Demand Response

The Role for Policy, Pricing and Technology

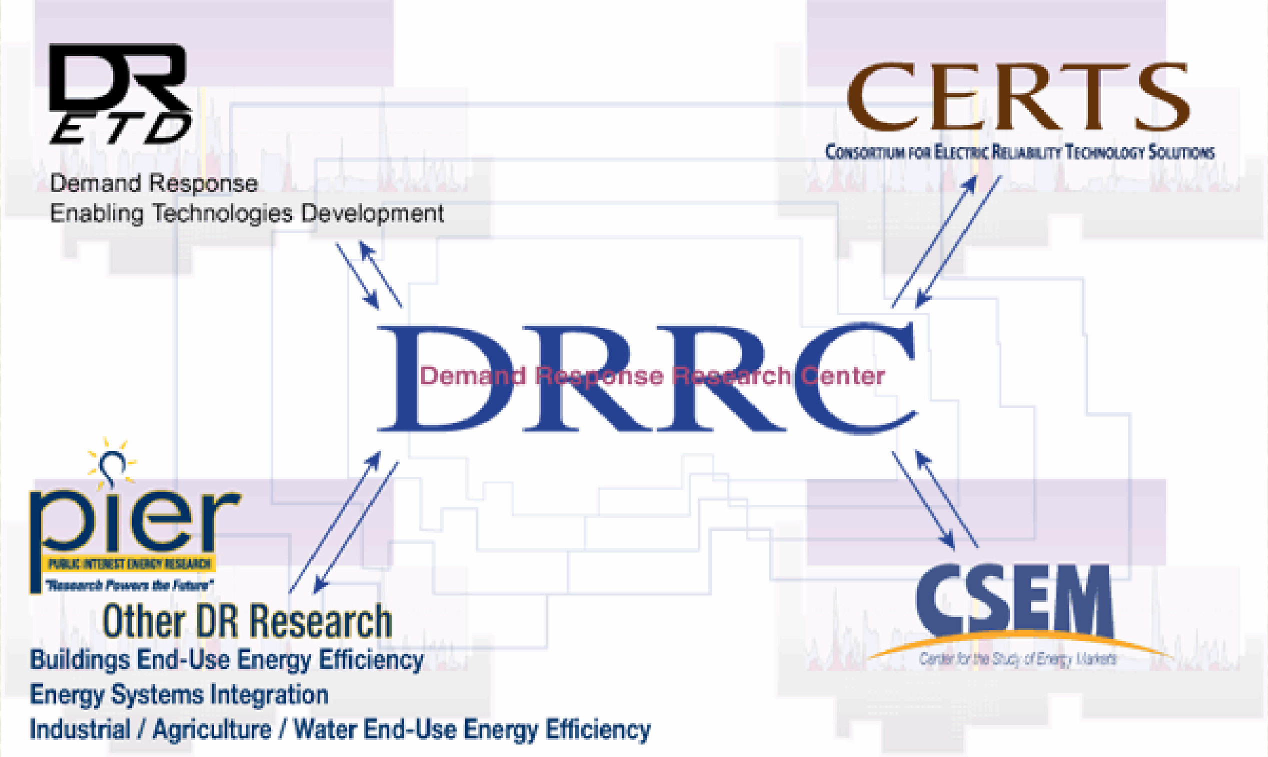
Demand Response Research Center

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 Demand Response Research Center



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

The Problems

***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		Customer Impact	Purpose of DR	Valuing DR	Advance Notice	Time Perspective	
5	**Full Outage**	Entire facility outage.	Total Loss of Service	System Protection	Full Outage Cost	None	0-6 hrs/yr	
4	**End-Use Curtailment**	Targeted end-use automatic curtailment brief period	Loss of End-Use	Grid or System Protection	Expected Value Partial Outage Cost	Seconds or Less	2-10 hrs/yr	Reliability Responsive DR
3	**Voluntary Partial End-Use Curtailment**	Reduced usage, increase temp settings or curtailments	Some Comfort Impacts	Reliability and Economics		Seconds to Hours	20-40 hrs/yr	
2	**Shifting or Rescheduling**	Load Shifting or Rescheduling	No Noticeable Impacts	Economics	kW	Hours to Days	40-100 hrs/yr	Price Responsive DR
1	**Basic Service**		None	None	kWh	Annual	years	Efficiency and Conservation

