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Highlights from Two National Studies of the Potential for Energy Efficiency and Demand Response

Prepared for
Western Load Research Association

by
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A little personnel history

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Overview

- Highlights from two studies:
  - **Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030)**, EPRI, January 2009
    http://www.epri.com
  - **A National Assessment of Demand Response Potential**, FERC, June 2009
  - http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp
- Implications for load researchers and energy analysts

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What is a “potential” study?

- A market assessment of what is **possible** and/or **likely to occur** in the future under a set of specific assumptions

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EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.

(2010–2030)

Objectives

- Inform utilities, policymakers, and other industry stakeholders in their efforts to develop actionable savings targets for energy-efficiency and demand-response programs
  - I.e., how much EE and DR are possible
- Identify and incorporate impact of existing/future codes and standards
- Perform scenario analysis
- Support EPRI's Energy Efficiency Initiative

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Analysis requirements

- Develop a thorough understanding of how customers use energy today
  - Customer data by sector, segment and end use
- Forecast how use will change in the future
  - Annual energy use
  - Peak demand
- Understand and *characterize* key forecast drivers
  - Energy prices
  - Customer growth
  - Trends in technology, construction and behavior
  - Appliance/equipment standards and building codes
  - Policies and initiatives (Energy Star, LEED, etc.)
    - Study conducted prior to ARRA and Obama election

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Study resources

- Key data sources
  - EIA Annual Energy Outlook (AEO) 2008
  - EIA market surveys (RECS, CBECS, MECS)
  - Dozens of market studies from across U.S.
  - Comprehensive database of EE measures (Global's DEEM database)
  - EPRI Energy Efficiency Initiative research and results
- Detailed modeling using Global's LoadMAP™ tool
- Opinions of 50+ experts from utilities, regulators, gov't, NGOs

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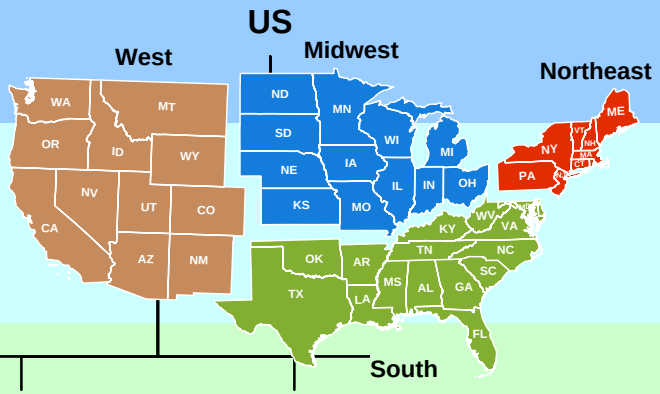
Analysis detail – a bottom-up approach

National

Regional



Sector

Residential | Commercial | Industrial

Existing homes/buildings and new construction are treated separately.

End-Use

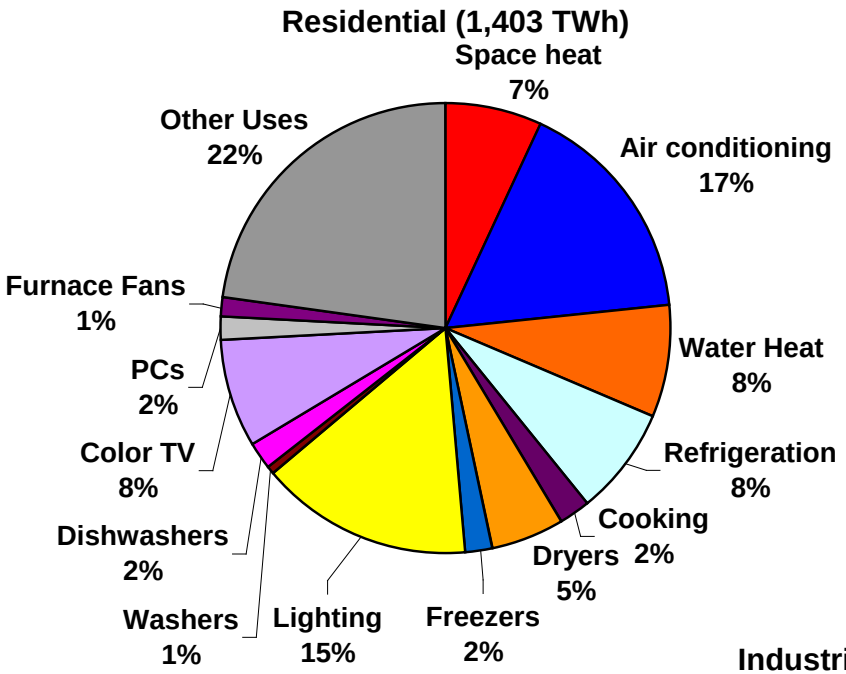
Lighting | Space heating | Space cooling | Ventilation | Refrigeration | Others...

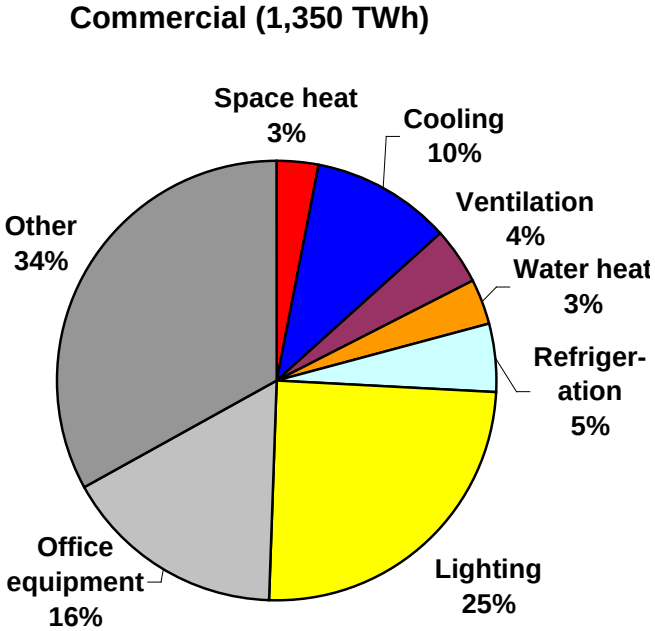
Technology

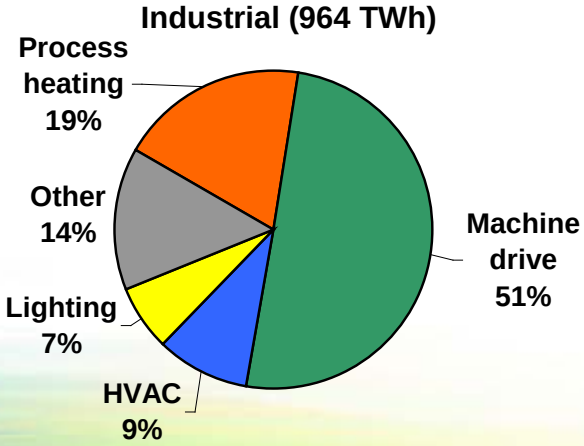
Heat pump | Central A/C | Chiller | Other

