Demand Response

What is it and why is everyone talking about it?

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United States Demand Response Coordinating Committee (DRCC)

Sponsorship of research, education, and forums on DR
& Official U.S. vehicle for participation in IEA DR Program

- AEP
- National Grid
- TVA
- Southern Company
- Demand Response Research Center
- NYSERDA
- MidAmerican
- Ameren
- ISO-NE
- Salt River Project
- PJM
- SCE
- SDG&E
- PG&E
- MISO

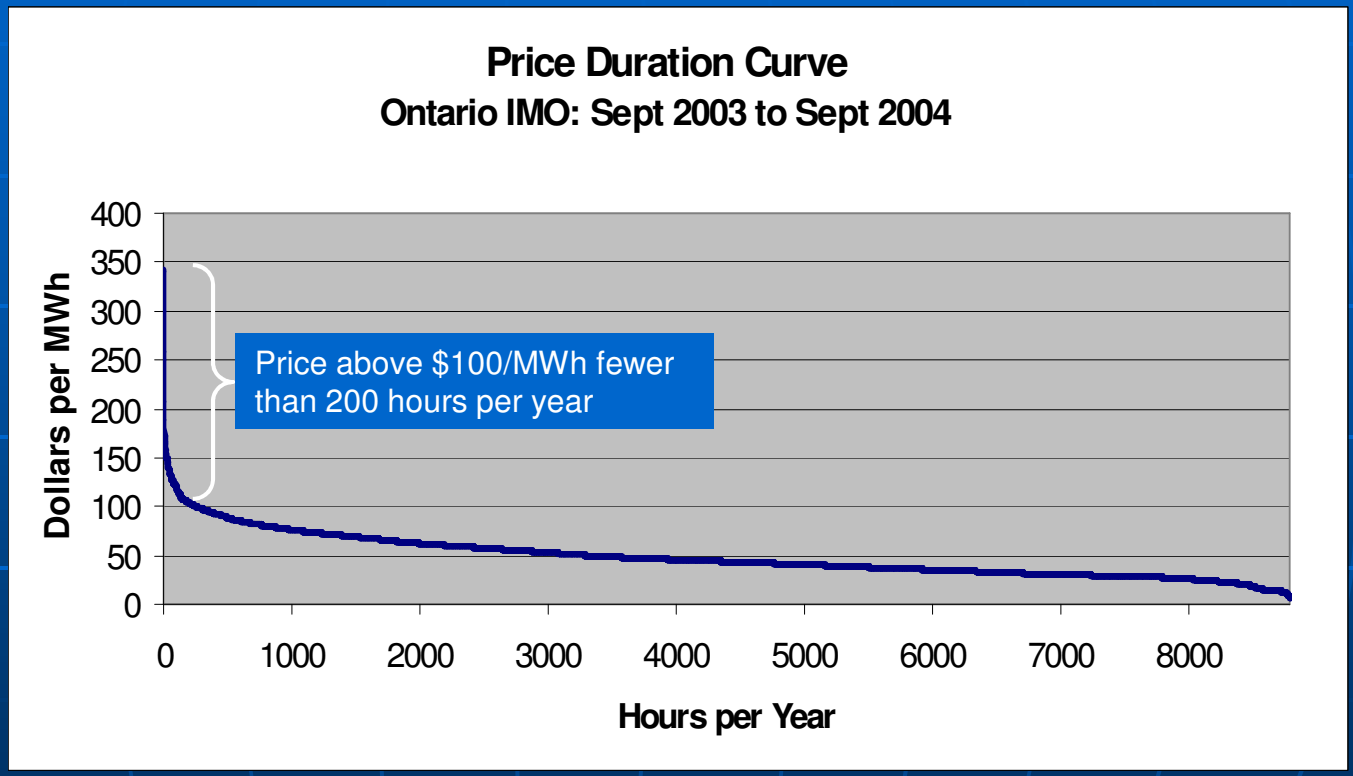
Topics To Be Covered

- Definitions, terminology and examples
- Role of technology
- Applications
- Benefits, barriers and challenges
- Stakeholders
- Policy developments
- Chickens and Eggs

DR – the picture worth a thousand words?

Small changes in load at critical peak times

Avoidance of rolling blackouts and/or need to build new capacity (generation, transmission, and distribution)



- Greater reliability
- Lower total electric system costs
- Lower individual electric bills

DRCC Demand Response Definition

- *Providing wholesale and retail electricity customers with the ability to choose to respond to time-based prices and other types of incentives by reducing and/or shifting usage, particularly during peak demand periods, such that modifications in customer demand become a viable option for addressing pricing, system operations and reliability, infrastructure planning, operation and deferral, and other issues.*

Demand – An Evolutionary Perspective

- Conservation
  - Running out of oil
- Load Management
  - Curtailment and Control
- Efficiency – Phase 1
  - Get the same benefit with less energy
- Demand Side Management
  - Utility-oriented; IRP
- Efficiency – Phase 2
  - Beyond the end use
- Demand Response
  - Dynamic, communication and price-based
- Optimization (Smart Age)
  - Systems approach: Smart Grid, Smart Homes, Smart appliances

Demand Response – Then and Now

- "Direct load control"
- Emergency-driven
- Blackout avoidance
- Reliability-focused
- Old Technology
- Blunt Instrument
- One size fits all
- Opt-in

