



# PJM's Wholesale Electricity Markets: Historic Performance and Challenges/Opportunities Ahead

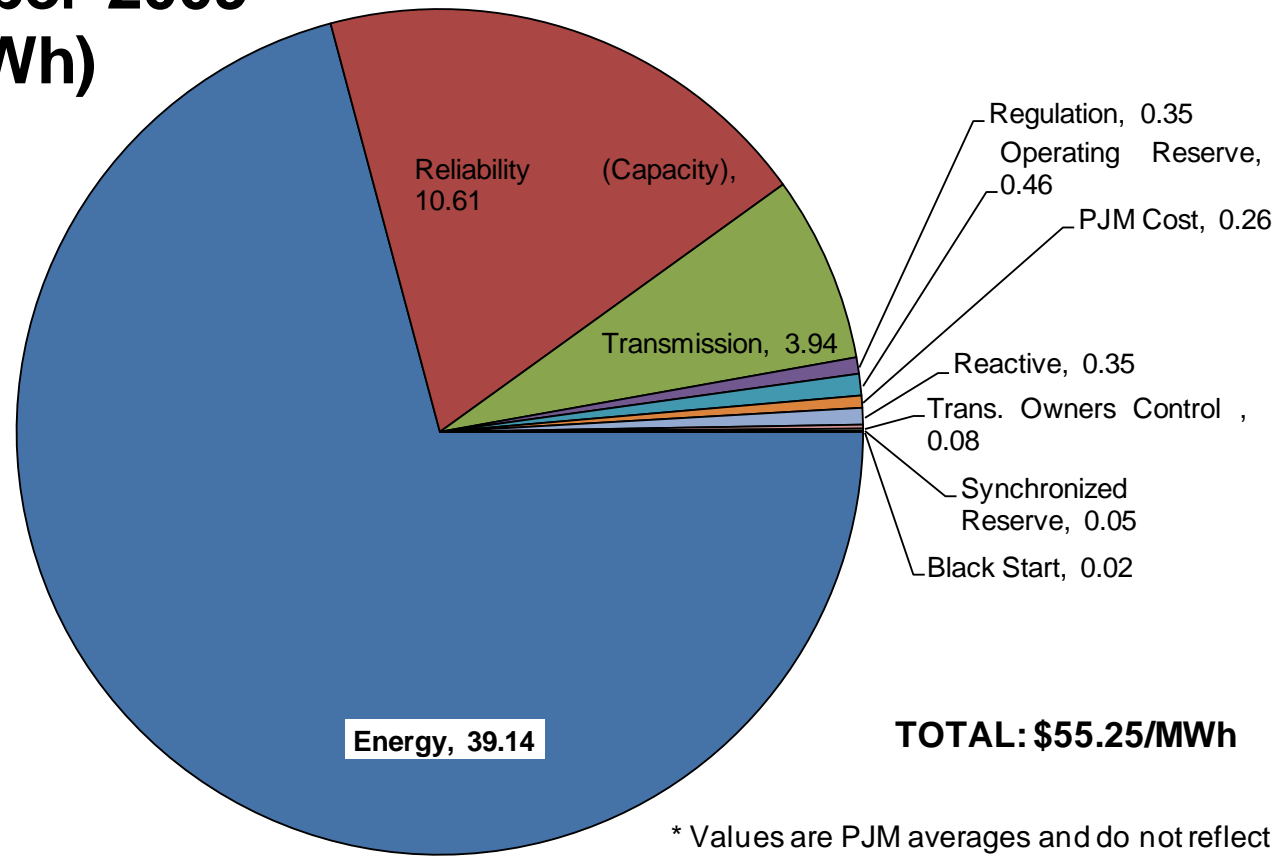
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PJM Interconnection

- Overview of wholesale market costs
- Energy market performance
- Capacity market performance
- Demand response and Smart Grid in PJM's markets
- Future Challenges
  - Climate Change Policy
  - Renewable Energy Integration
  - Smart Grid/AMI

## PJM Wholesale Cost YTD October 2009 (\$/MWh)

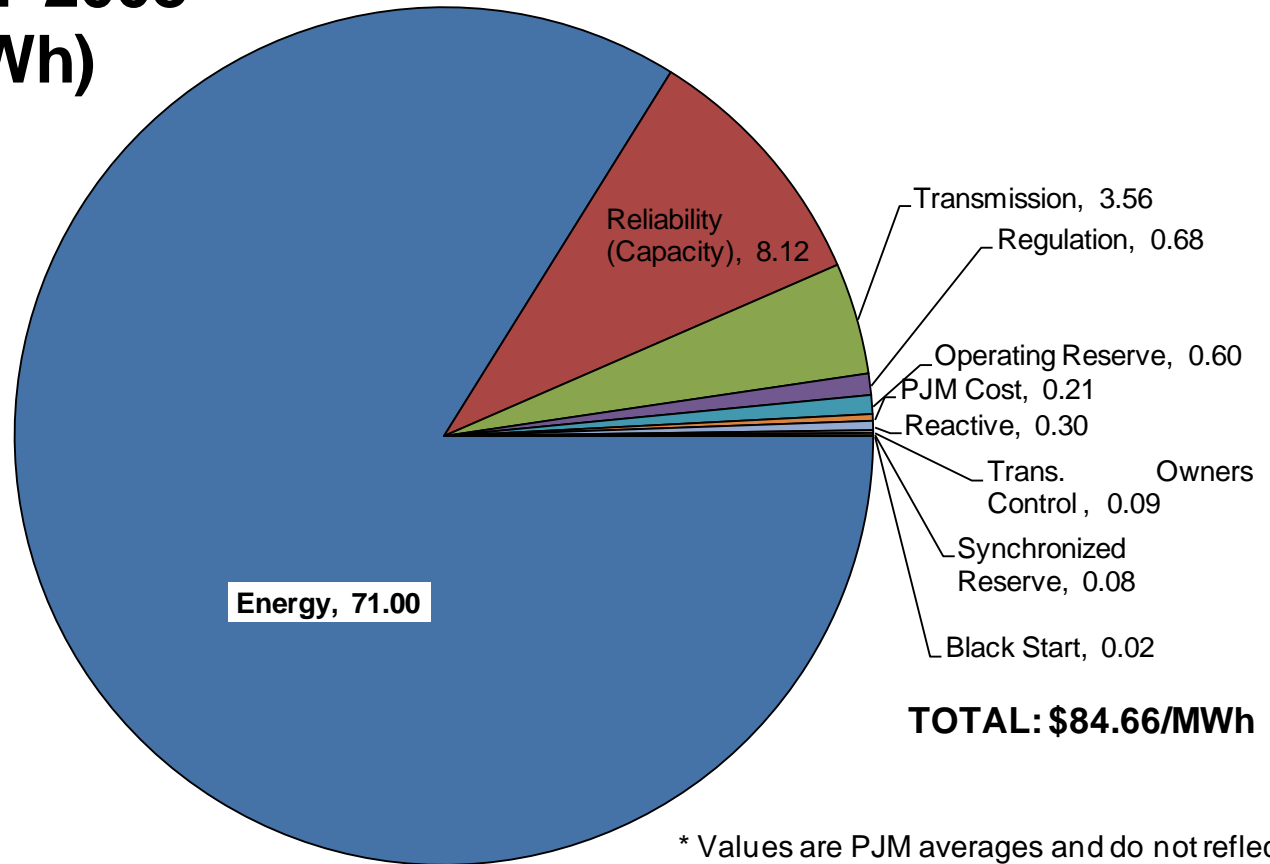
Energy: 71%  
Capacity: 19%  
Transmission: 7%



\* Values are PJM averages and do not reflect potential locational cost differences.

