Committee on Energy Resources and the Environment
Committees on Energy Resources & the Environment and Consumer Affairs
What’s the Charge to Charge? Rate Design Principles to Facilitate EV Charging
Workplace Charging of Electric Vehicles

NARUC 2017 Summer Policy Meeting
San Diego, CA

Jim Lazar, RAP Senior Advisor

July 18, 2017
Issues

Is workplace charging desirable? 
For the EV Owner? 
For the grid?
Goals

- Ensure people can charge when needed.
- Not all customers can charge at home.
- Reasonable cost to the consumer.
- Minimal or beneficial impacts on the grid.
- Workplace charging may be desirable.
Typical System Load Profile (without solar)

Source: LBNL
Price Can Influence When EVs Are Charged

Dallas/Ft Worth
(standard rates)

San Diego
(time-of-use rates)

Copied from: M.J. Bradley, 2017
Workplace Charging and the Duck Curve

Home Charging w/o TOU

Workplace Charging
Large Commercial Load Profile

http://jon.ochshorn.org
Key Rate Design Terms

• **(NCP)** Non-Coincident Peak Demand Charge: Monthly fee based on highest hour during the billing period.

• **(CP)** Coincident Peak Demand Charge: Monthly fee based on highest usage during the on-peak hours, e.g. 2 – 8 PM.

• **TOU:** Energy charge that varies by time of day in two or more periods.

• **CPP:** Critical peak pricing that applies only for short periods after notice.
Large Commercial Rate Design: An Impediment to Workplace Charging

Eversource New Hampshire (NCP) Demand Charge: $13.75/kW
Energy Charge: ~$0.12/kWh energy

6.6 kW charger, 200 kWh/month:
$90 Demand + $24 energy = $114 =

= $0.57/kWh $5.70/gallon equivalent
Sacramento Municipal Utility District

<table>
<thead>
<tr>
<th>Demand Charge Type</th>
<th>Rate (2023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCP Demand Charge</td>
<td>$2.82/kW</td>
</tr>
<tr>
<td>CP Demand: (2 – 8 PM, summer)</td>
<td>$6.91/kW</td>
</tr>
</tbody>
</table>

**Energy Charges:**

- **Off-Peak:** $0.10
- **Mid-Peak:** $0.13
- **On-Peak (2 – 8 PM, Summer):** $.19

$18.61 Demand + $23 energy = $42

= $0.21/kWh $2.10/gallon equivalent
# Southern California Utility w/TOU

<table>
<thead>
<tr>
<th>Burbank Water and Power</th>
<th>Schedule D</th>
<th>Schedule C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand</td>
<td>$10.96</td>
<td>None</td>
</tr>
<tr>
<td>4 - 7 PM Mon-Fri</td>
<td>$0.215</td>
<td>$0.260</td>
</tr>
<tr>
<td>Mid-Peak</td>
<td>$0.134</td>
<td>$0.1625</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>$0.107</td>
<td>$0.130</td>
</tr>
<tr>
<td>EV Charging Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand 6.6 kW</td>
<td>$72.34</td>
<td></td>
</tr>
<tr>
<td>Energy 200 kWh</td>
<td>$26.82</td>
<td>$32.50</td>
</tr>
<tr>
<td>Total</td>
<td>$99.16</td>
<td>$32.50</td>
</tr>
<tr>
<td>Average $/kWh</td>
<td>$0.50</td>
<td>$0.16</td>
</tr>
</tbody>
</table>
Hawaii **Residential TOU Rate**
Optional
None of the customers peak at the time of the system peak
Whose Valley Do You Want to Fill?

The customer’s?

The System?
Peak Loads On Circuits Are Concentrated
Smart Charging: A Better Choice

• Beyond TOU: Dynamic Pricing
• Utility or Aggregator Control
• Flexible Charging
Smart Rate Design:

Rate design as though the future is important.
Only Component Sized To Customer Demand
Final Line Transformer
# Bottom Line: Smart Rates

## Customer-Specific Charges

<table>
<thead>
<tr>
<th>Customer Charge</th>
<th>$/Month</th>
<th>$ 3.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformer:</td>
<td>$/kVA/Mo</td>
<td>$ 1.00</td>
</tr>
</tbody>
</table>

