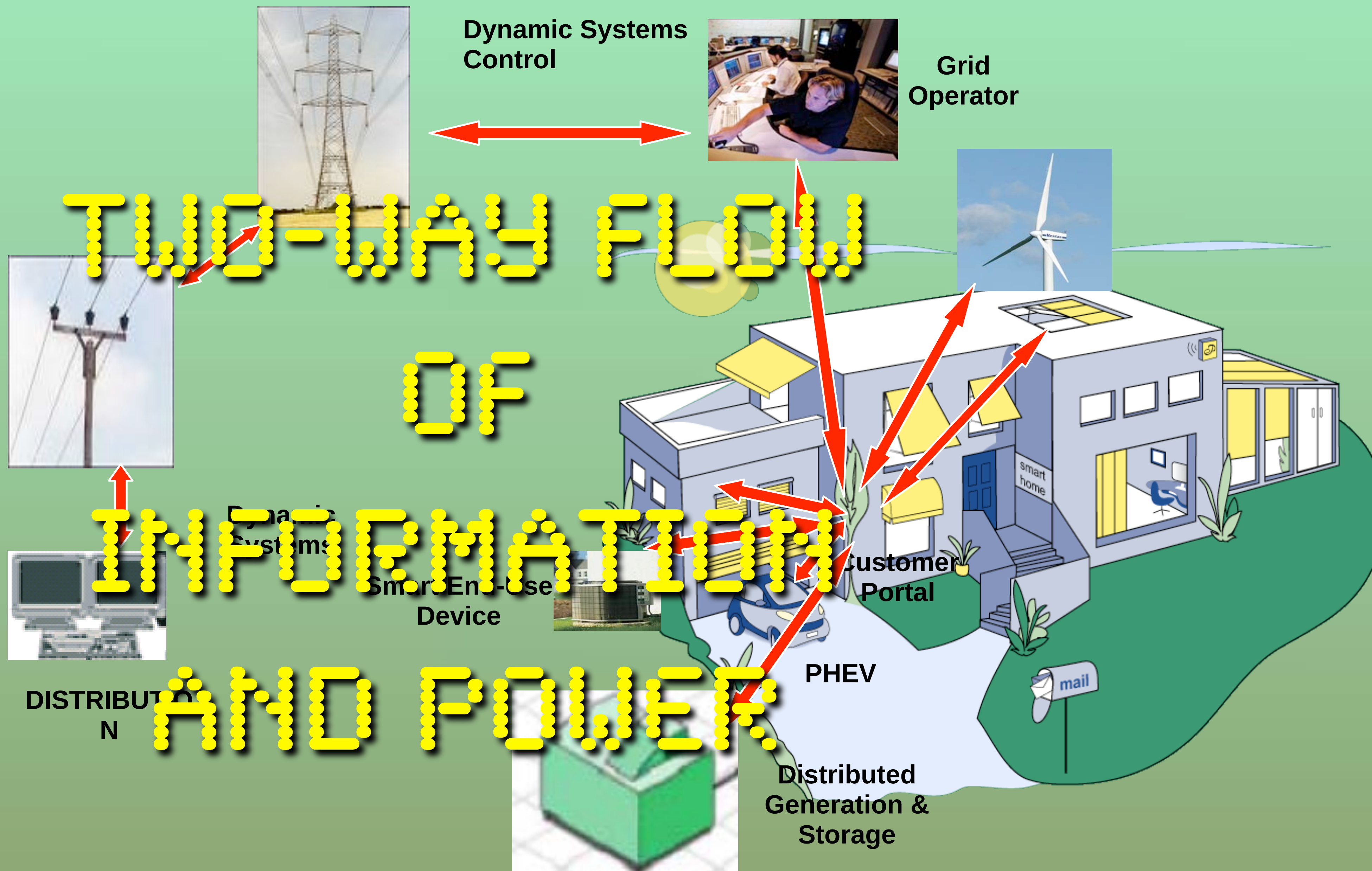
Energy Efficiency Summit 2008

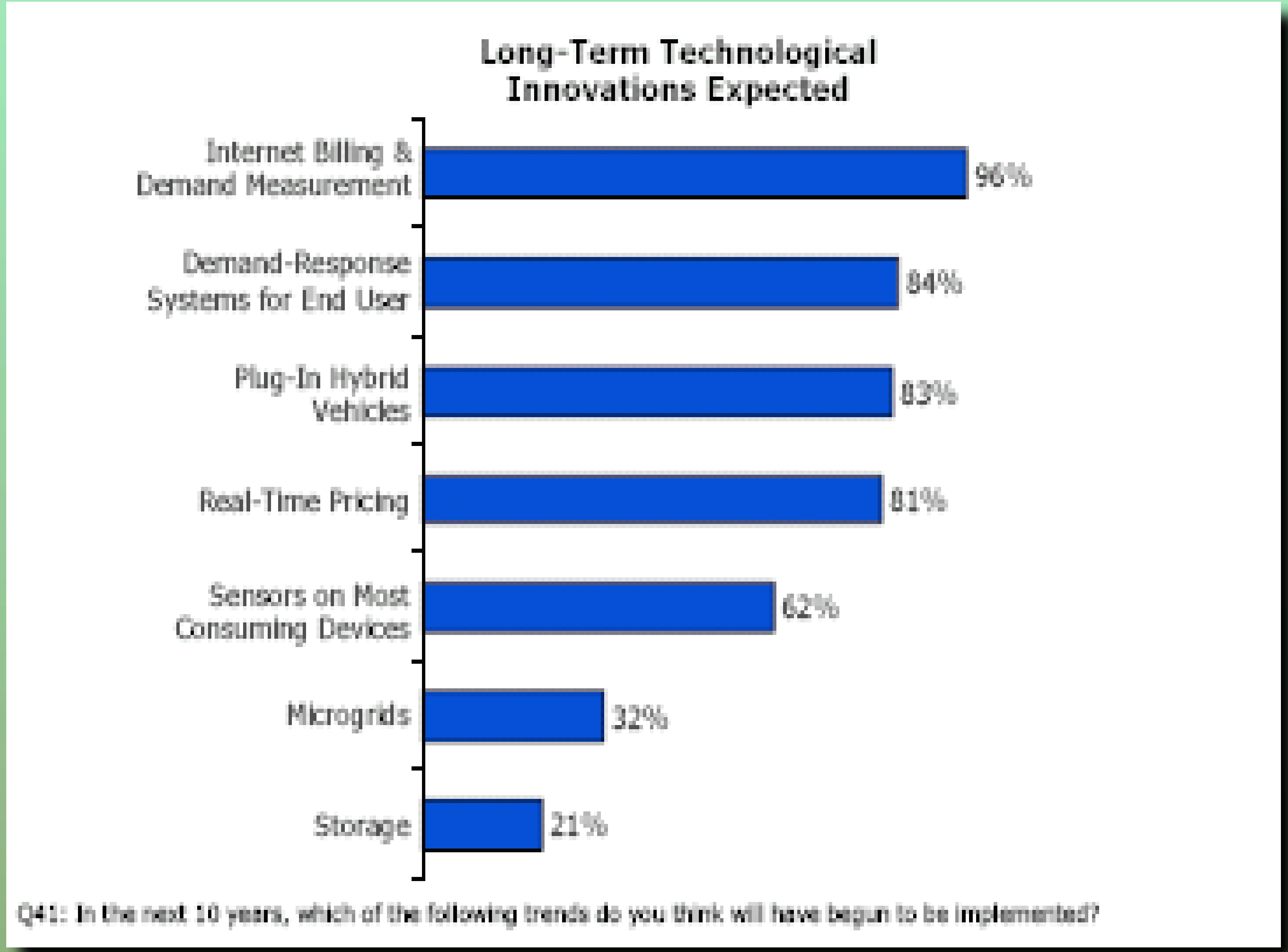
The Role of Energy Innovation in Furthering EE & DR or "Smart Power"

Jon Wellinghoff/Commissioner
Federal Energy Regulatory Commission
email:jon.wellinghoff@ferc.gov
Phone:(202) 502-6580
February 26, 2008

