

Building a Wind Industry in Ohio

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April 18, 2008

Wind Energy

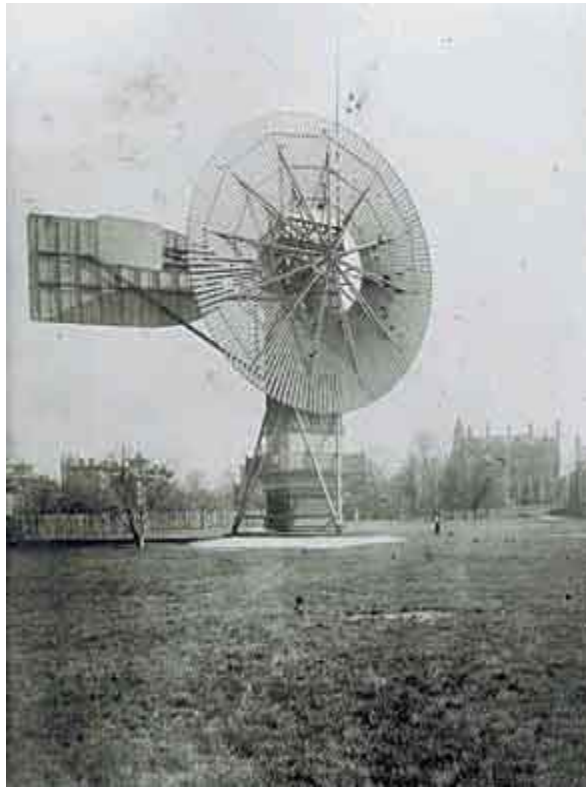
- **Generation of electricity from wind, typically 3-bladed propeller device**
- **Fastest growing segment of energy in world:**
 - **>\$20 billion annually worldwide, ~\$9 billion in U.S.**
 - **~40% annual growth 1995-2005**
- **Cheapest form of non-polluting renewable energy, often competitive with conventional electric power in windy area**
- **Ohio has growing activities in wind development (Ohio Wind Working Group) and manufacturing (Great Lakes Wind Network)**
- **Most of market is onshore, but long-term opportunities offshore**

