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Building Rate Design for EVs from the Ground Up

NARUC Staff Subcommittee on Rate Design

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Outline

- What’s special about EVs?
- Regulatory principles
- Time-based cost allocation and rate design
- Options in practice
- Summary and resources

1 What’s Special About EVs?

Three Levels of EV Charging

Level 1: Standard household outlet (120 Volts)

1.5 kW 4 miles range per hour

Level 2: High-capacity residential circuit (240 Volts)

6.6 to 19 kW 20 miles range per hour

Level 3: Fast commercial chargers in public areas with very large electricity connection:

Up to 350 kW 200 miles range per hour

Basic EV Charging is a Lot Like… An Electric Water Heater!

Really!

Basic EV Charging

- 3.3 – 6.6 kW
- 2,000 – 4,000 kWh/year
- Can avoid peak charging
- Batteries likely equal a full day's supply

Water Heater

- 4.4 – 5.5 kW
- 2,000 – 4,000 kWh/year
- Can avoid peak charging
- Tank usually covers a full day's supply

Bigger Applications Raise Bigger Questions

- Residential EV truck adoption
  - Special chargers with 19 kW power draw
- Fast chargers
  - 40 kW to 350 kW
- Medium- and heavy-duty vehicles
  - High power draw
  - Route timing, battery capacity, and charging time

Fast Charging and Demand Charges

Non-coincident peak demand charge	**$10/kW**	**100 kW**	**$1000**
Energy charge (not time-differentiated)	$0.10/kWh	1000 kWh	$100.00
Total bill			$1100.00
Average $/kWh			$1.10

Non-coincident peak demand charge	**$2/kW**	**100 kW**	**$200.00**
Energy charge	$0.12	1000 kWh	$120.00
Total bill			$320.00
Average $/kWh			$0.32

State and Federal Policy Goals for EVs

- Improved public health
- GHG emissions reductions
- Energy independence
- Lowering consumer fuel expenditures

2 Regulatory Principles

Why and How Do We Regulate Utilities?

- Public policy goals
  - Efficient competition and control of monopoly pricing
  - Reliable provision of service
  - Societal equity (e.g., universal access and affordability)
  - Environmental and public health requirements
- Principles for setting utility prices
  - Effective recovery of revenue requirement
  - Customer understanding, acceptance, and bill stability
  - Equitable allocation of costs
  - Efficient forward-looking price signals

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.

Cost Causation for Electric System

- Shared system serves joint needs of all customers across all hours of year
- Each function has distinct cost drivers
  - Fuel, spot energy and some contract purchase costs vary by time
  - Coincident peaks drive generation resource adequacy, while year-round load patterns determines capacity mix and thus costs
  - Coincident peaks matter in T&D sizing, but energy flows and line losses are important
  - Basic meters are for billing, but costs of AMI are incurred for broad array of purposes