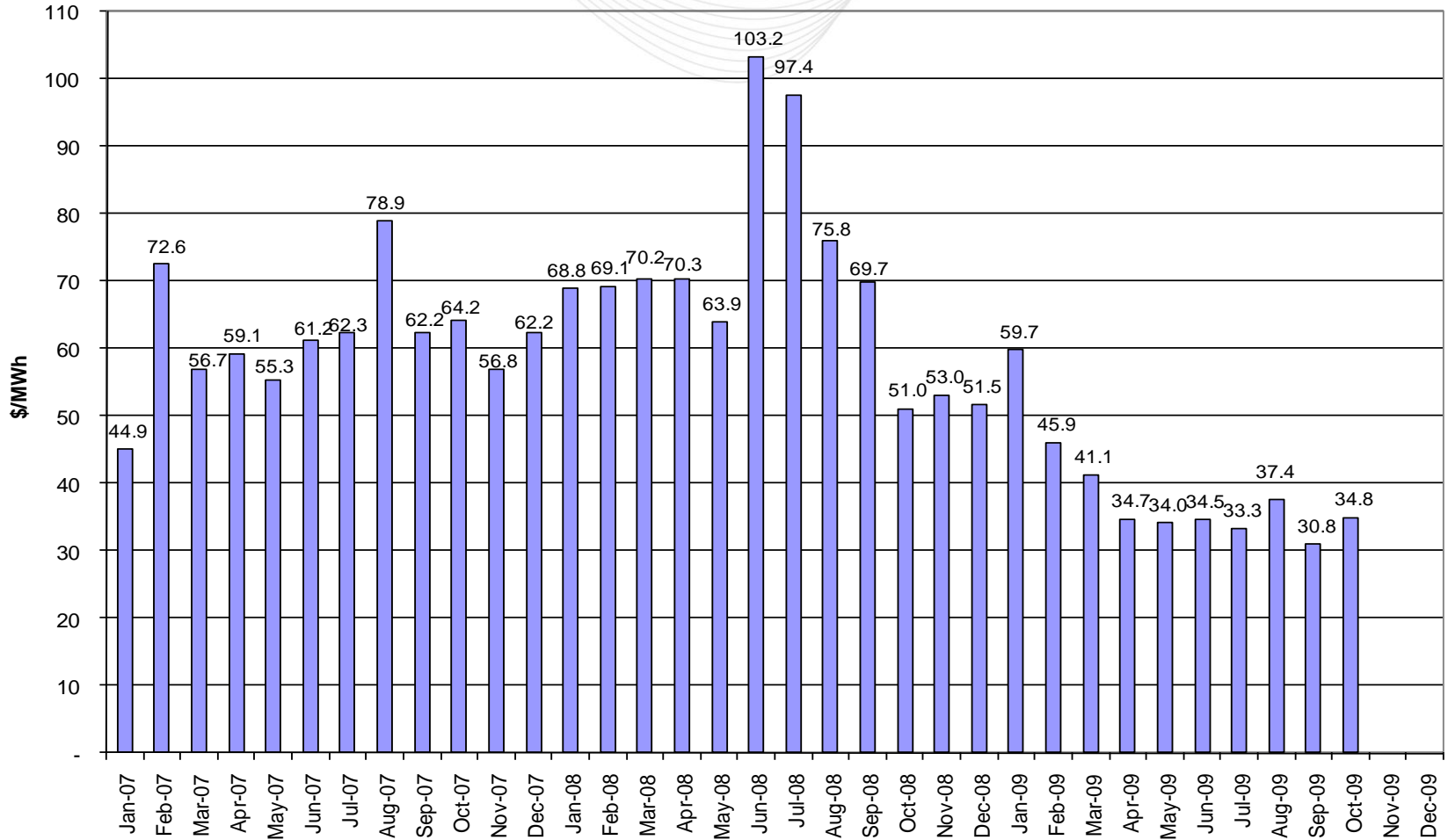
## PJM Wholesale Cost Full-Year 2008 (\$/MWh)

