



Overcoming Barriers to Customer Demand Response through Coordinated Retail and Wholesale Regulatory Policy

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Prepared by

Daniel Schnitzer and Liz Hicks, KEMA
Burlington, Massachusetts USA
781-418-5700

Daniel.Schnitzer@kema.com, Liz.Hicks@kema.com

Overview of this Presentation

- Purpose and scope
- Defining DR
- State of knowledge on DR
- What is optimal participation?
- Key barriers
- Next Steps

Our Team

Experts on DR, EE and AMI policy, design, implementation and evaluation

- Ms. Elizabeth Hicks, Senior Principal, KEMA.- Policy, Design Eval.
- Dr. Miriam Goldberg, Senior Vice President, KEMA., Eval, Design, Policy
- Mr. Daniel Schnitzer, Energy Analyst, KEMA., Policy
- Mr. Daniel Waitroob, Director, KEMA. Implementation
- Mr. Taff Tschamler, Director, KEMA Retail Energy Markets Advisory Service. Retail Markets
- Ms. Kristie Deluliis, Manager, KEMA Retail Advisory Service. Retail
- Dr. Stephen George, Principal Consultant, FSC Group. All areas
- Dr. Lynne Kiesling, Senior Lecturer, Department of Economics, Northwestern University. Policy and Retail Markets

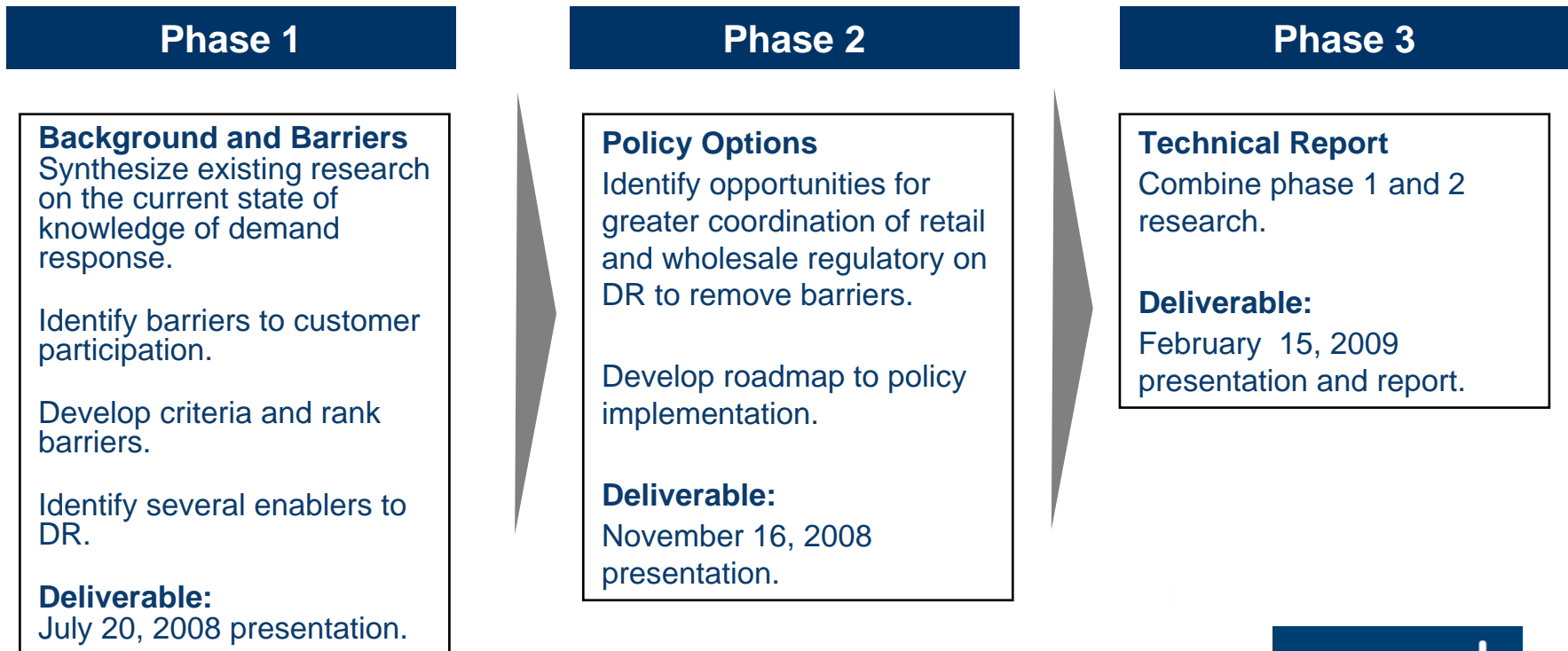
Project Motivation

- Stems from NARUC/FERC Collaborative on Demand Response
- Seeks to enhance coordination between retail and wholesale policies to reduce barriers to demand response and stimulate greater participation

