2011 Wind Technologies Market Report

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Report Summary

August 2012

Presentation Overview

- Introduction to current edition of U.S. wind energy market report
- Wind Energy Market Trends
  - Installation trends
  - Industry trends
  - Cost trends
  - Performance trends
  - Wind power price trends
  - Policy and market drivers
  - Future outlook

2011 Wind Technologies Market Report

Purpose, Scope, and Data:

- With a focus on 2011, summarize trends in the U.S. wind power market, including information on wind installations, industry developments, project costs, O&M costs, performance, power sales prices, policy/market trends
- Scope primarily includes wind turbines over 100 kW in size
- Data sources include AWEA, EIA, FERC, SEC, etc. *(see full report)*

Report Authors:

- Primary authors: Ryan Wiser and Mark Bolinger, Berkeley Lab
- Contributions from others at Berkeley Lab, Exeter Assoc., NREL

Available at: http://www1.eere.energy.gov/wind/

New to the Current Edition of the Report

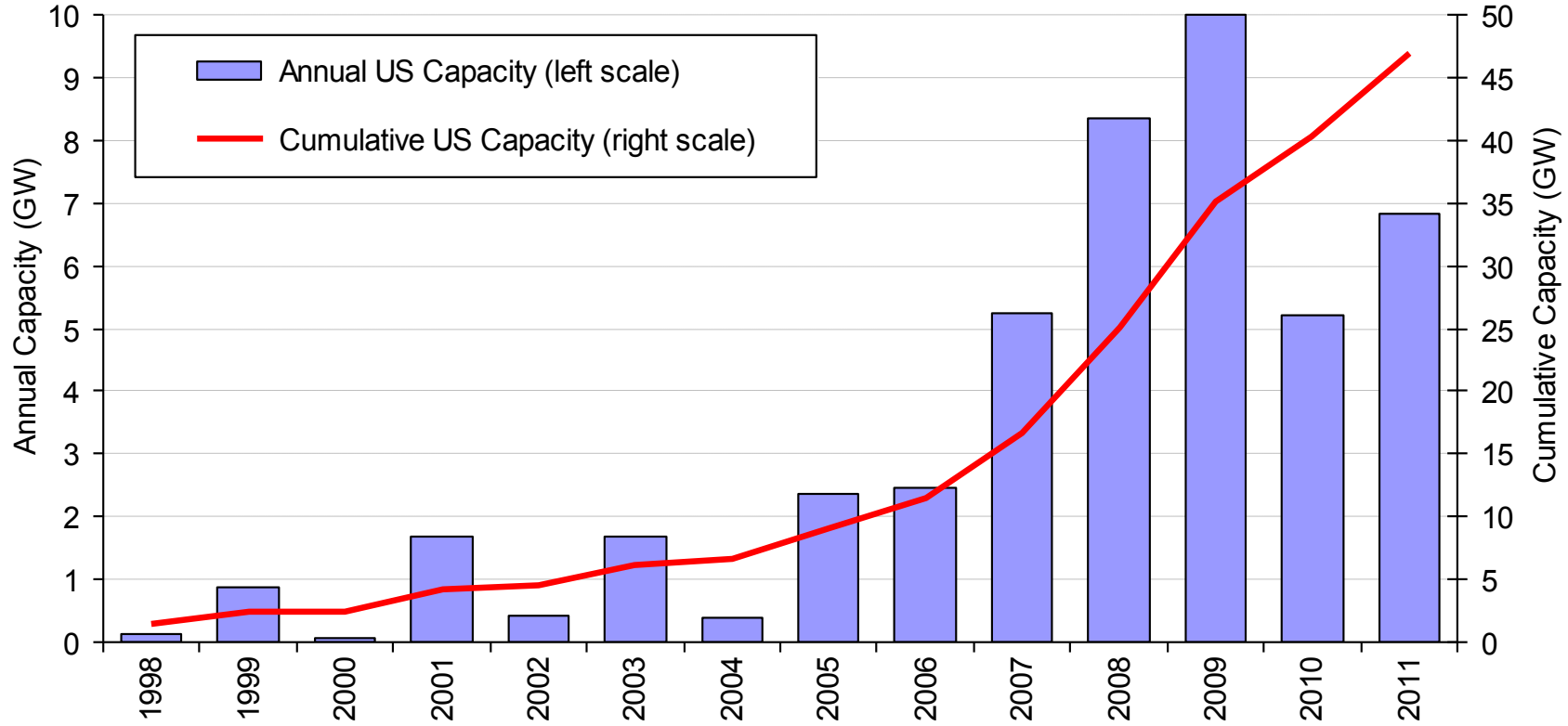
- Summary of trends in the wind resource conditions in which wind power projects have been sited
- Expanded discussion of how the reporting of power sales prices impacts the apparent pricing of wind, including new data on full-term power purchase agreement pricing
- Shortened discussion of offshore wind energy → companion report funded by the U.S. Department of Energy focused exclusively on offshore wind will be published later this year

Key Findings

- Wind is a credible source of new generation in the U.S.
- Despite the lack of policy clarity, turbine manufacturers and their suppliers continued to localize production in 2011
- Turbine scaling has boosted wind project capacity factors
- Falling wind turbine prices have begun to push installed project costs lower
- Lower wind turbine prices and installed project costs, along with improved capacity factors, are enabling aggressive wind power pricing
- Looking ahead, projections are for continued strong growth in 2012, followed by a dramatically lower but uncertain 2013

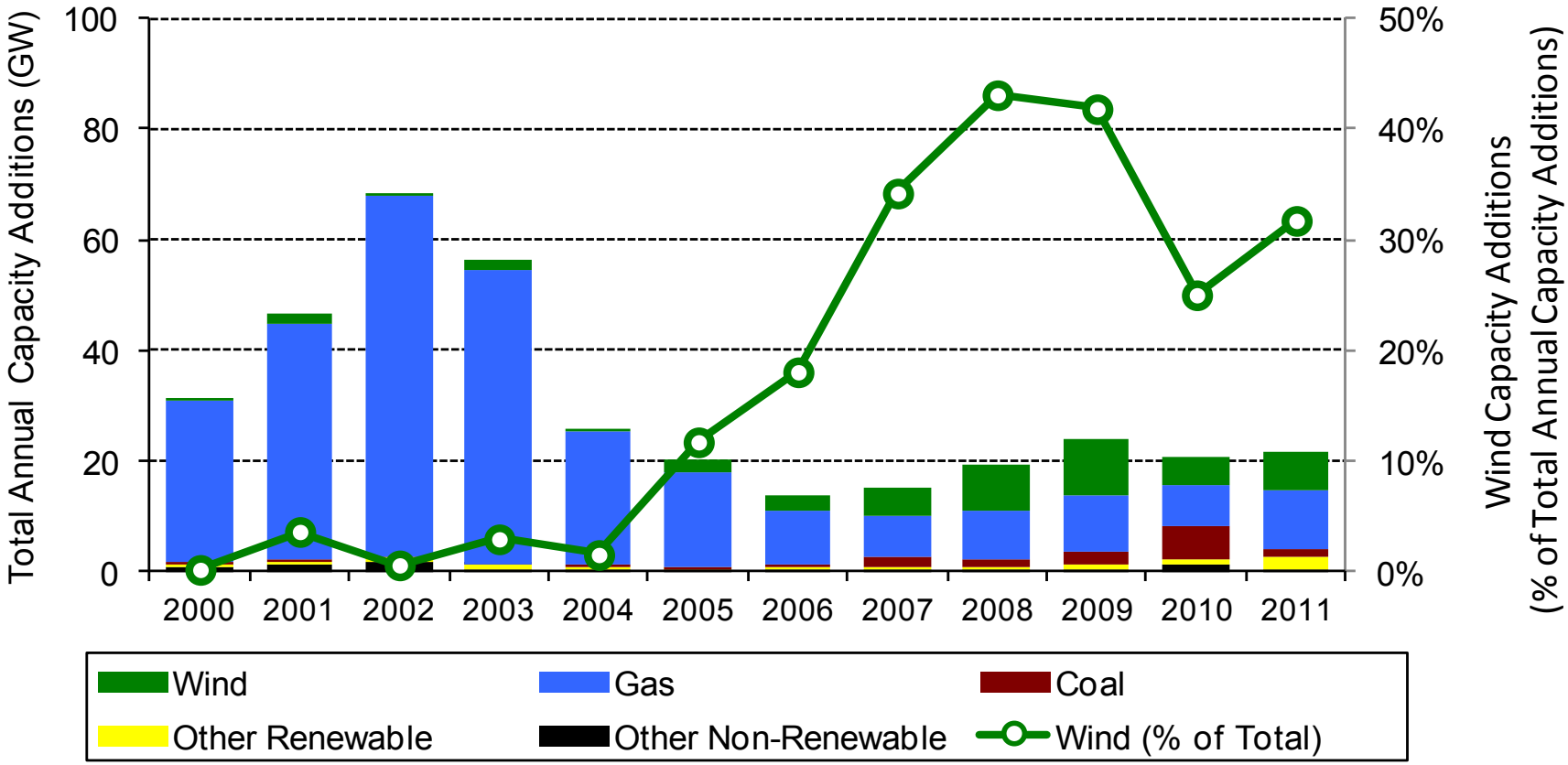
Installation Trends

Wind Power Additions Increased in 2011, but Remained Below 2008 and 2009 Levels



- 6.8 GW of wind power added in 2011 in U.S., 31% higher than in 2010
- $14 billion invested in wind power project additions
- Cumulative wind power capacity up by 16%, bringing total to 47 GW

Wind Power Comprised 32% of Electric Generating Capacity Additions in 2011



- Wind power in 2011 was again the 2nd-largest resource added (after gas, and for the 6th time in the past seven years)

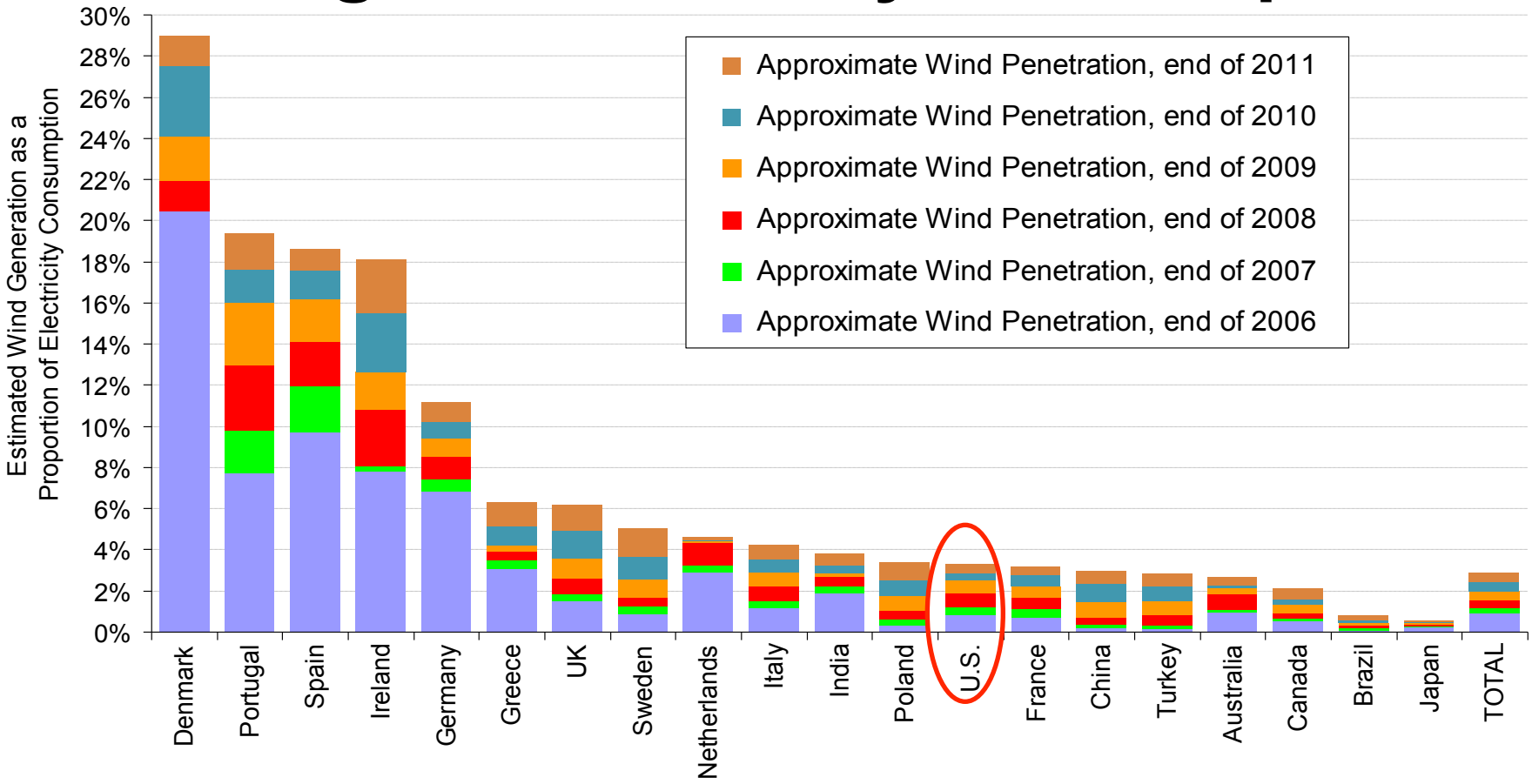
China Was 1st and the U.S. Was 2nd in Both New and Cumulative Wind Power Capacity

Annual Capacity (2011, MW)		Cumulative Capacity (end of 2011, MW)	
China	17,631	China	62,412
U.S.	**6,816**	**U.S.**	**46,916**
India	3,300	Germany	29,248
Germany	2,007	Spain	21,350
U.K.	1,293	India	16,266
Canada	1,267	U.K.	7,155
Spain	1,050	France	6,836
Italy	950	Italy	6,733
France	875	Canada	5,278
Sweden	763	Portugal	4,214
Rest of World	5,766	*Rest of World*	34,453
TOTAL	**41,718**	**TOTAL**	**240,861**

Source: BTM Consult; AWEA project database for U.S. capacity

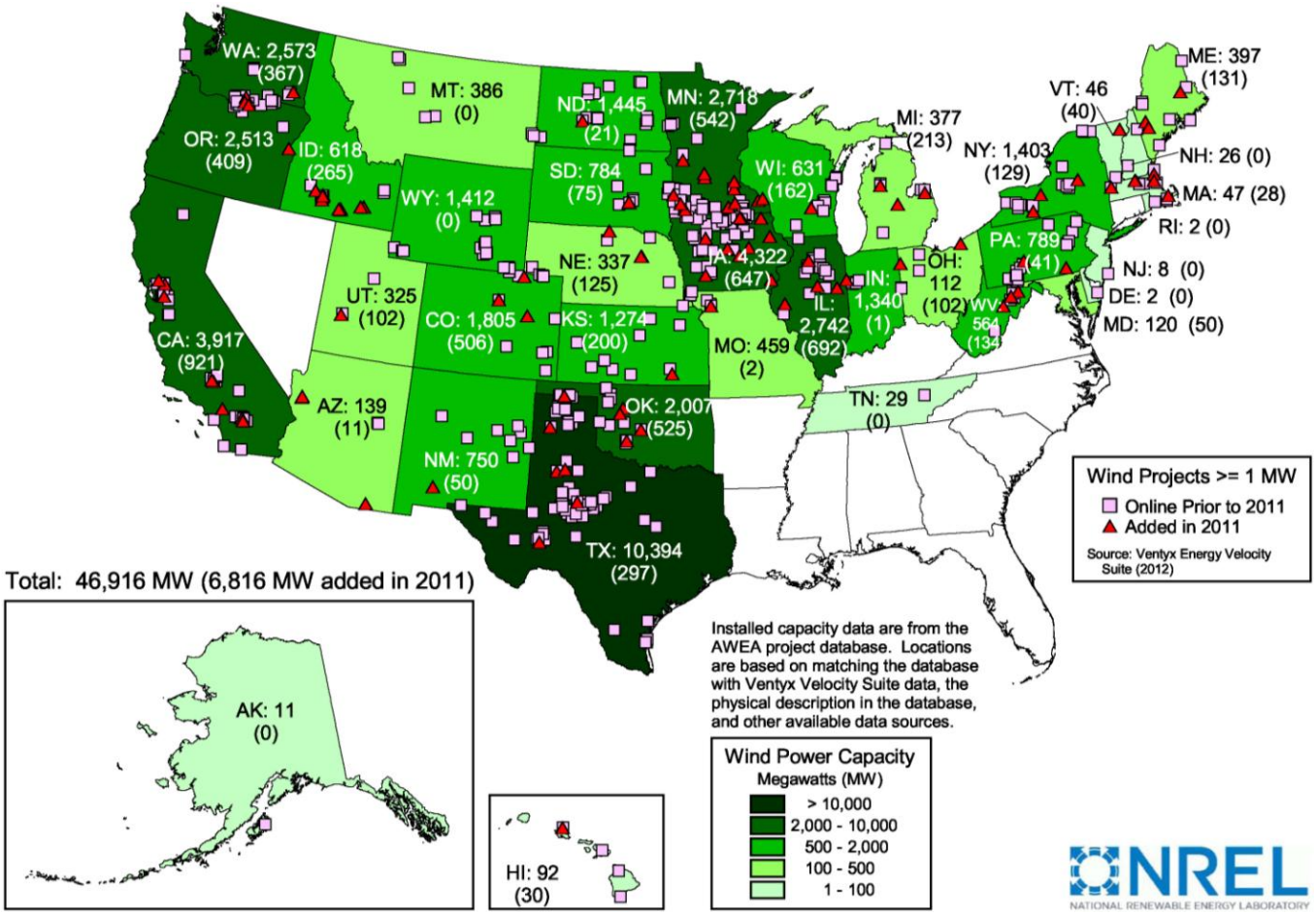
- Global wind power capacity additions in 2011 up 6% from 2010 level
- U.S. additions = 16% of global additions in 2011, up from 13% in 2010 but down from 26-30% from 2007 through 2009

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 power capacity at the end of 2011

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



Note: Numbers within states represent cumulative installed wind capacity and, in parentheses, annual additions in 2011.

California Added the Most Wind Capacity in 2011; Six States Exceed 10% Wind Energy

Capacity (MW)				Percentage of In-State Generation			
Annual (2011)		Cumulative (end of 2011)		Actual (2011)*		Estimated (end of 2011)**	
California	921	Texas	10,394	South Dakota	22.3%	South Dakota	22.1%
Illinois	692	Iowa	4,322	Iowa	18.8%	Iowa	20.0%
Iowa	647	California	3,917	North Dakota	14.7%	Minnesota	14.9%
Minnesota	542	Illinois	2,742	Minnesota	12.7%	North Dakota	14.1%
Oklahoma	525	Minnesota	2,718	Wyoming	10.1%	Colorado	10.7%
Colorado	506	Washington	2,573	Colorado	9.2%	Oregon	10.5%
Oregon	409	Oregon	2,513	Kansas	8.2%	Idaho	9.7%
Washington	367	Oklahoma	2,007	Idaho	8.2%	Kansas	9.2%
Texas	297	Colorado	1,805	Oregon	8.2%	Oklahoma	9.1%
Idaho	265	North Dakota	1,445	Oklahoma	7.1%	Wyoming	8.8%
Michigan	213	Wyoming	1,412	Texas	6.9%	Texas	7.3%
Kansas	200	New York	1,403	New Mexico	5.4%	Maine	6.5%
Wisconsin	162	Indiana	1,340	Washington	5.3%	New Mexico	5.8%
West Virginia	134	Kansas	1,274	Maine	4.5%	Washington	5.5%
Maine	131	Pennsylvania	789	Montana	4.2%	California	4.7%
New York	129	South Dakota	784	California	4.0%	Montana	3.8%
Nebraska	125	New Mexico	750	Illinois	3.1%	Illinois	3.7%
Utah	102	Wisconsin	631	Hawaii	3.1%	Hawaii	3.7%
Ohio	102	Idaho	618	Nebraska	2.9%	Indiana	3.0%
South Dakota	75	West Virginia	564	Indiana	2.7%	Nebraska	2.9%
Rest of U.S.	274	*Rest of U.S.*	2,915	*Rest of U.S.*	0.4%	*Rest of U.S.*	0.5%
TOTAL	**6,816**	**TOTAL**	**46,916**	**TOTAL**	**2.9%**	**TOTAL**	**3.2%**

* Based on 2011 wind and total generation by state from EIA's *Electric Power Monthly*.

