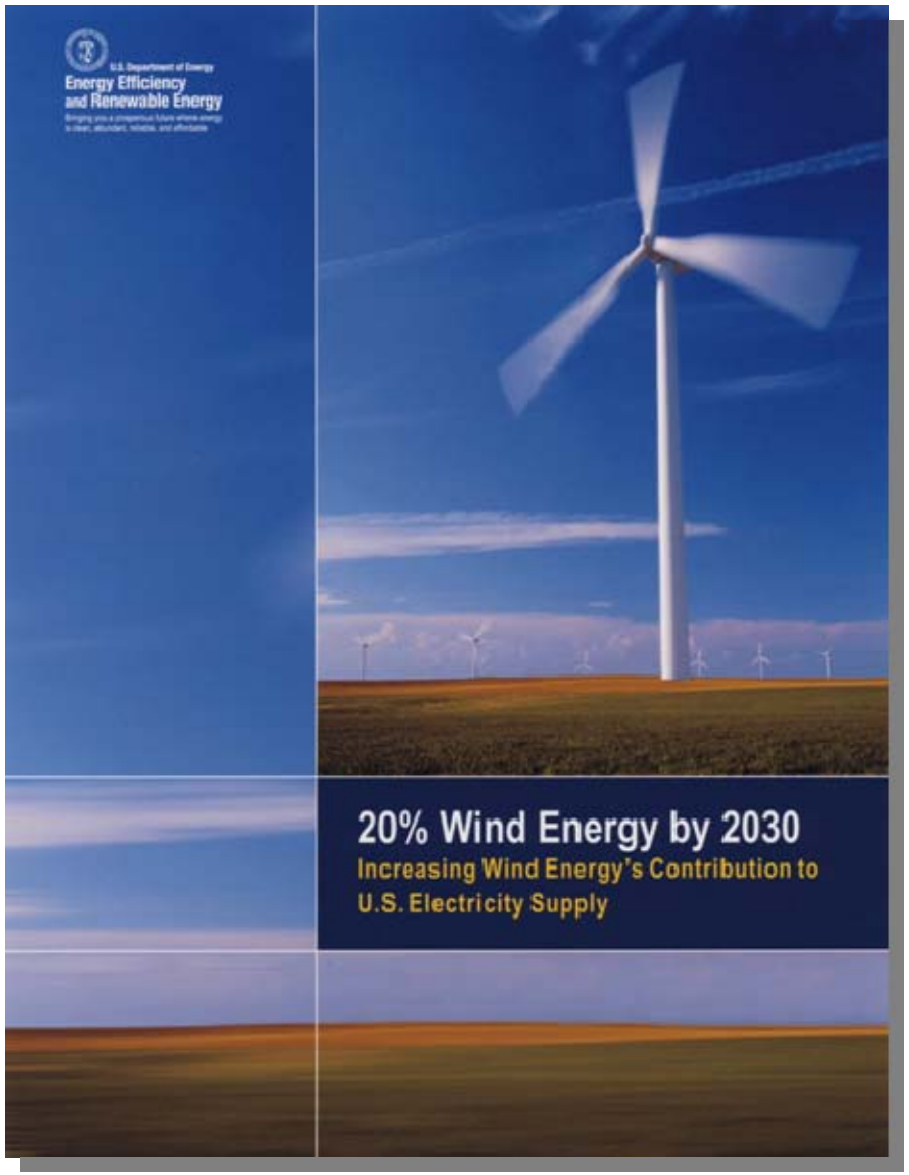

20% Wind Energy
by 2030

Presentation and Objectives Overview

- Background
- 20% Wind Scenario
- Costs
- Benefits
- Challenges
- Summary



The 20% Technical Report

- Explores one scenario for reaching 20% wind energy by 2030 and contrasts it to a scenario in which no new U.S. wind power capacity is installed
- Is not a prediction, but an analysis based on one scenario
- Does not assume specific policy support for wind
- Is the work of more than 100 individuals involved from 2006 - 2008 (government, industry, utilities, NGOs)
- Analyzes wind's potential contributions to energy security, economic prosperity and environmental sustainability

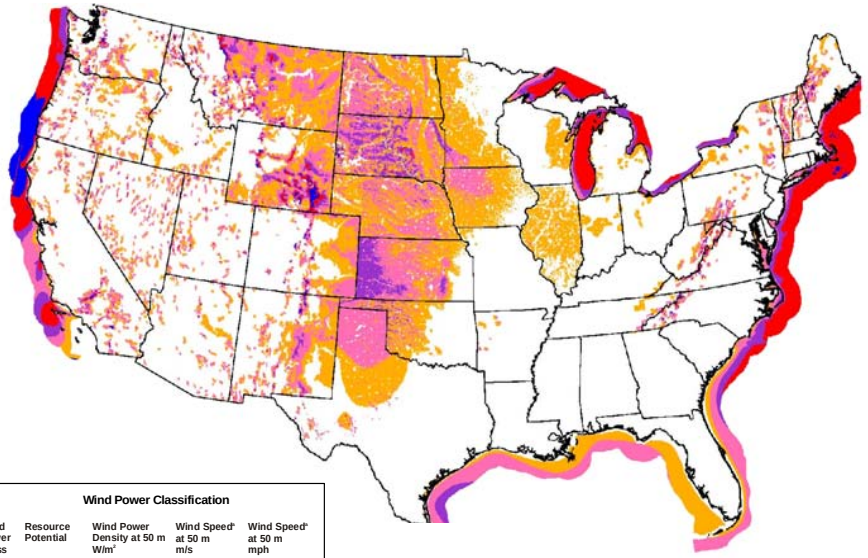

The 20% Wind Scenario

The 20% Wind Energy Scenario

- Primary Assumptions:
  - U.S. electricity consumption grows 39% from 2005 to 2030 -- to 5.8 billion MWh (Source: EIA)
  - Wind turbine energy production increases about 15% by 2030
  - Wind turbine costs decrease about 10% by 2030
  - No major breakthroughs in wind technology

- Primary Findings:
  - 20% wind electricity would require about 300 GW (300,000 MW) of wind generation
  - Affordable, accessible wind resources available across the nation
  - Cost to integrate wind modest
  - Raw materials available
  - Transmission a challenge

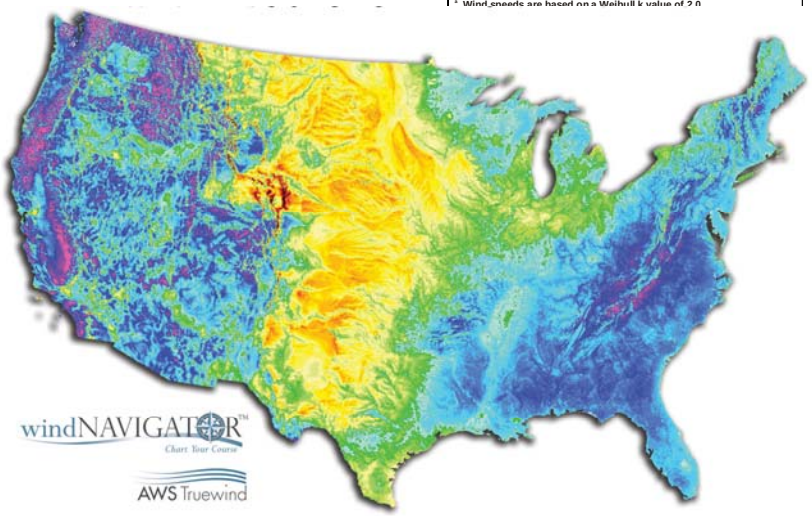
U.S. Wind Resource Maps



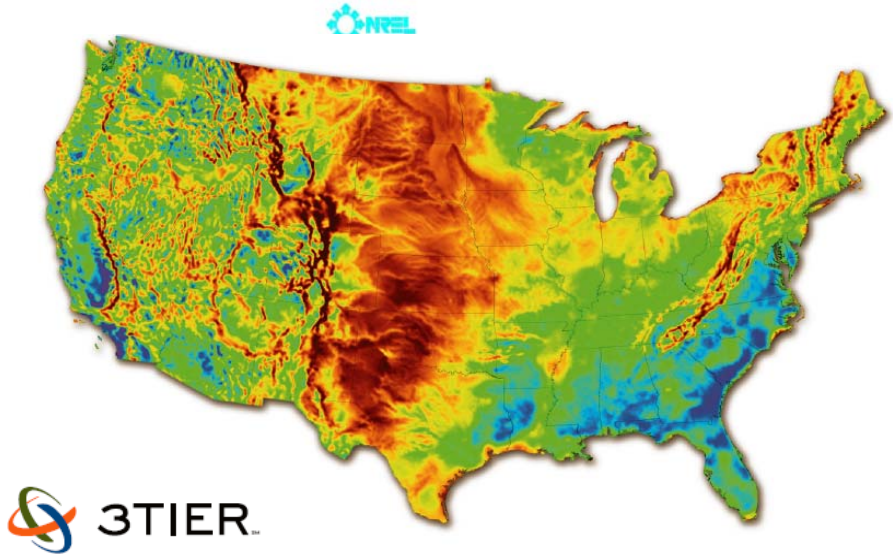
Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m²	Wind Speed* at 50 m m/s	Wind Speed* at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

