

The Future of Wind

Kansas Wind & Renewable Energy Conference '09

Jim Walker

Vice Chairman, enXco

Past President, American Wind Energy Association

***“It’s tough to make predictions, especially about the future”
Y. Berra, American Philosopher***



First, a word about my sponsor

Installed Capacity : 863 MW
Under Construction : 173.5 MW
Announced Developments : 450 MW
Total Project Development : 1929.5 MW



Owner/Developed/Financed/EPC/O&M	Owner/O&M	Developed/EPC	EPC/O&M	Other Role
Owner/Developed/EPC/O&M	Developed/Financed/EPC/O&M	Developed/O&M	O&M	
Owner/EPC/O&M	Developed/EPC/O&M	Developed	In-Development Under EDF-EN Canada	

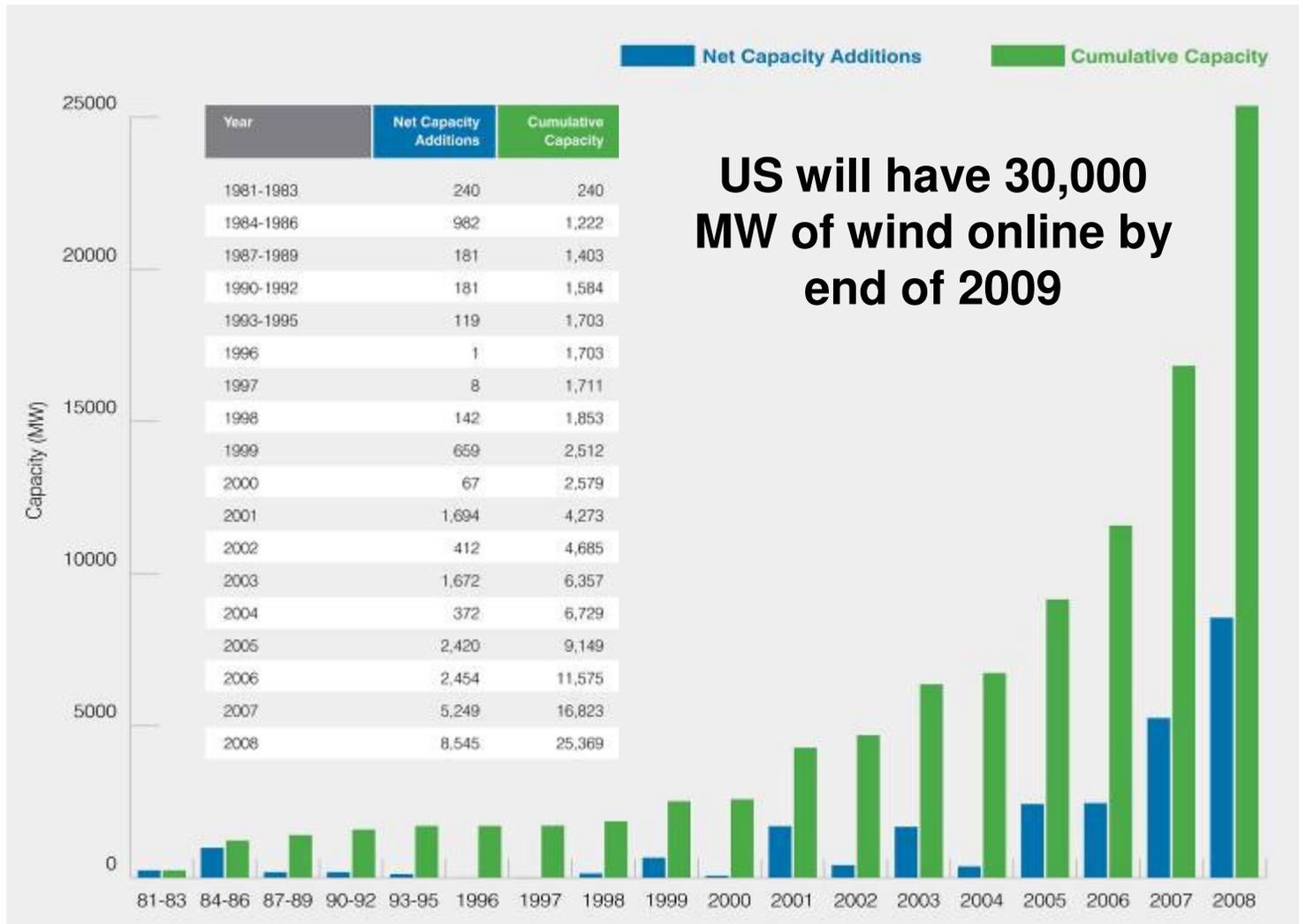


2008 Was a Banner Year for Wind

- ▶ 9,500 MW installed in the US in the 12 month period from 1 April 2008 to 31 March 2009
- ▶ Investment in wind projects in US grew from \$700M in 2004 to **\$17B** in 2008 (\$48B worldwide)
- ▶ US surpassed Germany as the world leader in new installations, total wind capacity and annual output
- ▶ **35,000 jobs** were added in wind industry in 2008, raising total to 85,000, compared to 82,000 for the coal industry (EIA).



U.S. Wind Project Growth





President Obama has called for the U.S. to double its production of renewable energy in 3 years

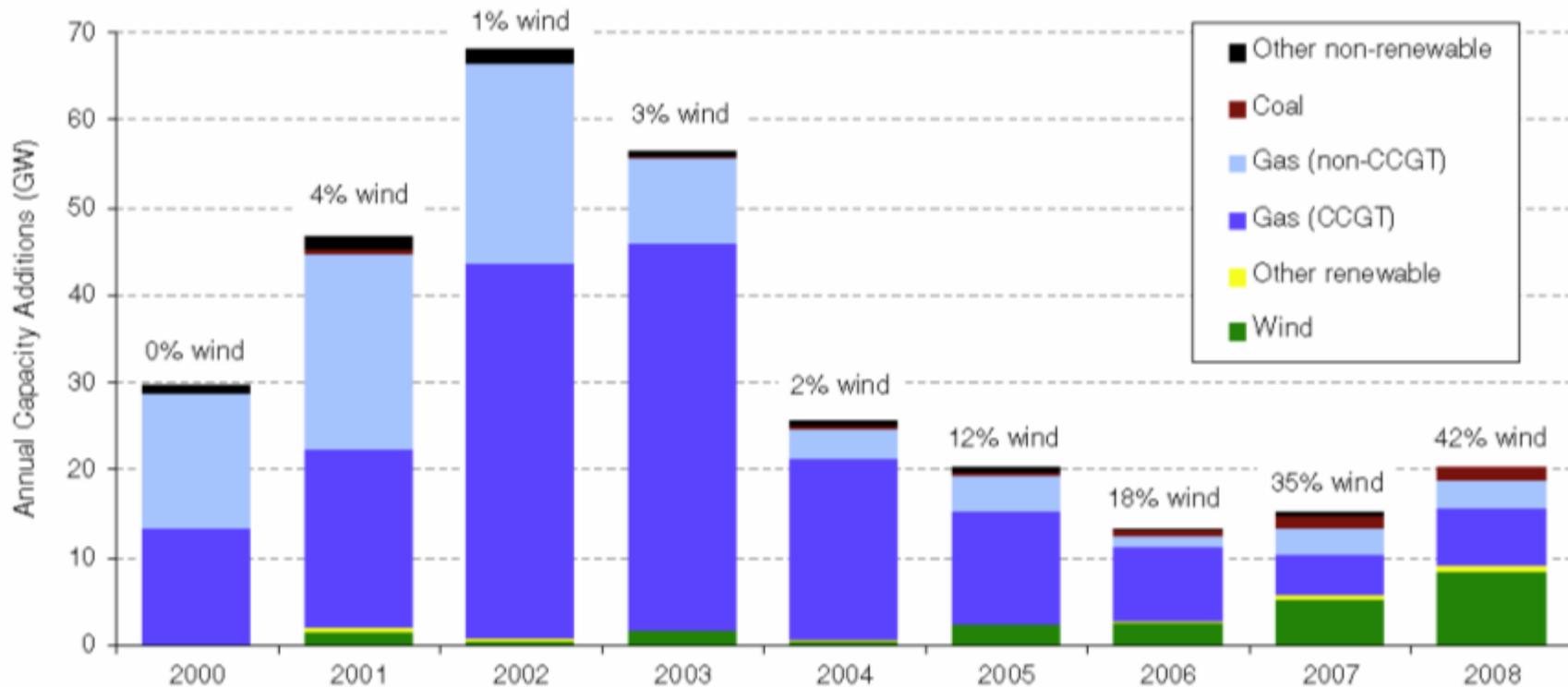
Strong Policy Support from Administration & Congress



President Obama gives “thumbs up” to wind energy industry leaders at AWEA member Cardinal Fastener manufacturing facility



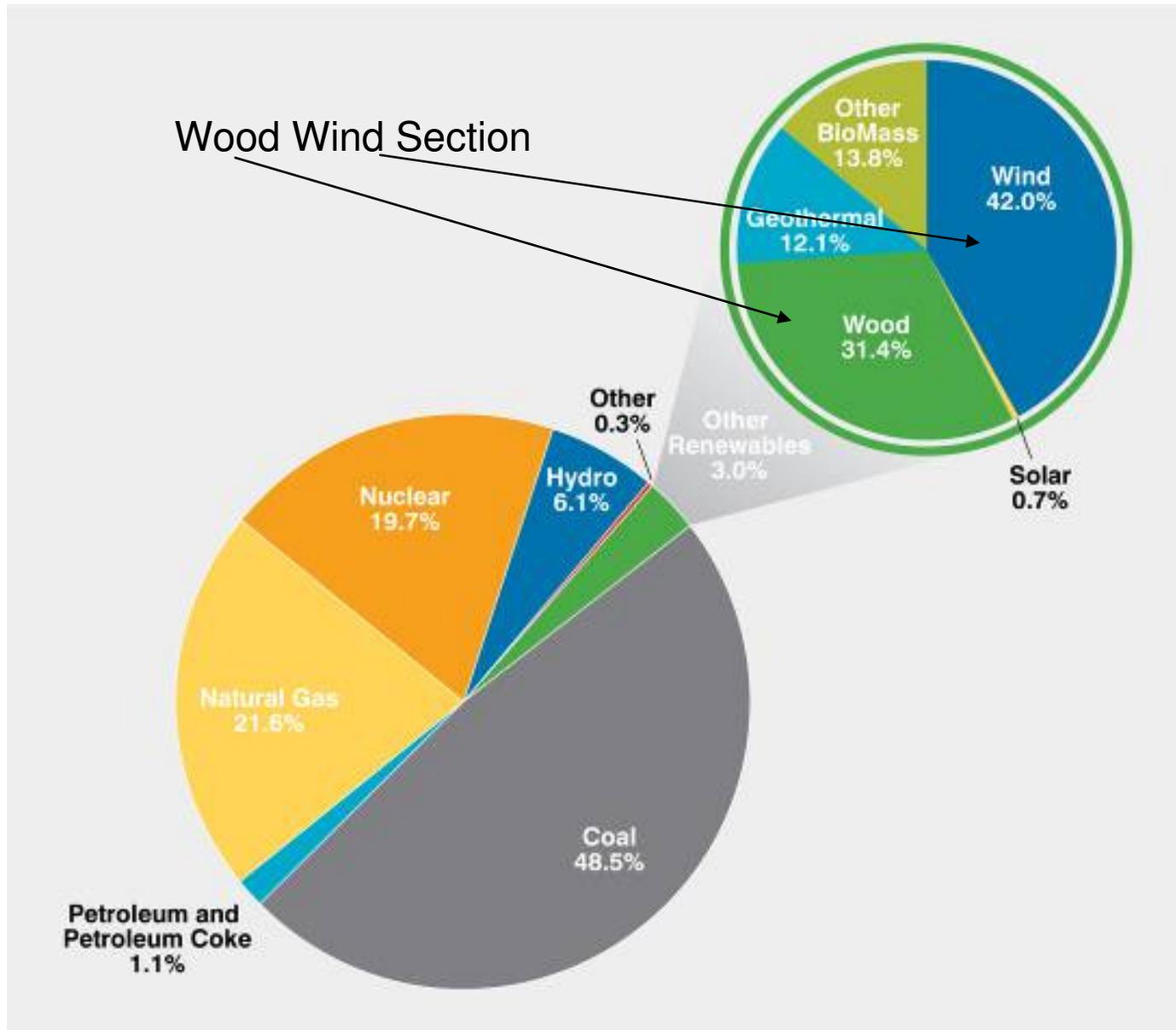
Wind Power Contributed 42% of All New Generating Capacity in the US in 2008



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



Non-Hydro Renewables Still only 3% of U.S. Electricity Generation, but Growing Fast





© UFS, Inc.

