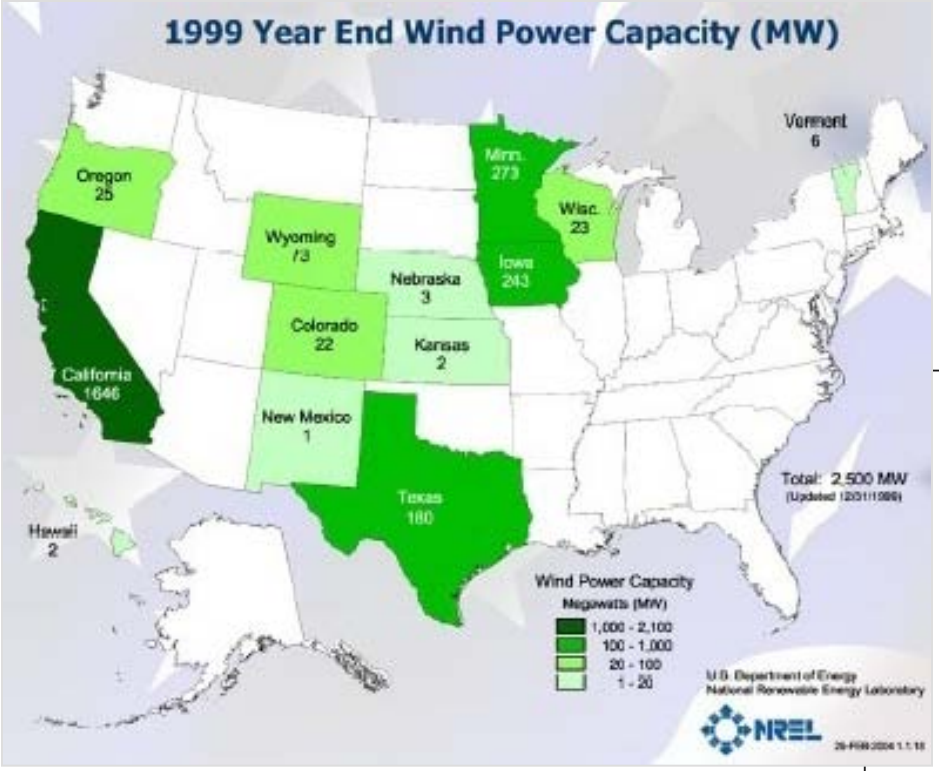
Wind Energy Update

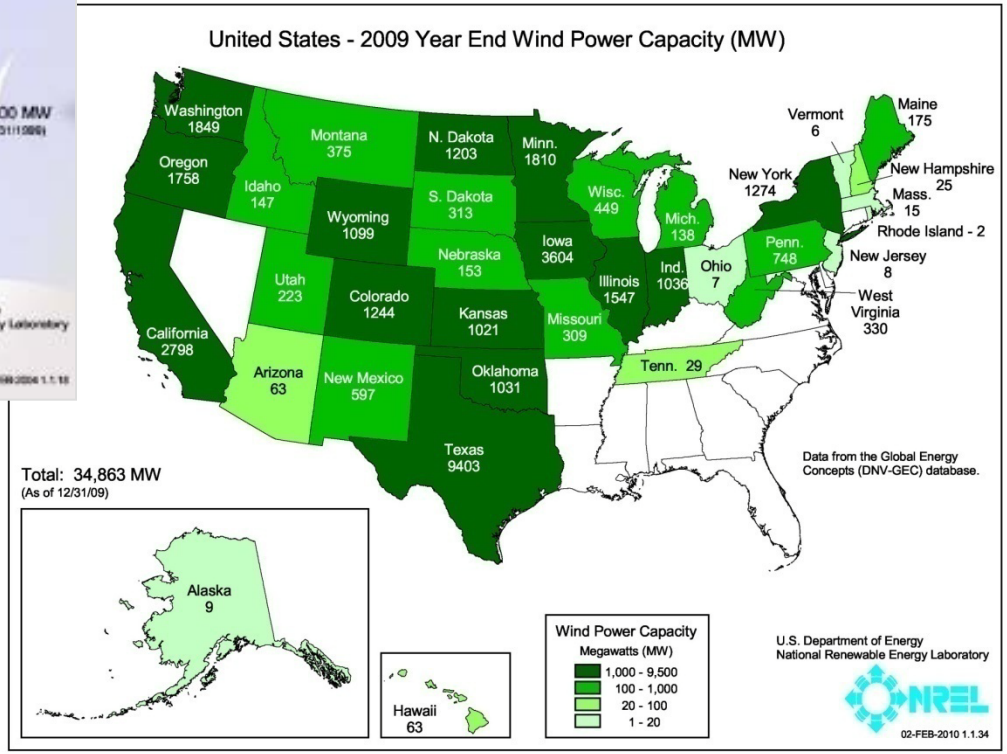
Larry Flowers

National Renewable Energy Laboratory

BLM – August 31, 2010

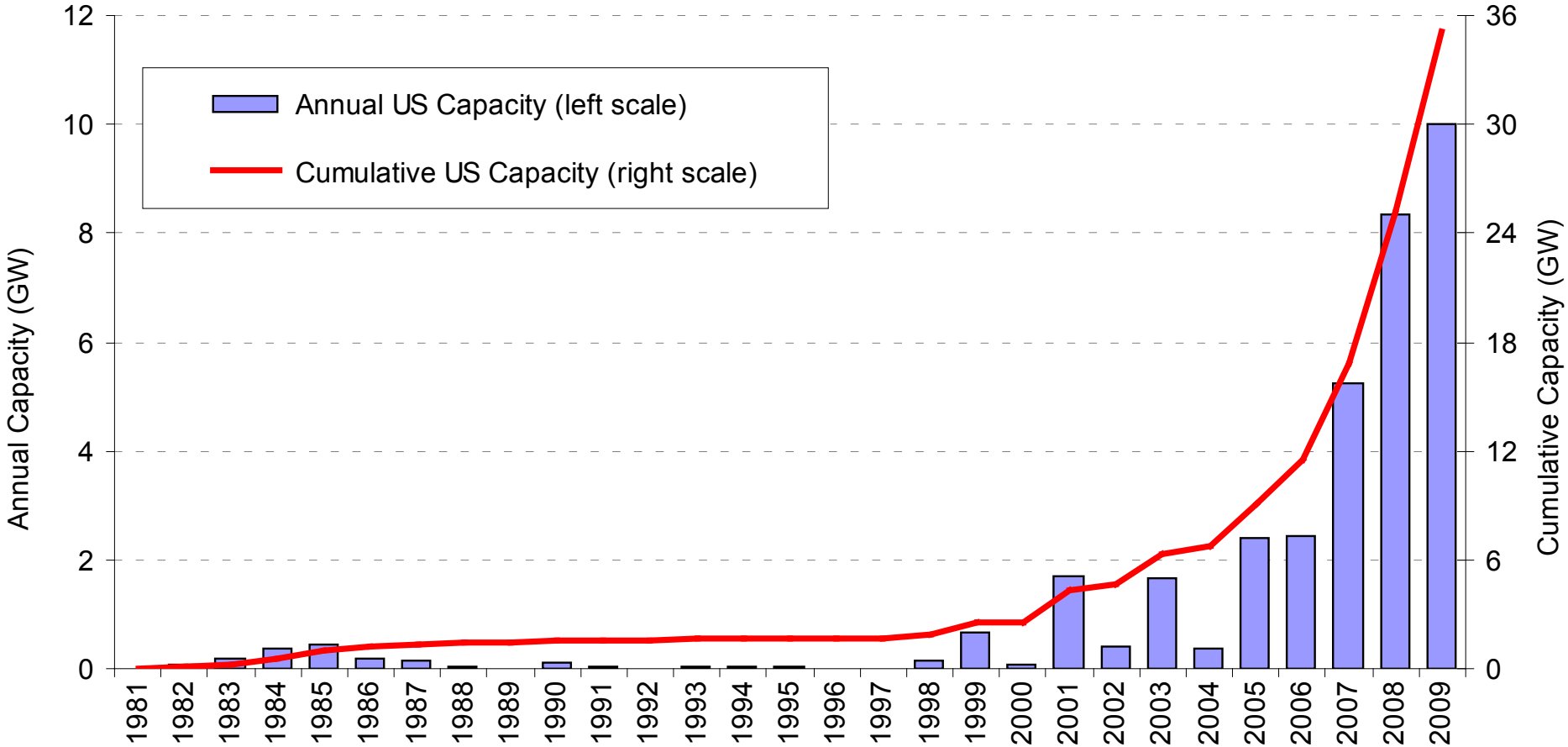
Installed Wind Capacities ('99 – '10)