Project Goals

Project seeks to:

- 1. Examine “barriers to customer participation” in demand response
- 2. Identify policy options capable of reducing or overcoming barriers



Discussion of DR “Types”

- From literature review and ongoing dialogue, there is a consensus on how to define demand response:
- **Demand Response can be define as:** Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized. (DOE 2006)
 - There is less consensus on how to organize different “types” of demand response, as unique categories are not well suited to capture the many facets of DR characteristics.
 - These characteristics - purpose, penalties, payments, triggers or load - are often *not* unique to individual types of DR.

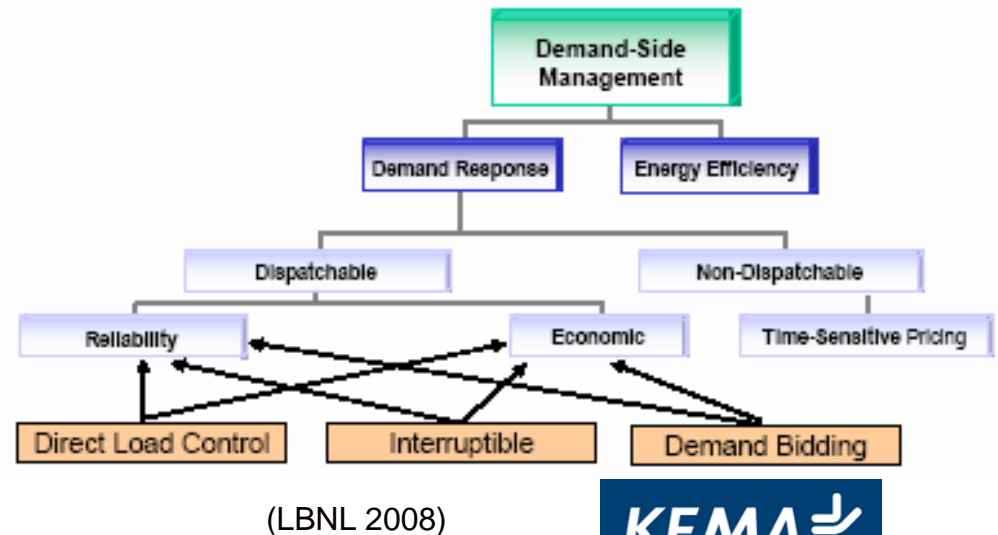
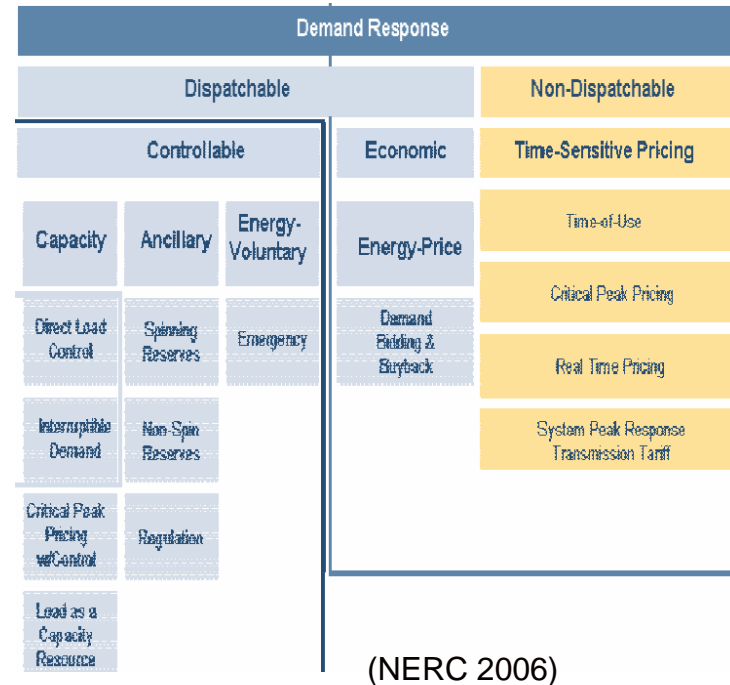
Existing Typologies

NERC provides definitions for the two main divisions of DR types:

