

# Wind Energy & Economic Development



Marguerite Kelly

National Renewable Energy Laboratory

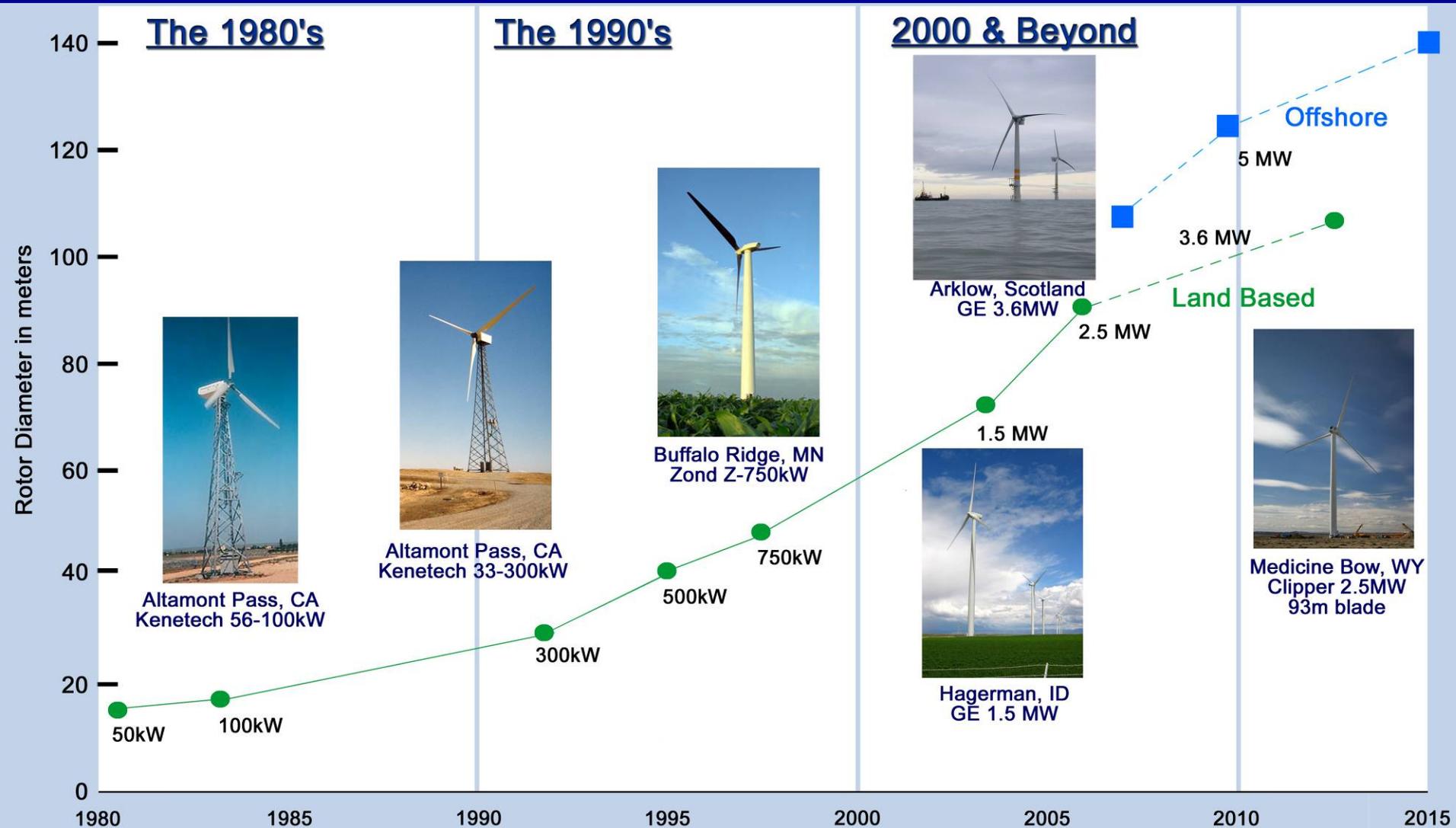
June 8, 2007

Golden, CO

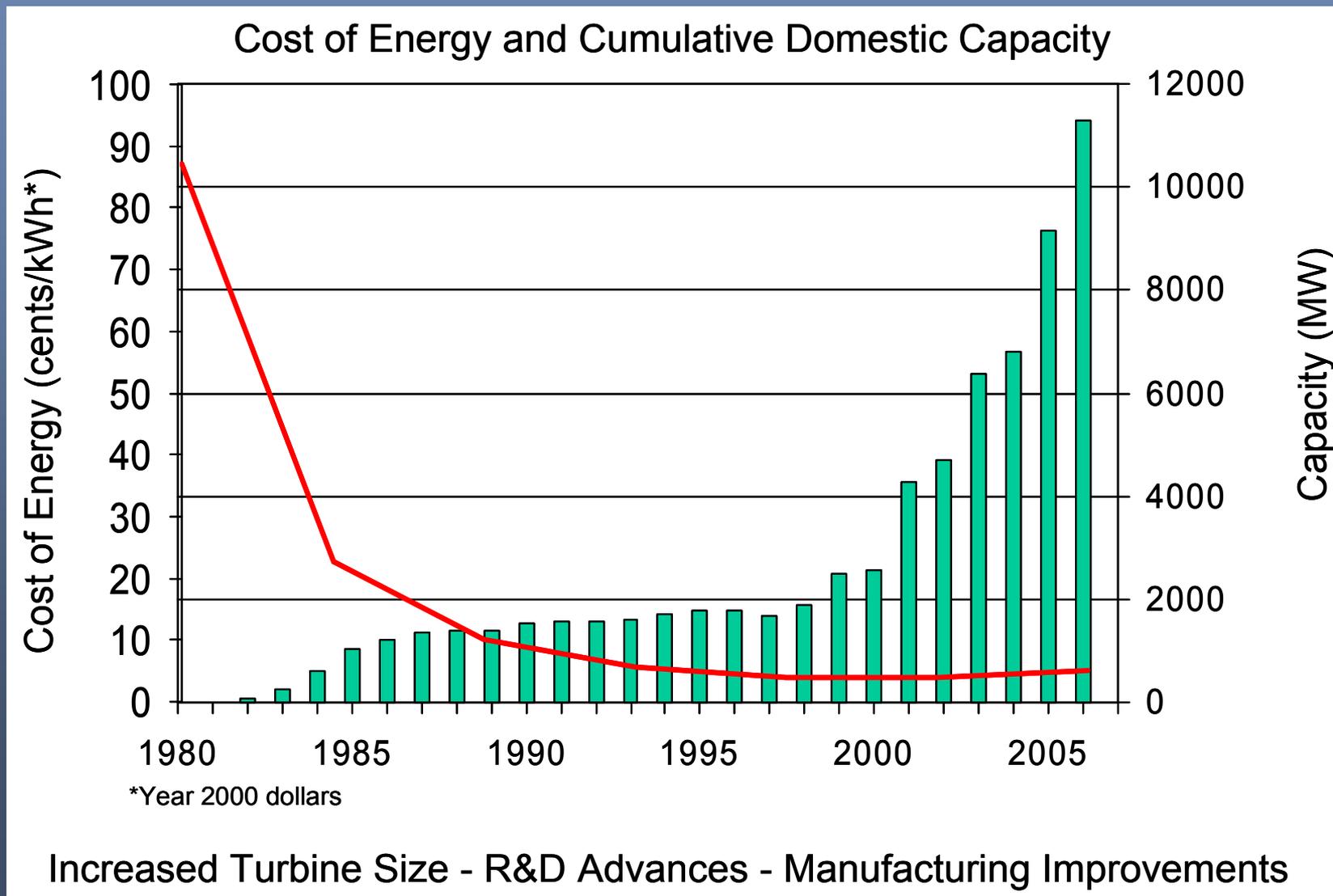
# Topics

- Background
- Drivers for Wind in the U.S.
- Economic development Impacts (modeling and experience)
  - Jobs
  - Manufacturing
  - Property taxes
  - Cross-technology comparisons
- 20% analysis
- Questions