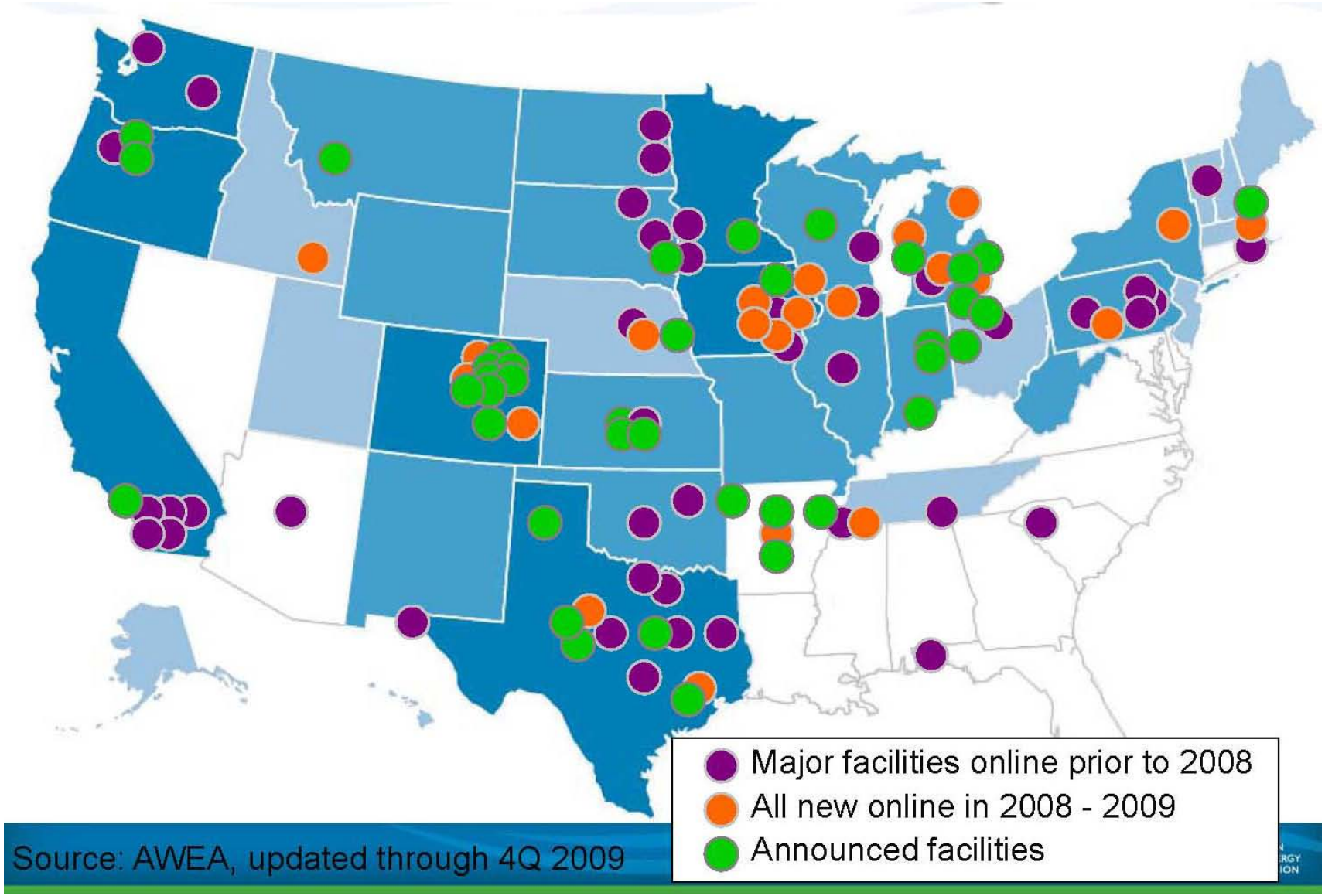
***Preliminary data**

Five Years of Strong Growth:
2009: 9,994 MW Added; $21 billion Investment

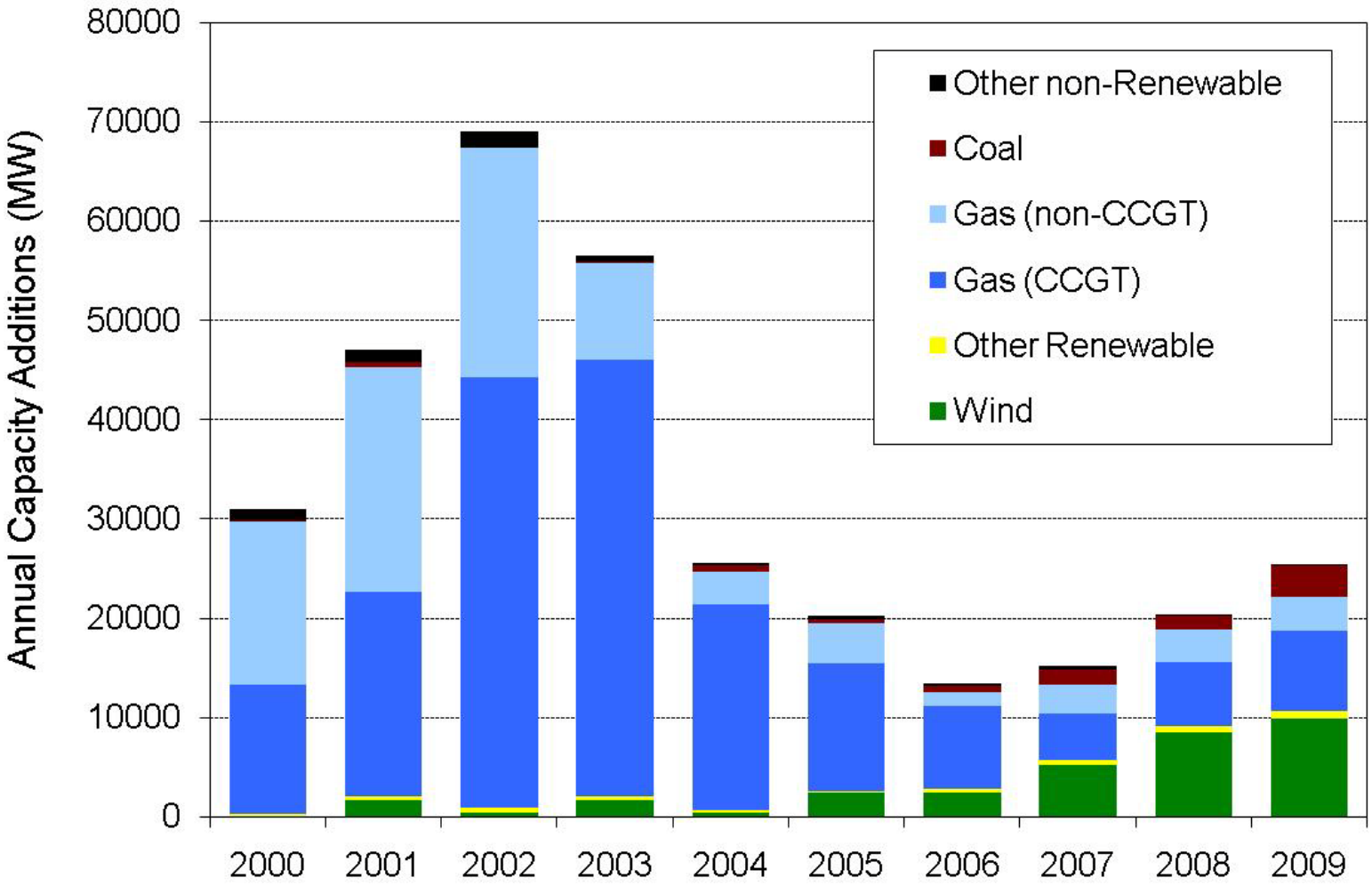


2nd largest market (behind China) in 2009 capacity additions; largest market in terms of cumulative capacity

U.S. Wind Manufacturing

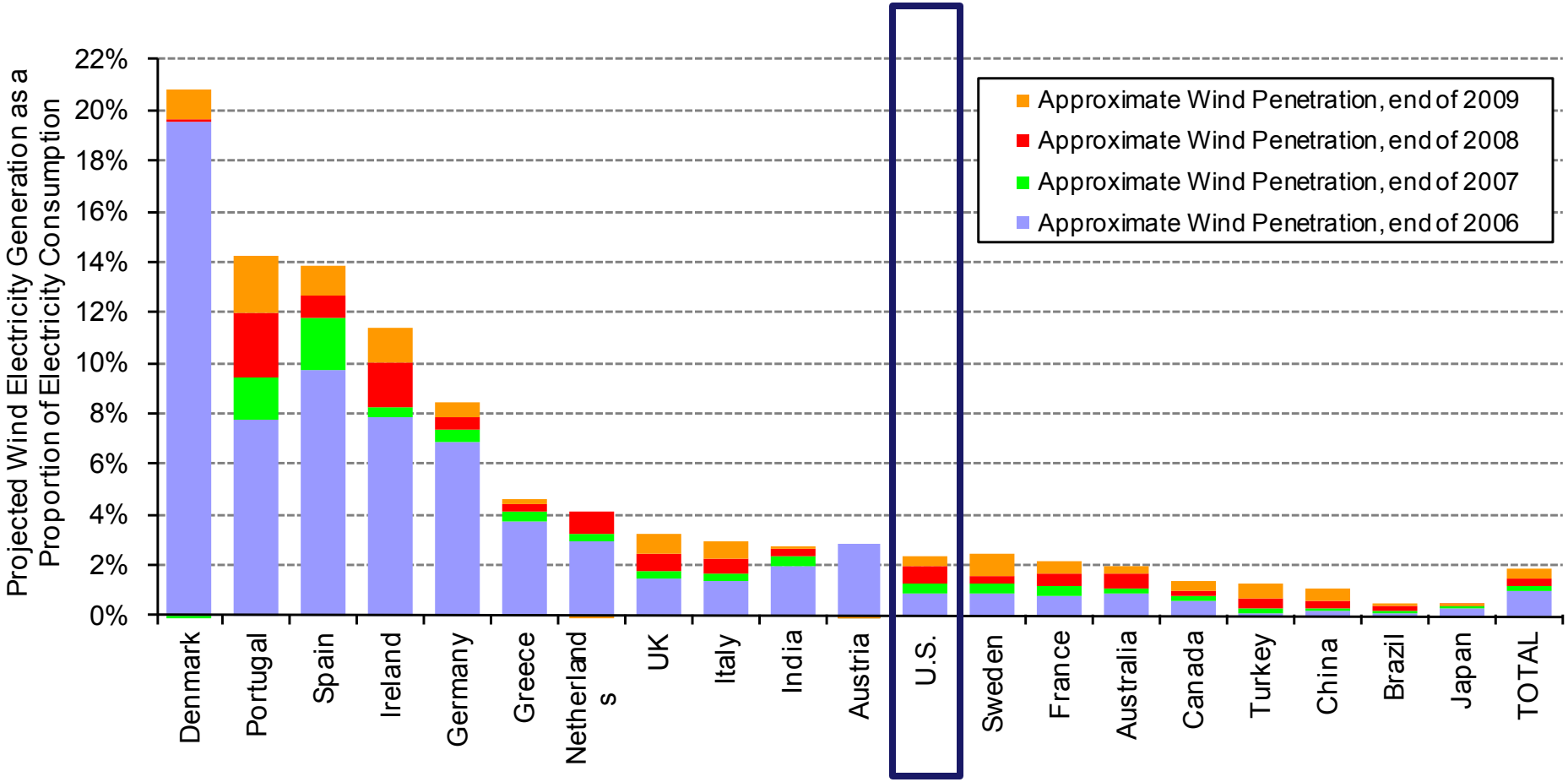


Wind Is a Major Source of New Capacity Additions: 39% in 2009



Source: EIA, Ventyx, AWEA, IREC, Berkeley Lab

Wind Capacity at End of 2009 Could Deliver 2.4% of US Electricity Supply



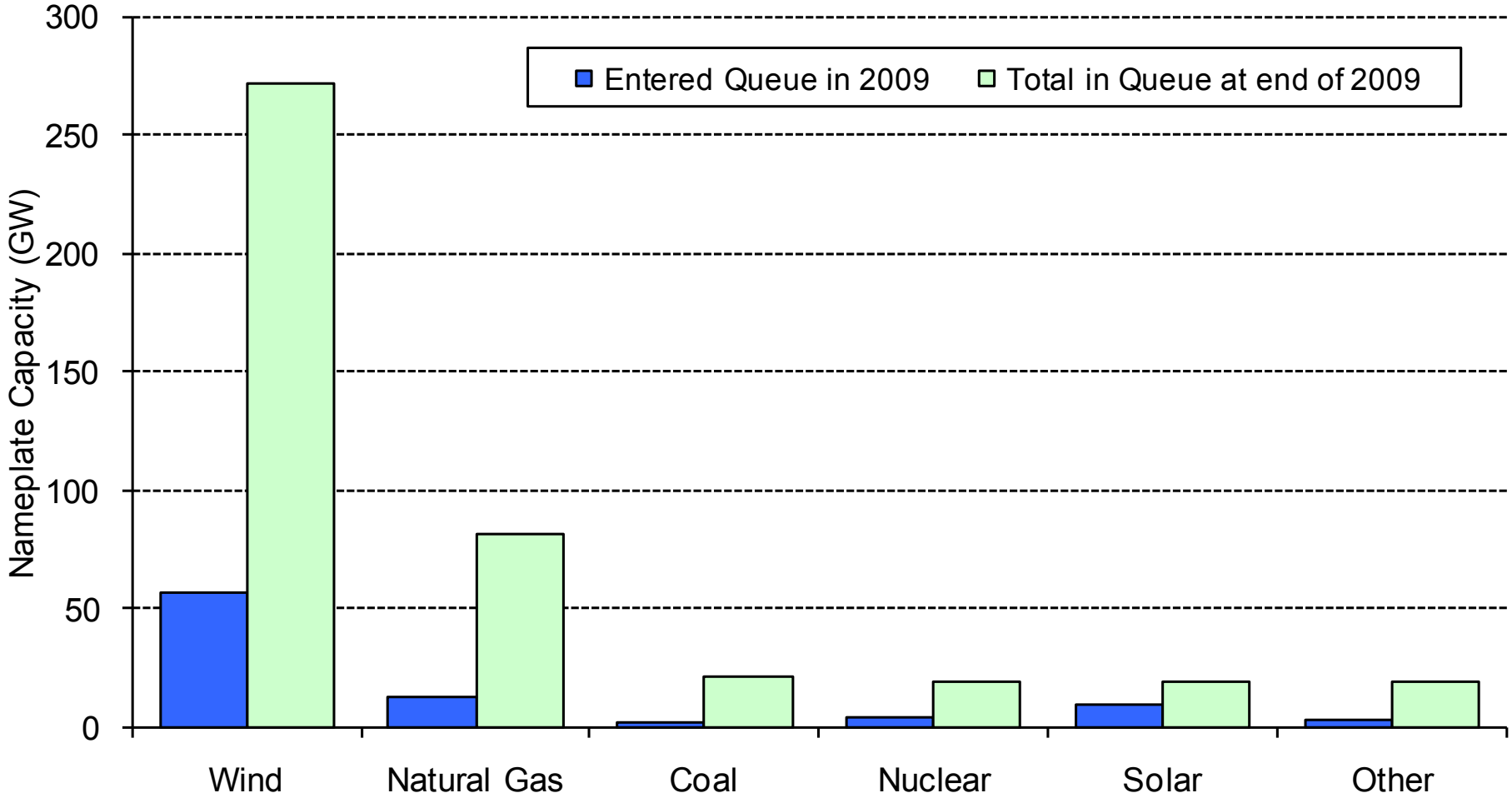
Note: Figure only includes the 20 countries with the most installed wind capacity at the end of 2009

Four States Have Achieved > 10% Wind; Texas Continues to Lead in Capacity

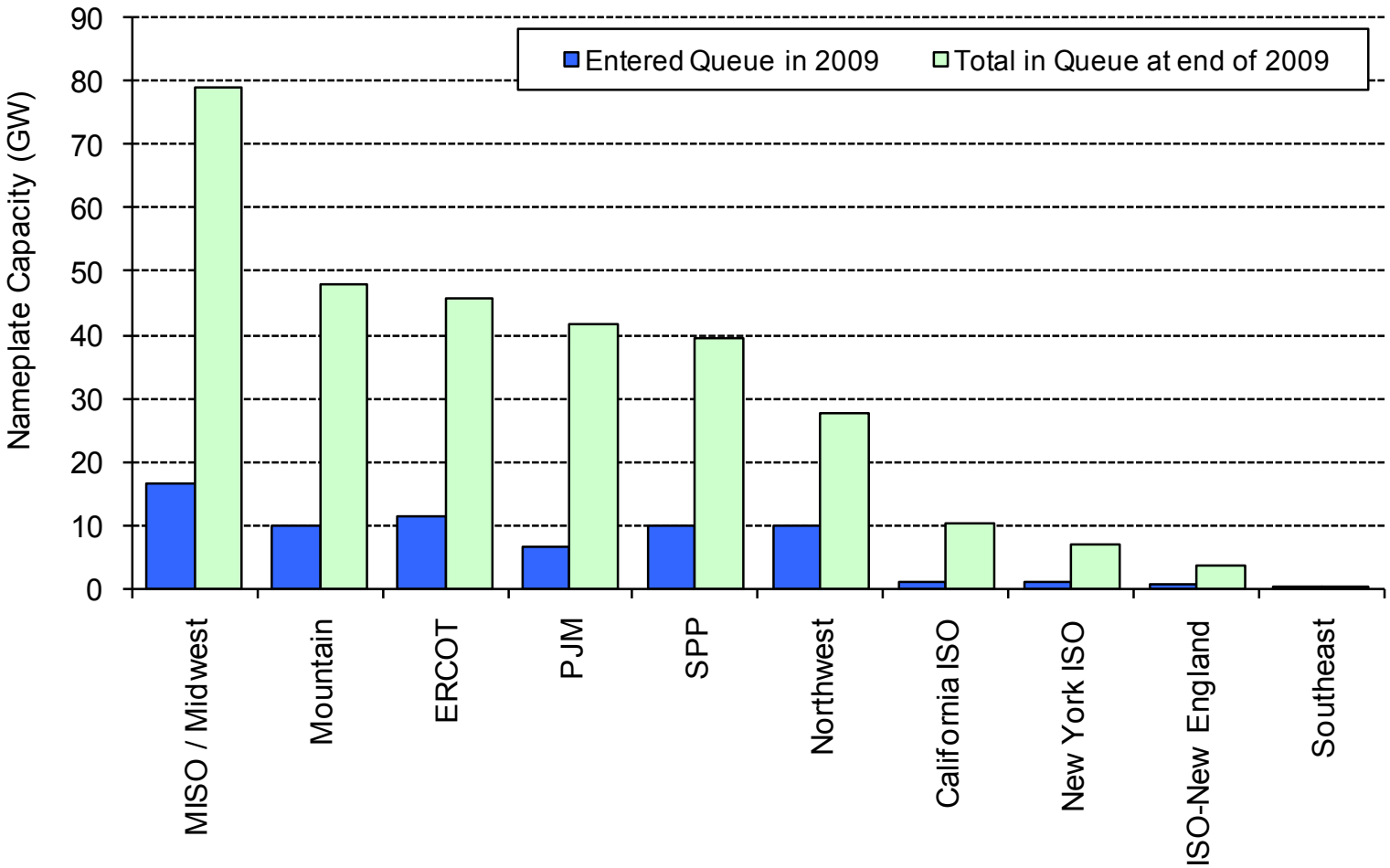
Annual Capacity (2009, MW)		Cumulative Capacity (end of 2009, MW)		Estimated Percentage of In-State Generation	
Texas	2,292	Texas	9,410	Iowa	18.8%
Indiana	905	Iowa	3,670	South Dakota	13.6%
Iowa	879	California	2,798	North Dakota	11.5%
Oregon	754	Washington	1,908	Minnesota	10.0%
Illinois	632	Oregon	1,821	Oregon	8.7%
New York	568	Minnesota	1,810	Kansas	7.2%
Washington	542	Illinois	1,547	Colorado	7.0%
North Dakota	488	New York	1,274	Wyoming	6.9%
Wyoming	425	Colorado	1,246	Texas	6.3%
Pennsylvania	388	North Dakota	1,203	Oklahoma	5.0%
Oklahoma	299	Oklahoma	1,130	Montana	4.8%
California	281	Wyoming	1,101	Washington	4.5%
Utah	204	Indiana	1,036	New Mexico	4.4%
Kansas	199	Kansas	1,014	California	3.1%
Colorado	178	Pennsylvania	748	Maine	3.1%
Missouri	146	New Mexico	597	Idaho	2.9%
Maine	128	Wisconsin	449	Indiana	2.7%
South Dakota	126	Montana	375	Hawaii	2.2%
Montana	104	West Virginia	330	Illinois	2.1%
New Mexico	100	South Dakota	313	New York	2.0%
Rest of U.S.	358	*Rest of U.S.*	1,376	*Rest of U.S.*	0.25%
TOTAL	**9,994**	**TOTAL**	**35,155**	**TOTAL**	**2.4%**