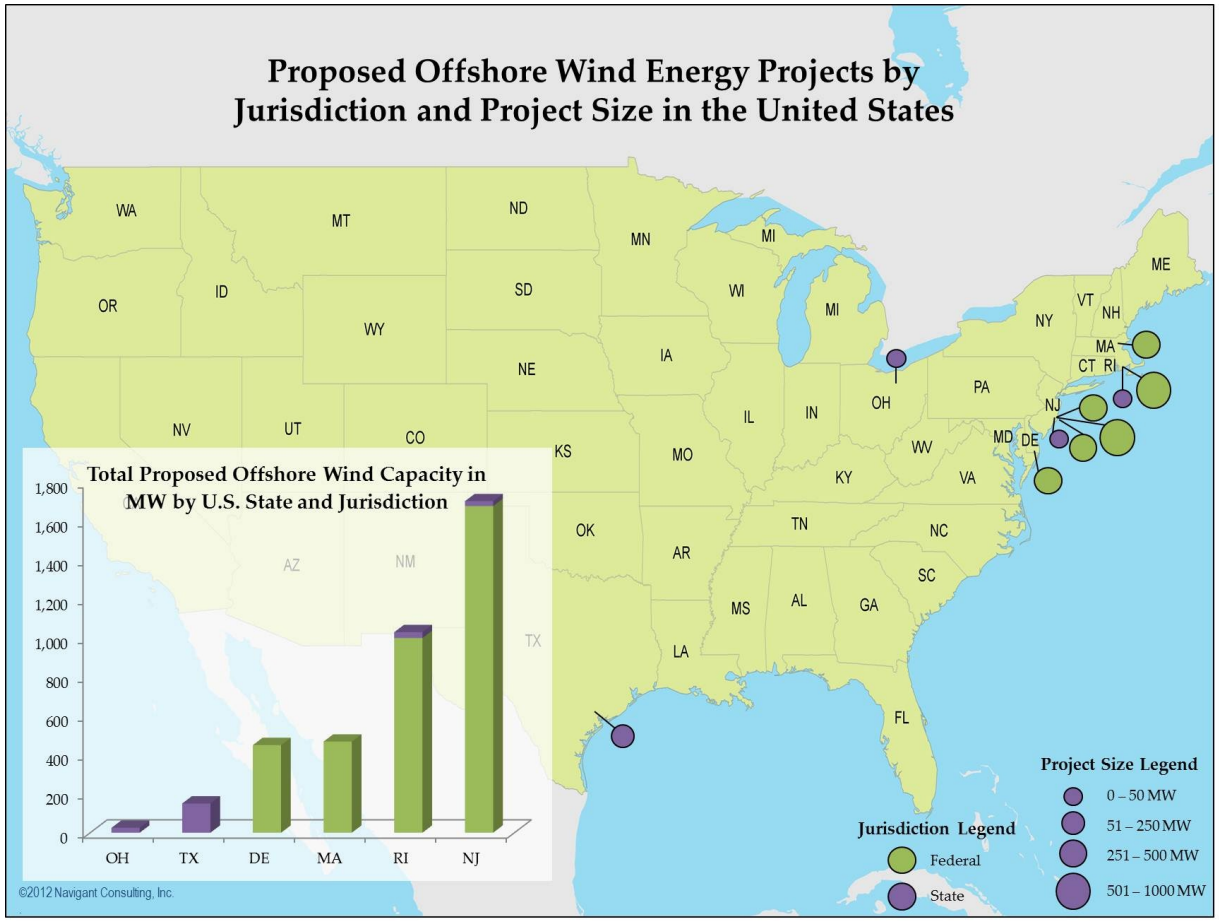
** Based on a projection of wind electricity generation from end-of-2011 wind power capacity, divided by total in-state electricity generation in 2011.

Source: AWEA project database, EIA, Berkeley Lab estimates

At end of 2011:

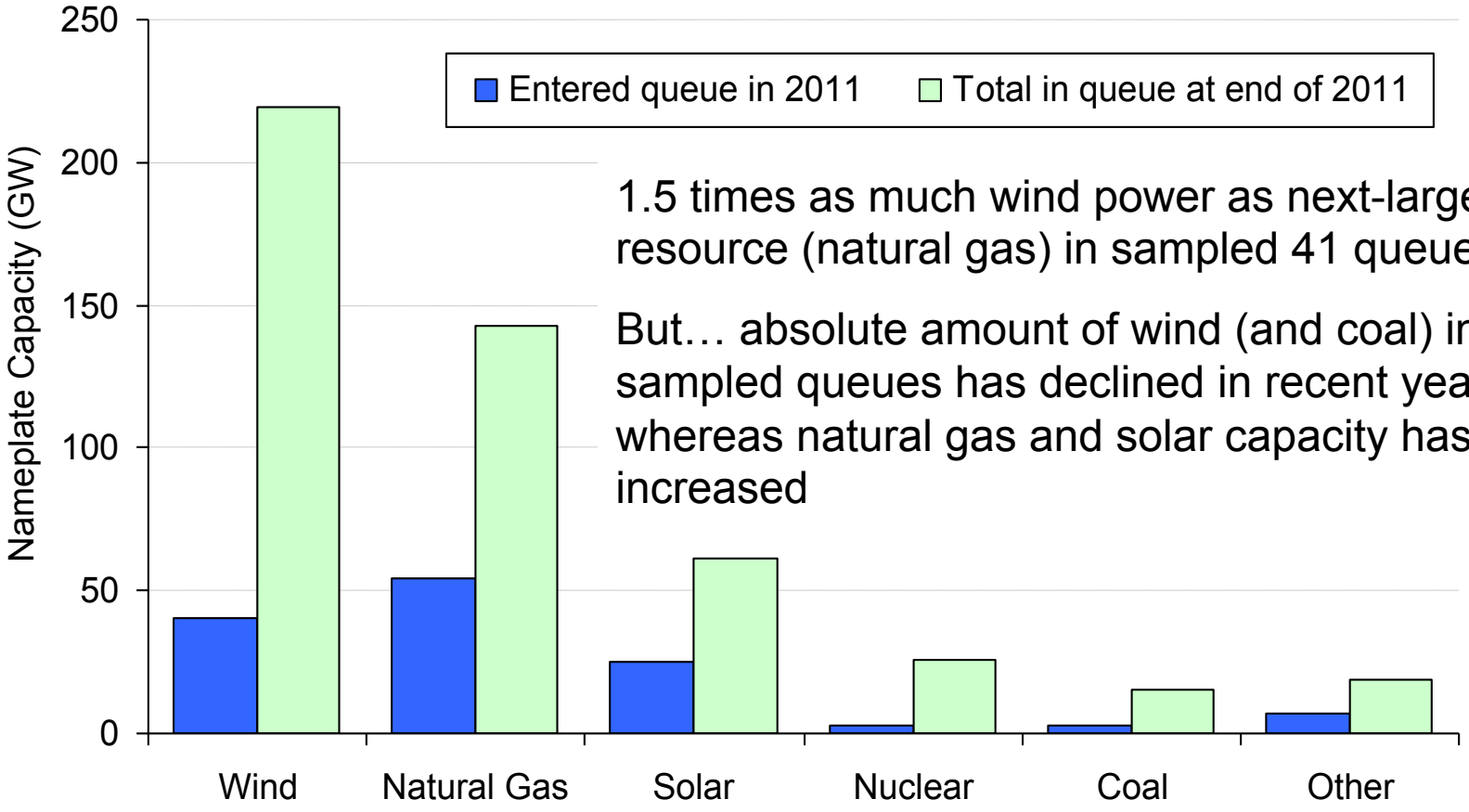
- Texas continued to lead in cumulative capacity, by a large margin
- 20 states had >500 MW of capacity (8 had >2000 MW)
- 2 states had the ability to provide >20% of total in-state generation from wind (6 states >10%, 14 states >5%)

No Offshore Turbines Commissioned in the U.S., But 10 Projects Totaling 3.8 GW Are Somewhat More Advanced in Development



- Two projects have power purchase agreements (PPAs):
  - Cape Wind (MA)
  - Deepwater (RI)
- Nation's first offshore wind power PPA cancelled in 2011: NRG Bluewater (DE)

Roughly 220 GW of Wind Power Capacity in Transmission Interconnection Queues

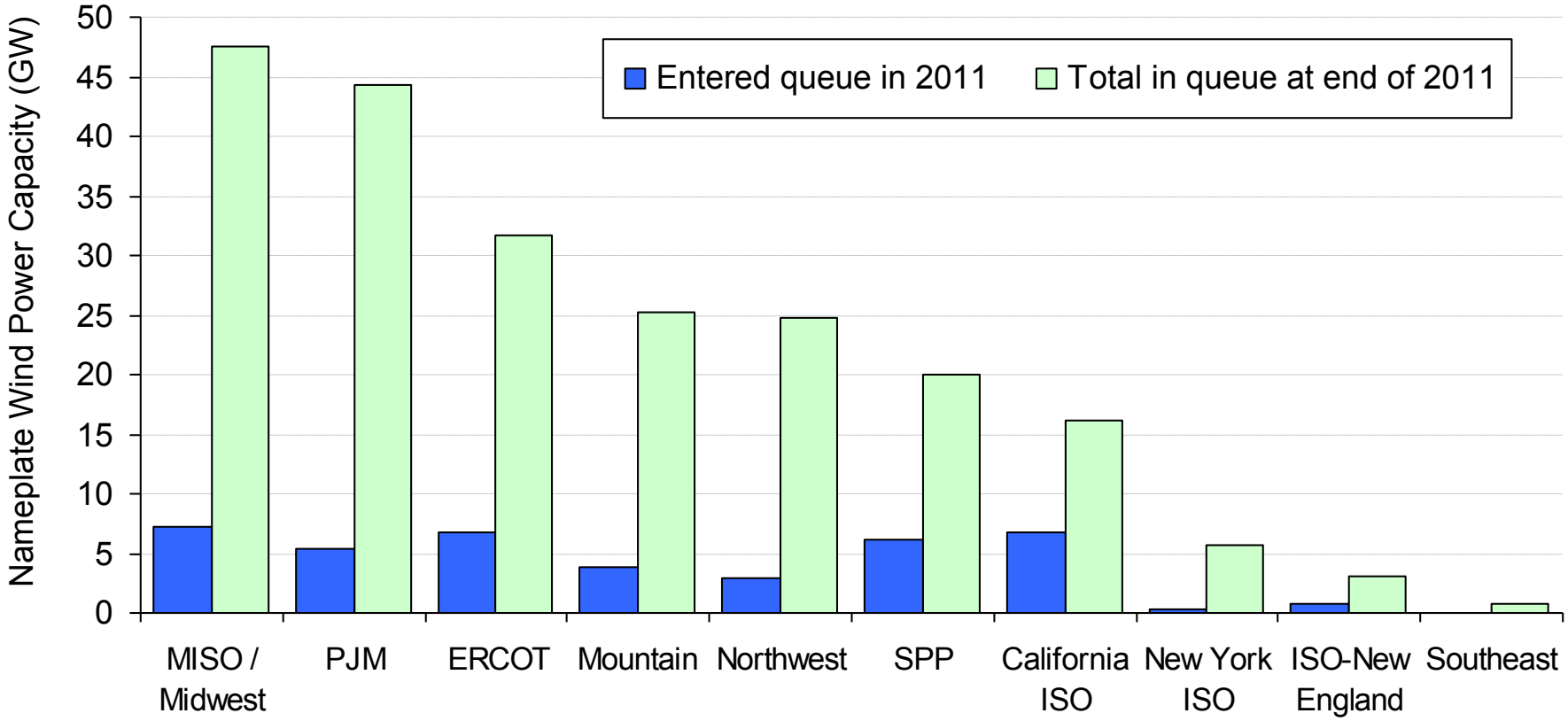


1.5 times as much wind power as next-largest resource (natural gas) in sampled 41 queues

But… absolute amount of wind (and coal) in sampled queues has declined in recent years whereas natural gas and solar capacity has increased

Not all of this capacity will be built….

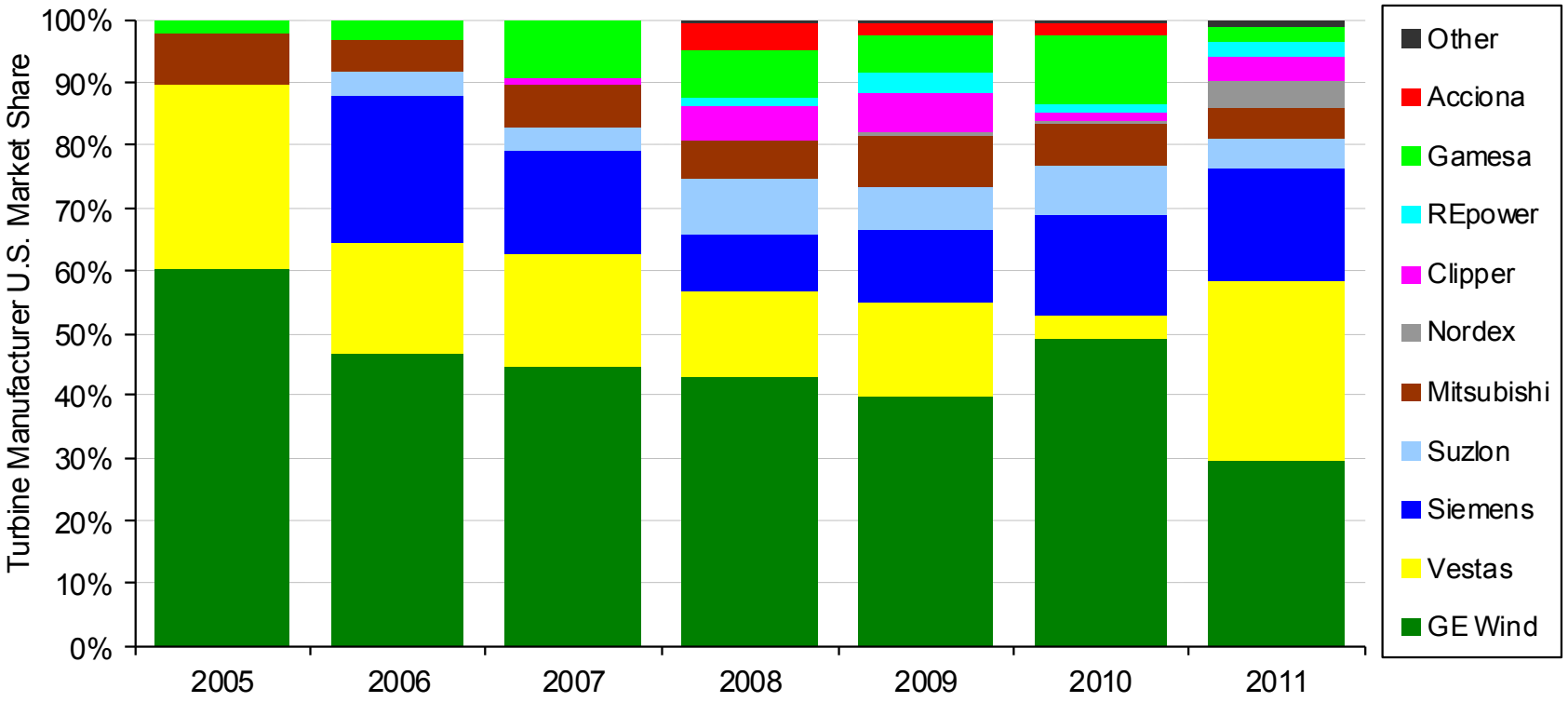
96% Planned for Midwest, PJM, Texas, Mountain, Northwest, Southwest Power Pool, and California



Not all of this capacity will be built….

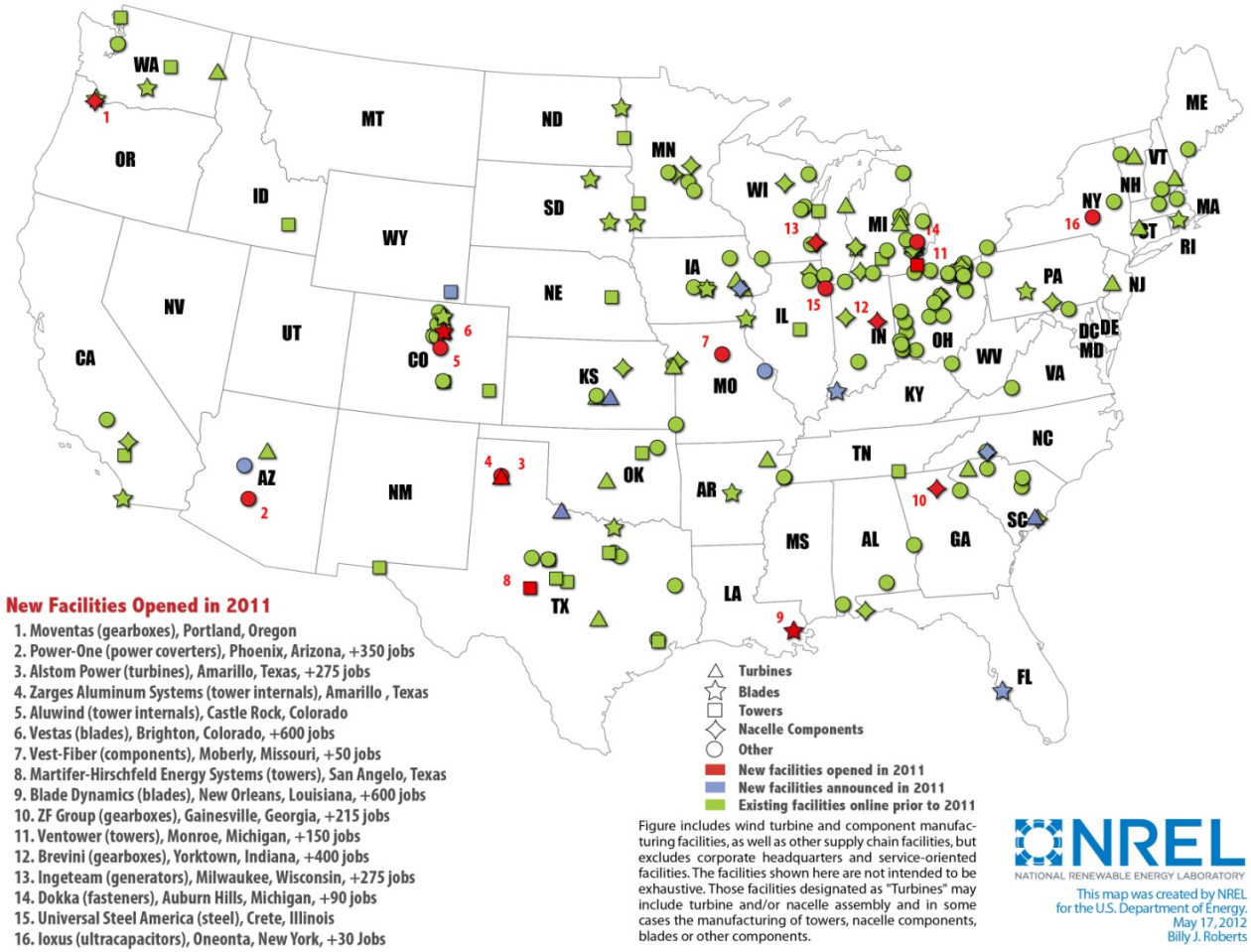
Industry Trends

Despite Ongoing Proliferation of New Entrants, "Big 3" Turbine Suppliers Gained Market Share



- Increase in number of turbine vendors serving market since 2005, but top three (in aggregate) have gained market share since 2008-09
- 2011 installations by Chinese and South Korean manufacturers included: Sany Electric, Samsung, Goldwind, Hyundai, Sinovel, and Unison

U.S. Wind Manufacturing Has Increased, but Supply Chain Is Under Severe Pressure



New Facilities Opened in 2011

1. Moventas (gearboxes), Portland, Oregon
2. Power-One (power coverters), Phoenix, Arizona, +350 jobs
3. Alstom Power (turbines), Amarillo, Texas, +275 jobs
4. Zarges Aluminum Systems (tower internals), Amarillo , Texas
5. Aluwind (tower internals), Castle Rock, Colorado
6. Vestas (blades), Brighton, Colorado, +600 jobs
7. Vest-Fiber (components), Moberly, Missouri, +50 jobs
8. Martifer-Hirschfeld Energy Systems (towers), San Angelo, Texas
9. Blade Dynamics (blades), New Orleans, Louisiana, +600 jobs
10. ZF Group (gearboxes), Gainesville, Georgia, +215 jobs
11. Ventower (towers), Monroe, Michigan, +150 jobs
12. Brevini (gearboxes), Yorktown, Indiana, +400 jobs
13. Ingeteam (generators), Milwaukee, Wisconsin, +275 jobs
14. Dokka (fasteners), Auburn Hills, Michigan, +90 jobs
15. Universal Steel America (steel), Crete, Illinois
16. Ioxus (ultracapacitors), Oneonta, New York, +30 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 and/or nacelle assembly and in some cases the manufacturing of towers, nacelle components, blades or other components.

