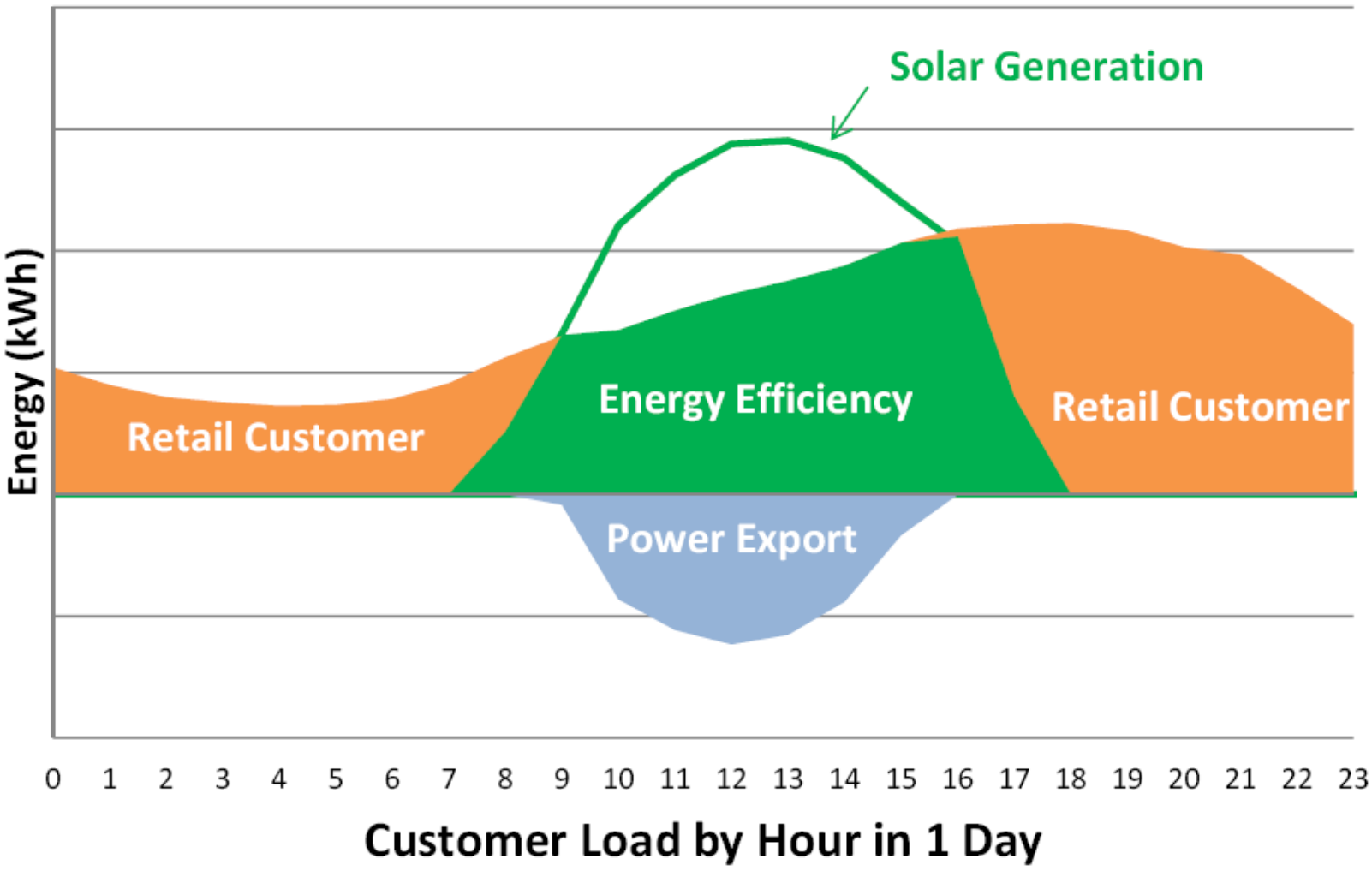
Peak Load Reduction



Equity Between Customers



Equitable Treatment of Solar



Types of TOU Rates

- Simple Two-Period Rates
- Three-Period Rates
- Three-Period Seasonal Rates
- Critical Peak Pricing (CPP)
- Real-Time Pricing (RTP)
- *Alternative: Peak-Time Rebates (PTR)*

Example Two-Period Rate
Jacksonville, FL

		Standard	Optional TOU
Customer Charge	$/month	$7.34	$7.34
Energy Charge	$/kWh		
On-Peak		$0.1072	$0.2156
Off-Peak		$0.1072	$0.0628

Example Three-Period Rate
Arizona Public Service

June – August Billing Cycles (Super Peak Summer)
$0.46517 per kWh during Super-Peak hours, plus $0.24477 per kWh during On-Peak hours, plus $0.05517 per kWh during Off-Peak hours

Super Peak: 3 – 6 PM
On-Peak: 12 – 3 PM and 6 – 7 PM

Example Seasonal Three-Period Seasonal Rate Southern California Edison

	Summer	Winter
Customer Charge	**$0.94**	**$0.94**
On-Peak	**$0.436**	**$0.336**
Shoulder	**$0.286**	**$0.282**
Off-Peak	**$0.131**	**$0.135**

Example Critical Peak Rate
Oklahoma Gas and Electric

		Summer
Customer Charge		**$13.00**
Off-Peak		**$0.044**
On-Peak		**$0.160**
Critical Peak		**$0.400**
Critical: Maximum 80 hours per year		
On-Peak: 2 - 7 PM Monday - Friday		

