Scarcity Pricing In a Smart Energy Future

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Overview

- Changing Context – From Current Market Designs to Smart Meters, Smart Rates, & Price Responsive Demand (PRD)
- Retail / Wholesale Coordination Necessary for PRD: The Role of Scarcity Pricing
- Scarcity Pricing through an Operating Reserve Demand Curve: Concept & Practical Considerations

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

Market Design Assumptions & Compromises

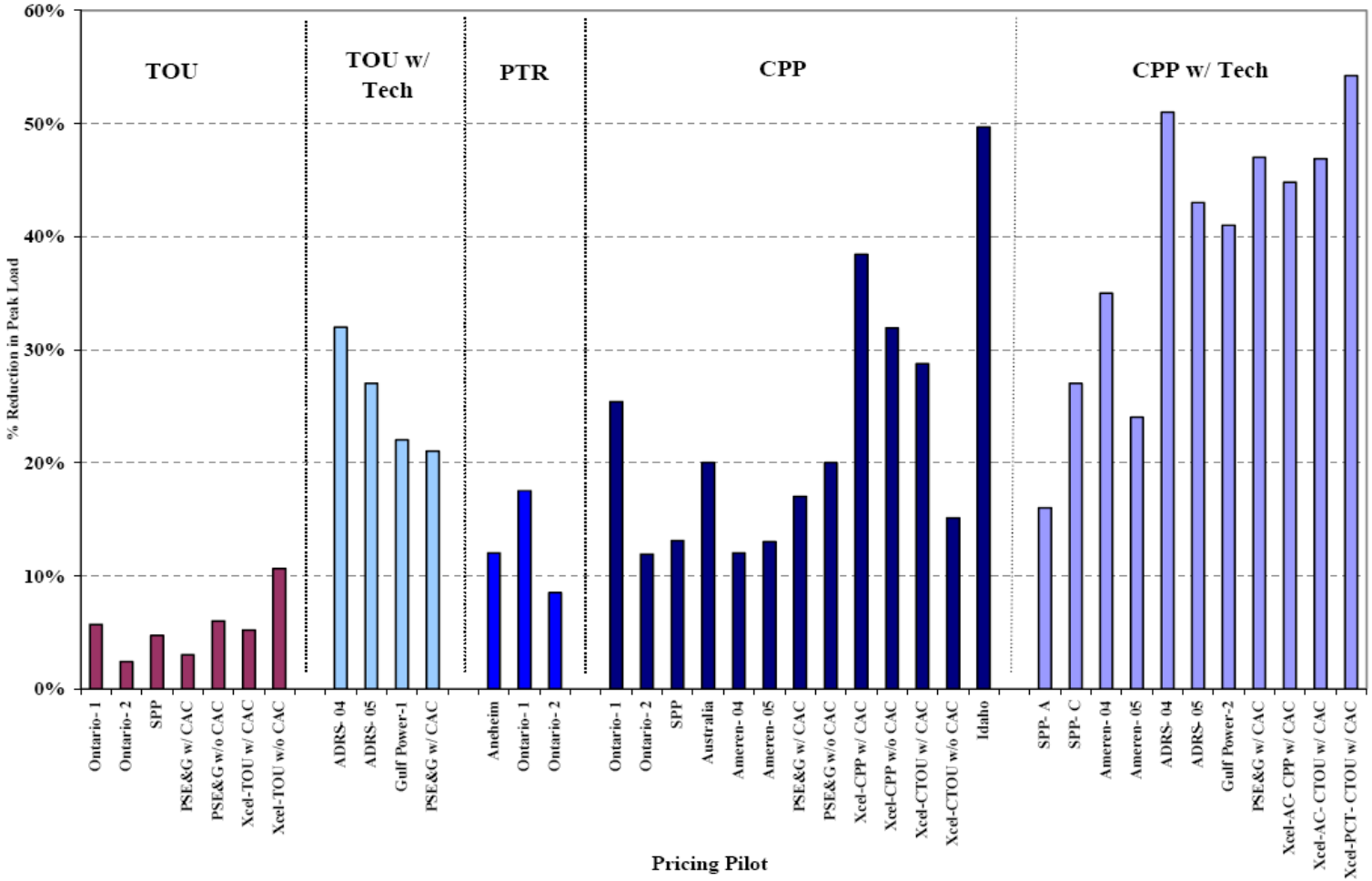
- Assumption #1: Demand Inelastic in Short-run Markets
- Assumption #2: Demand Cannot be Used to Set Prices
- Generator Offers Set Prices
- Cap Generator Offers to Avoid Price Volatility
- Create Capacity Markets to Address "Missing Money Problem"
- Mitigation in "Capacity Markets" leads to Administrative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

What are the Implications of Changing our Assumptions ?

