



20% Wind Energy  
by 2030



# The 20% Wind Energy Scenario

## ▲ Primary Assumptions:

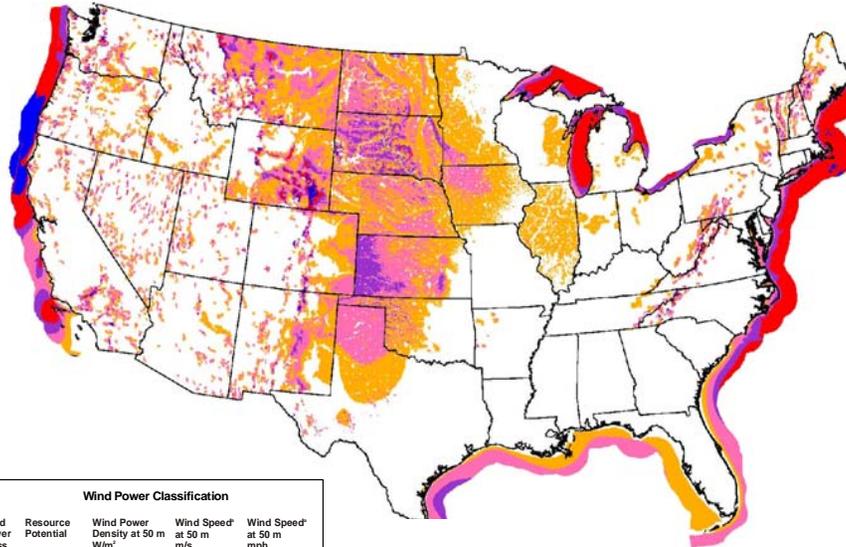
- U.S. electricity consumption grows 39% from 2005 to 2030 -- to 5.8 billion MWh (Source: EIA)
- Wind turbine energy production increases about 15% by 2030
- Wind turbine costs decrease about 10% by 2030
- No major breakthroughs in wind technology

## ▲ Primary Findings:

- 20% wind electricity requires 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

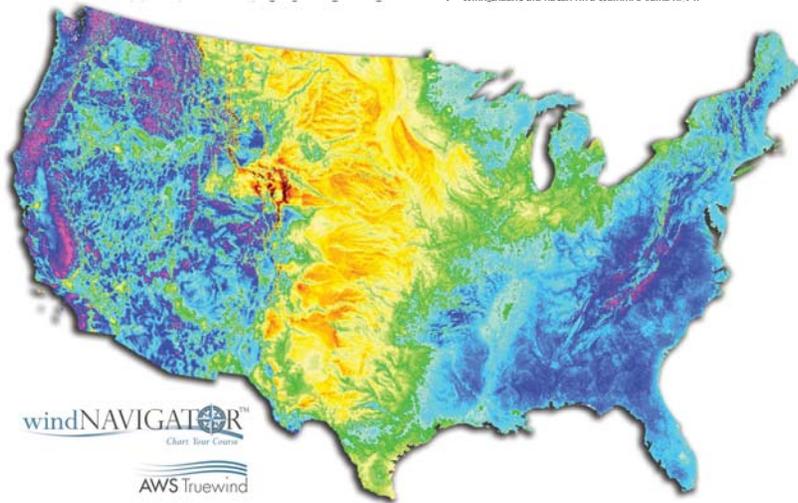


# U.S. Wind Resource Maps



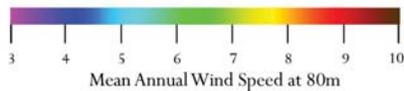
Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s	Wind Speed <sup>a</sup> at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

<sup>a</sup> Wind speeds are based on a Weibull k value of 2.0

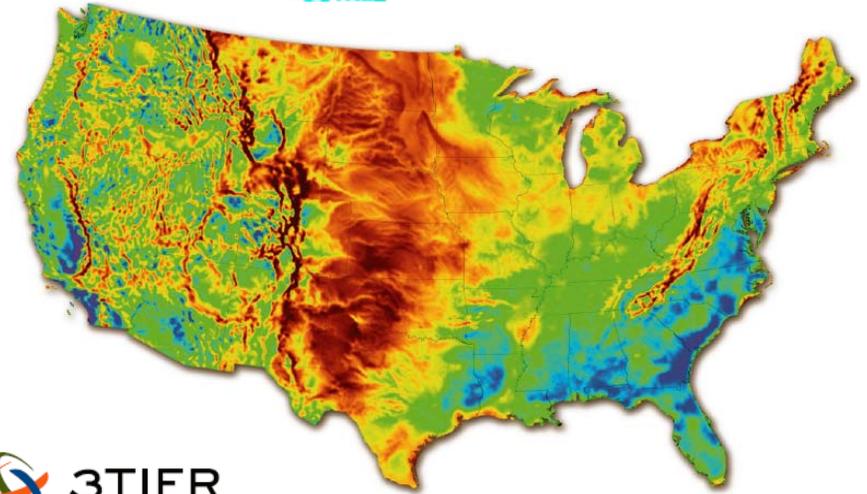


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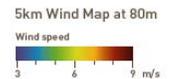
Wind Resource of the United States at 2.5km grid cell resolution.  
SOURCE: Data and image developed by AWS Truewind for windNavigator.  
<http://navigator.awstruewind.com>