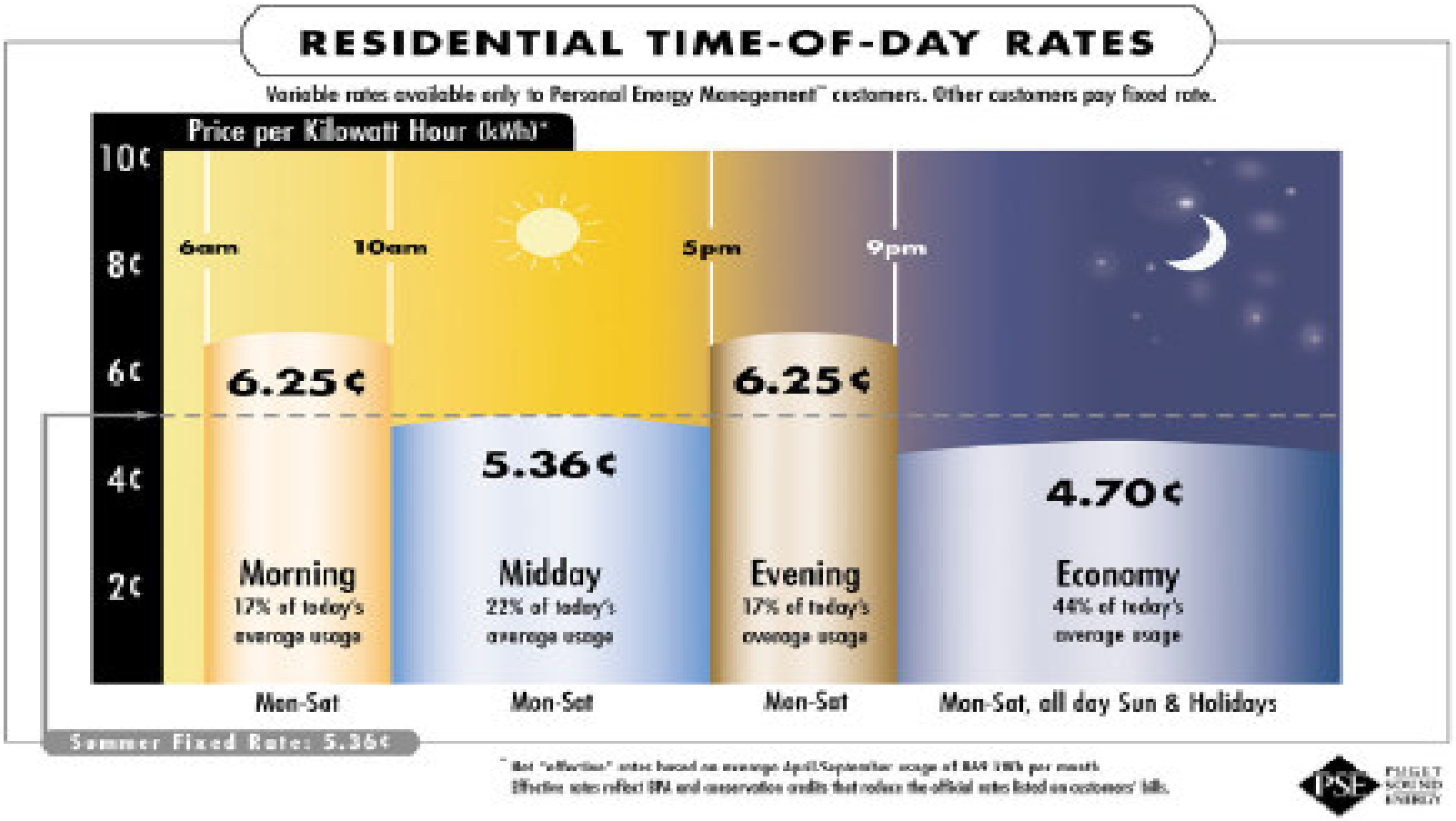
- Customer choice
- Optimize Efficiency
- Mass Mkt Capability
- New Technologies
- Tie to Mkt Dynamics
- Risk/Reliability tool
- Smart Bldgs & Appl.
- Opt-out

Demand Response – Types and Options

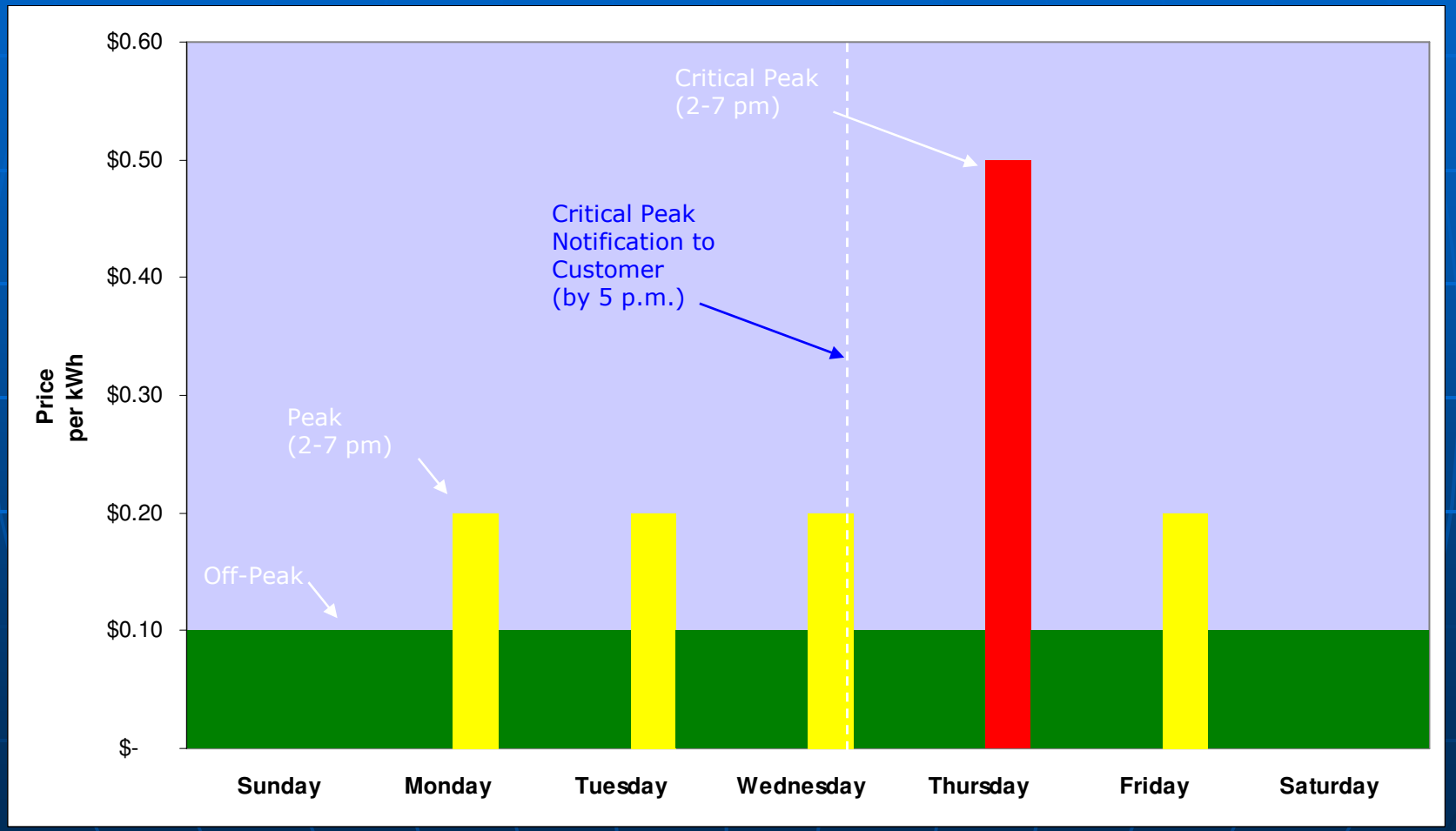
- Price-based
  (aka dynamic pricing or "economic" programs)
  - TOU
  - RTP
  - CPP
- Incentive-based
  (aka emergency/reliability programs)
  - DLC
  - Interruptible/Curtailable
  - Demand Bidding/By-Back
  - Capacity Market
  - Ancillary Services Market

