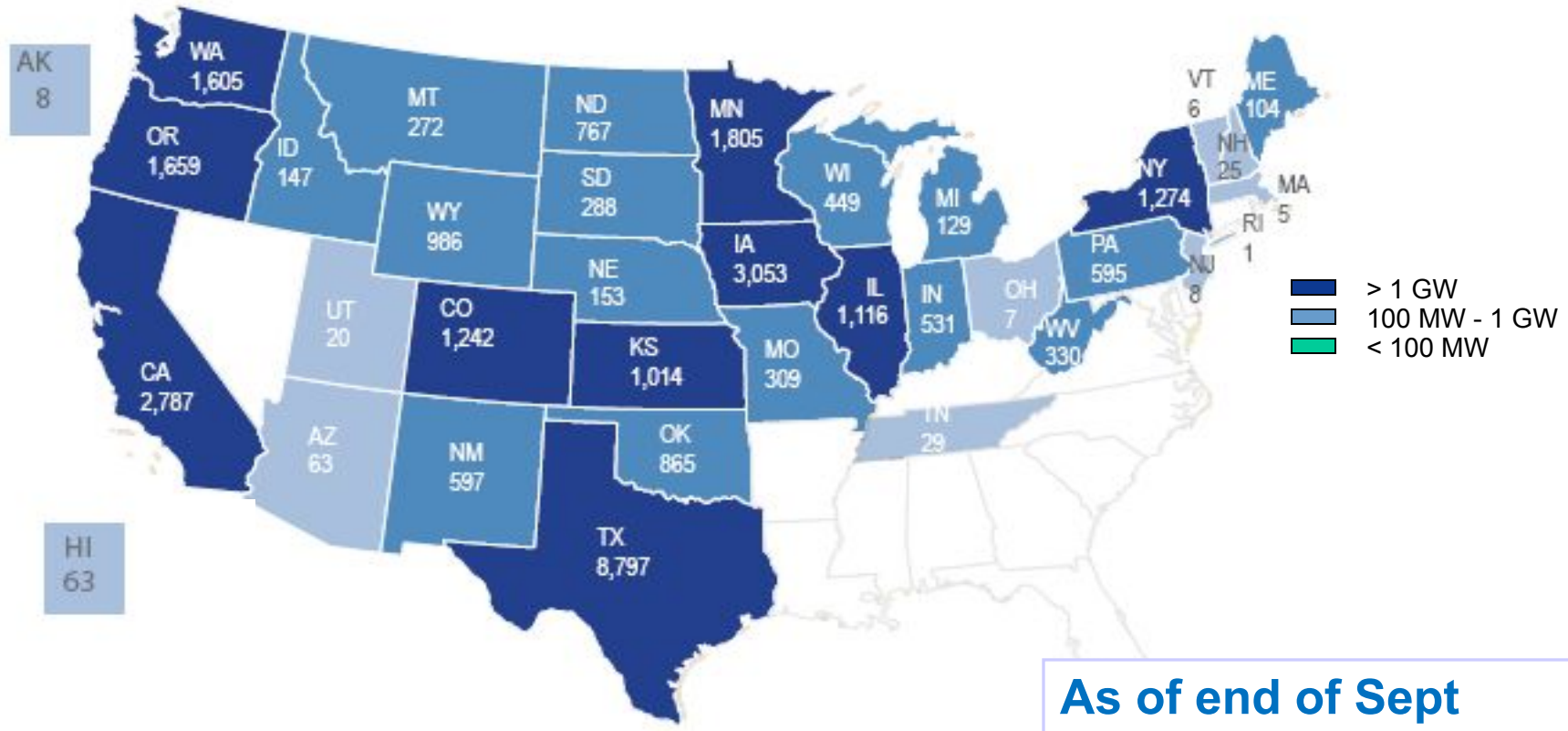
Wind Energy Update

Larry Flowers
National Wind Technology Center, NREL

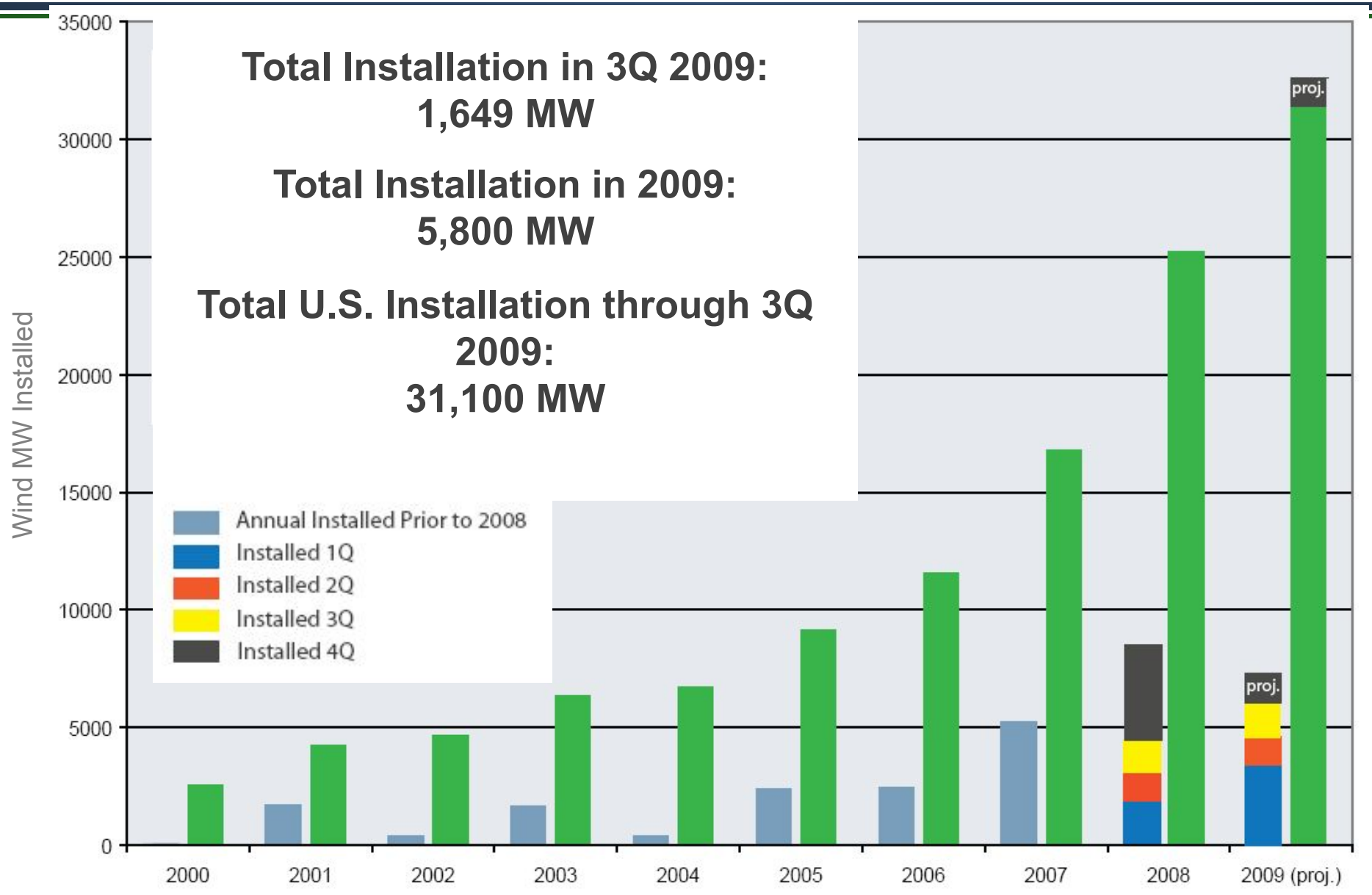
Nebraska - November, 2009

Installed Wind Capacity through end 3Q09

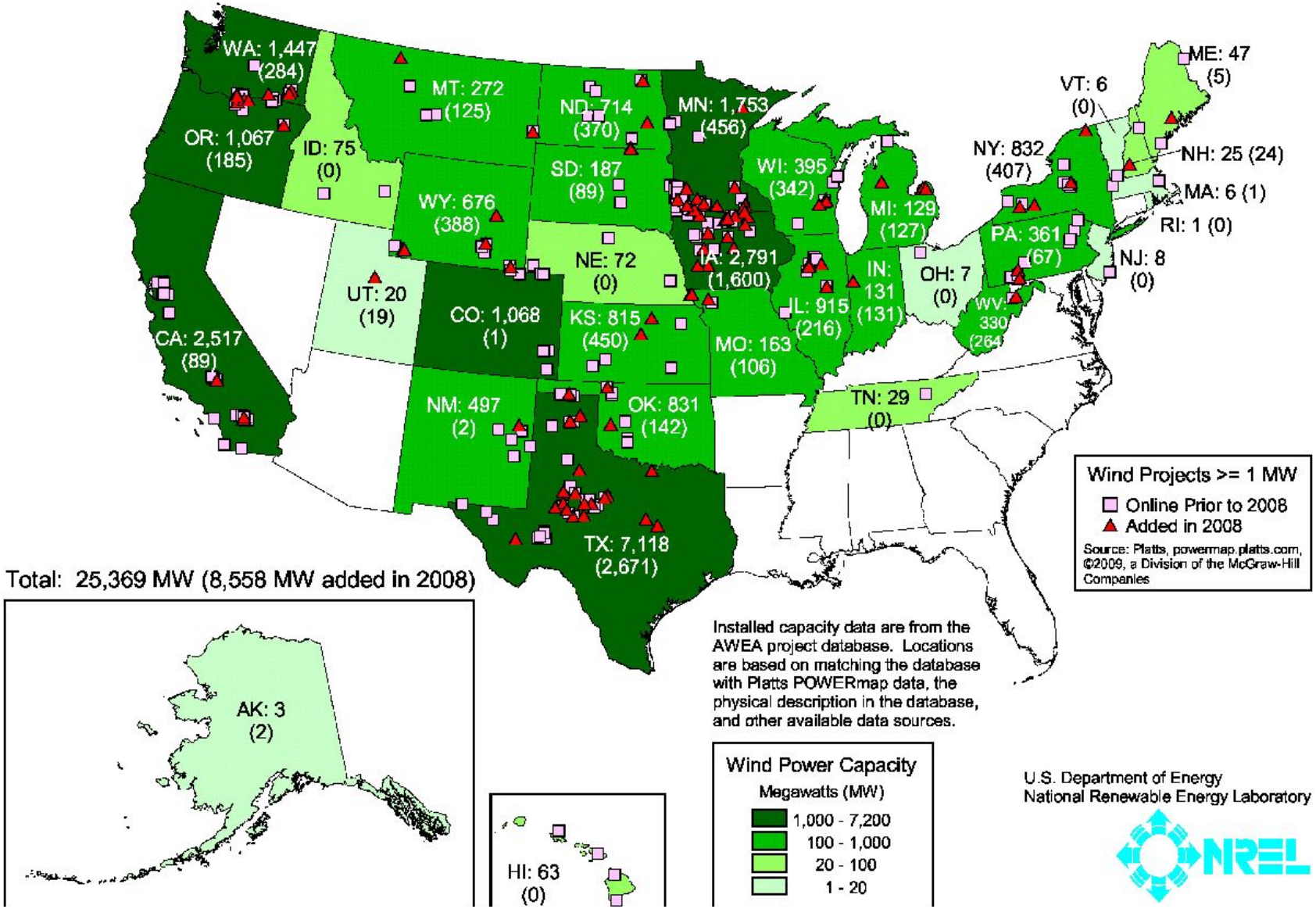


As of end of Sept 2009, 31,109 MW of wind installed in 36 states

Wind Industry 3Q 2009



Geographic Spread of Wind Projects in the United States Is Reasonably Broad



Texas Easily Led Other States in Both Annual and Cumulative Capacity

Annual Capacity (2008, MW)		Cumulative Capacity (end of 2008, MW)		Estimated Percentage of In-State Generation	
Texas	2,671	Texas	7,118	Iowa	13.3%
Iowa	1,600	Iowa	2,791	Minnesota	10.4%
Minnesota	456	California	2,517	South Dakota	8.8%
Kansas	450	Minnesota	1,753	North Dakota	7.1%
New York	407	Washington	1,447	Kansas	6.7%
Wyoming	388	Colorado	1,068	Colorado	6.6%
North Dakota	370	Oregon	1,067	Oregon	5.4%
Wisconsin	342	Illinois	915	Texas	5.3%
Washington	284	New York	832	New Mexico	4.5%
West Virginia	264	Oklahoma	831	Wyoming	4.1%
Illinois	216	Kansas	815	Washington	3.9%
Oregon	185	North Dakota	714	Oklahoma	3.7%
Oklahoma	142	Wyoming	676	Montana	3.4%
Indiana	131	New Mexico	497	California	3.1%
Michigan	127	Wisconsin	395	Hawaii	2.2%
Montana	125	Pennsylvania	361	Idaho	1.6%
Missouri	106	West Virginia	330	New York	1.4%
South Dakota	89	Montana	272	Illinois	1.4%
California	89	South Dakota	187	Wisconsin	1.3%
Pennsylvania	67	Missouri	163	West Virginia	0.9%
Rest of U.S.	52	*Rest of U.S.*	622	*Rest of U.S.*	0.2%
TOTAL	**8,558**	**TOTAL**	**25,369**	**TOTAL**	**1.8%**