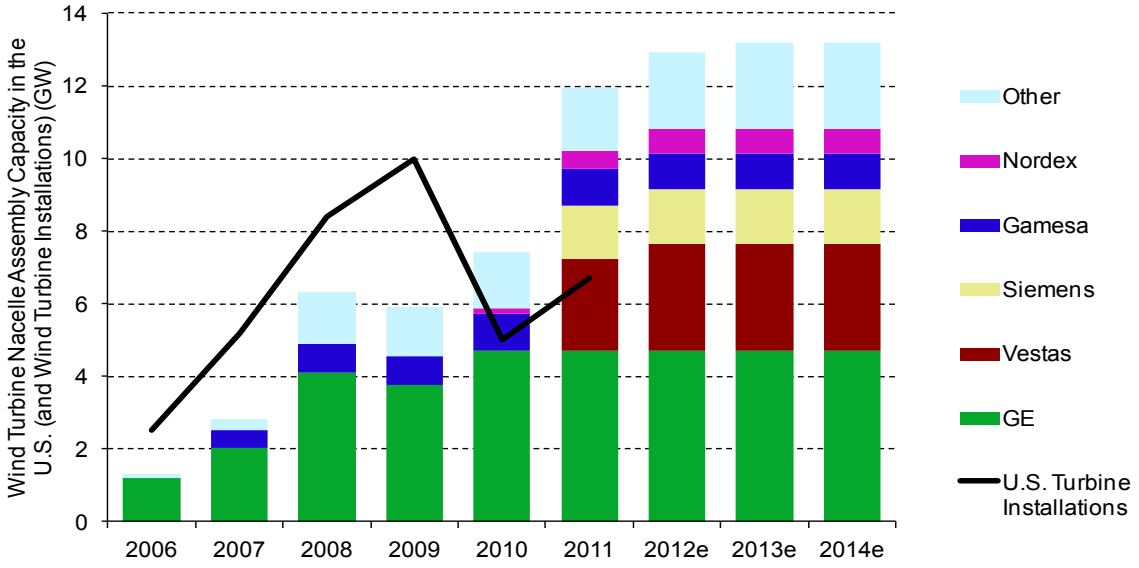
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

This map was created by NREL for the U.S. Department of Energy. May 17, 2012 Billy J. Roberts

- Larger number of new manufacturing facilities opened in 2011 than in 2010
- 8 of 10 turbine OEMs with largest share of U.S. market in 2011 had one or more manufacturing facilities in the U.S. in 2011; only one major OEM had U.S. manufacturing in 2004

Note: map is not intended to be exhaustive

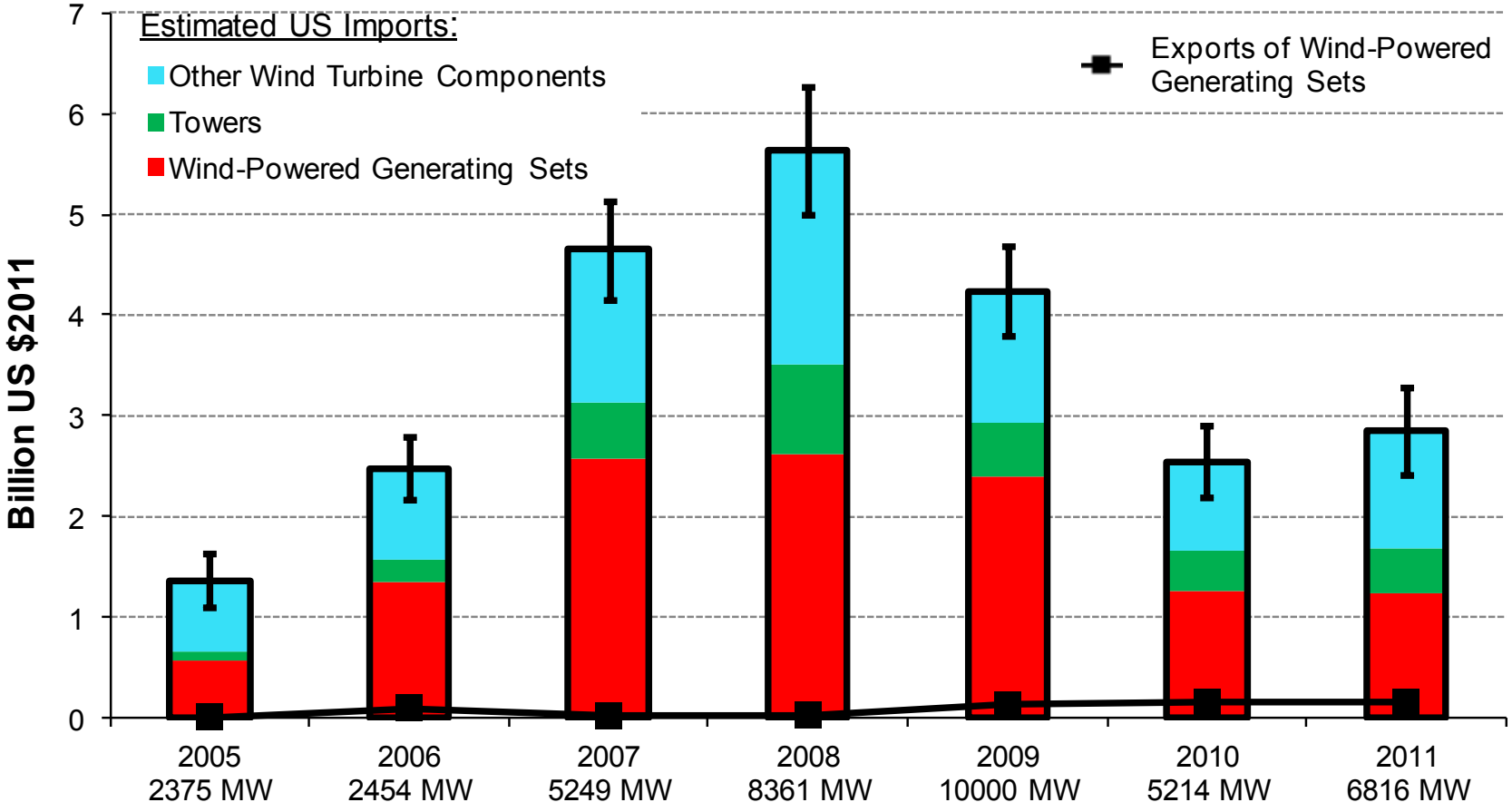
Substantial Over-Capacity of U.S. Nacelle Assembly Capability in 2011, with Even Greater Over-Capacity Possible After 2012



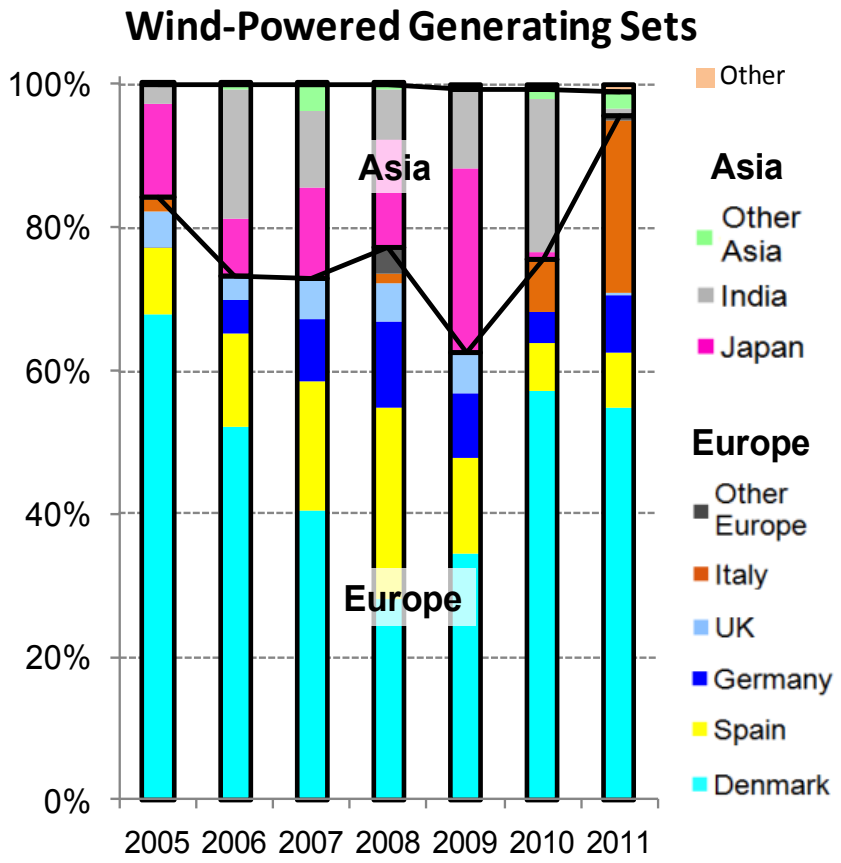
Source: Bloomberg New Energy Finance

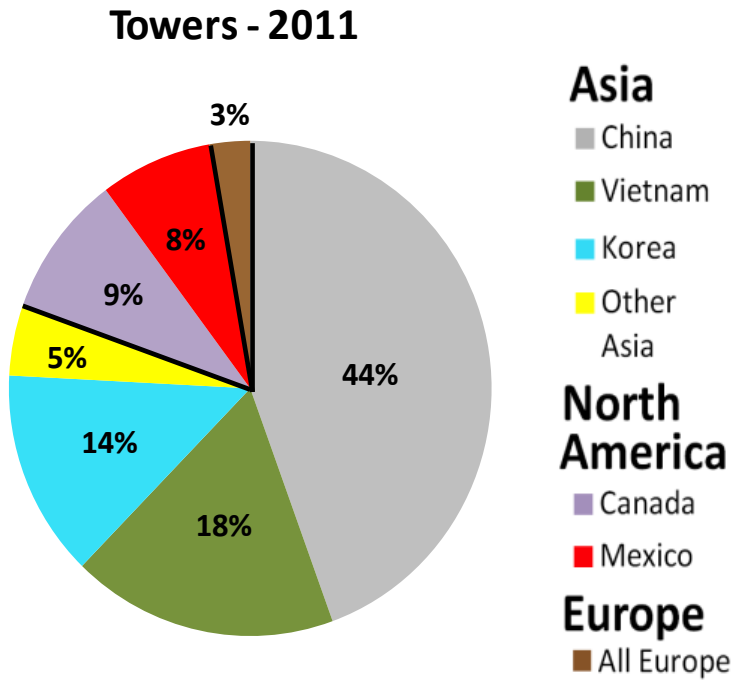
- Substantial growth in wind capacity additions in 2012, but weakened prospects after 2012
- 75,000 full time workers employed directly or indirectly in wind industry…but layoffs have begun, and more are likely
- Downward pressure on turbine and component pricing → lower profit margins & weakened financial results

Estimated U.S. Imports of Wind-Related Equipment Increased Somewhat in 2011 Relative to 2010; Exports Held Steady



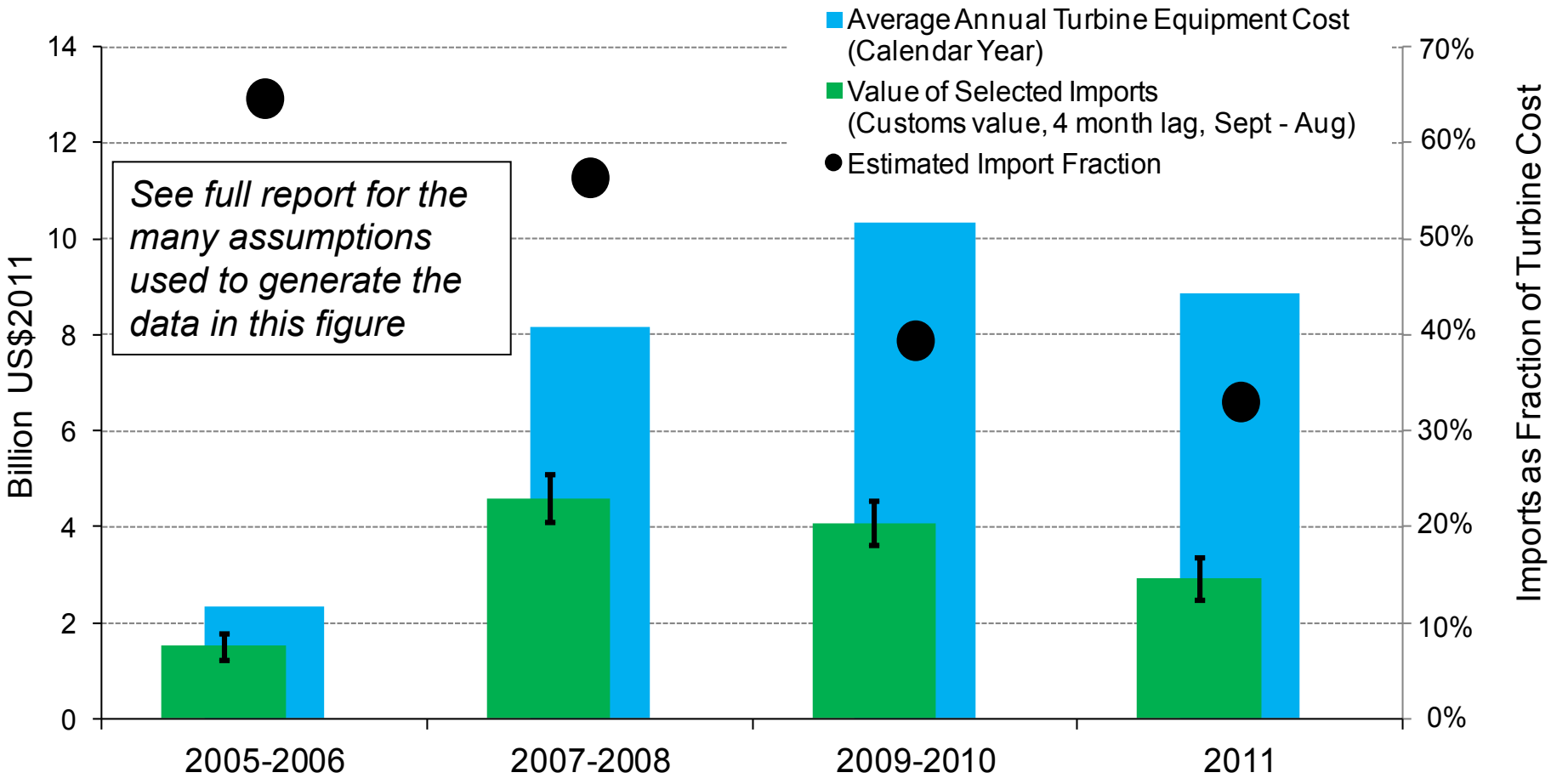
Source Markets for Imports Have Varied Over Time, and By Type of Wind Equipment





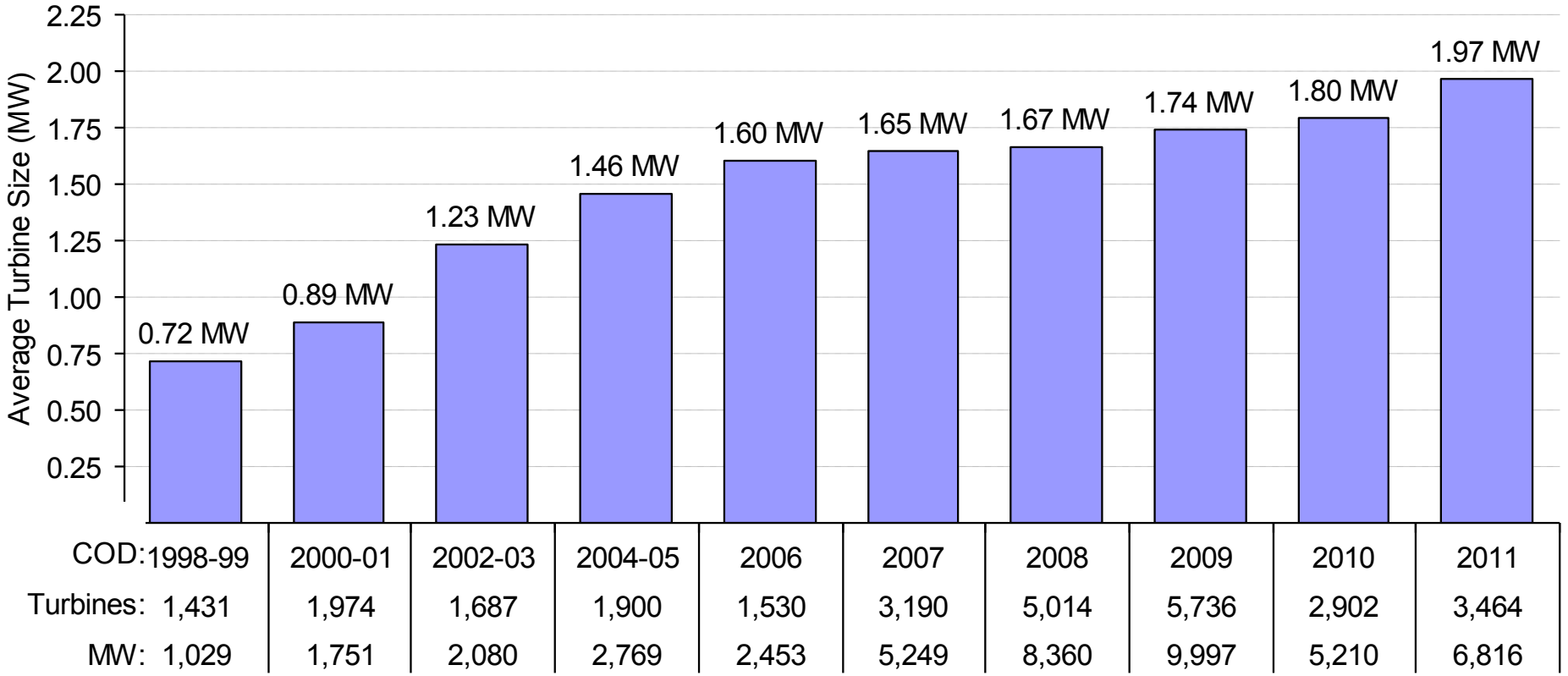
- U.S. imports of wind-powered generating sets largely come from Europe, whereas U.S. imports of towers largely come from Asia

A Growing % of Equipment Used in U.S. Projects Has Been Sourced Domestically



- Domestic content has increased from 35% in 2005-06 to 67% in 2011

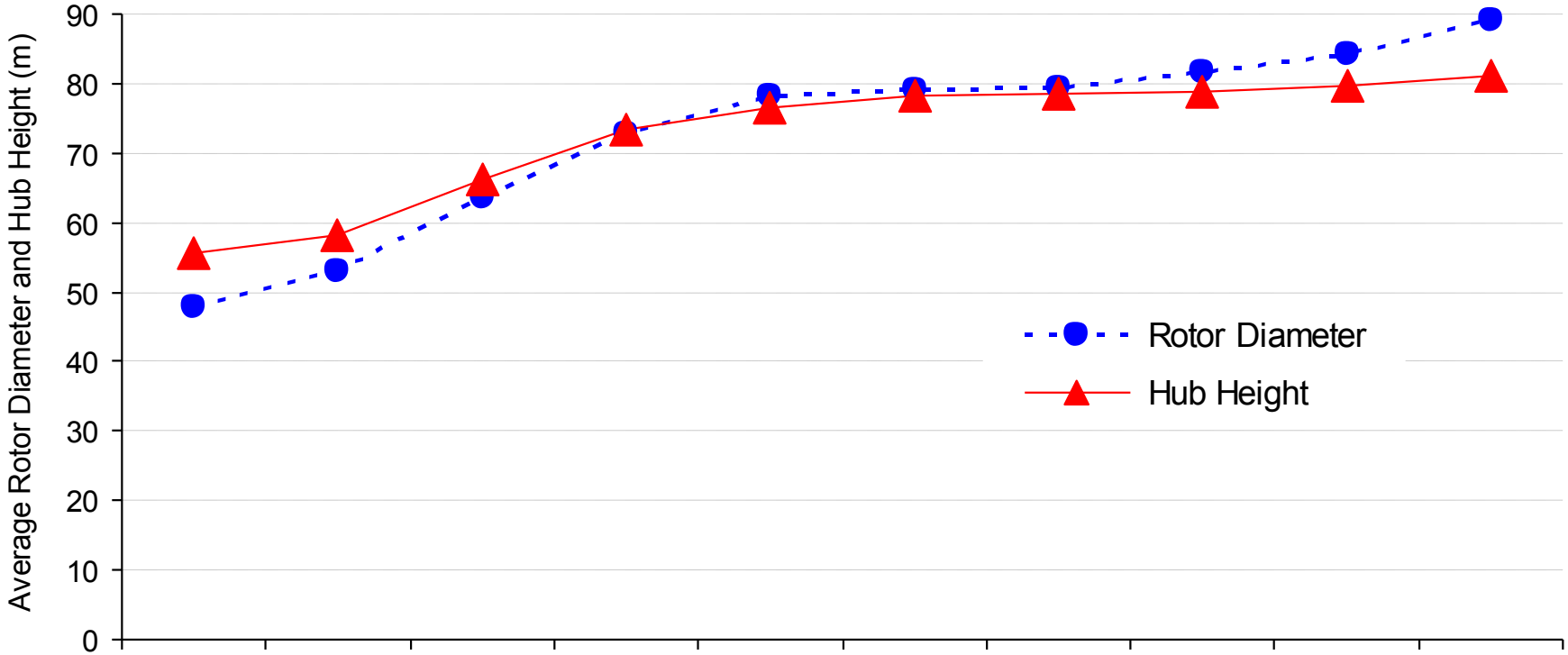
Average Turbine Size Increased in 2011



COD:	1998-99	2000-01	2002-03	2004-05	2006	2007	2008	2009	2010	2011
Turbines:	1,431	1,974	1,687	1,900	1,530	3,190	5,014	5,736	2,902	3,464
MW:	1,029	1,751	2,080	2,769	2,453	5,249	8,360	9,997	5,210	6,816

