PIER: Demand Response Research Center

Scoping Study

To Develop a

Demand Response Research Plan

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Sponsored by the California Energy Commission

Demand Response Research Center

Objective

Develop, prioritize, conduct and disseminate multi-institutional research to facilitate Demand Response.

Scope

Technologies, policies, programs, strategies and practices, emphasizing a market connection

Stakeholders

Partners Planning Committee, Annual R&D Plan

- State Policy Makers
- Researchers
- Information and Metering System Developers
- Aggregators
- Program Implementers
- Utilities
- Industry Trade Associations
- Building Owners / Operators
- Building Equipment Manufacturers
- End-Use customers

Framing DR Research

The Problem

- Demand Response (DR) options have been offered by utilities and other providers for more than 30 years.
- There is no agreement regarding how to define DR, how to evaluate cost effectiveness, or how DR should be integrated into a utility resource plan.
- Market volatility, system resource needs, regulatory concerns and customer choice have created unique market pressures to resolve demand response offerings.
- Program instability, uncertain incentives and conflicting rates constrain customer new technology development and system-wide solutions.

Research Agenda

Developing a DR Research Plan

Convene a National Panel of DR Experts

- Roundtable Forum (December 2-3)
- Summarize DR knowledge
- Identify DR research needs (Problems vs. Opportunities)
- Identify specific research opportunities

Partners Planning Committee

- Review and classify DR research opportunities
- Define / Prioritize DR projects
- Fund DR projects

Research Issues

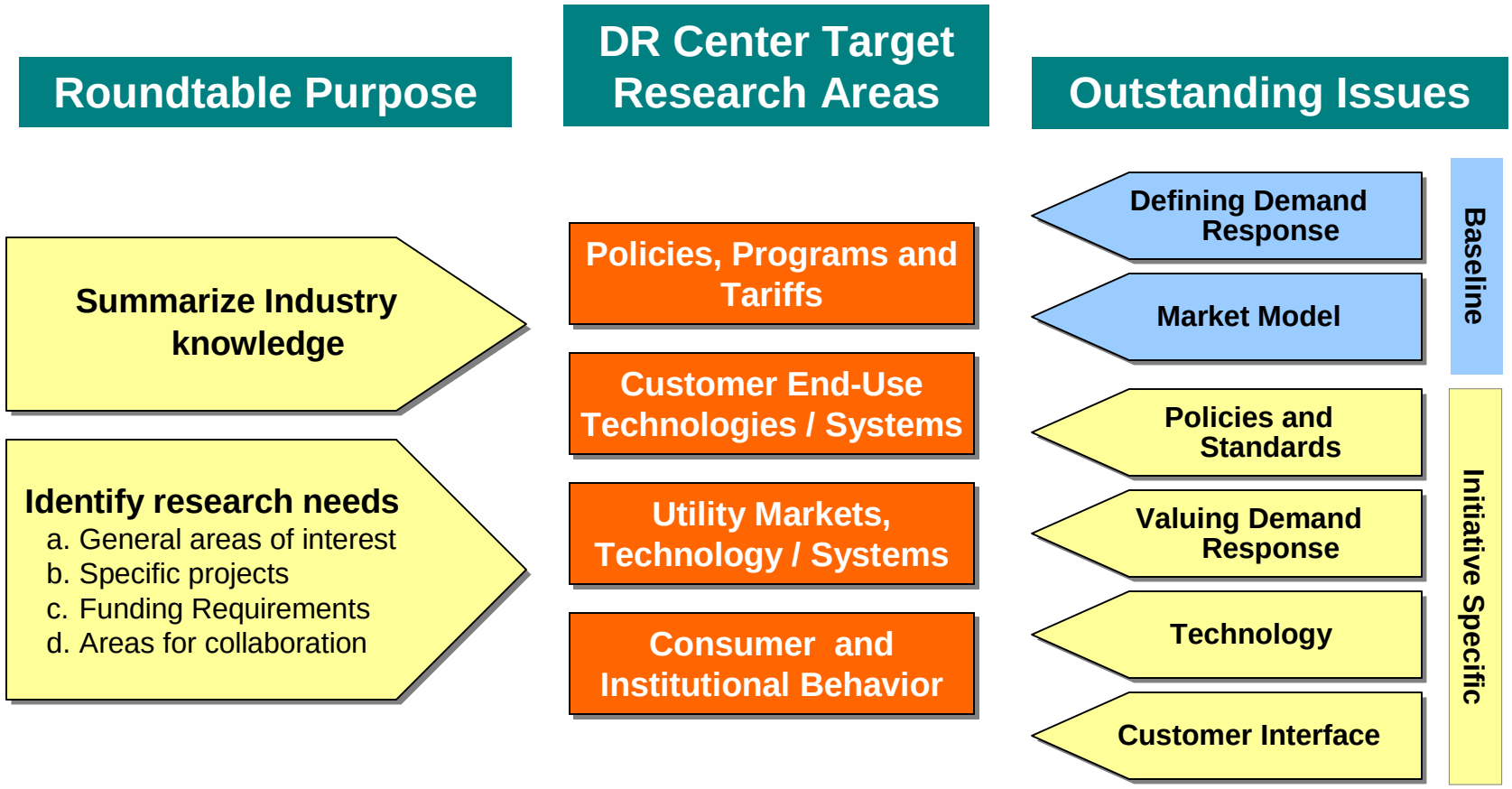
Framing the Demand Response Research Issues

