RAP® Energy solutions for a changing world

Smart Rate Design for a Smart Future

New Hampshire Energy Efficiency & Sustainable Energy Board
Concord, NH

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The Regulatory Assistance Project (RAP)®

RAP Introduction

- The Regulatory Assistance Project (RAP) is a global, non-profit team of energy experts, mostly veteran regulators, advising current regulators on the long-term economic and environmental sustainability of the power and natural gas sectors. Funded philanthropically and by U.S. DOE, EPA (www.raponline.org)
  - *Non-advocacy; no interventions*
- David Littell, former Maine PUC and Maine DEP Commissioner

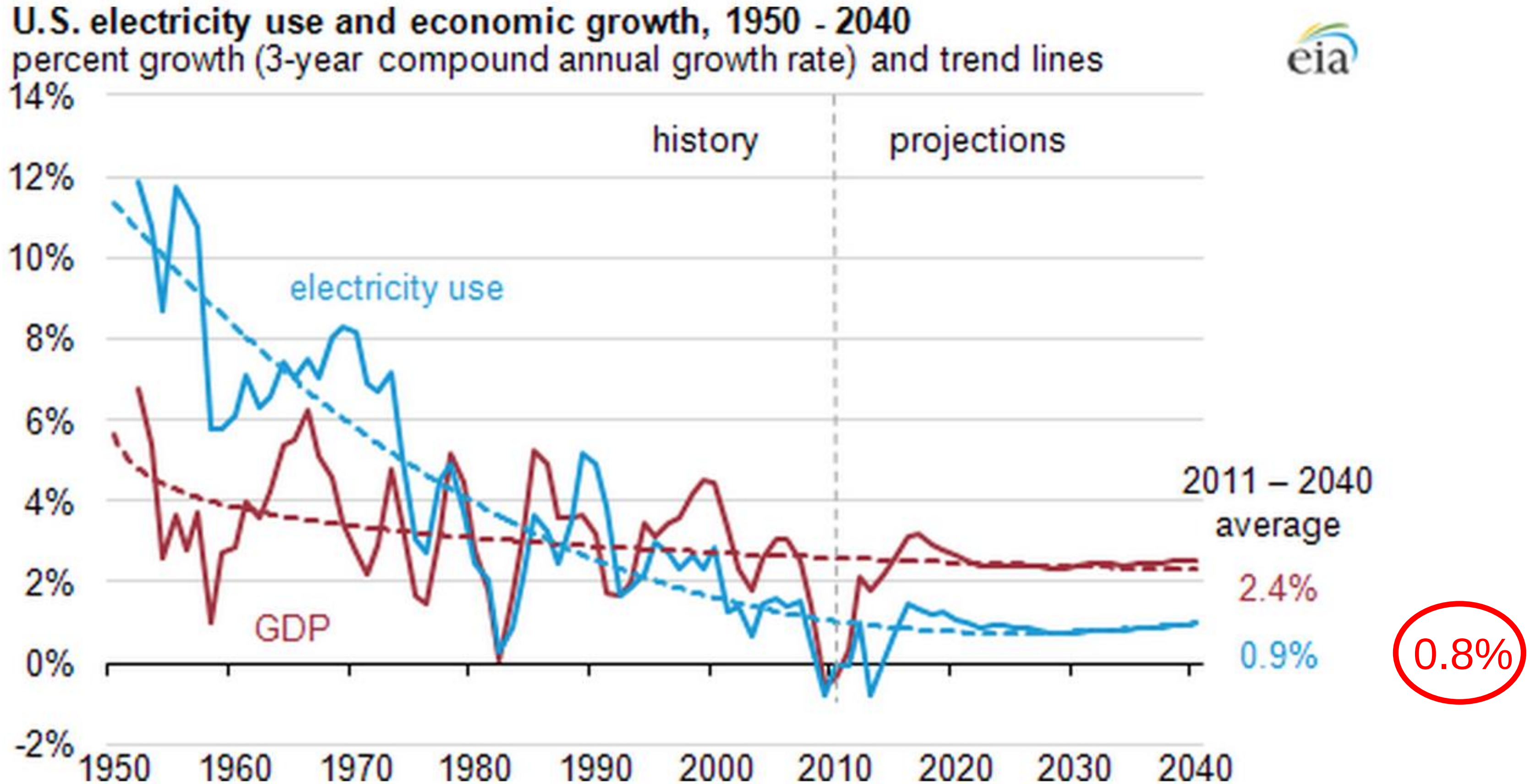
Outline

- Power Sector Transformation
- Smart Energy Technologies
- Smart Rate Design
- Demand Charges for Residential?
- Distributed Generation Rate Making and Value
- Smart Grid Cost Allocation Issues

Power Sector Transformation (PST)

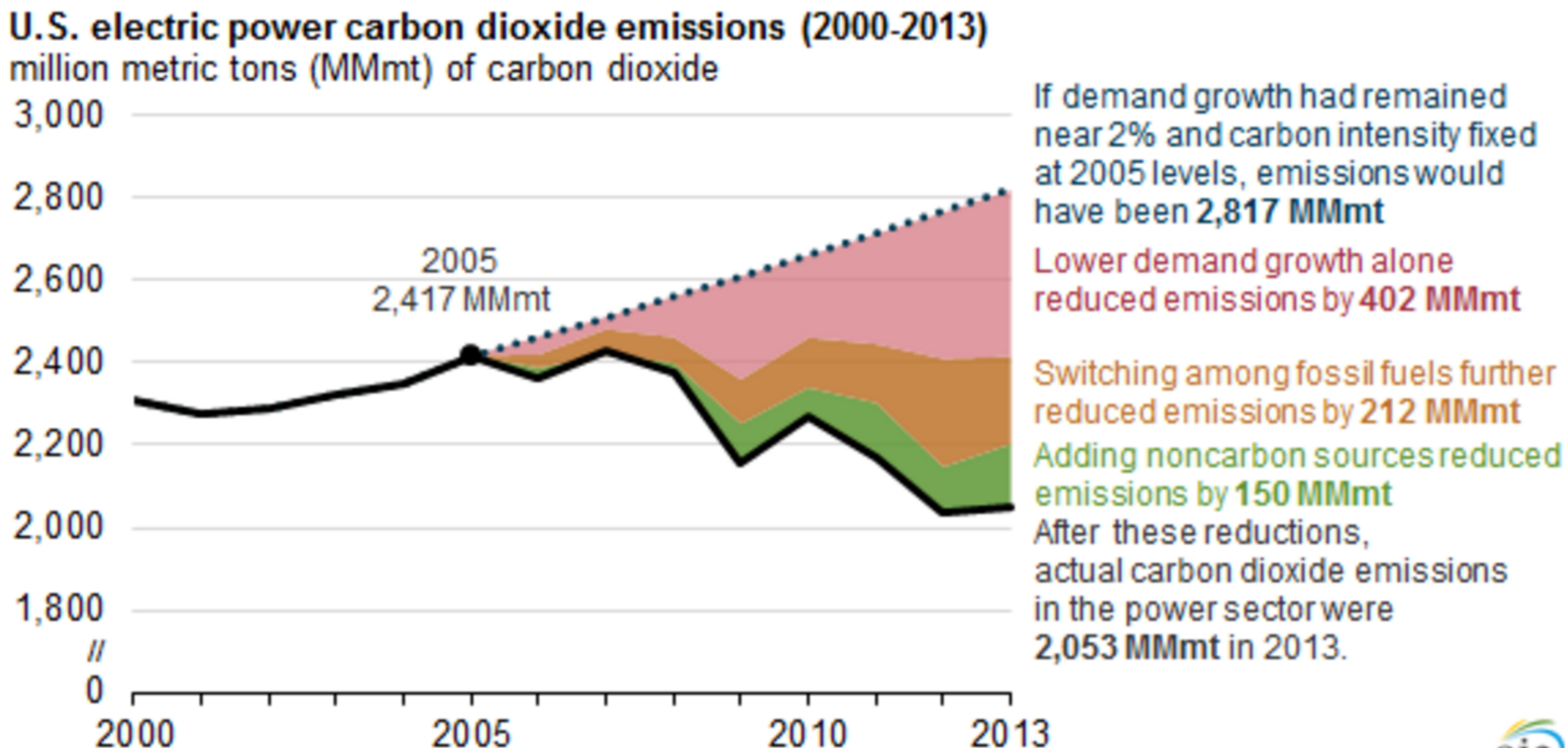
- For 100 years, we've managed supply only
- We can now manage electricity demand too
- Further, "supply" ≠ centralized generation
- Likely will evolve into series of "markets"
- What role for regulators, the regulatory compact, in these uncharted waters?

U.S. economy and electricity demand growth are linked, but relationship is changing