Example Critical Peak Rider
Arizona Public Service

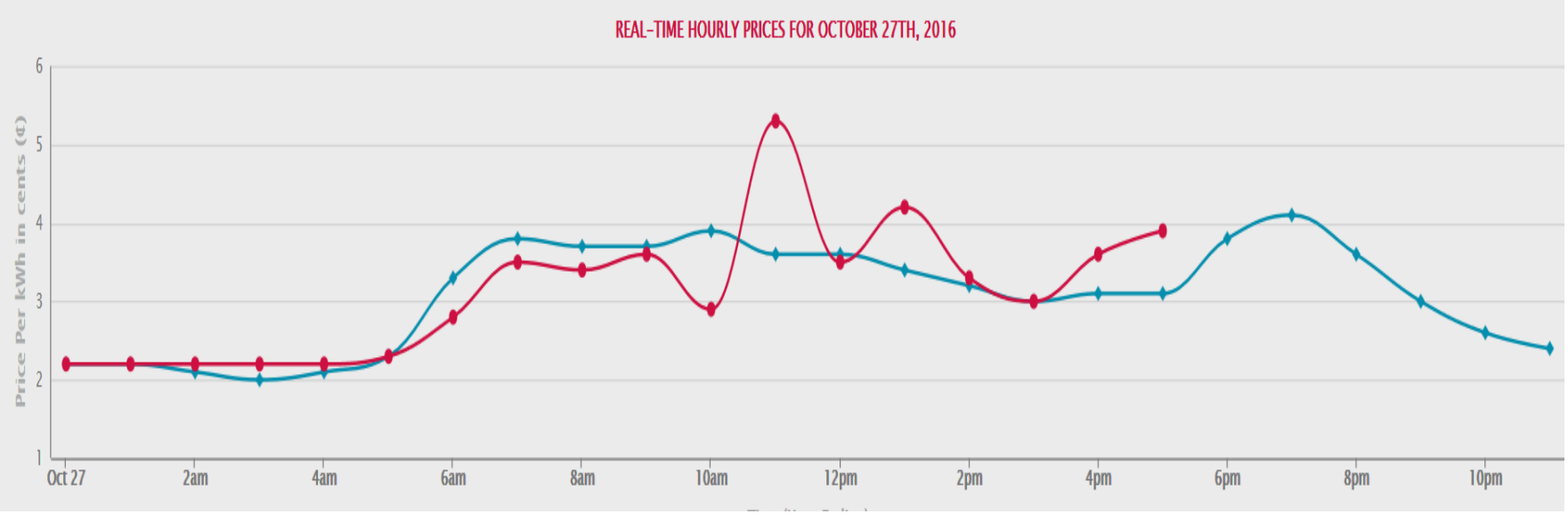
RATES

A. Critical Peak Price $ 0.250000 per kWh
Critical Peak Price applies to KWh usage during a CPP Event.

B. Energy Discount
All residential customers $ (0.012143) per kWh

Real-Time Pricing
Commonwealth Edison

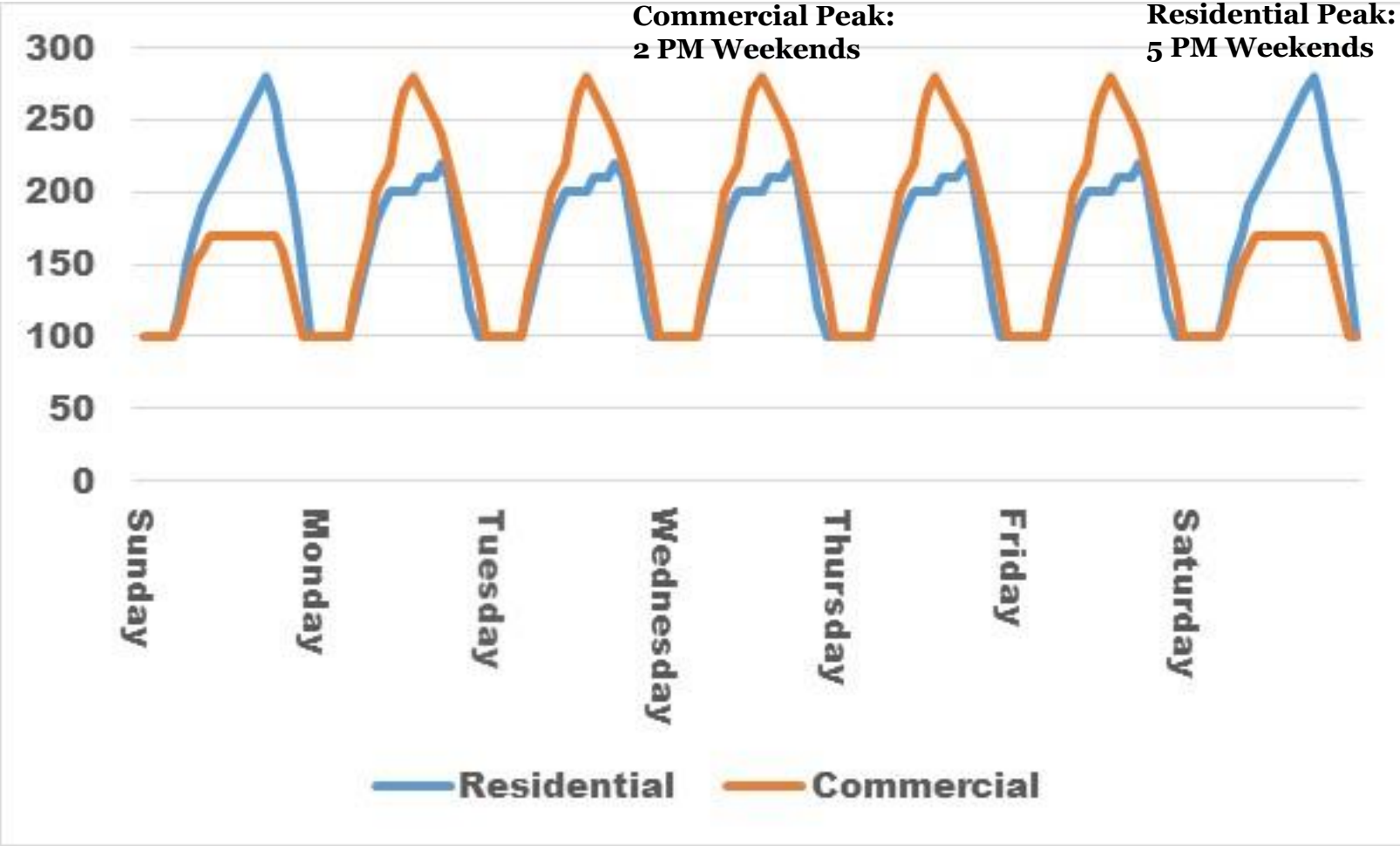
- Customer Charge
- Distribution Charge
- “Personal Capacity Charge”
- Hourly Energy Charge