Source: AWEA project database, EIA, Berkeley Lab estimates

- 13 states had >500 MW of wind capacity at the end of 2008 (7 had >1000 MW, 3 had >2500 MW)
- 2 states (IA and MN) have in-state wind generation that exceeds 10% of total in-state generation (6 other states exceed 5%)

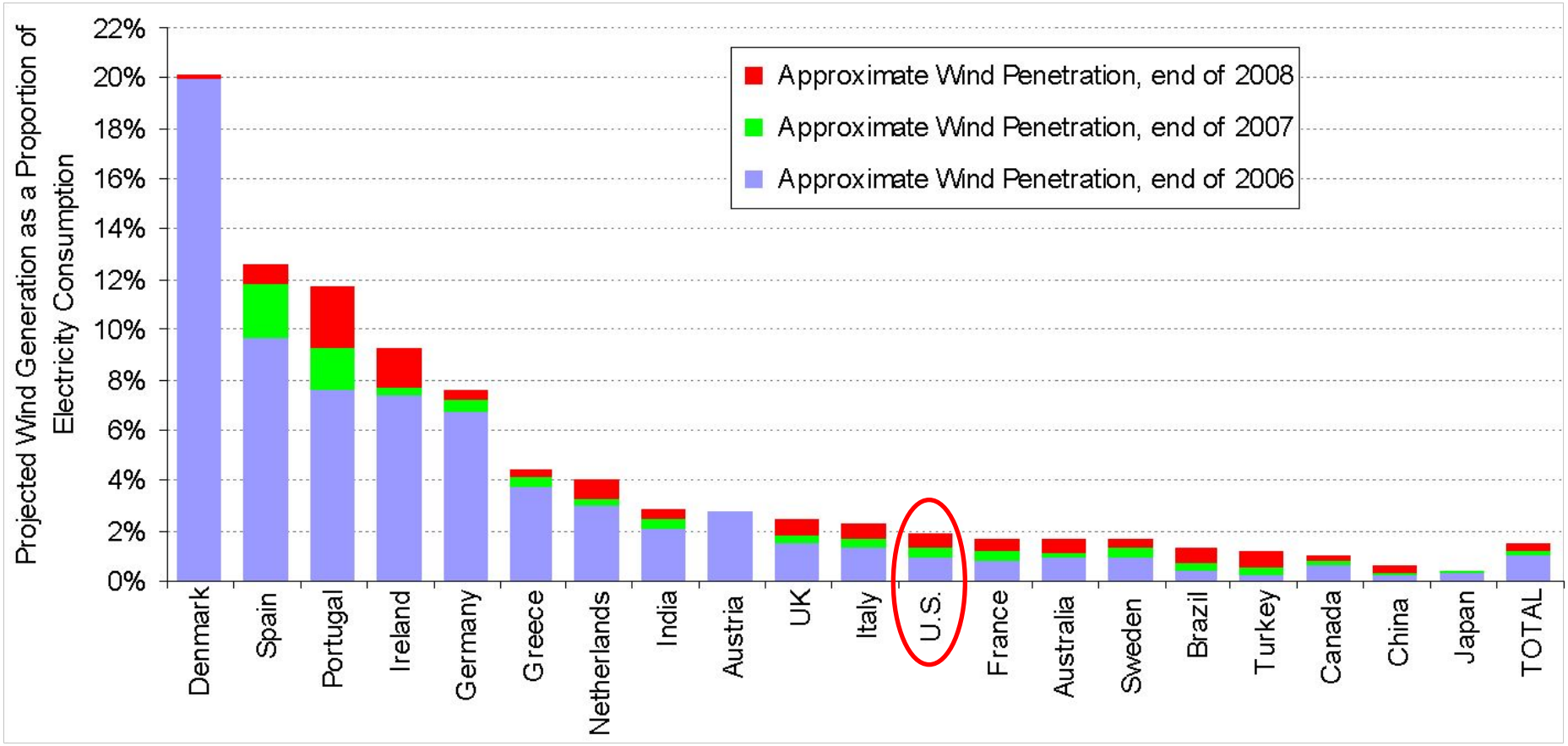
Wind Now >20% of Some Utilities' Sales

Total Wind Capacity (end of 2008, MW)			Estimated Percentage of Retail Sales (for utilities with > 100 MW of wind)	
Xcel Energy	2,906		Minnkota Power Cooperative	22.6%
MidAmerican Energy	2,363		Empire District Electric Company	20.7%
Southern California Edison	1,137		Otter Tail Power	14.9%
Pacific Gas & Electric	981		Southern Minn. Muni. Power Authority	13.0%
Luminant	913		Austin Energy	11.7%
City Public Service of San Antonio	502		Xcel Energy	10.7%
American Electric Power	468		MSR Public Power Agency	9.3%
Alliant Energy	446		Great River Energy	9.1%
Austin Energy	439		City Public Service of San Antonio	8.2%
Puget Sound Energy	435		MidAmerican Energy	8.1%
Exelon Energy	351		Public Service New Mexico	6.2%
Great River Energy	319		Luminant	5.6%
Empire District Electric Company	255		Alliant Energy	5.4%
First Energy	244		Puget Sound Energy	5.3%
San Diego Gas & Electric	239		Seattle City Light	5.3%
Portland General Electric	225		Northwestern Energy	5.0%
Public Service New Mexico	204		Minnesota Power	4.6%
MSR Public Power Agency	200		Aquila	3.9%
Reliant Energy	199		Portland General Electric	3.3%
Minnkota Power Cooperative	193		Southern California Edison	3.1%

Source: AWEA, EIA, Berkeley Lab estimates

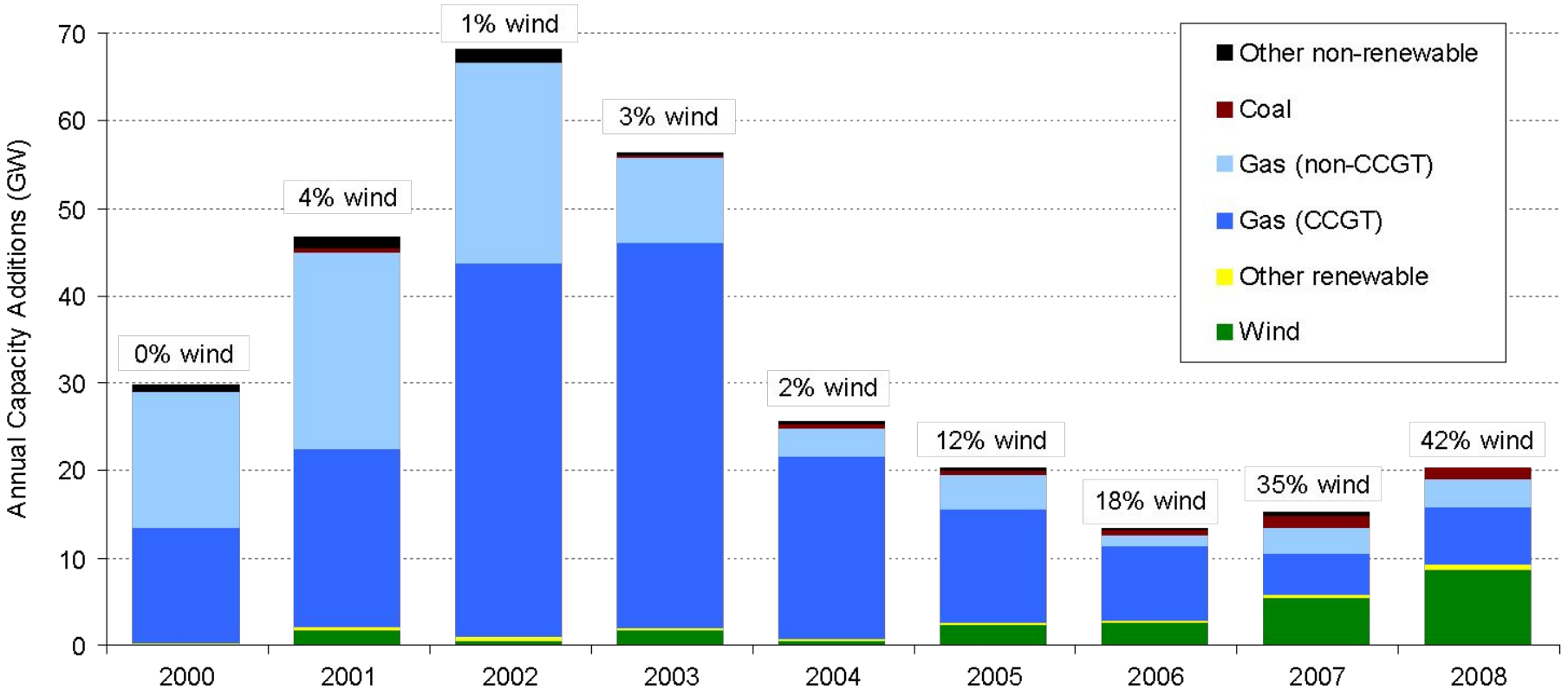
See full report for the many assumptions used to generate the data in this table

U.S Lagging Other Countries in Wind As a Percentage of Electricity Consumption



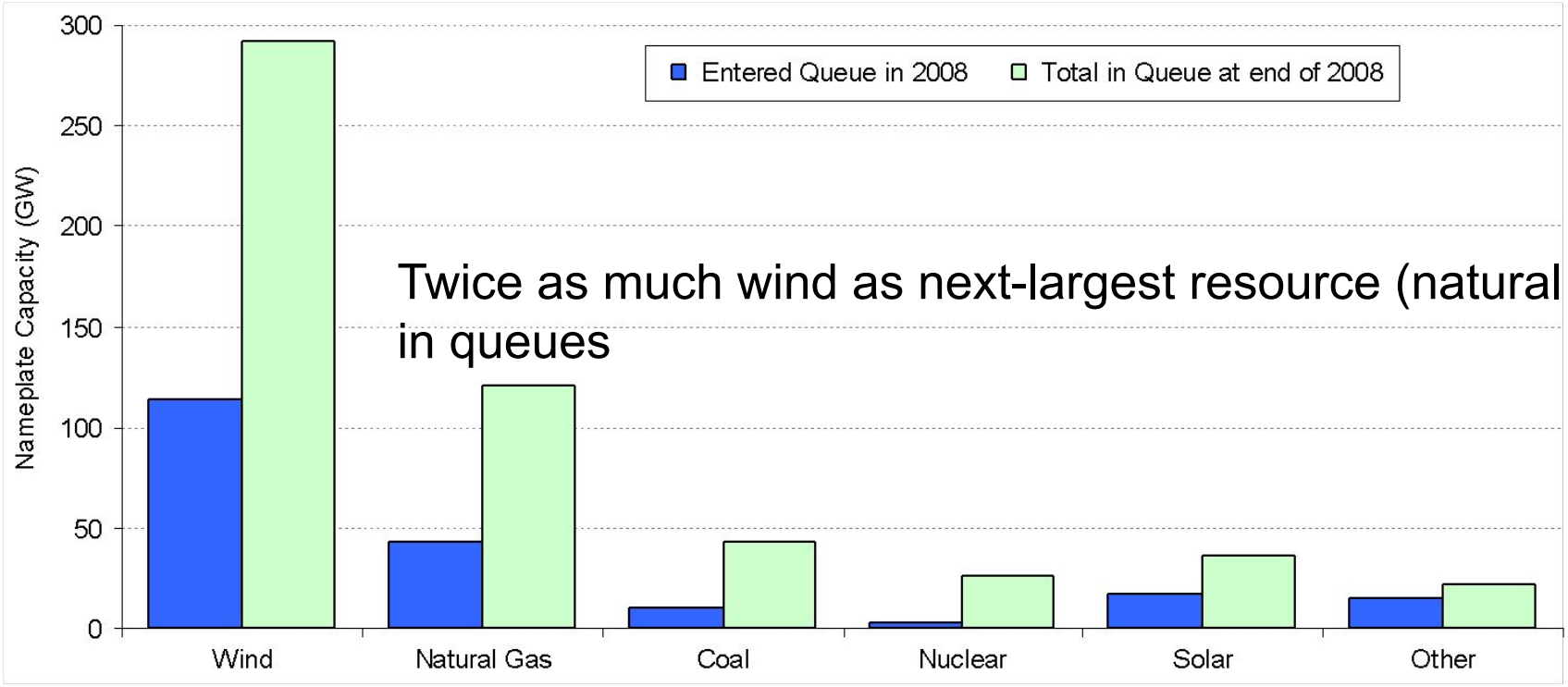
Note: Figure only includes the 20 countries with the most installed wind capacity at the end of 2008

Wind Is a Major Source of New Generation Capacity Additions: Wind Contributed 42% of New Additions in the US in 2008



