OSIsoft Users Conference 2011

Industrial Energy Strategies Workshop

March 28, 2011
San Francisco, CA

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Midwest ISO Fast Facts

Midwest ISO's Reliability Footprint

Midwest ISO's Market Footprint

Interconnected High Voltage Transmission Lines

- 56,300 miles

Installed Generation Capacity

- 144,132 MW (market footprint)
  - 1,304 generating units
- 160,757 MW (reliability footprint)
  - 1,522 generating units

Peak Demand – 7/13/2006

- 116,030 MW (market footprint)
- 136,520 MW (reliability footprint)

Midwest Market Highlights

- $24 billion annual gross market charges (2009)
- 300 Market Participants who serve 40+ million people

Three Control Centers

- Carmel, IN (Headquarters)
- St. Paul, MN
- Indianapolis, IN (Backup)

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Markets - Tools to Efficiently Manage Your Assets

Market	Summary	Implications
Day-Ahead Energy Market	▸ Forward energy and ancillary services – Price differentiated by physical location	▸ Facilitate an efficient commitment of generation
Real-Time Energy Market	▸ Spot energy and ancillary services – Price differentiated by physical location – 5-minute energy dispatch	▸ Dispatch the lowest-cost resources to satisfy system demand without overloading the transmission network
Financial Transmission Rights Market (FTR)	▸ Allows participants to hedge transmission congestion risk associated with serving load or engaging in other market transactions ▸ Preserves the value of existing investments through FTR allocation	▸ Provide transparent economic signals to guide short-run operational and long-run investment decisions by participants and regulators
Resource Adequacy	▸ Year and month ahead forward “planning reserve” or “capacity” product ▸ Assures ability to produce energy and ancillary products	

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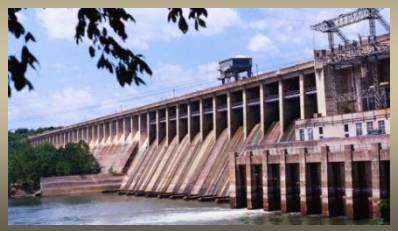
Setting the Table for Discussion

- Majority of current wholesale electricity markets have ample generation capacity
- Significant load forecasting uncertainty based on economic conditions, but most forecasts do not predict significant load growth for 4-6 years
- State and Federal legislation (EPA), mandates, subsidies, grants and political “environment” have an impact that is at the forefront of most discussions
- While there have been a number of progressive and optimistic pilot projects, studies and research efforts, the primary area of actual development in the Midwestern US has been in wind (and regional solar) generation

