Demand Response Hardware and Tariffs: California’s Vision and Reality

ACEEE Summer Study
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Overview

1. Vision of Demand Response in California
2. Background
3. Overview of Tariffs and Sign-Ups
   – Define and compare current options
4. Preliminary Results of the Statewide Pricing Pilot for smaller customers
5. Business plan for Advanced Metering Infrastructure
6. Outstanding Issues/Concluding Remarks
Vision

• If economic, customers should have a choice of the following rates:

• Residential and Small Commercial (< 200 kW)
  – Default: CPP
  – Options: TOU

• Large Customers (200 kW to 1 MW)
  – Default: CPP
  – Options: TOU, RTP

• Very Large Customers (> 1 MW)
  – Default: RTP
  – Options: TOU, CPP
Background (part 1)

• In Summer 2002, the California Energy Commission, Public Utilities Commission, and Power Authority initiated a joint proceeding on advanced metering, demand response, and dynamic pricing

• The proceeding is novel because it involves three energy agencies in California working together

• Objectives of the OIR
  – Enhance system reliability
  – Reduce power purchases and consumer costs
  – Protect the environment

• Progress to date:
  – Several large-customer tariffs have been offered
  – A small-customer pricing pilot is in progress
Background (Part 2)

• In response to the 2000-2001 crisis, the CEC advocated for (1) advanced meters, and (2) real-time pricing (RTP) tariffs
• AB29x provided funding for the meters: ~25,000 installed
• CPUC rejected RTP tariffs, but required TOU for >200 kW customers
• RTP has been put on hold due to: high retail prices compared to wholesale prices, no day-ahead hourly market, and a controversy regarding development of customer baselines.
• Critical Peak Pricing and Demand Bidding tariffs are available for customers larger than 200 kW
• Utilities will file preliminary business cases re: new metering and billing systems in October, 2004
• Unresolved is how to harmonize the need for price responsive vs. emergency response tariffs/programs
DYNAMIC PRICING vs. TOU PRICES

- **Time-of-Use (TOU)** is typically 3 time blocks published in advance for entire season
  - Peak, Shoulder, Off-Peak
  - Can’t foresee weather or equipment failures
- **Critical Peak Pricing (CPP)** is a high price imposed on a few days a year when energy is expensive or system conditions are critical or near critical
  - Non-CPP hours are less expensive as a result
  - Day-ahead notification offers additional time for response
- **Real-Time Pricing (RTP)** is hourly real-time marginal cost of a kWh
  - Reflects hot weather, scarcity, or equipment failure
  - Day ahead notification offers additional time for response
Programs/Tariffs in California IOU

- **Interruptible/Curtailable**: Discounted Demand Charges for “Non-Firm Load”; Limit on number and duration of calls; Penalties for non-performance; ~ ½ hour response time; closed to existing customers
- **Demand Bidding**: Voluntary; Market-based (forecasted hourly price) or System Emergency ($0.50/kWh); paid for performance against at “baseline”; no penalties
- **Critical Peak Pricing**: Tariff with “Super-Peak” prices ~ $1.00/kWh; “Super-Peak” for ~ 70 hours per summer; compensating reductions in other time periods; revenue neutral for class with no response
- **California Power Authority Demand Response Partnership**: Monthly availability payment (~$8/kW summer month) and energy payment with performance requirement and non-performance penalties
- **Air Conditioning Cycling/Smart Thermostats**: Traditional A/C cycling or signal to thermostat with “set-up”; override option
- **Backup Generators**: Paid $0.20/kWh against a baseline; 15 minute response; voluntary; to avoid rolling blackouts
An Example of Interruptible/Curtailable Response

Large Transmission Level Service in PG&E
Average Hourly Load per Customer
May and June 2000 and 2001

5 Curtailments in May/June 2000

2000
2001
Example of Smart Thermostat Response for Small Commercial Cust. Thermostat Raised 4 deg. F.

