Demand Response
The Role for Policy, Pricing and Technology
Two Objectives

1. Identify critical problems that keep demand response from becoming a significant system resource.

2. Identify the policy and technology initiatives California is pursuing to establish a new vision of demand response.
The Problems

- "Why was there virtually no reduction in electricity peak demand from the customer side of the market when wholesale prices increased by a factor of five in less than a week in the summer of 2000?" *
- How do we solve outage management practices that exempt 50% of the utility customers?
- How do you provide customers with the capability to better manage their electric bills and tailor reliability to their individual needs?
- What can we do to turn demand response into a viable resource?

* CEC Action Plan, October 11, 2002
DR programs can be best characterized as patches to compensate for poor or ineffective rate design.

Price
Without basic price information customers cannot establish a value function or make rational investment decisions.

Rates
Customers don’t understand their electric rates.

Programs
Electrical systems require that technologies and procedures be in place and instantly available – they weren’t.
The Questions

Define Demand Response
A customer or utility perspective?

Market Models
Regulated models seek participants for programs.
Competitive models incent customers and create markets.

Policies and Standards
Policies establish priorities. Standards create expectations.
There are no policies or standards for demand response.

Valuing Demand Response
How do you value demand response?
What comes first, demand response or supply?

Technology
Technology to support utility or customer needs?
Are efficiency and demand response compatible options?

Customer Interface
What role for customer information?
DRRC Research Plan

Strategic R&D: Defining Demand Response
- Creating a 21st Century Vision of Demand Response
- Establish the Value of Demand Response

Policy R&D: Create a Policy Foundation for Demand Response
- Incentives and Rate Design for Efficiency and Demand Response
- Building and Appliance Standards to Support Demand Response

Technical and Market R&D: Development and Implementation
- Demand Response Simulation and Planning Model
- DR Technology and Program Development and Assessment
- Customer Education Resource Library
- Customer Information Needs and User Interface
### A Customer Model of Demand Responsive

#### The Customer Perspective

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Customer Impact</th>
<th>Purpose of DR</th>
<th>Valuing DR</th>
<th>Advance Notice</th>
<th>Time Perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Basic Service</td>
<td>None</td>
<td>None</td>
<td>kWh</td>
<td>Annual</td>
<td>years</td>
</tr>
<tr>
<td>2.0</td>
<td>Shifting or Rescheduling</td>
<td>No Noticeable Impacts</td>
<td>Economics</td>
<td>kW</td>
<td>Hours to Days</td>
<td>40-100 hrs/yr</td>
</tr>
<tr>
<td>3.0</td>
<td>Voluntary Partial End-Use Curtailment</td>
<td>Some Comfort Impacts</td>
<td>Reliability and Economics</td>
<td>Expected Value Partial Outage Cost</td>
<td>Seconds to Hours</td>
<td>20-40 hrs/yr</td>
</tr>
<tr>
<td>4.0</td>
<td>End-Use Curtailment</td>
<td>Loss of End-Use</td>
<td>Grid or System Protection</td>
<td>Full Outage Cost</td>
<td>Seconds or Less</td>
<td>2-10 hrs/yr</td>
</tr>
<tr>
<td>5.0</td>
<td>Full Outage</td>
<td>Total Loss of Service</td>
<td>System Protection</td>
<td>Full Outage Cost</td>
<td>None</td>
<td>0-6 hrs/yr</td>
</tr>
</tbody>
</table>

- **Customer Facility Envelope / Equipment**
  - Control Systems
  - Interface

- **Purpose of DR**
  - Total Loss of Service
  - System Protection
  - Load Shifting or Rescheduling
  - Reliability and Economics
- **Advance Notice**
  - None
  - Seconds or Less
  - Seconds to Hours
- **Time Perspective**
  - 0-6 hrs/yr
  - 2-10 hrs/yr
  - 20-40 hrs/yr

#### Notes:
- Customer facility, end-uses and operating practices define the infrastructure that form the foundation for all DR and efficiency options.
- Efficiency and Demand Response are both part of the same continuum, differing only in time perspectives and valuation factors.
Regulatory Policy Initiatives

1. Statewide implementation of advanced metering (AMI).
2. Critical Peak Pricing as the default tariff.
3. Programmable controllable thermostats in the Building and Appliance Standards.
Statewide Implementation of AMI

Automated Meter Reading (AMR)

- Drive-by Systems
  - 6.5 years Payback
  - $92 Average Dollar Cost

Advanced Metering Infrastructure (AMI)

- Fixed Network Systems
  - 6.5 years Payback
  - $107 Average Dollar Cost

- $100
- $75
- $50
- $25

Functional Capability

- kWh Usage
- kW Interval Data
- Dispatchable Rates
- Tamper Detection
- Outage Monitoring
- Read on Demand
- Selectable Billing Dates
- Customer Usage Profiles
- Dynamic Load Research

DRRC
Demand Response Research Center
Residential CPP rates can, within five years of deployment reduce California’s peak load by 1,500 to over 3,000 mW.

Dynamic rates encourage greater conservation and peak demand impacts than conventional inverted tier or time-of-use rates.

Residential and small to medium commercial and industrial customers understand and overwhelmingly prefer dynamic rates to existing inverted tier rates.