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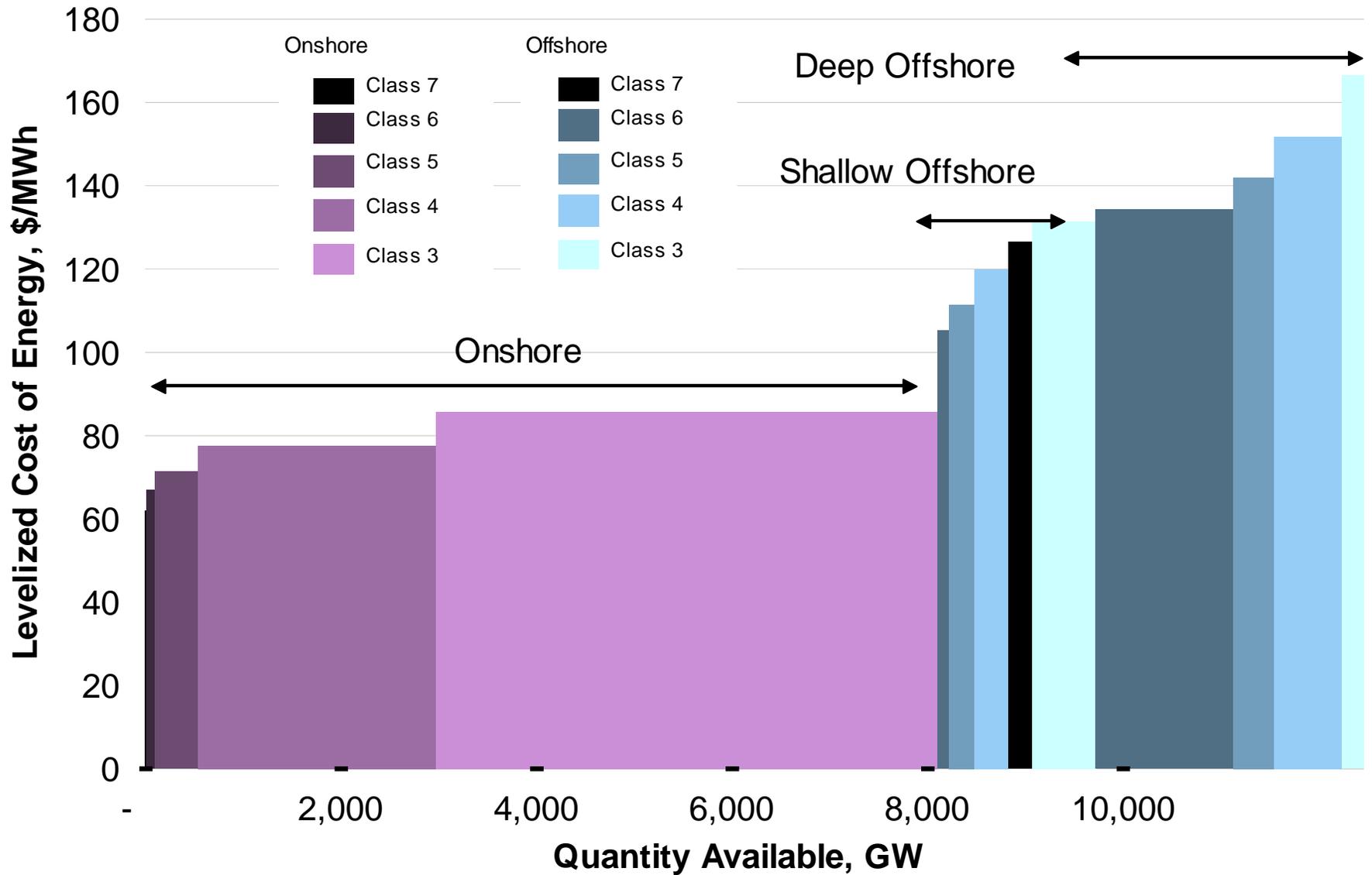
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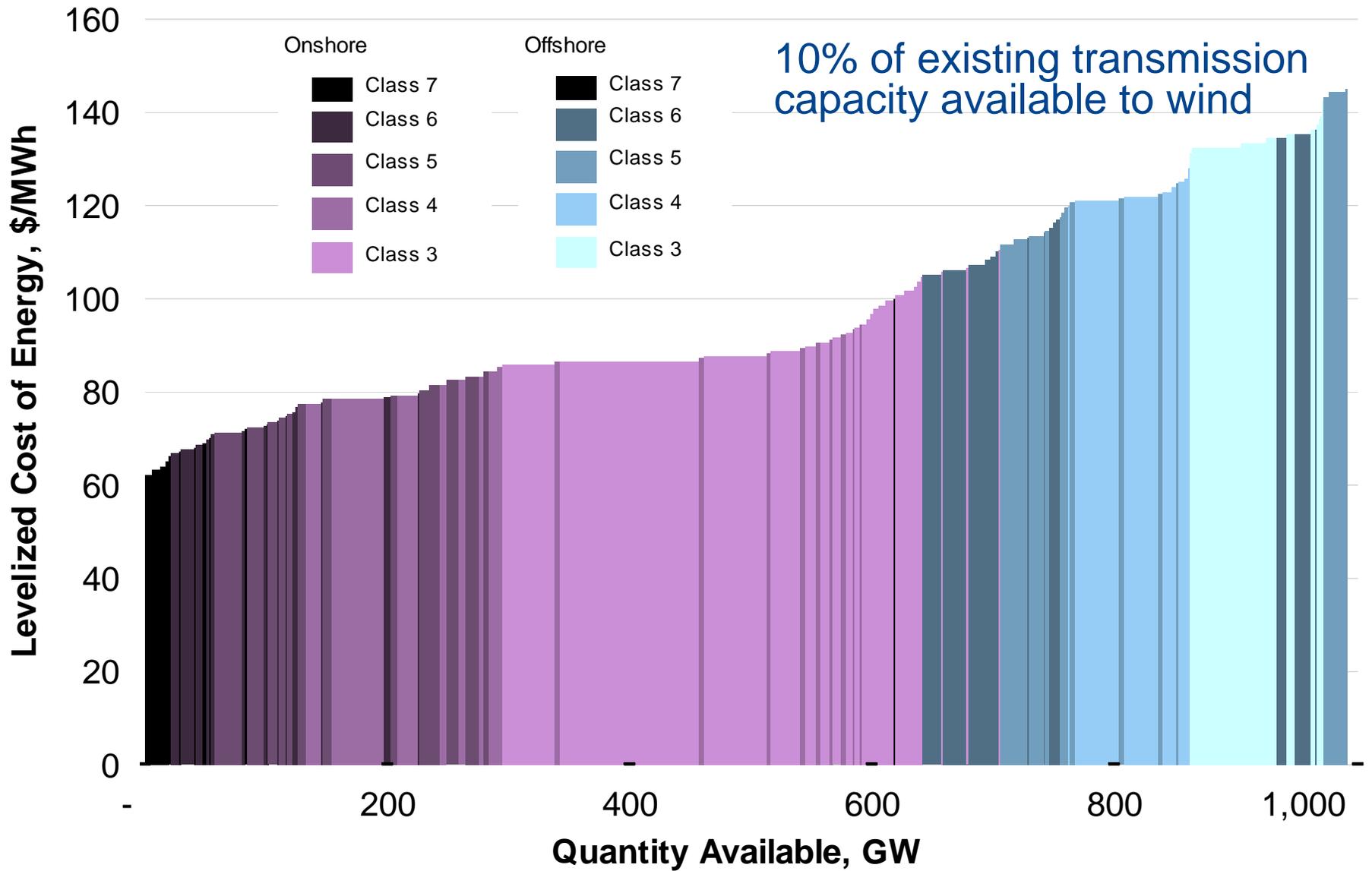


# Resource Potential Exceeds Total Electricity Demand



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

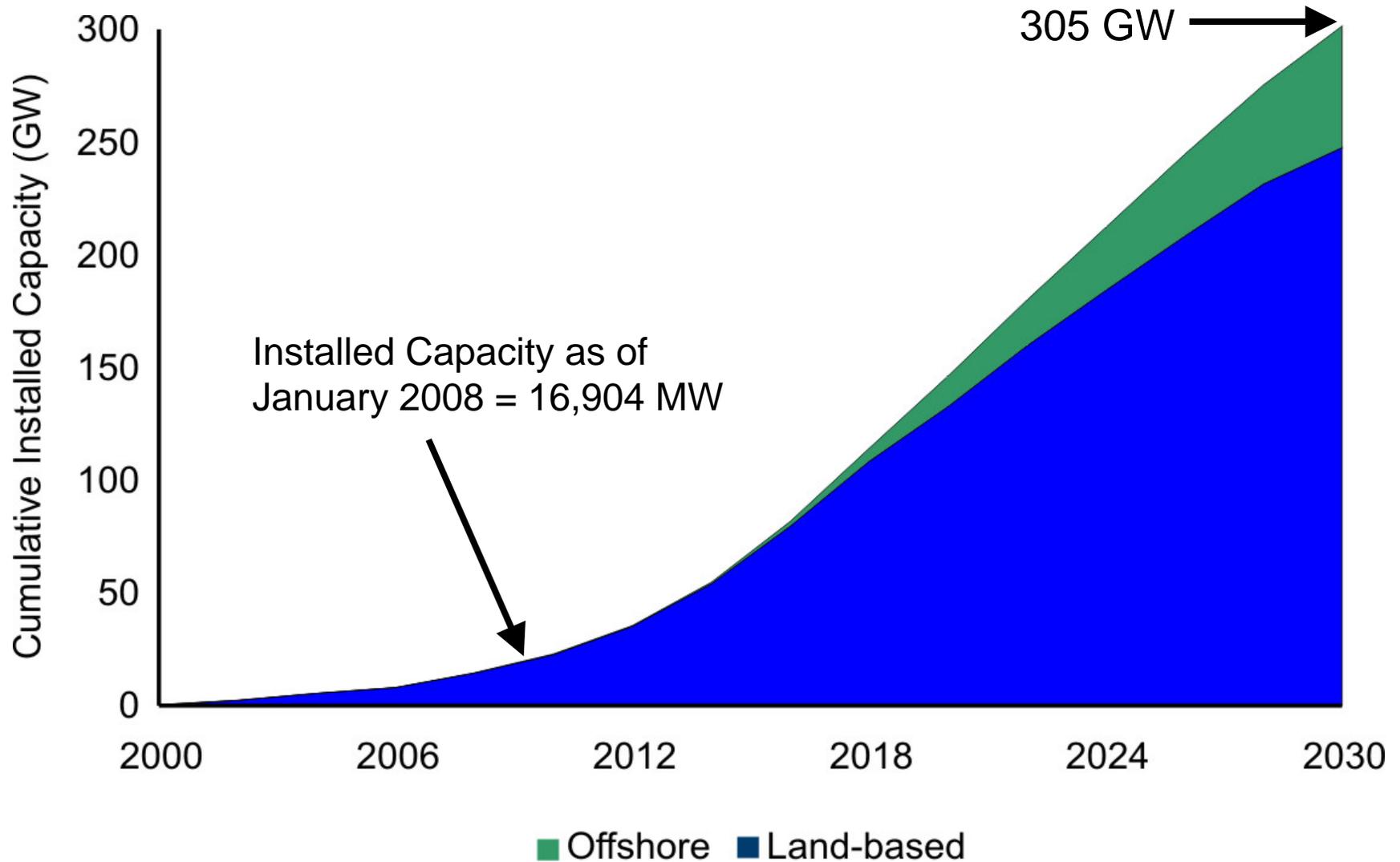
# Cost of Wind and Transmission: Economically Available



