Energy Supply and Demand
“A Market Perspective”

Presented at:
EnergySMART 2012 Conference
Westin Hotel, Boston
October 1-3, 2012

Presented by:
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(with contribution from Ahmad Faruqui and Metin Celebi)

October 3, 2012
Contents

♦ Energy Consumption: “The Story of Five Forces”
♦ Fuels Markets and Impact on Power Generation
♦ Power Market Dynamics
♦ Futures and Scenario-Based Strategic Planning
Long term forecasts of peak demand are on a downward trajectory

Comparison of Annual Average Growth Rates for NERC-Wide Summer Peak Demand

Source: NERC, 2011 Long Term Reliability Assessment
Five forces are creating the new normal

1. Weak economy
2. Demand-side management
3. Codes and standards
4. Distributed generation
5. Fuel switching
Weak Economy

Economic Recovery is Slow

♦ The economic recession caused a significant drop in electricity demand and we have only partially recovered from this drop

♦ The “pace and shape” of the economic recovery will dramatically influence electricity demand, according to NERC

♦ Some of the recessionary impacts may be permanent
  • Some businesses have closed or relocated offshore
  • Unemployment and underemployment has an effect of reducing electric consumption and the purchase of electricity consuming appliances
  • Some consumers have become more frugal than before
Demand Side Management

DSM is Contributing to Reduced Demand Growth

♦ Behavior-modifying programs are the newest element in the energy efficiency
♦ Web portals and social media are raising the energy consciousness of consumers
♦ In-home displays can promote savings by changing behavior
  • Pilots have suggested a significant conservation effect from these devices
  • 6.5% energy savings per device owner
♦ Bill comparison creates social pressure to conserve

SPOTLIGHT ON SAVINGS

» 20 GWh saved over the life of the program
» 254 kWh / household average savings
» $0.039 / kWh average cost effectiveness
» Program has saved more than US$2 million for its members
» Savings and measurement methodology independently verified by Power Systems Engineering

Delivering Cost-Effective Energy Efficiency at Scale

The Opower platform has provided Connexus with a cost-effective way to meet their energy efficiency targets. In 2010, the Opower program accounted for just 25% of Connexus’ efficiency budget, but more than 50% of the savings committed to in the utility’s Conservation Improvement Program plan.

Source: Opower
The EIA is attributing declining per capita residential electricity sales to Energy Independence and Security Act of 2007

The EIA forecasts that lighting per household in 2035 will be almost half of the 2010 level
Distributed Generation
Rooftop Solar and Other DG are Here to Stay

- Distributed generation with net metering could lower demand significantly
- The growth in DG depends on:
  - retail cost of electricity – *Increasing*
  - cost of on-site generation – *Decreasing*
  - net metering regulations – *Varies by state*
  - storms and outages – *More frequent than before*

![Capital Cost Projections for Residential Rooftop PV Systems ($/kW of DC capacity)](chart)

Fuel Switching and Other Forces

Economics of Fuels Can Encourage Customers to Reduce Electric Consumption

♦ Lower gas prices from fracking could result in people shifting away from electricity and towards gas for heating
♦ Oak Ridge National Laboratory has developed gas-fired heat pumps, which could supply both heating and cooling
♦ Higher cost of electricity would further encourage customers to switch away from electricity
♦ Other Forces are also suppressing demand growth:
  • Disruptive end-use technologies
  • An iEverything appliance, Green Buttons, and smart phones
  • Federal and state legislation requires lower carbon emissions
Growth Story
Overall Viewpoint on Growth

♦ The drop in demand growth seems to be permanent, not transitory

♦ The growth may *not* return with “normal” economic activity

♦ The *new normal* may be growth at about half of the pre-recession value, in the 0.7% to 0.9 % a year range

♦ Survival of traditional utilities in a sub one-percent growth world calls for new thinking

♦ Both utilities and regulators have to come up with new solutions that delink earnings from sales

♦ As Fox-Penner argues in Smart Power, utilities should consider becoming smart wires companies or integrated energy service companies
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Abundance of Shale Gas Continues to Keep Price of Natural Gas Low

♦ At prices below $2.75/mmBtu, natural gas is competing with Powder River Basin coal (Source: Goldman Sachs Securities Division)

♦ This has a significant effect on short and long-term power generation

Sources and Notes:
Historical and futures price data from Bloomberg.
Oil price base case extended based on No. 2 futures at NY Harbor, then based on average of Brent and WTI futures escalation, then reverting to escalation at inflation rate over a 5-year transition period. Oil high and low cases based on 50% of difference between AEO 2012 Reference case and High/Low Oil cases.
Gas prices escalate based on inflation after futures end. High and low cases are 30% above and 25% below base case.
Coal prices from futures, escalating with inflation thereafter.
Fuels