- Six outstanding issues characterize current demand response problems and unrealized opportunities.
- The six issues address two principal areas of concern:
  1. Baseline assumptions define the customers, market and vision for DR, and
  2. Initiative specific assumptions address technology choice, operational capabilities and valuation.

The Issues

BASELINE	**Defining Demand Response**	Whose needs? DR options can be defined from a customer or utility system perspective.
	Market Model	Regulated, single supplier or competitive? DR can seek out participants in narrowly defined programs or incent customers to seek out options tailored to their own specific needs.
INITIATIVE SPECIFIC	**Policies and Standards**	Priorities and expectations? Unlike energy efficiency, there are no DR policies or standards.
	Valuing Demand Response	Whose value? Both the scope and methodology of DR evaluations are considered deficient.
	Technology & Operations	Supplemental automation or integrated design? What role does technology play, should efficiently and DR be integrated, and how should DR be introduced?
	Customer Interface	Customer or ratepayer? Define and understand customer behavior and the role of information.

DR Roundtable Forum



DR Research Center – R&D Criteria

Does DR Center R&D ..

State Priorities	Support CEC research priorities?
State Policy	Support State policy goals?
Market Barriers	Advance science or technology appropriate for PIER funding?
Public Benefit	Provide a clear public benefit?
Net Benefits	Reduce electric costs and increase value?
Reliability	Improve electric system reliability?
Environment	Reduce system environmental impacts?
State Economy	Enhance California's economy?
Energy Market	Demonstrate a connection to the energy market?

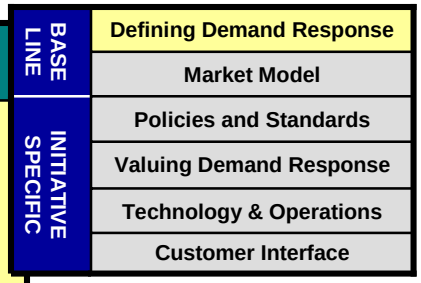
1. Defining Demand Response

Issue – Defining DR

DR can be defined from either a utility or customer perspective. Each perspective embodies a different set of problems and opportunities, which can yield uniquely different research requirements.

Almost all DR options today reflect a utility perspective. By contrast, almost all efficiency options reflect a customer perspective.

Should DR Research Center R&D attempt to resolve existing problems or emphasize a focus on new opportunities ?



