Integrating Price Responsive Demand

Commissioner Paul A. Centolella
Public Utilities Commission of Ohio

PJM Demand Response Symposium

November 10, 2009

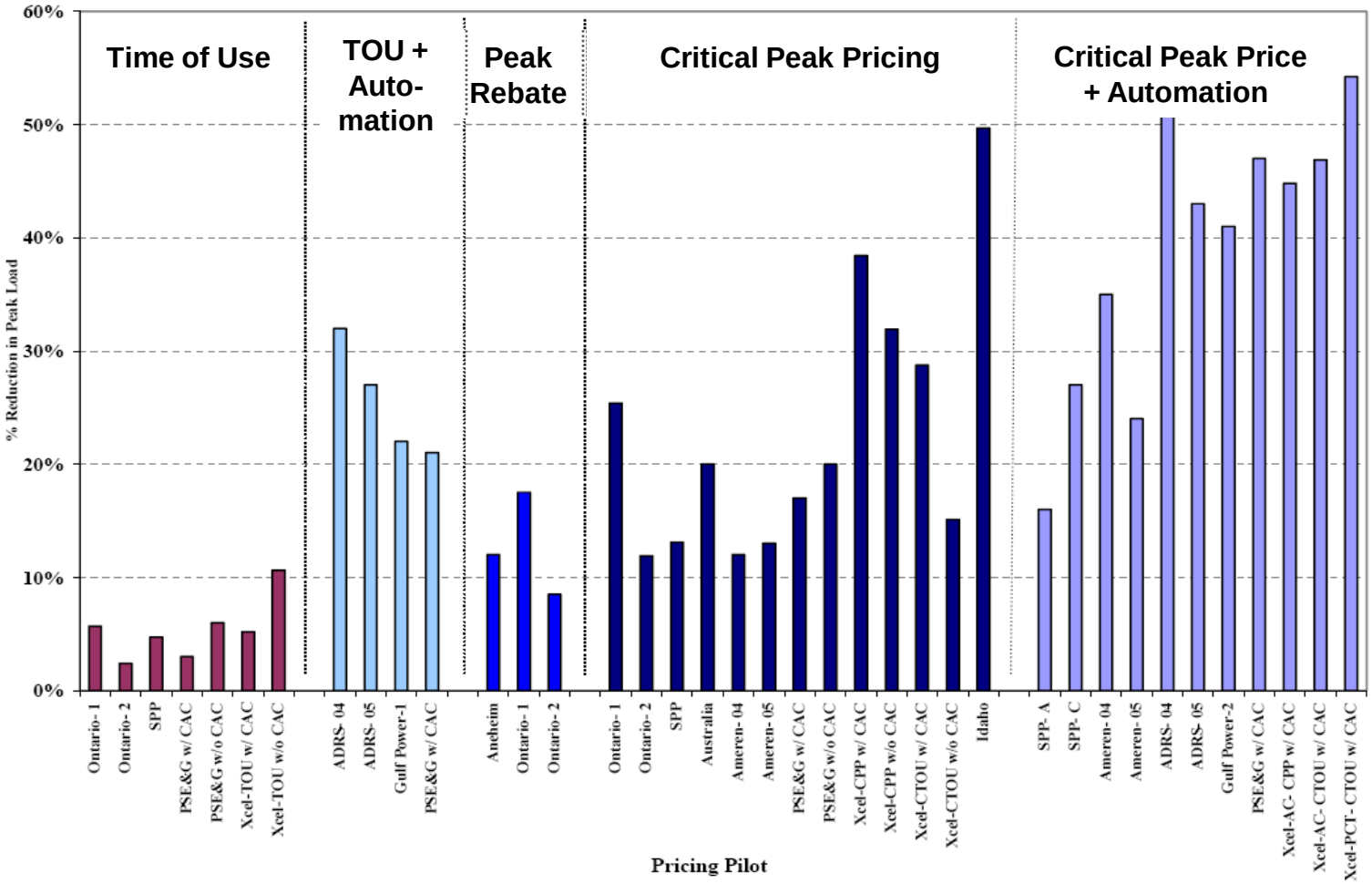
The views expressed herein are my own and should not be regarded as an opinion regarding the merits of any pending cases.