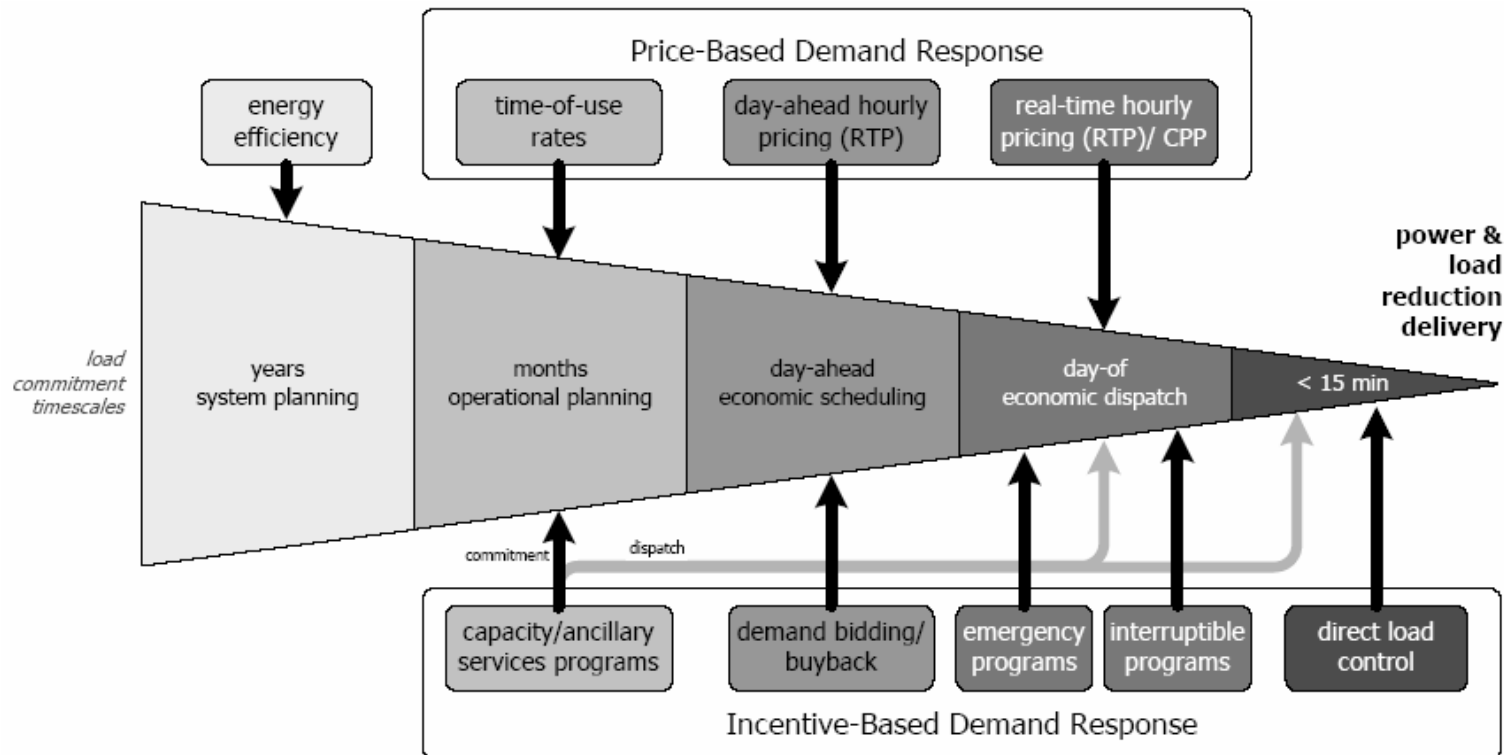
Dispatchable DR influences participation through an *inducement* or *incentive*. Resources can supply capacity, ancillary services and emergency energy with a *high degree of certainty*.

Non-Dispatchable DR links prices in retail and wholesale markets. Retail customers receive a price signal reflecting the costs of production and delivery. When high energy prices are correlated with reliability problems, actions taken by customers to reduce load can have a positive impact on reliability in addition to reducing overall costs. Some DR is achieved without operator dispatch and is undertaken without knowledge of the LSE, as is the case with seasonal or TOU rates.

DOE alternatively notes this distinction as “Incentive-Based,” vs. “Priced-Based” DR.



DOE Typology



Factors Affecting Participation in DR Types

- Customers participate via tariffs, in the case of Price-Based DR, and programs or markets organized by LSEs, third party aggregators, utilities, distribution companies, and RTOs.
- Each type of DR has its own form of incentive. Certain customer classes tend to be best suited to certain types of DR, and certain retail and wholesale market structures tend to better support certain types
- There are two dimensions of “participation:” getting customers to enroll in an opt-in situation, and getting the response from the enrolled resource.
- Rates/programs must be designed to optimize the combined effect of resource levels provided per participant.

