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THE BENEFITS OF DYNAMIC PRICING IN MASS MARKETS

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• Many utilities are considering the system-wide deployment of smart meters
  ▶ They can improve utility operations and the cost savings can cover a substantial portion of the multi-million dollar investment
  ▶ However, depending on the utility, the “gap” between operational benefits and AMI costs may still be quite large

• One way of bridging the gap is to use smart meters as a means of providing “smart” prices to customers that would induce demand response, obviating the need for expensive peaking capacity and energy

• As a bonus, smart pricing would eliminate an important inequity in existing rate designs
  ▶ Consumers who use relatively less power during expensive peak periods subsidize others
The inequity in flat rates may amount to $4 billion dollars for a state with 10 million customers.

Load Shapes by Customer Type
(10 million customers total)

Rates
Flat = $0.10/kWh
Peak = $0.20/kWh
Off-Peak = $0.067/kWh

Amount of Cross-Subsidy
Per customer = $10/month
Total per month = $33.3 million
NPV (10 years) = $3.9 billion
Smart prices allow for risk sharing between suppliers and consumers
Critical-peak pricing (CPP) is by far the most popular design

- It is essentially a time-of-use (TOU) rate on most days of the year
- When the power system encounters critical conditions, the peak-period price rises to much higher but known levels, either on a day-ahead or day-of basis
- In variable critical-peak pricing (VPP), the critical-peak price rises to an unknown level that reflects actual market conditions
- Both of these rate designs approximate real-time pricing (RTP) rates and are easier for mass market customers to deal with
A CPP rate will provide customers with substantial opportunities to save money
For a vast majority of summer hours, the customer will save money

Price Duration Curve

Cost-Based CPP/TOU Rate

Current Rate

Number of Hours in Summer Period

Rate ($/kWh)
Dynamic prices have had a substantial impact in a hot climate such as California’s Central Valley.

Figure 11
Hourly Load Shape - Complex Daily Share Model - Zone 4
They produce an impact even in a mild climate such as San Francisco’s.
The higher the price, the greater is the drop in peak usage, with the reduction varying with market segment.
Load reductions can be enhanced through enabling technologies

<table>
<thead>
<tr>
<th>Type of Technology</th>
<th>Percent drop in critical peak load</th>
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</thead>
<tbody>
<tr>
<td>Smart Meter</td>
<td></td>
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<tr>
<td>Smart Thermostat</td>
<td></td>
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<tr>
<td>Gateway Systems</td>
<td>50%</td>
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<tr>
<td>Weighted Average</td>
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Under traditional ratemaking, 50% of the customers would be worse off under dynamic pricing.
That fear may keep customers from even trying out the new rates

- And *fear of that fear* may keep us from even offering dynamic pricing to customers, since we are anxious to “protect the customers from themselves”
- How do we break out of this bubble?
Flat rates embody an *implicit* but very real risk premium that insures customers against price volatility.

The risk premium is proportional to the volatility of loads, the volatility of spot prices and the correlation between loads and spot prices.

Thus, if load volatility is 0.2, price volatility is 0.6 and price-load correlation is 0.4, the risk premium is about 5%.

\[ \pi = \exp( \sigma_L \cdot \sigma_P \cdot \rho_{L,P} ) \]

Where:

- \( \pi \) = Risk Premium
- \( \sigma_L \) = Load Volatility
- \( \sigma_P \) = Spot Price Volatility
- \( \rho_{L,P} \) = Correlation Between Load and Spot Price
A Monte Carlo simulations suggest that a 3% risk premium is a conservative estimate.
After crediting for the risk premium, dynamic pricing rates become attractive for 70% of customers.
Enter demand response

- There is substantial evidence that dynamic pricing will lower critical peak loads by more than 10% per average household.
- The bigger the household’s monthly consumption level, the more will be the load drop.
- Customers in hot climate zones will exhibit the most demand response.
After crediting customers with the risk premium and demand response, we can attract over 95% of customers.
Aggregate MW impacts and financial benefits depend on the number of participating customers

- The participation rate will depend on the deployment scenario and marketing strategy
- A mandatory scenario will generate the highest number of participants, followed by an opt-out scenario (around 70-90 percent) and finally by an opt-in scenario (from 10 to 30 percent)
- In all cases, the CPP rate needs to generate substantial bill savings for customers
Impacts vary by utility size and location

Impact on Four Representative U.S. Utilities

MW or Millions of 2007 Dollars

Large Southeastern
Large Western
Midsize Mid-Atlantic
Small Midwestern

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