An Example of a CPP Tariff for Large Customers

Prices on CPP Days

TOU Prices

Prices on non-CPP days

$/KWh

hour of day
## Demand Response Programs/Tariffs
### Investor Owned Utilities as of June 2004
### MW Available

<table>
<thead>
<tr>
<th>Program</th>
<th>SDGE</th>
<th>SCE</th>
<th>PGE</th>
<th>Total by Program</th>
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<td>25</td>
<td>710</td>
<td>360</td>
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<td>Demand Bidding</td>
<td>12</td>
<td>80</td>
<td>60</td>
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<td>Critical Peak Pricing</td>
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<tr>
<td>Air Conditioning Cyclers/Smart Thermostat</td>
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<td>300</td>
<td>0</td>
<td>303</td>
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<tr>
<td>Backup Generators</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td><strong>Total by Utility</strong></td>
<td><strong>110</strong></td>
<td><strong>1,103</strong></td>
<td><strong>628</strong></td>
<td><strong>1,841</strong></td>
</tr>
</tbody>
</table>

Grand Total: 1,841
Comparison of Various Rate Options

- **Interruptible/Curtailable Rates**: Offer significant reductions in energy costs (~15%) but stiff penalties for non-performance (~$8/kWh); can go years with few calls; other years (2001) with many calls; closed to existing customers

- **Demand Bidding**: Relatively modest economic savings; so far limited need for this program in 2003/2004

- **Critical Peak Pricing**: Again, modest upside (~2% if relatively responsive); customer with flatter load shape can benefit; designed to be called 12 times per year, regardless of need

- **California Power Authority Demand Response Partnership**: still uncertainty regarding who controls this program

- **Air Conditioning Cycling/Smart Thermostats**: generally for smaller customers; various interruption/incentive combinations

- **Backup Generators**: intended only to prevent rolling blackouts; some controversy re: environmental impacts; only in SDG&E
A Statewide Pilot to Test Various Rates and Customer Response

• Beginning in the Summer of 2003, 2,500 customers involved in various pricing pilots to test response to:
  – Time-of-Use
  – Critical Peak Price with a fixed critical peak time period (CPP_F)
  – Critical Peal Price with variable time period (CPP_V)
    • And with smart thermostats
• Charles River Associates conducted extensive analysis of data
  – Using various techniques
• Also the CEC assessed some of the data
• A sampling of the results follow
• In summary, residential response of ~12% for CPP_F during critical peak events; up to ~45% for CPP_V with smart thermostat
  – For all the details see Statewide Pricing Pilot Summer 2003 Impact Analysis, Charles River Associates. Visit soon www.energy.ca.gov/DemandResponse/Documents/SPP_reports
SPP climate zones vary from cool Zone 1 to very warm Zone 4

Source: CRA presentation, May 22 Chicago Pricing Conference
CPP-F Experiment, Average Over All 12 CPP-F days in Climate Zone 3 (Inland Valleys)
A Very Hot Day in San Diego

CPP-V Experiment in SDG&E
Results from August 15, 2003

- With Thermostat, CPP-V Rate
- With Thermostat, Flat Rate
- Control

Kilowatts (KW) vs. Time (0:15 to 23:15)
The most current results

Change in Consumption during Peak Period for CPP_F customers on Critical Peak Days -- Summer 2003

Zone 1 | Zone 2 | Zone 3 | Zone 4 | Statewide
---|---|---|---|---
-8% | -10% | -13% | -16% | -12%
1% | -11% | -16% | -17% | -12%

Constant Elasticity of Substitution Model (CRA)
CEC Method
Own-Price Elasticities
California SPP vs. Nationwide Historical Results

Average = -0.30

Source: Predicting California Demand Response, Chris King and Sanjoy Chatterjee, Public Utilities Fortnightly, July 1, 2003, p.27-32 w/ CPP-F data added by Roger Levy, May, 2004
Summary of Pilot Results to Date

- Customers on CPP_F, CPP_V, and TOU respond to price
- Results are consistent with other studies
- In my opinion, the 2003 data have been sufficiently analyzed
- Awaiting, results from 2004

- Next step will be development of Advanced Metering Infrastructure Business Cases
  - Filings in October 2004
Ongoing issues

• How much DR can be counted upon
  – At what price or during what sort of “near-emergency” system conditions
  – Duration of such response
    • An hour or two or longer?
    • How quickly can response occur?
  – How to value such various types of response?
    • Like a combustion turbine? More or less valuable
• Business Case Development
• Regulatory Structure in California
  • Direction is a bit cloudy at the moment
  • A “capacity” market with reserve margins of 15% to 17% may include both capacity and energy payments, hence may moderate and complicate real time prices.
  • Not determined how demand response will figure into this calculation, but it’s clear that CPUC intends to include it, somehow
Concluding Remarks

• Price responsive demand will enhance the competitiveness of electricity markets
• A direct link between wholesale and retail markets is essential
• However, other types of electrical system emergencies may require instantaneous load response
• California had a separate proceeding dealing with interruptible load programs
• We plan to merge price-sensitive demand response and interruptible programs
  – For example, one approach could involve a curtailment signal that a customer would not have the option to override.
• Yet, additional infrastructure is needed for this to occur
• And, only time will tell how this plays out