Customer Facility Envelope / Equipment	Control Systems
	Interface

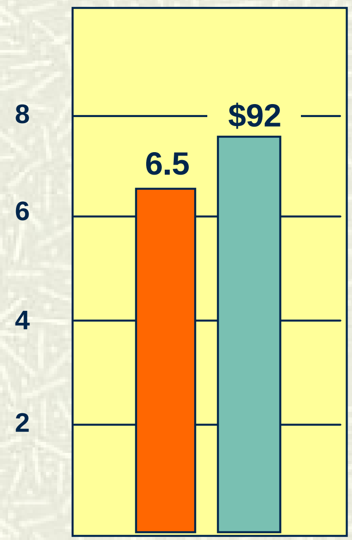
- Customer facility, end-uses and operating practices define the infrastructure that form the foundation for all DR and efficiency options.
- Efficiency and Demand Response are both part of the same continuum, differing only in time perspectives and valuation factors.

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)

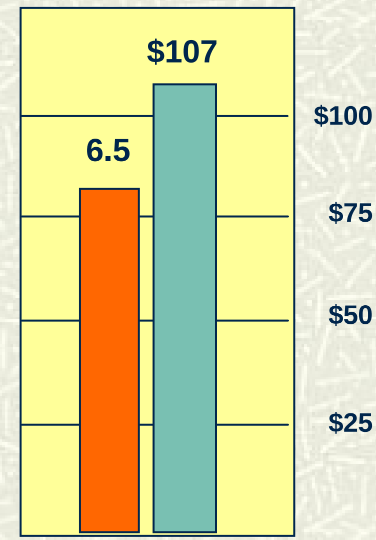


Drive-by Systems

Functional Capability

AMR	Functional Capability	AMI
●	kWh Usage	●
☐	kW Interval Data	●
☐	Dispatchable Rates	●
☐	Tamper Detection	●
☐	Outage Monitoring	●
☐	Read on Demand	●
☐	Selectable Billing Dates	●
☐	Customer Usage Profiles	●
☐	Dynamic Load Research	●

Advanced Metering Infrastructure (AMI)



Fixed Network Systems

Average Expected Payback (years)

Average Dollar Cost per Meter Installed

Statewide Pricing Pilot - Conclusions

System Impacts

Residential CPP rates can, within five years of deployment reduce California's peak load by 1,500 to over 3,000 mW.