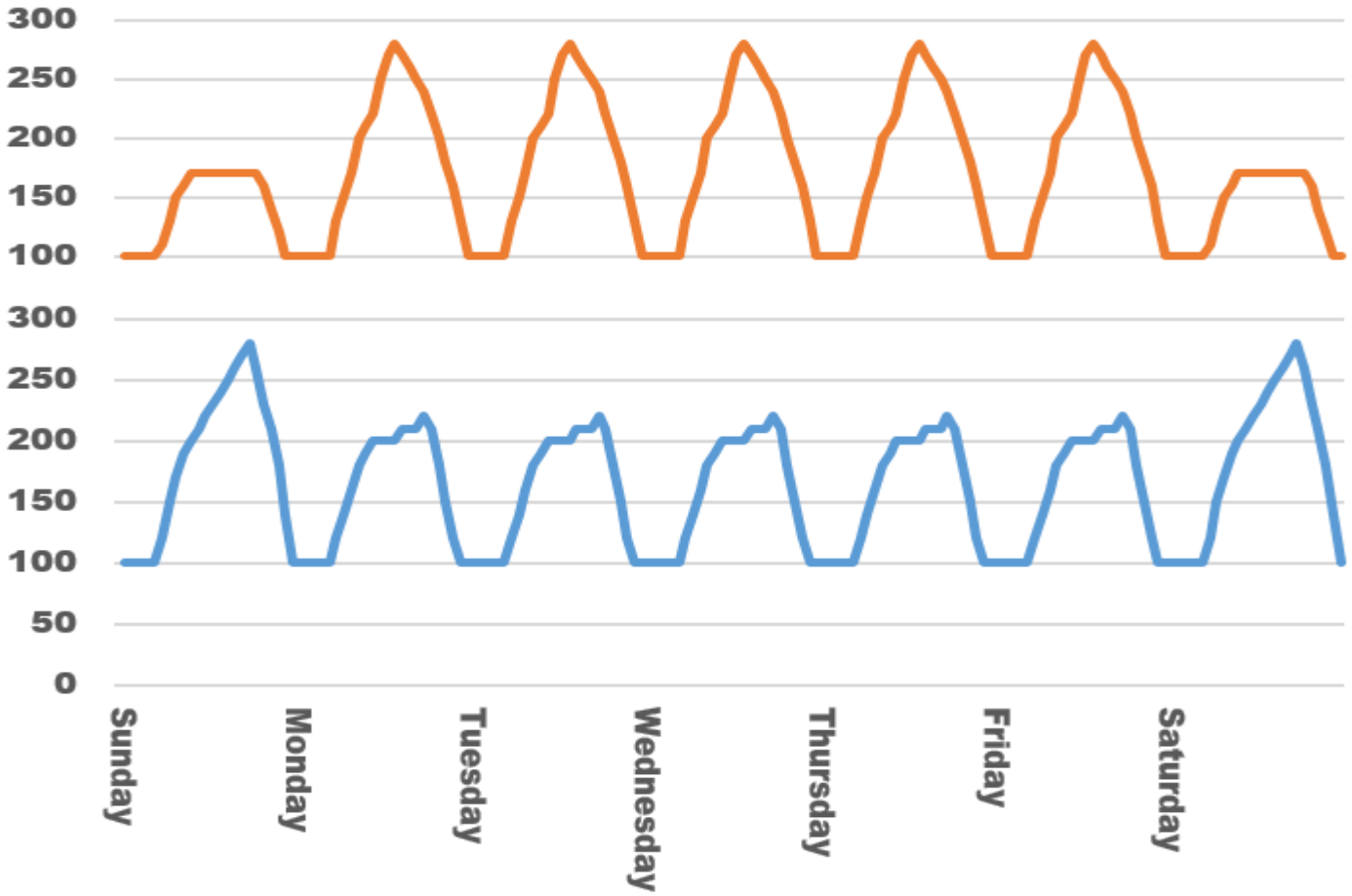
Choosing TOU Periods

- System Dispatch Characteristics
- Current Load Shape
- Projected Future Load Shape
- Integrated Resource Plan
- Market Price Data

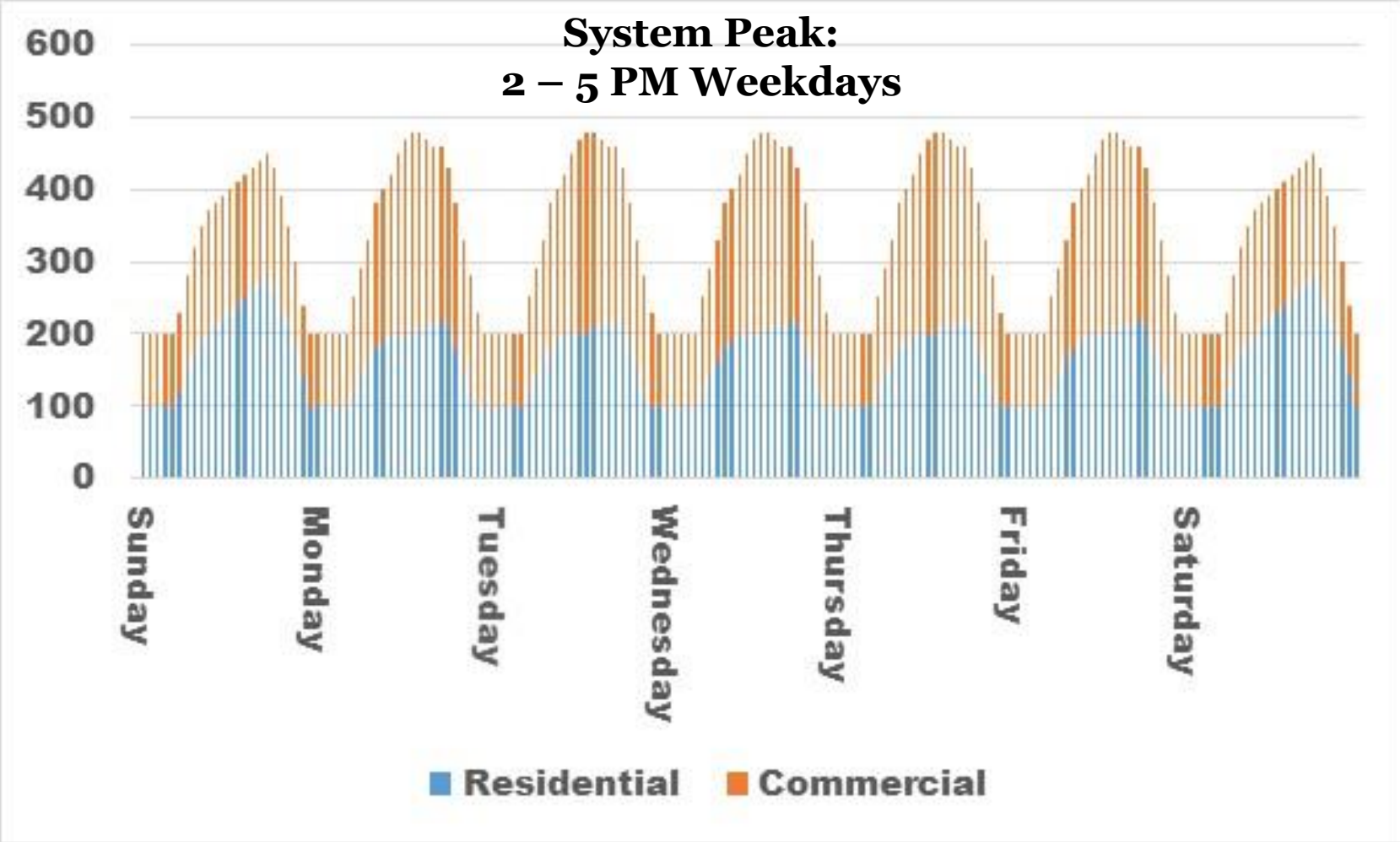
Different Classes and Circuits Peak at Different Times