- 42% of turbines installed in 2011 were > 2.0 MW, up from 28% in 2010, 24% in 2009, 20% in 2008, 16% in 2006 & 2007, and just 0.1% in previous years

Average Hub Heights and Rotor Diameters Have Increased Over Time



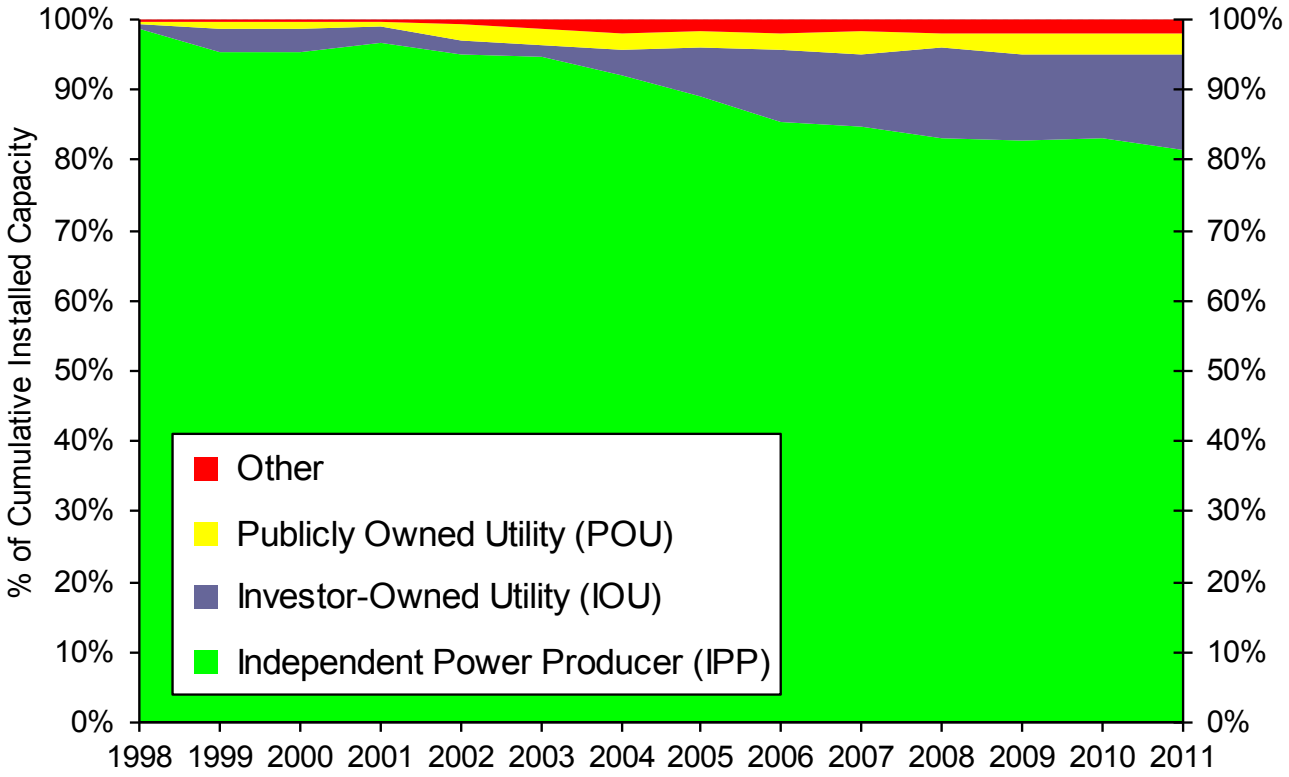
COD:	1998-99	2000-01	2002-03	2004-05	2006	2007	2008	2009	2010	2011
Turbines:	1,403	1,974	1,683	1,918	1,477	3,190	5,004	5,733	2,901	3,464
MW:	1,001	1,751	2,074	2,734	2,402	5,249	8,349	9,993	5,208	6,816

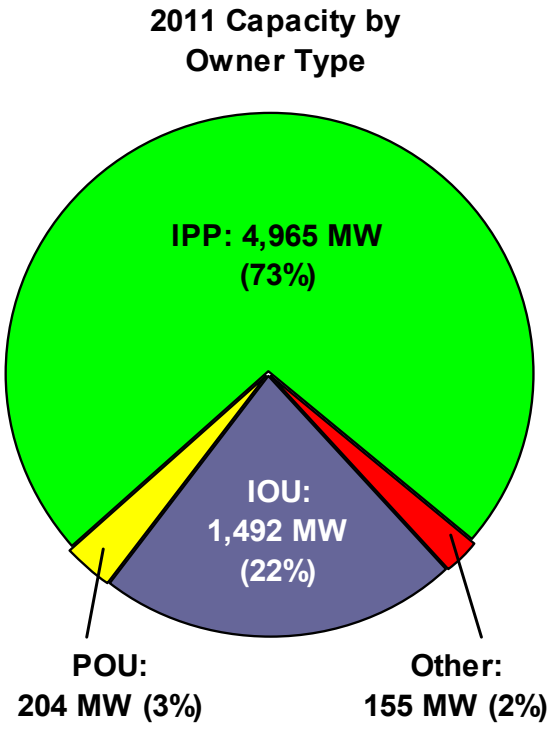
- On average, since 1998-99, hub heights are 25 meters (45%) higher and rotor diameters are 41 meters (86%) larger

Project Finance Was a Mixed Bag in 2011

- Weakened debt market
  - Greek/European debt crisis drove retrenchment
  - New banking regulations lead to shorter bank loan tenors, though institutional lenders continued to offer longer-term products
  - 4,000 MW of new wind raised $5.9 billion in debt, down 30% from 2010
  - Bank loan pricing ratcheted up a bit, but interest rates starting below 6% still achievable
- Tax equity market improved somewhat
  - $3.5 billion in tax equity committed to wind in 2011, similar to 2010
  - 19 tax equity deals in 2011, with 22 active investors
  - Pricing stable and new/returning investors entered the market
  - Attrition of investors possible with loss of 1603 Treasury Grant program

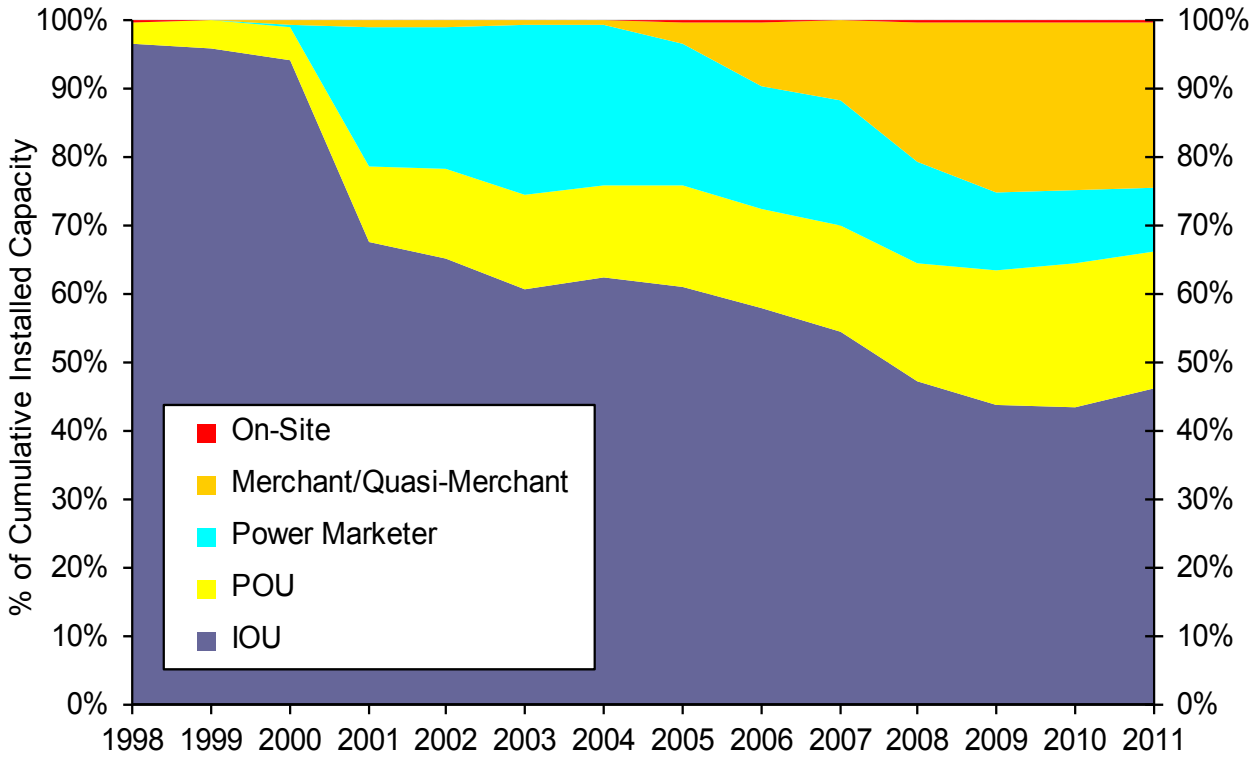
Utility Project Ownership Increased in 2011, but IPP Ownership Remained Dominant

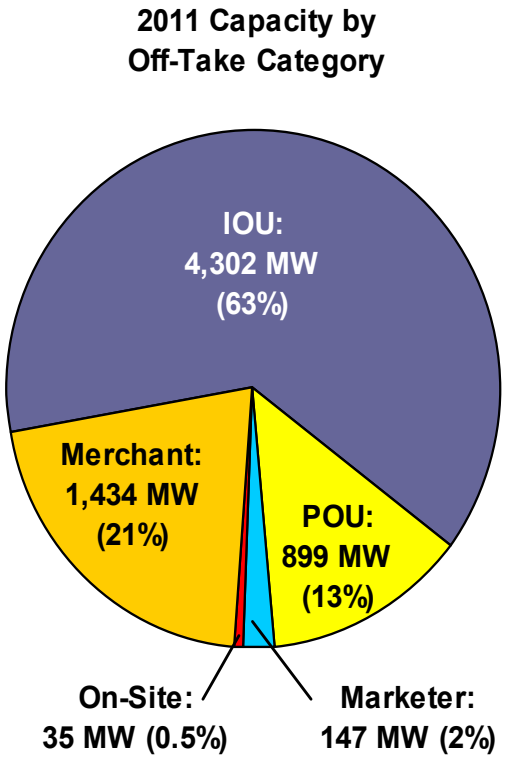




Utility ownership jumped to 25% in 2011 (up from 15% in 2009 and 2010) on the back of nearly 600 MW of new capacity built/owned by MidAmerican

Electric Utilities Are Still the Dominant Off-Takers of Wind Power

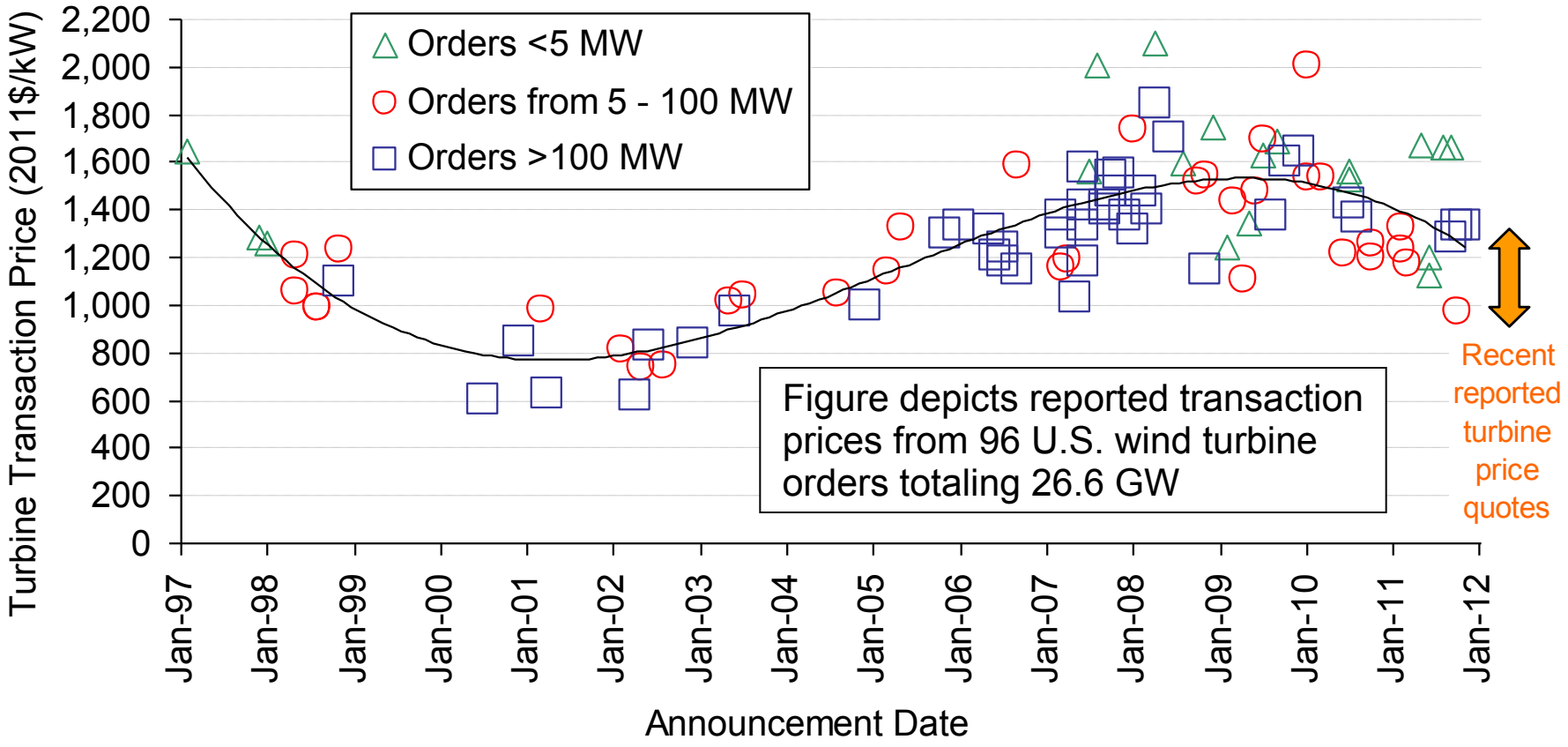




- Scarcity of power purchase agreements drove continued merchant development, though at somewhat lower levels than in recent years

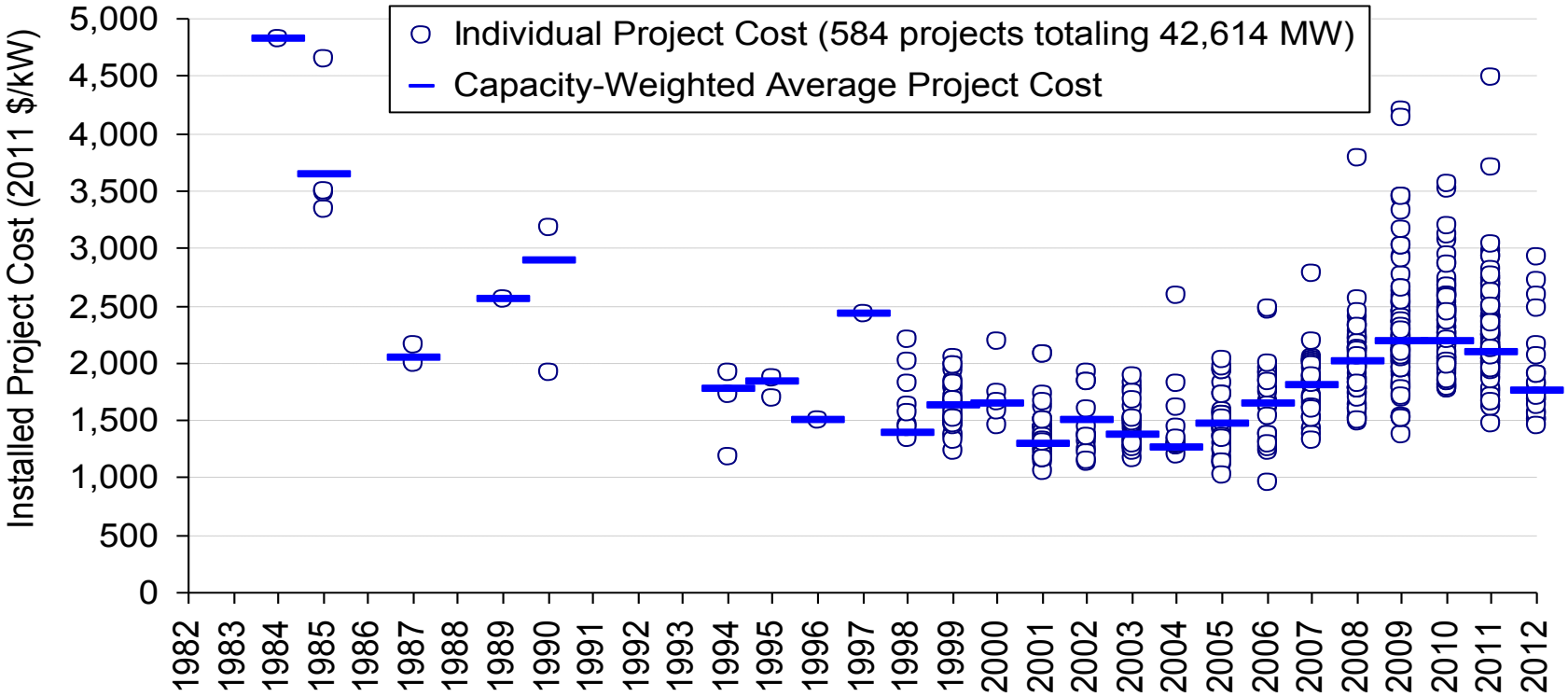
Cost Trends

Wind Turbine Prices Continued to Decline in 2011, After Rising from 2002-2008



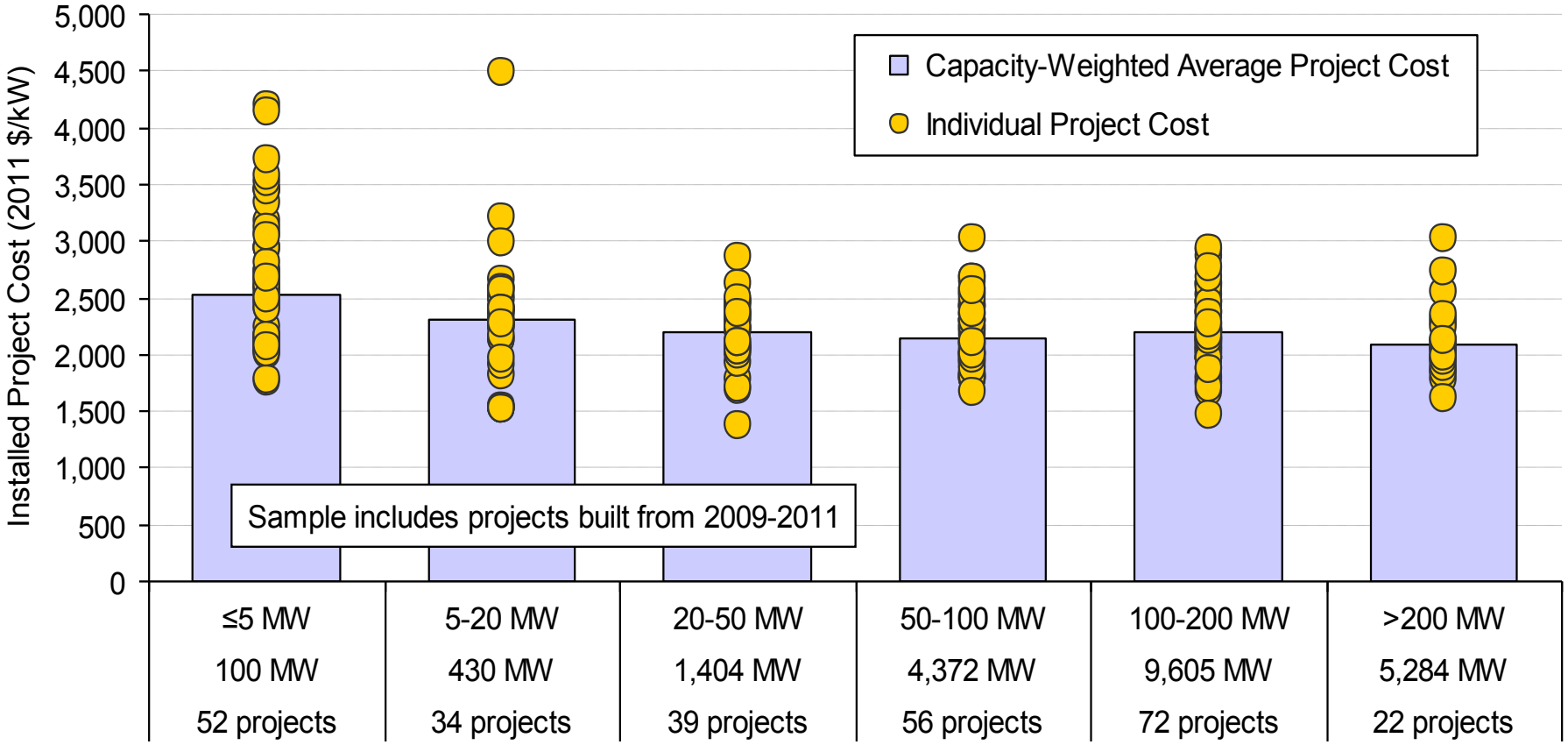
- Recent turbine price quotes reportedly in the range of $900-1,270/kW, with more-favorable terms for buyers and improved technology