Up to 10 equipment efficiency options per technology

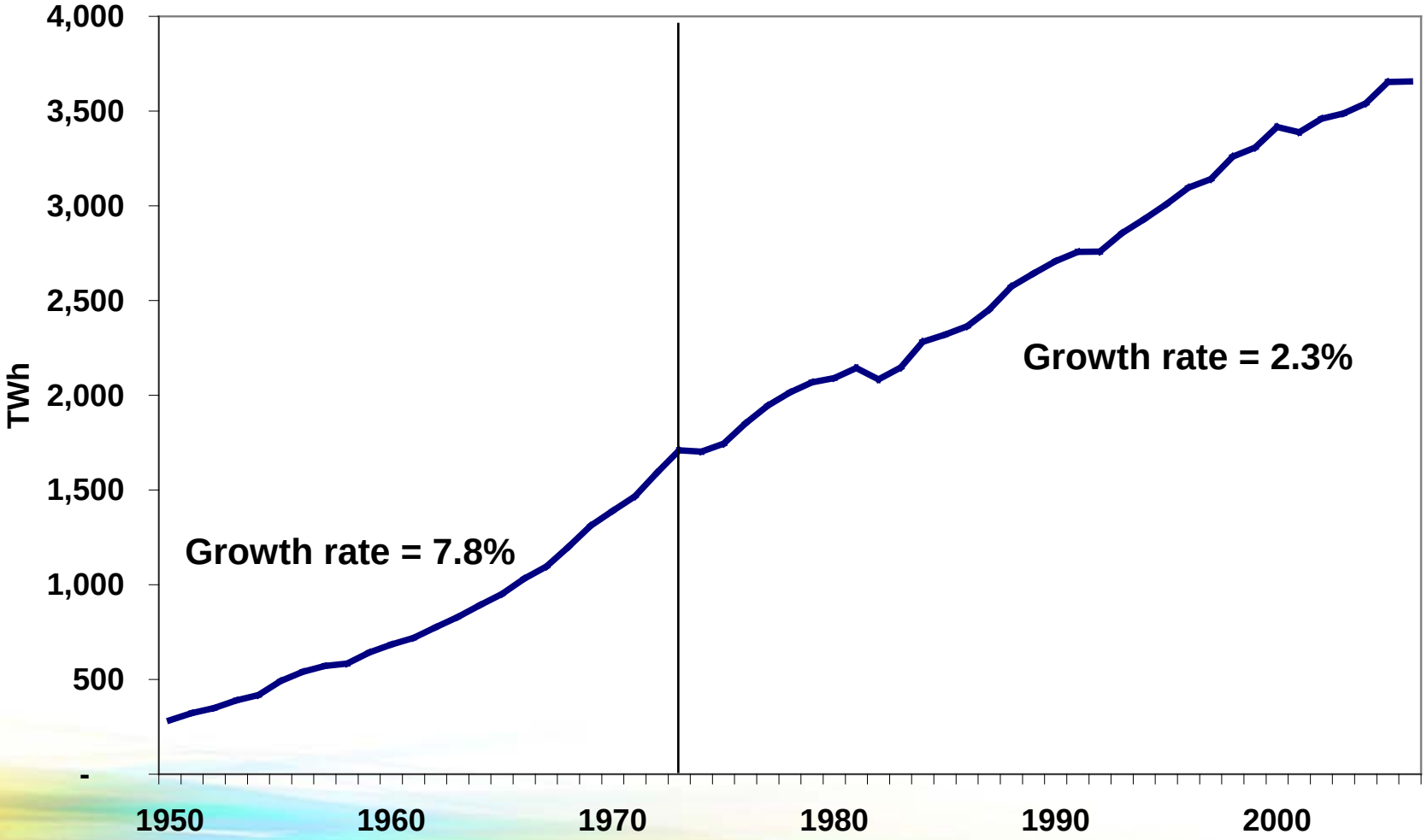
2008 Electricity use by sector and end use



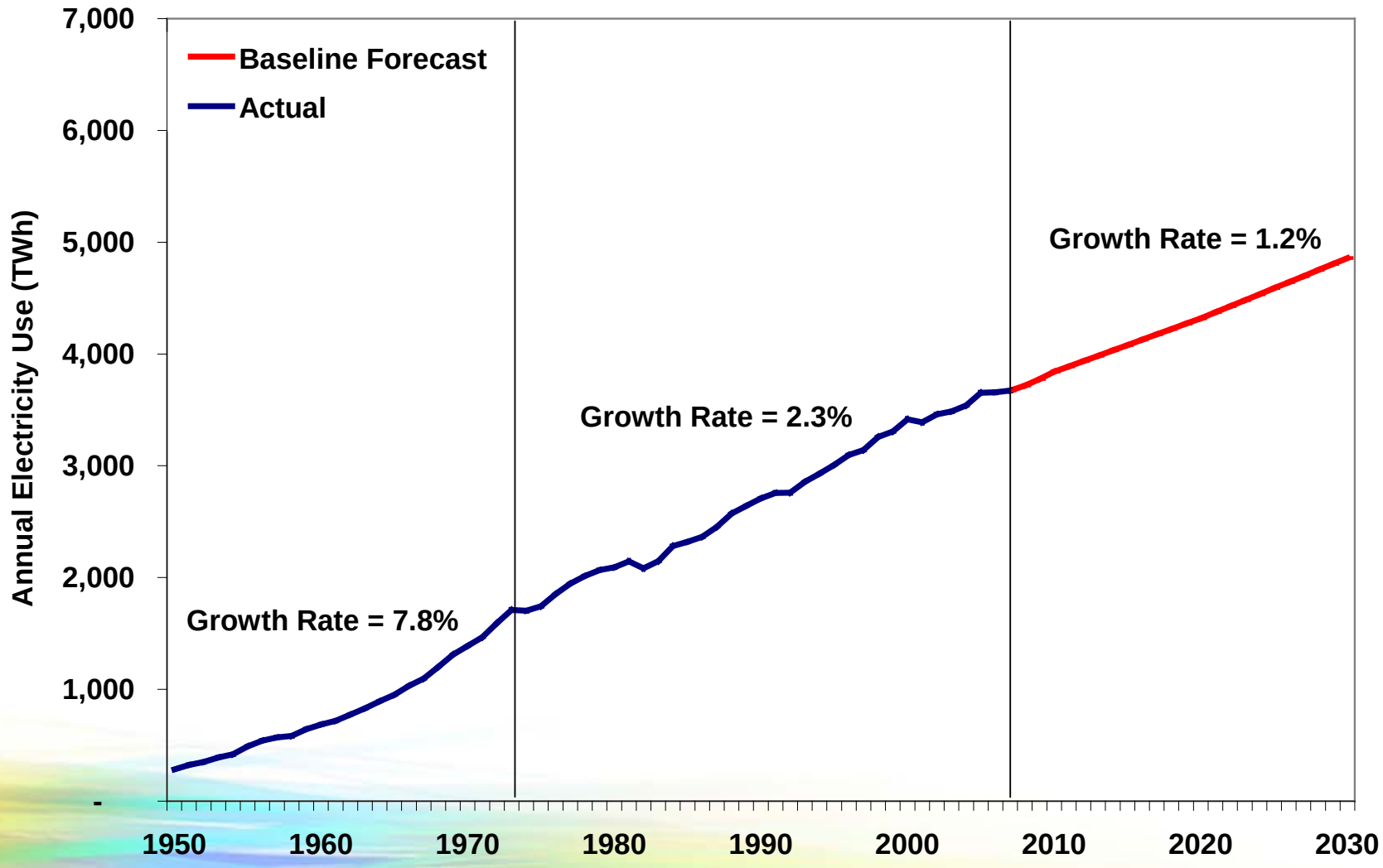




Context: Historical U.S. electricity use (Residential, commercial & industrial)



Historical use and the baseline forecast



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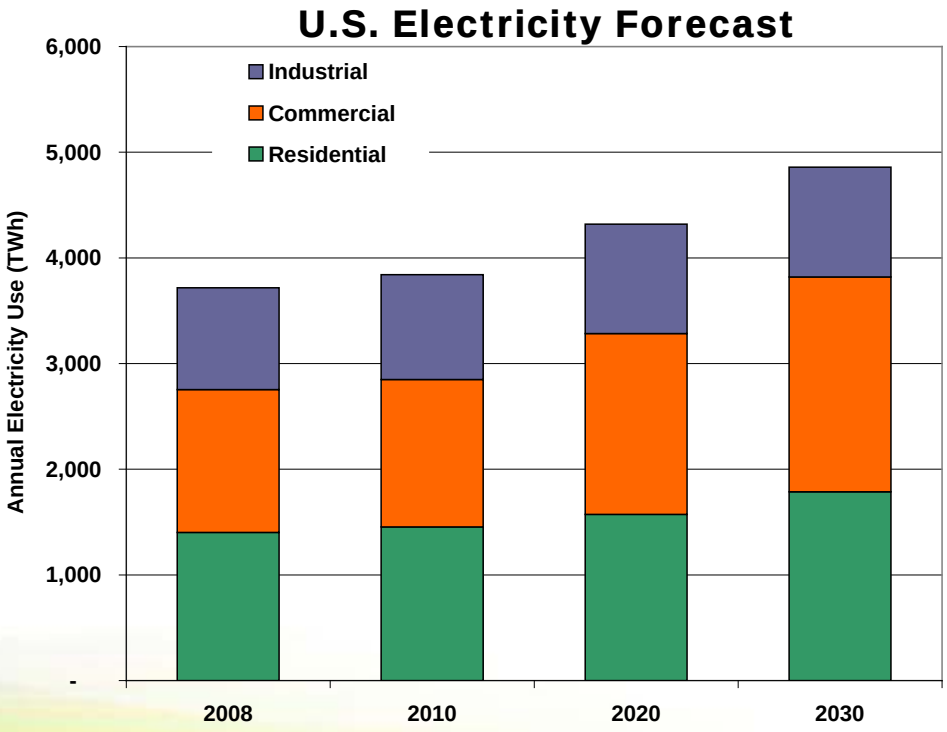
The business-as-usual forecast: 2008 Annual Energy Outlook

