Electric Vehicles: Regulatory Considerations

Presentation to the NARUC Staff Subcommittee on Accounting & Finance

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Regulatory Assistance Project

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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
Outline

• Technology, Trends, and Electrification in Perspective
• The Role of Pilot Programs, Data, and Reporting
• EVs and Rate Design
Technology, Trends, and Beneficial Electrification
U.S. Light-Duty EV Sales Have Increased Dramatically

Source: https://electricdrive.org/index.php?ht=d/sp/i/20952/pid/20952
States Had to Go It Alone, But Developed Strong Models

- EV Policy:
  - CA, MA, NY, MD, MN, MI, CO
- Other policies:
  - ZEV
- California ACT & VGI
- Transportation Climate Initiative -- TCI
The New Administration

- Admin’s climate response
- Exec. Order federal vehicles
- Secretary Buttigieg:
  - Millions of new EVs …
  - Charging infrastructure …
  - Powered by clean energy …
  - in all parts of the country.
  - New fuel economy standards?
- A renewed PEV Tax Credit?
- Ending taxpayer subsidies for fossil fuel?
Isn’t all electrification created equal?

- Brattle: “Utility sales could nearly double by 2050”!
- Isn’t it all about load growth?
Beneficial Electrification (BE) - Three Conditions

1. Saves Customers Money Over Long-Term
2. Reduces Environmental Impacts
3. Enables Better Grid Management
1. Saves Customers Money Long-Term
Efficiency Across Fuel Types

2. Reduces Environmental Impacts
Power sector fuel mix is changing: MISO example

3. Enables Better Grid Management

GTM, How California Can Shape, Shift and Shimmy to Demand Response Nirvana, January 26, 2017.

Managing Load

EVs can be a benefit … or a problem for the electric grid.

Draw high amounts of power for short periods of time.
Managing Load

*EV load must be managed effectively, otherwise all ratepayers will share in the expensive costs of upgrading and maintaining the distribution system to accommodate increased load on the system.*

Managing Load

Pairing EV adoption and EV charging with intelligent rate design can improve electric distribution system utilization and create downward pressure on rates through load management and system peak reduction.

Rates

EV Capacity Utilization – Low

Driving: ~4%

Parked at home, connected and Charging: ~10%

Parked elsewhere: ~47%

Parked at home, connected: ~40%

Beneficial Electrification (BE) - Three Conditions

1. Saves Customers Money Over Long-Term
2. Reduces Environmental Impacts
3. Enables Better Grid Management
Questions
Pilots – precursor to programs
State and Utility Action on EVs

Figure 1. Q2 2020 State and Utility Action on Electric Vehicles

Utility Involvement in EV Charging

Why pilots before programs?

- Pilot programs can be helpful before the adoption of larger, more permanent programs.
- They are transitional arrangements that allow for useful experimentation.
- Operate under time and budget limitations, providing opportunities for learning.
- They provide opportunities for learning and gaining experience, a key to scaling up to more permanent programs.
What are the goals of the pilot?

- What is the goal of supporting an EV build-out or EV pilot?
- Is the goal consistent with other state goals?
- How can it be served most cost-effectively?
- What are the range of successful and low-cost deployment strategies?
- Do utility programs align with existing state agency programs? Do they fill an existing need?
Is the pilot clear and accessible to customers?

- In order to promote the understanding of new rate designs and program offerings, what education and outreach activities are most helpful to provide customers?
- Does the pilot benefit and serve low-income and rural customers?
- Does the pilot include a rate design to encourage EV charging practices that are consistent with efficient and reliable use of the grid?
Utility Infrastructure Investments

• What utility investments should regulators authorize utilities to add to the rate base for public charging infrastructure?
• Which public charging infrastructure should be allowable utility investments in whole or in part?
• Are there program designs for charging infrastructure that support private contributions?
• What investments in information systems and technology are necessary to support EV charging infrastructure?
Elements of good pilot programs

- Clear and measurable goals — identifying what success looks like.
- Extensive and frequent data reporting to enable monitoring and eventual scaling.
- Customer education -- helping the public understand the benefits of transportation electrification and most effective use
- Effective planning to reach different customer needs – low-income and rural
Valuable information to gather

- Circuits and feeders with excess seasonal or year-round daytime capacity – useful for peak charging
- Average and median utility/ratepayer cost for installation of charging infrastructure (incl. supply, distribution and system upgrades)
- Utilization rates of chargers
- Customer response
Foundation for future performance-incentive metrics