Conservation and Peak Load Impacts

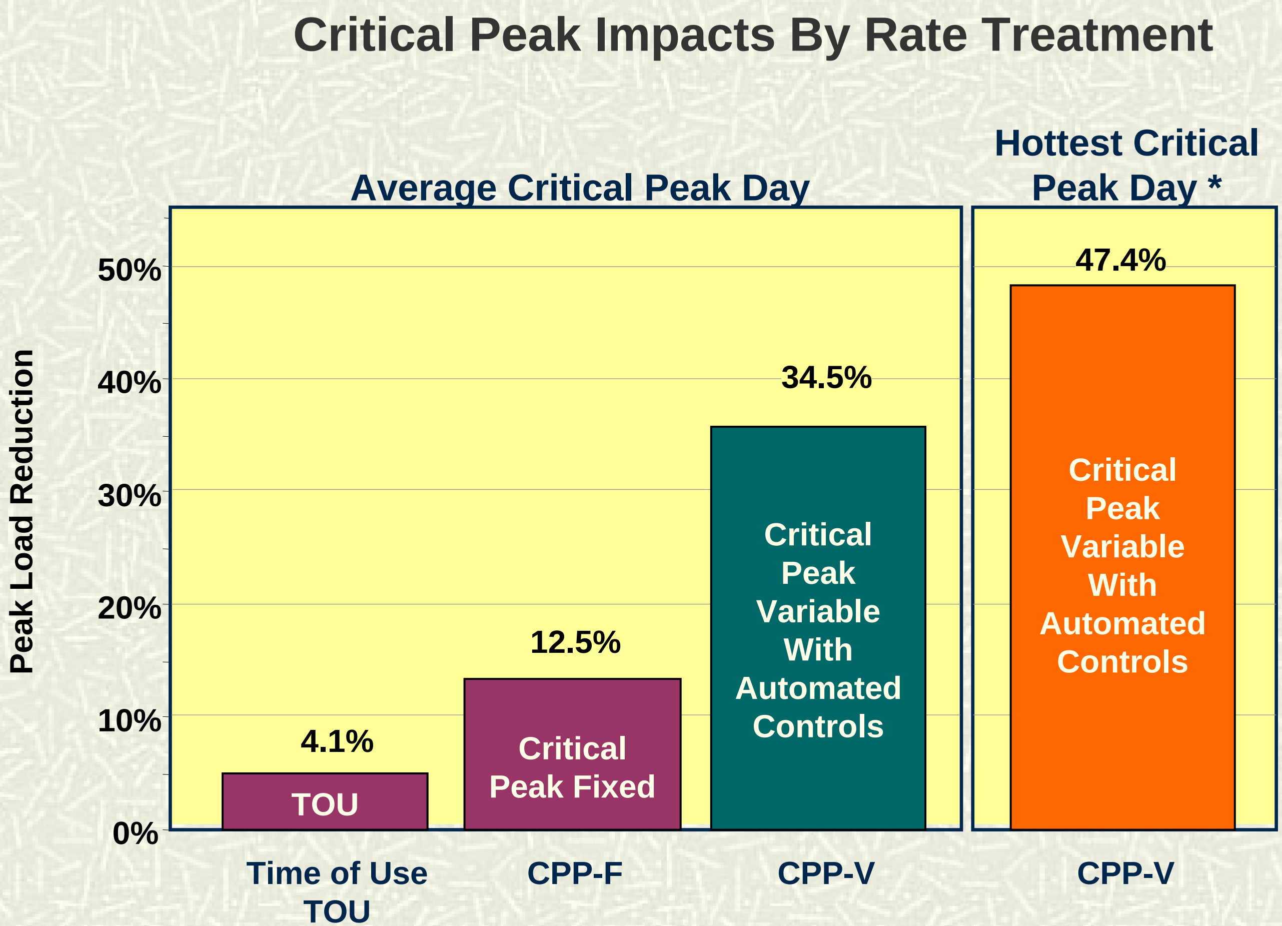
Dynamic rates encourage greater conservation and peak demand impacts than conventional inverted tier or time-of-use rates.