1. Utility Perspective

- DR is considered a program
- DR and efficiency are separate
- DR is separated into distinct economic and reliability options

2. Customer Perspective

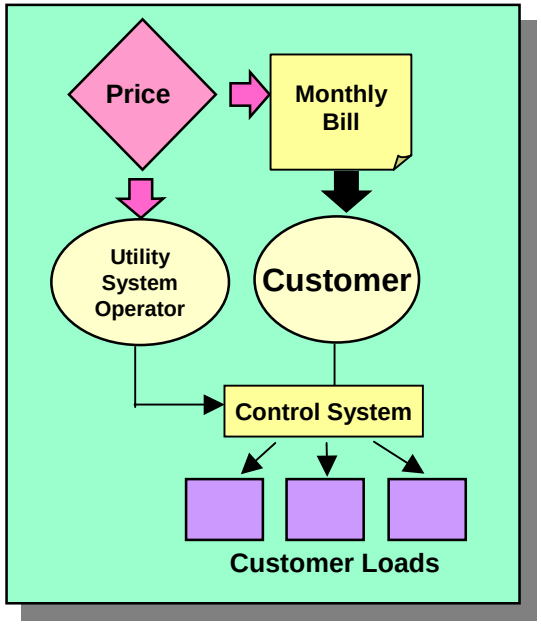
DR and energy efficiency are part of a single continuum for guiding investment and operating decisions.

1. Defining Demand Response

Option 1: A Conventional Utility Perspective

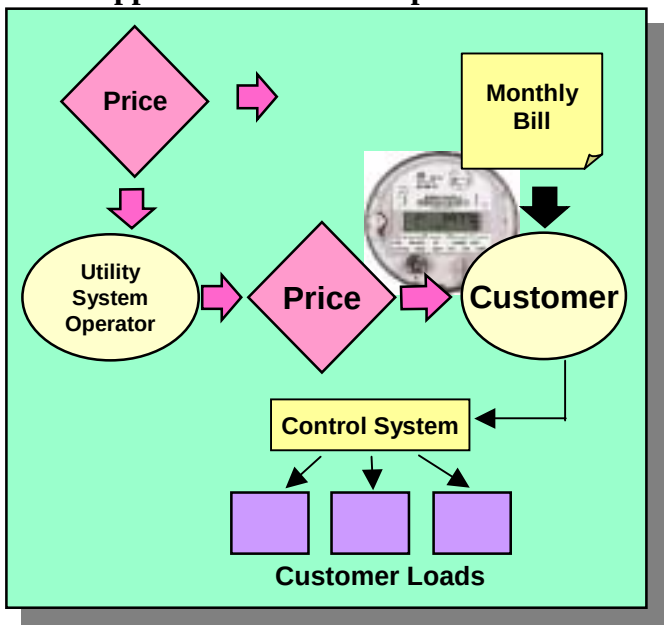
Today the utility perspective divides DR into two distinct and mutually exclusive categories: (1) reliability-responsive or (2) price-responsive.

