State of the U.S. Wind Power Market:

Preview of the "2011 Wind Technologies Market Report"

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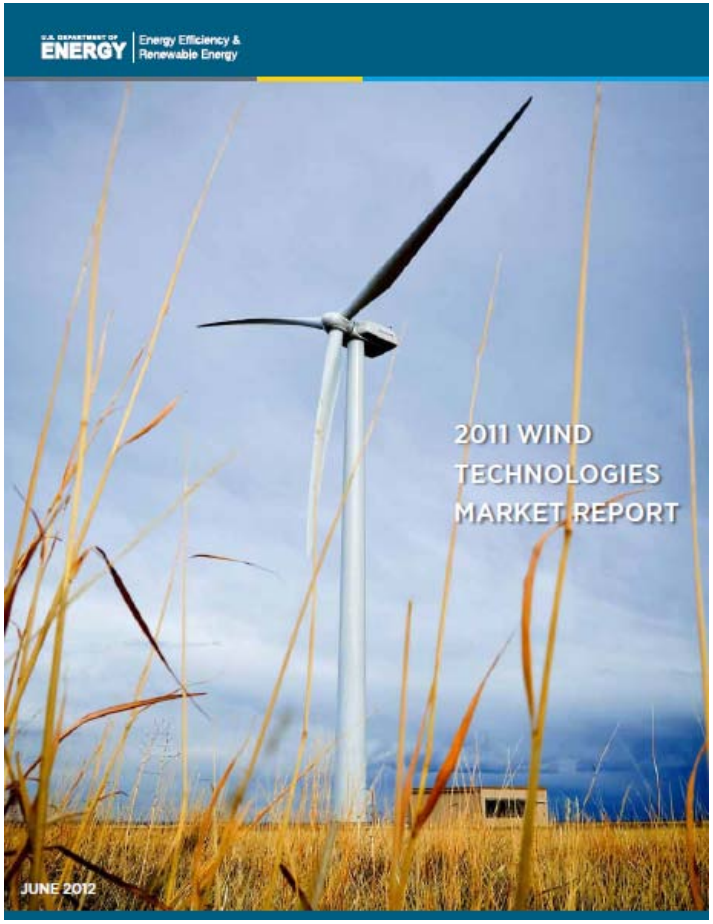
2011 Wind Technologies Market Report

- Publicly available annual report summarizing key trends in the U.S. wind power market
- Current report will focus on 2011; scope primarily includes utility-scale wind projects; data sources are numerous and diverse
- Funded by the U.S. DOE's Wind and Water Power Program, with multiple content contributors
- Expected to be available in mid-July 2012: http://www1.eere.energy.gov/wind/

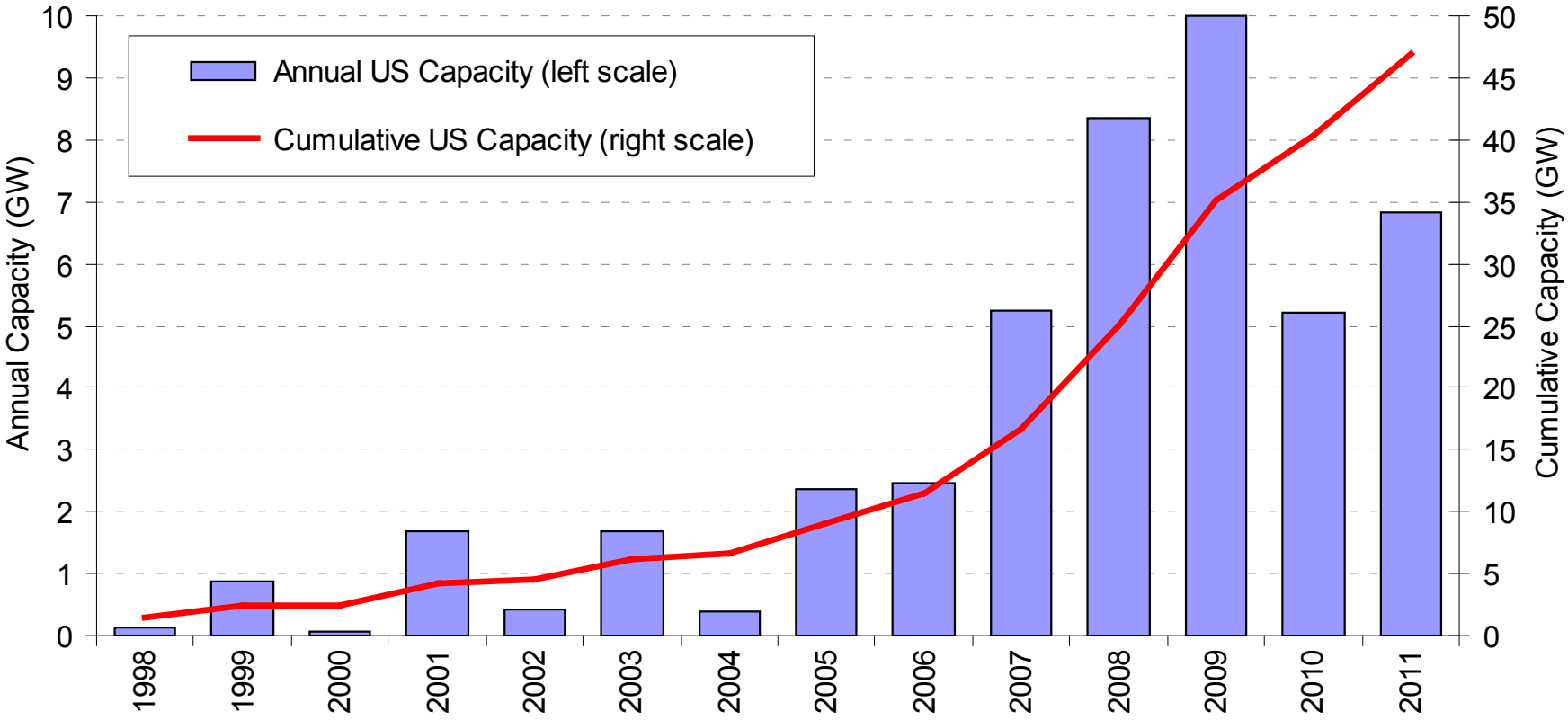
Report Contents

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



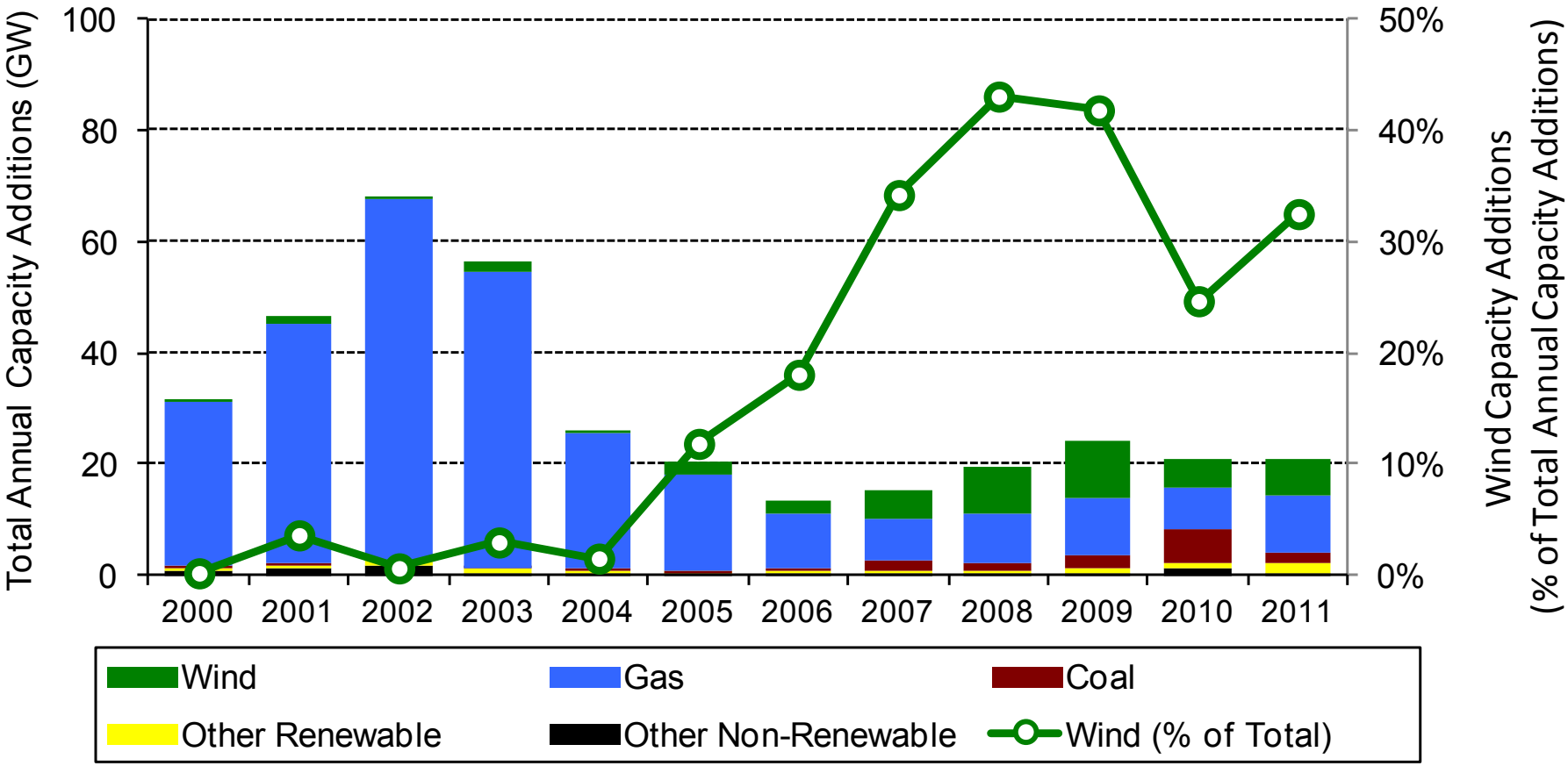
This presentation covers a subset of the content, with an emphasis on cost/performance/pricing trends