21st Century Smart Power Grid



10 Year Smart Power Outlook



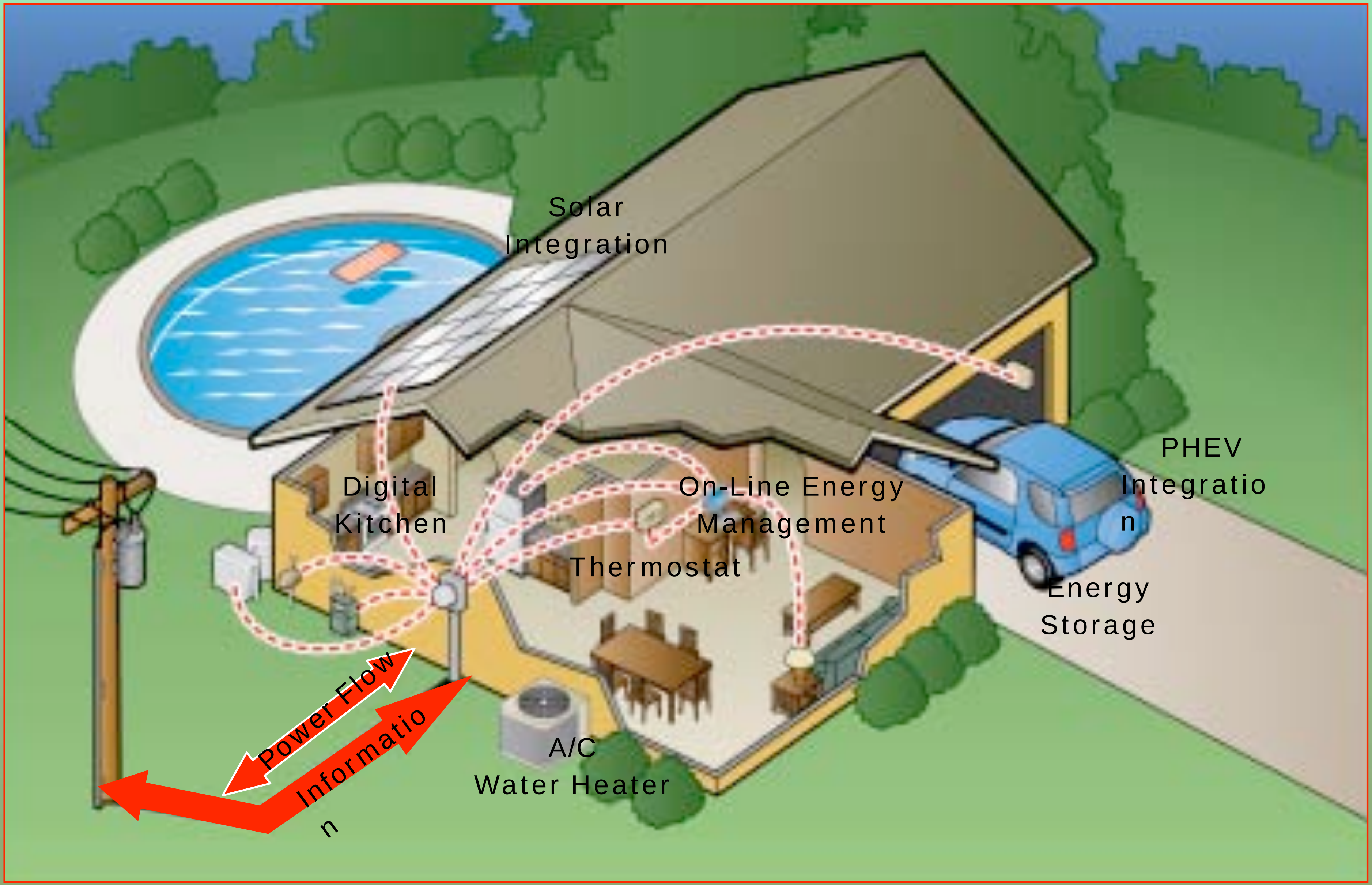
The Smart Power Grid

20th Century Grid	21st Century Smart Grid
Electromechanical	Digital
One-way communications (if any)	Two-way communication
Built for centralized generation	Accommodates distributed generation
Radial topology	Network topology
Few sensors	Monitors and sensors throughout
“Blind”	Self-monitoring
Manual restoration	Semi-Automated restoration and, eventually, self-healing
Prone to failures and blackouts	Adaptive protection and islanding
Check equipment manually	Monitor equipment remotely
Emergency decisions by committee and phone	Decision support systems, predictive reliability
Limited control over power flows	Pervasive control systems
Limited price information	Full price information
Few customer choices	Many customer choices

7 Key Qualities of Smart Power Grid

- **Self-healing.** Grid Rapidly Detect, Analyze, Respond and Restore.
- **Empower and Incorporate the Consumer.** Ability to Incorporate Consumer Equipment and Behavior in Grid Design and Operation.
- **Tolerant of Attack.** Grid Mitigates and Resilient to Physical and Cyber Attacks.
- **Provides Power Quality Needed by 21st Century Users.** Grid Provides Quality Power Consistent with Consumer and Industry Needs.
- **Accommodates Wide Variety of Supply and Demand.** Grid Accommodates Variety of Resources (Including DR, CHP, Wind, PV).
- **Fully Enables Maturing Electricity Markets.** Allows for and is Supported by Competitive Markets.

Smart Power Systems Integration at Consumer Level



What Makes Meter "Smart" or "Advanced"

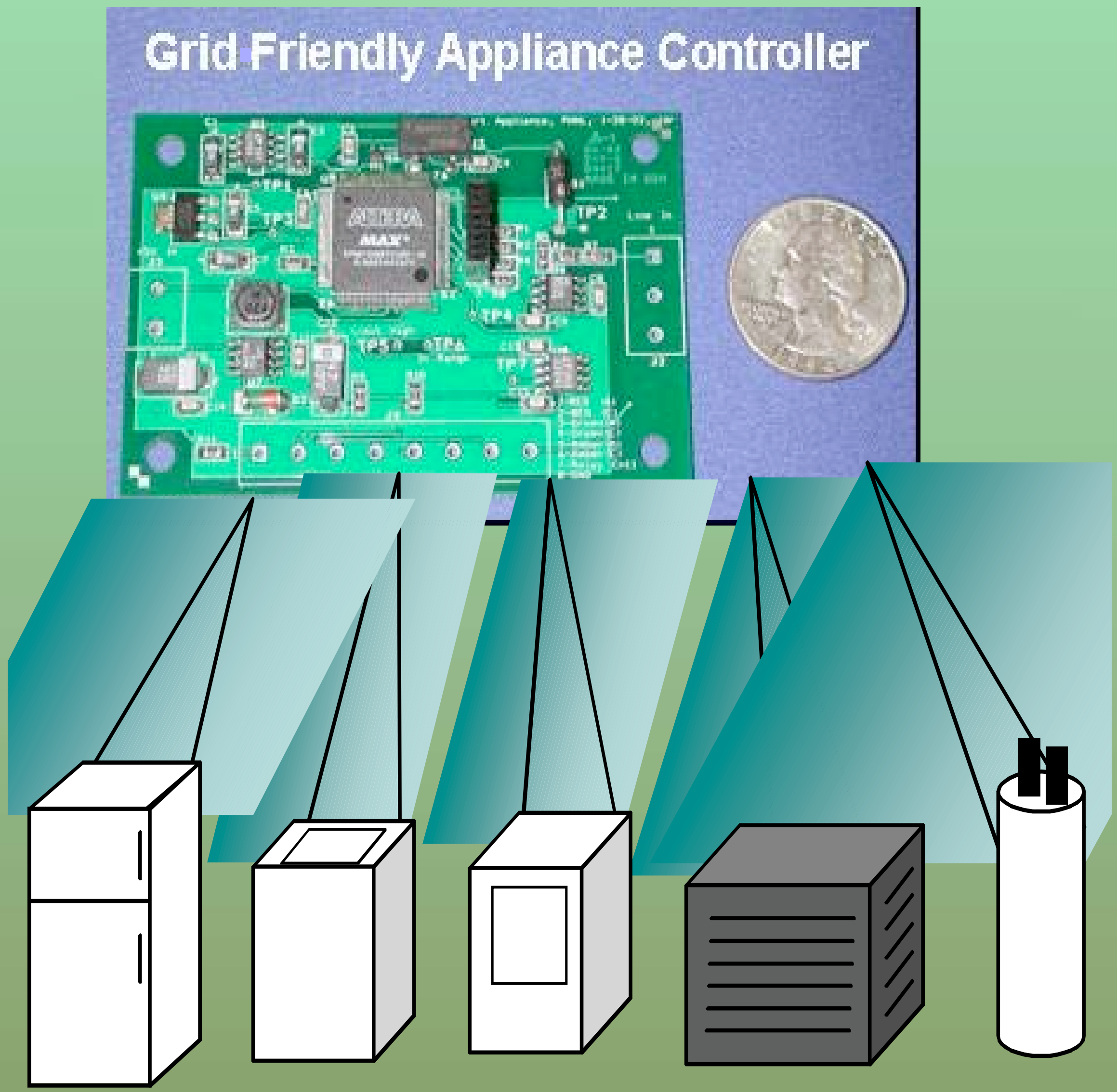
The Three Functions Make a Meter Smart Are:

- **The Ability to Take Interval Measurements, Measuring Both What Was Consumed and When.**
- **Automatic Transmission of the Resulting Data, Eliminating the Need for Manual Reading.**
- **Two-way Communications: Ability to Both "Listen" and "Talk".**

Two Functions Add Value for Smart Power:

- **Interfaces with HAN for Real-Time Data to Consumer**
- **Remote Connect and Disconnect**

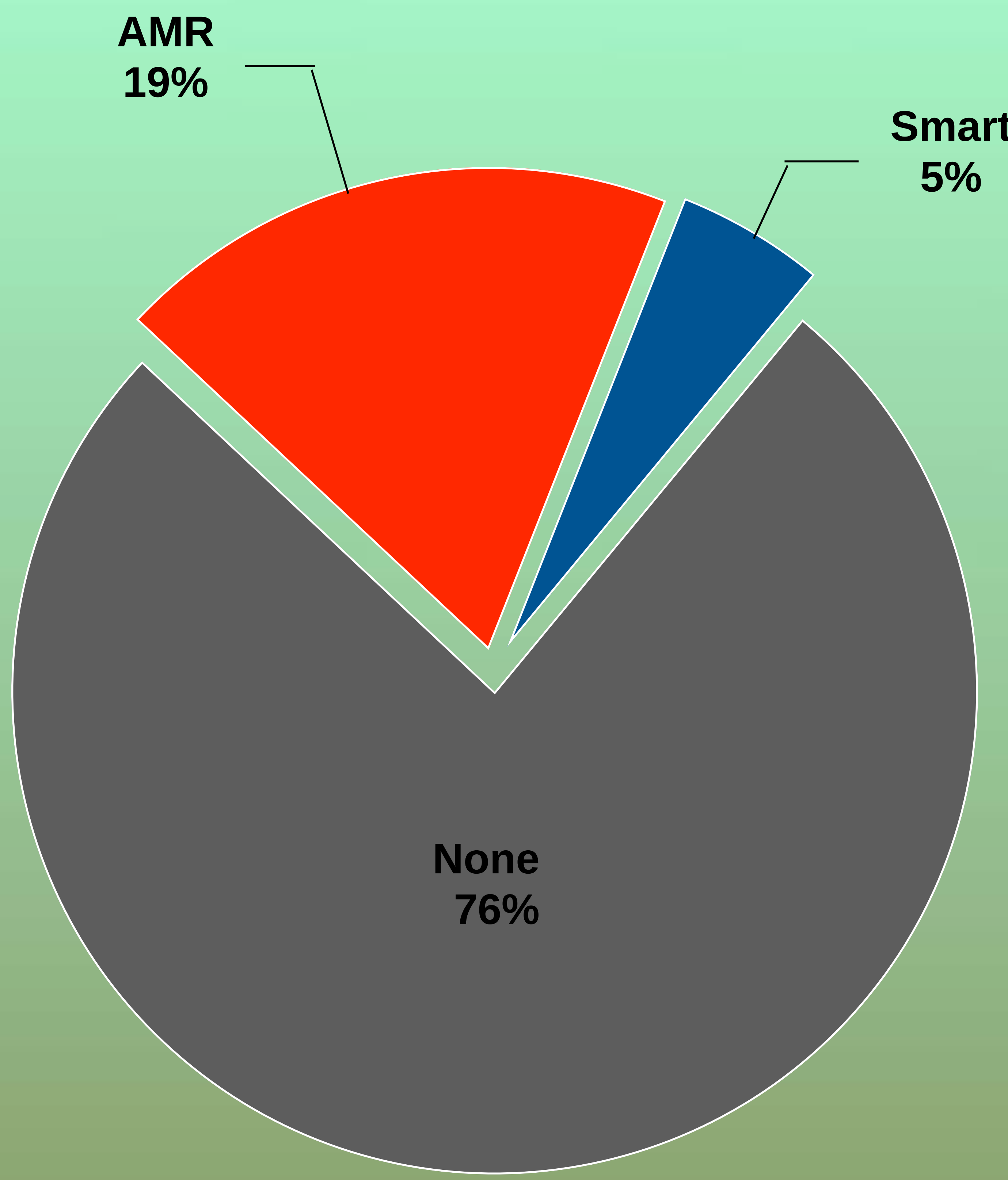
Smart Power at Residential Customer Level



Grid Friendly Appliances sense grid frequency excursions & control region's appliances to act as spinning reserve – No communications required!