Key Challenges

- Globalization
- Rising costs & uncertainty related to new generation
- Power demands of digital applications & electric vehicles
- Integration of variable renewable generation
- Significant reductions in Greenhouse Gas Emissions

Affordably meeting growing demand for energy services, while sharply reducing carbon emissions, will require empowering & engaging consumers with efficient pricing.

Estimated Household Demand Response



Source: A. Faruqui & S. Sergici, *Household Response to Dynamic Pricing of Electricity A Survey of Seventeen Pricing Experiments* (2008)

Price Responsive Demand

- The Predictable Response to Changes in Wholesale Prices by Consumers on Dynamic or Time-Differentiated Retail Pricing
  - Examples: Critical Peak, Critical Peak Rebate, & Real-Time Pricing
- Necessary Coordination of Wholesale & Retail Markets
  - Mass Market PRD Will Not be Offered & Dispatched as a Resource
  - Expansion Depends Upon Significant AMI Investment
- Price Responsive Demand is Characteristic of Efficient Markets

Ohio's 2008 Electricity Law

- Price Responsive Demand
  - State policy to encourage time-differentiated retail pricing
  - Ohio Peak Demand Reduction Standard: 7.75% by 2018
- Smart Grid
  - State policy to encourage AMI
  - Authorized single issue & incentive ratemaking for grid modernization
  - Required development of distribution quality of service standards
- Energy Efficiency
  - Ohio Electric Efficiency Standard: 22%+ reduction by 2025

PUCO Supported Development of Dynamic Pricing

AEP Smart Grid Project Approval:

"For customers, the ability to have real-time price information and the ability to respond to such prices means that they may develop consumption patterns that both save them dollars while helping the utilities shave their peaks. … The essence of this project is an infrastructure that embraces the following elements: advanced metering, dynamic pricing, information feedback to consumers, automation hardware, education, and energy efficiency programs."

- AEP Electric Security Plans, Case No. 08-917-EL-SSO, Entry On Rehearing (July 23, 2009)

Price Responsive Demand in Ohio

- AEP: Approved Phase 1 Smart Grid deployment, includes
  - 110,000 Advance Meters and the direction to develop dynamic pricing
  - ARRA Smart Grid Demonstration Grant application pending
- DP&L: pending case
  - Company proposing Territory-wide AMI & Home Energy Display rollout
  - Company proposing Critical Peak and Critical Peak Rebate pricing
- First Energy: Commission Supported ARRA application, includes:
  - Year 1: 5,000 customer peak time pricing experiment
  - Year 2: Expands to 44,000 customers based on Year 1 findings
  - ARRA Investment Grant Award: $36 million for Ohio
- Duke Energy Ohio: Approved Smart Grid deployment
  - 50,000 electric Advanced Meters deployed in 2008
  - Advanced Meters to be deployed throughout service territory within 5 years
  - Company proposing Critical Peak Pricing pilot & initiated collaborative
  - ARRA Investment Grant Award: $100 million for Ohio