New Wind Capacity Up in 2011, But Still Less Than in 2008 and 2009



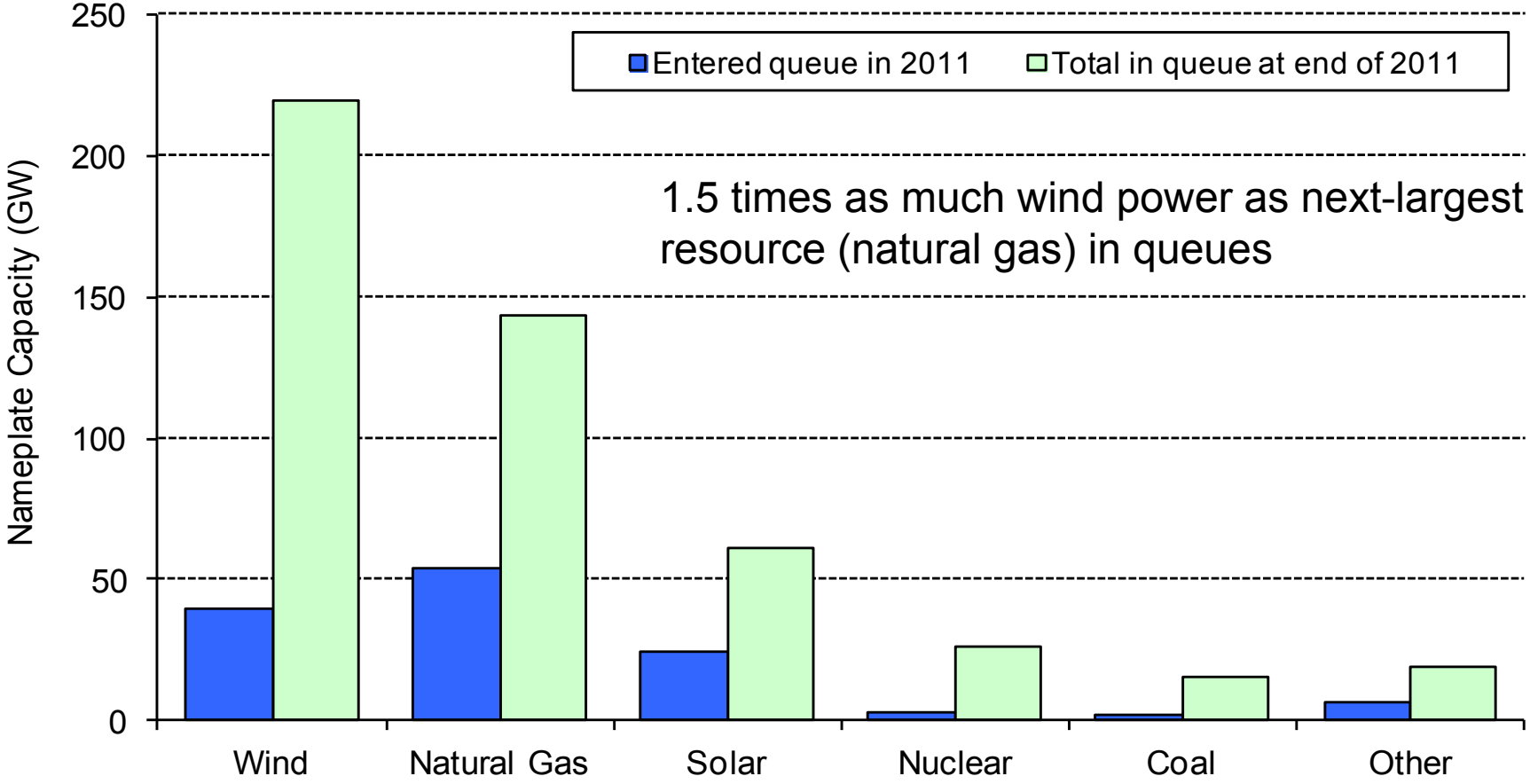
- 6,816 MW added in 2011, a $14 billion of investment
- Cumulative capacity increased by 17% to 47 GW

Wind is a Major Source of New Capacity: 33% in 2011, Second Only To Gas



Source: EIA, Ventyx, AWEA, IREC, SEIA/GTM, Berkeley Lab

Interconnection Queues Suggest That Wind and Gas Will Continue to Dominate



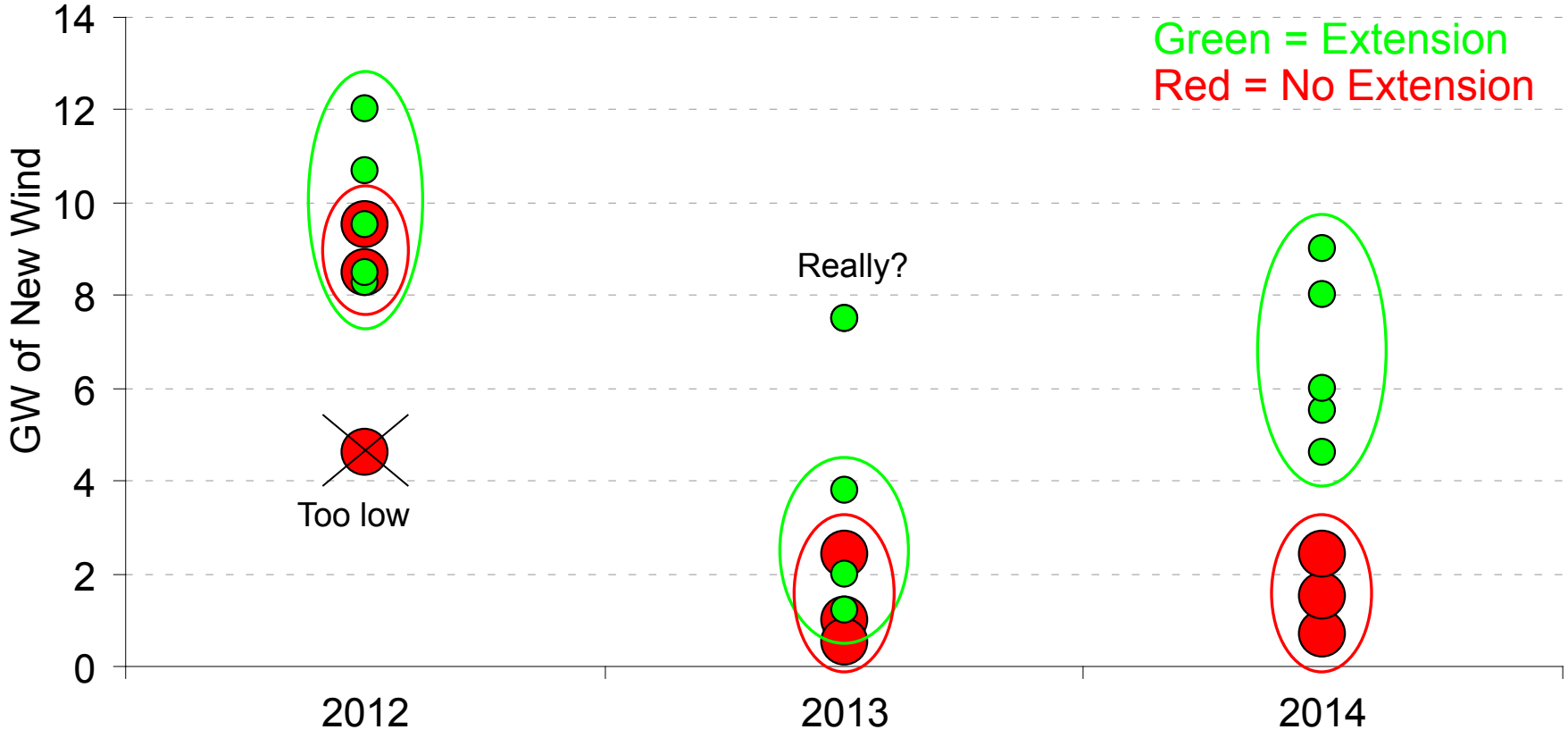
Not all of this capacity will be built….