Smart Power at Commercial Customer Level

Smart Meter Installations



135 million

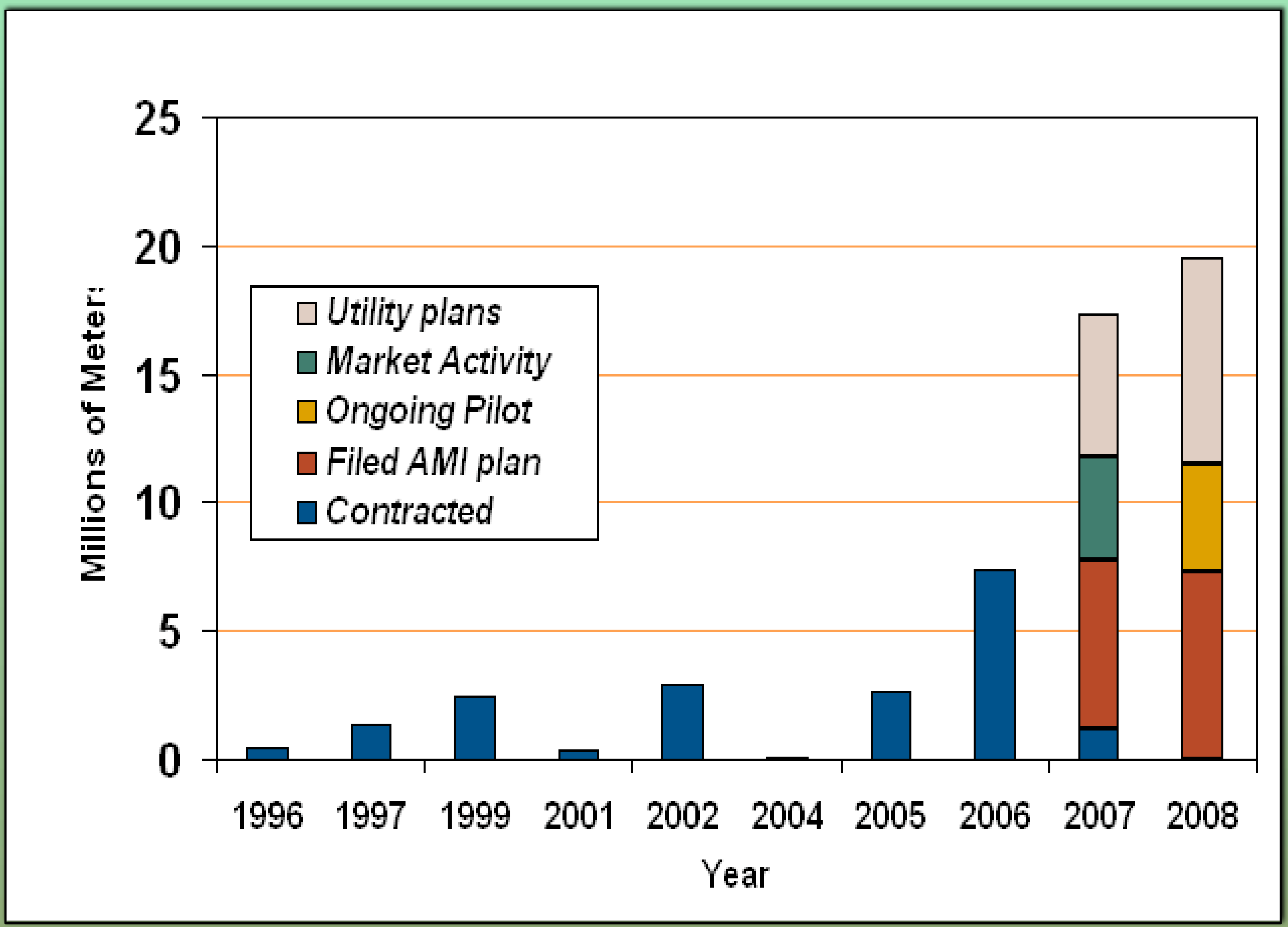
Electric

Specific Utility Cost Data

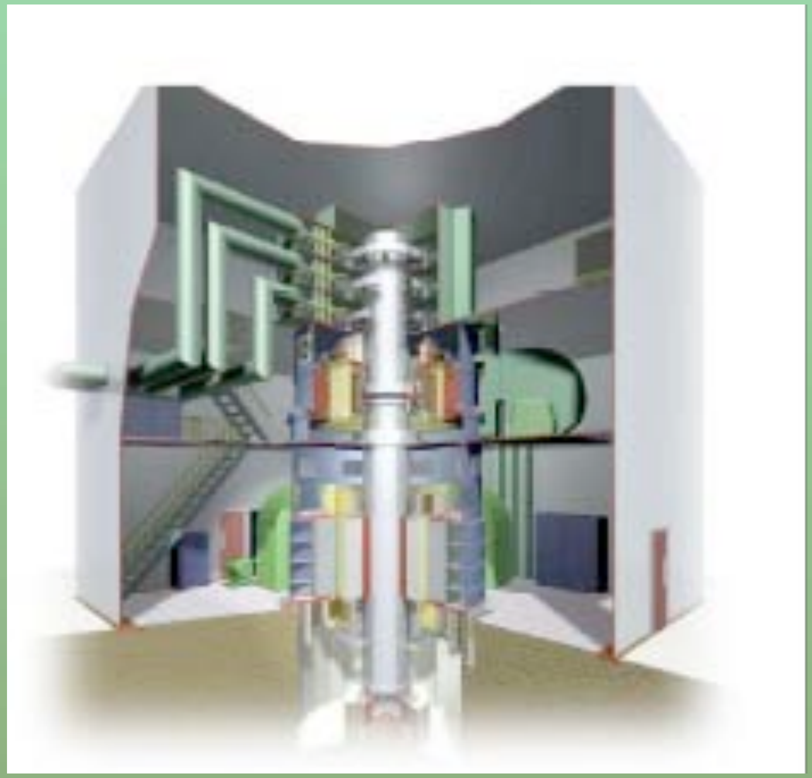
(Source: KEMA)

Utility	Projected AMI Project Cost (total)
Con Edison	$892 million
Baltimore Gas & Electric	$400 million
CenterPoint	$1.8 billion
Southern Company	$280 million
Pepco	$128 million
San Diego Gas & Electric	$574 million
Pacific Gas & Electric	$1.7 billion
Southern California Edison	$1.3 billion
Portland General Electric	$130 million