Wind Is Big



Wind History in Ohio

First wind electricity generator:
Charles Brush, Cleveland, 1888

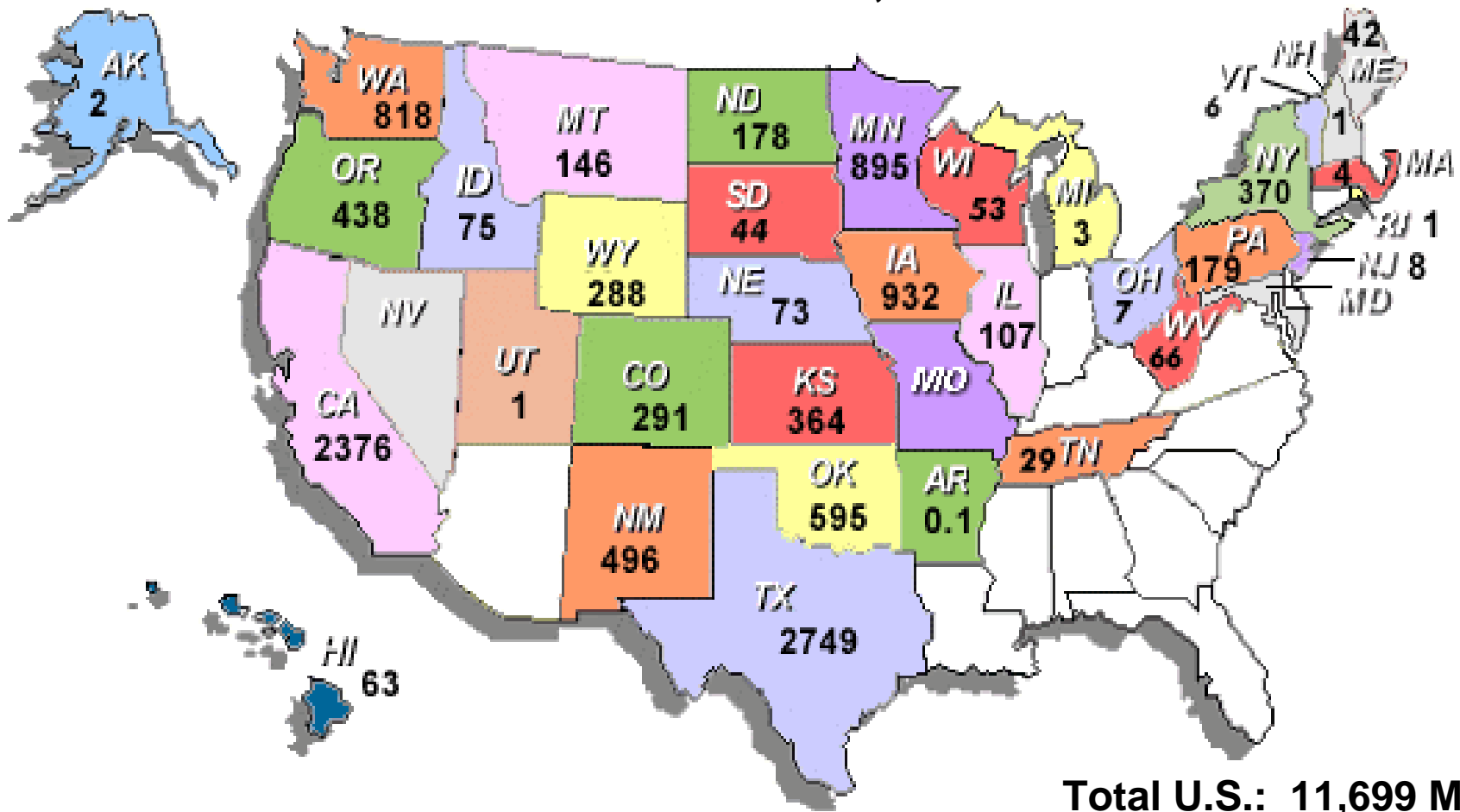


Experimental turbine:
NASA, Sandusky, late 1970's



Installed Wind Capacity (MW)

As of March 31, 2007



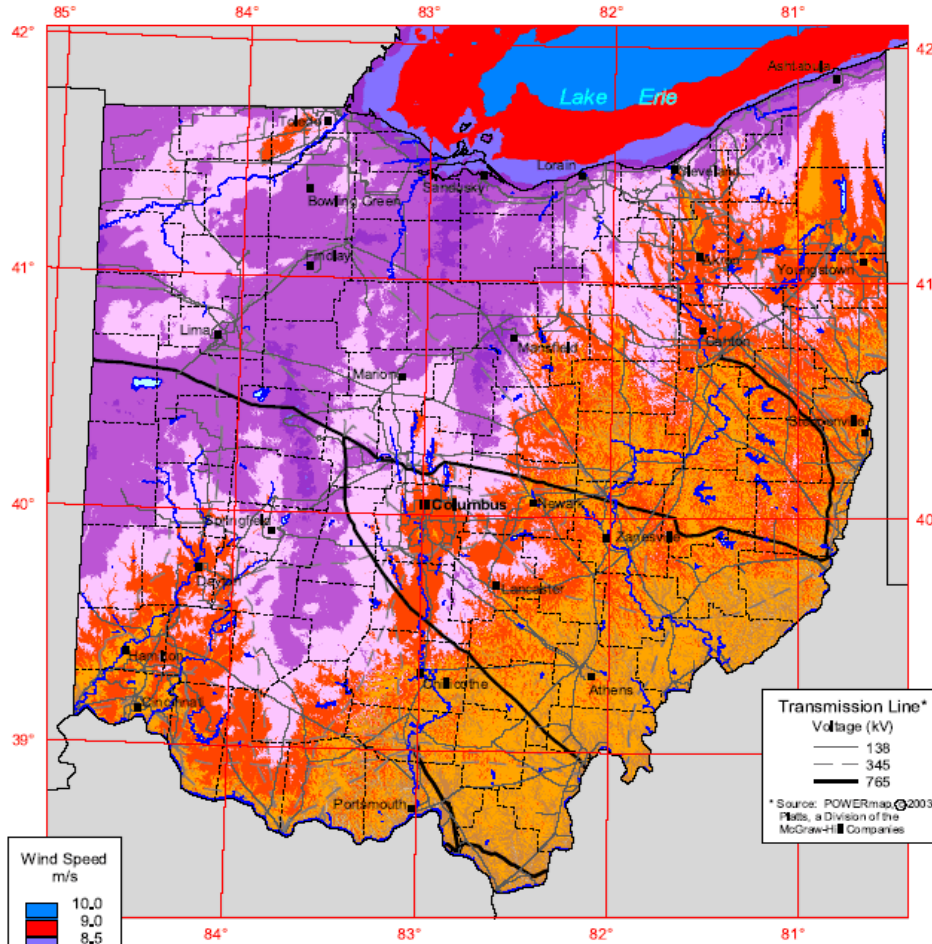
Source: American Wind Energy Association