Wind Build Forecasts Reveal Developer Optimism in the Interconnection Queues

PTC Assumption	Source	2012 (MW)	2013 (MW)	2014 (MW)	Cumulative 2012-2014
No Extension	EIA	4,600	1,000	700	6,300
	Bloomberg NEF	9,500	500	1,500	11,500
	Navigant	8,500	2,400	2,400	13,300
Extension	Bloomberg NEF	9,500	2,000	5,500	17,000
	MAKE	10,700	3,800	4,600	19,100
	IHS EER	12,000	1,200	6,050	19,250
	Navigant	8,500	7,500	8,000	24,000
	BTM	8,250	7,500	9,000	24,750

The most aggressive forecast under a PTC extension scenario is less than 25 GW in aggregate from 2012-2014 (i.e., less than 1/8 of the wind capacity in the interconnection queues at the end of 2011)

PTC Extension vs. No Extension Scenarios: Projections Do Not Materially Differ Until 2014



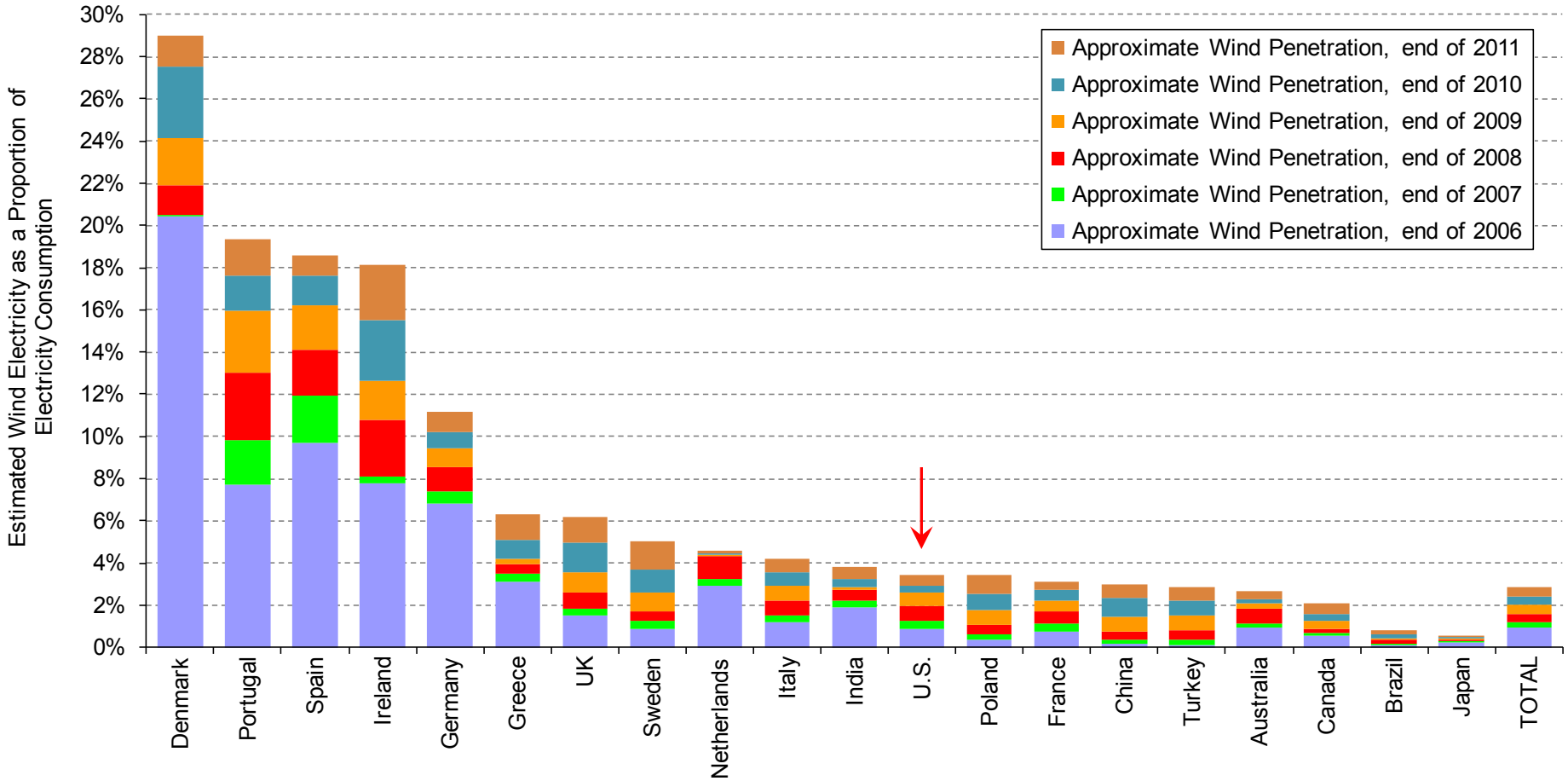
- Whether or not the PTC is extended, 2013 is likely to be a “lost year”
- At this point, even a 2-year extension would feel more like a 1-year extension

Globally, the US is Second (to China) in Both New and Cumulative 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

Wind Capacity at End of 2011 Equates to ~3.4% of U.S. Electricity Consumption



Note: Figure only includes the 20 countries with the most installed wind capacity at the end of 2011

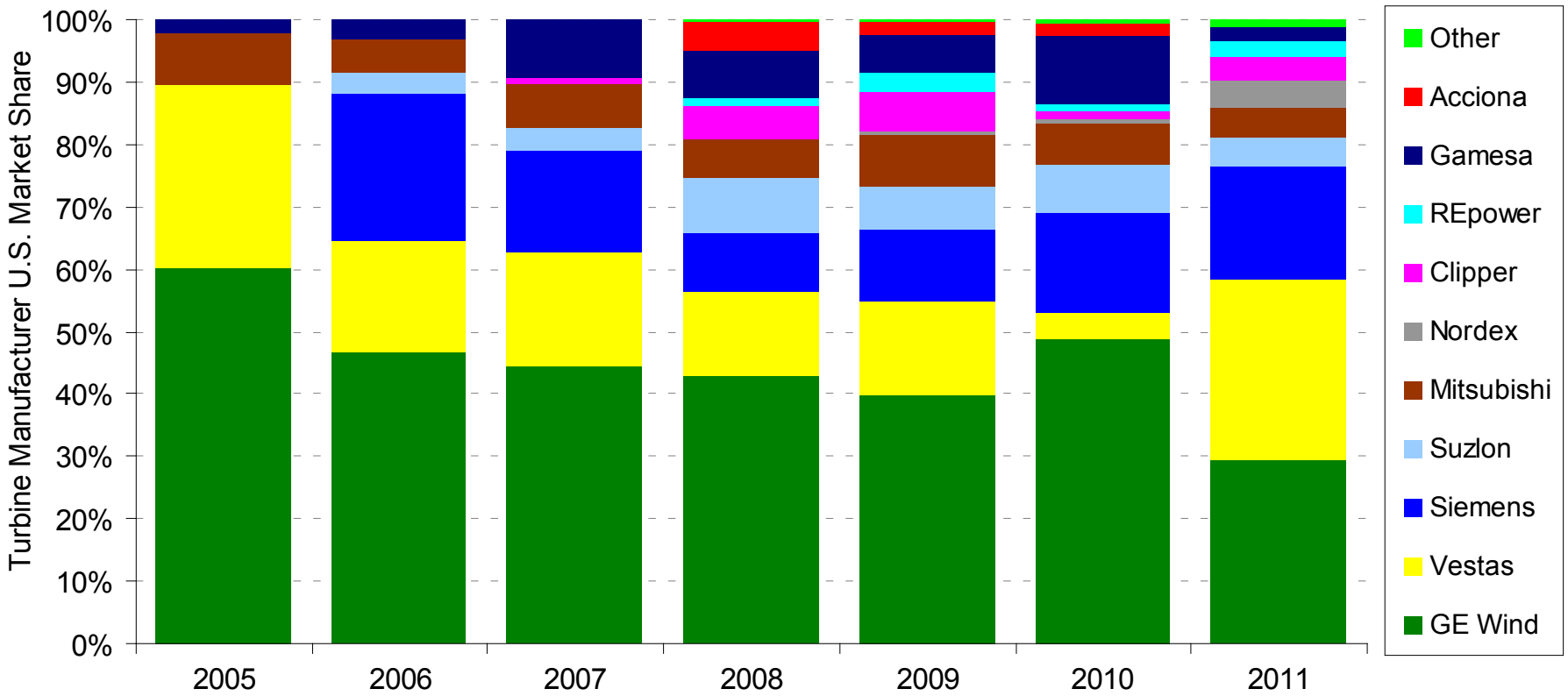
Top 20 States All Have > 500 MW; Six States Have Achieved > 10% Wind

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%**

At end of 2011:

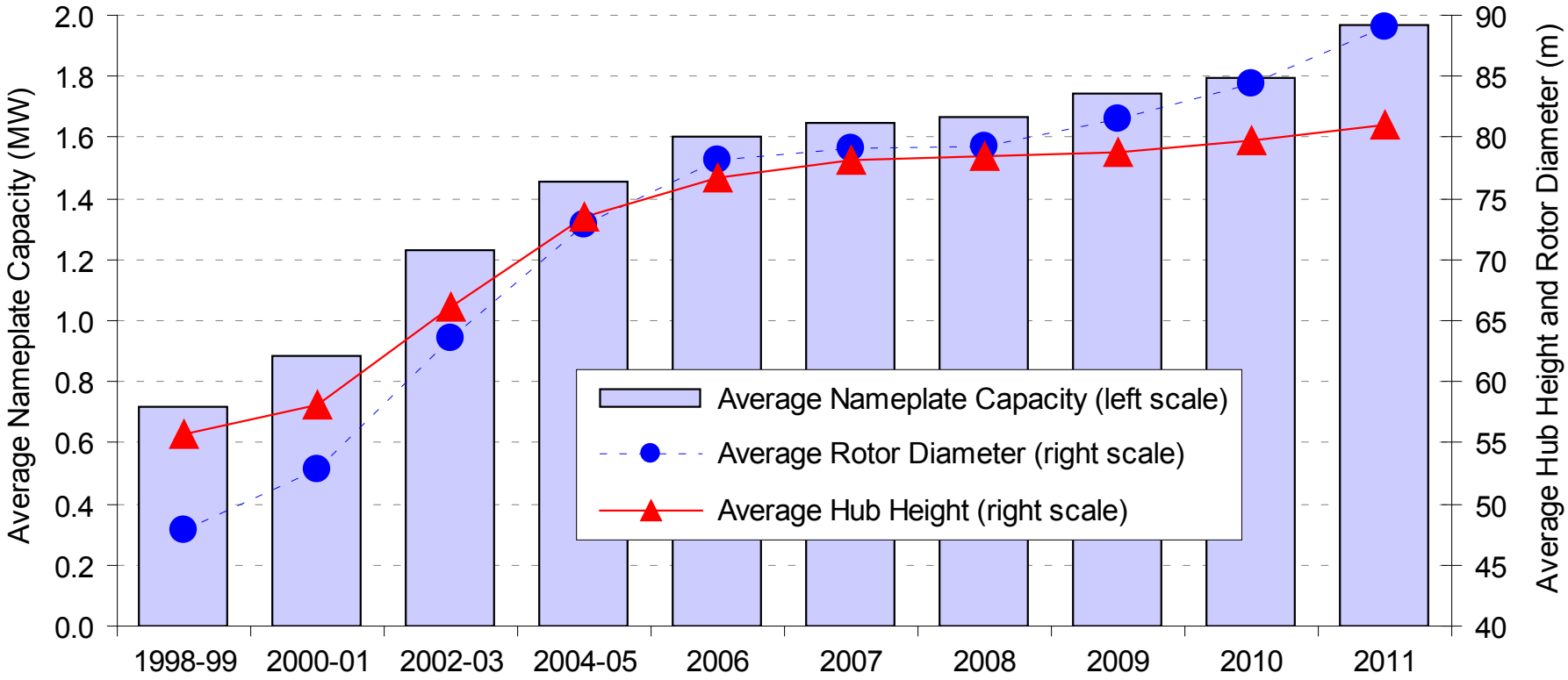
- 8 states had >2000 MW of wind capacity (14 had >1000 MW)
- 2 states had the ability to provide >20% of total in-state generation from wind (6 states >10%, 14 states >5%)

GE Tied With Vestas For Top US Market Share in 2011



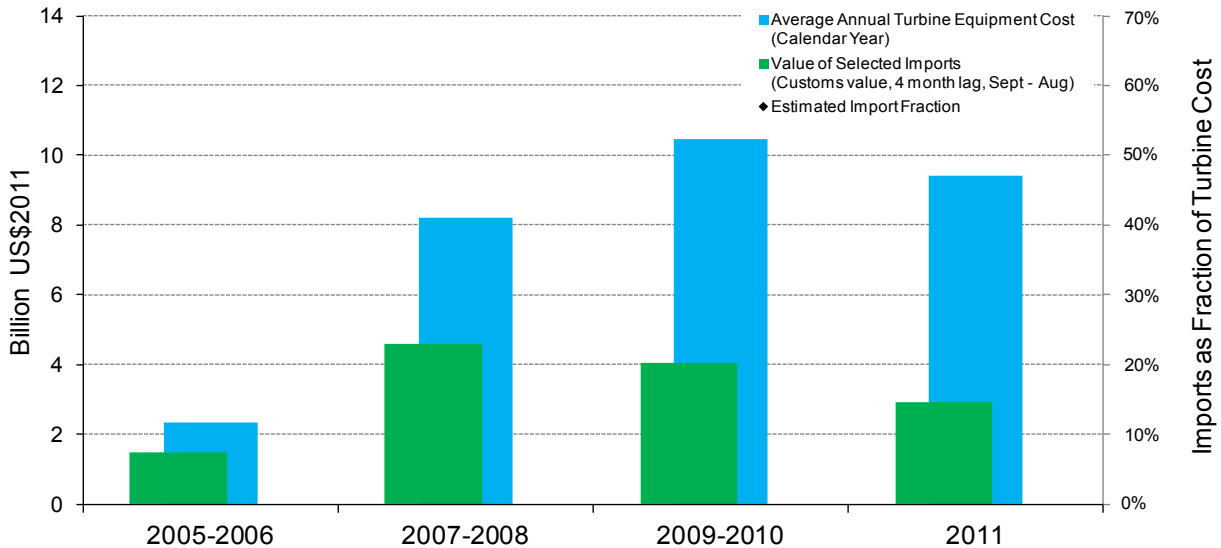
- Though the number of OEMs serving the US has increased, the "big three" (GE, Vestas, Siemens) have actually *gained* market share since 2008/2009
- Potentially reflects a focus on "bankable" turbines that grew out of the financial crisis

Turbine Scaling Experiencing a Second Leg Up

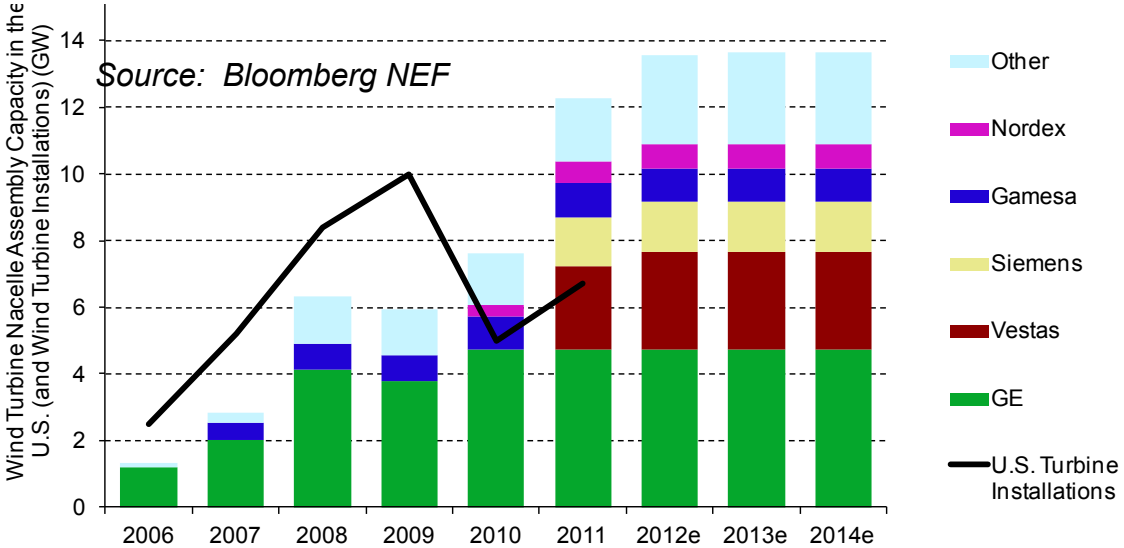


- 42% of turbines installed in 2011 were >2.0 MW, up from 28% in 2010
- Recent spurt in rotor scaling reflects proliferation of low wind speed designs

Domestic Manufacturing Increased in 2011, Even in the Face of Market Uncertainty

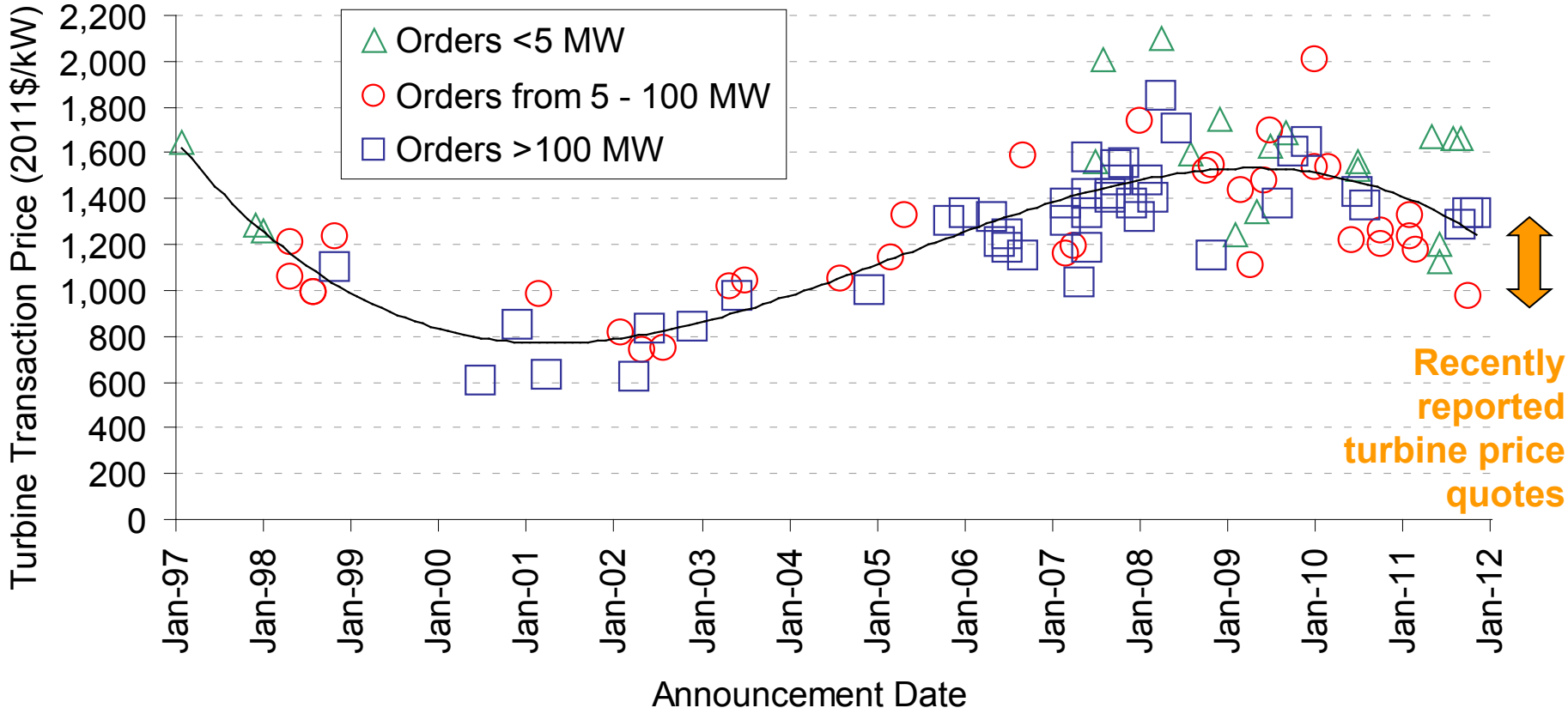


- A growing % of turbine equipment used in US projects has been sourced domestically – roughly 70% in 2011, up from 35% in 2005-06