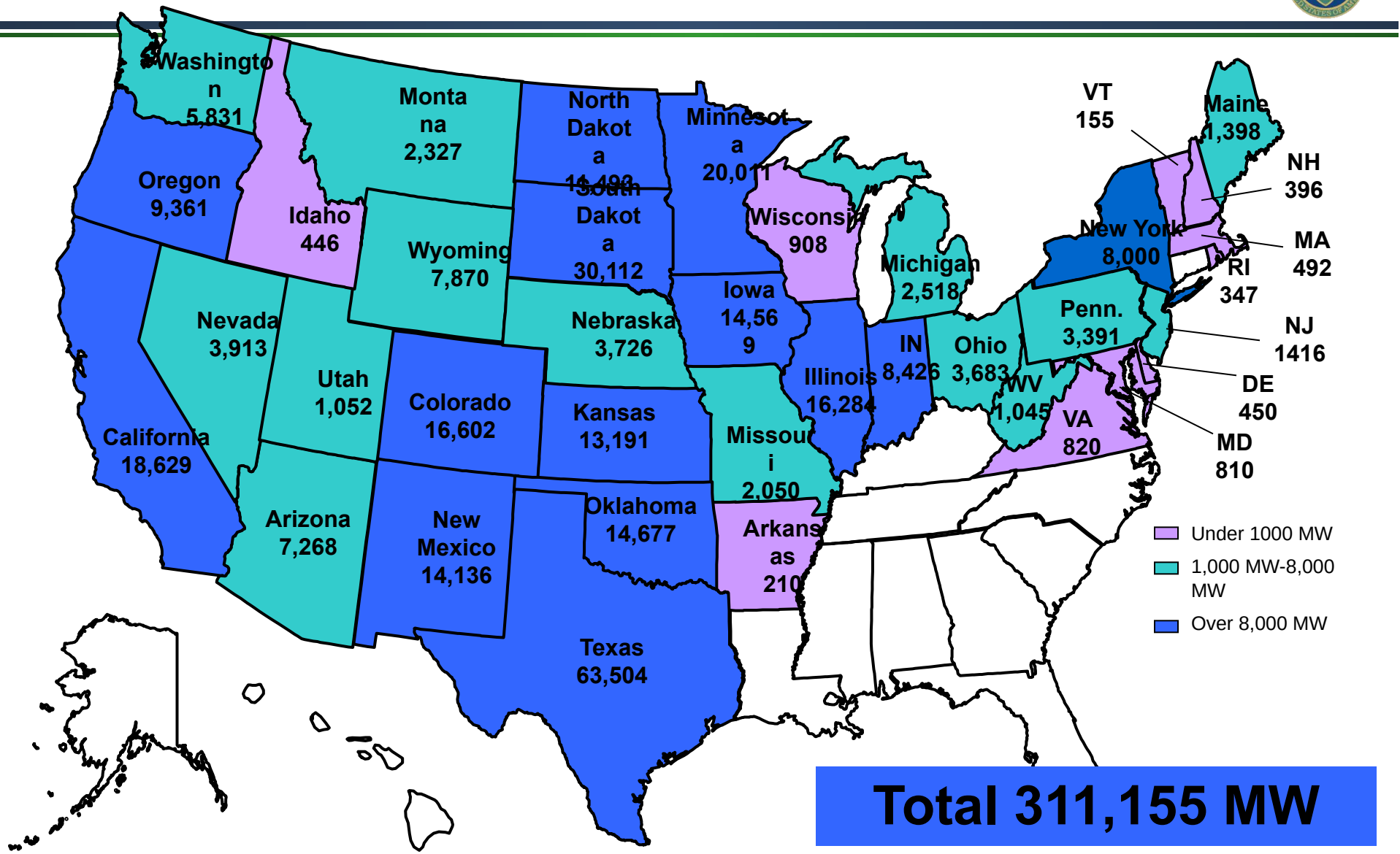
- Wind was the 2nd-largest resource added for the 4th-straight year

Nearly 300 GW of Wind in Transmission Interconnection Queues



- MISO (64 GW), ERCOT (52 GW), SPP (48), and PJM (43 GW) account for >70% of total wind in queues
- ***Not all of this capacity will be built….***

Wind Power in Queues (MW)

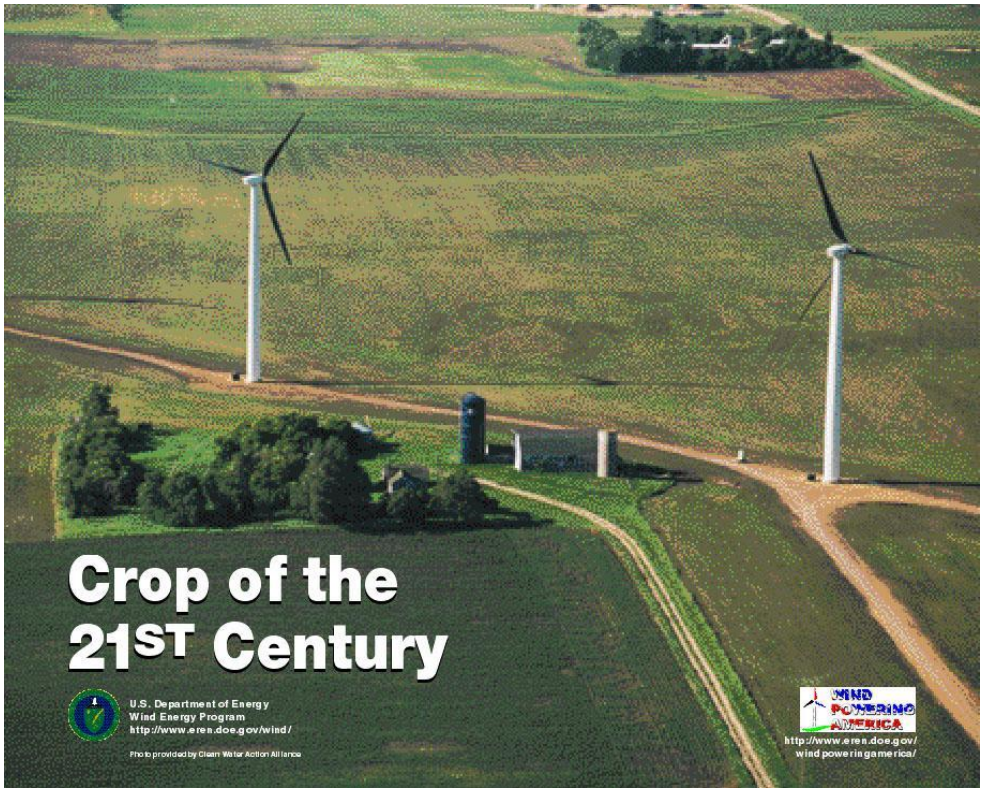


Total 311,155 MW

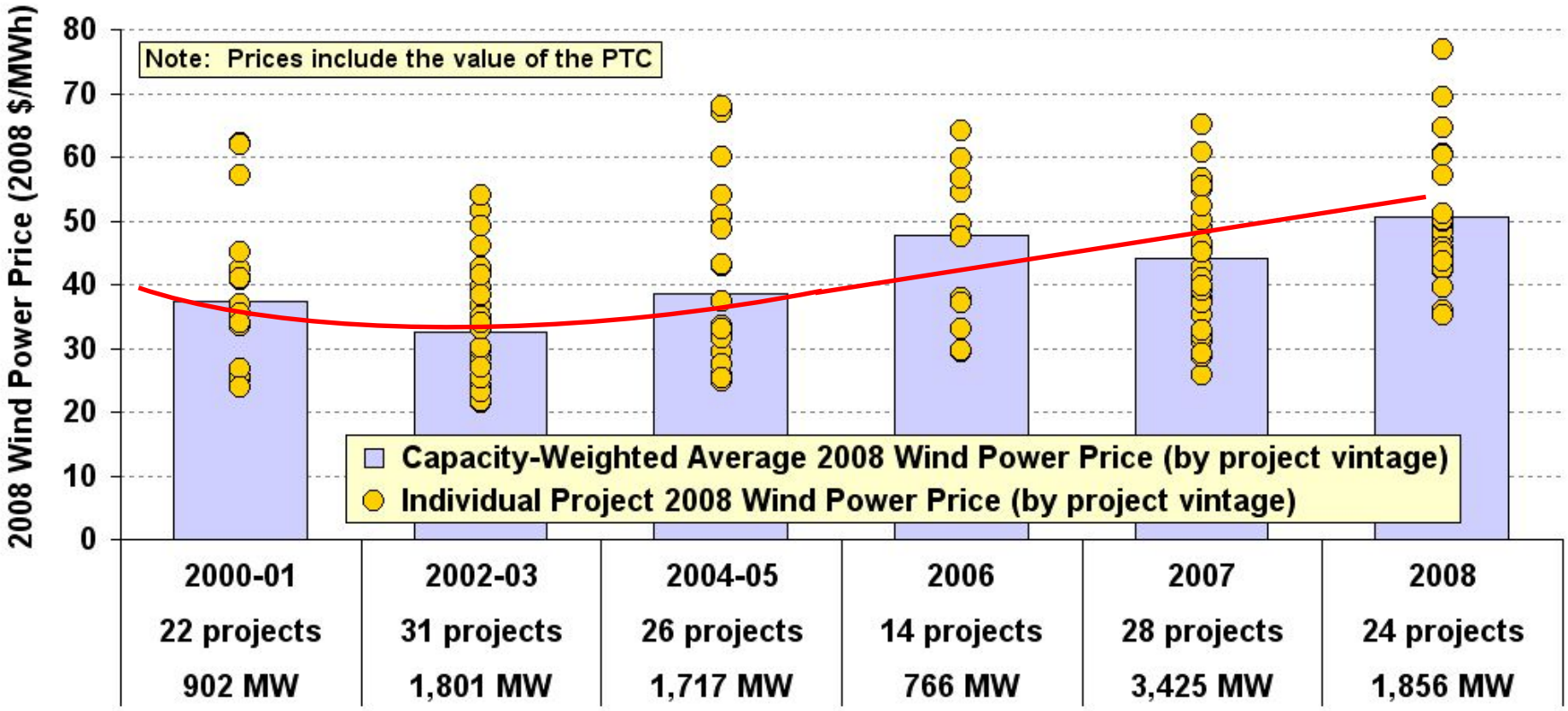
Source: AWEA

Drivers for Wind Power

- Declining Wind Costs
- Fuel Price Uncertainty
- Federal and State Policies
- Economic Development
- Environment/Water
- Public Support
- Green Power
- Energy Security
- Carbon Risk



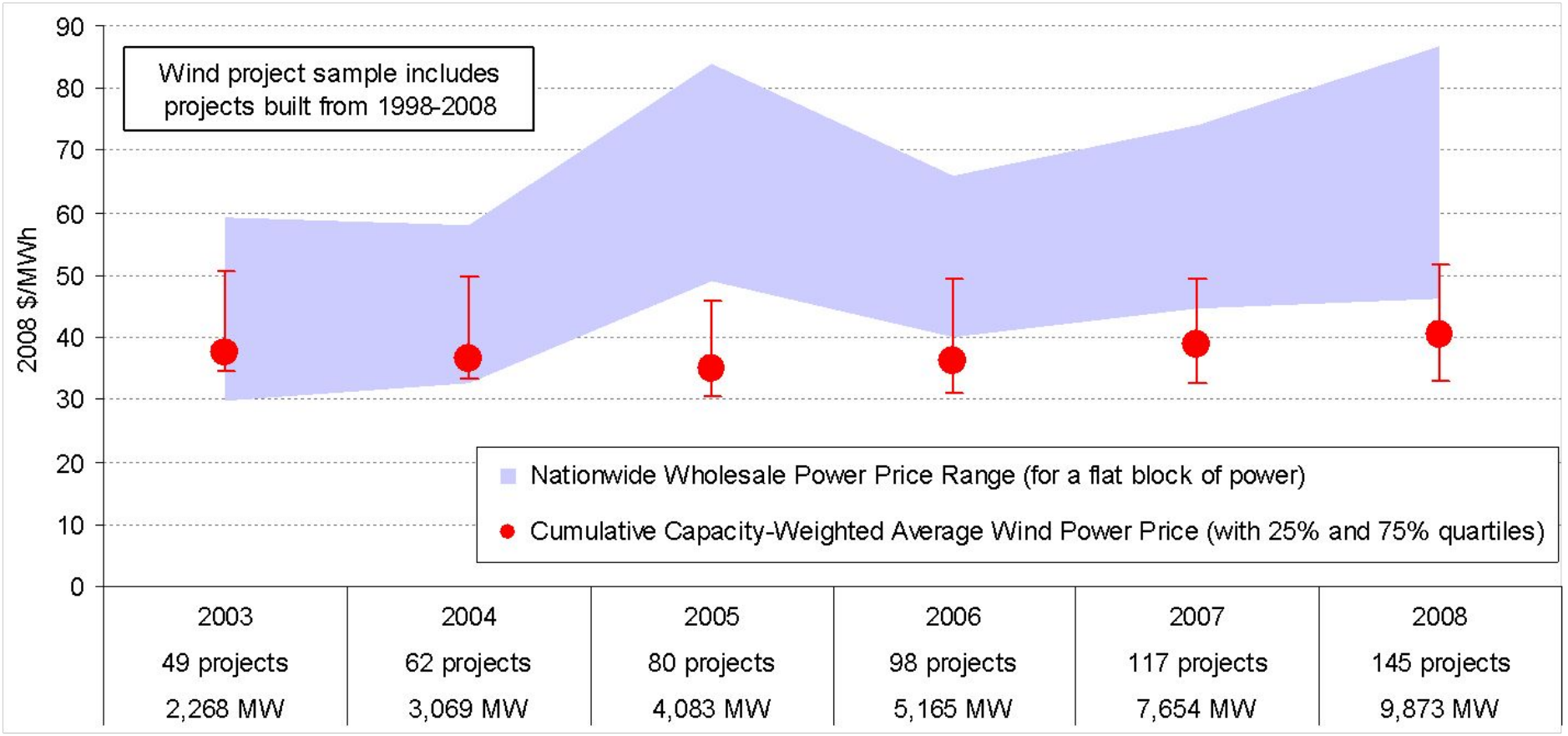
As a Result of Foregoing Trends, Wind Prices Have Been Rising Since 2002-03…