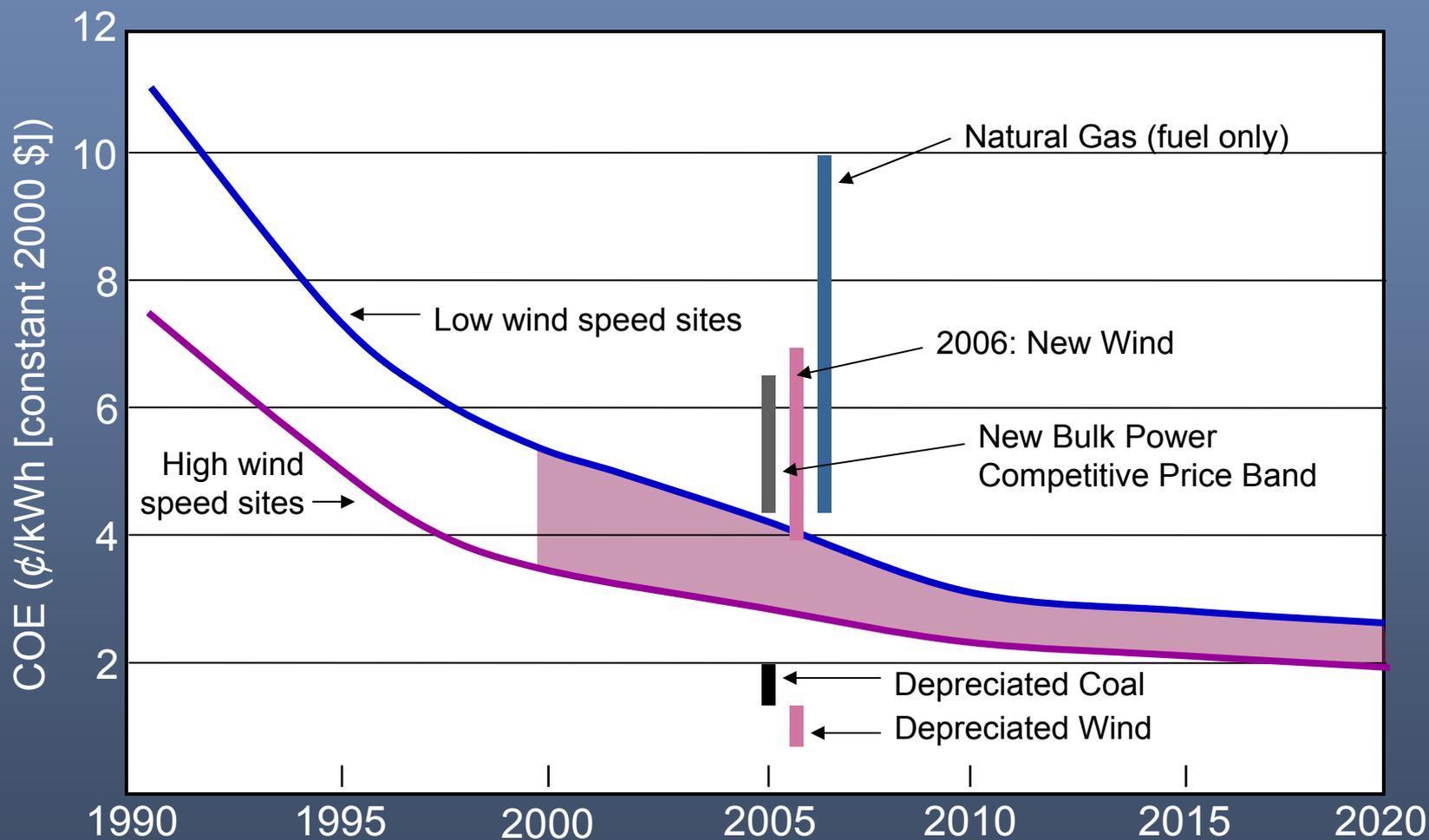
# Evolution of U.S. Commercial Wind Technology