Huge Opportunity for Ohio

- Industry manufacturing constrained:
 - 2+ year delivery times for new turbines
 - Desperate needs across supply chain (especially gearboxes, bearings, casting, towers)
 - New manufacturing factories being located (each employing several hundred)
- North America is key focus of industry expansion:
 - U.S. largest market (especially in future), but most turbines made in Europe
 - Transportation and currency swings make importation expensive
- Wind is high-priority industry for Ohio:
 - Heavy industrial manufacturing, similar to Ohio legacy industries
 - Substantial supply chain participation already (though could be much greater)
 - Significant employment potential in Ohio associated with wind manufacturing (REPP: 13,000 jobs)

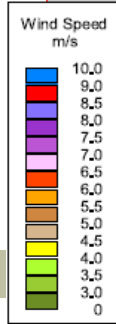
Ohio Wind Resources

Ohio - Annual Average Wind Speed Estimates at 100-m Height



**66,000 megawatts
developable
on-shore**

**Perhaps similar
magnitude off-
shore in Lake Erie**



Total wind energy potential from windy lands (7.2 m/s and greater) = 66,000 MW (land-based development only).

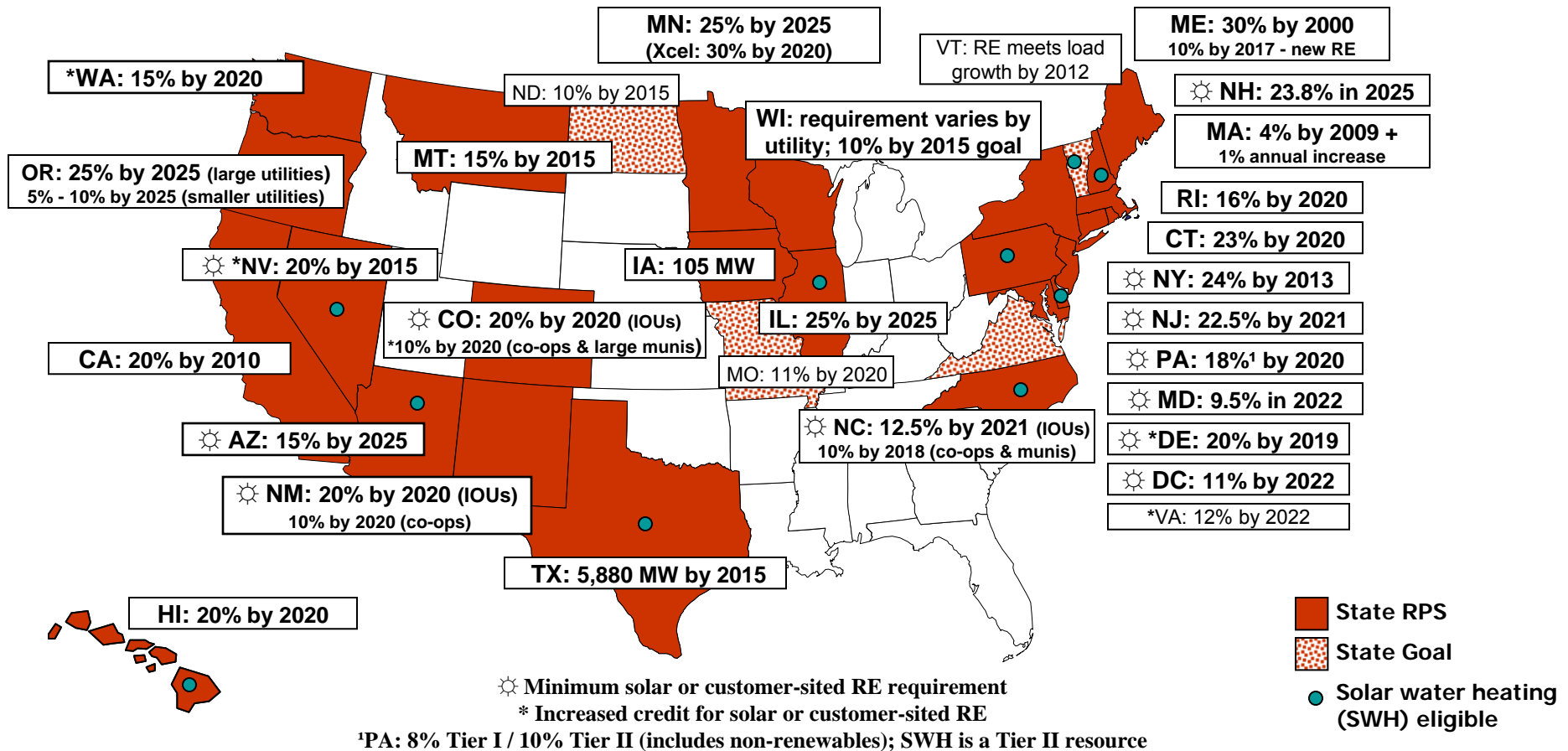
Sensitive environmental lands, urban areas, airports, and water bodies (such as Lake Erie) are excluded.



