The State of the U.S. Wind Energy Market:

Wind Technologies Market Report: 2010

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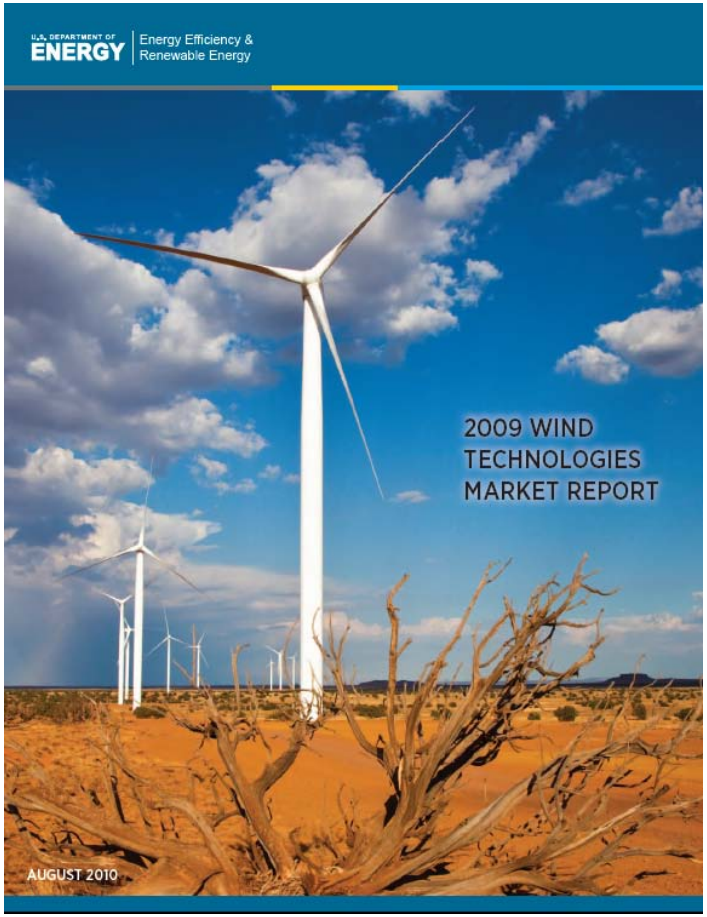
Annual Wind Technologies Market Report: To Be Published in Late June 2011

- Annual, publicly available report summarizing key trends in the U.S. wind power market, building from AWEA's data collection efforts
- Current report will focus on 2010; scope primarily includes utility-scale wind projects; data sources are diverse and numerous
- Funded by the U.S. DOE's Wind and Water Power Program, with numerous content contributors
- Expected to be available in late June 2011: http://www1.eere.energy.gov/windandhydro/

Report Contents

- Installation trends
- Industry trends
- Price, cost, performance trends
  - Power sales prices
  - Installed wind project costs
  - Wind turbine transaction prices
  - Wind project performance
  - O&M cost trends
- Policy and market drivers
- Future outlook



This presentation covers a subset of the content, with an emphasis on cost/performance/pricing trends

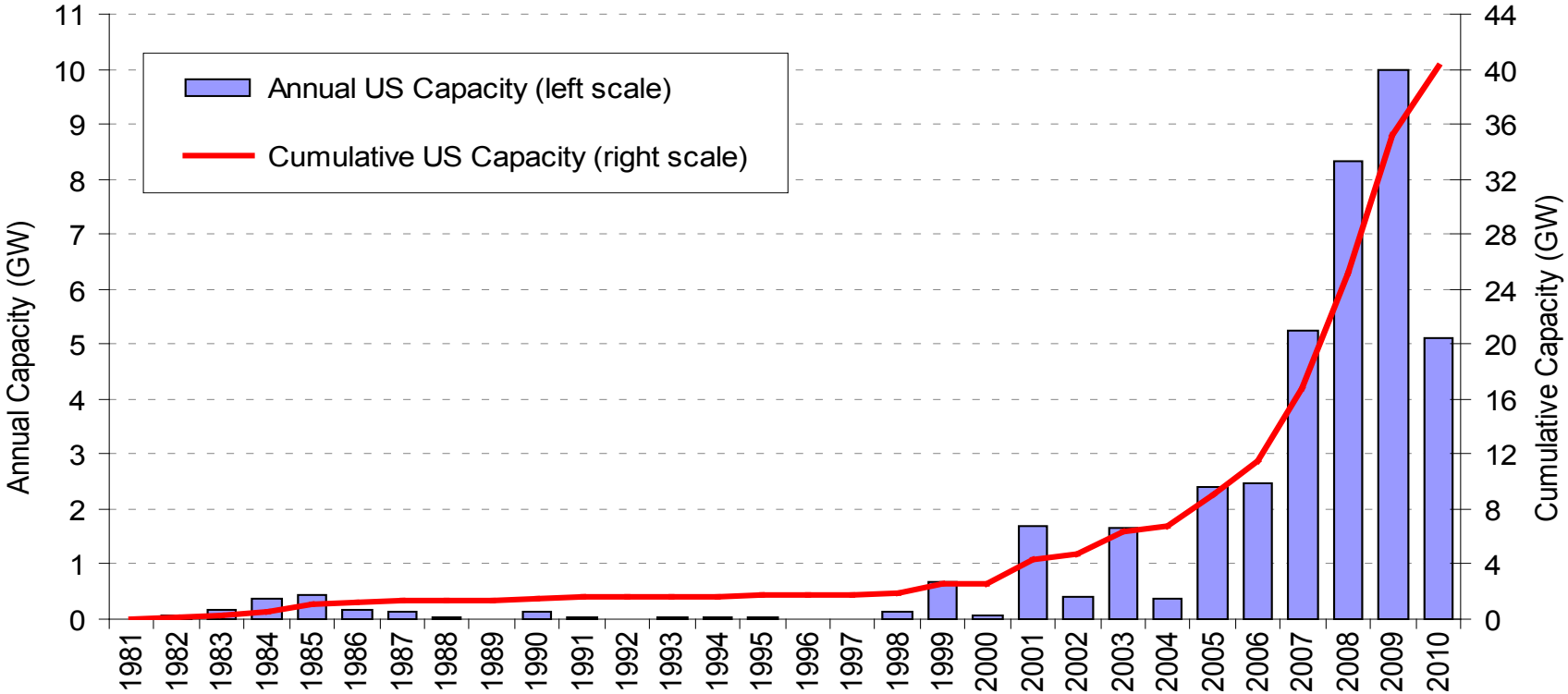
Basic Themes of this Presentation

- The U.S. wind industry has matured, giving it the standing for significant additional growth
- Wind was competitive in wholesale power markets for much of the 2000s
- Variety of headwinds, including an erosion in economic competitiveness, has caused a slower-growth environment to prevail in the recent past
- Absent improved economics or new policy, achieving sustained additions similar to 2008-09 levels will be challenging
- Recent reductions in wind turbine prices and increased wind turbine performance are substantially improving the economic competitiveness of wind energy

Overview of Domestic Wind Market: 2010 – A Somewhat Trying/Mixed Year

- Growth in 2010 (5 GW) = ½ that in 2009, 40% lower than 2008
- U.S. 2nd largest country in annual additions (China now dominant)
- U.S. dropped to 2nd in cumulative capacity, also after China
- 25% of new capacity from wind (3rd to nat. gas, edged by coal)
- Wind energy represents 2.9% of U.S. electricity consumption
- Four states > 10% wind energy (SD, IA, ND, MN); 13 states > 5%
- 260 GW of wind power in ISO/utility interconnection queues
- Increase in local manufacturing → lower import fraction (41% in 09-10)

Slower Growth Environment in 2010:
5,113 MW Added; $11 billion Investment



- Capacity additions ½ that seen in 2009; 40% below 2008
- Low wholesale electricity prices, relatively high wind energy prices, weakness of economy, reduced demand for (renewable) energy, transmission limitations, etc.