State of Knowledge

- DR types
- Optimal Level of Participation
- Examples of Enabling Technologies

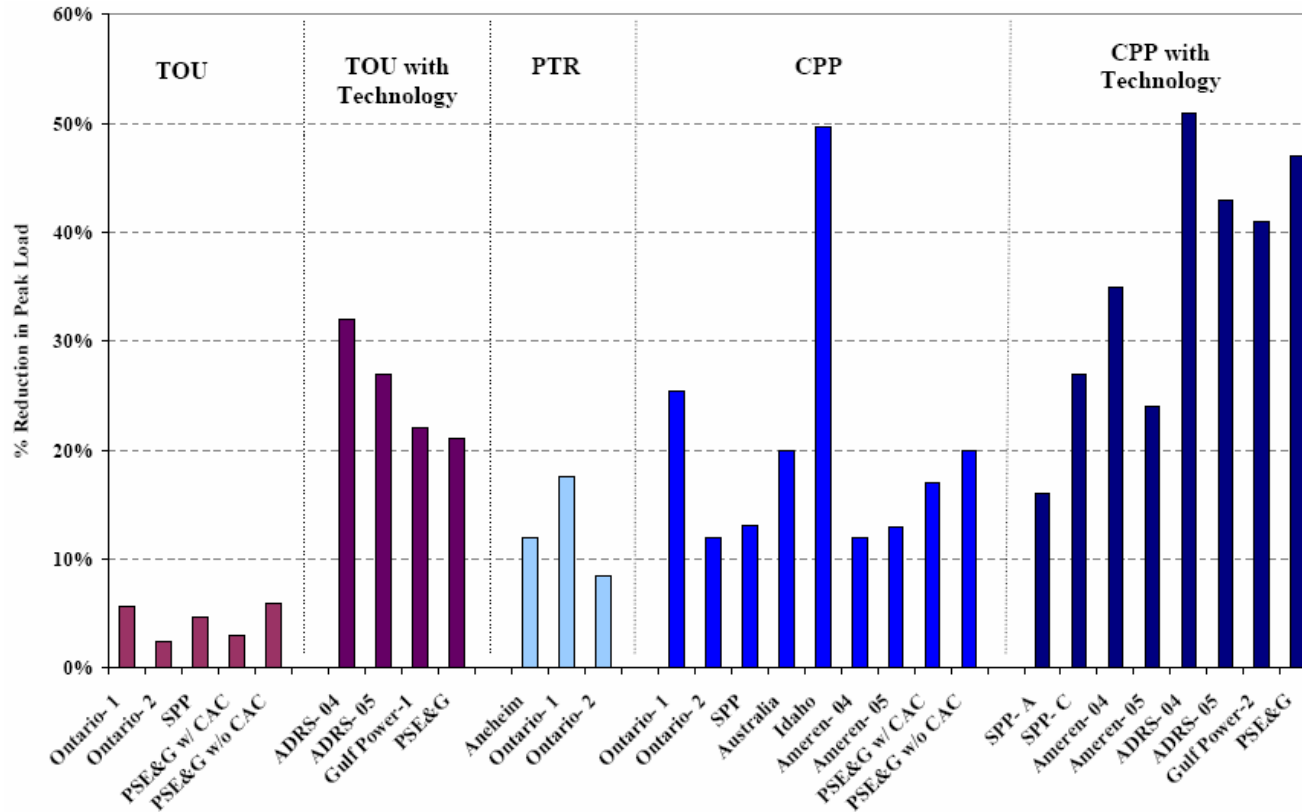
Non-Dispatchable (Price-based) DR

Type	Customer Class	Enabling Tech	Participation	Avg. Participant Peak Load Reduction	System Peak Reduction	Reference
TOU	All	Requires TOU/two-register meter, can be manually read.	Low	See graph	N/A	Faruqui, 2008
CPP	All (Mostly mass market)	AMI	Low	See graph	N/A	Faruqui, 2008
RTP	All (Mostly largest C/I)	AMI	Low	12-33%	<1%	Goldman et al, 2004

Dispatchable (Incentive-based) DR

Type	Customer Class	Enabling Tech	Participation	Avg. Participant Peak Load Reduction	System/Service Territory Reduction	
Demand Bidding	Large C/I; Mass Market w/ Enabling Tech		Low	Up to 10%		Gunn, 2006
Interruptible Tariffs	Large C/I		High	Up to 15- 20%		Gunn, 2006
Direct Load Control	Mass Market, C/I	Powerline Communications System, bidirectional direct control PCTs, load switches for AC loads, pool pumps, water heaters	High	Up to 20%	Up to 10- 20%	FPL