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

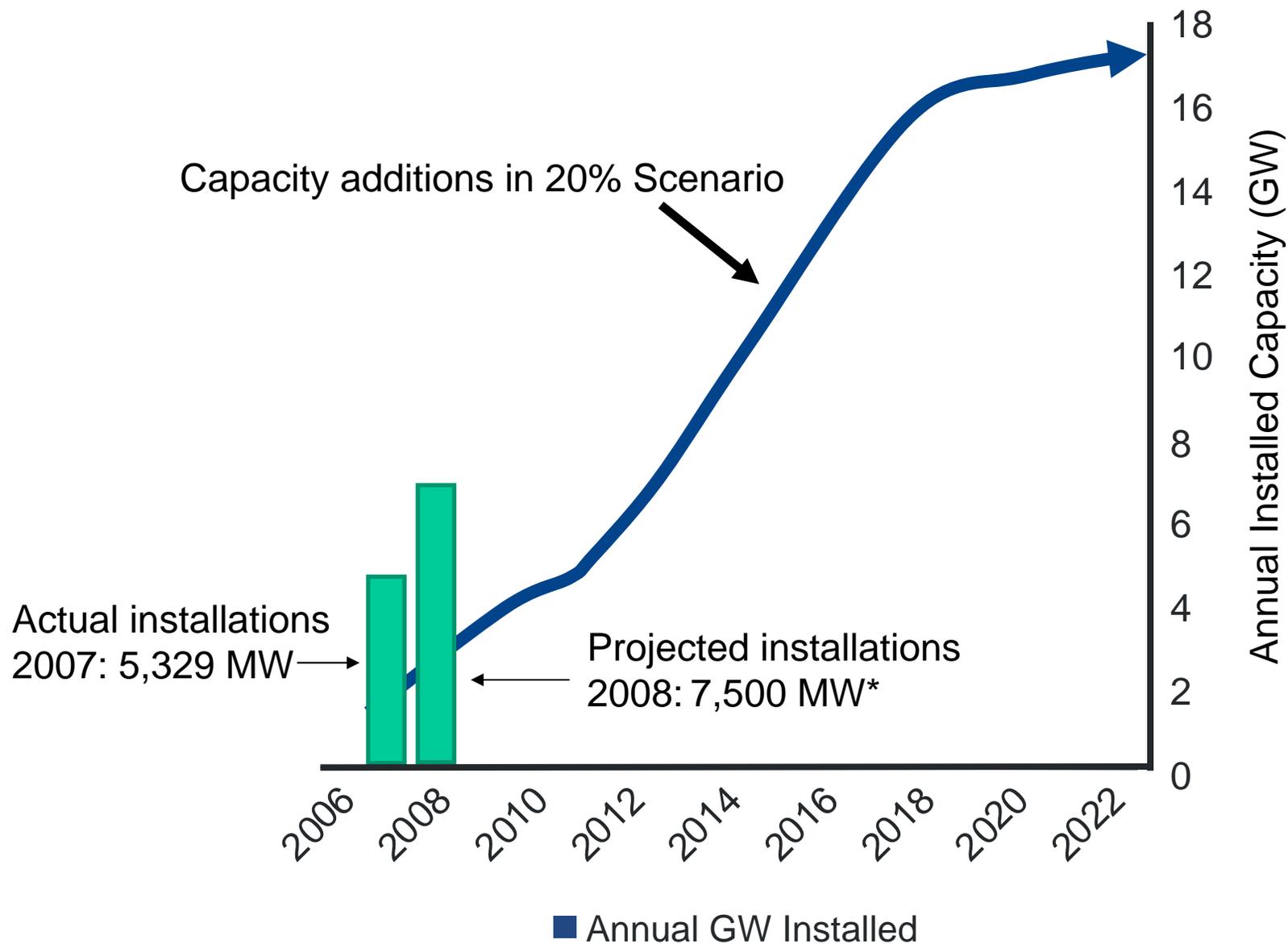


# 20% Wind Scenario





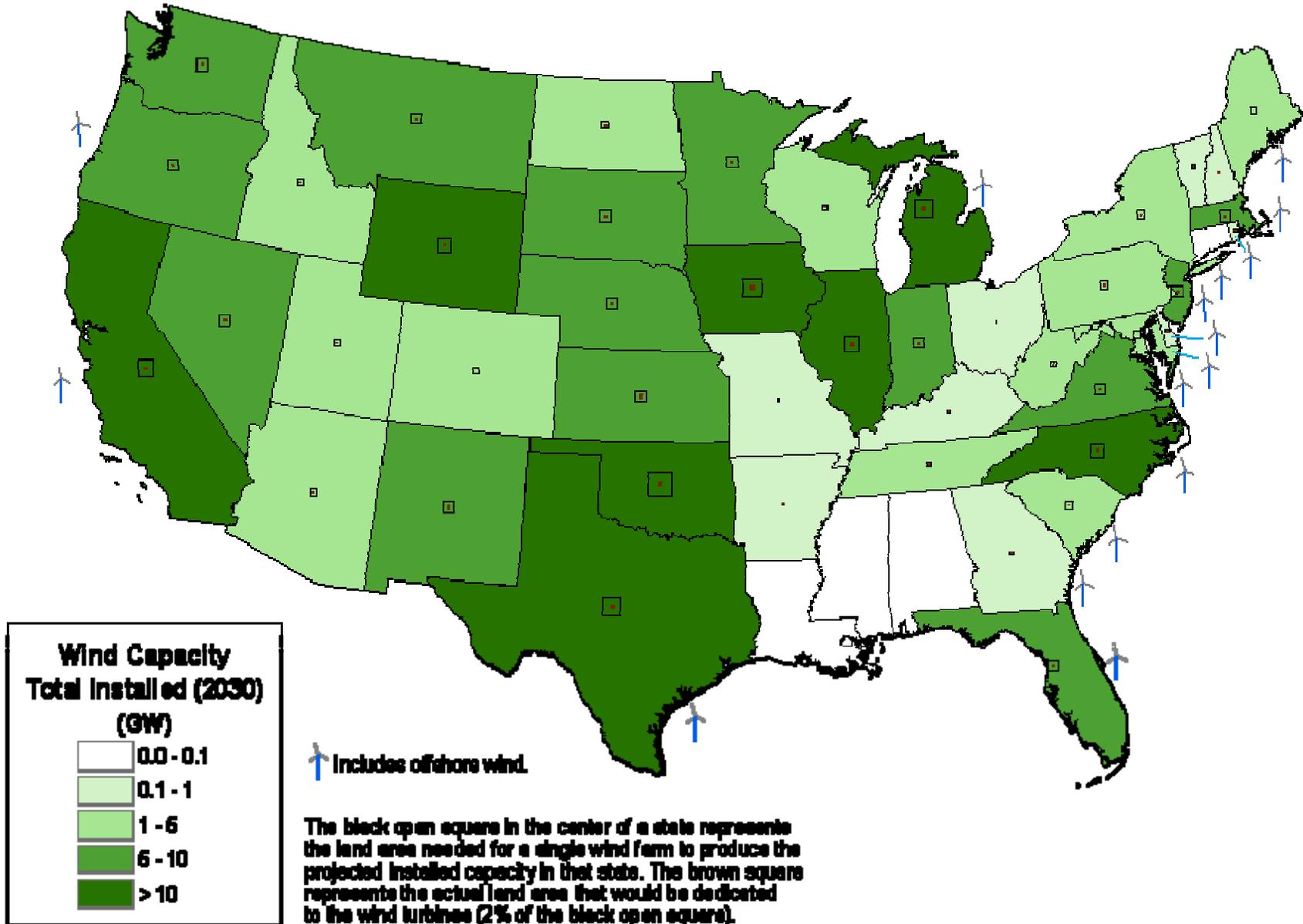
# Annual Installed Capacity vs. Current Installed Capacity