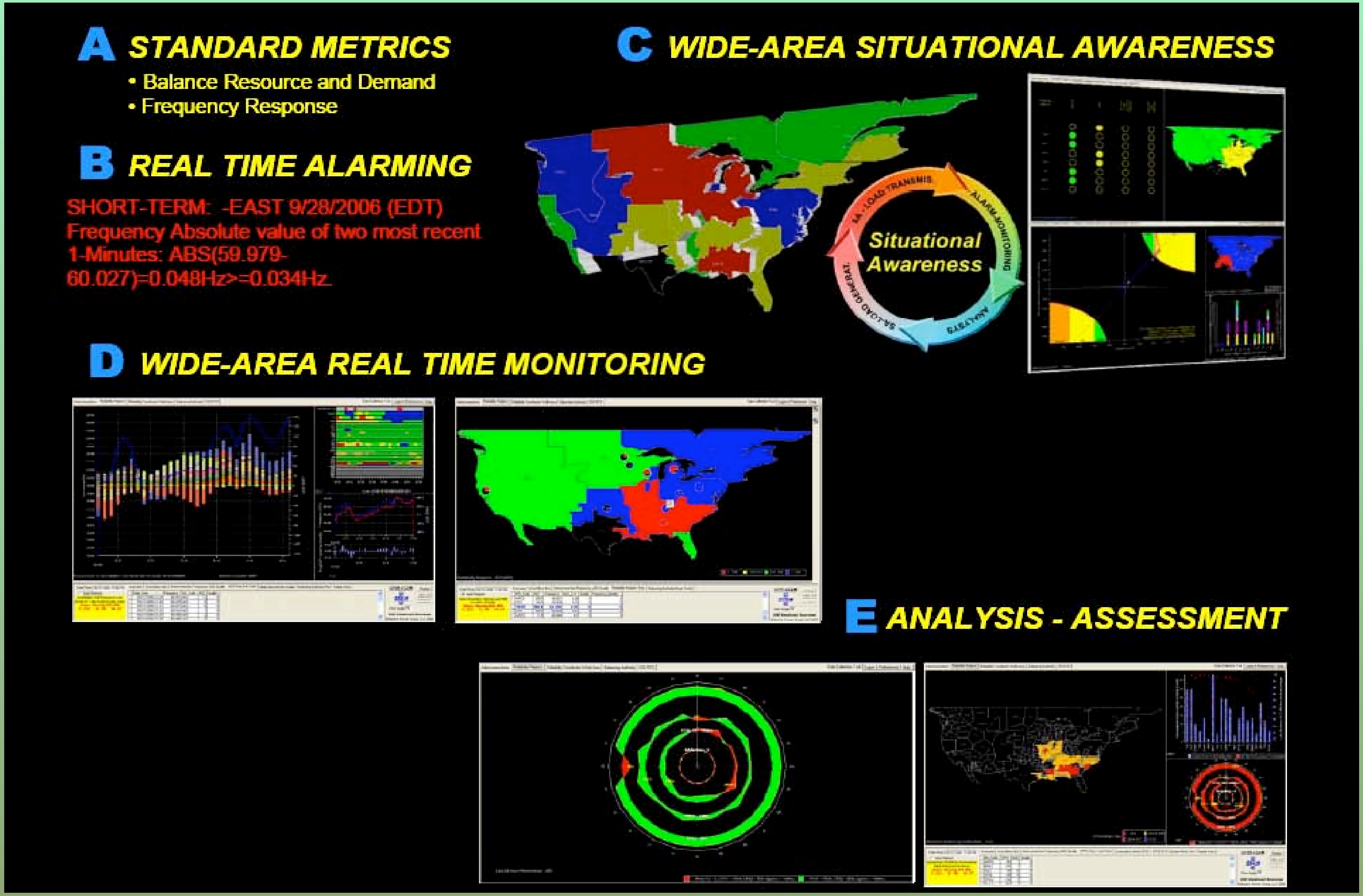
AMI Installations



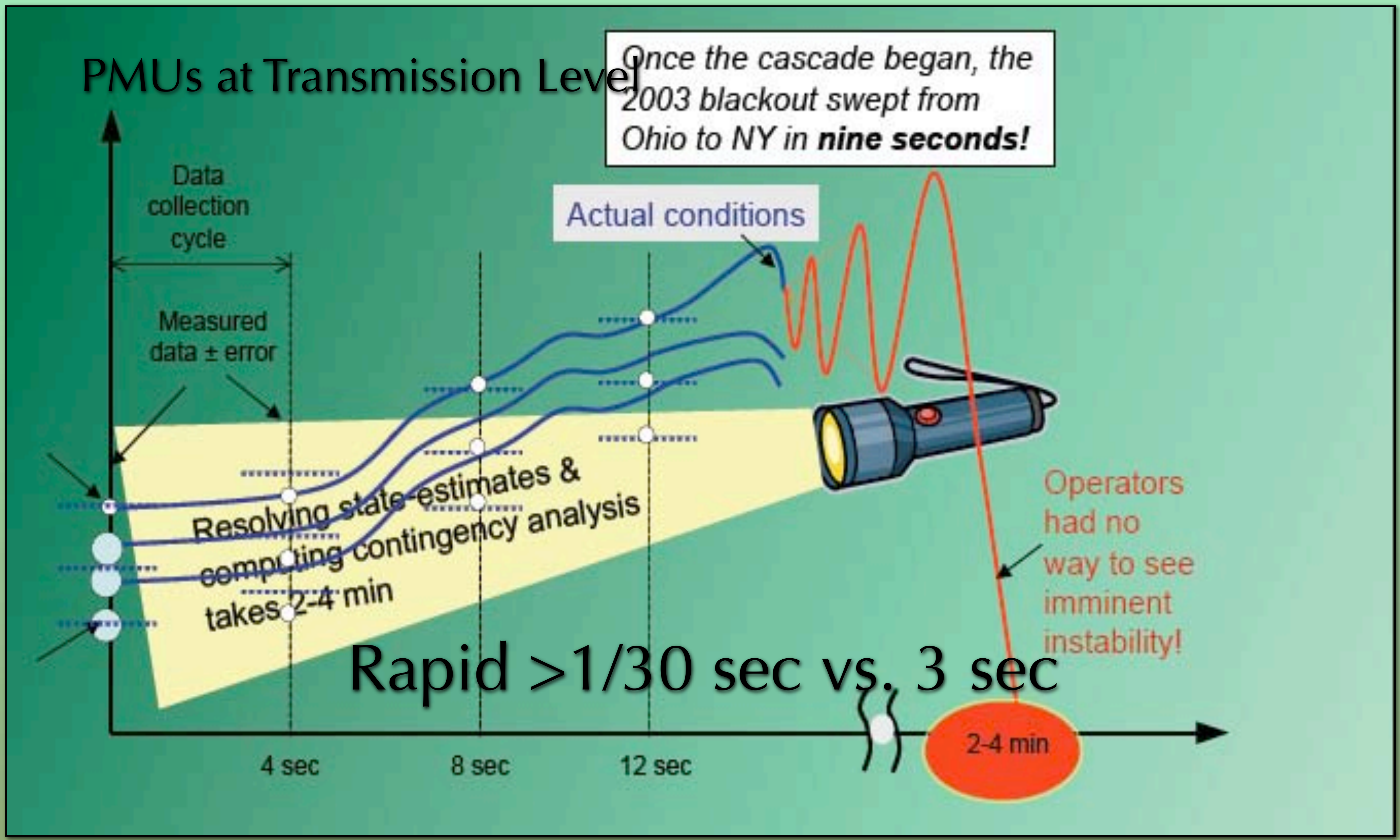
Smart Power at Transmission Level

VFT Technology	
▪Provides continuously variable phase angle shift up to 360 degrees. ▪By adjusting phase angle, RT regulates power flow and control is steady, smooth and continuous. ▪Continuous rather than step-wise control ▪Improves grid stability ▪Low harmonic generation	