Non-Dispatchable DR



Comparison of Time-Varying Rates for Mass Market Customers (Faruqui, 2008)

Optimal Participation (1)

- What is optimal participation :
 - Getting as much DR as possible for the cost
 - The total amount of DR it is cost effective to get
 - Having enabling technology so customer can fully participate
 - Clear Policy Objectives
 - An appropriate benefit cost test

Optimal Participation (2)

- How to optimize DR:
 - Having retail price signals reflect the actual cost of serving customers
 - Communication of the prices to customers
 - Customer education about the opportunity
 - Tools for customer to control load
 - Market rules that create sustainable business models for DR aggregators and enabling technology providers
 - Cost recovery of enabling technologies for the disco
 - M&V that provides reliable impacts and improves results over time

Some examples of enabling technologies

Technology/ Program	Description	Availability	Key Challenges	Key Strategies	Examples
Smart Grid/ GridWise technologies	Smart grid technologies include both customer side and grid side technologies that allow for more efficient operation of the Grid.	Available in pilot situations	Cost Customer Acceptance Communication Protocols	Pilot Programs R&D programs	GridWise Pilot in Pacific NW
Smart appliances/ Smart Home	Homes with gateways that would allow for control of appliances and other end-uses via the internet.	Available	Cost Customer Acceptance Communication Protocols	Pilot Programs Customer education	GridWise Pilot in Pacific NW
Load control of AC via smart thermostat	AC controlled via smart thermostat Communication can be via wireless, PLC or internet	Widely available	Cost Customer acceptance	Used to control loads in congested situation Pilot and full scale programs Customer education	LIPA, Austin Energy, Utah Power and light ISO New England
Dynamic Pricing/ Critical Peak Pricing with enhanced metering	Providing customers with either real time or critical peak pricing via a communication technology. Communication can be via wireless, PLC or internet. Customers can also be provided with educational materials.	Available	Cost Customer acceptance Split incentives in de-regulated markets Regulatory barriers	Pilot and full scale Programs Used in congested areas Customer education	Georgia-large users Niagara Mohawk California Peak Pricing Experiment

Barriers –Overall

- Barriers occur across the entire supply chain of market actors
- Some key differences in different market structures
- Some barriers the same despite market structure
- Lack of many successful larger scale efforts to frame research
- Technology has been changing rapidly
- Difference between “DR Programs” and “Pricing Programs”

Barriers – Customers (1)

- Key customer barriers include:
 - Access – customers don't “do DR on their own”
 - Lack of information – including information on the opportunities that exist and the real time cost nature of electricity
 - Information about the benefits that can be made by changing behavior
 - Lack of understanding between the actions that can provide those benefits

Barriers – Customers (2)

- Customer Barriers continued:
 - Lack of enabling technologies especially for Mass Market customers
 - No experience with time differentiated rates for electric usage
 - Possible savings may not be worth hassle costs unless price differentials are quite high
 - Don't want to give up lack of control
 - Lack of trust of savings – don't believe it is there
 - DR framed as an opportunity to save rather than pricing

Barriers – Market Actors in the Supply Chain

- Market actors include:
 - Aggregators such as Comverge and Enernoc
 - Distribution Utilities (both in a vertically integrated market and competitive)
 - Generators
 - Retailers
 - ISO's
- Barriers more likely to vary by type and market design

Barriers – Market Actors (2)

- Barriers for Market Actors include:
 - Lack of infrastructure and enabling technologies
 - Lack of PRD in RTO dispatch and capacity markets
 - Owners Generators seeking to maximize profits
 - Split incentives between retail supplier and distribution company
 - Lack of known cost recovery for regulated entities
 - Lack of real time or TOD price signals
 - Inability to make a return on DR costs for regulated companies
 - Lack of market mechanisms to facilitate DR
 - Distrust of savings by operators of the system

Criteria to Rank Barriers

- Criteria used:
 - Intensity
 - Ease of removal
 - Magnitude of impact on DR
 - Net Value
 - Level of interdependencies