Source\*: AWEA, 2008

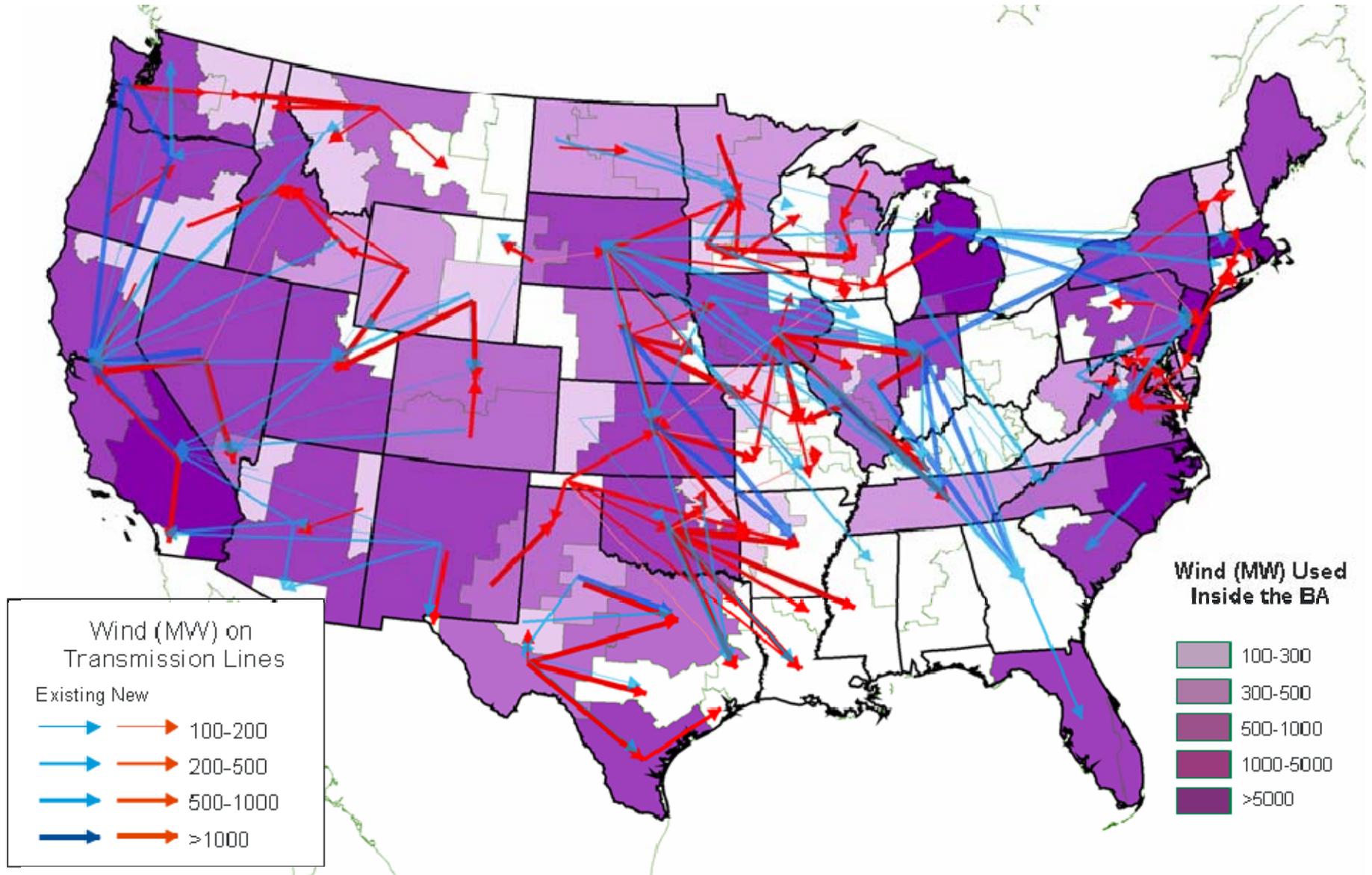


# 46 States Have Wind Development by 2030 Under The 20% Wind Scenario





# Need for New Transmission: Existing and New in 2030

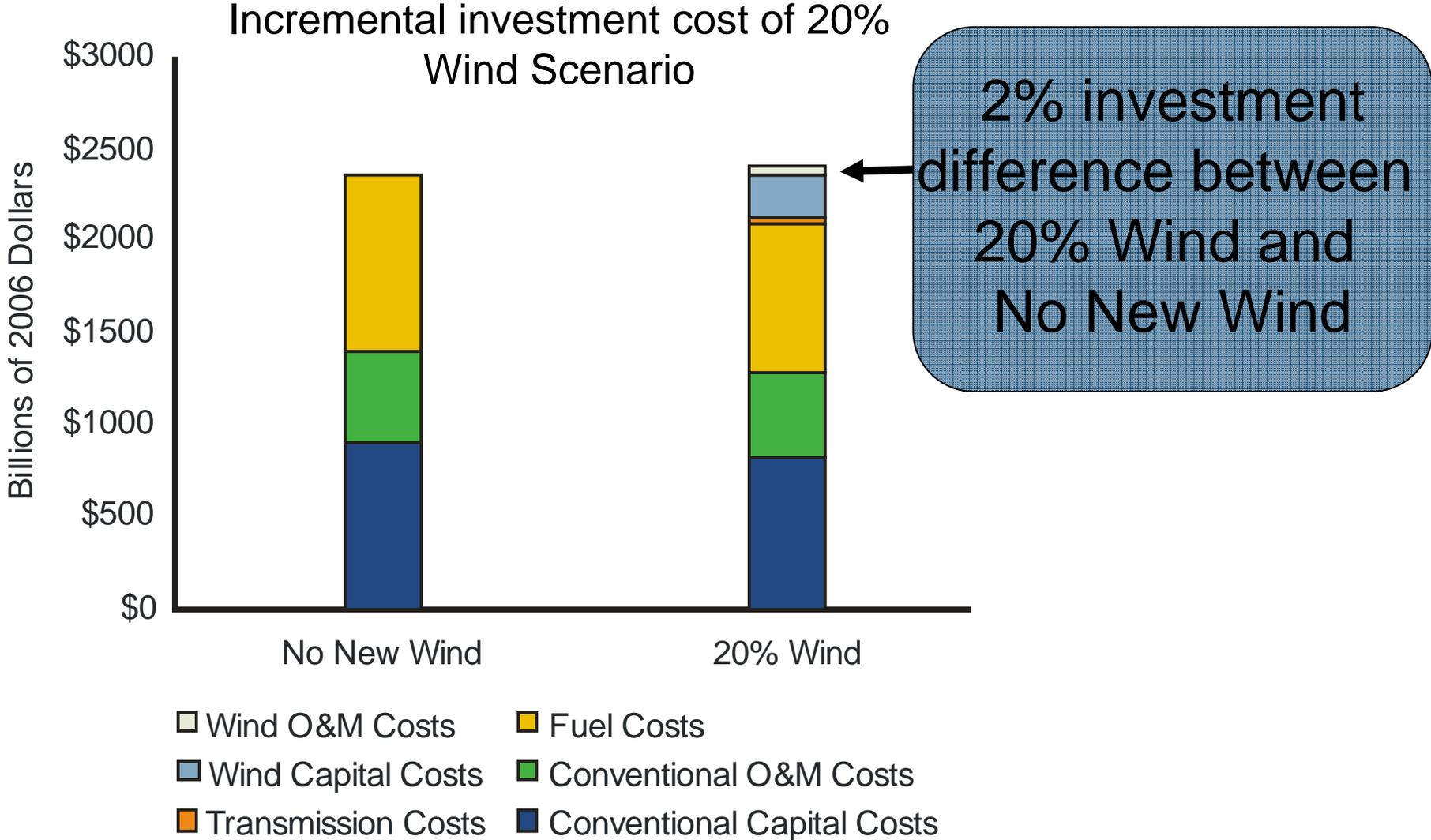


# Costs, Benefits, and Impacts of the 20% Wind Scenario





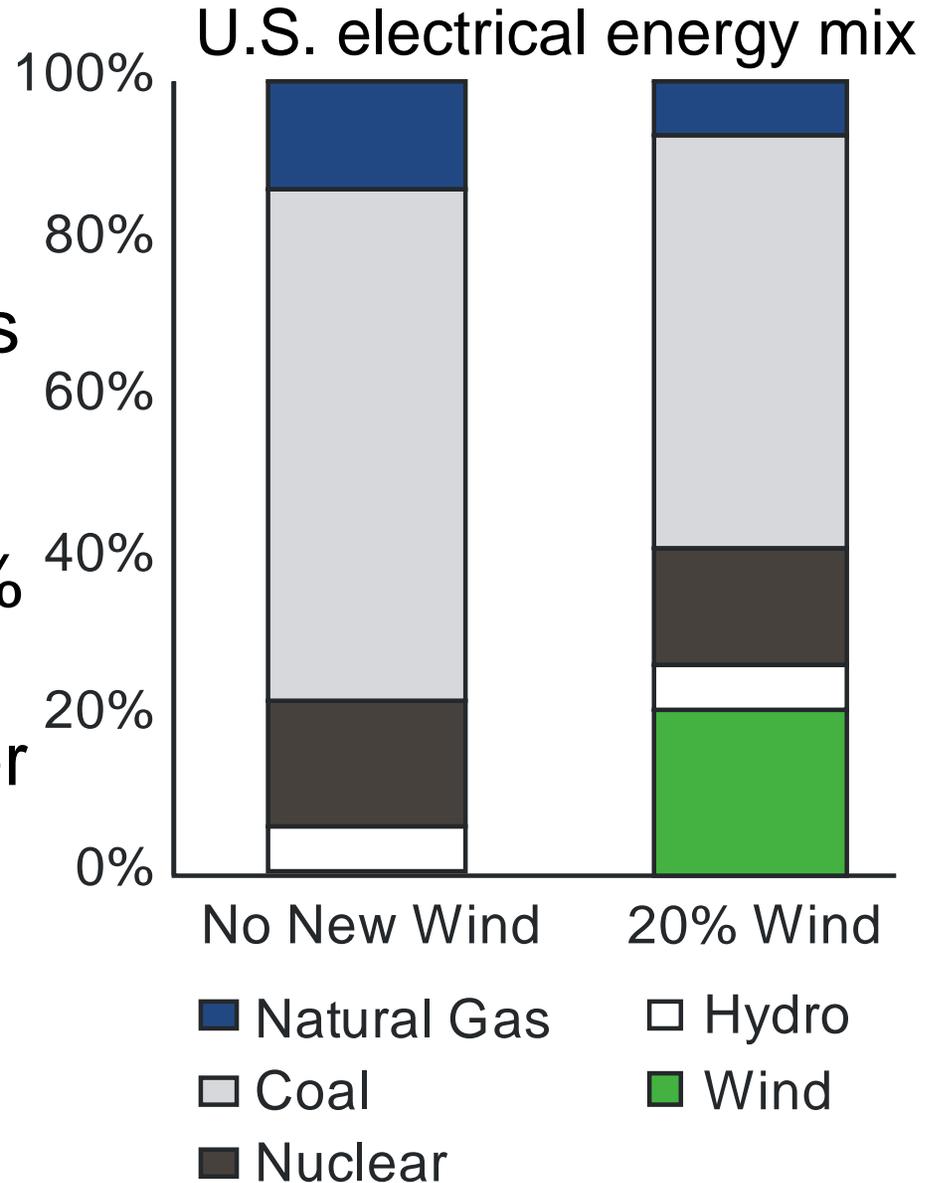
# Economic Costs of 20% Wind Scenario





# 20% Wind Scenario Impact on Generation Mix in 2030

- Reduces electric utility natural gas consumption by 50%
- Reduces total natural gas consumption by 11%