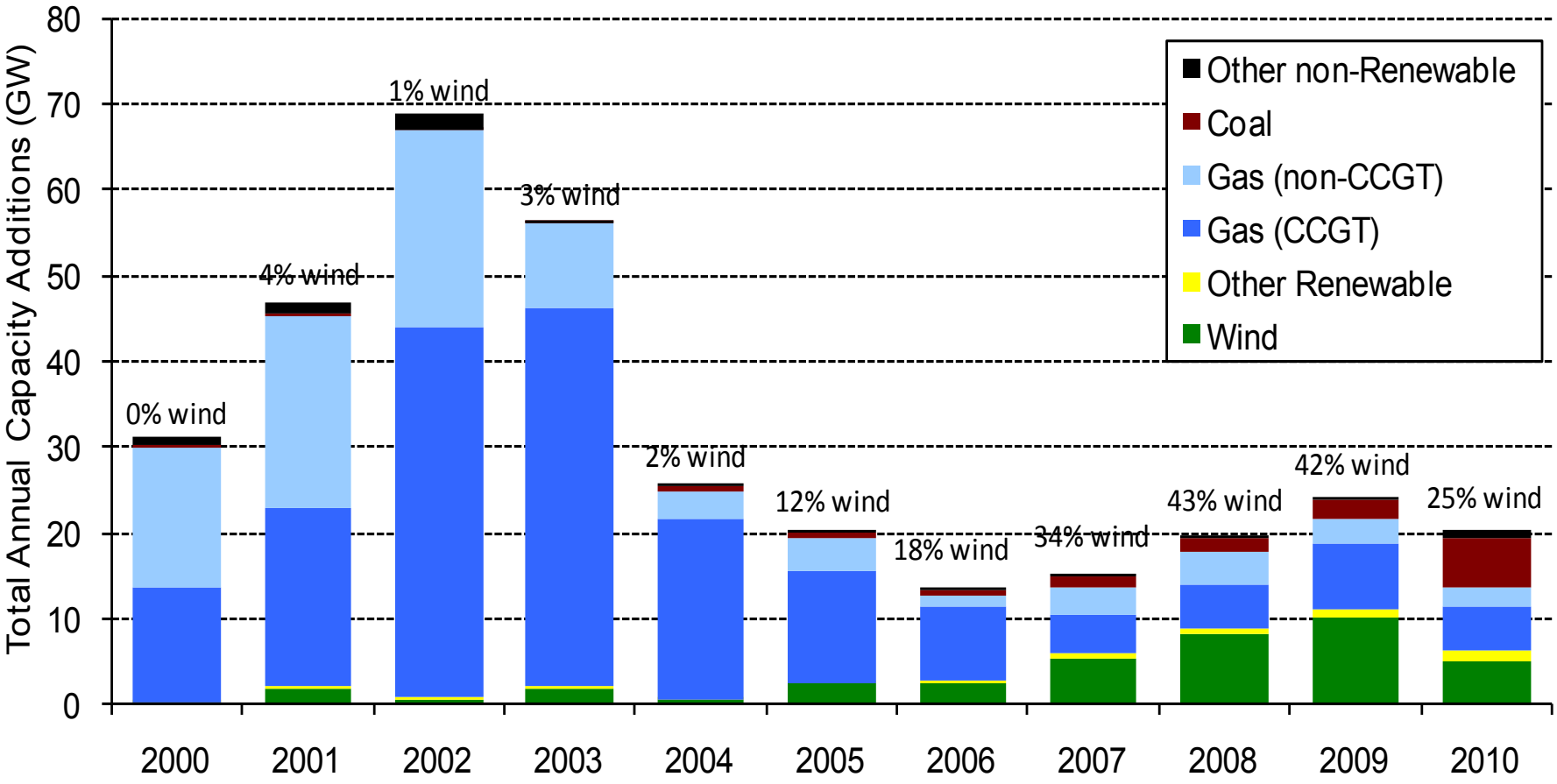
US: 2nd Largest in New Additions in '10; Dropped to 2nd in Cumulative Capacity

International Rankings of Wind Power Capacity

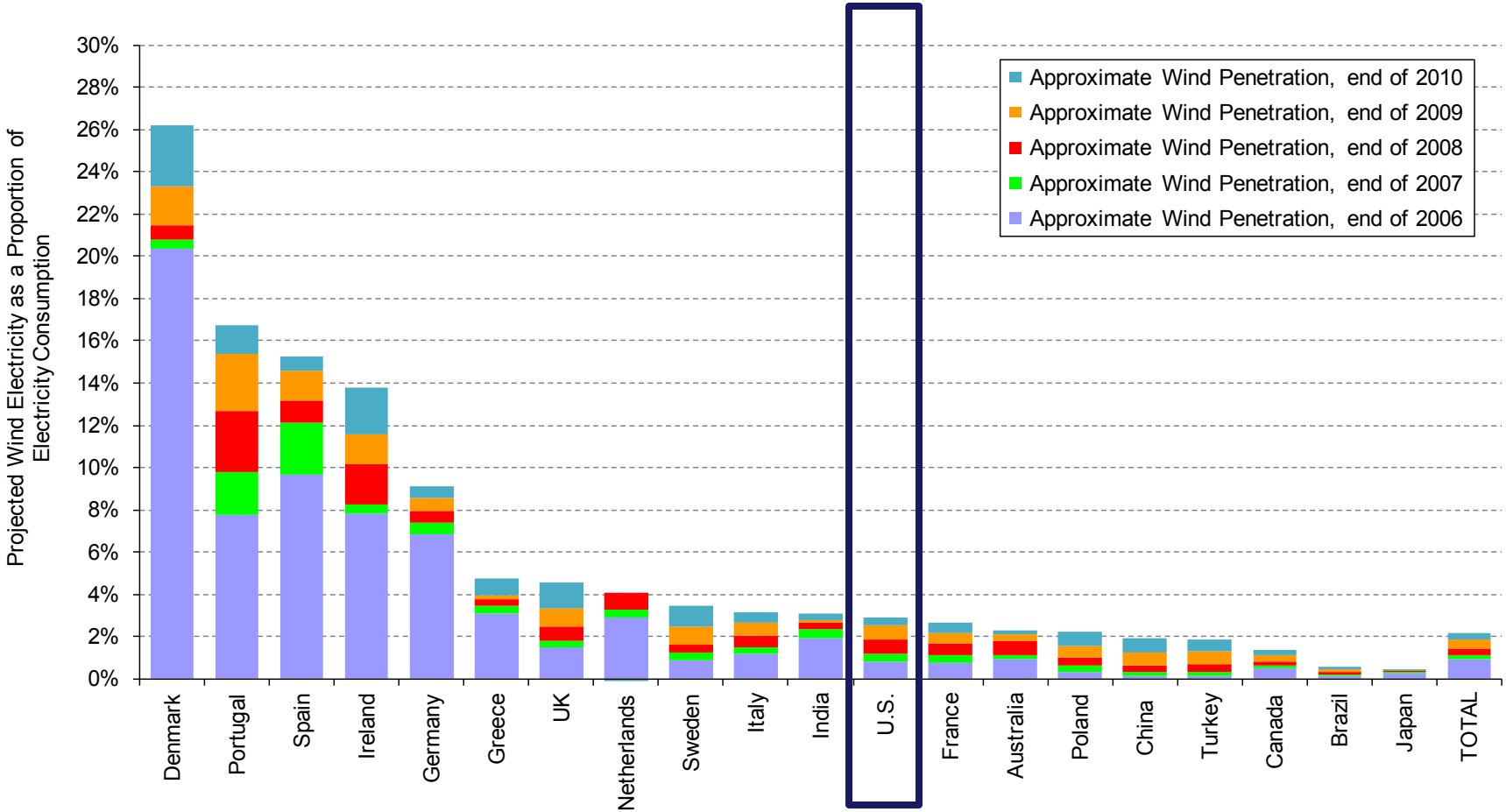
Annual Capacity (2010, MW)		Cumulative Capacity (end of 2010, MW)	
China	18,928	China	44,781
U.S.	**5,113**	**U.S.**	**40,267**
India	2,139	Germany	27,364
Germany	1,551	Spain	20,300
U.K.	1,522	India	12,966
Spain	1,516	France	5,961
France	1,186	U.K.	5,862
Italy	948	Italy	5,793
Canada	690	Canada	4,011
Sweden	604	Portugal	3,837
Rest of World	5,205	*Rest of World*	28,371
TOTAL	**39,402**	**TOTAL**	**199,513**