Barriers Ranking								
			Score High = 5 Med = 3 Low = 1	Score Easy = 5 Medium = 3 Hard = 1	Score High = 5 Med = 3 Low = 1	Score High = 5 Med = 3 Low = 1	Score High = 5 Med = 3 Low = 1	Score
Segment	General Barrier	Detailed Barrier	Intensity	Ease of Removal	Magnitude of Impact on DR	Net Value	Inter-dependence	Overall Score
Customer	Performance Uncertainty	Uncertainty of how new controls will affect operations or comfort	5	3	3	3	1	3
Customer	Performance Uncertainty	Uncertainty of effect on bill	5	3	3	3	1	3
Disco, VIU, Aggregator	Performance Uncertainty	Uncertainty of delivered reductions	5	3	3	3	3	3.4
Customer	Lack of knowledge	Lack of understanding of how to control load	3	5	5	5	1	3.8
Customer	Lack of knowledge	Lack of understanding of time-varying rates	3	5	5	5	1	3.8
Customer - mass market	Lack of infrastructure	metering or other enabling technology	5	3	5	3	5	4.2
Customer - Large C/i	Lack of infrastructure	metering or other enabling technology	3	5	3	5	3	3.8
Customer	Lack of infrastructure	advan- tage of time based	3	5	3	3	3	3.4
Aggregator or Supplier	Market Rules/ Regulation	default rate	5	1	3	3	5	3.4
Customer	Market Rules/ Regulation	Lack of time based rates	3	1	5	5	5	3.8
Aggregator, Disco or Supplier	Market Rules/ Regulation	Lack of time base rates	3	1	5	5	5	3.8
Disco , VIU	Market Rules/ Regulation	recovery for enabling tech	5	5	5	5	5	5
Aggregators	Market Rules/ Regulation	mechanism for treating DR like	5	3	3	3	1	3
Disco, Suppliers	Split Incentives	Split incentives for benefits	3	1	3	3	3	2.6
State regulators	Market Rules/ Regulation	Resistance to passing wholesale rates	5	1	5	5	1	3.4
Aggregator or Supplier	Market Rules/ Regulation	Lack or variable default rate	5	3	5	3	3	3.8
Disco	Market Rules/ Regulation	make return on enabling equipment	5	3	5	3	3	3.8
Disco and aggregators	Market Rules/ Regulation	with EE/ DR plan and funding	3	5	3	3	3	3.4
customer	Lack of information	DR framed as savings rather than pricing	3	3	3	3	3	3
RTO	Market Rules/ Regulation	Dispatch and capacity makret	3	5	3	3	3	3.4
Owners of generatio	Market Rules/ Regulation	wish to maximize profit	3	5	3	3	3	3.4

Next Tasks

- Develop Policy Options
 - Provide solutions
 - Facilitate factors that increase participation in Demand Response
- Final Report
 - Recommendations

Feedback

- Are there other major barriers you see ?
- Are the criteria we developed useful?
- Are there some new good new examples we may have not looked at ?

Questions or Comments?



Dan Schnitzer
Liz Hicks
Tel. 781-418-5700
Daniel.Schnitzer@kema.com
Liz.Hicks@kema.com

Appendix A

Regulatory Barriers

Barrier	Vertically Integrated Market	Competitive Market
Lack of metering infrastructure to support time-differentiated rates	X	X
Uncertain cost recovery of enabling technologies	X	X
Lack of hedge premium in fixed rates	X	
Reluctance to expose customers to market-based rates	X	X
Lack of time-differentiated rates in some states' default service structure for certain customer classes		X
Retail/wholesale caps can limit price responsiveness		X
Access to meter data limited by rules		X
Low regulator priority for DR	X	X
Inappropriate incentives for emergency DR participation	X	X
Lack of coordination b/w EE and DR design and implementation	X	X
Complex pricing options difficult for policymakers to compare/evaluate	X	X

Dispatchable DR- Demand Bidding

- Not currently applicable to mass-market customers
- Requires substantial amount of load to bid into markets
- Baseline requirements vary from program-to-program, ranging from stringent to more flexible.
- Common in competitive wholesale markets.
- Participation in Demand Bidding doesn't have high transaction costs
- The average response for the CA utility Demand Bidding programs is less than the CPP program (about 2.5% versus about 3% for PG&E, and 5% for SDG&E).

Dispatchable DR – Interruptible Tariffs

- Usually for medium to large C&I customers.
- Historically used as a way to offer discounts to large customers in regulated markets, as the incentive was provided up-front and the interruption was rarely, if ever, called.
- Essential to aggregator business models.
- Recent work done in conjunction with the DR filings for their 2009-2011 programs by California's three IOUs shows pretty low average response for price-based programs such as CPP

Dispatchable DR – DLC

- Needs an enabling technology: PCTs, load switches effective at controlling AC loads, pool pumps, water heaters.
- Customer may have the choice of overriding
- DLC for mass market is prevalent in many regulated and unregulated markets
- Can be only in an emergency situation, seasonal or daily
- FPL is already obtaining a 10% demand reduction using direct load control.

Dispatchable DR – DLC (cont.)

