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Building Rate Design for EVs from the Ground Up

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Outline

- Regulatory principles
- Time-based cost allocation and rate design
- Time-varying rate design in practice
- Summary and resources

1 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
 - Investments and behavioral choices
- Distributed generation
- Storage
- Electric vehicles
 - Choice of vehicle and charging efficiency
- Electric heating
 - Investment and weatherization options

2 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

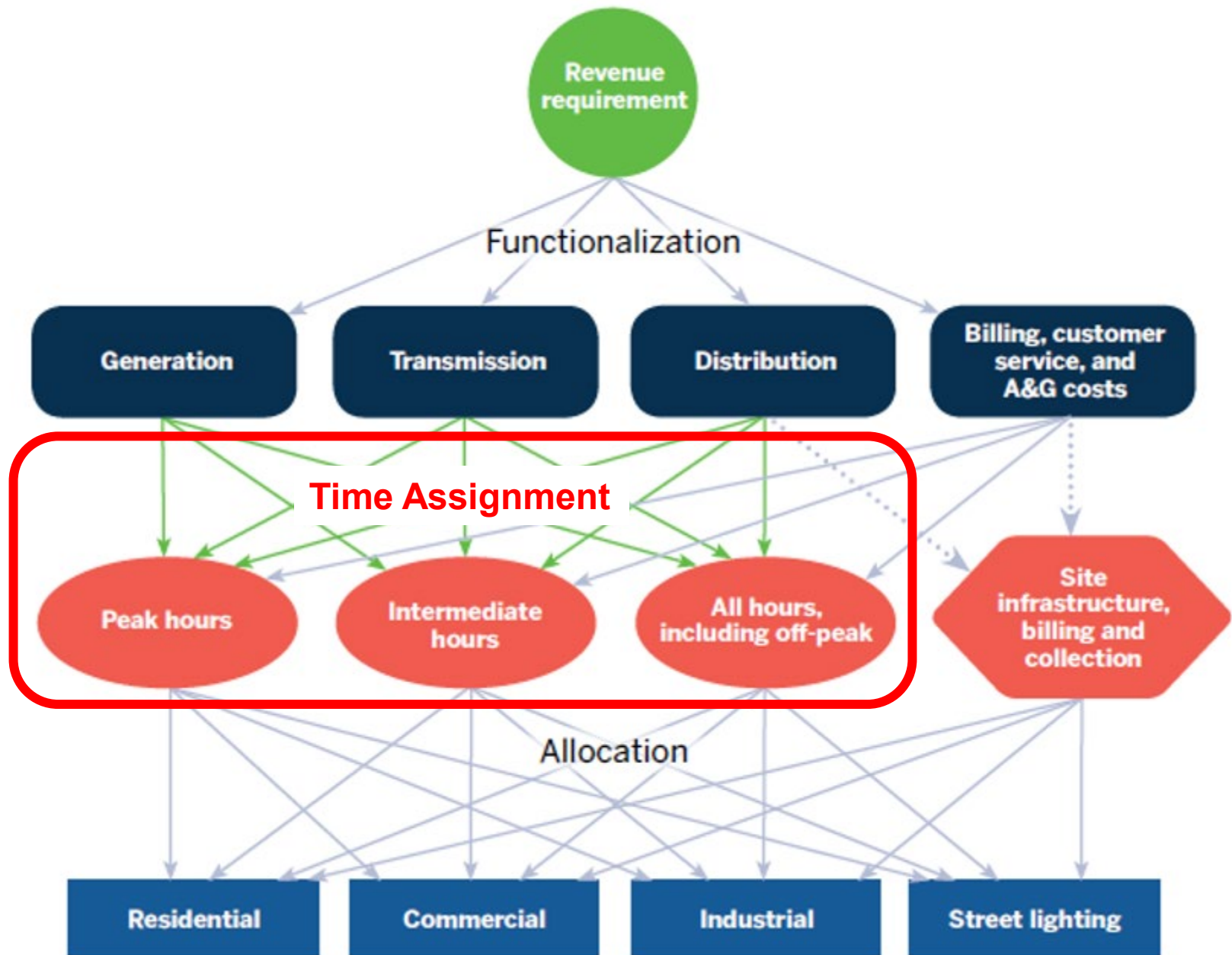
- Demand at what hours?
 - System peak, equipment peak, or class peak?
 - Demand allocators typically only use a subset of the relevant hours
- Energy-classified costs are usually allocated using annual kWh usage
 - Fails to reflect time-varying costs
- Time-based allocation addresses these issues