Key Challenges & Opportunities

Demand Response / Energy Efficiency

Renewables Management & Integration



Infrastructure Development & Cost Sharing

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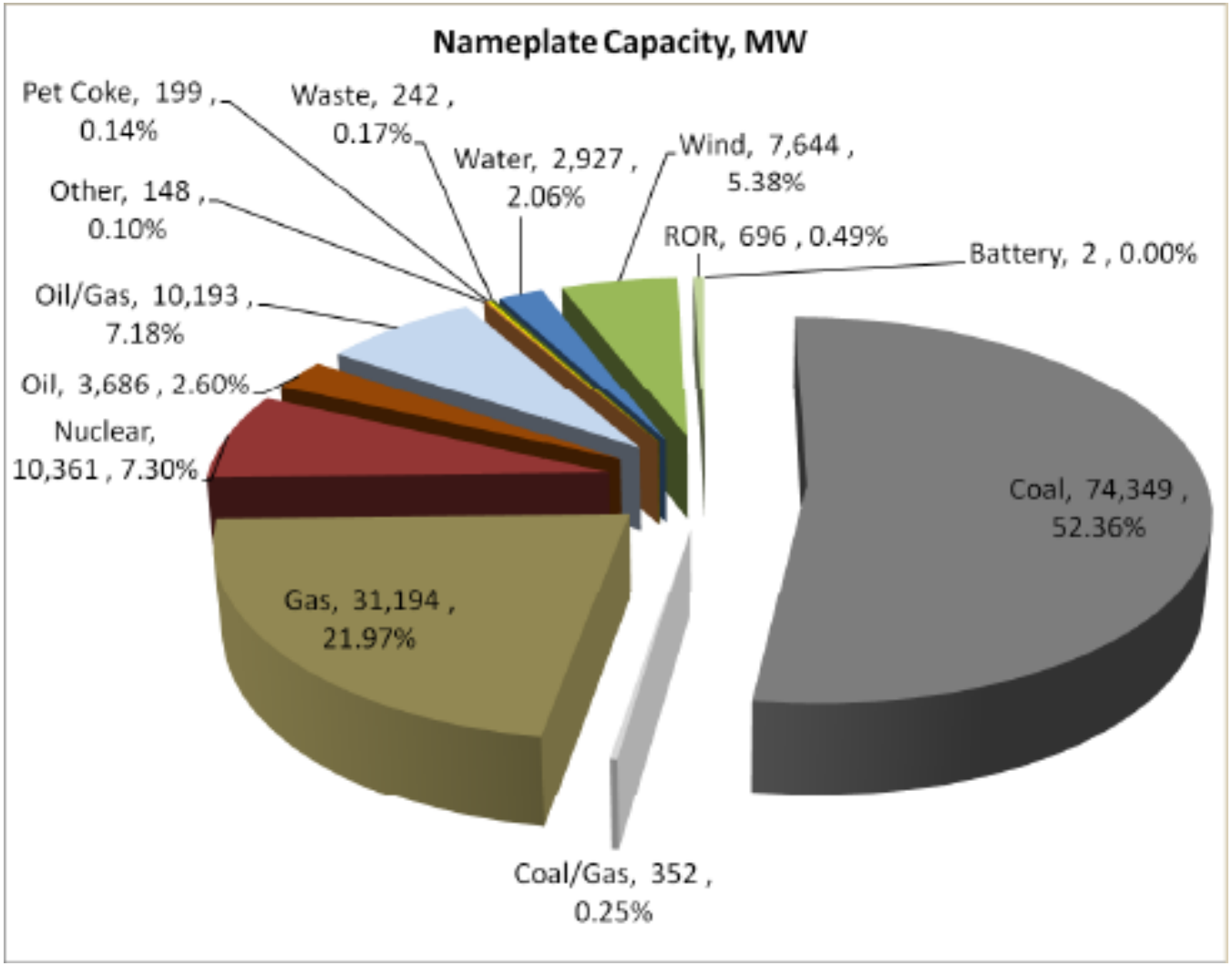
Midwest ISO Capacity Composition

(2010)