- According to the 2008 Annual Energy Outlook:
  - Electricity use will be **30%** higher than in 2008

- This is *after* savings from:
  - Price/market effects
  - Codes & standards
  - Impacts of past programs



Types of energy-efficiency potential

Increasing EE potential

- **Technical potential** – most efficient measures are adopted, regardless of cost
- **Economic potential** – only cost-effective measures are adopted by the utility's customers – we used participant test
- **Maximum achievable potential (MAP)** – reflects customer preferences, and budget constraints
- **Realistic achievable potential (RAP)** – reflects existing market, financial, political, and regulatory barriers to "perfect" program implementation

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Overview of energy-efficiency measures

- Residential
  - High-efficiency appliances, lighting, HVAC, water heating, and electronics
    - Includes hyper-efficient
  - Thermal shell measures
  - Maintenance and repair measures
  - Programmable thermostats
  - In-home displays
- Commercial
  - High-efficiency HVAC, refrigeration, IT
  - Economizers, EMS
  - High-efficiency lighting, occupancy sensors & daylighting
- Industrial
  - High-efficiency motors and drives
  - High-efficiency HVAC and lighting
  - Process heating

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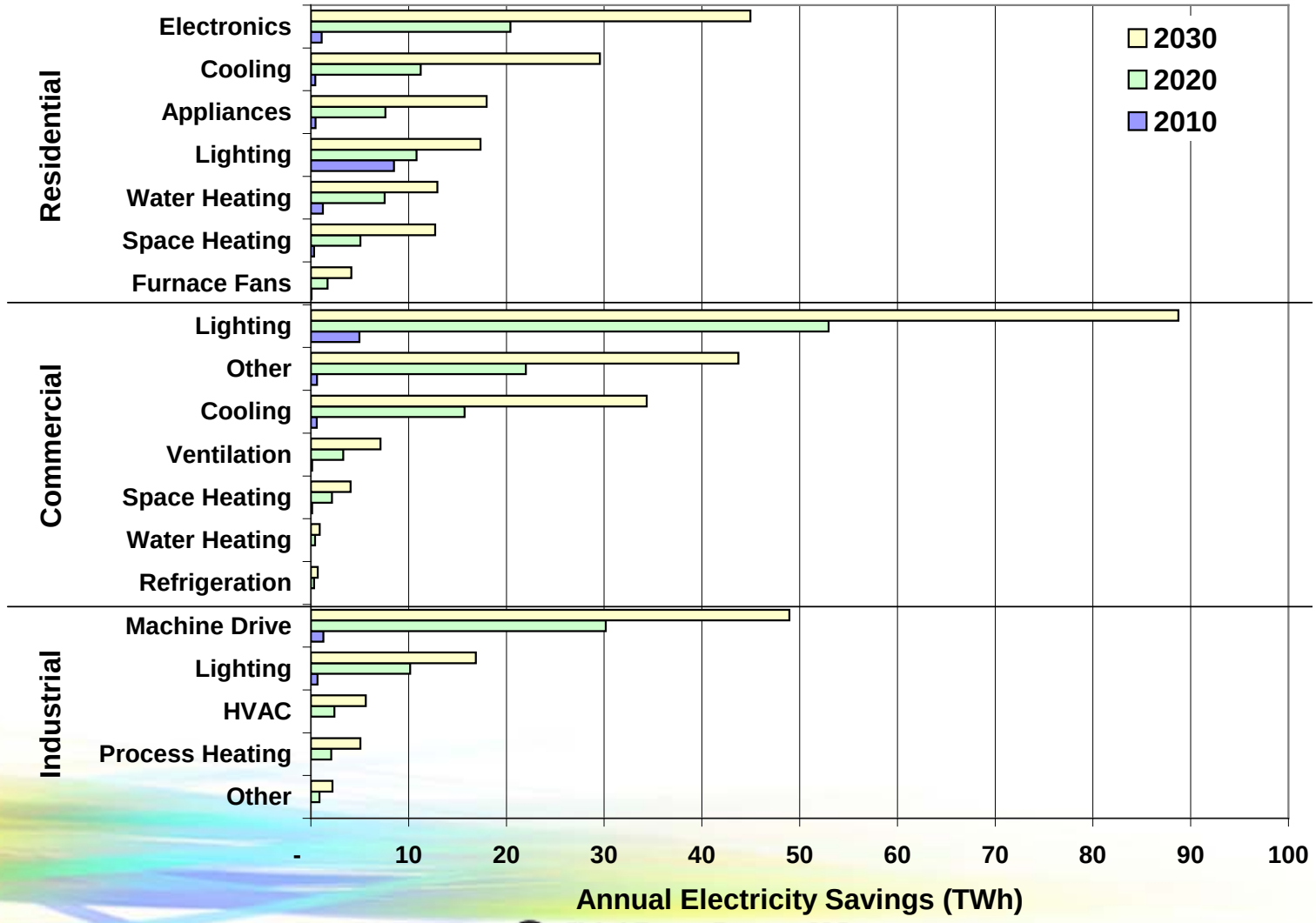
Top measures for U.S. Realistic achievable potential



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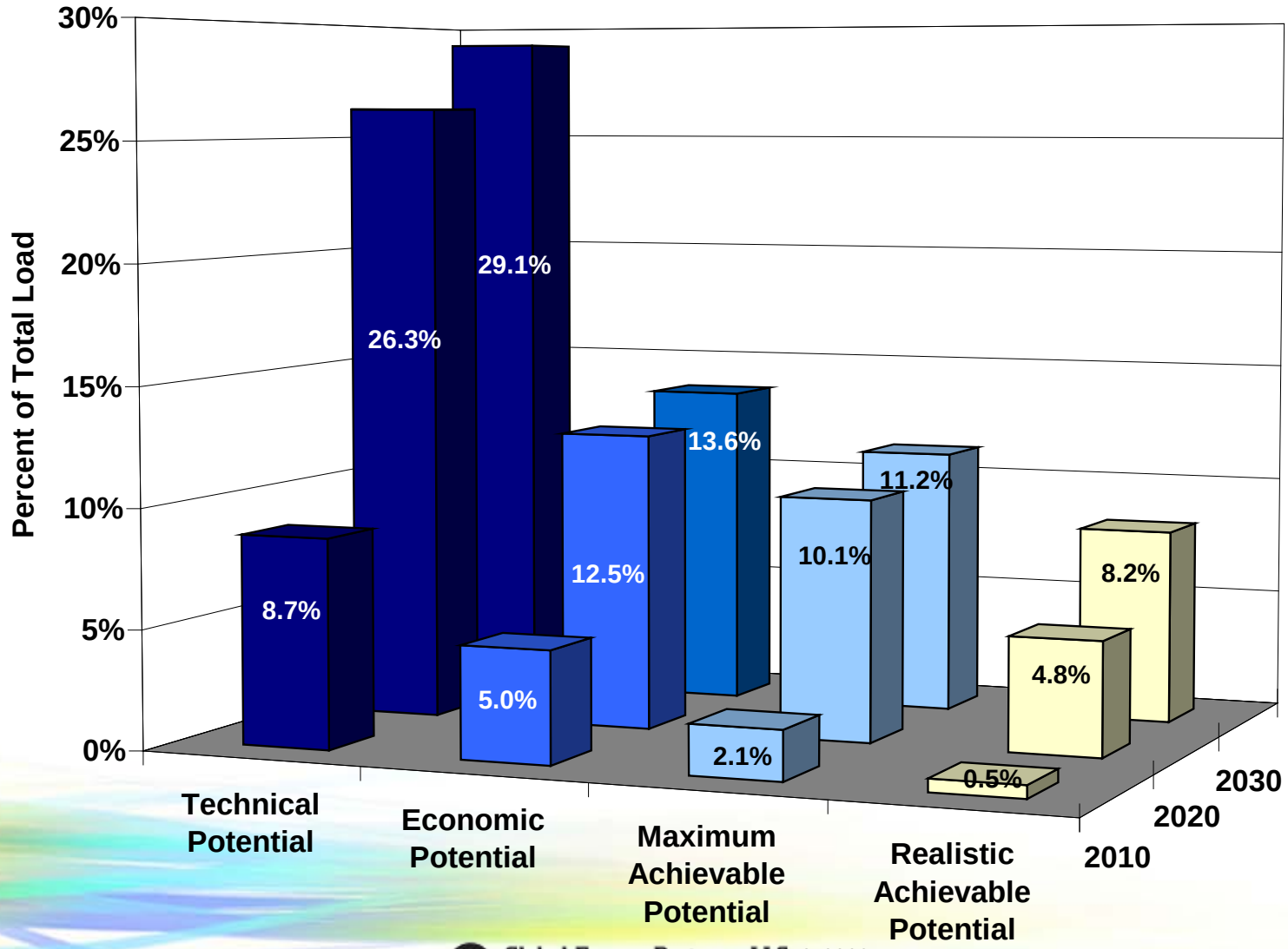
U.S. energy efficiency potential
Percent of total load