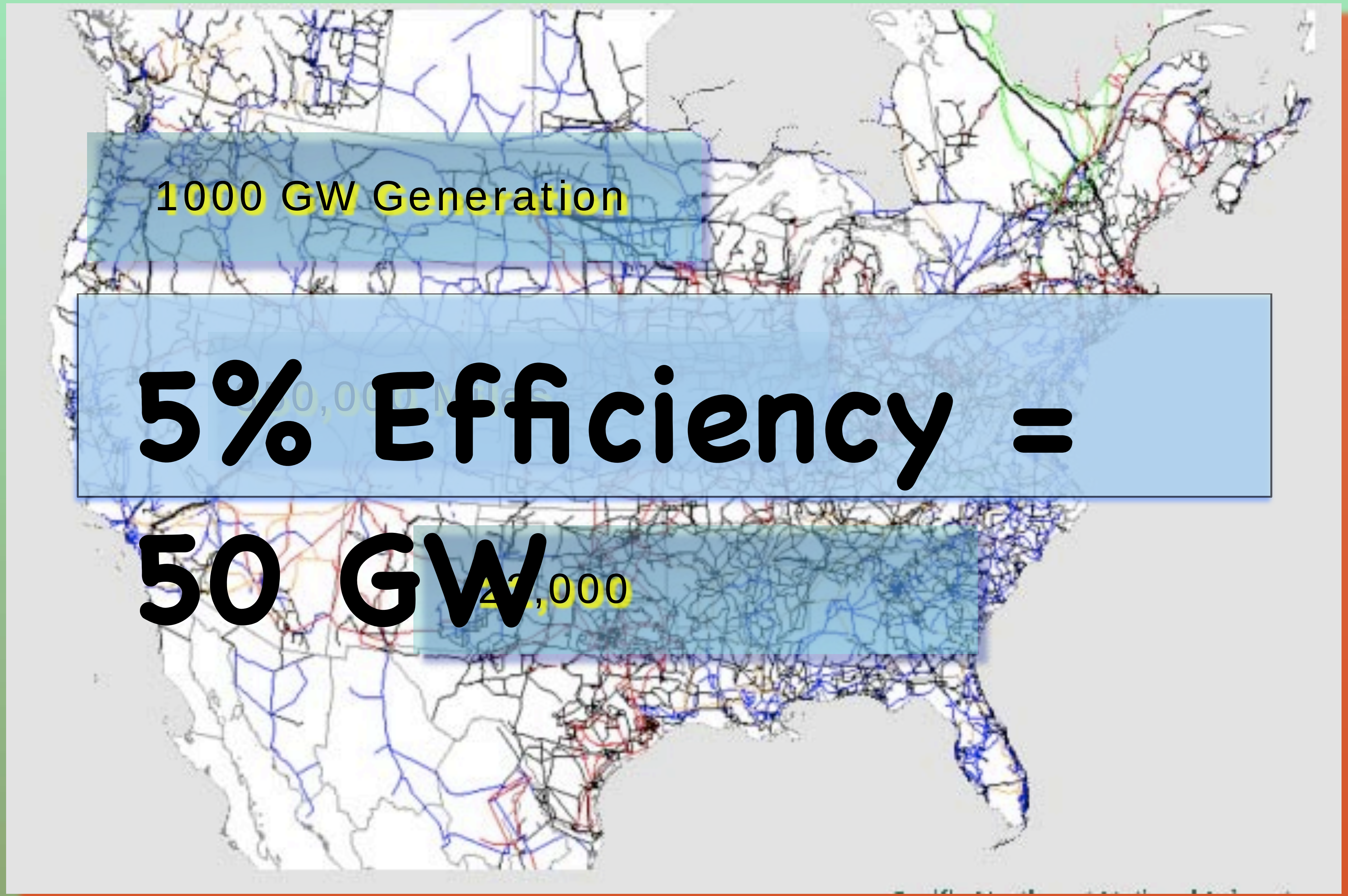
Visualization Tools



Smart Power for Grid Efficiency – 2003 Blackout

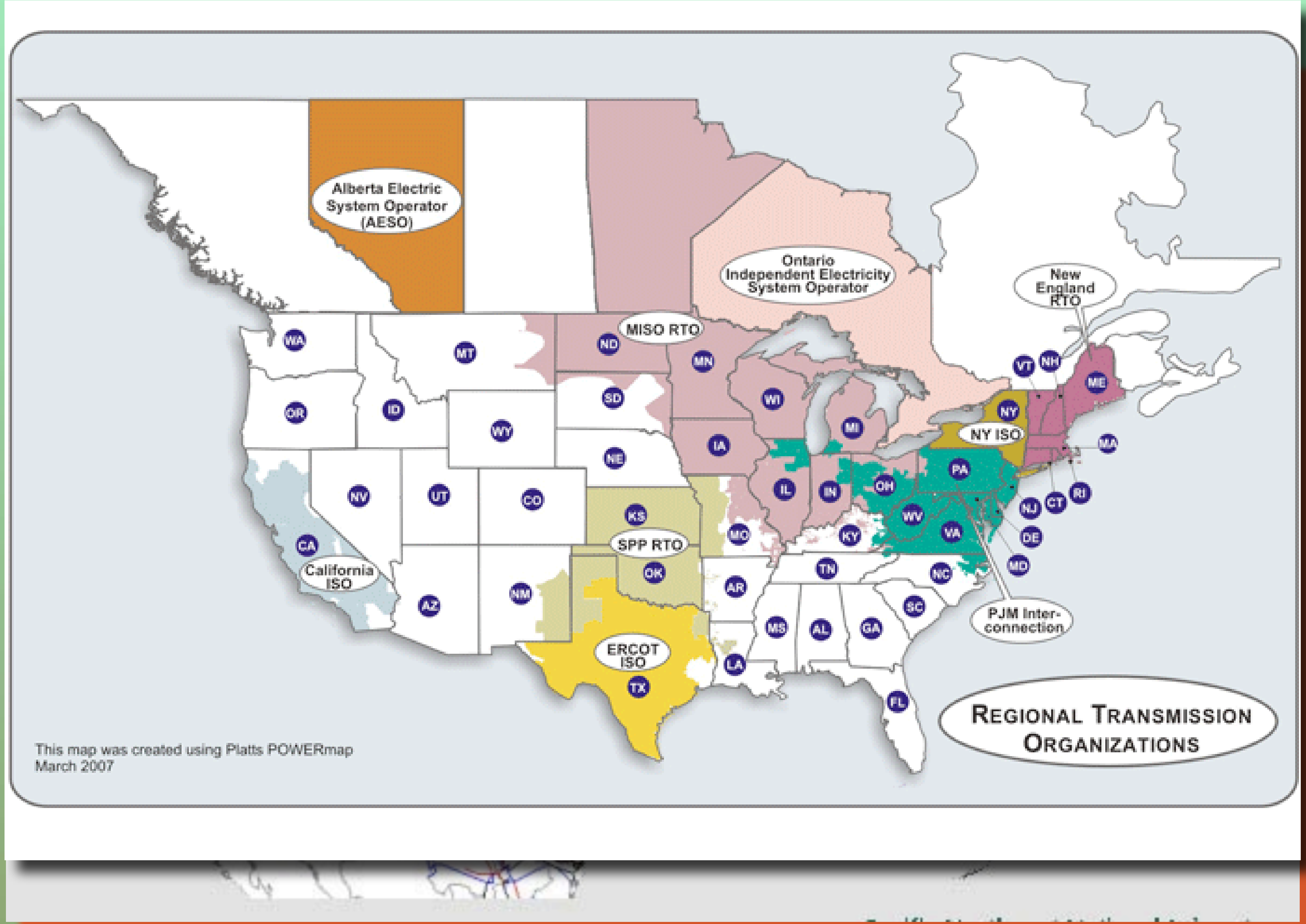


Grid Efficiency Potential



5% Efficiency = 50 GW

Organized Wholesale Markets

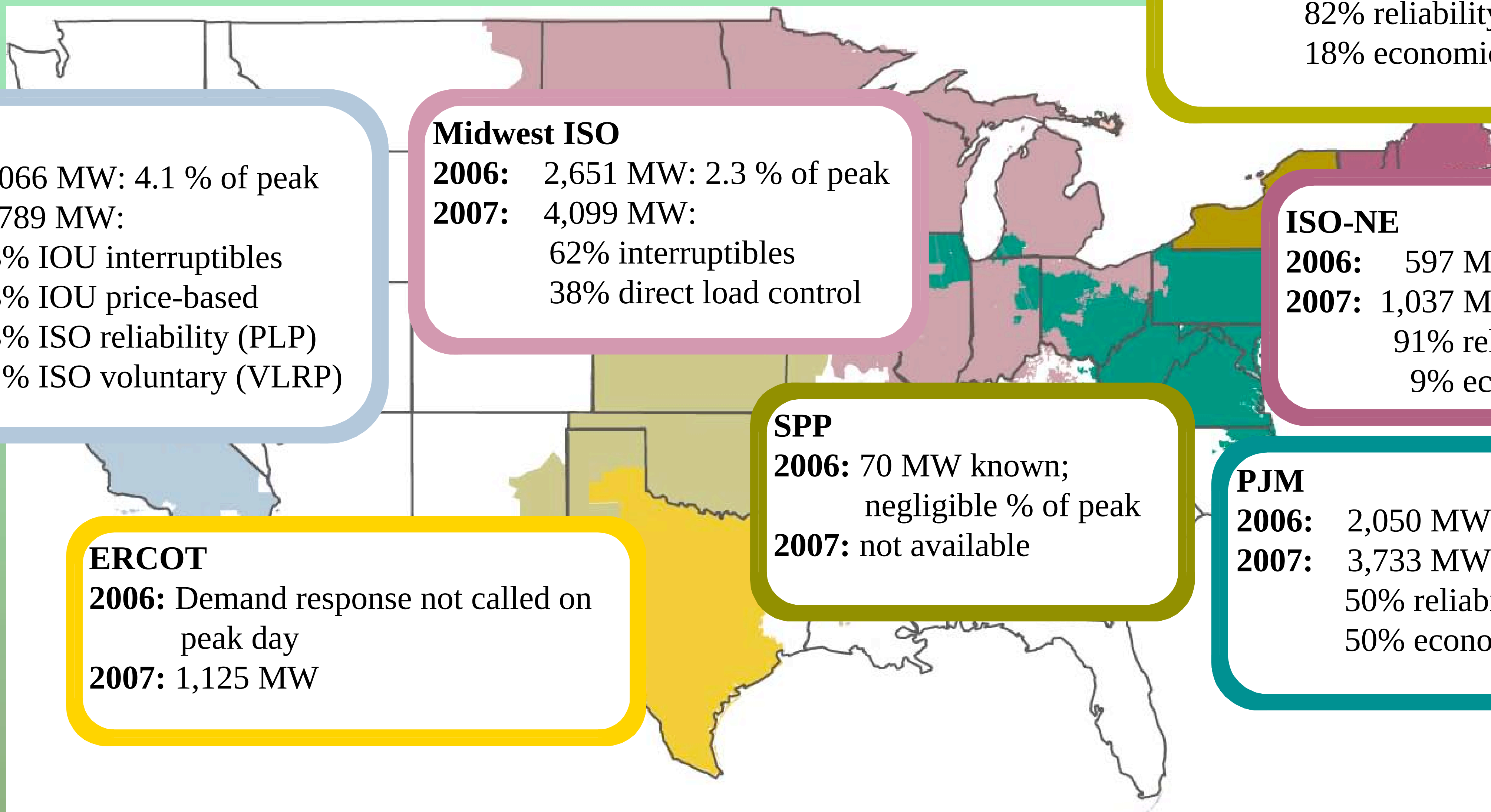


FERC Action on Wholesale Market to Enable Demand Resources

- Demand Resources Participate in Energy markets:
  - ISO-NE, NYISO, PJM Currently
  - MISO, CAISO, SPP in Development
- Demand Resources in Ancillary Services Markets:
  - ISO-NE, NYISO, PJM
  - MISO, CAISO in Development
- Demand Resources in Capacity Markets:
  - ISO-NE’s Forward Capacity Market Auction
  - NYISO’s Special Case Resource Auctions
  - PJM’s Reliability Pricing Model Auctions

Market Element	NYISO			ISO-NE			PJM			CAISO			MISO			SPP			ERCOT		
	H	O	I	H	O	I	H	O	I	H	O	I	H	O	I	H	O	I	H	O	I
Demand Response Program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
Emergency Situation DR Program	✓	·	·	✓	·	·	✓	·	·	·	·	·	·	✓			·		✓		
Real Time DR Bids	✓	✓		✓			✓			✓	✓		✓	✓			✓		✓		
Day Ahead DR Bidding into Market	✓			✓			✓	✓		·	✓			✓					✓		
Capacity Market DR Participation	✓	✓		✓	✓		✓		✓	·									✓		
DR in Long-Term Tx Planning	✓			✓			·	✓		✓			·		✓						
Bid Price Floor or Cap for DR	✓			✓																	
	·			·																	
Ancillary Services DR Participation	✓	✓		✓	✓		✓	·		✓	✓			✓					✓		
Reactive Supply & Voltage Control		·		✓	·		·	·		·	·			·					·		
Regulation		✓			·		✓	·		·				✓							
Spinning	✓	✓		✓			✓	·			✓			✓							
Non-spinning (10 Min.)	✓	✓		✓			·	·		✓				✓					✓		
Long Term Supplemental (30 Min.)	✓	·		✓			·	·		✓				✓							
Generator Imbalances	·	·		·	·		·	·		·				·							

Summer 2006 Demand Response Contributions and Summer 2007 Program Enrollment



NYISO
2006: 948 MW: 2.8 % of peak
2007: 2,199 MW:
82% reliability
18% economic

CAISO
2006: ~ 2,066 MW: 4.1 % of peak
2007: 2,789 MW:
58% IOU interruptibles
38% IOU price-based
3% ISO reliability (PLP)
1% ISO voluntary (VLRP)

Midwest ISO
2006: 2,651 MW: 2.3 % of peak
2007: 4,099 MW:
62% interruptibles
38% direct load control