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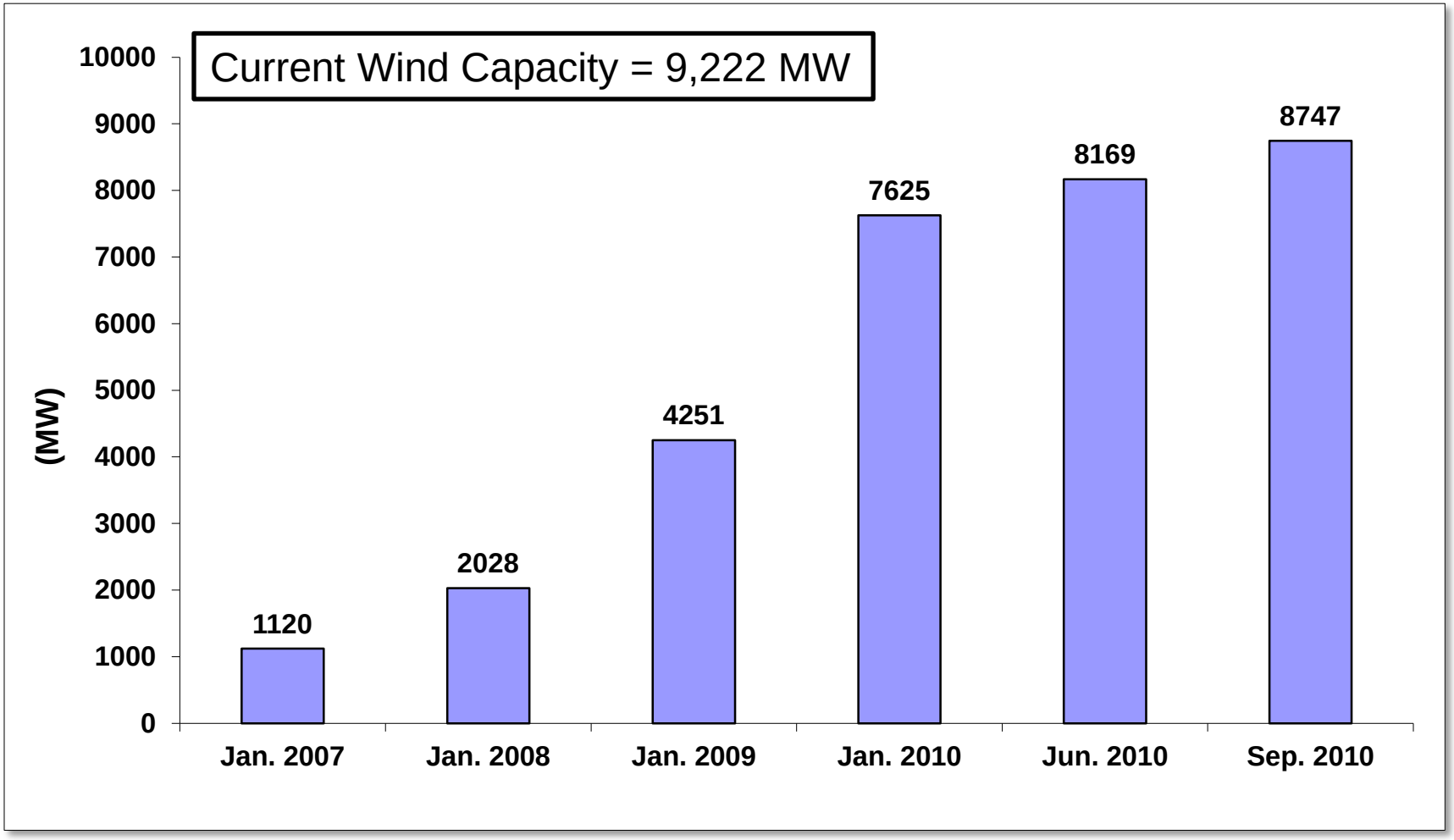
Wind Generation Growth in Midwest ISO