THERE'S NO HEAVIER BURDEN
THAN A GREAT POTENTIAL!

LINUS

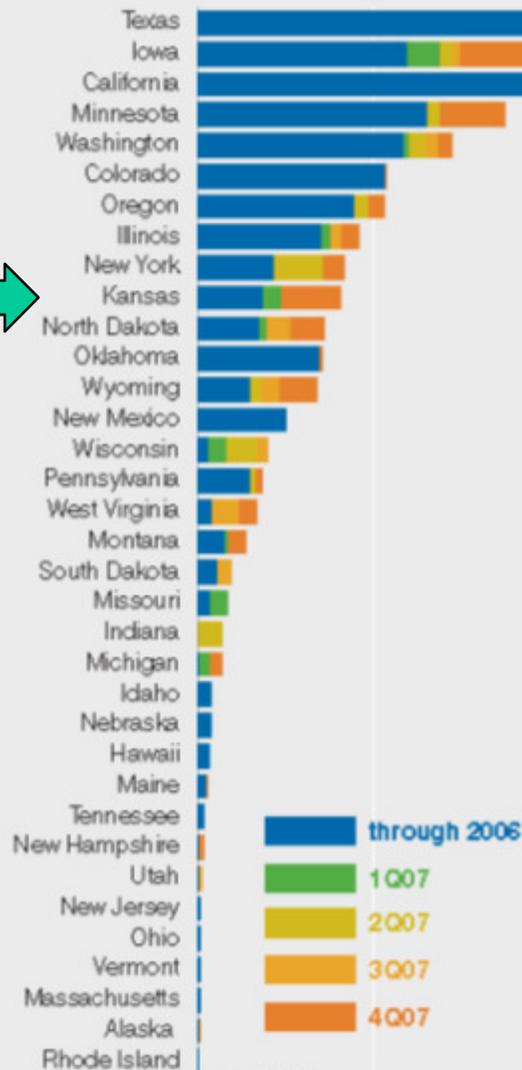


Kansas Has Great Wind Potential

- ▲ 1. North Dakota 1,210
- ▲ 2. Texas 1,190
- ▲ 3. Kansas 1,070
- ▲ 4. South Dakota 1,030
- ▲ 5. Montana 1,020
- ▲ 6. Nebraska 868
- ▲ 7. Wyoming 747
- ▲ 8. Oklahoma 725
- ▲ 9. Minnesota 657
- ▲ 10. Iowa 551
- ▲ 11. Colorado 481
- ▲ 12. New Mexico 435
- ▲ 13. Idaho 73
- ▲ 14. Michigan 65
- ▲ 15. New York 62
- ▲ 16. Illinois 61
- ▲ 17. California 59
- ▲ 18. Wisconsin 58
- ▲ 19. Maine 56
- ▲ 20. Missouri 52

And is Beginning to Live Up To It

Wind Power Capacity Growth by State



Added Most Capacity In 2008

Capacity Added In 2008

Texas	2671.3 MW
Iowa	1599.8 MW
Minnesota	455.65 MW
Kansas	450.3 MW
New York	407 MW

Fastest Growth In 2008

Growth

Indiana	first utility-scale project
Michigan	48x
Utah	21x
New Hampshire	17x
Wisconsin	6x

Highest share of electricity from wind In 2008

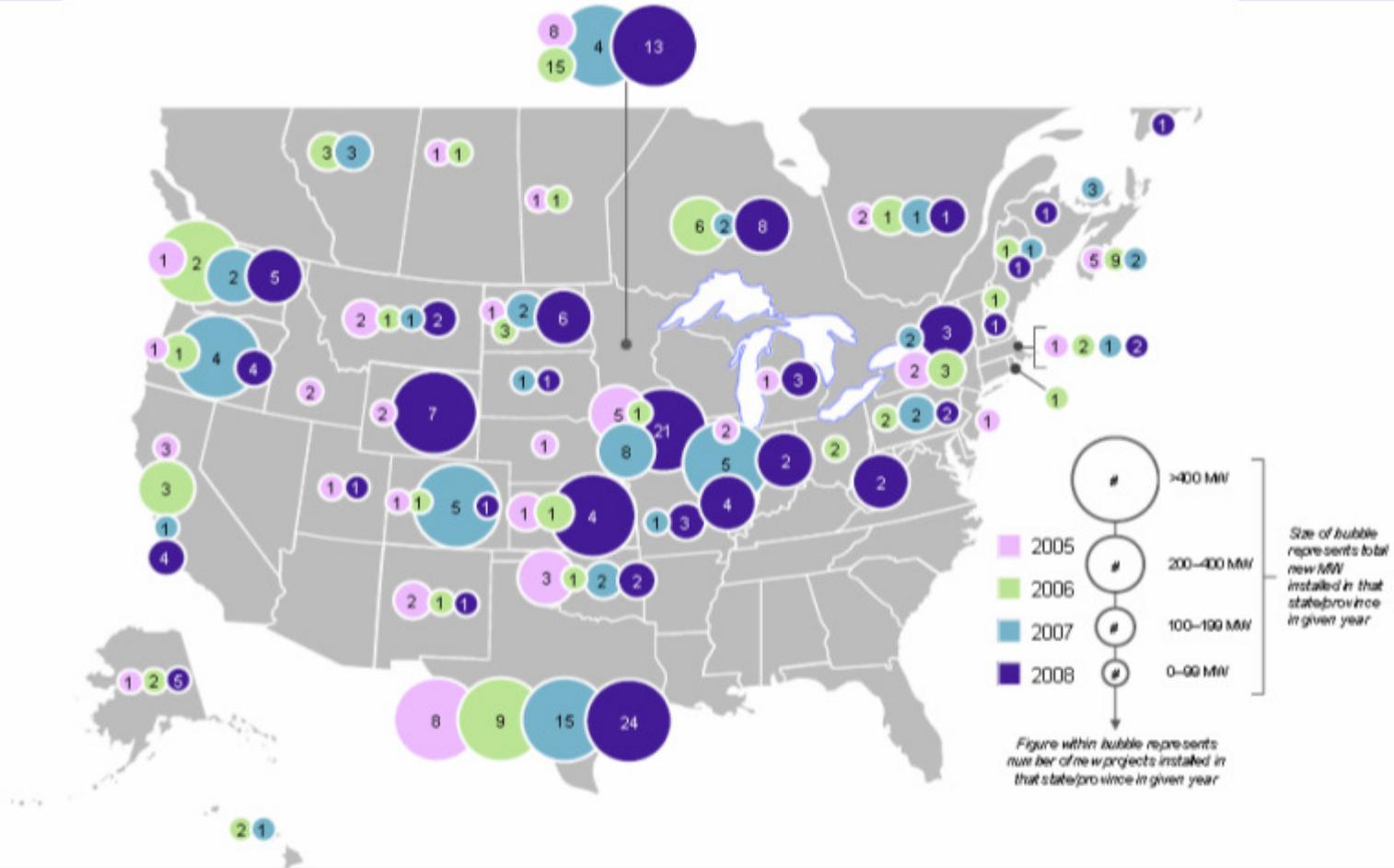
Percentage

Minnesota	7.48%
Iowa	7.10%
Colorado	5.91%
North Dakota	4.86%
New Mexico	4.41%

Source: AWEA



Kansas Prominent Among Regional Opportunities

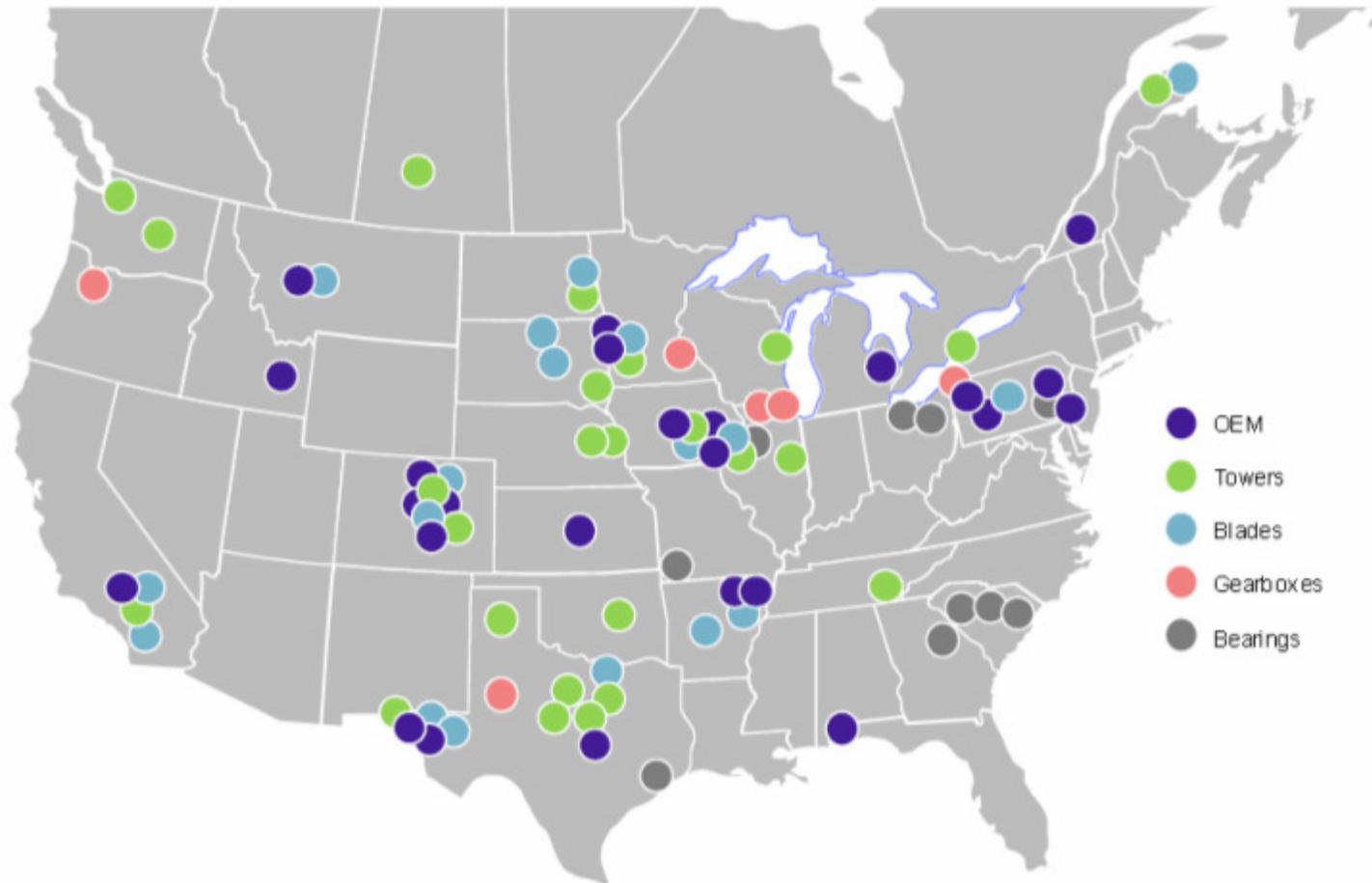


Wind development has shifted gradually further from load centers highlighting the need for transmission to sustain future growth