Coal Prices are Expected to Stay Relatively Flat

- Reduction in coal usage is expected to keep coal prices relatively flat
- This could change significantly if coal exports continue to increase significantly

Source: The Brattle Group
Coal Plants Are Becoming Less Economic with Low Gas Prices

- The effect of low gas prices is cutting into the profitability of coal plants
- Increase in cycling further increases the fixed costs of coal plants

Merchant Generation in Eastern PJM

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As of July 2012, roughly 30 GW of coal plants have announced retirement by 2016

*The Brattle Group* projects over 60 GW will retire due to current outlook of market conditions and environmental regulations.
Power Market Dynamics

Gas Price is a Major Contributor to Coal Retirement

$1 change in natural gas price can change the retirement prospects significantly, even with lenient environmental regulations.
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Futures
From Traditional to Enhanced Planning

Traditional Resource Planning Process
- Develop base case assumptions
- Sensitivity analyses around single variables (e.g. high/low gas prices; high/low load growth)

Enhanced Planning
- Develop scenarios that represent possible future states
- Develop range of resource strategies
- Test strategies against scenarios
- Develop “robust strategy” that performs well across range of scenarios and incorporates decision points and flexibility for future adjustments
- Risk-adjusted cost analysis
Scenario-Based Strategic Planning for Energy Industry

1. Interviews with Executives and Strategic Planning Team
2. Facilitation of Scenario Development
3. Guided Strategic Decision Making Process
4. Develop and Implement Business Plans in support of Strategies

Strategy Analysis

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<th>Selected Scenarios</th>
<th>Short-Term (1-3 yrs)</th>
<th>Mid-Term (3-5 yrs)</th>
<th>Long-Term (5-10 yrs)</th>
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The Brattle Group
Sample Scenario: **Shrinking Energy Demand** (capturing High DG and DSM)

**Political & Economic Environment**
- Slow economic recovery
- Losing manufacturing base, financial markets remain stressed
- Zero to negative net demand growth
- Polarized political environment
- Difficult access to capital

**Environmental Policies**
- Some environmental policy implemented by 2020
- Low compliance cost (<$500/kW)
- No carbon legislation

**Renewable Energy Policies**
- State renewable policies in place
- No significant wind build-out, due to zero to negative load growth

**Energy Market Pricing**
- Gas prices are low to moderate, $3-$4/MMBtu (in 2012$)
- Low gas prices volatility
- Wholes Power prices remain relatively low for both peak and off-peak

**Story:**
Economy does not recover or recovers very slowly and financial markets remain weak. Housing market remains soft through 2020. Politically unpopular to drive further renewable and environmental policy without further subsidy. Fixed costs of investments (renewables, environmental, and transmission) are in utility rates and drive up rates which in turn decreases demand.

**Implications:**
- Consider early retirement or mothballing coal plants
- Continued rate increases
- Pressure on financial metrics for utilities
- Need to sell capacity but prices remain low

**Transmission Policies & Business Environment**
- Build the approved transmission lines but no more additional investments

**New Markets & Game Changers**
- Some conservation and demand response (to save money) contribute to reducing net growth
- Solar PV cost decreases and becomes moderately to highly adopted in the Midwest (contributing to the downward spiral)
- Other DG becomes increasingly attractive as rates increase due to reduction in demand

**Customers**
- Increasing rates causes delinquencies
- Larger customers will be first movers on DG and DR
- Great need to cut costs
- Economic development opportunities needed
Sample Futures with Risk Factors

- Wholesale Power Market Prices
- High Gas Price (low growth)
- High Gas Price (high growth)
- Low Gas Price (high growth)
- Decarbonization (Strict Environmental Policies)
- Decentralization (High Distributed Generation)

Fixed Costs (retrofit, renewables, financing, etc.)
Developing Energy Business Strategies Require Understanding of Drivers

- Developing strategic direction for energy companies require an understanding of numerous and sometimes conflicting objectives
  - Reliability
  - Operating and capital cost constraints
  - Stakeholder interests
  - Public image
  - System fundamentals
  - Short and long-term targets
- Making strategic decisions involves iterative reviews of options, analyses, and prioritizing
- Use performance-tracking systems will help decision-making
The Brattle Group

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Strategic Planning  
Transmission  
Valuation and Risk Management
Judy Chang is a Principal leading Brattle’s efforts in strategic planning for utilities. She is an energy economist with background in Electrical Engineering and Public Policy. She has recently worked on regulatory and market issues around the integration of renewable energy, developing analytical tools to assess the potential impact of market structure on renewable energy assets. She has provided expert testimonies before FERC and state agencies.

For several utility clients, Judy has led senior executives and company leadership teams in developing long-term strategic plans through detailed understanding of potential impacts of future industry and regulatory changes. She has led executive teams in developing consensus by jointly addressing regulatory uncertainties in a structured manner.