Smart Meters, Smart Rates & Price Responsive Demand

- Ohio S.B. 221 (Effective July 2008):
  - State Policy to Encourage AMI & Time-Differentiated Pricing
  - Electric Security Plan: Single Issue & Incentive Ratemaking for Grid Modernization
- Over 40 U.S. Electric Utilities in 37 States Have Announced AMI Plans
  - If fully implemented, Deploy More Than 42 Million AMI Meters
- American Recovery and Reinvestment Act:
  - $4.5 Billion for Smart Grid
  - Recovery Plan "will result in more than … 40 million 'Smart Meters' in American homes." *Whitehouse Benchmarks Report* (Jan. 24, 2009)
- Smart Meters Will Require Smart Rates
  - 2-Part Tariffs Reducing Consumer Resistance to Dynamic Retail Rates
    - Hedge Total Bill + Dynamic Pricing of Demand Reductions & Increments

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
- PRD is a Characteristic of Efficient Markets
- Expansion Depends Upon Significant AMI Investment
- Mass Market PRD May Not be Offered and Dispatched as a Resource

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

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 Intermittent Resources
- Mass Market PRD Statistically Less Variable than Large Customer Demand Response or Generation
- AMI Can Provide Targeted, Rapid, & Verifiable Load Reductions in Emergencies
- AMI Allows Access to More Load Data, Providing an Opportunity to Reduce Forecast Uncertainty

Integrating PRD in RTO Markets & Operations

- Use Transparent Forecast Demand Response Curve based on Statistically Predictable Relationship Between Price & Demand
- ***Scarcity Pricing Reform: Operating Reserve Demand Curve based on the Value of Reserves to Consumers***
- Synchronize Capacity and Scarcity Pricing so Having Capacity is a Hedge on Scarcity Prices
- Resource Adequacy: Price Responsive Loads must have Capacity based on their Firm Demand after accounting for PRD & should have 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).

Scarcity Pricing Reform

- Order 719: Bid Caps that Prevent Prices from Matching Demand to Available Supply in an Operating Reserve Shortage are Unreasonable
  - *"…they may not produce prices that accurately reflect the value of energy and, by failing to do so, may harm reliability, inhibit demand response, deter entry of demand response and generation resources, and thwart innovation."*
  - RTOs May Propose Any of 4 Alternatives or a Comparable Approach that allows Demand Response to set Scarcity Prices:
    - Increase supply and demand bid caps during an emergency
    - Increase only demand bid caps during an emergency
    - Establish a demand curve for operating reserves, raising reserve prices in agreed upon manner when approaching shortage conditions
    - Set the market-clearing price during an emergency equal to payments in emergency demand response program

Scarcity Pricing Reform

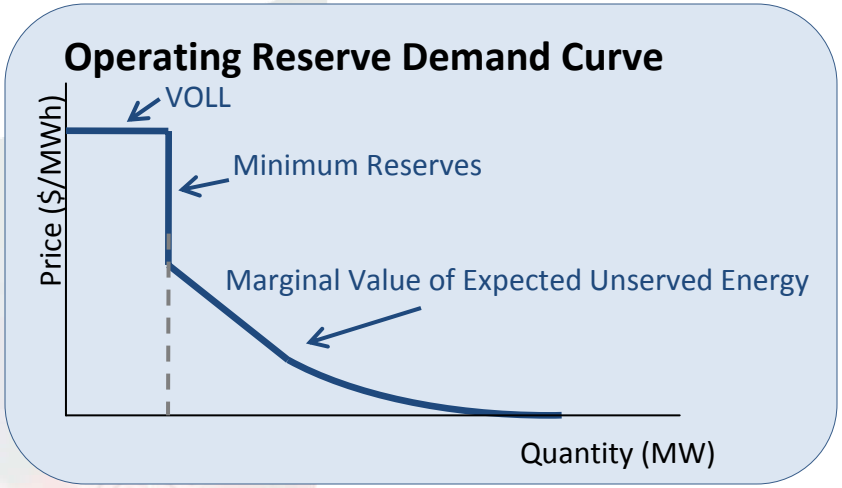
- FERC Order 719 Goals:
  - Maintaining Reliability
  - Eliminating Barriers to Comparable Treatment of Demand Response
  - Allocating Energy during a Shortage to Those Who Value it Most
- FERC Order 719 Criteria – Alternate Proposal would:
  - Improve Reliability by Reducing Demand & Increasing Generation
  - Support Investment in Demand Response Technologies
  - Encourage Reliance on Existing Generation & Demand Resources
  - Encourage Entry of New Generation and Demand Resources
  - Ensure Comparability of Treatment & Compensation for All Resources
  - Ensure Market Power Mitigated & Gaming Deterred, including Demand disciplining Bidding to Competitive Levels