Approach 1: Reliability-Responsive DR



Flat Rate, Fixed Incentive, Direct Control

Approach 2: Price-Responsive DR



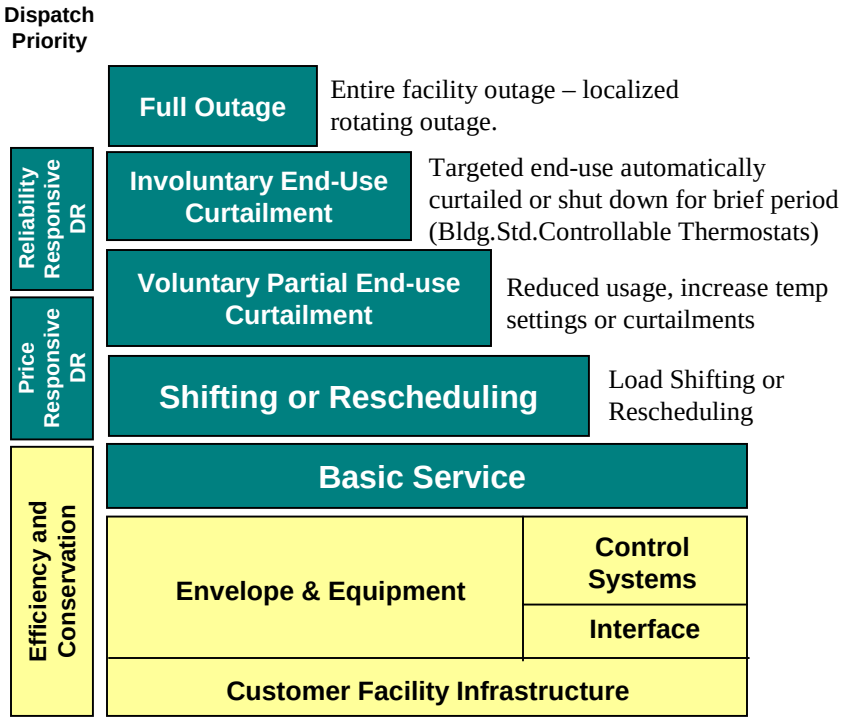
Dispatchable Price/Rate, Indirect Control

1. Defining Demand Response

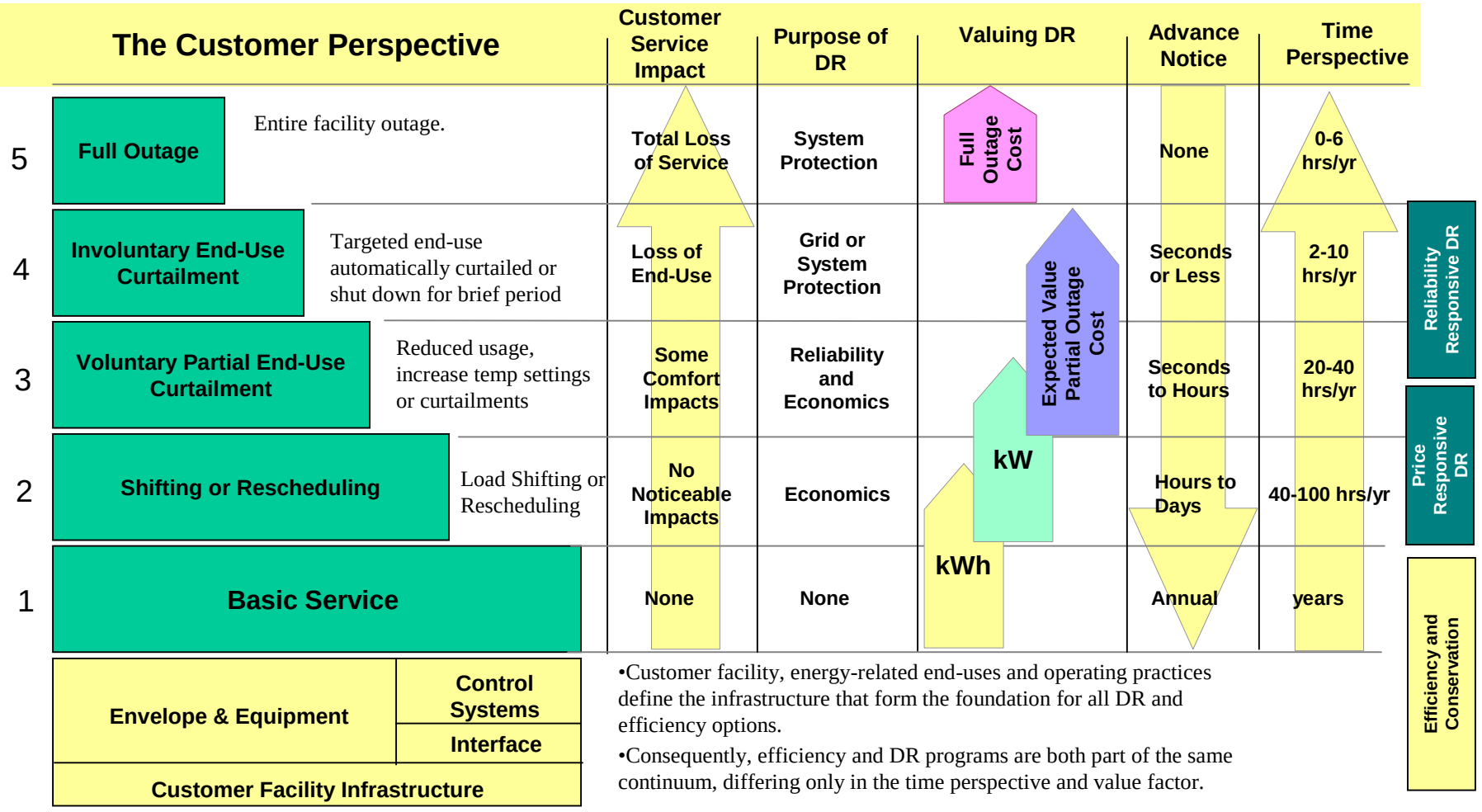
Option 2: A Customer Integrated Perspective

