Industry Trends and the Future of Demand Response

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Market Forces

What if...

... demand grew 50% in 20 years?

... 50% of skilled workers retired in 10 years?

... carbon constraints became severe?

... fuel costs kept going up?

... power quality demands got much higher?

... renewables were mandated all over the country?

... reliability rules became more stringent?

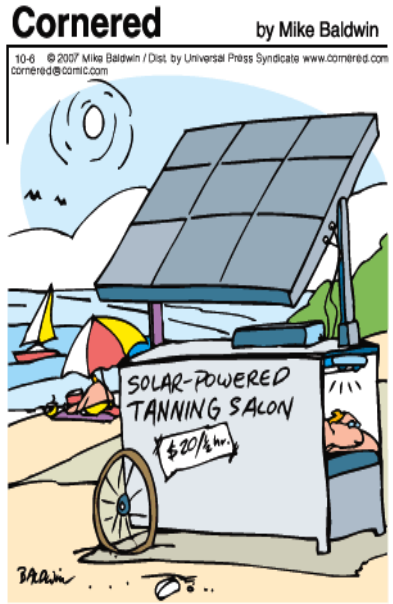
Would you...

... build 50% more power plants... hire 50% more workers... build 50% more power lines... raise rates over and over again?

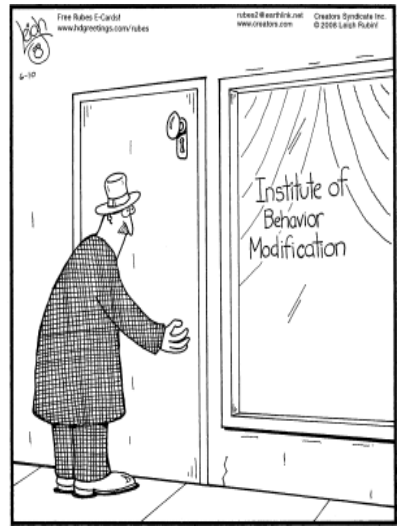
What if they all came true... all at once

Factors Driving the Smart Grid Evolution

1. Distributed Communications
2. Supply and Demand Tech
3. Architectural Standards
4. Demographic/Economic Shifts
5. Government Policies