Note: 63% of wind capacity has Non-Firm transmission service

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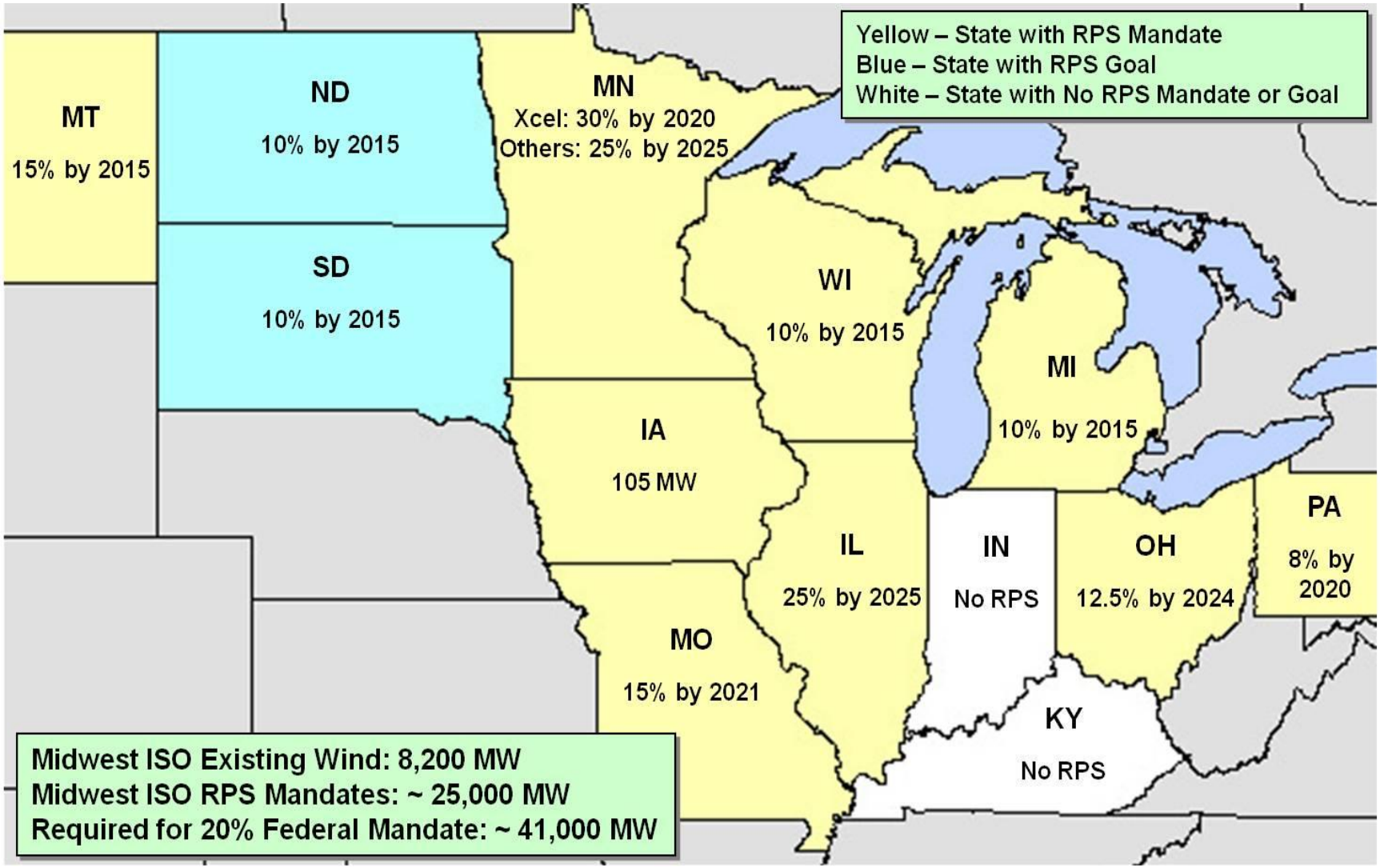
Midwest ISO States – RPS Requirements



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Wind Generation - Intermittency

Operational Issues

Wind Generation Currently Not in Dispatch

Implications

- Manual curtailments during congestion management
  - Since wind is not in the Midwest ISO RT co-optimization, it cannot be dispatched down automatically during congestion.
  - If wind generation is contributing to a constraint, it must be manually curtailed, if conventional generation alone can not solve the constraint.
  - During 2009 curtailments, the average LMP was nine dollars, even though Resources with marginal costs of negative twenty five dollars or below were being curtailed
- Generation surplus events
  - Wind generation peaks during light load periods at night. Committed generation during this time can be close to economic minimum limits, typically with coal on the margin.
  - Sudden large increase in wind output can create a situation with excess generation requiring decommitting generation units on the margin.
  - Decommiting these units results in the unavailability of the units for dispatch for an extended period of time. When wind output moderates and the decommitted units are unavailable, expensive gas units might need to be dispatched.

Dispatchable Intermittent Resource (DIR) Design Comparison

	Intermittent Resources Today	DIR Design Concept
DA Market Offer	Full Generation Resource Structure	Full Generation Resource Structure
DA Pricing	Eligible to set LMP	Eligible to set LMP
RT Market Offer	Not Available	Forecast Maximum Limit replaces Economic Maximum
RT Pricing	Not eligible to set LMP	Eligible to set LMP
RT Dispatch	Echo State Estimator; Manually Curtail/Dispatch	Co-optimized 5 min. market dispatch

Midwest DR Market Philosophy

- Markets work best when there is vigorous and voluntary participation by both buyers (demand response) and sellers
  - Demand response can reduce the need for new generating capacity
  - Demand response can address real-time reliability issues
  - Demand response can mitigate peak prices and price volatility
  - Demand response can limit supplier market power.