Customer Acceptance

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

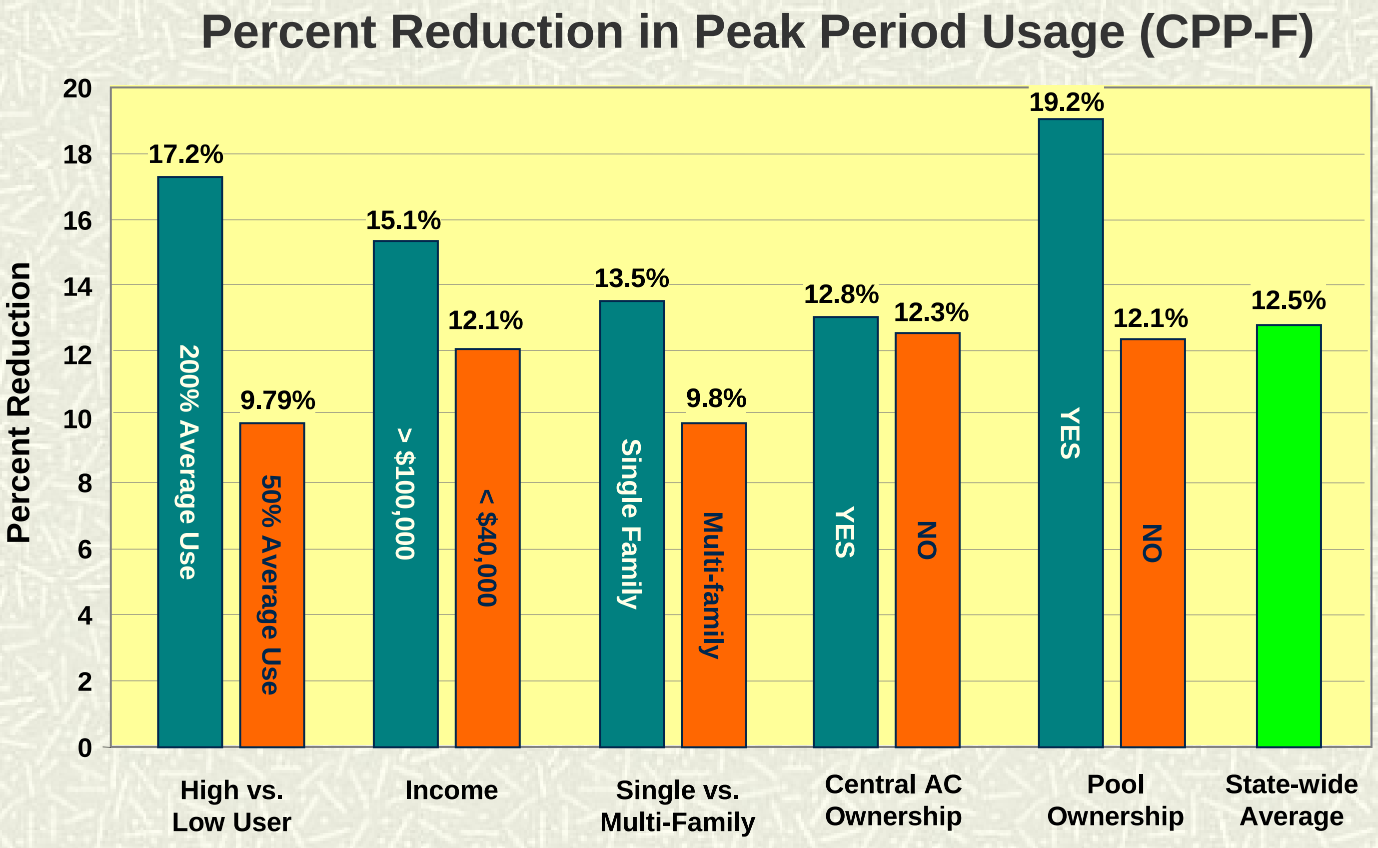
Source: CEC staff conclusions based on review of collective SPP reports.

Residential Load Impacts (Technology)



Source: Statewide Pricing Pilot Summer 2003 Impact Analysis, Charles Rivers Associates, Table 1-3, 1-4, August 9, 2004.

Residential Load Impacts (Demographics)



Source: Statewide Pricing Pilot, Summer 2003 Impact Analysis, CRA, August 9, 2004, Table 5-9, p.90

