Demand Response: Issues and Challenges

Charles Goldman
Lawrence Berkeley National Laboratory
CAGoldman@lbl.gov

FERC Demand Response Technical Conference
January 25, 2006

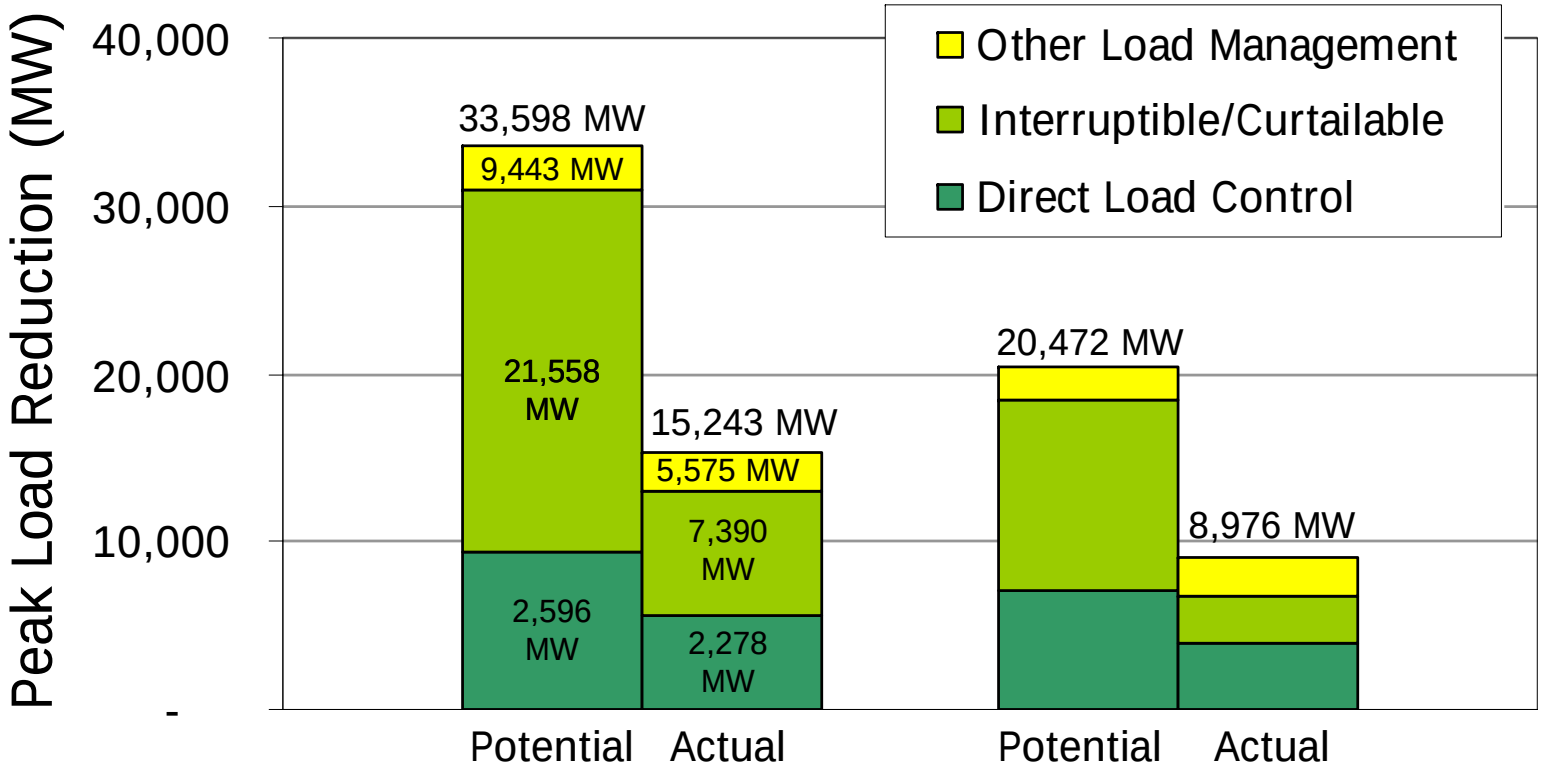
Overview

- Regulatory and Market Context for Demand Response
- Types of Demand Response Options
- Demand Response Issues and Challenges

Regulatory and Market Context

- Regulatory policy context
  - Strong Federal policy support for DR
  - Varying level of interest and support among state PUCs
    - Re-emergent interest in DR as part of IRP (Pac NW)
    - Explicit DR goals as part of resource adequacy (CA)
    - RTP as default service (MD, NJ, PA, NY)
- Market situation
  - Adequate to high reserve margins in most markets; few “hot spots” (SW CT, S. CA, NYC)
  - Price volatility in <u>most</u> regional energy and capacity markets continues to decline
  - Gradual decline of legacy load management programs
  - Increased role of ISO/RTOs