FPL as case example:

- Residential/Business-on-call
 - Installed devices: 800,000
 - Control capability (normal / SCRAM): 1000 MW / 2000 MW
 - Customer satisfaction is high. (TWACS, 2006).
 - Enabling technology: FPL uses Powerline Communications System, bidirectional direct control
 - Marketing: No marketing for res program; 60 inquiries a month with 80 to 85% sign-up.
- Large C&I
 - Installed devices: 500
 - Enabling technology: C/I requires advanced metering.
 - Control capability: 500 MW/500 MW

Non-Dispatchable DR - TOU

- Mass-market and C&I customers
- Requires TOU/two-register meter, can be manually read.
- Has been around for a long time with mixed results
- Generally when TOU is optional, many of the people who sign up will benefit relative to the flat rate without having to change consumption patterns.

Non-Dispatchable DR – Critical Peak Pricing

- CPP provides pricing at time of critical peak.
- CA one of the largest pilots
- Many different options offered in that pilot
- CA SPP estimated that 70 to 80% of customers would stay on a CPP rate if it was the default rate whereas the most you could expect to enroll on an opt-in basis is 20 to 30%
- High satisfaction: Roughly 60% of customers on the CPP rate in the CA SPP experiment stayed on the rate after the end of the pilot even though the incentives paid during the pilot went away and they were subsequently charged a monthly fee of between \$3 and \$5 for the meter.

Non-Dispatchable DR – CPP Mass Market

- Numerous recent dynamic pricing pilots show two things: mass market customers, on average, can and will respond to prices without enabling technology, but the presence of enabling technology (i.e., smart thermostat) increases the average impact by 50 to 100 percent.
- Lack of AMI makes it more difficult to have a large scale pricing program - this is most significant barrier to time-varying pricing.
- This is less of a barrier to C&I, as many already have interval meters
- One of the strongest conclusions of the SPP work for residential customers showed that customers with a/c were about twice as price responsive as customers without a/c.
- Literature clearly shows that residential customers have higher price elasticities than C&I customers

Non-Dispatchable DR- Critical Peak Pricing – Large C/I

- The CPUC's recent proposed decision on dynamic tariffs in conjunction with PG&E's rate design case is the first major step in the direction of opt-out, dynamic pricing
- The SPP found that C&I customers below 20 kW did not, on average, respond to even very high CPP prices (e.g., in the \$1/kWh range) in the absence of enabling technology (PCTs).
- For C&I customers between 20 and 200 kW, there was a small reduction in demand on CPP days without PCTs and it jumped to around 10% with PCTs.
- Average Elasticity Values for large C&I are lower than residential elasticities for CPP. However, as stated, the aggregate impact of C&I can be much higher due to the segments larger average load.
- As of May 2008, SDG&E has default CPP pricing for customers above 20 kW (about 4,500 customers), with TOU as opt out rate.

Large C/I Elasticities from CPP

- Table shows arc elasticities averaged over all prices (L) and over prices above \$500/MWh (R).
- Elasticities decrease slightly because the load response (numerator) is fairly consistent across range of prices, while the price differential (denominator) increases with higher event prices.
- Goldman et al. attributes this to the notion that many large C&I customers are only willing to curtail or forego load which they consider “discretionary.”