China rapidly becoming the dominant market, worldwide

Wind Is a Major Source of New Capacity: 25% in 2010, a Drop From Earlier Years



Wind Capacity at End of 2010 Equates to ~2.9% of U.S. Electricity Consumption



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

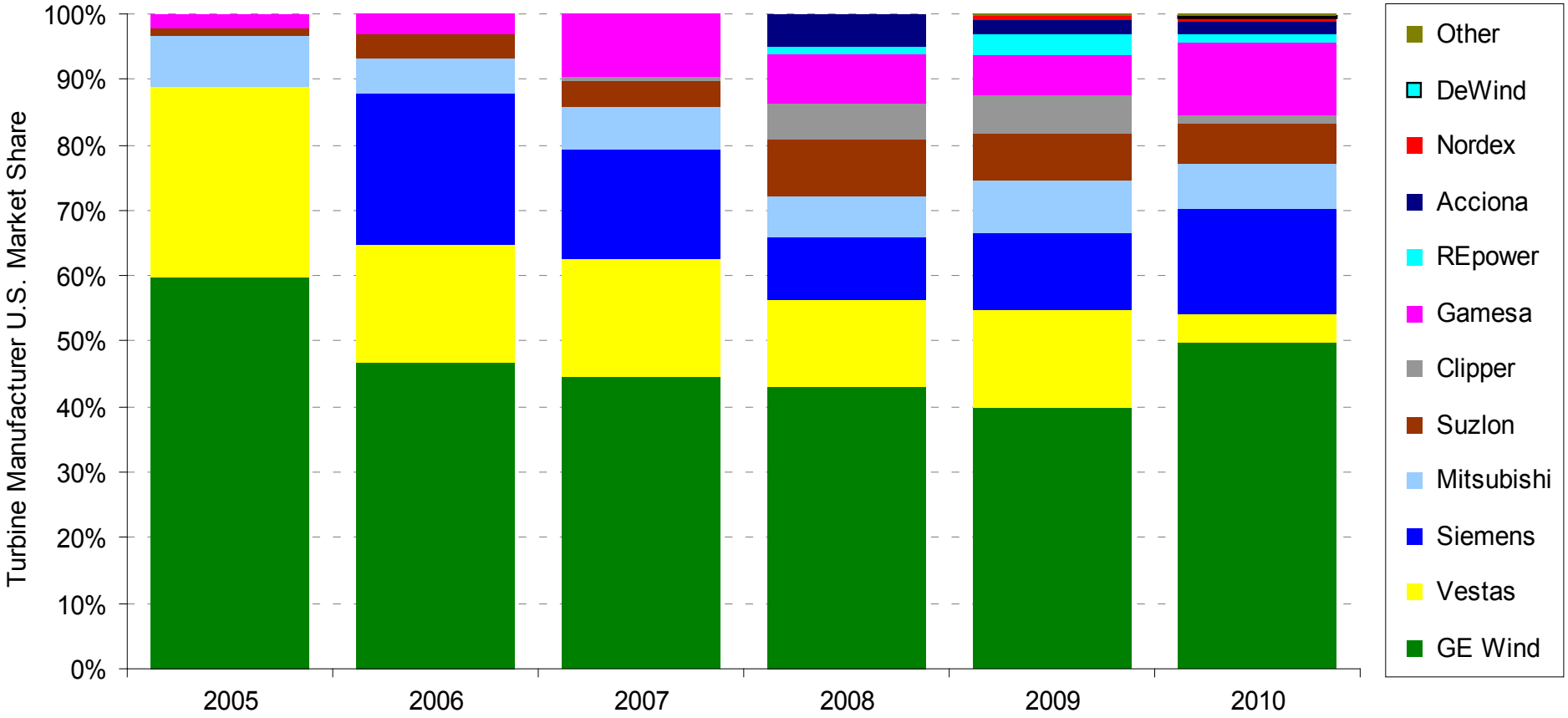
Four States Have Achieved > 10% Wind; Texas Continues to Lead in Capacity

Annual Capacity (2010, MW)		Cumulative Capacity (end of 2010, MW)		*Estimated* Percentage of In-State Generation*	
Texas	680	Texas	10,089	South Dakota	23.2%
Illinois	498	Iowa	3,675	Iowa	16.9%
California	455	California	3,253	North Dakota	13.5%
South Dakota	396	Minnesota	2,205	Minnesota	12.3%
Minnesota	396	Washington	2,104	Oregon	9.8%
Oklahoma	352	Oregon	2,104	Wyoming	8.2%
Wyoming	311	Illinois	2,045	Colorado	7.8%
Indiana	303	Oklahoma	1,482	Kansas	7.6%
Oregon	283	North Dakota	1,424	Idaho	7.3%
North Dakota	221	Wyoming	1,412	Oklahoma	6.9%
Idaho	206	Indiana	1,339	Texas	6.7%
Washington	196	Colorado	1,299	New Mexico	6.0%
Missouri	149	New York	1,274	Washington	5.2%
New Mexico	102	Kansas	1,074	Maine	4.4%
West Virginia	101	Pennsylvania	748	Montana	3.9%
Maine	92	South Dakota	709	California	3.9%
Maryland	70	New Mexico	700	Indiana	3.0%
Arizona	65	Wisconsin	469	Illinois	2.8%
Kansas	61	Missouri	457	Hawaii	2.4%
Nebraska	60	West Virginia	431	New York	2.0%
Rest of U.S.	118	*Rest of U.S.*	1,974	*Rest of U.S.*	0.3%
TOTAL	**5,113**	**TOTAL**	**40,267**	**TOTAL**	**2.6%**

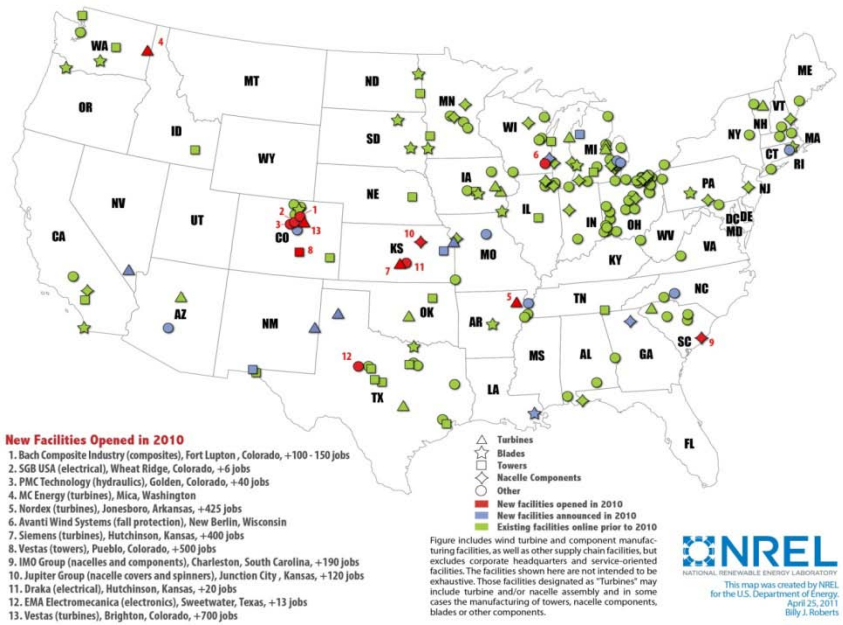
* Based on a projection of wind electricity generation from end-of-2010 wind power capacity, divided by total in-state electricity generation in 2010.