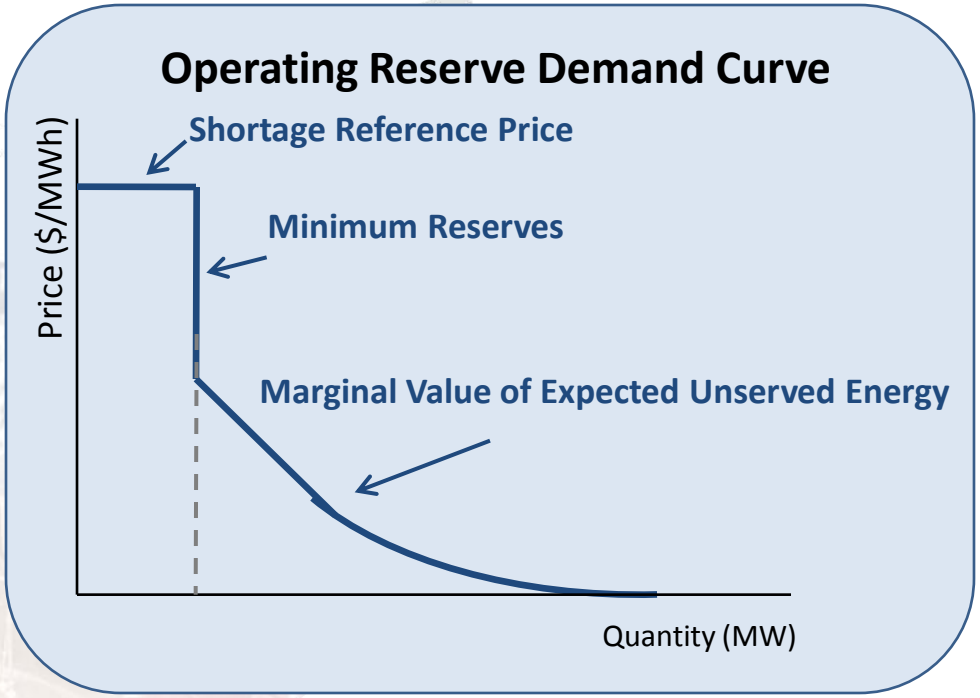
Integrating PRD in PJM Markets & Operations: The Package of Necessary Elements

- Use Transparent Forecast Demand Curve based on Statistical Relationship of Price & Demand in Capacity Markets, Planning, & Operations
- Scarcity Pricing Reform: Operating Reserve Demand Curve based on the Value of Reserves to Consumers
- Synchronize Capacity Market and Scarcity Pricing so Capacity is a Hedge against Scarcity Prices: i.e. Loads with Adequate Capacity Avoid Scarcity Prices & Resources Cannot Receive Capacity & Scarcity Payments
- Adequacy & Choice: Price Responsive Loads must have Capacity for their Firm Demand after PRD & the Option to Hold Additional Capacity
- Capacity Emergency Procedures: Non-discriminatory Curtailment based on relative Capacity Deficiency

See: P. Centolella & A. Ott, *The Integration of Price Responsive Demand into PJM Wholesale Power Markets and System Operations* (March 2009).

Operating Reserve Demand Curve

- At Minimum Reserves, Shortage Reference Price = Value of Load to Consumers who would be Curtailed
- Shortage Reference Price sufficient to Elicit Voluntary Reductions
  - Australian National Electricity Market: Approximately $6,800(US)/MWh
  - MISO Ancillary Services Market: $3,500/MWh
- Obtain Additional Reserves when Approaching Shortage Up to the Value of Expected Unserved Energy with Added Reserves

