Wind Energy Overview

- Global installed wind energy capacity reached 74,223 MW in 2006, up from 59,091 MW in 2005 – an annual growth rate of 32%.
- The countries with the highest total installed capacity are Germany (20,621 MW), Spain (11,615 MW), the USA (11,603 MW), India (6,270 MW) and Denmark (3,136 MW).
- US wind power generating capacity increased by 27% in 2006 and is expected to increase an additional 26% in 2007.
- In 2006, new utility-scale turbines were installed in a total of 20 states across the country.
- The top five states in new installations in 2006 were Texas (774 MW), Washington (428 MW), California (212 MW), New York (185 MW) and Minnesota (150 MW).
- In 2006, Texas (2768 MW) took over the lead from California (2361 MW) in cumulative installed capacity
- Wind energy facilities currently installed in the U.S. will produce an estimated 31 billion kilowatt-hours annually or enough electricity to supply 2.9 million American homes.
- Wind energy's delivered cost has fallen 90% in the past 25 years and is now competitive with newly-constructed, conventional generation sources (contract prices are typically 4-6 cents per kWh).

Wind Turbines

- Today's utility-scale wind turbines produce enough energy for 300 to 600 typical US households per turbine, are down for maintenance less than 2% of the time, and have a typical rotational speed of approximately 15 RPM.
- Onshore turbines from the leading manufacturers range from 850 kW to 2.5 MW with tower heights of 40 to 120 meters (131 to 394 feet) and rotor diameters of 52 to 94 meters (171 to 308 feet).
- The top selling onshore turbines are 1.5 to 2.0 MW with a typical hub height of 80 meters (262 feet).
- Larger offshore turbines range from to 3.0 to 6.0 MW with rotor diameters of 90 to 114 meter (295 to 374 feet) and towers up to 124 meters (407 feet). Offshore turbines can be larger because it is easier to transport large rotor blades by ship than by land.

Developing a Project

- The 12 steps for developing utility-scale wind projects are: site selection, land agreements, wind assessment, environmental review, economic modeling, interconnection studies, permitting, sales agreement, financing, turbine procurement, construction contracting, and operations & maintenance.

Wind Resource Requirements

- A minimum class 3 wind resource, with an average annual wind speed of 6.3 m/s or 14.1 mph at 50 meters (164 feet) above the ground, is required for a successful wind project.
- Western NC contains 297,849 acres of mountain ridge top land with a wind resource of class 3 or greater.
- A wind map provides a good estimate of the wind resource at a site; however, on-site wind measurements are required to determine the economic feasibility and to secure financing.

Capacity Factor, Availability and Energy Payback

- The capacity factor of a power plant is the ratio of the actual energy output over a period of time and its output if it had operated at full capacity during that time period.
- Because of variations in speed, a wind farm will generate electricity 65-90% of the time, generate power at full rated capacity about 10% of the time, and on average throughout the year the plant will generate 30% to 40% of its rated capacity (capacity factor).
- The availability factor of a power plant is the amount of time that it is able to produce electricity over a certain period, divided by the amount of the time in the period.
- The typical availability factor for a modern wind turbine is 98%.
- The energy output of a wind turbine is optimized by properly matching rotor diameter to generator size for a given wind resource.
- Energy payback: a study by the University of Wisconsin-Madison calculated the energy payback of Midwestern wind farms to be between 17 and 39 times more energy than is embodied during manufacturing and construction, depending on the wind resource.

FAA Lighting

- New Federal Aviation Administration (FAA) guidelines for aviation lighting on wind energy projects went into effect on Feb. 1, 2007. A new chapter, Marking and Lighting Wind Turbine Farms, has been added.
- Synchronized flashing red lights (FAA L-864) are to be mounted to the nacelle for turbines on the perimeter of the wind farm with unlighted gaps of no more than ½ mile.
- Not all wind turbine units within a farm need to be lighted. Definition of the periphery of the installation is essential.
- Daytime lighting of wind farms is not required, as long as the turbine structures are painted in a bright white color or light off-white color most often found on wind turbines.

Ice

- Ice throw, while it can occur under certain conditions, is of little danger. Setbacks typically used to minimize noise are sufficient to protect against danger to the public.
- Ice buildup slows a turbine's rotation and will be sensed by the control system, causing the turbine to shut down.
- A recommended setback in cold climates is 1.5 x (hub height + rotor diameter).