- Wind power prices bottomed out with projects built in 2002-03
- Projects built in 2008 are ~$15-20/MWh higher on average

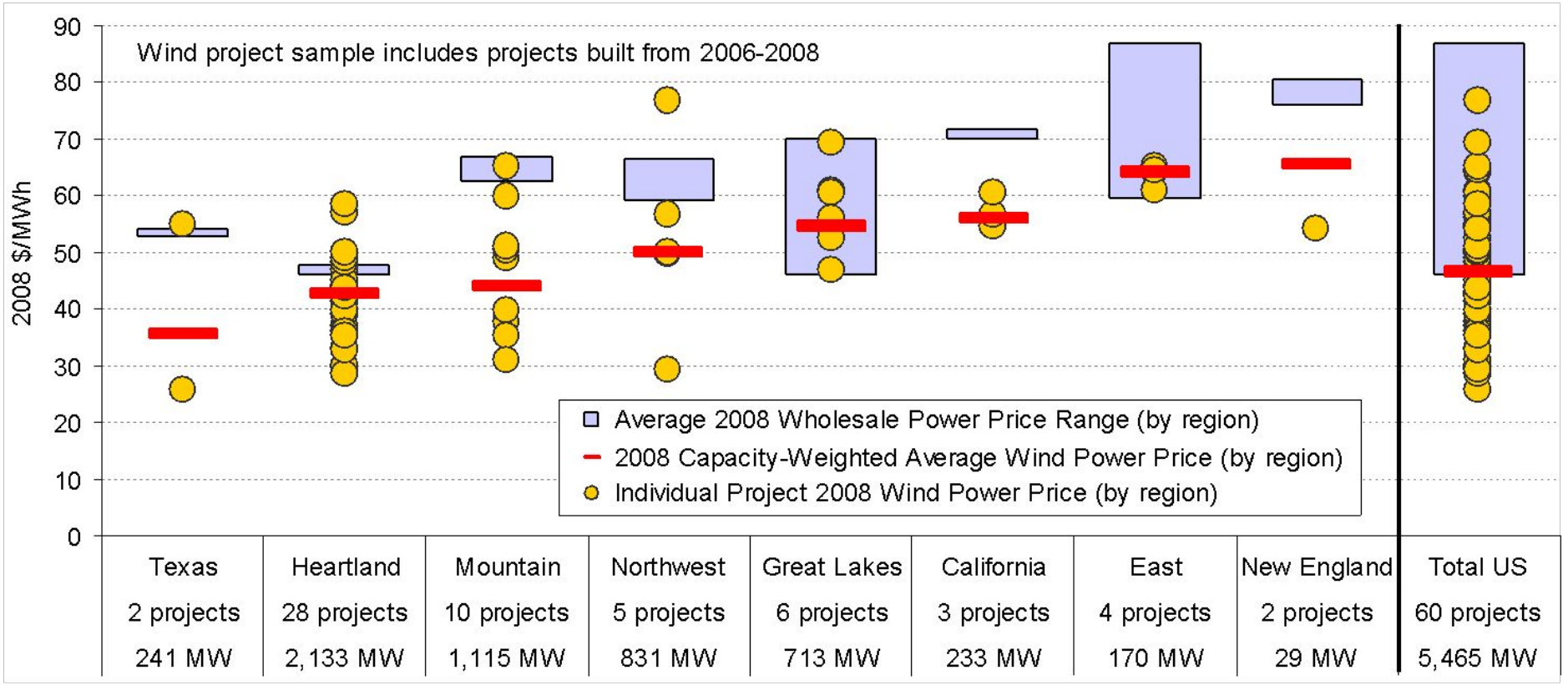
2008 Wind Market Report; LBL

Wind Has Been Competitive with Wholesale Power Prices in Recent Years



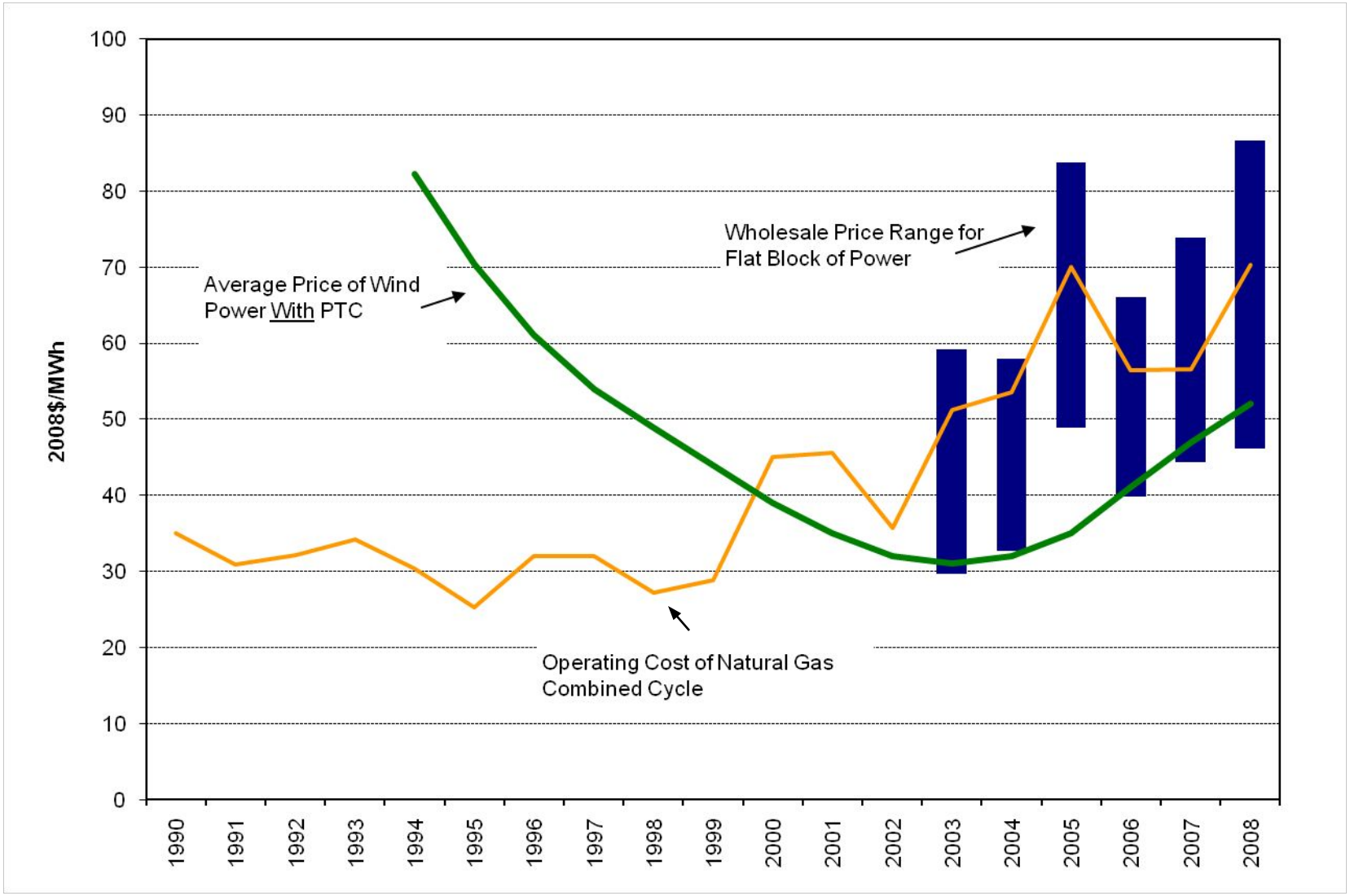
- Wholesale price range reflects flat block of power across 23 pricing nodes
- Wind power prices include sample of projects built from 1998-2008

Even Among More-Recent Projects, Wind Was Competitive in Most Regions in 2008



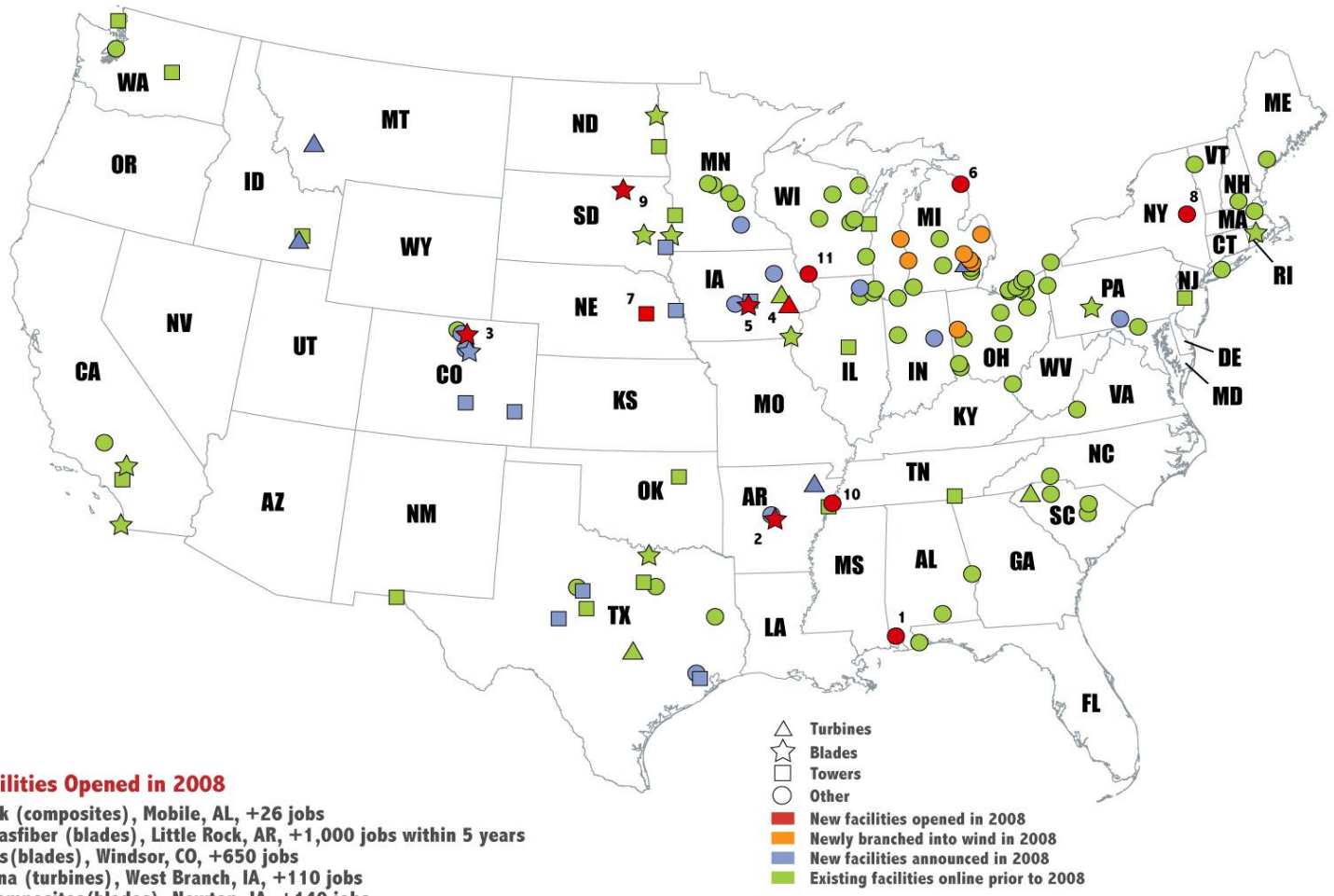
Note: Within a region there are a range of wholesale power prices because multiple wholesale price hubs exist in each area (see earlier map)