* Wind speeds are based on a Weibull k value of 2.0

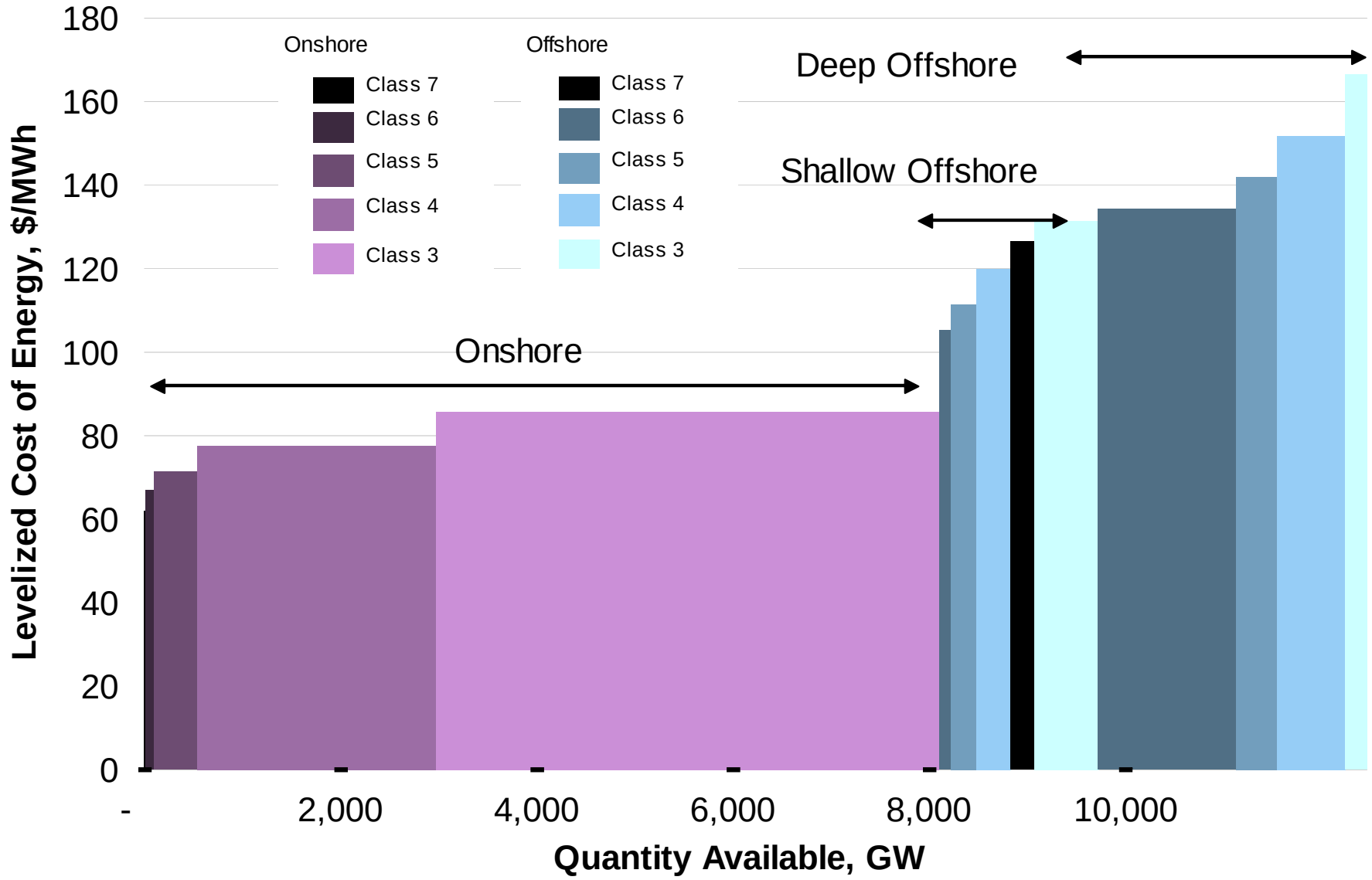


Wind Resource of the United States at 2.5km grid cell resolution.
SOURCE: Data and image developed by AWS Truewind for windNavigator: http://navigator.awstruewind.com



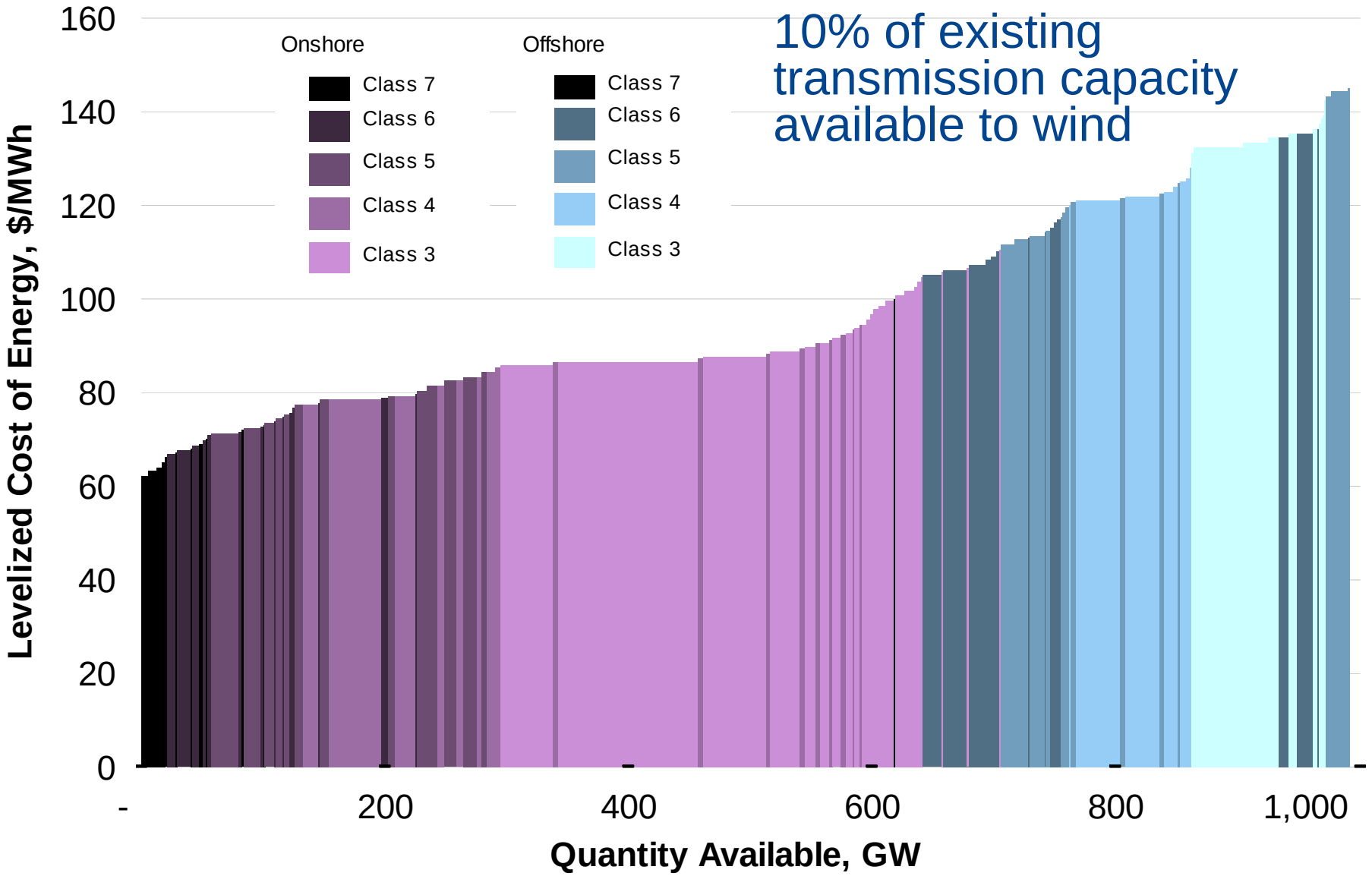
5km Wind Map at 80m
Wind speed
3
6
9 m/s

Resource Potential Exceeds Total Electricity Demand



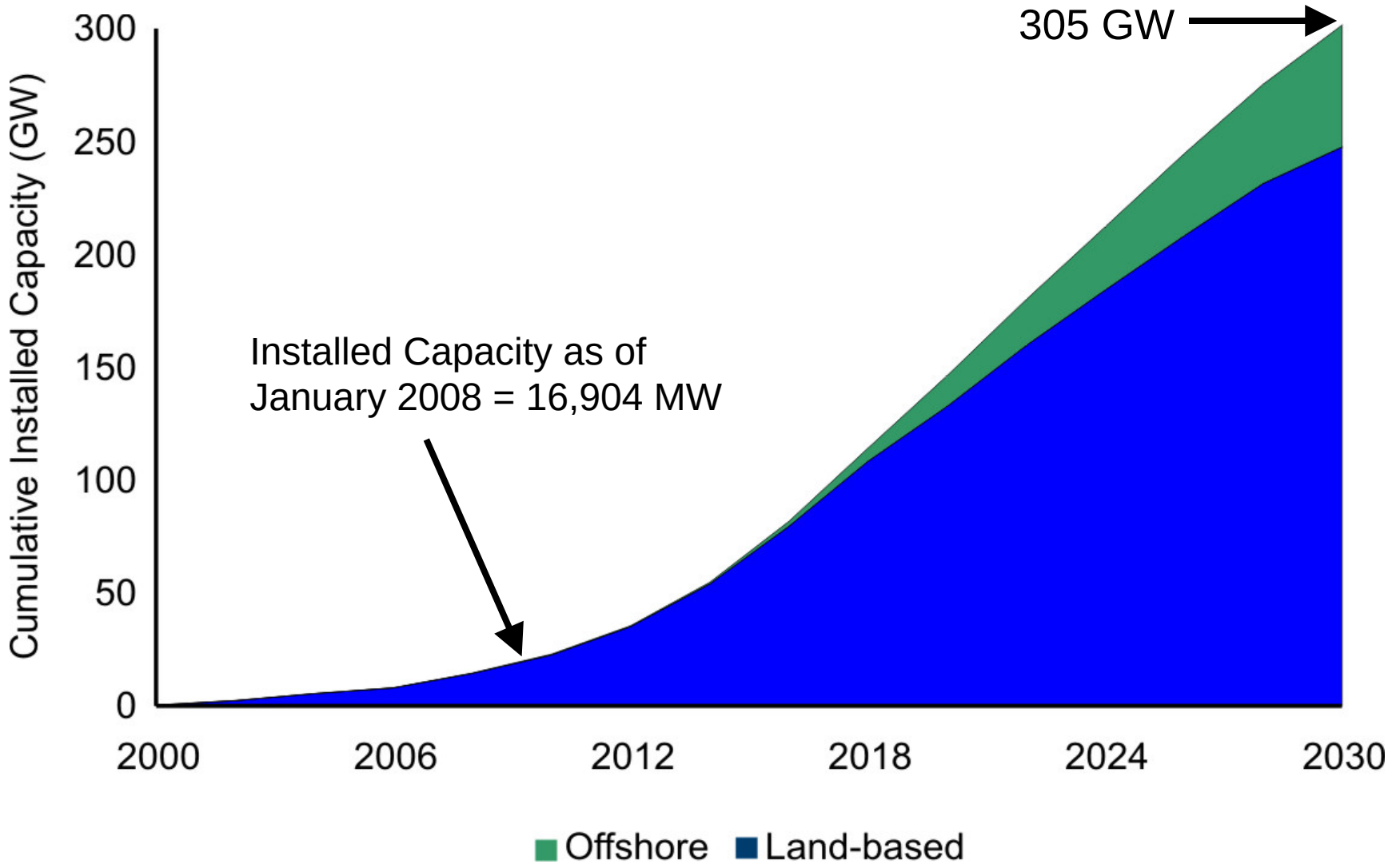
2010 Costs w/o PTC, w/o Transmission or Integration costs