Though Slow to Reflect Declining Wind Turbine Prices, Reported Installed Project Costs Finally Turned the Corner in 2011

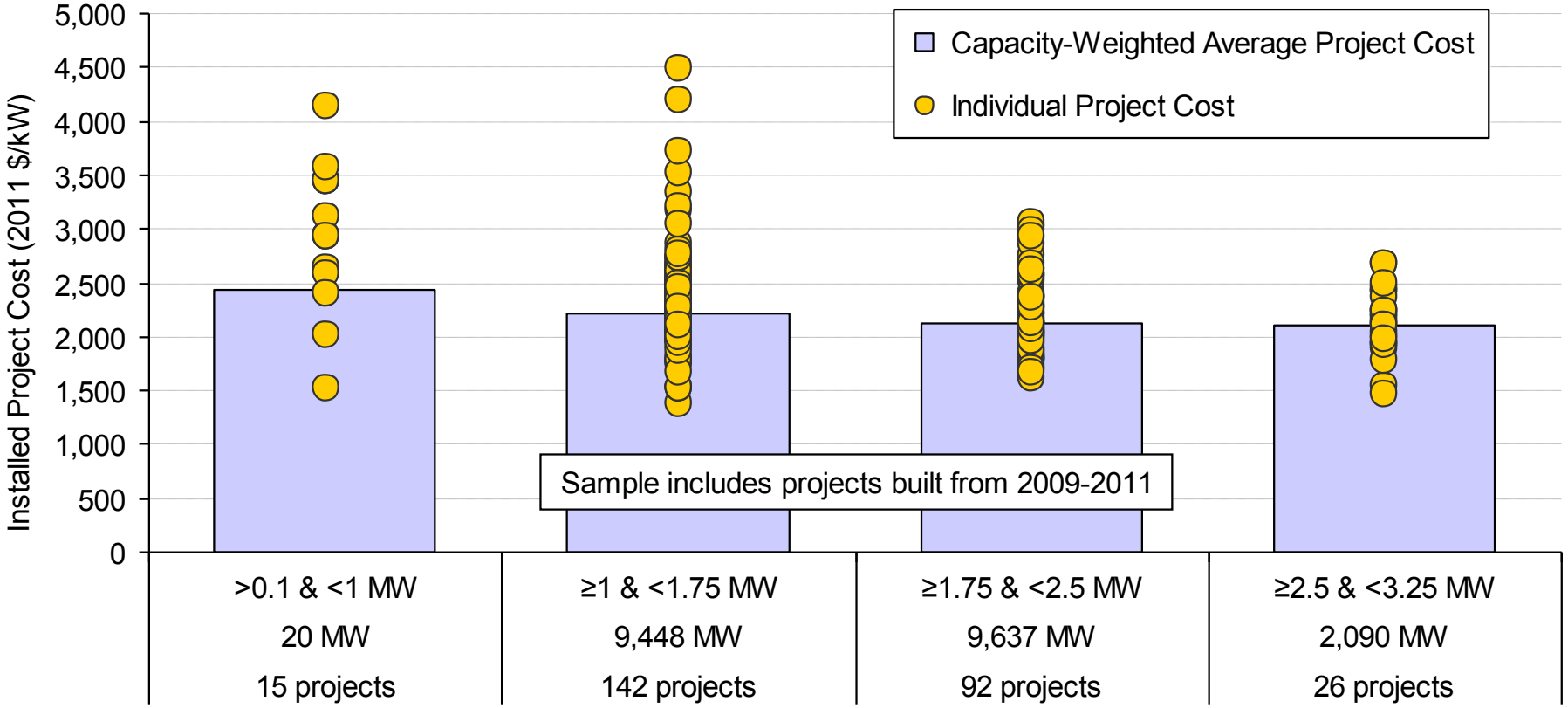


Note: 2012 sample of 20 projects totaling ~2.6 GW is preliminary, but suggests lower costs for 2012 projects

Economies of Scale Evident At Least At Low End of Project Size Range

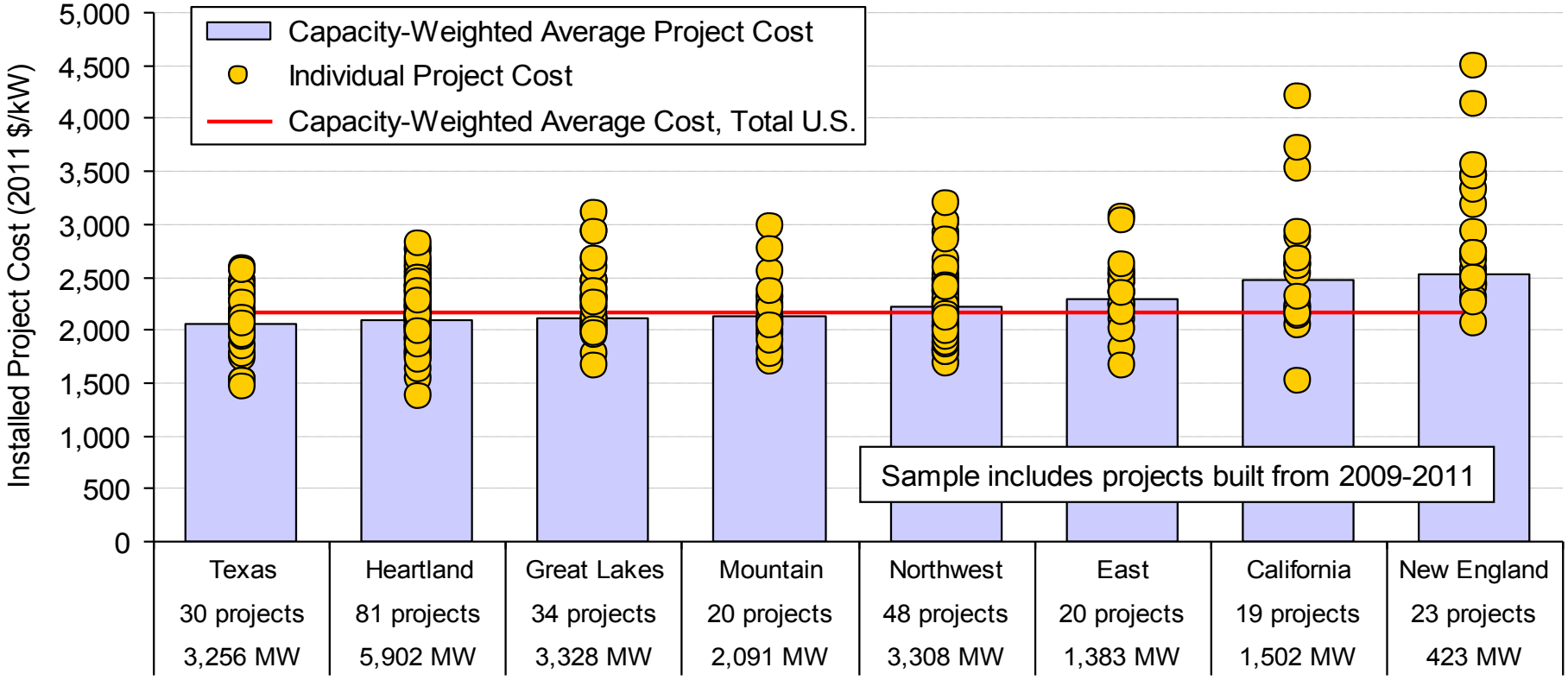


Economies of Scale Also Evident (Though Somewhat Less So) By Turbine Size



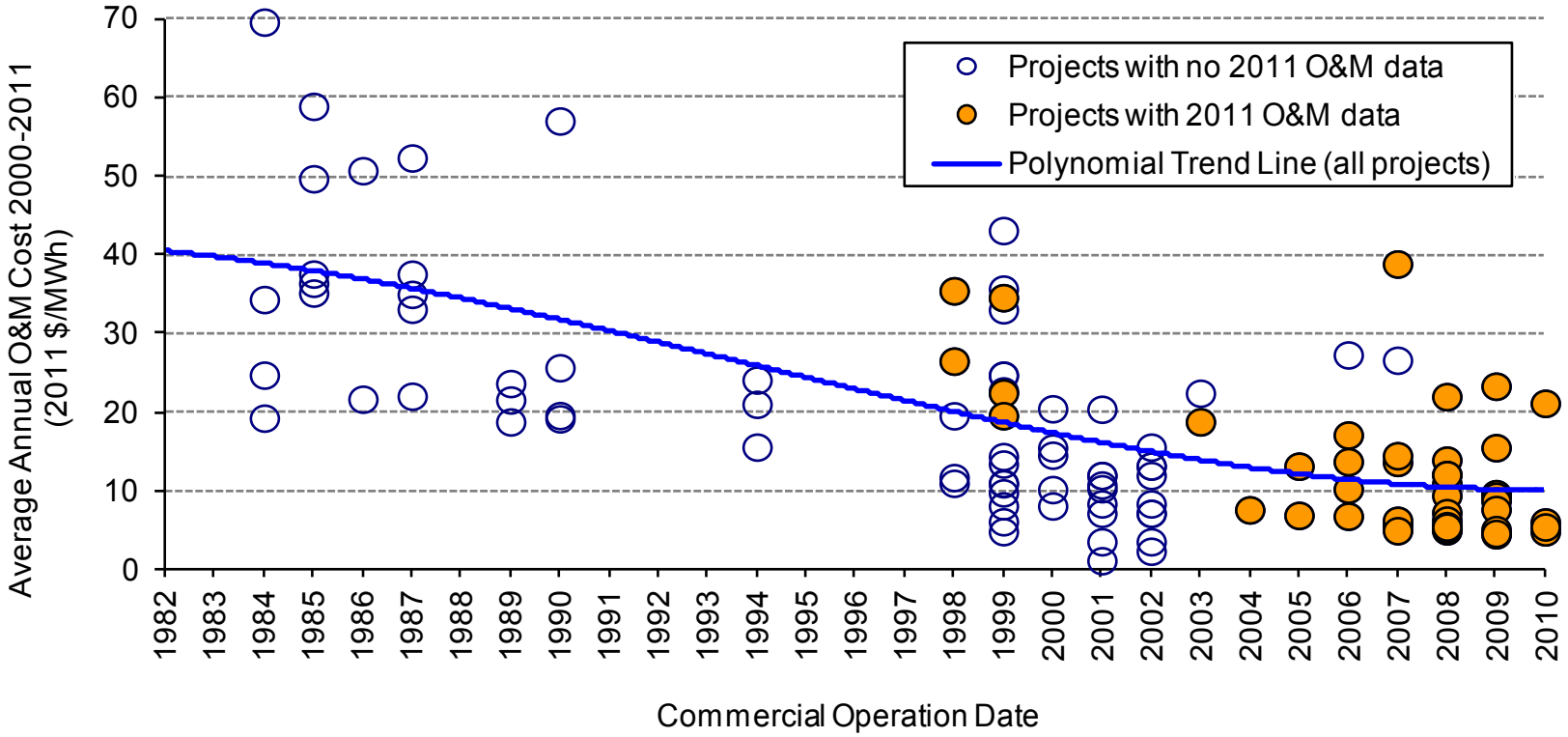
- Theory: A project may be built less-expensively using fewer larger turbines instead of a larger number of smaller turbines

Some Regional Differences in Wind Power Project Costs Are Apparent



- Different permitting/development costs may play a role at both ends of spectrum: it's easier to build in TX and the Heartland and more difficult in New England and CA (see slide 42 for regional definitions)

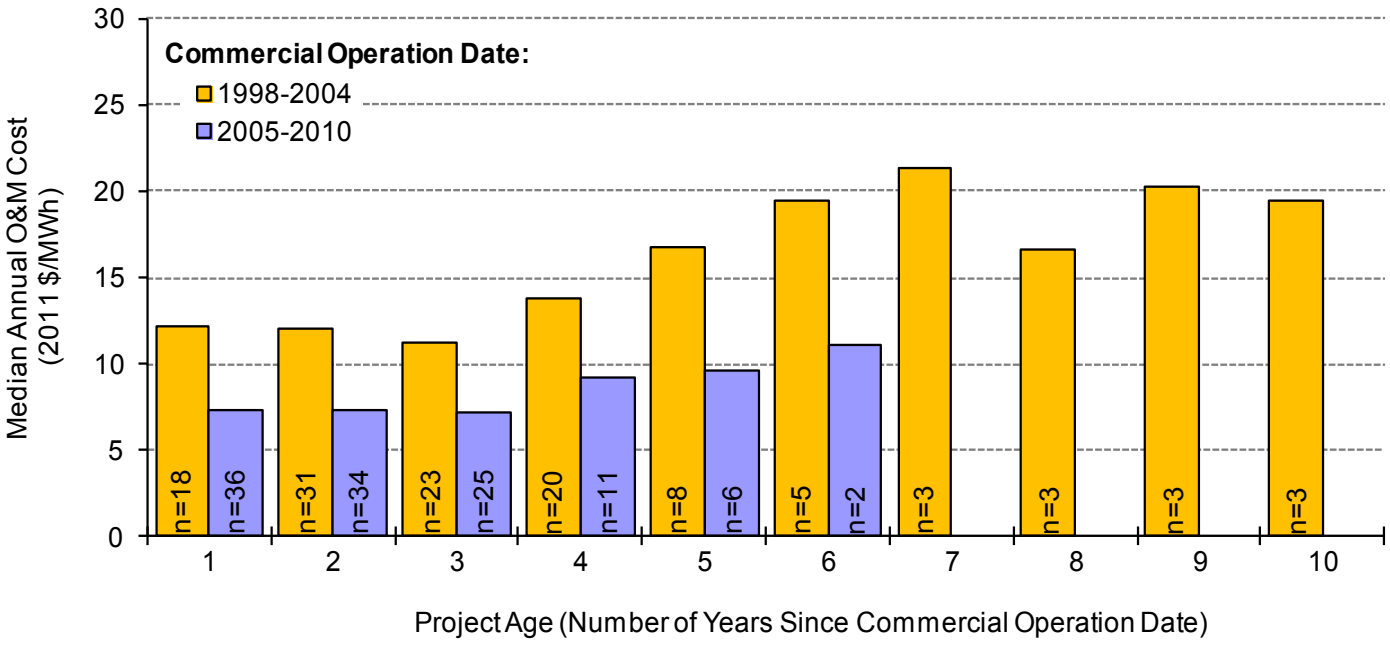
Newer Projects Appear to Show Improvements in Operations and Maintenance Costs



Capacity-weighted average 2000-11 O&M costs for projects built in the 1980s equal **$33/MWh**, dropping to **$23/MWh** for projects built in 1990s, and to **$10/MWh** for projects built since 2000

*Note: Sample is limited, and consists of 133 wind power projects totaling 7,965 MW; few projects in sample have complete records of O&M costs from 2000-11; O&M costs reported here **DO NOT** include all operating costs*

O&M Costs Appear to Increase with Project Age, and Decrease for More Recently Installed Projects

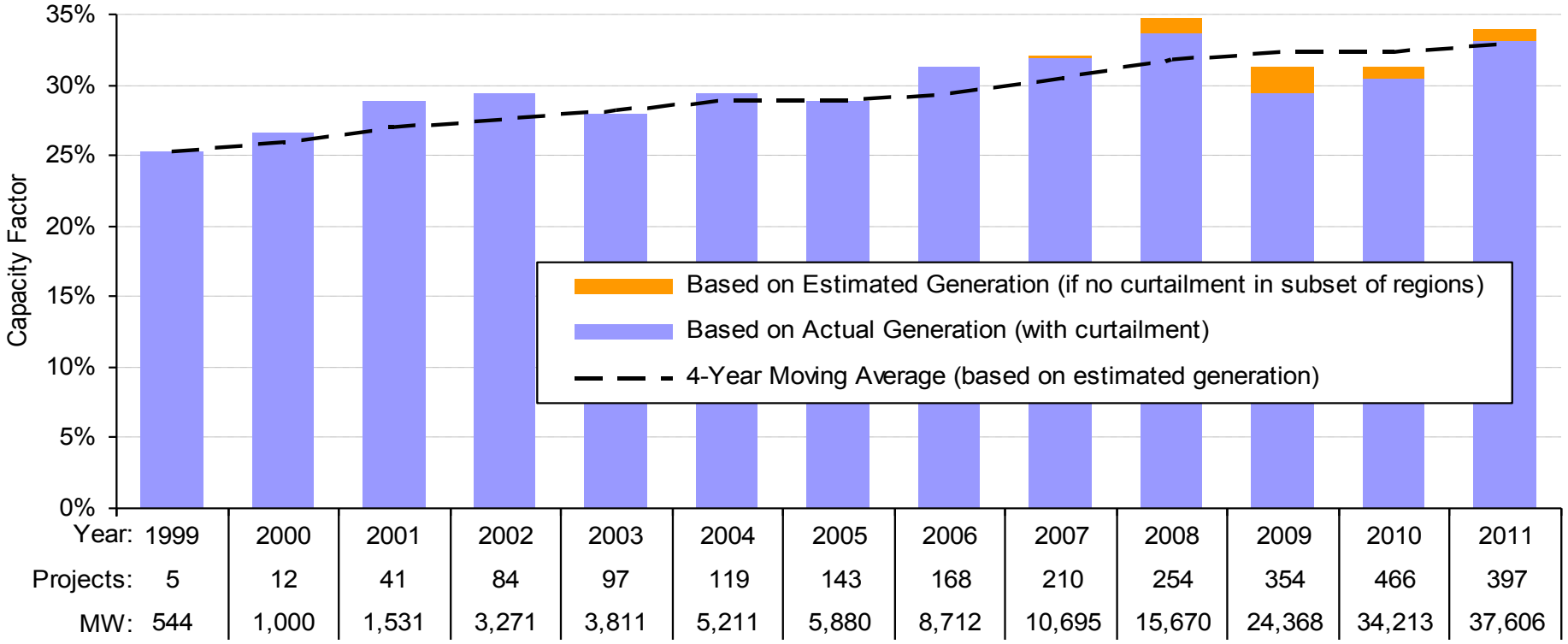


Note: Sample size is extremely limited

O&M reported in figure <u>does not</u> include all operating costs: Statements from public companies with large U.S. wind asset bases report total operating costs in 2011 for projects built in the 2000s of ~$22/MWh

Performance Trends

Average Capacity Factors Have Improved Over Time, But Leveled Off in Recent Years



Year:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Projects:	5	12	41	84	97	119	143	168	210	254	354	466	397
MW:	544	1,000	1,531	3,271	3,811	5,211	5,880	8,712	10,695	15,670	24,368	34,213	37,606

- General improvement reflects increase in hub height and rotor diameter
- Drop in 2009 and 2010, and rebound in 2011, driven in part by: (1) inter-annual wind resource variation, and (2) wind power curtailment

Curtailment a Growing Issue in Some Areas

Estimated Wind Curtailment (GWh and % of potential wind generation)