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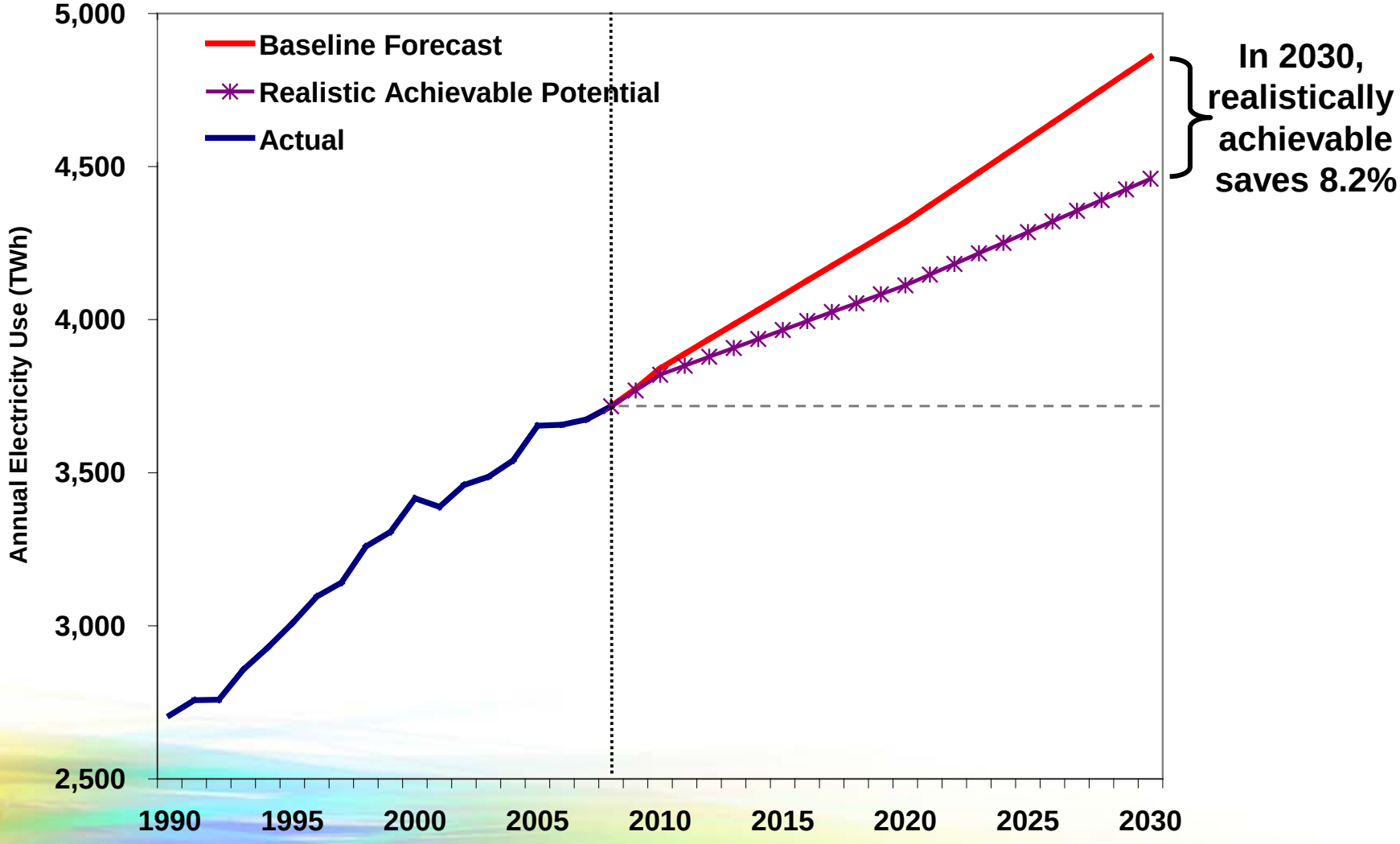
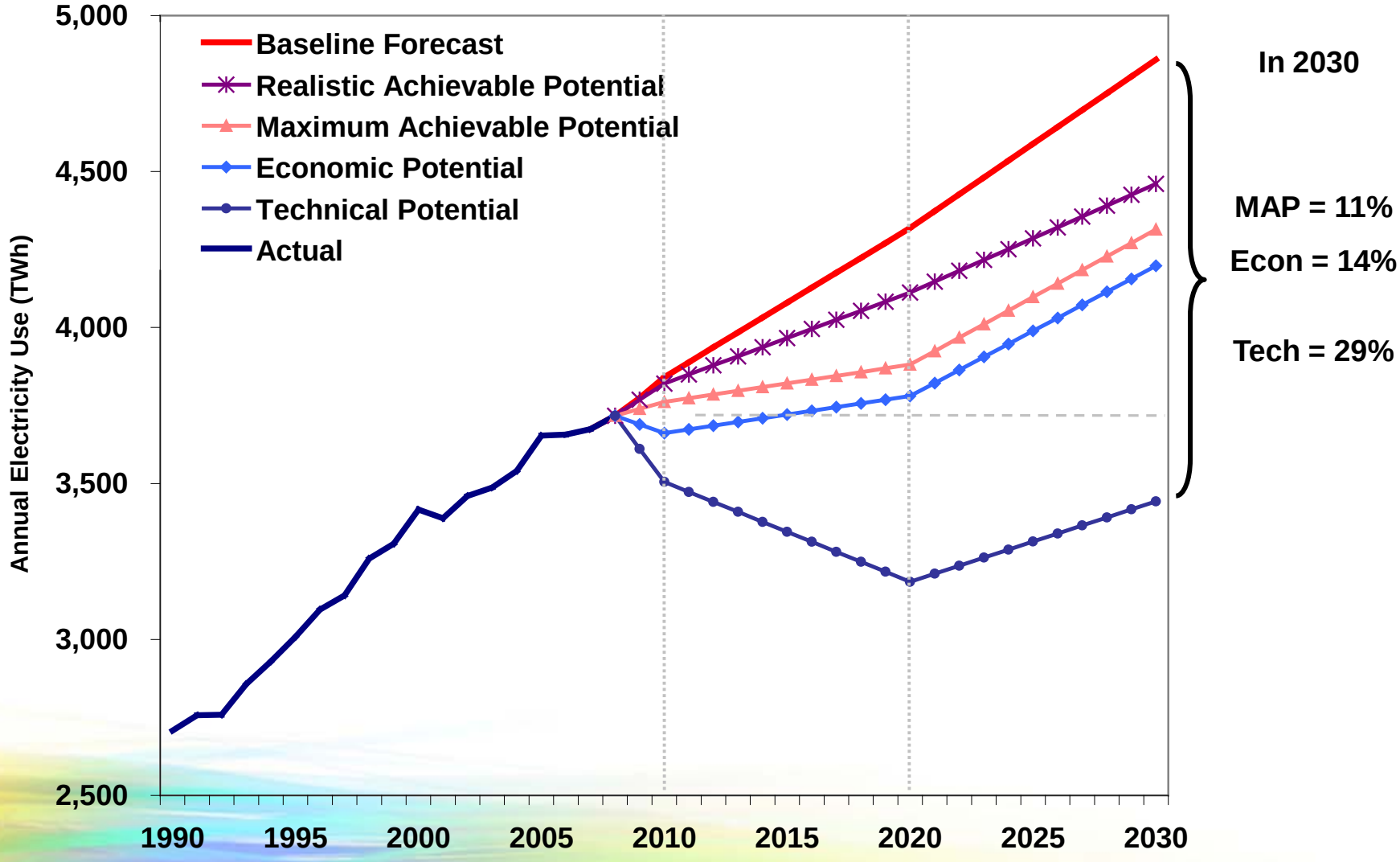
Realistically achievable potential