- Reduces electric utility coal consumption by 18%
- Avoids construction of 80 GW of new coal power plants

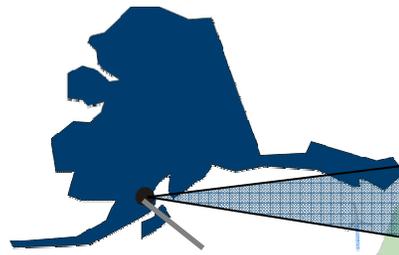




Most area  
available  
for farming or  
grazing



# Total Area Required for 20% Scenario

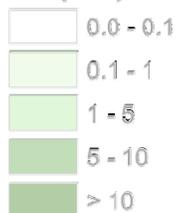


Anchorage, AK  
1,961 mi<sup>2</sup>

**Actual footprint only  
2-5% of area,  
~ 618,000 acres:  
slightly less than area  
of Rhode Island or  
half the size of  
Anchorage, Alaska**

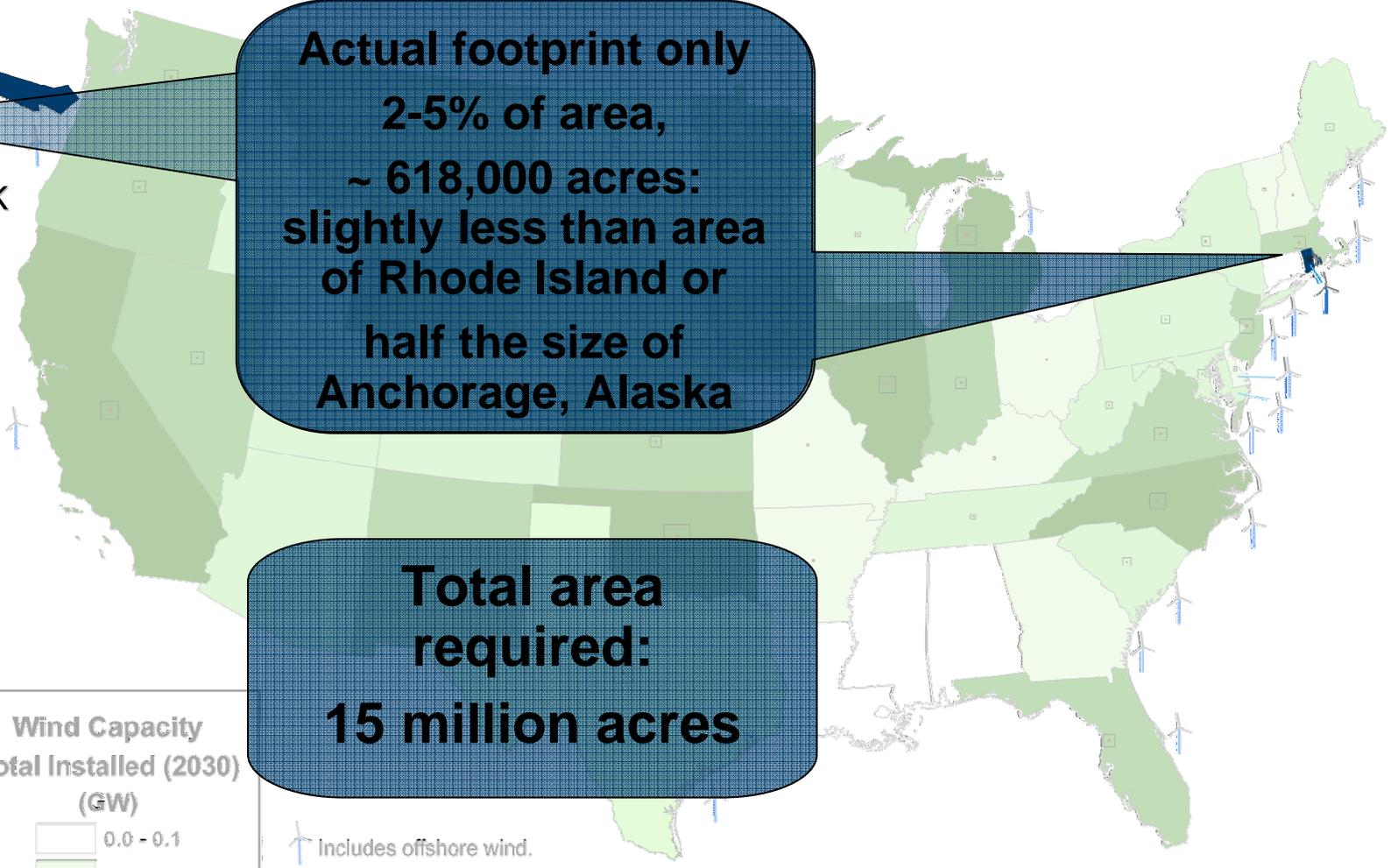
**Total area  
required:  
15 million acres**