Technology Shifts

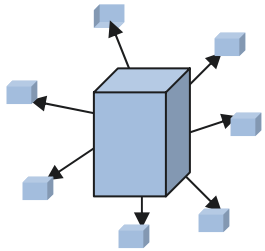


Behavior Shifts

Intelligence to the Edges

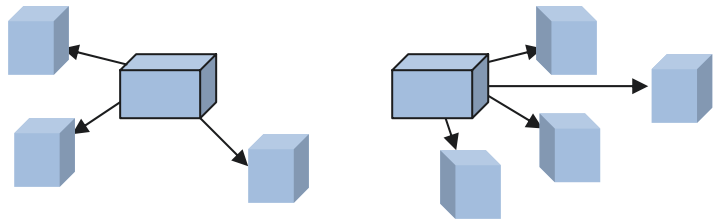
Centralized

- Mainframe
- Intelligence in middle



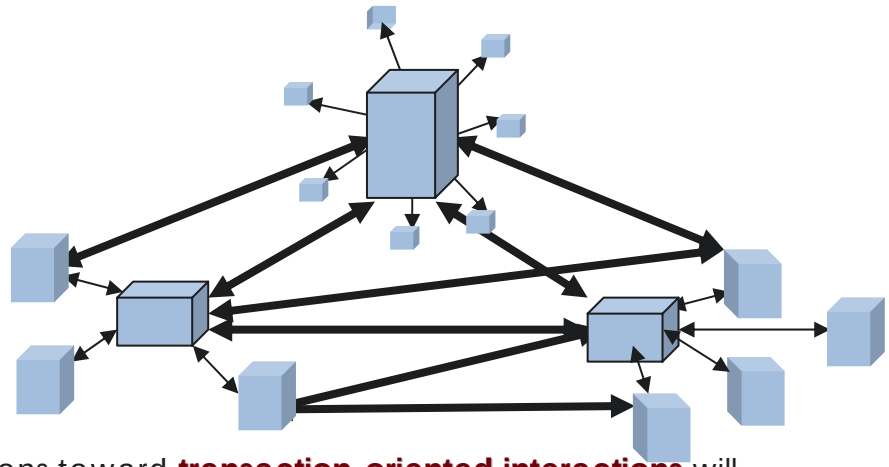
Distributed

- Client-server
- Intelligence migrates out



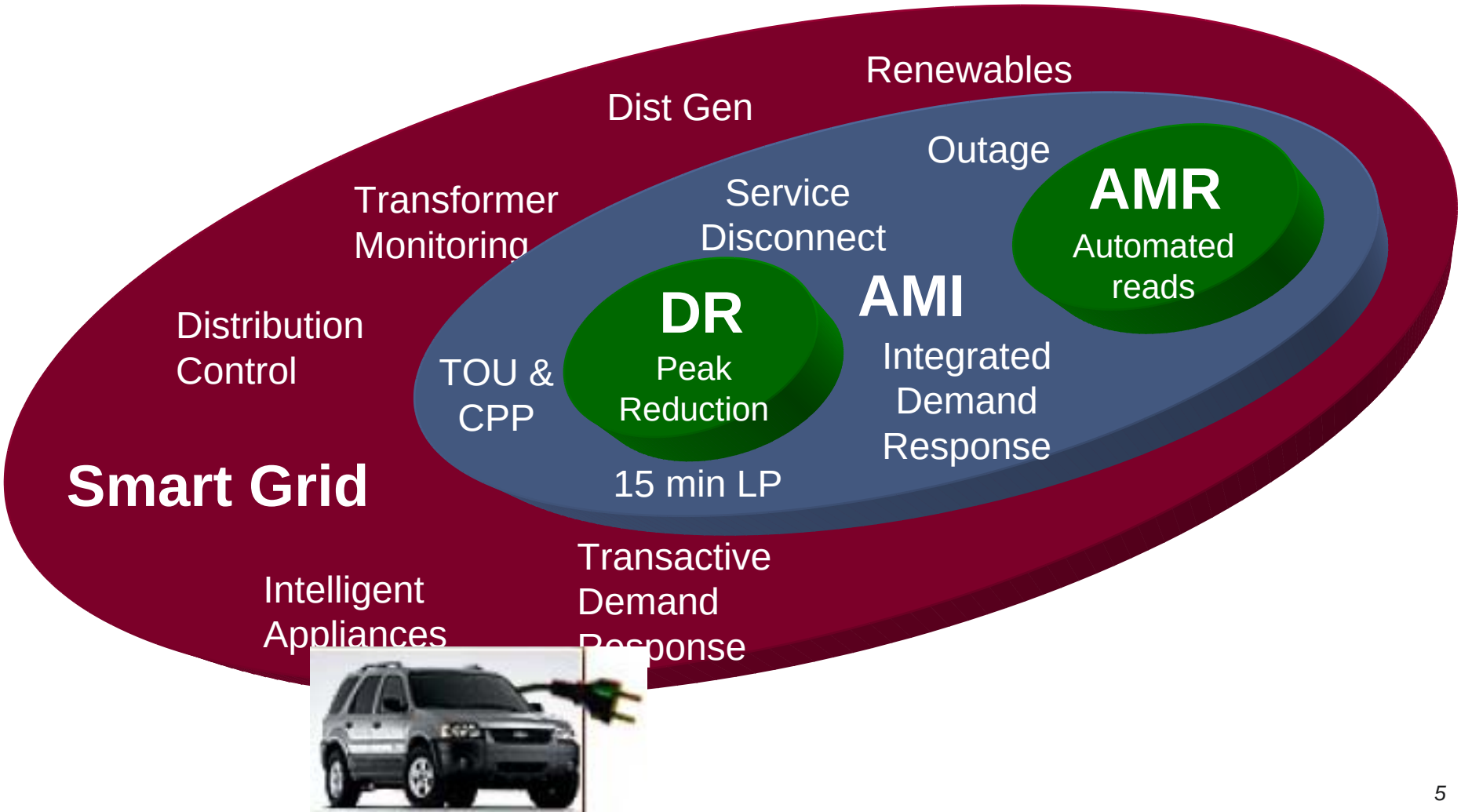
True network

- Internet
- Intelligence everywhere



The move from control-based interactions toward **transaction-oriented interactions** will significantly improve information exchange between the electric system devices and the end-use consumers.

