U.S. Wind Industry: On the Move

Denise Bode
Chief Executive Officer
American Wind Energy Association
Market Update
With over 25,000 megawatts, the U.S. is now the #1 wind energy producer in the world.

Global Wind Energy Council, January 2009
Nearly 8,500 MW installed from 5,000 turbines in 2008

Source: AWEA, January 2009
Wind - One of the Leaders in New Electric Capacity

In 2002, wind was less than 2% of new capacity and is now over 40%.
U.S. Wind Power Capacity (MW)

Total: 25,170 MW

Source: AWEA, January 2009
New Manufacturing

- 55 manufacturing facilities opened, expanded or announced in 2008
- 35,000 wind industry jobs created in one year

Source: AWEA, Sample of Manufacturing Facilities, November 2008
Growing the Wind Industry
20% Wind Energy by 2030

The U.S. possesses sufficient and affordable wind resources to obtain at least 20% of its electricity from wind by the year 2030.

Doubling Renewable Energy in Three Years

- President Obama has called for the U.S. to double its production of renewable energy in 3 years.

President Obama gives “thumbs up” to wind energy industry leaders at AWEA member Cardinal Fastener manufacturing facility.
Wind Industry Ahead of Curve in Achieving 20% Wind Energy by 2030

Wind capacity has already doubled in the past three years

Capacity additions in 20% Scenario

Actual installations 2007: 5,329 MW

8,300 MW -- 42% of new U.S. capacity -- added in 2008
Legislative Priorities

☑ Immediate Impact:
  ▪ Restructure PTC to work in adverse economy

☑ Short-Term Impact:
  ▪ Multi-year PTC Extension

☐ Mid-Term Impact:
  ▪ National Renewable Electricity Standard (RES)
  ▪ Transmission Legislation

☐ Long-Term Impact:
  ▪ Effective Carbon Regulation

www.NewWindAgenda.org
National Renewable Electricity Standard

• Seeking a 25% by 2025 RES

• Generation from wind could increase 10-fold compared to today, and meet over 10% of U.S. generation needs

• Wind installations could increase from 25 GW today to 150 GW more by 2025

Source: UCS, 2009
Federal Level Transmission Policies

- Interconnection-Wide Transmission Planning
- Interconnection-Wide Transmission Cost Allocation and Certainty for Cost Recovery
- Federal Siting

www.auea.org/GreenPowerSuperhighways.pdf
Conceptual Transmission Expansion Plan

Accommodate 400 GW of wind power

$60 billion investment

This map shows the wind resource data used by the WinDS model for the 20% Wind Scenario. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.
National Climate Change Legislation

• A national RES is the first and critical step toward achieving 20% wind power and reaching climate targets as proven in Europe.

• National climate policy will get us even closer.
Benefits of Achieving 20% Wind Power

www.NewWindAgenda.org
Job Projections Under 20% Report

- Over 500,000 total jobs would be supported by the wind industry

- Wind industry currently employs 85,000 Americans

Source: U.S. DOE, 20% Wind Energy by 2030
CO₂ Reductions From Electricity Sector

No New Wind Scenario CO₂ emissions
20% Wind Scenario CO₂ emissions
USCAP path to 80% below today’s levels by 2050

Source: U.S. DOE, 20% Wind Energy by 2030
Significant Water Use Savings

- Avoids the consumption of 4 trillion gallons of water cumulatively through 2030
- Cuts electric sector water consumption by 17% in 2030

Source: U.S. DOE, 20% Wind Energy by 2030
Managing Wind’s Variability

• Wind is an energy resource, not a capacity resource
  • ‘Reliability’ concerns often founded on serious misunderstandings of how grid operates, how wind projects fit into system operations

• Wind power output is ‘variable,’ not ‘intermittent’
  • Wind forecasting plays key role today, will play increasingly important role in future

• There is a cost to managing wind’s variability - depends upon system’s characteristics, but is generally low
  • Many wind integration studies have been performed in US, EU
# Wind Integration Costs

<table>
<thead>
<tr>
<th>Date</th>
<th>Study</th>
<th>Wind Capacity Penetration (%)</th>
<th>Regulation Cost ($/MWh)</th>
<th>Load Following Cost ($/MWh)</th>
<th>Unit Commitment Cost ($/MWh)</th>
<th>Gas Supply Cost ($/MWh)</th>
<th>Total Operating Cost Impact ($/MWh)</th>
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<td>2002</td>
<td>BPA</td>
<td>7</td>
<td>.19</td>
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<td>April ‘06</td>
<td>Xcel-PSCo</td>
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<td>3.32</td>
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</table>
Wind Integration Lessons Learned

- Wind forecasting can significantly reduce integration costs by reducing uncertainty
- Wind resources spread over larger areas are less variable
- Diverse wind has very little variability on the minute-to-minute time scale
- Wind is easier to integrate on more flexible power systems
- Market/system operation reforms, such as control area consolidation, can significantly reduce wind integration costs, as can coordinated regional operations
Accommodating Variability on the Power Grid

Flexibility Supply Curve

High Cost

Markets
Real-Time Day-Ahead Demand Response

Flexible Generation
Simple Cycle GT Combined Cycle GT

Traditional Storage
Hydro Pumped Hydro Gas Storage

Wind Curtailment
In Range of 1 or 2%

Storage
CAES Batteries SMES CAES Capacitors Flywheels

Low Cost

High Flexibility
Many GW, Infinite Time

Low Flexibility
Few MW, Short Time

Source: U.S. DOE, Wind Dispatchability and Storage
Thank you!

More information about AWEA:

www.awea.org
202-383-2500
windmail@awea.org

The world’s largest and most anticipated annual event for wind energy

www.windpowerexpo.org
Appendix
## Wind Energy Variability

Because wind energy output adds almost no variability on the minute-to-minute time scale, very large amounts of wind energy can be added to the grid with virtually no impact on the use of spinning reserves.

<table>
<thead>
<tr>
<th>Study</th>
<th>Wind Amount</th>
<th>1 minute</th>
<th>5 minute</th>
<th>1 hour</th>
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<tbody>
<tr>
<td>Texas 2008</td>
<td>15,000 MW</td>
<td>6.5 MW</td>
<td>30 MW</td>
<td>328 MW</td>
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<tr>
<td>California 2007</td>
<td>12,500 MW (plus 2,600 MW of Solar)</td>
<td>3.3 MW</td>
<td>14.2 MW</td>
<td>129 MW</td>
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<tr>
<td>New York 2005</td>
<td>3,300 MW</td>
<td>- - -</td>
<td>1.8 MW</td>
<td>152 MW</td>
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</tbody>
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Transmission: A Smart Investment

Results from Texas Study Show that Benefits of Transmission for Wind Exceed Costs

(Source: Electric Reliability Council of Texas)