Cost of Wind and Transmission: Economically Available

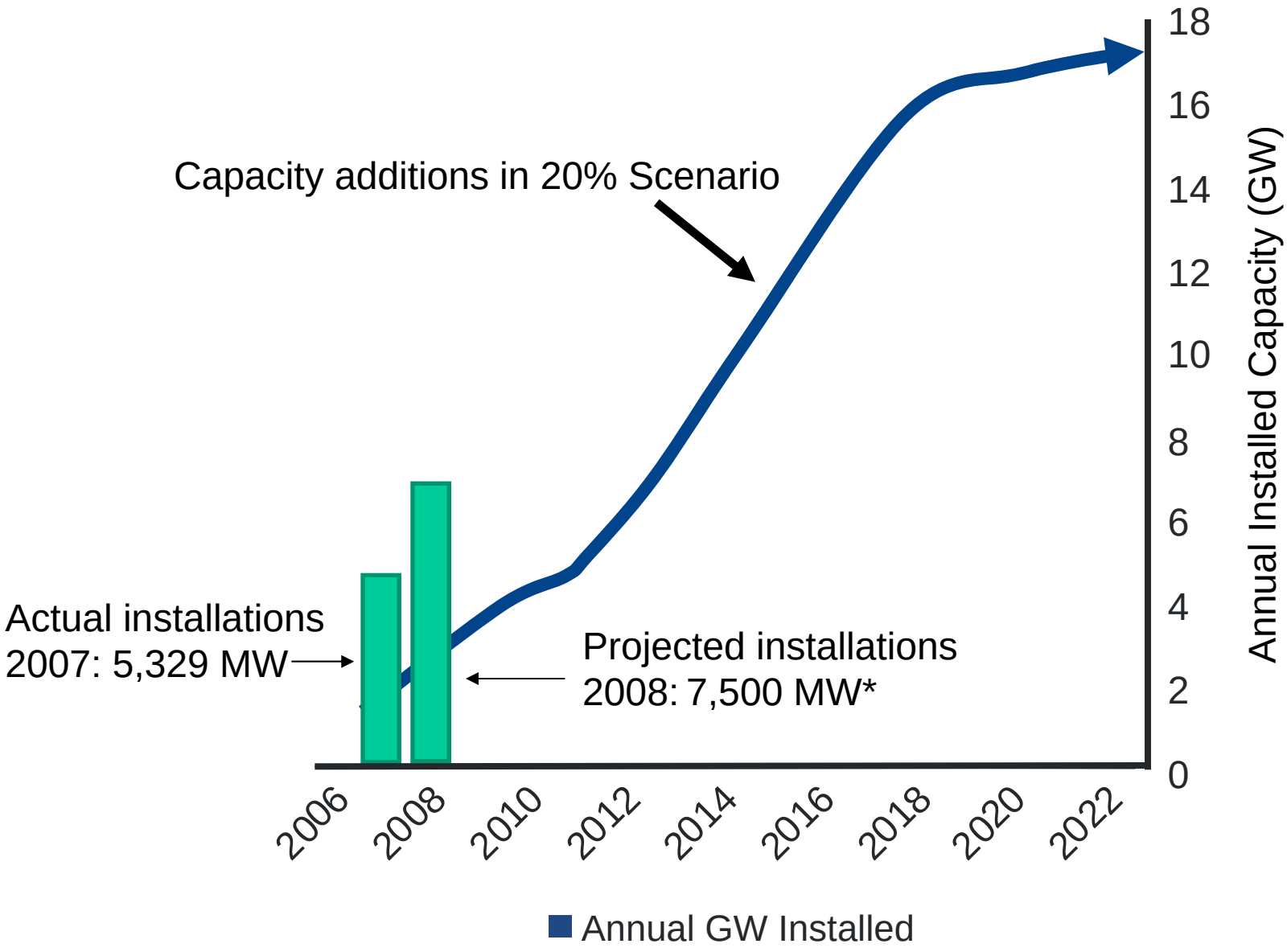


2010 Costs w/o PTC, $1,600/MW-mile, w/o Integration costs

20% Wind Scenario

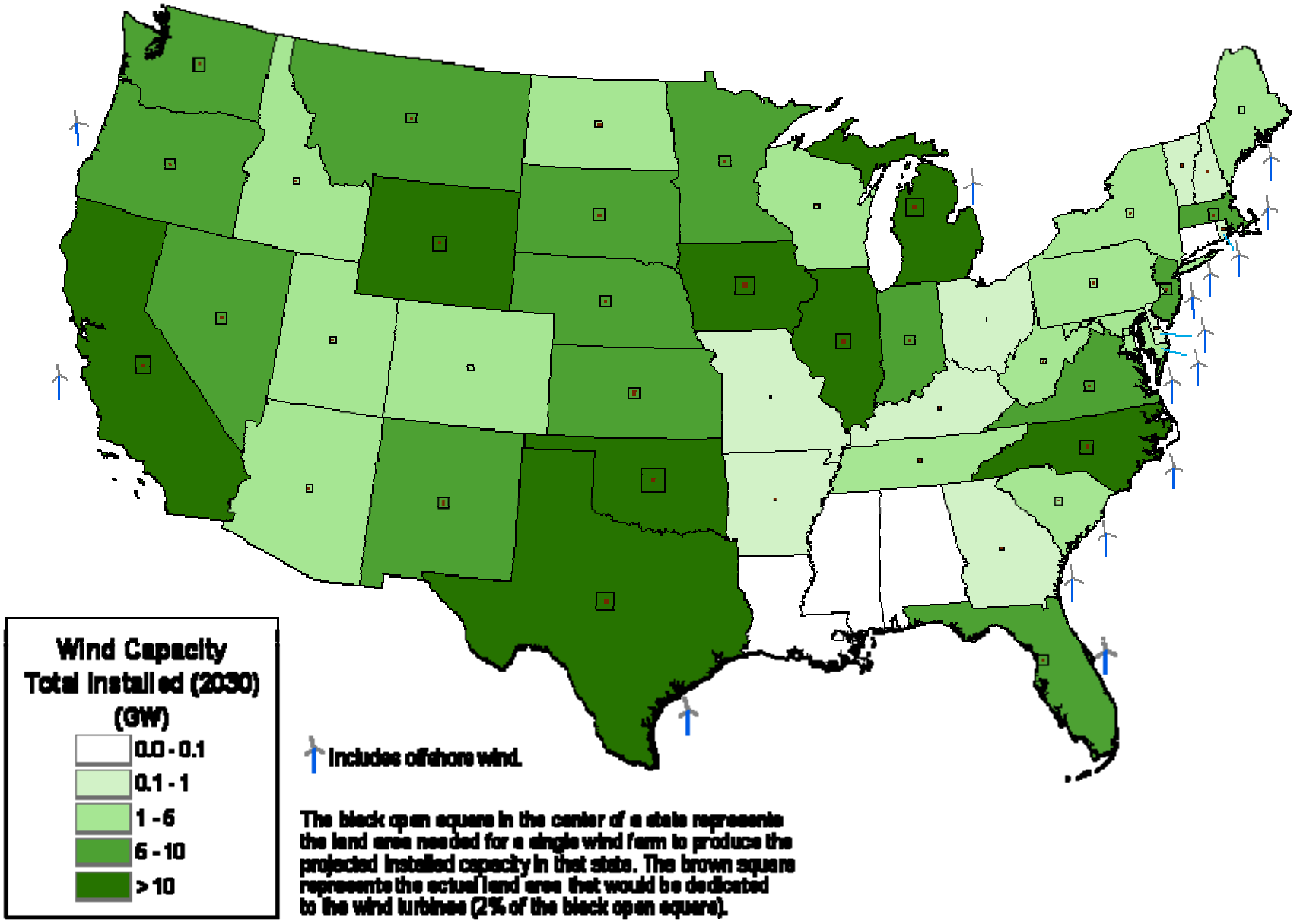


Annual Installed Capacity vs. Current Installed Capacity

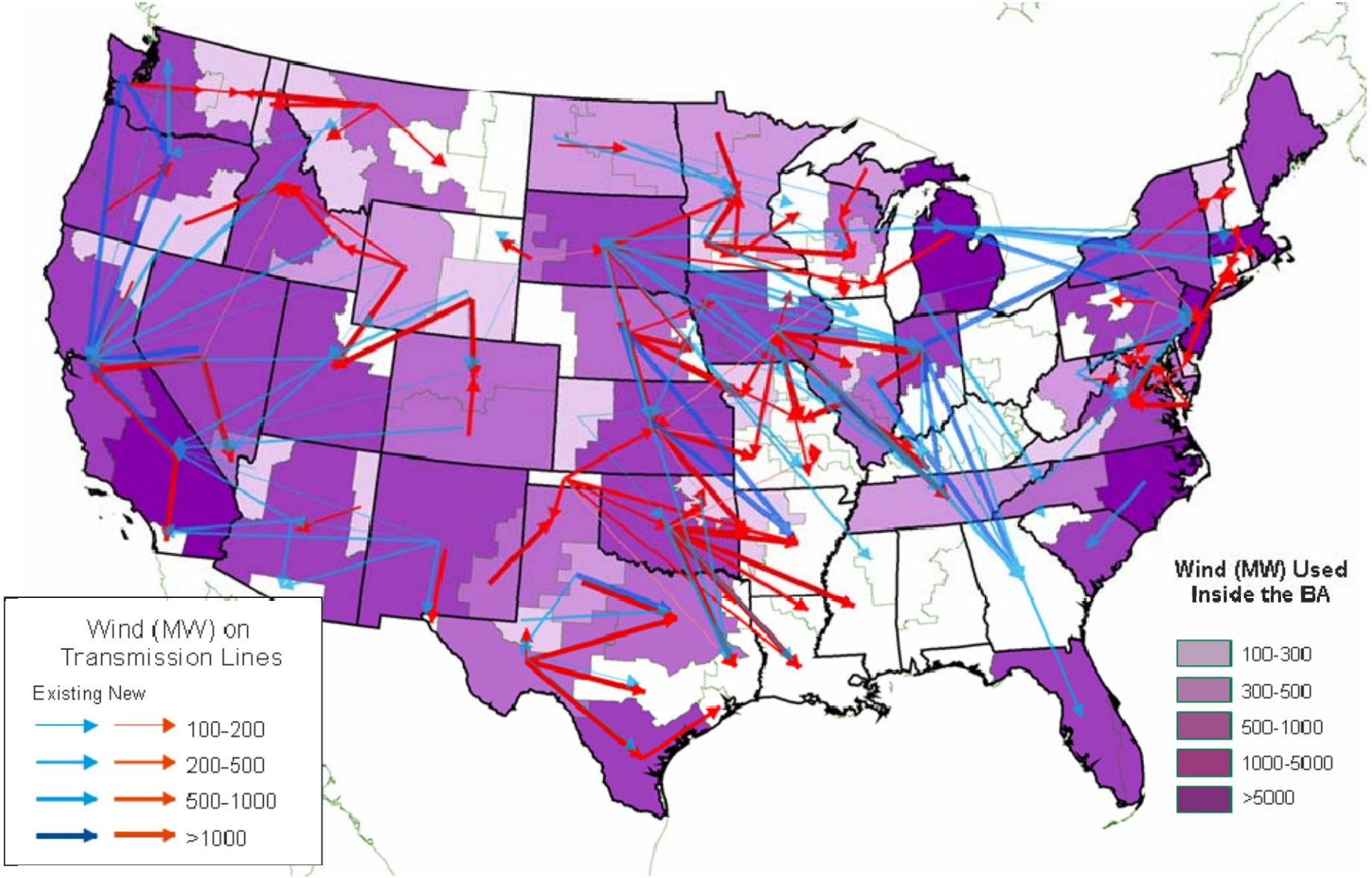


Source*: AWEA, 2008

46 States Would Have Substantial Wind Development by 2030

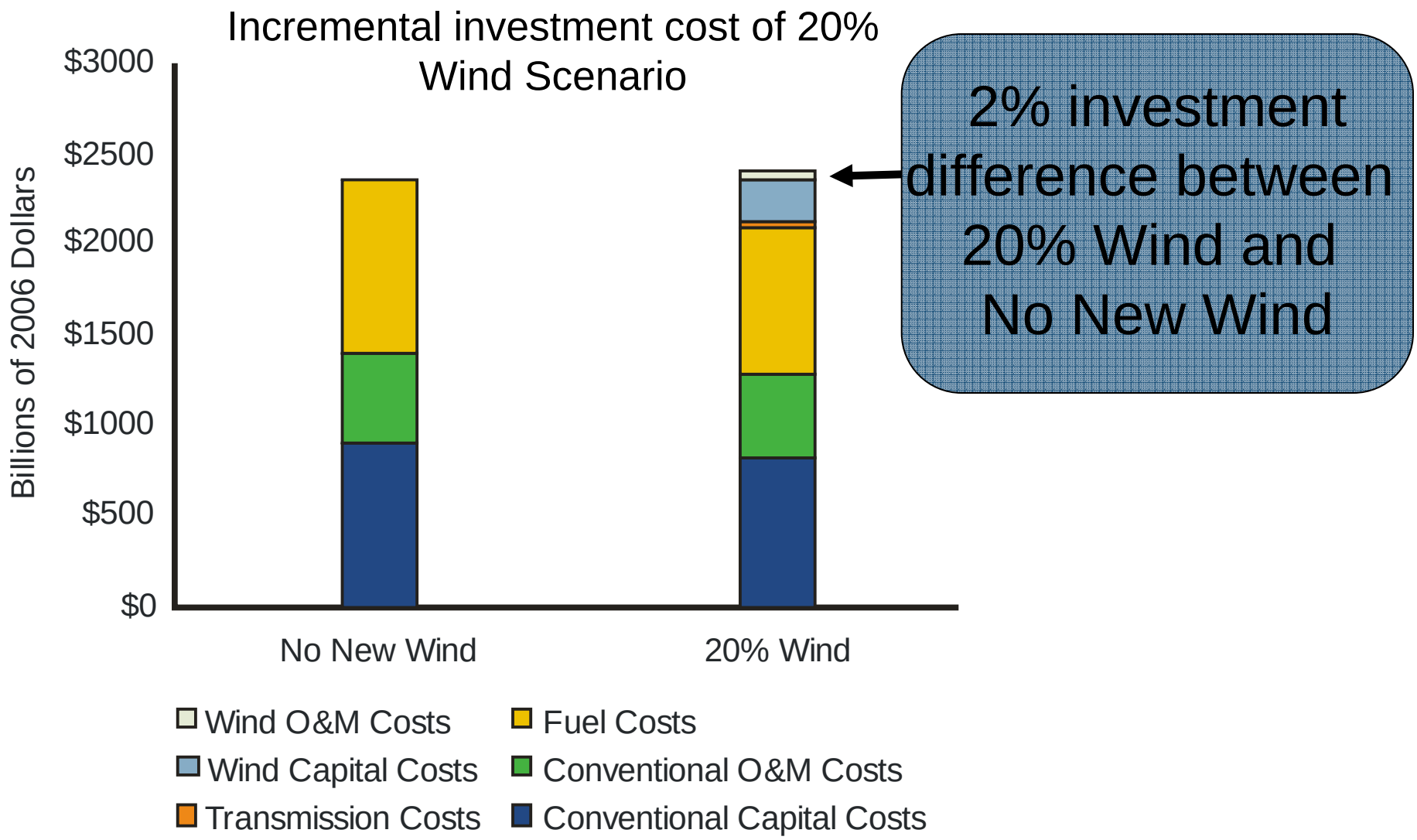


Need for New Transmission: Existing and New in 2030