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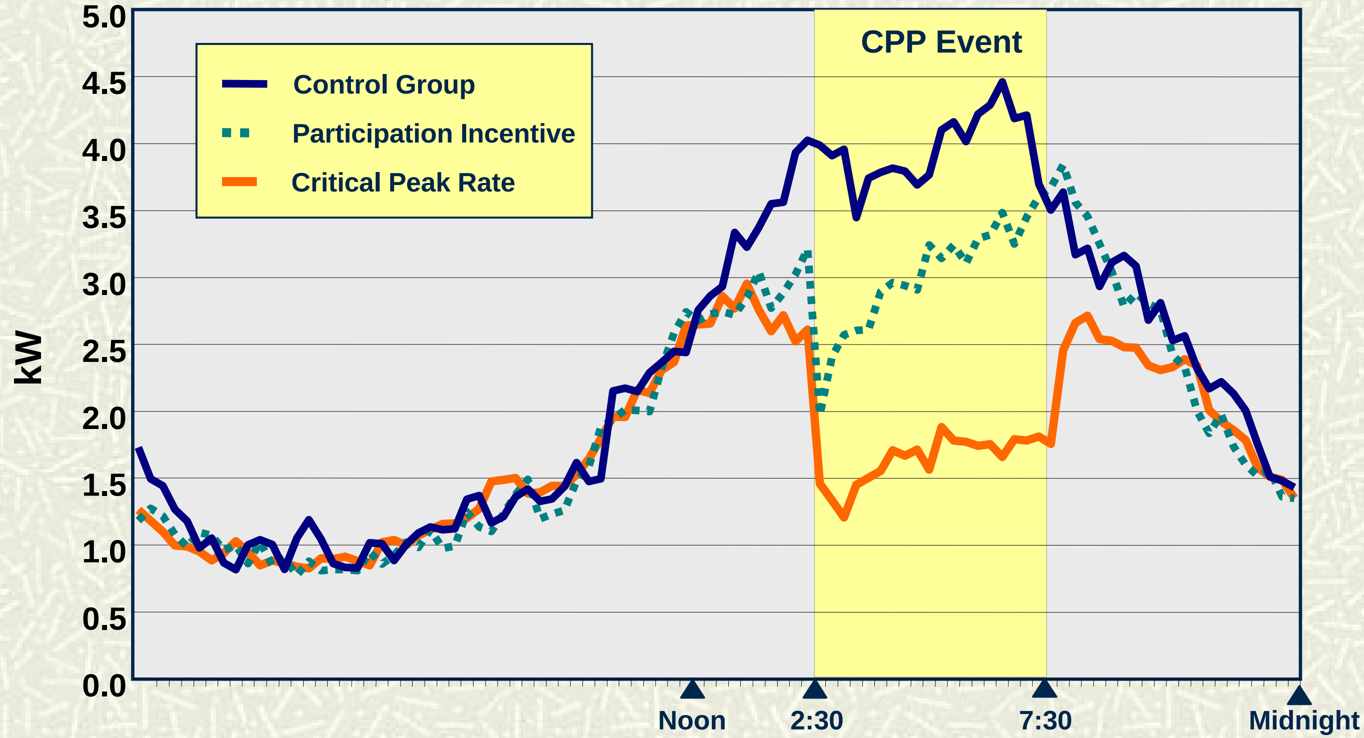
Residential Load Impacts (Incentives)

Residential Response with Automation: Participation Incentive vs. Critical Peak Rate