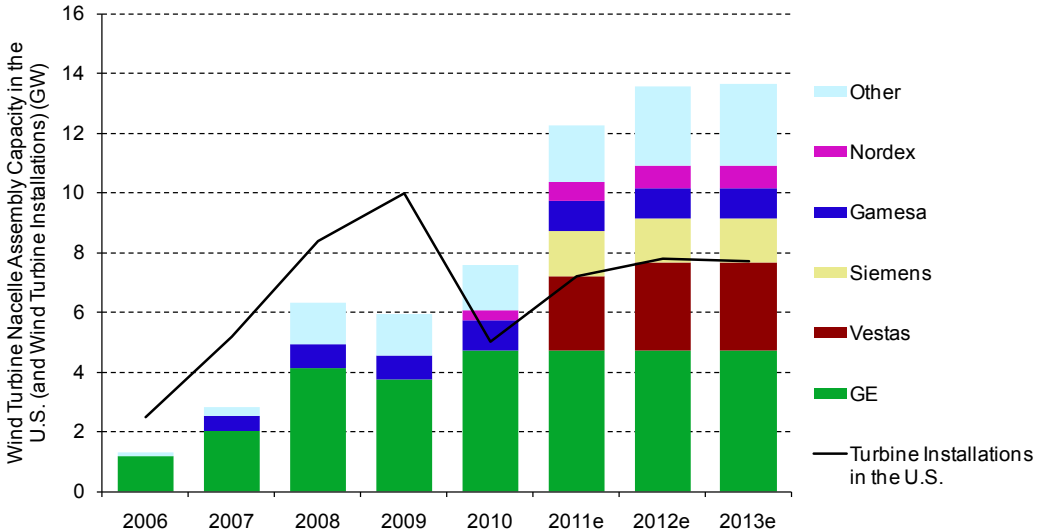
Source: AWEA project database, EIA, Berkeley Lab estimates

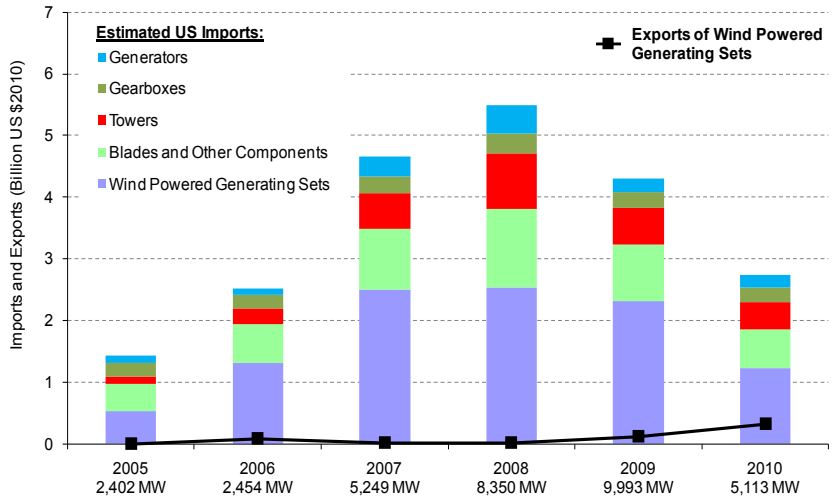
Growing Competition Among Wind Turbine Manufacturers

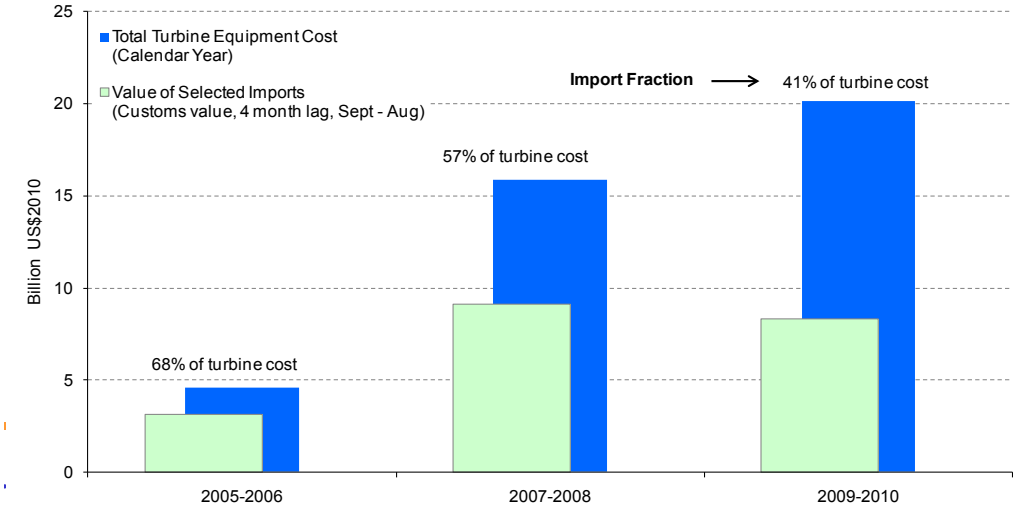


Domestic Manufacturing Increasing: ~60% of Turbine Equipment Installed in 09-10

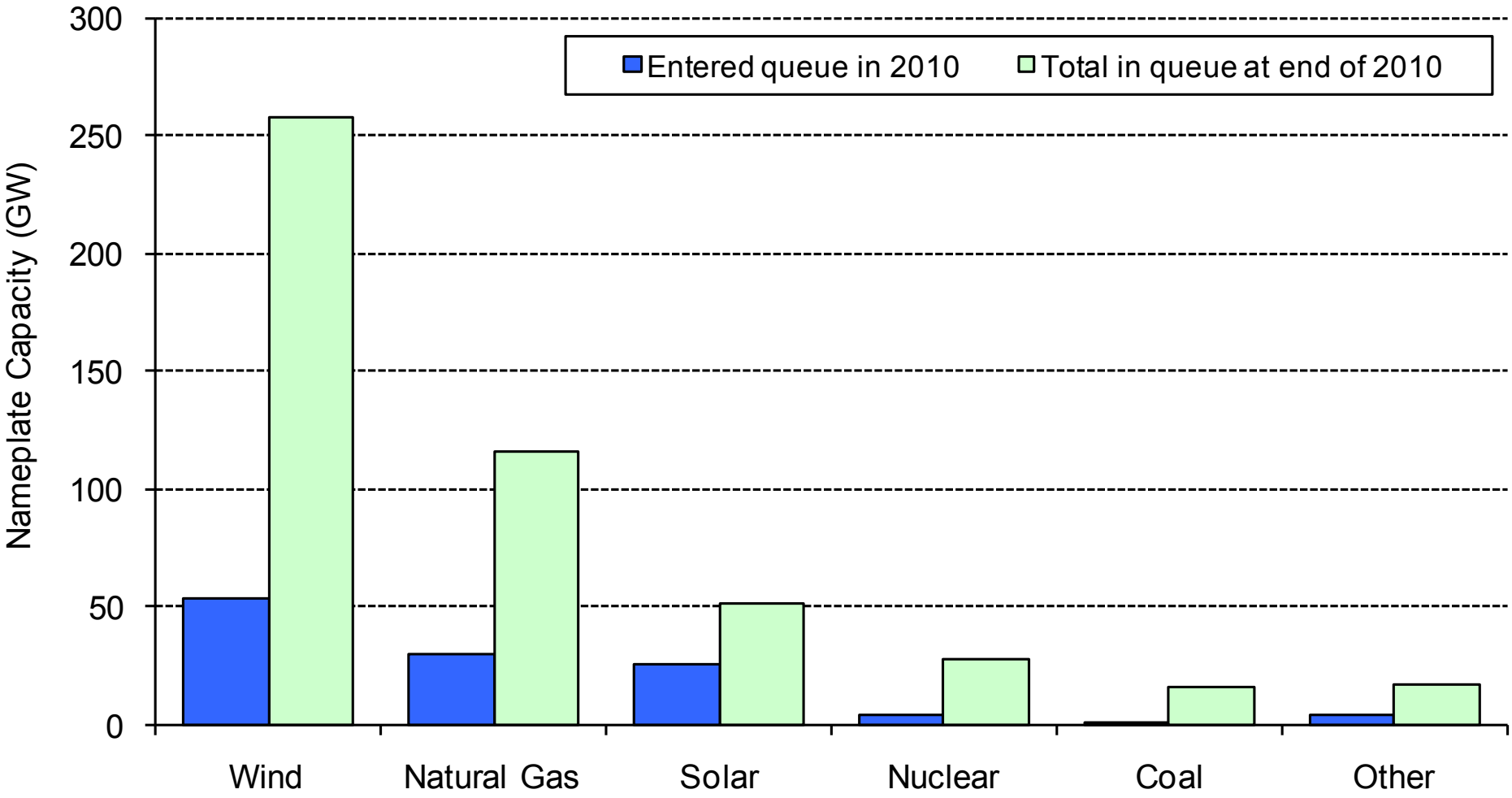








Interconnection Queues Are Clogged with Wind Projects: 260 GW



Market Resurgence Expected in Near-Term, But Not to Levels Seen in 2009

Source	2011	2012	2013
EIA (2011)	4,450	7,480	170
BTM (2011)	8,000	10,000	8,000
IHS EER (2011)	5,700	6,100	6,300
Bloomberg NEF (2011)	7,300	7,800	7,700
UBS Limited (2011)	5,400	5,600	5,900

Lower (and uncertain) market forecasts due in part to:

- State RPS' predicted to require just 4-6 GW/yr RE additions
- Const. transmission → curtailment, move to lower wind sites

Absent new policy, economics will largely determine market size beyond RPS

Datasets Used To Explore Cost, Performance, and Price Trends

Project- and Turbine-Level Capital Costs

- 485 projects built from 1983-2011, 34.2 GW
- 81 turbine transactions from '97-'11, 23.9 GW

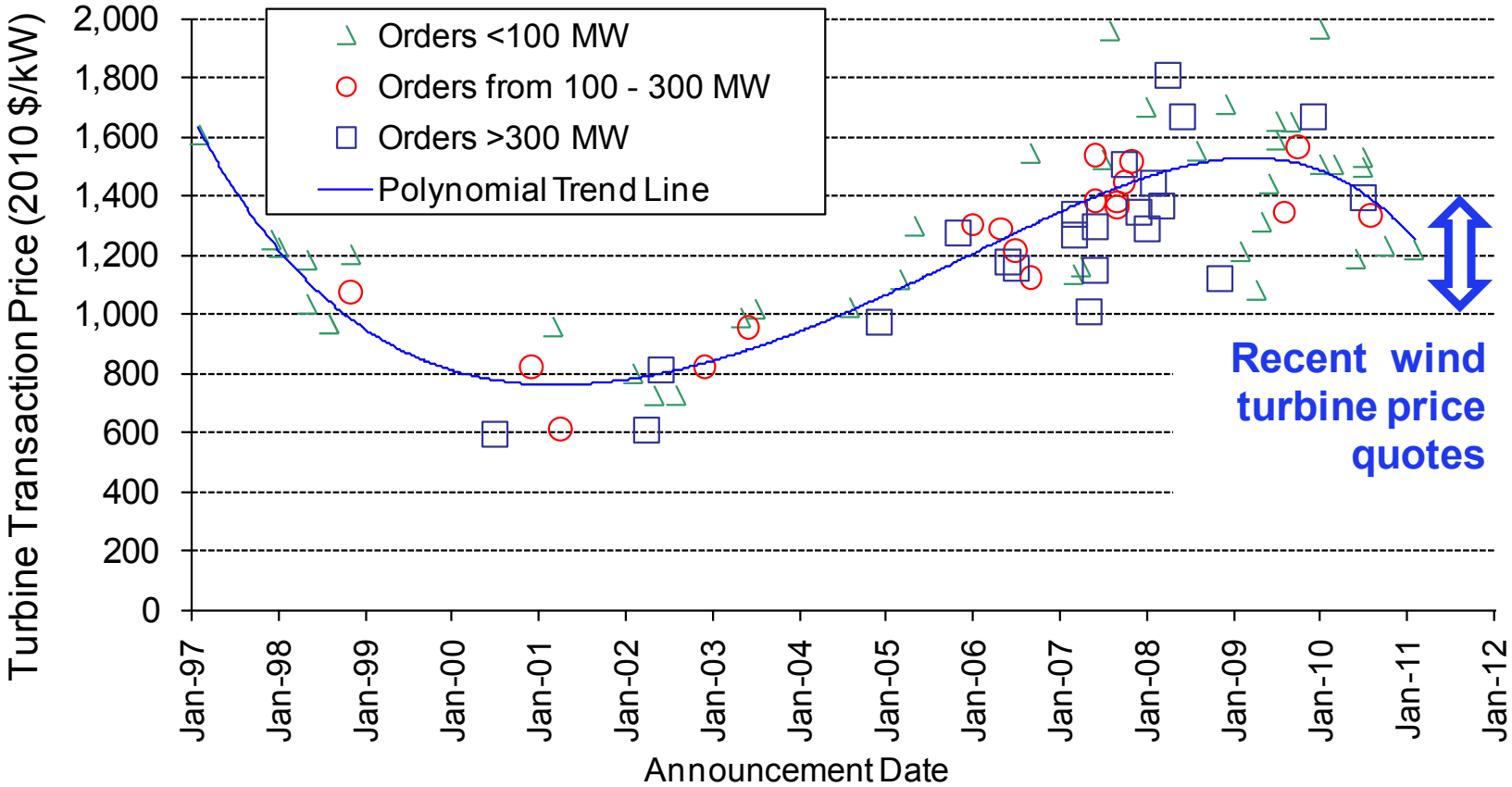
Project-Level Performance / Capacity Factors

- 338 projects built from 1983-2009, 32.0 GW

Project-Level Power Sales Prices

- 232 projects built from 1998-2010, 17 GW
- All-in long-term electricity/REC PPA contracts

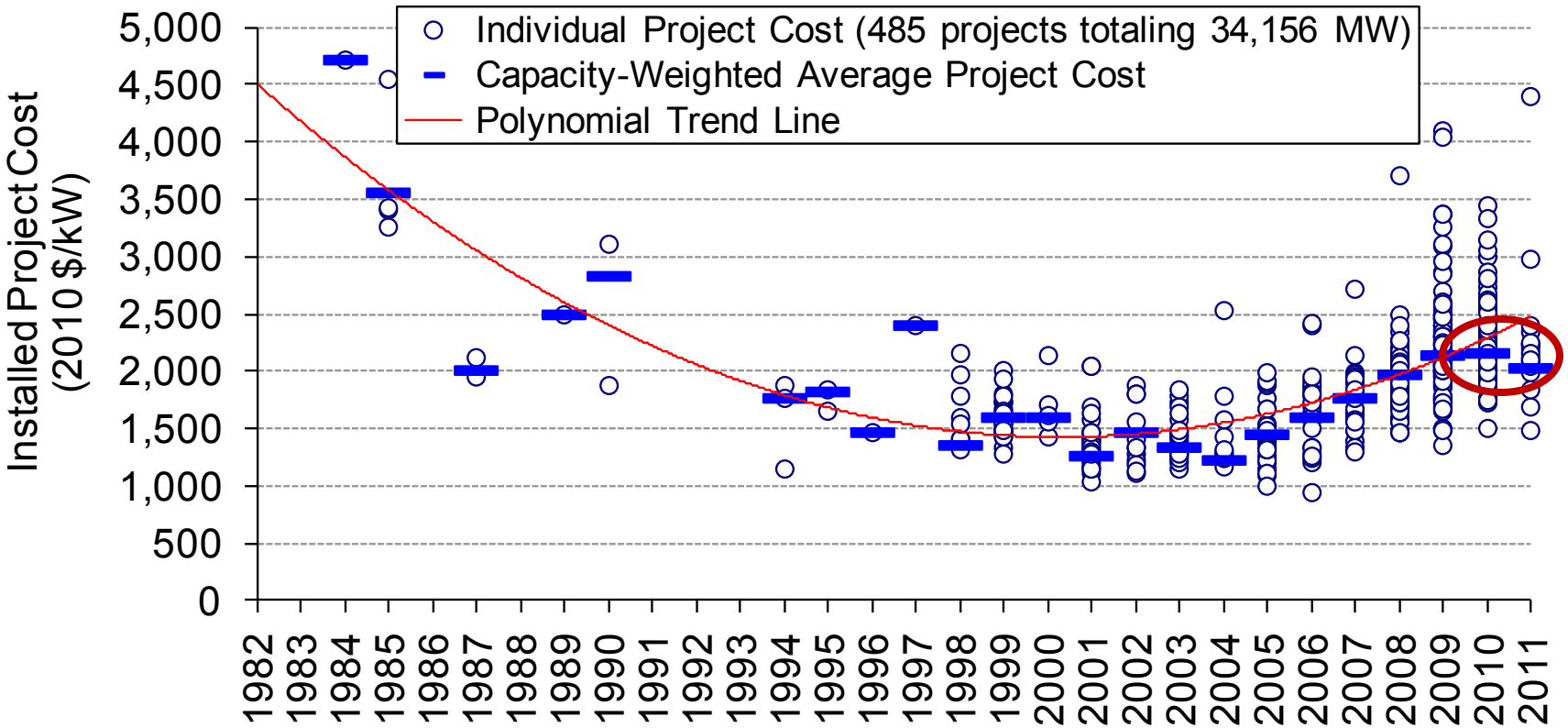
Wind Turbine Prices Have Softened Since Their Highs in 2008



Turbine prices up ~$800/kW ($700→$1,500/kW) from 2002 to 2009, but have recently been in the $1,000-1,400/kW range