Costs, Benefits, and Impacts of the 20% Wind Scenario

Economic Costs of 20% Wind Scenario

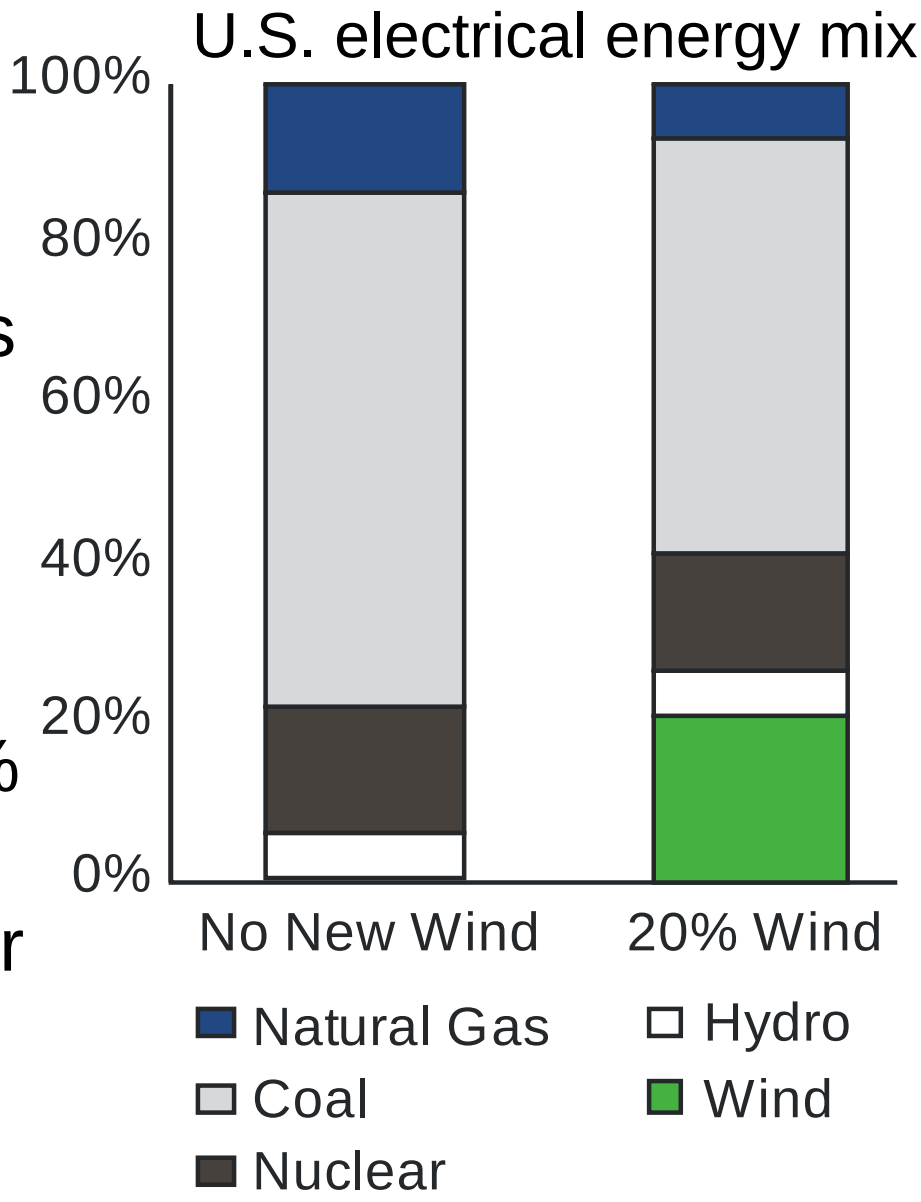


Electricity Sector Costs

- Incremental economic costs reflect:
  - Capital costs of wind projects relative to other projects
  - Incremental transmission investment
- No New Wind scenario costs over $2 trillion in new investment in net present value terms by 2030
- 20% Wind Scenario requires only 2% more investment ($43 billion in net present value)
- 50 cents per month on average household bill