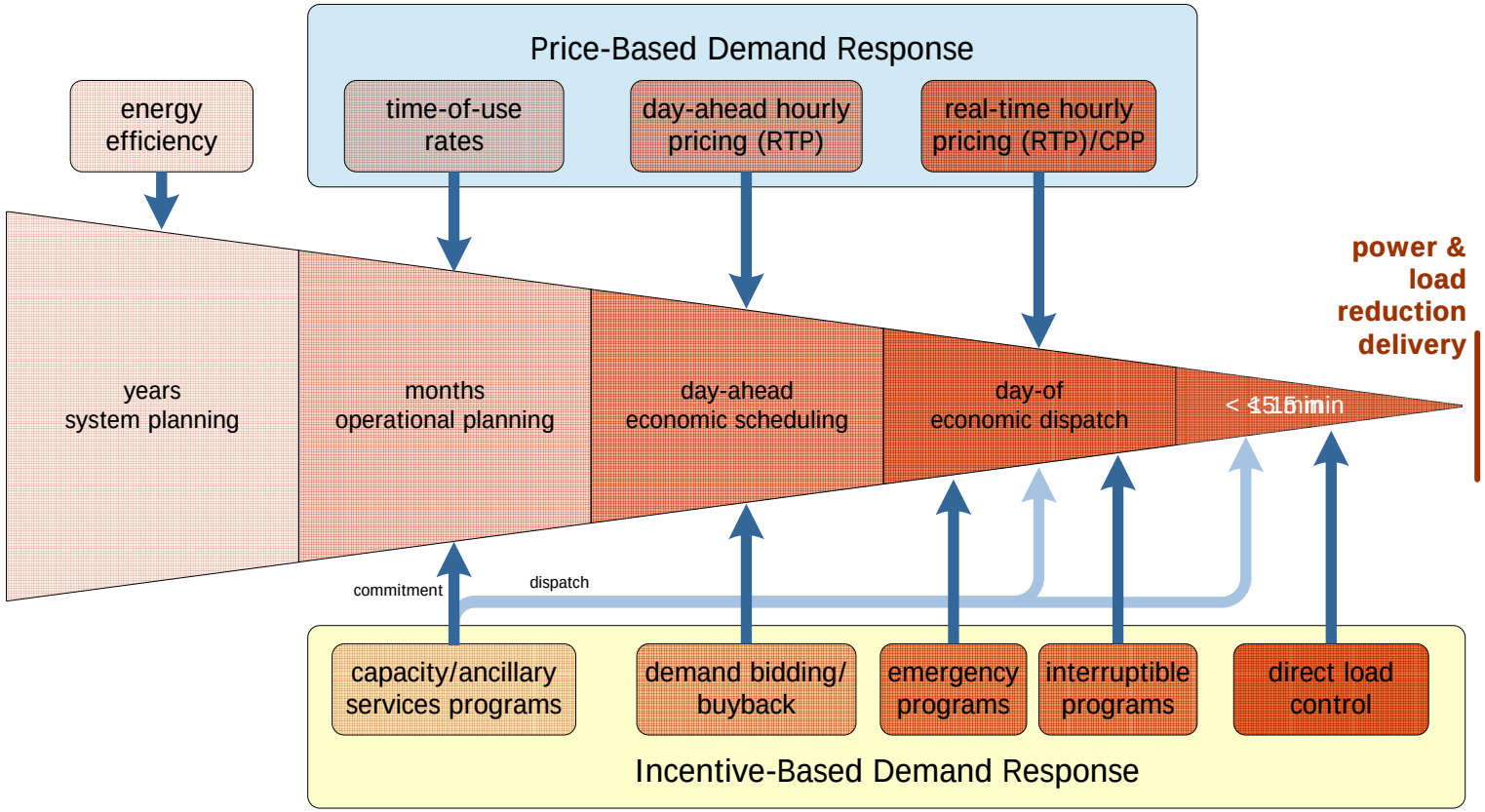
Current Demand Response Capability



1996		2004
407	Number of Utilities	273
572	Program Costs (million nominal $)	515

- DR potential capability has dropped by ~32% since 1996

Role of Demand Response in Electric Power Systems



- DR options include price-based DR (time-varying electricity tariffs) and incentive-based DR (programs that pay for load reductions)

Demand Response Options

- Price-based Options
  - Real-Time Pricing (RTP)
  - Critical Peak Pricing (CPP)
  - Time-of-use (TOU) rate
- Incentive-based DR Programs
  - Direct Load Control
  - Interruptible/curtailable service
  - Emergency DR Programs
  - Capacity Market Programs
  - Demand Bidding/Buyback programs

Demand Response Challenges

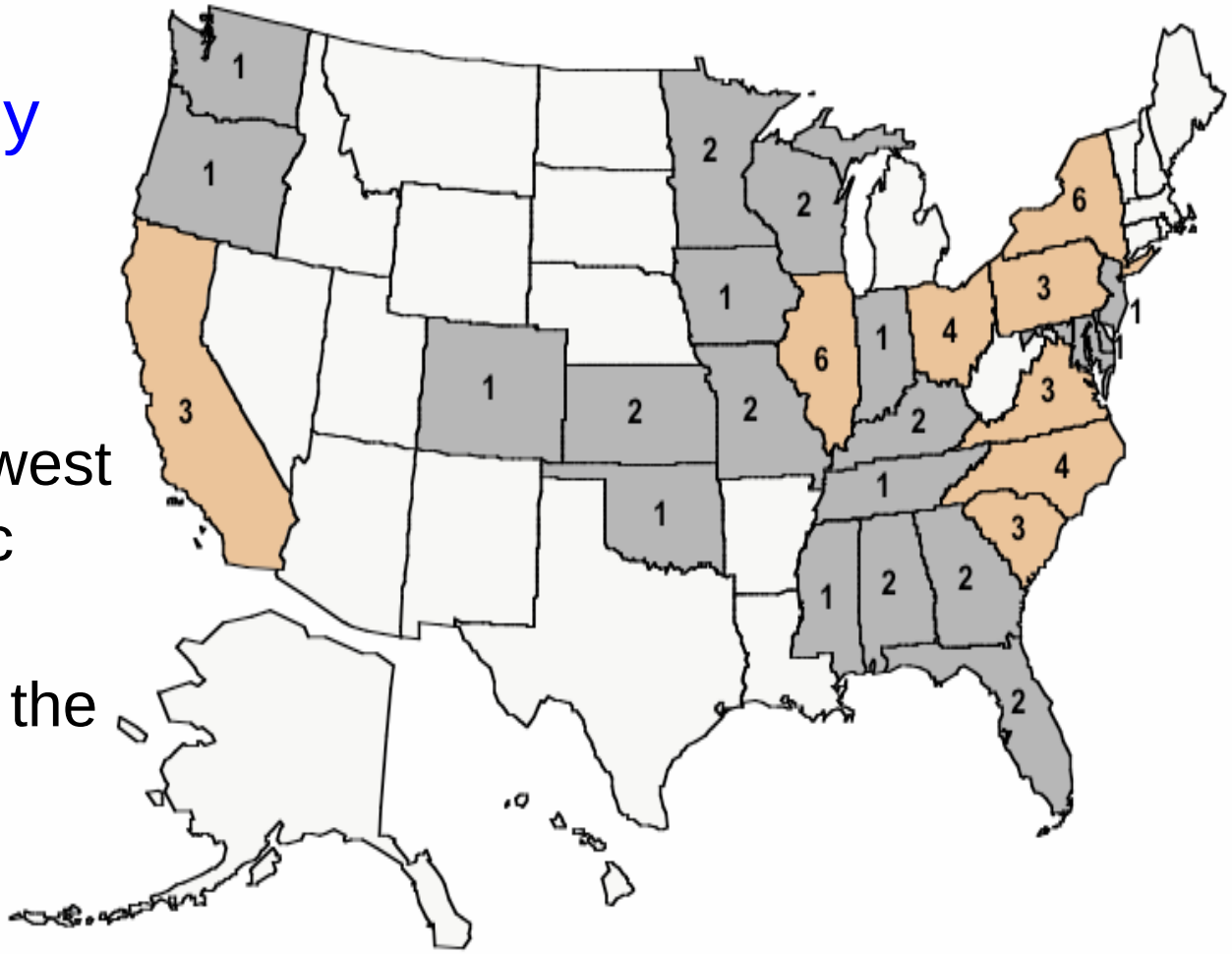
- Fostering Price-based Demand Response
- Improving Incentive-based DR Programs
- Strengthening DR Analysis and Valuation
  - Standardized methods and practices to report impacts and establish value of demand response
- Integrating DR into resource planning
- Increased Adoption of Enabling Technologies
  - DR enabling technologies and system integration to achieve sustainable price-responsive demand