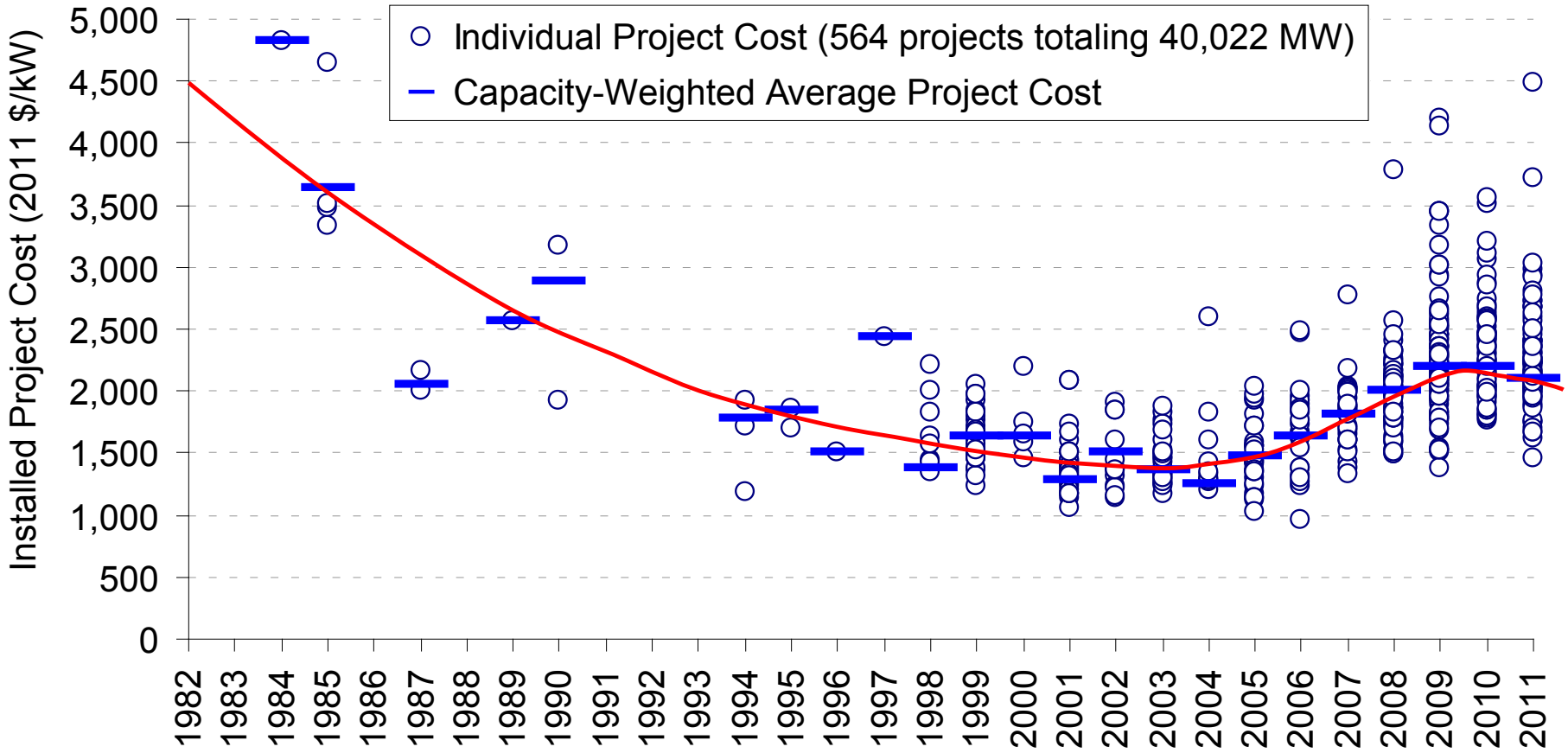
- The US now has almost 14 GW of nacelle assembly capacity
- 2012 may end up utilizing much of this capacity, but 2013 is likely to cause severe pain

Wind Turbine Prices Have Softened Since the Highs of 2008



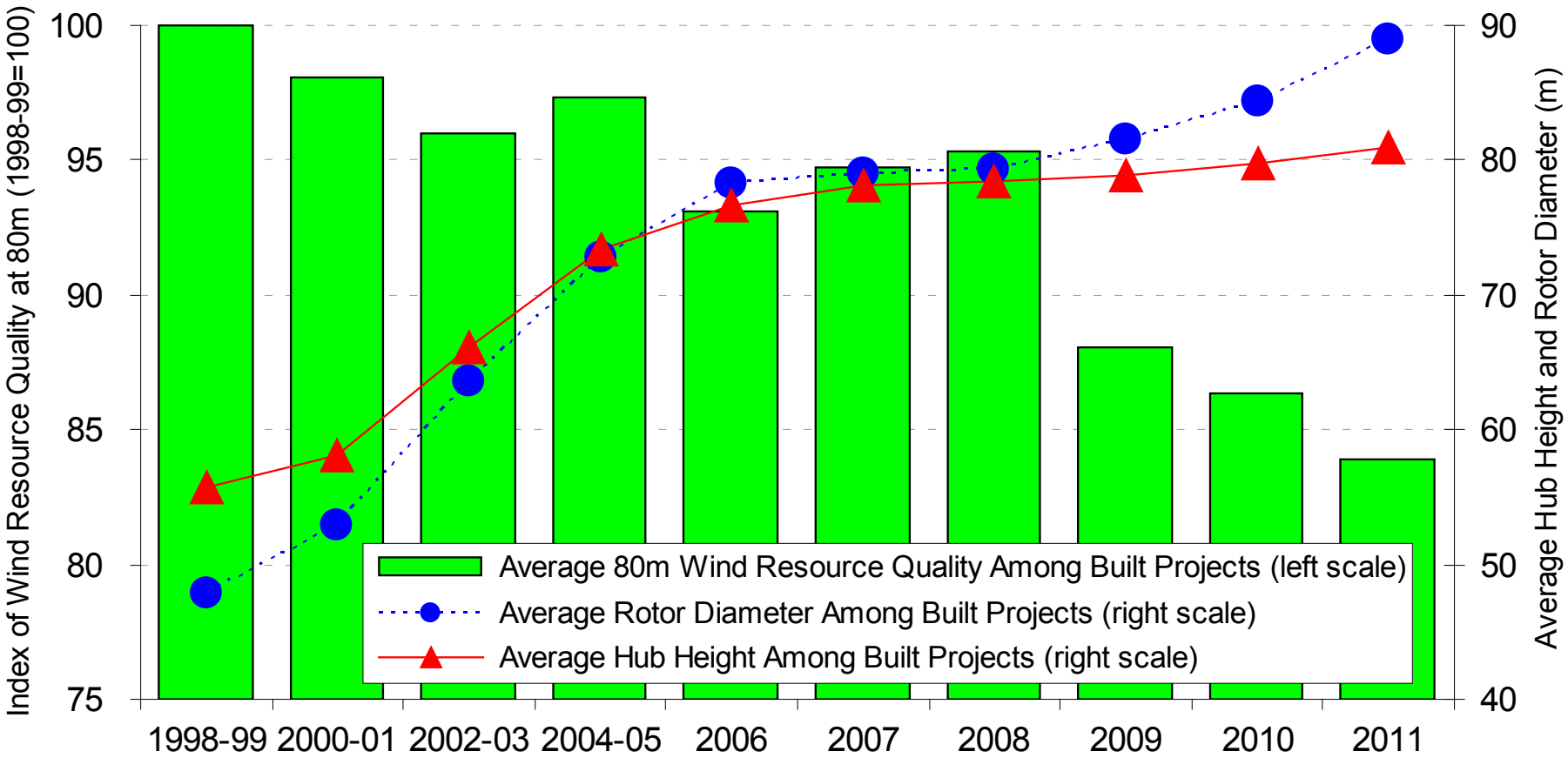
Recent visibility is low, due to dearth of orders for 2013 and beyond

Lower Turbine Pricing Has Been Slow to Influence *Reported* Installed Project Costs



Reported installed project costs appear to be turning the corner (and could be inflated somewhat by Section 1603 incentive)