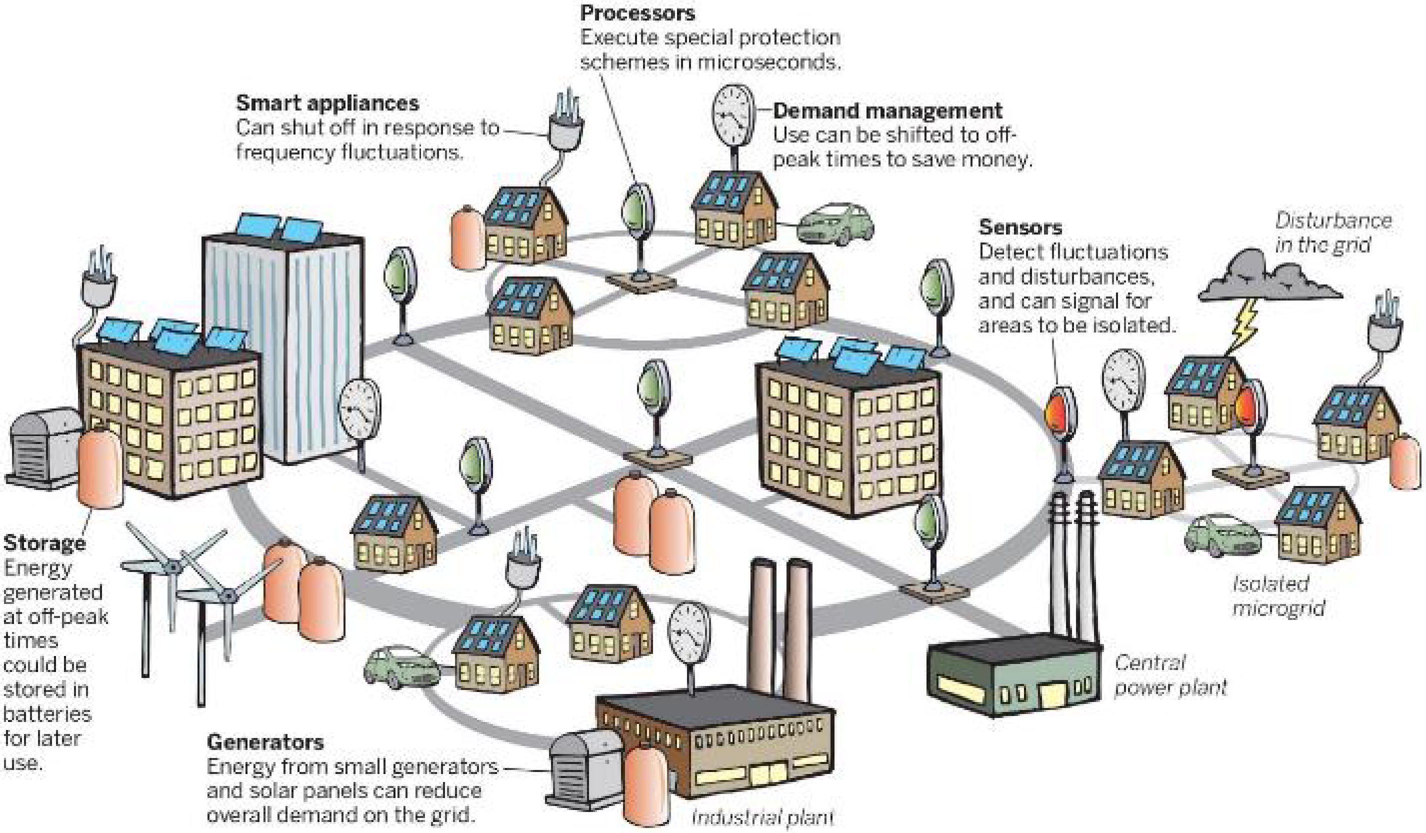
All Technologies and Behaviors

- Energy usage and management
- Distributed generation
- Storage
- Electric vehicles
  - Vehicle and charging options
- Electric heating
  - Equipment and weatherization options

Discounts and Economic Development Rates

- Pros
  - Advance public policy
  - Potentially lower rates for other customers
- Cons
  - Complexity
  - Encourages dependence

Electric System of the Future



Source: Adapted from U.S. Department of Energy. (2015). *United States Electricity Industry Primer*

3 Time-Based Cost Allocation and Rate Design

1992 NARUC Cost Allocation Manual

Typical cost classifications used in cost allocation studies are summarized below.

Typical Cost Function	Typical Cost Classification
Production	Demand Related Energy Related
Transmission	Demand Related Energy Related
Distribution	Demand Related Energy Related Customer Related