Source: CEC staff conclusions based on review of collective SPP reports.
Residential Load Impacts (Technology)

Critical Peak Impacts By Rate Treatment

- **Average Critical Peak Day**
  - TOU: 4.1%
  - Critical Peak Fixed: 12.5%
  - Critical Peak Variable With Automated Controls: 34.5%

- **Hottest Critical Peak Day**
  - CPP-V: 47.4%

Residential Load Impacts (Demographics)

Percent Reduction in Peak Period Usage (CPP-F)

Source: Statewide Pricing Pilot, Summer 2003 Impact Analysis, CRA, August 9, 2004, Table 5-9, p.90
Residential Response with Automation: Participation Incentive vs. Critical Peak Rate

Hot Day, August 15, 2003, Average Peak Temperature 88.5°
Residential Load Impacts (Historical)

Average Critical Peak Day

- **Three Tier TOU with Dispatched CPP**
  - AEP Pilot 1991
  - Midwest Pilot 2004
  - California Pilot 2003

- **Two Tier TOU with Dispatched CPP**
  - California Pilot 2003

Hottest Critical Peak Day

- **AEP Pilot 1991**
  - 47.4%

Source:
2. Private communication, residential TOU pilot study, May 2005.
### Customer Bill Impacts (Actual)

#### Summer / Winter 2003

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Small-Medium Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CPPV</td>
<td>CPPF</td>
</tr>
<tr>
<td>Participants (%)</td>
<td>71.1%</td>
<td>73.7%</td>
</tr>
<tr>
<td>Average Monthly</td>
<td>5.1%</td>
<td>5.5%</td>
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<tr>
<td>Savings (%)</td>
<td></td>
<td></td>
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<tr>
<td>Average Monthly</td>
<td>$6.81</td>
<td>$3.89</td>
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<tr>
<td>Savings ($)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants (%)</td>
<td>28.9%</td>
<td>26.3%</td>
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<tr>
<td>Average Monthly</td>
<td>4.0%</td>
<td>6.2%</td>
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<tr>
<td>Increase (%)</td>
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<tr>
<td>Average Monthly</td>
<td>$5.03</td>
<td>$4.93</td>
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<tr>
<td>Increase ($)</td>
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Customer Rate Preferences (Old vs. New)

<table>
<thead>
<tr>
<th></th>
<th>Original Inverted Tier Rate</th>
<th>Pilot Rates</th>
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</thead>
<tbody>
<tr>
<td>CPP-V</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>CPP-F</td>
<td>23%</td>
<td>77%</td>
</tr>
<tr>
<td>TOU</td>
<td>19%</td>
<td>81%</td>
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</table>

Residential

<table>
<thead>
<tr>
<th></th>
<th>Percent that Prefer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPP-V</td>
<td>30%</td>
</tr>
<tr>
<td>CPP-F</td>
<td>29%</td>
</tr>
<tr>
<td>TOU</td>
<td></td>
</tr>
</tbody>
</table>

Commercial

Technology Initiatives

- Long-term development – Reduce costs and improve performance (DRETD)
- Rapid Prototyping – Programmable Controllable Thermostat
- Building and Appliance Standards
DRETD – DR Enabling Technologies

- Wireless communications  [ Pico Radio ]
- MEMS sensors    [ Real-time meter, TempNodes ]
- Actuators       [ Pulse Width Modulator control signals ]
- Controls        [ DR enabled thermostat ]
- Network management
- Systems integration
- Low-cost packaging  [ PicoCubes ]
- Energy scavenging and storage
- Real-time operating systems  [ TinyOS ]

http://ciee.ucop.edu
## Regulatory Policy Initiatives

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<thead>
<tr>
<th>Measure</th>
<th>Purpose</th>
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</thead>
</table>
| **1** Statewide implementation of advanced metering. | - Facilitate pricing.  
- Support customer education. |
| **2** Critical Peak Pricing as the default tariff. | - Integrates efficiency and demand response on a common financial basis.  
- Demand response becomes a condition of service for all customers. |
| **3** Programmable controllable thermostats in the Building and Appliance Standards. | - Enable / automate customer choice.  
  - Economic response (CPP day ahead)  
  - Reliability response (CPP day of)  
- Enable system protection and redefine outage management. |
# Contact Information

| Demand Response Research Center (DRRC) | Mary Ann Piette, Director  
Phone: 510 486-6286  email: mapiette@lbl.gov,  
Roger Levy, Program Development  
Phone: 916-487-0227  email: RogerL47@aol.com |
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<tr>
<td>CEC Demand Response Sites</td>
<td><a href="http://www.energy.ca.gov/demandresponse">www.energy.ca.gov/demandresponse</a></td>
</tr>
<tr>
<td>Consortium for Electric Reliability Technology Solutions (CERTS)</td>
<td><a href="http://www.certs.lbl.gov">www.certs.lbl.gov</a></td>
</tr>
<tr>
<td>Center for the Study of Energy Markets (CSEM)</td>
<td><a href="http://www.ucei.berkeley.edu/power.html">www.ucei.berkeley.edu/power.html</a></td>
</tr>
<tr>
<td>Demand Response Enabling Technology Development (DRETD)</td>
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