Energy: 84%  
Capacity: 10%  
Transmission: 4%

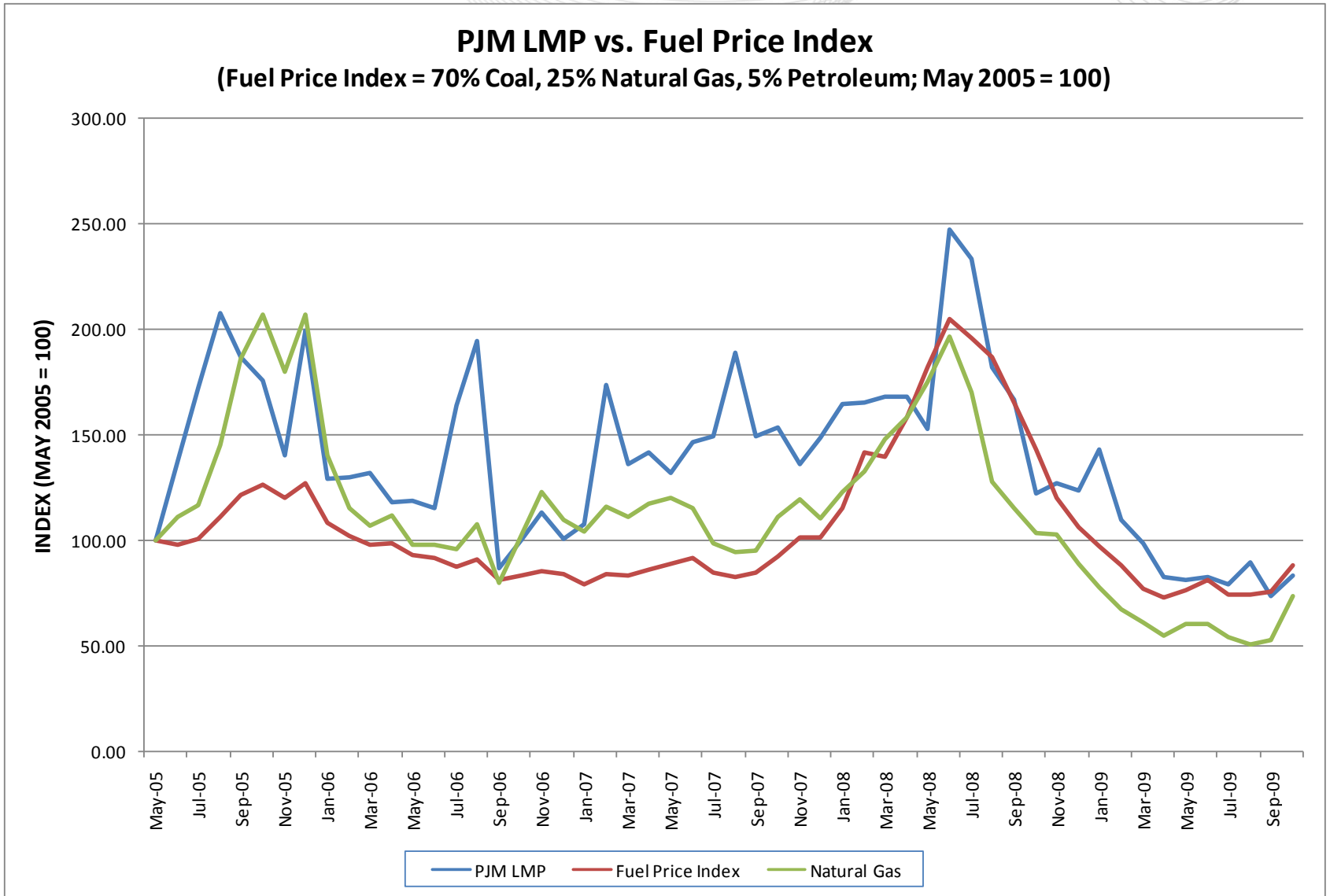


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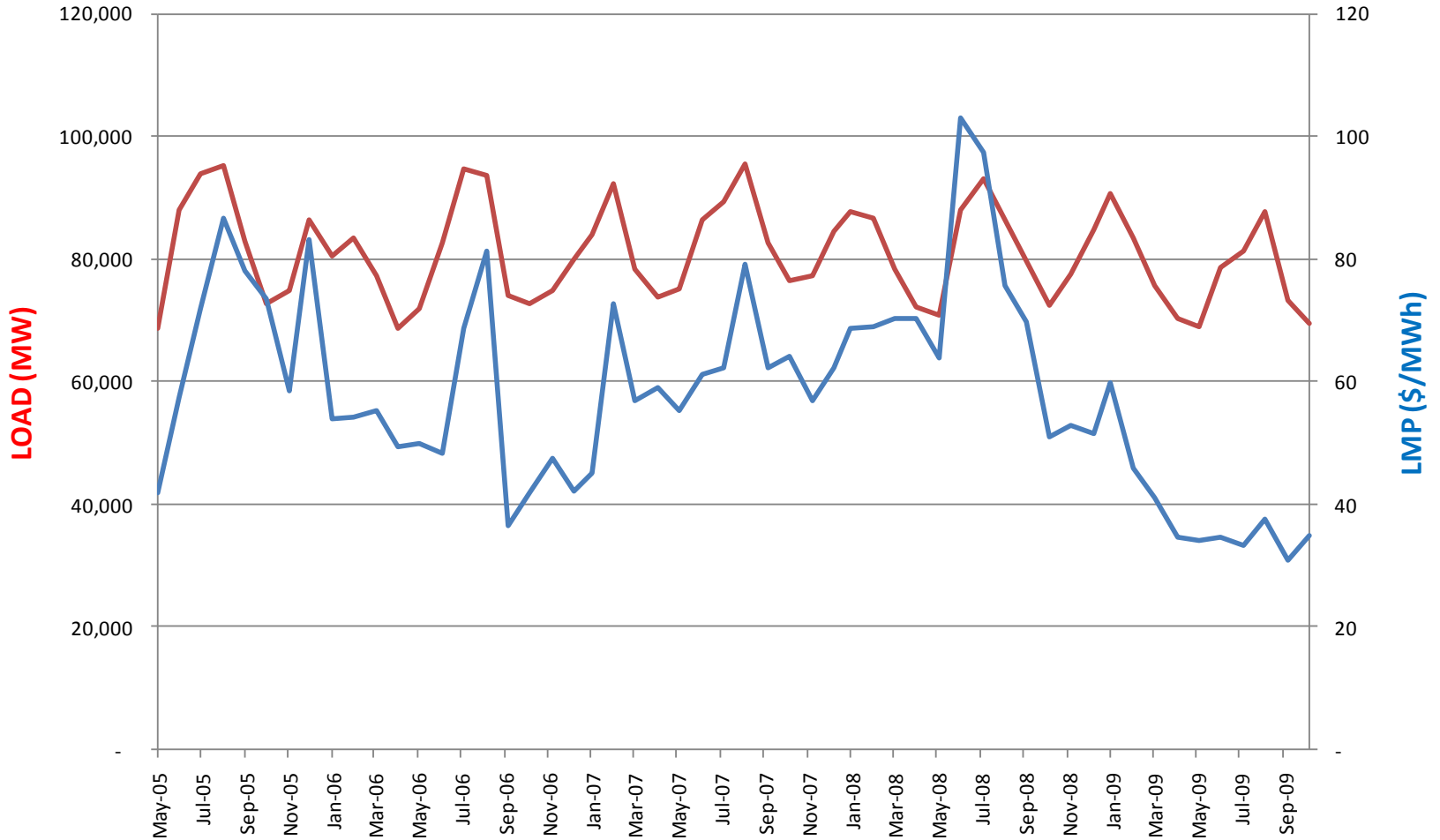
## PJM Load-Weighted Average LMP 2007-2009