- Traditional cost-of-service regulation encourages utilities to sell more electricity and to add capital assets to their rate base
- Performance-based regulation (PBR) links a portion of utility earnings to the utilities’ performance on public policy goals
Sample EV performance metrics

<table>
<thead>
<tr>
<th>Goal</th>
<th>Performance criteria</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase efficient EV charger deployment</td>
<td>The utility will track EV charger deployment and usage</td>
<td>Track number of charging station hosts taking advantage of incentives: Require reporting of average number of chargers per site; types of chargers; average cost per site and port; rates offered; rates selected; charging behaviors by rate class; host application processing times; average time spent at charging point, average time parked, average kilowatt charges</td>
</tr>
</tbody>
</table>
Questions
EVs and Rate Design
Key Issues for EVs and Rate Design

• Can good rate design help promote EV adoption?
  • Demand charges as a barrier to fast charging
  • TVR as an opportunity for lower fuel costs for EVs

• How can rate design for EVs benefit ratepayers overall?
  • Can we lower system costs in the long-term by managing load?
  • Will EVs lower rates by contributing more than their long-run marginal costs?
  • Are costs being allocated fairly and efficiently overall?
Why and how do we regulate utilities?

- Public policy goals
  - Efficient competition and control of monopoly pricing
  - Reliable and affordable provision of service
  - Societal equity (e.g., universal access)
  - 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.
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
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
Grid Management Programs

- Demand response programs provide payments for curtailment at key times
  - Is it worth it for the customer? Is there a loss of convenience?
- Ancillary services markets provide payments for more granular responses to support the grid
  - Frequency regulation and voltage support
The Opportunity of Time-Varying Rates

- Time-varying rates provide new electric end-uses the opportunity, but not a guarantee, of lower bills
  - Depends on ability to avoid high-cost times
  - To what extent is high demand for EV charging correlated with high-cost times?
- Affordable battery storage and energy management technology will increase flexibility for all customers
The Trouble with Rate Discounts

- Generous “whole house” rate structures for EV charging risk incentivizing additional energy usage more broadly
- Separate rates for specific end-uses have additional metering and billing costs
- Efficiency of electric transportation will be enormously important sooner rather than later
Typical cost classifications used in cost allocation studies are summarized below.

<table>
<thead>
<tr>
<th>Typical Cost Function</th>
<th>Typical Cost Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Demand Related Energy Related</td>
</tr>
<tr>
<td>Transmission</td>
<td>Demand Related Energy Related</td>
</tr>
<tr>
<td>Distribution</td>
<td>Demand Related Energy Related</td>
</tr>
<tr>
<td></td>
<td>Customer Related</td>
</tr>
</tbody>
</table>
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
Visual of Demand charges

Demand = 7 kW
Demand charge = $5/kW
Demand charge for month = $35
General 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
### Demand Charges and Fast Charging

<table>
<thead>
<tr>
<th>Non-coincident peak demand charge</th>
<th>$10/kW</th>
<th>100 kW</th>
<th>$1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy charge (not time-differentiated)</td>
<td>$0.10/kWh</td>
<td>1000 kWh</td>
<td>$100.00</td>
</tr>
<tr>
<td><strong>Total bill</strong></td>
<td></td>
<td></td>
<td>$1100.00</td>
</tr>
<tr>
<td><strong>Average $/kWh</strong></td>
<td></td>
<td></td>
<td>$1.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-coincident peak demand charge</th>
<th>$2/kW</th>
<th>100 kW</th>
<th>$200.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy charge</td>
<td>$0.12</td>
<td>1000 kWh</td>
<td>$120.00</td>
</tr>
<tr>
<td><strong>Total bill</strong></td>
<td></td>
<td></td>
<td>$320.00</td>
</tr>
<tr>
<td><strong>Average $/kWh</strong></td>
<td></td>
<td></td>
<td>$0.32</td>
</tr>
</tbody>
</table>
Modern embedded cost of service study flowchart