## Energy Charges

<table>
<thead>
<tr>
<th>Period</th>
<th>$/kWh</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-Peak</td>
<td>$0.08</td>
<td></td>
</tr>
<tr>
<td>Mid-Peak</td>
<td>$0.12</td>
<td></td>
</tr>
<tr>
<td>On-Peak</td>
<td>$0.18</td>
<td></td>
</tr>
<tr>
<td>Critical Peak</td>
<td>$0.75</td>
<td></td>
</tr>
</tbody>
</table>
BMW Charge-Forward With TOU Rates
BMW Smart Charging
With 40% Under Control

(EXAMPLE ASSUMES 40% CONTROL)
DEMAND RESPONSE
EXAMPLE DR EVENT 10/21, 8:00-9:00 PM

Vehicles and 2nd life battery together provide 100 kW DR Capacity

Energy solutions for a changing world
Summary

• Workplace Charging may be desirable
• NCP demand charges make workplace charging infeasible
• Good: CP demand charges
• Better: TOU rates
• Best: Smart rates and smart charging
• And now, let’s hear from a utility that has done some smart stuff.
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 and natural gas sectors. 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

Jim Lazar    jlazar@raponline.org
Electric Transportation and Rate Designs at SCE

Russell.Garwacki@sce.com
Director – Pricing Design and Research

NARUC Summer Policy Summit, July-2017
San Diego, CA
Electric Transportation – State Policy Direction

The California Legislature (SB350) and, subsequently, the CPUC had some very specific transportation electrification (TE) rate guidance:

- Since the TE findings in Pub. Util. Code § 740.12(a)(1) include, "reducing fuel costs for vehicle drivers who charge in a manner consistent with electrical grid conditions," the TE applications may propose projects to change the rate structures, including demand charges, that are currently in effect for electric vehicles used in commercial applications. However, the utilities should keep in mind that simply shifting costs to other ratepayer classes does not comport with cost causation rate design principles and may not be a viable solution.

"Consistent with Grid Conditions"
- SCE’s Pending Time-of-Use (TOU) Period/Rate Proposals

<table>
<thead>
<tr>
<th>Season</th>
<th>Existing</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-Peak</strong></td>
<td><strong>Summer</strong></td>
<td>Weekdays: 12:00 p.m. - 6:00 p.m.</td>
</tr>
<tr>
<td><strong>Mid-Peak</strong></td>
<td><strong>Summer</strong></td>
<td>Weekdays: 8:00 a.m. - 12:00 p.m.; 6:00 p.m. - 11:00 p.m.</td>
</tr>
<tr>
<td></td>
<td><strong>Winter</strong></td>
<td>Weekdays: 8:00 a.m. – 9:00 p.m.</td>
</tr>
<tr>
<td><strong>Off-Peak</strong></td>
<td><strong>Summer</strong></td>
<td>Weekdays: 11:00 p.m. – 8:00 a.m. Weekends: All hours</td>
</tr>
<tr>
<td></td>
<td><strong>Winter</strong></td>
<td>Weekdays: 9:00 p.m. - 8:00 a.m. Weekends: All hours</td>
</tr>
<tr>
<td><strong>Super Off-Peak</strong></td>
<td><strong>Winter</strong></td>
<td>N/A</td>
</tr>
</tbody>
</table>

- Peak periods shifted to later in the day.
- Establishes new flexible generation capacity cost component (aka “ramping”, all days).
- Introduces a “peak” time varying component in distribution rates.
- Super off-peak energy prices occur in the middle of winter weekdays/weekends.
“Consistent with Grid Conditions”
- SCE’s Pending Time-of-Use (TOU) Period/Rate Proposals

<table>
<thead>
<tr>
<th>Weekdays</th>
<th>Existing</th>
<th>Weekends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Feb</td>
<td>Mar</td>
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<td>Feb</td>
<td>Mar</td>
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<td>Nov</td>
<td>Dec</td>
<td>Jan</td>
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<tr>
<td>Dec</td>
<td>Jan</td>
<td>Feb</td>
</tr>
</tbody>
</table>

**Proposed**

<table>
<thead>
<tr>
<th>Weekdays</th>
<th>Proposed</th>
<th>Weekends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Feb</td>
<td>Mar</td>
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<tr>
<td>Feb</td>
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<td>Jan</td>
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<tr>
<td>Dec</td>
<td>Jan</td>
<td>Feb</td>
</tr>
</tbody>
</table>

- **On-peak**
- **Mid-Peak**
- **Off-peak**
- **Super Off-Peak**
“Change the Rate Structures, including Demand Charges”

**Motivation Behind Demand Charges**
- Designed to recover longer term capacity related costs, thereby reducing the volumetric rates to their short-run marginal cost levels.
- This structure encourages efficient consumption levels and load (energy) growth for a given peak demand level.
- Works reasonably well for the typical range of customer load profiles.