Kansas Is On The Wind Jobs Map

Regional Supply Chain Manufacturing Trends



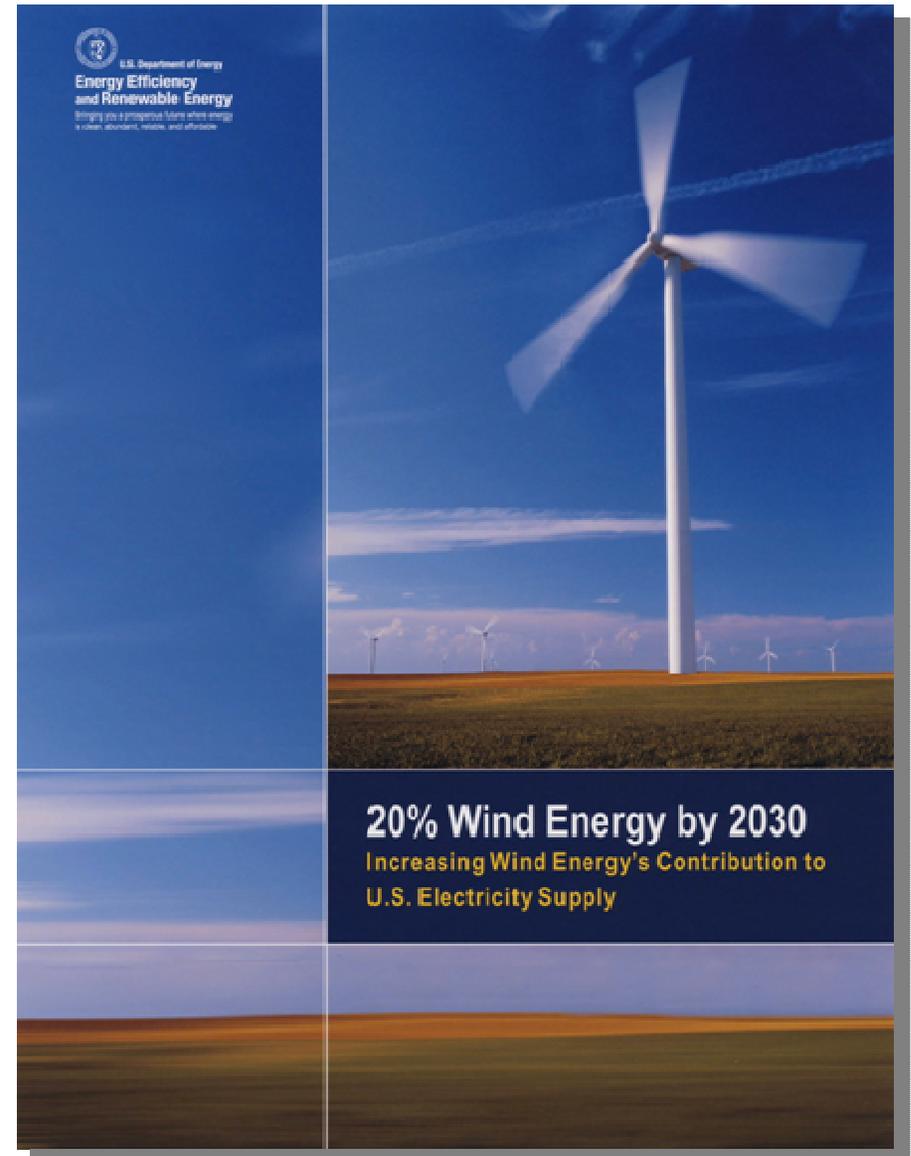
Central US leads wind supply chain investment while Hydro Quebec tenders drive investment in Canada.



20% Wind Study - US DOE May 2008

- Showed it is technically feasible to get as much of our electricity from wind by 2030 as we now get from nuclear (20%)
- Showed this would have significant positive economic benefits
- Identified key challenges to achieving such a goal

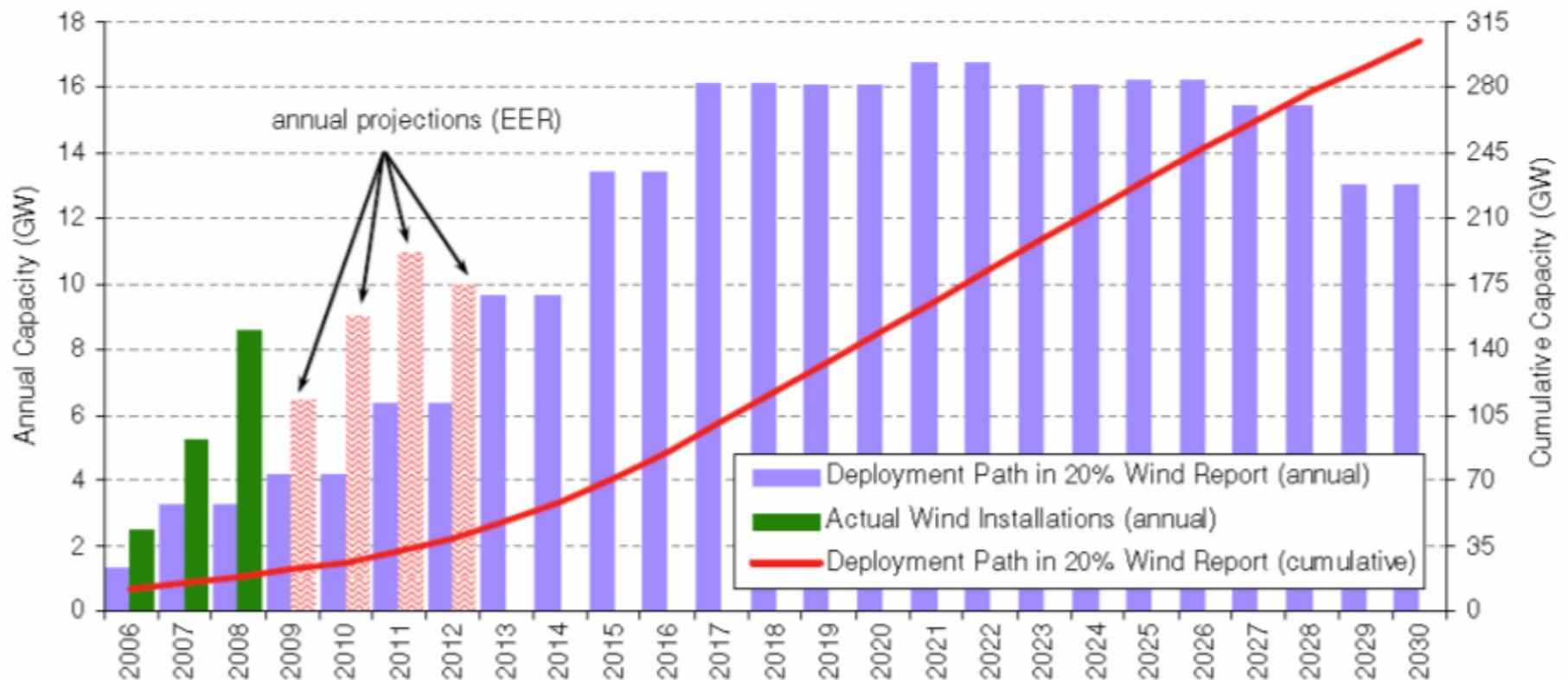
www.20percentwind.org





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

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





Wind Can Help Drive Recovery



Over 500,000 total jobs would be supported by the wind industry

Approx. 180,000 jobs supported directly by the wind industry in operations, construction, and manufacturing

- **During WWII, US was arsenal to the world**
 - FDR promised 60,000 airplanes, delivered 229,600
 - EVERYBODY pitched in.
- **Then it took 37% of GDP, 87% of Federal budget**
 - Now, as the lone(ly) Superpower, we have the resources to do 300 GW using only 2.5% of domestic steel production (20% Report)





Some Potential Feel Good

- ▲ US Manufacturing sector is the largest in the world
 - **Twice as big as the next country, China**
 - Growth in US manufacturing since 1990 has been \$800B, **more than the entire manufacturing sector of Germany**
- ▲ US Auto industry can build 10M vehicles/year – equals 1,700 GW (1,700,000 MW) of prime movers
- ▲ US Auto industry downsizing leaves vast pool of skilled labor and proven suppliers
 - Largest GM suppliers had revenues over \$10B.
 - Used to shaving costs and weight off millions of parts/year
- ▲ US Aerospace Industry a major world exporter
 - Also has idle capacity and transferable technology (it worked for the gas turbine guys)



The Public Underestimates the Capabilities of the US Auto Industry

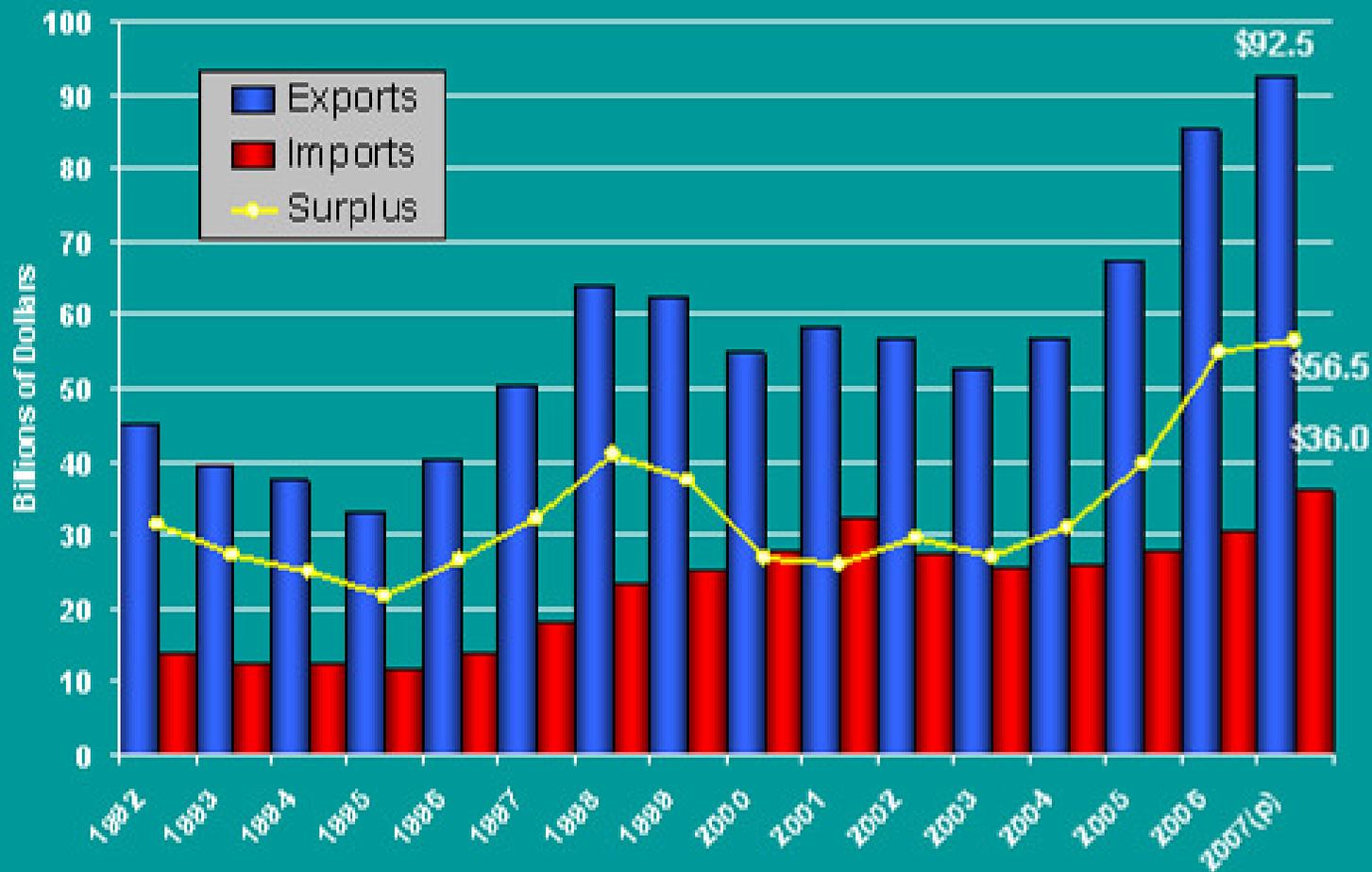
<<previous year **Top 20 motor vehicle producing countries 2007** v · d · e

Motor vehicle production (1000 units)

Country	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
Japan												11596
United States												10781
PR China												8882
Germany												6213 (includes GM Belgium)
South Korea												4086
France												3019
Brazil												2971
Spain												2890
Canada												2578
India												2307
Mexico												2095
UK												1750
Russia												1660
Italy												1284
Thailand												1238
Turkey												1099
Iran												997
Czech Rep.												939
Belgium												844
Poland												785

Reference: World Motor Vehicle Production by Country: 2006 - 2007 OICA. Retrieved on 2008-03-18.