Source: AWEA project database, EIA, Berkeley Lab estimates

Interconnection Queues Are Clogged with Wind Projects: Nearly 300 GW

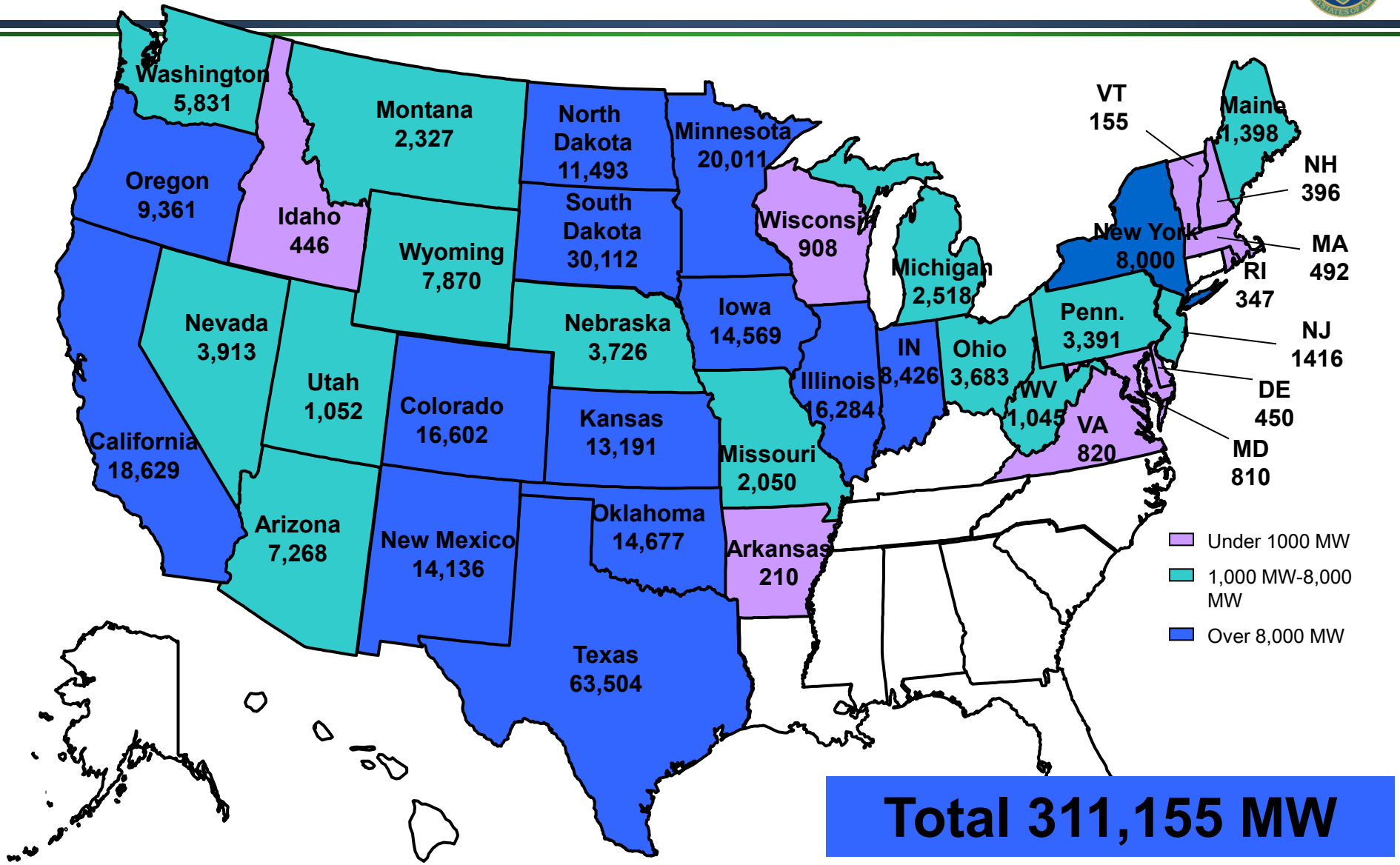


Wind Power Capacity in 33 Selected Interconnection Queues



Source: LBNL 2009 Wind Technology Market Report Draft

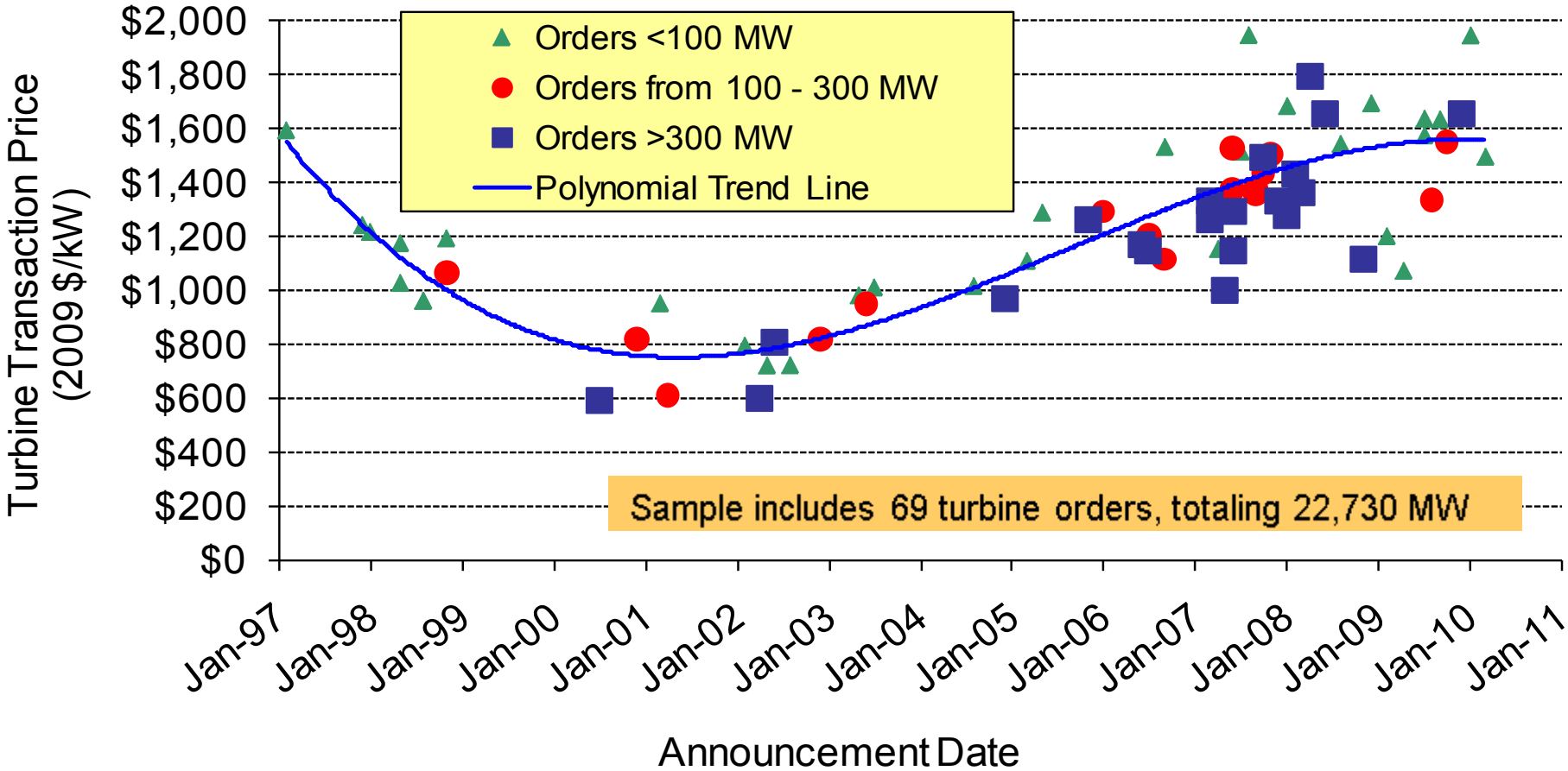
Wind Power in Queues (MW)