Noise

- An operating modern wind farm at a distance of 750 to 1000 feet is no noisier than a kitchen refrigerator or a moderately quiet room (approximately 35-45 decibels, A-scale)
- Even in rural or low-density areas, where there is little additional sound to mask that of the wind turbines, background noise created by the wind is often louder.
- In some hilly terrain where residences are located in sheltered dips or hollows downwind from turbines, turbine sounds may carry further and be more audible. This effect can generally be anticipated and avoided in the development process through adequate setbacks from homes.
- Low frequency and infrasound: It has been shown that there is no significant infrasound from modern wind turbines and that there is little low frequency noise. Problems with these types of sound did exist with early wind turbines installed in the US in the 1980s, such as the Mod-1 project on Howard's Knob in Boone, NC. Modern turbine designs have eliminated the problem.

Economic Development

- The main economic development benefits associated with wind projects are job creation, local project spending, annual property and sales taxes, and annual landowner easement payments.
- 40 to 140 jobs are created during the construction phase for every 100 MW of installed capacity; 6 to 10 new jobs are created during the operations phase for every 100 MW of installed capacity.
- $500,000-$1,000,000 in new annual property tax payments are generated for every 100 MW of installed capacity.
- Annual landowner easement payments are typically $2,000-$5,000 per MW of installed capacity. Leased farmland remains available for farming and grazing.
- All economic evidence of current properties located near wind farms discredits the notion that wind farm visibility negatively affects property value. Ten large US wind projects were studied and for the great majority of these projects, property values actually rose more rapidly within the view shed than they did in the comparable community.

Incentives

- The Federal Production Tax Credit (PTC) provides an inflation-adjusted 1.5 cents (currently at 1.9 cents) for each kilowatt-hour generated, over the first ten years of the project, which reduces the tax liability of a wind farm
- Many states offer green pricing which enables customers to pay a premium on their electric bills to support renewable energy.
- In North Carolina we have the NC Greenpower program which is the first statewide green energy program in the nation supported by all the state's utilities.

Utility Integration

- Few operating impacts occur when wind represents less than 15% of the system capacity and in many cases they increase system performance.
- Wind energy's variability is not a critical transmission integration issue, and many transmission service providers have adopted effective procedures for integrating wind energy into their existing transmission systems at operating impact costs of less than 0.5 cents per kWh.
- The Federal Energy Regulatory Commission (FERC) adopted a new regulation that aims to allow greater access to transmission lines for power generators of all types, including renewable energy projects. The new rule exempts intermittent power generators, such as wind power plants, from excessive "imbalance" charges when the amount of energy they deliver is different than the amount of energy they are scheduled to deliver.
- In contrast to conventional power plants, wind farms need not shut down altogether for maintenance and repairs—a turbine fault, when it occurs, can be repaired while the other turbines continue to operate.

Avian Impacts

- Wind energy development's overall impact on birds is extremely low compared with other human-related activities.
- Pre-construction wildlife surveys help mitigate bird and bat impacts and are now common practice throughout the industry.

Sources and Links for Further Information

- Global wind statistics: http://www.gwec.net
- FERC press release: http://www.ferc.gov/press-room/press-releases/2007/2007-1/02-15-07-E-1.asp
- Wind Energy Guide for County Commissioners: http://www.nrel.gov/docs/fy07osti/40403.pdf
- AWEA Wind Power Myths vs. Facts: http://www.awea.org/pubs/factsheets/050629_Myths_vs_Facts_Fact_Sheet.pdf
- Report on Infrasound from Wind Turbines: http://wind.appstate.edu/reports/06-06Leventhall-Infras-WT-CanAcoustics2.pdf
- FAA lighting requirements: http://www.oeaaa.faa.gov/oeaaaEXT/content/AC70_7460_1K.pdf
- Wind Powering America factsheet: http://www.nrel.gov/docs/fy05osti/37657.pdf
- Ice Shedding and Ice Throw: http://www.gepower.com/prod_serv/products/tech_docs/en/downloads/ger4262.pdf
- Effect of Wind Development on Property Values: http://www.crest.org/articles/static/1/binaries/wind_online_final.pdf
- Wind maps: http://wind.appstate.edu/windresources/windresources.php
- GE: http://www.gepower.com
- Vestas: http://www.vestas.com
- Windustry: http://www.windustry.org
- NC Greenpower: http://www.ncgreenpower.org
- Incentives database: http://www.dsireusa.org

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