DR & AMR / AMI / SmartGrid



Smart Grid Transition

Then Comes PHEV storage…
… and Solar/Wind Microgrids

Demand Response Software

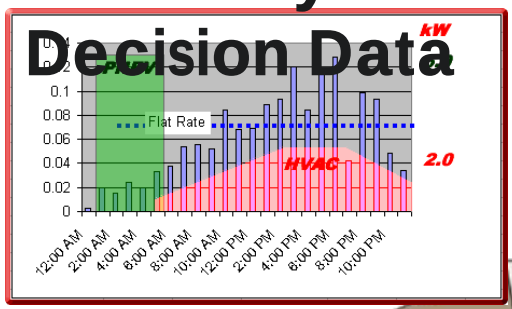
Robust Signalling

Common Platforms

AMI Enterprise

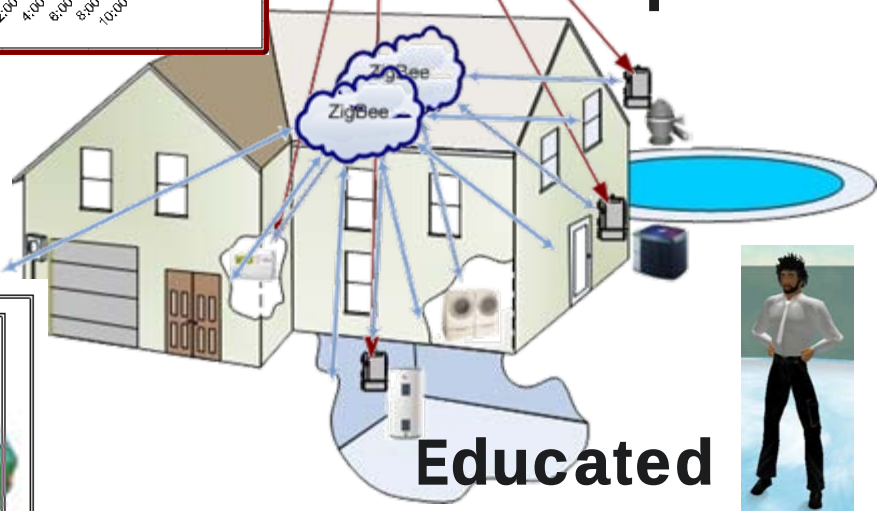
VHF Paging

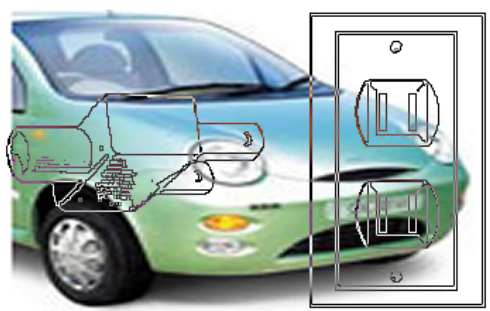
Timely Decision Data



Automated Response

AMI Network





Clean Technology

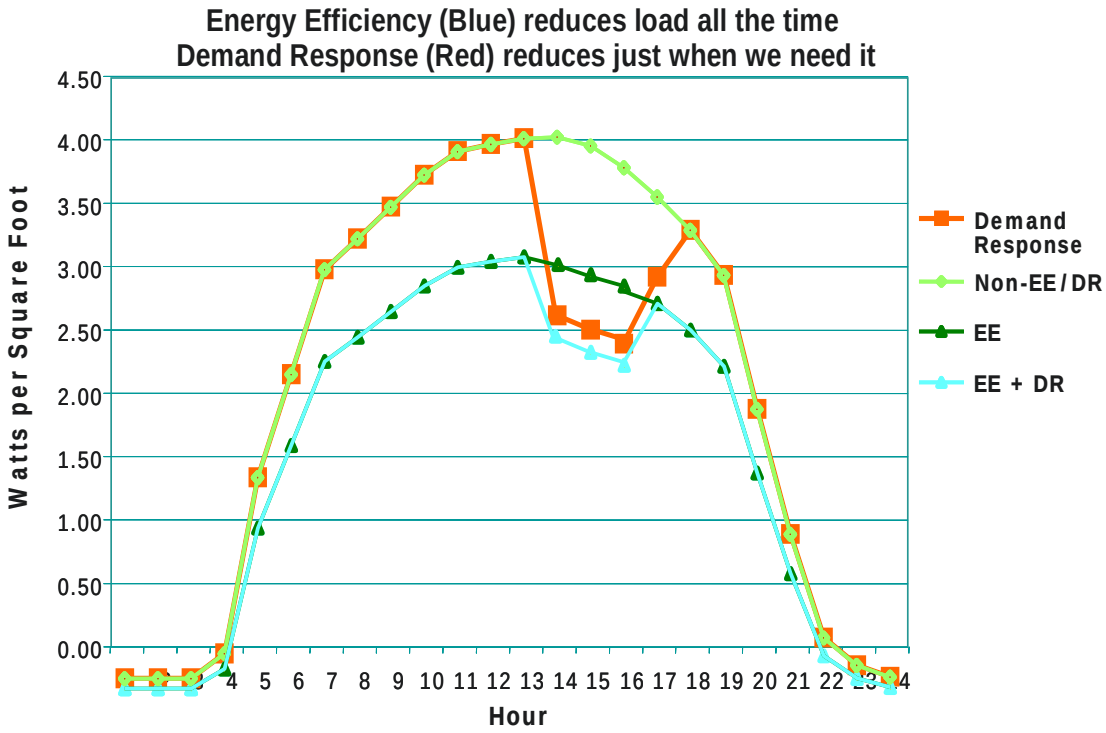
Educated & Motivated Consumers

Consumer Driven Approach

Source:

Innovative Uses of DR for Clean Energy

Clean Capacity Through Demand Response



Integrated DR Product Suite

Demand Response Automation Platform

Large Appliance Automation

Integrated Customer Experience

Customer Energy Portal

In Home Energy Display

Home HVAC Automation

- Comprehensive Suite
- ZigBee Integrated & Tested
- Open Standards
- Experience
- DR Leader & Roadmap

Evolving Business Models

Traditional Utility

- Grid Generation
- Retail Electric Supply
- Capacity Markets
- Utility-Scale Renewables
- Reliability

Traditional Customer

- Meter Data Analysis
- Facilities Management
- Performance-based Contracting
- Distributed Generation
- Energy Procurement
- Power Quality