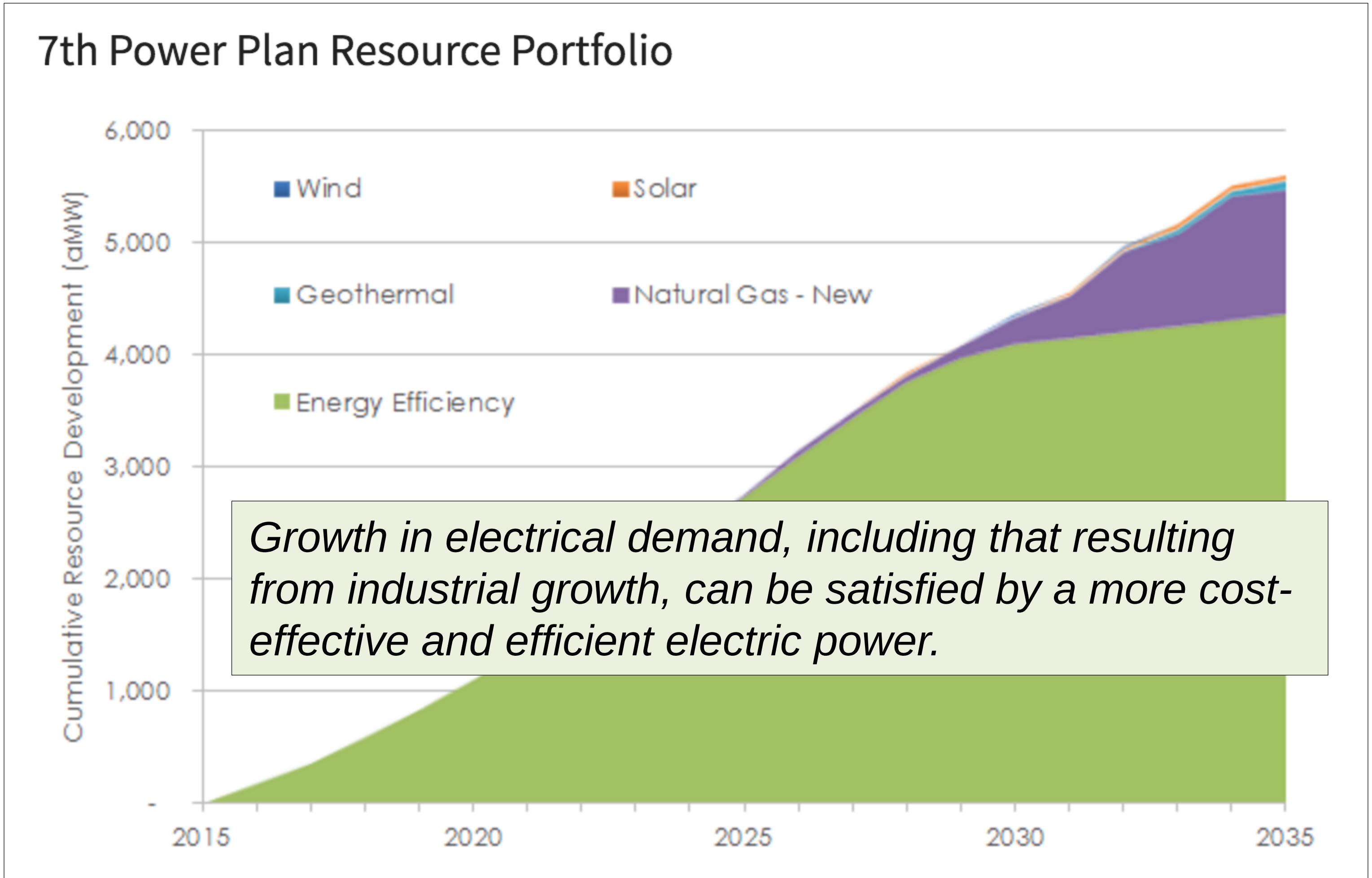
Source: U.S. Energy Information Administration, Annual Energy Outlook 2013 Early Release.

Lower electricity-related CO2 emissions reflect lower carbon intensity and electricity use



Source: U.S. Energy Information Administration, *Annual CO_2 Analysis*

Pacific Northwest Power & Conservation Council – 7th Power Plan (10 Feb 2016)



Growth in electrical demand, including that resulting from industrial growth, can be satisfied by a more cost-effective and efficient electric power.

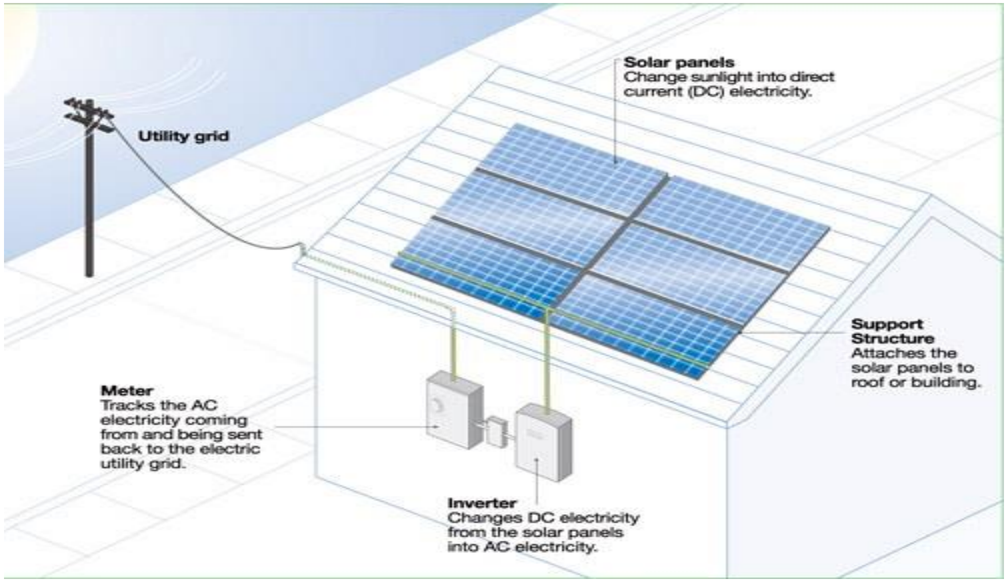
Smart Technology

Policies to Complement a Smart Future

- Grid technology to make smart rates work for consumers
- Revenue regulation to ensure utilities have a reasonable opportunity to earn a fair return
- Time-varying and dynamic rate designs

Smart Meters/Distributed Generation

Smart meters can power flows of DG in both directions on interval basis to determine billing (and value transactions)



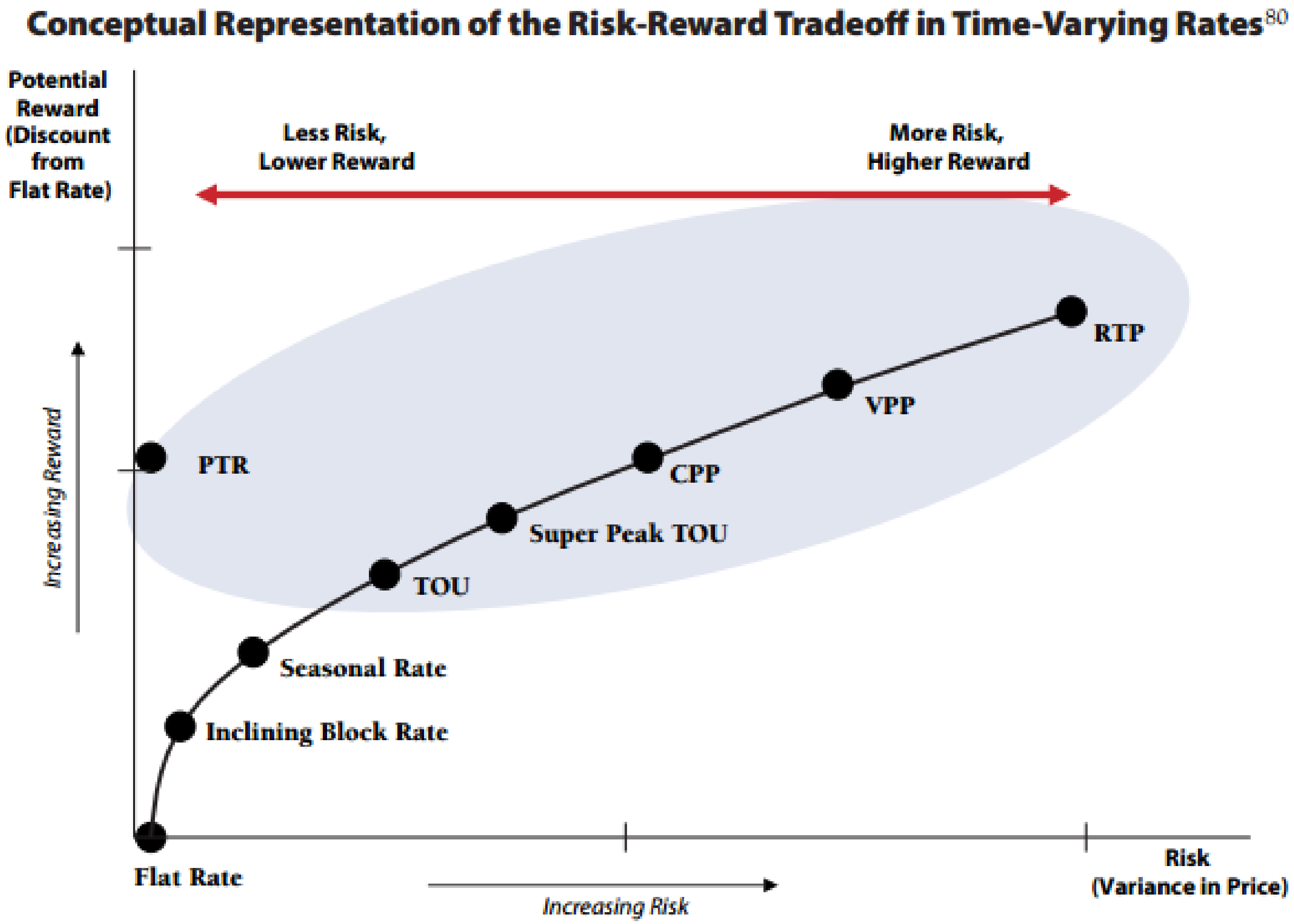
Enabling Technology and Services

Real cost rates work best with enabling technology – "Set and Forget"

Rate Design Issues

- Key issues for Rate Design and related issues nationally are:
  - Time-Varying Pricing (TOU, CPP, etc.)
  - Fixed Customer Charges
  - Demand Charges
  - Inclining Block Rates (IBR)
  - Net Energy Metering (NEM)
  - Decoupling efforts
  - Utility efforts to re-regulate

