MARKET CHALLENGES FACING COMPETITIVE POWER MARKETS IN THE NORTHEAST U.S.

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# Declining Nuclear Capacity

6,336 MW of baseload capacity; 31.8 million tons of CO2 avoided

## Plant Retirements (Announced or Recently Retired)

<table>
<thead>
<tr>
<th>Plant</th>
<th>Summer Capacity (MW)</th>
<th>Retirement Year</th>
<th>Reason</th>
<th>Annual Energy(^1) (million MWh)</th>
<th>CO2 Impact(^2) (million short tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal River 3</td>
<td>860</td>
<td>2013</td>
<td>Mechanical</td>
<td>7.0</td>
<td>5.3</td>
</tr>
<tr>
<td>San Onofre 2 &amp; 3</td>
<td>2,150</td>
<td>2013</td>
<td>Mechanical</td>
<td>18.1</td>
<td>8.8</td>
</tr>
<tr>
<td>Kewaunee</td>
<td>566</td>
<td>2013</td>
<td>Market</td>
<td>4.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Vermont Yankee</td>
<td>620</td>
<td>2014</td>
<td>Market</td>
<td>5.1</td>
<td>2.7</td>
</tr>
<tr>
<td>FitzPatrick</td>
<td>848</td>
<td>2016-17</td>
<td>Market</td>
<td>5.8</td>
<td>3.2</td>
</tr>
<tr>
<td>Pilgrim</td>
<td>677</td>
<td>By 2019</td>
<td>Market</td>
<td>5.8</td>
<td>3.1</td>
</tr>
</tbody>
</table>

1. Latest annual generation amount
2. Assumed replaced by gas generation with 8,500 average heat rate
Challenging Economics for Merchant Nuclear

Current power price environment provides unsustainable economics

Historical Day Ahead and Forward Power Prices

$45-75/MWh Price Range

$30-50/MWh Price Range

$30-42/MWh Price Range

Revenue Pressure for Nuclear
- Low natural gas prices
- Low demand growth
- Policies for out-of-market capacity additions
- Market design issues

Forward Prices

- WEST (ZONE A)
- HUD VL (ZONE G)
- Mass Hub
- PJM East HUB
- PJM WEST HUB
- CHICAGO HUB
- CINERGY-INDIANA ZONE

Price Range

$/MWh

Existing vs. New Generation Economics

PTC and ITC are considered subsidies; other state and local subsidies may also come into play that lower costs.

Source: EIA; Entergy Research and Analysis

Illustrative

Out-of-market subsidies depressing prices

Average Cost for New Generation vs. Existing Nuclear Cost $/MWh

Long Run Market Prices (Energy + Capacity) *Illustrative

Higher-cost units at risk of shutdown

Subsidies

*Illustrative
Proper compensation (price signals) for attributes provided by all resource types. For nuclear:
• Baseload energy/price stabilization
• Effectively zero greenhouse gas emissions
• On-site fuel supply

Our Objectives

Mark Structure Objectives
Aligning objectives and creating win-win

Long Term Policy Objectives

Reliability
• Sufficient capacity the system can count on
• Fuel diversity

Economic Sustainability
• Low cost/efficient system
• Reasonable return/sustained investments

Environmental Sustainability
• Achieve carbon targets
• Reduce other pollutants

What’s Needed?

Alignment
The Wholesale Markets Today

*Example: Current Northeast hybrid market structures are broken*

<table>
<thead>
<tr>
<th>Design</th>
<th>Description</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulated / Rate-Based</td>
<td>• Utility planned generation development through rate base</td>
<td>• Customers pay for prudently-incurred costs approved by regulators (who represent the market)</td>
</tr>
<tr>
<td></td>
<td>• Regulators approve projects based on economics, reliability, social and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>environmental benefits</td>
<td></td>
</tr>
<tr>
<td>Market-Based (Objective</td>
<td>• ISOs set long-term policy objectives for reliability and market economics</td>
<td>• Markets determine most efficient resources to meet long-term objectives</td>
</tr>
<tr>
<td>of Our Effort)</td>
<td>• Legislators and regulators set environmental goals</td>
<td>• New and existing generators receive proper compensation for attributes provided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Financial risk born by investors</td>
</tr>
<tr>
<td>Hybrid (NYISO, ISO-NE</td>
<td>• Artificially low “market” prices for existing generators</td>
<td>• Shutdown of otherwise economic units</td>
</tr>
<tr>
<td>Today)</td>
<td>• Growing out-of-market contracts to entice new generation based on case-by-case regulatory approval</td>
<td>• Higher retail prices due to excessive, uneconomical out-of-market contracts and special charges</td>
</tr>
<tr>
<td></td>
<td>• Continued state interventions</td>
<td>• Volatile market prices</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Financial risk born by ratepayers</td>
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*Functional Market Design*  

*Dysfunctional Market Design*
## Advocating for Energy Price Formation Improvements