Comparative Generation Costs



Source: LBL

Soaring Demand Spurs Expansion of U.S. Wind Turbine Manufacturing



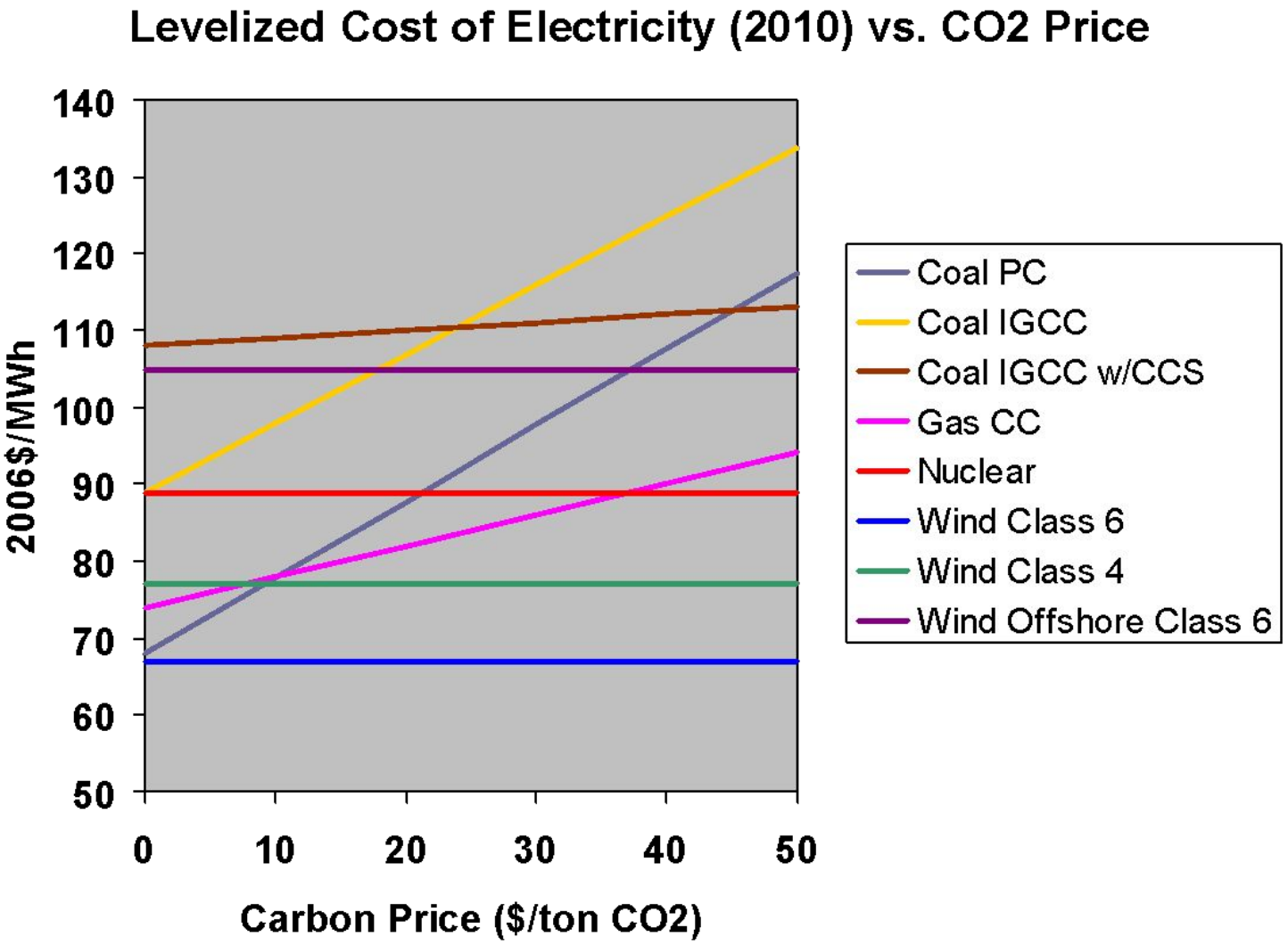
New Facilities Opened in 2008

1. Evonik (composites), Mobile, AL, +26 jobs
2. LM Glasfiber (blades), Little Rock, AR, +1,000 jobs within 5 years
3. Vestas (blades), Windsor, CO, +650 jobs
4. Acciona (turbines), West Branch, IA, +110 jobs
5. TPI Composites (blades), Newton, IA, +140 jobs
6. ATI Casting Services (casting and foundry), Alpena, MI, +20 jobs
7. Katana Summit (towers), Columbus, NE
8. GE (parts fulfillment center), Schenectady, NY
9. Molded Fiberglass (blades), Aberdeen, SD, +up to 750 jobs
10. GE (parts operation center), Memphis, TN
11. Wausaukee Composites (housings), Cuba City, WI, +61 jobs

Figure includes wind turbine and component manufacturing facilities, as well as other supply chain facilities, but excludes corporate headquarters and service-oriented facilities. The facilities shown here are not intended to be exhaustive. Those facilities designated as "Turbines" may include turbine assembly and/or turbine component manufacturing, in some cases also including towers and blades.

This map was created by The National Renewable Energy Laboratory for the U.S. Department of Energy. May 18, 2009

CO_2 prices significantly increase the cost of coal



Economic Development Opportunities

- **Land Lease Payments**: 3-5% of gross revenue $3000-4000/MW/year
- **Local property tax** revenue: 100 MW often brings in on the order of $500K-$1 million/yr
- 80-100 jobs/ 100 MW during **construction**
- 6-8 permanent **O&M jobs** per 100 MW
- **Local construction** and service industry: Foundations, roads-- often done locally
- Investment as **Equity Owners**: production tax credit, accelerated depreciation, project revenues
- **Manufacturing** and Assembly plants expanding in U.S.-- single most significant economic development opportunity

On-site & Project Development Labor

Truck drivers, crane operators

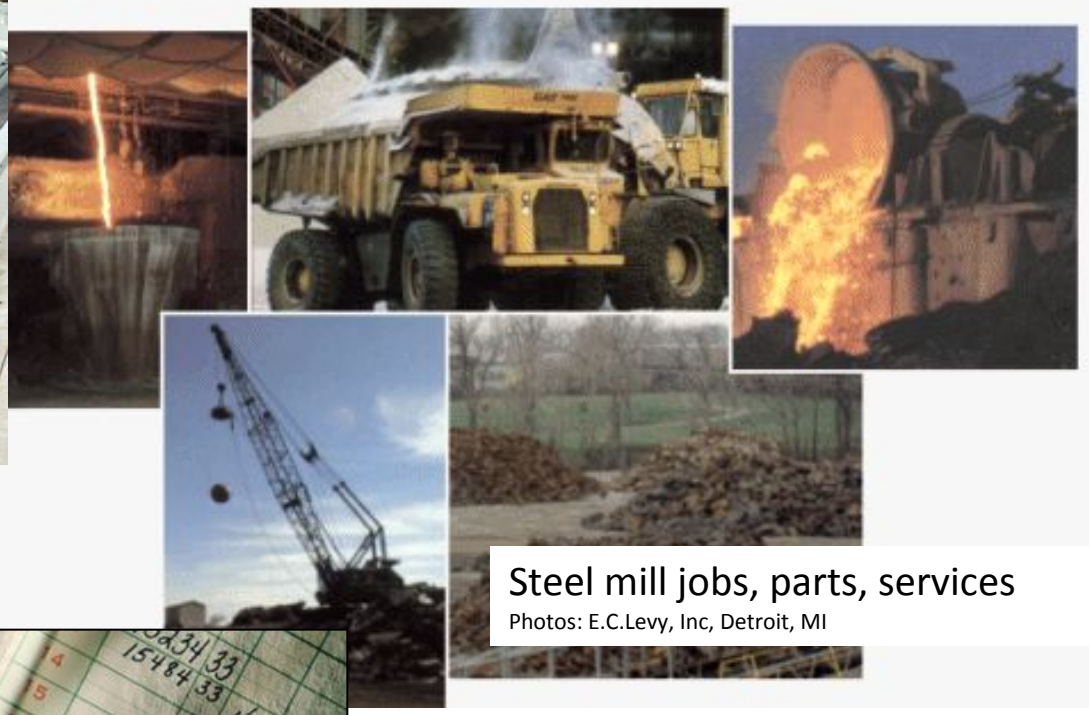
Earth moving, cement pouring

Management and support

Construction

Off-site and supply chain jobs, services, materials

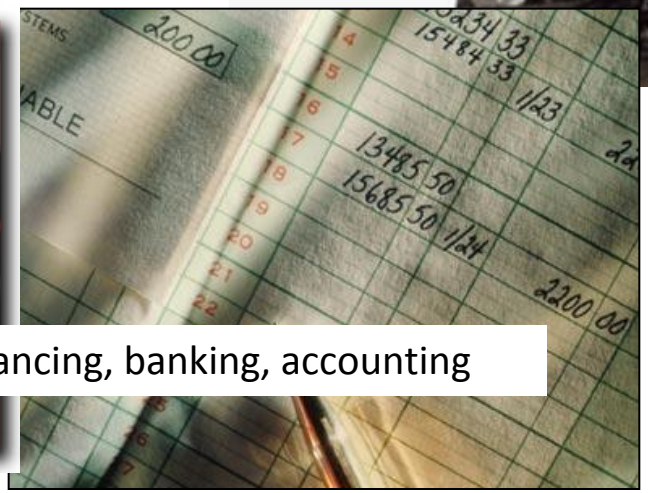
Blade and tower manufacturers



Steel mill jobs, parts, services

Photos: E.C.Levy, Inc, Detroit, MI

Property taxes



Financing, banking, accounting

Equipment manufacturing and sales

Induced jobs, services, materials

Money spent on local area goods and services from increased revenue: sandwich shops, childcare, grocery stores, clothing, other retail, public transit, new cars, restaurants, medical services

Jobs and Economic Impacts from the JEDI Model

1,000 MW of New Wind Power in Nebraska

JEDI Model Version W1.09.03e

Wind energy's economic "ripple effect"

Project Development & Onsite Labor Impacts

Landowner Revenue:
- $3 million/year

Local Property Taxes:
- $3.9 million/year

Construction Phase:
- 500 new jobs
- $33.9 million to local economies

Operational Phase:
- 51 new jobs
- $2.8 M/year to local economies

Local Revenue, Turbine, & Supply Chain Impacts

Construction Phase:
- 3,551 new jobs
- $410.5 million to local economies

Operational Phase:
- 87 new jobs
- $14.5 million/year to local economies

Induced Impacts

Construction Phase:
- 1,388 new jobs
- $138.3 million to local economies

Operational Phase:
- 63 new jobs
- $6.3 million/year to local economies

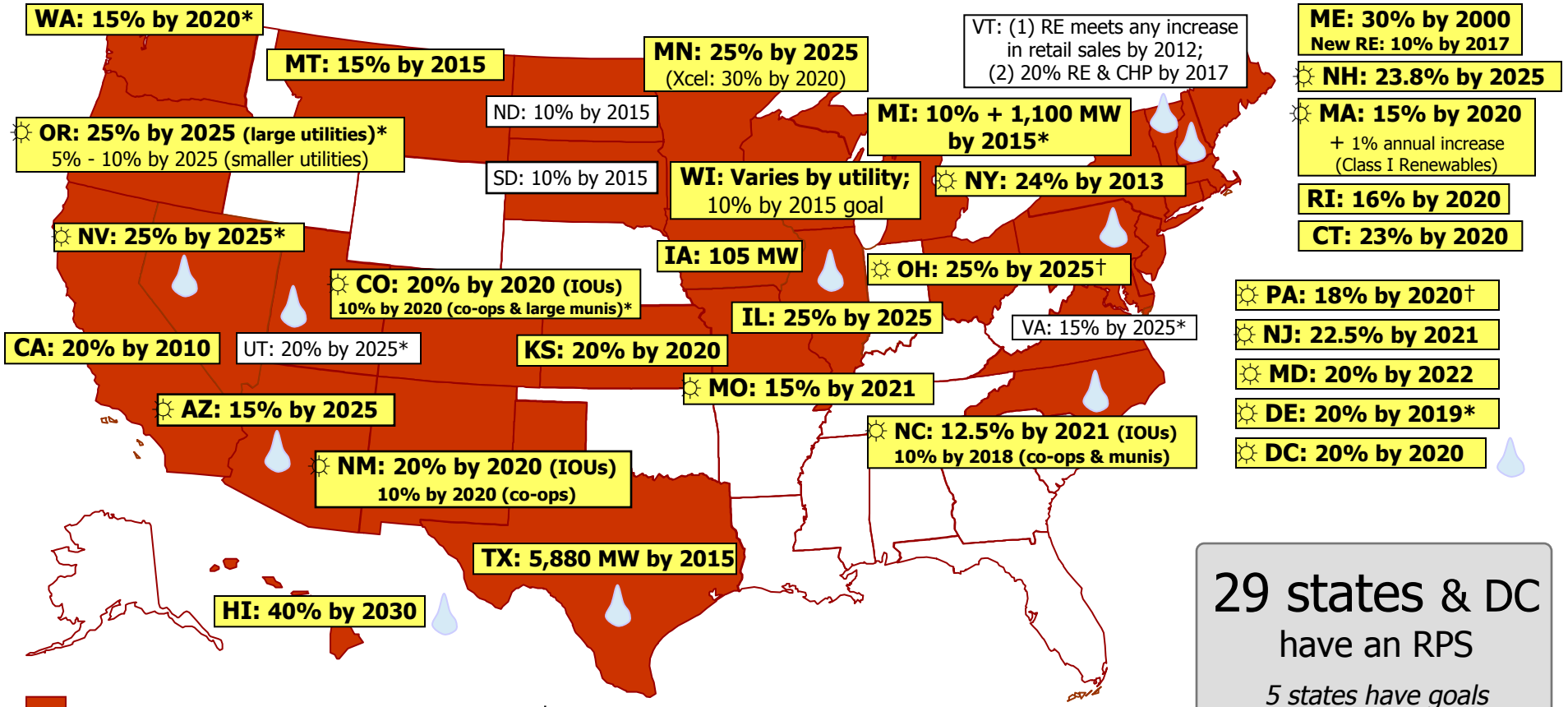
Construction Phase = 1-2 years
Operational Phase = 20+ years

Totals ***(construction + 20 years)***

Total economic benefit:	$1.05 billion
New local jobs during construction:	5,439
New local long-term jobs:	201