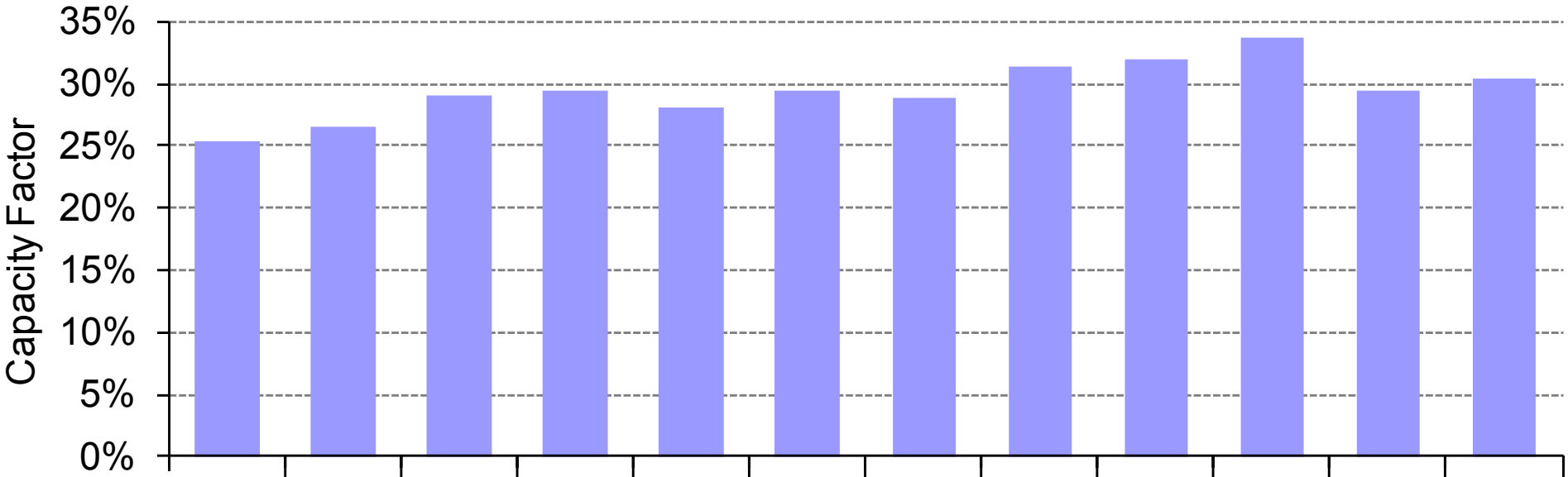
(combined with more-favorable terms for buyers; improved turbine technology)

Lower Turbine Pricing Working Its Way into Installed Project Costs: 2-year Lag



Project costs bottomed out in 2001-04; rose by $850/kW on average through 2009; held steady in 2010 ($2,160/kW); appear to be dropping in 2011

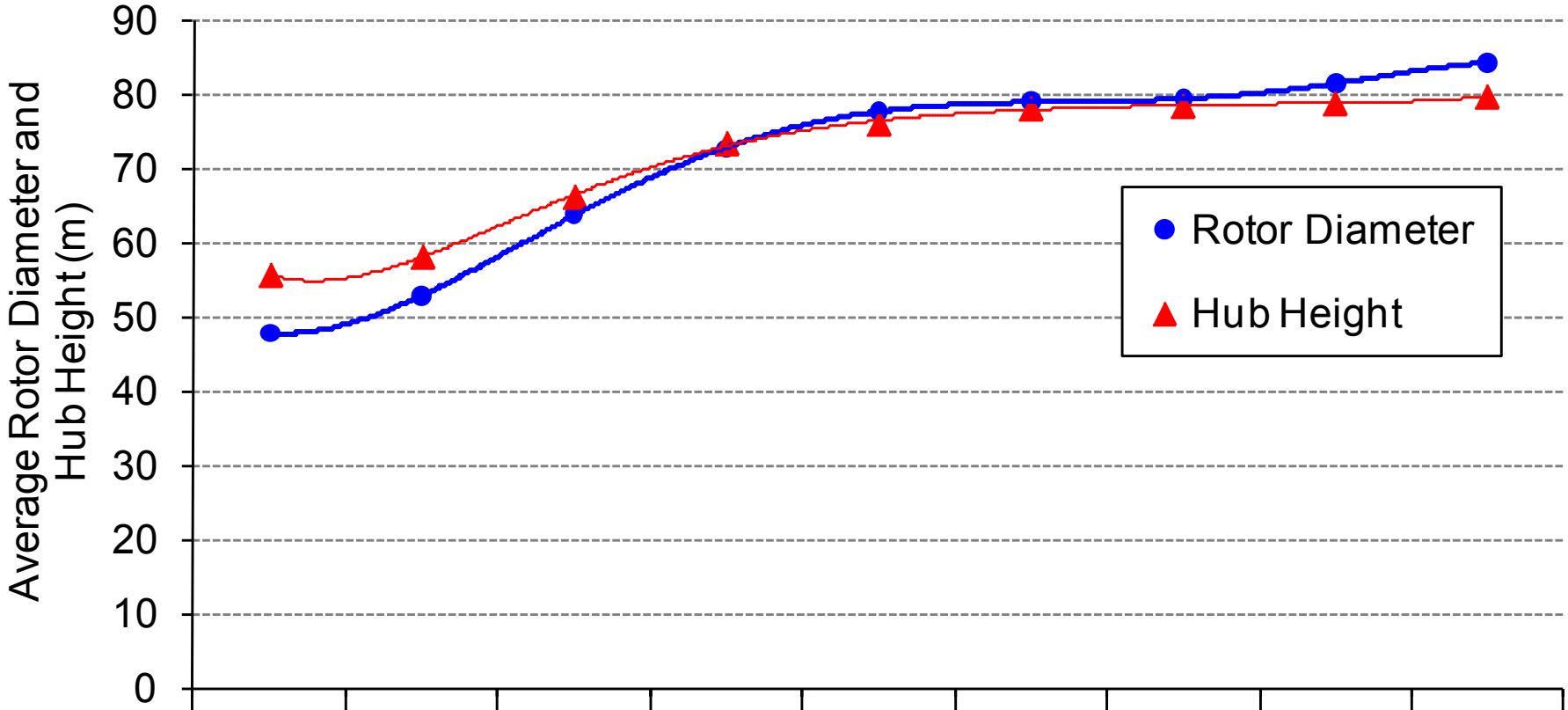
Fleet-Wide Avg. Capacity Factors (CF) Have (Generally) Increased Over Time



Year:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Projects:	6	12	41	85	98	118	144	169	212	256	358	338
MW:	549	1,005	1,545	3,285	3,826	5,182	5,894	8,726	10,712	15,686	24,403	31,986

