The Brattle Group

Cost-Benefit Analysis of Smart Metering and Smart Pricing

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A framework for quantifying costs and benefits

- Identify and measure costs
  - Deploying advanced metering infrastructure (AMI)
    - Advanced meters
    - Two-way communication links
    - Meter data management system
    - Billing system
  - Offering dynamic pricing signals
    - Administrative costs
    - Marketing costs

Framework (concluded)

- Identify and measure benefits
  - Operational benefits of AMI
  - Demand response (DR) benefits of dynamic pricing
- Operational benefits
  - Avoided meter reading costs
  - Faster outage detection
  - Remotely connect/disconnect service
- DR benefits
  - See next several slides
- Develop a present value of net benefits

Quantifying DR benefits

- Primary benefits = Quantity of DR (MW) * Value of avoided MW
- Quantity of DR = kW reduction per participant * Number of participants
- Value of avoided load = Cost of peaking capacity net of energy profits
- Secondary benefits = Reduction in wholesale prices + increased system reliability + reduced planning reserves + customer choice of rates

Will customers exhibit DR?

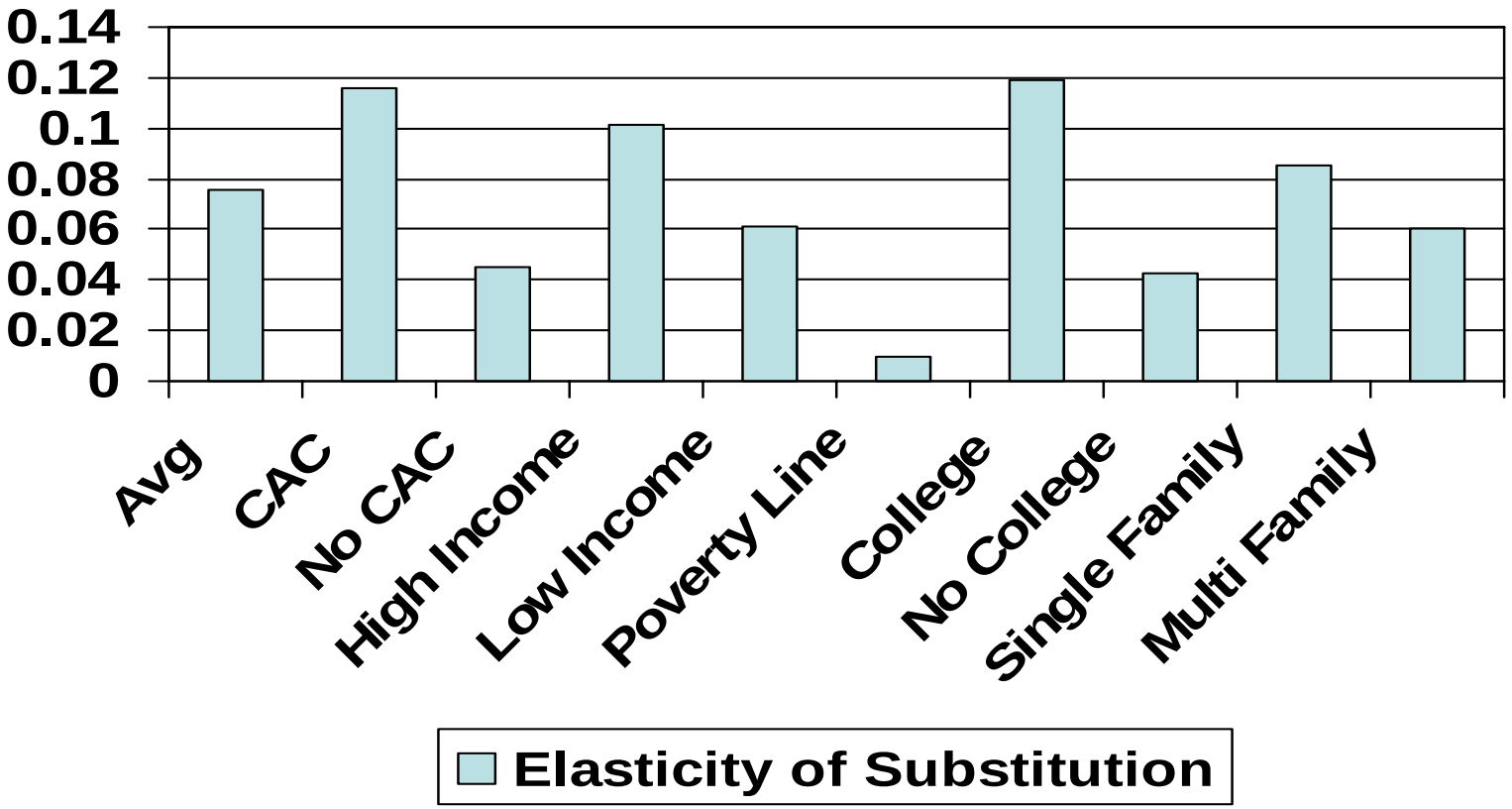
- Even a mild time-of-use (TOU) rate caused peak loads to drop by 5 % in Puget Sound

