Electricity Pricing: Policies, Practices and Pitfalls

Financial Research Institute Advanced Seminar

Carl Linvill, PhD, Principal
The Regulatory Assistance Project (RAP)®

+1 802 498 0723
clinvill@raponline.org
www.raponline.org
Rate design should make the choices the customer makes to optimize their own bill consistent with the choices they would make to minimize system costs.
The Basics: Smart Rate Design
RAP has described how technological change and the emergence of DERs affect residential rate design. And RAP’s Lead Article In Ahmad’s EJ Special Issue On Rate Design in October 2018 provides Non-Residential Rate Design guidance.
Principle #1

A customer should be allowed to connect to the grid for no more than the cost of connecting to the grid.
Principle #2

Customers should pay for the grid and the power supply in proportion to how much they use and when they use it.
Principle #2

Customers should pay for the grid and the power supply in proportion to how much they use and when they use it.
Principle #3

Customers delivering services to the grid should receive the full and fair value – no more and no less.
# Advanced Residential Rate Design

## Cost Recovery Only

<table>
<thead>
<tr>
<th>Charge Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Charge ($/mo.)</td>
<td>$10</td>
</tr>
<tr>
<td>Site Infrastructure ($/individual NCP kW)</td>
<td>$1</td>
</tr>
<tr>
<td>Bidirectional Distribution Network Charge (Cents/kWh on imports and exports)</td>
<td>5 cents</td>
</tr>
</tbody>
</table>

## Symmetric Charges and Credits

<table>
<thead>
<tr>
<th>Charge Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off-peak (cents/kWh)</td>
<td>5 cents</td>
</tr>
<tr>
<td>Mid-peak (cents/kWh)</td>
<td>12 cents</td>
</tr>
<tr>
<td>On-peak (cents/kWh)</td>
<td>28 cents</td>
</tr>
<tr>
<td>Critical peak (cents/kWh)</td>
<td>75 cents</td>
</tr>
</tbody>
</table>
2 Pitfall: Most Commercial Rate Design does not Align Pricing with System Costs
Non-Res Problems & Solutions

Problem #1: Most non-residential rates do not align customer rates with system costs

Solution #1: Non-Coincident Peak (NCP) Demand Charges should be lower

Problem #2: Technological change and the emergence of DERs (including ZEVs) make improvement necessary

Solution #2: Time-of-Use Rate Design reflects system costs better than non-coincident (NCP) and coincident peak (CP) demand charges
A Typical Rate for Large NR Customers (Generic)

Customer Charge: $100/month

Demand Charge: $10/kW

Energy Charge: $0.12/kWh
What’s the problem?

Customer Charge: $100/month

Demand Charge: $10/kW
   Not Linked To System Conditions

Energy Charge: $0.12/kWh
   Not Time-Differentiated
Pitfall: Dynamic Pricing has Potential but is Not Optimal for a Default Tariff Yet
Dynamic Pricing can be Effective If:

- LMP and CRR exist down to the feeder
- Free entry and exit on the distribution system
- Utility has the opportunity to be revenue adequate
- Political tolerance for scarcity pricing exists
Dynamic Pricing is not yet Optimal Because:

- Distribution system over-built (analog tech)
- Structural change massive (digital tech)
- Barriers to entry on the distribution system
- Embedded cost recovery
- Political tolerance for scarcity pricing low in many places
Pitfall: Subscription Pricing can be done Poorly
Some Questions to ask about Subscription Tariffs

- Does the subscription tariff hide price signals that will discourage conservation and discourage efficient customer choice and use of DERs?
- Is the tariff from a competitive provider or subject to competitive pressure from competitive offerings?
- Does the tariff promote or deter competitive innovation?
Policy Example Pitfall: Poor Rate Design can Deter EV Adoption
Residential: TOU rates with a CPP encourage beneficial charging

- Sends price signals for all hours, with a strong signal deterring use in highest stress hours (may be peak, may be ramping)
- Encourages electric vehicle charging during off-peak and shoulder hours
- Flat rates and high non-coincident demand charges make EV charging artificially expensive and do not align individual choice with system benefits
What about Today’s Typical Non-Residential Rate Design?

- 6.6 kW @ $12/kW $66
- 250 kWh @ $.010/kWh $30

- Total Cost: $96
- Cost/kWh: $96/250 = $.38/kWh
- FLUNKS “cheaper than gasoline” test
- Demand Charge is 68% of total bill
Typical System Load Profile (without solar)

Source: LBNL
Workplace and Home Charging and the Duck Curve

Trends in resource development are leading toward a growing need for flexible generating capacity starting in 2015.