Puget Sound Energy

Summer Pricing



Critical Peak Pricing Structure



Gulf Power GoodCents Select

GoodCents *SELECT*

Participation Charge $4.95/Month

Standard Residential Rate 6.3 cents/kWh

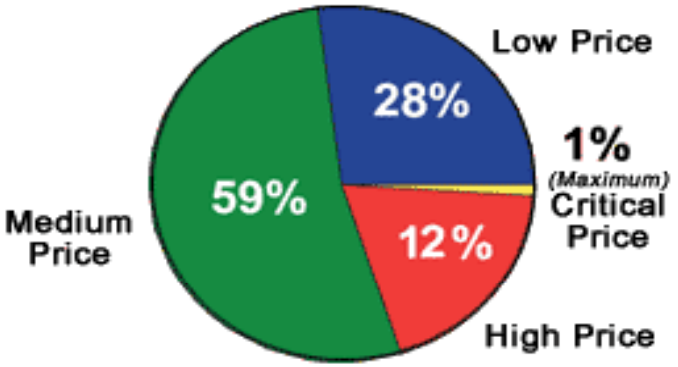
Price Per kWh*

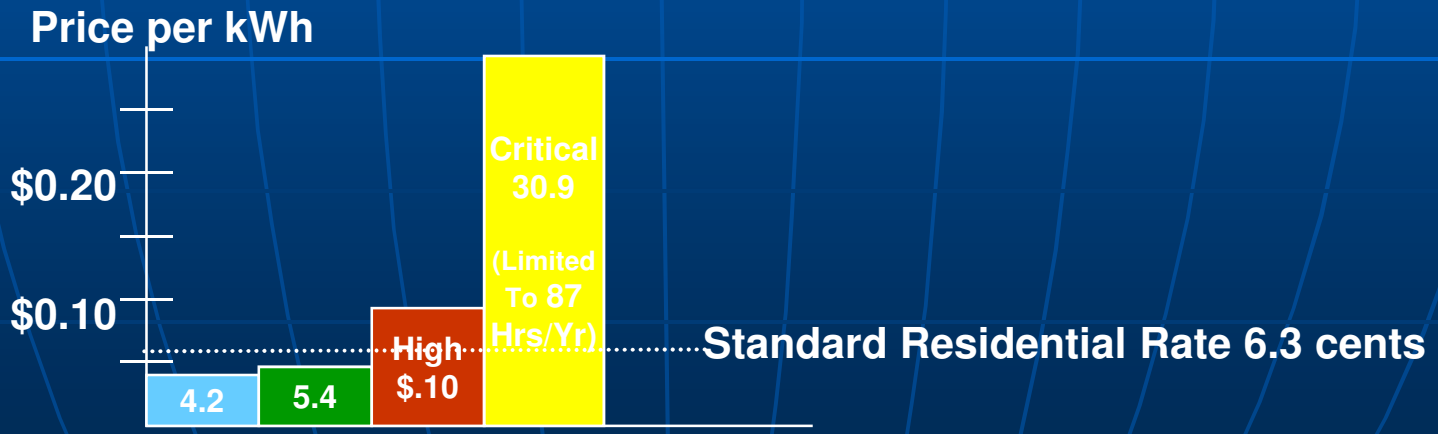
LOW	4.2 cents
MEDIUM	5.4 cents
HIGH	10.0 cents
CRITICAL	30.9 cents

*All prices are as of 06/07/02, excluding customer and/or participation charges and any applicable taxes. These prices are subject to change.

Residential Service
Variable Pricing (RSVP) Rate

Percent of Annual Hours In Effect





Gulf Power CPP

- CPP rate plus TOU – 5X differential
- 6000 customers paying $14.95/month
- Peak Reduction
  - Summer 40%
  - Winter 50%
- Overall usage reduction
  - 40% peak reduction for CPD
  - 20% and 5% for high and medium TOU
  - 3.8% net conservation effect
- High customer satisfaction; less than 2% churn rate
- Participants mainly high use customers

Demand Response – Characteristics of Types

- Incentive-based
  - Goal is "load acting as a resource"
  - Demand reductions occur via dispatch by system operators
  - Reductions are included in resource/supply portfolio
    - Same as a power plant (with limitations)
  - Response levels more variable
    - Minimal foreknowledge by end-use customers
    - Dispatch reasons varied
    - Less diversity in loads involved
  - Wholesale as well as retail level; FERC focus
  - Faster ramp up

Demand Response - Characteristics of Types

- Price-based
  - Goal is to provide price signal or dynamic incentive
  - Demand reductions occur via voluntary end-use customer response or DG
  - Reductions are included in load forecasts
    - Same as other tariffs and energy efficiency
  - Response levels become more predictable as function of:
    - Transparency/foreknowledge of prices
    - Weather
    - Experience
    - Diversity (number and types of customers)
  - Advanced metering, smart communcations
  - Longer lead time but more institutional?
  - Larger resource overall?