### Ensuring long-term health of energy markets

#### Principles

<table>
<thead>
<tr>
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<th>Description</th>
</tr>
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<tr>
<td>Market clearing price set by full cost of marginal decision</td>
<td>Prices should reflect start-up and no-load costs when clearing a generator offer and reflect reliability-driven operator actions in both the day-ahead and real-time market clearing price.</td>
</tr>
<tr>
<td>Transparency required for well-functioning markets</td>
<td>Move costs out of uplift (opaque and difficult to hedge) and into locational marginal prices that are visible to all.</td>
</tr>
<tr>
<td>Correct day-ahead commitment and pricing</td>
<td>Co-optimized energy and reserve prices should provide market signals that encourage proper day-ahead and real-time reliability/reserve planning, unit commitment and system dispatch.</td>
</tr>
<tr>
<td>Unwarranted mitigation is detrimental to market</td>
<td>Absent evidence of market power, participants must be allowed to submit risk-adjusted offers and bids without fear of mitigation.</td>
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Sources of Revenue in Deregulated Markets

“Day-Ahead” Energy price is the key for baseload nuclear plants

NY/NE/PJM Generating Plants’ Revenue Source by Technology

Source: Velocity Suite data; Entergy Research and Analysis
A.S.: Ancillary Services; PTC: Production Tax Credits; REC: Renewable Energy Credits
Market Price Formation Issues in Deregulated Markets

Price formation needs to reflect costs

- Out-of-market payments (uplifts) dampens market prices
- Imperfect pricing leads to inefficient decisions
- Full value of providing service should be in price

Uplift Example: November 8, 2012
ISONE Day Ahead Market Prices, $/MWh

- ~$128K uplift paid to ~23,100 MWh
- Estimated suppression: $5.5/MWh
Declining U.S. Reserve Margins – Partially due to Flawed Market Designs

Sustained low gas price environment has already led to retirement announcements of existing power plants – some of which are “efficient” but others of which may be the result of poor market rules.

Continued low gas price environment will force more nuclear and coal generators to retire prematurely*

The U.S. reserve margins may erode faster than expected, or deeper than is otherwise efficient (i.e., if the design of organized power markets were not flawed)

U.S. Reserve Margins 2010 – 2020; %

- Minimum Required for Reliability
- Accelerated nuclear and coal retirements**

*Before the end of their major equipment life

**Assumed 40 GW additional nuclear and coal retirements through 2020;

Source: NERC 2012, 13 and 2014 Long Term Reliability Assessments

Sustained low gas price environment has already led to retirement announcements of existing power plants – some of which are “efficient” but others of which may be the result of poor market rules.
Confluence of Events will Impact Electric Industry

Challenges and uncertainty lie ahead

• In the next few years, various companies and regional markets will face the need to:
  • Comply with regulations affecting hazardous air emissions (such as mercury) from coal and oil plants and manage more stringent ambient air quality standards for ozone and SO2
  • Comply with upcoming state plans to reduce carbon emissions under soon-to-be finalized guidance from the EPA
  • Ensure appropriate fuel diversity in their resource mix

• Existing nuclear units provide all of the following, which will be difficult to replicate in replacement capacity:
  • Essentially emissions-free generation including no greenhouse gases (GHG)
  • Produce output with high capacity factor (in the 90% output range)
  • Provide diversity of supply and associated economic and reliability benefits
  • Hard-to-replicate locational advantages and regional benefits including high-paying jobs and community-supporting tax base
Market Reforms Will Benefit All Stakeholders

The prudent option for long-term reliability and cost efficiency

Customer Energy Cost

1. Out-of-market intervention can suppress wholesale power prices and customer energy cost in the short term.

2. However, when low prices induce needed units to shut down, total energy cost to customers would rise to reflect shortage/cost of new build.

3. If we properly compensate for attributes generators provide in the wholesale market, it would temporarily raise wholesale prices...

4. ...However, it would minimize shutdowns and the need for new builds.

Illustrative

Long run cost (market based design)
In 2014, nuclear plants provided 797 million MWh or 19.5% of total U.S. power generation

- 99 operating reactors at 62 sites
- Approximately 100 GW installed capacity
- About half are unregulated assets

Sources: Velocity Suite, Nuclear Energy Institute
How can we address this complex problem?

With key objectives in mind, solutions may need to be designed so that they’re specific to particular regional markets and to the attributes needed in the region – on a technology neutral basis

- **Policymakers must stop picking winners and losers**
  - Currently, all resources are not considered equal

- **Value and compensate all resources based on the attributes they provide.** For example:
  - Nuclear – carbon-free, base load, on-site fuel, fuel price stability...
  - Renewables – carbon-free, low or no fuel cost...
  - Gas/Oil peakers – capacity resources with flexible response...
  - Gas/Oil CCGTs – intermediate to base load...

- **Be willing to make market design and philosophical changes to accomplish this objective**
  - Depending on the specific market, this may require changes in
    - Energy market pricing (LMPs), such as eliminating uplifts
    - Capacity market design for new attributes
    - Ancillary Service markets as new products for specific attributes