Total 311,155 MW

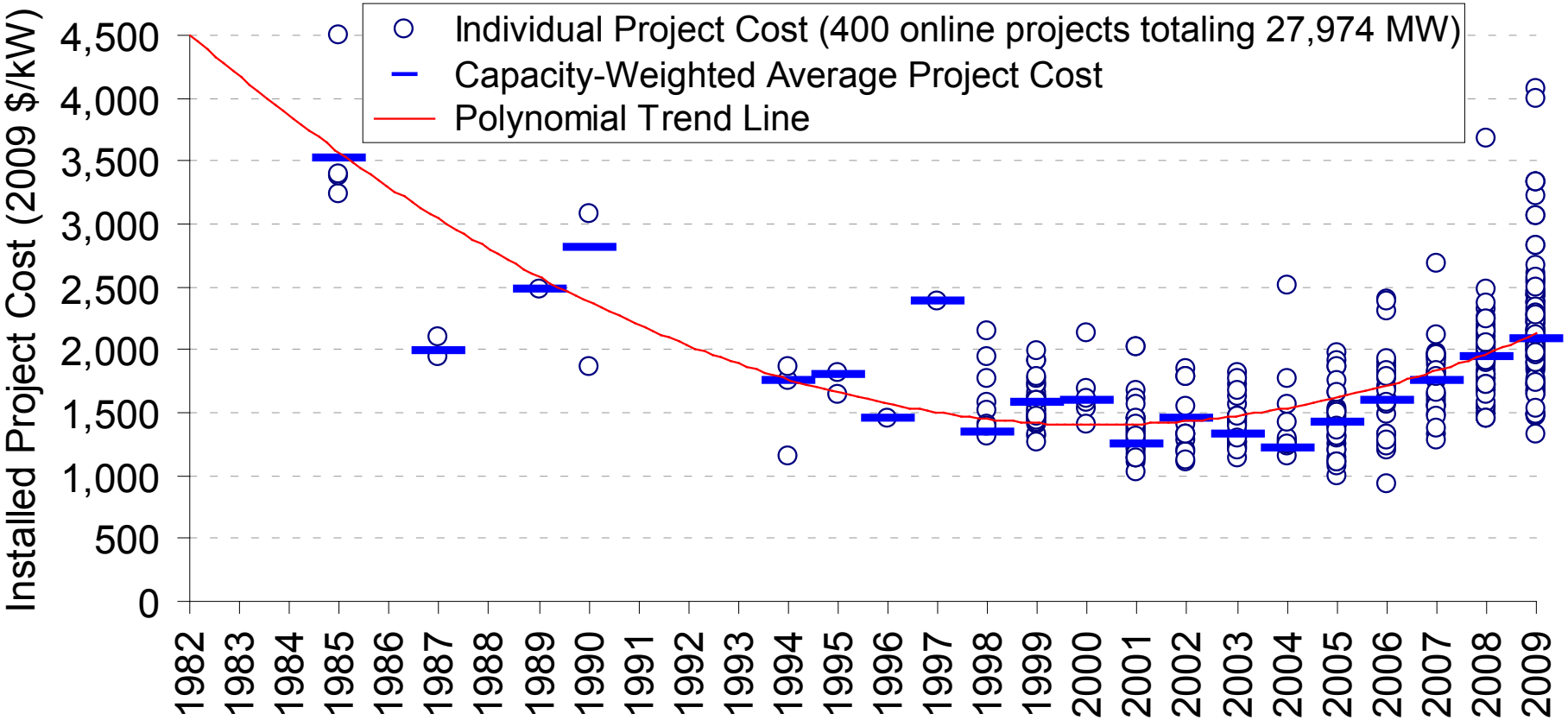
Source: AWEA

Wind Turbine Prices Are Softening, But Remain High By Historical Standards



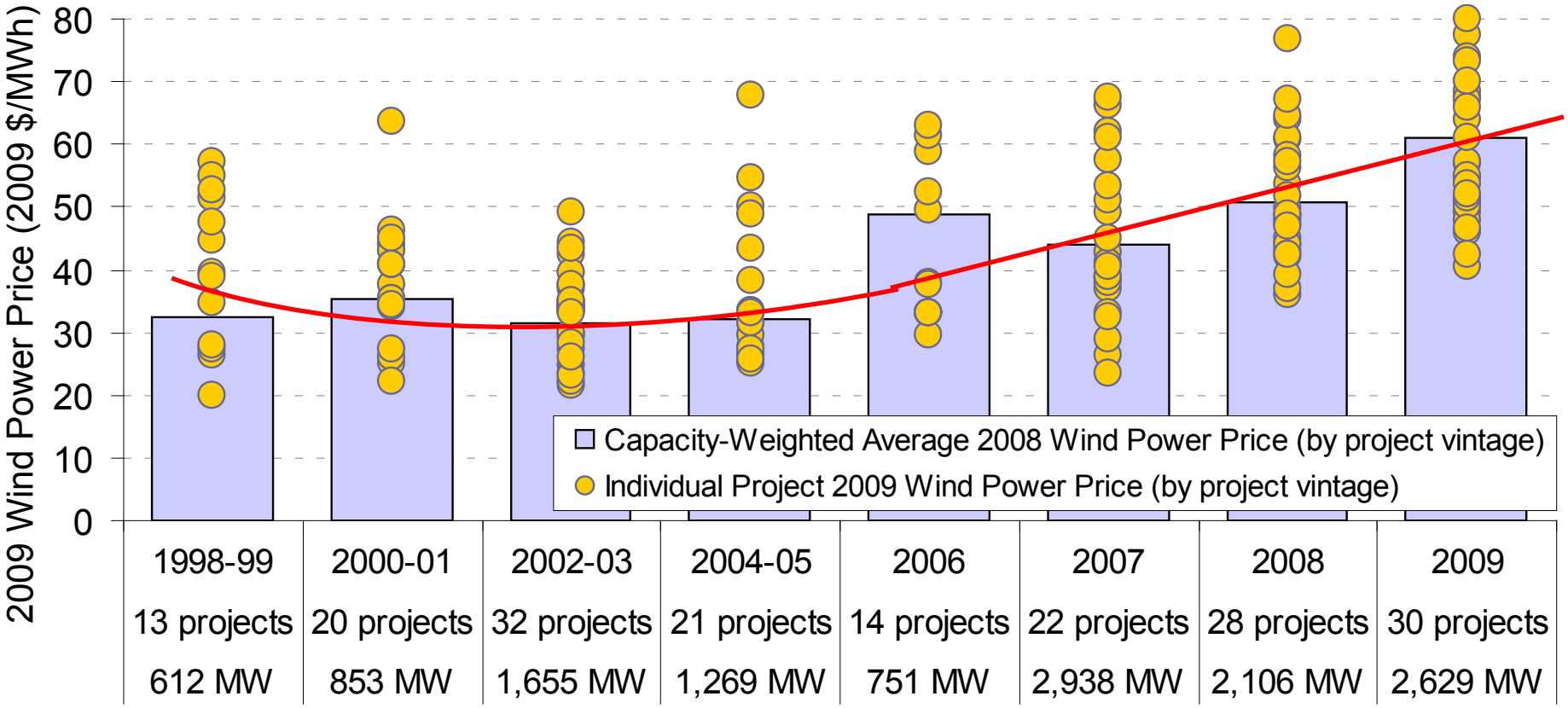
Turbine prices up by ~$800/kW from 2002 through 2009, but have softened since 2008 (though recent sample is small)

Wind Project Installed Costs in 2009 Continued to Rise, on Average



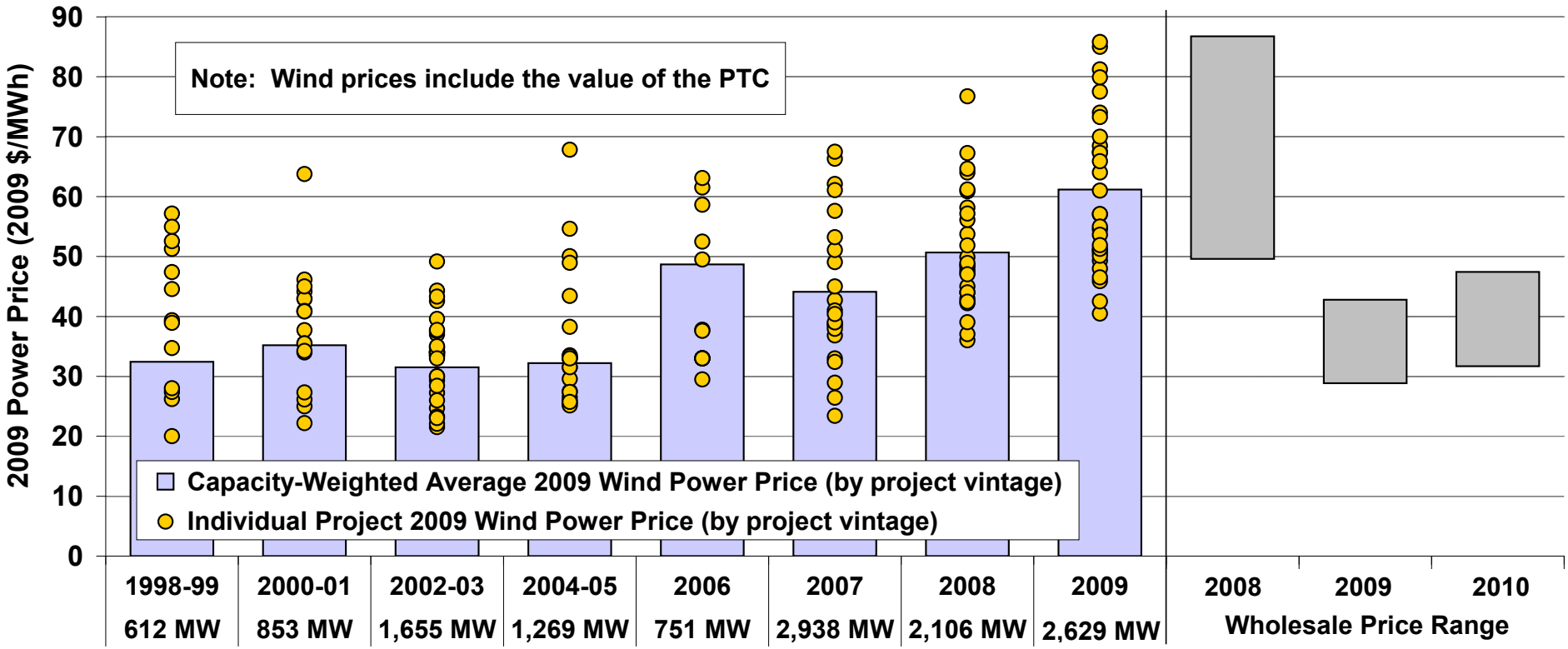
Project costs bottomed out in 2001-2004, and have risen by roughly $800/kW, on average, through 2009

Wind Power Sales Prices Have Been Rising

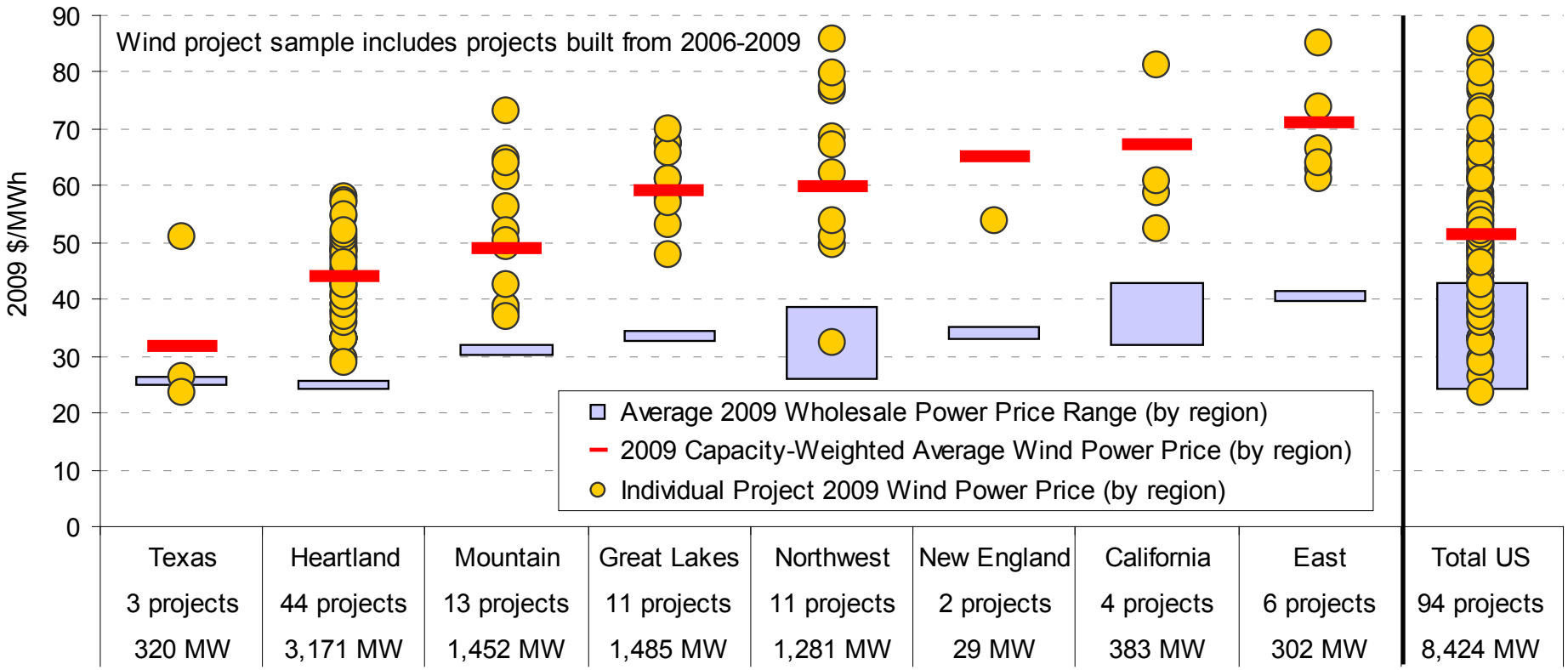


- Wind power prices bottomed out with projects built in 2002-03
- Projects built in 2009 are ~$30/MWh higher on average