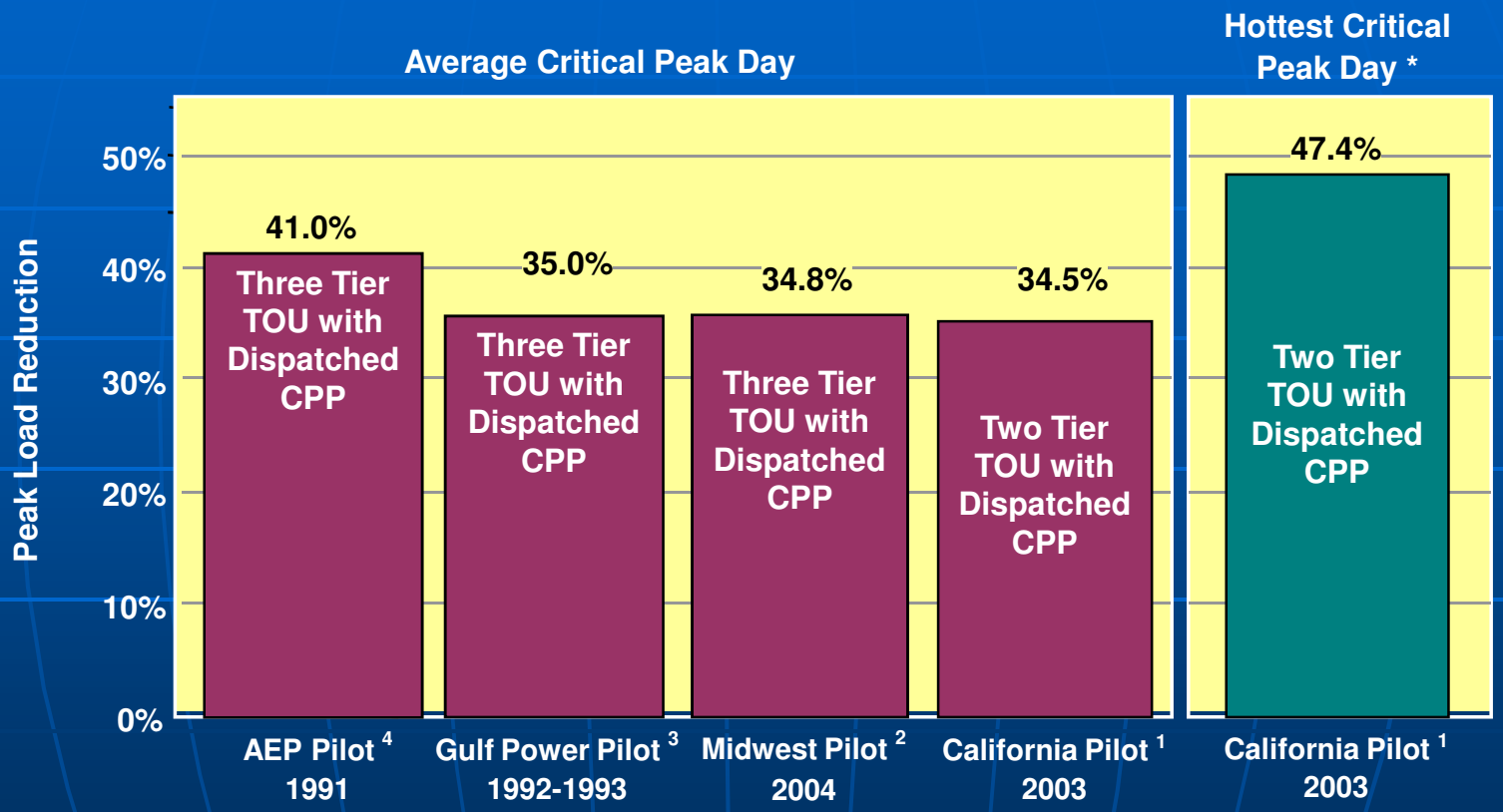
Types of Customer Response

- Forgoing
  - Potential loss of amenity/comfort
  - Examples are lighting, heating, A/C
- Shifting
  - Same task at a different time
  - “pre” vs “post”
  - Dishwashing, laundry, process
- Onsite Generation (Distributed)
  - Environmental concerns
- Automated Technologies
  - DLC
  - Smart thermostats
  - Ice storage
  - EMS

DR and Price Elasticity

- Price Elastcity (own-price)
  - Amount of decrease in consumption for a doubling (100%) increase in price
    - A 0.15 elasticity means a 15% reduction in usage in response to a price doubling
  - Range for C/I - .01-.27; .10 average
  - Range for Res – .07-.21; .10 average
  - Variations abound, but:
    - Residential higher than non-residential
    - Low-income higher than non
    - Nominal prices may matter as well

Residential Load Impacts (Historical Results)



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.

DR – Why Policy Makers Like It

- It makes intuitive sense
- Optimizes the system between supply and demand
- Moderates price spikes during peak period
- Mitigates market power of suppliers
- Avoids unnecessary supply/T&D investment
- Improves reliability of grid
- Solves specific geographic congestion
- Helps create a smart grid
- Can provide important non-DR benefits like outage management and restoration
- Provides customers with new options for managing their usage and bills

DR Potential and Capability

- 1996
  - Potential 33,598 MW
  - Actual 15,243 MW
  - Utility Spending $572M
  - Utilities Offering 407
- 2004
  - Potential 20,472 MW (3% of U.S. Peak)
  - Actual 8,976 MW (1.3% of Peak)
  - Utility Spending $515M
  - Utilities Offering 273
- Why?
  - Fewer utilities offering
  - Declining enrollment
  - Lack of maintenance of present infrastructure
  - Changing industry
- Caveat
  - The data is not good for any of this

DR – Potential Estimates

- Illustrative
  - CA $302M
  - FERC (U.S.) $ 52M
  - DOE (U.S.) $ 362M
  - New England (RTP) $ 350M
- Integrated Resource Planning
  - Midwest Utility $1,000M
  - IEA $1,476M
  - NWPCC $ 718M