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



Large drop in site resource quality (at 80m) in 2009-2011 coincides with latest spurt in rotor scaling – not clear which is driving which (and both could be influenced by the availability of Section 1603 grants in these years)

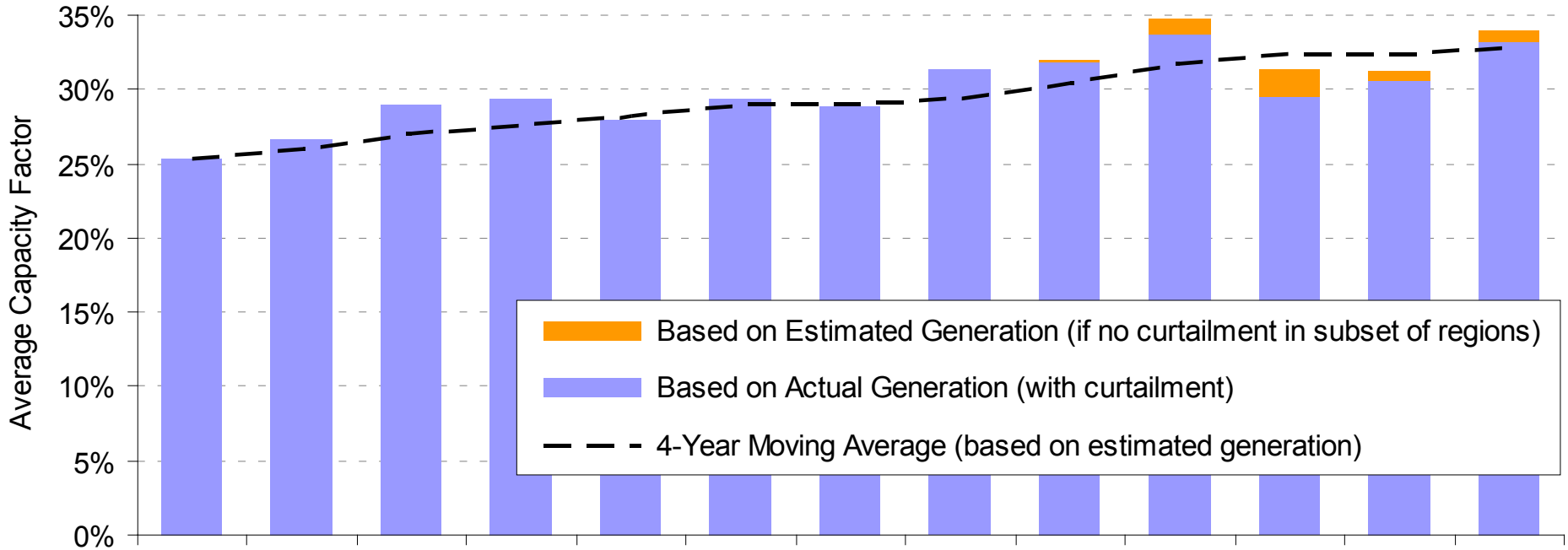
Curtailment Also Impacts Project Performance in Some Regions

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 6 Areas:	**109 (1.2%)**	**1,445 (5.6%)**	**4,183 (9.6%)**	**2,978 (4.8%)**	**3,526 (4.8%)**

2011 curtailment within these six areas equals the annual output of roughly 1,200 MW of wind power (assuming a 33% capacity factor)

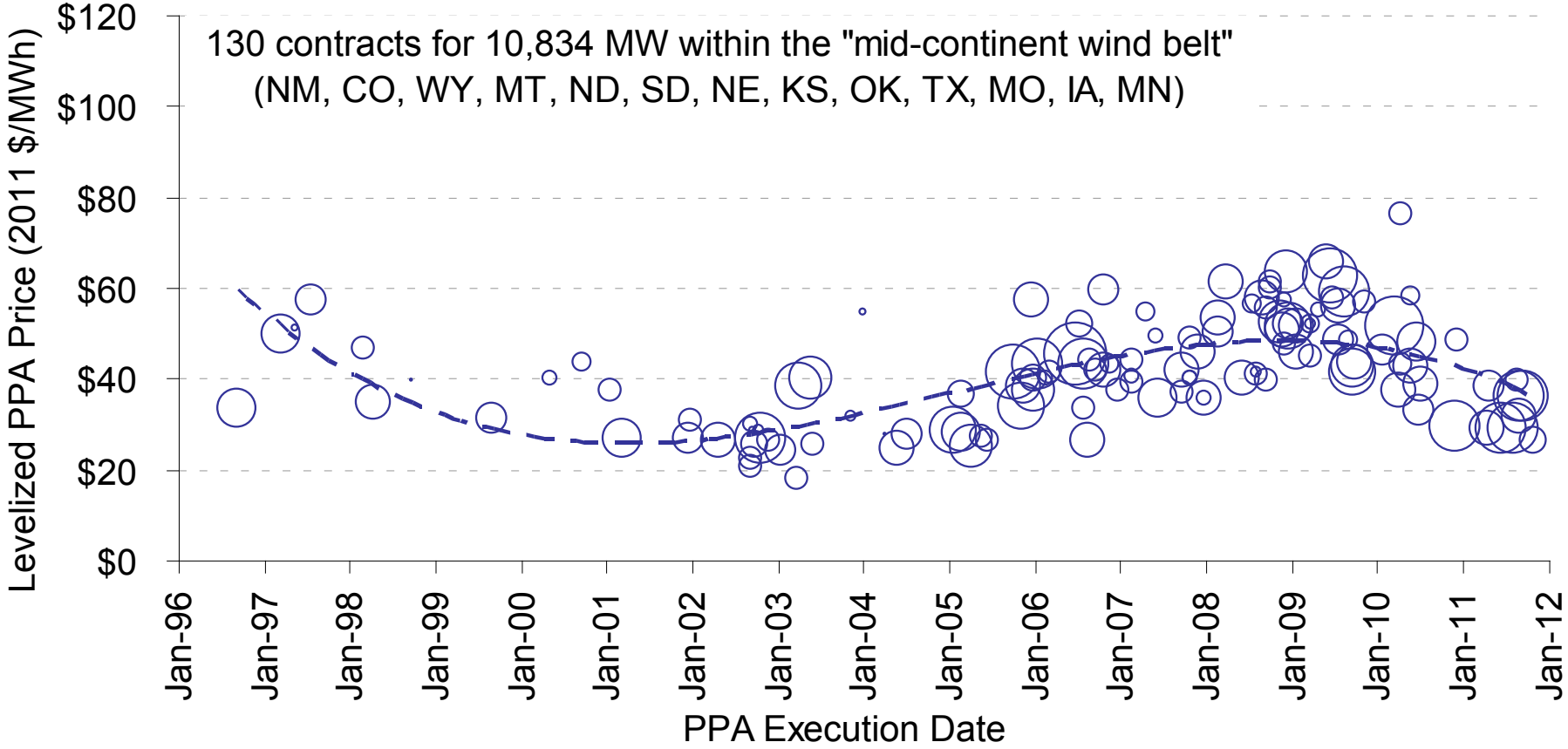
Nevertheless, Fleet-Wide Average Capacity Factors Have (Generally) Increased Over Time



Year:	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Projects:	5	12	40	83	96	118	142	167	209	253	353	465	398
MW:	544	1,000	1,519	3,259	3,800	5,200	5,868	8,700	10,684	15,658	24,356	34,201	37,615

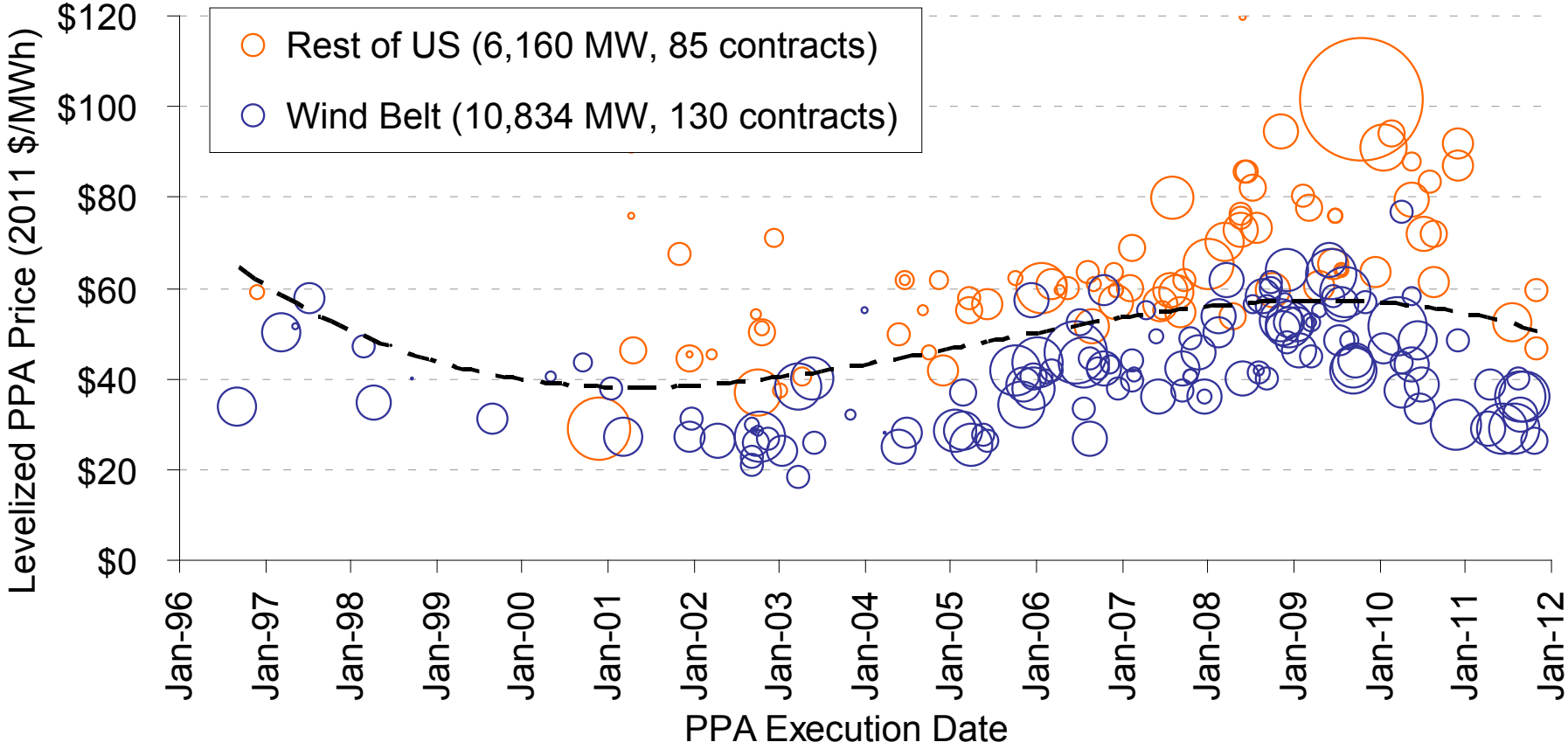
If no curtailment, fleet-wide average capacity factors would have been at least 1-2 percentage points higher from 2008-2011