Issue #1: Fostering Price-based Demand Response

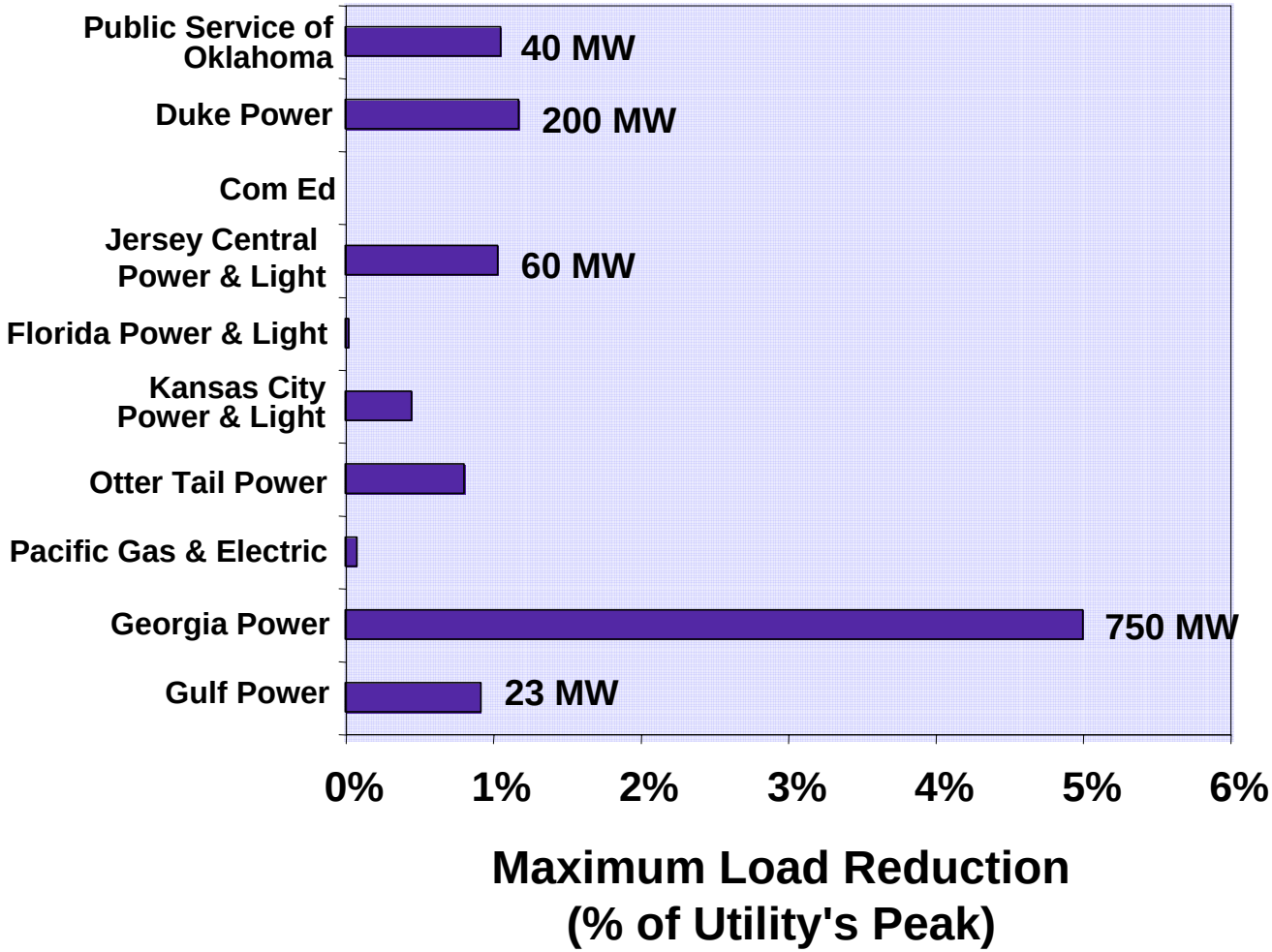
- Marginal cost of supplying electricity varies significantly; but nearly all customers face time-averaged, fixed retail rates
- Customers have little or no incentive to adjust their demand to supply-side conditions, which leads to inefficient use of resources
- Policy Issues**:**
  - **What evidence is there that RTP or CPP delivers DR?**
  - **Lack of advanced metering is major barrier to widespread implementation**
  - **Do state PUCs have political will to aggressively promote price-based DR?**