Near-Term Economics of Wind Have Become More Challenging

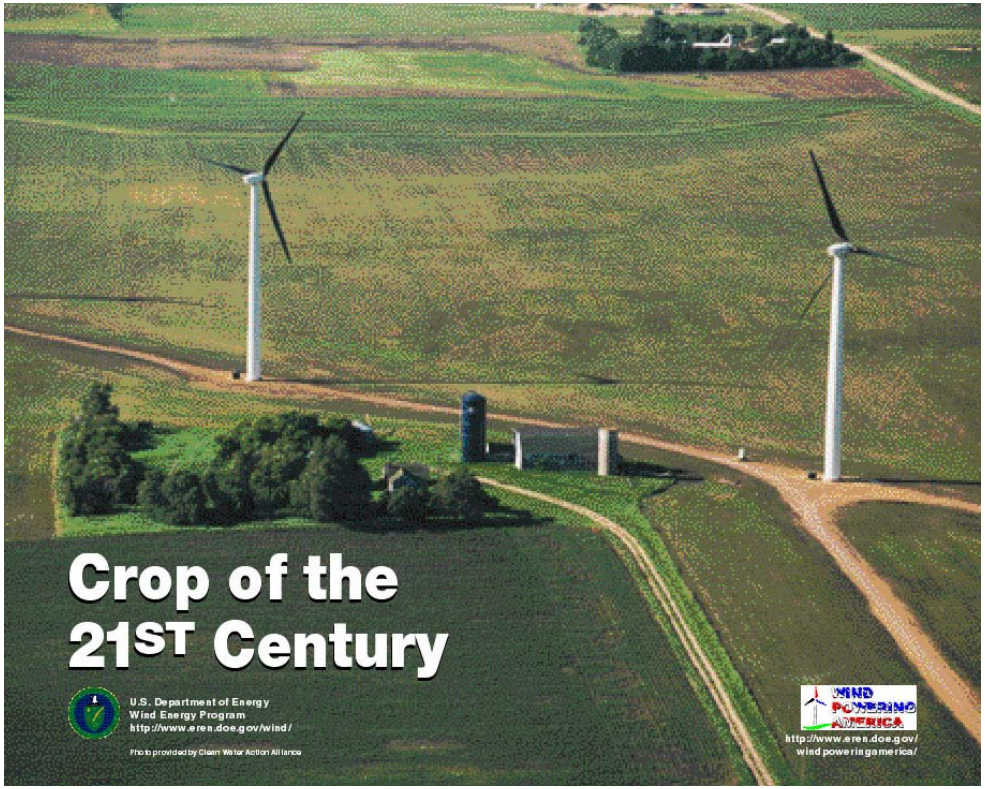


Short-Term Economic Challenges Crossed All Regions in 2009



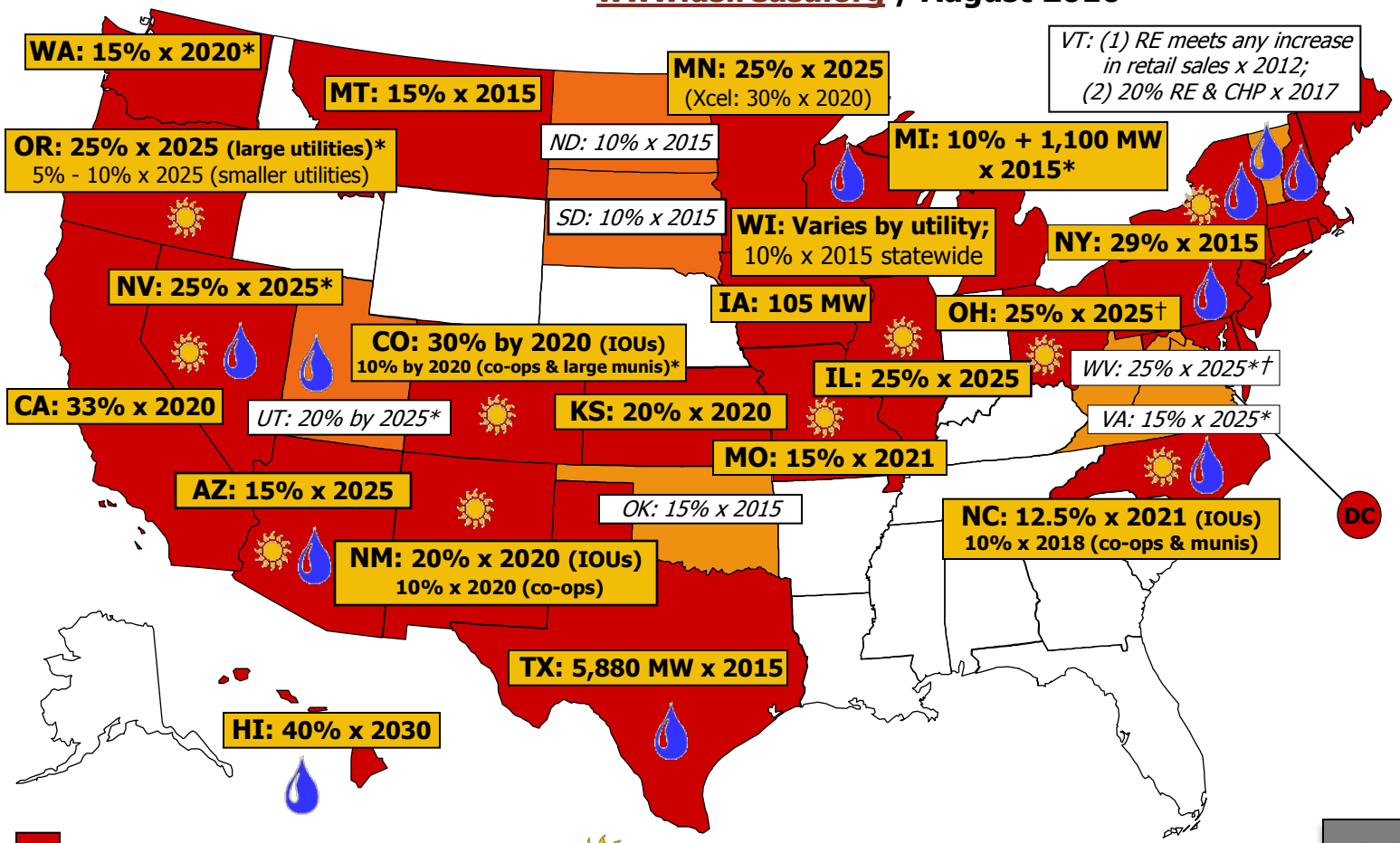
Drivers for Wind Power

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



Renewable Portfolio Standards

www.dsireusa.org / August 2010



ME: 30% x 2000
New RE: 10% x 2017

NH: 23.8% x 2025

MA: 22.1% x 2020
New RE: 15% x 2020
(+1% annually thereafter)

RI: 16% x 2020

CT: 23% x 2020

PA: ~18% x 2021†

NJ: 22.5% x 2021

MD: 20% x 2022

DE: 25% x 2026*

DC: 20% x 2020

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

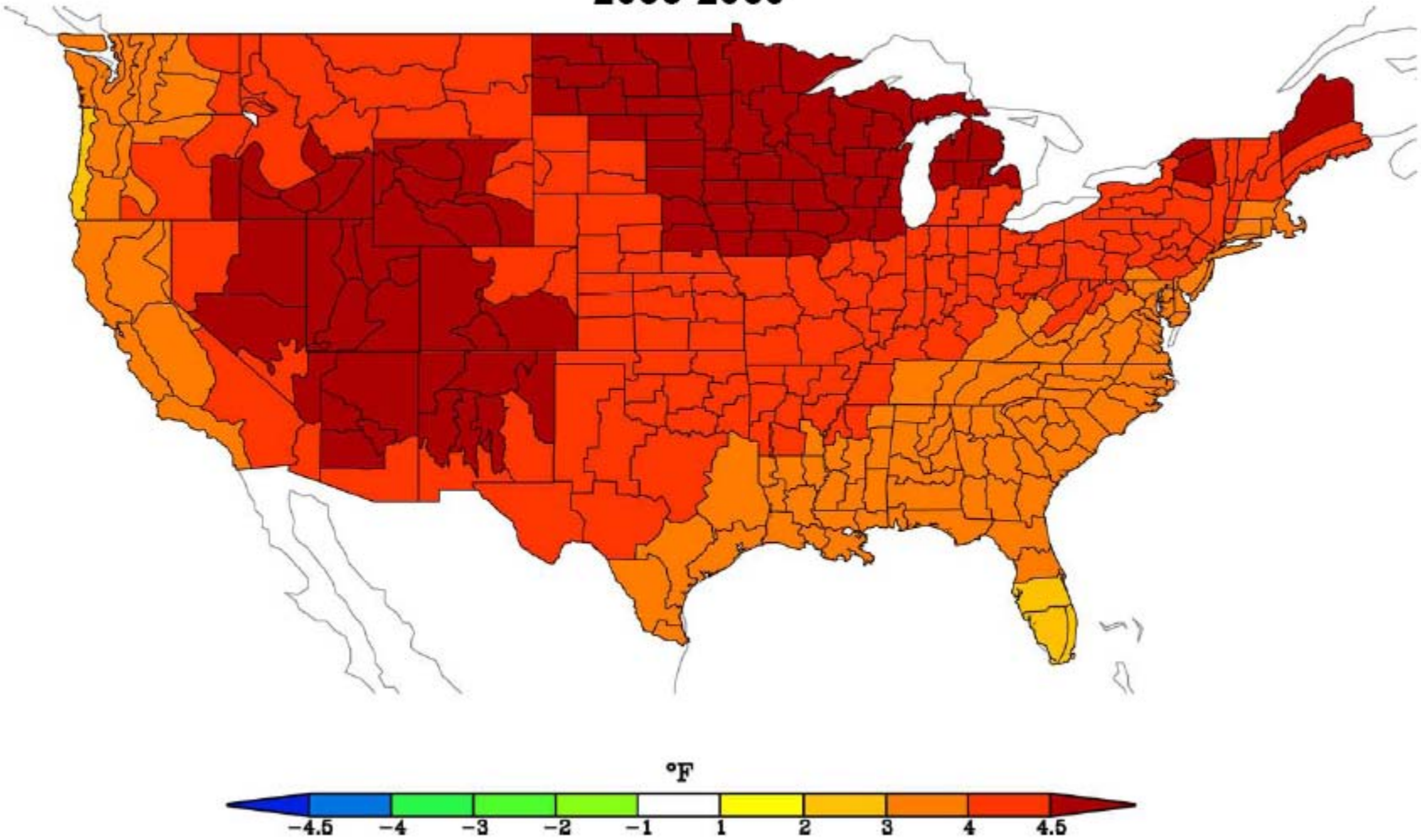
† Includes non-renewable alternative resources

29 states + DC have an RPS
(7 states have goals)