Empirical PPA Price Data From Mid-Continent "Wind Belt" Demonstrate Low/Declining Prices



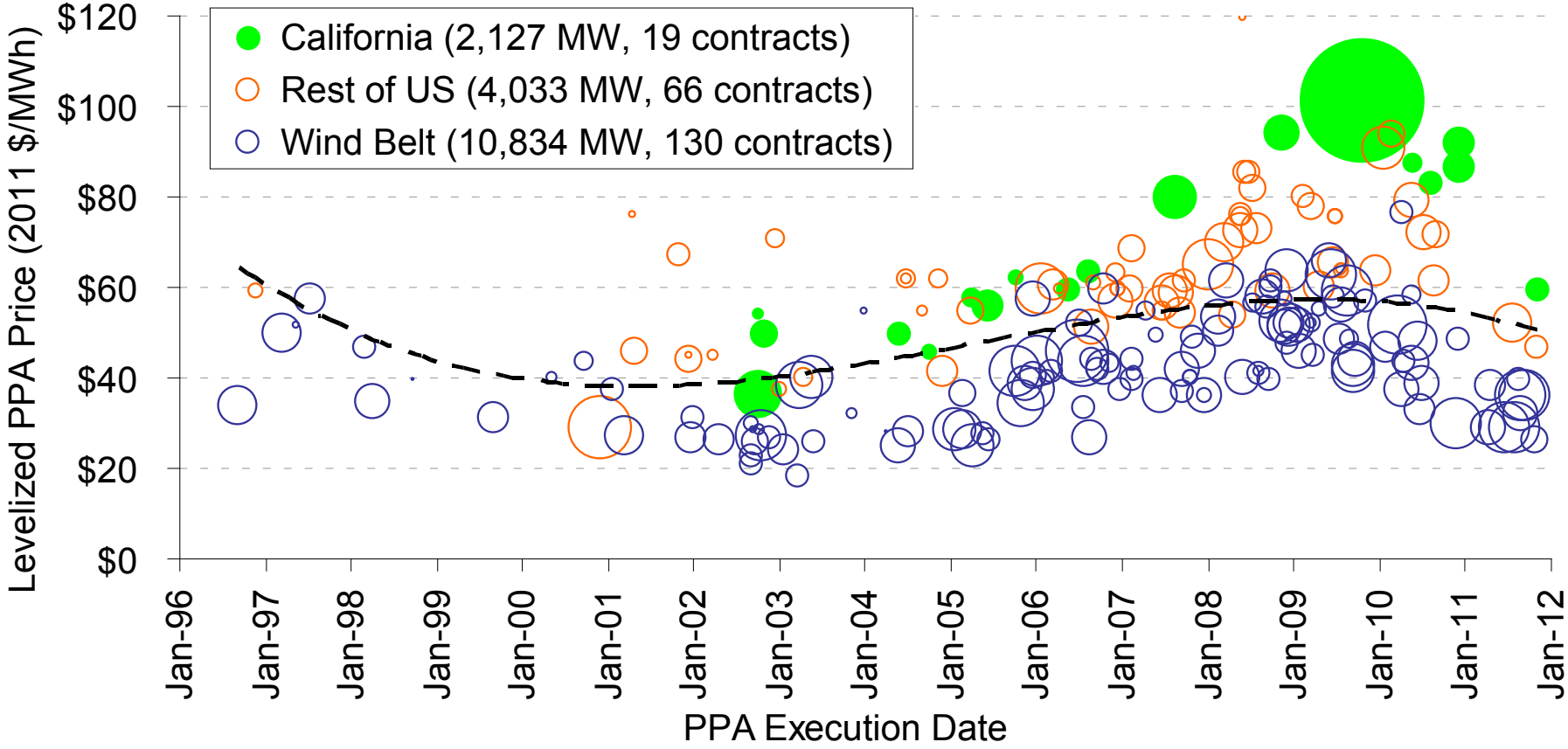
Sample restricted to "mid-continent wind belt" in a crude attempt to control for wind speed, and thereby emphasize the time trend

But Prices Are Higher Outside of the "Wind Belt"



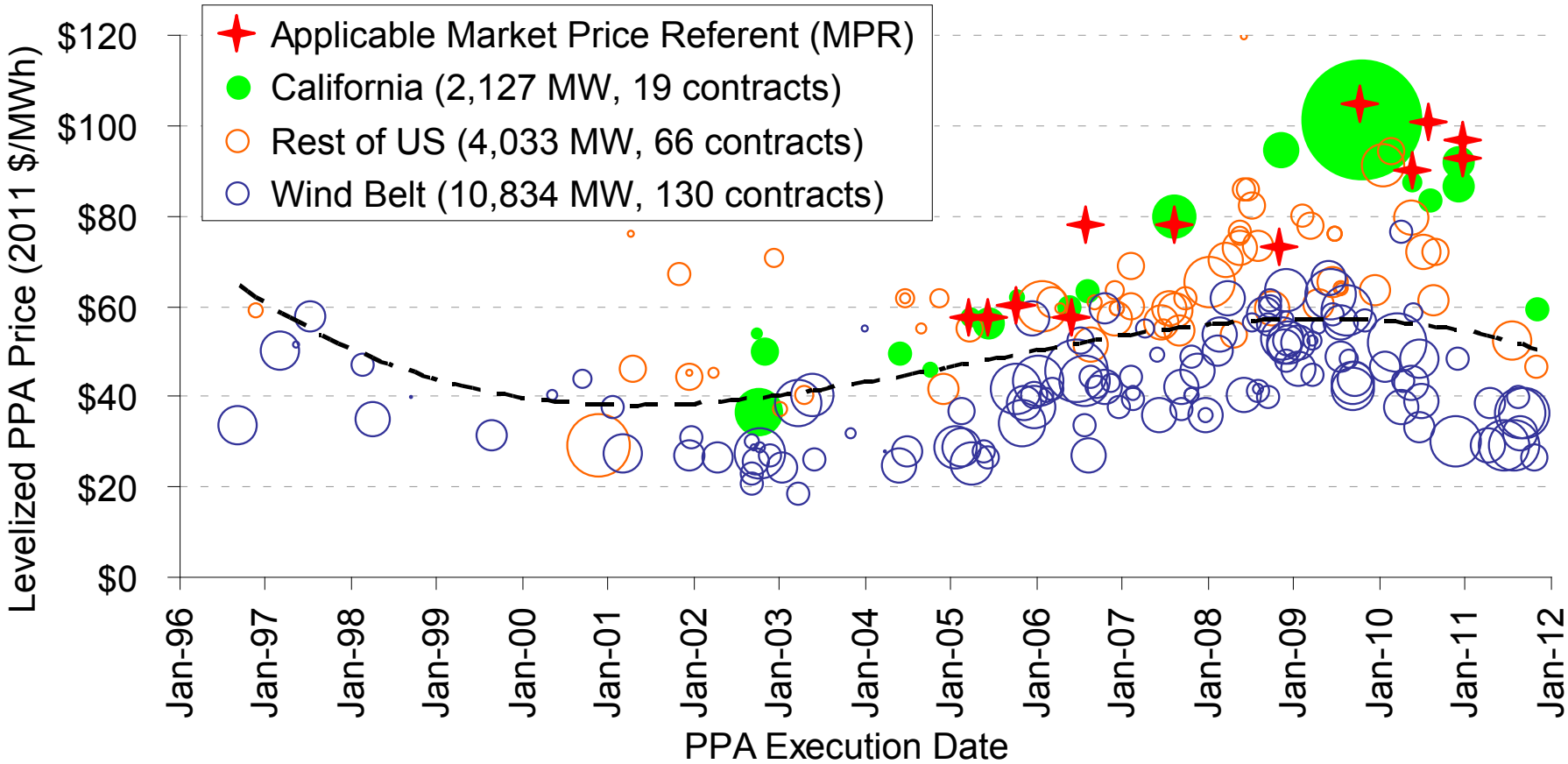
The full-sample "best fit" line almost perfectly divides the "wind belt" from the rest of the US