Renewable Portfolio Standards

www.dsireusa.org / August 2009



29 states & DC
have an RPS
5 states have goals

State renewable portfolio standard

State renewable portfolio goal

Solar water heating eligible

Minimum solar or customer-sited requirement

* Extra credit for solar or customer-sited renewables

† Includes separate tier of non-renewable alternative resources

Policy Is Now More Favorable to Wind Than At Any Other Time in the Past Decade

- ARRA 2009 established a number of federal policies to support wind
- Federal PTC currently in place through 2012 (longest extension in history)
- Wind projects can elect a 30% ITC or a 30% cash grant in lieu of the PTC
- Subsidized financing double-dipping penalty removed for ITC / cash grant
- New allocations of Clean Renewable Energy Bonds
- Expansion and enhancement of Federal loan guarantee program
- Increased R&D funding
- Four new state RPS policies (MI, MO, OH, KS), and many revisions to existing state RPS policies (total is now 29 states plus Washington, D.C.)
- State renewable funds, tax incentives, utility planning, green power, and growing interest in carbon regulation all also played a role in 2008
- Efforts to pass an RPS and carbon regulation at the Federal level continue

Environmental Benefits

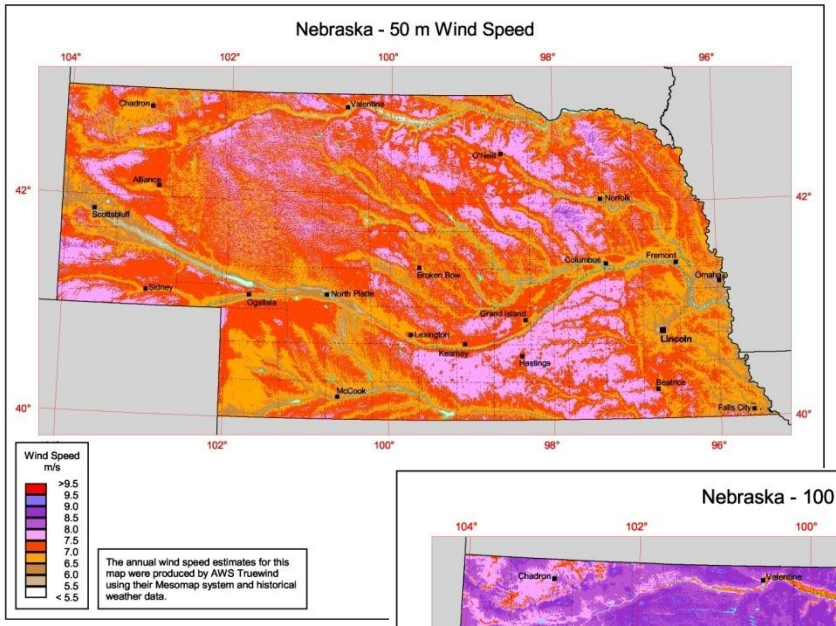
- No SOx or NOx
- No particulates
- No mercury
- No CO2
- No water

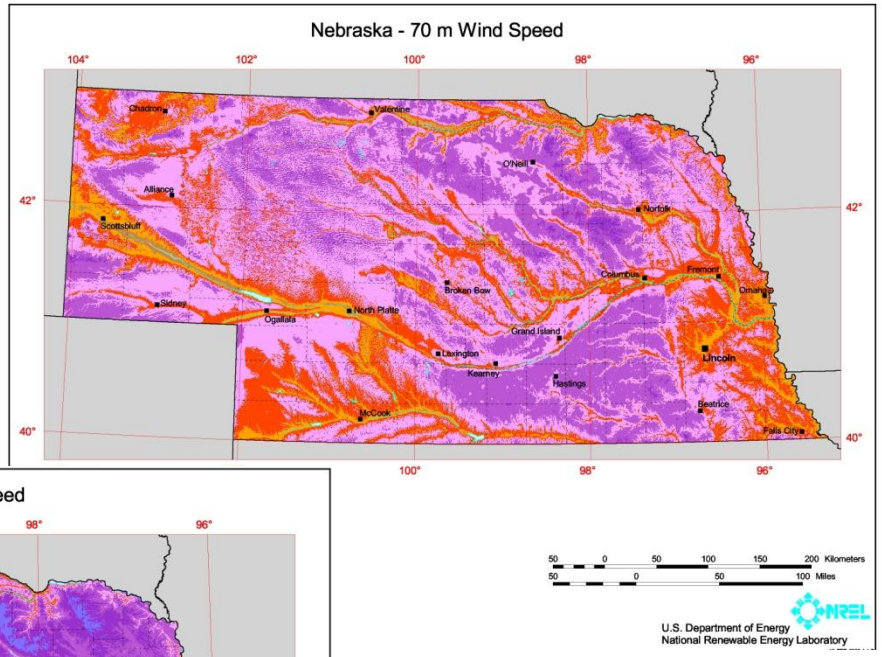
Key Issues for Wind Power

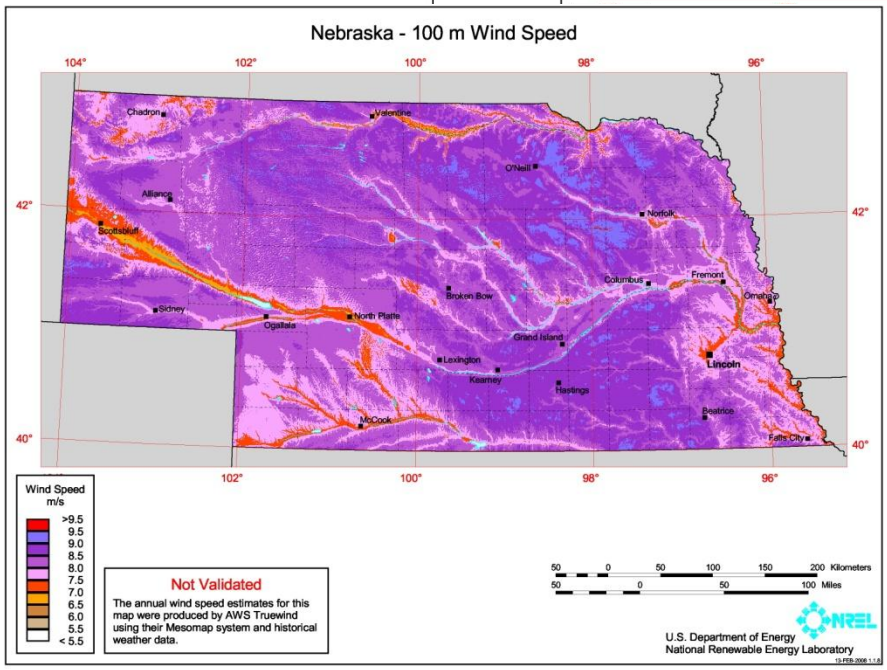
- Financial markets
- Policy Uncertainty
- Supply chain/workforce
- Siting and Permitting: avian, noise, visual, federal land
* Transmission: FERC rules, tariffs, new lines, PMA's

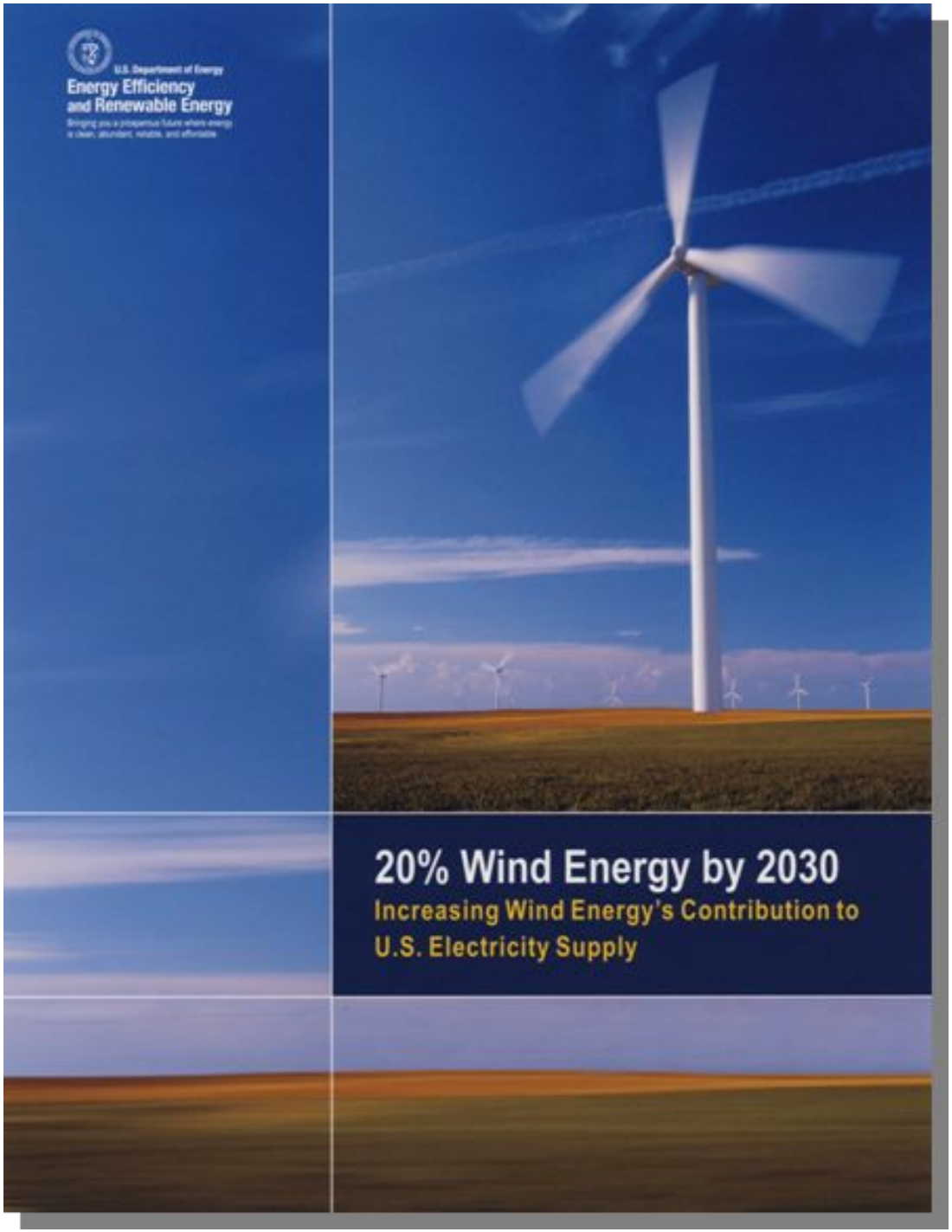
- Operational impacts: variability, ancillary services, forecasting, cost allocation
- Accounting for non-monetary value: green power, no fuel price risk, reduced emissions and water use