**Wind Capacity  
Total Installed (2030)  
(GW)**



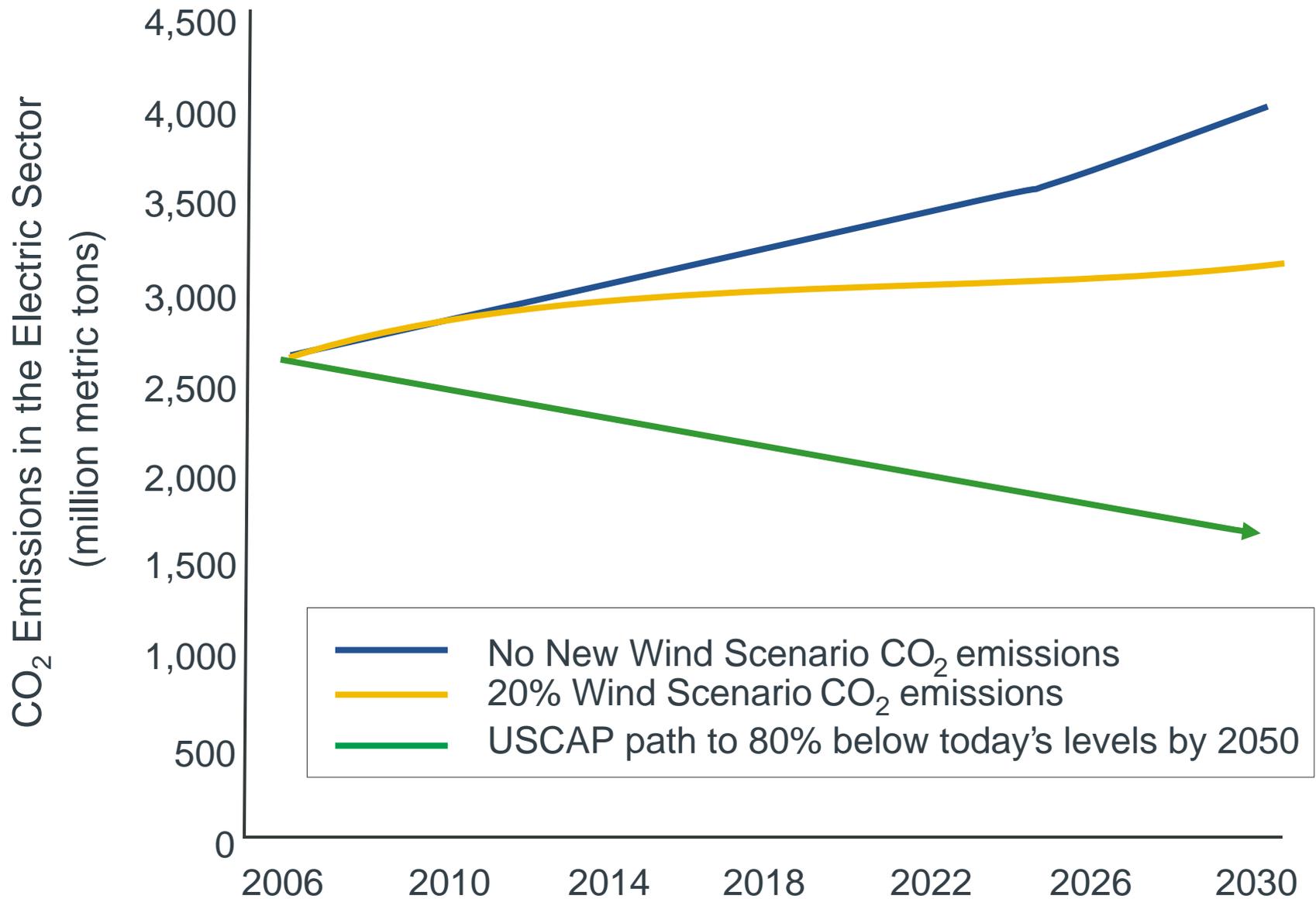
Includes offshore wind.

The black open square in the center of a state represents the land area needed for a single wind farm to produce the projected installed capacity in that state. The brown square represents the actual land area that would be dedicated to the wind turbines (2% of the black open square).