- Home Charging w/o TOU
- Workplace Charging

Net load - March 31

ramp need ~13,000 MW in three hours

over generation risk

12 AM 3 AM 6 AM 9 AM 12 PM 3 PM 6 PM 9 PM

Hour

2012 (actual)

2018 2019

2020

Megawatts

0 10,000 12,000 14,000 16,000 18,000 20,000 22,000 24,000 26,000 28,000

PREV
## Comparison of Three Rates: Consequences for NR EV Adoption

<table>
<thead>
<tr>
<th></th>
<th>Antiquated Rate</th>
<th>Coincident Peak Demand Charge</th>
<th>Smart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Charge</td>
<td>$10/kW</td>
<td>$10/kW</td>
<td>$2/kW</td>
</tr>
<tr>
<td>Demand Measurement</td>
<td>NCP</td>
<td>4 PM - 8 PM</td>
<td>Site Infrastructure</td>
</tr>
<tr>
<td>Energy</td>
<td>$0.12/kWh</td>
<td>$0.12/kWh</td>
<td>$.05 - $.75/kWh</td>
</tr>
<tr>
<td>Energy Measurement</td>
<td>No TOU</td>
<td>No TOU</td>
<td>TOU</td>
</tr>
</tbody>
</table>
# Smart Rate => Workplace EV Charging

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</table>

**Electric Vehicle Charging Cost Per Month**  
6.6 kW  
250 kWh

<table>
<thead>
<tr>
<th></th>
<th>NCP Demand</th>
<th>CP Demand</th>
<th>Energy</th>
<th>Total</th>
<th>Average $/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ 66.00</td>
<td>$</td>
<td>$ 30.00</td>
<td>$ 96.00</td>
<td>$ 0.384</td>
</tr>
<tr>
<td>CP Demand</td>
<td>$ 30.00</td>
<td>$</td>
<td>$ 30.00</td>
<td>$ 30.00</td>
<td>$ 0.120</td>
</tr>
<tr>
<td>Total</td>
<td>$ 96.00</td>
<td>$ 30.00</td>
<td>$ 30.00</td>
<td>$ 25.70</td>
<td>$ 0.103</td>
</tr>
<tr>
<td>Average $/kWh</td>
<td>$ 0.384</td>
<td>$ 0.120</td>
<td>$</td>
<td>$</td>
<td>$ 0.103</td>
</tr>
</tbody>
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Rate Design Takeaway
Rate design should make the choices the customer makes to optimize their own bill consistent with the choices they would make to minimize system costs.
Performance Incentive Mechanisms (PIMs)

FRI Advanced Rate Seminar

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“All regulation is incentive regulation”
– Peter Bradford

“Incentives” of traditional regulation

• Build and own assets to grow rate base
• Increase volume of sales and electricity usage to enhance profits (is decoupling enough?)
• Focus on inputs, not outputs
• Cut beneficial non-capital expenses
• Avoid disallowances/excessive conservatism
• Institutional inertia (rigid internal IOU dynamics)
PBR May Help Overcome Bad Outcomes

- Good things that are not profitable for the utility that don’t get done (Non-wires Solutions, aggregated DERs)
- Bad things that are profitable to the utility that should be prevented (Gold-plating physical assets)
- Good things not getting done for lack of interest or motivation (Platform innovation, 3rd Party innovation)
- Bad incentives not easily seen? (Deferring expenses like tree trimming, customer care, underserved communities)
PBR is . . .

- A regulatory framework to connect goals, targets, and measures to utility performance or executive compensation; and,
- Performance Incentive Mechanism (PIMs) which are a component of a PBR that adopts specific performance metrics, targets, or incentives to affect desired utility performance that represent the priorities of the jurisdiction.
## Starts with Goals/Outcomes - HI

### PBR Goals and Outcomes

**Table 1: PBR Goals and Outcomes**

<table>
<thead>
<tr>
<th>Goal</th>
<th>Regulatory Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enhance Customer Experience</strong></td>
<td></td>
</tr>
<tr>
<td><em>Traditional</em></td>
<td>Affordability</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
</tr>
<tr>
<td><em>Emergent</em></td>
<td>Interconnection Experience</td>
</tr>
<tr>
<td></td>
<td>Customer Engagement</td>
</tr>
<tr>
<td><strong>Advance Societal Outcomes</strong></td>
<td></td>
</tr>
<tr>
<td><em>Traditional</em></td>
<td>Capital Formation</td>
</tr>
<tr>
<td></td>
<td>Customer Equity</td>
</tr>
<tr>
<td><em>Emergent</em></td>
<td>GHG Reduction</td>
</tr>
<tr>
<td></td>
<td>Electrification of Transportation</td>
</tr>
<tr>
<td></td>
<td>Resilience</td>
</tr>
</tbody>
</table>
Goals/Outcomes vary by State - NV