**What’s Changed?**
- AMI metering allows for detailed study of relationships between coincident and non-coincident peak demands and peak period energy and demands.
- New electric transportation entrants have very low load factors, at least initially.
Serving Many Load Profile Masters

Illustrative

- **Rail**
  - On-Peak (4-9pm)

- **Residential EV**
  - On-Peak (4-9pm)
  - Weekdays and Weekends

- **Mass Transit**
  - Mature Deployment
  - Early Deployment
  - On-Peak (4-9pm)

- **Workplace Charging**
  - Office Building - Summer
  - Building w/ EV Charging
  - On-Peak (4-9pm)
“Shifting Costs to other(s). . . does not Comport with Rate Design Principles”

- SCE adopted an Economic Development Rate mentality for its TE Application.
- Encouraging new growth is not a “shift” of costs as long as the price is above the marginal cost floor.
- SCE proposed a 5-year introductory period without demand charges followed by a 5-year phase-in of demand charges to facilitate this infant industry.
- End-state TE rate structures envisioned to be consistent with remaining customers’ rate structures.
**Rate Proposal**

Illustrative

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### Early Deployment Stage

- **Demand**: 300 kW
- **Energy**: 15,000 kWh (Monthly)

### Full Deployment with Load Management

- **Demand**: 400 kW
- **Energy**: 75,000 kWh (Monthly)

---

### Sample Rates

<table>
<thead>
<tr>
<th></th>
<th>Short Term</th>
<th>Long Term (Cost Based)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand ($/kW)</td>
<td>X</td>
<td>$10.00</td>
</tr>
<tr>
<td>Energy ($/kWh)</td>
<td>$0.15</td>
<td>$0.10</td>
</tr>
</tbody>
</table>

---

### Monthly Bill

<table>
<thead>
<tr>
<th>Bill Component</th>
<th>Short Term</th>
<th>Long Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Charge</td>
<td>X</td>
<td>$3,000</td>
</tr>
<tr>
<td>Energy Charge</td>
<td>$2,250</td>
<td>$1,500</td>
</tr>
<tr>
<td><strong>Total Bill</strong></td>
<td><strong>$2,250</strong></td>
<td><strong>$4,500</strong></td>
</tr>
</tbody>
</table>

---

- **50% Energy Bill Savings on Short Term Energy Only Rate**
- **Customer will be indifferent as higher load factor (flatter load curve) is achieved**
Life Cycle Schematic of ET Rate Proposal
Illustrative

<table>
<thead>
<tr>
<th>Energy + Demand</th>
<th>Energy Only</th>
<th>Return to Energy + Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Period</strong></td>
<td><strong>Short-Term Period</strong></td>
<td><strong>Medium/Long-Term Period</strong></td>
</tr>
<tr>
<td>![Image](energy_d demand.png)</td>
<td><img src="energy_only.png" alt="Image" /></td>
<td><img src="return_to_energy.png" alt="Image" /></td>
</tr>
<tr>
<td>x 5</td>
<td>x 5 (\rightarrow) 20</td>
<td>x 20</td>
</tr>
</tbody>
</table>

- **Energy (Monthly kWhs)**
  - 12-Month Period
  - 12-Month Period
  - 12-Month Period

- **Demand (kWs)**
  - 12-Month Period
  - 12-Month Period
  - 12-Month Period

- **Load Factor:**
  - 7%
  - 15%
  - 26%

**Improving Load Factors**

*Energy usage increases as number of buses increases.*
So We Ditch Demand Charges? – Not so fast!!

Consider the Supply-side Analogy

• A reliability must-run generator is paid based on their availability to provide capacity irrespective of how often they’re actually called.
• If this structure did not exist, these services would not be provided.