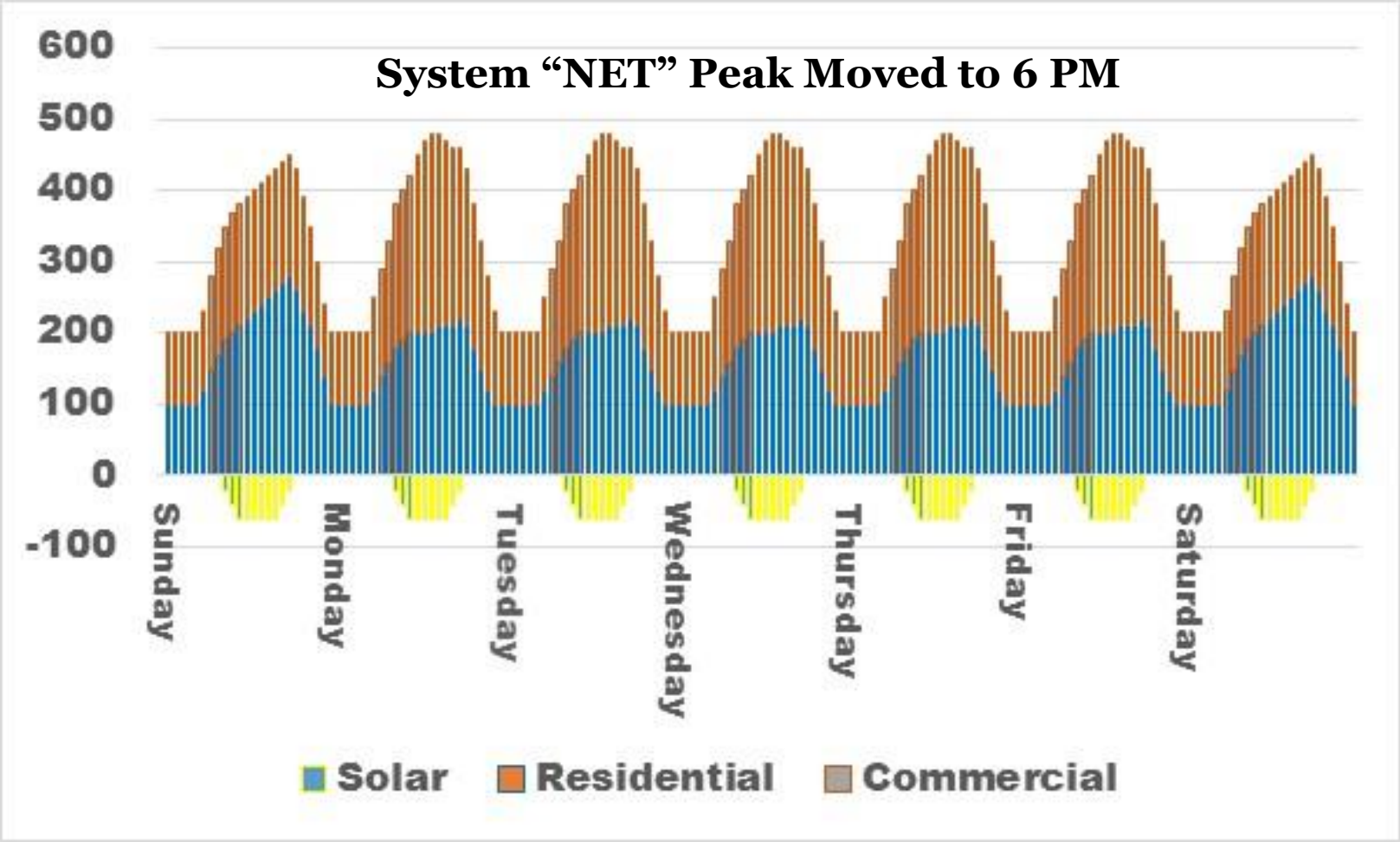
Class Demands May Drive Distribution Capacity Requirements



System Peak Drives Power Supply Costs



Solar Can Change This



Possible Result:
Different TOU Periods for Different Classes

Residential:	Commercial:
Monday – Sunday	Monday – Friday
3 PM – 8 PM	1 PM – 6 PM

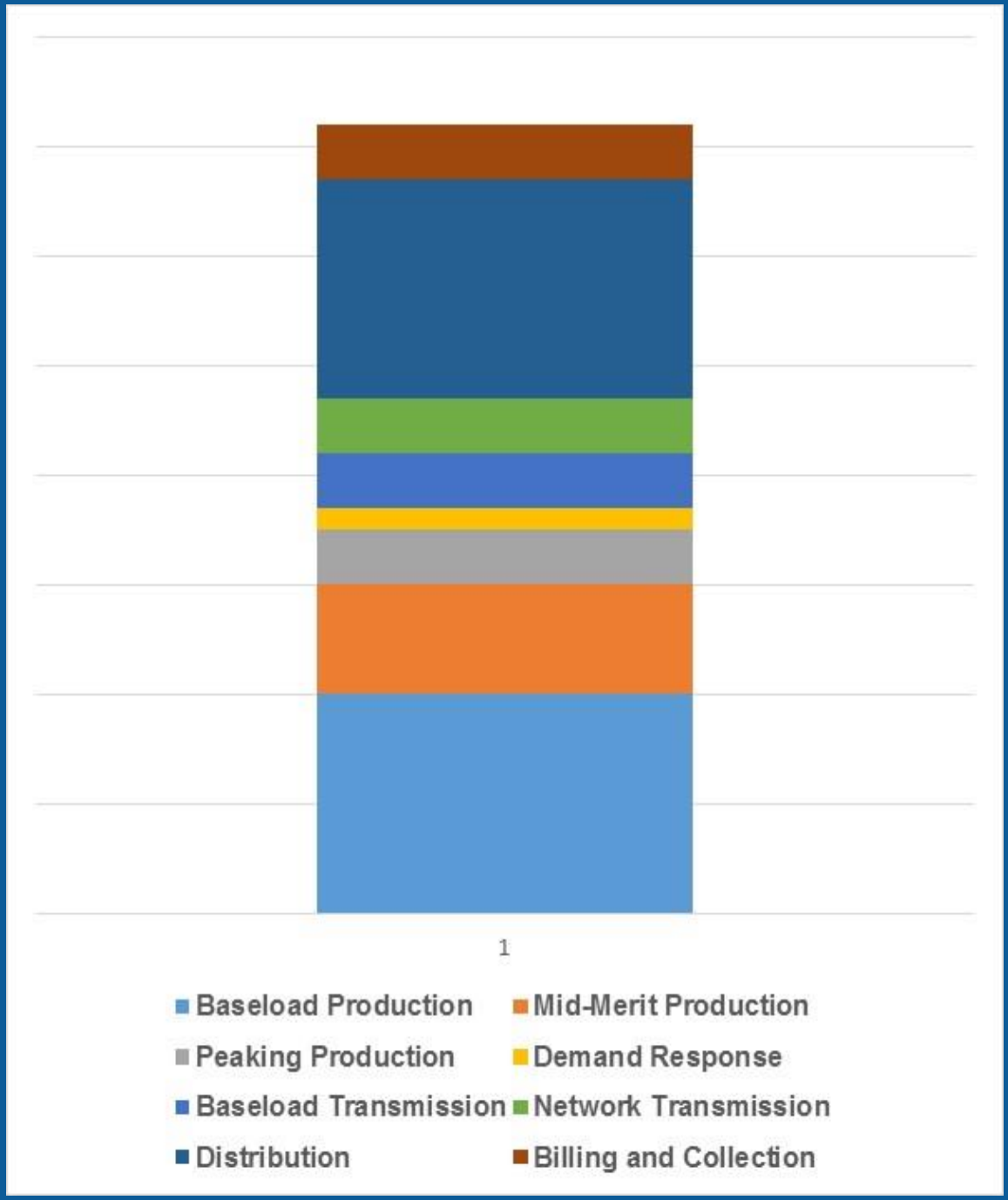
How Long Should the On-Peak Period Be?

