Boom & Bust & Boom
Wind Energy In The United States

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Agenda & Goals

Agenda
1. Boom
2. History
3. Regulatory
4. Economics
5. Scenarios

Goals
• Market conditions for wind energy in US
• Drivers that create wind energy market
• Future scenarios
The United States Wind Energy Industry Is In A Boom Cycle

~ 2,500 MW installed in 2005

2005 total capacity = 9.2 GW = 2.7MM homes
Globally, Wind Energy Is A Growth Industry

Dec 2004 installed MW = 42.7 GW
Average 3-year growth rate = 23%

Source: BTM Consulting
Growth Opportunities Are Attracting New Participants Throughout The Value Chain

- Manufacturer
  - New Entrants
  - New Capacity

- Developer
  - New Entrants
  - Turbine Constrained

- Debt Financier
  - New Entrants
  - European Expertise

- Owner
  - New Entrants
  - Tax Appetite

- Power Purchaser
  - New Entrants
  - Fuel Diversity

Pacing item in wind energy market is turbine supply
Historically, Wind Energy Booms Bring Wind Energy Busts

- Wind history marked by expansion & contraction
Boom & Bust Of Wind Track Production Tax Credit

- Wind history marked by expansion & contraction
- Dependency on Production Tax Credit (PTC)
Turbine Size Has Increased Consistently Though The Boom & Bust Cycle

- Technology advances resulted in larger turbines
The Cost of Wind Energy Has Dropped By More Than 85% In Last 20 Years

- Technology and larger turbines result in lower cost of energy

Source: American Wind Energy Association
Production Tax Credits (PTC) Provide Incentives To The Most Productive Wind Projects

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<th>Capital Spend</th>
<th>Efficiency</th>
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<td><strong>Investment Tax Credit</strong></td>
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- Investment tax credits resulted in sub-optimal investments
- Tax equity received benefits regardless of power output
NEPA Extended PTC For A 2 Year Cycle

Production Tax Credit (PTC)

• Extended Through December 31, 2007
• Current Value = 1.9 cent / kWh

Requirements For Tax Credit
1. Owner must apply tax credit to liability
2. Generation from qualified facility
3. MWh must be sold to 3rd party
Renewable Portfolio Standards Will Create 22,000 MW Of Renewable Capacity by 2015

- **AZ: 1.1% by 2007**
  - AZ Goal: 15% by 2025
- **CA: 20% by 2017**
  - CA Goal: 20% by 2010
- **CO: 10% by 2015**
- **DE: 10% by 2019**
- **HI: 20% by 2020**
- **IL: 8% by 2012**
- **IA: 2% of 1999 sales**
- **MA: 4% by 2009**
- **ME: 30% by 2000**
- **MD: 7.5% by 2019**
- **MI: 8% by 2012**
- **MN: 10% by 2015**
- **MT: 15% by 2015**
- **NJ: 6.5% by 2009**
- **NY: 24% by 2013**
- **NC: 10% by 2017**
- **NH: 10% by 2015**
- **RI: 16% by 2020**
- **VT: 10% by 2012**
- **WA: 15% by 2015**
- **WI: 2.2% by 2011**
  - WI Goal: 10% by 2015
- **WV: 10% by 2020**
- **WY: 10% by 2020**

**CA Goal: 30% set-aside for onsite generation; NV: Solar is 5% of annual**

**MN: Specific mandate for Xcel and non-binding for other utilities**

**PA: 8% from “Tier 1” resources (solar, wind, geothermal, biomass); 10% from “Tier 2” (waste coal, IGCC, MSW, large hydro, DSM and distributed generation)**

**Note:** Standards expressed as total renewable energy generation as a percent of covered companies’ retail sales.
SB 20 Increased TX RPS Beyond Original Requirements In SB7

Texas superceded the goals in SB7 due to effective RPS design:

- Tradable Renewable Energy Credit (REC)
- Penalty for non-compliance
Each MWh Of Production Creates Three Value Streams In Texas*