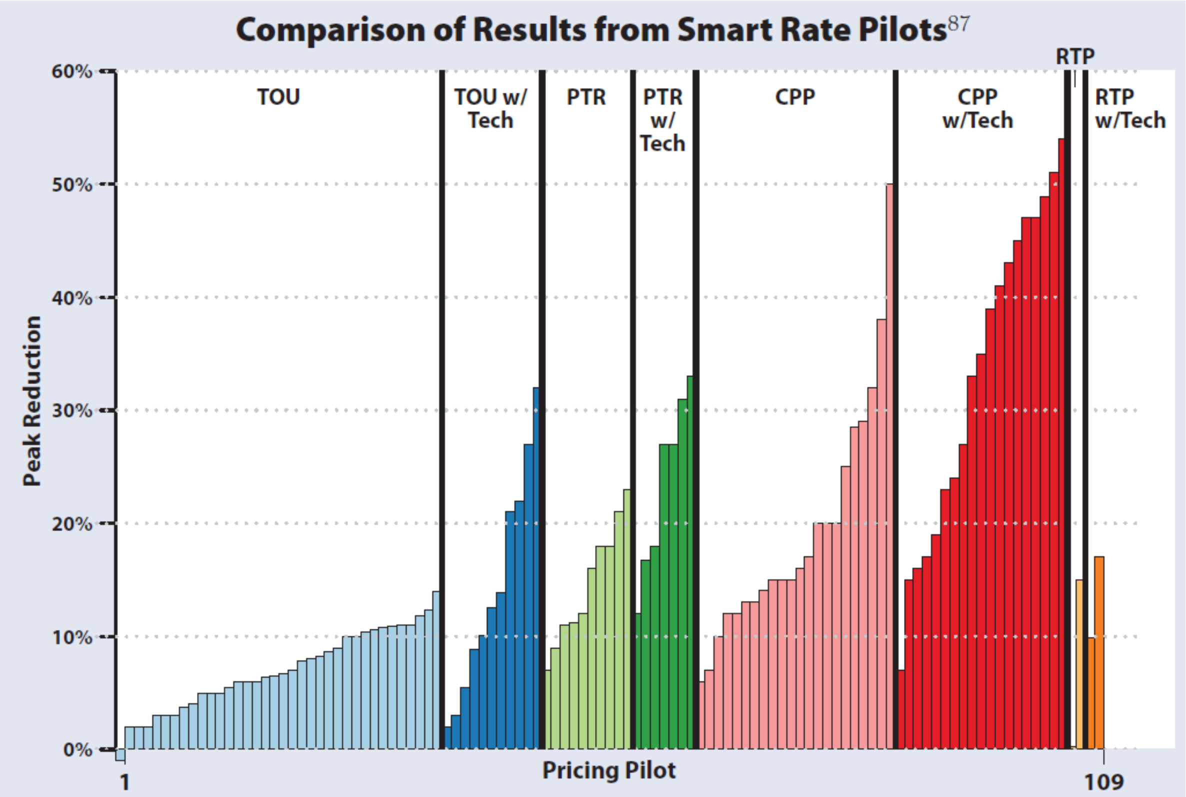
Smart Rates



Conceptual Representation of the Risk-Reward Tradeoff in Time-Varying Rates[80]
Potential Reward (Discount from Flat Rate)
Less Risk, Lower Reward
More Risk, Higher Reward
Increasing Reward
PTR
RTP
VPP
CPP
Super Peak TOU
TOU
Seasonal Rate
Inclining Block Rate
Flat Rate
Increasing Risk
Risk (Variance in Price)

Smart Rates Can Reduce Total System Costs & Customer Bills

Smart rates can produce significant peak load reductions and shift energy consumption



A Declining Block Rate Design

What does this rate design say?

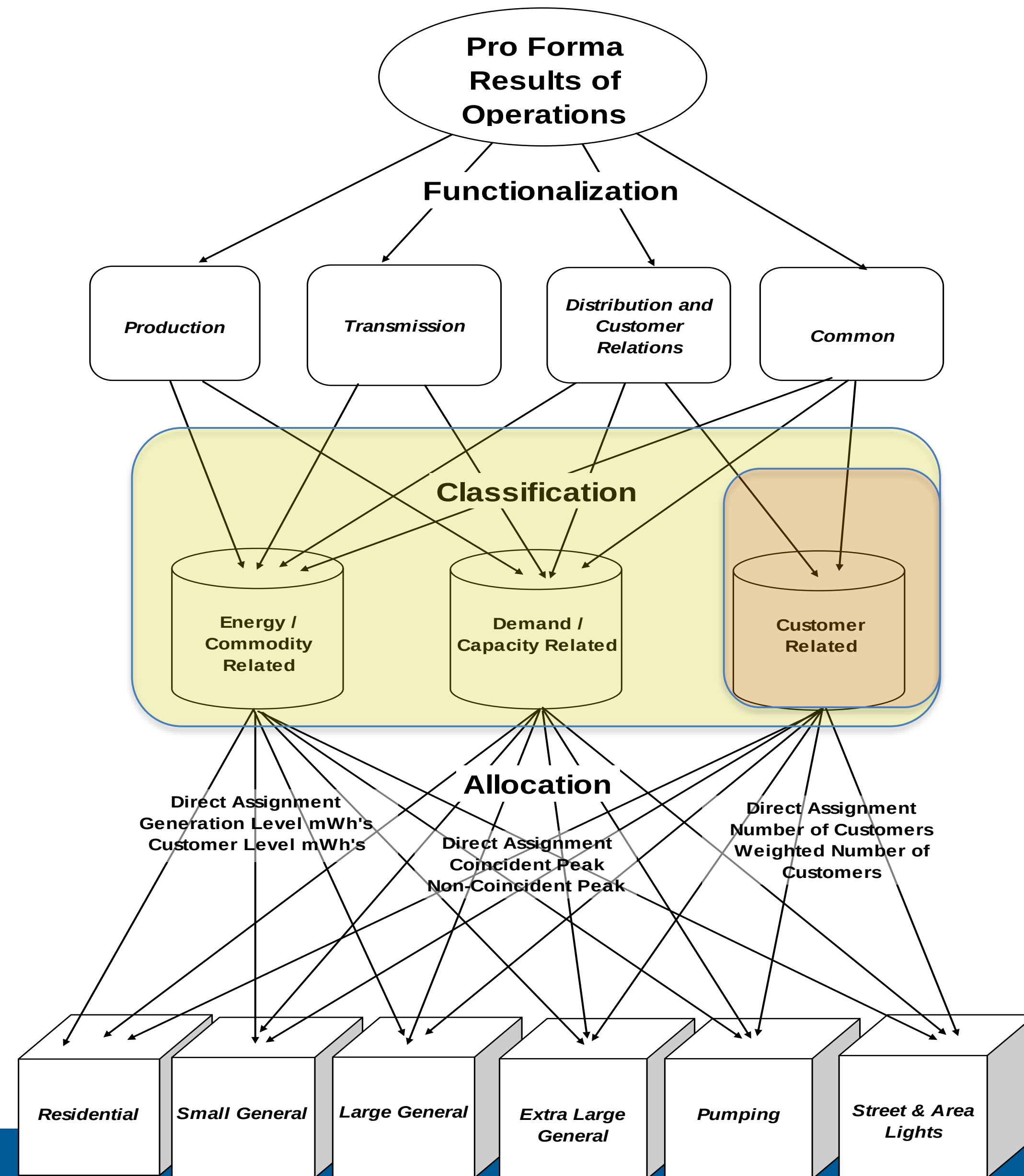
$1.50 $2.25 $2.75

An Inclining Block Rate Design

What does this rate design say?

Rate Making's 2nd Half: After the Revenue Requirement is set – how the RR is allocated for Rates for each class

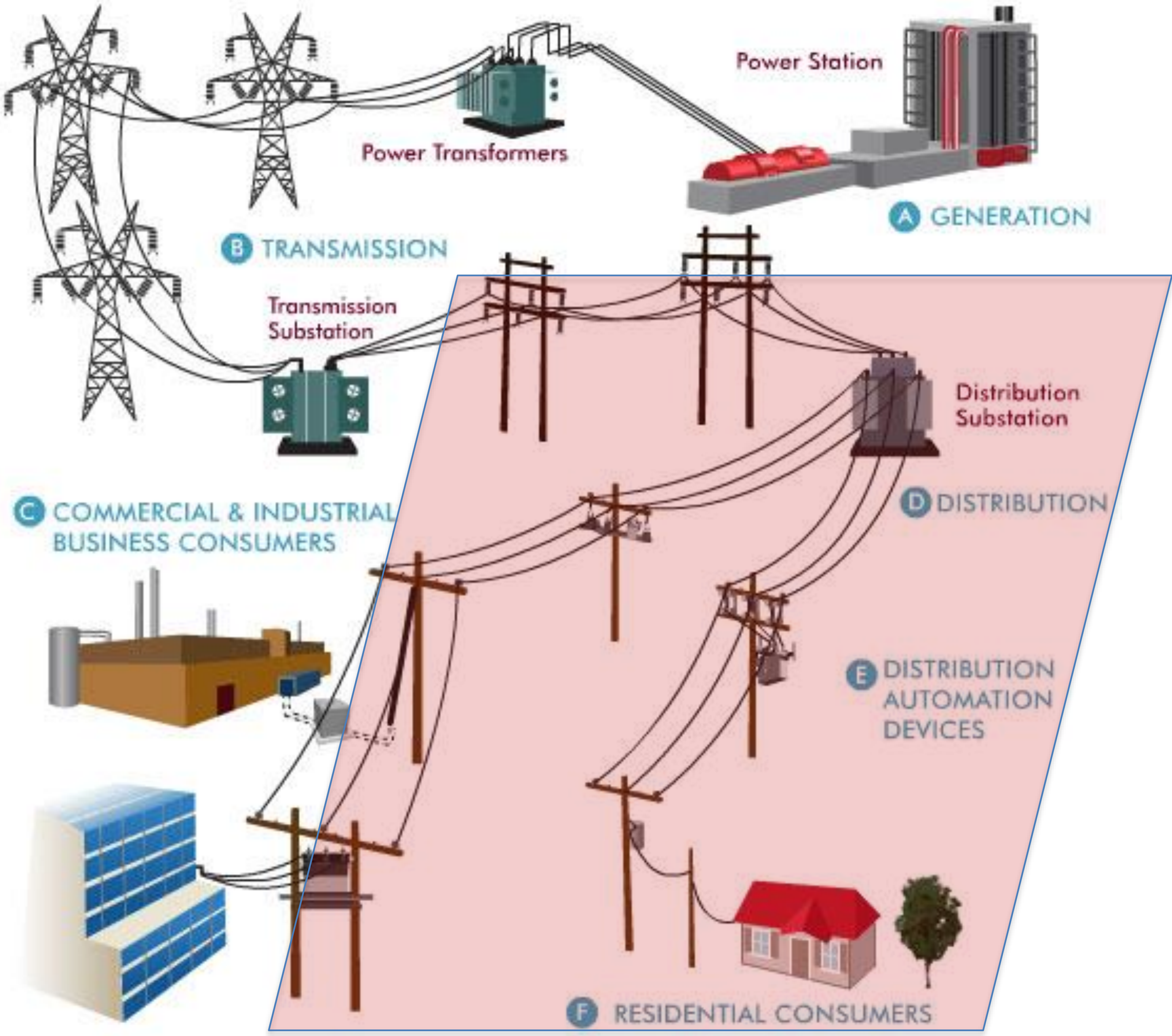
ELECTRIC COST OF SERVICE STUDY FLOWCHART