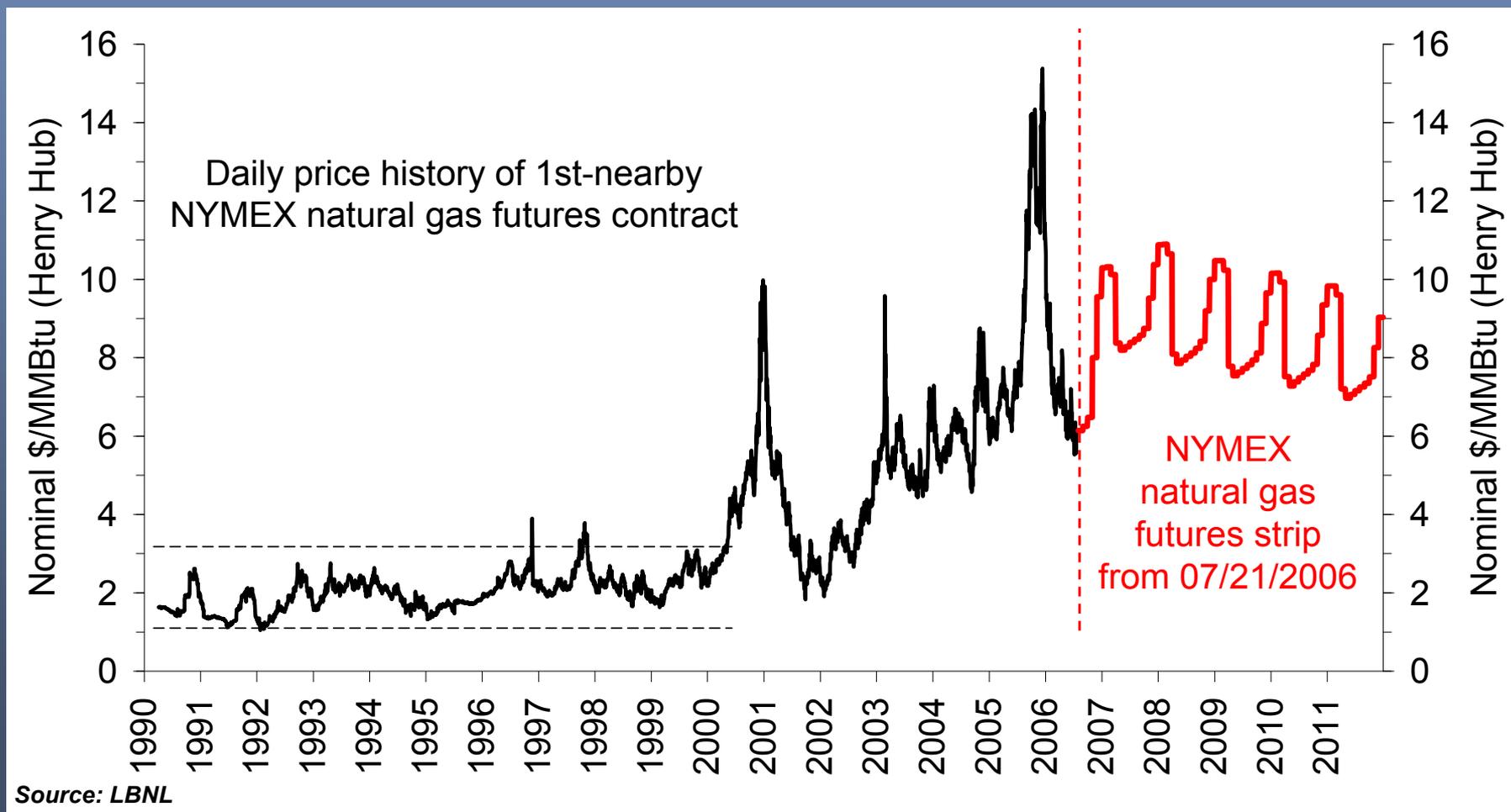
# Capacity & Cost Trends



# Wind Cost of Energy

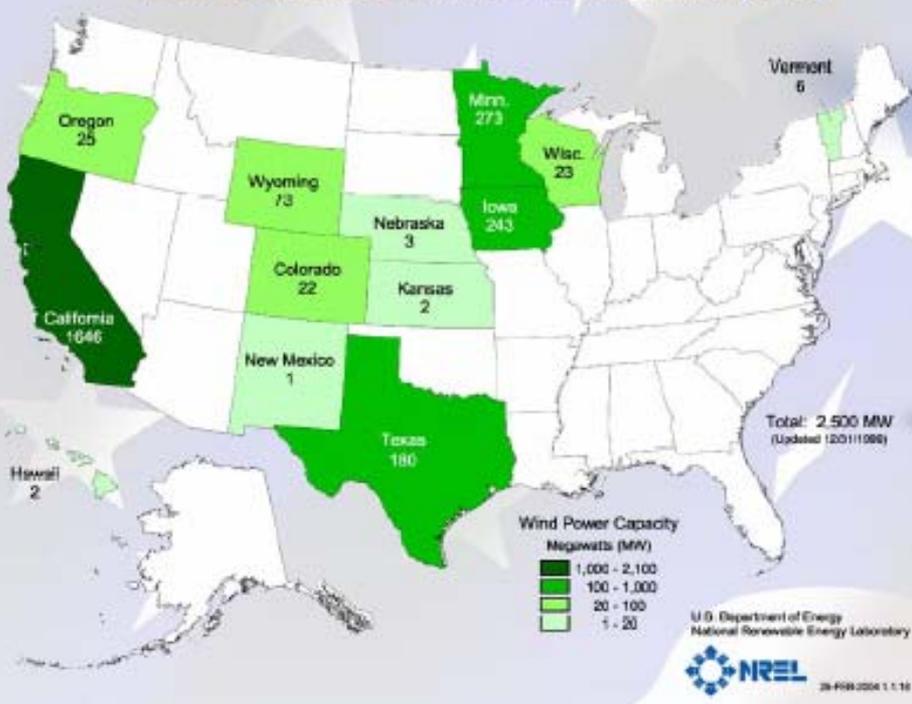


# Natural Gas – Historic Prices

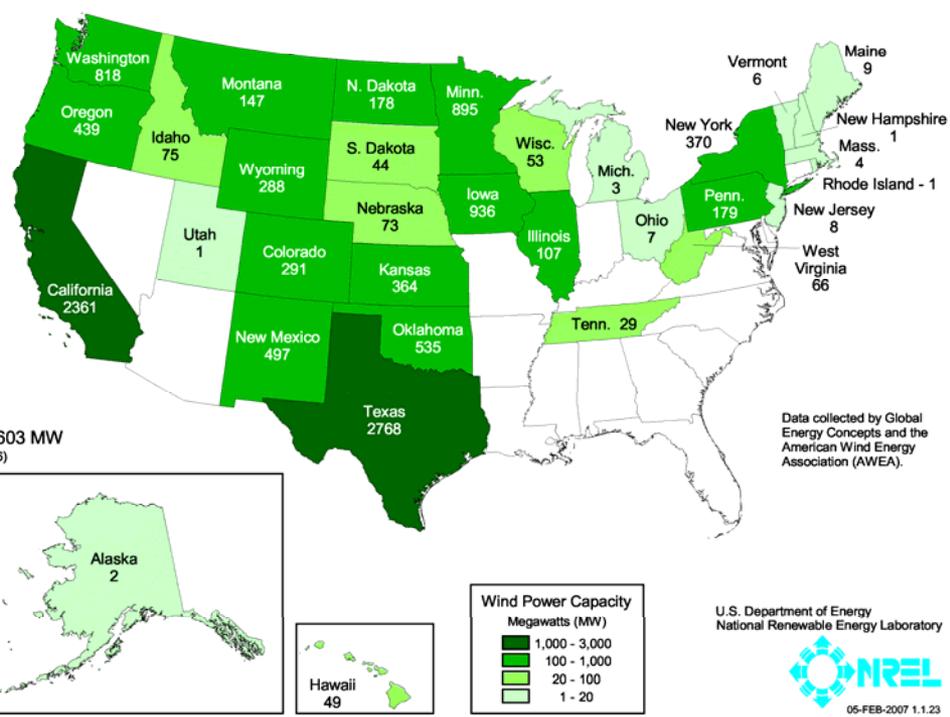


# Installed Wind Capacities (99-06)

1999 Year End Wind Power Capacity (MW)

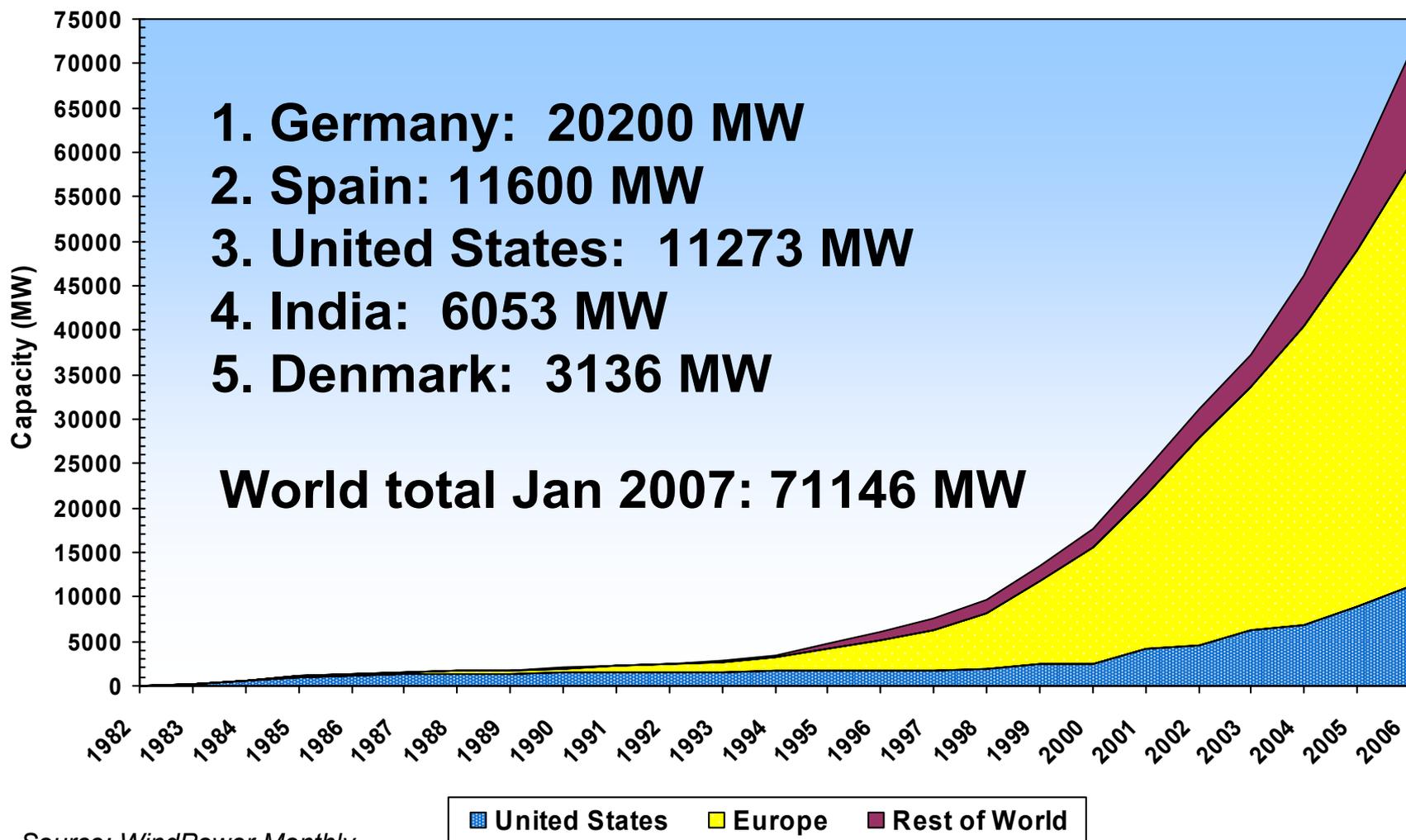


United States - Current Installed Wind Power Capacity (MW)



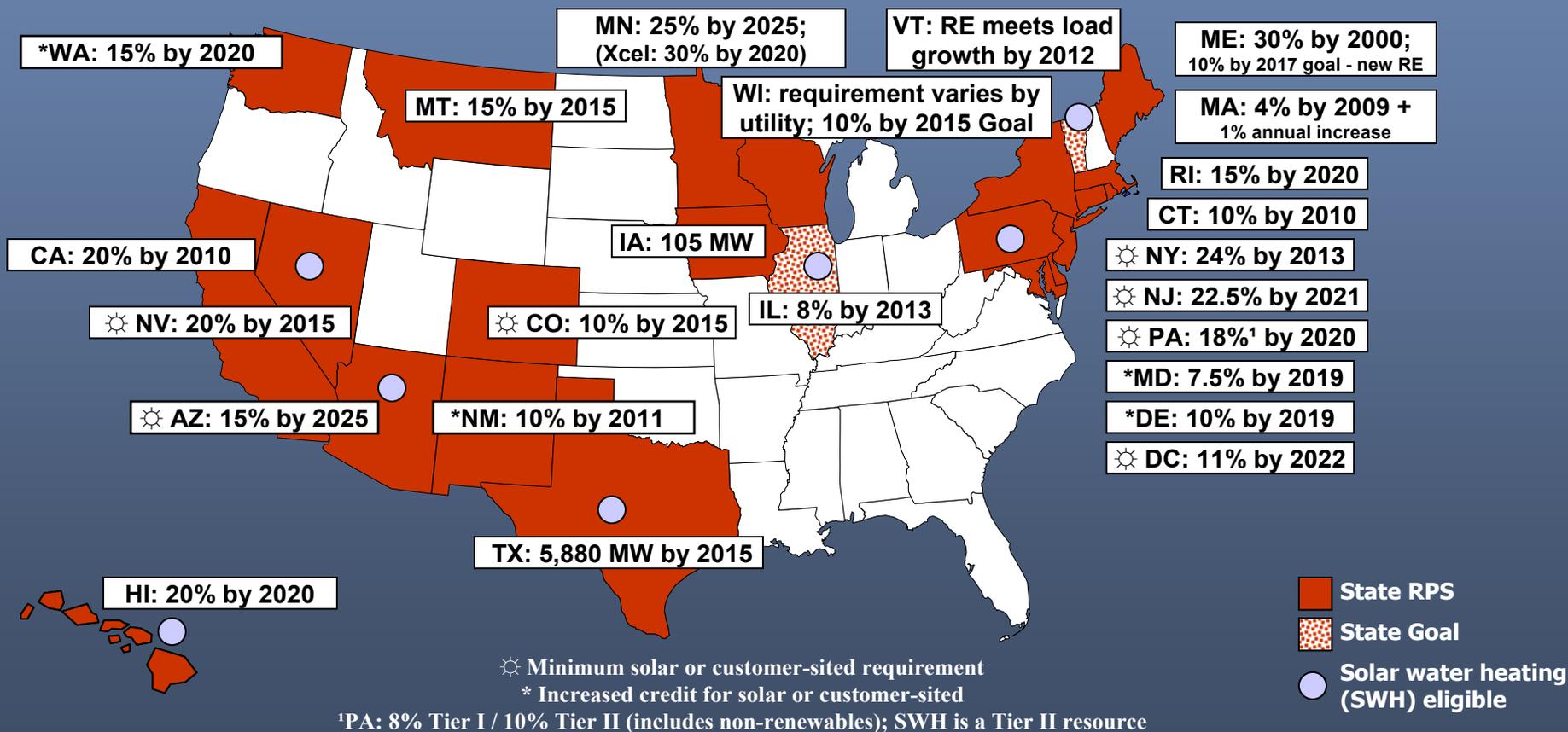
# People Want Renewable Energy!