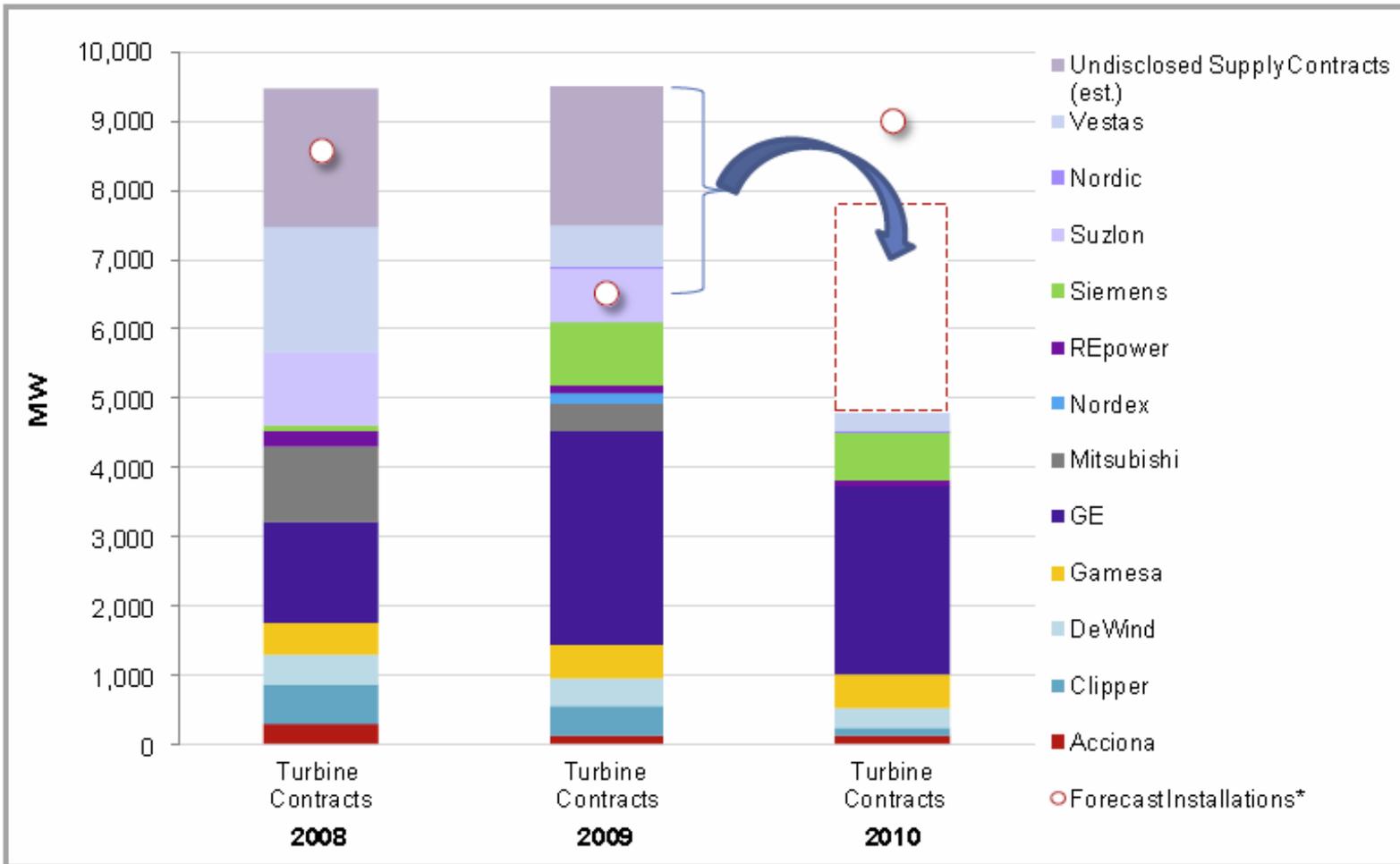
Aerospace Foreign Trade





Recovery Has Yet to Hit Order Books

US Wind Turbine Order Books Compared to Activations: 2008–2010



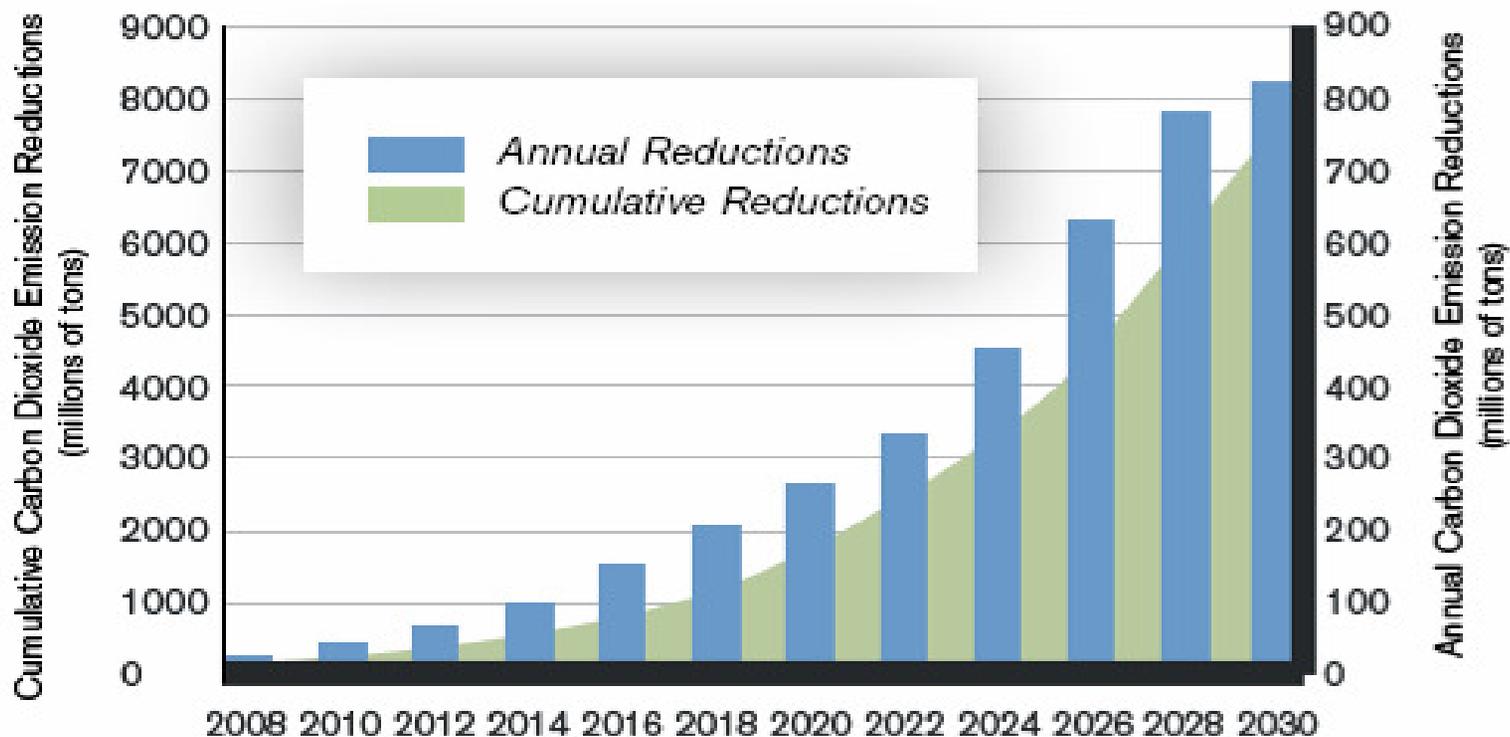
Note: Publicly announced supply agreements broken out by OEM. Multi-year contracts split equally over announced time period. Includes contracts >5 MW. Undisclosed supply contracts include unannounced orders with some major IPPs, including NextEra Energy and Iberdrola

Source: Emerging Energy Research



Wind is a Powerful Climate Change Tool

CO2 Emissions Reductions from 20% Wind Energy by 2030



Achieving the 20% wind vision would avoid the emissions of 7,600 million metric tons of carbon dioxide by 2030, equivalent to removing 140 million vehicles from the roads. Source: U.S. DOE, 20% Wind Energy by 2030 Report

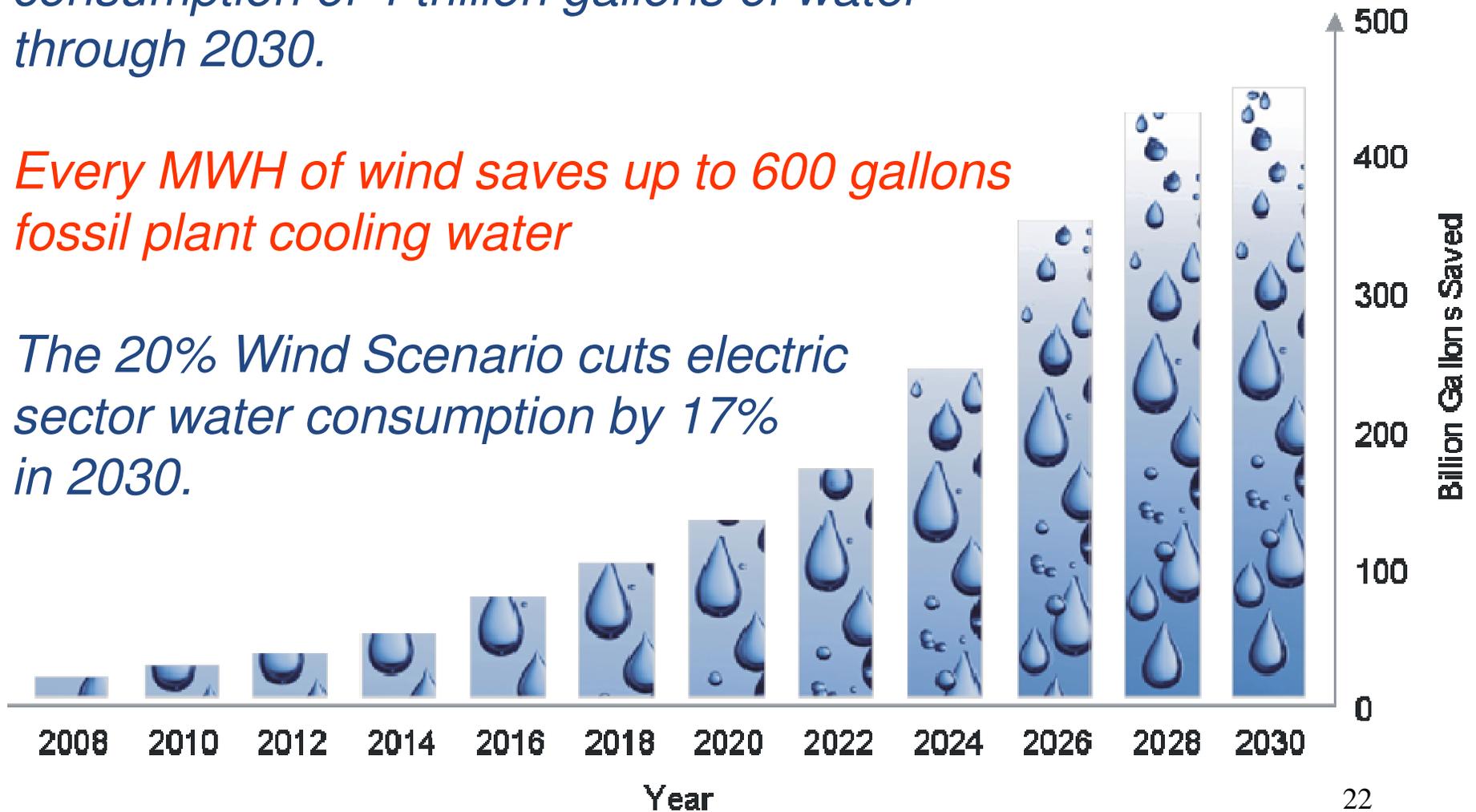


Significant Water Use Savings

Cumulatively, the 20% Wind Scenario would avoid the consumption of 4 trillion gallons of water through 2030.

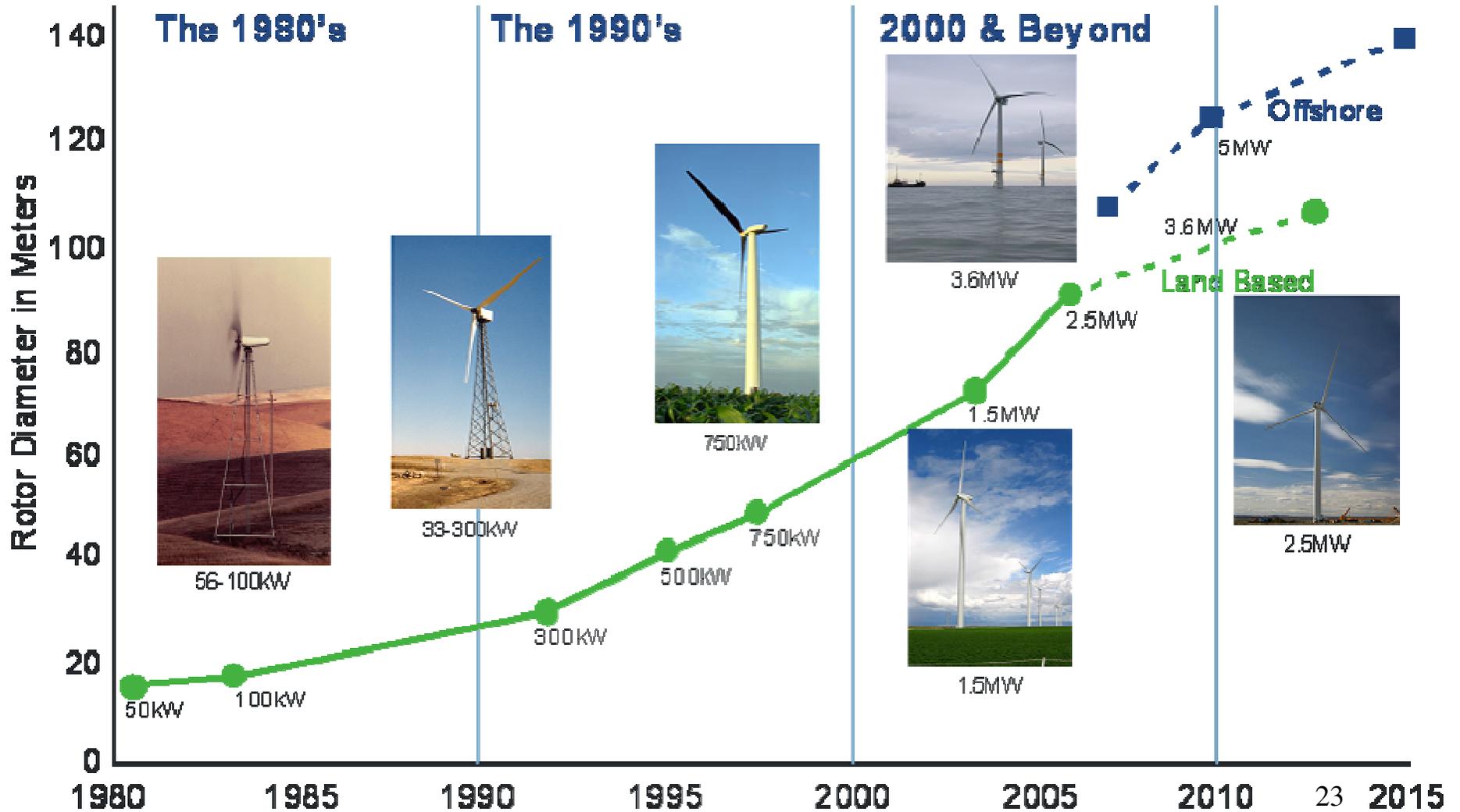
Every MWH of wind saves up to 600 gallons fossil plant cooling water

The 20% Wind Scenario cuts electric sector water consumption by 17% in 2030.