Pro Forma Results of Operations by Customer Group

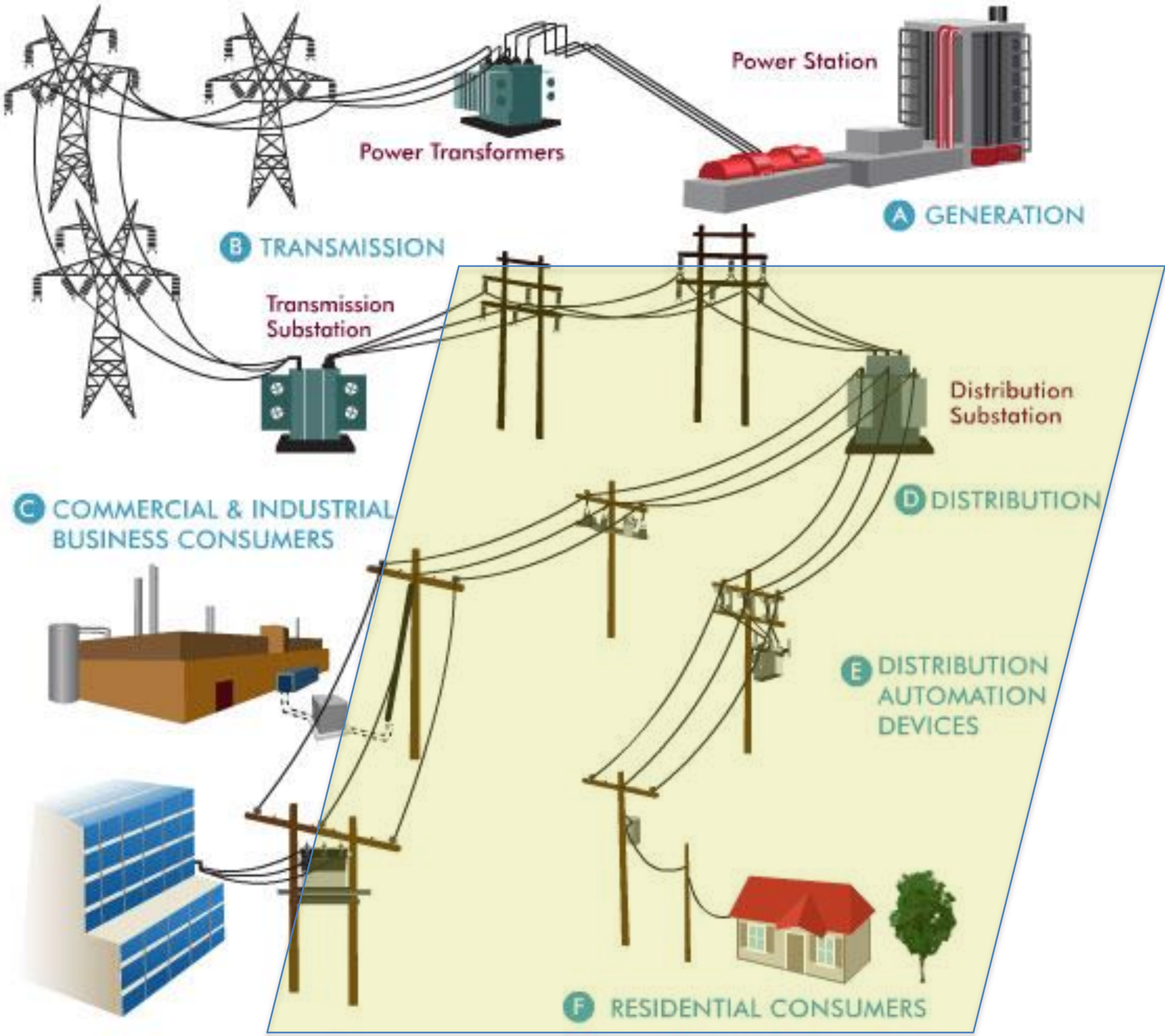
Straight Fixed/ Variable

100% of Distribution System Classified as Customer-related



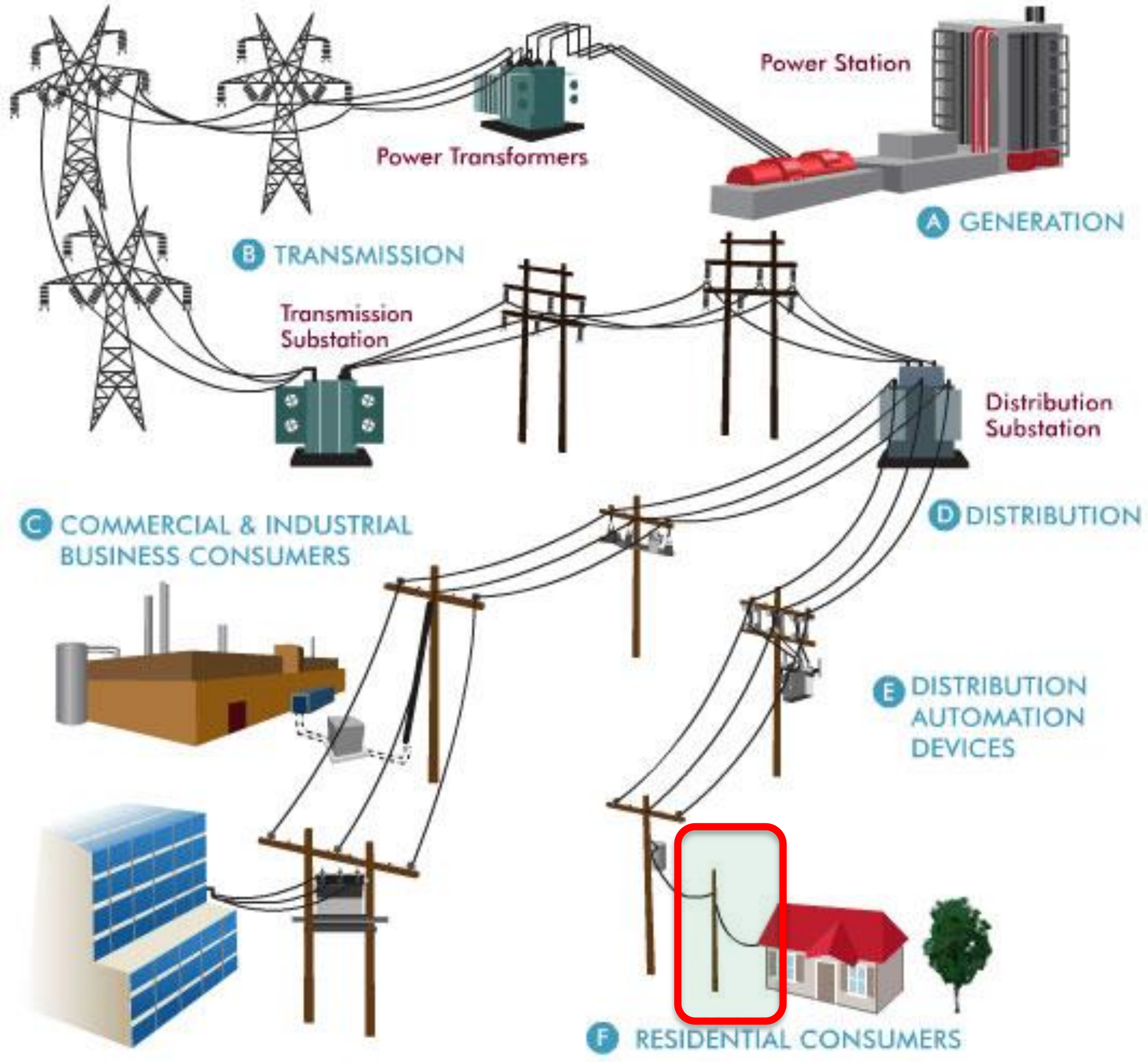
Minimum System Method

~50% of Distribution System Classified as Customer-related



Basic Customer Method

ONLY Customer-Specific Facilities Classified as Customer-related

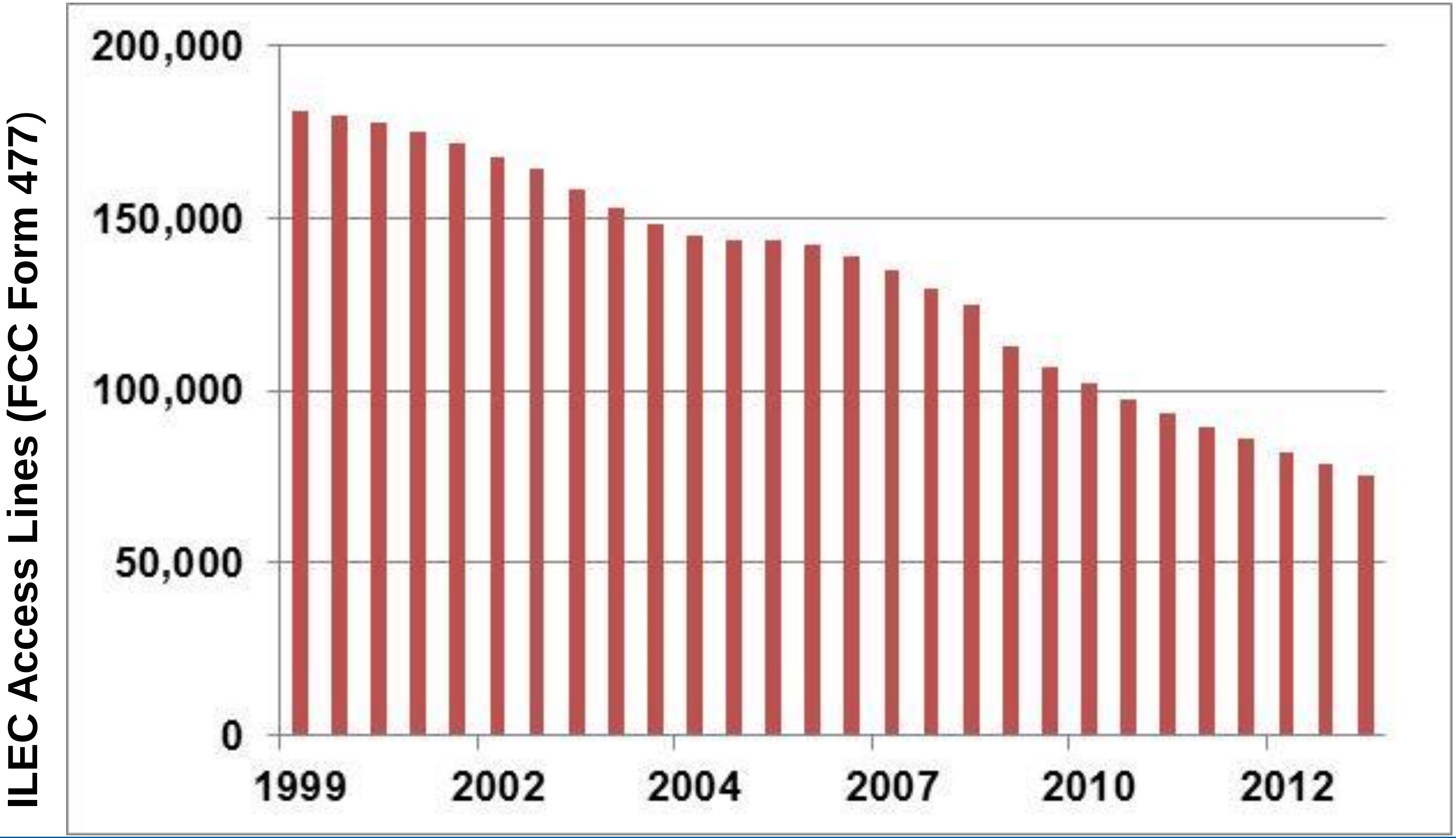


Comparing Methods

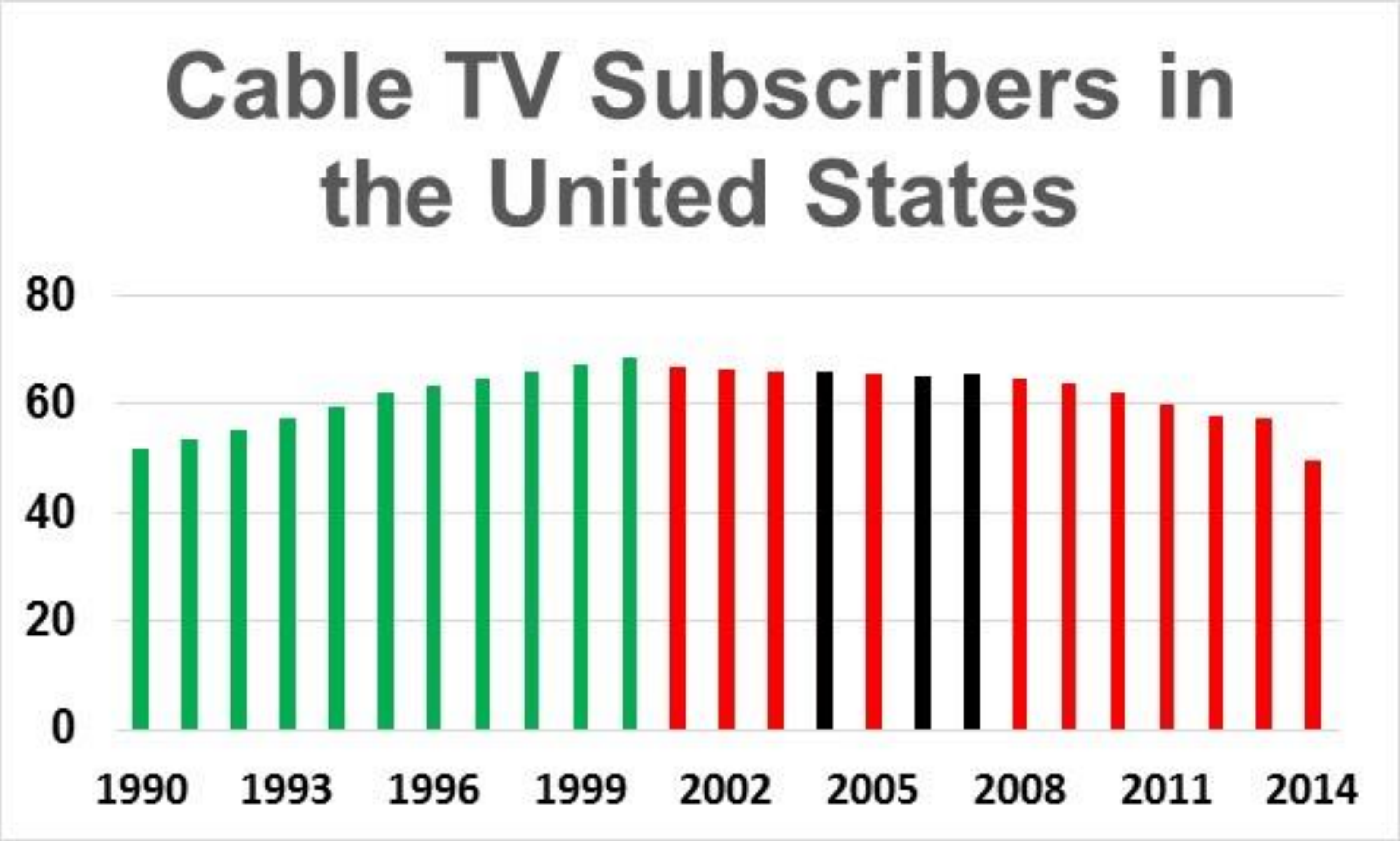
Cost Category	Straight Fixed/ Variable	Minimum System Method	Basic Customer Method
	$/month/customer		
Poles	$ 10	$ 5	$ -
Wires	$ 20	$ 10	$ -
Transformers	$ 10	$ 5	$ -
Services	$ 1	$ 1	$ 1
Meters	$ 1	$ 1	$ 1
Billing	$ 2	$ 2	$ 1
Customer Service	$ 2	$ 2	$ 1
Totals	**$46**	**$26**	**$4**

Other Competitive Industries?

Experience of Landline Phone Companies?