## Total Installed Wind Capacity



Source: WindPower Monthly

# Renewables Portfolio Standards



# Drivers for Wind Power

- Declining Wind Costs
- Fuel Price Uncertainty
- Federal and State Policies
- Economic Development
- Green Power
- Energy Security



# Windy Rural Areas Need Economic Development

United States - Wind Resource Map

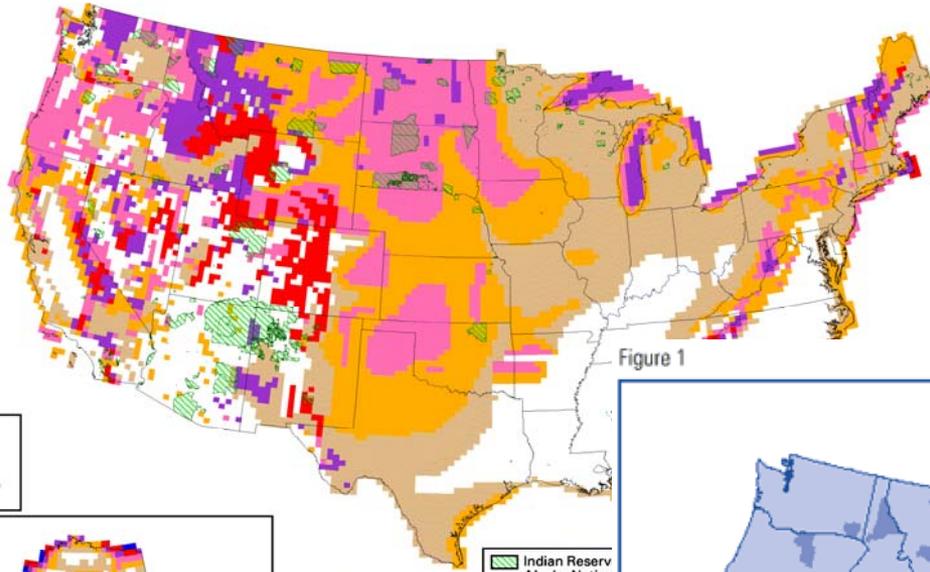
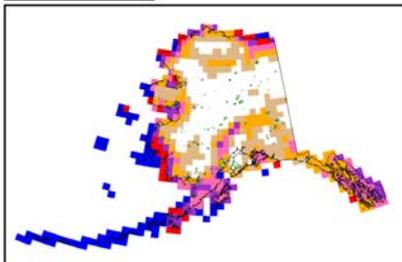


Figure 1

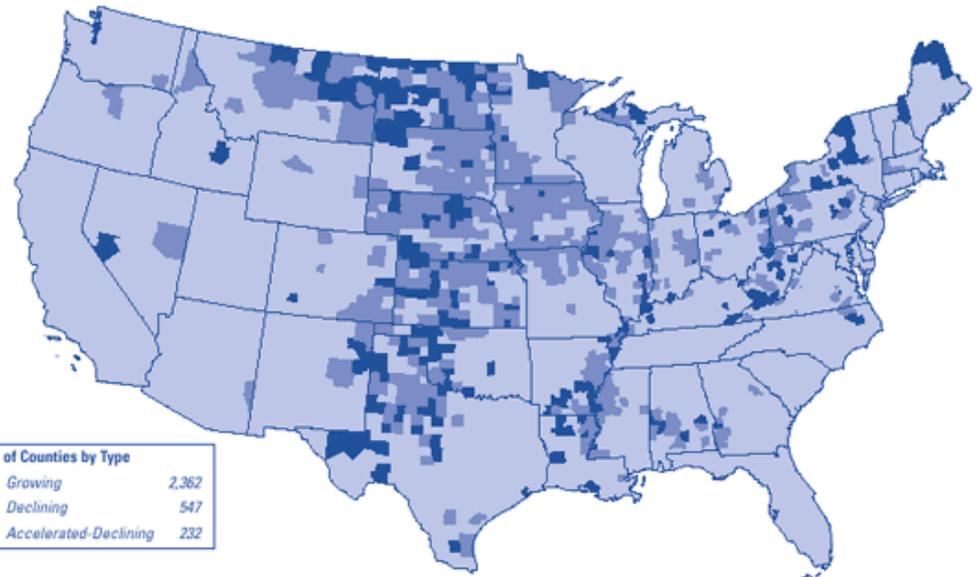


Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s
2	Marginal	200 - 300	5.6 - 6.4
3	Fair	300 - 400	6.4 - 7.0
4	Good	400 - 500	7.0 - 7.5
5	Excellent	500 - 600	7.5 - 8.0
6	Outstanding	600 - 800	8.0 - 8.8
7	Superb	800 - 1600	8.8 - 11.1

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

Indian Reserve  
Alaska Native

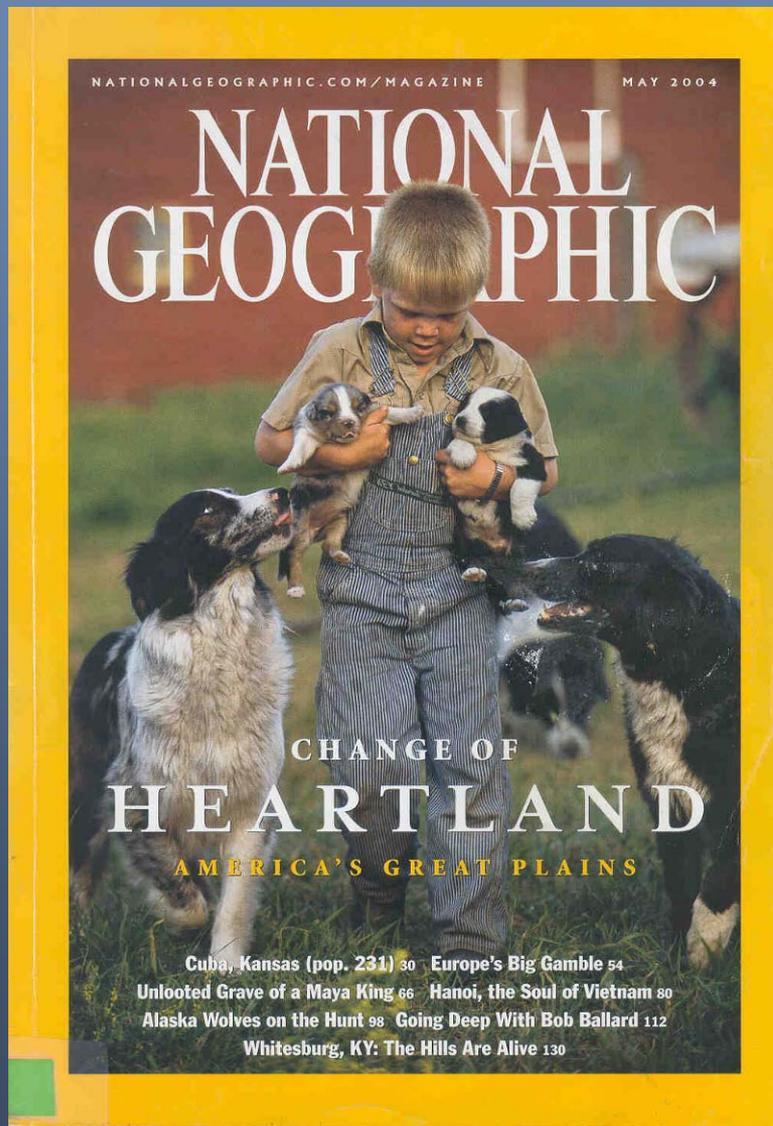
Geographic Distribution of Depopulation



No. of Counties by Type	
Growing	2,362
Declining	547
Accelerated-Declining	232

Source: 2000 Census compared with 1970 Census.