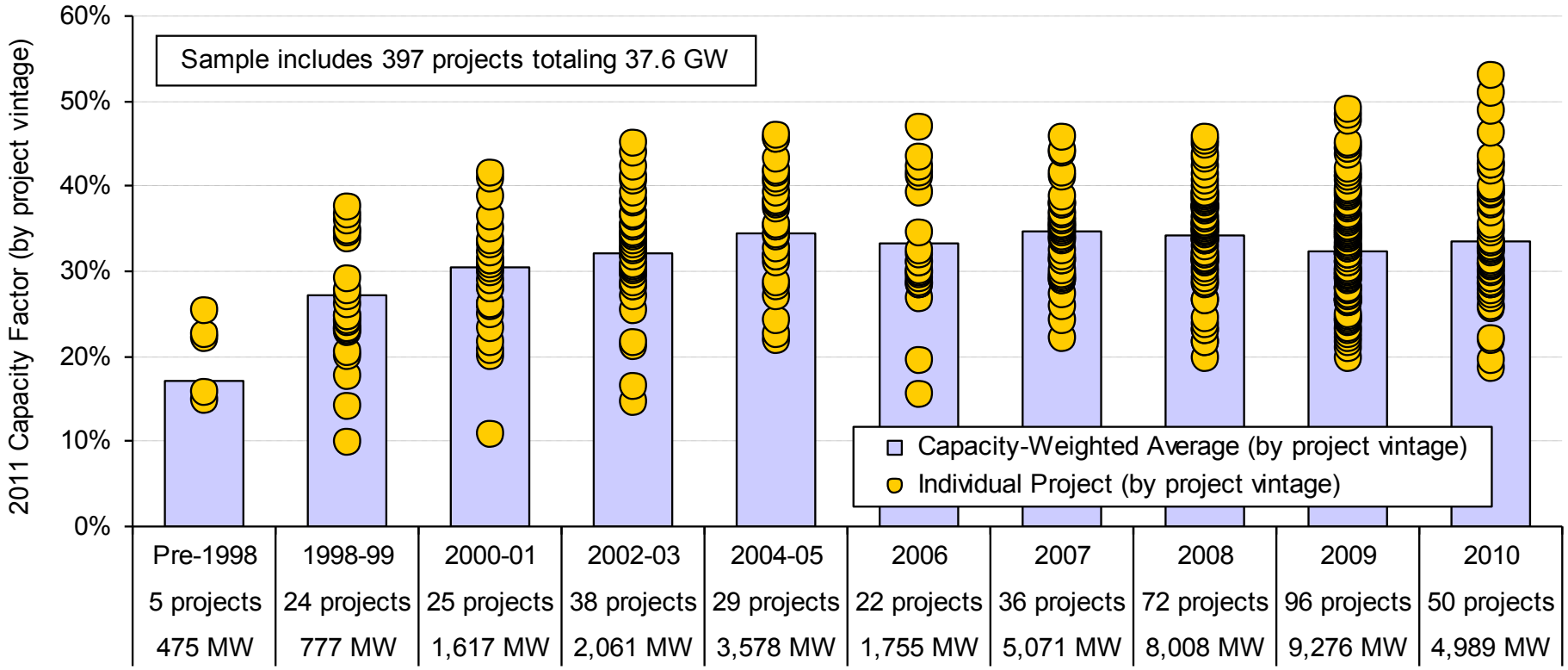
	2007	2008	2009	2010	2011
Electric Reliability Council of Texas (ERCOT)	109 (1.2%)	1,417 (8.4%)	3,872 (17.1%)	2,067 (7.7%)	2,622 (8.5%)
Southwestern Public Service Company (SPS)	N/A	0 (0.0%)	0 (0.0%)	0.9 (0.0%)	0.5 (0.0%)
Public Service Company of Colorado (PSCo)	N/A	2.5 (0.1%)	19.0 (0.6%)	81.5 (2.2%)	63.9 (1.4%)
Northern States Power Company (NSP)	N/A	25.4 (0.8%)	42.4 (1.2%)	42.6 (1.2%)	54.4 (1.2%)
Midwest Independent System Operator (MISO), less NSP	N/A	N/A	250 (2.2%)	781 (4.4%)	657 (3.0%)
Bonneville Power Administration (BPA)	N/A	N/A	N/A	4.6* (0.1%)	128.7* (1.4%)
Total Across These Six Areas:	**109 (1.2%)**	**1,445 (5.6%)**	**4,183 (9.6%)**	**2,978 (4.8%)**	**3,526 (4.8%)**

*A portion of BPA's curtailment is estimated assuming that each curtailment event lasts for half of the maximum possible hour for each event.

Source: ERCOT, Xcel Energy, MISO, BPA

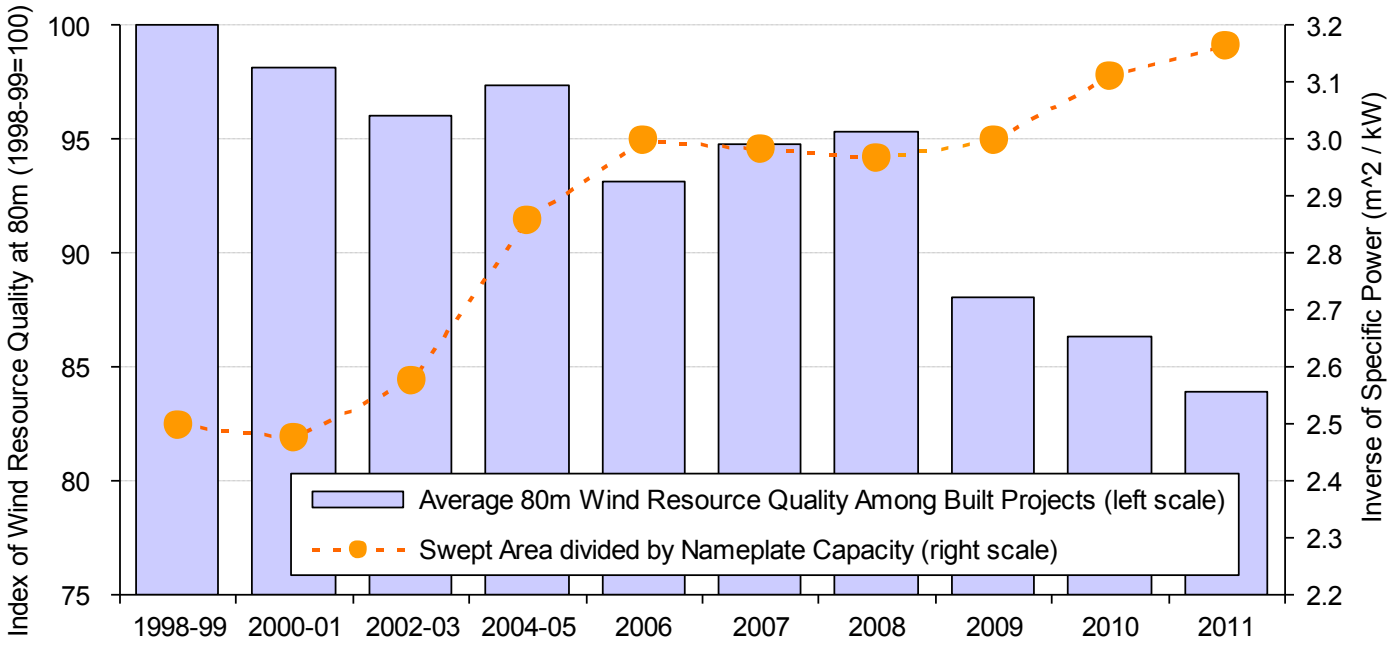
Assuming a 33% capacity factor, the total amount of wind generation curtailed in 2011 within just the six territories shown above equates to the annual output of roughly 1,220 MW of wind power capacity

Binning by Project Vintage and Focusing on 2011 Performance Tells A Similar Story



- Projects installed since 2005 have bucked the trend of generally increasing capacity factors among more-recently built projects

Turbine Scaling Should Boost Performance, but Is Offset By Declining Resource Quality

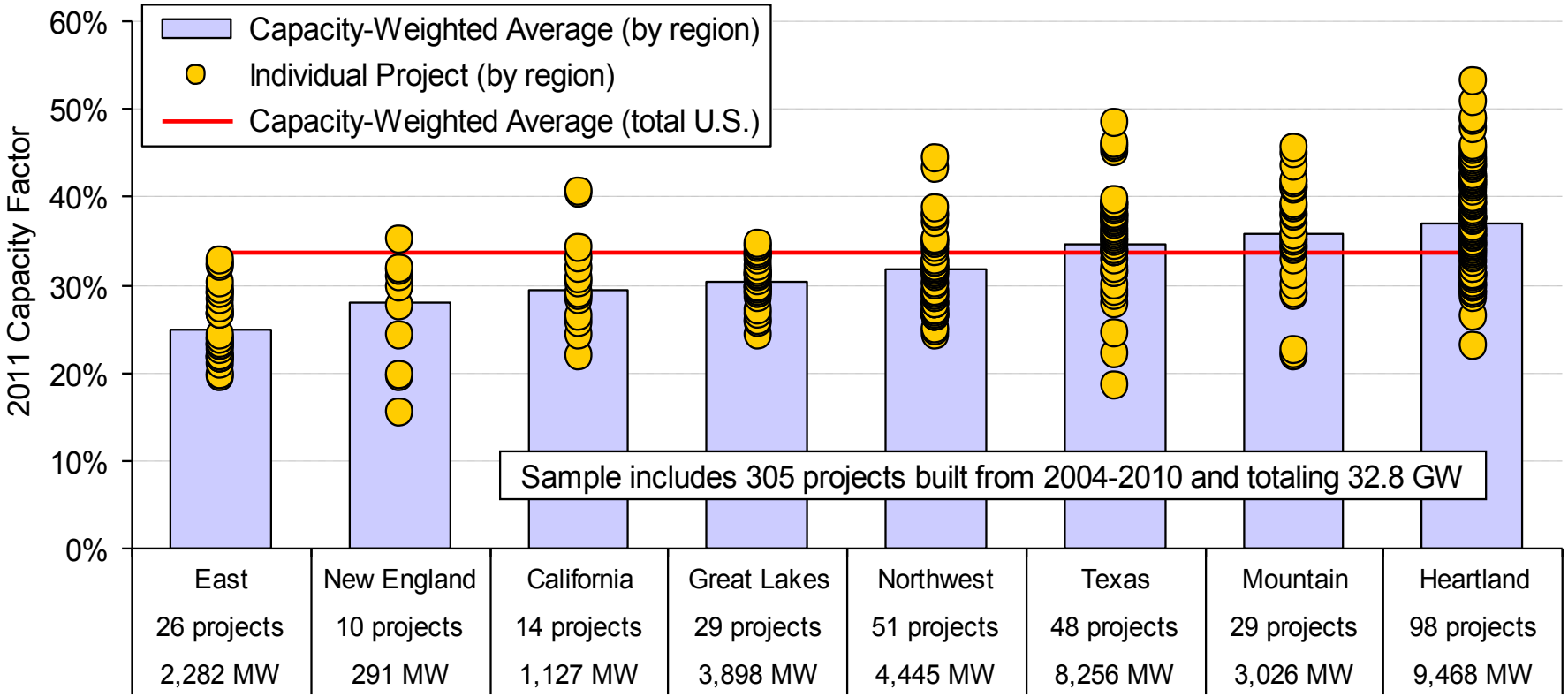


Both hub height and swept rotor area relative to turbine capacity were relatively stable from 2006-2009

Rotor scaling since 2009 is expected to boost performance in future years

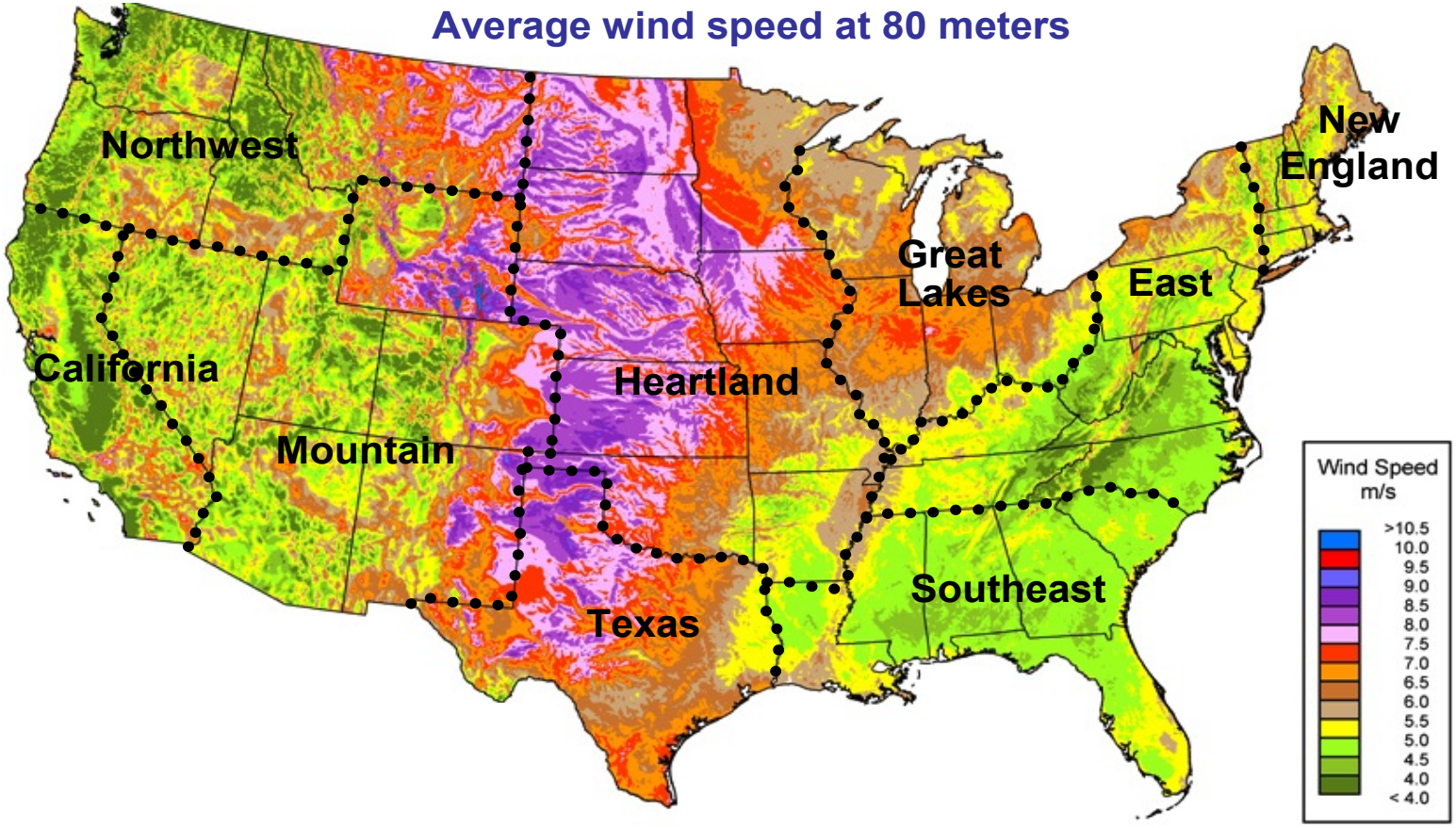
- Projects increasingly sited in lower wind speed areas, particularly since 2008: 2011 projects were (on avg.) located in estimated 80-meter resource conditions that are 16.1% worse than projects built in 1998-99 → likely a result of improvements in low wind speed technology, transmission/siting limitations, and policy influences

Regional Performance Differences Are Apparent



Average capacity factors highest in the Heartland and Mountain regions, lowest in the East and New England

Performance Differences Are Roughly Consistent with the Relative Quality of the Wind Resource in Each Region

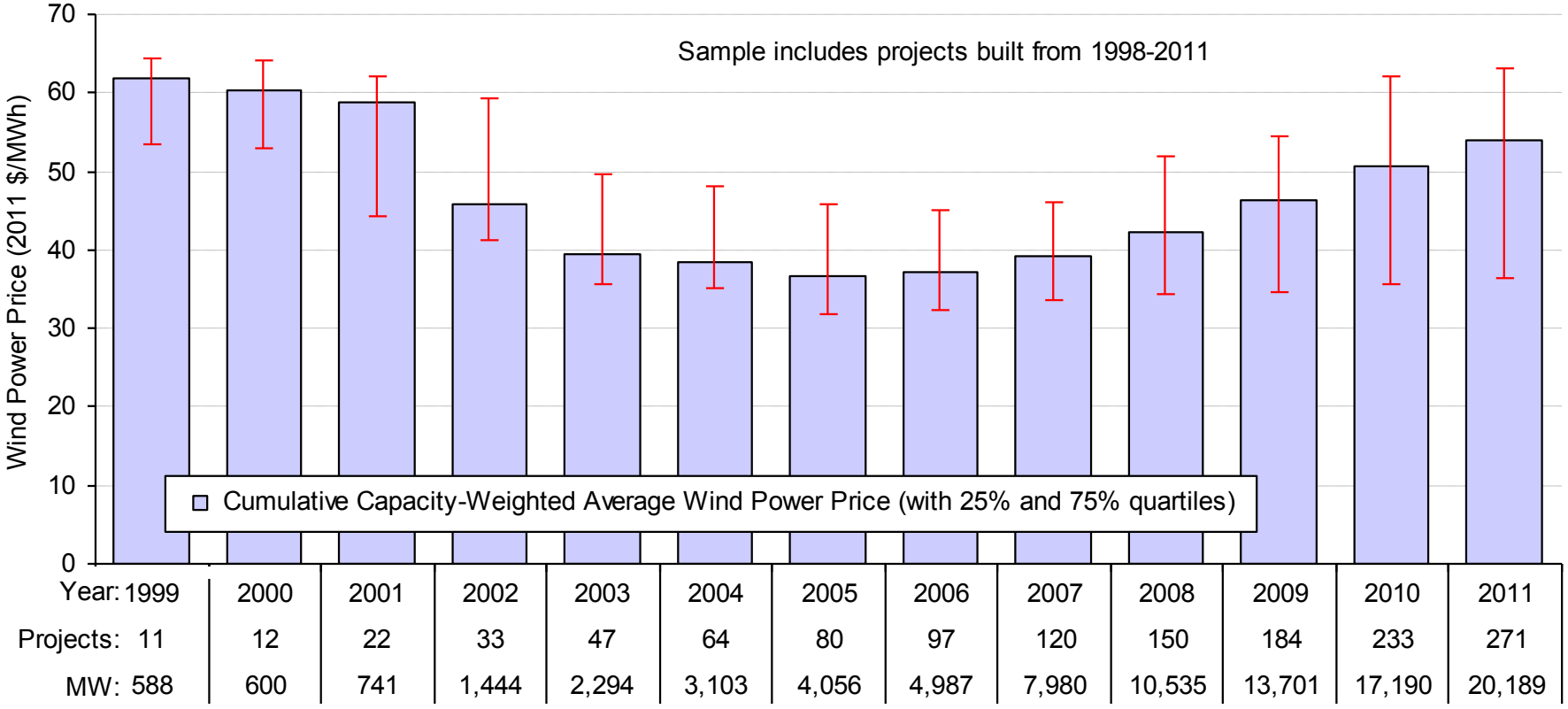


Wind Power Price Trends

Sample of Wind Power Prices

- Berkeley Lab collects data on historical wind power sales prices
- Sample includes 271 projects built from 1998-2011, totaling 20,189 MW (44% of all wind capacity added in that period)
- Prices reflect the historical bundled price of electricity and RECs as sold by the project owner under a power purchase agreement
  - Dataset excludes merchant plants and projects that sell renewable energy certificates (RECs) separately
  - Prices reflect receipt of state and federal incentives (e.g., the PTC or Treasury grant), as well as various local policy and market influences; as a result, prices do not reflect wind energy generation costs