- Additional evidence is beginning to emerge from other pilots
  - AmerenUE, Missouri
  - Anaheim Public Utilities, California
  - BC Hydro, British Columbia, Canada
  - Commonwealth Edison, Illinois
  - Hawaiian Electric, Hawaii
  - Idaho Power, Idaho
  - Ontario, Canada
  - Pepco, Washington, D.C.
  - Public Service Electric & Gas, New Jersey

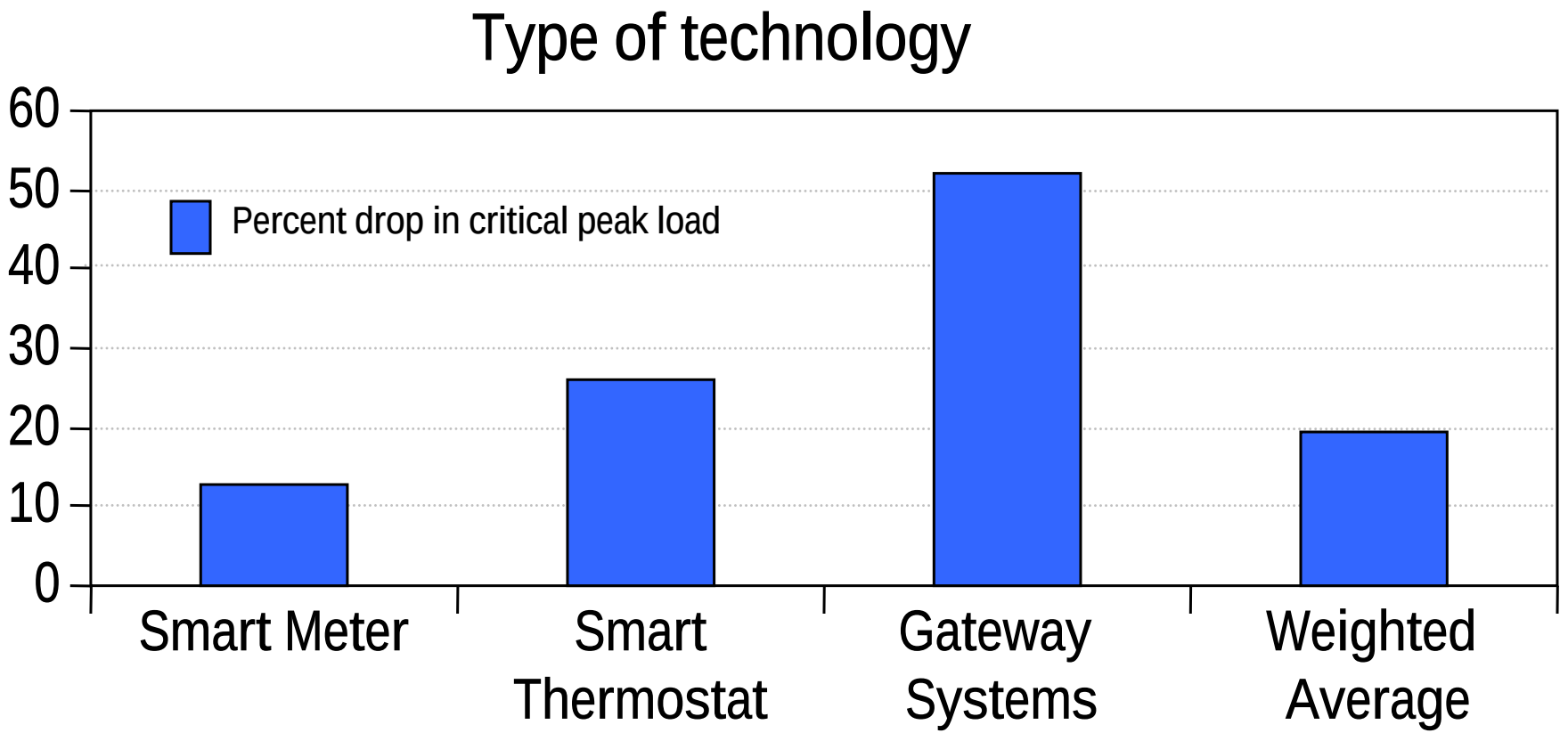
The most comprehensive evidence comes from California