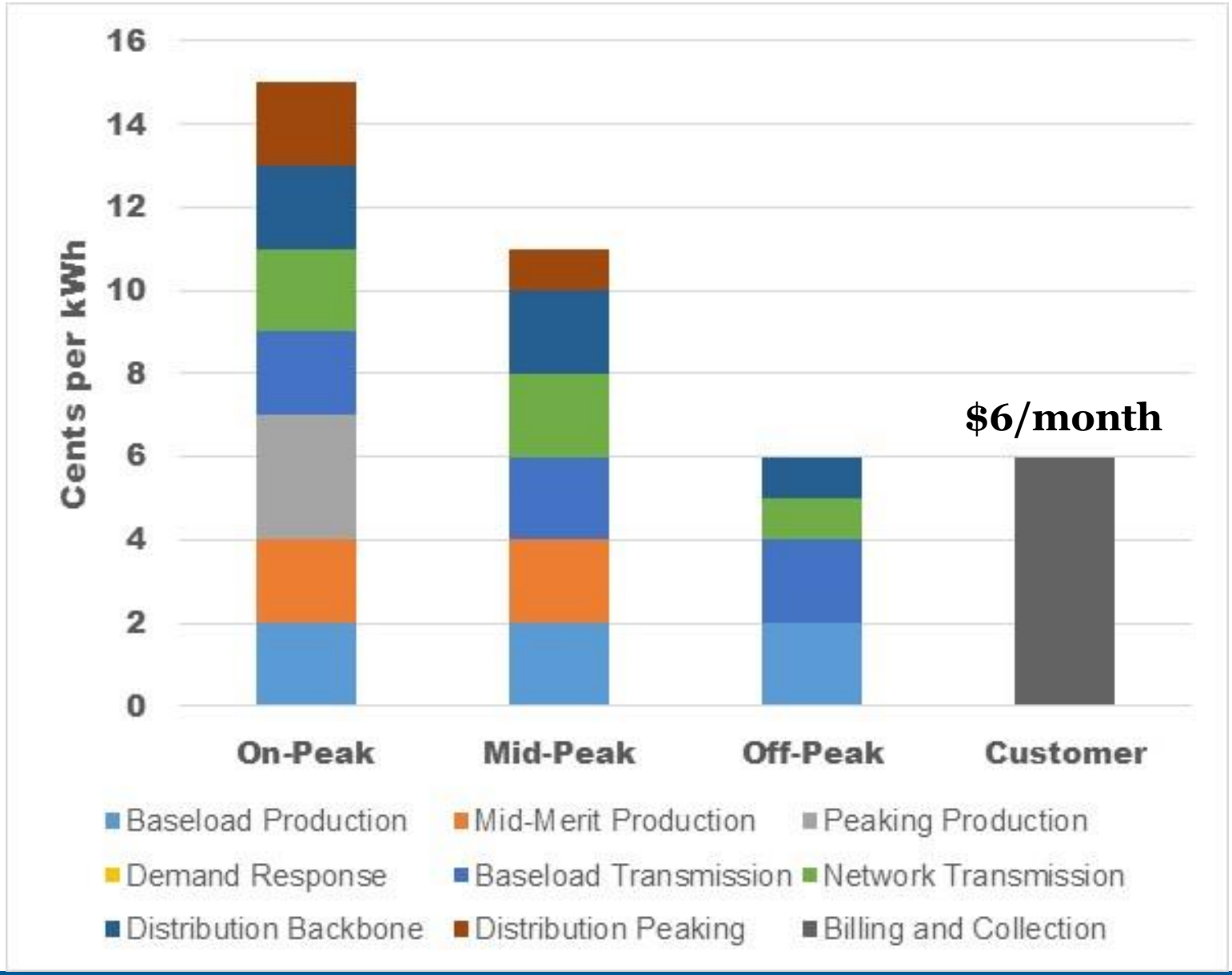
- Evidence is that 3 hours is the longest that people can defer without significant impact.
- Example: SRP EZ-3 Rate
  - Peak Period is 3 PM – 8 PM
  - Each customer chooses 3 hour slot
  - All customers are in the 5-6 PM slot

Assigning Costs to Periods Based on System Utilization in Periods

Off-Peak	Baseload Generation, Transmission, Distribution
Mid-Peak	Intermediate Generation, Transmission, Distribution
On-Peak	Peaking Generation, Distribution
Critical Peak	Demand Response

Functionalized System Costs




16
14
12
10
8
6
4
2
0
Cents per kWh
$6/month
On-Peak
Mid-Peak
Off-Peak
Customer
Baseload Production
Mid-Merit Production
Peaking Production
Demand Response
Baseload Transmission
Network Transmission
Distribution Backbone
Distribution Peaking
Billing and Collection

Expected Results

- Lower loads during peak hours
- Higher loads during off-peak hours
- Value proposition for:
  - Load management technology
  - Consumer engagement
  - Customer-based storage

Demand Charges

- Historically used for Commercial and Industrial customers
- NOT used for small commercial or residential due to high diversity.
- Non-Coincident Peak **(NCP):**
  - **$/kW measured at any hour**
- Coincident Peak **(CP):**
  - **$/kW measured 3 PM – 7 PM ONLY**

What Rate Form Is Most Effective at Tracking Capacity-Related Costs

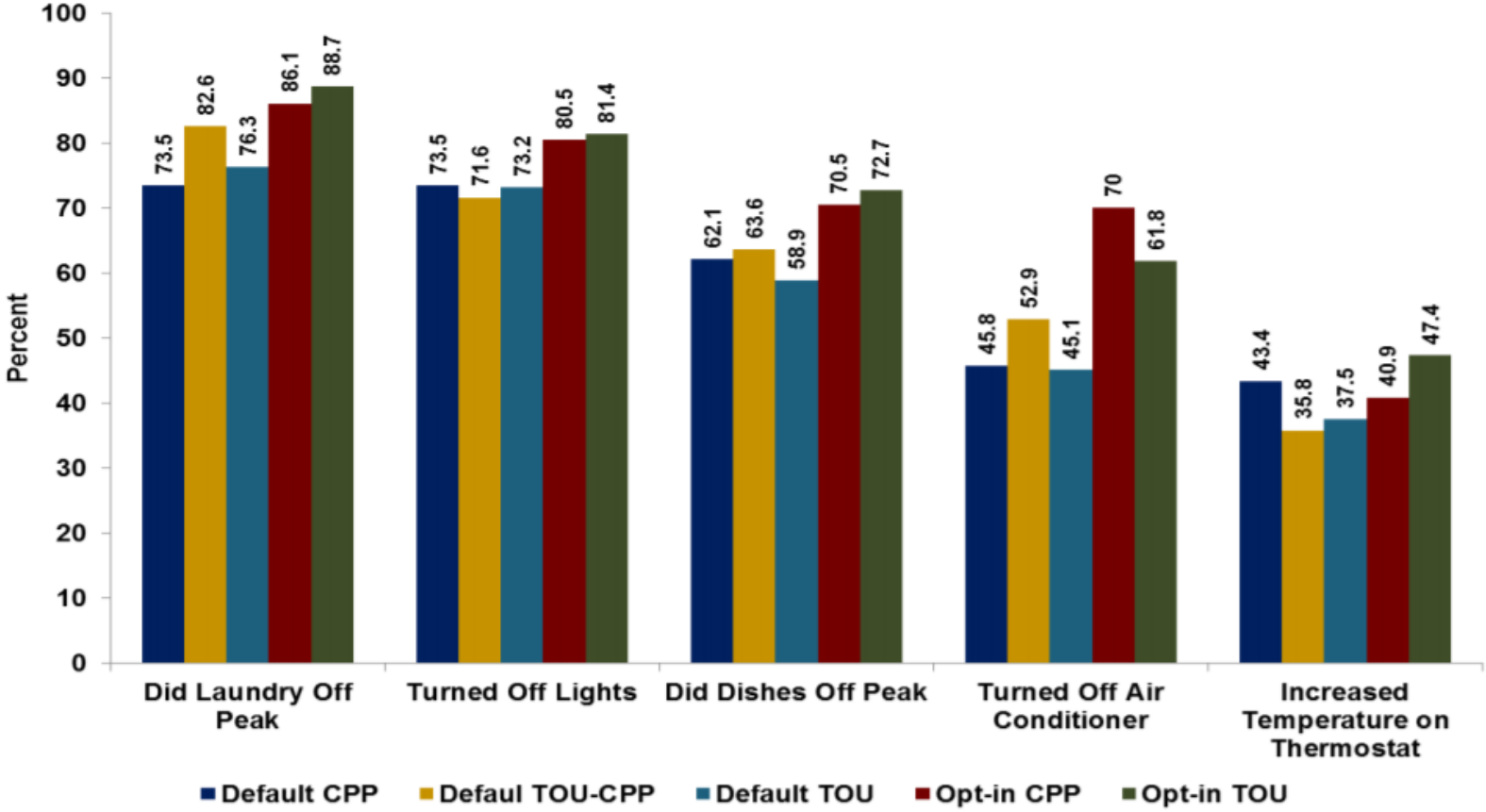
Exhibit 3. Garfield and Lovejoy Criteria and Alternative Rate Forms