and economic and technical potential



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Summary of key findings from EPRI Study

- By 2030, the electric utility industry can *realistically* expect to offset 35% of the growth in electricity sales through energy-efficiency programs. This represents:
  - 400 TWh
  - 8.2% of total load in 2030
  - Reduction in growth rate from 1.2% to 0.8% per year
- Energy-efficiency programs also impact peak demand
  - 7.7% of peak demand in 2030

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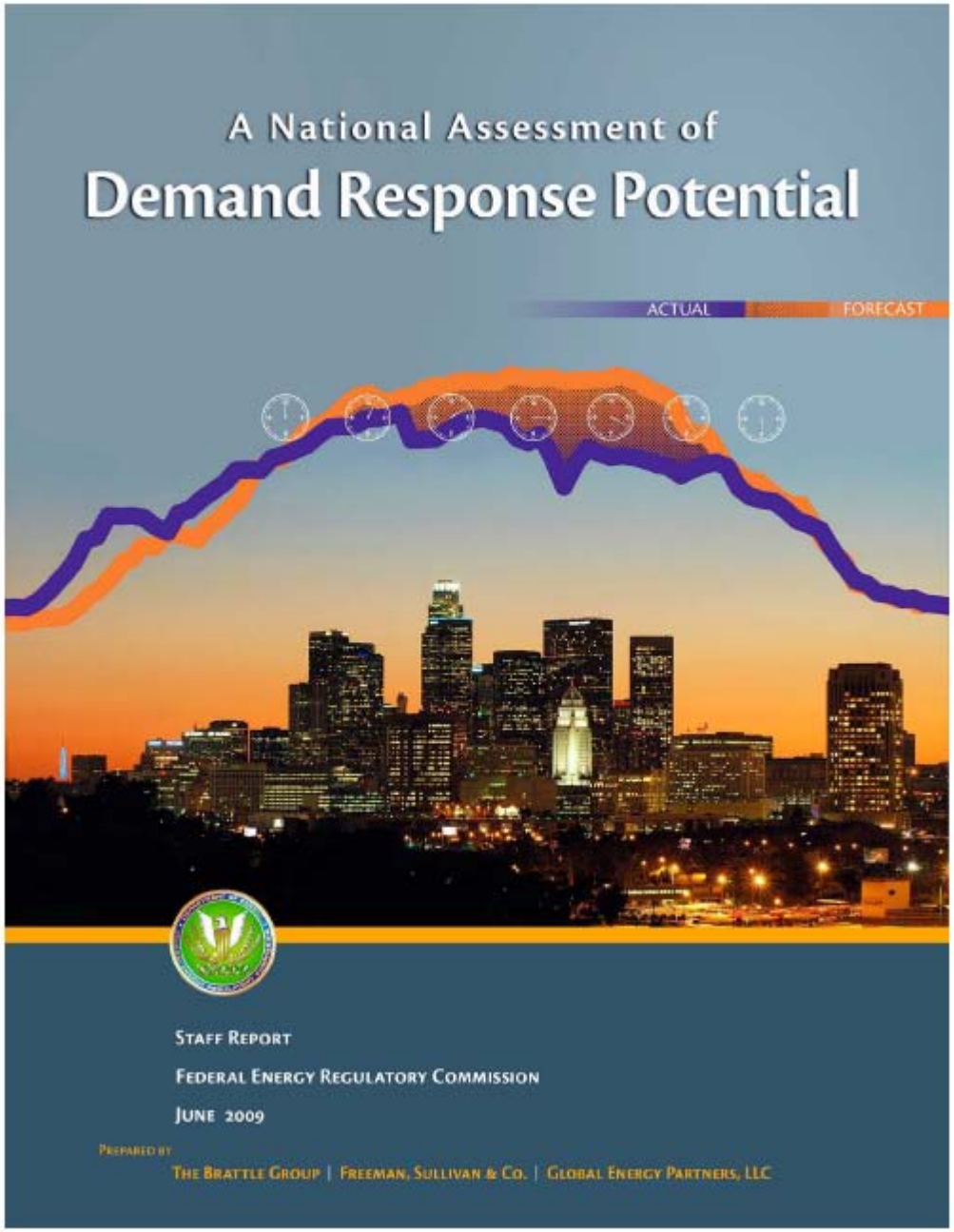
A National Assessment of
Demand Response Potential
ACTUAL
FORECAST
Staff Report
Federal Energy Regulatory Commission
June 2009
Prepared by
The Brattle Group | Freeman, Sullivan & Co. | Global Energy Partners, LLC

Objectives

Section 529 (a) of the Energy Independence and Security Act of 20071 requires the Federal Energy Regulatory Commission to conduct a National Assessment of Demand Response Potential and report to Congress on the following:

- Estimation of nationwide demand response potential in 5 and 10 year horizons on a State-by-State basis, including a methodology for updates on an annual basis;
- Estimation of how much of the potential can be achieved within those time horizons, accompanied by specific policy recommendations, including options for funding and/or incentives for the development of demand response;
- Identification of barriers to demand response programs offering flexible, non-discriminatory, and fairly compensatory terms for the services and benefits made available; and
- Recommendations for overcoming any barriers.

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Demand response programs

- Dynamic pricing without enabling technology
- Dynamic pricing with enabling technology
- Direct load control (DLC)
- Interruptible tariffs
- Other DR
  - Demand bidding, capacity bidding, aggregator offerings
  - Available primarily to medium and large C&I

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Four scenarios are analyzed

- Business-as-usual (BAU)
  - Existing and planned DR stays constant
- Expanded business-as-usual (EBAU)
  - Current mix of DR programs expands to all states and achieves "best practices" levels of participation
  - Modest amount of DR from pricing programs and AMI deployment
- Achievable potential (AP)
  - AMI is universally deployed
  - Dynamic pricing is default tariff
    - Other programs are available to those who don't enroll
  - Options available to everyone
- Full participation
  - All cost-effective DR is pursued

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Comparison of the four scenarios

Table 1: Key Differences in Scenario Assumptions

Assumption	Business-as-Usual	Expanded BAU	Achievable Participation	Full Participation
AMI deployment	Partial Deployment	Partial deployment	Full deployment	Full deployment
Dynamic pricing participation (of eligible)	Today's level	Voluntary (opt-in); 5%	Default (opt-out); 60% to 75%	Universal (mandatory); 100%
Eligible customers offered enabling tech	None	None	95%	100%
Eligible customers accepting enabling tech	None	None	60%	100%
Basis for non-pricing participation rate	Today's level	"Best practices" estimate	"Best practices" estimate	"Best practices" estimate