Optional RTP Tariffs: Overview

- RTP offered as Optional Tariff by more than 40 utilities
  - Popular in Southeast, Midwest and Mid-Atlantic
  - Not offered by many utilities in the West or New England

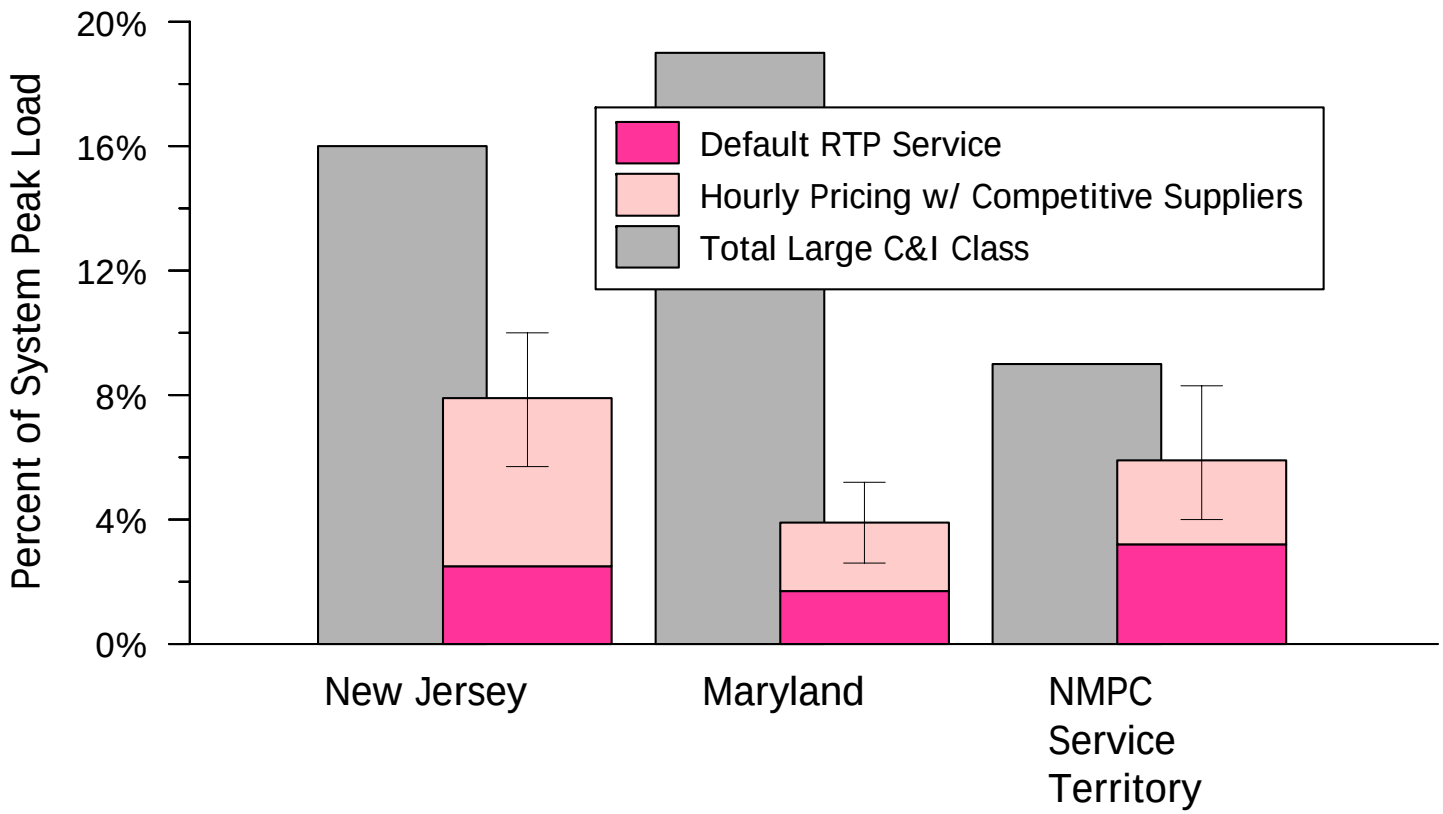


Customer Response to High Prices in RTP Programs



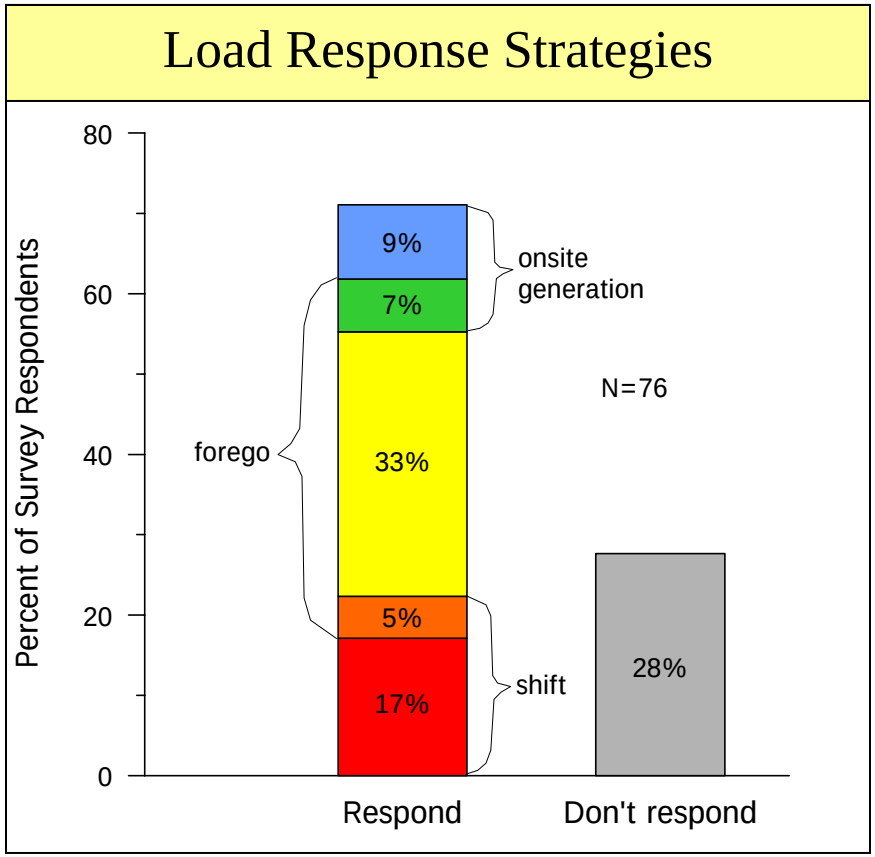
- **Aggregate load reductions are ~1% of utility peak for almost all RTP programs, except Georgia Power**

RTP as Default Service: Customers Exposed to Spot Market Prices



- **Customers face spot prices through default RTP and contracts with competitive retailers**