Garfield and Lovejoy Criteria	CP Demand Charge	NCP Demand Charge	TOU Energy Charge
All customers should contribute to the recovery of capacity costs.	N	Y	Y
The longer the period of time that customers pre-empt the use of capacity, the more they should pay for the use of that capacity.	N	N	Y
Any service making exclusive use of capacity should be assigned 100% of the relevant cost.	Y	N	Y
The allocation of capacity costs should change gradually with changes in the pattern of usage.	N	N	Y
Allocation of costs to one class should not be affected by how remaining costs are allocated to other classes.	N	N	Y
More demand costs should be allocated to usage on-peak than off-peak.	Y	N	Y
Interruptible service should be allocated less capacity costs, but still contribute something.	Y	N	Y

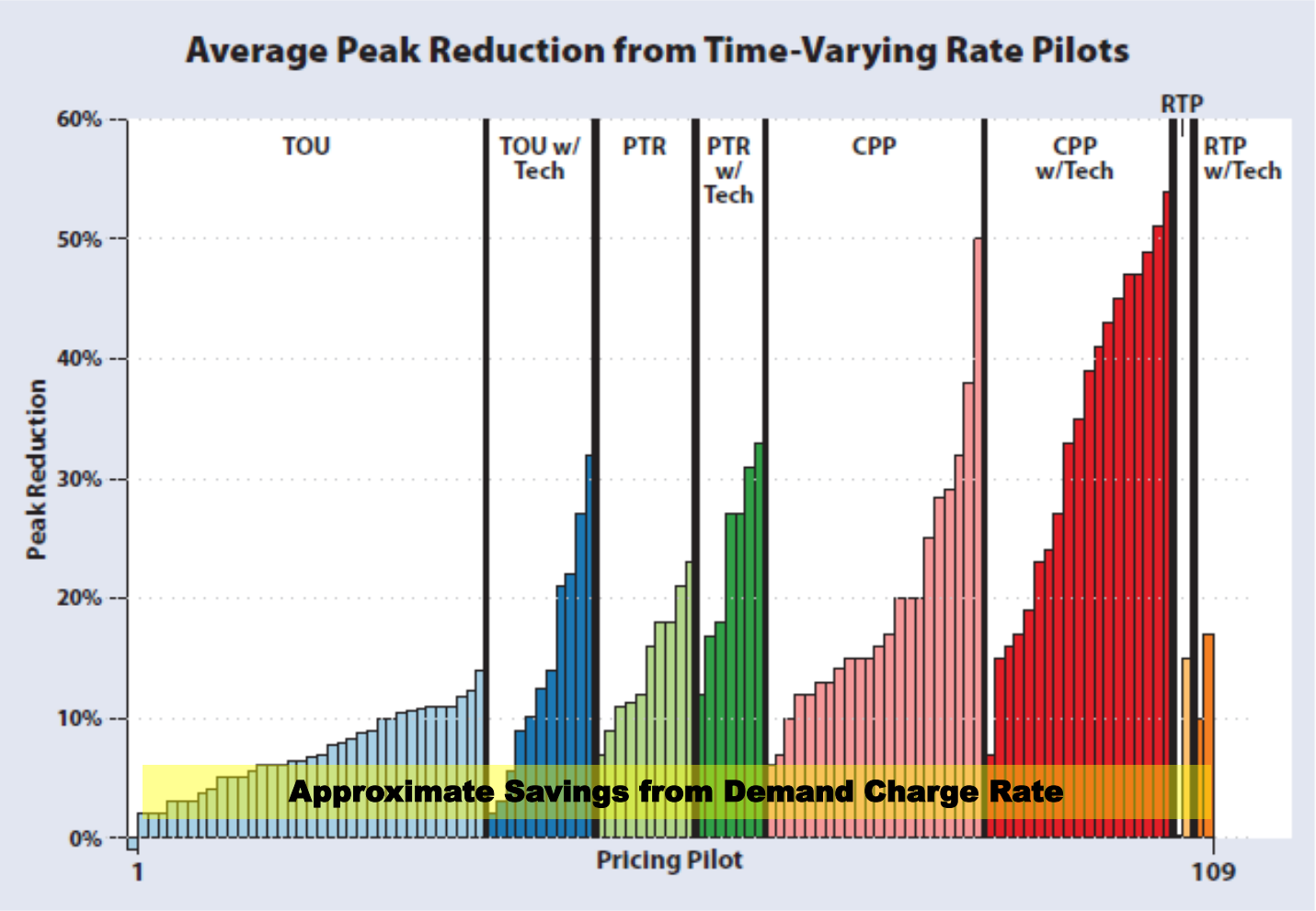
Impact of Different Rate Forms On kWh Usage and Peak Demand

	Peak Demand	Total kWh
Flat Rate $5/mo + $.12/kWh	Baseline	Baseline
Inclining Block	▼5% -10%	▼5% -10%
High Fixed Charge	▲5% - 10%	▲5% - 10%
NCP Demand Charge	▼1% -2%	▲5% - 10%
CP Demand Charge	▼5% -10%	▲5% - 10%
TOU Rate	▼10% -20%	Little Change
Critical Peak Rate	▼20% - 30%	Little Change
TOU + Inclining Block	▼15% - 30%	▼5% -10%
Critical + Inclining Block	▼25% - 35%	▼5% -10%