Cable TV Rates



Discussion / Q & A

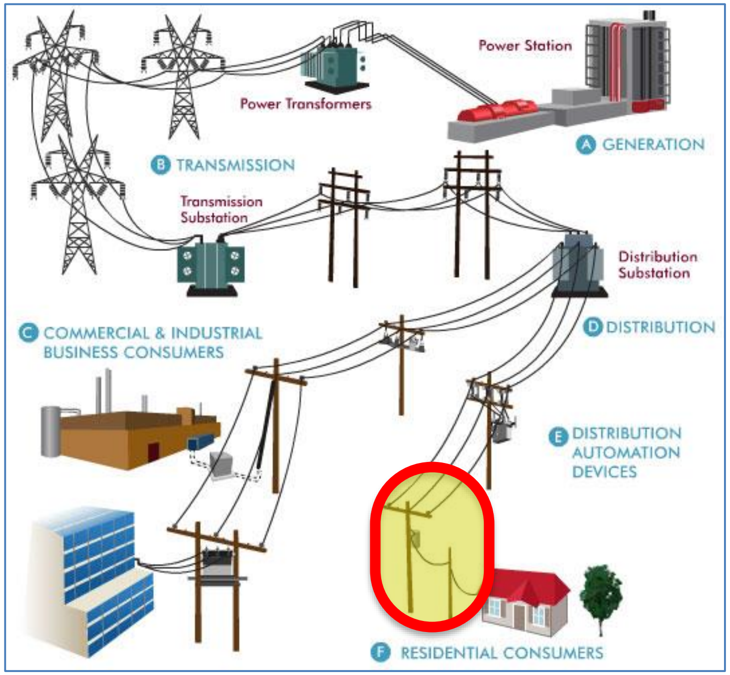
Demand Charges

Basic Tariff For Large Commercial Customer	
Rate Element	**Price**
Customer Charge $/month	$20.00
Demand Charge $/kW/month	$10.00
Energy Charge $/kWh	$0.08

- Old demand charges pre-dated interval metering
- Were used as a proxy for customer peak usage

Problem #1: Very Few Costs Are Related to Small Customer-Specific Demand

- Most of the distribution system is shared, and sized to the group **coincident peak** (CP) demand.
- Only the customer's connection to the system is sized based on customer **non-coincident peak** (NCP) demand.



Lower Load-Factor Customers Can Share Capacity

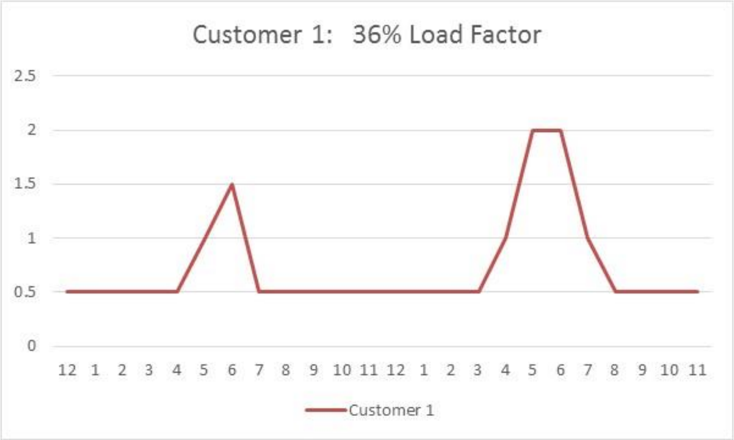
- Morning loads
- Evening loads
- 24/7 loads

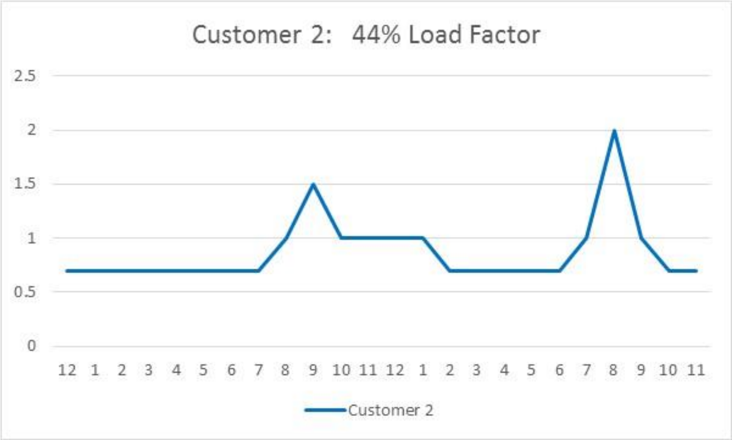
High School Stadium Lighting: A Caricature of the Problem