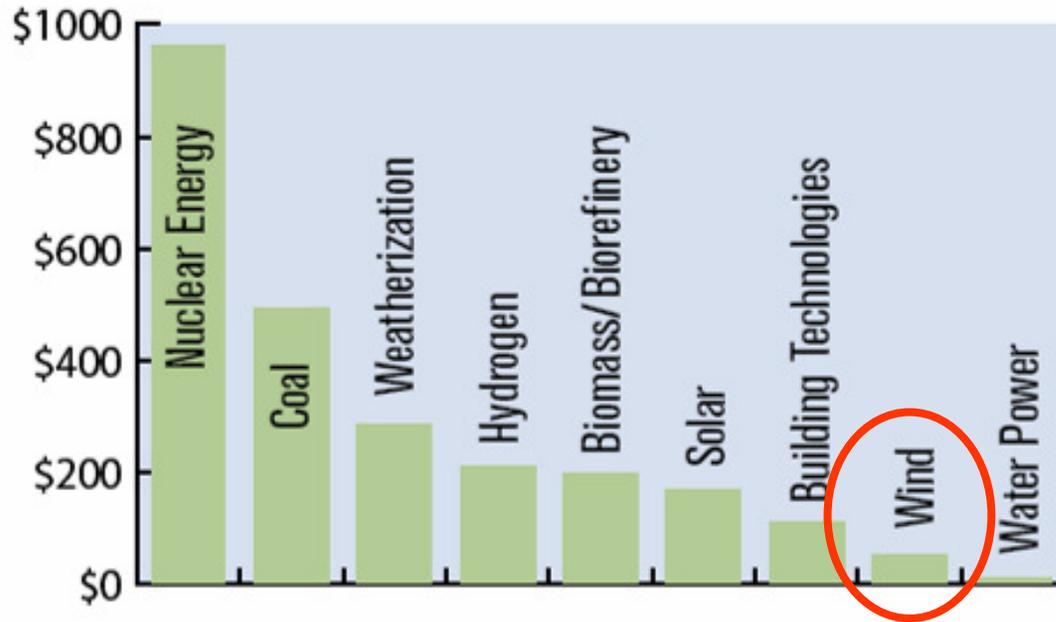
Continued Evolution of Wind Technology is a Good Investment





Yet Wind R&D Has Been Underfunded

U.S. Department of Energy R&D Energy Program Funding

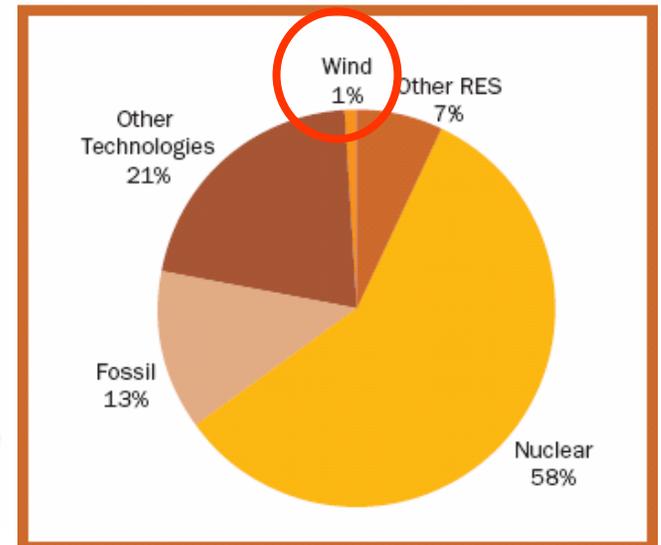


The DOE wind program currently receives about \$50 million annually, a level that is inadequate compared with funding levels for other fuels and energy sources. Source: DOE Congressional Budget Request for 2009

AWEA R&D Committee recommending increase to \$200M+/year

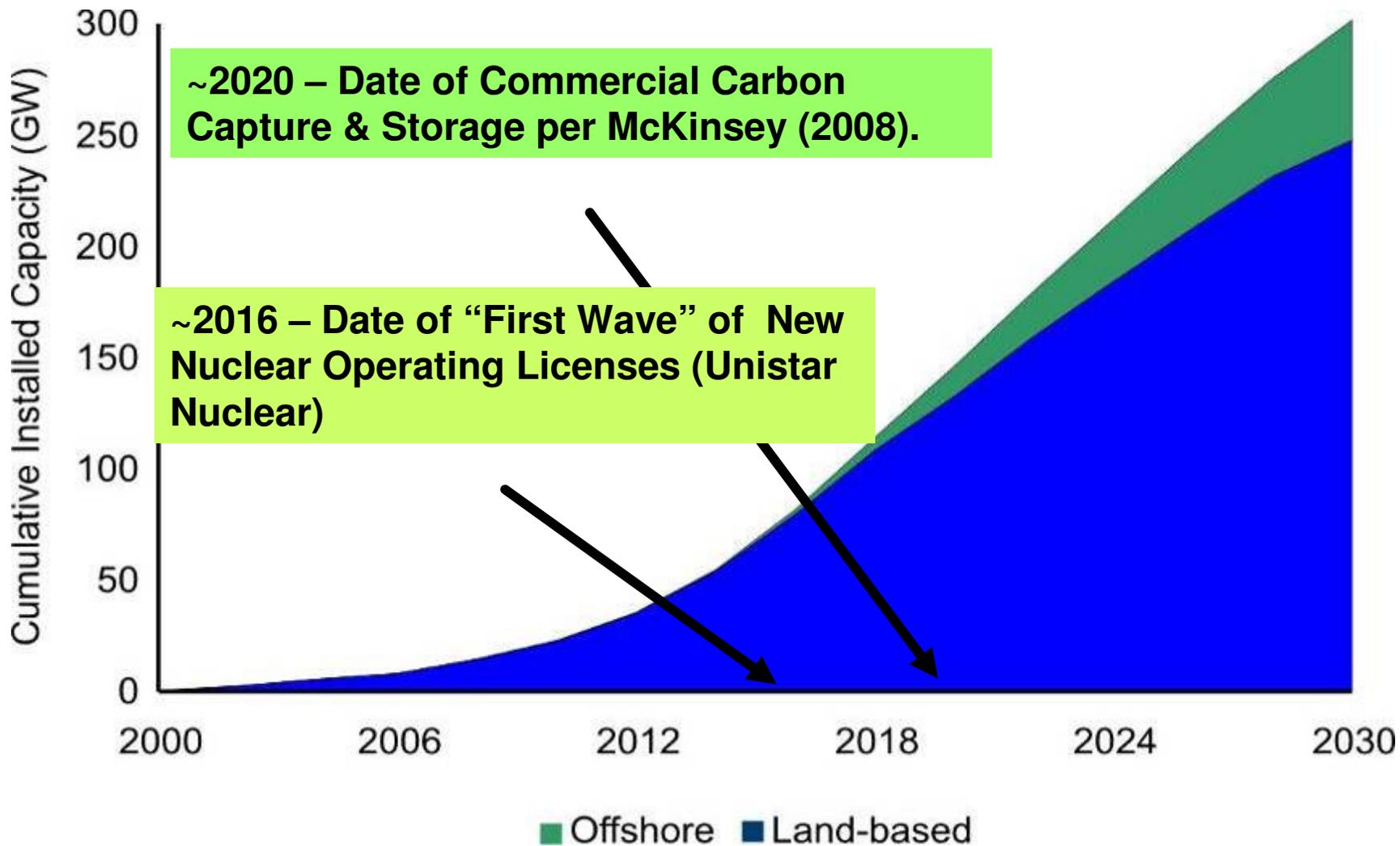
Wind received only 1% of energy R&D funding in IEA countries from 1974-2002