- **Fixed Value Components**
  - PTC

- **Variable Price Components**
  - MWh
  - REC

Project owners monetize renewable attribute of wind energy

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* Prices of power and REC are illustrative.
Wind Shifts The Point On The Dispatch Stack

Cumulative Capacity (MW)

Full Load Cost ($/MWh)

Min. Load 23,044 MW
Med. Load 32078 MW
Max. Load 64268 MW

Hydro
Nuclear
Coal
Combined Cycle
Gas/Oil Boiler
GT Oil

FLCost w/Emissions
FLCost w/o Emissions

Average fuel prices:
• NG = $8.60/MMBtu
• Coal = $1.30/MMBtu
• Resid = $8.00/MMBtu
• Distl = $12.00/MMBtu
ERCOT Power Tracks Natural Gas And Demonstrates Similar Volatility

Financial risks resulting from volatility are passed through to power buyers
Cost Of Wind Energy Is Fixed And Not Subject To Fuel Volatility

Policy makers promote lower wind energy as method to decrease portfolio volatility
Volatility in gas prices makes some wind programs cheaper for ratepayers

by Susan Nelson

Xcel Energy Inc. customers in Colorado who get all of their electricity through the company’s WindSource program recently found that the run-up in natural gas and coal commodity prices left their rates, which include a surcharge to support the development of wind-generated electricity, lower than the rates of customers who rely on conventional fuel sources.

on a waiting list,” Henley said. "Gas prices are very volatile," and this means the price advantage could change. People enrolling in WindSource must commit to one year in the program, Henley said.

At the moment, Xcel Energy, which owns its wind farms in Colorado, does not have any plans to build more wind farms, he said.

Other companies that offer wind power to customers at a premium to conventional power are also in some

Costs resulting from rising gas prices and high volatility are mitigated with fixed price wind
Wind Energy Is Competitive With Gas

North America Cost of Electricity (c/kWh) -- Initial Year (2006)
Carbon Constraints Increase Cost Competitiveness To Coal

North America Cost of Electricity (c/kWh) -- Initial Year (2006)

- Nuclear (w/ PTC)
- Nuclear
- Wind (w/ PTC) 2006 price
- Wind (w/o direct incentives) 2008 price
- Hydro
- Natural Gas Combined Cycle (H Class)
- NGCC (F Class)
- Supercritical PC Plant
- Subcritical PC Plant

Legend:
- Operations & Maintenance
- Low wind speed adder (33% net CF)
- Nuclear Decommissioning Fund ($400MM)
- Wind System Integration Costs
- Fuel Base (NG @ $5.5/MMBTU, coal $25/ton)
- Capital (wind capacity factor = 44%)
- Fuel Adder (NG @ $8/MMBTU, coal $45.5/ton)
- Emissions Offsets & Controls (NOx, SO2, Hg)
- Emissions Offsets Adder (CO2 @ $8/ton)
PTC Extension Results In Growth Paced By Suppliers’ Increase In Production Capacity

Earlier extension results in larger increase in production capacity due to:

- Base-load of manufacturing capacity
- Domestic sub-suppliers increasing production capacity
Delayed Or No PTC Extension Slows Growth - Gas Price & Local Regulation Define Market

- Rate of penetration moves directionally with gas prices
- Wind without PTC is in the money in some markets
  - States with Renewable Portfolio Standard
  - Generation markets with gas on margin
Long Term Growth Defined By Regulatory, Technology, CO2, Interconnection

**Regulatory**
- National RPS
- PTC

**Technology**
- Substitutes (Nuke, Coal)
- Cost reduction

**CO2**
- Fuel cost-adder to thermal

**Interconnection**
- Transmission upgrades
- Market rules
Long Term Growth Defined By Regulatory, Technology, CO2, Interconnection

“We are focusing our investment in alternatives and renewables on power generation because it accounts for over 40 percent of man-made greenhouse gas emissions, the biggest single source. It is also the area where technology can be applied most cost-effectively to reduce emissions [...] As the pricing of carbon develops through trading schemes and other initiatives, the market will grow rapidly as low-emission technologies displace less clean forms of power generation.”

BP chief executive Lord Browne

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Thank You!

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