- Two state commissions and three investor-owned utilities conducted a scientifically designed experiment with 2,500 residential and small commercial and industrial customers in 2003-05
- Impacts were estimated for standard time-of-use (TOU) and dynamic critical peak pricing (CPP) rates
- Customers on TOU rates dropped peak loads by 5 %, when prices doubled
- Customers on CPP rates dropped loads by 13 %, when prices quintupled
  - 30% of the customers accounted for 80% of the impact

Price responsiveness varies by customer characteristics

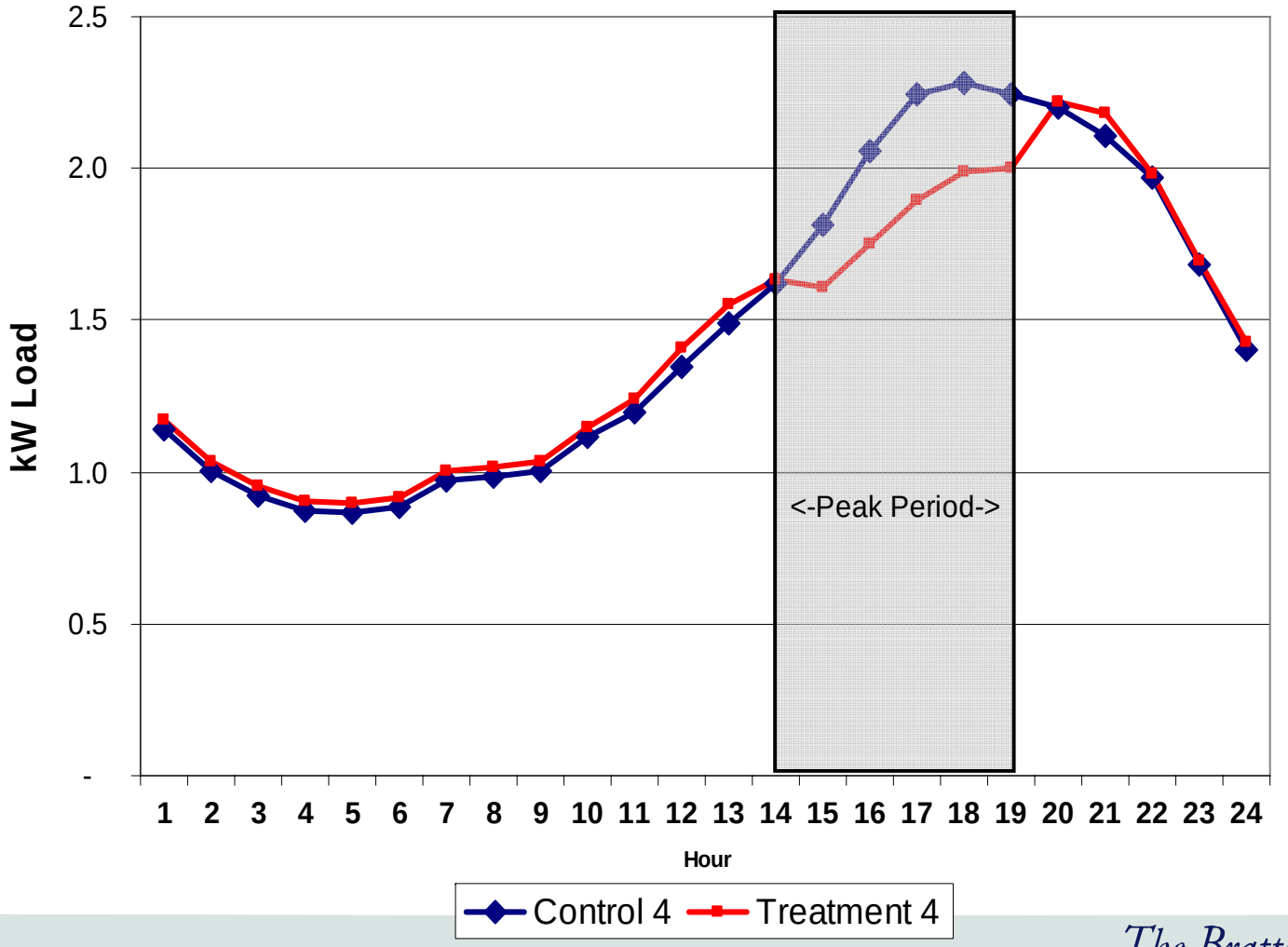


Enabling technologies boost the drop in critical peak loads



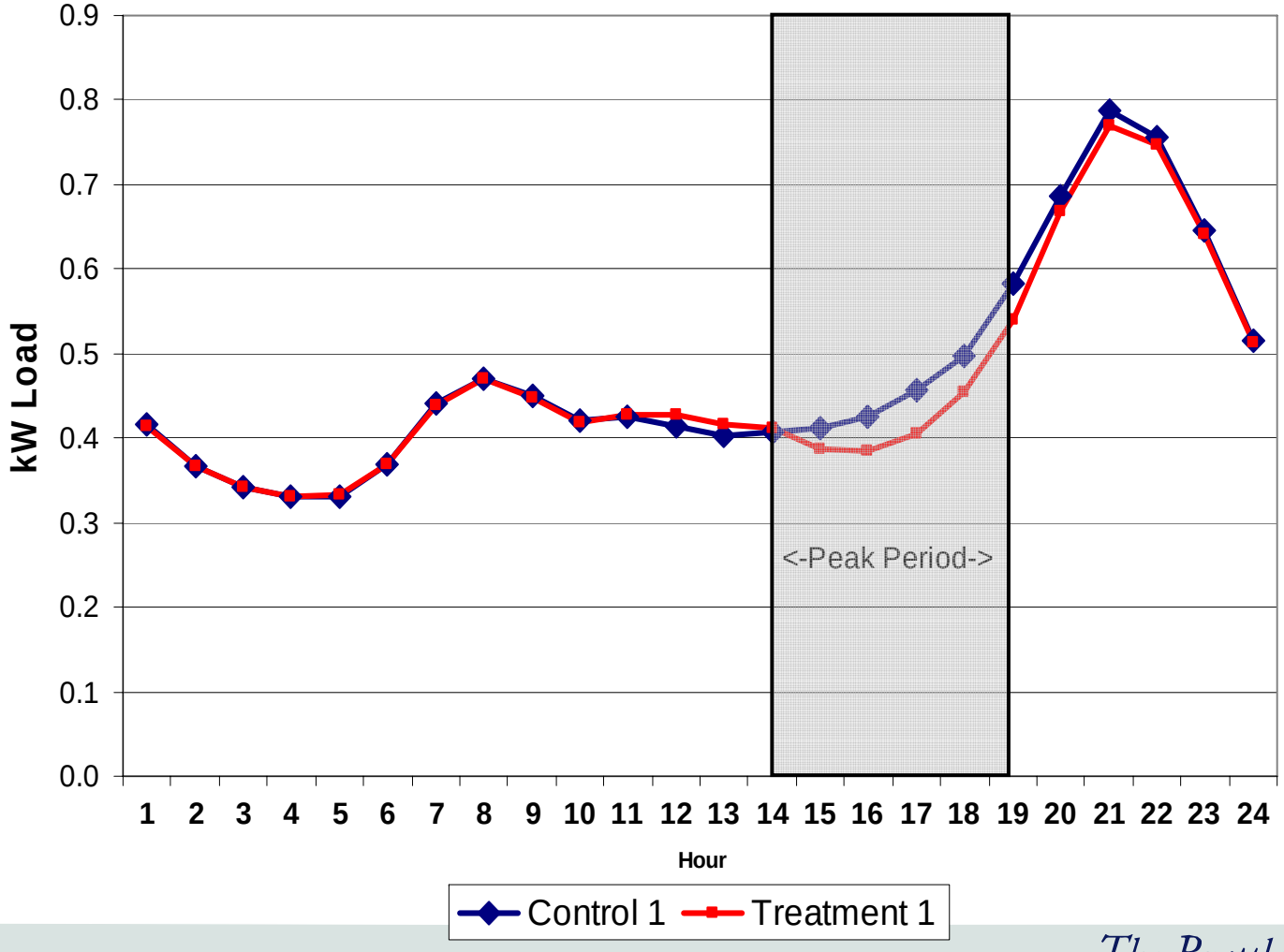
Dynamic prices have a substantial impact in a hot climate (Central Valley)