- Existing and planned Midwest ISO market structures seek to provide opportunities for demand to participate on a comparable basis as supply side resources
  - Ability to make consumption decisions based on the value of energy consumed relative compared to the prevailing market price
  - Ability to offer and fully monetize the value of flexibility that can be offered to dynamically balance market supply and demand

Midwest ISO Demand Response "Programs"

- The Midwest ISO currently has no demand side 'programs'
  - 'Programs' as used in some jurisdictions typically refer to temporary initiatives to promote a certain activity or action
  - 'Programs' also may provide side payments for participation; these side payments are funded by charges socialized across all Market Participants
  - The Midwest ISO approach has been to provide market mechanisms that provide opportunities and incentives for full demand participation
    - Some states in the Midwest ISO footprint have demand programs

Current Demand Response Participation

(as of February 28th)

DR Type	Max	Min	Avg
DRR I & II	46	46	46
DR	4,858	3,047	3,698
BTMG	5,689	5,015	5,306
EDR	357	357	357
Total	**10,950**	**8,465**	**9,407**

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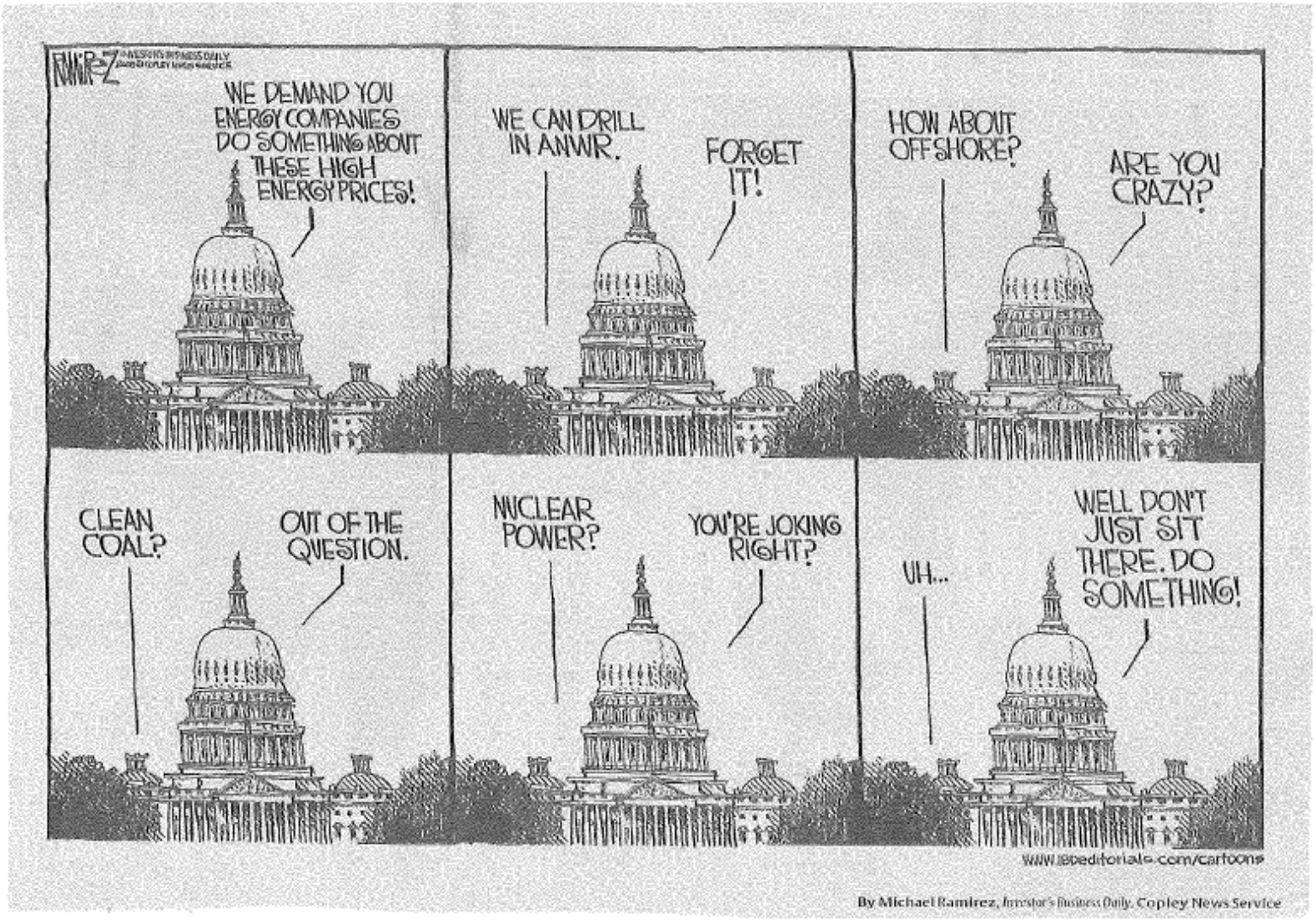
Demand Response (LMP) Order from FERC