1992: NARUC Electric Utility Cost Allocation Manual, p. 21

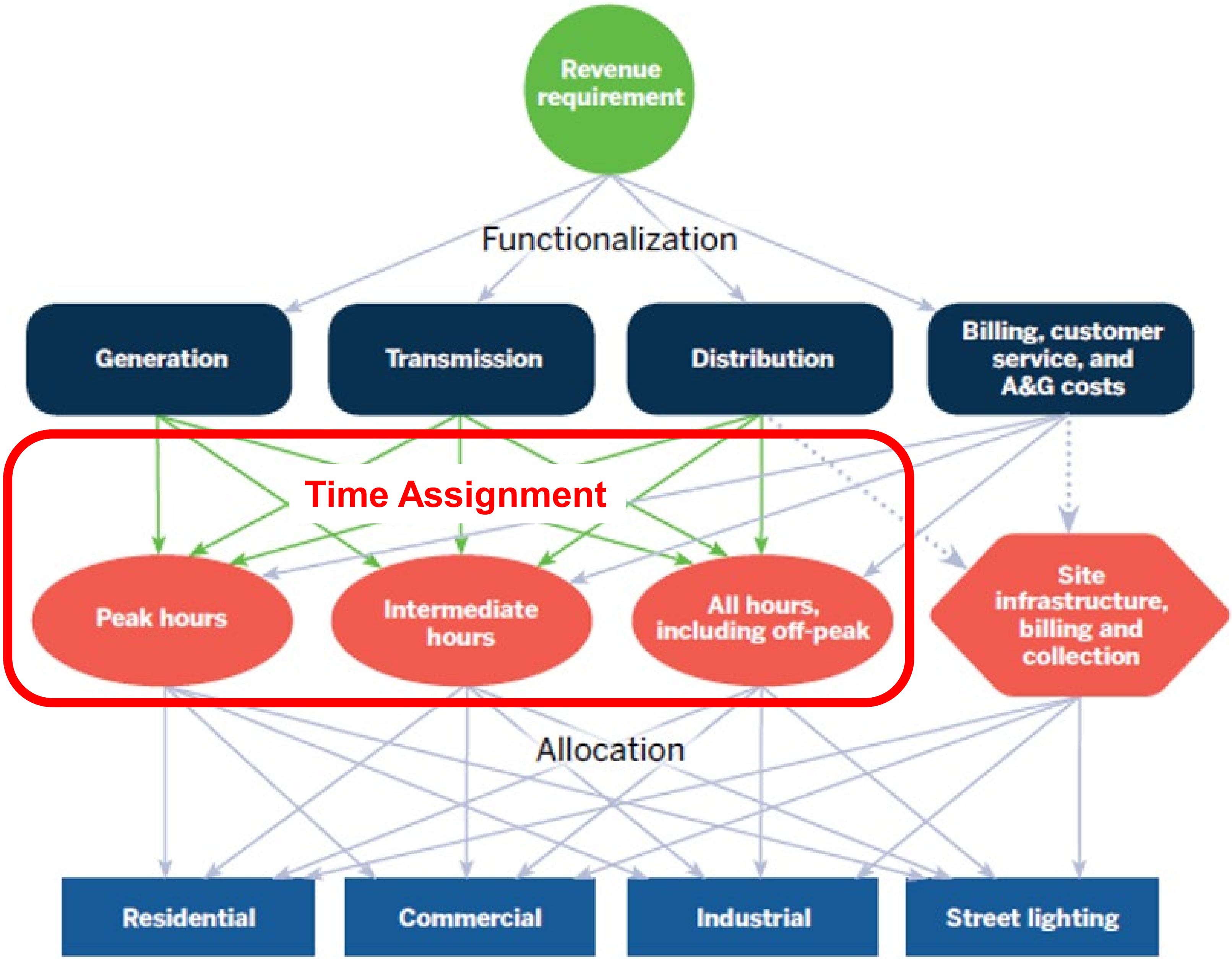
Issues With Traditional Demand & Energy Allocators

- Demand at what hours?
  - System peak, equipment peak, or class peak?
  - Demand allocators typically only use a subset of the relevant hours
- Energy-classified costs are usually allocated using <u>annual</u> kWh usage
  - Fails to reflect time-varying costs
- Time-based allocation addresses these issues