Table 1: Working Goals and Outcomes for Nevada Alternative Ratemaking

<table>
<thead>
<tr>
<th>Goal</th>
<th>Outcome(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promote Just and Reasonable Rates</td>
<td>• Affordability</td>
</tr>
<tr>
<td></td>
<td>• Regulatory Efficiency</td>
</tr>
<tr>
<td>Enrich Customer Experience</td>
<td>• Customer Satisfaction and Engagement</td>
</tr>
<tr>
<td></td>
<td>• Reliability and Resiliency</td>
</tr>
<tr>
<td>Enhance Utility Performance and Operations</td>
<td>• DER Utilization &amp; Effectiveness</td>
</tr>
<tr>
<td></td>
<td>• Cost Control</td>
</tr>
<tr>
<td></td>
<td>• System Flexibility</td>
</tr>
<tr>
<td></td>
<td>• Safety</td>
</tr>
<tr>
<td>Advance State Environmental Policy</td>
<td>• GHG Reduction</td>
</tr>
<tr>
<td></td>
<td>• Energy Efficiency and Clean Energy Deployment</td>
</tr>
<tr>
<td></td>
<td>• EV Infrastructure Deployment</td>
</tr>
</tbody>
</table>
### And then Metrics - MN

<table>
<thead>
<tr>
<th>OUTCOME</th>
<th>PERFORMANCE CRITERIA</th>
</tr>
</thead>
</table>
| **Affordability**               | • Rates per KWh based on total revenue, reported (1) by customer class and (2) with all classes aggregated  
                                 | • Average monthly bills for residential customers  
                                 | • Total disconnections for nonpayment for residential customers  
                                 | • Total arrearages for residential customers                                                                                                                   |
| **Reliability**                 | • System Average Interruption Duration Index (SAIDI)  
                                 | • System Average Interruption Frequency Index (SAIFI)  
                                 | • Customer Average Interruption Duration Index (CAIDI)  
                                 | • Customers Experiencing Long Interruption Duration (CELID)  
                                 | • Customers Experiencing Multiple Interruptions (CEMI)  
                                 | • Average Service Availability Index (ASAII)  
                                 | • Equity – Reliability by geography, income, or other relevant benchmarks  
                                 | • Momentary Average Interruption Frequency Index (MAIFI)  
                                 | • Power Quality                                                                                                                                               |
| **Customer Service Quality**    | • Existing multi-sector metrics, including ACSI and J.D. Power  
                                 | • Subscription to third-party customer satisfaction metrics, e.g. ACSI, Xcel Energy alternative proposal  
                                 | • Call center response time  
                                 | • Billing invoice accuracy  
                                 | • Number of customer complaints  
                                 | • Equity metric – customer service quality by geography, income or other relevant benchmarks  
                                 | • Equity metric – customer service quality by geography, income or other relevant benchmarks                                                                 |
| **Environmental Performance**   | • Total carbon emissions by (1) utility-owned facilities and PPA’s and (2) all sources  
                                 | • Carbon intensity (emissions per MWh) by (1) utility-owned facilities and PPA’s and (2) all sources  
                                 | • Total criteria pollutant emissions  
                                 | • Criteria pollutant emission intensity (criteria pollutant emissions per MWh)  
                                 | • CO2 emissions avoided by electrification of transportation – Alternative & Original approach; CO2 rate would not be verified as of April 30  
                                 | • CO2 emissions avoided by electrification of buildings, agriculture, and other sectors; CO2 rate would not be verified as of April 30                                                                 |
| **Cost-effective Alignment of Generation and Load** | • Demand response, including (1) capacity available (MWh) and (2) amount called (MW, MWh per year)  
                                 | • Amount of demand response that SHEDS loads that can be curtailed to provide peak capacity and supports the system in contingency events  
                                 | • Amount of demand response that SHAPEs customer load profiles through price response, time varying rates, or behavior campaigns;  
                                 | • Amount of demand response that SHIFTS energy consumptions from times of high demand to times when there is a surplus of renewable generation                                                                 |

Source: Regulatory Assistance Project (RAP)®
And then turn to Identifying PIMs Place in the Constellation of Mechanisms