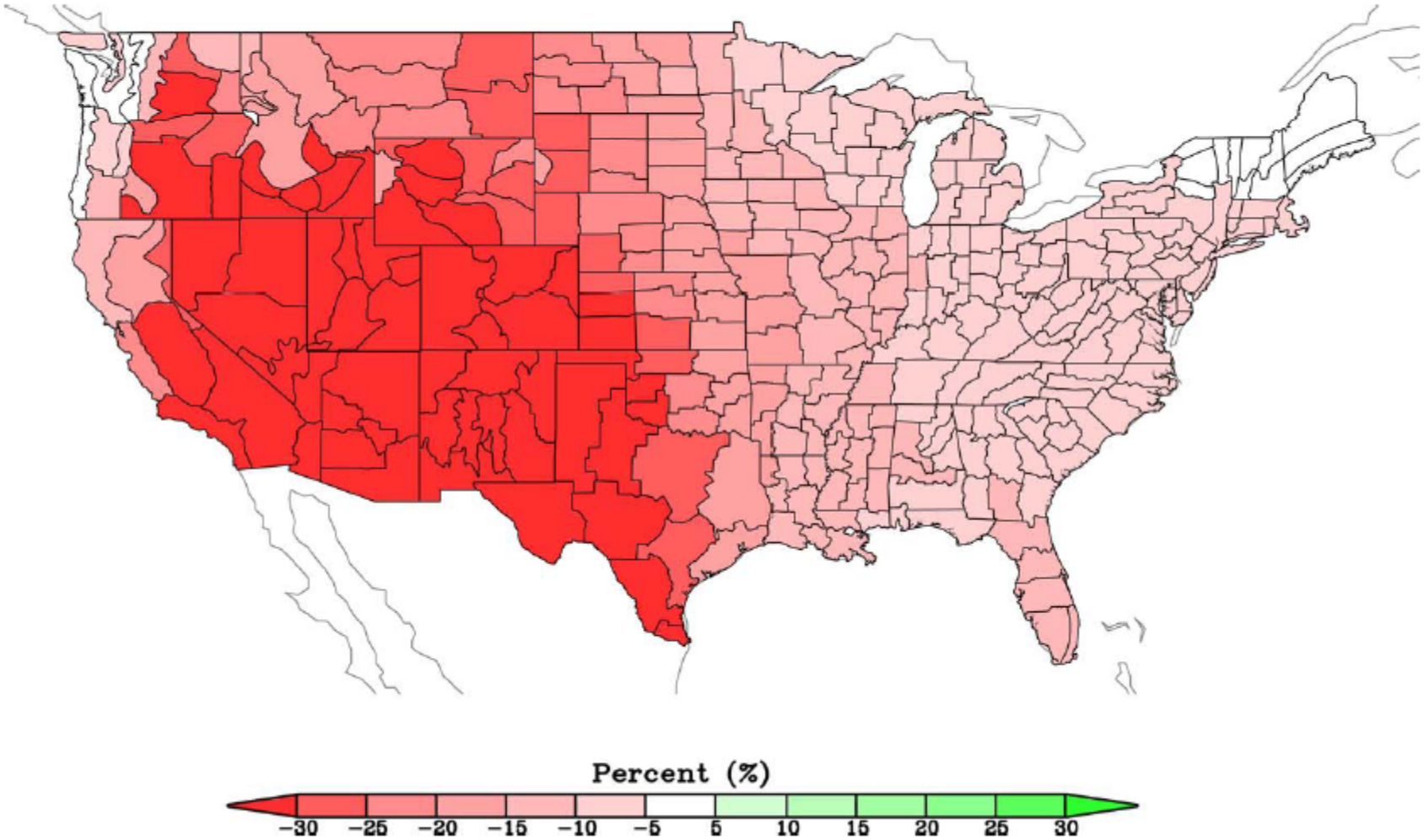
Environmental Benefits

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

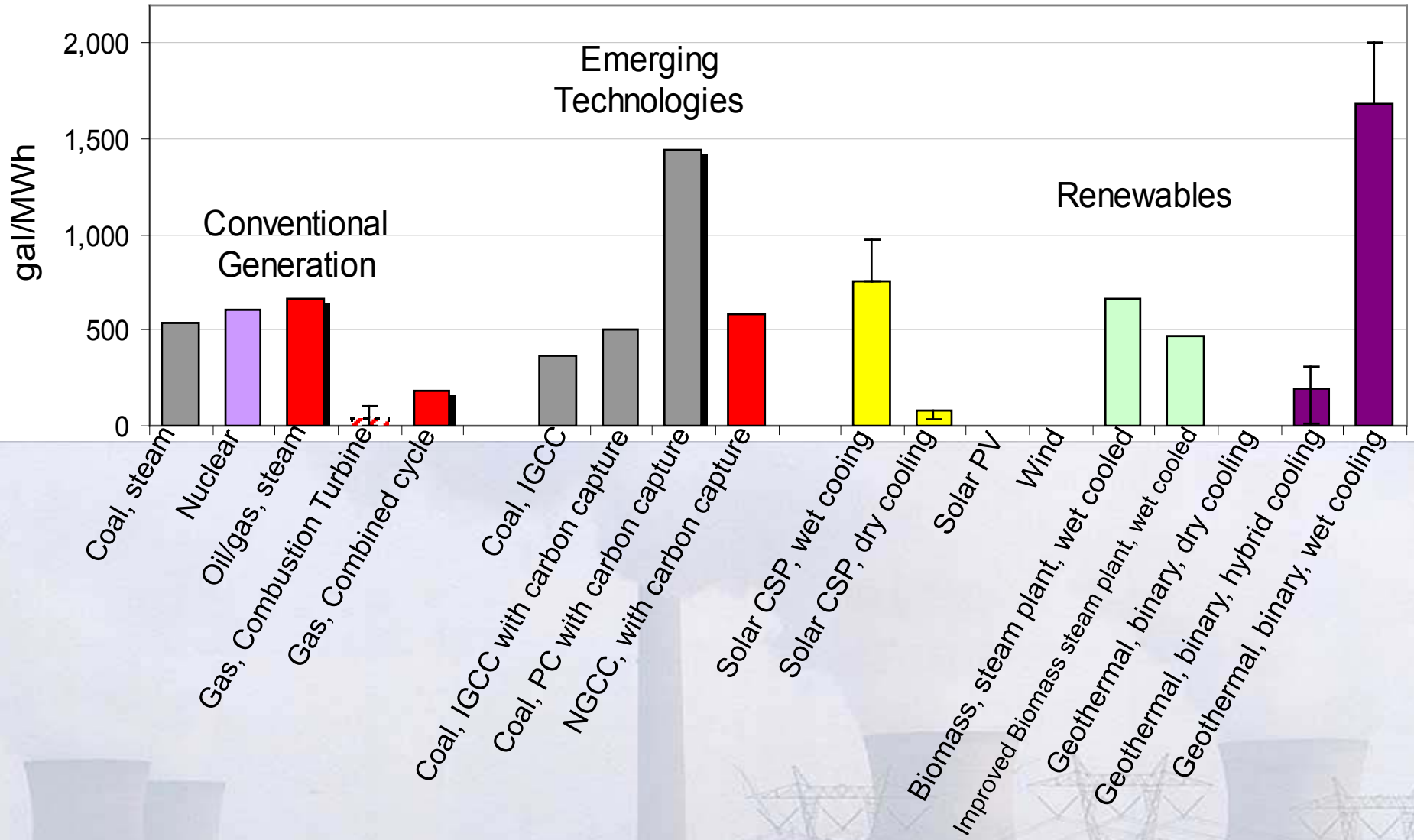
Change in Annual Temperature
2035-2060



Change in Annual (PCPN-Potential Evapotranspiration) 2035-2060



Water Intensity of Electricity Generation



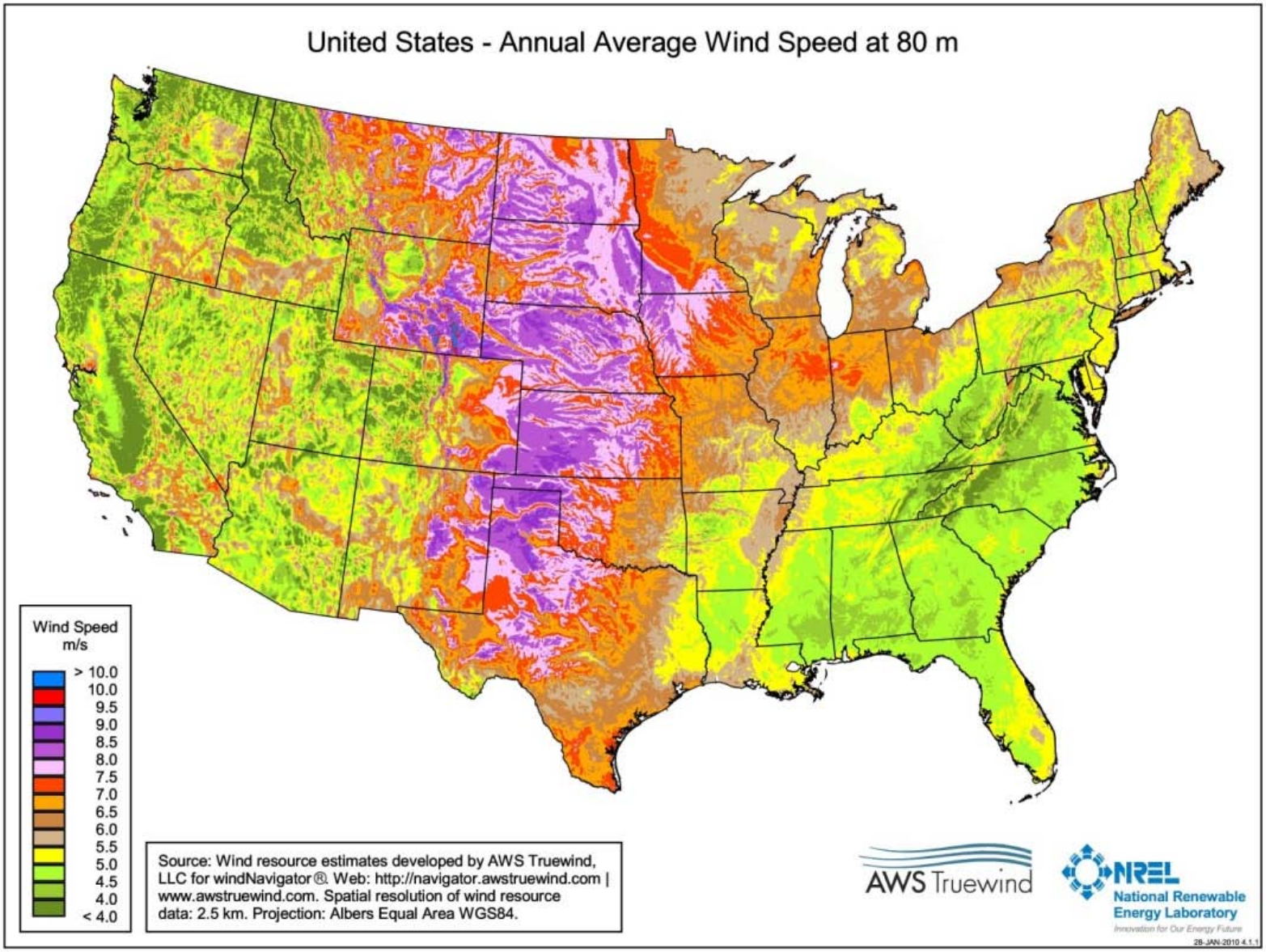
Source: Western Resource Advocates
"The Energy-Water Nexus: A Case Study of the Arkansas River Basin" 2008

The View from the Top

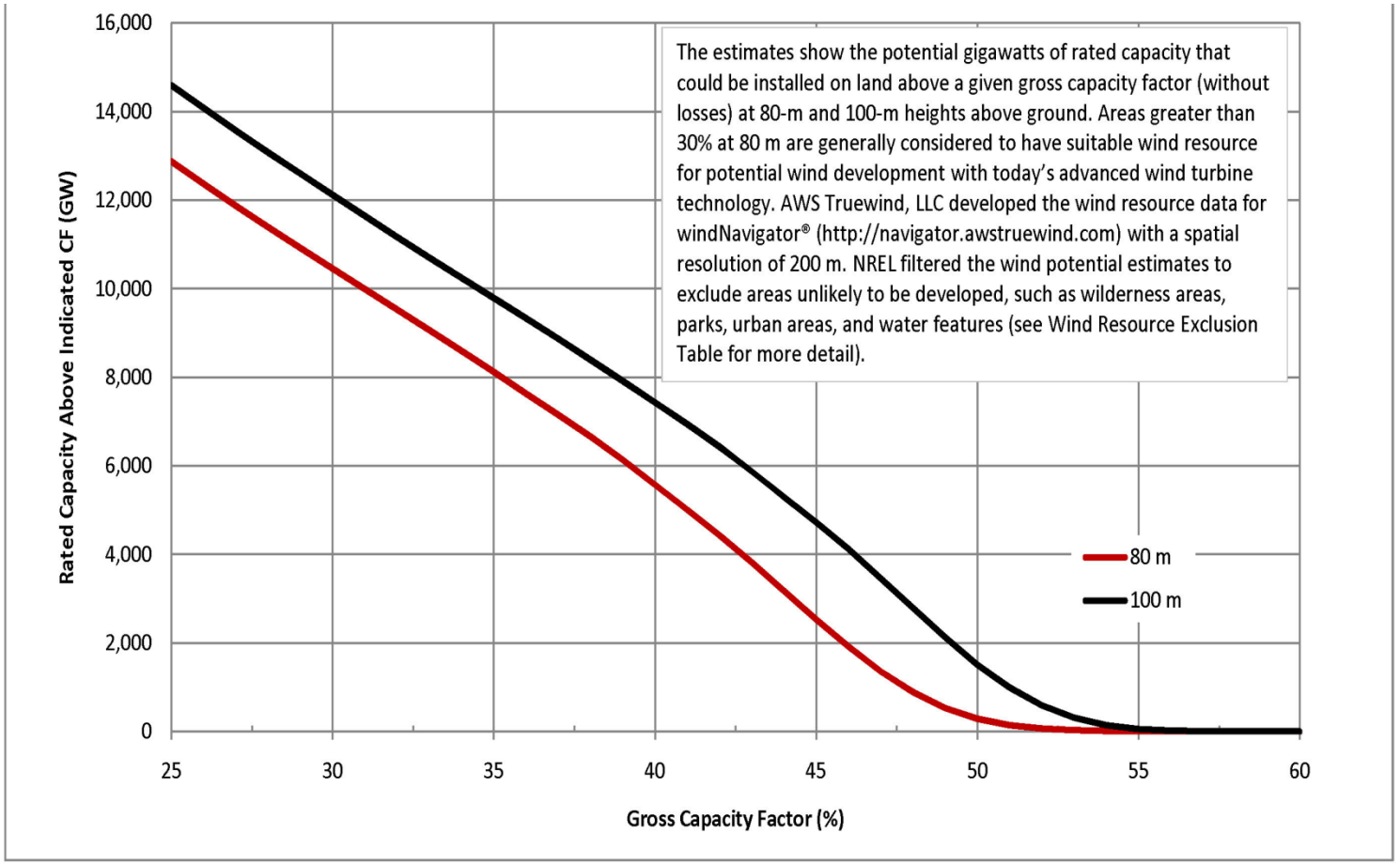
"There's a two-thirds chance there will be a [water] disaster … and that's in the best scenario."

Steven Chu, U.S. Energy Secretary and Nobel Laureate

Lower 48 Wind Resources



United States (48 Contiguous States) – Wind Resource Potential Cumulative Rated vs. Gross Capacity Factor (CF)



The estimates show the potential gigawatts of rated capacity that could be installed on land above a given gross capacity factor (without losses) at 80-m and 100-m heights above ground. Areas greater than 30% at 80 m are generally considered to have suitable wind resource for potential wind development with today's advanced wind turbine technology. AWS Truewind, LLC developed the wind resource data for windNavigator® (http://navigator.awstruewind.com) with a spatial resolution of 200 m. NREL filtered the wind potential estimates to exclude areas unlikely to be developed, such as wilderness areas, parks, urban areas, and water features (see Wind Resource Exclusion Table for more detail).

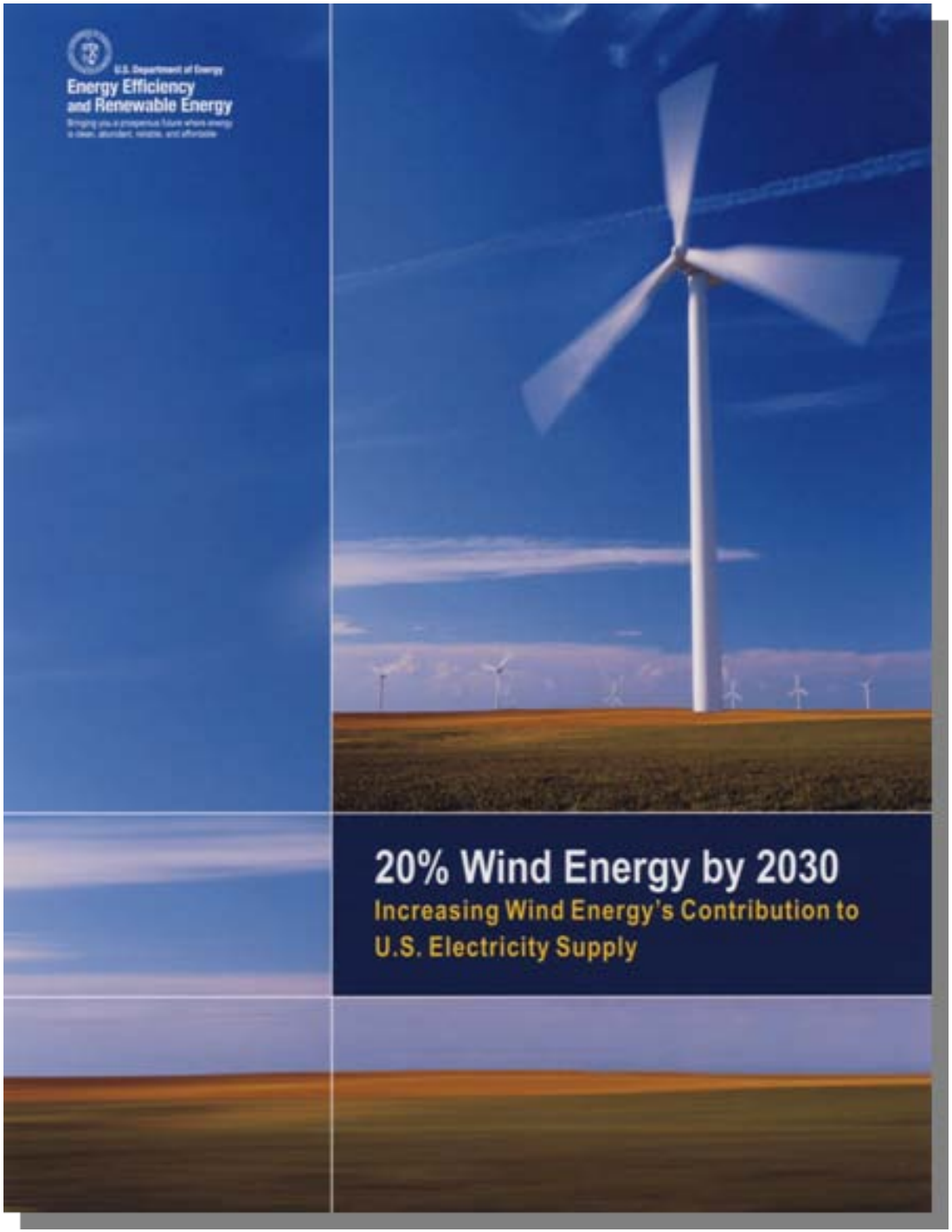
National Renewable Energy Laboratory
Innovation for Our Energy Future

AWS Truewind

Western State Wind Capacities

	Resource (MW)	MW Installed*	20% (MW)
AZ	10,904	63	2,720
CA	34,110	2,739	16,690
CO	387,220	1,248	2,510
ID	18,076	164	2,820
MT	944,004	386	5,260
NV	7,247	-	7,490
NM	492,083	597	6,450
OR	27,100	1,920	7,990
UT	13,104	223	2,450
WA	18,479	1,914	9,870
WY	552,073	1,101	12,770
	2,504,400	**10,355**	**77,020**