# The Depopulation of the Great Plains

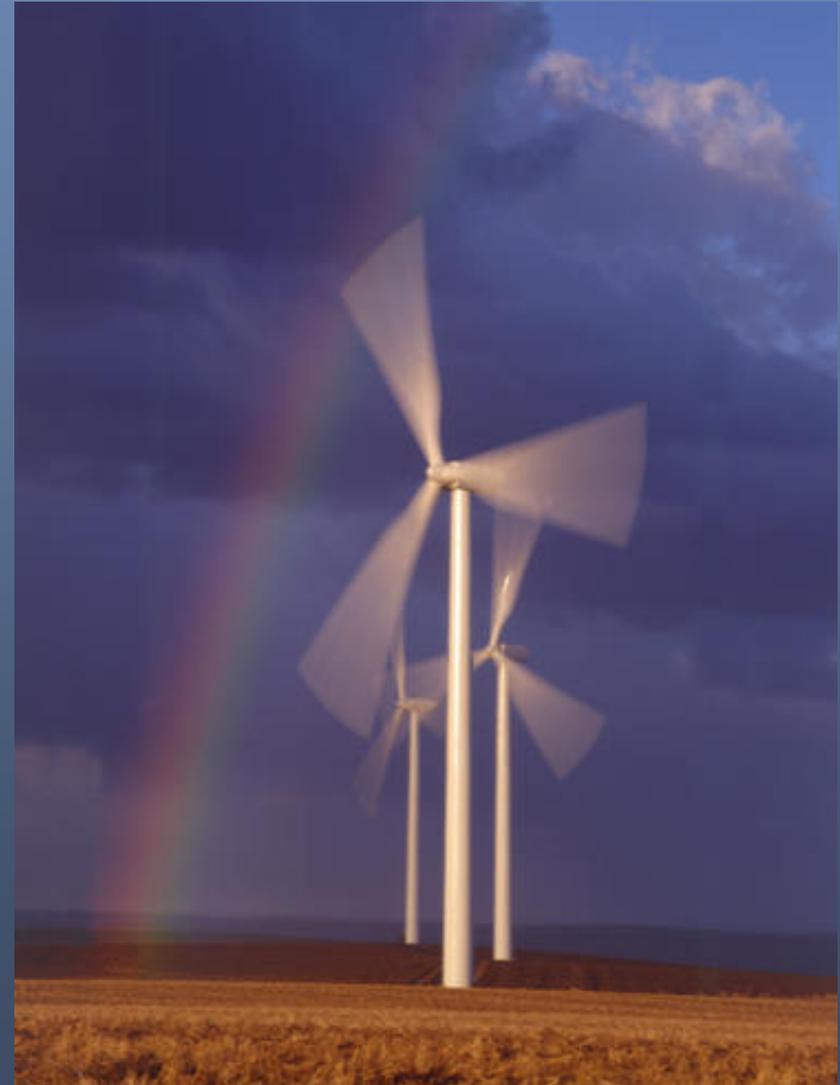


*“When you lose the school,” said a retired teacher, “you’ve lost the town.”*



# Economic Development Impacts

- Construction
- Operations and maintenance
- Property tax revenues
- Landowner revenues
- Manufacturing
- Multiplier effect
- Net economic development impacts of wind vs. fossil fuels



# Economic Development Impacts: Jobs



- 40-140 jobs during construction per 100 MW (less for new projects)
- 6-20 permanent O&M jobs per 100 MW (average 10 per 100 MW)
- Local construction and service industry – local contracts
- Local benefits if local labor base has robust technical and construction resources
- Multiplier effect: increased local income induces spending on other local goods and services

# Calculating Economic Development Impacts

- **Direct:** Immediate effect of project expenditures (on-site contractors and local manufacturing)
- **Indirect:** Increase in local economic activity (bankers, local services)
- **Induced:** Change in wealth that occurs from the spending of people directly and indirectly employed by the project.



\$1M construction	Direct jobs created
Logan Co, CO	11.1
Navajo Co, AZ	12.5
McCone Co, MT	15.8

\$30M investment in a wind plant	Direct, indirect, and induced jobs
Nevada	43
California	64

# Direct on-site jobs and parts during construction



Truck drivers, crane operators



Earth moving, cement pouring



Management and support



Construction

# Direct wind project jobs during operations



Operations and maintenance, management



Landowner royalties



Parts and materials purchased



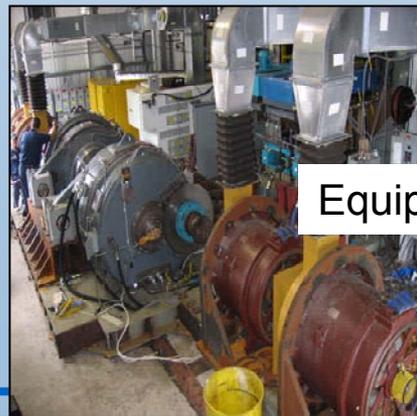
Utility services and subcontractors



# Indirect jobs, services, materials



Steel mill jobs, parts, services  
Photos: E.C.Levy, Inc, Detroit, MI



Equipment manufacturing and sales

# Induced jobs, services, materials

Child care, grocery store, clothing, other retail, public transit, new cars, restaurants, medical services



# Economic Development Impact: Manufacturing

- 3000 manufacturing jobs per 1000 MW (REPP)
- The U.S. wind industry employs more than 2,000 people, and contributes to the economies of 46 states (AWEA)
- In a mature wind market, these numbers are larger. The Danish Wind Manufacturers Association estimates:
  - that wind power creates 22 direct and indirect jobs for each MW of installed capacity
  - 5 jobs/MW (installation)
  - 17 jobs/MW (manufacturing related)



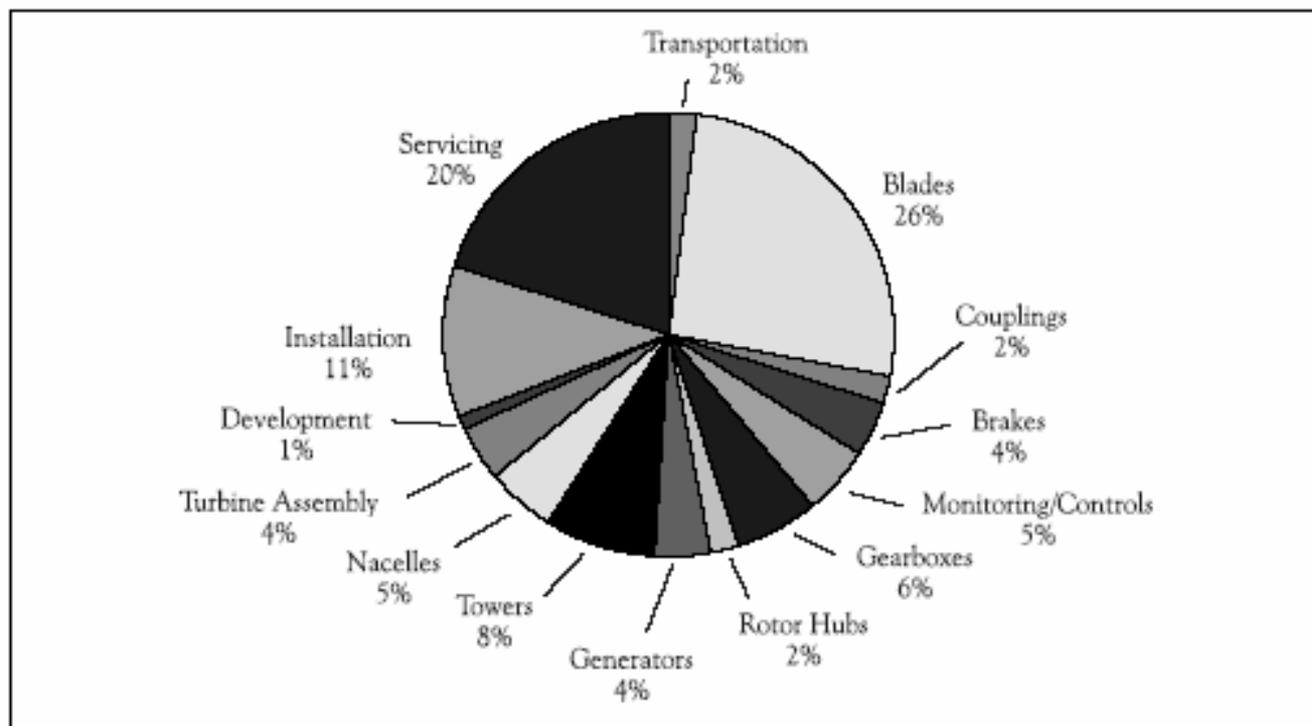
***ND towers and blades are valuable state exports:***

- LM Glasfiber blade manufacturing plant created 130 jobs, 20% of the ND lignite industry
- DMI has towers installed in 12 states

**Spanish company Gamesa is building new plant in PA, creating 1,000 new jobs over next 5 years and \$40M in new investment**

# Jobs Created by Wind Power

Figure 3. Labor Requirements for Wind by Activity



A 37.5-MW wind farm creates 180 person-years of work over a 10-year period

2,000 MW of wind power creates 9,694 person-years of work

# Economic Development Impact: Property Taxes

- Typically 1%-3% of *assessed* value
- A typical 100-MW wind farm creates \$500K - \$1M/year
- Assessed at the county level
- Varies greatly from county to county, depending on assessed value, abatements, tax rate, exemptions
- Some states receive payments in lieu of taxes
- Wind farms are often assessed more taxes than other forms of generation



# Economic Development Impacts



- Land Lease Payments: 2-3% of gross revenue \$2500-4000/MW/year
- Local property tax revenue: 100 MW generates \$500K-\$1 million/yr
- 100-200 jobs/100 MW during construction
- 6-10 permanent O&M jobs per 100 MW
- Local industry: concrete, towers, electrical services
- Manufacturing and Assembly plants expanding in U.S. (e.g. IL, CA, ND, PA, IA, MN, CO?)