- **Large C/I customers facing spot prices ranges from 4-8% of total system peak load**

Niagara Mohawk: Barriers to RTP
What Customers Told Us



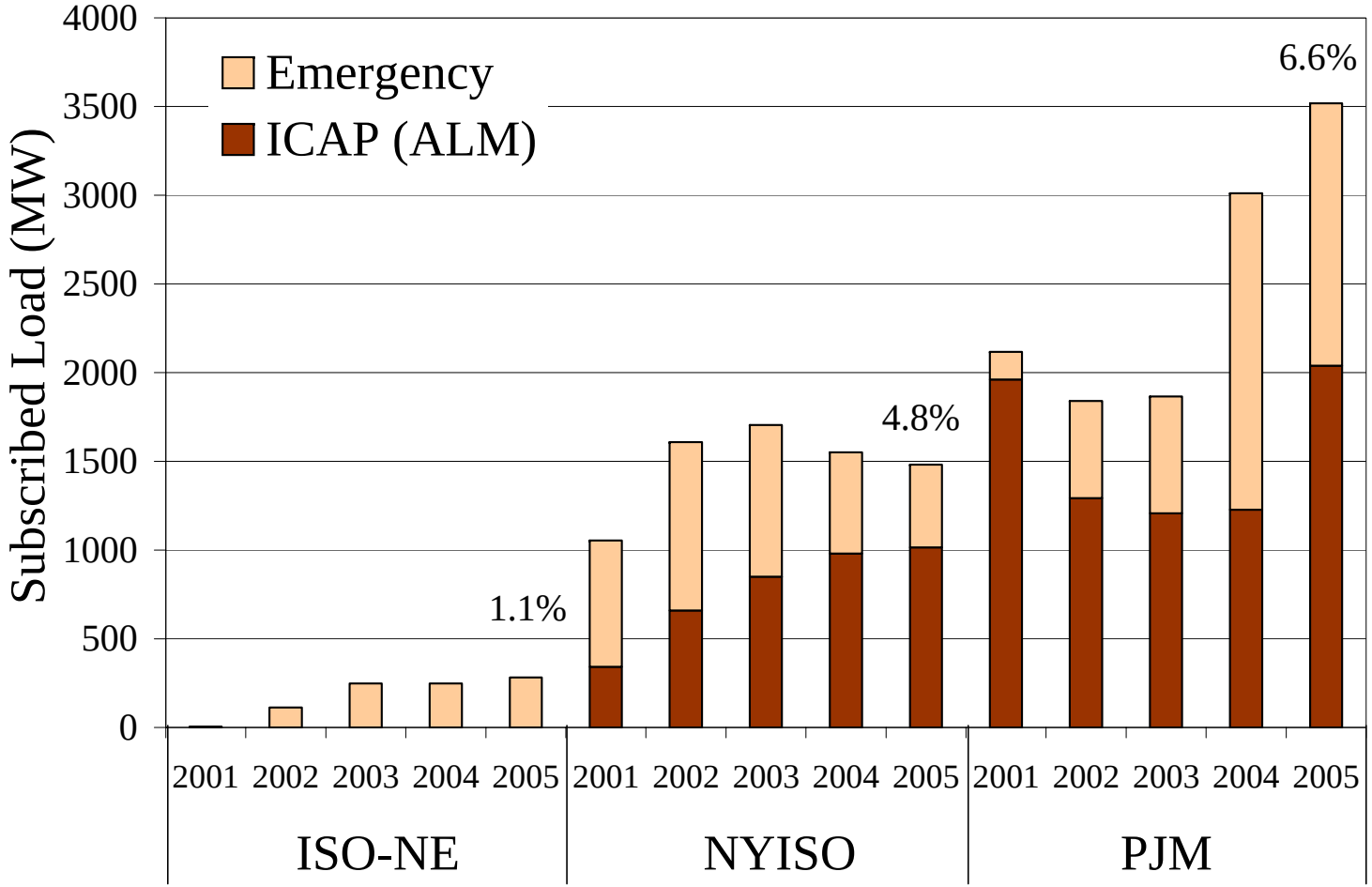
Barriers to Price Response (N=76)	Frequency
No barriers encountered	9
Organization/ Business Practices	
Insufficient time to pay attention to prices	**39**
Institutional barriers	**23**
Inflexible labor schedule	**16**
Inadequate incentives	
Electricity is not a priority	**17**
Cost/inconvenience outweighs savings	**17**
Risk averse/ hedged	
Management views price response as too risky	**10**
Flat rate or time-of-use contract makes responding unimportant	**9**