Hot Day, August 15, 2003, Average Peak Temperature 88.5^0

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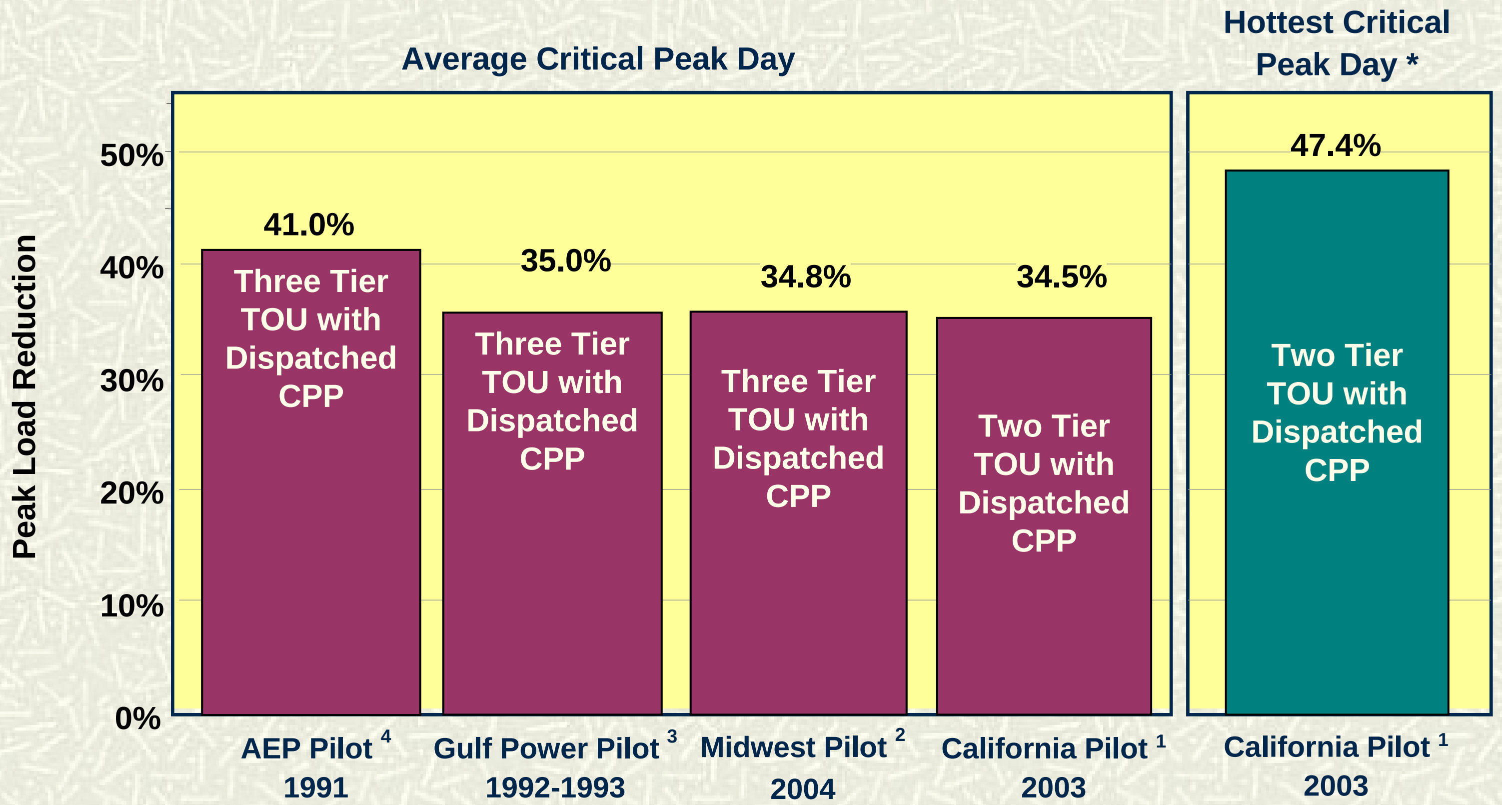
Residential Load Impacts (Historical)



Source:

1. Statewide Pricing Pilot Summer 2003 Impact Analysis, Charles River Associates, Table 1-3, 1-4, August 9, 2004. Hottest day impacts on page 105.
2. Private communication, residential TOU pilot study, May 2005.
3. Results of the Pilot Residential Advanced Energy Management System, Gulf Power, November 1994.
4. Levy Associates case study report, July 1994.