Total Energy R&D Shares in IEA Countries from 1974 to 2002 (US\$)⁵⁷



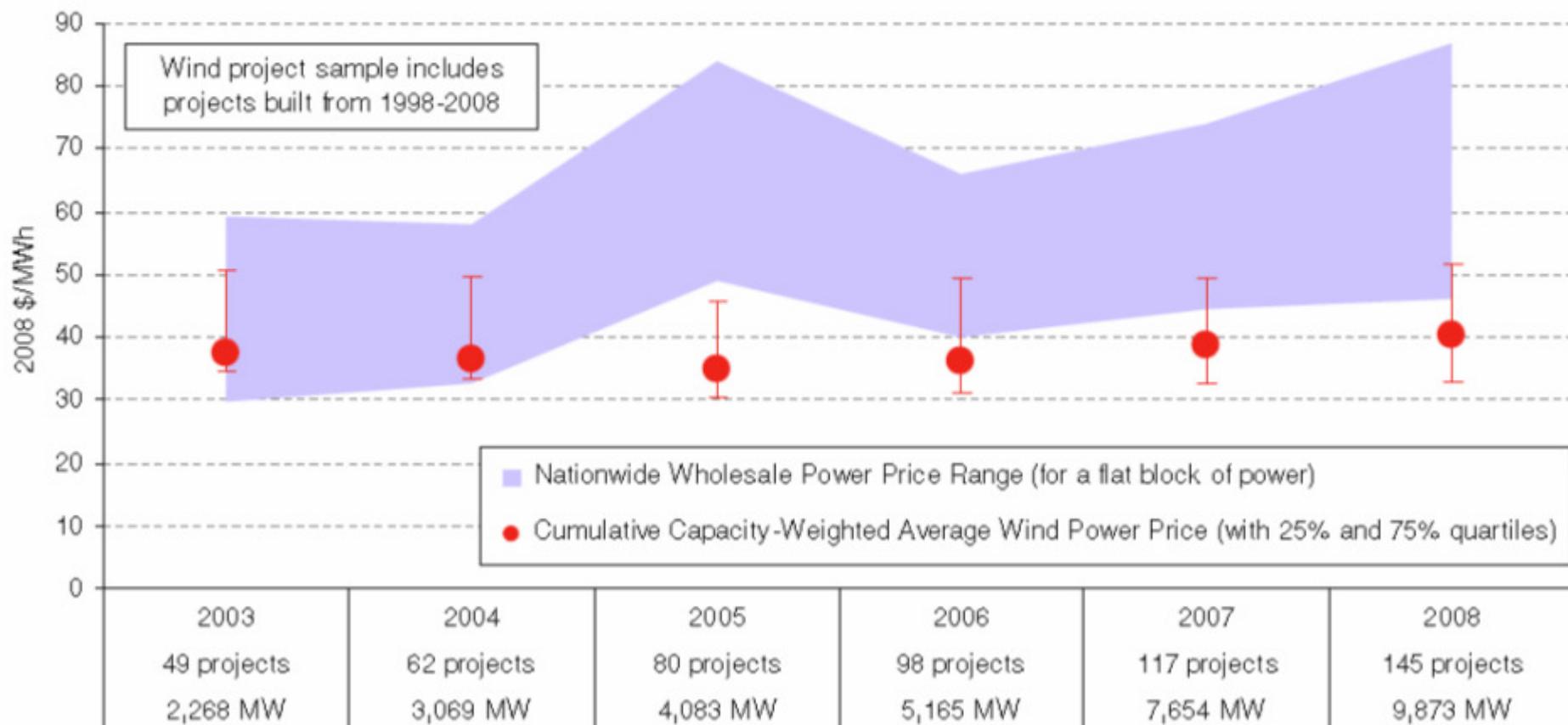


Wind Buys Time for Other Options





Wind Has Been Competitive with Wholesale Power Prices in Recent Years

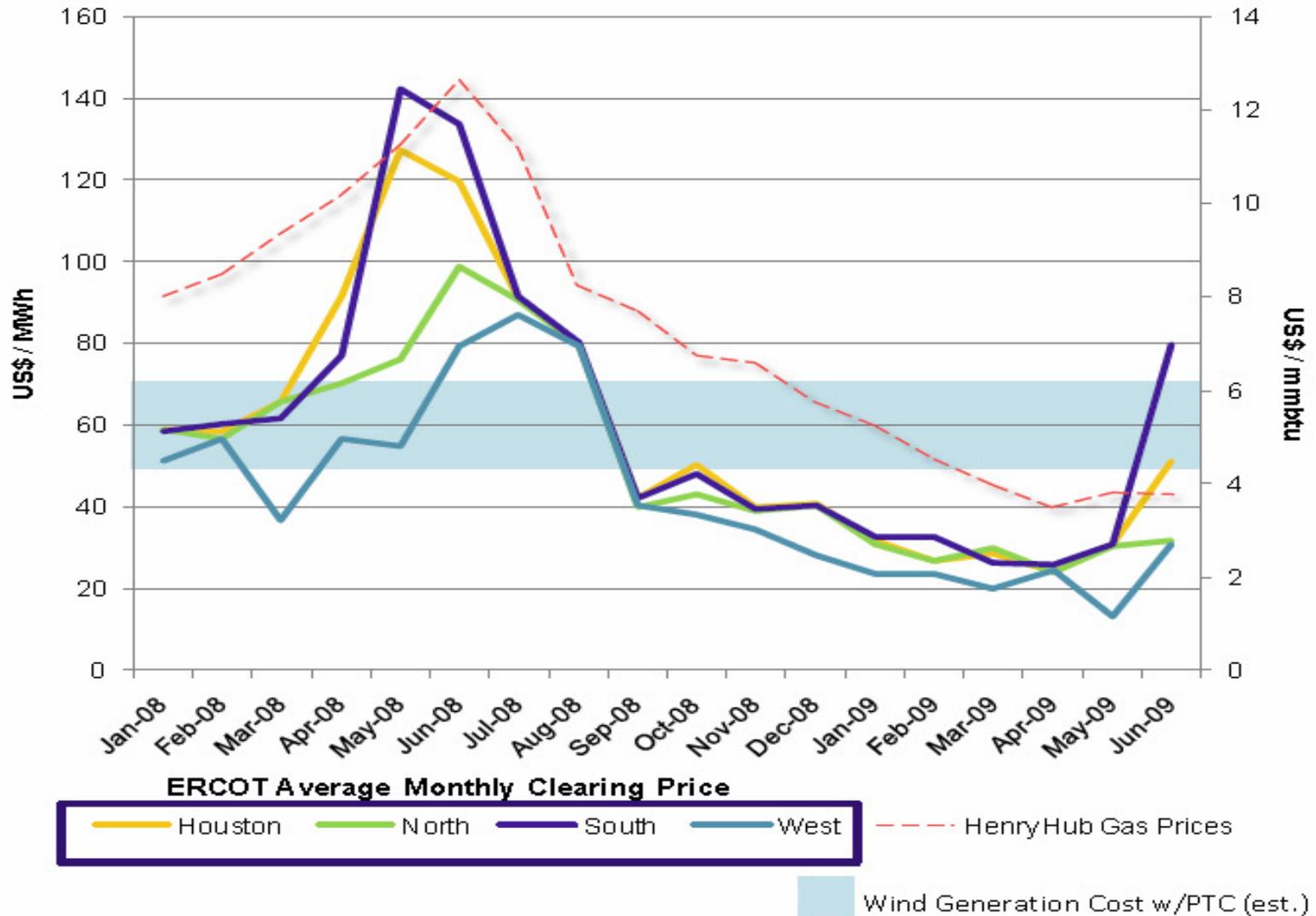


- Wholesale price range reflects flat block of power across 23 pricing nodes (see previous map)
- 2009 to be far more challenging, as wholesale prices have dropped sharply since mid-2008



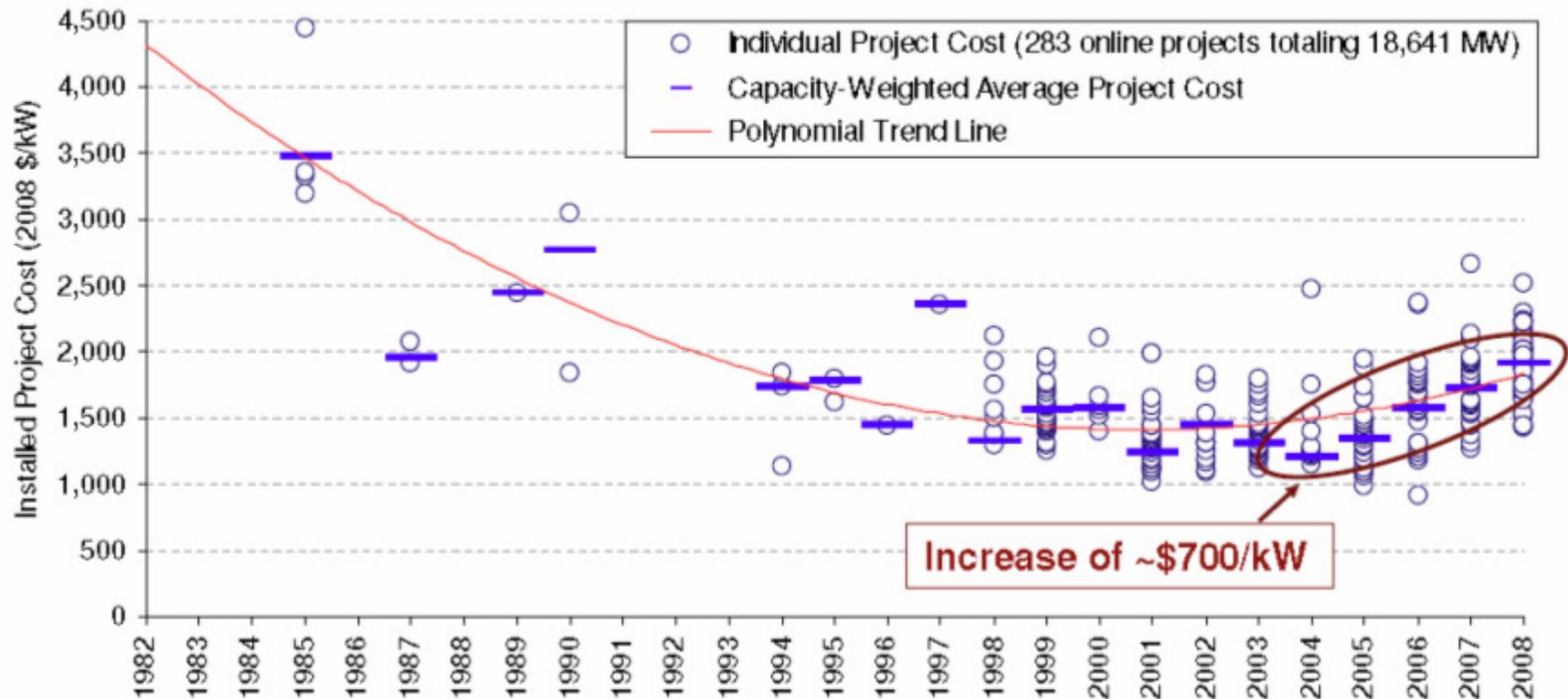
Texas Market Hurt by Low Gas Prices, Transmission Constraints

Exhibit 2: Texas Electricity Market Rates vs. Wind Generation Costs





Installed Project Costs Rose Substantially, After a Long Period of Decline

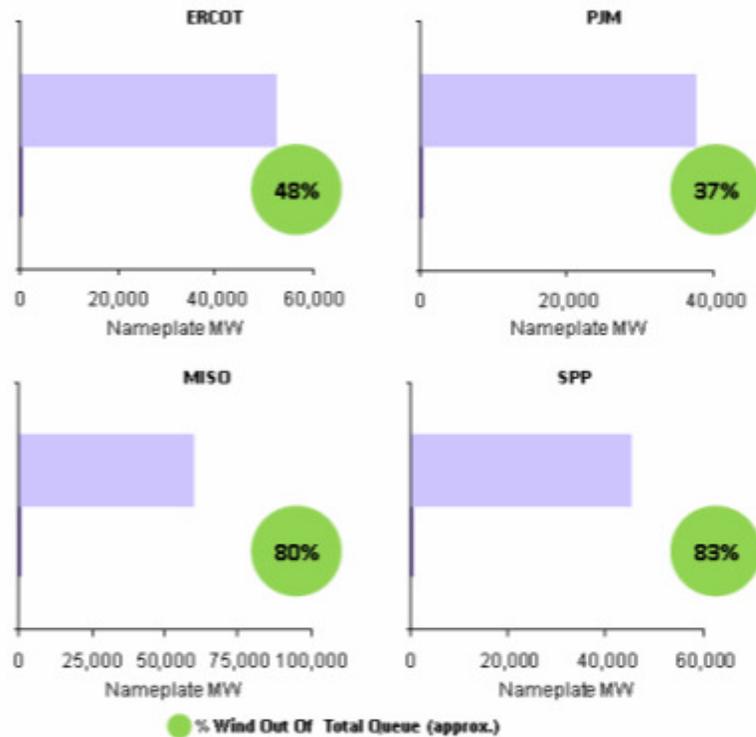


Sample of 3,600 MW of projects proposed for construction in 2009 (not shown in graphic) are ~\$205/kW higher still (averaging ~\$2,120/kW)

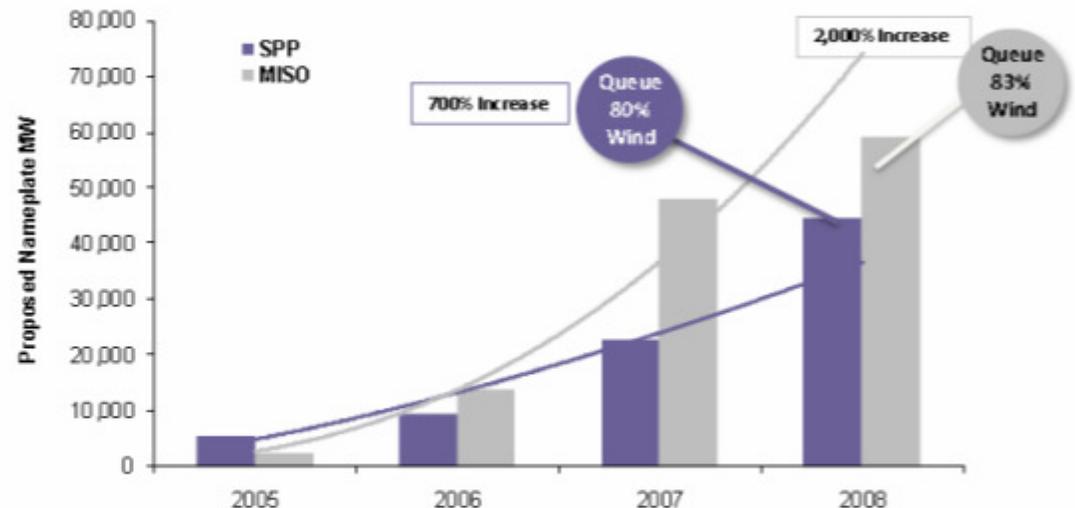
Transmission Initiatives Adapt to US Wind Growth