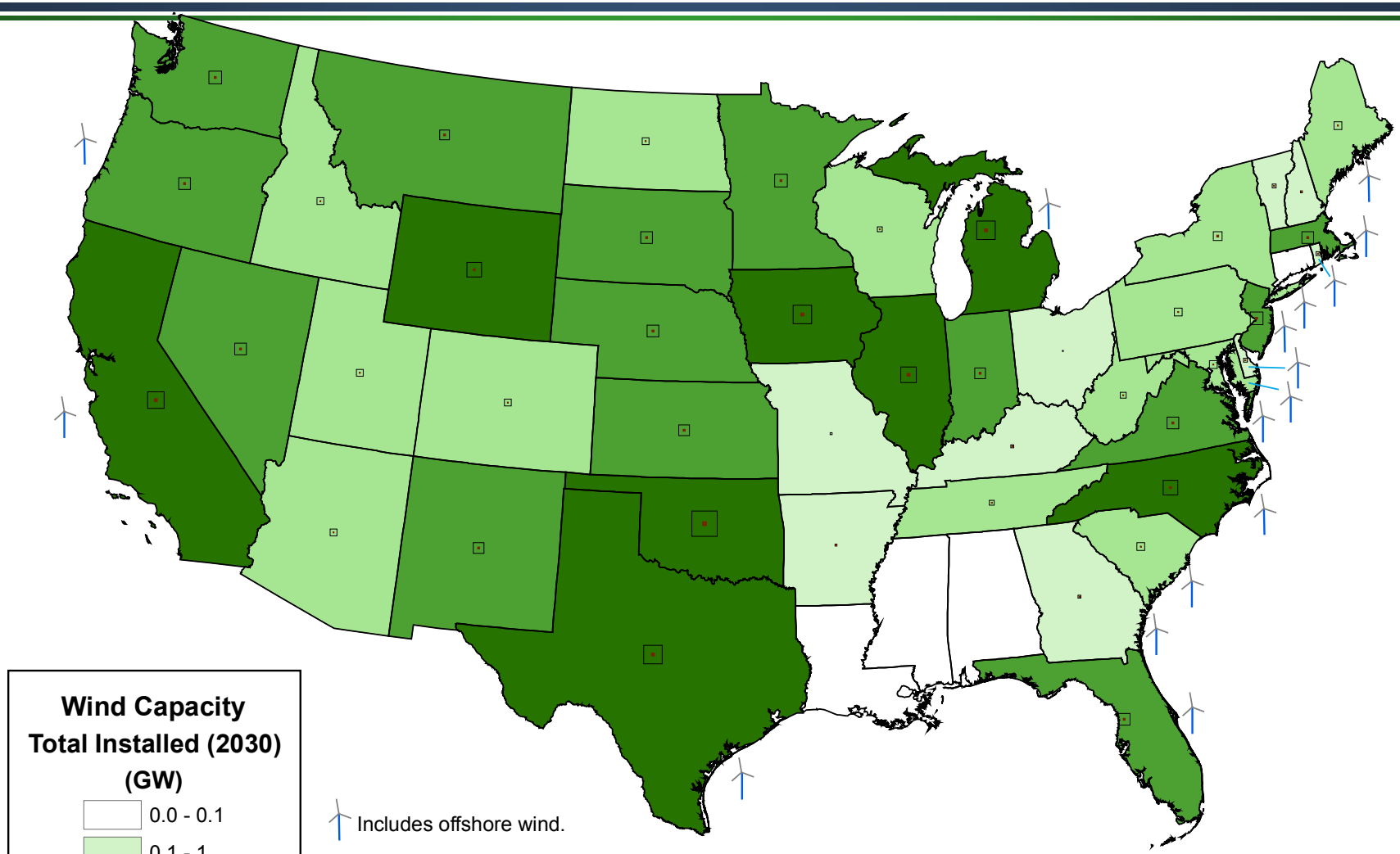
** as of 2nd Quarter 2010*



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

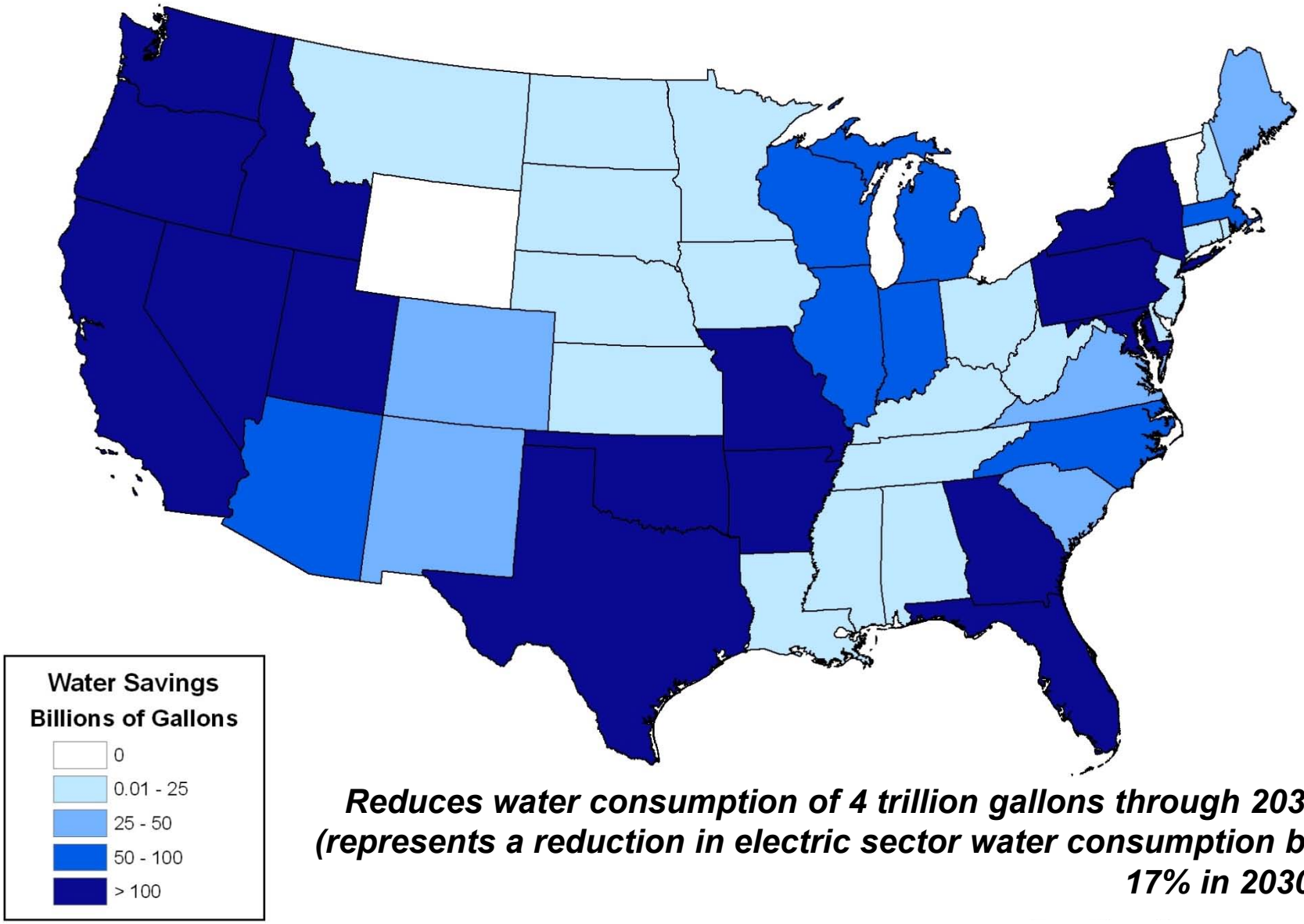
- Yogi Berra

46 States Would Have Substantial Wind Development by 2030



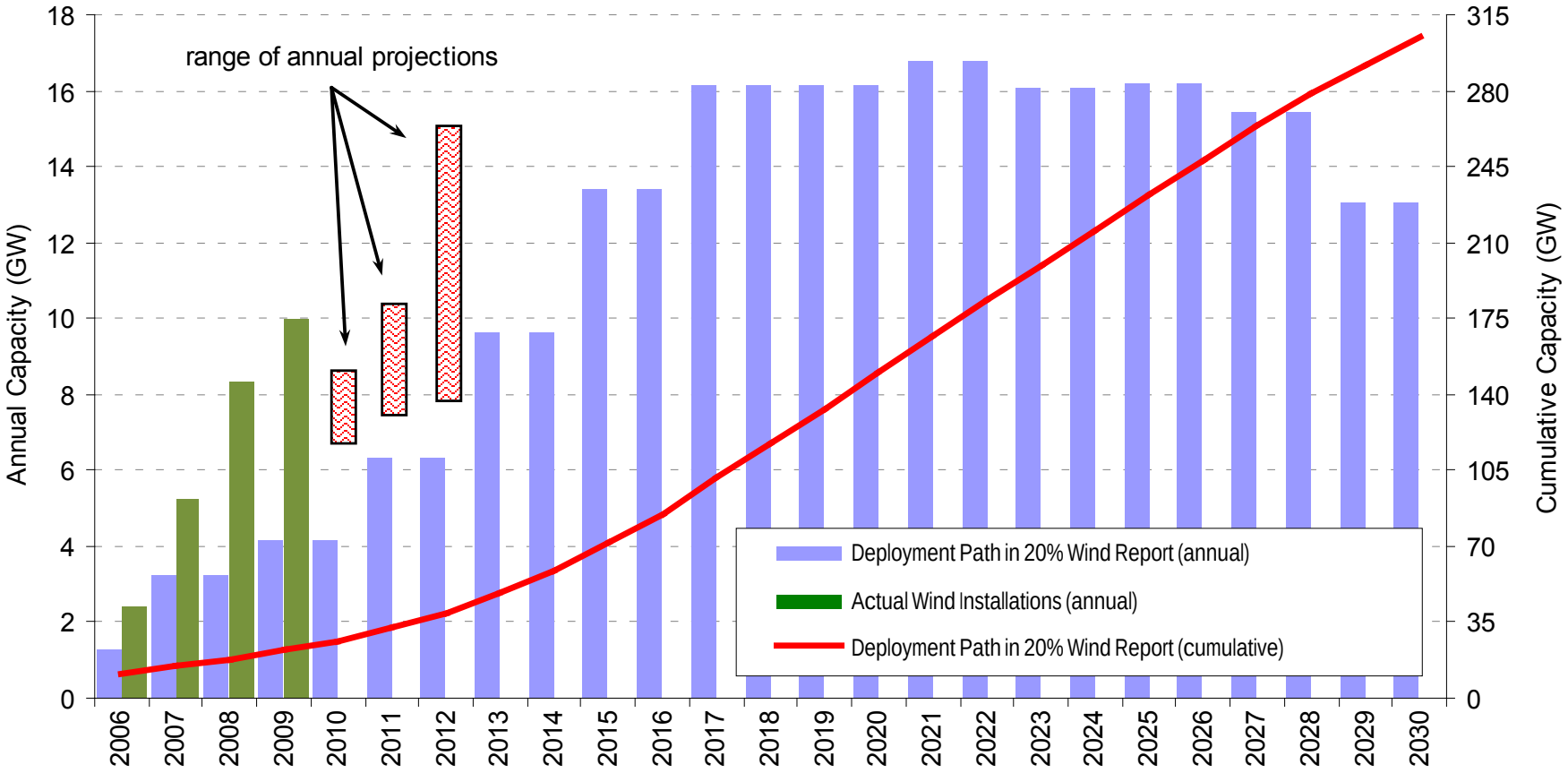
The black open square in the center of a state represents the land area needed for a single wind farm to produce the projected installed capacity in that state. The brown square represents the actual land area that would be dedicated to the wind turbines (2% of the black open square).

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)

Wind Power Capacity Growth: 20% Wind Report, Actual Installations, Forecasted Growth