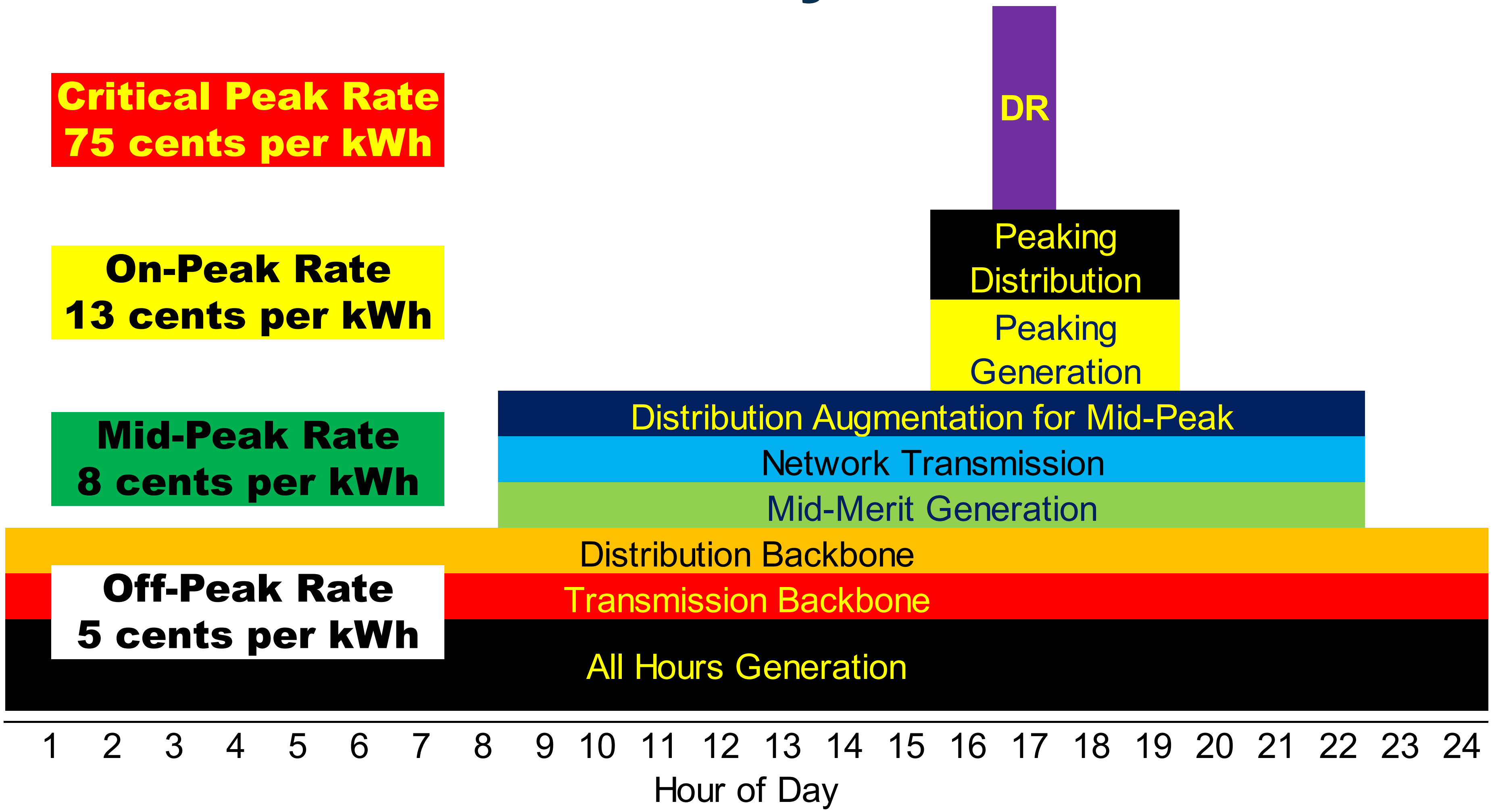
Issues with Demand Charges

- Historic justifications for demand charges are fading away
  - Advanced metering brings new capabilities
  - Generation options, net load patterns, and reliability risks are changing
- Demand charges are an inefficient way to price shared system capacity generally
  - Overcharge customers that consume relatively more at off-peak times
  - Overcharge customers with load diversity and undercharge customers that hog capacity
- Narrower applications for demand charges may be appropriate
  - Likely a proxy for more sophisticated system of time- and location-varying rates