There is an emerging customer perspective that views DR and efficiency as a single continuum, differentiated only by response time and valuation.

- The customer facility, end-use energy infrastructure and operating practices establish and reflect the customer value of service – what customers want and what they are willing to pay for.
- All efficiency and DR programs derive from this infrastructure and value. The outage cost and/or actions to avoid outages are equal to the probability of a loss of service times the value of service.
- Consequently, efficiency and DR programs are both part of the same continuum, differing only in the time perspective and value factor.



Defining Demand Response – Option 2: A Customer Integrated Perspective



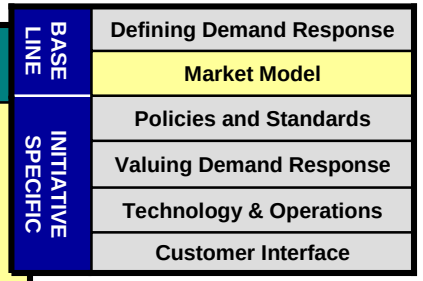
- Customer facility, energy-related end-uses and operating practices define the infrastructure that form the foundation for all DR and efficiency options.
- Consequently, efficiency and DR programs are both part of the same continuum, differing only in the time perspective and value factor.

1. Defining Demand Response

Problems	Opportunities
• Funding for efficiency cannot be used to support DR • Building and appliance standards sub-optimize infrastructure decisions and create barriers for DR. • Non time-differentiated or market based rates undervalue both efficiency and DR options. • Market potential is artificially limited by mutually exclusive DR economic and reliability options. • DR participation incentives create equity, evaluation and administrative problems.	• Integrating efficiency and DR incentives into the customer rate would simplify billing, program management, evaluation, eliminate gaming and equity problems and improve the valuation of each. • Integrating efficiency and DR would simplify customer investment and operating decisions and expand the market potential for each.

Research Plan

2. Market Model



Issue – Market Model

There are two fundamental market models that can be used to deliver DR products and services. Each model makes different assumptions regarding the role and form of incentives, technology and system operation.

Almost all DR options today are provided through a regulatory, utility-oriented 'push approach'. By contrast, almost all efficiency options are provided through a competitive, customer-oriented 'pull approach'.