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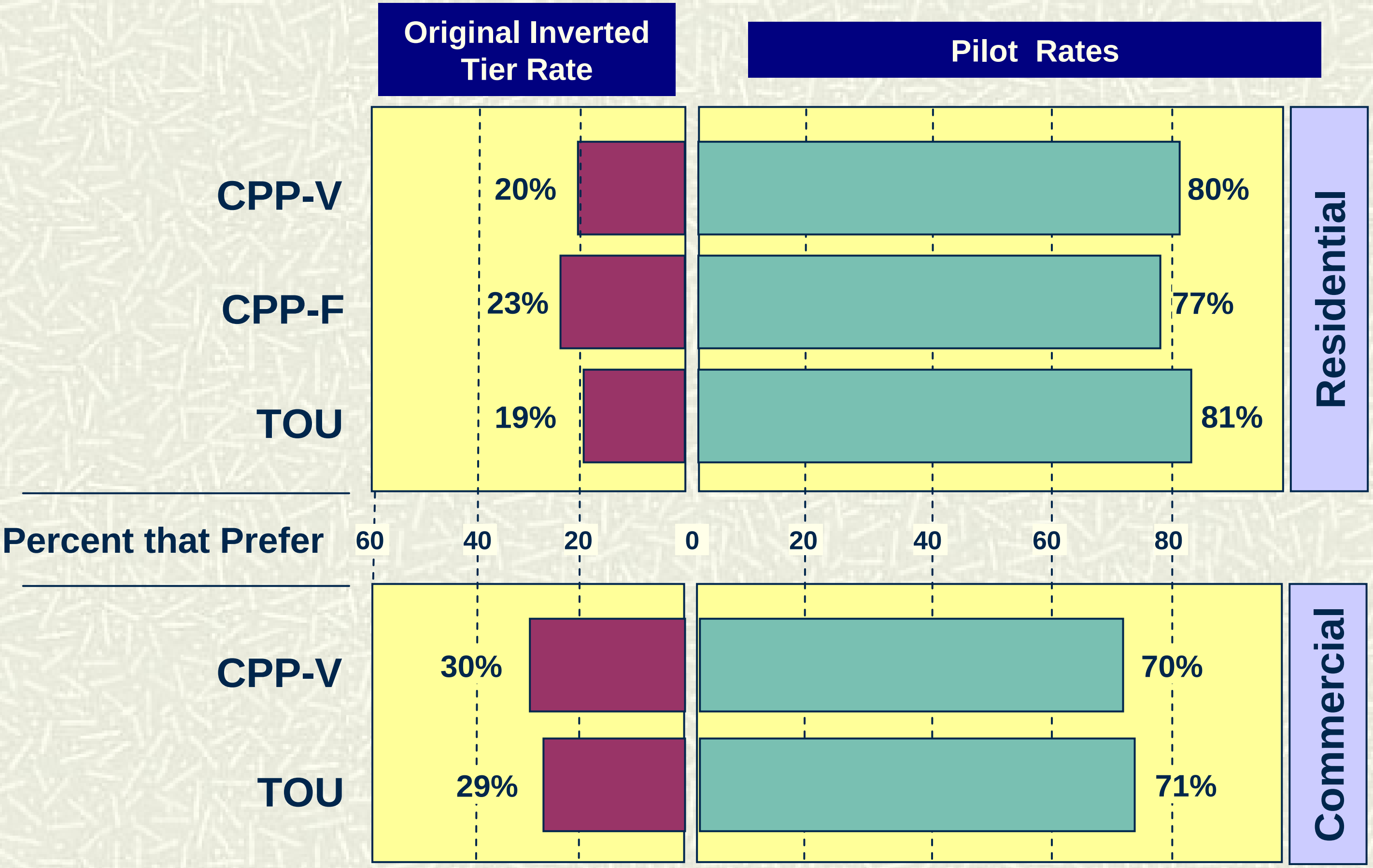
Customer Bill Impacts (Actual)

		Residential			Small-Medium Commercial	
		CPPV	CPPF	TOU	CPPV	TOU
Customers With Bill Savings	Participants (%)	71.1%	73.7%	70.0%	80.3%	58.2%
	Average Monthly Savings (%)	5.1%	5.5%	4.5%	12.2%	9.6%
	Average Monthly Savings ($)	$6.81	$3.89	$3.25	$155.17	$90.65
Customers With Bill Increases	Participants (%)	28.9%	26.3%	30.0%	19.7%	41.8%
	Average Monthly Increase (%)	4.0%	6.2%	3.0%	5.0%	10.0%
	Average Monthly Increase ($)	$5.03	$4.93	$3.32	$22.89	$62.52

summer / winter 2003

Source: Statewide Pricing Pilot, Shadow Bill Results, WG3 report, June 9, 2004.

Customer Rate Preferences (Old vs. New)



Source: SPP End-of-Summer Survey Report, Momentum Market Intelligence, WG3 Report, January 21, 2004, p23-24.

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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]***

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Regulatory Policy Initiatives

	Measure	Purpose
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.

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Contact Information

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Consortium for Electric Reliability Technology Solutions (CERTS)	www.certs.lbl.gov
Center for the Study of Energy Markets (CSEM)	www.ucei.berkeley.edu/power.html
Demand Response Enabling Technology Development (DRETD)	www.ciee.ucop.edu/dretd