

Wind Power Siting Issues

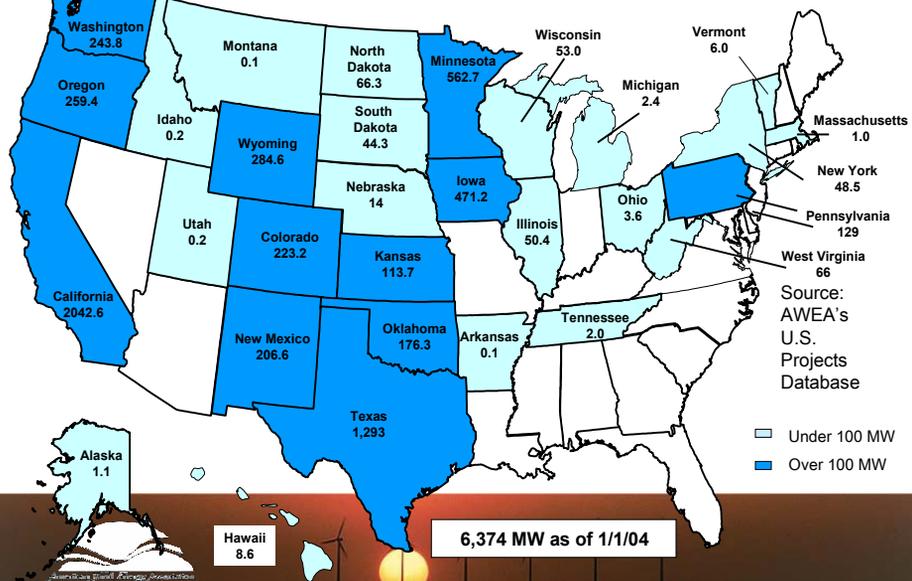
John R. Dunlop
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American Wind Energy Association

Michigan Wind Working Group
2004 October 05

Image courtesy of NEG Micon

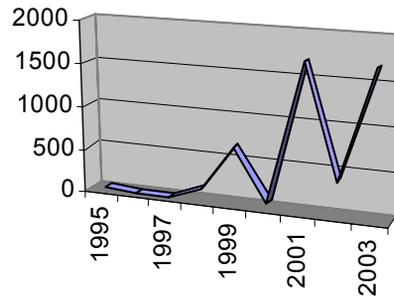


United States Wind Power Capacity (MW)



Industry Needs Consistent Policy Support

- Less than 500 MW expected to be installed in 2004 due to expiration of wind energy Production Tax Credit
- Short-term federal policy has derailed industry's growth every two years.



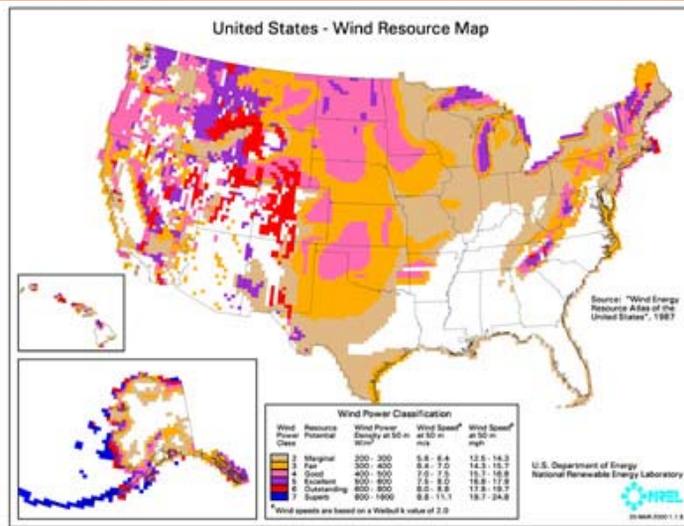
U.S. Federal Production Tax Credit

- enacted 1992 - 1.5¢/kW.h for 10 years
- Expired - for 3rd time - on 2003 Dec. 31 at 1.8¢/kW.h
- Congress passed extension through 2005 last Thursday, September 23
 - Retroactive to January 1
 - No changes in provisions
 - Bush signed the bill yesterday, Oct 05
- Extension through 2006 still in “JOBS” bill
 - Congress may consider in “Lame Duck” session
 - May increase technologies, may not include inflation adjustment
 - House conferees appointed Sept 29