DR Myths and Misconceptions

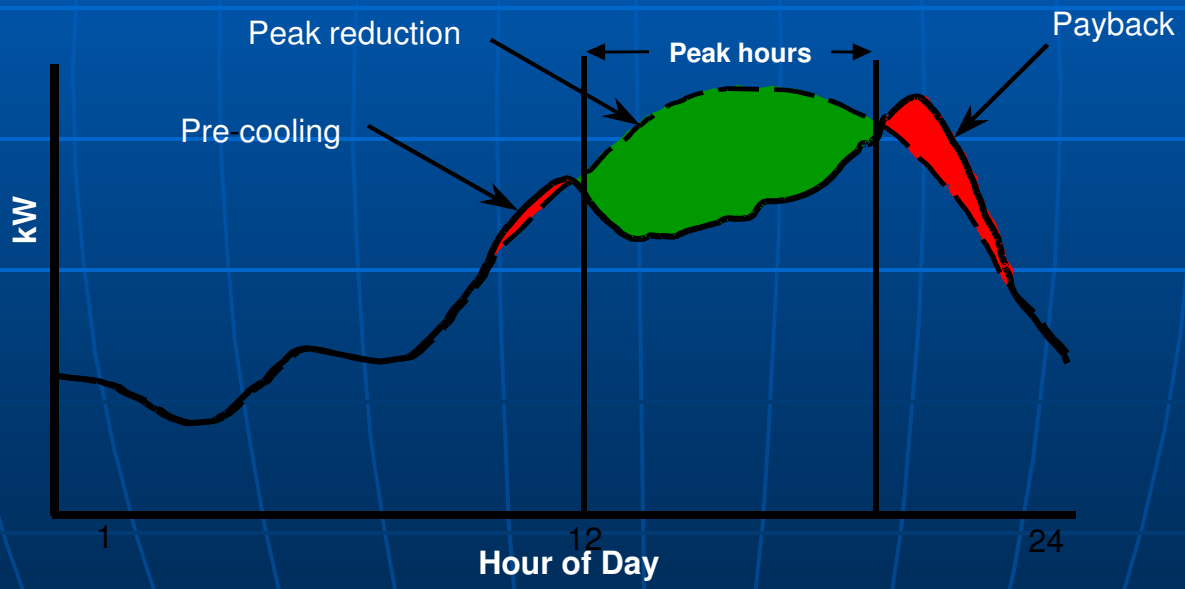
- It’s all about real time
- Supply programs in drag
- Negative environmental impact
- Technology costs are too high
- No efficiency/conservation effect
- Customers don’t want or won’t accept
- DR is bad for low-income consumers
- Competitive Market will eagerly supply it
- Benefits are not high enough to justify

Issue: Demand Response and Energy Efficiency

- Fraternal twins in the same DSM family
- Complementary vs. Competitive
  - NEDRI definition
  - Conservation effect of demand response
  - Information effect of demand response technologies
  - Neither one can fully do what the other one does best
- Need to work together – not against
- Demand response is not trying to steal the other twin's allowance

Conservation Effect of Dynamic Rates

- Payback or pre-heating occurs for some end uses, such as electric heating
- No payback for other end uses, such as turning off lights
- On average, there is net conservation averaging 4%



Source: King and Delurey, *Public Utilities Fortnightly*, Forthcoming

Issue: Demand Response and the Environment

- Net Reductions
- Fuel Mix On-Peak vs Off-Peak
- Distributed Generation (DG)
  - Clean vs Dirty DG
  - EPA Study as part of NEDRI
  - EPA-State Clean Energy Partnerships
- Alternative Portfolio Standards
  - Pennsylvania
  - Illinois
  - Nevada
- Dynamic Emissions Management

Issue: Competitive vs Regulated

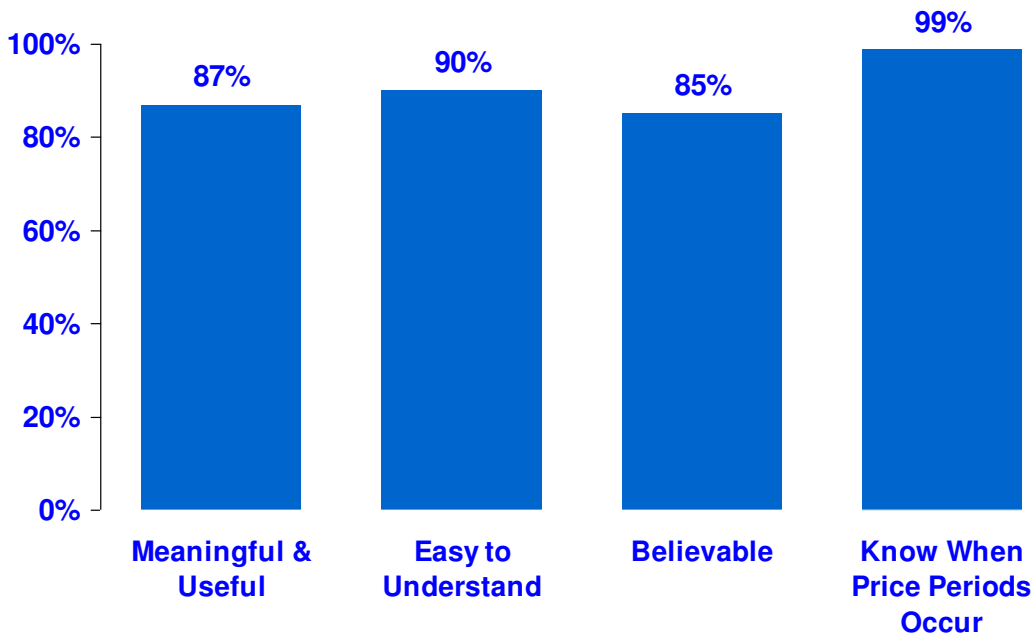
- Much of U.S. is not deregulated/restructured
- Competitive commodity market did not deliver demand response
- Technology costs high on a disaggregated basis
- Marketers struggling with basic product
- Competitive providers limited to ISO programs & direct to C/I Customers
- Vertical integration may be the better model