- Most customers report multiple barriers to price response;~15% respond without obstacles

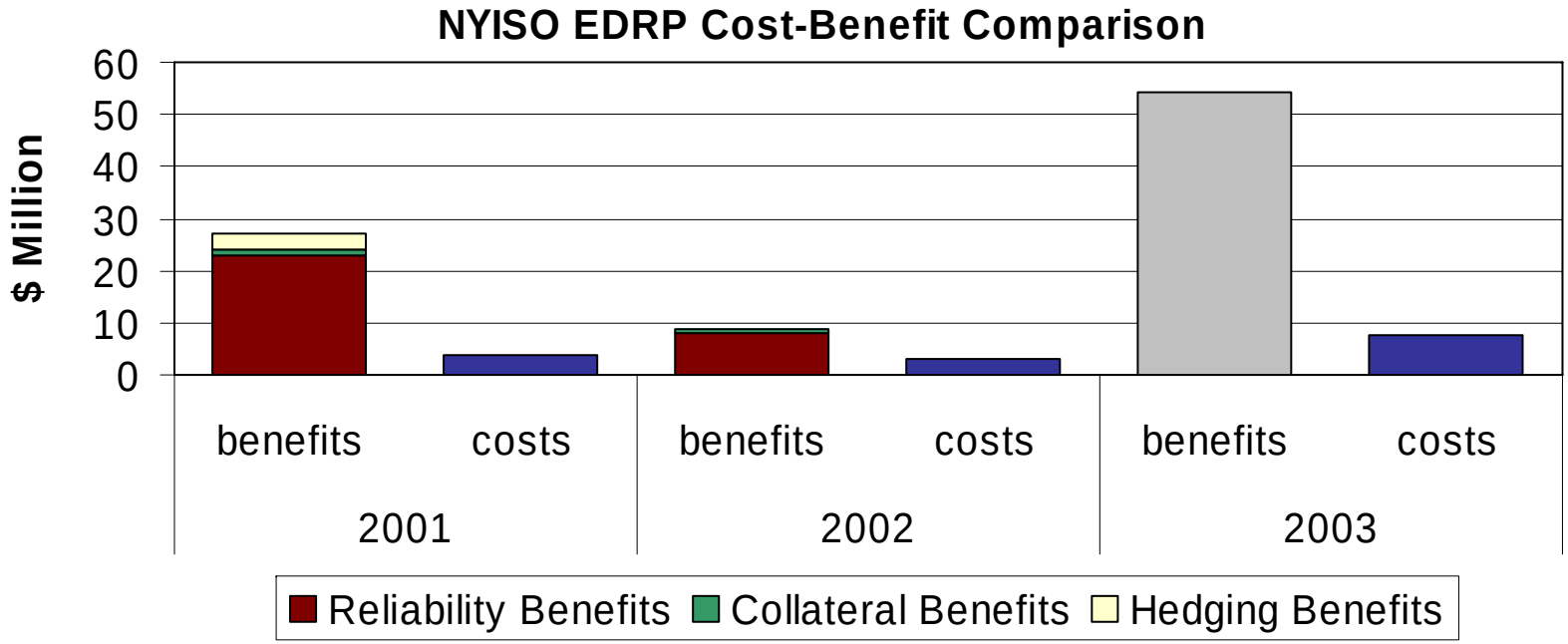
Issue #2: Improving Incentive-Based Demand Response Programs

- **Trends in ISO DR programs**
- **Issues:**
  - **Not all ISOs have integrated DR into their wholesale markets**
  - **Traditional Load Mgmt. programs (DLC and I/C) need to be adapted to new market structures and circumstances**

ISO "Reliability-based" DR Programs: Enrollment is increasing



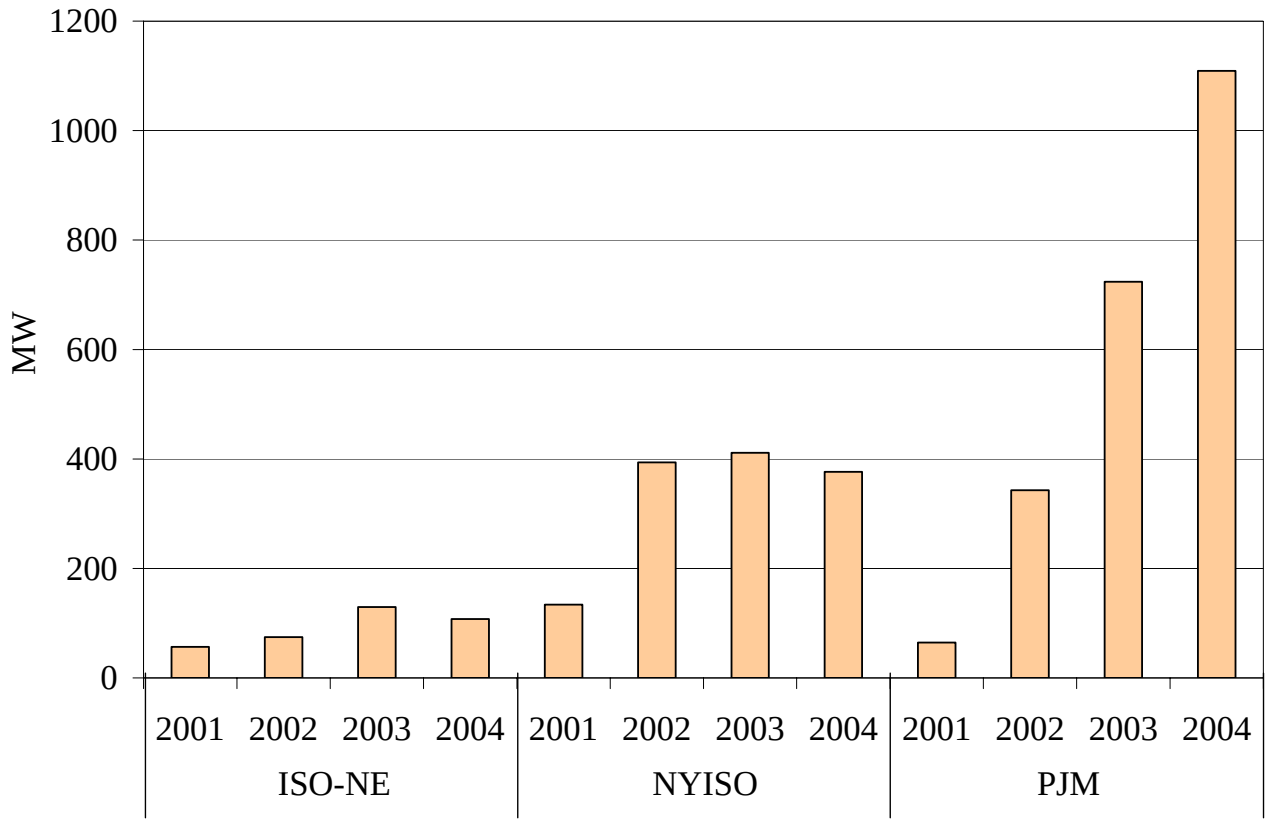
Emergency DR programs can be very cost-effective



