Electric Vehicles and Rate Design

Virtual Alaska Electric Vehicle (EV) Workshop

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Outline

• Rate design principles
• What’s special about EV charging?
• Rate design examples
• Summary and resources
High-level perspective on EV policy

- Need to create virtuous cycle among:
  - Consumer education
  - EV affordability and access
  - EV charging affordability and access
- Pay attention to policy at “the seams”
  - EVs and electric utility regulation
  - EVs and transportation funding
Rate design principles
Principles of smart rate design

1. Customers should be able to connect to grid for no more than the cost of connecting to grid.

2. Customers should pay for grid services and power supply in proportion to how much they use these services and how much power they consume.

3. Customers who supply power to grid should be fairly compensated for full value of power they supply.
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
- **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
2 What’s special about EV charging?
Three “levels” of EV charging

**Level 1:** Standard household outlet (120 Volts)
- 1.5 kW
  - Adds about 4 miles range per hour

**Level 2:** High capacity residential circuit (240 Volts)
- 6.6 kW
  - Adds about 20 miles range per hour

**Level 3:** Fast commercial chargers in public areas
  - with very large electricity connection:
    - Up to 350 kW  
    - Adds up to 200 miles in 15 minutes
Level 2 EV charging is a lot like... an electric water heater!
Really!

Electric Vehicle
• 3.3 – 6.6 kW
• 2,000 – 4,000 kWh/year
• Can avoid morning and early evening 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 morning and early evening peak charging
• Tank usually covers a full day’s supply

Really!
Public DC fast charging

- May be needed to enable the EV transformation
- Very high capacity: 40 kW to 350 kW
Medium- and heavy-duty vehicles

- Require power levels similar to fast charging
  - Similar location and rate issues
- Fleet operators have additional issues
  - Route timing, battery capacity, and charging time
3 Rate design examples
## 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</strong></td>
<td>Multifamily: $7</td>
<td>$25</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</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>5 cents</td>
</tr>
<tr>
<td><strong>Mid-peak (cents/kWh)</strong></td>
<td>9 cents</td>
<td>8 cents</td>
</tr>
<tr>
<td><strong>On-peak (cents/kWh)</strong></td>
<td>14 cents</td>
<td>13 cents</td>
</tr>
<tr>
<td><strong>Critical peak (cents/kWh)</strong></td>
<td>75 cents</td>
<td>75 cents</td>
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</table>
## Oklahoma Gas & Electric - Variable peak pricing

<table>
<thead>
<tr>
<th>Customer Charge ($/mo)</th>
<th>$13.00</th>
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</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>3.27</td>
</tr>
<tr>
<td>Standard</td>
<td>7.70</td>
</tr>
<tr>
<td>High</td>
<td>18.40</td>
</tr>
<tr>
<td>Critical</td>
<td>38.00</td>
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</table>
Visual of demand charges

Demand = 7 kW
Demand charge = $5/kW
Demand charge for month = $35
## 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>$0.05/kWh</td>
<td>1000 kWh</td>
<td>$50.00</td>
</tr>
<tr>
<td>Total bill</td>
<td></td>
<td></td>
<td>$1050.00</td>
</tr>
<tr>
<td>Average $/kWh</td>
<td></td>
<td></td>
<td>$1.05</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>Total bill</td>
<td></td>
<td></td>
<td>$320.00</td>
</tr>
<tr>
<td>Average $/kWh</td>
<td></td>
<td></td>
<td>$0.32</td>
</tr>
</tbody>
</table>
Demand charge reform options

- Base demand charges on costs of “site infrastructure” with rest in time-varying kWh rates
  - Sacramento Municipal Utility District
- Replace demand charge with kWh rate based on class average load factor
  - Connecticut
- Give a demand charge “holiday”
  - Rhode Island
PG&E commercial EV rate design proposal

1) Customers choose subscription level, based on charging needs

2) Subscription remains consistent month-to-month

3) Energy usage is billed based on time-of-day pricing

Source: [https://www.greentechmedia.com/articles/read/pge-ditch-demand-charges-for-commercial-ev-charging](https://www.greentechmedia.com/articles/read/pge-ditch-demand-charges-for-commercial-ev-charging)
Other rate options

• “Economic development” rates
  • Historically used primarily for large businesses
  • Charging less than fully allocated costs or long-run marginal costs brings risks for other ratepayers
• Managed charging and demand response
  • Payment from utility in exchange for controlled charging
Rate design summary

- Time-varying rates incentivize charging at lower-cost hours
  - Opportunities for affordable charging
- Demand charges cause significant issues for low utilization fast chargers
  - General need for demand charge reform
- “Economic development” rates may be helpful in short-term
- Smart charging and demand response programs may be an alternative to smart rate design
Resources from RAP

- Smart Rate Design for a Smart Future
- 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