Nebraska Wind Resources



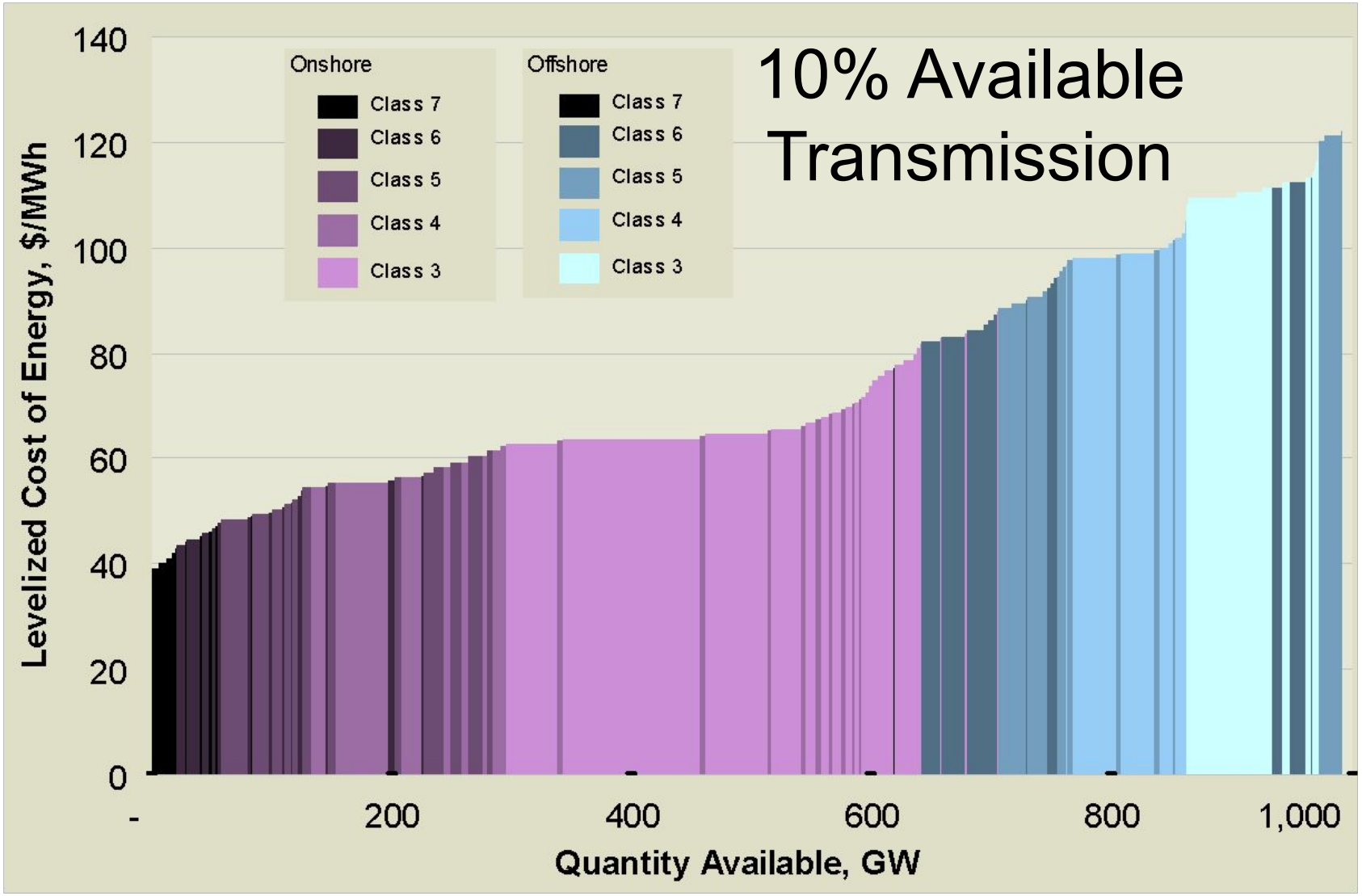






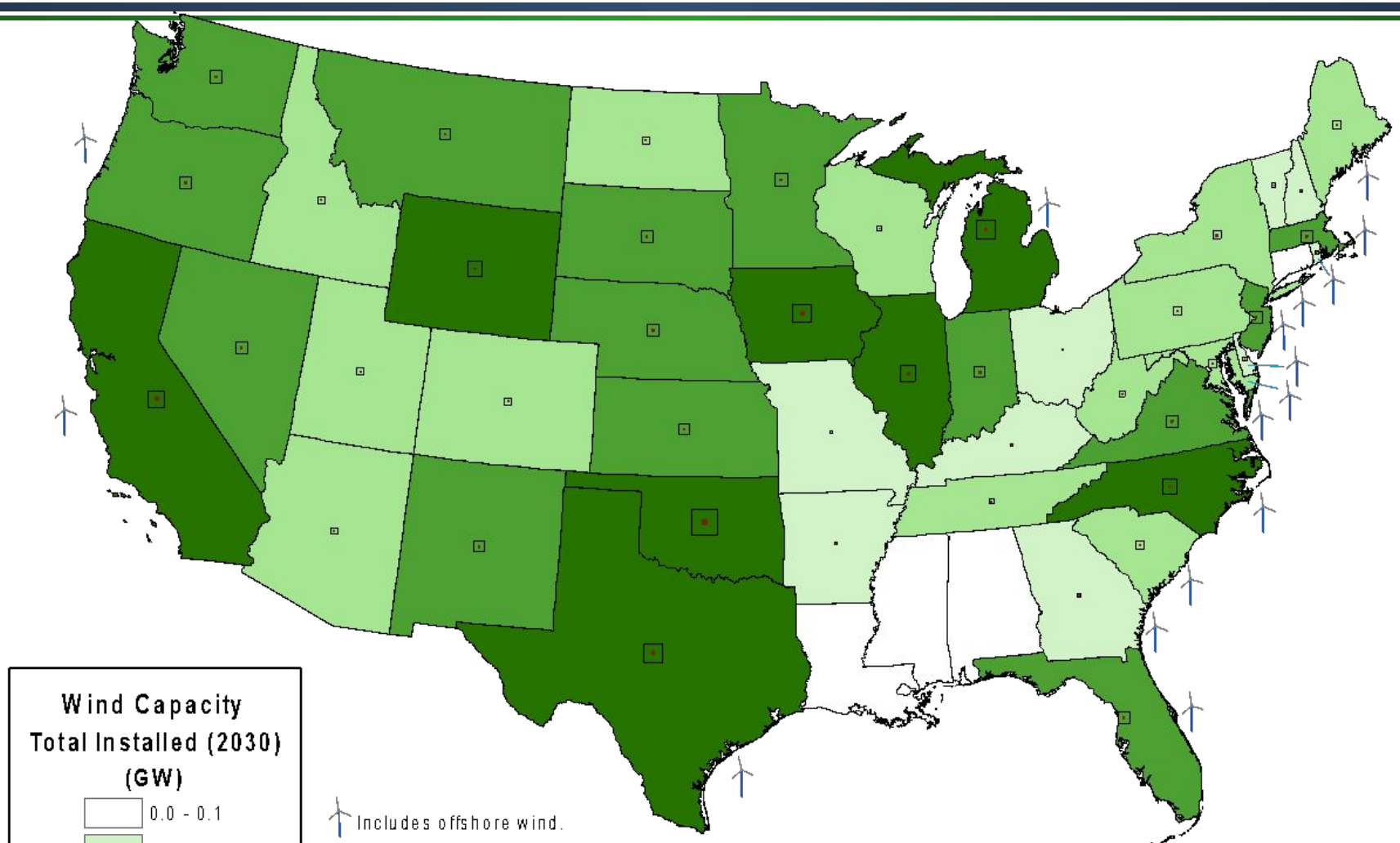
"The future ain't what it used to be."

- Yogi Berra



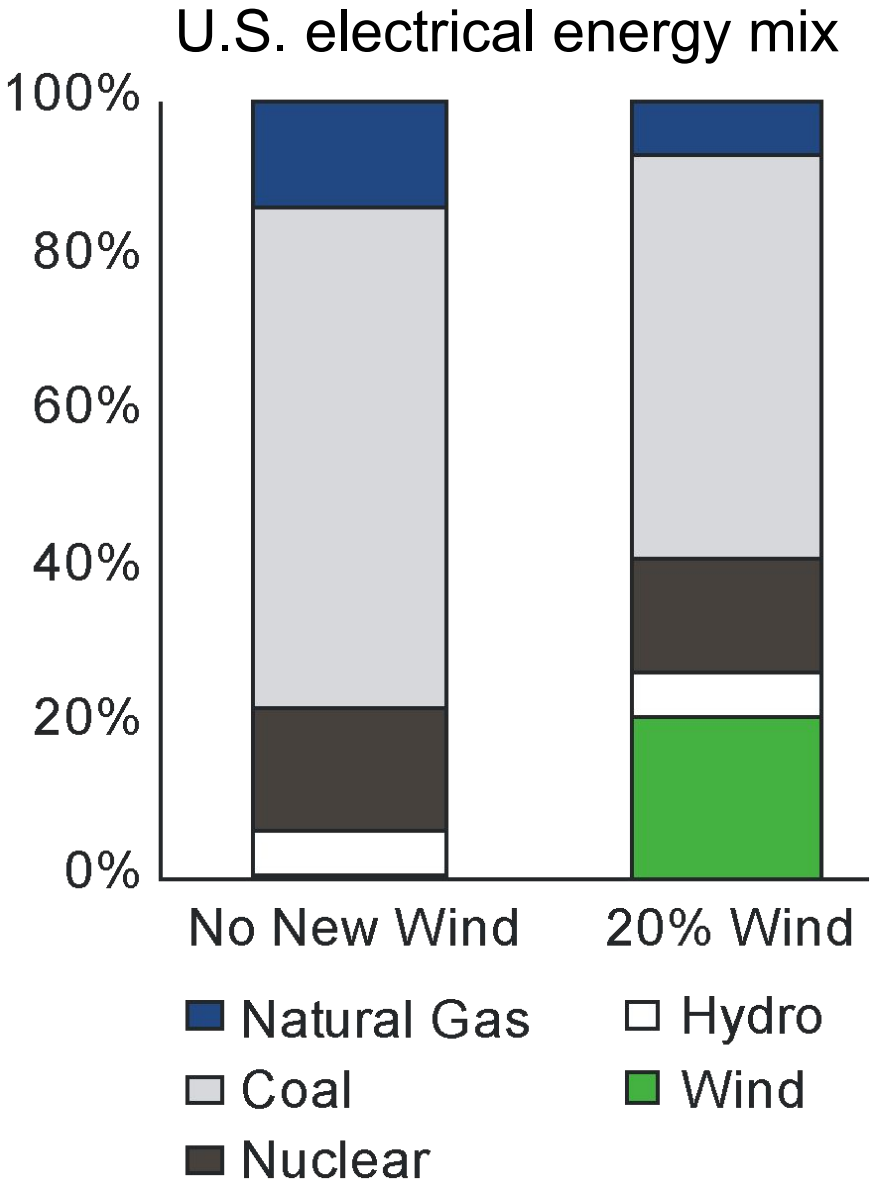
2010 Costs w/ PTC, $1,600/MW-mile, w/o Integration costs

46 States Would Have Substantial Wind Development by 2030



20% Wind Scenario Impact on Generation Mix in 2030

- Reduces electric utility natural gas consumption by 50%
- Reduces total natural gas consumption by 11%
- Natural gas consumer benefits: $86-214 billion*
- Reduces electric utility coal consumption by 18%
- Avoids construction of 80 GW of new coal power plants



Source *: Hand et al., 2008

National (U.S.) Economic Impacts

Cumulative Impacts from 2007-2030

From the 20% Scenario – 300 GW new Onshore and Offshore Development

JEDI Model Version W1.09.03e

Wind energy's economic "ripple effect"

Project Development & Onsite Labor Impacts

Landowner Revenue:
- $783 million

Local Property Taxes:
- $1,877 million

Construction Phase:
- 834,072 FTE jobs
- $65 billion to the US economy

Operational Phase:
- 366,441 FTE jobs
- $17 B to the US economy

Local Revenue, Turbine, & Supply Chain Impacts

Construction Phase:
- 2.63 M FTE jobs
- $526 billion to the US economy

Operational Phase:
- 1.3 M FTE jobs
- $207 billion to the US economy

Induced Impacts

Construction Phase:
- 2.75 M FTE jobs
- $353 billion to the US economy

Operational Phase:
- 1.64 M FTE jobs
- $192 billion to the US economy

Construction Phase = 1-2 years
Operational Phase = 20+ years

Totals* *(construction + 20 years)

Total economic benefit: $1.36 trillion
New local jobs during construction: 6.2 M FTE
New local long-term jobs: 3.3 M FTE

Nebraska – Economic Impacts

From the 20% Scenario
7,880 MW new development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $20 Million/yr

Local Property Tax Revenue:
- $30 Million/yr

Construction Phase:
- 12,900 new jobs
- $1.5 B to local economies

Operational Phase:
- 2,000 new long-term jobs
- $165 M/yr to local economies

Indirect & Induced Impacts

Construction Phase:
- 13,100 new jobs
- $1.2 B to local economies

Operational Phase:
- 1,500 local jobs
- $145 M/yr to local economies

Totals (construction + 20yrs)

Total economic benefit = $8.9 B

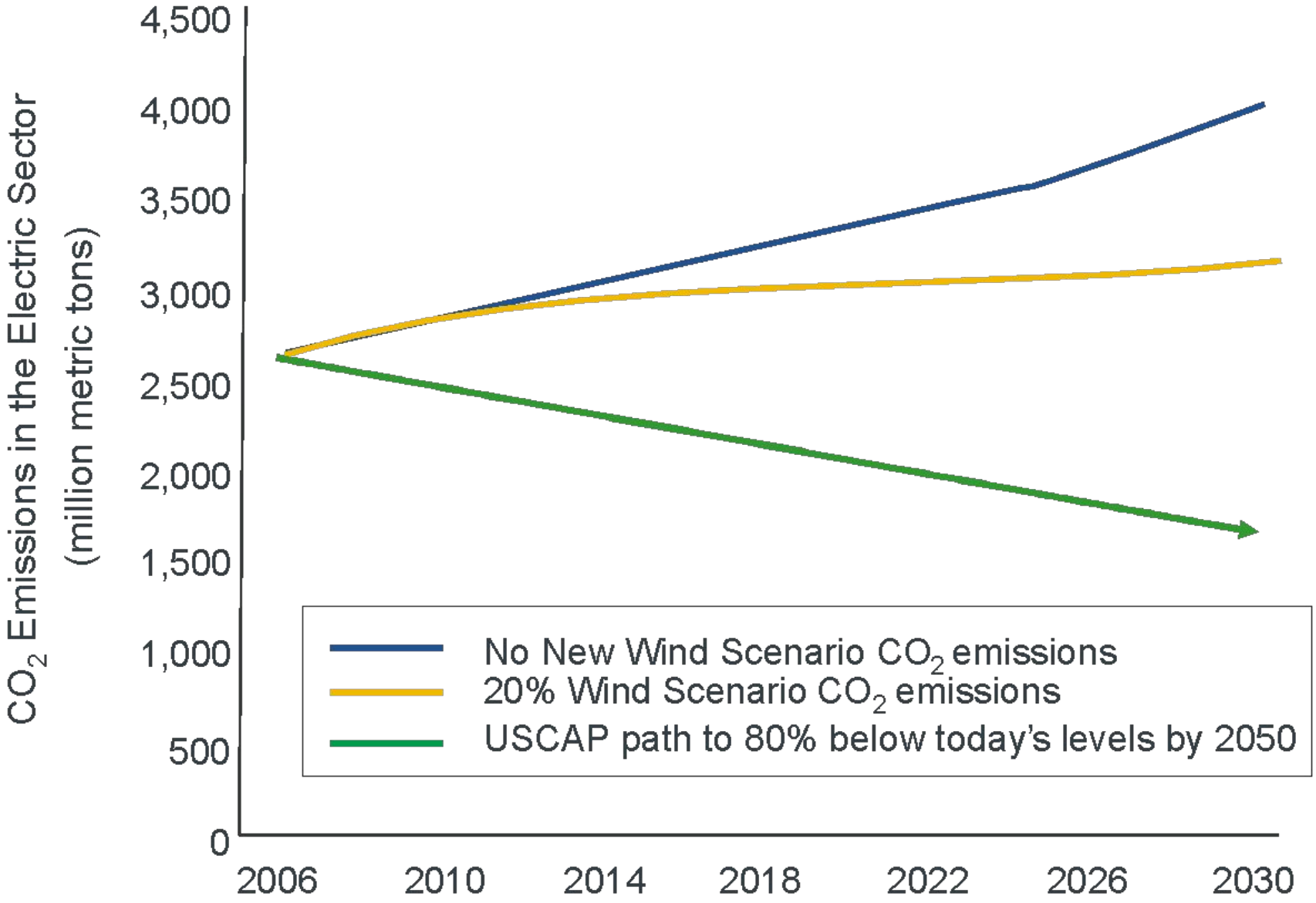
New local jobs during construction = 26,000