Transaction Utility

- Grid Generation
- Utility-Scale Renewables
- Reliability

Services

- Smart Meter
- DR+/-, EE
- Renewables
- Capacity Mkt

- Performance Contracting
- DG/EE
- Procurement
- PowerQuality
- Emissions

Transaction Customer

- Service
- HVAC
- Maintenance

PJM Load Response

EMERGENCY

Designed to provide a method by which end-use customers may be compensated by PJM for reducing load during an emergency event.

ECONOMIC

Designed to provide an incentive to customers or curtailment service providers to reduce consumption when PJM LMP prices are high.

Load Response = Demand Side Response (DSR)

Comparison of Revenue Opportunities for Demand Response Current vs. Revised

Revenue Opportunity	PJM (as of 12/31/05)	PJM with new initiatives
Real-Time/Spot Energy Sales	Yes	Yes
Day-Ahead Energy Sales	Yes	Yes
Forward Energy Sales	No	Yes; Forward Energy Reserve Market (under development)
Forward Capacity Sales	Yes, but limited	Yes; RPM auction provides options for participants
Energy & Capacity payment for emergencies	Not in all cases	Yes; Emergency program changes ensure payment
Ancillary Services	No	Yes; Synchronous Reserves & Regulation (mandatory training for CSP's @ pjm.com)