- FERC Order 475 – March 15, 2011
- DR must be compensated for the service it provides to the energy market at the market price (or LMP)
- Seeking to provide comparable compensation based upon comparable service
- LMP is paid under conditions when it is cost-effective to do so, as determined by a net benefits test
  - Test that ensures the overall benefit of the reduced LMP that results from dispatching DR exceeds the cost of dispatching the DR)
- Other areas covered in the Order include Measurement and Verification (M&V) and cost allocation in order to pay DR LMP

ARC Participation Status

STATE	DOCKET #	STATUS AT COMMISSION
IL		ARC Participation approved per retail choice
IA	NOI-2008-0003	Order - temporarily prohibiting
IN	43566	Order -end-use customer via state regulated utilities can participate per the specific utility programs (not direct)
KY		Order - Banned
MI	U-16020	Order - Banned new, grandfathered current ARCs
MN	CI-09-1449	Order – Prohibits bidding into markets by non-utilities
MO	2010-187	Order - temporarily prohibiting
MT		Order - temporarily prohibiting
ND	PU-10-59	OPEN Docket – temporarily prohibiting
SD	EL-10-0003	Order – Prohibits ARCs in state
WI	5-UI-116	Order - temporary ban

Messaging



http://www.thedailyshow.com/watch/wed-june-16-2010/an-energy-independent-future

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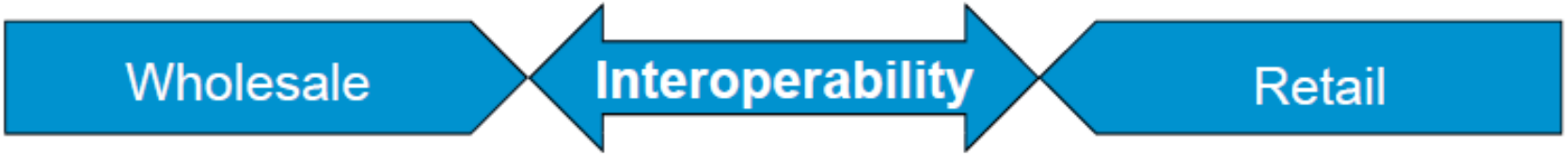
Technology Implications

- Significant development opportunities with new and undeveloped technologies
  - Compressed air energy storage (CAES)
  - Flywheels
  - Battery Storage (wholesale-scale)
  - PEV as storage?
- While current costs are not competitive with current generation and load alternatives, regulatory landscape can have an impact on both their need and operating characteristics
- Primary component that doesn't get a lot of attention is DATA

“SmarterGrid”: Synergies and Opportunities



Reliability
- Wide Area Visualization
- Congestion Management
- Transmission Automation

Generation Optimization
- Energy
- Regulation
- Reserves

Generation Portfolio Evolution
- Wind
- Solar
- Storage
- Demand Response

- ***Reliability***
- ***Incentives***
- ***Alignment***
- ***Data***

Usage Modifications
- Price Responsive Demand
  - *Consumer* choice
- Direct Load Control – Utility choice
- Direct Load Control – Wholesale dispatched

