Improving Markets for the Efficient Integration of Distributed Renewable Resources

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ICC Policy Forum: The Market Challenges of Integrating Renewables
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Integrating Distributed Renewables: Efficient Pricing

• Increasingly Granular Time-, Location-, & Product-Specific Pricing

• Scarcity Pricing: Customer Value of Reliability

• Distributed Intelligence: Responses to Efficient Pricing

• Pricing Carbon
RTO Settlements Lack Efficient Granular Price Signals

- Demand (& Non-aggregated DER) Settle at **Average Hourly Zonal Prices**

![Graph showing variance in peak day average hourly load node & zonal LMPs for ComEd Zone (8/11/16)]

- Hides large price variances between load nodes
- Price swings suggest interval to interval variances are likely to be significant
- **Nodal and Interval pricing of Demand is Foundational for the Valuation of Distributed Resources**

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1 ICC Policy Forum: The Market Challenge of Integrating Renewables
Distribution Issue: Varying Time, Location, & Product Value

- Three Products in AC Grid: Real Power, Reactive Power, & Reserves
- DER Tradeoff: Unit of Capacity Generally Can Provide Only 1 at a Time

**N.Y. REV Modeling Results:**

*Summer Day, High DER Scenario for an Illustrative 800 Bus Commercial / Residential Distribution Feeder* ¹

- Cost of EV charging 42% lower
- Cost of Commercial Space Conditioning reduces 12% with 20% flexible demand
- PV revenue increases 6% with reactive power sales
No Single Distribution Value (Value of D)

- In some cases, DER can defer more expensive distribution investments
- Efficient forward contracting requires multi-layered, location-specific forecasts
- DER that reduces costs in some hours may be uneconomic at other times

Consider Variable Time- & Location-Specific Rebates & Dispatchable Option Contracts
Scarcity Pricing: Customer Value of Reliability

- Reliability Value of Resource Adequacy is Time and Location Specific
- Operating Reserve Demand Curve (ORDC) can reflect Reliability Value to Customer
  - At minimum reserve levels, ORDC sets Reserve Price = Customer Value (VOLL)
  - At higher reserve levels, ORDC sets Reserve Price = VOLL x Probability of Service Interruptions
- PJM Shortage Pricing is Not Based on Customer Value

Efficient Scarcity Pricing:
- Reflects Time- & Location-Specific Reliability Value of Resources
- Can Animate Responsive Demand
Capacity: Understanding Missing Money

- **Capacity: Imprecise Reliability Measure**
  - RPM is an Administrative Mechanism, Not an Efficient Two-Sided Market
- **RTO Capacity Requirements based on 1 in 10 Year Loss of Load Expectation**
  - First reference to 1 in 10 LOLE in 1940s
  - No Clear Economic Basis for 1 in 10 LOLE
  - LOLE Definitions Vary and Do Not Consider Quantity of Load Interrupted
- **Issue: With 90%+ of Service Interruptions typically related to Distribution Outages, High Capacity Requirements May Be Distorting Reliability Investments**
Integrating Distributed Intelligence

- Rapid Growth in Smart, Price Responsive Demand
  - Internet of Things leverages Thermal Inertia in Buildings
  - Unsubsidized EVs: Potentially cost competitive by 2025

- Objective of Efficient Pricing & Settlements in Wholesale Markets: Animate Utilities and Retail Suppliers to Compete to Help Customers their Manage Demand & Total Energy Costs

- Smart Devices Continuously seek to Optimize based on Anticipated, Real-time, Location-specific Prices

5X Increase in Smart Building Connected Devices by 2021

New Car Sales: Percent Electric Vehicles

Source: Bloomberg New Energy Finance
Recognizing the Response to Efficient Prices

• DR programs not designed to support adoption of smart devices – DR relies on:
  – Dispatch: Becomes computationally Intractable
  – Reduction from Baseline: Smart devices always optimizing based on relative price differentials

• Given PJM forecasting, actual reductions in peak demand have limited impacts on capacity requirements
  – Reductions on 10 Coincident Peak days for 18 consecutive years to produces only 50% reduction in forecast capacity requirements

• Centolella & Ott PRD Proposal: Recognition of Price Responsive Demand
  – Use in system planning and operations, ... forecast demand response curves that reflect a statistically predictable relationship between prices and demand;
  – Implement an Operating Reserve Demand Curve with an appropriately high price;
  – Set capacity and planning reserves for forecasted firm demand, after accounting for expected Price Responsive Demand

• Altered in Stakeholder Process: Imposed Requirements Comparable to a Supply Resource, despite the Lack of any Wholesale Market Payment
Pricing Carbon

• Most studies agree that pricing carbon would reduce greenhouse gas emissions more cost-effectively than a Renewable Portfolio Standard\(^9\)
  – An RPS fails to recognize other actions that could reduce emissions, treats all renewables as if they had equivalent impacts on system emissions, and does not reflect emissions costs in prices

• Regional Market in which Some States Price Carbon appears to be Technically Feasible\(^{10}\)
  – Preventing “Leakage” – shifting of generation to non-carbon constrained states – Requires an Import Charge & Export Credit at the Seam
    • Leakage solution needs to be consistent with Economic Dispatch and Avoid altering bidding incentives so as to create “Pay as Bid” outcomes
    • Requires a One-Stage Solution – Not the 2-Stage Proposal being studied by CA ISO
  – Additional Analysis Required
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References