U.S. Department of Energy
National Renewable Energy Laboratory
10-NREL-0007 422



Renewable Portfolio Standards



Ohio Portfolio Standard

- 25% advanced energy by 2025
 - ½ renewables
 - ½ in-state
- Likely to be signed into law in spring 2008
 - August 2007, proposed by Governor
 - October 2007, passed by Senate (SB 221), though without interim requirements or enforcement provisions
 - April 2007, revised bill in House with stronger AEPS provisions

Ohio: #2 in Wind Mfg. Potential

Components of Wind Turbines						
State	Employees At Potential Companies	Rotor	Nacelle & Controls	Gearbox & Drive Train	Generator & Power Electronics	Tower
California	102,255	25,226	52,490	1,380	14,889	8,270
Ohio	80,511	30,578	33,367	6,360	3,372	6,834
Michigan	66,550	27,719	30,241	2,466	926	5,198
Texas	60,229	15,191	28,339	1,678	3,006	12,015
Illinois	57,304	20,001	24,193	5,520	3,143	4,447
Indiana	53,063	18,962	20,359	4,783	2,633	6,326
Pennsylvania	50,304	16,647	20,844	2,565	1,997	8,251
Wisconsin	48,164	17,795	21,317	3,796	567	4,689
New York	47,376	10,855	24,188	4,020	5,966	2,347
South Carolina	20,532	4,398	4,510	6,780	1,765	3,079

Source: Renewable Energy Policy Project, September 2004

Ohio Suppliers to Wind Industry

Company	City	Product
Advance Manufacturing	Cleveland	Large castings
Advantech	Cincinnati	Control systems
Afab Tech	Mansfield	Cooling systems, electronics
American Tank & Manufacturing	Cleveland	Tower components
Argo-Hytos	Bowling Green	Filtration systems
Avon Bearings	Avon	Bearings
Canton Drop Forge	Canton	Castings for gearboxes
Cardinal Fastener	Bedford Heights	Fasteners
Cast-Fab Technologies	Cincinnati	Castings
Cincinnati Gear	Cincinnati	Gears
Cleveland Gear	Cleveland	Gears
Dyson	Painesville	Nuts and bolts
Eaton	Cleveland	Electronics and valves
EGC	Chardon	Tension bolts
ERICO	Solon	Grounding
Honeywell	Urbana	Obstruction lighting
Joslyn Hi-Voltage	Cleveland	Switches
Koyo	Westlake	Bearings
Lubrizol	Wickliffe	Lubricants
Magma Machine	Cincinnati	Castings for hubs
Michael Byrne Manufacturing	Mansfield	Gears
Molded Fiberglass	Ashtabula	Blades
Owens-Corning	Toledo	Composite fibers for blades
Parker-Hannifin	Mayfield Heights	Pitch control systems
Rotek	Aurora	Bearings
Sherwin-Williams	Cleveland	Coatings for blades
Swiger Coil	Cleveland	Windings and generators
Timken	Canton	Bearings

Local Strengths

- Local supply chain and R&D expertise:
 - Bearings: Timken, Rotek, Avon Bearings
 - Blades and materials: MFG, Owens-Corning, Sherwin-Williams
 - Drive trains: Eaton, Parker-Hannifin
 - Gears: Horsburgh & Scott, Cleveland Gear
 - Control systems: Parker-Hannifin
 - Lubricants: Lubrizol
 - Casting, machining and fabrication: Many companies
 - Steel
- Deepwater port infrastructure for installation/logistics management
- Substantial research capabilities:
 - NASA-Glenn's wind tunnels and icing research/testing equipment
 - Case Western Reserve University's Institute of Energy Innovation
 - Regional excellence in materials science
 - University Clean Energy Alliance of Ohio
 - Ohio Third Frontier Program (\$1.6 billion over 10 years)
 - Great Lakes Wind Energy Center for offshore R&D

Great Lakes Wind Energy Center

- **Two components:**
 - 5-20 megawatt demonstration project (2-10 turbines) 3-6 miles offshore downtown Cleveland
 - Affiliated research/testing center for new wind technology R&D
- **Purposes:**
 - Attract research, manufacturing and services for future global offshore wind industry
 - Set precedents and improve economics for subsequent offshore wind project development in Great Lakes
 - Create powerful visual icon for Cleveland
- **2008: detailed feasibility study to ensure viability of concept**

Long-Term Wind Vision

- **Ohio as a major North American center of wind technology R&D and manufacturing**
- **Ohio as a large market for onshore wind deployment**
- **Great Lakes (starting with Lake Erie) as a growing market for offshore wind installation, with Ohio ports as primary logistics hub**
- **Lake Erie ports as a major gateway for shipping large wind turbines and components (e.g., blades, towers)**

Contact Information

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