Transportation Electrification
- PHEVs
- EVs

Smart Distribution
- Outage Analysis
- Automated Switching

Usage Monitoring – AMI / Smart Meters

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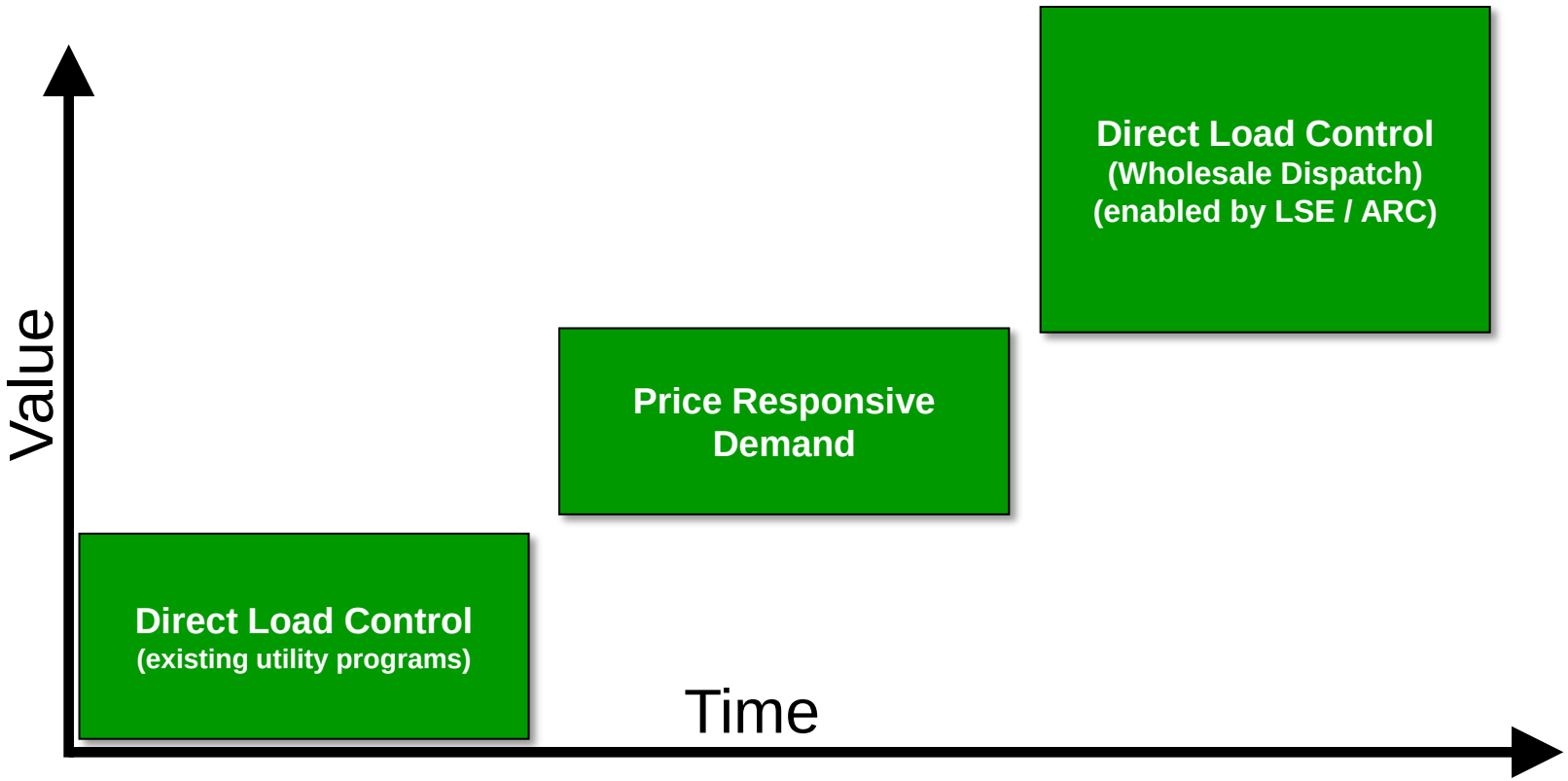
DR Value – Enable Load to Deploy Like Supply



Advantages/ Benefits:

- Peak shaving
- Emergency Response

- Energy efficiency
- Peak shaving
- Valley filling

- Peak shaving
- Valley filling
- Ramp management
- Regulation provider
- Operating reserves provider
- Uncertainty management

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Summary

- Significant challenges exist when developing reliability and market mechanisms for both traditionally-regulated states and retail choice states
  - Capacity construct methodology
  - Implementation of ARC
  - Different cost recovery mechanisms and operating characteristics

- Demand Response (DR) receives comparable treatment in the Midwest ISO, with future emphasis placed on:
  - Price Responsive Demand (PRD) and storage/new technologies
  - SmarterGrid: data, interoperability, pricing
  - Market improvements in energy and ancillary services markets
  - Incorporation into planning and development horizons