Cost-effectiveness driven by:

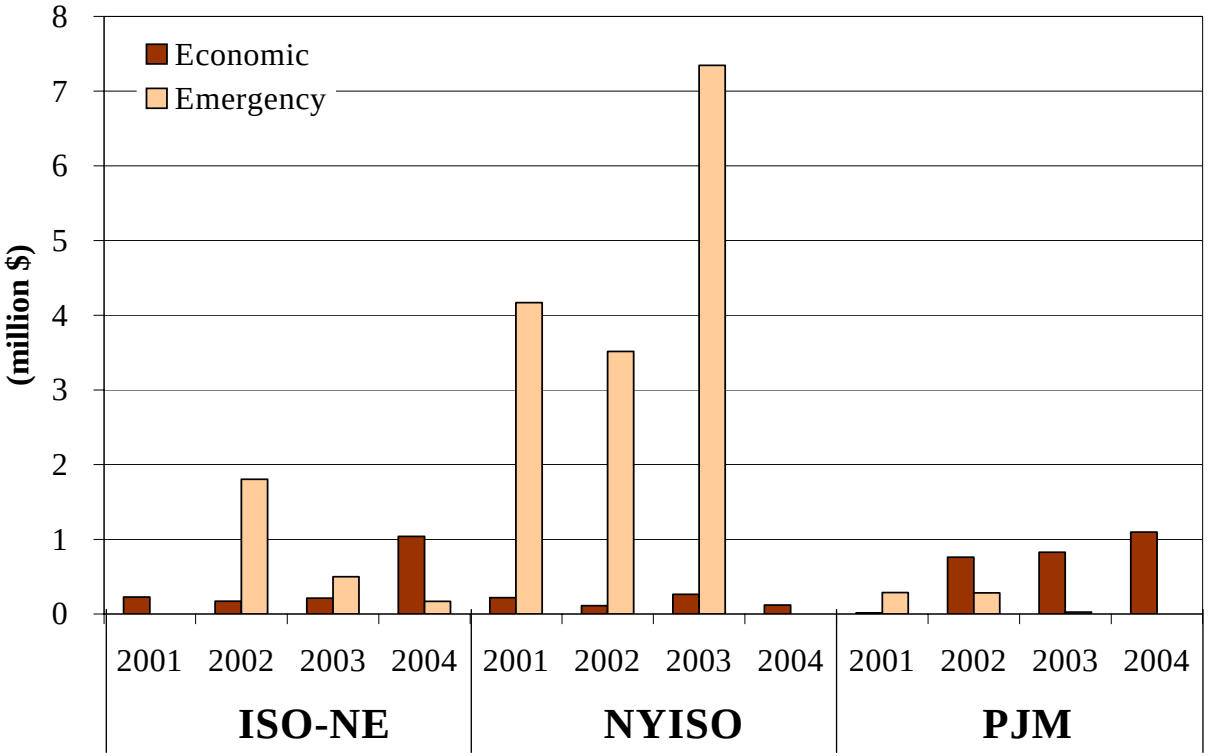
- number of events
- customer response & program payments
- assumed value of lost load
- “supply curve” flexibility

ISO "Economic" DR Programs: Enrollment Increasing - Performance Lags



- **Subscribed load increasing, particularly in PJM**
- **However, scheduled load curtailments are typically low:**
  - **~10-15 MW peak (NYISO day-ahead market and PJM real-time market)**

ISO DR Program Costs and Payments



Cumulative Payments made to participants by 3 ISOs (2001-2004):

- Emergency DR Pgm: $18.1 M
- Economic DR Pgms: $5 M

Issue #3: Strengthening DR Analysis and Valuation

- Challenges in measuring DR Impacts
  - Direct Load Control impacts are reasonably well-characterized, but impacts from price-based DR depend on customer behaviors that are price- or incentive-driven
- Challenges in estimating net benefits of DR
  - Cost reporting issues (participant costs)
  - Value of DR not fully reflected in standard B/C tests
  - Reliability benefits valued differently by customers
  - Other benefits difficult to quantify
- Bottom Line: More comprehensive evaluation framework needed to fully value benefits of DR