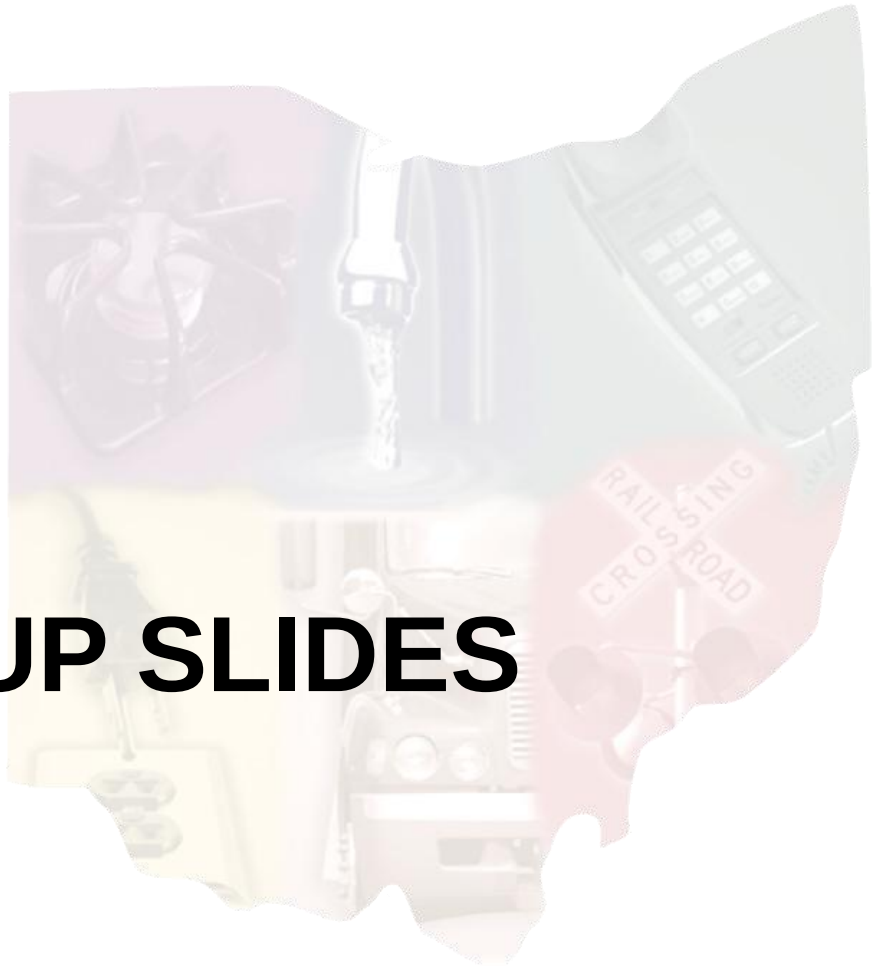


Reliability Benefits of PRD

- Beneficial Feedback: Price increases cause an offsetting demand reduction
  - Enhances reliability for any given level of reserves
  - Improves predictability of demand & power flows for operations
  - Facilitates integration of variable resources
- Mass market Price Responsive Demand statistically less variable than large customer demand response or generation
- AMI allows access to more load data, providing an opportunity to reduce forecast uncertainty
- AMI can measure & ensure targeted, rapid, & verifiable load reductions in emergencies