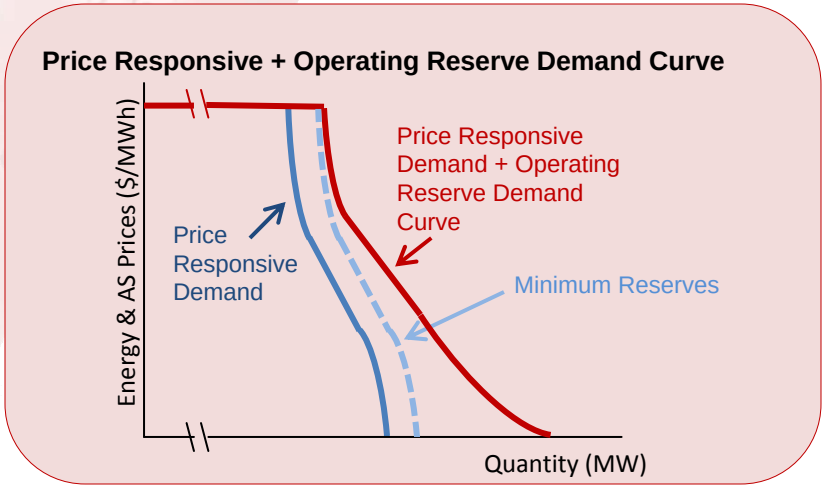
Principles for Scarcity Pricing Reform

- Create Markets in which Demand Response, including PRD, Can Set Prices
  - Efficient, Mitigates Market Power, & Enhances Reliability
- Accurately Reflect Scarcity Conditions in Energy & Ancillary Service Prices
  - Integrate Markets and Operations
  - Provide Efficient Price Signals
- Distinguish Scarcity from Market Power: Continue to Mitigate Market Power
- Respect Consumer Preferences
  - Opportunities for Hedging and Price Response
  - Providing Value to Consumers

Operating Reserve Demand Curve

- Maintain Minimum Reserves for Reliability
- At Minimum Reserves, Price = Value of Lost Load to Consumers who would be Curtailed
- Obtain Additional Reserves when Approaching Shortage to the Extent They are Expected to Provide Value
- Curve Slopes to Reflects Declines in LOLE & VEUE with Increasing Reserves
- PRD & Operating Reserve Demand Curve Rotate Slope of Demand Curve





Effects of Operating Reserve Demand Curve

- Scarcity Conditions Reflected in Energy & Ancillary Service Prices
  - PRD Can Respond to Energy & Ancillary Service Price Signals
  - More Accurate Price Signals for Demand Response & Generators
- Sets Operating Reserves Based on Expected Value to Consumers
  - Operating Reserve Price Reaches the Estimated Value of Lost Load just before Load would be Shed in a Capacity Emergency
  - Would Recognize Additional Operating Reserves Reduce the Probability of Curtailment and the Extent to which they are Valuable to Consumers
- Signals the Need for Added Reserves before a Shortage Occurs
- Consistent with Market Power Mitigation & Generator Offer Caps
- Consistent with Consumers Having a Choice to Hedge Price Volatility

Practical Considerations

- Locational Operating Reserve Requirements & Forecasts of PRD
  - Alternative Approaches for Defining Local Reserve Requirements
  - Statistical Methods Will Improve PRD Forecasts with Local Experience
- Value of Lost Load can be Difficult to Estimate
  - Estimates Vary Within and Between Customer Classes
  - Different Policy Judgments Possible:
    - Australian National Electricity Market: Approximately $6,800(US)/MWh
    - MISO Ancillary Services Market: $3,500/MWh
    - NYISO Spinning Reserves: $850 - $1,750/MWh
    - For Many C&I Customers Estimated Outage Cost Over $10,000/MWh
  - Shortage Reference Price should be Sufficient to Elicit Voluntary Reductions at Minimum Reserve Levels to Minimize the Risk of Involuntary Curtailment

Practical Considerations

- Synchronize Scarcity Pricing with Energy & Ancillary Service Offset to Capacity Costs
  - Capacity Market Provides Timely & Effective Hedge
- Facilitate Optional Hedging for Price Responsive Loads
  - Allowing Loads to Hedge through Forward Capacity or Capacity & Energy Contracts
- In Generation Emergency, Ensure Any Curtailment is Non-Discriminatory
  - Involuntary Curtailment Based on Relative Capacity Deficiency
  - Capacity Tracking

Conclusion

- Responsibility to Create a Path toward a Sustainable, Reliable, and Affordable Energy Future
- Creating that Future will Require Engaging Consumers in the Smart and Efficient Use of Electricity
- Necessary Condition is Making Efficient Price Signals Available to Consumers who are Able and Willing to Respond