All customers should pay a “fair-share” of capacity elements

• Energy-only Rates encourage uneconomic by-pass, especially after a scaling up of rates to recover the authorized functional revenue requirement.
• One way to address this issue is to extend the partially resourced customer treatment (e.g. Stand-by rate structure with its own separate rate group) currently in place for large cogeneration customers to other partially resourced customers.
• Basis of an Arizona Decision (2016) and near all-party Settlement (2017).
Questions?
Appendix
### SCE’s Optional Rate Designs Favorable for Electric Transportation

<table>
<thead>
<tr>
<th>Rate Schedule</th>
<th>Maximum Demand (Voltage Level)</th>
<th>Applicability</th>
<th>Rate Structure</th>
</tr>
</thead>
</table>
| TOU-EV-3      | ≤ 20 kW                        |                                                                                | • Customer Charge;  
• TOU Energy Charges;  
• Time-related Demand Charge (TRD);  
• Facilities-related Demand Charge (FRD);  
• Option B includes a FRD Charge Offset \(^3/\) |
| TOU-EV-4      | 21 - 500 kW                    | Applicable for businesses solely for the charging of EVs on a premise or public right of way where a separate SCE meter to serve EV charging facilities is required | • Customer Charge;  
• TOU Energy Charges;  
• FRD Charge;  
• Includes a FRD Charge Offset \(^3/\) |
| TOU-EV-6      | > 500 kW (Secondary, Primary, Subtransmission) |                                                                                | • Customer Charge;  
• TOU Energy Charges;  
• FRD Charge;  
• Includes a FRD Charge Offset \(^3/\) |
| TOU-EV-7 \(^1/\) | ≤ 20 kW                        |                                                                                | • Customer Charge;  
• TOU Energy Charges;  
• 5-year intro period w/ no demand charge, followed by 5-year phase-in of demand charges;  
• At the end of the 10\(^{th}\) year, rate will include FRD demand charge to collect 60\% of all distribution capacity costs; the remaining 40\% will be collected through TOU energy charges |
| TOU-EV-8 \(^1/\) | 21 - 500 kW                    |                                                                                | • Customer Charge;  
• TOU Energy Charges;  
• 5-year intro period w/ no demand charge, followed by 5-year phase-in of demand charges;  
• At the end of the 10\(^{th}\) year, rate will include FRD demand charge to collect 60\% of all distribution capacity costs; the remaining 40\% will be collected through TOU energy charges |
| TOU-EV-9 \(^1/\) | > 500 kW (Secondary, Primary, Subtransmission) |                                                                                | • Customer Charge;  
• TOU Energy Charges;  
• 5-year intro period w/ no demand charge, followed by 5-year phase-in of demand charges;  
• At the end of the 10\(^{th}\) year, rate will include FRD demand charge to collect 60\% of all distribution capacity costs; the remaining 40\% will be collected through TOU energy charges |
SCE’s Optional Rate Designs Favorable for Electric Transportation (cont.)

<table>
<thead>
<tr>
<th>Rate Schedule</th>
<th>Maximum Demand (Voltage Level)</th>
<th>Applicability</th>
<th>Rate Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOU-8-Option A</td>
<td>&gt; 500 kW (Secondary, Primary, Subtransmission)</td>
<td>Applicable to customers who participate in Permanent Load Shifting (PLS), Cold Ironing pollution mitigation programs or the charging of zero emissions electric transportation intended for the transport of people or goods.</td>
<td>• Customer Charge; • TOU Energy Charges; • FRD Charge</td>
</tr>
<tr>
<td>TOU-EV-1</td>
<td>N/A</td>
<td>Applicable to residential customers exclusively for the charging of electric vehicles on a separate meter</td>
<td>• Customer Charge; • TOU Energy Charges</td>
</tr>
<tr>
<td>TOU-D-C ²/</td>
<td>N/A</td>
<td>Applicable to residential customers; whole-house rate targeted for higher-usage customers, including those with EVs.</td>
<td>• Customer Charge; • TOU Energy Charges</td>
</tr>
</tbody>
</table>

1/ Pending CPUC approval in SCE’s Transportation Electrification Application (A.17-01-021).

2/ Pending CPUC approval in SCE’s 2018 GRC Phase 2 Application (A.17-06-030).

3/ Waives demand charges for EV charging if the EV demand does not exceed the demand of the associated facility. This structure helps the customer control their electricity costs associated with demand charges.
Committee on Energy Resources and the Environment