Prices are back at 2003 levels today with low fuel prices and declining demand

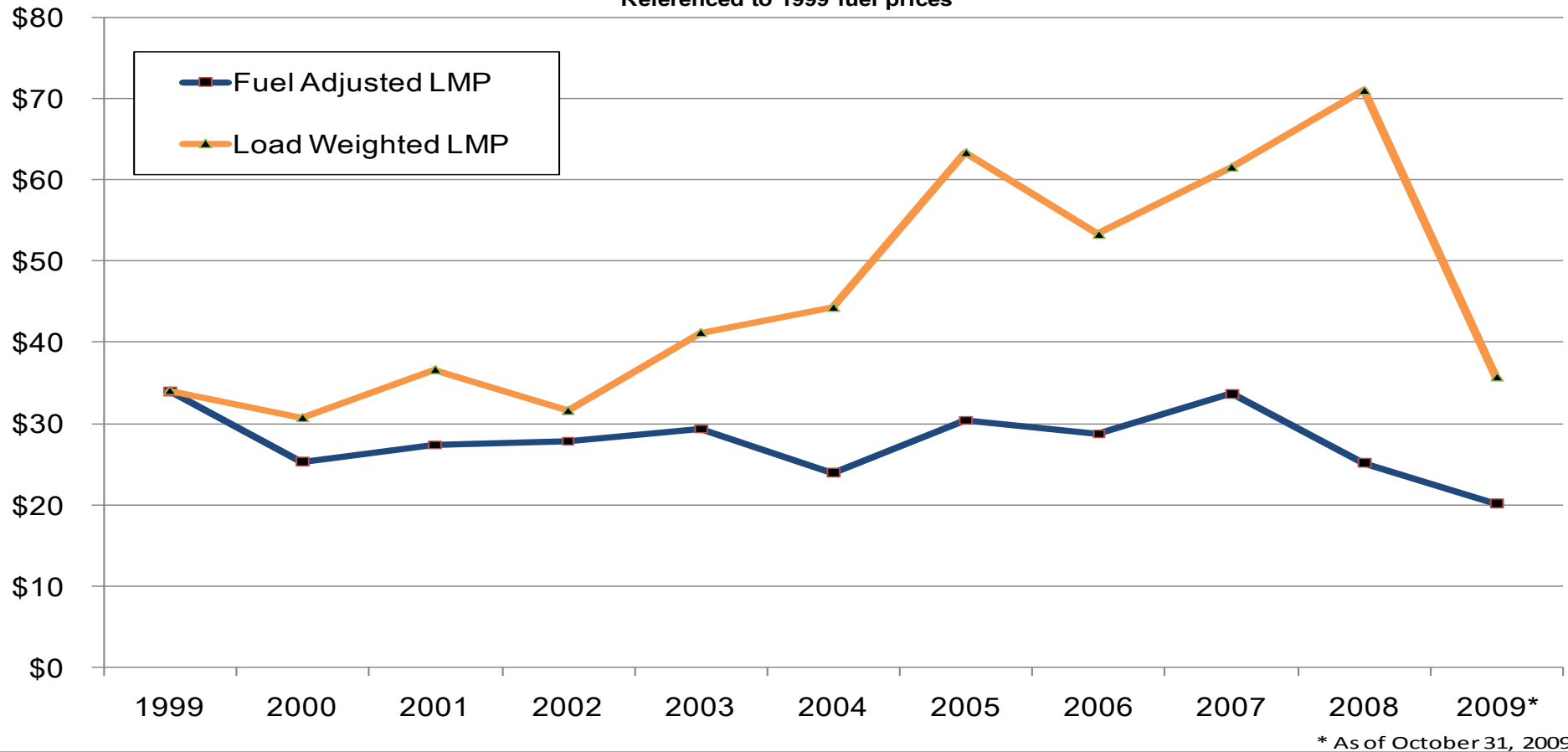


## PJM Average Hourly Load vs Load-Weighted Average LMP



Average hourly loads down 1.7% and 4.6% in 2008 and 2009

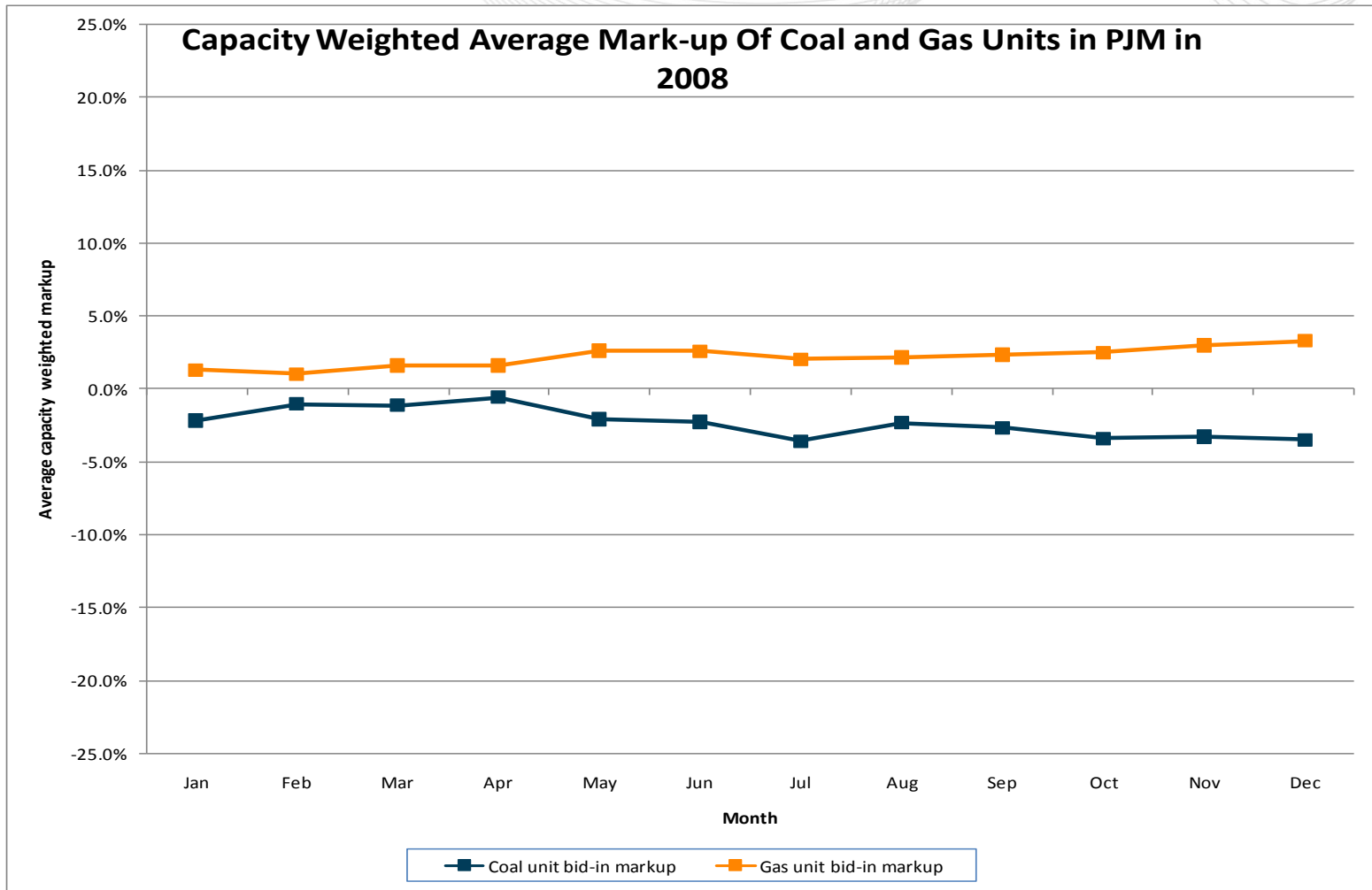
**Fuel Cost-Adjusted LMP**  
Referenced to 1999 fuel prices



\* As of October 31, 2009

Changing fuel mix, improved nuclear and overall fleet performance, integrations, and demand growth are all factors





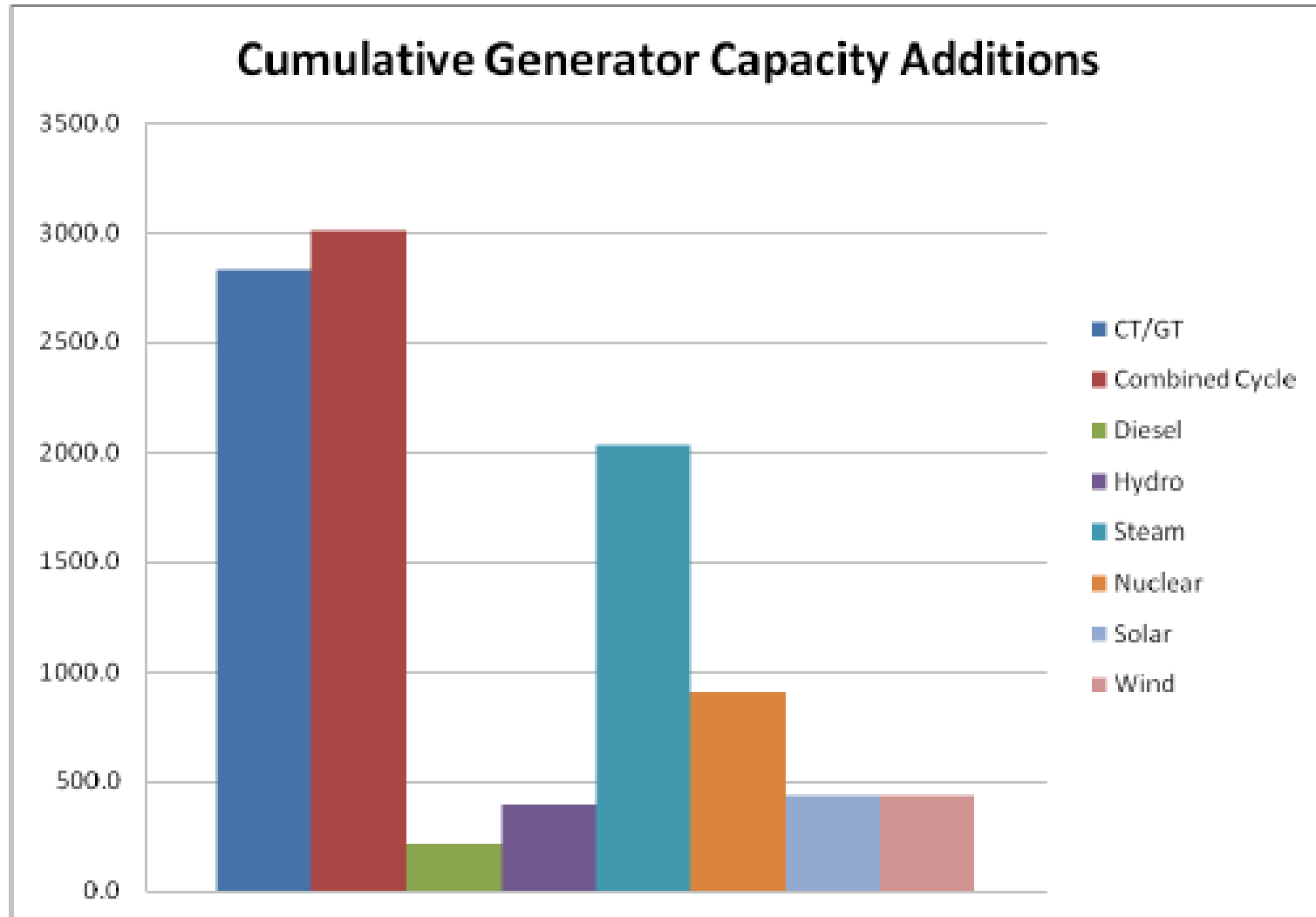
Overall mark-ups in 2009 are negative year-to-date.