Issue – Customer Acceptance

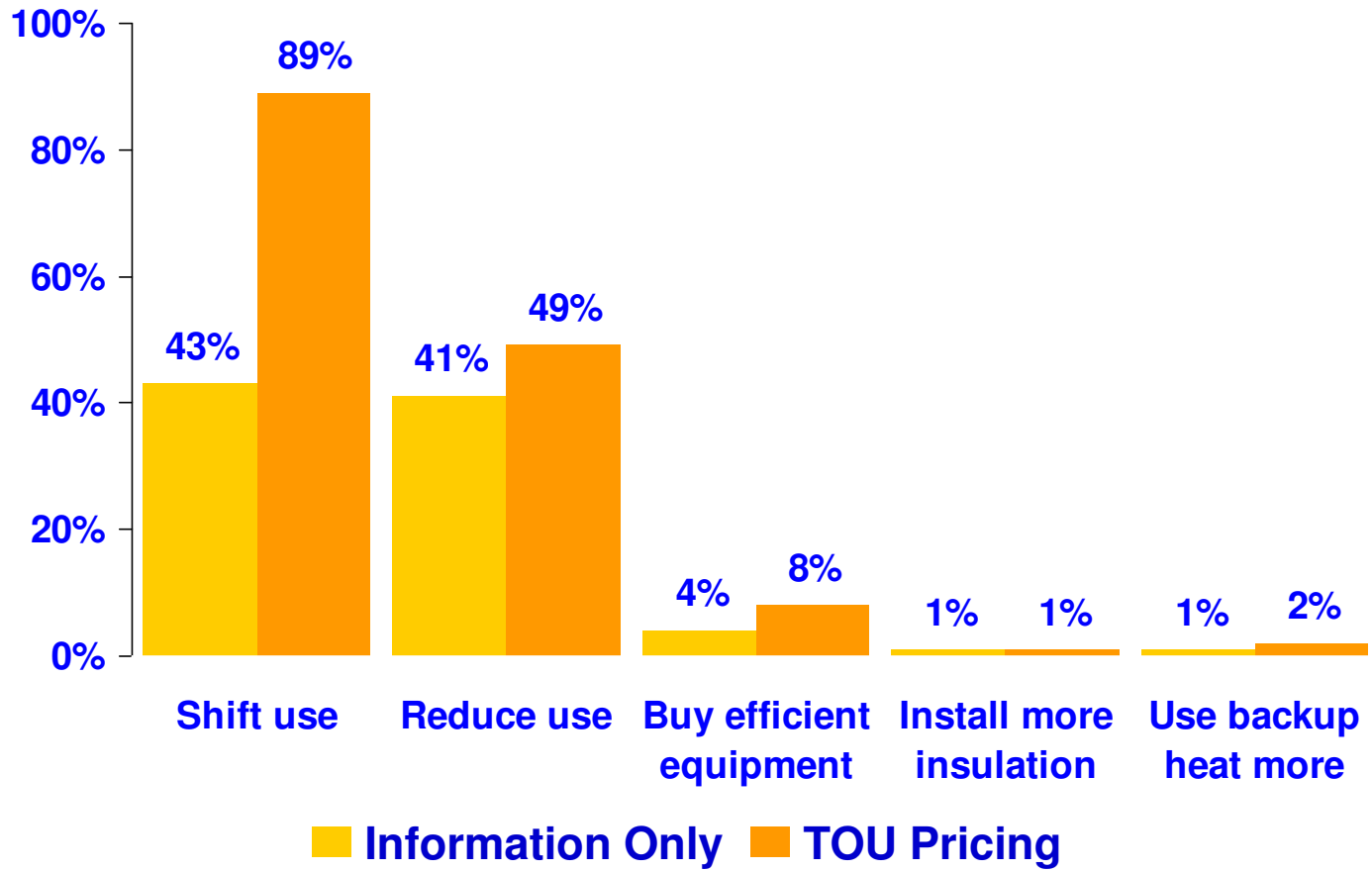
- They are price elastic
- They like information about their electricity purchases
- They like having technology
- They want understandable programs
- They want help in participating
- Civic duty works – but for how long

Puget Sound Market Research Results

- Attitudes toward time-differentiated pricing
  - 67% - TOU is a good idea
  - 66% - reduces need for power plants
  - 64% - TOU pricing is fair
  - 72% - concept is easy to understand
  - 37% - should pay the same price no matter what time of day they use power
- Customer reaction to information



Puget: Types of Actions Taken by Customers



Gulf Power – Research Results

- **I pay more attention to my electricity consumption now that I am on the GoodCents Select Program.**

1 Strongly Disagree	15 --- 4%
2 Disagree	37---11%
3 Agree	102 --- 29%
4 Strongly Agree	193 --- 56%
Total	347--- 100%

- **I have NOT had to significantly adjust my lifestyle with the GoodCents Select Program.**

1 Strongly Disagree	16--- 5%
2 Disagree	47 ---14%
3 Agree	140 ---40%
4 Strongly Agree	144 ---41%
Total	347 ---100%

Gulf Power - Research Results

o Would you recommend GoodCents Select to others?

Yes	311 ---89%
No/uncertain	37 ---11%
Total	348 ---100%

o Have you recommended GoodCents Select to anyone?