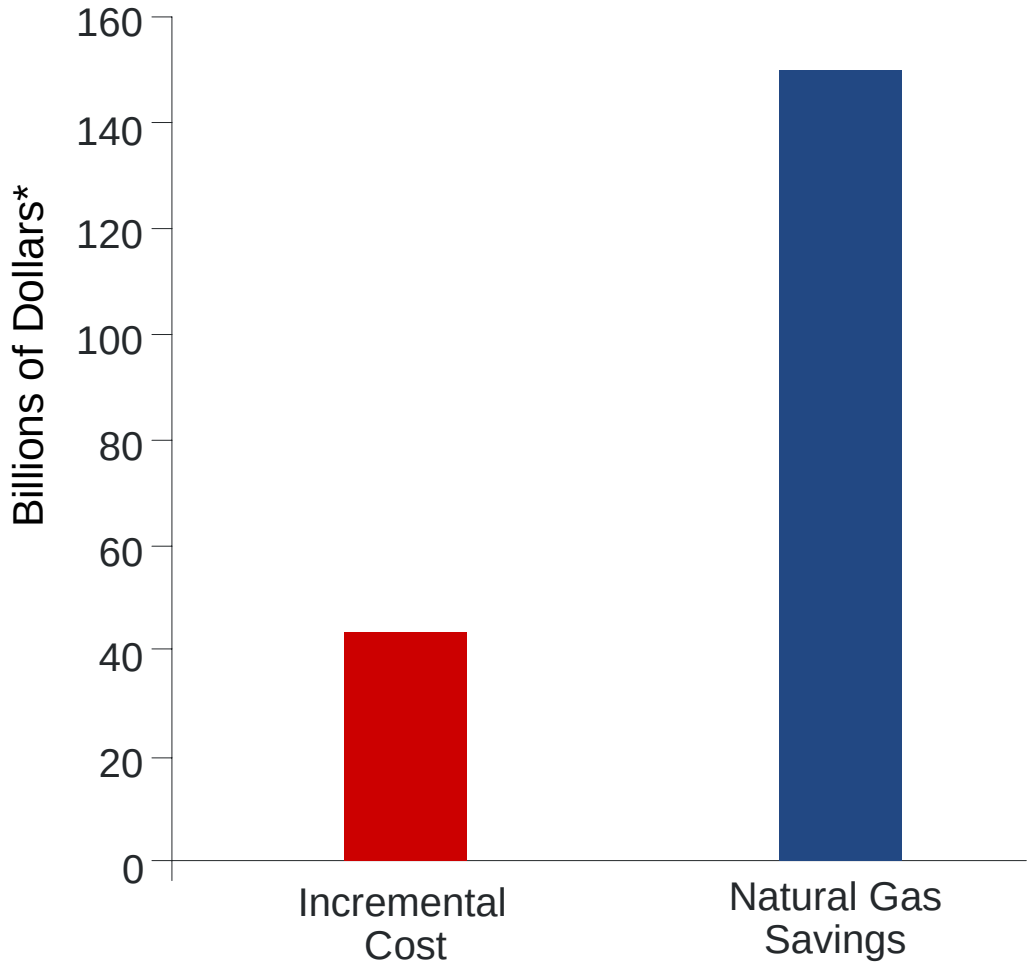
20% Wind Scenario Impact on Generation Mix in 2030

- Reduces electric utility natural gas consumption by 50%
- Reduces total natural gas consumption by 11%
- Natural gas consumer benefits: $86-214 billion*
- Reduces electric utility coal consumption by 18%
- Avoids construction of 80 GW of new coal power plants



Source *: Hand et al., 2008

20% Wind Cost Increment Compared to Savings from Reduced Natural Gas Price Pressure



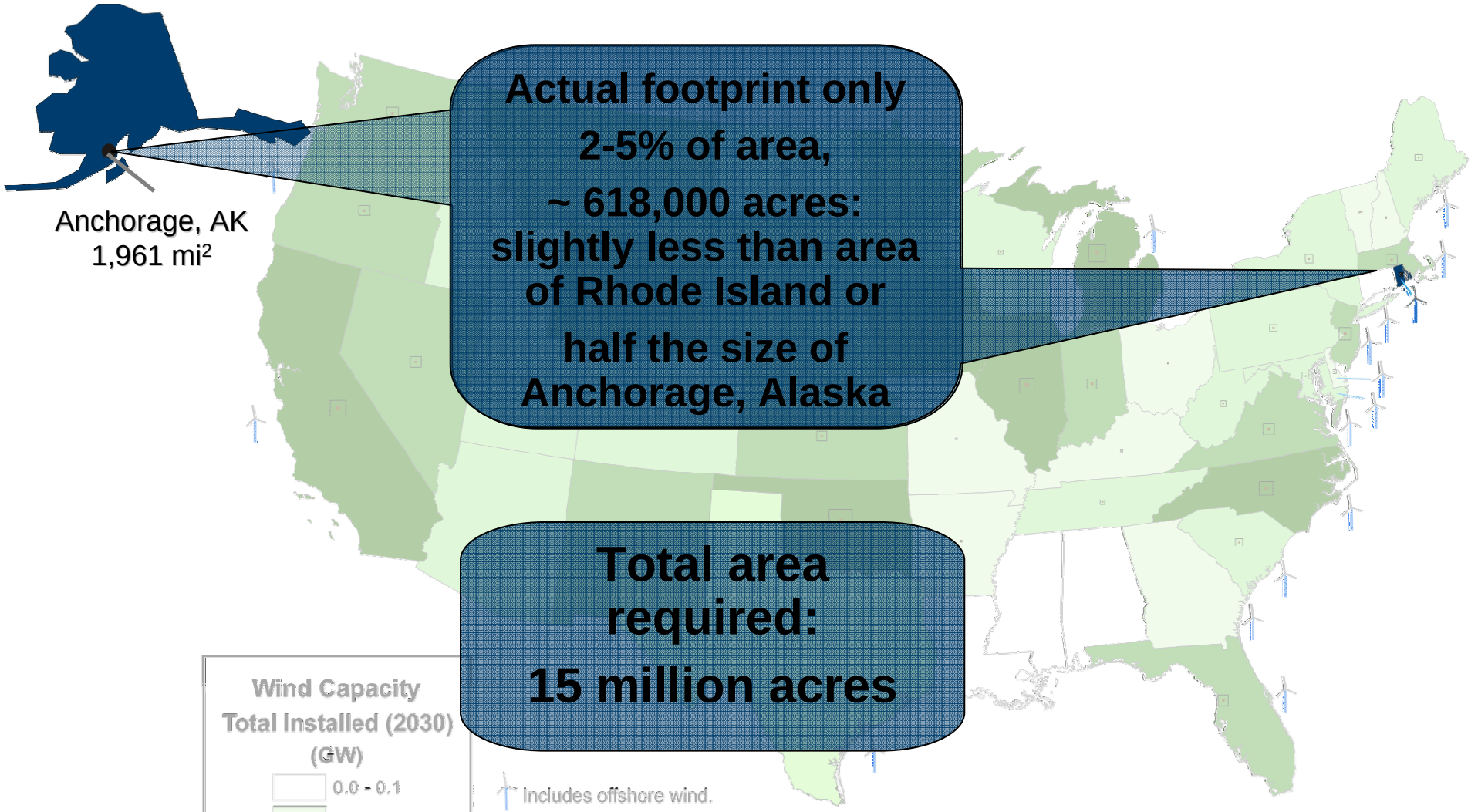
*NPV

The benefits from reduced pressure on natural gas prices across all gas users would be $150 billion (NPV), by itself exceeding the incremental cost of investing in the 20% Scenario.