Is one model better than the other? *Can DR Center R&D resolve which choice is best?*

1. Pull Model (Competitive–Customer-Oriented) *Example Slide #14*

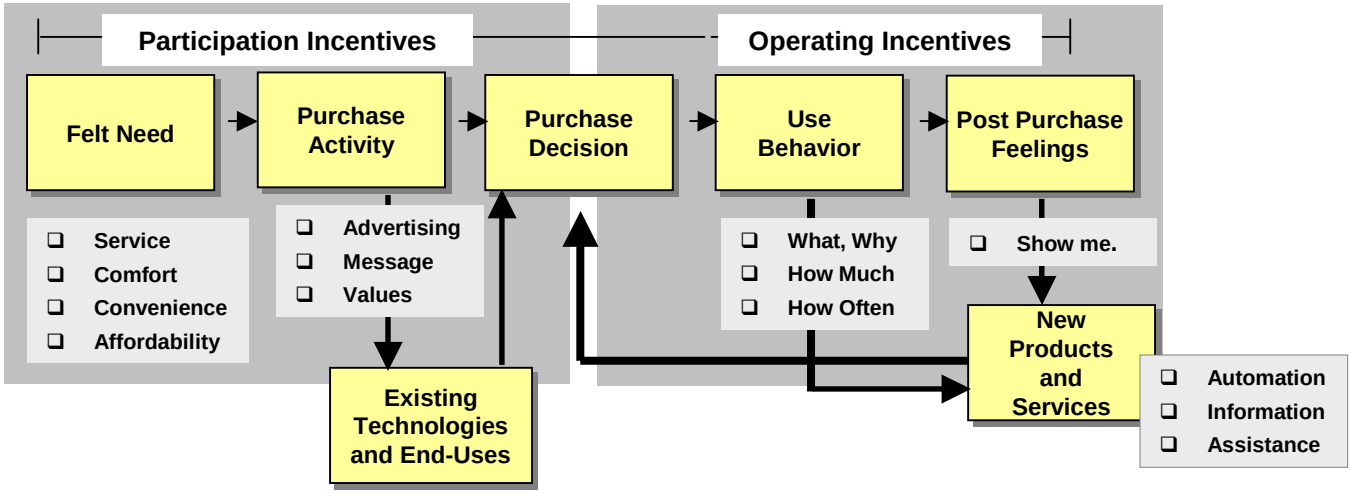
- Incentives encourage independent providers to develop pricing, promotional, distribution channel and new products and services
- Incentives encourage customers to seek out and invest in products and services that meet their needs.

2. Push Approach (Regulatory – Utility-Oriented) *Example Slide #15*

- Regulatory mandates provide financial incentives or penalties to utilities to promote narrowly defined initiatives targeted to specific customer groups.
- Products and services are pushed into the market irrespective of customer needs for service.

2. Market Model

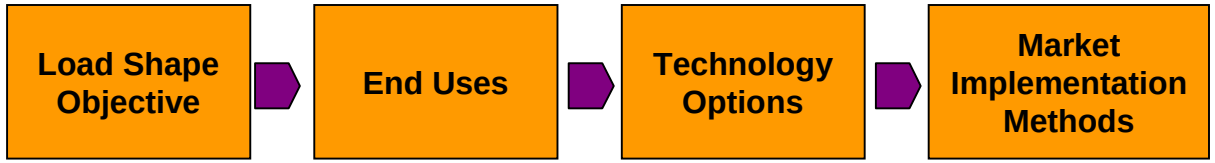
Option 1: Competitive, Customer Oriented Market Model



- Product and service development usually begins with an attempt to satisfy customer needs.
- Participation incentives are employed to overcome purchase barriers.
- Operating incentives and different forms of feedback are employed to confirm individual customer impacts, reinforce purchase decisions and encourage re-purchase activity.

2. Market Model

Option 2: Regulatory, Utility Oriented Market Model



Load Shape Objective	End Uses	Technology Options	Market Implementation Methods
1. Impact on capacity	1.Thermal load	1.Building envelope	1.Education
2. Impact on energy	2.Fixed cycle	2.Efficient equipment	2.Consumer contacts
3. Timing of impacts	3.Service	3.Thermal storage	3.Trade ally / cooperatives
• Price responsive		4.Energy and kW control	4.Advertise / Promote
• Reliability responsive		5.Farming operations	5.Alternative pricing
		6.Distributed generation	6.Direct incentive
			7.Policy (new)
			8.Regulation / Standards

- DR program development usually focuses on ways to resolve utility system operational or economic problems.
- Participation incentives are employed to encourage customer sign-up.
- Operating incentives are rarely used. Feedback, when provided, generally relates to system or class not individual customer impacts.