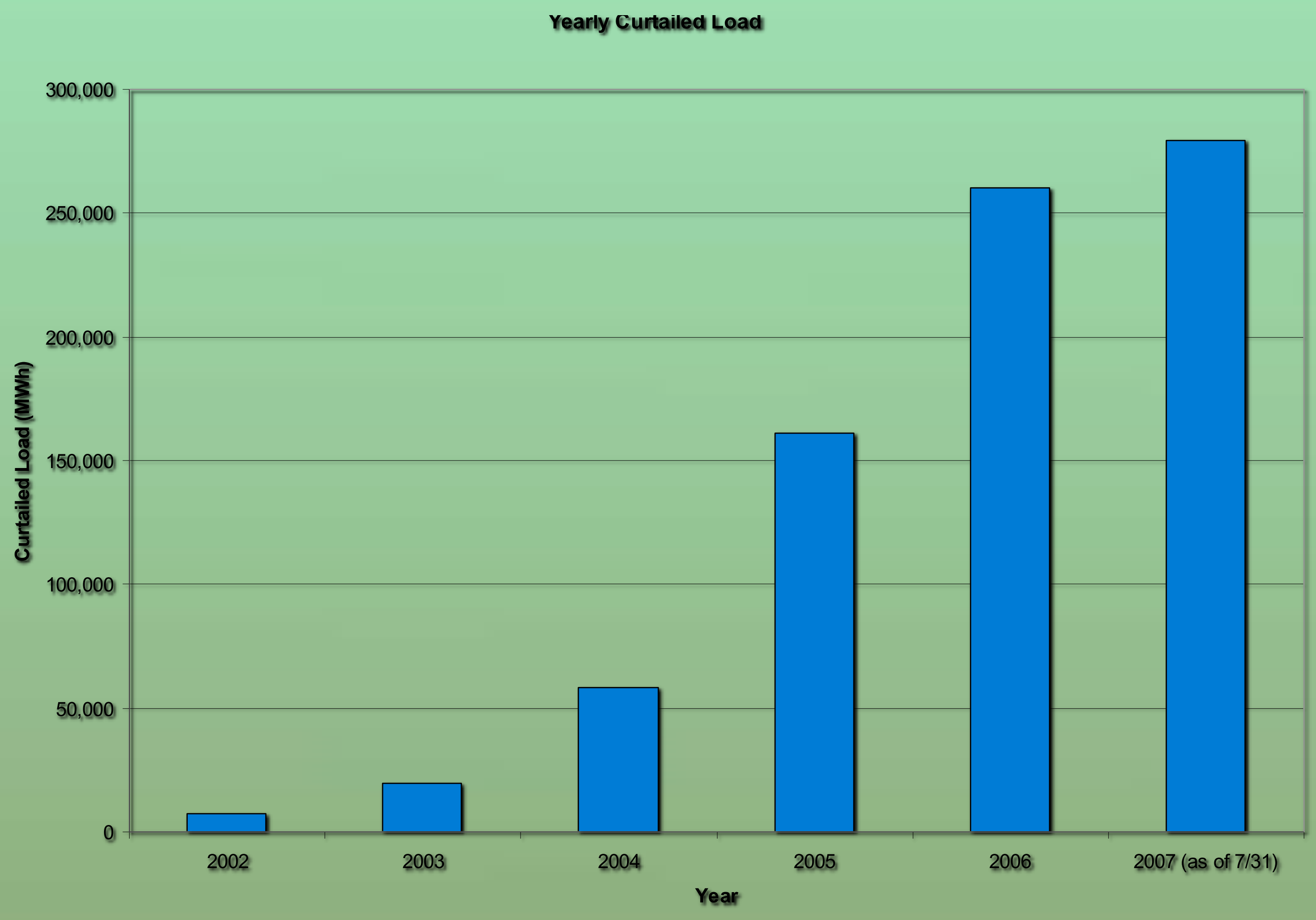
ISO-NE
2006: 597 MW: 2.1 % of peak
2007: 1,037 MW:
91% reliability
9% economic

SPP
2006: 70 MW known; negligible % of peak
2007: not available

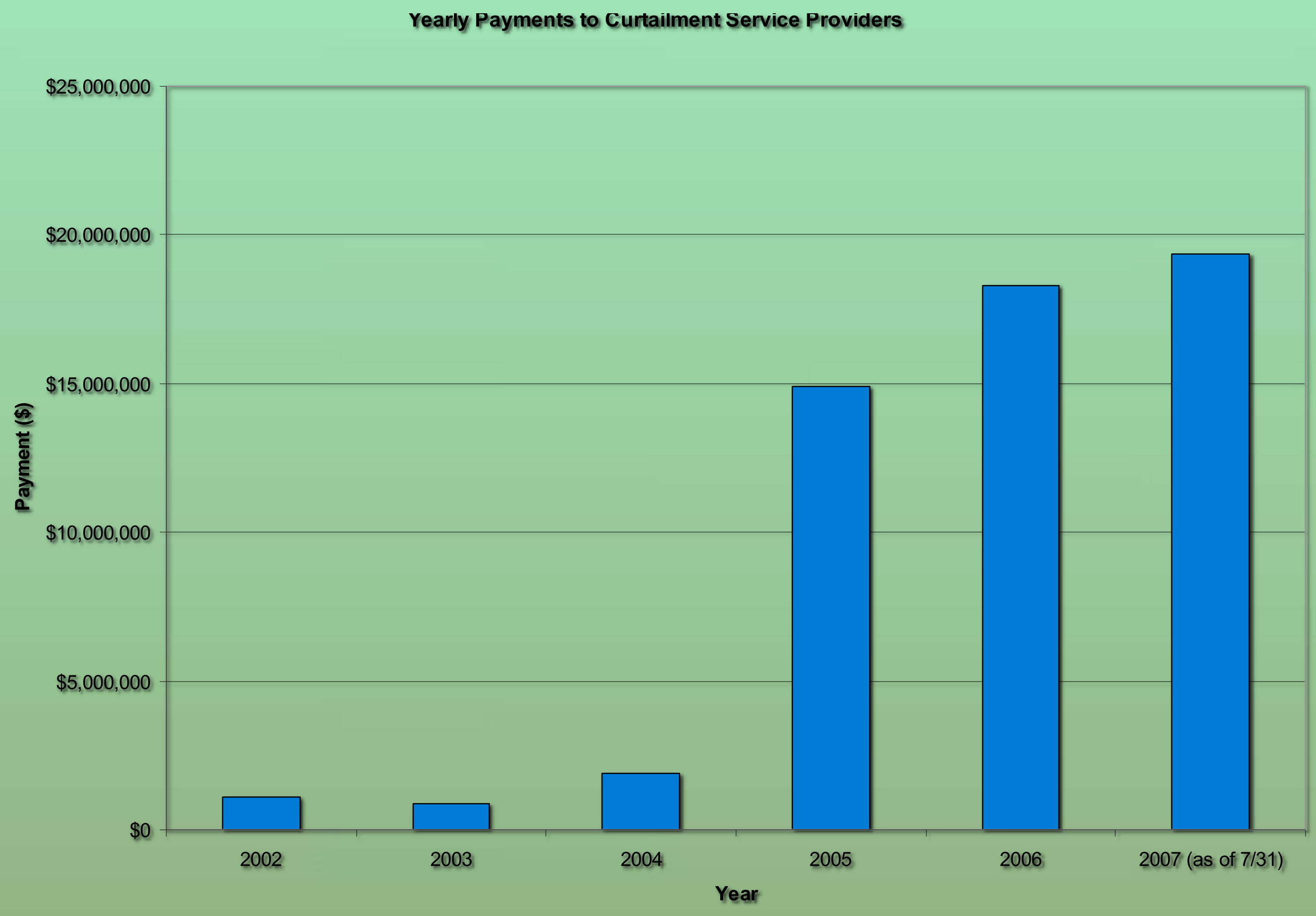
PJM
2006: 2,050 MW: 1.4 % of peak
2007: 3,733 MW:
50% reliability
50% economic