Modern embedded cost of service study flowchart



Build a Cost-Based TOU Rate for Shared Elements of System



Illustrative Smart Rate Design

	Residential	Medium C&I
Customer Charge ($/mo.)	Multifamily: $7 Small Single-Family: $10 Large Single-Family: $15	$100
Site Infrastructure ($/kW)	N/A	$2
Off-peak (cents per kWh)	7 cents	5 cents
Mid-peak (cents/kWh)	9 cents	8 cents
On-peak (cents/kWh)	14 cents	13 cents
Critical peak (cents/kWh)	75 cents	75 cents

4 Options in Practice

Spectrum of Options

- Rate design reform generally
- Special rates and discounts
- Demand response and managed charging
- Transactive energy and V2X

Time-Varying Rate Design Parameters

- Goals of time-varying rate design
  - Improve cost causation basis of rates and intra-class cost allocation
  - Avoiding adverse impacts to revenue stability and individual customer bills
  - Keep rates understandable and allow customers to manage their bills
- Key design choices
  - Which customers?
  - What time patterns?
  - Which costs?
  - How do you ensure customer understanding and minimize adverse bill impacts?

Considerations Beyond Efficient Pricing

- How complex is too complex for a given set of customers?
  - How flexible is the given EV charging application?
  - What other types of usage will be on this rate?
  - What transition measures or assistance can be given to customers?
- How are costs being allocated overall?
  - Setting rates between marginal costs and fully allocated costs can be justified, but should be thought through
- Special metering, billing, and administrative costs
- Technology-specific rates have pros and cons
  - Administrative complexity
  - Discounts create lock-in

OG&E Residential – Summer Variable Peak Pricing

Customer Charge ($/mo)	$13.00

Off-Peak (cents/kWh)	3.6
On-Peak (cents/kWh)	
Low	3.6
Standard	8.5
High	19.7
Critical	41.6

SMUD – Medium General Service Time-of-Day Rate – Primary

Customer Charge ($/mo.)	$281.50	
Site Infrastructure ($/kW)	$2.96	
	Non-Summer	Summer
Off-peak saver (cents per kWh)	6.8 cents	N/A
Off-peak (cents/kWh)	10.8 cents	10.2 cents
On-peak (cents/kWh)	12.4 cents	20.1 cents
Summer demand charge ($/kW)	N/A	$9.67