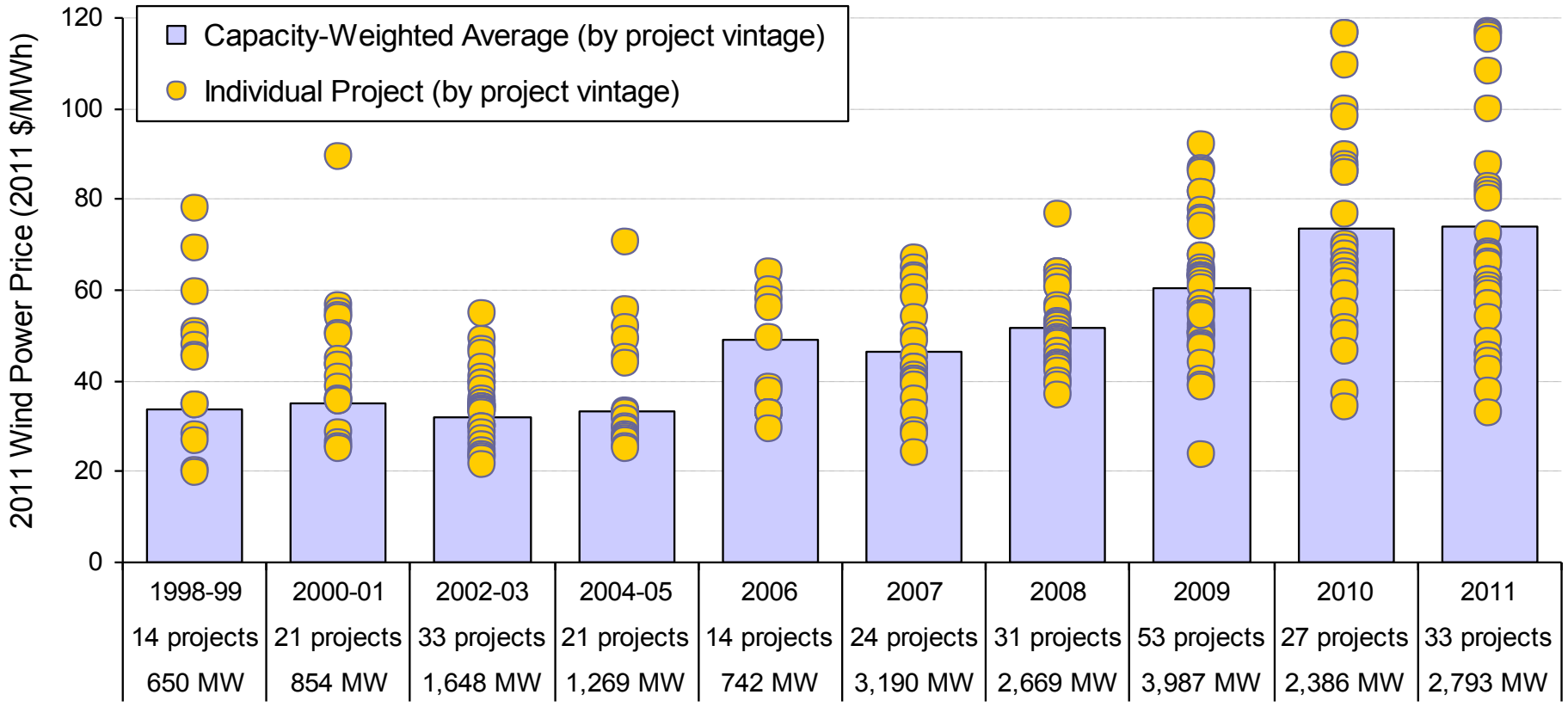
Cumulative, Sample-Wide Wind Power Prices Continued to Move Higher in 2011



Year:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Projects:	11	12	22	33	47	64	80	97	120	150	184	233	271
MW:	588	600	741	1,444	2,294	3,103	4,056	4,987	7,980	10,535	13,701	17,190	20,189

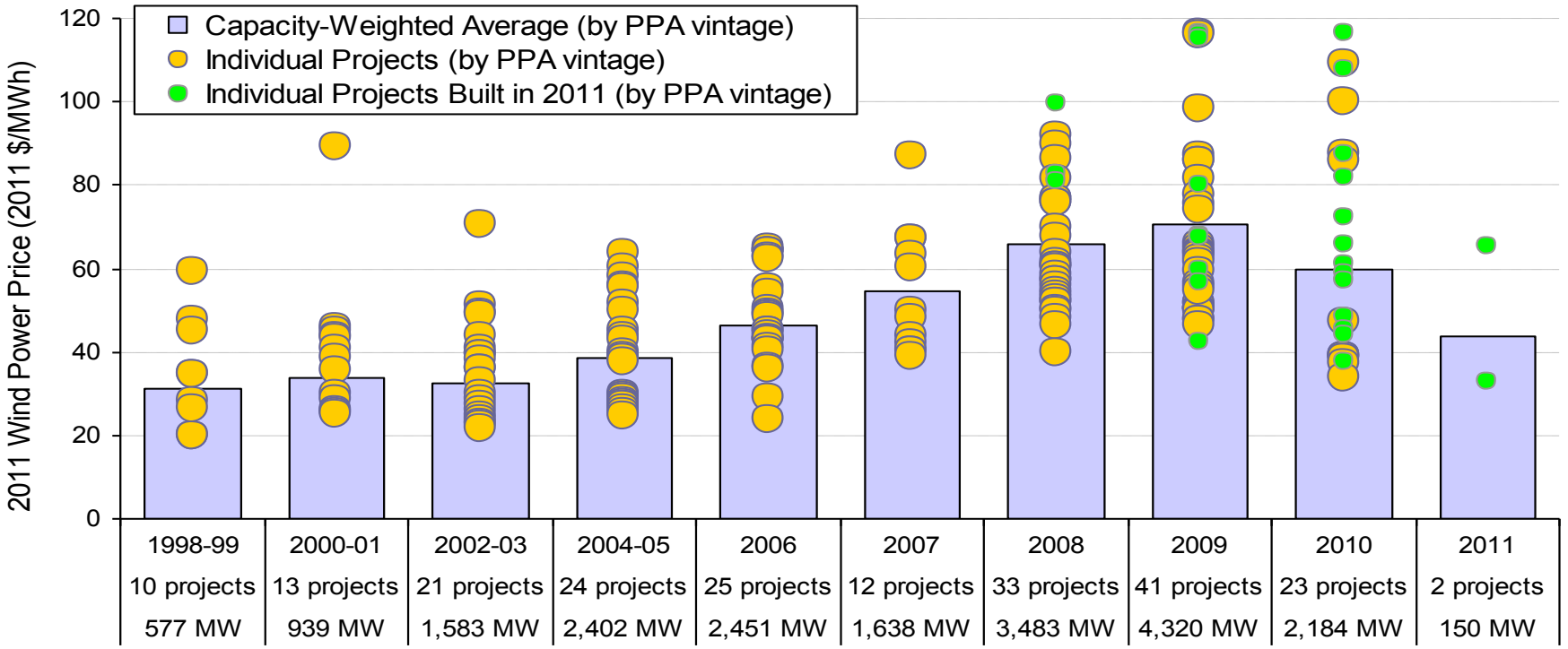
General trend of falling and then rising prices consistent with the project cost trends shown earlier, but cumulative nature of figure results in a smoother, less-responsive curve that lags the directional changes in cost trends

Binning Wind Power Sales Prices by Project Vintage Also Fails to Show a Price Reversal



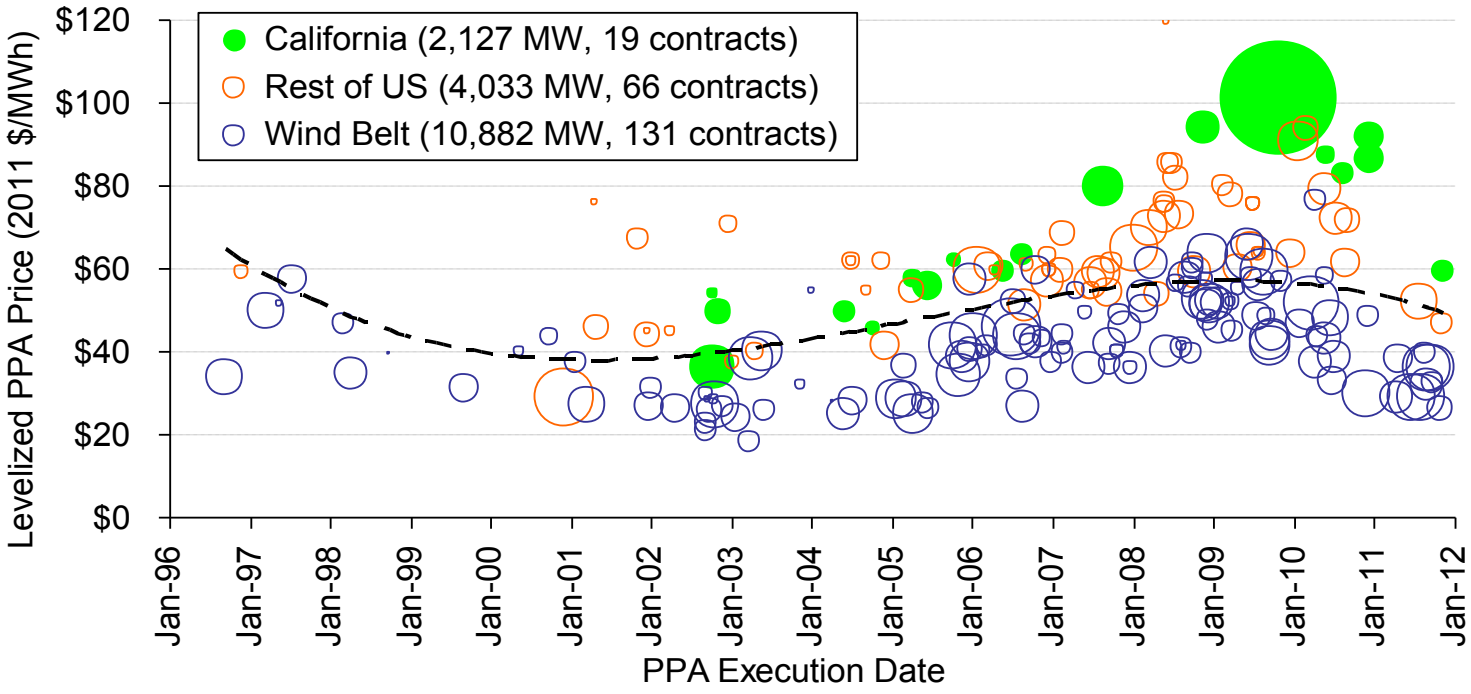
Graphic shows prices in 2011 from projects built from 1998-2011

Binning Wind Power Sales Prices by PPA Execution Date Shows Steeply Falling Prices



- In previous slide, substantial lag between PPA execution and project completion masked the recent reduction in prices that becomes apparent when projects are binned by PPA execution date

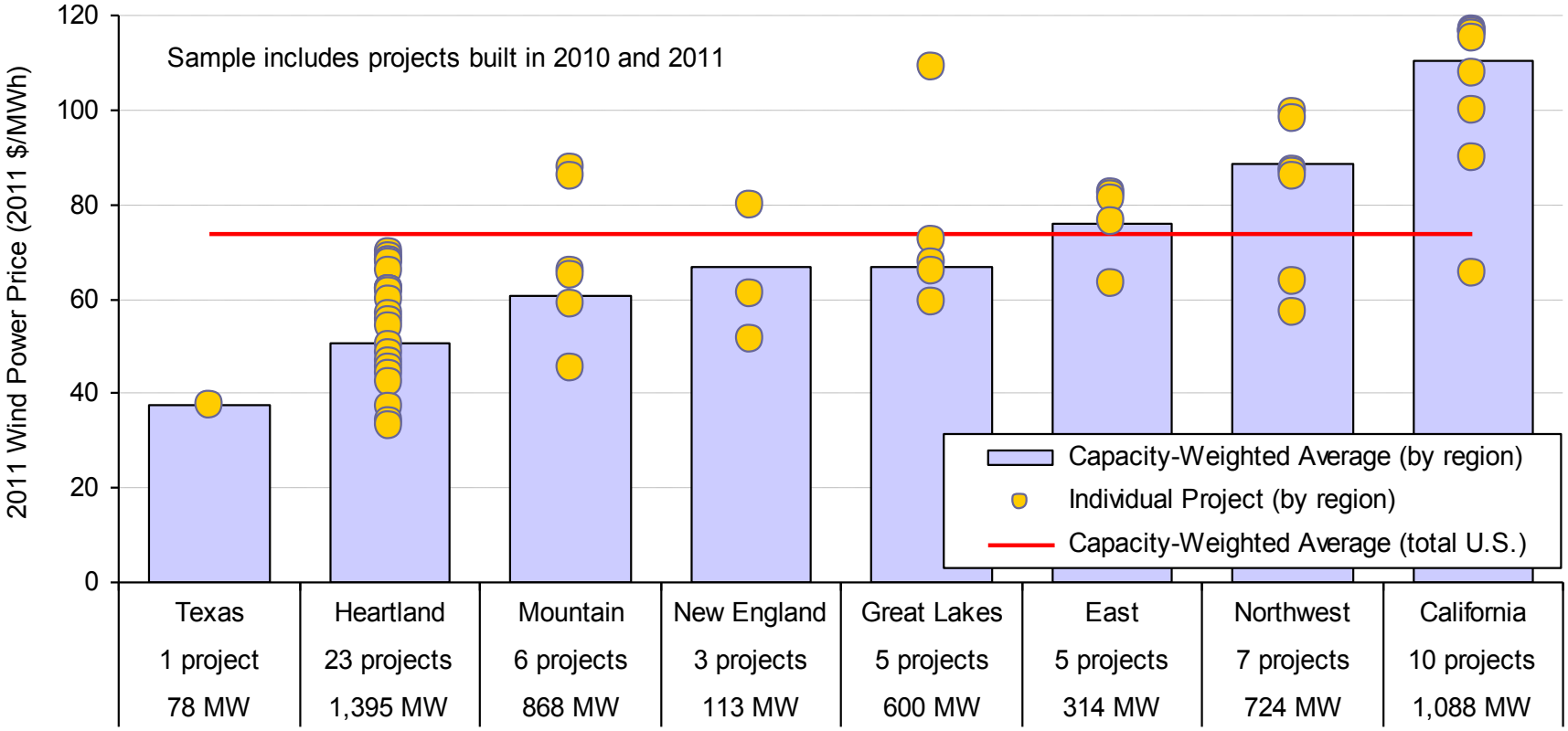
Focusing on a Smaller Sample of Full-Term PPAs Demonstrates that Levelized Wind Prices Declined in 2011 and Vary by Region



Full-term (rather than historical) data allow for a calculation of levelized prices over the entire PPA duration

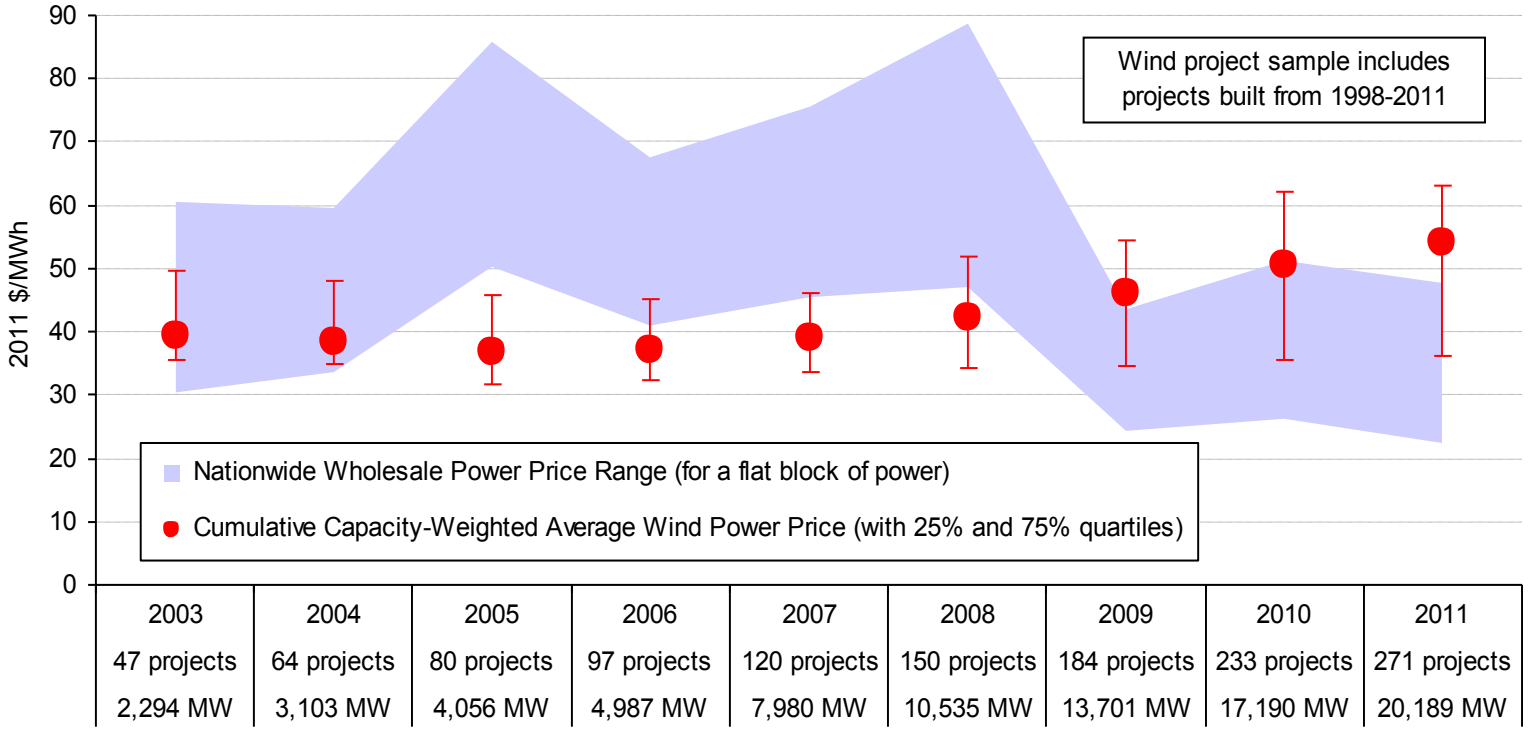
Among the sample of PPAs signed in 2011, the capacity-weighted average levelized price is $35/MWh, down from $59/MWh for PPAs signed in 2010 and $72/MWh for PPAs signed in 2009

Wind Pricing Varies Widely By Region



Though sample size is problematic in several regions, Texas, the Heartland and the Mountain regions appear to be among the lowest price areas, on average, while California is by far the highest price region

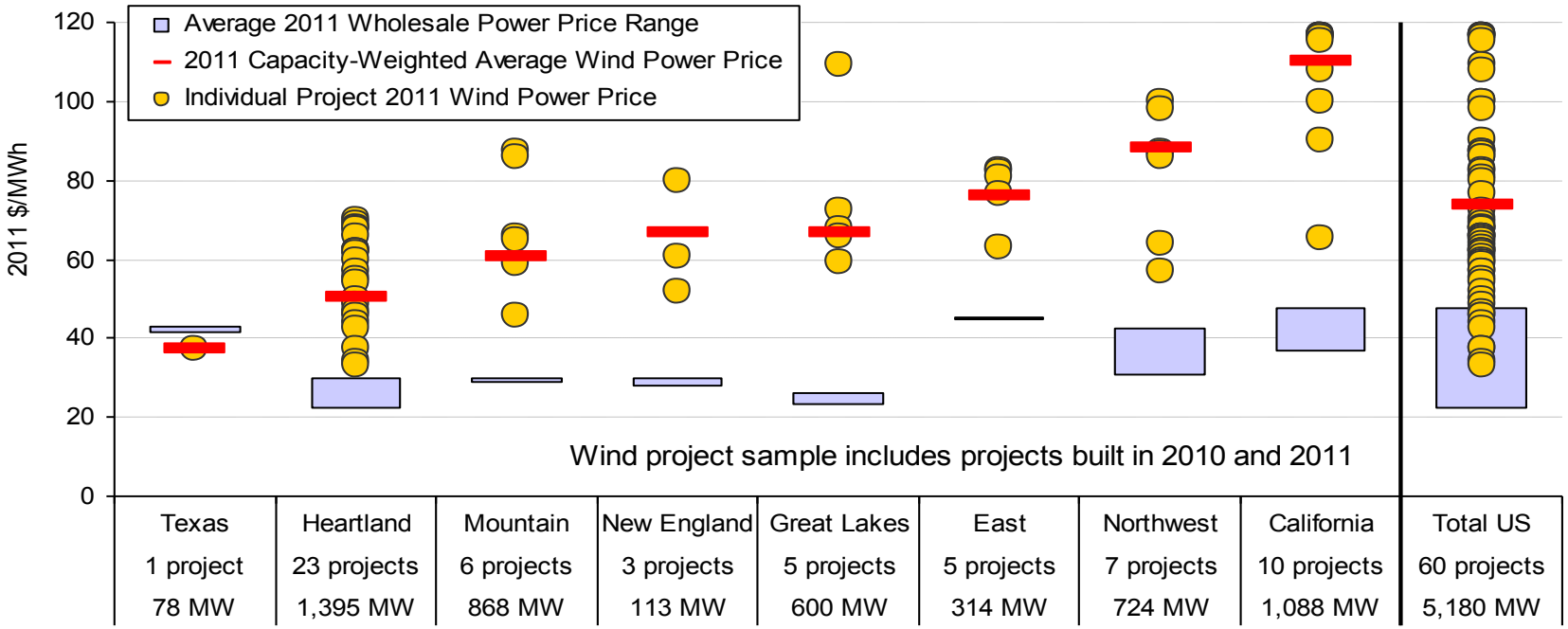
Low Wholesale Electricity Prices Continued to Challenge the Relative Economics of Wind Power



- Wholesale price range reflects flat block of power across 23 pricing nodes across the U.S.
- Recent wholesale prices reflect low natural gas prices, driven by weak economy and shale gas
- Price comparison shown here is far from perfect – ***see full report for caveats***