Prices Have Been Particularly High in California



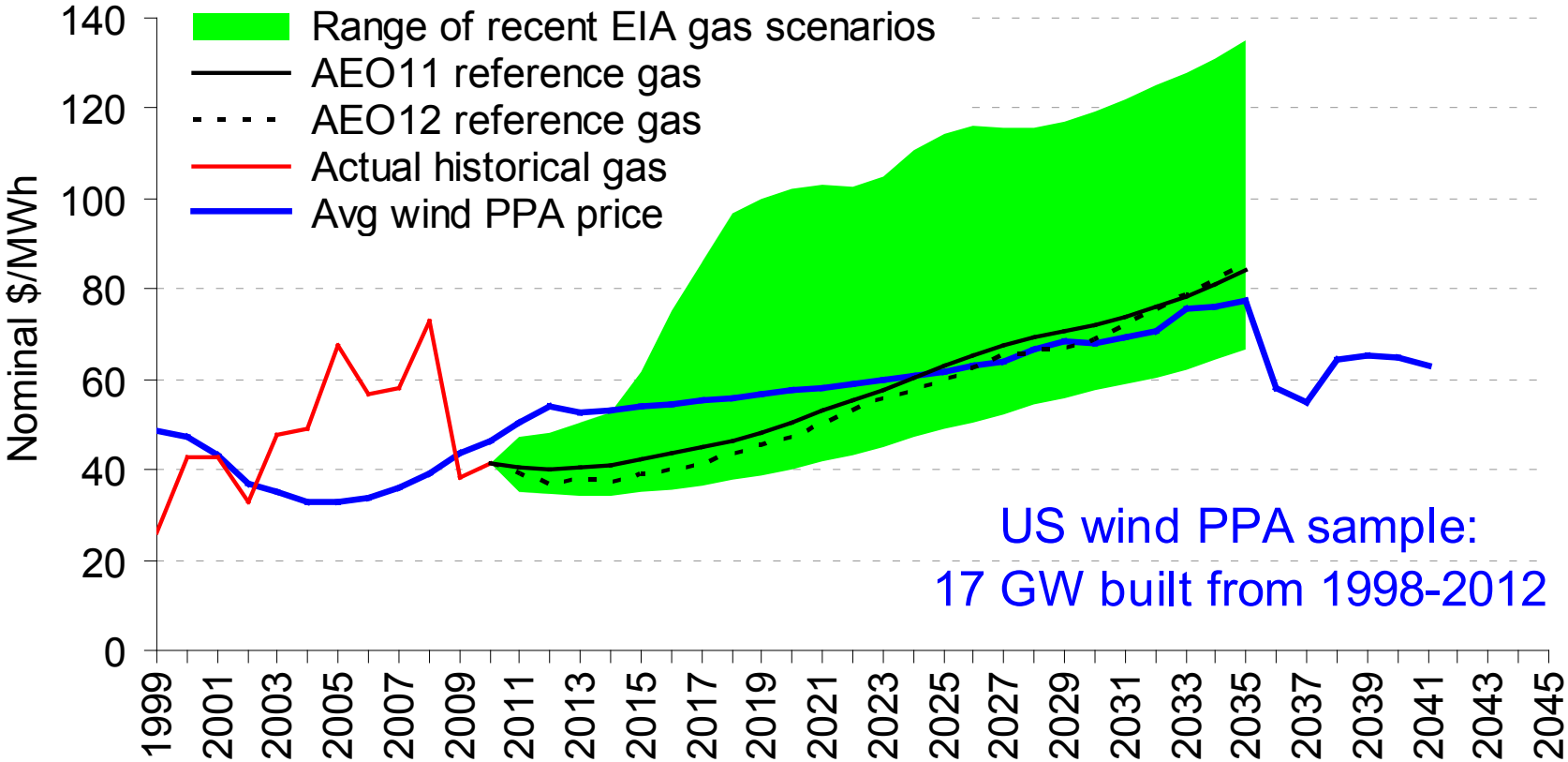
California has not always been such an outlier (see 2002-2006 projects), suggesting that something has changed…

CA's RPS Policy Design Could Be A Driver



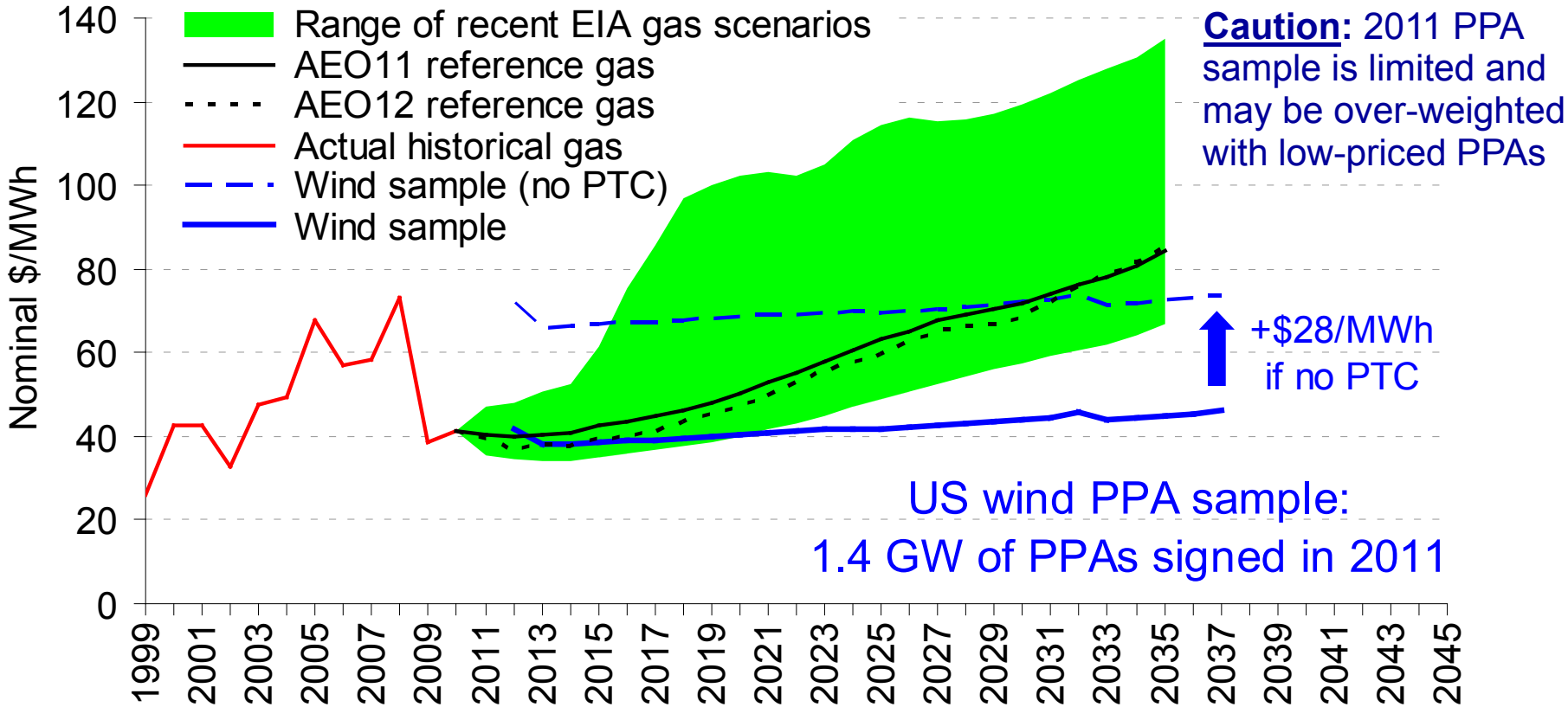
The Market Price Referent (MPR) – a measure of the all-in cost of building new gas-fired generation, and the benchmark against which most CA RPS contracts are measured – may have inflated wind PPA prices in California

This Same PPA Sample Compares Favorably To A Range of Natural Gas Price Forecasts



- The average wind PPA price exceeds reference case gas projections until 2024
- ***BUT*** wind enters the green "cone of uncertainty" much earlier, and after 2014 serves as an effective hedge against many of the higher-priced gas scenarios

A Sub-Sample of Just the Most Recent Wind PPAs is Much More Competitive



- Focusing only on the most recent contracts, wind (or at least this limited sample) is fully competitive with natural gas price projections
- ***BUT*** if the PTC expires, wind as a "fuel saver" will be less compelling, even at today's lowest wind prices (though some long-term hedge value will remain)

Conclusions

It Was the Best of Times…	…And The Worst of Times
Wind has become a credible source of new generation/capacity in the US…	…but little new generation/capacity is needed (also less RPS demand than in the past).
Lower turbine prices and better performance have enabled very aggressive PPA prices…	…but low gas and wholesale power prices have lowered the bar in lock step.
Domestic manufacturing capacity has ramped up considerably…	…but much of this new capacity will soon be idle, due to PTC uncertainty.
2012 could be a record-setting year in terms of new build…	…but 2013 will be a very slow year, even if the PTC is extended.

"That which does not kill us makes us stronger" **– Wind should be well-positioned when "the worst of times" get better**