LDA	CT		Steam		Diesel	
	Offer capped MW	Offer capped run hours	Offer capped MW	Offer capped run hours	Offer capped MW	Offer capped run hours
EMAAC	23.1%	22.9%	0.1%	0.4%	3.4%	8.9%
RTO	5.5%	5.6%	0.0%	0.1%	3.3%	1.8%
SWMAAC	49.6%	53.1%	0.4%	0.6%	3.3%	1.8%
WMAAC	64.3%	52.0%	0.4%	0.6%	22.5%	2.5%

## Market-wide Offer Capping:

DA Energy Market 0.2% of unit hours

RT Energy Market 1.0% of unit hours



Change in Capacity Availability	Installed Capacity MW
New Generation	5056.6
Generation Upgrades (not including reactivations)	4258.2
Generation Reactivation	529.7
Forward Demand and Energy Efficiency Resources	10167.1
Cleared ICAP from Withdrawn or Canceled Retirements	3644.6
Net increase in Capacity Imports	3984.5
<b>Total Impact on Capacity Availability in 2012/2013 Delivery Year</b>	<b>27640.7</b>

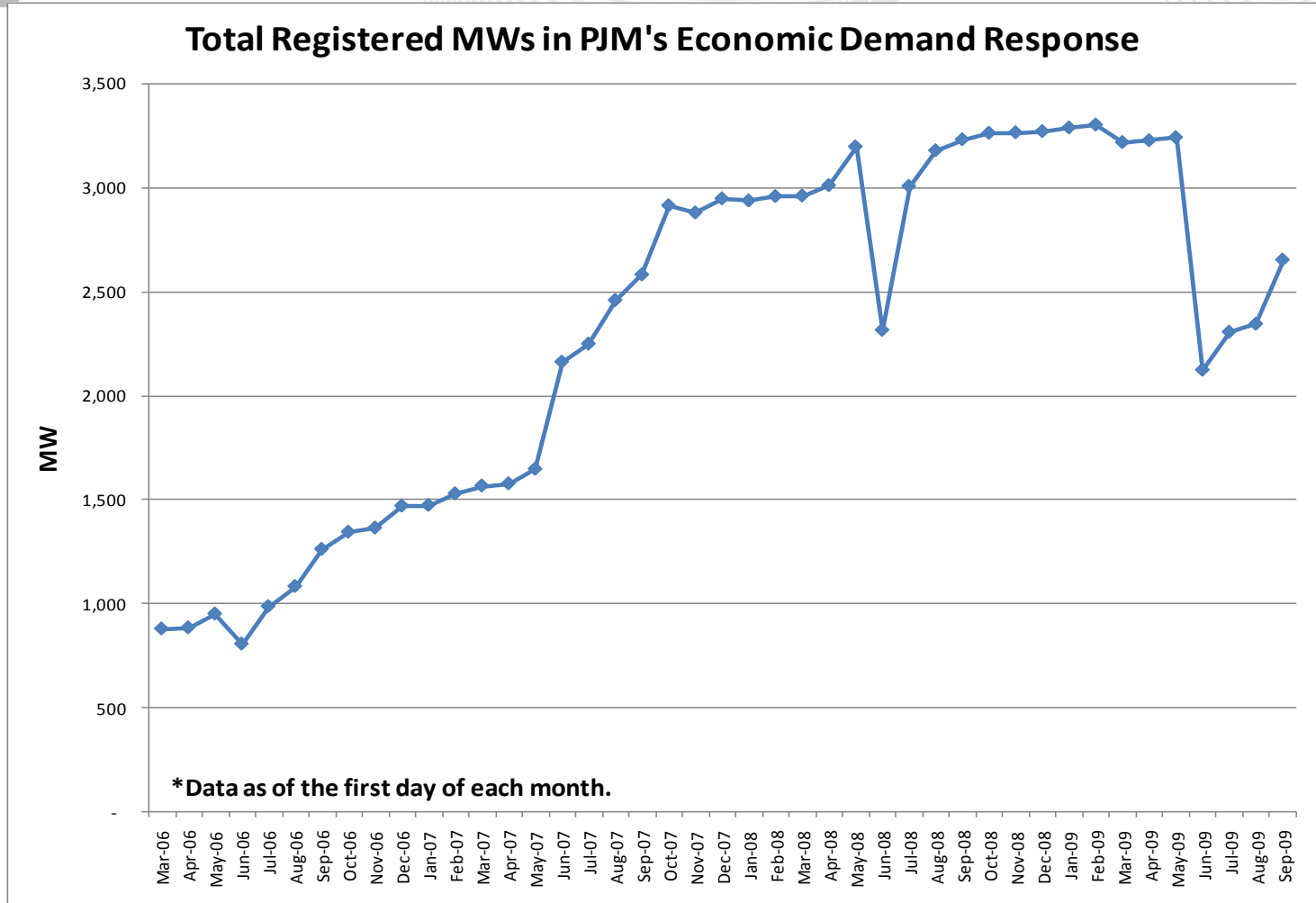
Customer goal is to manage energy costs by:

- Reducing or shifting consumption away from high price periods
- Committing to reductions for reliability needs

From an operational perspective it is:

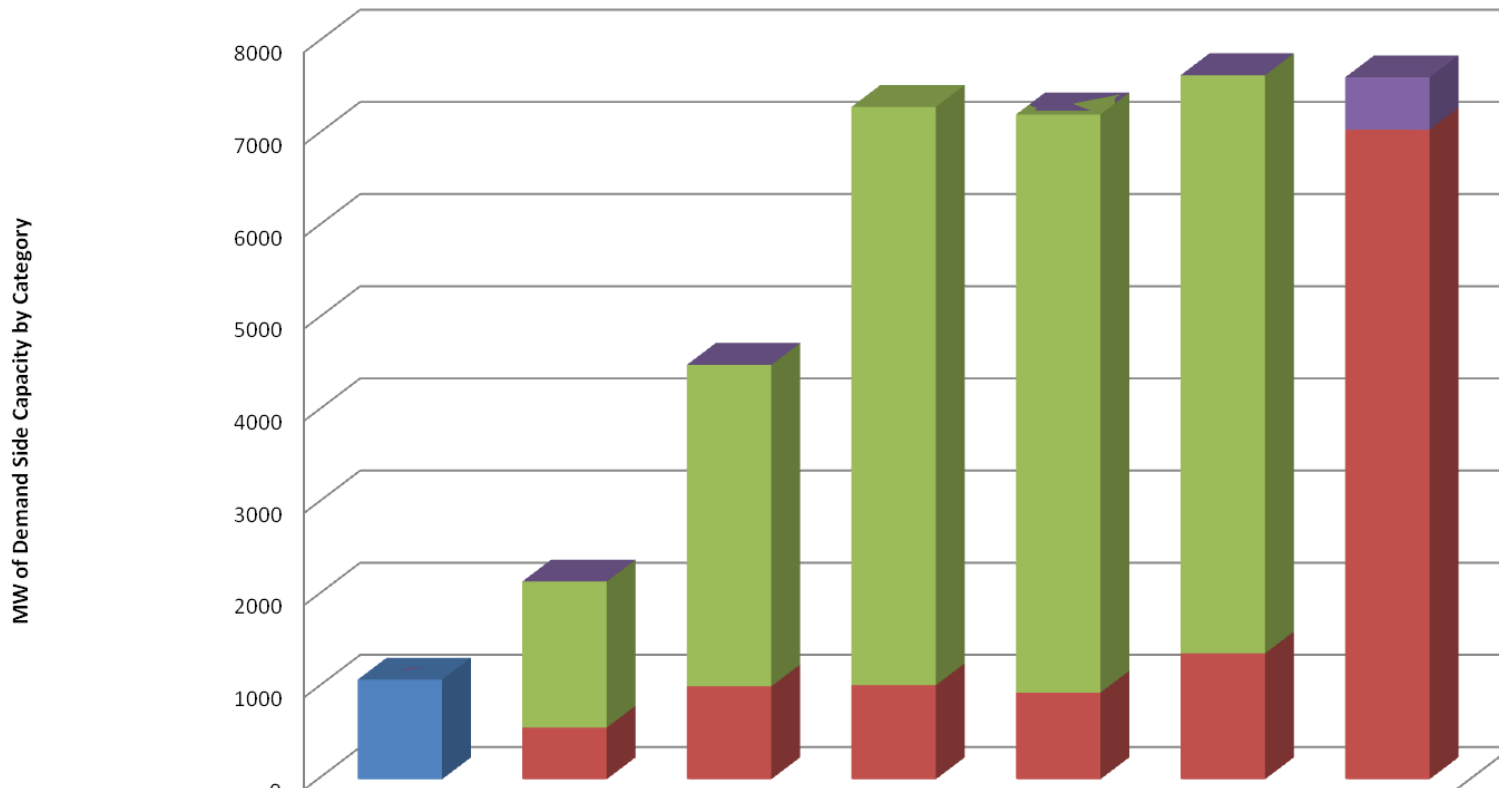
- consumer ability to change consumption in response to energy market prices
- consumers ability to reduce consumption to meet system needs during an emergency