# CO<sub>2</sub> Emissions from the Electricity Sector

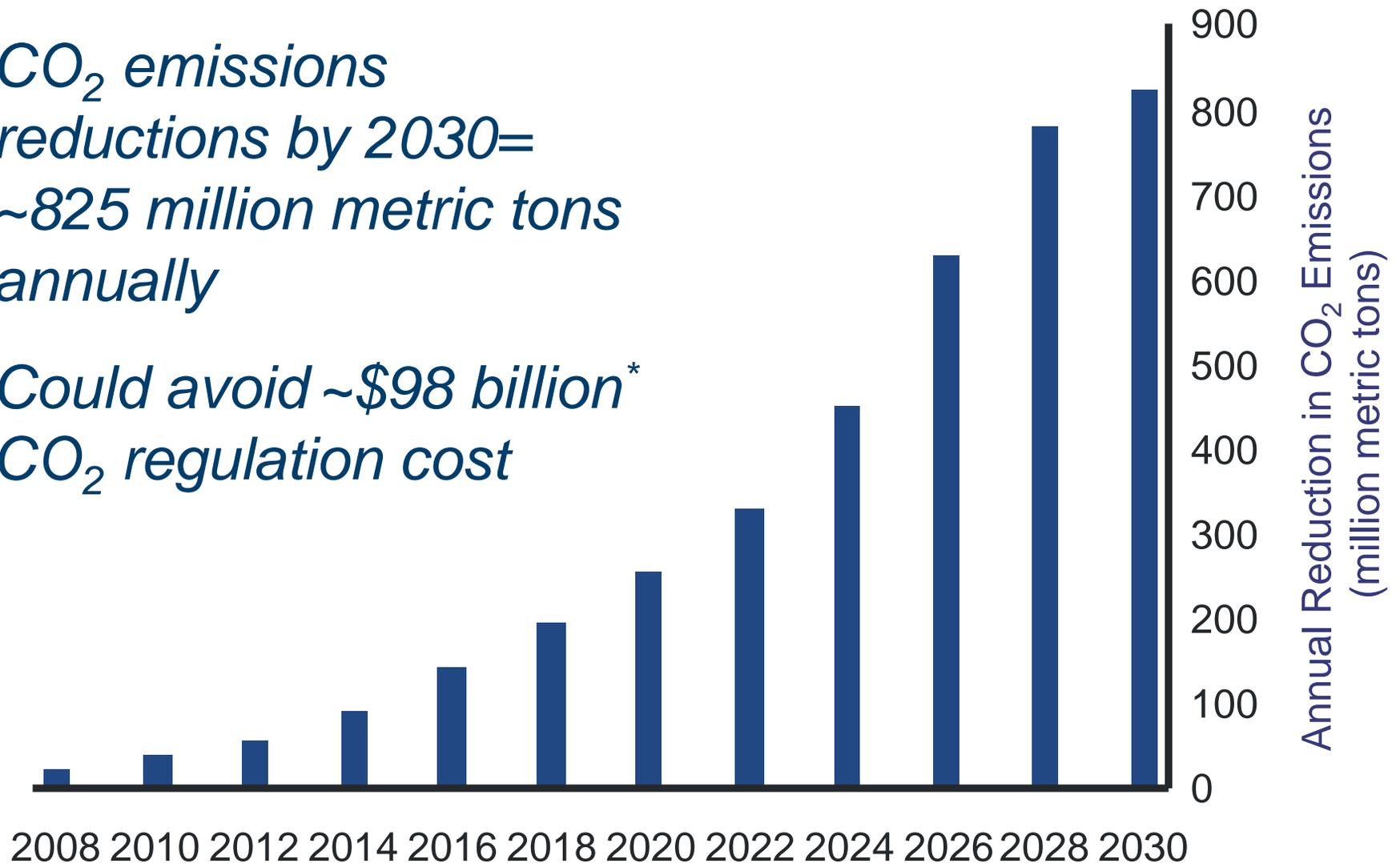




# Annual CO<sub>2</sub> Emissions Reductions

*CO<sub>2</sub> emissions reductions by 2030= ~825 million metric tons annually*

*Could avoid ~\$98 billion\* CO<sub>2</sub> regulation cost*



Source \*: Hand et al., 2008

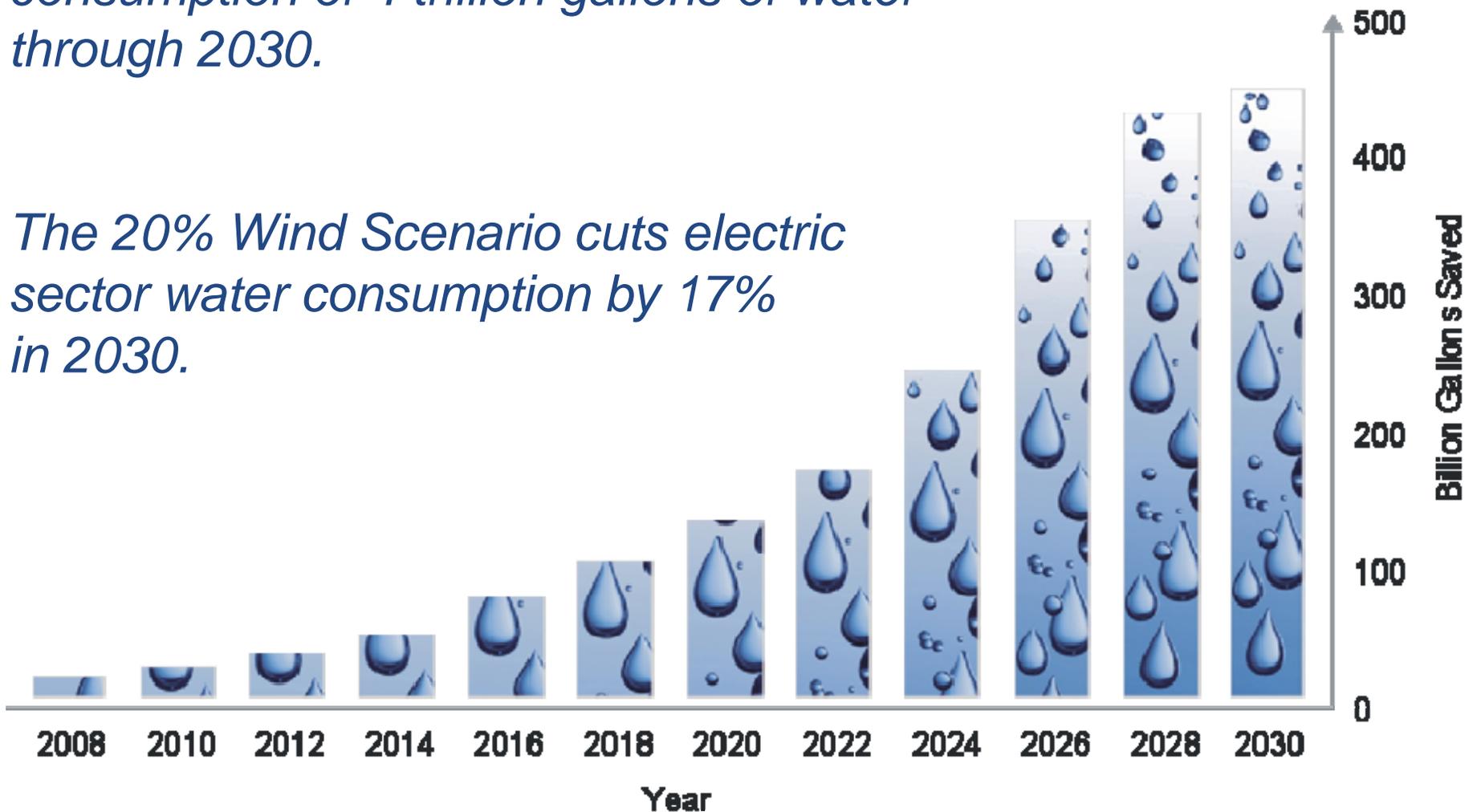
■ Annual Reductions



# Significant Water Use Savings

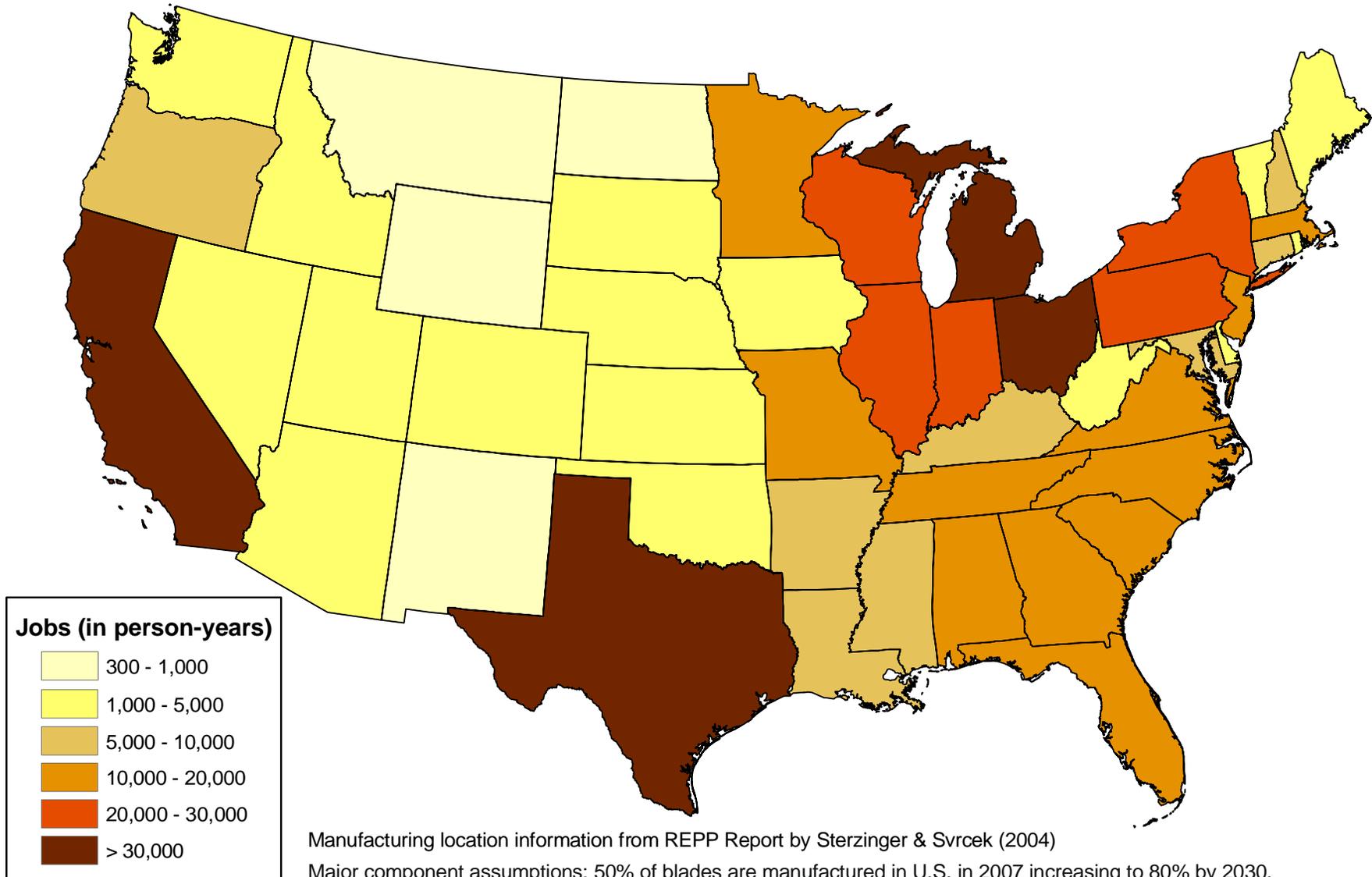
*Cumulatively, the 20% Wind Scenario would avoid the consumption of 4 trillion gallons of water through 2030.*