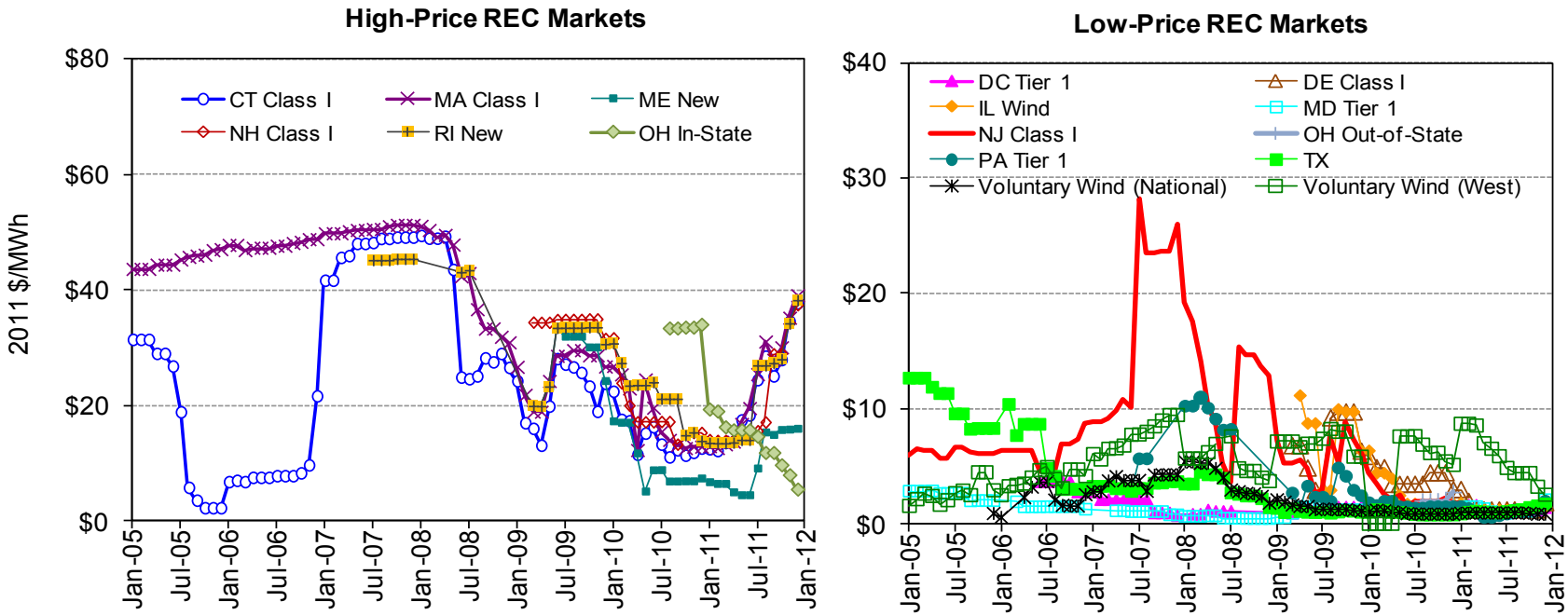
Gap Between Wholesale Prices and Wind Power Prices Crossed All Regions in 2011

But… many PPAs signed in 2011 (shown earlier, many at $30-40/MWh) are competitive at 2011 wholesale prices



Notes: Within a region there are a range of wholesale prices because multiple price hubs exist in each area; price comparison shown here is far from perfect – ***see full report for caveats***

Renewable Energy Certificate (REC) Prices Rise in Northeast, Remain Depressed Elsewhere



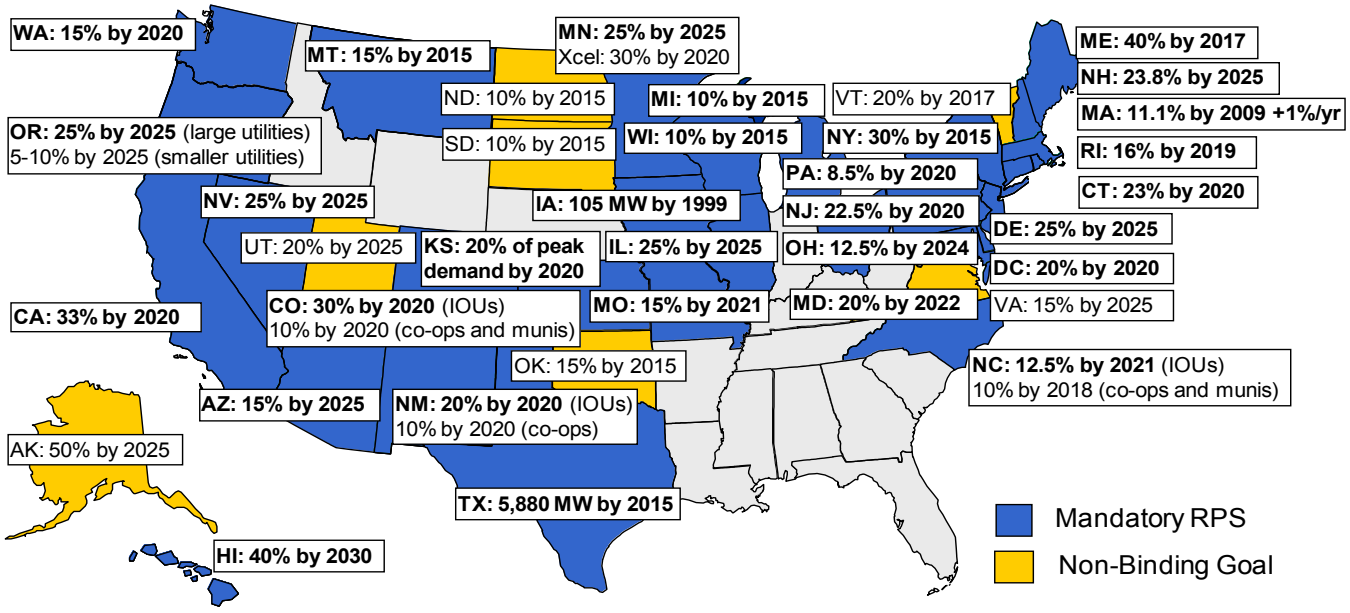
REC prices vary by: market type (compliance vs. voluntary); geographic region; specific design of state RPS policies

Policy and Market Drivers

Uncertainty Reigns in Federal Incentives for Wind Energy Beyond 2012

- Commercial wind projects placed in service before the end of 2012 have access to either the PTC or ITC
- Treasury cash grant program available for projects that were under construction by the end of 2011 and placed in service by the end of 2012
  - > 60% of the new wind capacity installed in 2011 elected the cash grant
- First-year "bonus depreciation" at 100% through 2011; reverted back to 50% for 2012 (and slated to disappear altogether in 2013)
- The Section 1705 loan guarantee program has wound down: program closed on four loan guarantees to wind projects totaling 1,024 MW, 285 MW of which were online by the end of 2011
- **With PTC, 30% ITC, 30% cash grant, and bonus depreciation all currently scheduled to expire at the end of 2012, the wind sector is currently experiencing serious federal policy uncertainty, and therefore rushing to complete projects by the end of the year**

State Policies Help Direct Location and Amount of Wind Development, but Current Policies Cannot Support Continued Growth at Levels Seen in the Recent Past



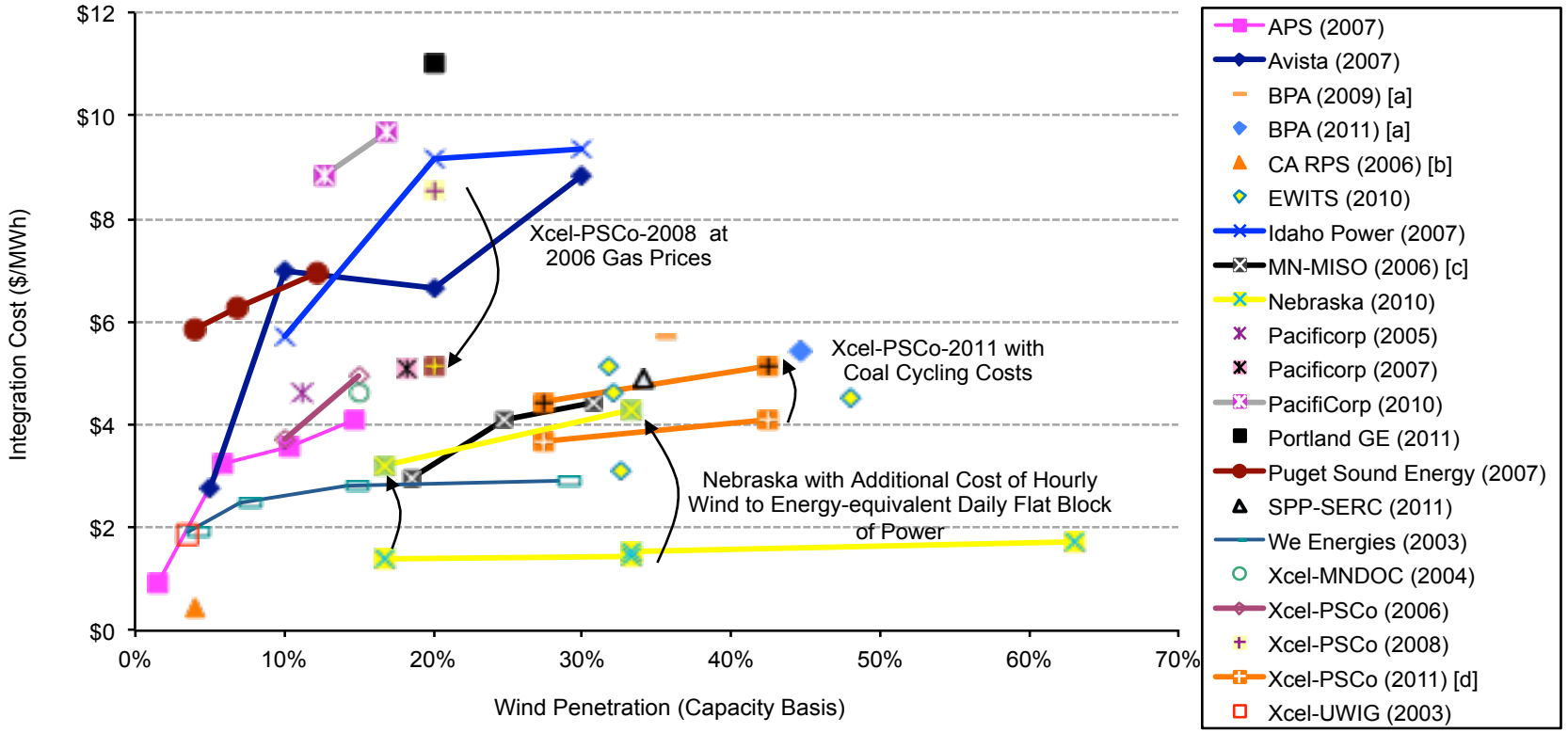
Source: Berkeley Lab

- 29 states and D.C. have mandatory RPS
- State RPS's can support ~4-5 GW/yr of total renewable energy additions in near term, on average (less for wind specifically)

Despite Progress on Overcoming Transmission Barriers, Constraints Remain

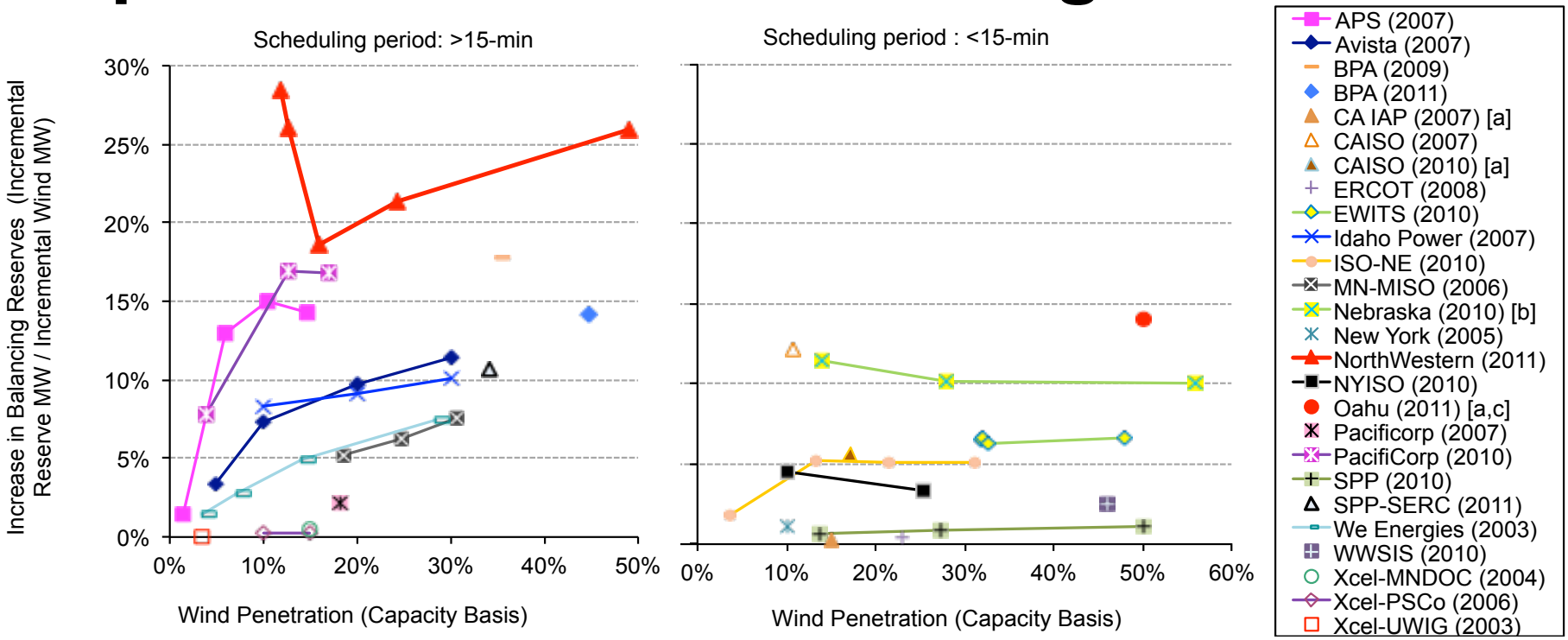
- 2,300 circuit miles of new transmission under construction near end of 2011; additional 17,800 circuit miles planned through 2015
- AWEA has identified near-term transmission projects that – if all were completed – could carry ~45 GW of wind capacity
- FERC Order No. 1000 requires public utility transmission providers to improve planning processes and determine a cost allocation methodology for new transmission facilities
- States, grid operators, regional organizations, and DOE continue to take proactive steps to encourage transmission investment to improve access to renewable resources
- Numerous transmission projects designed, in part, to support wind made further progress in development and/or construction in 2011
- BUT…lack of transmission still a major barrier to wind development (witness curtailment data shown earlier on slides 37 & 38)

Integrating Wind Energy into Power Systems Is Manageable, but Not Free of Costs



Notes: Because methods vary and a consistent set of operational impacts has not been included in each study, results from the different analyses of integration costs and balancing reserves are not fully comparable. There has been some recent literature questioning the methods used to estimate wind integration costs and the ability to explicitly disentangle those costs.

Studies Find that Greater Wind Penetration Requires Increased Balancing Reserves



- The estimated increase in balancing reserves rarely exceeds 15% in these studies
- "Fast" markets (i.e., with shorter scheduling periods) can generally integrate wind more easily, with less need for increased balancing reserves (see graph on right)

Future Outlook

Forecasts Predict Substantial Growth in Wind Additions in 2012 as Developers Rush to Complete Projects Before the Scheduled Expiration of Federal Incentives

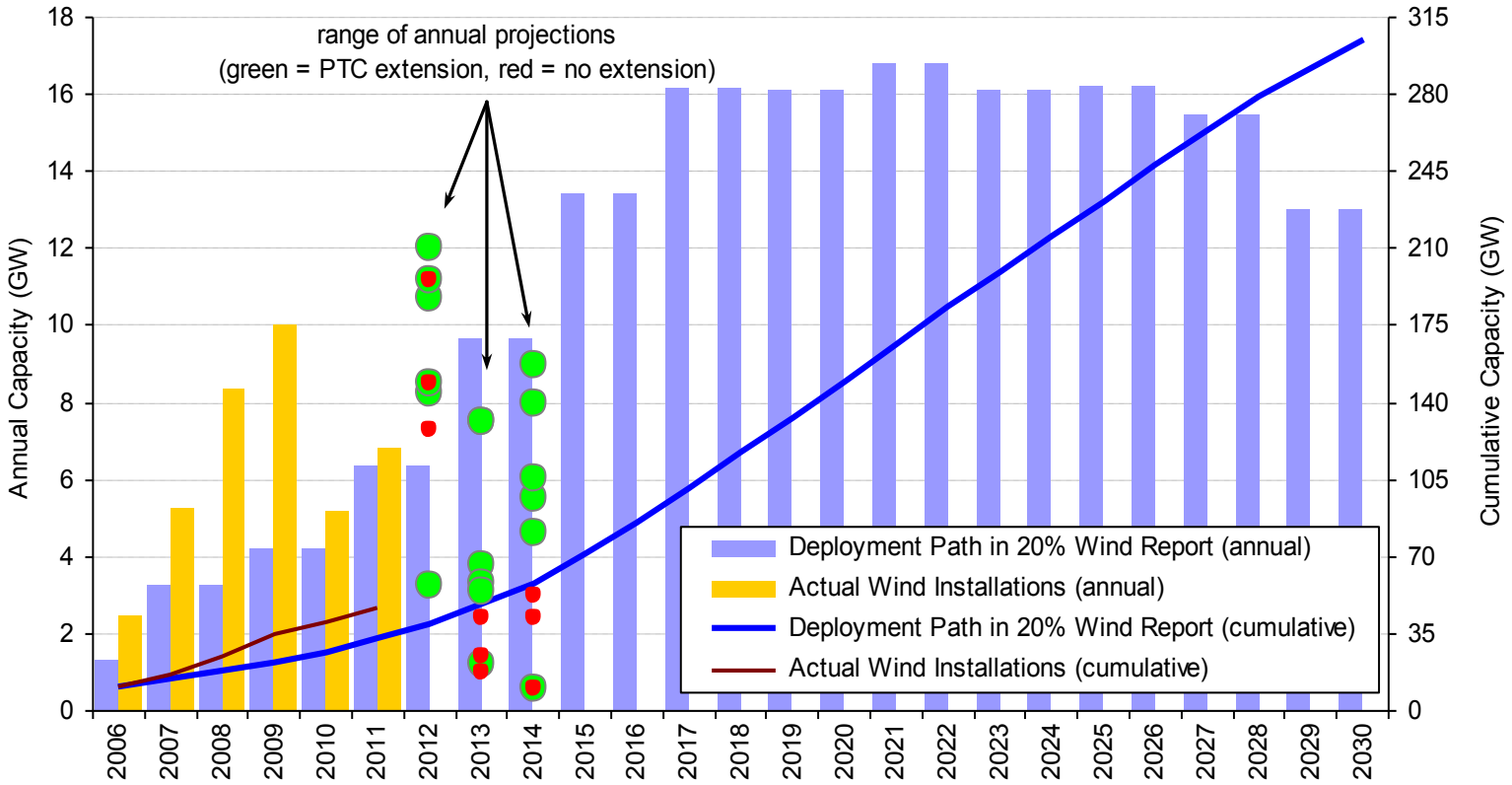
Source	Assumed Status of Federal Tax Incentives After 2012	2012	2013	2014	Cumulative Additions 2012-2014
EIA (2012)	Expired	7,280	1,430	600	9,310
Bloomberg NEF (2012a)	Expired	11,200	1,000	3,000	15,200
Navigant (2011)	Expired	8,500	2,400	2,400	13,300
EIA (2012)	Extended Indefinitely	3,230	3,320	580	7,130
BTM (2012)	Presumably Extended	8,250	7,500	9,000	24,750
Bloomberg NEF (2012a)*	Extended – 3 year	11,200	3,100	5,500	19,800
IHS EER (2012)	Extended – 3+ year	12,000	1,200	6,050	19,250
MAKE (2012)	Extended – details n/a	10,700	3,800	4,600	19,100
Navigant (2011)	Extended – 4 year	8,500	7,500	8,000	24,000

Uncertainties in Near-Term Market Growth Reflect Conflicting Trends

- Lower additions anticipated in 2013 and 2014, with predictions varying in part based on PTC extension assumptions
- Lower prices for wind energy realized in more recent PPAs may support higher growth in the future, but headwinds include:
  - Possible expiration of federal incentives at the end of 2012
  - Continued low natural gas and wholesale electricity prices
  - Inadequate transmission infrastructure in some areas
  - Modest electricity demand growth and need for new capacity
  - Softer incremental demand from state RPS markets in near term
  - Growing competition from solar energy in some regions of the country

U.S. Is on a Trajectory that May Lead to 20% of Electricity Coming from Wind

But ramping up further to ~16 GW/year and maintaining that pace for a decade is an enormous challenge, and is far from pre-determined; forecasts for growth in 2013 and 2014 are below the 20% trajectory



For More Information...

See full report for additional findings, a discussion of the sources of data used, etc.

- http://www1.eere.energy.gov/wind//

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