2. Market Model

Problems	Opportunities
• To avoid double dipping, customers can't participate in multiple DR or efficiency options. • The majority of customers can't participate in DR programs because they are only offered to the largest C/I and residential customers. • DR program designs reflect utility rather than customer needs. • DR and efficiency marketing efforts often compete for the same customers. • DR programs are usually voluntary, resulting in self-selection, limited cost effectiveness and unstable participation.	• Tariff policies that integrate DR and efficiency incentives make both options a condition of service. • Integrating incentives into a default rate would open DR to competitive market forces, stimulate creative DR options, provide equity and open participation to the entire customer population. • An integrated DR and efficiency approach should be more efficient and effective, simplifying customer education and focusing marketing on adaptation strategies and technologies instead of recruitment.

Research Plan

3. DR Policies and Standards

Issue – DR Policies and Standards

In most industries, policies and standards are established to reflect a consensus regarding both the priority and value of a good or service.

- Policies establish priorities among competing options.
- Standards reflect policy and establish measurable or comparable expectations between existing and future visions.

There are no state or federal policies or standards to guide DR design or implementation. In contrast, state and federal standards institutionalized energy efficiency and created a competitive market among suppliers.

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1. ***Should DR Center R&D consider the integration of DR into building and appliance standards?***
2. ***How might DR building and appliance standards impact other R&D requirements?***

3. DR Policies and Standards

Problems	Opportunities
• DR options often conflict with each other as well as efficiency options. • DR programs are reactionary - favored when there are capacity problems and disfavored at all other times. • DR suffers from pilotitus – every utility feels compelled to pilot, test, reinvent and reestablish the value of DR each time implementation is considered. • There are no performance standards to guide DR reliability options. • There is no guidance to distinguish between retail and wholesale DR options. • Regulators are not inclined to support long-term DR policies that value flexibility or preparedness for possible future events not easily captured in cost benefit models.	• DR policies and standards would stabilize technology, installation, rate design and customer education for utilities and customers alike. • DR capability could be designed into appliance and energy management systems, automating customer response to price signals and low power conditions. • DR, like efficiency, would become a condition of service if the incentives for both were integrated under a common rate.

Research Plan

4. Valuing DR

Issue – Valuing DR

DR options are typically designed as distinct stand alone programs that target specific customers and/or loads for very specific actions. Each program is usually subject to a cost effectiveness test that values expected load and energy impacts to the utility, customer and society.

DR options can require implementation of metering, communications, information and control systems that often have unrelated but beneficial impacts on basic utility business and other operating systems. There is little guidance regarding how to account for or allocate the costs and benefits between basic utility business and demand response.

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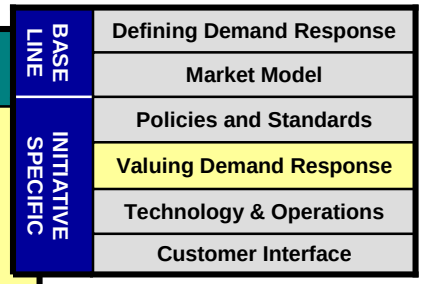
1. **What methodology should be used to evaluate DR?**
2. **What costs and benefits should be treated as a 'cost of service' versus a program cost and which should be counted first?**



4. Valuing DR

Problems	Opportunities
• Valuing DR by the equivalent cost of peaking capacity excludes T&D, environmental, market management, customer and societal values. • Existing service and costs are used as the benchmark for evaluating DR options. There is no attempt to establish whether the current service is adequate or what level of service customers want or need. • Costs and benefits are valued from the utility, revenue requirement not the customer perspective. • Customer benefits from better pricing, better information and better control are not valued.	• DR provides capability to mitigate market power, manage distribution congestion and reduce the incidence of rotating outages, all of which have high perceived values. How can these perceived values be quantified and accounted for in DR evaluations? • What criteria or benchmarks should be used to determine when utilities should deploy advanced information and communication technologies and when a technology is a cost of service or program cost?