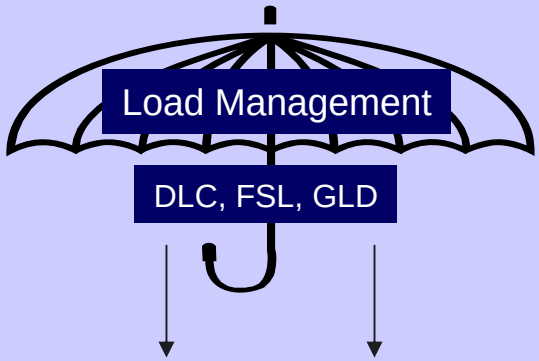
Definition & Purpose of RPM

- Reliability Pricing Model (RPM) is PJM's new resource adequacy construct
- The purpose of RPM is to develop a long term pricing signal for capacity resources and LSE obligations that is consistent with the PJM Regional Transmission Expansion Planning Process (RTEPP)
- RPM adds stability and a locational nature to the pricing signal
- RPM replaced PJM's capacity construct effective June 1, 2007

Source:

Load Response in PJM

Energy	Capacity	Ancillary Services
• Economic • Emergency – Energy Only	• Emergency – Capacity Only • Emergency – Full (also gets an energy payment)	• Synchronous Reserves • Regulation
Voluntary load reductions for <u>energy</u>, even during a PJM emergency event	**Mandatory** reduction for PJM Load Management emergency event	Load bids into these markets and responds to an event exactly like a generator **Mandatory** response to a Synchronous Reserve event if cleared in market



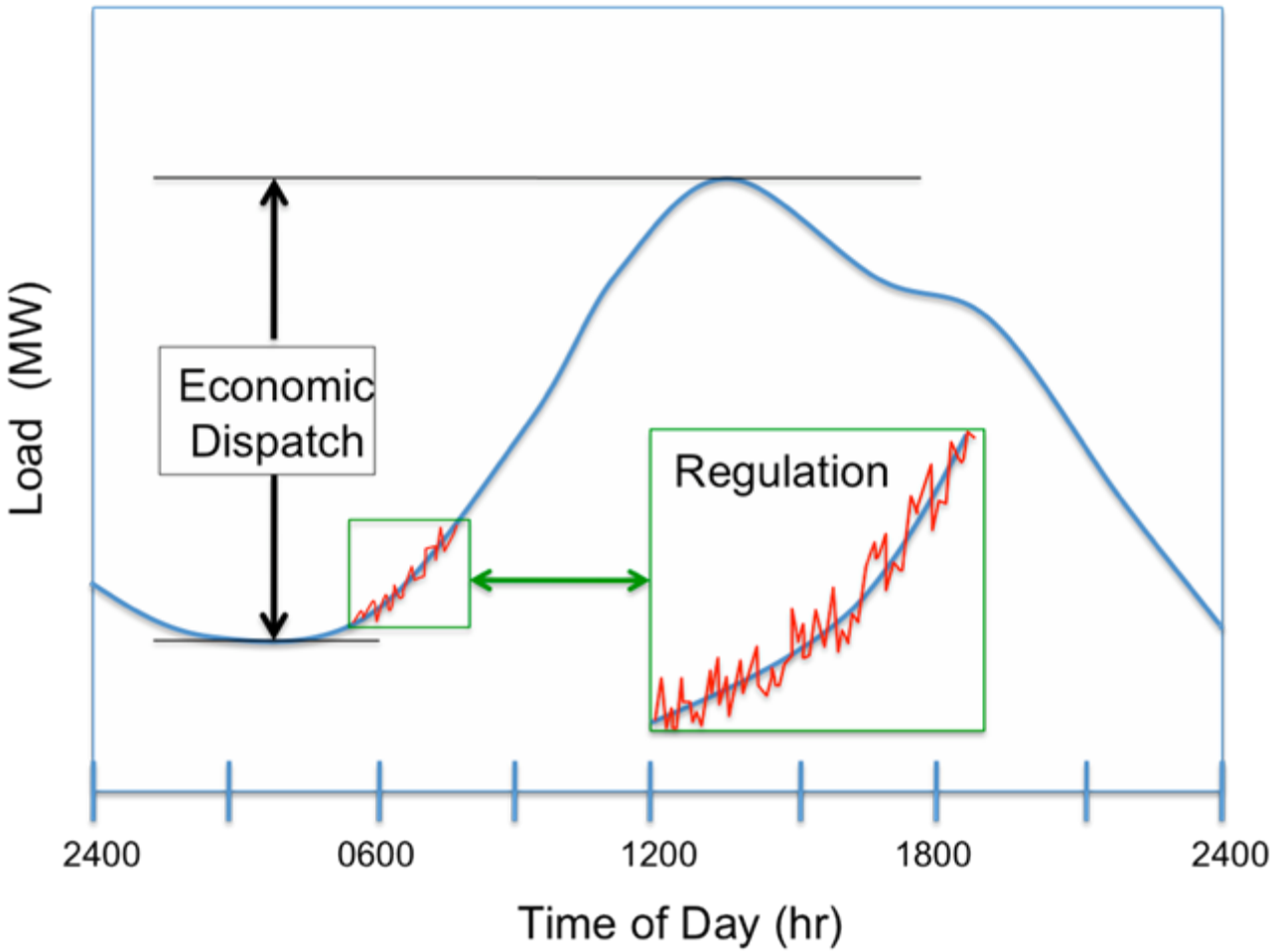
Source:

Other Options for Participation

- PJM Ancillary Service Markets
  - PJM Regulation Market
    - Automatic adjustment of load in response to PJM regulation control signal
  - PJM Synchronized Reserve Market
    - Ability to achieve required reduction of load in a 10 minute period when notified by PJM
- Details of these markets are covered in “Load Response for Ancillary Services” training presentation
- Mandatory online training for participation

Source:

What is Frequency Regulation?

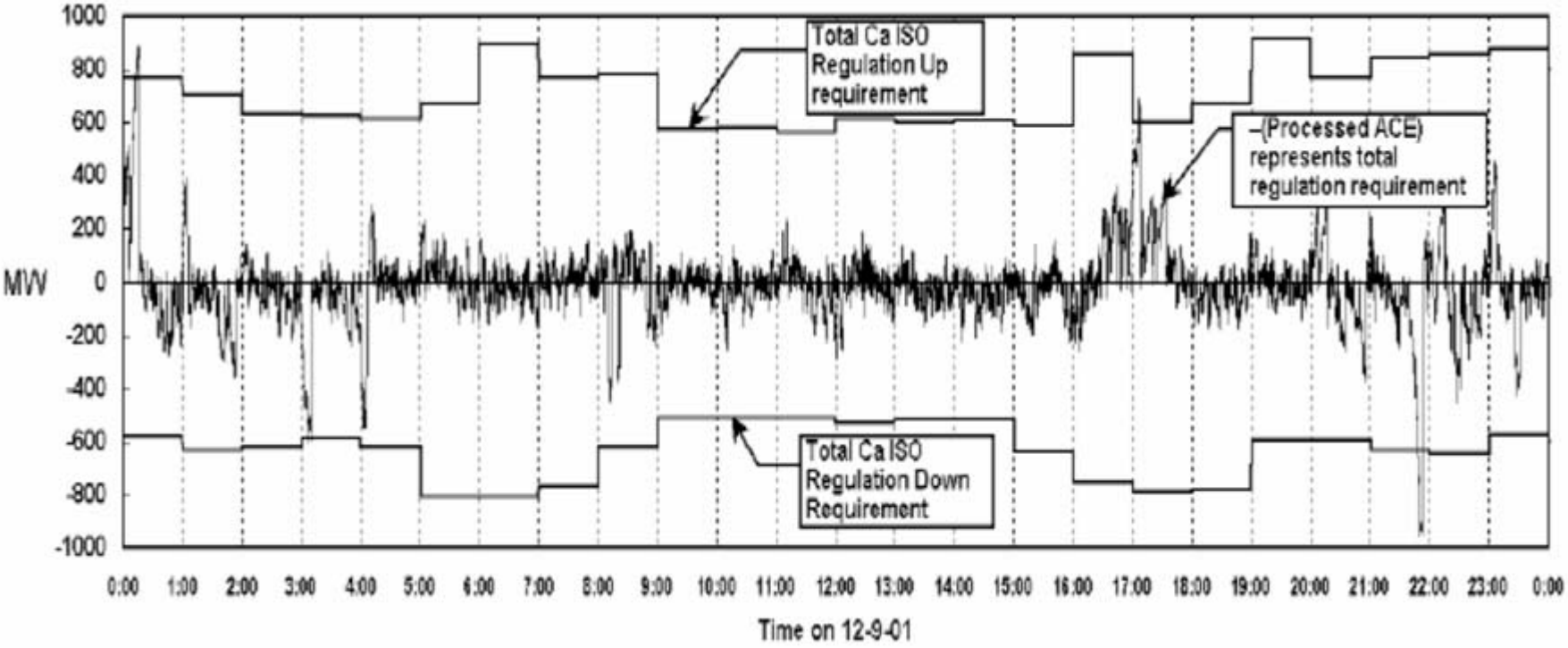


Regulation is the continuous adjustment of AC electricity frequency (60 Hz)