SMUD: Customers Actually Do Things



TOU and Critical Peak Pricing Works



Current Rocky Mountain Power Rate (Summer)

Energy Charge:

Billing Months - May through September inclusive

8.8498¢ per kWh first 400 kWh

11.5429¢ per kWh next 600 kWh

14.4508¢ per kWh all additional kWh

Incorporating TOU with Inclining Blocks Is Not Difficult

Energy Charge:

Billing Months - May through September inclusive
8.8498¢ per kWh first 400 kWh
11.5429¢ per kWh next 600 kWh
14.4508¢ per kWh all additional kWh

TOU Overlay:

On-Peak Surcharge: $.05/kWh
Off-Peak Discount: $.05/kWh

Peak-Time Rebates

- Targeted at key critical peak hours
- Events announced
- Customer usage during event compared to a baseline usage for that customer.
- Credit applied for reduced usage

NO surcharge applied for increased usage

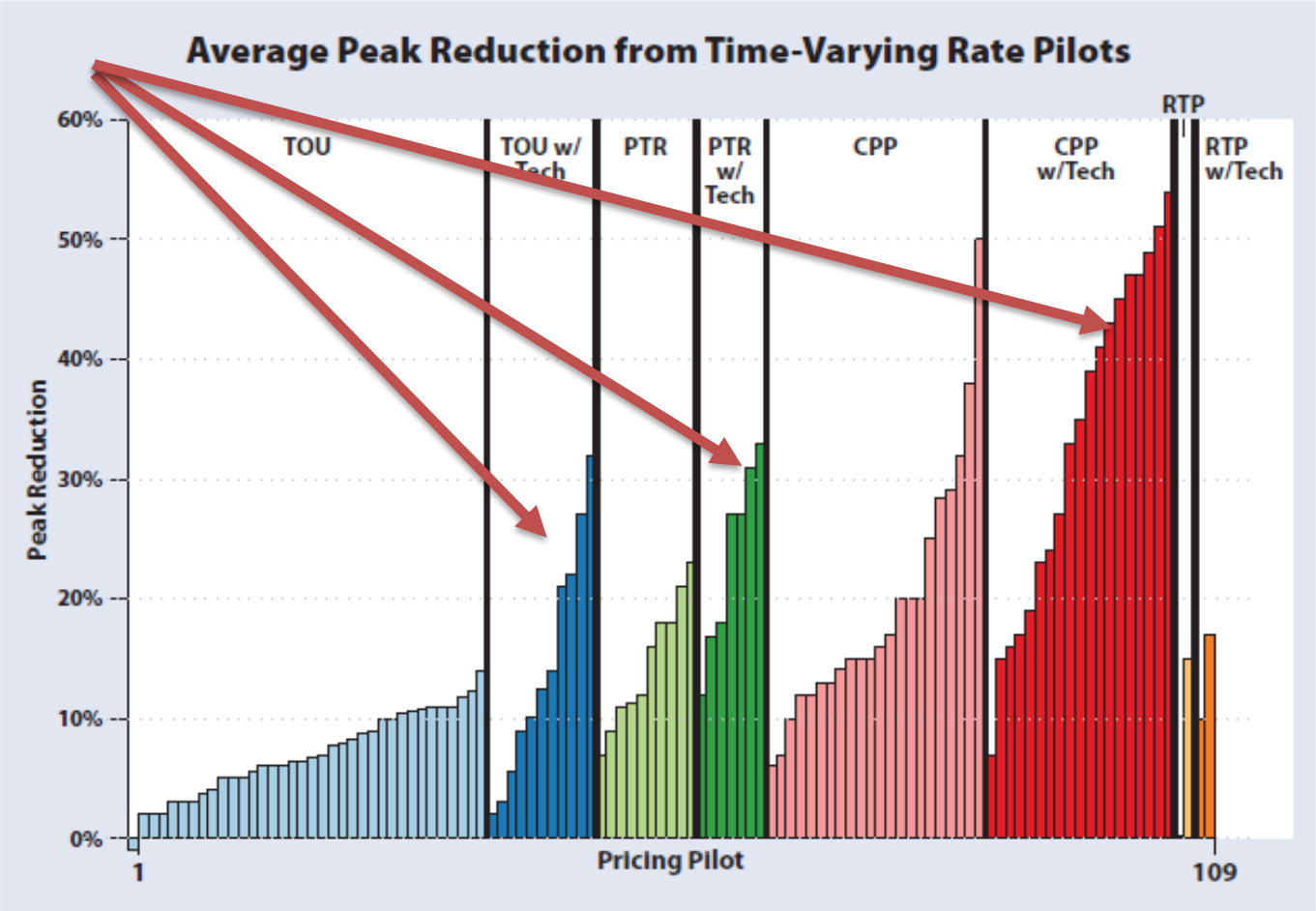
Baltimore Gas and Electric PTR

Customer Charge	**$/month**	**$ 7.90**
Distribution Charge	**$/kWh**	**$ 0.035**
Default Supply	**$/kWh**	**$ 0.092**
PTR Credit	**$/kWh**	**$ 1.25**

Customer Empowerment

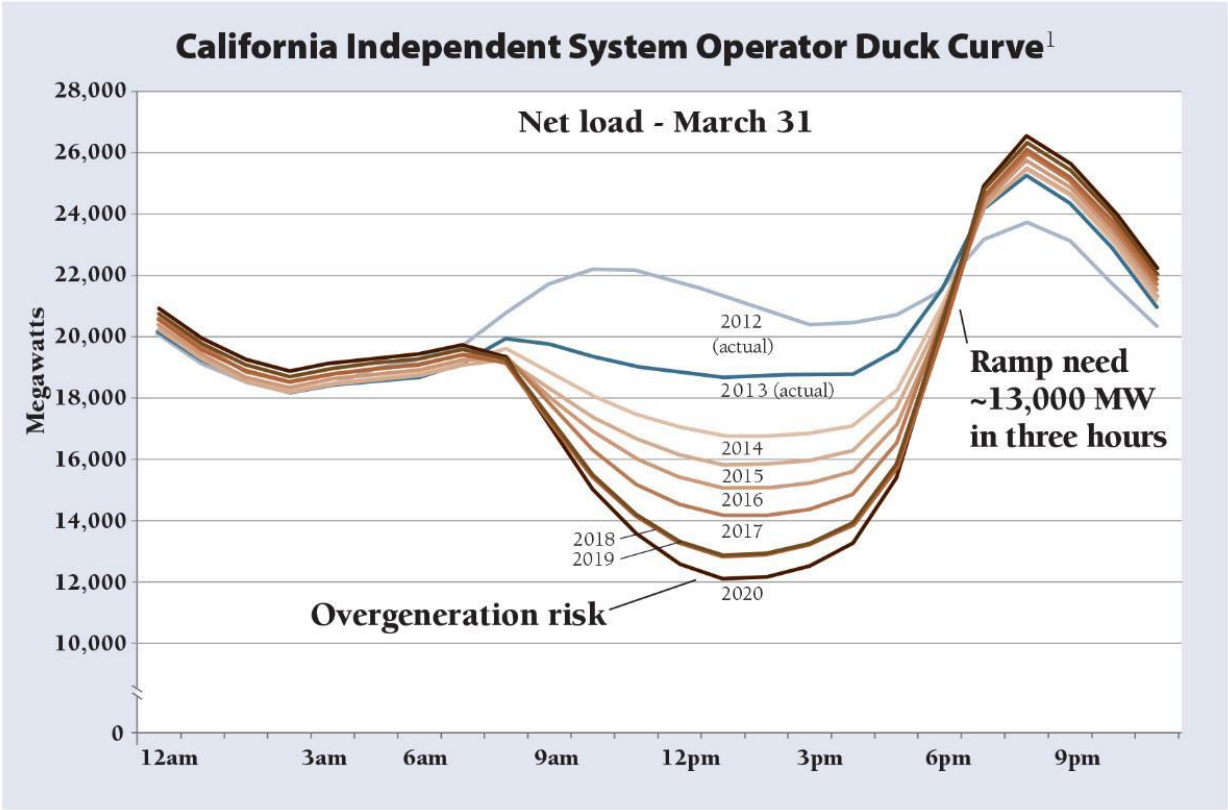
- Keep it simple!
- Print the rate on the bill, including all riders.
- Provide technology to curtail use “hands-free” for major loads
- Shadow billing / Bill Guarantee for first year.