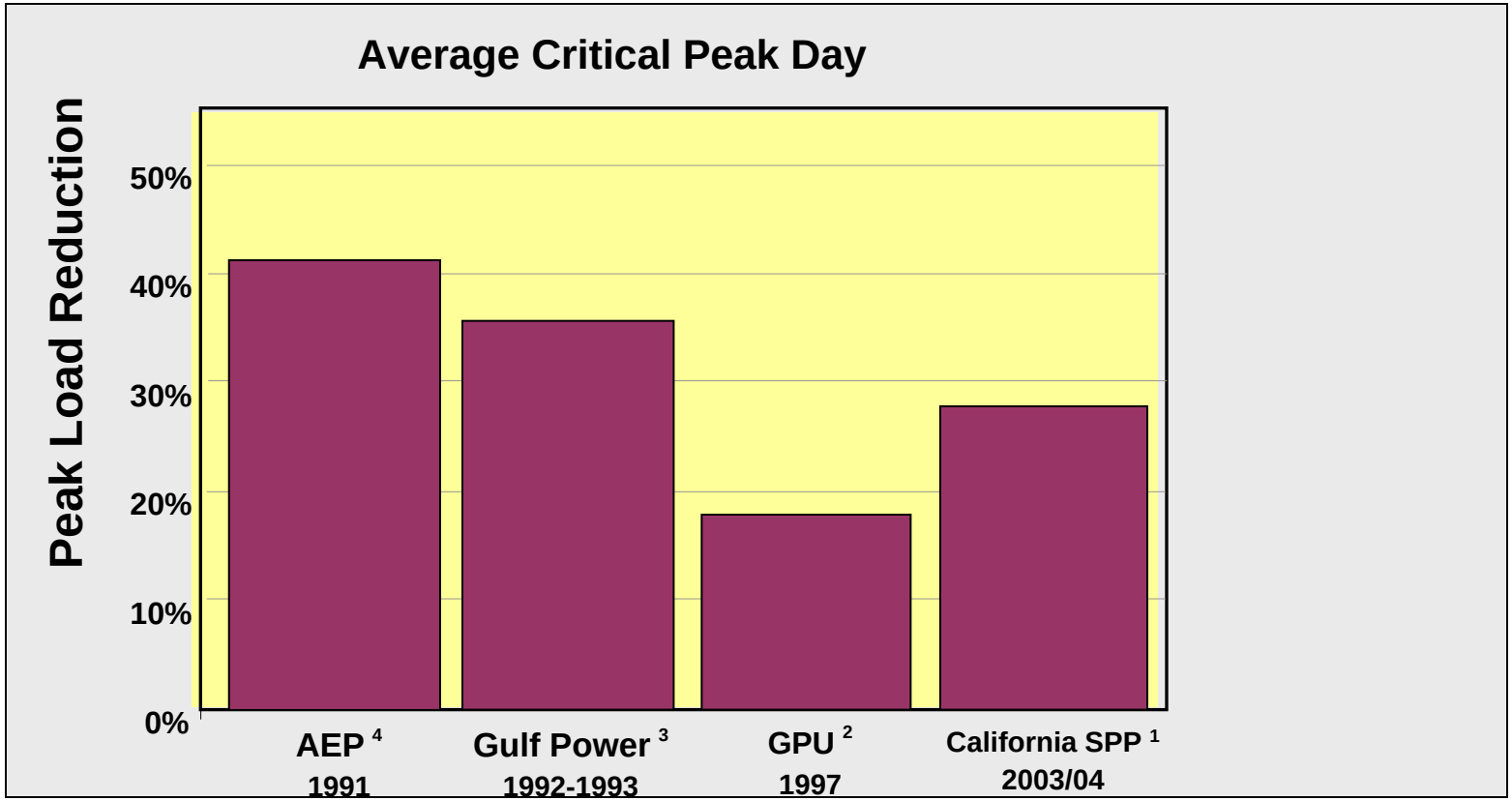
Issue #4: Integrating DR into Resource Planning

- How much DR is needed for ensuring resource adequacy, given market structures and system conditions?
- Improve characterization of DR in Resource Planning Models
- Organized Markets: ISO/RTO evaluations focus on short-term impacts and benefits of DR
  - More effort needed to characterize long-term impacts and potential DR benefits, as part of ISO long-range planning studies

Issue #5: Increased Adoption of Enabling Technologies

- Lack of interval metering is significant barrier to deployment of price-based demand response among residential and small C/I customers
- Many large C/I customers do not fully utilize capabilities of EMCS and EIS systems, advanced HVAC and lighting controls
  - Load curtailments often implemented manually by large C/I customers
- **Enabling technologies that automate load response provide opportunity to improve persistence of load impacts and increase number of customers willing to curtail loads**

Load Response from Critical Peak Pricing and Enabling Technologies



Source:

1. CA Statewide Pricing Pilot CRA 2005
2. Residential TOU pilot study Braithwait 2000.
3. Results of the Pilot Residential Advanced Energy Management System, Gulf Power, November 1994.
4. Levy Associates case study report, July 1994.

Contact Information

Charles Goldman
1 Cyclotron Rd
MS 90-4000
Berkeley CA 94720
510 486-4637

LBNL Electricity Markets and Policy Group Publications

http://eetd.lbl.gov/EA/EMP/emp-pubs.html

LBNL Reports on RTP Experience

"A Survey of Utility Experience with Real Time Pricing"

G. Barbose, C. Goldman and B. Neenan. LBNL-54238, December 2004.

"Real Time Pricing as Default or Optional Service for C&I Customers: Comparative Analysis of Eight Case Studies"

G. Barbose, C. Goldman, R. Bharvirkar, N. Hopper and B. Neenan. LBNL-57661, August 2005.

"Customer Strategies for Responding to Day-Ahead Market Hourly Electricity Pricing"

C. Goldman, N. Hopper R. Bharvirkar, B. Neenan, R. Boisvert, P. Cappers, and D. Pratt. LBNL-57128. August 2005.

Reports available at:
http://eetd.lbl.gov/ea/EMS/drlm-pubs.html