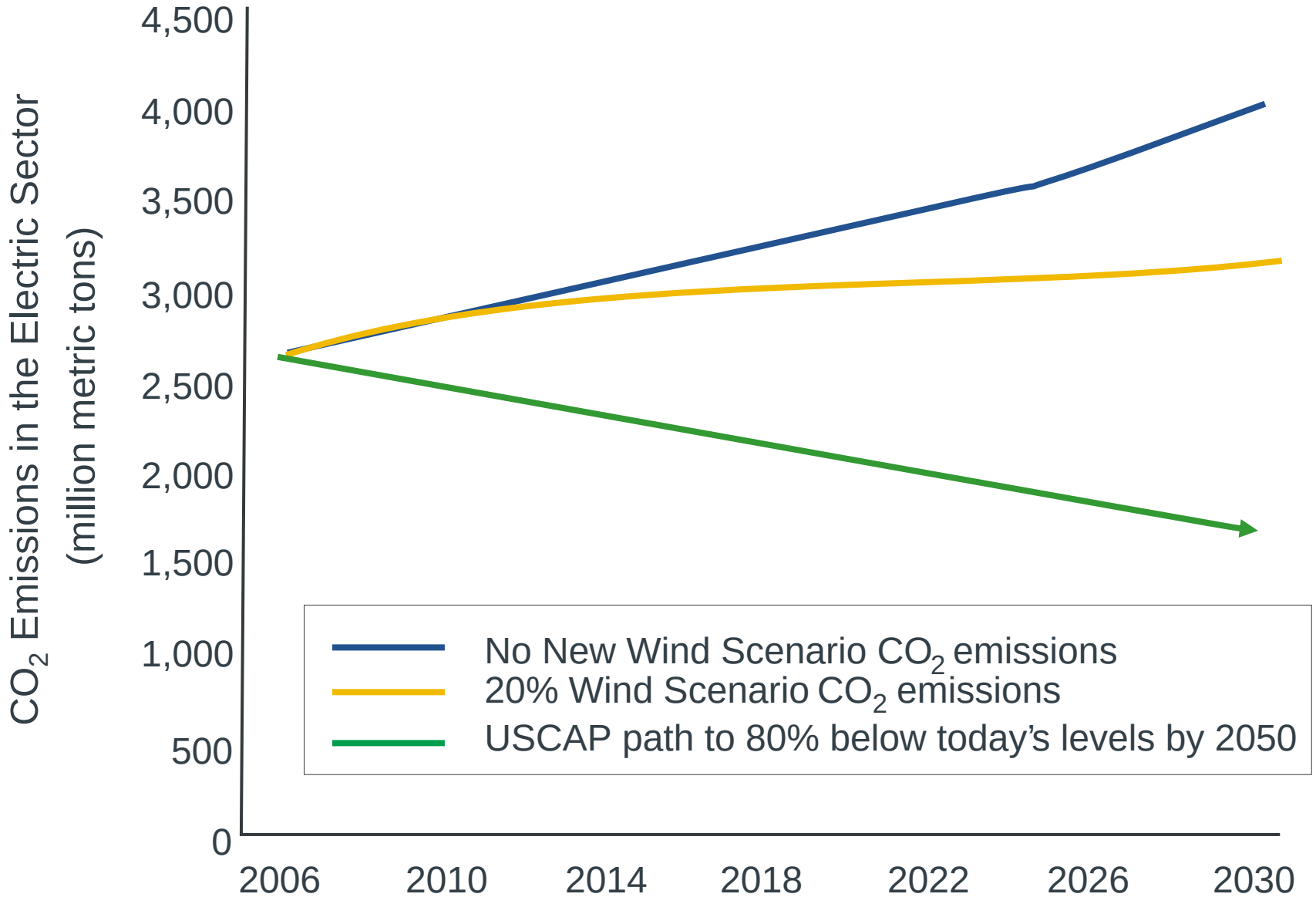
Source: Hand et al., 2008


Most area
available
for farming or
grazing

Total Area Required for 20% Scenario



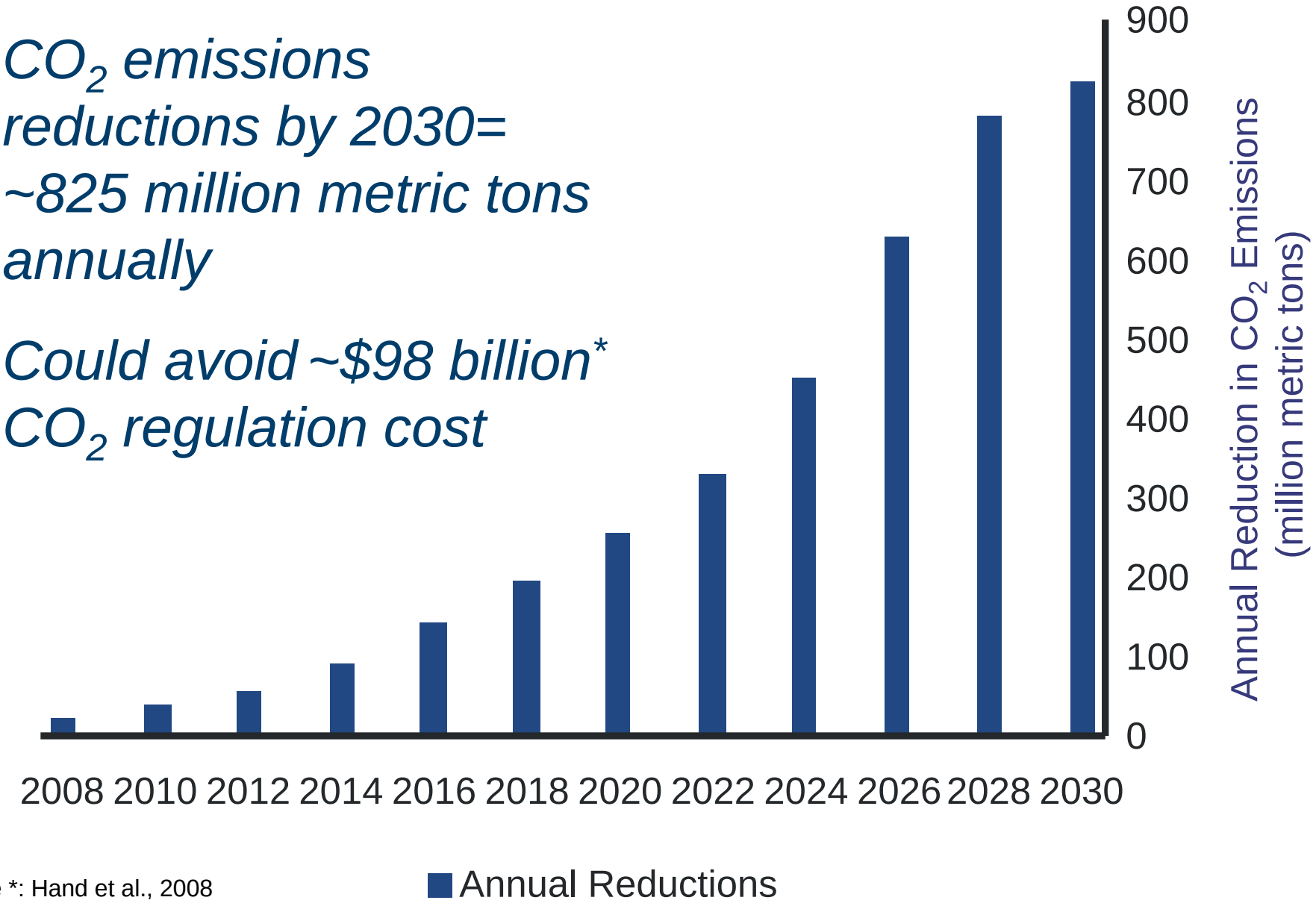
CO_2 Emissions from the Electricity Sector



Annual CO_2 Emissions Reductions

CO_2 emissions reductions by 2030= ~825 million metric tons annually

Could avoid ~$98 billion CO_2 regulation cost*



Source *: Hand et al., 2008

Wind Power Avoids Other Negative Impacts

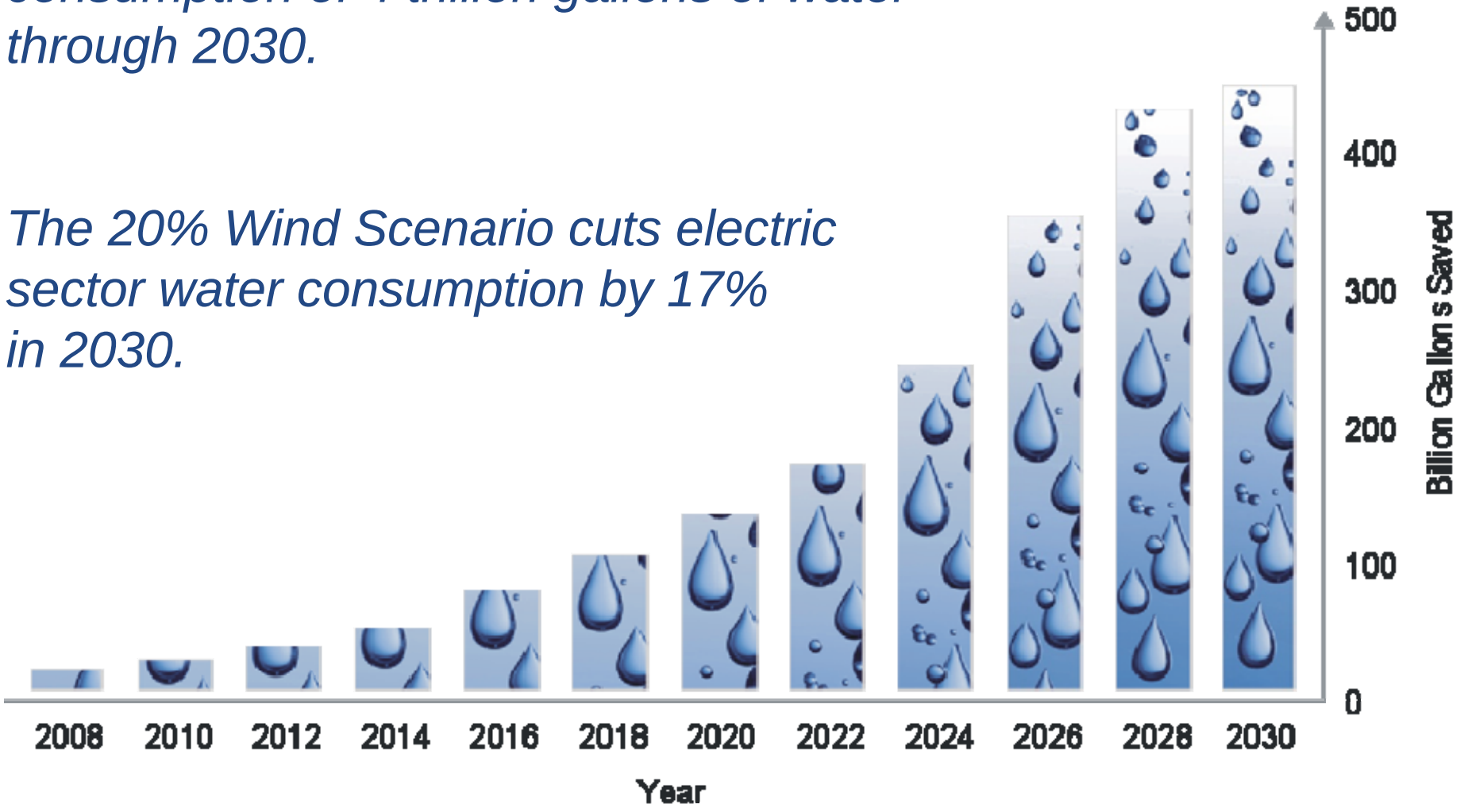
- Wind power avoids the negative impacts of generated fossil fuels:
  - Air emissions of mercury or other heavy metals
  - Emissions from extracting and transporting fuels
  - Lake and streambed acidification
  - Production of toxic solid wastes, ash, or slurry