Results

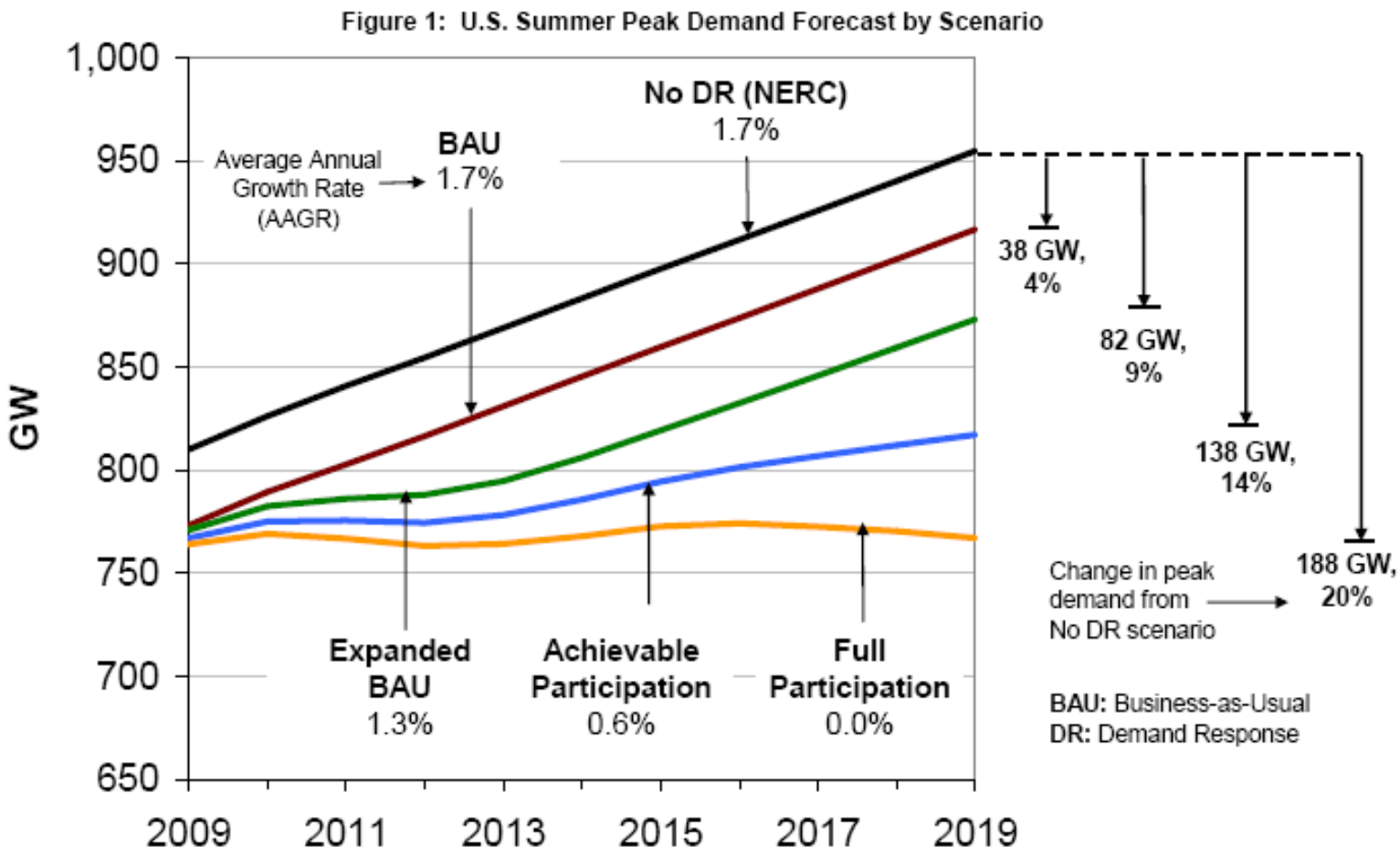
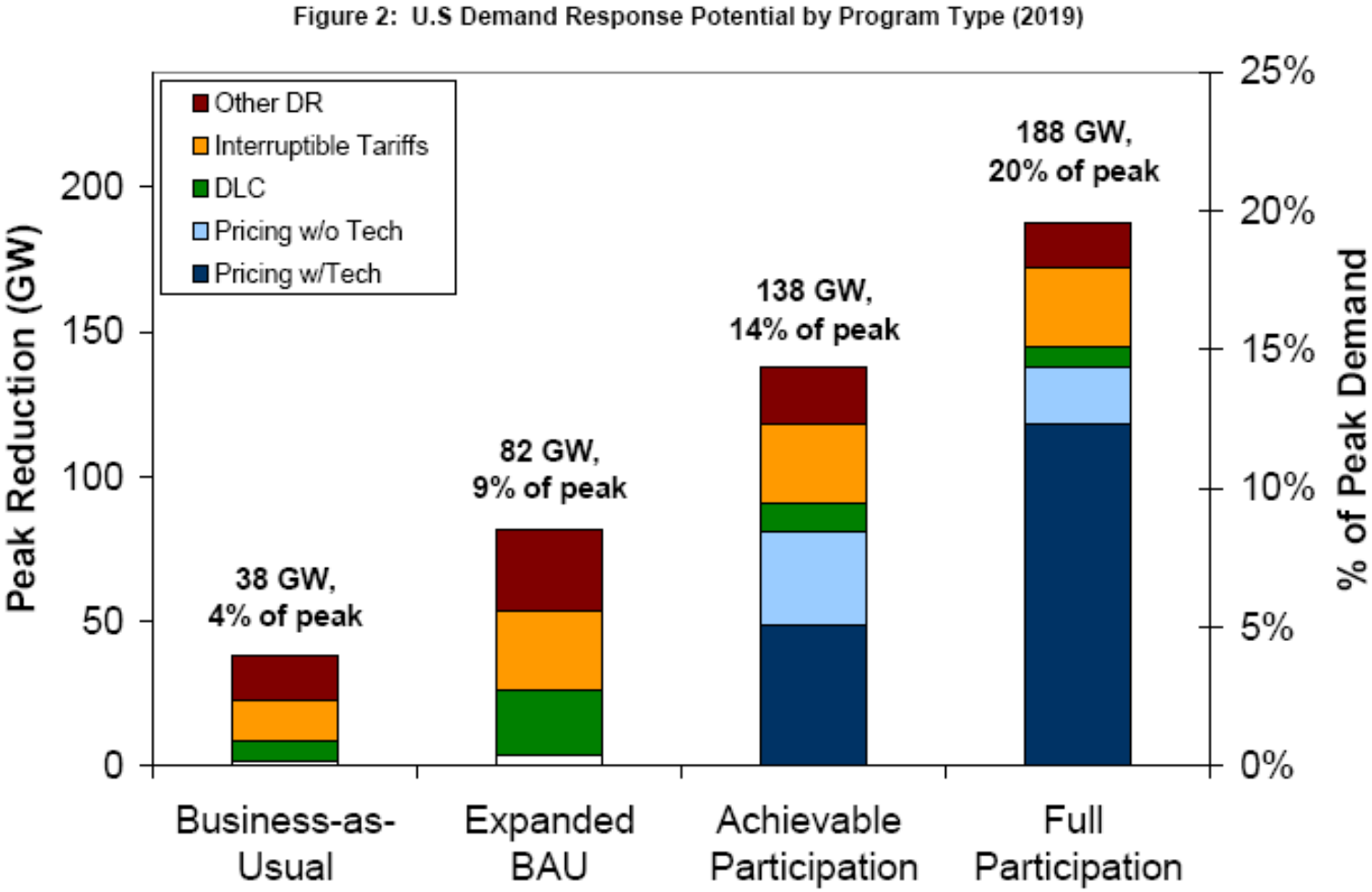


Figure 1: U.S. Summer Peak Demand Forecast by Scenario
GW
1,000
950
900
850
800
750
700
650
2009
2011
2013
2015
2017
2019
No DR (NERC)
1.7%
BAU
1.7%
Average Annual Growth Rate (AAGR)
Expanded BAU
1.3%
Achievable Participation
0.6%
Full Participation
0.0%
38 GW, 4%
82 GW, 9%
138 GW, 14%
188 GW, 20%
Change in peak demand from No DR scenario
BAU: Business-as-Usual
DR: Demand Response

DR potential in 2019 by type



Top 10 states (savings in GW)