# Jobs and Economic Development Impact Model (JEDI)

**JEDI is an input-model that can be adapted to your local area (state, county or region).**

**JEDI Traces linkages in the economy: what are economic impacts from dollars spent on the wind project**

**Economic development impacts include jobs created, wages and salaries earned, and increases in overall economic activity.**

**JEDI uses state and county multipliers derived from the Minnesota IMPLAN Group, Inc. (IMPLAN) accounting software and data derived from government surveys of business and consumer spending patterns.**

**Download the latest version from the Wind Powering America website's Economic Development page.**

# Estimated impacts to the Great Lakes Region by 2030 from 97 GW of new wind development, according to the 20% Scenario\*

*Wind energy's economic "ripple effect"*

## Direct Impacts

### Landowner Revenue:

- \$262 million/yr

### Local Property Taxes:

- \$58,700/yr

### Construction Phase:

- 145,000 new jobs through 2030
- \$19 billion to local economies

### Operational Phase:

- 21-23,000 long-term O&M jobs
- \$2.1B/yr to local economies



## Indirect Impacts

### Construction Phase:

- 58,000 jobs through 2030
- \$5.7 B to local economies

### Operational Phase:

- 5,500 long-term jobs
- \$621M/yr to local economies

## Induced Impacts

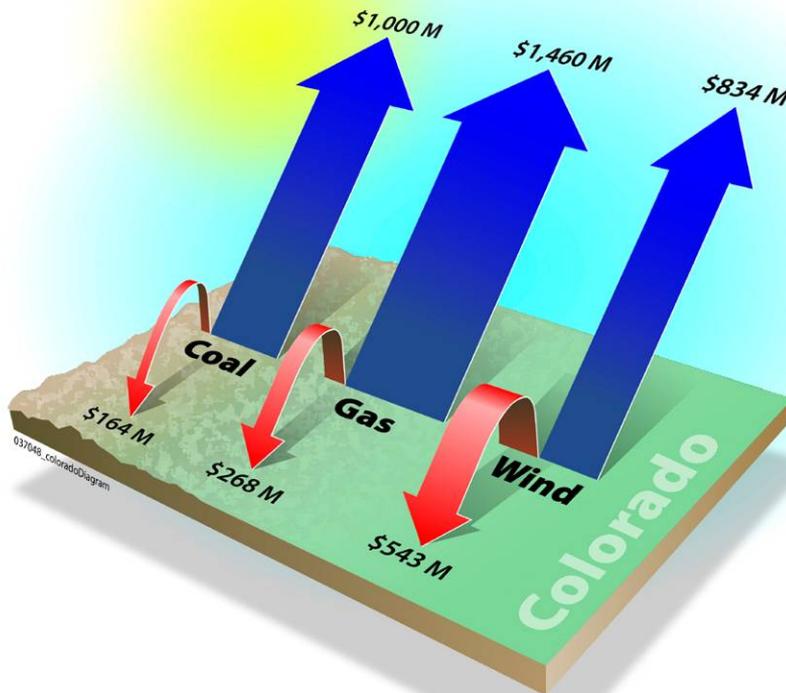
### Construction Phase:

- 88,000 jobs through 2030
- \$9B to local economies

### Operational Phase:

- 13-15,000 long-term jobs
- \$1.4B/yr to local economies

## Calculating the direct economic impacts of new wind plants in comparison to new coal and natural gas plants, using dollar flow analysis

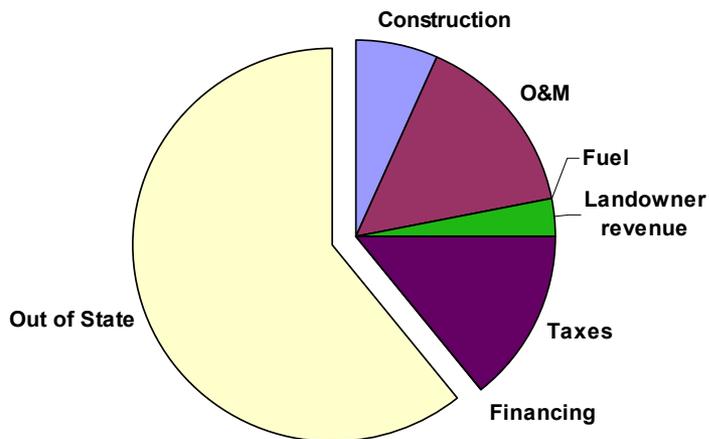


- Construction of the plant (parts and labor)
- 20 years of operation (parts and labor)
  - Fuel and fuel transport
- Property taxes
- Landowner revenues
- Project financing
- Suzanne Tegen did this first as a PHD thesis. Hours on the phone interviewing different people to obtain data.

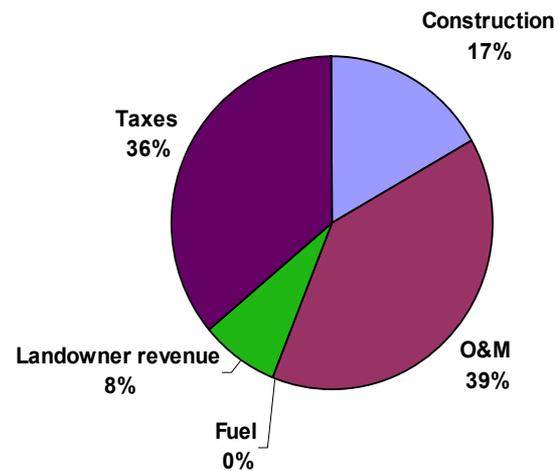
# Dollar flow analysis: in-state vs. out-of-state

A new large wind project in Colorado will bring benefits to the state's economy. Direct benefits are shown here.

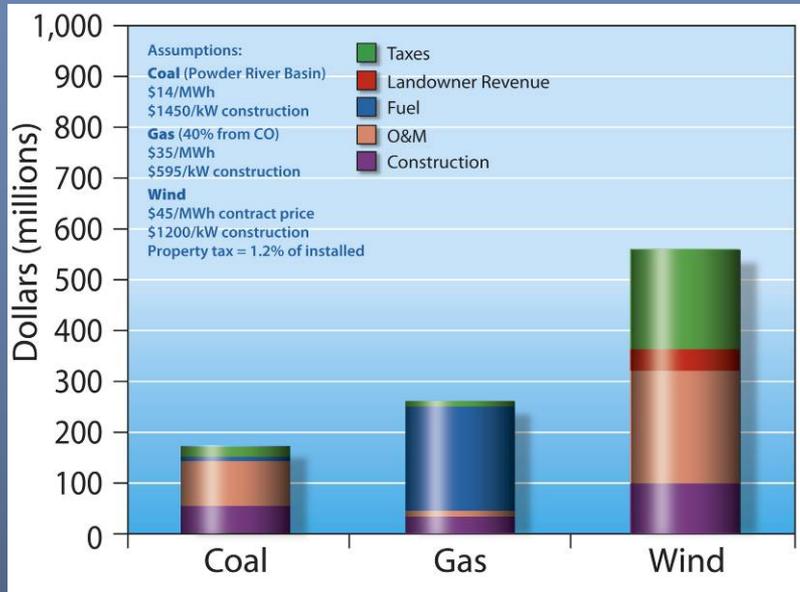
**Economic benefits in-state and out-of-state from new wind power in Colorado (20 years + construction)**



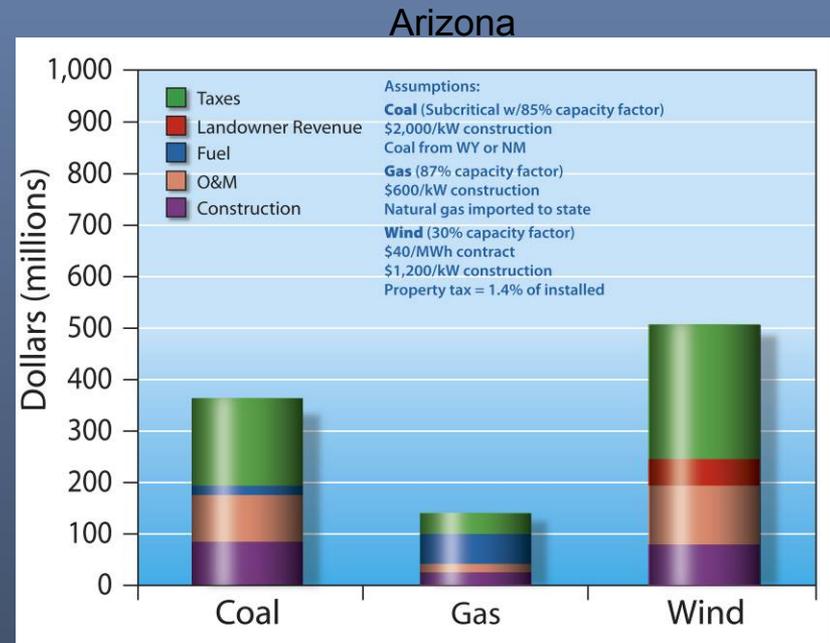
**In-state benefits of new wind power in Colorado (20 years + construction)**



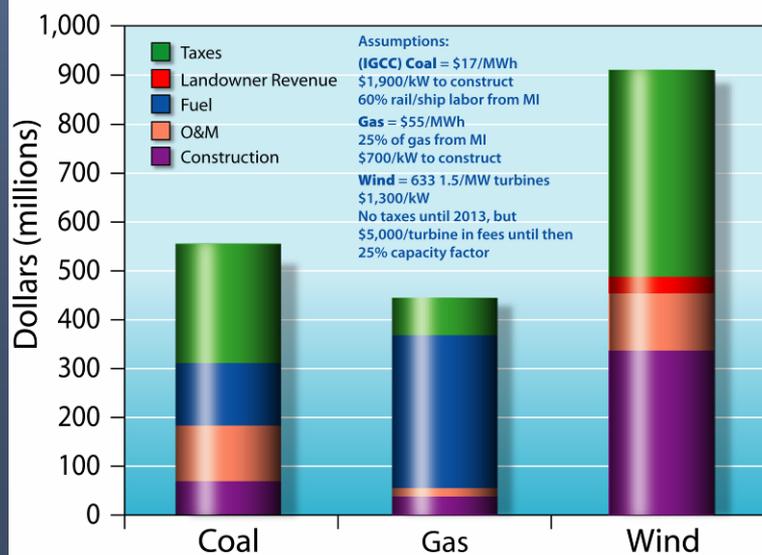
# Economic Impacts of Alternative Generation