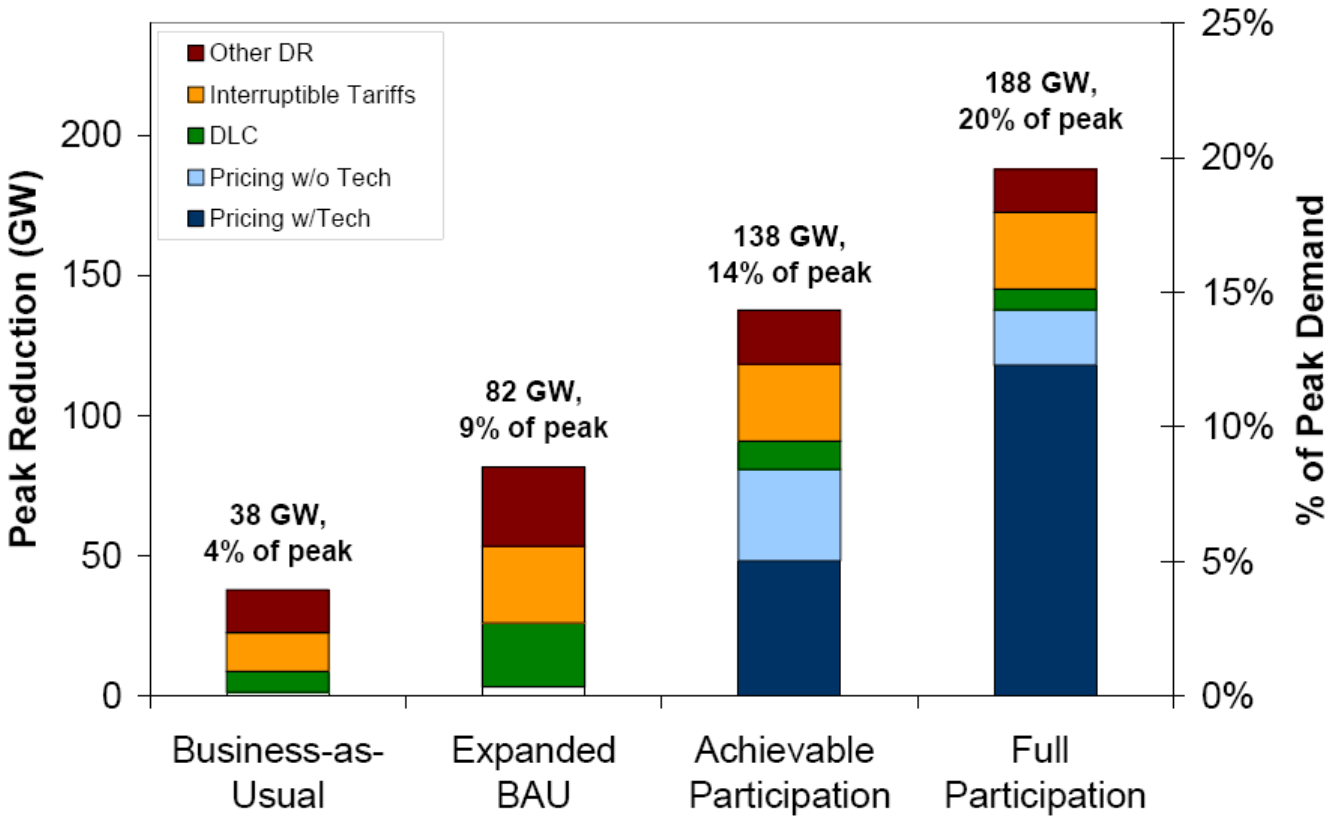
Economic Benefits of PRD

- Consumers empowered to control their bills & are able to hedge price risks consistent with their preferences
  - Consumers can choose how to respond to energy & ancillary service prices
- Consumer costs further reduced to the extent of efficiency gains
  - Revenue shifts from capacity market to energy & ancillary services markets
  - Accurate prices elicit demand response & generation when & where needed
- Demand response enhances market power mitigation
  - Pivotal Supplier Test is retained during shortages
- Regressive cross-subsidies are reduced by efficient retail pricing
- Generation investment decisions can be deferred



BACKUP SLIDES

U.S. Demand Response Potential



"The largest gains in demand response impacts can be made through dynamic pricing programs when … offered as the default tariff."

Source: The Brattle Group, et al., *FERC Staff Report: A National Assessment of U.S. Demand Response Potential* (June 2009).

Necessity of Retail - Wholesale Coordination on PRD

- Planning and Resource Adequacy
  - Current Forecasting Techniques
    - Do Not Consider Price Responsive Demand
    - Based on Data from Periods without Dynamic Retail Pricing
  - Use of Current Forecasting Would Result in Carrying Capacity & Planning Reserves for Demand that Would not be Present at Higher Spot Prices
    - Resource Adequacy Requirement Eliminates Opportunity to Achieve Capacity Savings – Often the Single Largest Cost Savings in a Business Case for AMI
    - Added Capacity Keeps Spot Prices Too Low to Evoke Significant Demand Response
- System Operations
  - Short-term Forecasts, Unit Commitment & Dispatch Do Not Consider PRD
  - Systems, Operating Procedures, & Bid Caps Prevent PRD from Matching Demand to Available Supply

Market Design Assumptions & Compromises

- Assumption #1: Demand Inelastic in Short-run Markets
- Assumption #2: Demand Cannot be Used to Set Prices
- Generator Offers Set Prices
- Cap Generator Offers to Avoid Price Volatility
- Create Capacity Markets to Address "Missing Money Problem"
- Mitigation in "Capacity Markets" leads to Administrative Capacity Prices
- Dilute Energy & Ancillary Service Price Signals
- Need Intermediary (Curtailment Service Provider) for Demand Response
- Limited Demand Participation in the Market

What are the Implications of Changing our Assumptions ?