Photo courtesy: NREL

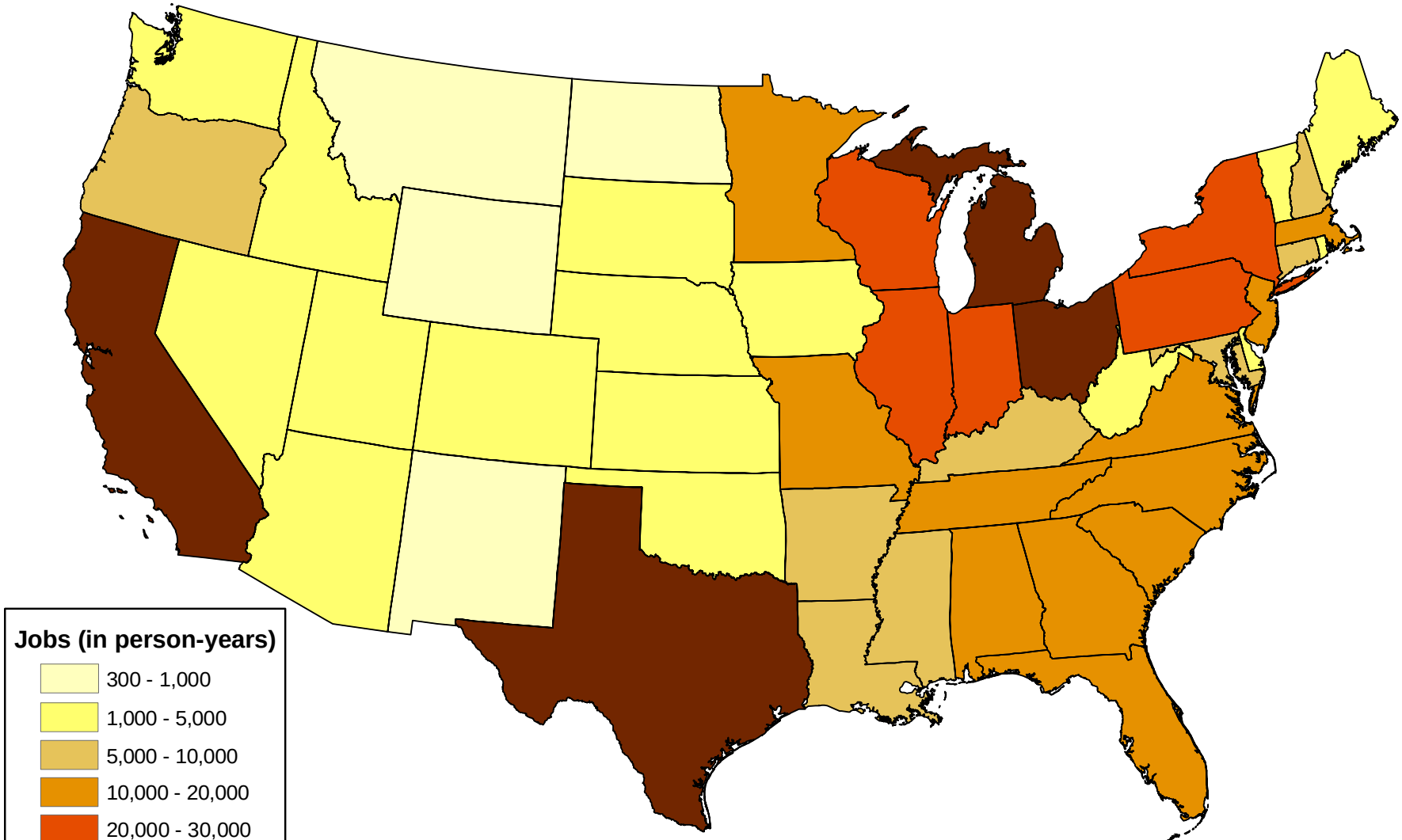
Significant Water Use Savings

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

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



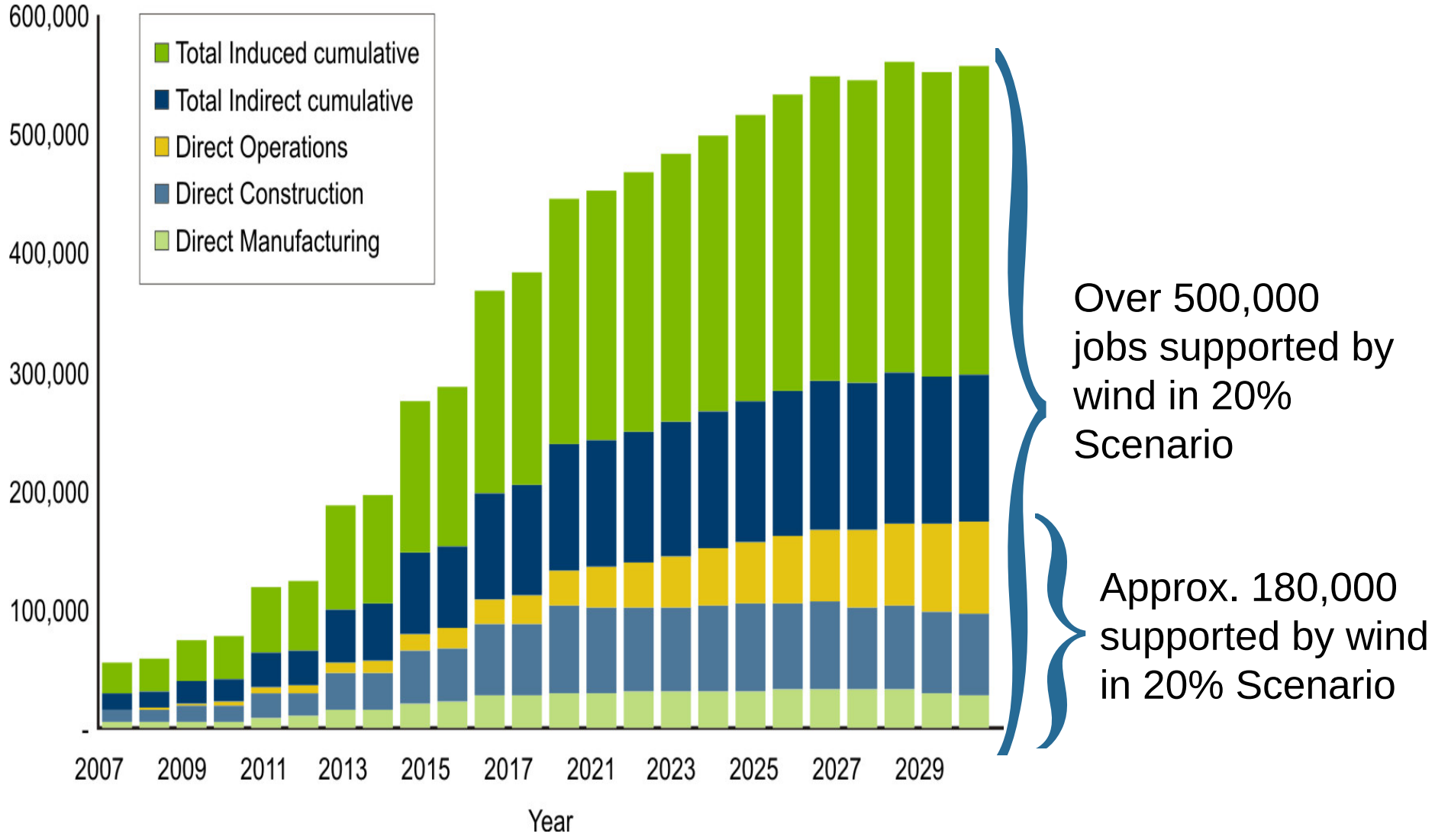
Manufacturing Jobs Supported by State



Manufacturing location information from REPP Report by Sterzinger & Svrcek (2004)

Major component assumptions: 50% of blades are manufactured in U.S. in 2007 increasing to 80% by 2030, 26% of towers are from the U.S. in 2007 increasing to 50% by 2030 and 20% of turbines are made in the U.S. increasing to 42% by 2030.