Wind Development Activity and Transmission

Wind in Major Interconnection Queues*



Wind in MISO and SPP Interconnection Queues, 2005–2008*

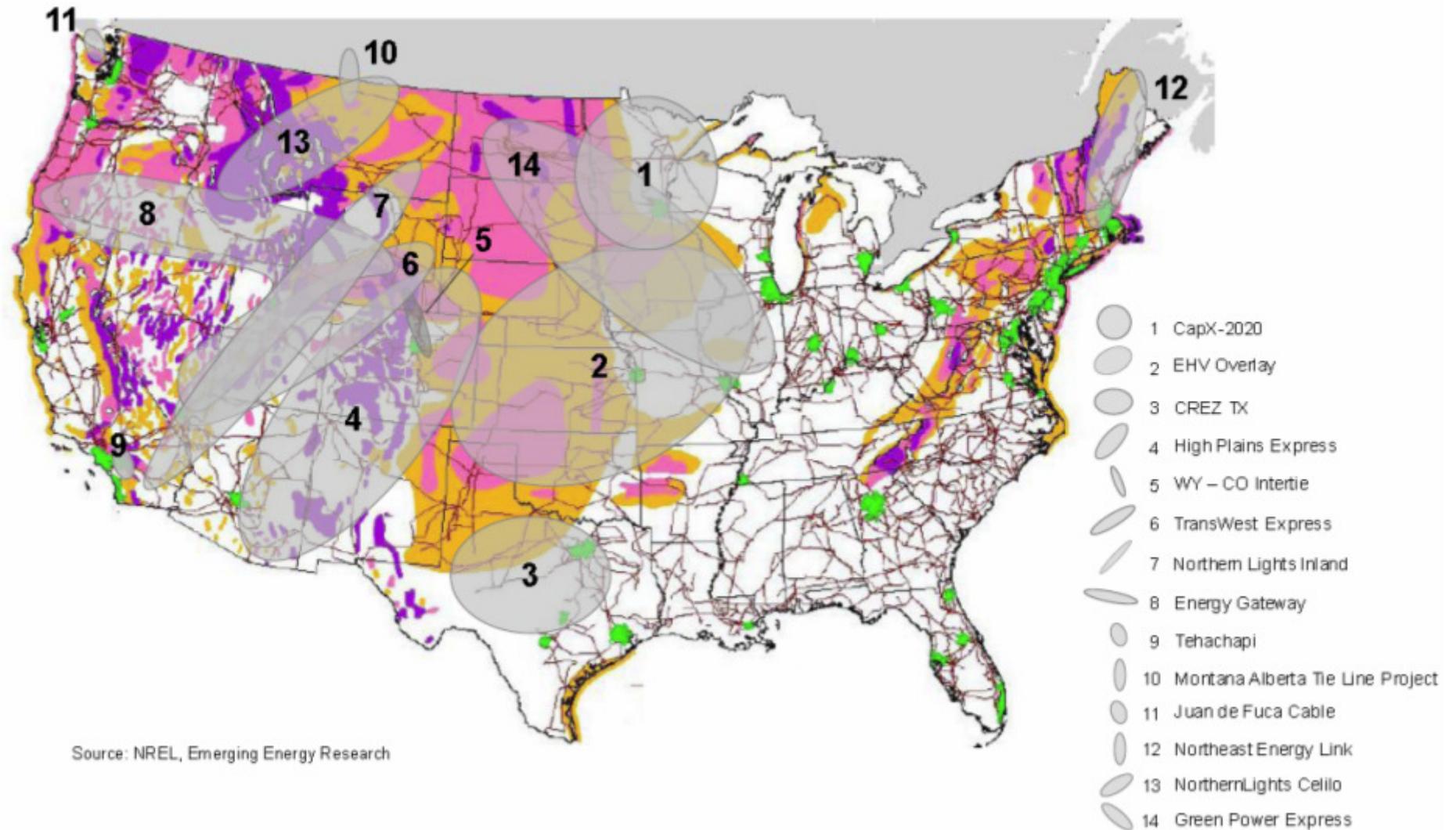


Note: *Includes all active, non-operational wind interconnect requests as of 22 February 2009
Source: RTOs/ISOs, Emerging Energy Research

As wind project development reaches record heights, grid planners and developers are increasingly incorporating wind into transmission proposals

Transmission Initiatives Adapt to US Wind Growth

Transmission Project Examples



Source: NREL, Emerging Energy Research



Studies Find that the Cost of Integrating Wind into Power Systems Is Manageable

Date	Study	Wind Capacity Penetration	Integration Cost (\$/MWh)				TOTAL
			Regulation	Load Following	Unit Commit.	Gas Supply	
2003	Xcel-UWIG	3.5%	0	0.41	1.44	na	1.85
2003	We Energies	29%	1.02	0.15	1.75	na	2.92
2004	Xcel-MNDOC	15%	0.23	na	4.37	na	4.60
2005	PacifiCorp-2004	11%	0	1.48	3.16	na	4.64
2006	Calif. (multi-year)*	4%	0.45	trace	trace	na	0.45
2006	Xcel-PSCo	15%	0.20	na	3.32	1.45	4.97
2006	MN-MISO**	31%	na	na	na	na	4.41
2007	Puget Sound Energy	12%	na	na	na	na	6.94
2007	Arizona Pub. Service	15%	0.37	2.65	1.06	na	4.08
2007	Avista Utilities	30%	1.43	4.40	3.00	na	8.84
2007	Idaho Power	20%	na	na	na	na	7.92
2007	PacifiCorp-2007	18%	na	1.10	4.00	na	5.10
2008	Xcel-PSCo***	20%	na	na	na	na	8.56

* Regulation costs represent 3-year average.

** Highest over 3-year evaluation period.

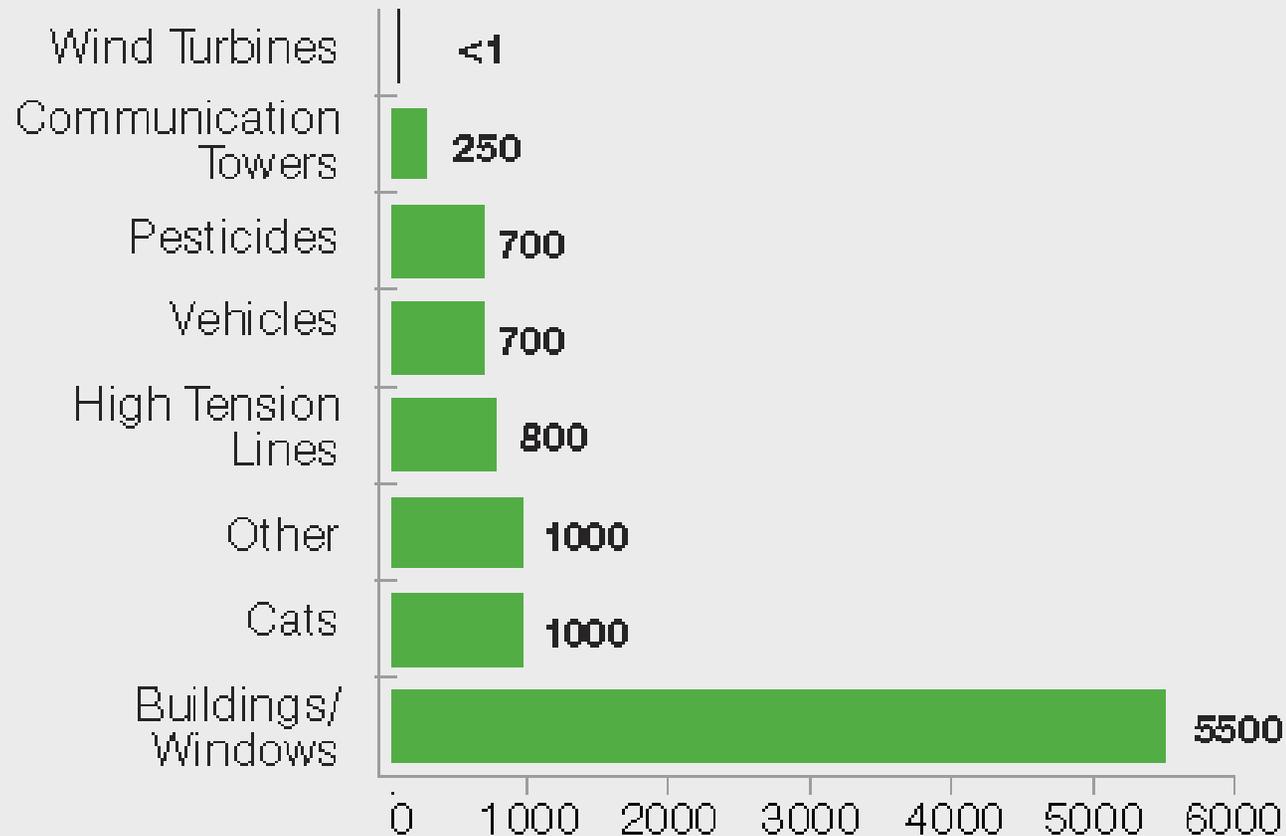
*** This integration cost reflects a \$10/MMBtu natural gas price scenario. This cost is much higher than the integration cost calculated for Xcel-PSCo in 2006, in large measure due to the higher natural gas price; had the gas price from the 2006 study been used in the 2008 study, the integration cost would drop to \$5.13/MWh.

- Wind integration costs are < \$10/MWh for capacity penetrations of up to ~30%
- Regulation impacts are small, load-following and unit commitment larger
- Larger balancing areas and use of wind forecasts ease integration challenges, and operators are increasingly relying on these strategies



Impacts on Wildlife & Habitat Real But Manageable with Careful Siting

Causes of Bird Fatalities, Number per 10,000 fatalities

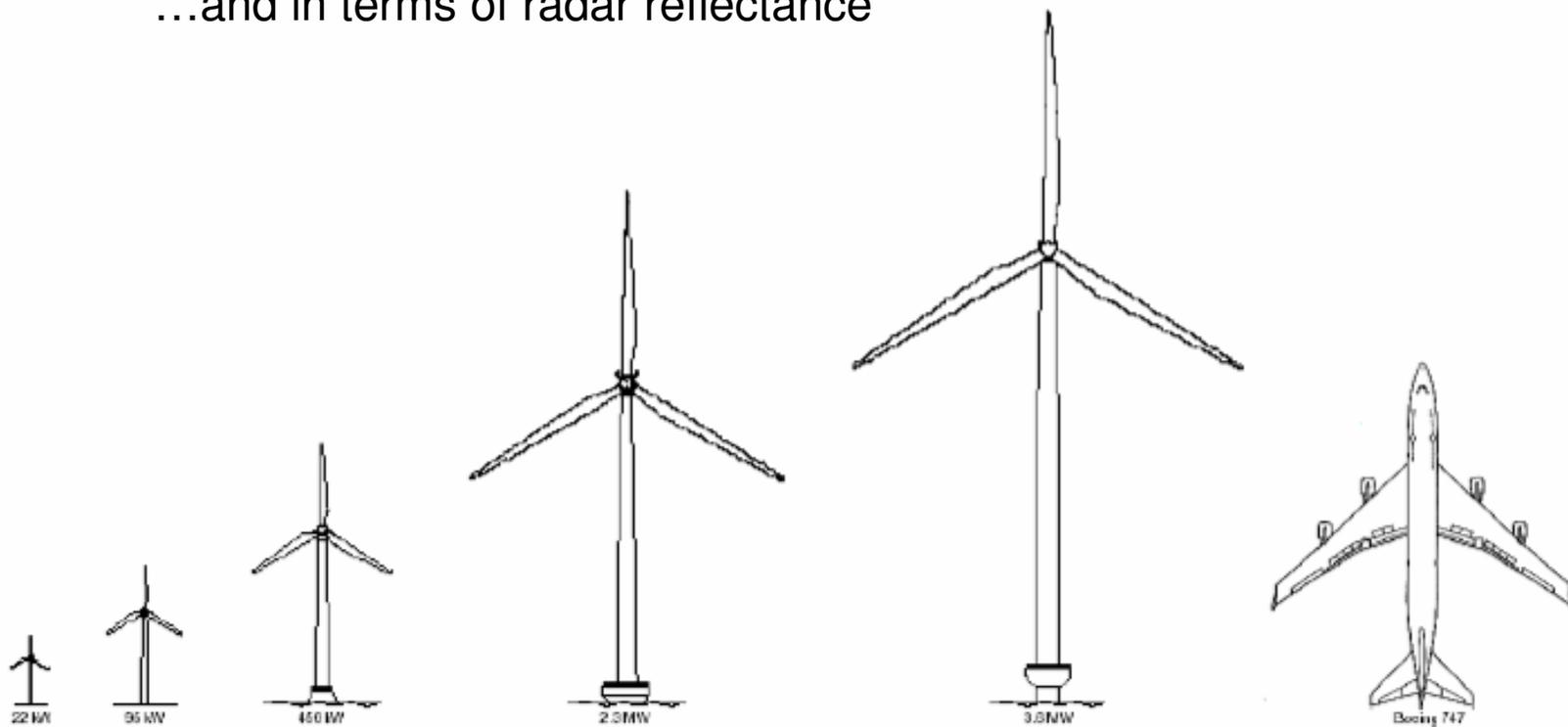


Data Sources: Erickson et al., 2002., Summary of Anthropogenic Causes of Bird Mortality.