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Year Rate Case Cycle</td>
<td>Metrics Reporting Requirements</td>
<td>RPS and EEPS Requirements</td>
</tr>
<tr>
<td>Revenue Decoupling (RBA Provision)</td>
<td>Backstop PIMs (SAIDI, SAIFI, Customer Service)</td>
<td>System Planning Requirements</td>
</tr>
<tr>
<td>RAM Attrition Relief Provisions (O&amp;M, Rate Base, Depreciation &amp; Amortization)</td>
<td>Demand Response PIM</td>
<td>Competitive Bidding Framework</td>
</tr>
<tr>
<td>Partial Revenue Cap (RAM Cap)</td>
<td>Renewable Procurement PIM</td>
<td>Approval of Major Capital Projects, Fuel Contracts, and Purchased Power Contracts</td>
</tr>
<tr>
<td>Major Projects Interim Recovery Mechanism</td>
<td>ECAC/ECRC Fuel Cost Risk Sharing Incentive</td>
<td>Approval of Rules and Standards</td>
</tr>
<tr>
<td>Earnings Sharing Mechanism</td>
<td>ECAC Generation Efficiency Incentive</td>
<td>Approval of Accounting Policies and Financing Arrangements</td>
</tr>
<tr>
<td>Major Projects and Baseline Projects Credit Mechanisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECAC/ECRC and PPAC fuel and purchased power pass-through</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Hawaii Public Utilities Commission
No Deadband, Symmetric Compensation

- Based on a compliant result at the origin
- Utility wins or loses revenue based on performance
- Dollar for unit, no limits

Note pressure on measurement and verification of savings
Symmetric Deadband & Compensation

- Based on a compliant result around a deadband at the origin
- Utility wins or loses revenue based on performance
- Dollar for unit
- No limits

Note pressure on measurement and verification of savings
One-sided Penalty (Bad Utility, Bad Utility)

- No upside
- Deadband from adequate performance
- Severe penalty for poor performance
Asymmetric Compensation
(Maybe you have a little potential)

- Upside
- Capped, for superior performance
- Deadband from adequate performance
- Severe penalty for poor performance
One-sided Reward
(We like you, we really like you, … but there’s a limit)

- Upside
- Capped for superior performance above present level
- No penalty
Hit the Target, get the toy

- Upside bonus
- Capped for significant specific superior performance
- No penalty
PIMs related to DER deployment
Is there a DER deployment baseline?

- How would DERs be deployed in a competitive market?

- How much DERs and what types can the distribution and transmission system accommodate? At what costs?

- What is the right (efficient, least-cost) level of DER deployment?
What to measure?

- Number of DER systems deployed
- Total installed capacity of DER on a particular system, or
- Total amount of energy produced from DER units
- Number of units
- Capacity measure in kW or MW, and
- Energy measured in kWhs or MWhs
New York “REV”

- Survey to assess utility performance in DER facilitation avoids the challenge of developing a baseline
- Avoids baselining
- Avoids using exogenous factors to measure
- Avoids detailed interconnection review
Utility revenue within NY REV

Integration of markets, customers, DER developers and utility regulation

• Metrics to encourage utilities to motivate third party activity where that provides efficient system outcomes

• Outcome-based incentives encourage innovation by utilities, allowing utilities to determine the most effective strategy
NY REV rewards distribution utilities for achieving facilitated competition and customer satisfaction

- Earnings Adjustment Mechanisms
- Financial details set in rate cases for each distribution utility
- Some EAMs are expected to supplement contributions to platform service revenues for the foreseeable future.

Adopted a System Efficiency Incentive

PIM is 45% of the net benefits (the remainder go to ratepayers) from annual capacity market savings as a result of incremental BTM PV beyond forecasts, DR not eligible for existing incentives, incremental storage, additional peak reductions from NWA’s or partnerships with third parties.

Metrics to be tracked that may become eligible:

- Installed energy storage capacity
- CO₂ avoided through EVs
- Light Duty Government and Commercial Fleet Electrification
- Low-income and multi-unit apartment building EV charging sites
- Distributed Generation Interconnection
About RAP & Carl

• The Regulatory Assistance Project (RAP) is an independent, non-partisan, NGO dedicated to accelerating the transition to a clean, reliable efficient energy future.

• Carl is a Principal with RAP & lives in Davis, CA
  • Focused on market design, pricing and resource planning
  • Former PUC Commissioner and Energy/Economic Advisor to Governor Guinn (NV)
  • Serving on EIM Governing Body (Chair)
  • PhD Economics (Carolina), BA Math (UC Davis)
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Learn more about our work at raponline.org

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