What Does Regulation Cost?

- Contract for expected need (+ margin)
- Cost (fossil fuels) is opportunity cost of not generating during that period
- Cost of energy provided to Ancillary Service is far above wholesale or retail rates
- Contract is for capacity, not energy

Regulation Contract

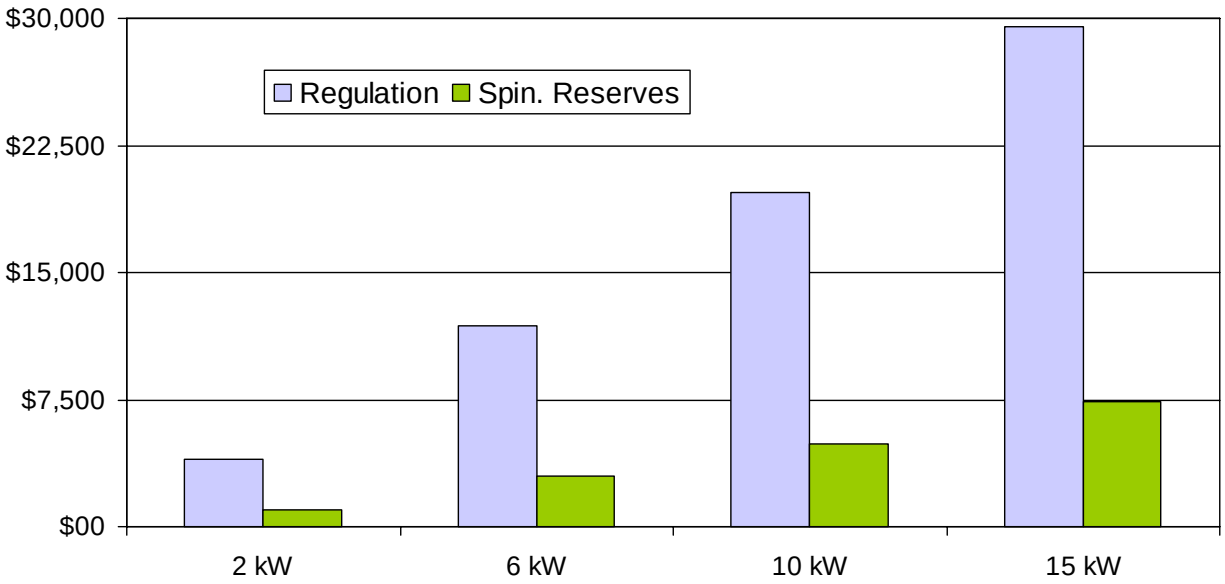


Regulation - Market Value

	Average Market Clearing Price ($/MWh)		
	2004	**2005**	**2006**
PJM	$42.75	$49.73	$32.69
ISO-NE	$28.92	$30.22	$24.02
NY ISO	$22.59	$39.21	$51.26
ERCOT	$22.66	$38.07	n/a
CA ISO	$29.00	n/a	$36.04