New local long-term jobs = 3,600

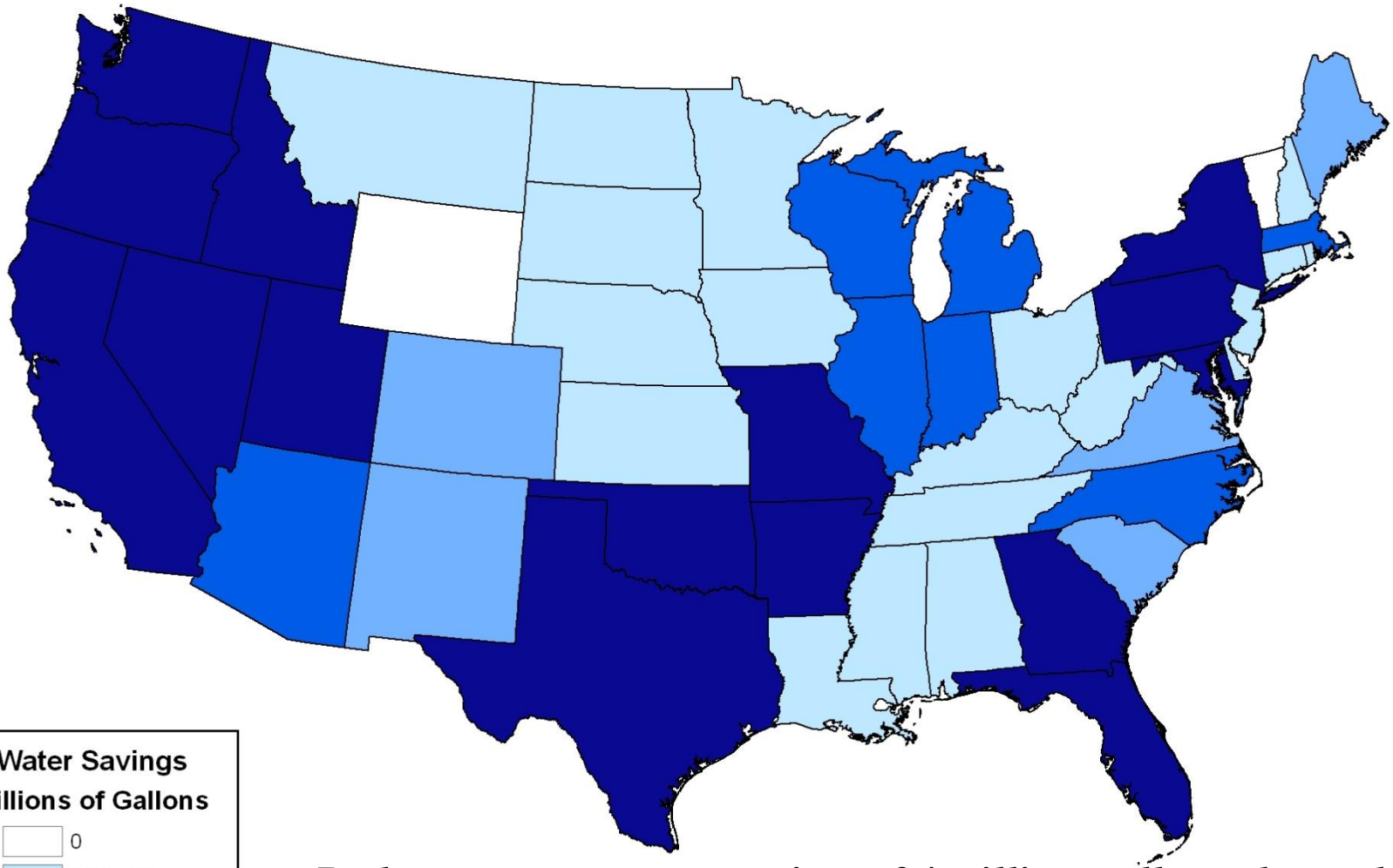
All jobs rounded to the nearest hundred jobs; Millions of dollars greater than 10 million are rounded to the nearest five million

Construction Phase = 1-2 years
Operational Phase = 20+ years

CO2 Emissions from the Electricity Sector

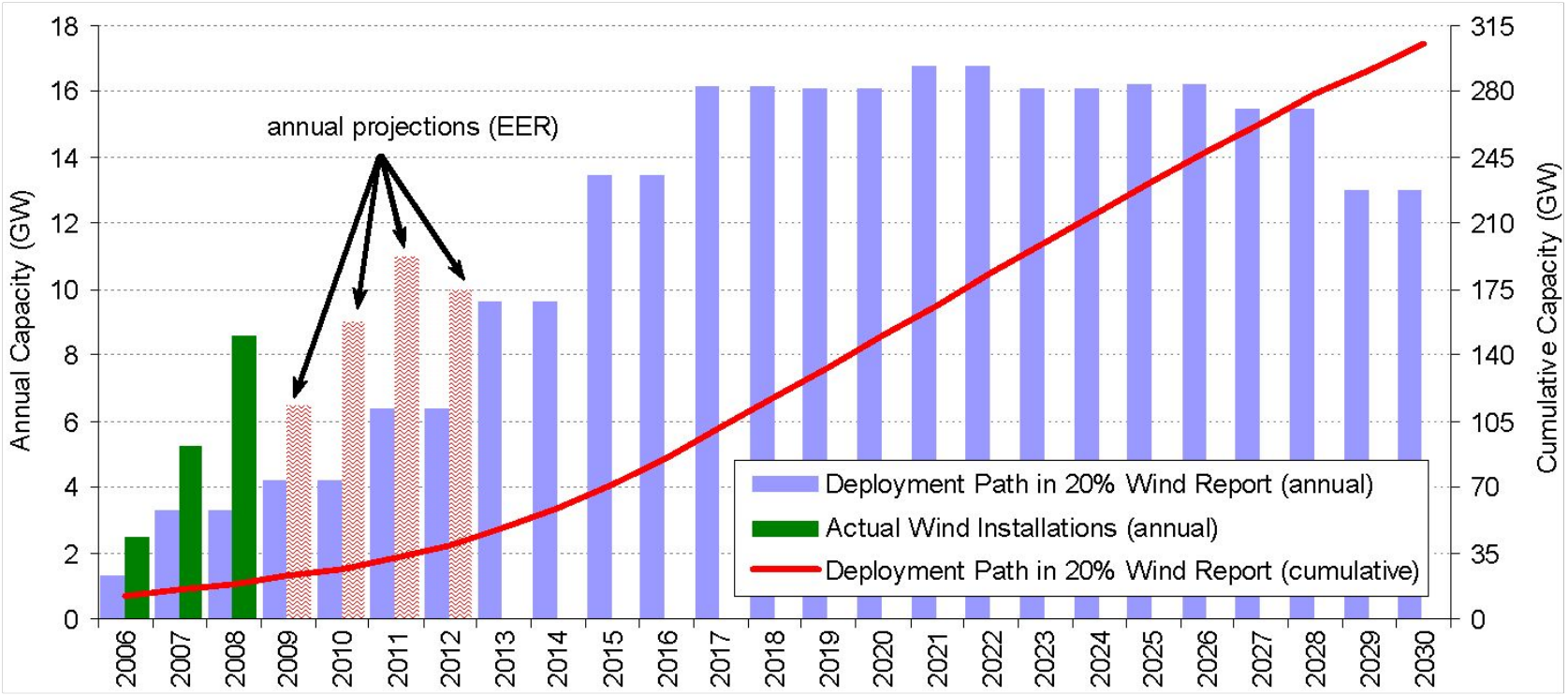


Cumulative Water Savings from 20% Scenario



Reduces water consumption of 4 trillion gallons through 2030 (represents a reduction in electric sector water consumption by 17% in 2030)

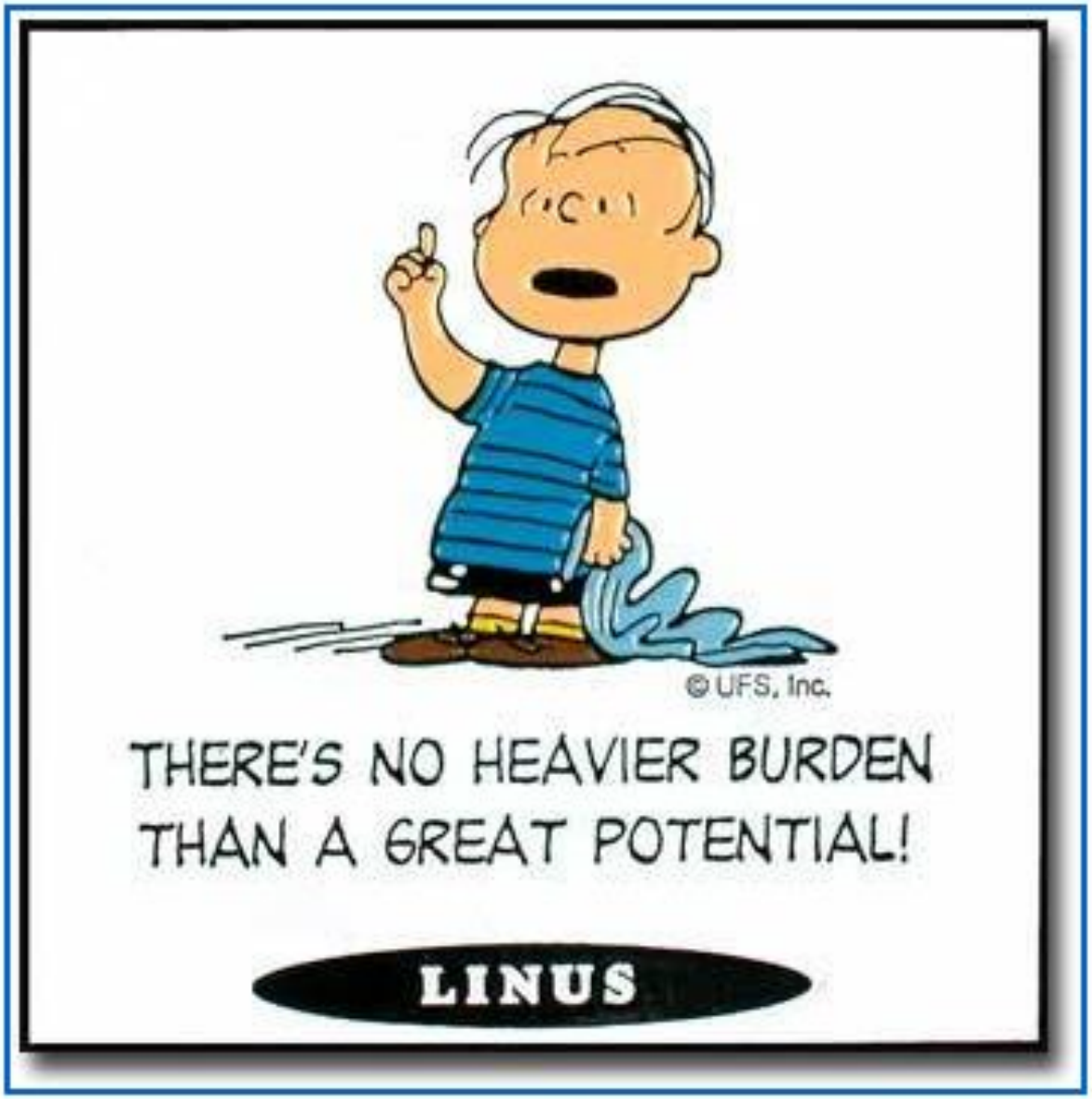
U.S. Remains on Early Track To Meet 20% of Nation's Electricity with Wind by 2030



But ramping up to ~16 GW/year and maintaining that pace for a decade is an enormous challenge, requiring proactive policy, substantial transmission expansion, mitigation of output variability, and eased siting and permitting processes

Big Twelve Standings

	Football	Wind Resources GW (NR)	2009 MW (NR)	20% GW (NR)
TX	10 - 6	1360 (1)	8797 (1)	20.5
OK	7 - 3	401 (9)	865 (12)	38.5
KS	5 - 6	914 (2)	1,014(10	7.2
IA	2 - 4	482 (7)	3,063 (2)	19.9
NE	3 - 2	889 (3)	153 (22)	7.9
CO	2 - 3	267 (12)	1,242 (9)	2.5
MO	1 - 4	79 (14)	309 (19)	0.1
			15,433	96.6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THAN A GREAT POTENTIAL!
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