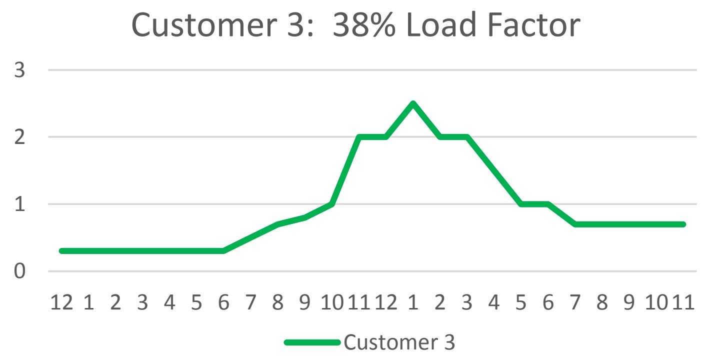
CP: None

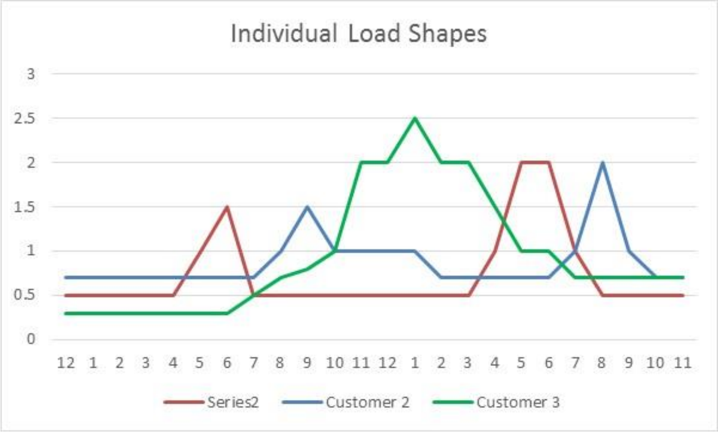
NCP: 1% Load Factor

Basic Issue #2: Individual Load Shapes Vary

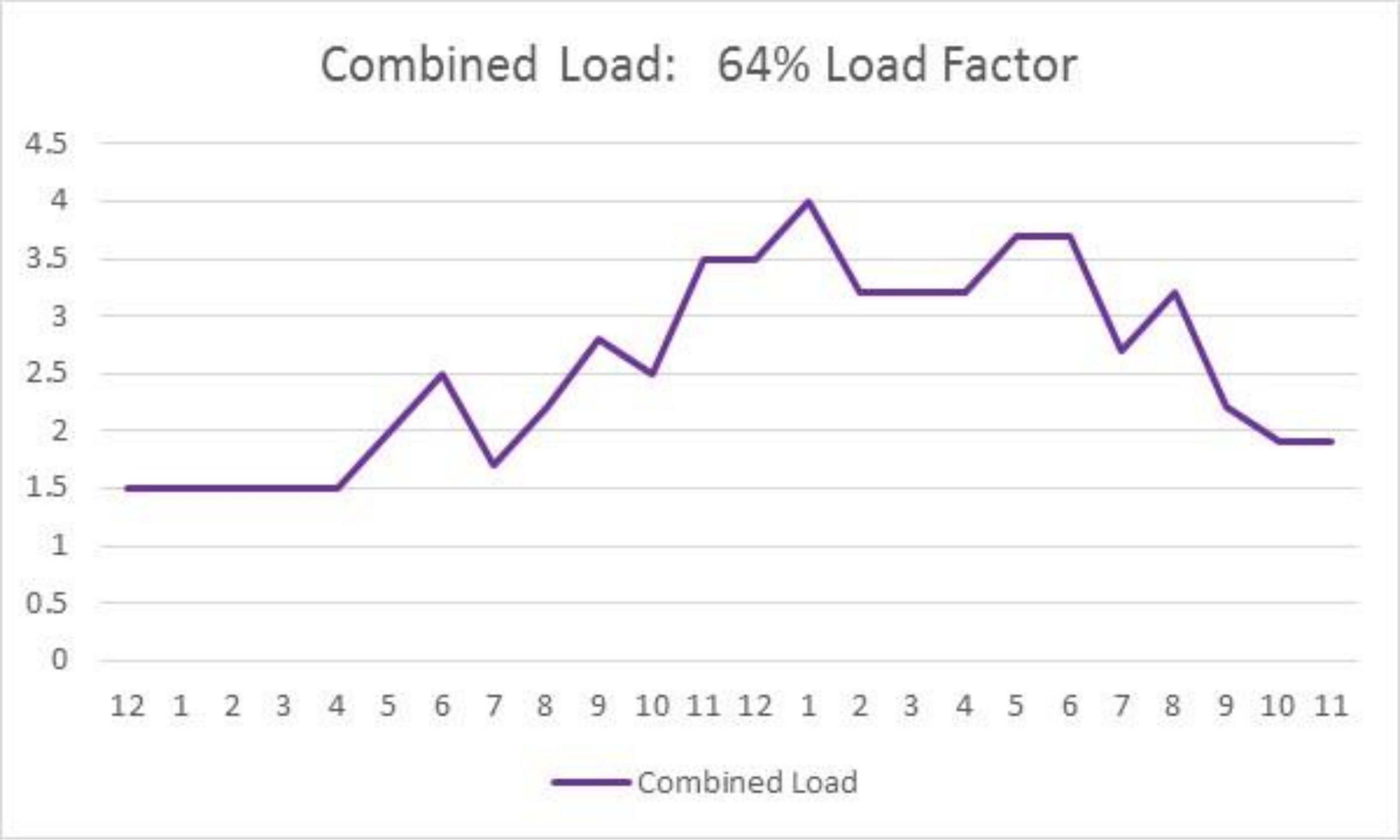








Utility Sees the **Combined** Load of Many Customers With Different Shapes



Demand Charges Shift Costs to Occasional Users

- If the Demand Charge were $10/kW:
  - Use 5 kW for **1 hour** in a month => demand charge of **$50**
  - Use 5 kW for **720 hours** in a month => demand charge of **$50**

A Cost-Based Residential Demand Charge Rate
EdF (France) Base Rate

Typical Dwelling Units	Contract power-rating (kVA)	Subscription Including Tax $/month	Price per kWh incl. tax $/kWh	Incre-mental $/kW / Month
Apartments	**3**	$ 4.76	$ 0.154	
	6	$ 7.73	$ 0.154	$ 0.99
Small SF Home	**9**	$ 10.24	$ 0.154	$ 0.84
	12	$ 15.75	$ 0.154	$ 1.84
	15	$ 18.07	$ 0.154	$ 0.77
Large SF Home	**18**	$ 20.78	$ 0.154	$ 0.90
	24	$ 44.24	$ 0.154	$ 3.91
	30	$ 54.67	$ 0.154	$ 1.74
	36	$ 63.32	$ 0.154	$ 1.44

Discussion / Q & A

Inclining Block Rates (IBR)

- A common rate design globally
- Goals include
  - Allocation of low-cost resources
  - Recognition of load
  - Encouragement of conservation
  - Essential needs at affordable cost
  - Low-income benefits

Residential Inclining Block Rate

City of Palo Alto (California)	
Customer Charge	None
First 300 kWh	$0.096/kWh
Next 300 kWh	$0.130/kWh
Over 600 kWh	$0.174/kWh

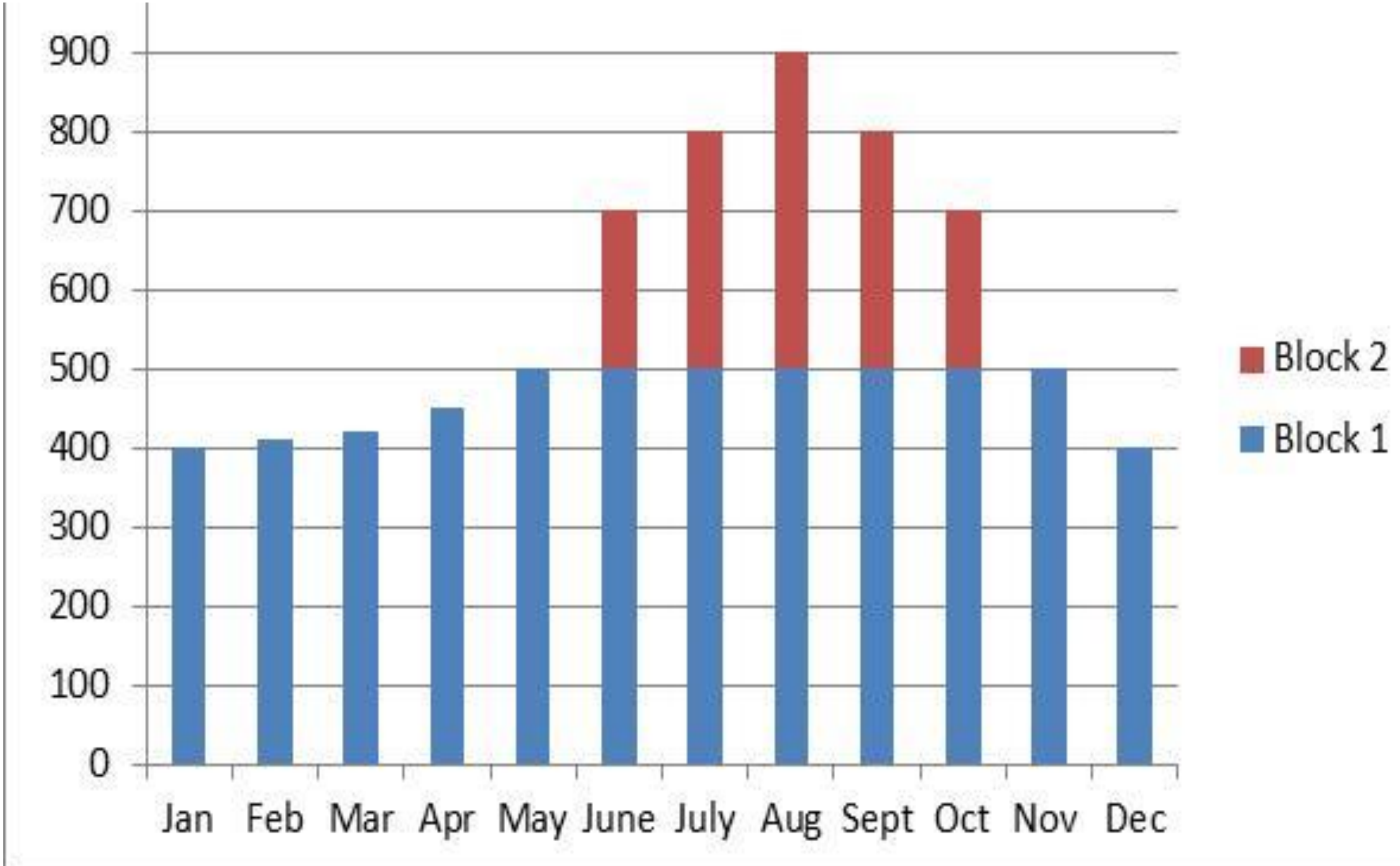
How an Inclining Block Rate Affects Most Consumption