Basic per Vehicle Values

10 –Year Present Value V2G Revenue Potential

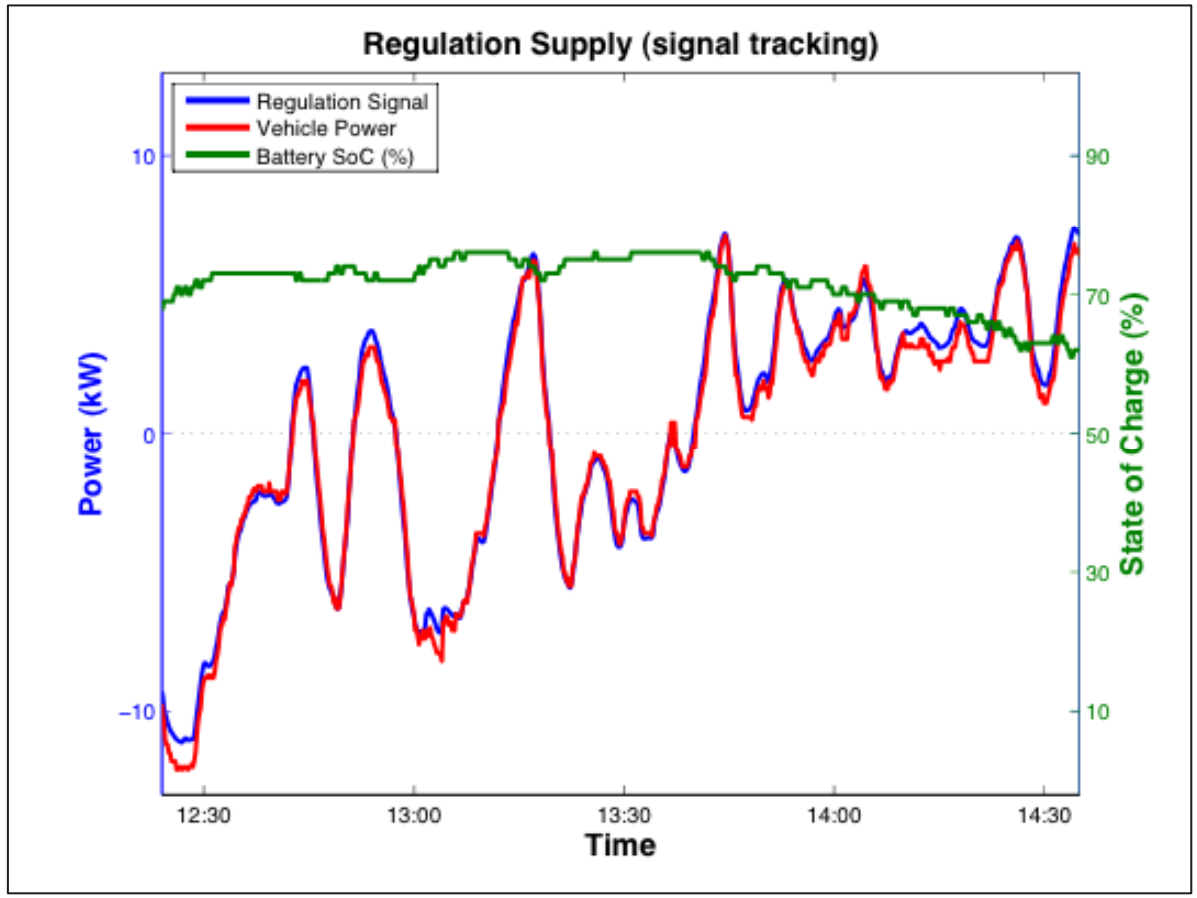


Assumptions: 80% availability; Reg. $40/MW-h; Spin. $10/MW-h, 7% discount rate, example calculations

Green Mountain College

Providing Regulation from an EV

- Red line shows power (kW) to the battery (left axis)
- Green line shows the state of charge steadily rising (right axis)
- Blue line shows shows the regulation signal. Notice how closely the commanded power follows the power delivered by the vehicle



Consumer Driven Approach

- Intuitive Web Controls
- Current kW-hr Pricing Info
- Access to education
- Access to account data
- Streamlined bus. process

Thank You!

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