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

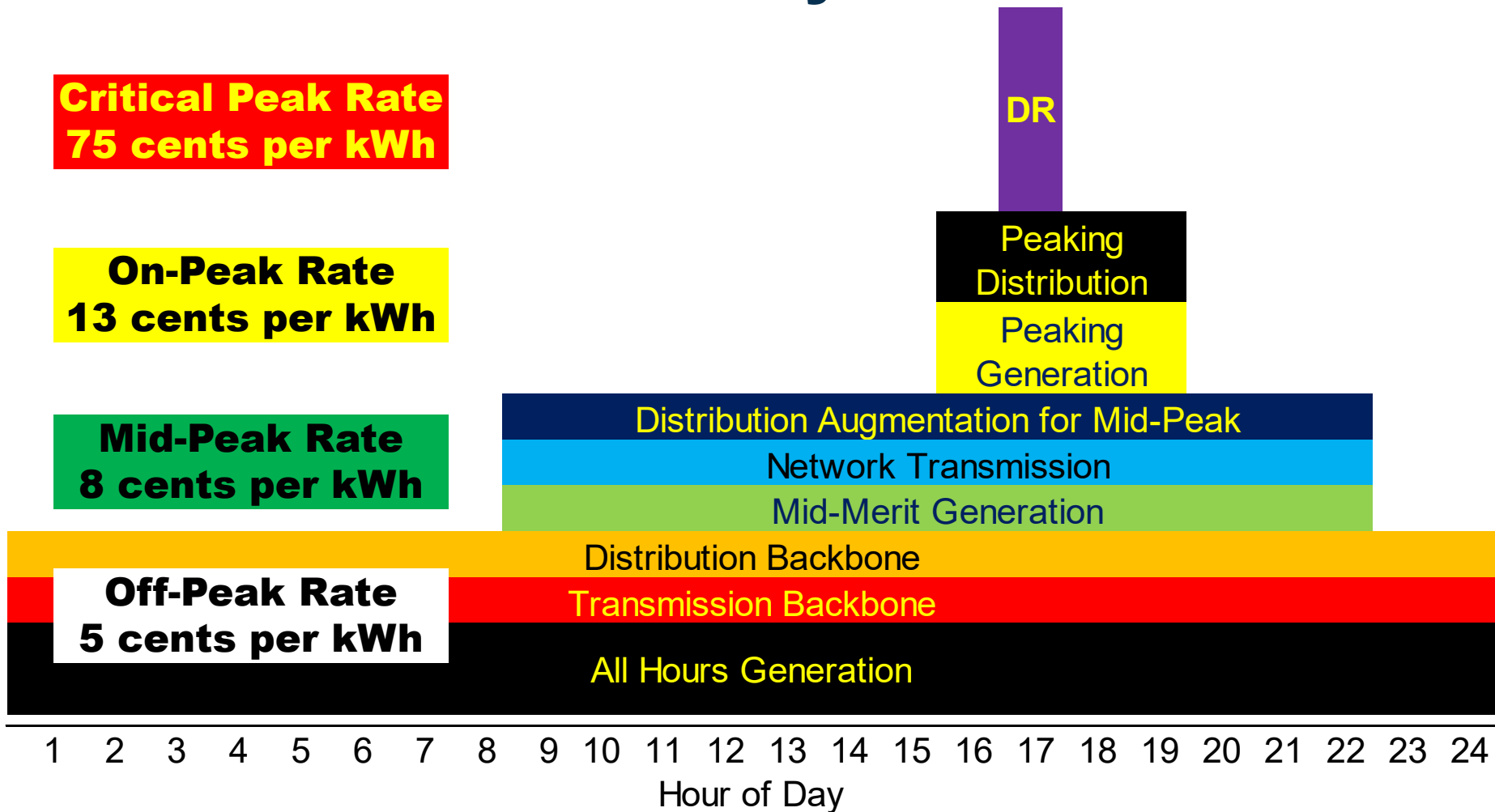


Modern embedded cost of service study flowchart





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

3 Time-Varying Rate Design in Practice





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?

Fort Collins Residential TOU

Customer Charge (\$/mo.)	\$8.59	
	Non-Summer	Summer
Off-peak (cents/kWh)	7.2 cents	7.2 cents
On-peak (cents/kWh)	22.4 cents	26.2 cents
Tier Charge	Additional 2.5 cents over 700 kWh	

Burbank Municipal Power Optional TOU for EV Owners

Customer Charge (\$/mo.)	\$8.99	
Site Infrastructure (\$/mo.)	Small: \$1.37 Medium: \$2.76 Large: \$8.27	
	Non-Summer	Summer
Off-peak (cents/kWh)	8.2 cents	8.2 cents
Mid-peak (cents/kWh)	16.3 cents	16.3 cents
On-peak (cents/kWh)	N/A	24.5 cents



OG&E Residential – Summer Variable Peak Pricing

Customer Charge (\$/mo)	\$13.00
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Off-Peak (cents/kWh)	3.27
On-Peak (cents/kWh)	
Low	5
Standard	10
High	22
Critical	41

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

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
- Technology-specific rates have pros and cons
 - Administrative complexity
 - Discounts create lock-in

4 Summary and Resources



Summary

- Time-varying pricing, based on good cost causation analysis, can lower future system costs and allocate costs fairly across customers
- Demand charges and the demand classification should be reexamined generally
- Complexity of time-varying pricing can vary and involves qualitative tradeoffs



Resources from RAP

- [Smart Rate Design for a Smart Future](#)
- [Demand Charges: What are They Good For?](#)
- [Taking First Steps: Insights for States Preparing for Electric Transportation](#)
- [Beneficial Electrification \(four-part series\)](#)
- [Principles of Modern Rate Design](#)
- [Smart Non-Residential Rate Design](#)
- [Getting from Here to There – Regulatory Considerations for Transportation Electrification](#)
- [EV grid blog post – Calming Chicken Little](#)

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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Key Terms for Rate Design

- **Customer Charge:** Fixed monthly fee to access utility service
- **Energy Charge:** Price per kWh of consumption
- **Demand charge:** A rate charged on a customer's highest 15- or 30-minute individual peak usage
 - Typically defined as highest non-coincident individual peak over whole month, but sometimes during “peak window”

Key Terms for Rate Design

- **Time of use (TOU) rate:** Time-varying kWh prices with preset times and price schedules
- **Critical peak pricing (CPP):** Higher rate for highest 50-100 hours in year
- **Peak time rebate (PTR):** Bill discount for reductions below baseline at peak times
- **Real time pricing (RTP):** Granular price signals that fluctuate in response to system conditions or markets
- **Demand response:** Program that compensates customer for reducing load in response to signal
- **Vehicle-to-grid:** Range of advanced programs to provide grid services from EV batteries