Colorado



Michigan





# AWEA/DOE/NREL 20% Analysis



**Meeting 20% of the nation's electricity demand with wind energy will lead to enormous benefits to rural landowners and towns, the manufacturing sector, and infrastructure across America**

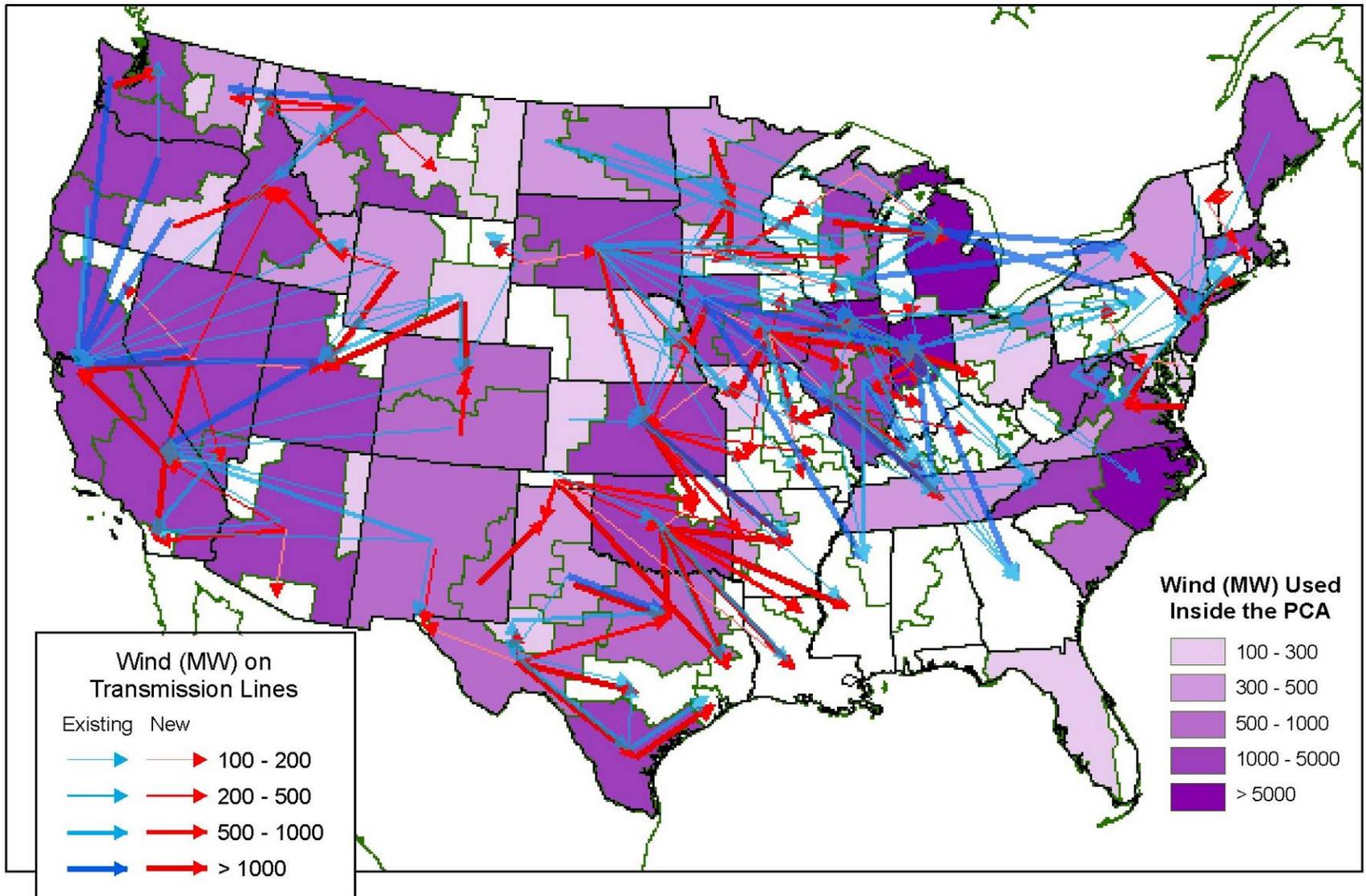
How large are the investments and what will they impact?

- 323 GW of new wind installed in the U.S.
- Over \$313 Billion in investment
- 1 million new construction jobs (cumulative through 2030)
- 2.33 million job-years, during operations (cumulative for 20 years)
- Increased income for rural landowners and
- Property tax revenue for schools, roads and county services

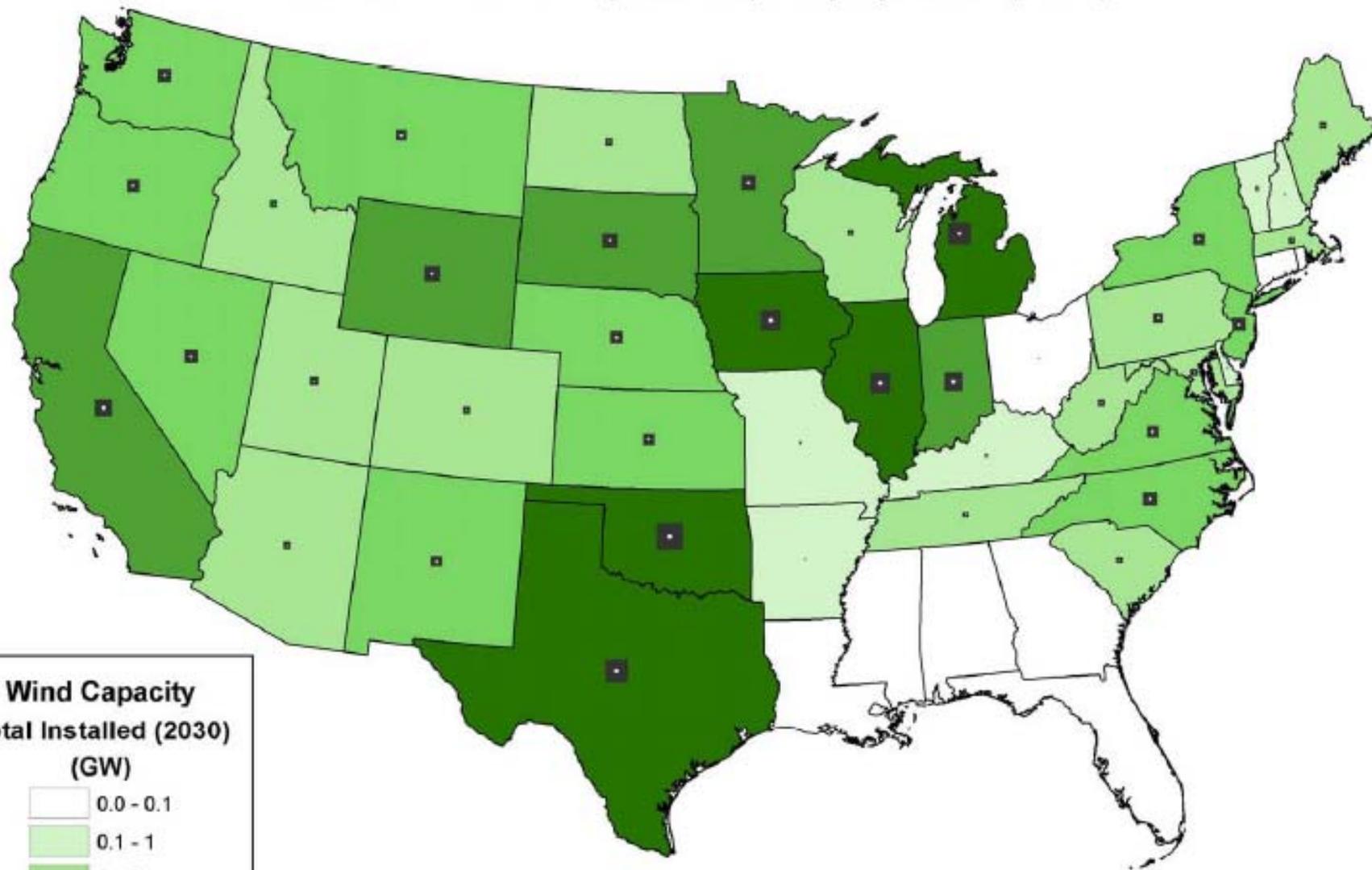
# 2030 - Between PCA Transfers and In-PCA Use for Wind (All Classes)

Total Between PCA Transfer  $\geq$  100 MW (all power classes, onshore and offshore)

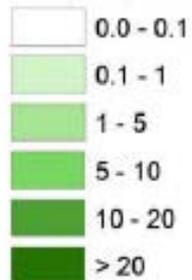
Arrows originate and terminate at the centroid of the PCA for visualization purposes; they do not represent physical locations of transmission lines.