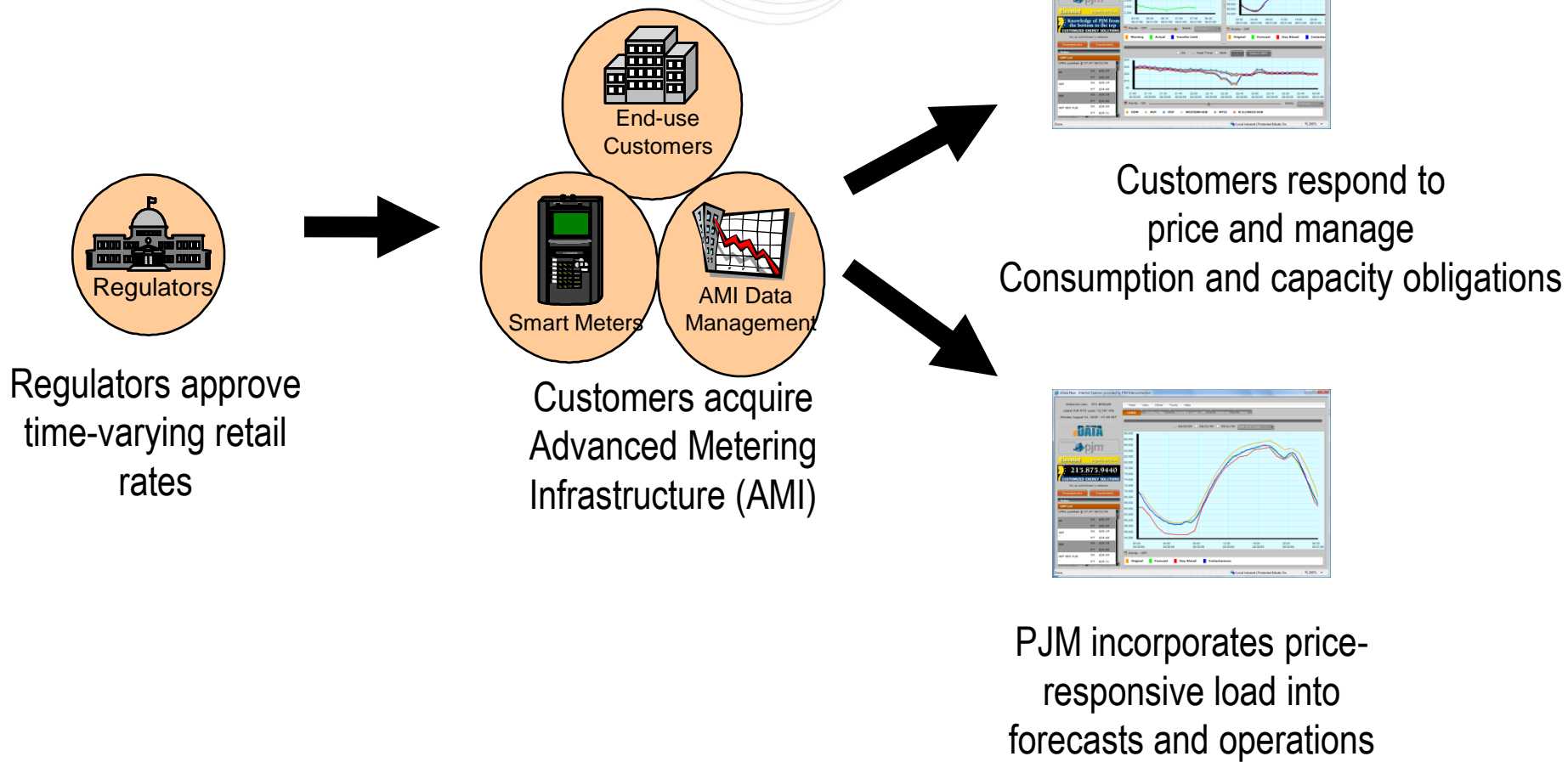
Dips in June are due to re-registration requirements. Registrations have fallen off from their highs with low LMPs are far fewer opportunities to respond.

## Participation of Demand-side Resources as Capacity in PJM by Delivery Year



	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
Energy Efficiency	0	0	0	0	0	0	568.9
ILR	0	1584.6	3488.6	6274	6274	6274	0
DR (RPM Auction plus FRR)	0	560.7	1007.9	1021	939	1364.9	7047.3
ALM (Pre-RPM)	1081	0	0	0	0	0	0

# Price Responsive Demand: The Long-Term Vision for DR

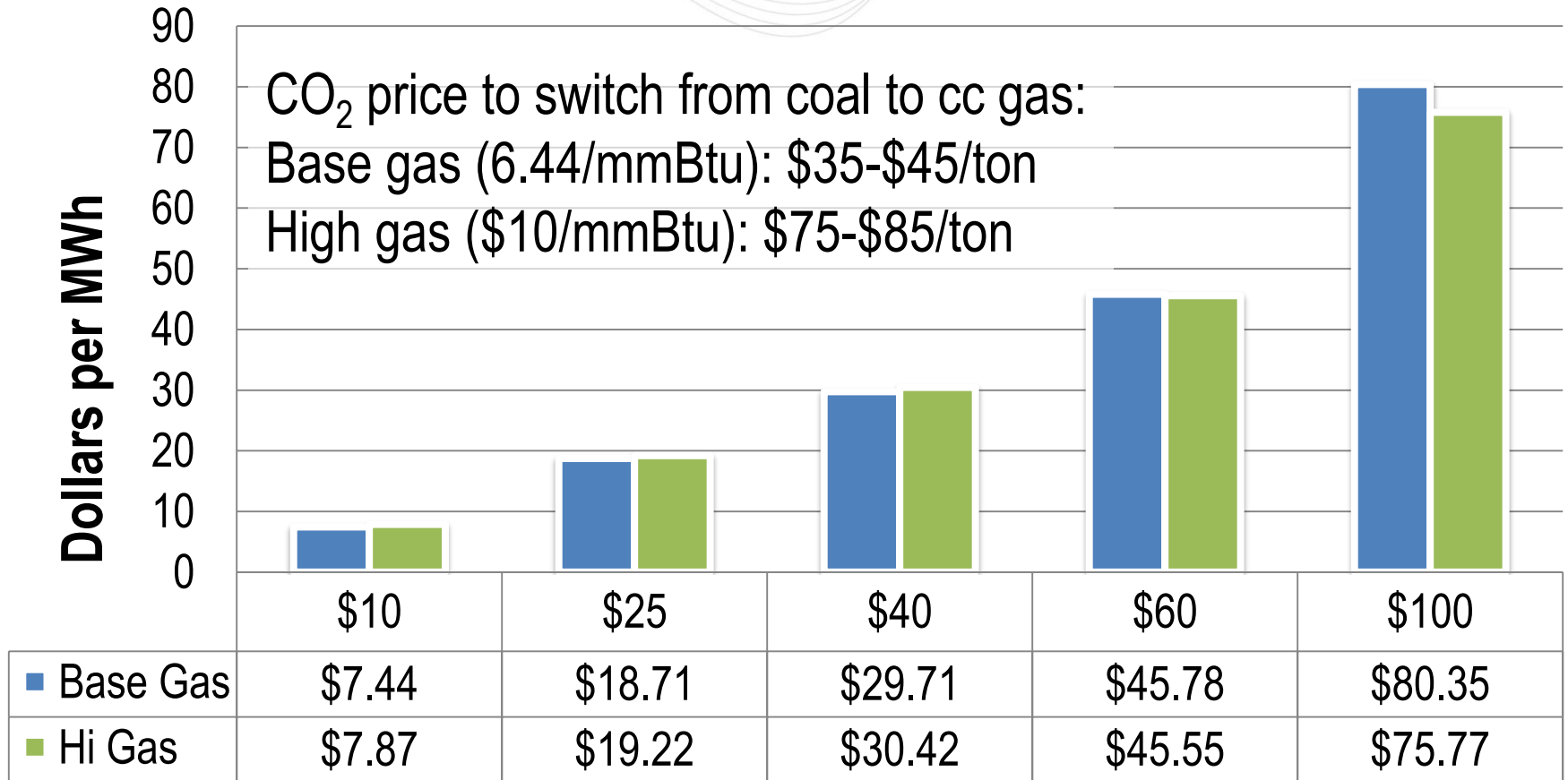




- Smart meter allows car to roam
- Mid-Atlantic Grid Interactive Car Consortium (MAGICC)
- **Over one year experience**