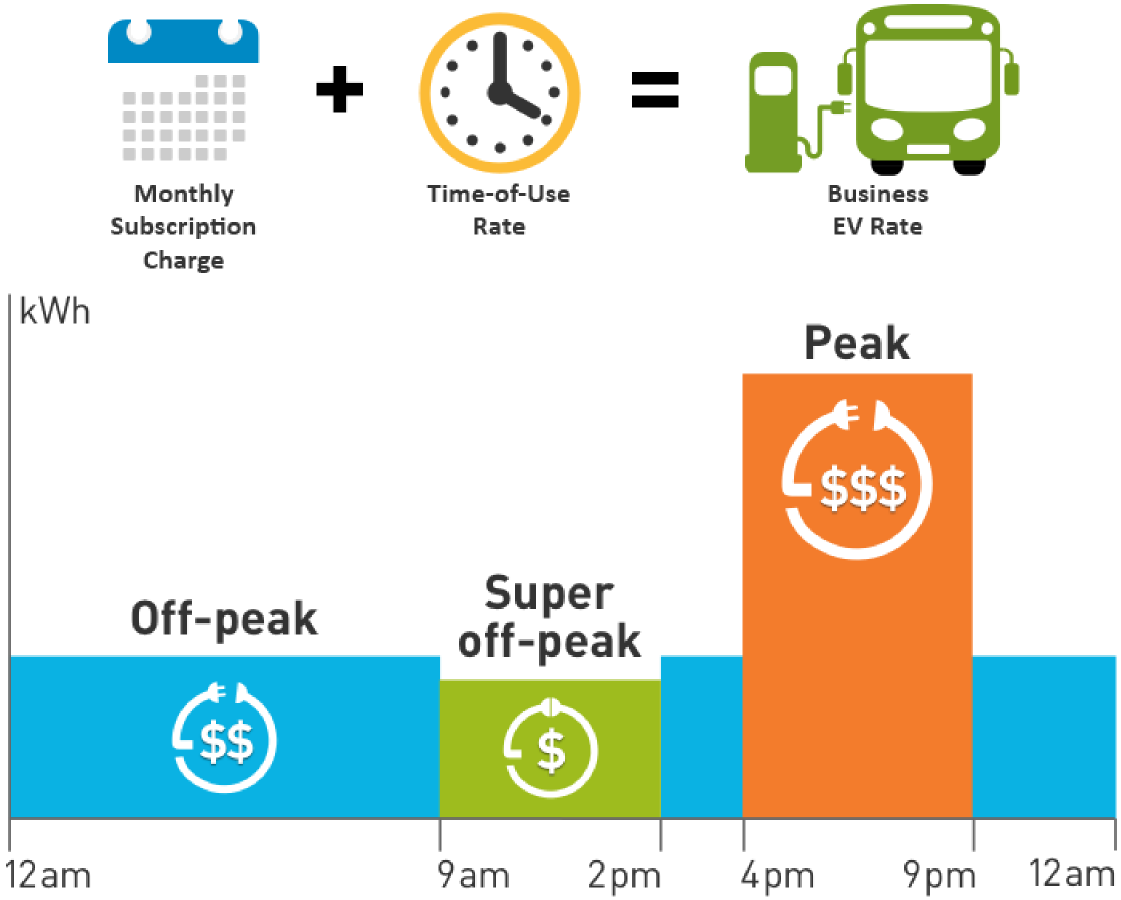
Burbank Municipal Power Optional TOU for EV Owners

Customer Charge ($/mo.)	$9.76	
Site Infrastructure ($/mo.)	Small: $1.48 Medium: $3.00 Large: $8.99	
	Non-Summer	Summer
Off-peak (cents/kWh)	8.8 cents	8.8 cents
Mid-peak (cents/kWh)	17.7 cents	17.7 cents
On-peak (cents/kWh)	N/A	26.6 cents

Eversource CT EV Rate Rider

- Available for public level 2/3 chargers and private chargers participating in managed charging
- Must be separately metered
- "Rates for electric service provided to a facility under this rider shall be determined in accordance with the Company's general service rate schedule that would otherwise apply to the load being served. Where a rate component of such schedule is priced on a demand basis (i.e., per kW or per kVA) the EV customer under this Rider will be subject to a charge determined on an equivalent per kWh basis using the corresponding average price of such rate component."

PG&E Commercial EV Rate



MA ConnectedSolutions for EVs

- $50 to enroll in program, $20 payment annually to stay in program
- Only certain auto manufacturers can participate
- Charging pauses during peak event and resumes afterwards

Transactive Energy Rates Across the Country

- New York Value of Distributed Energy Resources Tariff
- New Hampshire Electric Cooperative Transactive Energy Rate Pilot
- CalFUSE proposal

4 Summary and Resources

Summary

- Electric vehicles are special but not THAT special
- Major opportunities for rate design reform in a modernizing electric system
- We need to strike a balance between current public policy needs and broader regulatory principles

Resources from RAP

- Electric Cost Allocation for a New Era: A Manual
- Smart Rate Design for a Smart Future
- Demand Charges: What are They Good For?
- Smart Non-Residential Rate Design
- Electricity Regulation in the U.S.: A Guide

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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