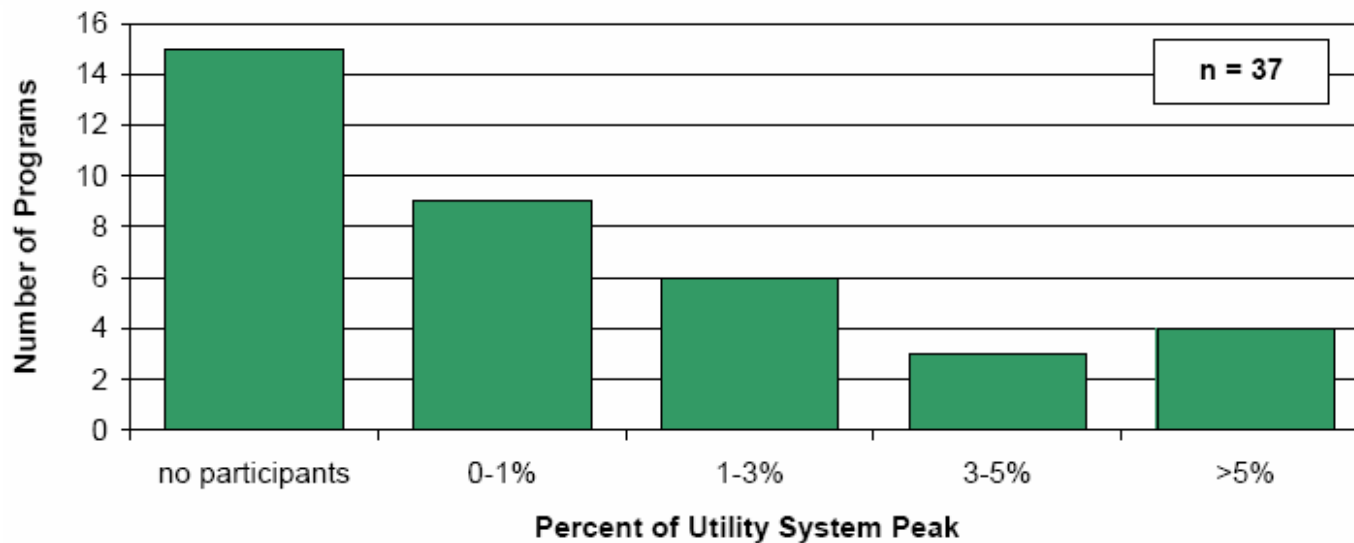
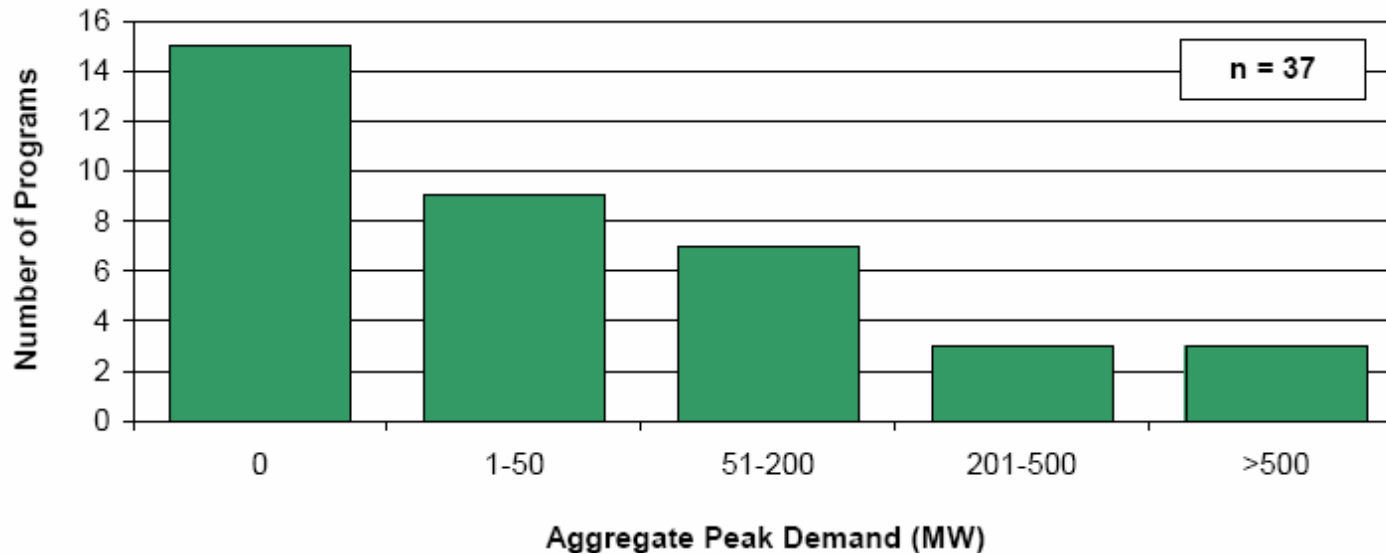
Customer Segment	Market		
		Critical-peak Pricing	Critical-peak Pricing
Commercial/retail		-0.10	-0.04
Government/education		-0.06	-0.04
Healthcare		-0.01	-0.00
Manufacturing		-0.05	-0.03
Public works		-0.08	-0.05

(Goldman, 2007)

Non-Dispatchable- Real Time Pricing

- Commonly implemented to provide customers opportunity to realize bill savings, reduce peak demand
- Most RTP rates not broadly and proactively marketed
- Most providers offering RTP provide limited assistance to help customers manage exposure to price volatility (e.g. technical assistance to develop strategy, internet-based access to hourly consumption data in real-time or day-after)
- Default rates for largest C&I in many competitive markets
- Most RTP generates modest load reductions in terms of absolute magnitude because of small amount of enrolled load (see graphs)
- Mass-market customers have not had much exposure to RTP – participation is dominated by large industrials, which often have on-site generation
- However, ComEd has an RTP tariff for residential customers, which is real RTP – not day ahead hourly pricing.

RTP enrollment and performance



(Goldman, 2004)