Figure 11
Hourly Load Shape - Complex Daily Share Model - Zone 4



Dynamic prices even have an impact in a mild climate (San Francisco)

Figure 8
Hourly Load Shape - Complex Daily Share Model - Zone 1



California's utilities are developing advanced metering infrastructure (AMI) business cases

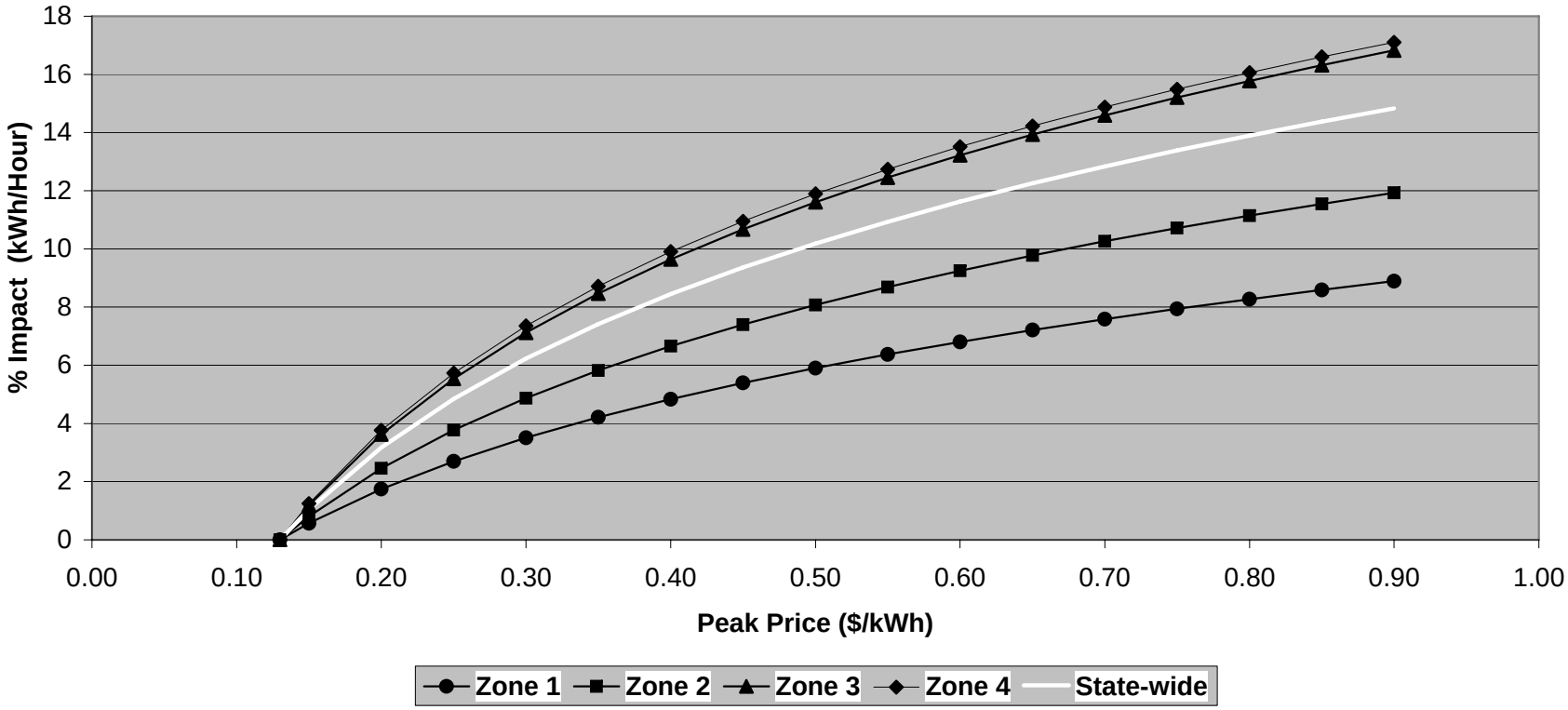
- PG&E's $1.7 billion AMI filing was unanimously approved by the CPUC in July
  - Almost 90% of the benefits come from operational savings
  - By 2011, the utility projects more than 500 MW of demand response if a third of its customers with central air conditioning adopt dynamic pricing tariffs
  - It is proceeding to deploy five million electric meters and four million gas meters
- SDG&E's AMI filing is currently in hearings before the CPUC
- SCE has filed a Phase I feasibility report
  - It plans to file an application next year

Can others make use of the California results?

- Magnitude of response is driven by several factors
  - Existing rate design
  - New dynamic rate design
  - Existing load shape
  - Saturation of central air conditioning
  - Weather conditions
- Once these "initial conditions" are specified, the California pricing model can be used to make preliminary forecasts of dynamic pricing impacts in other regions
- Responses may be more transferable across regions than is generally believed