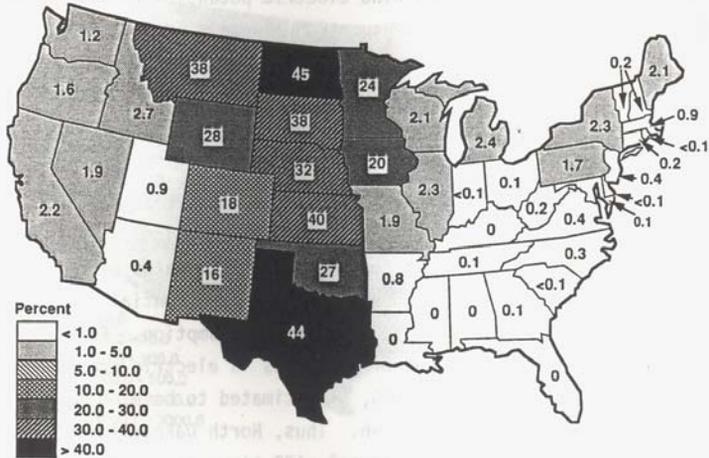


Other announcements in past two weeks:

- New York became 17th state with renewable energy standard – 25% by 2013
 - Others: Minnesota, Iowa, Wisconsin
- Minnesota EQB approved 1st of four new transmission lines for wind
- Gamesa to establish U.S. Headquarters in Philadelphia; 400 MW PPA; blade manufacturing in PA
- MidAmerican (Iowa) to complete 100 MW project by end of 2004 (edging MN to become #3 wind-producing state)



a) Total Electric Consumption



Wind installation top states = States with RES

- 1. California 2006 MW
- 2. Texas 1305 MW
- 3. Minnesota 551 MW
- 4. Iowa 482 MW

2004 January



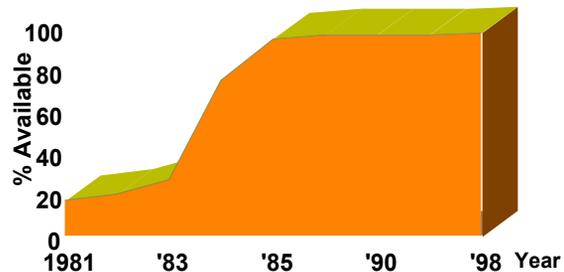
Turbine Technology Constantly Improving

- Larger turbines
- Specialized blade design
- Better electronics
- Computer design modeling
- Manufacturing improvements

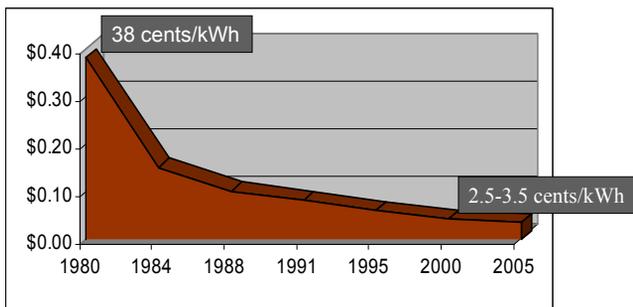


Technology Improvements Lead to Better Reliability

- Drastic improvements since mid-80's
- Manufacturers report availability data of over 98%



Cost Improvement Driving Wind's Success



Levelized cost at excellent wind sites in U.S. nominal dollars, including U.S. tax incentives

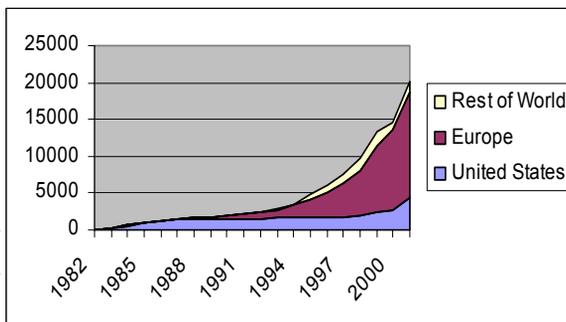


Wind Is Growing Worldwide

28%/year (5-year average)

Installed Capacity as of 2004 January

1. Germany: 14,000 MW
2. U.S.: 6400 MW
3. Spain: 5800 MW
4. Denmark: 3100 MW
5. India: 1900 MW



Source: AWEA press release, WPM



Wind Project Siting Issues

**An overview of siting issues that
can affect the success of a wind
power project**



SINGLE MOST IMPORTANT ISSUE: *LOCATION*

- Wind resource is *highly* site sensitive
- Impact of a turbine or a project is sensitive to the proximity to people
- Ensuring safe and successful project is sensitive to location



Siting Considerations by Area of Influence and Perspective

Area of influence

- I – Wide area (selection of state, region or county to explore)
- II – Project area (selection of township, sections to locate project)
- III – Turbine siting (individual turbine locations)