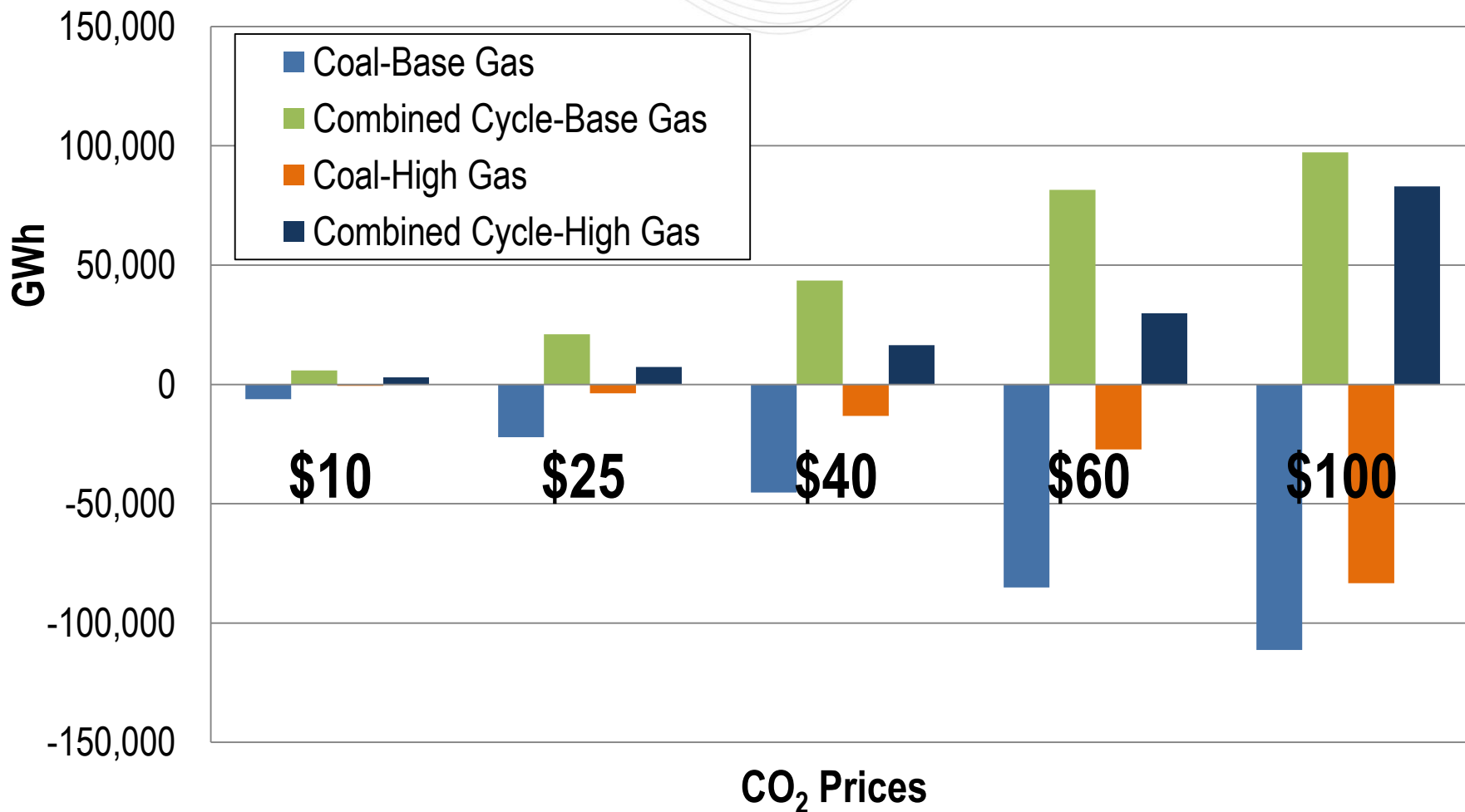


## LMP Increase by CO<sub>2</sub> Price and Gas Price



Approximately 75-80% of CO<sub>2</sub> price is transmitted to load-weighted Average LMP.