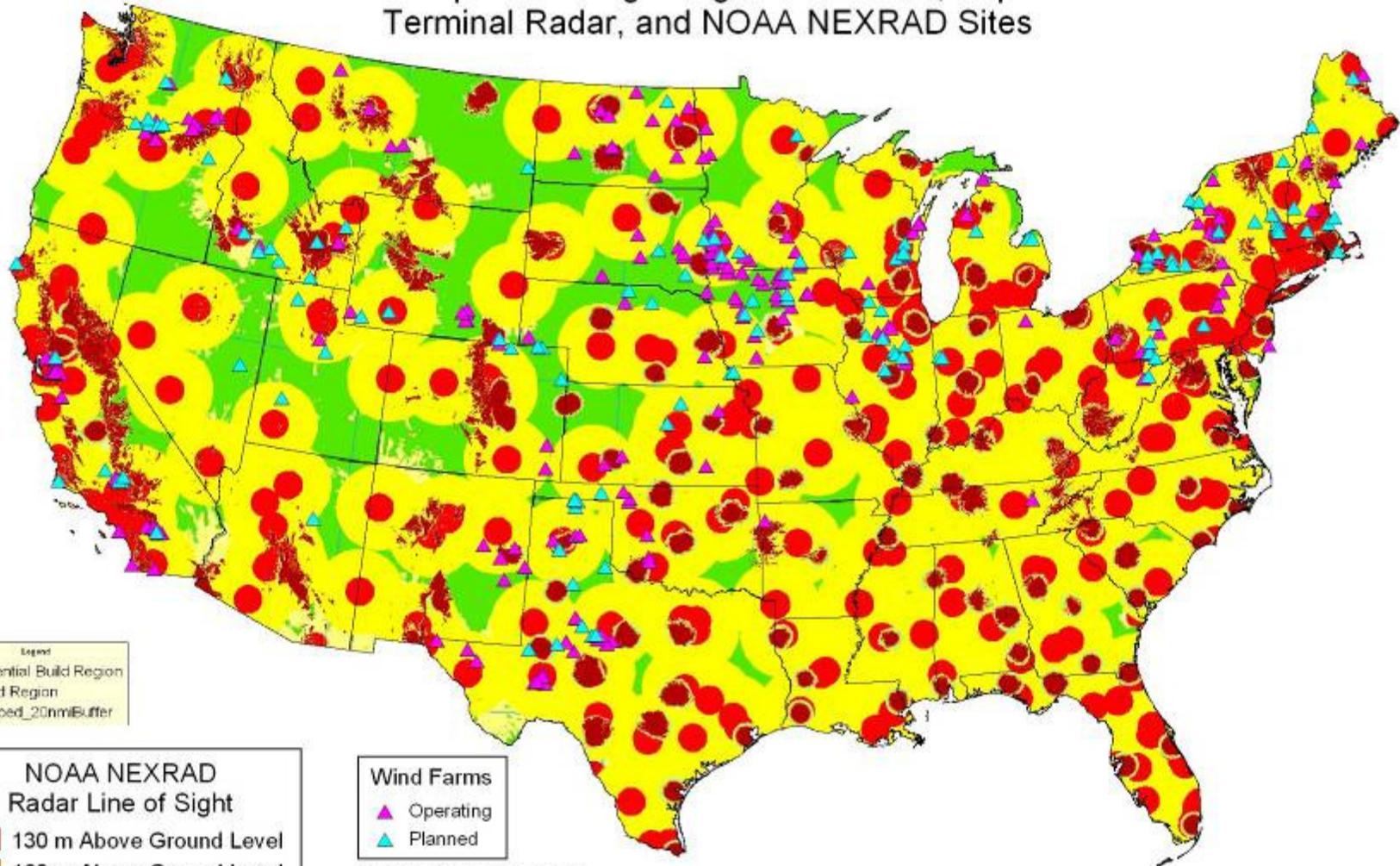
Wind turbines and aircraft are in same range regarding dimensions...

SIEMENS

...and in terms of radar reflectance



Potential Impact of Long Range Radar Sites, Airports with Terminal Radar, and NOAA NEXRAD Sites



Legend
 Potential Build Region
 Build Region
 Clipped_20nmBuffer

NOAA NEXRAD Radar Line of Sight
 130 m Above Ground Level
 160 m Above Ground Level
 200 m Above Ground Level

Wind Farms
 Operating
 Planned

Wind plants from POWERmap,
 powermap.platts.com ©2007
 Platts, a division of the
 McGraw-Hill Companies

0 - 30 miles
 30 - 90 miles

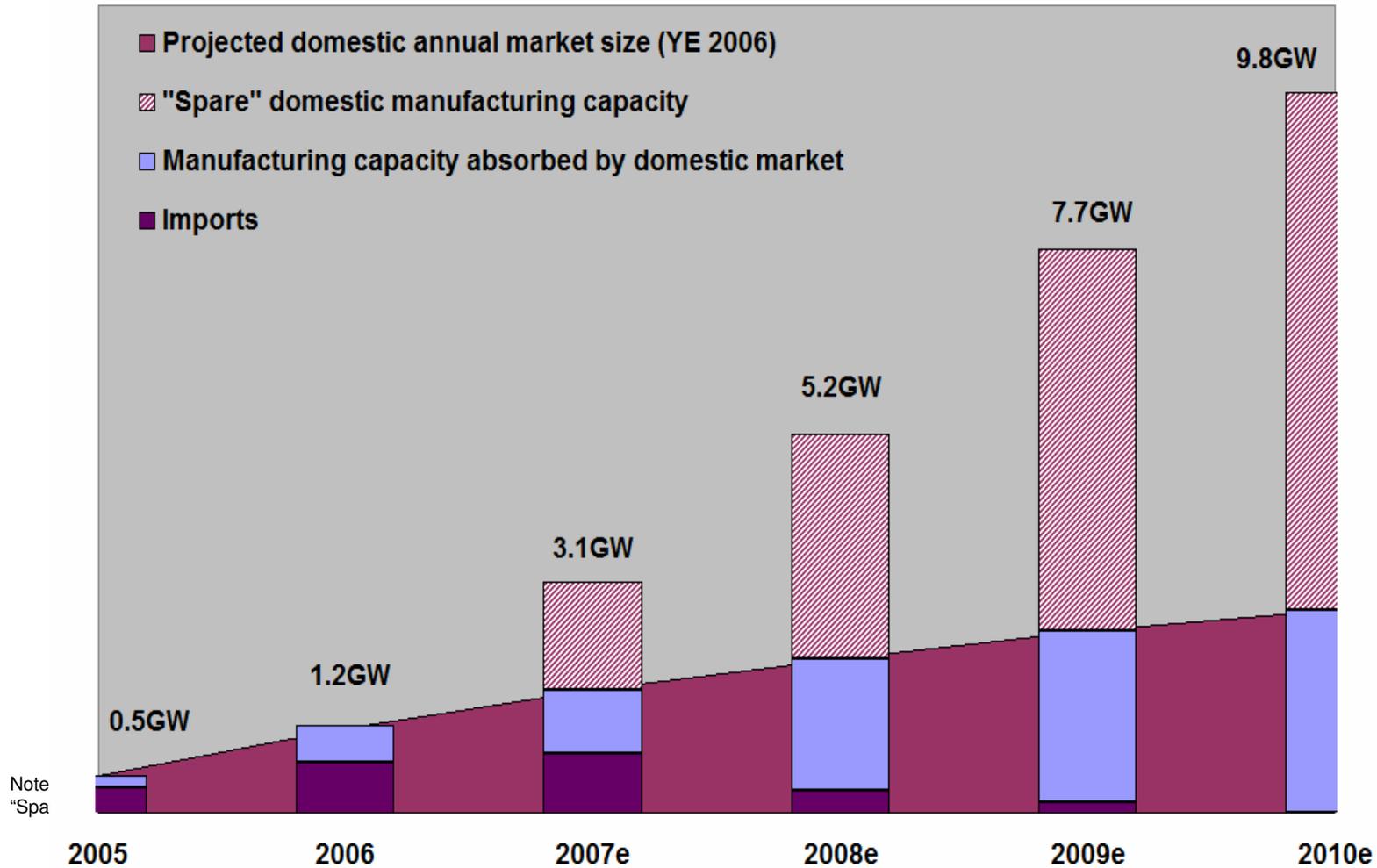
100 0 100 200 300 400 Miles

China Expected to be Largest Wind Market in 2009





Surplus Turbine Capacity Forecast for China



Source: New Energy Finance, Bloomberg, 09 October 2007



Emerging Energy Research's Forecast

2009 - Outlook



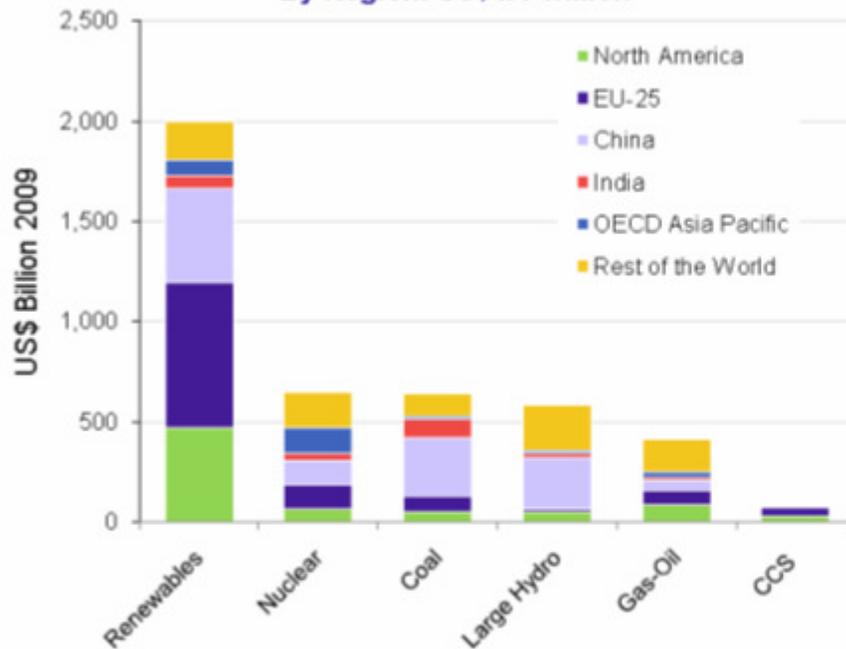
Strong recovery in late 2010 through 2011 although transmission constraints could constrain growth over the longer term



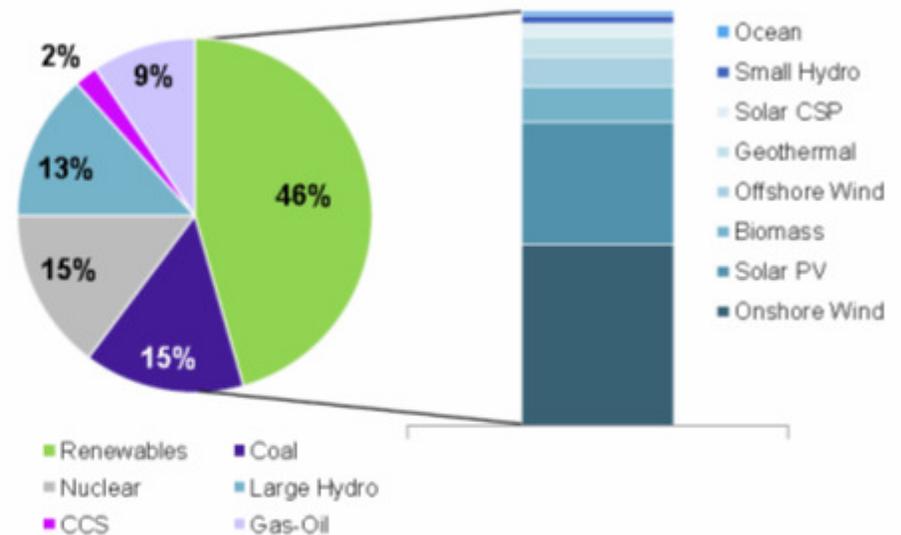
Wind a \$1 Trillion Investment Opportunity

Global Renewable Power Generation Forecasts: 2009–2020 Power Generation Investment Forecast

2009–2020 Power Generation Investments
By Region: US\$4.4 Trillion



2009–2020 Renewables Power Generation
Investments: US\$2 Trillion



The renewables generation market is forecast to see US\$2 trillion in investment between 2009 and 2020, representing 46% of total power generation investments



U.S. Department of Energy

Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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



State Leadership Remains Critical

- ▶ Historically wind development has been driven by state leadership
 - California in 1980s
 - Texas – more MW built in 2008 than in California since the Gold Rush
 - Minnesota – Buffalo Ridge, Community Wind
 - Iowa – gained both operating projects and manufacturing jobs
- ▶ Key levers still largely at state and local level, with regional input
 - Project siting decisions
 - State RPS and goals
 - Rate recovery by utilities
 - Transmission planning and cost recovery
- ▶ So keep the momentum going!