Usage Block	% of Customers Whose Usage Ends In This Block	% of kWh Sales To Customers Whose Usage Ends in This Block	% of kWh Sales to Customers Whose Usage Exceeds This Block
0 - 250	29%	8%	92%
251 - 500	33%	23%	69%
501 - 750	17%	20%	51%
751 - 1,000	9%	15%	34%
>1,000	12%	34%	
Average Monthly kWh Usage:			526

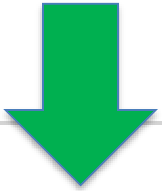
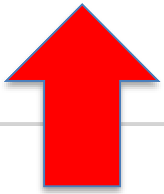
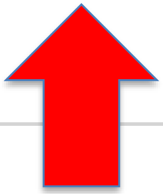
Seasonal + Inclining Block

Arizona Public Service Company (Arizona) Optional TOU Available		
	Winter	Summer
0 – 400 kWh	$0.0942	$0.0969
401 – 800 kWh	$0.0942	$0.1382
801 – 3,000 kWh	$0.0942	$0.1617
Over 3,000 kWh	$0.0942	$0.1726

An Inclining Block Rate *Can be* a Seasonal Rate



Impact of Rate Design on Usage

	Simple Flat Rate	Inclining Block	High Fixed Charge	Demand Charge
Customer Charge	$ 5.00	$ 5.00	$ 45.00	$ 5.00
Demand Charge	None	None	None	$8.00/kW
First 500 kWh	$ 0.12	$ 0.08	$ 0.08	$ 0.08
Over 500 kWh	$ 0.12	$ 0.15	$ 0.08	$ 0.08
Impact on Usage				

Discussion / Q & A

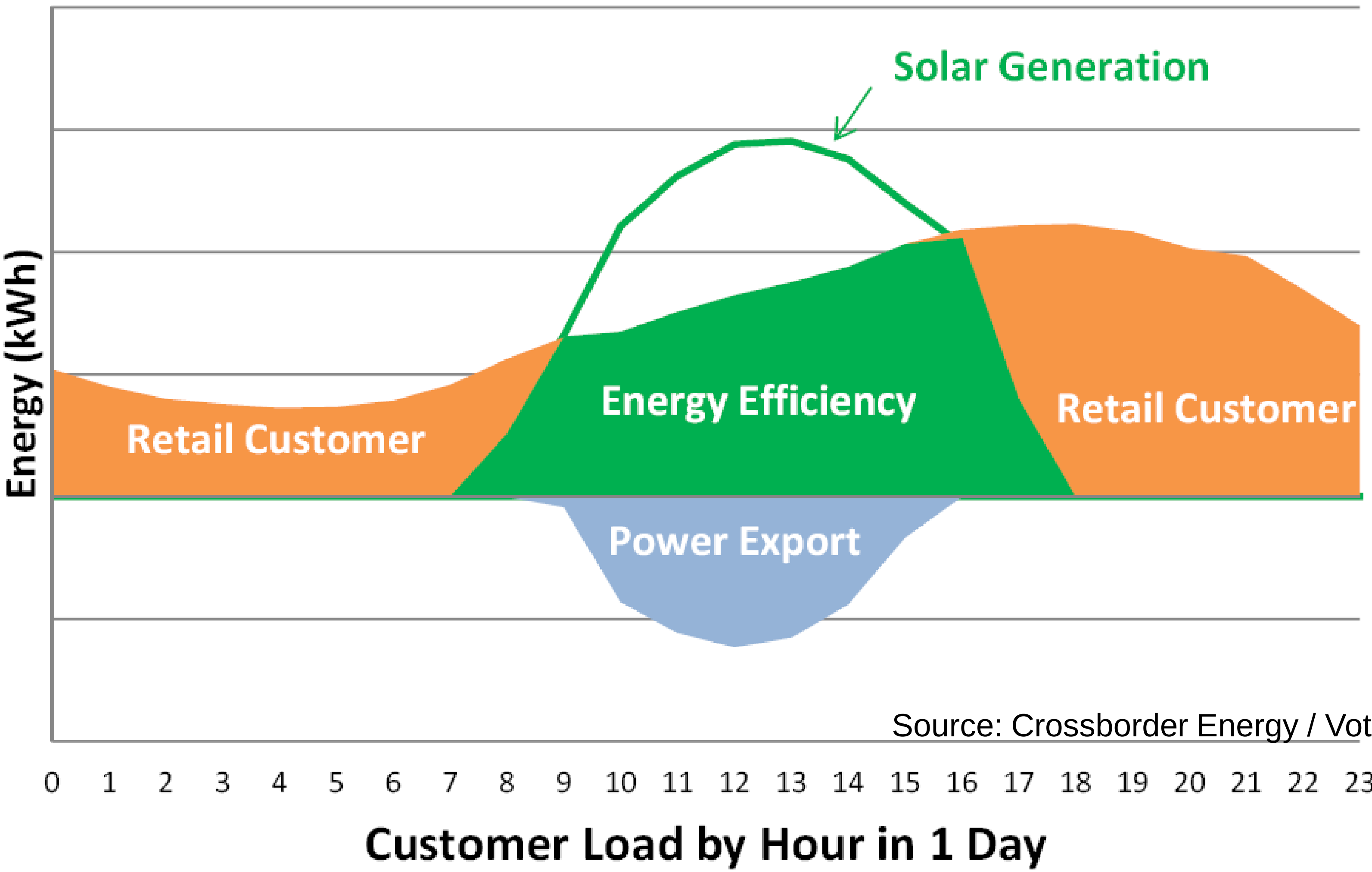
All Kilowatt-Hours Are Not Equal

Local Organic Tomatoes $3.00/lb.

Supermarket Tomatoes $2.00lb.

Local Organic Tomatoes may have different value to consumers.

Issues With Home-Grown Electricity

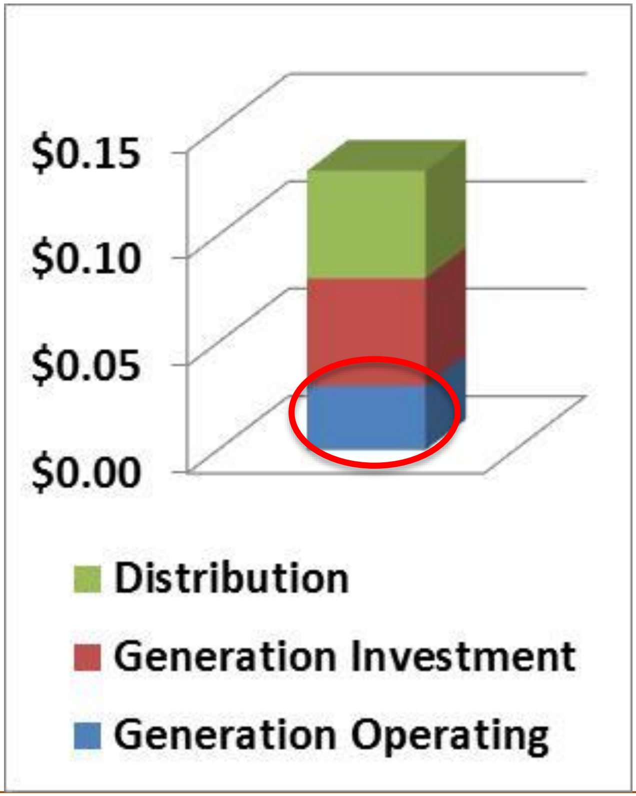


Source: Crossborder Energy / VoteSolar

Two Views of Cost Recovery

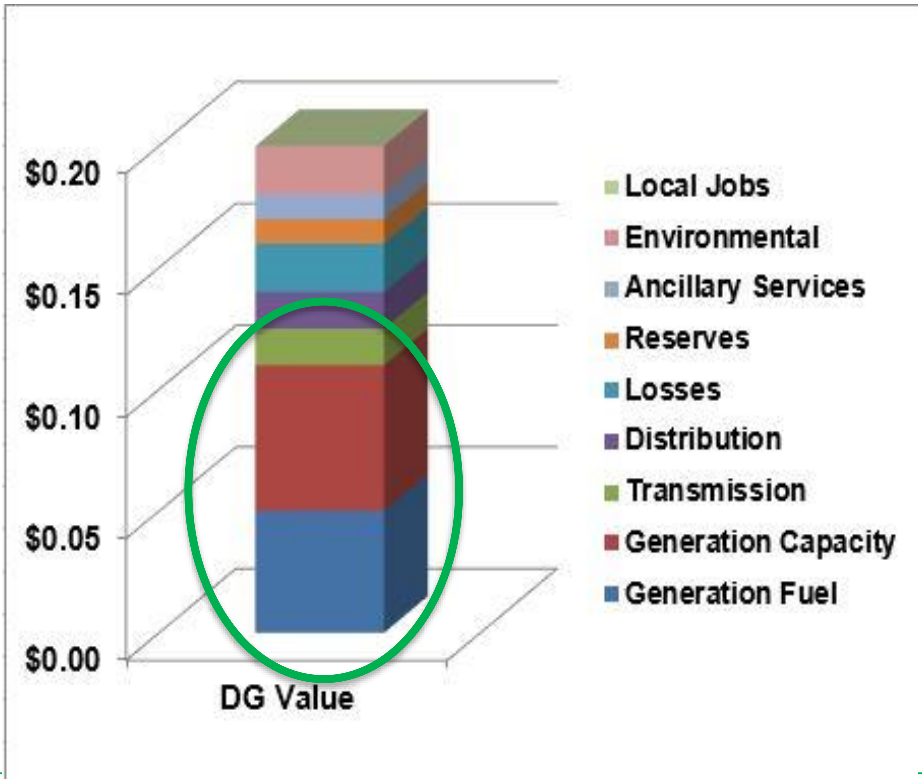
Traditional Utility View

- DG customer “uses” the grid and should pay for it;