Yes	255 ---82%
No/uncertain	56 ---18%
Total	311 ---100%

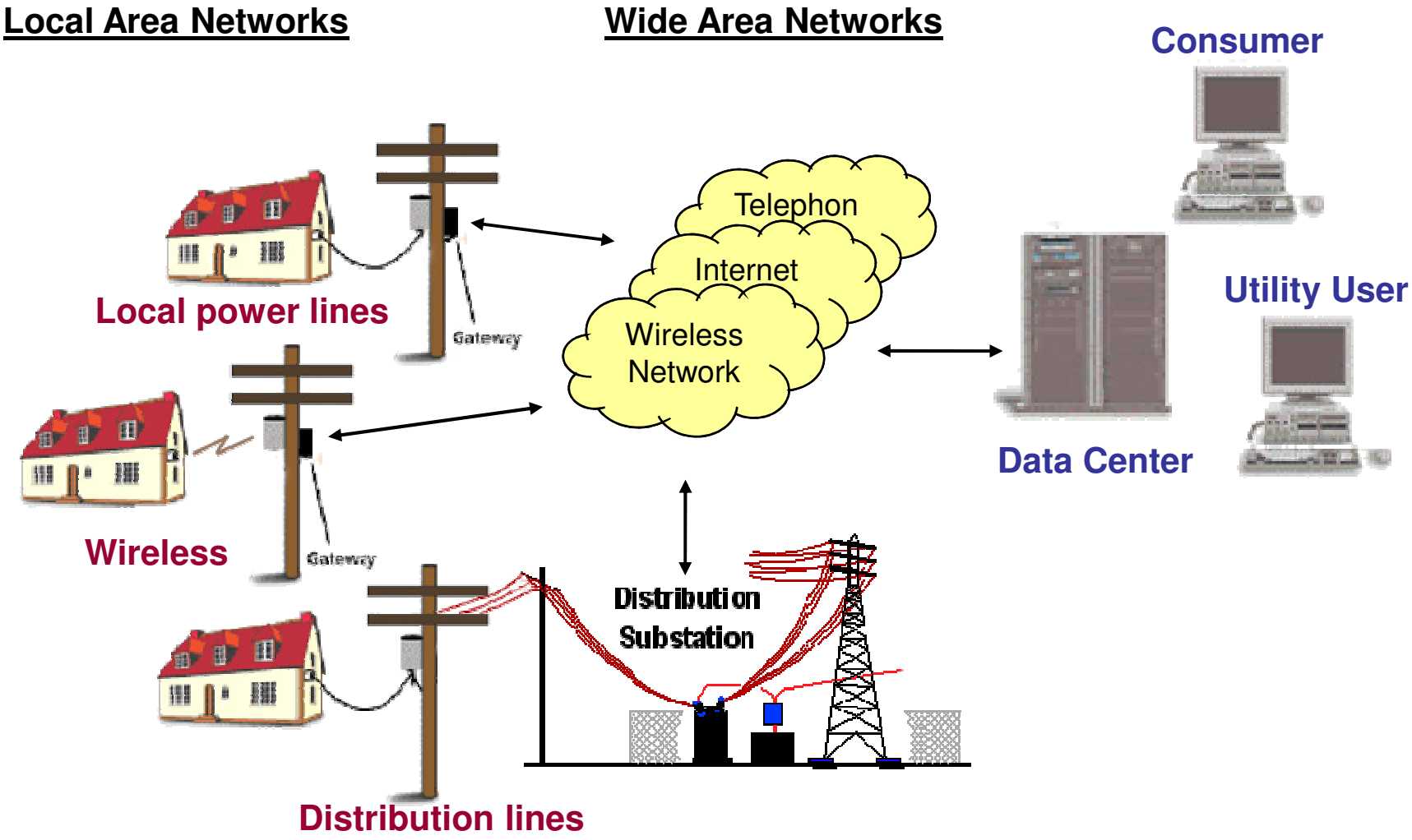
Issue: Technology

- DR without Technology
- Direct Load Control
- Informational Display
- Advanced Metering and Communications
- Automated Communications and Controls
- Smart Thermostats
- Energy Management Systems
- Building Optimization
- Bidding and Dispatch Systems and Platforms
- Virtual Negawatt Systems
- Distributed Generation

Metering Technology

- Three stages
  - Basic black
    - Fill up the bucket and come and get it….
  - AMR (Automatic Meter Reading) (aka “drive-by”, mobile)
    - Communications but limited
    - Not a demand response driver
    - Not usually tied to interval metering
  - Advanced Metering (aka fixed network, advanced meter infrastructure (AMI)
    - Fixed communications (wireless, power line, RF, mesh
    - Interval metering
    - Frequent data availability and access
    - Supportive of demand response

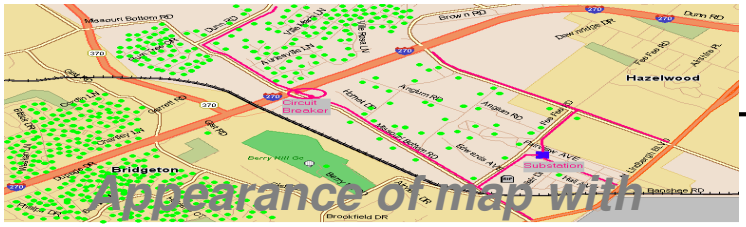
AMI Communication Networks



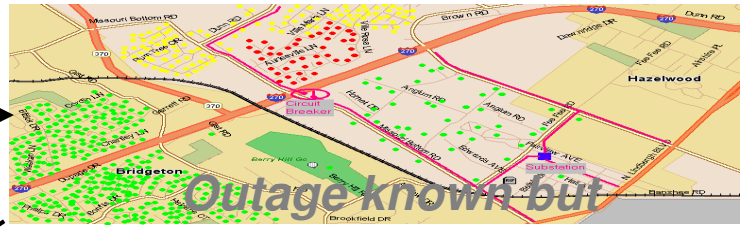
New Utility Capabilities Enabled by AMI

Service	New Capabilities Enabled
Power Quality	**Meter-level voltage monitoring**
Distribution Automation	**Load balancing** **Capacitor bank switching*** **Regulator and tap changer monitoring*** **Transformer load management** **Automated outage management**

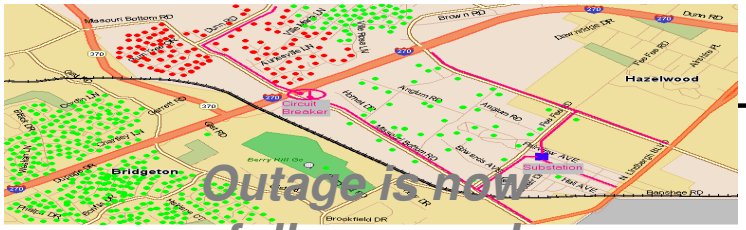
* - requires additional devices



Appearance of map with normal power status



Outage known but not yet fully mapped



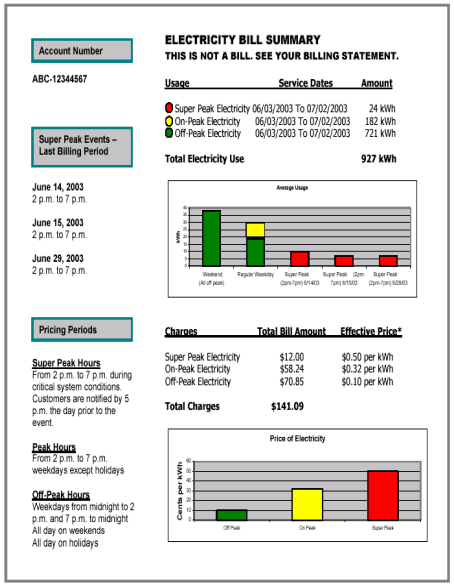
Outage is now fully mapped

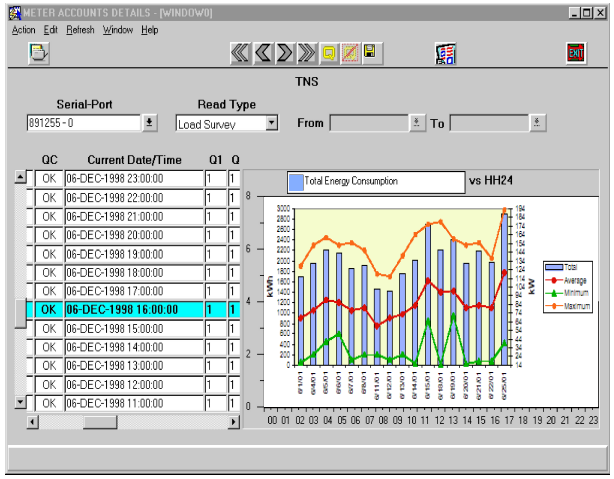
Individual customer s still out

Monitor restoration to be sure power is fully restored

New Customer Options Enabled by AMI (Basic)

Service	New Options Supported
Billing	**Choice of billing date** **No estimated bills** **Month-to-date bill** **Projected month-end bill**
Pricing	**Flat rates** **Time-of-use** **Critical peak pricing** **Real-time pricing**
Outage Response	**Automatic outage detection** **Restoration verification**
Usage Information	**Real-time meter read** **First call problem resolution** **Web data access** **Monthly detailed usage reports** **Baseline threshold alarms** **Month-to-date usage** **Daily or hourly data to walk customer through usage patterns**