Siting Considerations by Area of Influence and Perspective

Perspective

- Wind project owner/developer
- Community interest
- Environmental considerations



Siting Matrix

Perspective: Wind Project Interest Community Interest Environmental Impact

Area of Influence:

Wide Area	X	X	X
Project Area	X	X	X
Turbine Siting	X	X	X



I – Wide Area

Wind Project Interest

- Adequate wind resource
- Adequate transmission capacity

Community Interest

- Economic development opportunities
- Areas of scenic beauty
- Parks
- Recreational areas
- Military training grounds



II – Project Area

Wind Project Interest

- Local terrain
- Existing and projected uses of the land

Community Interest

- Airports
- Airplane safety
- Aerial farming operations
- Enhanced tourism
- Paleontological and archaeological sites
- Cultural sites



II – Project Area

Environmental Consideration

- Wetlands
- Nesting areas
- Sensitive species



Siting Matrix

Perspective: Wind Project Interest Community Interest Environmental Impact

Area of Influence:

Wide Area	X	X	X
Project Area	X	X	X
Turbine Siting	X	X	X



III – Turbine Siting

Wind Project Interest

- Turbine spacing for optimum electricity production
- Minimize overall project footprint

Community Interest – **Frequently most important area for local siting authorities**

- Safety (catastrophic failure; ice shedding)
- Acceptance (visibility, sound levels, solar flicker, electromagnetic interference)
- Compatibility with land use
- Neighboring commercial interests



III – Turbine Siting

Environmental Consideration

- Surface water runoff
- Ground water quality
- Avian behavior



Siting Matrix

Perspective: Wind Project Interest **Community Interest** Environ. Impact

Area of Influence:

Wide Area	X	X	X
Project Area	X	X	X
Turbine Siting	X	X	X



Community Interests: Wide Area

Economic Development

- Local business activity
- Local jobs
- Local taxes



Community Interests: Project Area

Airports

- Proximity to airports (federal jurisdiction)

Airplane Safety

- Visibility (nighttime lighting)
- Minimize visibility from the ground

Aerial farming operations

- Host and neighboring land owners



Community Interests: Project Area

Tourism

- Traffic issues
- Setback requirements

Paleontological, archaeological, cultural sites

- Sites may be significant
- Egress may be required
- Federal, state regulations may prevail



Community Interests: Turbine Siting

Geometry

- Spacing for optimum performance → rotor diameter
- Setback from specified “receptor” → overall height (“fall zone”)

Definitions

- D, Diameter: Diameter of rotor disk
- H, Hub Height: Height of center of rotation
- T, Total Height: Height from ground to tip of vertically extended blade ($H + \frac{1}{2} D$)



Community Interests: Turbine Siting

Safety

- Catastrophic failure: $T + \text{margin}$ (1.25 T?)
- Ice Shedding: 2 T (based on geometry)

Acceptance

- Visibility: neutral color, uniform appearance, spacing between turbines
- Sound: “aero-acoustic” sound; 50 dB(A) at “receptor”
- Solar flicker (sunshine interrupted by blades): unique and transitory phenomenon; proximity and screening
- Electromagnetic interference (may cause “shadows” in weak TV signals)
 - Enhance signal strength; provide alternative receiver



Community Interests: Turbine Siting

Compatible land use

- Minimize land taken out of production
- Site turbines and roads to be compatible

Neighboring commercial interests

- Neighbor may wish to develop wind resource
- Turbines may cause “wind shadow” for 10 D downwind
- Minimum setbacks of 3-5 rotor diameters (depending on terrain)



Non-location-dependent permitting issues

Human safety

- Control unauthorized egress

- Fire control

Community safety

- Fire protection (roadways, authorized egress)

- Highway safety (transportation of large, slow loads)

Community acceptance

- Transportation planning (noise, dust)

- Construction (noise, dust)



Non-location-dependent permitting issues

Environmental consideration

- Type of safety lighting may impact birds (flashing better)

Commercial value

- Avoid damage to roads

- Avoid interference with traffic

- Site cleanup

- Local goods and services

- Weed control

Decommissioning

- Remove above-ground and surface materials



Wind Project Siting Issues

Goal

Projects that are commercial successes and successful for the communities that host them



AWEA Expectations for Future Growth

- ~1,700 MW added in 2003 (~6,400 MW total)
- Project 20,000 MW total installed capacity by 2010
- 6% of U.S. electricity supply by 2020

➔ = 100,000 MW of wind power installed by 2020



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