Solar Advocate View

- Value of distributed resource is greater than the retail rate;



Traditional Ratemaking View

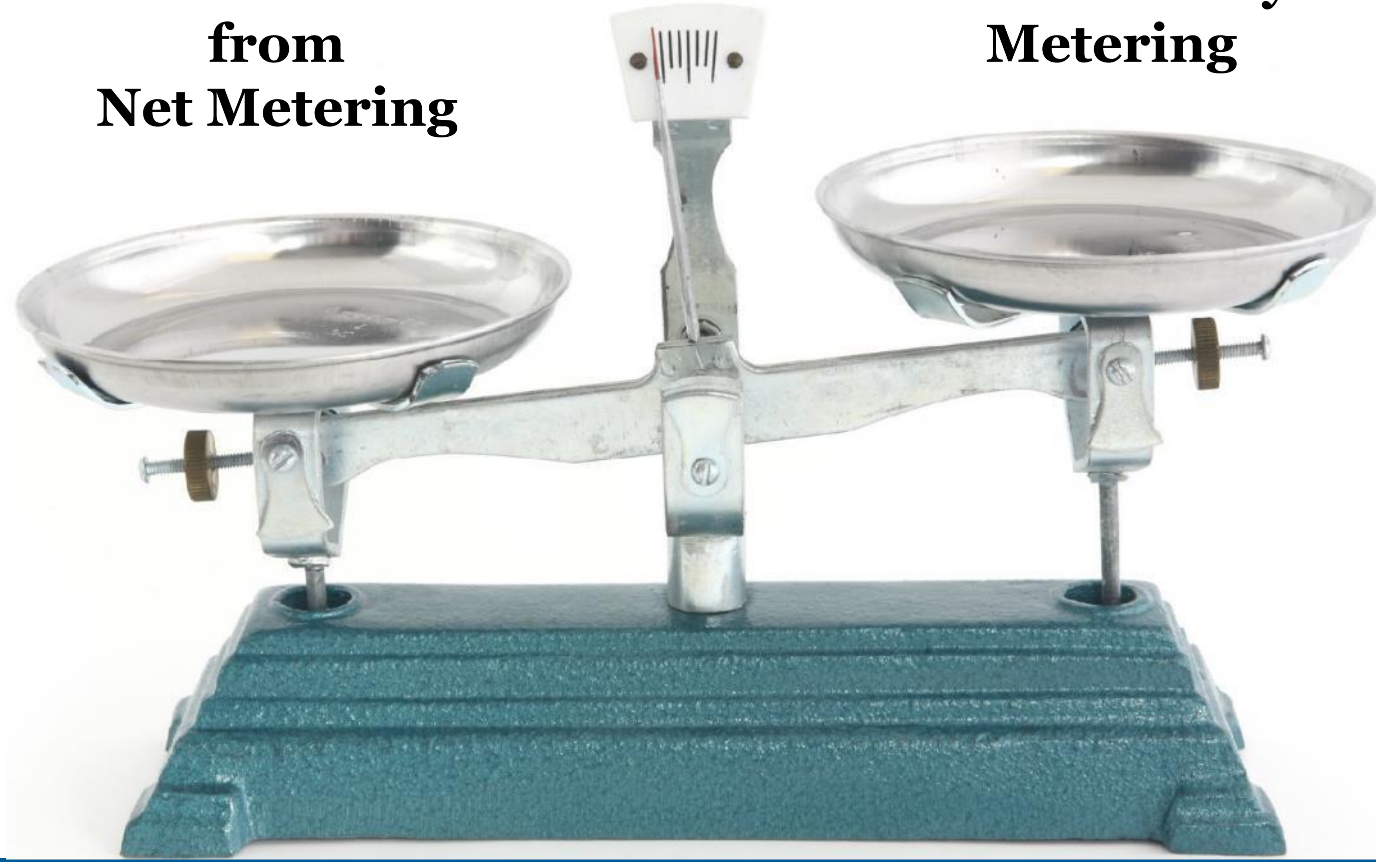
Utility Average Cost of Service

Retail Rates

Critical View of Net Metering

Lost Revenues from Net Metering

Short-run Fuel and Purchased Power Costs Avoided By Net Metering



Solar Advocate View of Net Metering

Lost Revenues From Net Metering

Long-Run Avoided Cost for Generation, Trans, Dist
+ Reduced Emissions
+ Avoided Fuel Cost Risk
+ Avoided Fuel Supply Risk
+ Local Economic Development
+ Future Carbon Costs
+ Shading Benefits on AC Load
+ Much, much more

Smart Grid Cost Allocation

Cost Allocation of Smart Grid Costs: Smart Grid Benefits

- **Reliability** improvement: distribution automation
- **Peak load reduction** through Time of Use and Critical Peak Pricing
- **Loss reduction:** voltage control, power factor correction, phase balancing
- **Remote shut-off** and turn-on
- Reduced O&M expense for **meter reading**

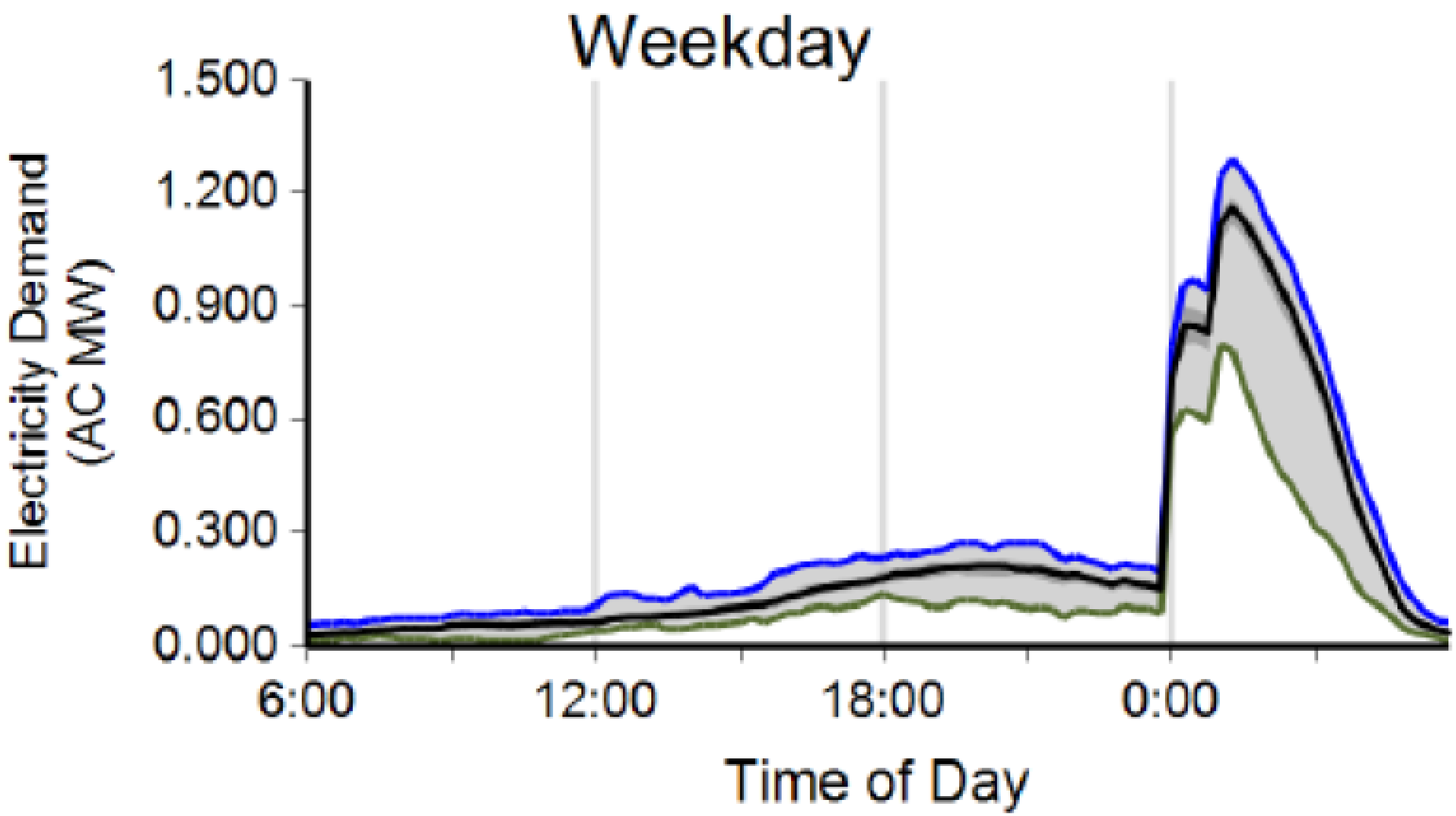
Cost Allocation of Smart Grid Costs

Smart Grid Element	Pre-Smart Grid Element	"Traditional" FERC Account	Traditional Classification		Smart Grid Classification
Smart Meters	Meters	370	Customer		Demand / Energy / Customer
Distribution Control Devices	Station Equipment	362	Demand		Demand / Energy
Data Collection System	Meter Readers	902	Customer		Demand / Energy / Customer
Meter Data Management Syste	General Plant	391 - 397	Subtotal PTDC		Demand / Energy / Customer
Smart Grid Managers	Customer Accounts Supervision	901	Customer		Demand / Energy
Energy Storage Devices (Batteries; Ice Bear)	Installations on Customer Premises	371	Customer		Demand / Energy

Electric Vehicles

- Market for off-peak power
- Provide multiple ancillary services
- Potential Source of on-peak power (V2G)

San Diego's Off-Peak Charging



Water Heaters

- Peak load reduction
- Off-peak load augmentation
- Heat pump water heaters COP 3.3

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

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