But… some leveling off in capacity factors in recent years is also apparent

Historical Increase in CF Due In Part to Increased Hub Height & Rotor Diameter



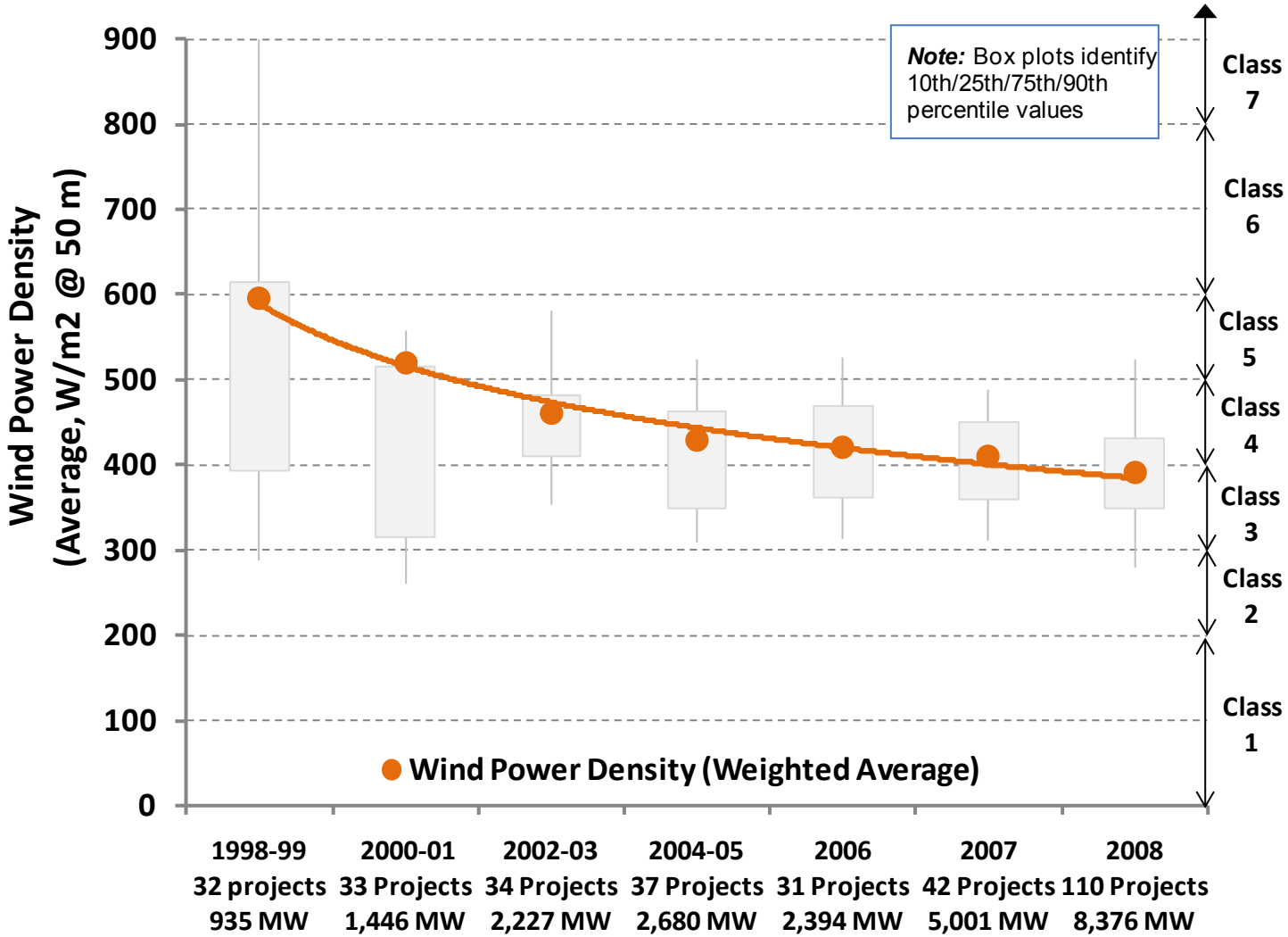
COD:	1998-99	2000-01	2002-03	2004-05	2006	2007	2008	2009	2010
Turbines:	1,418	1,982	1,686	1,942	1,515	3,190	5,004	5,733	2,855
Capacity:	1,014 MW	1,756 MW	2,080 MW	2,779 MW	2,440 MW	5,249 MW	8,348 MW	9,993 MW	5,113 MW

Recent Moderation of CF Increase Driven In Part By Lower Wind Speed Sites…

Projects increasingly sited in poorer wind regimes at 50m:

High Class 5 in 98-99

High Class 3 in 2008

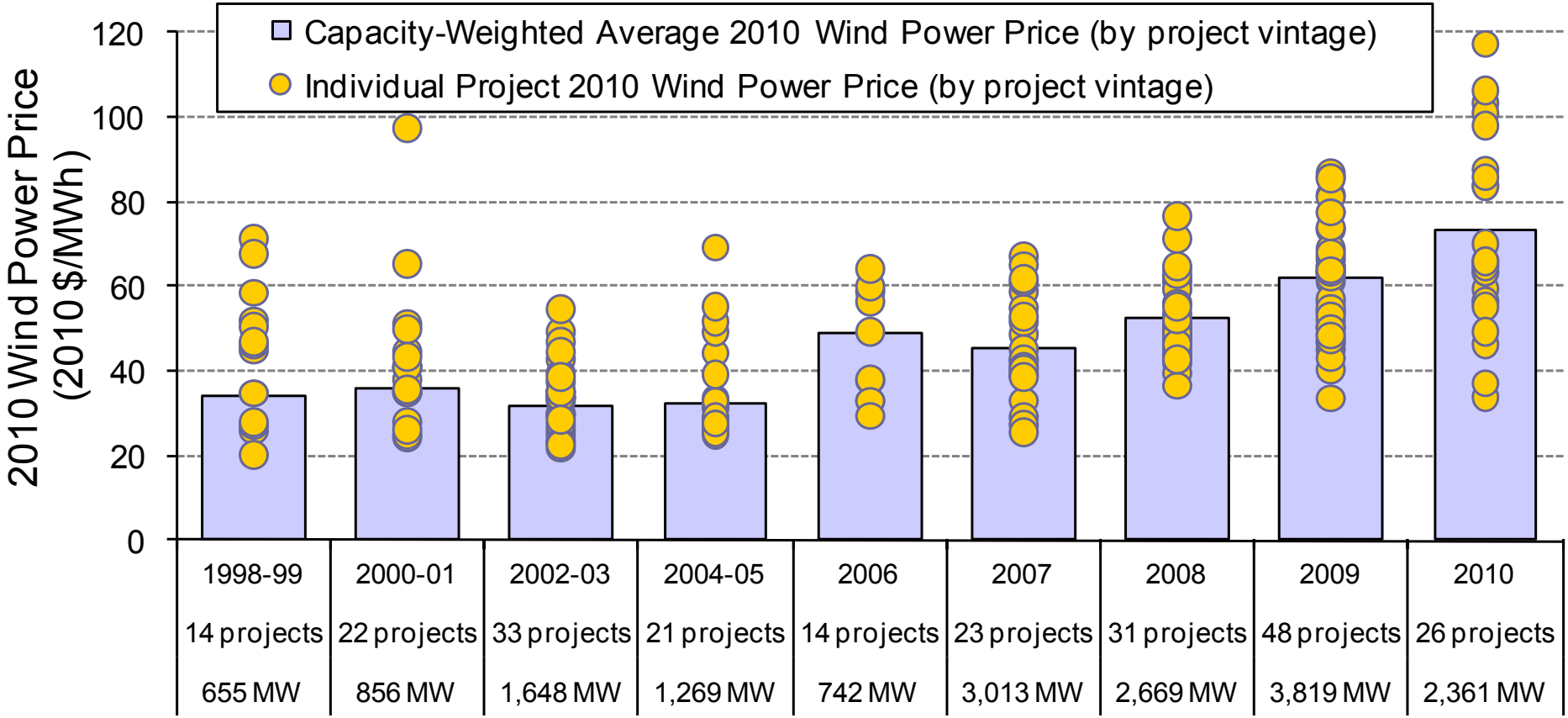


…and Growing Amounts of Wind Energy Curtailment in Some Regions

Wind Curtailment, GWh (percent potential generation)	2007	2008	2009	2010
Electricity Reliability Council of Texas	109 (1.2%)	1,417 (8.4%)	3,872 (17.1%)	2,067 (7.7%)
Southwestern Public Service Co.	N/A	0 (0.0%)	0 (0.0%)	0.9 (0.0%)
Public Service Company of Colorado	N/A	2.5 (0.1%)	19.0 (0.6%)	81.5 (2.2%)
Northern States Power Co.	N/A	25.4 (0.8%)	42.4 (1.2%)	42.6 (1.2%)
Midwest ISO, less NSP	N/A	N/A	250 (2.2%)	781 (4.4%)
Bonneville Power Administration	N/A	N/A	N/A	4.6* (0.1%)
Total Across These 6 Areas:	**109 (1.2%)**	**1,445 (6.4%)**	**4,183 (10.4%)**	**2,978 (5.1%)**