  - In the mid-1980s, EPRI pooled data from five pricing experiments and showed that customer response patterns were consistent across California, Connecticut, North Carolina and Wisconsin

Percent drop in critical-peak load will vary with price and climate

Figure 1-2
Percent Reduction in Peak-Period Energy Use on Critical Days
Average Summer, 2003/04



Putting it all together in five easy steps

- 1: Develop a dynamic pricing rate and estimate its impact per customer
  - Ball park estimate: 10-30 % per participant
- 2: Identify the number of participants and associated marketing costs
  - Ball park estimate: 10 – 30 % of the target market
- 3: Compute aggregate DR impact
  - Ball park estimate: 1 to 9 % of peak demand
- 4: Estimate value of avoided costs
  - Ball park estimate: $52 – 85 /kW-yr
- 5: Estimate the present value of benefits with the present value of costs and derive an estimate of net benefits

Additional reading

- Ahmad Faruqui, “2050: A pricing odyssey,” The Electricity Journal, October 2006
- Roger Levy, “A vision of demand response: 2016,” The Electricity Journal, October 2006
- Plexus Research, Inc., Deciding on Smart Meters, Edison Electric Institute, September 2006
- FERC, Demand Response and Advanced Metering, Staff Report, August 2006
- Robert Earle and Ahmad Faruqui, “Toward a new paradigm for valuing demand response,” The Electricity Journal, May 2006
- US Department of Energy, Benefits of Demand Response in Electricity Markets, February 2006

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