Jobs Supported by 20% Scenario



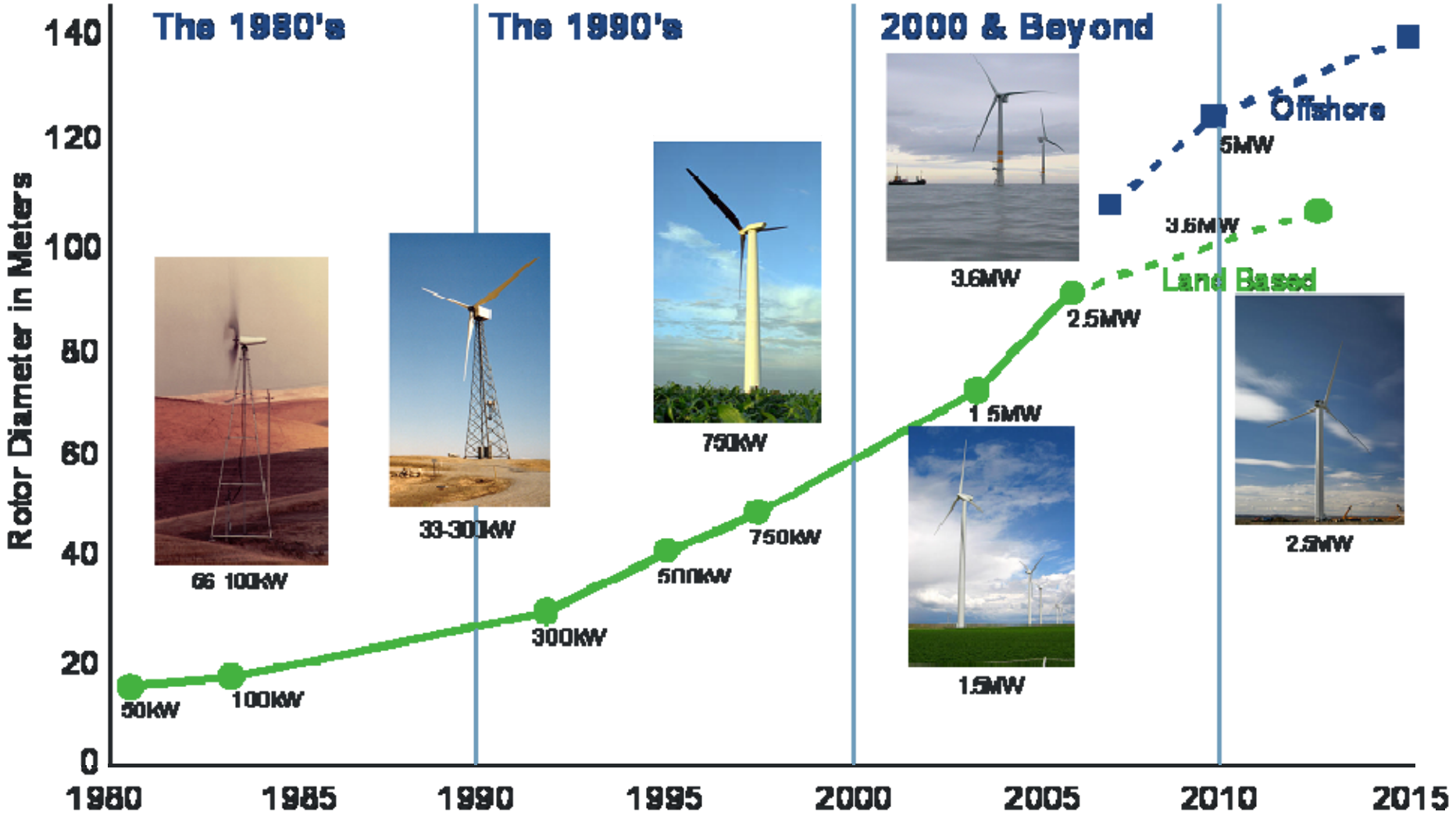
Challenges to Achieving the 20% Wind Scenario

Transmission

- Enhancement of electrical transmission system required in all electricity-growth scenarios
- Transmission is needed to:
  - Relieve congestion in existing system
  - Improve system reliability for all customers
  - Increase access to lower-cost energy
  - Access new and remote generation resources
- Wind requires more transmission than some other options as best winds are often in remote locations

Photo courtesy: NREL

Continued Evolution of Commercial Wind Technology is Needed



Examples of Technology Improvements in Support of 20% Scenario

- Increase capacity factors
  - Pursue larger rotors and taller towers
  - Continue improvements to blades, rotors, drive-train components and controls
  - Enhance reliability of major components
- Reduce capital costs
  - Reduce aerodynamic and mechanical loads through advanced blade and rotor concepts
  - Reduce turbine weight through judicious use of newer, high-strength maters
  - Improve component manufacturability and manufacturing processes
- Mitigate risks
  - Evaluate performance to enable early identification of issues
  - Track O&M needs to enhance experience base for turbines and components
  - Conduct testing and certification activities

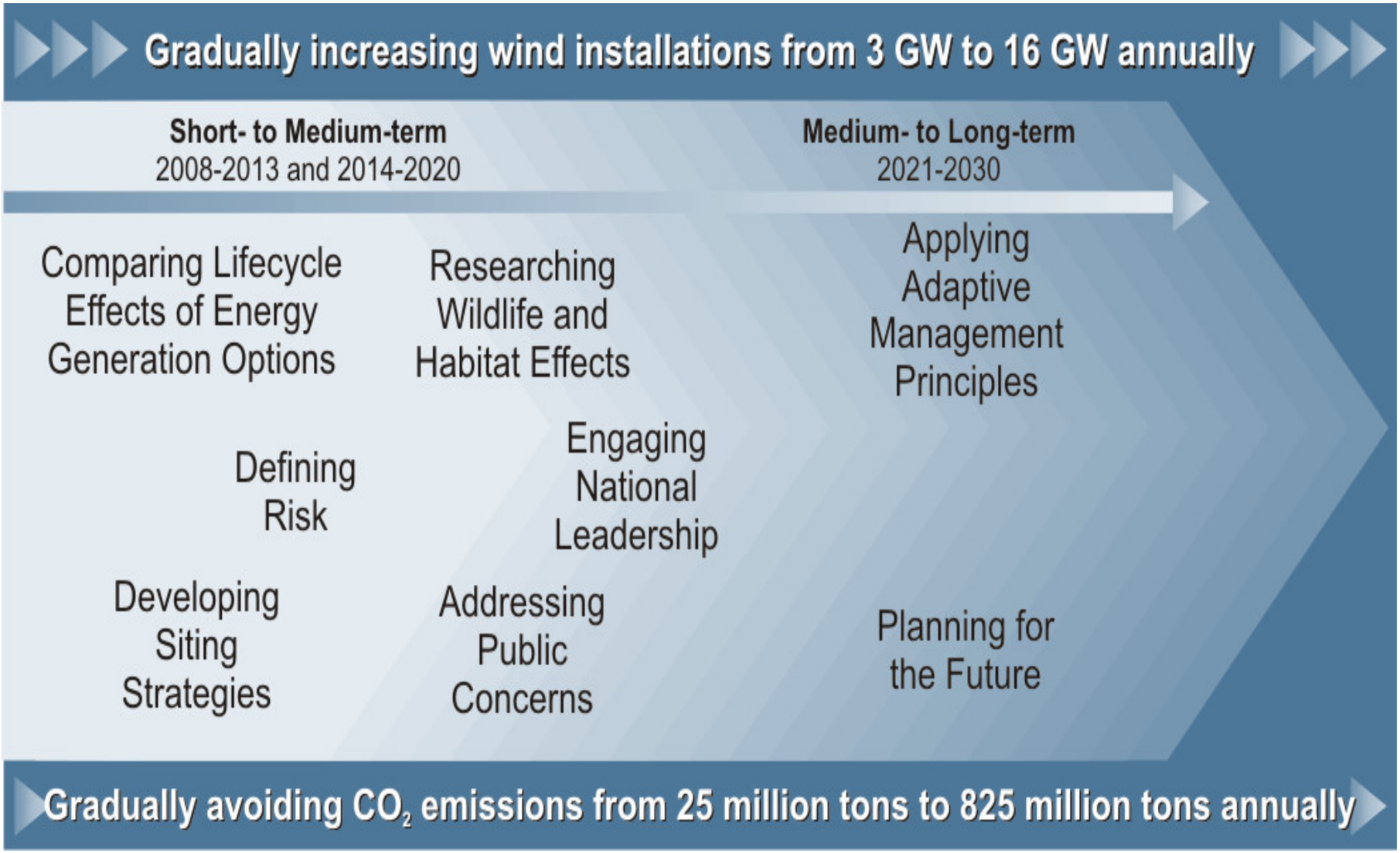
Project Siting

- Project siting often raises local concerns about:
  - Visual impacts
  - Property value impacts
  - Impacts on local wildlife/habitats
  - Turbine or rotor noise
  - Land use

Photo courtesy: US Fish and Wildlife

- Wind generation is responsible for 0.003% of human-caused avian mortality (National Research Council, 2007)
- Bat mortality has been higher than expected
- No site or cumulative impacts on bird or bat populations have been demonstrated, to date

Siting Processes




Summary

20% Wind Scenario

- Explores one scenario for reaching 20% wind energy by 2030 and contrasts it to a scenario in which no new U.S. wind power capacity is installed
- Is not a prediction, but an analysis based on one scenario
- Critically examines wind's roles in energy security, economic prosperity and environmental sustainability
- Would require about 300 GW (300,000 MW) of wind generation
- Shows that affordable, accessible wind resources available across the nation

Summary: Costs & Benefits

Incremental direct cost to society	$43 billion 50 cents/month/ household
Reduction in emissions of greenhouse gasses and avoided carbon regulation costs	825 million tons of CO_2 $50 to $145 billion
Reduction in water consumption	8% through 2030 17% in 2030
Jobs supported and other economic benefits	500,000 total with 150,000 direct jobs $2 billion in local annual revenues
Reduction in nationwide natural gas use and likely savings for all gas consumers	11% $86-214 billion

Sources: DOE, 2008 and Hand et al., 2008

Note: All dollar values are in NPV

References

- U.S. Department of Energy. 2008. *20% Wind Energy by 2030*. DOE/GO-102008-2567. Washington, DC.
- AWEA. 2008. Wind Power Outlook 2008. Washington, DC.
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