Source: LBNL 2009 Wind Technology Market Report Draft

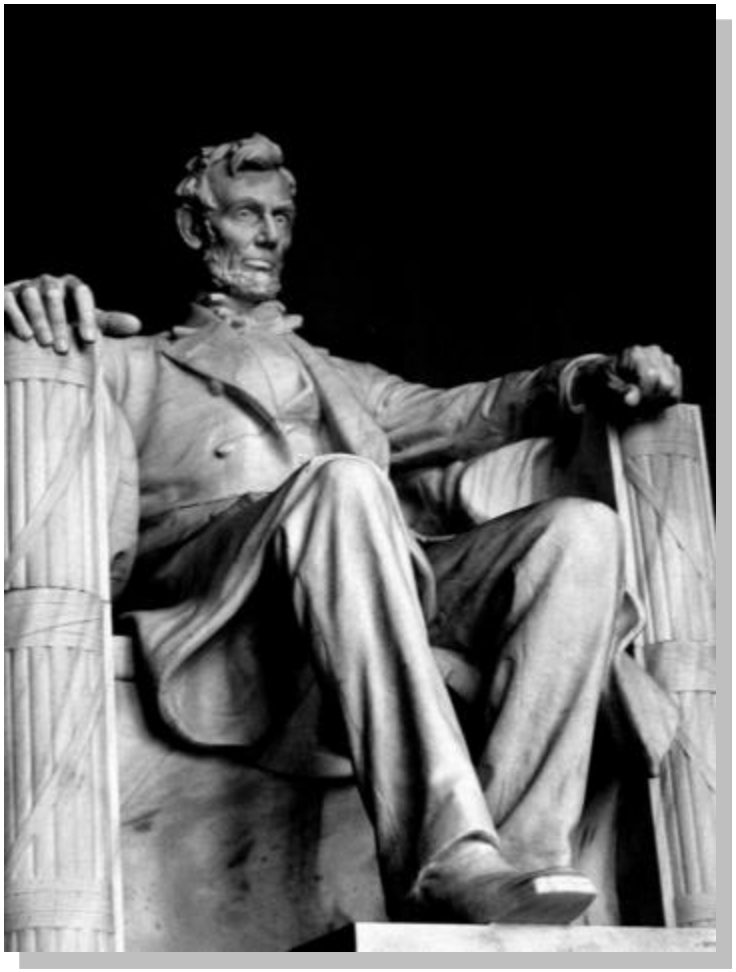
Key Issues for Wind Power

- 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

6540
GOOD IDEA
BAD LOCATION
Chautauqua County Citizens
For Responsible Wind Power

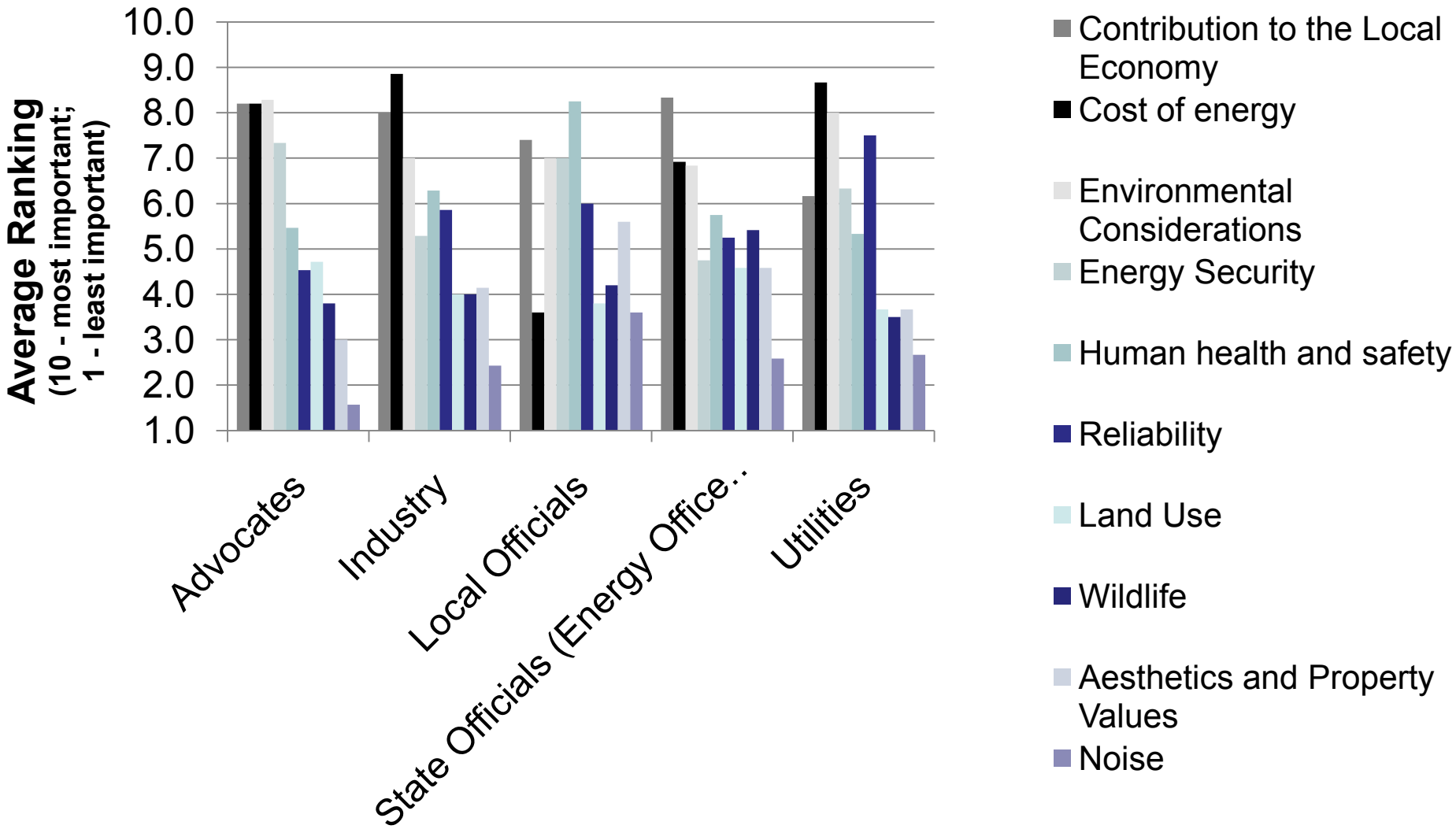


"With public sentiment nothing can fail; without it, nothing can succeed."

- Abraham Lincoln

Wind Stakeholders

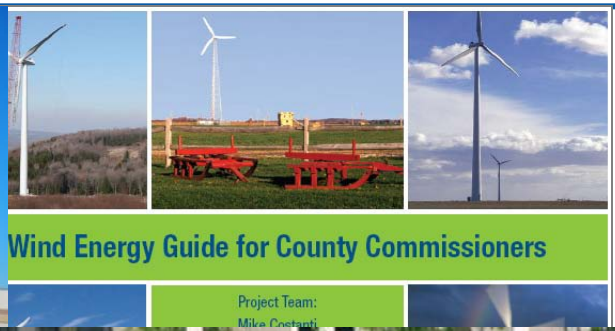
Stakeholder Wind Perspectives

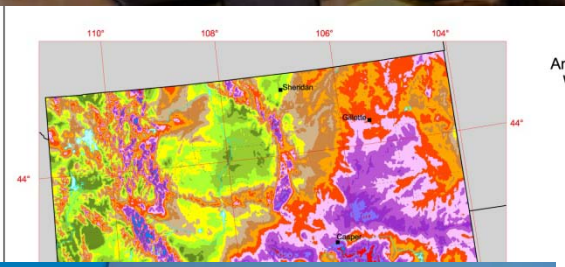


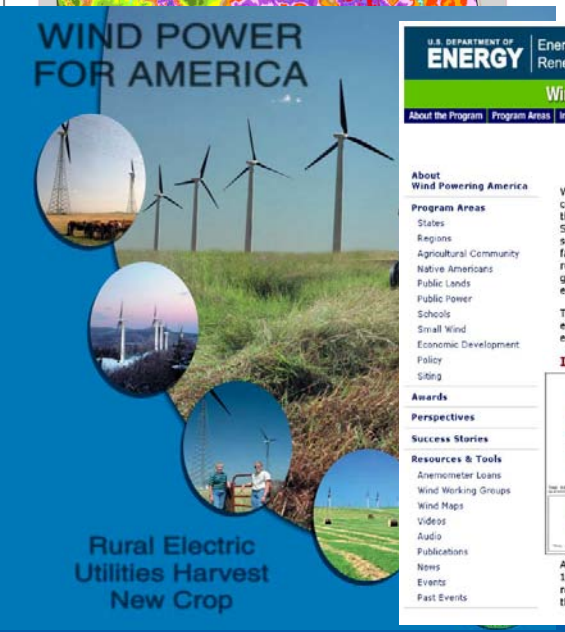
Transmission Acceptance

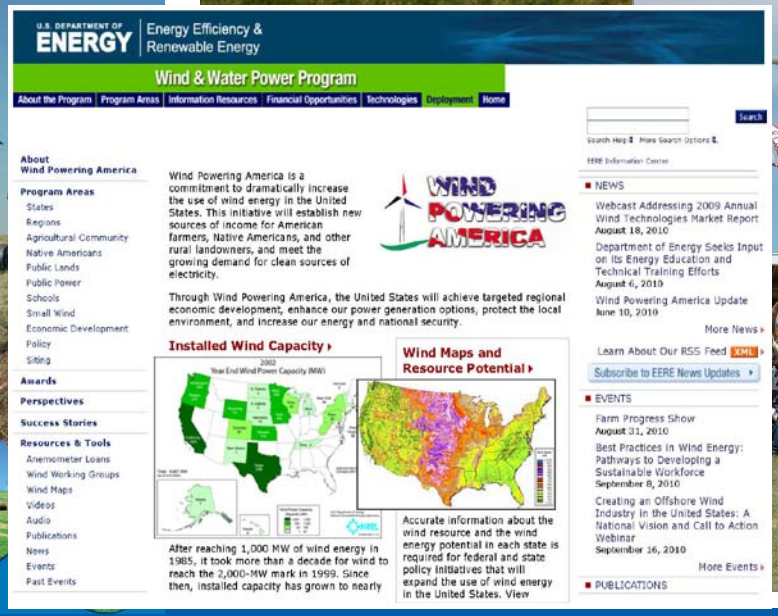
- U.S. is heavily engaged in regional transmission route options analysis & planning (e.g., EWITS, WECC, WGA, RMATS, SPP, ERCOT)
- Identification of Competitive Renewable Energy Zones (CREZ) at the state and regional level helps focus the analyses
- Federal lands corridors identified but not thoroughly vetted with stakeholders
- Several states and their utilities are active in stakeholder and community engagement (e.g., TX, CA, MN, MT)
- Some innovative approaches being taken to secure stakeholder involvement and acceptance (e.g., MATL, CA RETI, HART, CAPEX 2020); traditional stakeholder processes ineffective
- Basic approach: convince stakeholders that transmission is both needed (e.g. to meet state RPS) and transcends utility interests
- More local, more difficult
- Multi-state cooperation is critical, but politically difficult
- Economic development potentials creating inter-regional stress

Wind Powering America

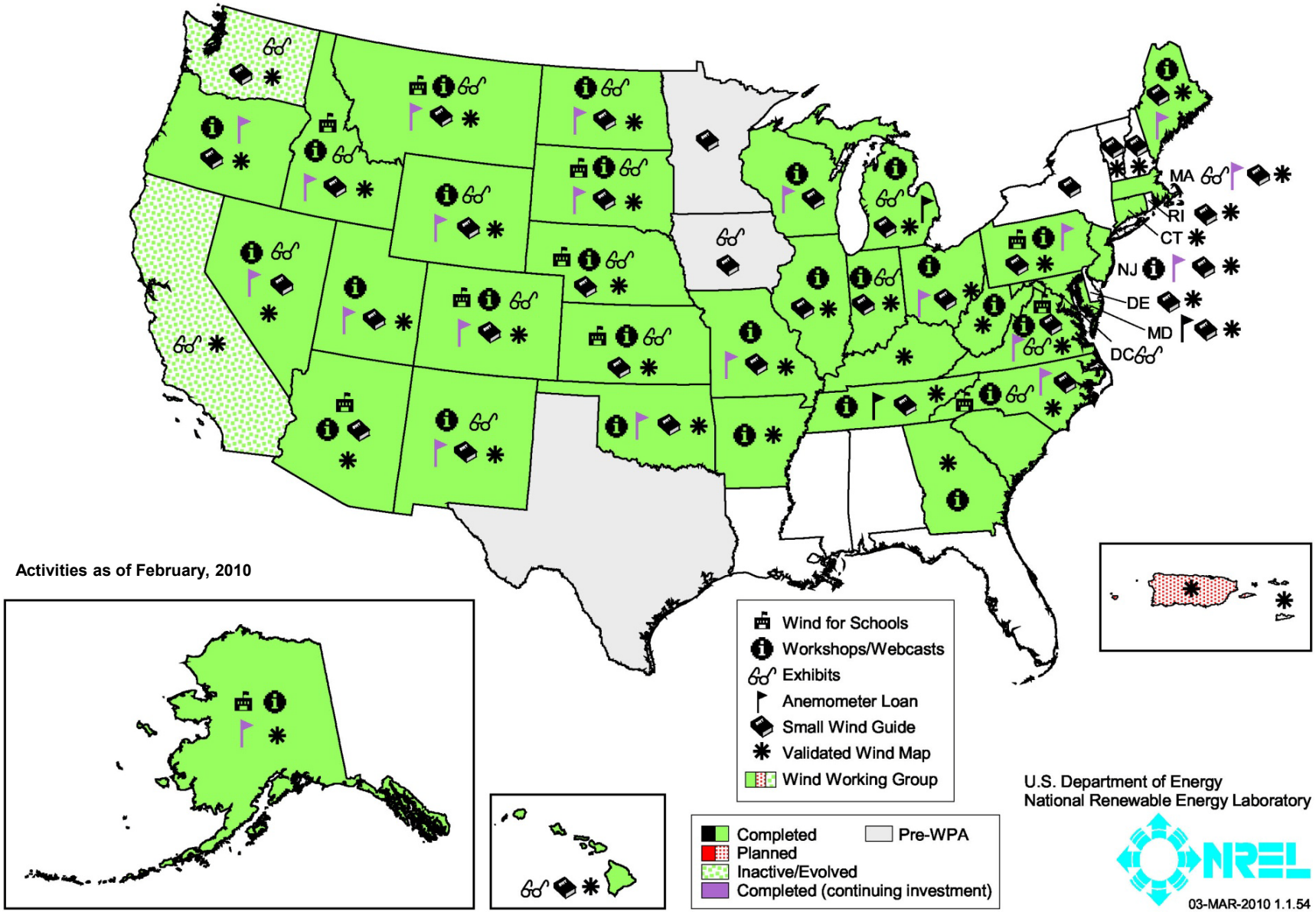








Technical Approach: Wind Powering America State Activities



Accomplishments / Progress / Results

State Maturity Index

Installed Capacity*	WWG Effectiveness	Policy Environment
< 20 MW	None	Minimal
20-100 MW	Formative	Selective
100-1000 MW	Maturing	< 10% RPS
> 1000 MW	Sustainable	> 10% RPS

West, 1999

	Installed Capacity*	WWG Effectiveness	Policy Environment
Alaska			
Arizona			
California	1646		
Colorado	22		
Hawaii	2		
Idaho			
Montana			
Nevada			
New Mexico	1		
Oregon	25		
Utah			
Washington			
Wyoming	73		

*based on data through 12/31/99

West, 2009

	Installed Capacity*	WWG Effectiveness	Policy Environment
Alaska	9		
Arizona	63		
California	2798		
Colorado	1244		
Hawaii	63		
Idaho	147		
Montana	375		
Nevada			
New Mexico	598		
Oregon	1758		
Utah	223		
Washington	1849		
Wyoming	1099		

*based on data through 12/31/09

Education: Wind for Schools

Carpe Ventem

www.windpoweringamerica.gov