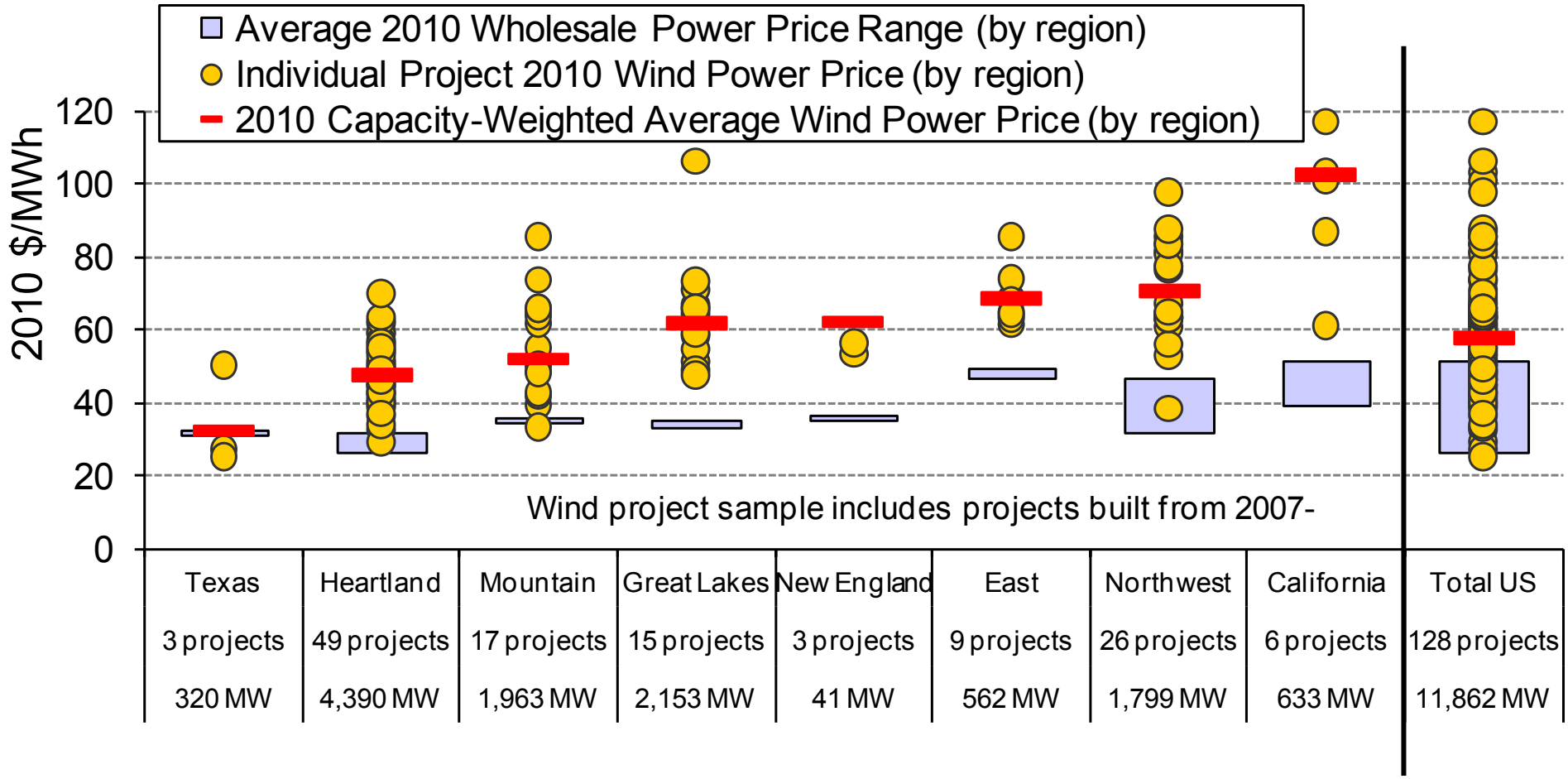
U.S. fleet-wide capacity factors from 2008-10 would have been 1-2 percentage points higher absent curtailment

As a Result of these Trends, Wind Power Sales Prices Increased, through 2010

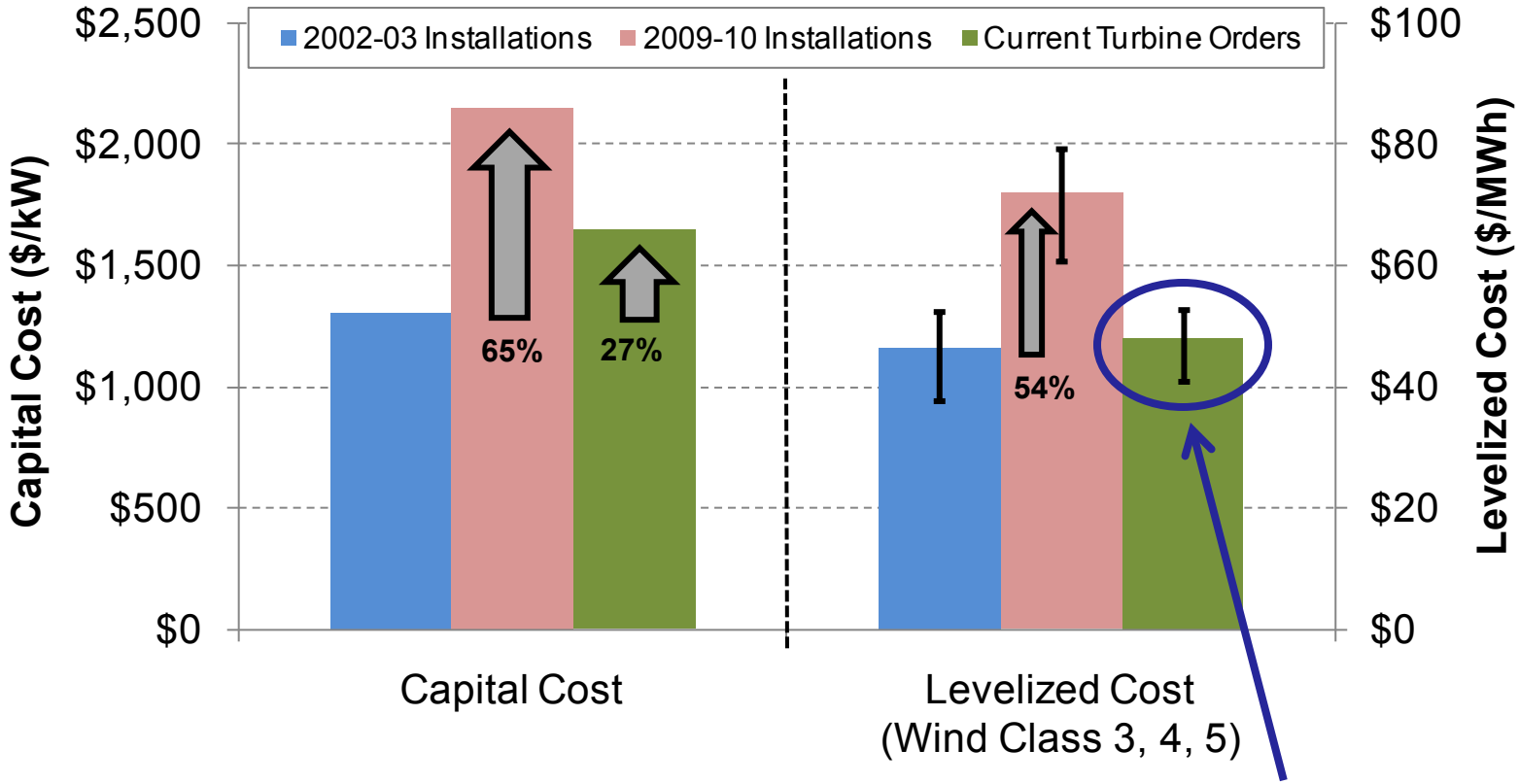


- Wind power prices bottomed out with projects built in 2002-05
- Projects built in 2010 had an average price of >$70/MWh

Combined with Low Wholesale Prices, Economics Became More Challenging



But… Relief Is On The Way: Declining Capital Costs, Improved Technology



Expected levelized cost of new builds in attractive sites, with $500/kW drop in turbine/capital cost and improved turbine performance (higher CF), approaching earlier lows

Conclusions

- Wind industry has matured, giving it the standing to be a major contributor to the U.S. supply mix
- Along with policy, much of the growth this decade has been driven by the relative economic attractiveness of wind
- Economic attractiveness of projects installed in recent years declined as a result of increased capital cost, plateau in capacity factors, and lower wholesale electricity prices
- Existing state RPS' may support 4-6 GW/yr of RE additions: absent new policy, achieving 2009 levels of capacity additions will require a return to greater economic competitiveness
- Recent declines in turbine prices and improved technology makes wind more competitive, but new transmission and additional policies may be needed to underpin greater growth

For More Information...

See upcoming full report for additional findings, discussion of data sources, etc.

- http://eetd.lbl.gov/ea/ems/re-pubs.html
- http://www1.eere.energy.gov/windandhydro
- Expected to be available by late June 2011

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