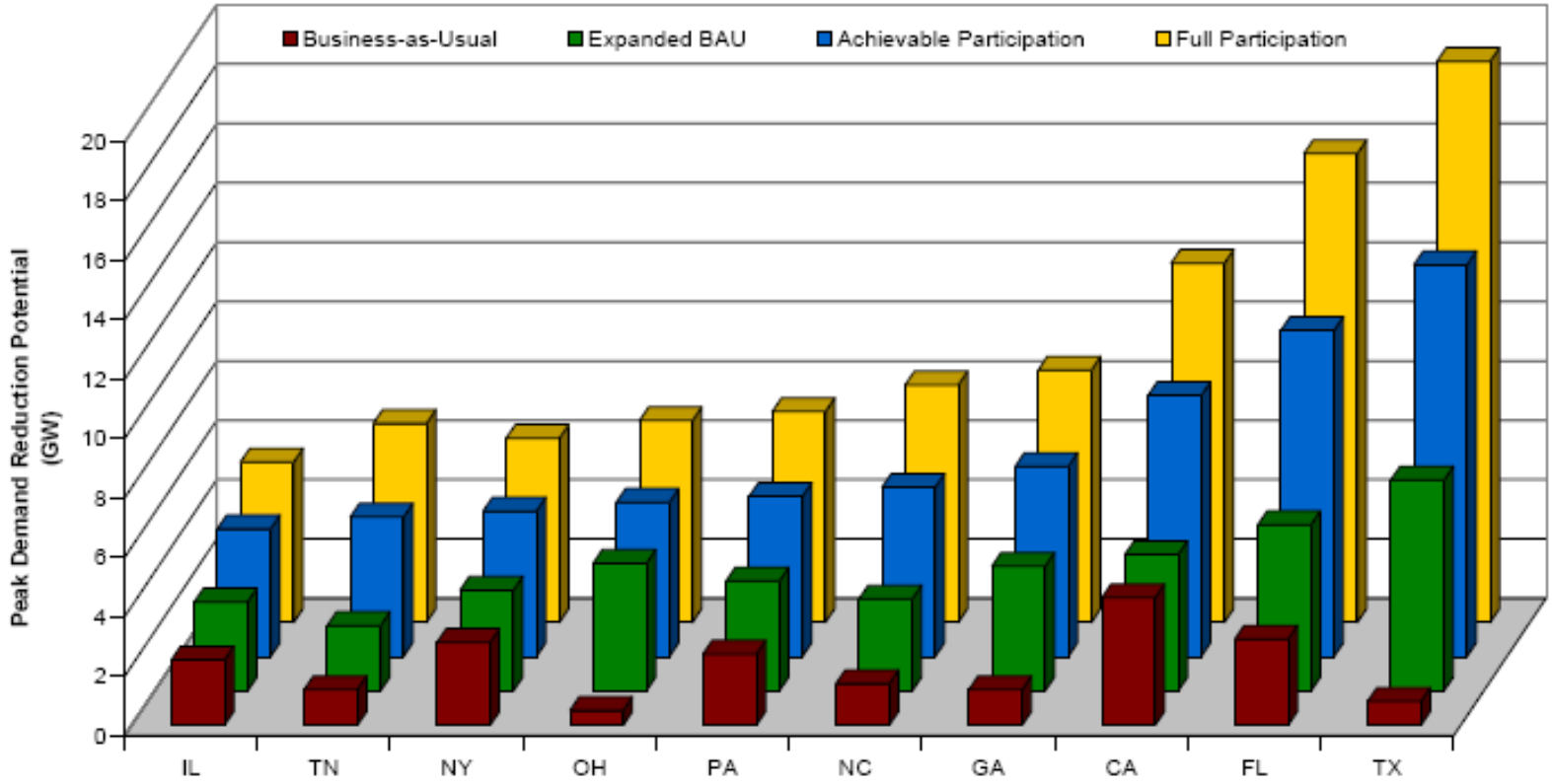


Figure 16: Top Ten States by Achievable Potential in 2019 (GW)

Top 10 States (savings as a % of peak)

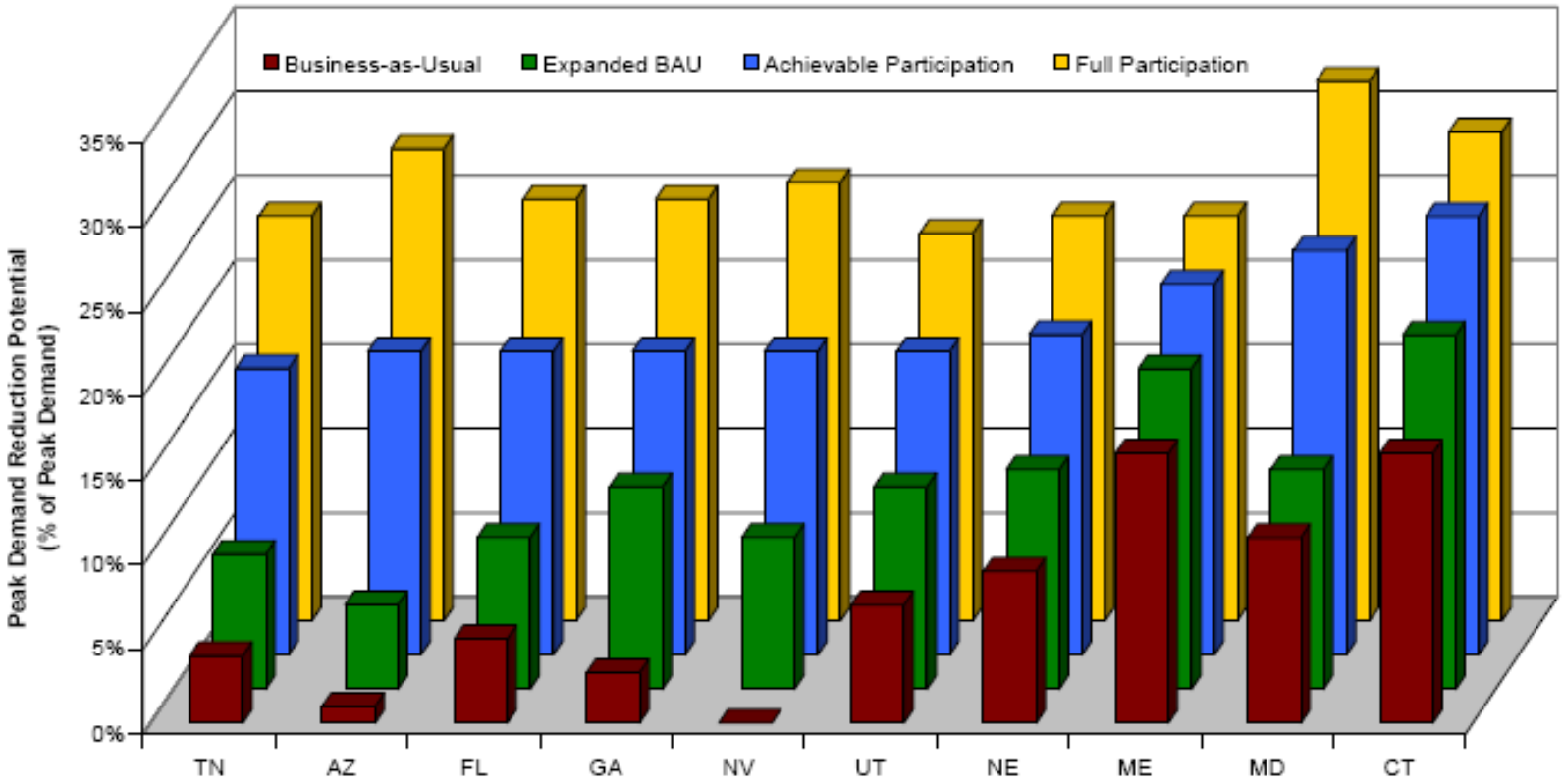
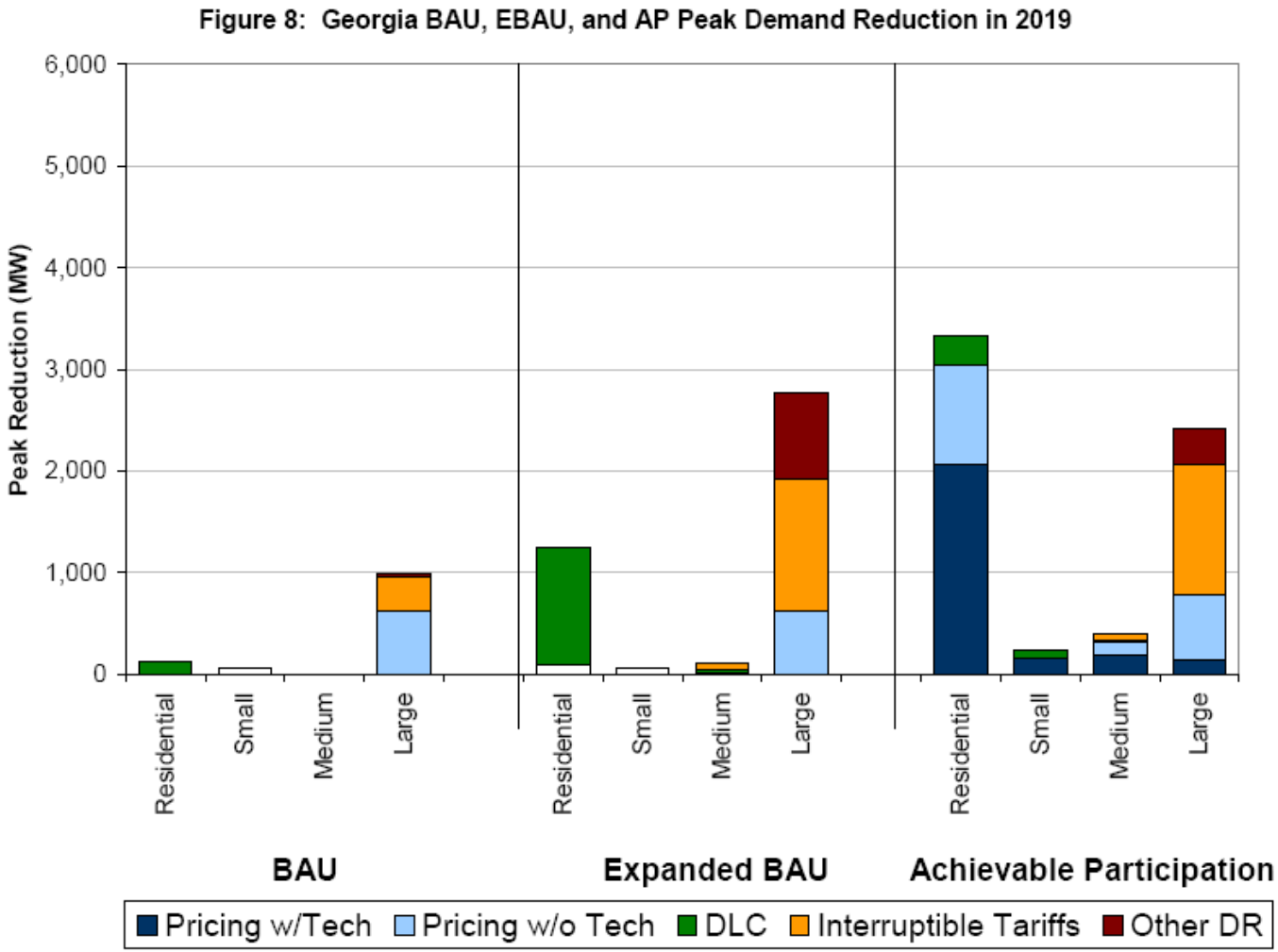