DR Costs

- Participant
  - Initial - technology
  - Event-specific
    - Comfort/amenity
    - Business loss
    - Rescheduling Costs (e.g. overtime)
- System
  - Initial
    - Metering/communications
    - System hardware/software
    - CIS/billing
    - Customer education/marketing
  - Ongoing
    - Program administration
    - Marketing/recruitment
    - Payments to participants
    - Monitoring and evaluation
    - Infrastructure maintenance

DR - Who Benefits and How

- Participants
  - New info about their bill
  - New ability to lower their bill
  - New control over their end uses
- Non-Participants
  - Lower peak demand means lower peak wholesale prices, to everyone’s benefit

DR - Who Benefits and How

- Utilities/LSEs
  - New abilities to control load
  - New information about customers
  - Information to use in optimizing system operations and planning (risk management)
  - New product choices for customers

DR - Who Benefits and How

- Utilities/LSEs
  - Automated meter reading
  - Outage detection and management
  - Monitoring and Verification
  - Power Quality
  - Automated Control
  - Potential Gateway
  - Reduced Operating Costs
  - Customer Satisfaction

DR - Who Benefits and How

- Regional System
  - Optimize system operations and planning
  - Avoid unnecessary expansion
  - Address local load pockets
  - Reduce emissions in certain areas (a potential dynamic tool?)
  - Support for Renewables

DR - Who Benefits and How

- Retail Marketers and Renewables
  - Faster, more accurate settlements
  - Ability to offer new product choices as alternative to default service
  - High peak prices stimulate on-peak renewables

DR Policy Initiatives

- PURPA 1978
- Load Control
- Restructuring
- FERC directives to ISOs/RTOs
- RTP for large customers
- Competitive metering
- Default service pricing
- System benefit funding
- Mega-mandates (CA, Ontario)
- Portfolio standards
- EPACT 2006

EPACT Components

- Section 103 (FEMP)
- Section 1252 (Smart Metering)
  - Requirements on States
  - Requirements on DOE
  - Requirements on FERC
  - It is the policy of the U.S. ……

Other EPACT Provisions

- Energy Efficiency
- Net Metering
- Transmission Incentives
- Competition Study
- Distributed Generation Study
- Natural Gas Report
- Grid Congestion

Section 1252 – DOE & FERC

- DOE
  - Technical Assistance
  - "two or more states"
  - Report to Congress on "how much by when"
- FERC
  - Information gathering and assessment by region
  - "establishing a baseline and reference point"

DOE Report to Congress

- Congress:
  - How much potential and how much can we get by 2007?
  - Give us recommendations
- DOE
  - Not enough time to do a good job
  - Not enough time to impact 2007
  - Lack of consistency in data and analytical methods makes comparing existing estimates challenging if not prohibitive
  - Recommendations
    - Need to come up with methodologies and analytical framework

Section 1252 - States

- Requirement is on the body that governs the utility
  - State Commission
  - Muni Governing Body
  - Rural Cooperative
- Requirement is to investigate and make a determination on:
  - Offering all customers time-based rates and providing meters that enable such
  - Providing all customers with advanced metering
- Focus/purpose is customer – a new tool
- Applies to traditional and deregulated states and customers

State Developments on Demand Response and Advanced Metering – EPACT, Etc.

- Arizona
- Arkansas
- California
- Connecticut
- Delaware
- District of Columbia
- Idaho
- Illinois
- Kentucky
- Louisiana
- Maryland
- Massachusetts
- Montana
- Nevada
- New Jersey
- New Hampshire
- New Mexico
- New York
- Ohio
- Oregon
- Pennsylvania
- Rhode Island
- Texas
- Vermont
- Virginia
- Washington State

EPACT Perspectives

- Opportunity
  - States want improved efficiency of the electricity system
  - DR's many aspects benefit from examination
  - The beginnings of a smart grid
  - Utilities want smart metering and all that comes with it
  - Section 1252 comes at same time as end of transition periods in restructured states and rising prices
- Threat
  - States challenged with their regular agendas
  - States want to do the right thing – resources constrained
  - A box-checking exercise instead of an opportunity?
  - Section 1252 comes at same time as end of transition periods in restructured states and rising prices
  - DR & AM community is small and under-resourced

Stakeholders - What They Want and What They Don't Want

- What Utilities Want
  - A smarter system and the ability to optimize their business
  - To know more about their customers and offer new things
  - Flexibility in how to proceed
  - Cost recovery or better yet - incentives

Stakeholders - What They Want and What They Don't Want

- Utilities Don't Want
  - Unfunded mandate
  - To be second guessed
  - Policy makers to pick a technology winner
  - To create future stranded investment

Stakeholders - What They Want and What They Don't Want

- Customers want
  - New tools and options for managing their energy and reducing their bill
  - The kind of information they have with all other purchases
  - New choices for how they buy electricity – market based or other
  - Easy to understand, holistic offerings

Stakeholders - What They Want and What They Don't Want

- Customers Don't Want
  - Confusing programs and offerings
  - To be placed on a new rate and not have a choice
  - To feel helpless in reducing their bills

Stakeholders - What They Want and What They Don't Want

- Regulators Want
  - To do the right thing by both the customer and the utility
  - To support development of a market if that is the path chosen
  - To help customers manage their bill and give them new options
  - To comply with EPACT

Stakeholders - What They Want and What They Don't Want

- Regulators Don't Want
  - To make a wrong choice
  - To do anything to raise rates
  - Angry customers
  - To take unnecessary risks after restructuring experience to date

DR – A Chicken and Egg Situation

- DR requires enabling technology
- Enabling technology provides benefits outside of demand response
- Enabling technology provides benefits to different parties in different places
- Enabling technology is more cost-effective with DR benefits
- Multiple stakeholders and decision pockets
- Case specific, comprehensive analysis is required

DR – The Challenges

- DR needs "nourishment" in its infancy
- NGO Community not driving it like efficiency
- DR expertise and information is diverse and dispersed
- Benefits are dispersed
- Pilots need to test for right thing
- Business cases are needed
- No natural flow and exchange of ideas and info
- What is known is unknown
- Much is not known
- DR not being recognized as its own discipline
- Some places need/want DR quickly
- Policy makers voice support it but look for assistance and support

DR – The Opportunity

- Use EPACT as the platform upon which to bring all stakeholders together and figure out a “win-win” way to make demand response part and its enabing technologies part of the system.

Thank You

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www.demandresponseinfo.org