ERCOT
2006: Demand response not called on peak day
2007: 1,125 MW

PJM Demand Response



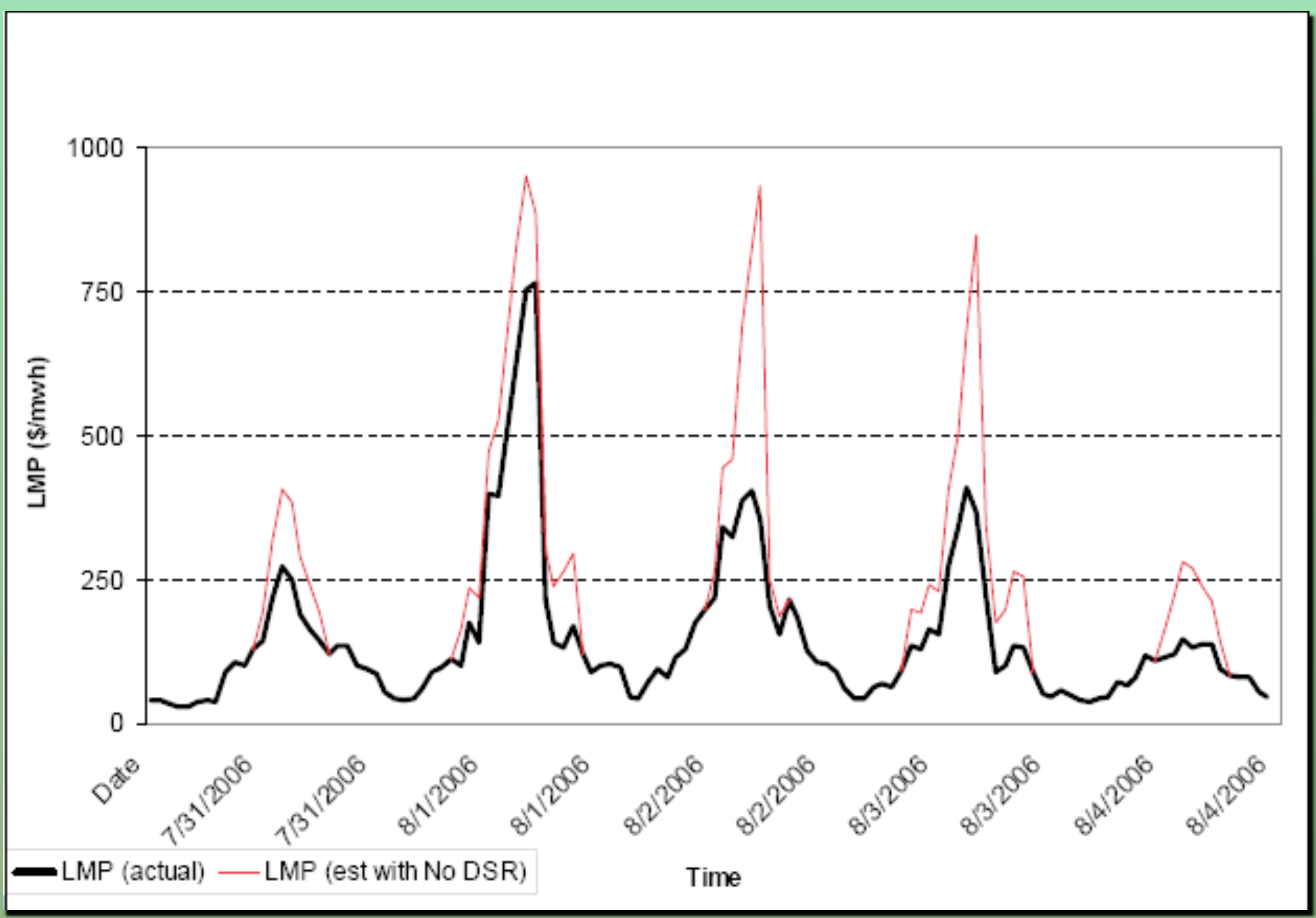
PJM Demand Response



Smart Grid Benefits

PJM Demand Response

$650 Million in Consumer Savings



FERC Action
Regional Transmission Planning*

- Regional Transmission Planning
  - Use/Consider Comparable to Central Generation
    - Demand Response
    - Energy Efficiency
    - Distributed Generation
    - Smart Grid Upgrades and Grid Operation Optimization

** OATT Reform*
Order 890 (February 2007)

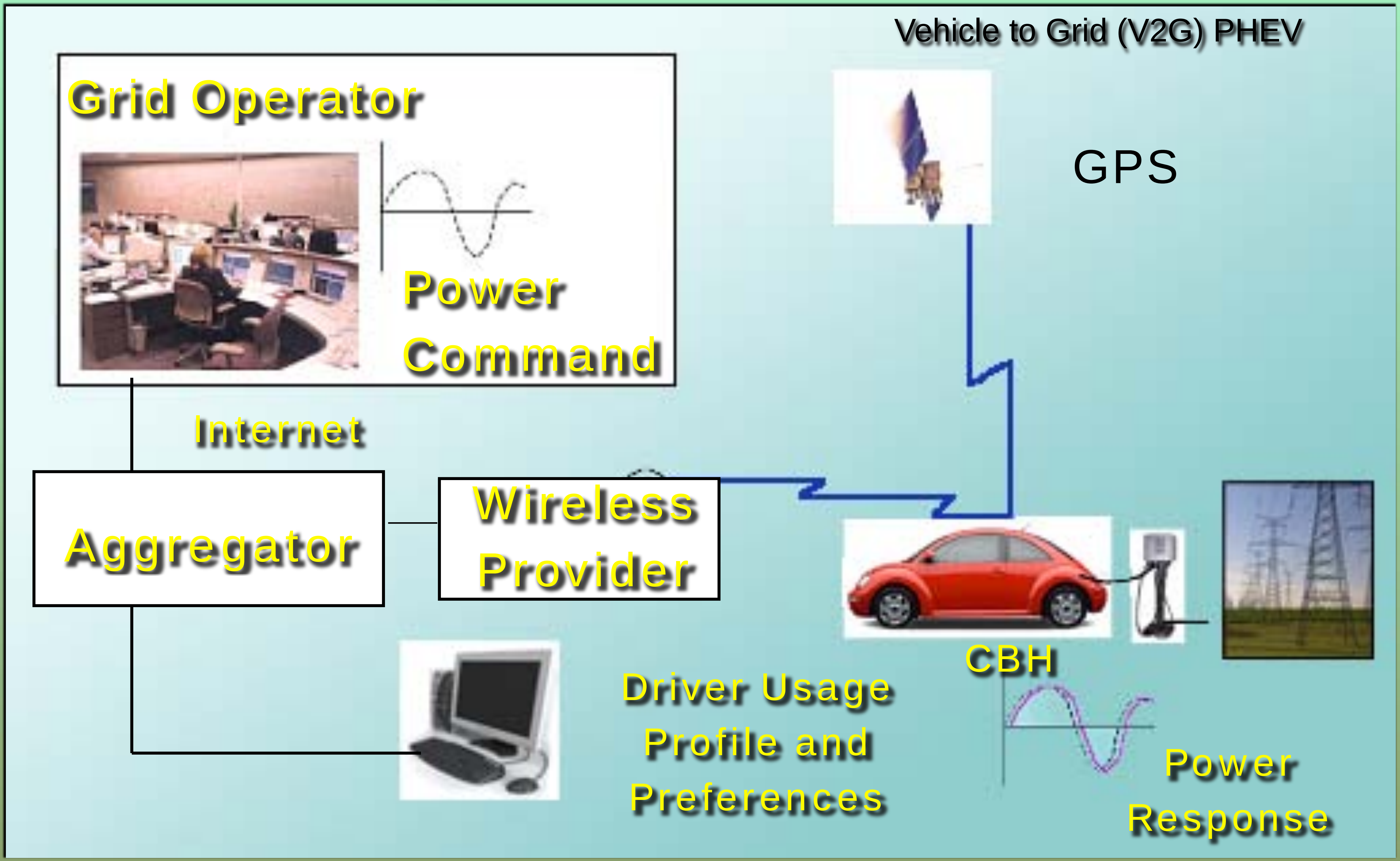
Smart Power Costs vs. Benefits

Target Sector Costs	10-Year Investment Level ($B)
Residential	**7-10**
Commercial	**13-20**
Network Infrastructure	**$25-30**
TOTAL	**45-60**

Source of Benefits	Potential Benefits/year ($B, by 2015)
“Smarting up” of customer premises (smart homes, intelligent buildings)	**$6-8**
Enabling of Demand Response and AMI deployment	**$5-8**
Investments in smart grid technologies	**$2-3**
DG, smart grid-interactive storage technologies and microgrids	**$1-2**
TOTAL/year	14-21

Smart Power for Transportation

Smart Power Transportation Interface



PHEV V2G Benefits

- **Efficient Grid Management**
  - Ancillary Services (Spinning Reserve & Regulation)
  - Dispatchable Reactive Power
  - Peak Demand Services (Demand Response)
  - Reduced Operating and Planning Reserves
  - Distribution/Substation Level Support
  - Reduced Line Losses
  - Improved Power Plant Efficiency
  - Improved Load Factor
- **Storage & Integration of Renewable Power**
  - Wind & Solar

PHEV Grid Efficiency

THANK YOU!