Figure 17: Top Ten States by Achievable Potential in 2019 (% of Peak Demand)

Case Study: Georgia



Key drivers of DR achievable potential

- Saturation of central air conditioning
  - Higher AC leads to higher DR
- Cost effectiveness
- Customer mix
  - More residential and large C&I customers leads to higher DR
- Regional price elasticity
  - Customers west of the Rockies are more price responsive
- Rate of AMI deployment

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Implications for load researchers

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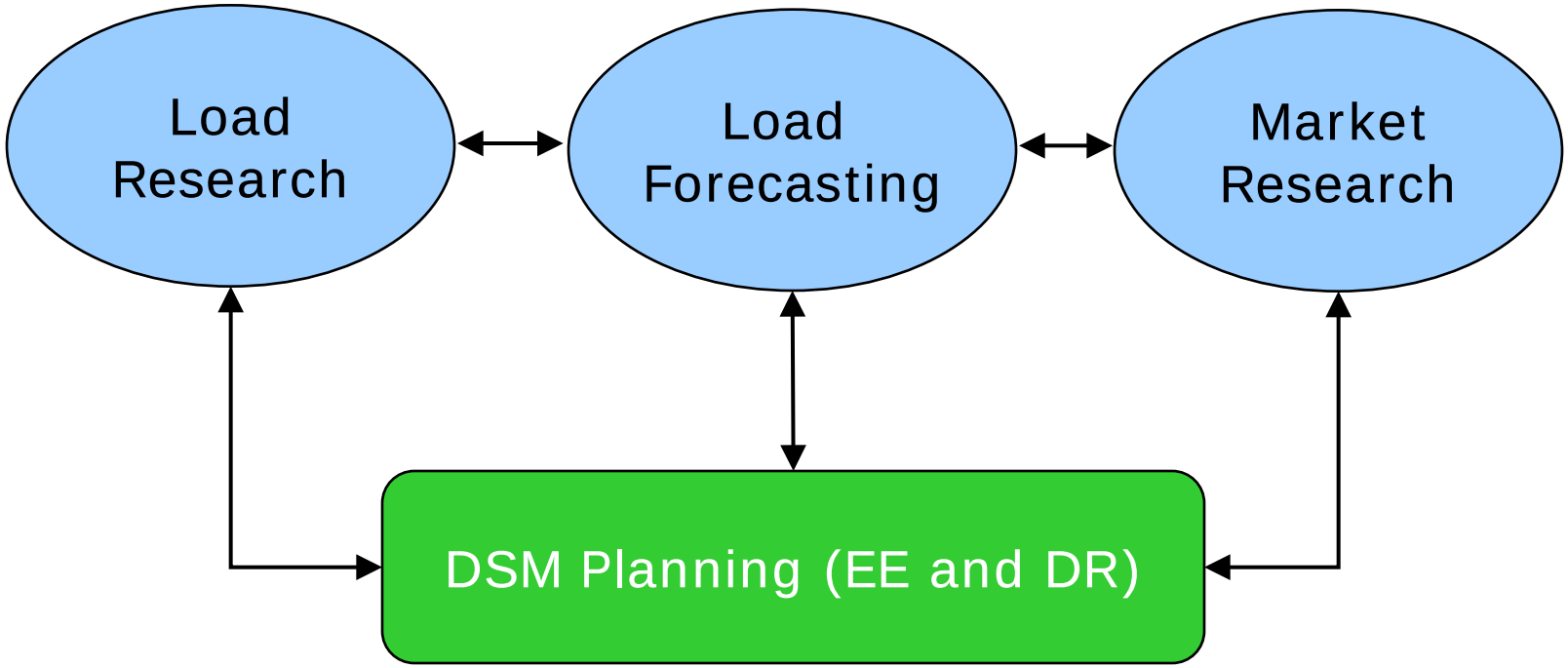
Load researchers are on the "planning" team…



…but the extent of involvement varies

Recap of data needs for EE and DR studies

- How customers use energy today
  - Number of customers, annual use and peak demand
  - By sector, rate class, segment and end use
- Business-as-usual forecasts of annual use and peak
- Identify and characterize/quantify key forecast drivers
  - Customer growth
  - Trends in equipment/technology, construction
  - Appliance/equipment standards and building codes
  - Policies and initiatives (ARRA, Waxman-Markey, etc.)
  - Customer behavior and response
  - Load impacts

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The challenge for load researchers

1. Need to do your primary job(s)
2. Opportunity (or requirement) to get involved in broader analysis tasks
   a. IRP process
   b. EE potential and planning
   c. DR potential and planning
3. You have tremendous knowledge and data to contribute to the process

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Questions?

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