Research Plan

5. Technology

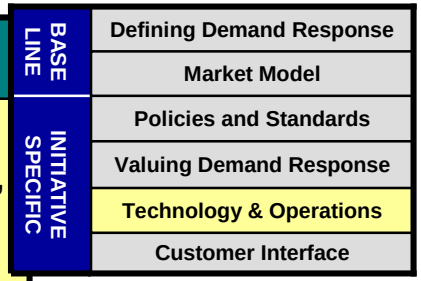
Issue – Technology

DR technologies, like program options, are designed to support utility, not customer needs. As a result, technologies operate as stand alone devices, are appended to rather than integrated with customer/facility end-use devices and systems. They follow vendor defined defacto rather than formal industry standards for performance, operation, maintenance and interconnection to related utility and customer information systems.

The lack of standards and interoperability often requires repetitive utility field trials to establish engineering performance and compliance with related safety codes.

From the customer perspective, the lack of integration into existing energy system controls, creates barriers to automation which in turn limit DR participation and effectiveness.

1. ***What are the opportunities for developing common certification and standards for utility-oriented DR technologies?***
2. ***What are the opportunities for imbedding DR technology in appliance and building control systems?***
3. ***What are the opportunities to design and operate end-use systems that enable customer price responsive shifting and curtailment while minimizing loss of service?***



5. Technology

Problems	Opportunities
• There are no reference designs or performance standards to govern advanced metering, load control or customer interface device development, performance or operation. • Load control and energy management interfaces used to support DR options are usually designed as add-ons to a customer system. Installation may require permits and licensed contractors, which increase costs. Installation and operating characteristics may jeopardize or invalidate customer system warranties.	• Reference designs and engineering performance standards would substantially simplify or eliminate the need for utility field trials, encourage competitive development, and reduce unit costs. • Integrating communication and control capabilities into the electronics of existing systems could substantially reduce costs and expand DR availability.

Research Plan

6. Establishing the Customer Interface

Issue – Establishing the Customer Interface

The customer interface is the hardware, software or information that links the energy user (customer) to their energy using environment.

The customer interface can include the energy bill, rate or real-time displays dedicated to energy usage or designed into appliance control panels. With few exceptions, the printed monthly bill is the only energy-related information customers receive. Pilots and market surveys show that customers

- don't understand their rates
- don't understand kWh or other metrics of energy measurement,
- don't understand their monthly bills, however
- they will respond to price incentives and appeals to modify usage patterns.

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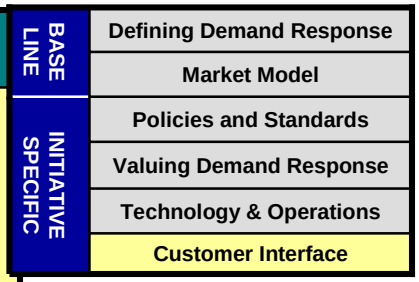
1. ***What role does information and the customer interface play in the effectiveness of efficiency and DR options?***
2. ***What types of information, what forms of accessibility and what standards should be considered in developing a customer interface?***



6. Establishing the Customer Interface

Problems	Opportunities
▪ DR incentives usually have no relationship to customer response or actual DR events. • Monthly energy bills usually do not provide any feedback regarding customer DR participation impacts. • Customers generally don't have access to information or tools to analyze rate options or usage patterns. • Customers do not have rates or systems that notify them of critical system conditions or high priced energy. • There are no standards to govern the collection or access to information. • What information do customers need, when, and in what form to support energy decisions.	Advanced metering and information systems would: 1.Support the integration of DR incentives into the basic rate, eliminate separate DR payments, improve feedback and reduce actual program costs. 2.Reward customers based on contribution rather than participation 3.support real-time displays and other information feedback devices

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