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





# Manufacturing Jobs Supported by State

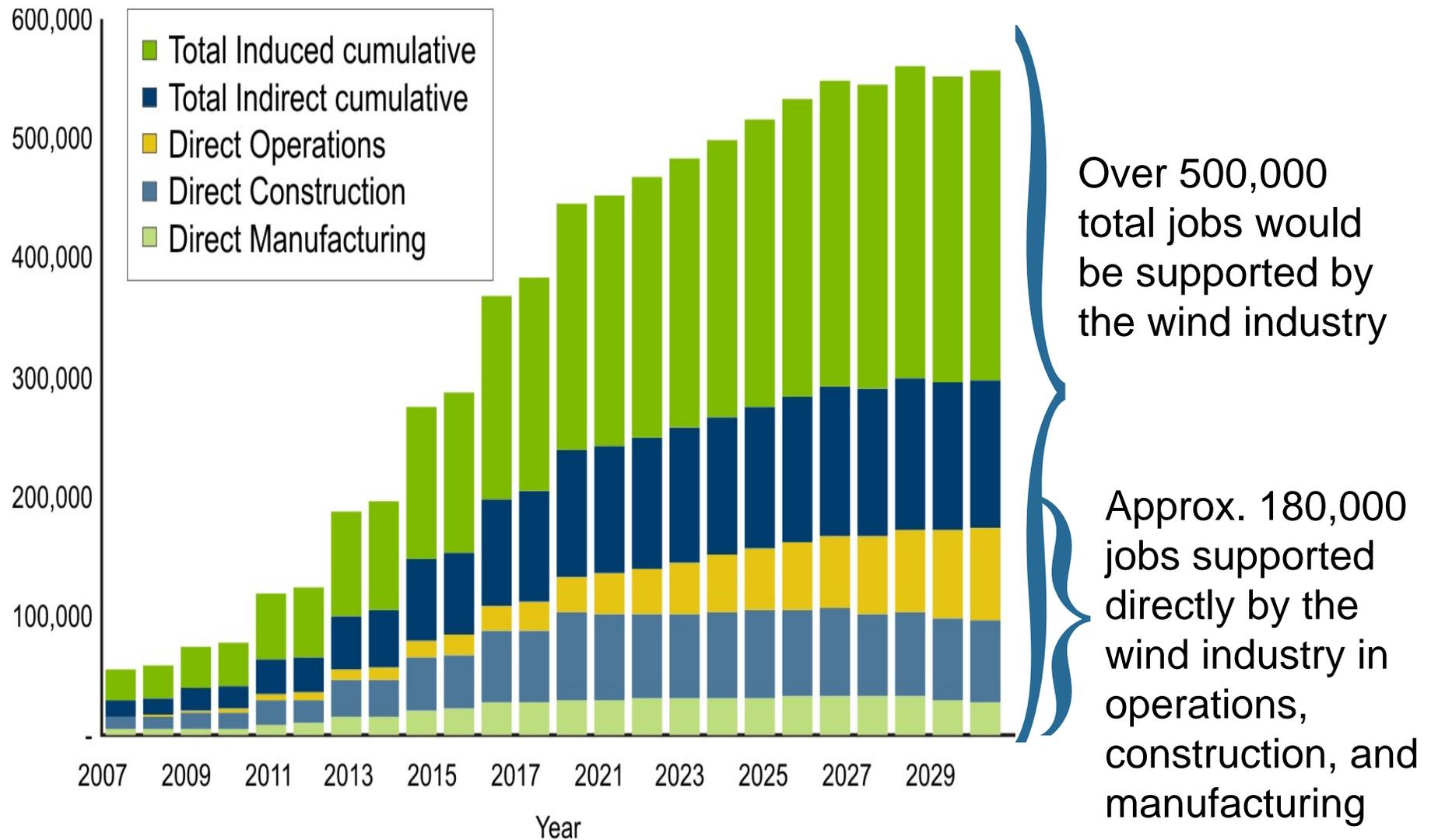


Manufacturing location information from REPP Report by Sterzinger & Svrcek (2004)

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% Wind Scenario



# Challenges to Achieving the 20% Wind Scenario



# Transmission

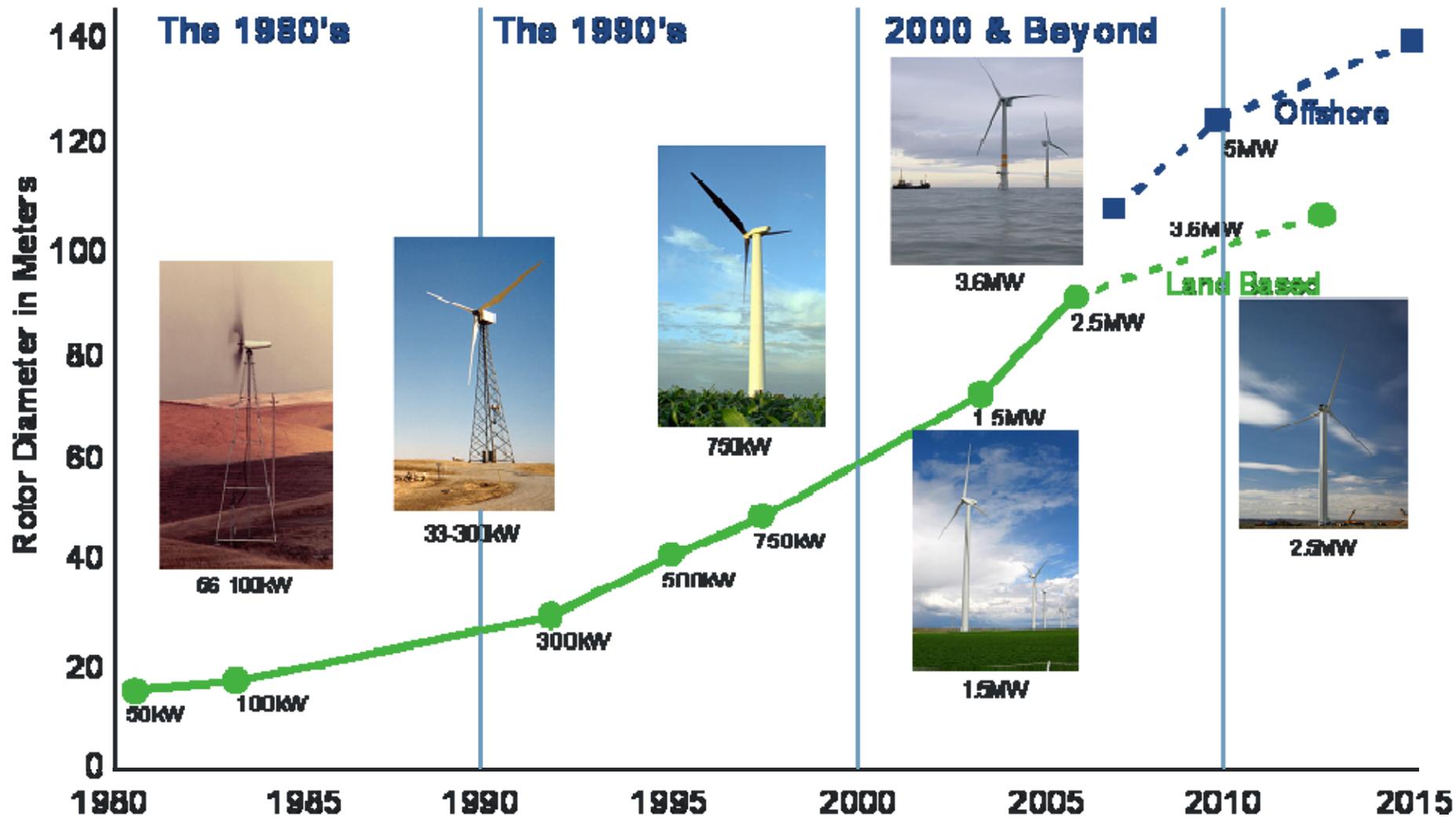
- ✦ Enhancement of electrical transmission system required in all electricity-growth scenarios
- ✦ Transmission is needed to:
  - Relieve congestion in existing system
  - Improve system reliability for all customers
  - Increase access to lower-cost energy
  - Access new and remote generation resources
- ✦ 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





## Project Siting: Concerns

### ▲ 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

# 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
- ✦ Would require about 300 GW (300,000 MW) of wind generation- an increase of about 290 GW in wind installations between 2007 to 2030
- ✦ Shows that affordable, accessible wind resources available across the nation



## Summary: **Costs** & Benefits

Incremental direct cost to society	<b>\$43 billion</b> <b>50 cents/month/ household</b>
Reduction in emissions of greenhouse gasses and avoided carbon regulation costs	825 million tons of CO <sub>2</sub> \$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



# For More Information on 20% Wind Energy:

[www.20percentwind.org](http://www.20percentwind.org)

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# Thank you!

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