Technology Can Help



Looking Ahead: Hawaii and California

Once installed solar passes about 25% of peak demand, the system "net" load shape changes.



Hawaii: Solar @ 16% of Customers

Table 3. HECO Companies' Net Energy Metering Program Capacity and Enrollment

Capacity (MW)	**HECO**	**HELCO**	**MECO**
Installed or Approved	327.9	73.3	88.8
In the Queue	17.3	5.1	11.9
Total	**345.2**	**78.4**	**100.7**
Total NEM Customers	51,680	11,549	12,893
System Peak Load (MW)	1,165	188	191
NEM % of All Customers	17%	14%	18%
NEM of System Peak	**30%**	**42%**	**53%**

Peak Load Impacts May Reach A Limit

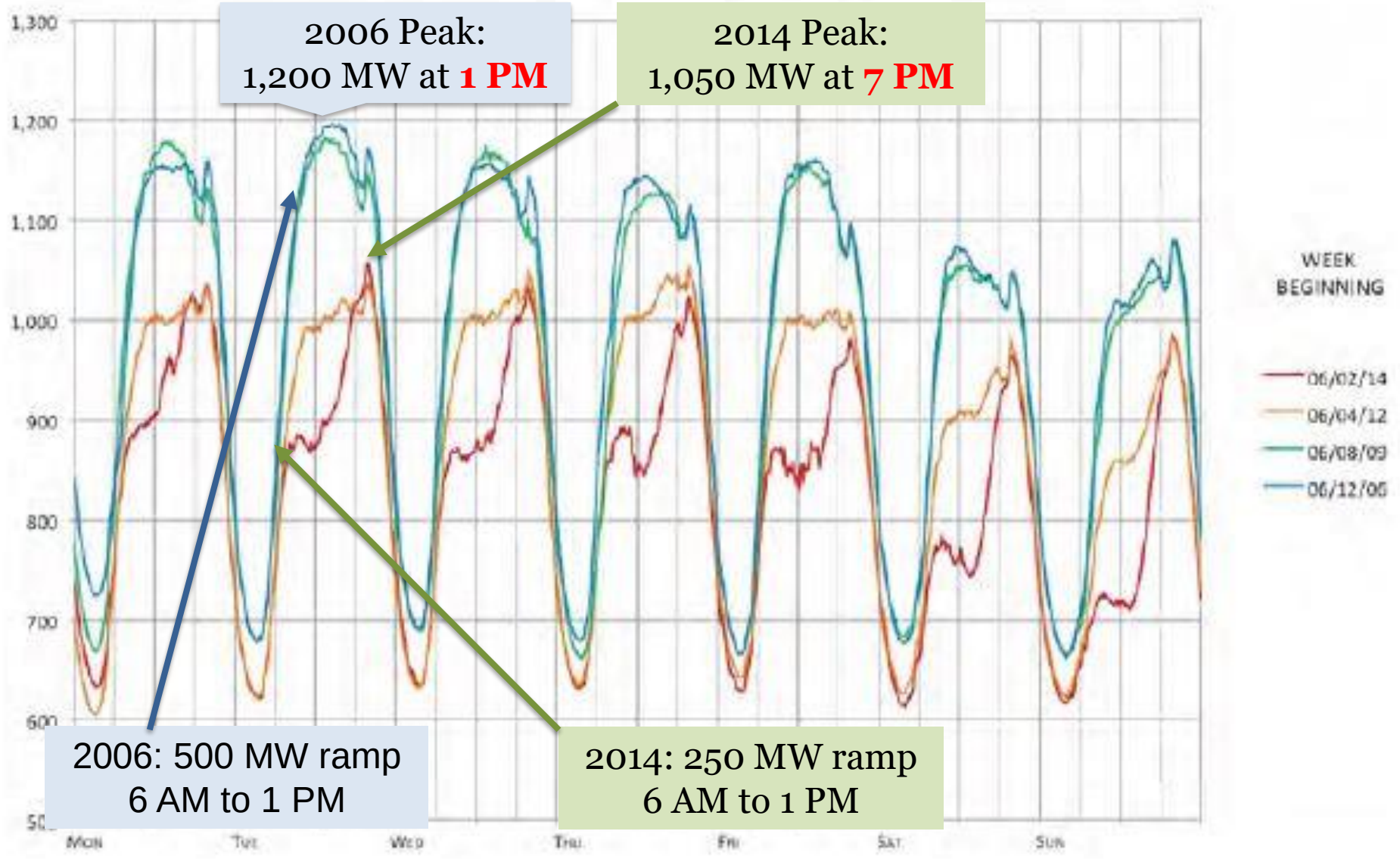


Figure 1-7. O'ahu System Load Profiles, 2006–2014

Source: Hawaiian Electric Co

Grid-Supply Rate (Hawaii)

Charges for all power received from grid	
Customer Charge	$10.30
First 350 kWh	$.234
Next 850 kWh	$.246
Over 1,200 kWh	$.265
Minimum bill:	$25.00
Credit for all power delivered to grid	($.151)

Any customer surplus credit at end of month is forfeited.

Summary

- Customers can, will, and do respond.
- TOU rate design is utility-specific
- Costs can be assigned based on multiple functions
- TOU is more effective at reducing peak demand than demand charges.
- TOU combined with inclining block rates = BOTH load-shifting AND kWh savings.
- Peak-Time Rebates are an option.

Smart Rate Design

Customer-Specific Charges		
Customer Charge	$/Month	$ 3.00
Transformer:	$/kVA/Mo	$ 1.00

Bi-Directional Energy Charges		
Off-Peak	$/kWh	$ 0.08
Mid-Peak	$/kWh	$ 0.12
On-Peak	$/kWh	$ 0.18
Critical Peak	$/kWh	$ 0.75

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

Learn more about RAP at www.raponline.org

Jim Lazar, jlazar@raponline.org
John Shenot, jshenot@raponline.org

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