Revenue requirement

Functionalization

Generation
Transmission
Distribution
Billing, customer service, and A&G costs

Allocation

Peak hours
Intermediate hours
All hours, including off-peak

Site infrastructure, billing and collection

Residential
Commercial
Industrial
Street lighting

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

Critical Peak Rate
75 cents per kWh

On-Peak Rate
15 cents per kWh

Mid-Peak Rate
10 cents per kWh

Off-Peak Rate
5 cents per kWh

Distribution Augmentation for Mid-Peak
Network Transmission
Mid-Merit Generation

DR
Peaking Distribution
Peaking Generation

Distribution Backbone
Transmission Backbone
All Hours Generation

Hour of Day
## Illustrative Smart Rate Design

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Medium C&amp;I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge ($/mo.)</strong></td>
<td>Multifamily: $7</td>
<td>$100</td>
</tr>
<tr>
<td></td>
<td>Small Single-Family: $10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large Single-Family: $15</td>
<td></td>
</tr>
<tr>
<td><strong>Site Infrastructure ($/kW)</strong></td>
<td>N/A</td>
<td>$2</td>
</tr>
<tr>
<td><strong>Off-peak (cents per kWh)</strong></td>
<td>7 cents</td>
<td>6 cents</td>
</tr>
<tr>
<td><strong>Mid-peak (cents/kWh)</strong></td>
<td>12 cents</td>
<td>11 cents</td>
</tr>
<tr>
<td><strong>On-peak (cents/kWh)</strong></td>
<td>17 cents</td>
<td>16 cents</td>
</tr>
<tr>
<td><strong>Critical peak (cents/kWh)</strong></td>
<td>75 cents</td>
<td>75 cents</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Customer Charge ($/mo.)</th>
<th>$8.59</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Summer</td>
</tr>
<tr>
<td>Off-peak (cents/kWh)</td>
<td>7.2 cents</td>
</tr>
<tr>
<td>On-peak (cents/kWh)</td>
<td>22.4 cents</td>
</tr>
<tr>
<td>Tier Charge</td>
<td>Additional 2.5 cents over 700 kWh</td>
</tr>
</tbody>
</table>
Burbank Municipal Power Optional TOU for EV Owners

<table>
<thead>
<tr>
<th>Customer Charge ($/mo.)</th>
<th>$8.99</th>
</tr>
</thead>
</table>
| Site Infrastructure ($/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

<table>
<thead>
<tr>
<th>Customer Charge ($/mo)</th>
<th>$13.00</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Off-Peak (cents/kWh)</strong></td>
<td>3.27</td>
</tr>
<tr>
<td><strong>On-Peak (cents/kWh)</strong></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
</tr>
<tr>
<td>Standard</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>22</td>
</tr>
<tr>
<td>Critical</td>
<td>41</td>
</tr>
</tbody>
</table>
**SMUD – Medium General Service**

**Time-of-Day Rate - Primary**

<table>
<thead>
<tr>
<th>Customer Charge ($/mo.)</th>
<th>Customer Charge ($/kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Charge ($/mo.)</strong></td>
<td>$281.50</td>
</tr>
<tr>
<td><strong>Site Infrastructure ($/kW)</strong></td>
<td>$2.96</td>
</tr>
<tr>
<td><strong>Off-peak saver (cents per kWh)</strong></td>
<td>Non-Summer</td>
</tr>
<tr>
<td>6.8 cents</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Off-peak (cents/kWh)</strong></td>
<td>10.8 cents</td>
</tr>
<tr>
<td><strong>On-peak (cents/kWh)</strong></td>
<td>12.4 cents</td>
</tr>
<tr>
<td><strong>Summer demand charge ($/kW)</strong></td>
<td>N/A</td>
</tr>
</tbody>
</table>
New PG&E Commercial EV Rates

Distribution kW subscription of ~$1.20 to $2 per kW
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
Summary

• Time-varying pricing, based on good cost causation analysis, can provide opportunities for low-cost EV charging, 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

• Technology-neutral pricing and well-designed load management programs are more sustainable than technology-specific discounts
Questions?
RAP Resources on Electrification

- Roadmap for Electric Transportation
- Taking First Steps: Insights for States Preparing for Electric Transportation
- Beneficial Electrification: Ensuring Electrification in the Public Interest
- Beneficial Electrification of Transportation
- Getting From Here to There: Regulatory Considerations for Transportation Electrification
- Blog post: We All Wish We Were More Flexible: Electrification Load as a Grid Flexibility Resource
RAP Resources on Ratemaking

- Smart Rate Design for a Smart Future
- Demand Charges: What are They Good For?
- Principles of Modern Rate Design
- Smart Non-Residential Rate Design