## Installed Wind Nameplate Capacity by State (2030)

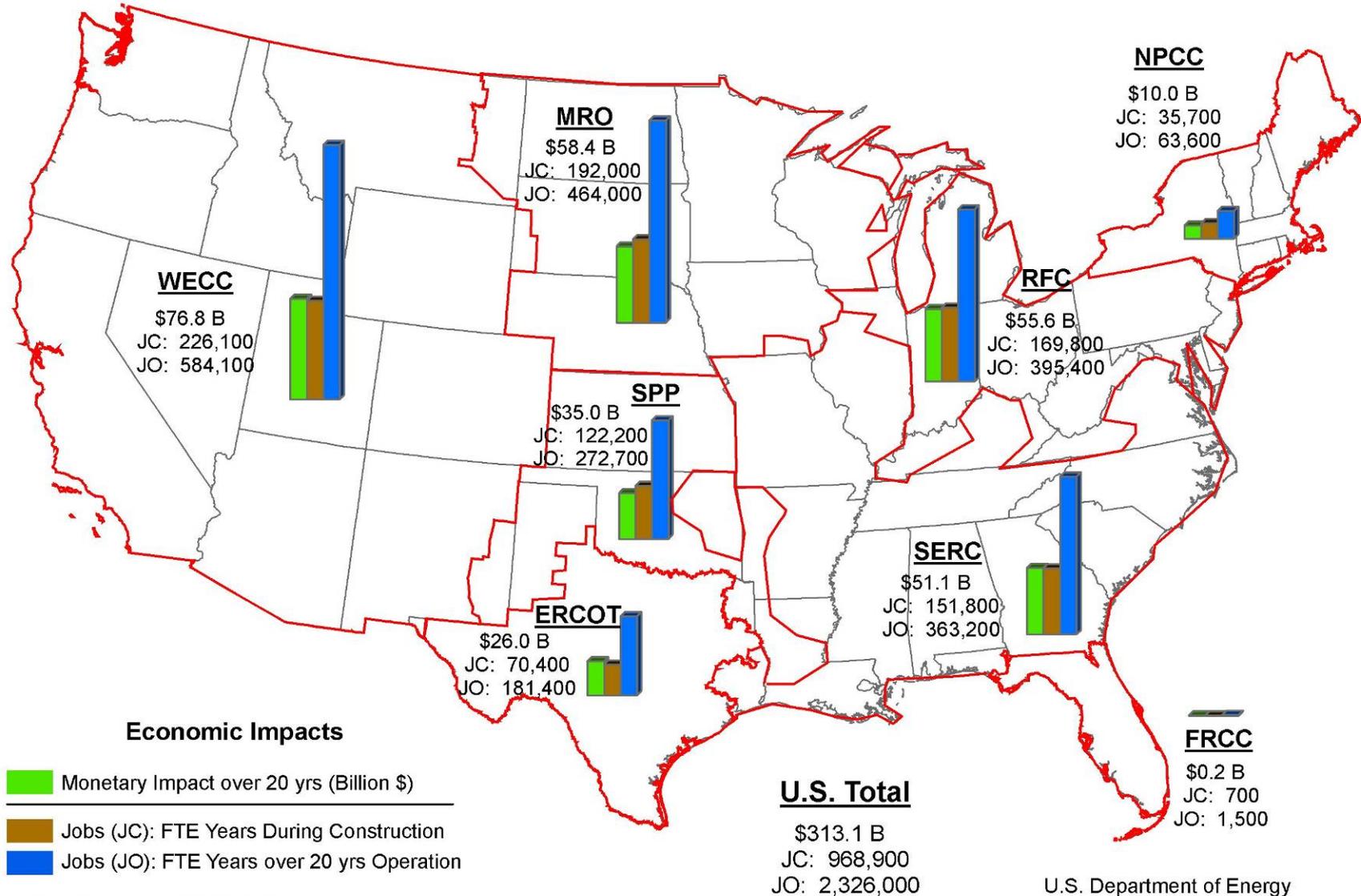


### Wind Capacity Total Installed (2030) (GW)



The black 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 white square represents the actual land area that would be dedicated to the wind turbines (2% of the black square).

# 20% Wind Electricity by 2030 - Economic Impacts by NERC Region



## Economic Impacts

- Monetary Impact over 20 yrs (Billion \$)

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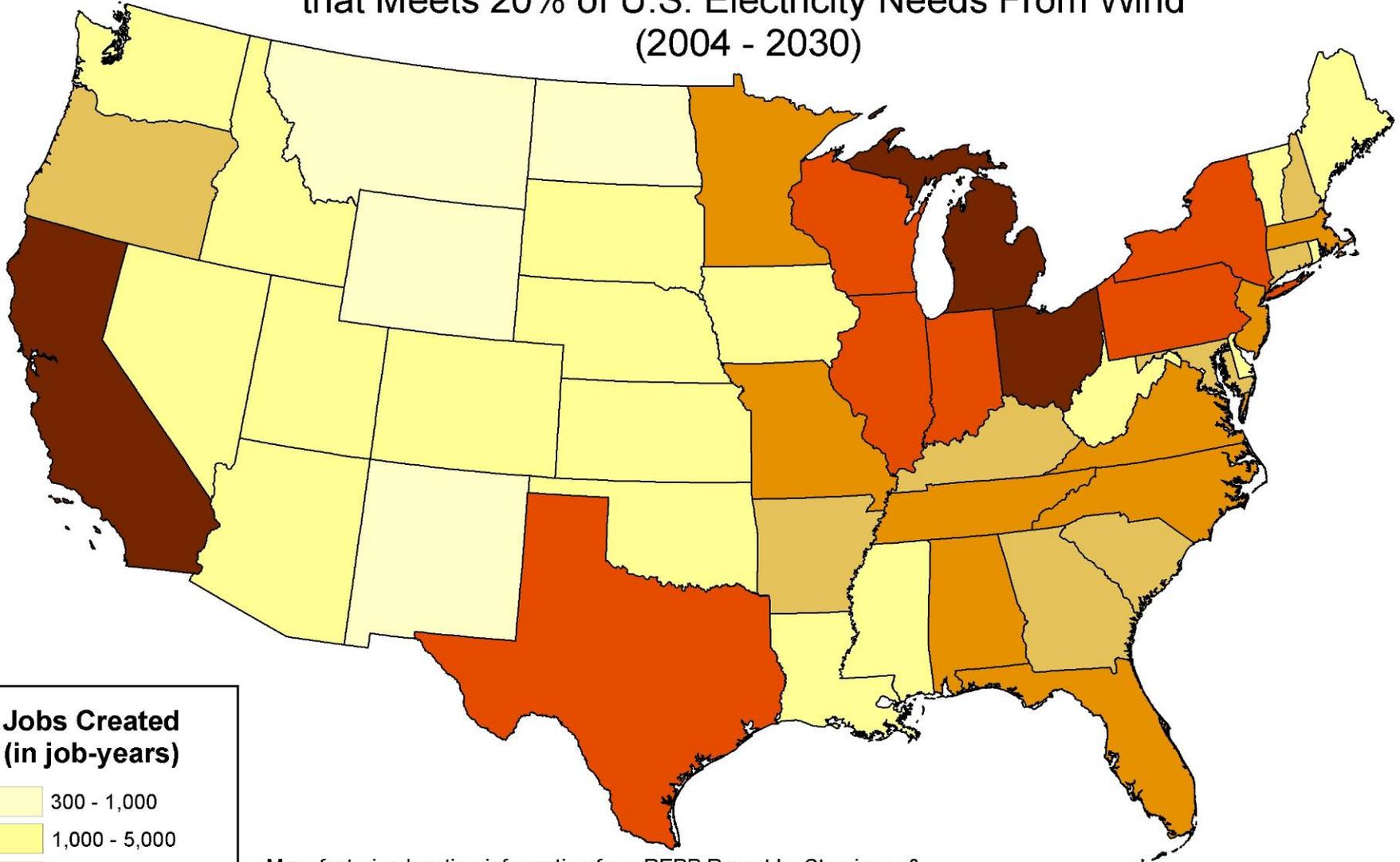
- Jobs (JC): FTE Years During Construction
- Jobs (JO): FTE Years over 20 yrs Operation

Optimistic case = 323 GW of wind capacity.  
All job values rounded to the nearest 100.

U.S. Department of Energy  
National Renewable Energy Laboratory



# Total Cumulative Manufacturing Jobs Created by Scenario that Meets 20% of U.S. Electricity Needs From Wind (2004 - 2030)



## Jobs Created (in job-years)



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

Major component assumptions: 50% of blades are manufactured in U.S. in 2004 increasing to 80% in 2030, 26% of towers are from the U.S. in 2004 increasing to 50% in 2030 and 20% of turbines are made in the U.S. increasing to 42% by 2030.

# Conclusions

- 20% wind energy penetration is possible
- 20% penetration is not going to happen under business as usual scenarios
- Policy choices will have a large impact on assessing the timing and rate of achieving a 20% goal
- Key issues: market transformation, transmission, project diversity, technology development, policy, public acceptance
- 20% Vision action plan: WindPower 2007

# Carpe Ventem



[www.windpoweringamerica.gov](http://www.windpoweringamerica.gov)