### Change in Coal and Combined Cycle Generation by CO<sub>2</sub> Price

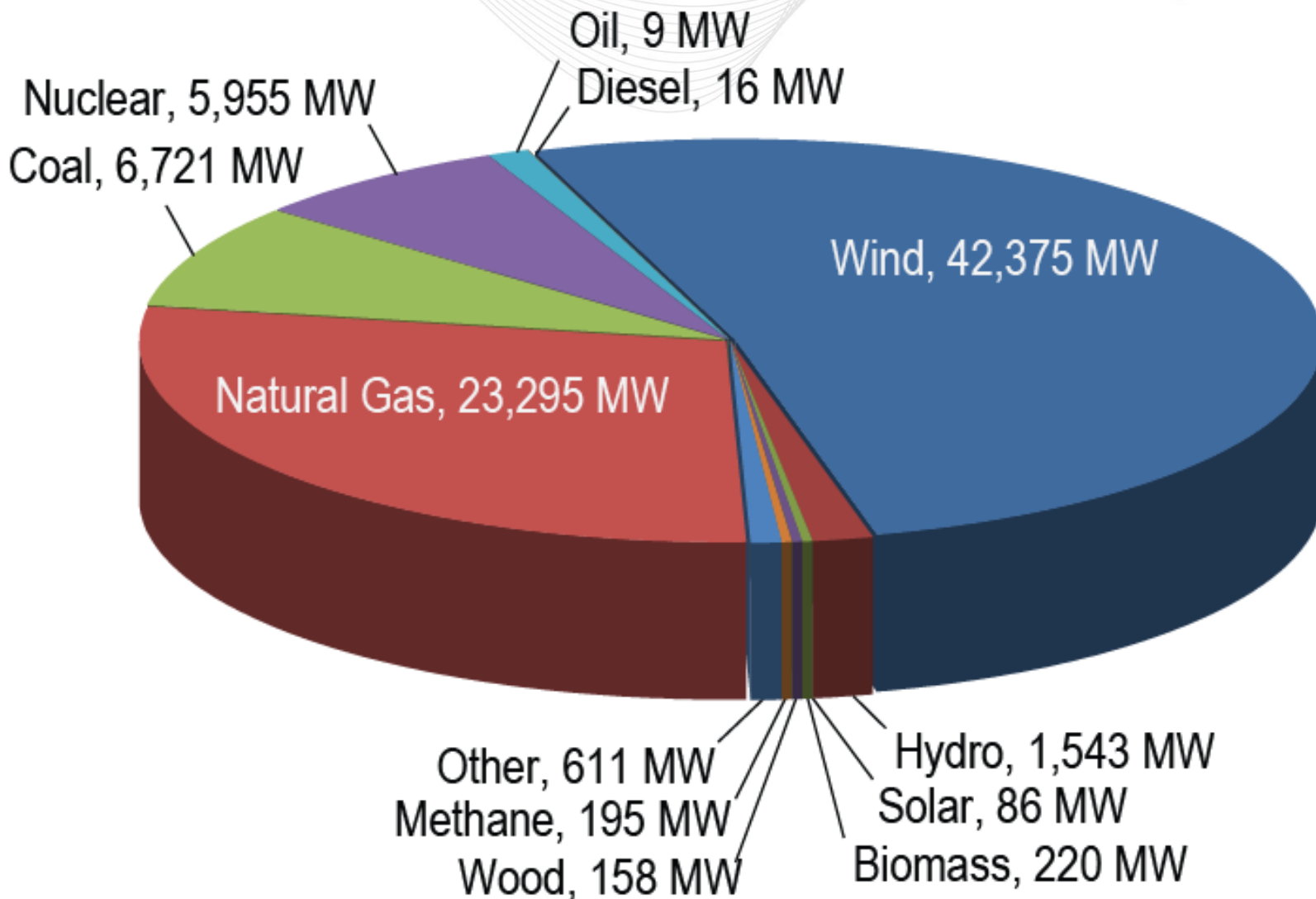


## Generation Displacement, Emissions Reductions, and Price Reductions Achieved

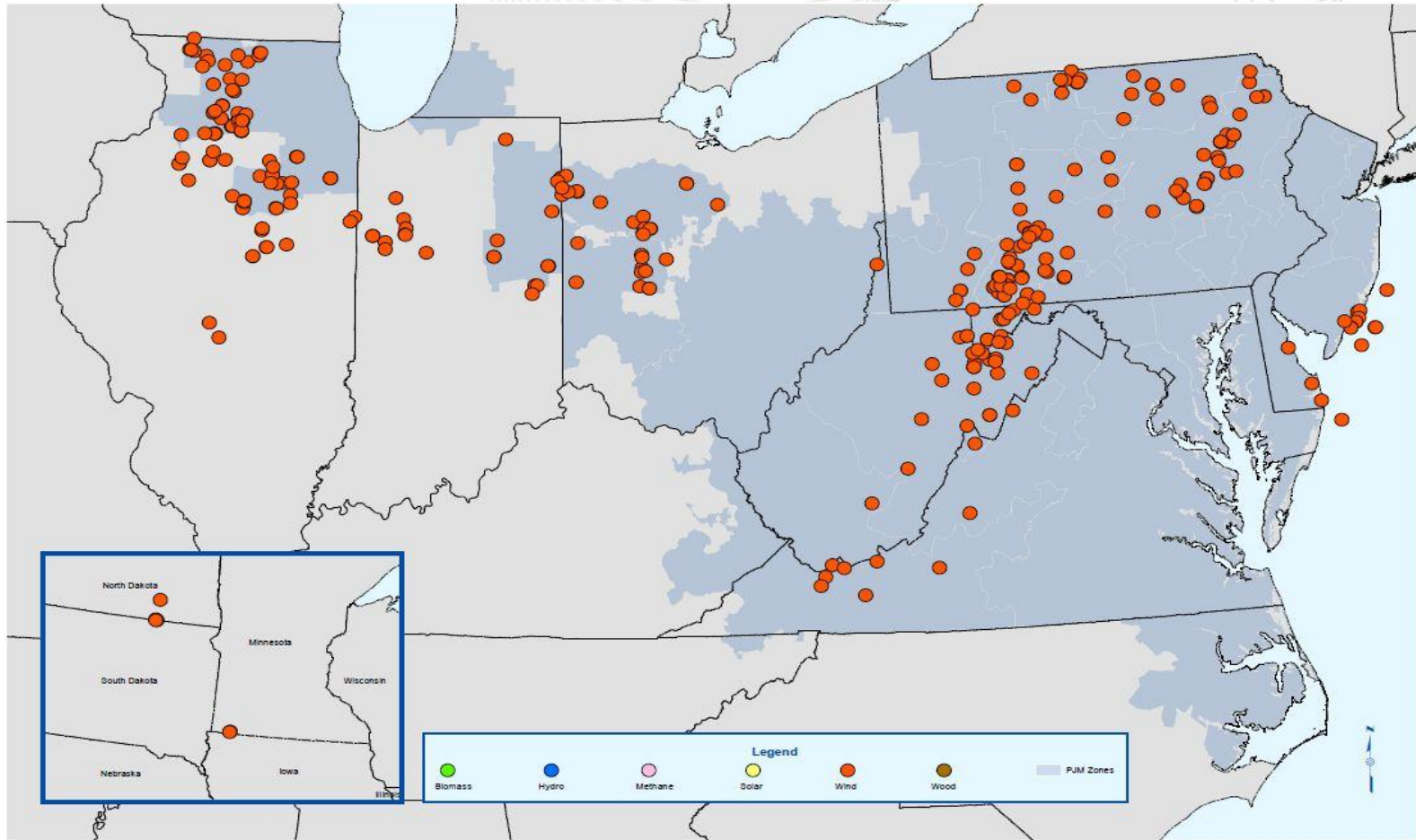
	Load Reduction Percentage			15 GW Wind
	2%	5%	10%	
Coal	6,741 GWh	18,376 GWh	41,972 GWh	26,303 GWh
Combined Cycle Gas	6,555 GWh	15,685 GWh	28,587 GWh	13,009 GWh
Additional CO <sub>2</sub> Reductions (tons)	10-14 million	29-34 million	58-64 million	34-37 million
LMP (\$/MWh)	\$2 - \$4	\$5 - \$9	\$11 - \$17	\$5 - \$5.50

- Displaced generation is at a \$0 CO<sub>2</sub> price in the base gas case only.

# Generation in the Interconnection Queue, August 2009

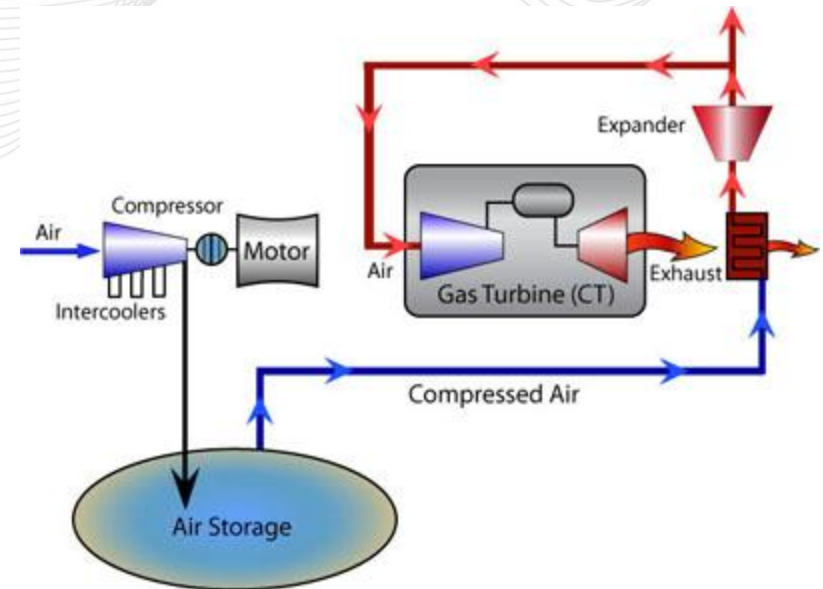






As of 10/1/2009 there was 2,542 MW of wind in-service operating at a 26% capacity factor in 2009

- PSE&G Power is evaluating projects to develop, design, construct and operate CAES
- PJM analyzing accommodating CAES capabilities in existing PJM market structure
- If in the right location CAES could help integrate wind and take full advantage of the “low fuel cost” of wind



Alabama Electric Cooperative 110 MW  
McIntosh compressed air storage power  
plant



## Operational Details

- Altairnano, Inc – Li-Ion nano titanate battery
- Energy: 300 kWh
- Power: 1 MW for 15 minutes
- Efficiency: 90% round trip
- Usable Charge Range: 5-99%
- Good Resource for Regulation



- Markets are working:
  - Energy markets follow supply/demand fundamentals
  - Market power has not been a factor in price formation
  - RPM has attracted “new” capacity resources as designed
  - Demand-side is becoming and ever larger factor in wholesale markets
- Challenges and opportunities ahead:
  - Climate change policy impacts loom large as do ways in which to mitigate those impacts
  - Continued expansion of demand response through smart grid/AMI deployment
  - Renewable energy and alternative technology integration can take advantage of smart grid and climate change impacts
  - Market design provides a robust foundation to help meet the next challenges and take advantage of future opportunities