



Wind Energy Update



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Bozeman, MT

Sizes and Applications



Small (≤ 10 kW)

- Homes
- Farms
- Remote Application



Intermediate (10-250 kW)

- Village Power
- Hybrid Systems
- Distributed Power

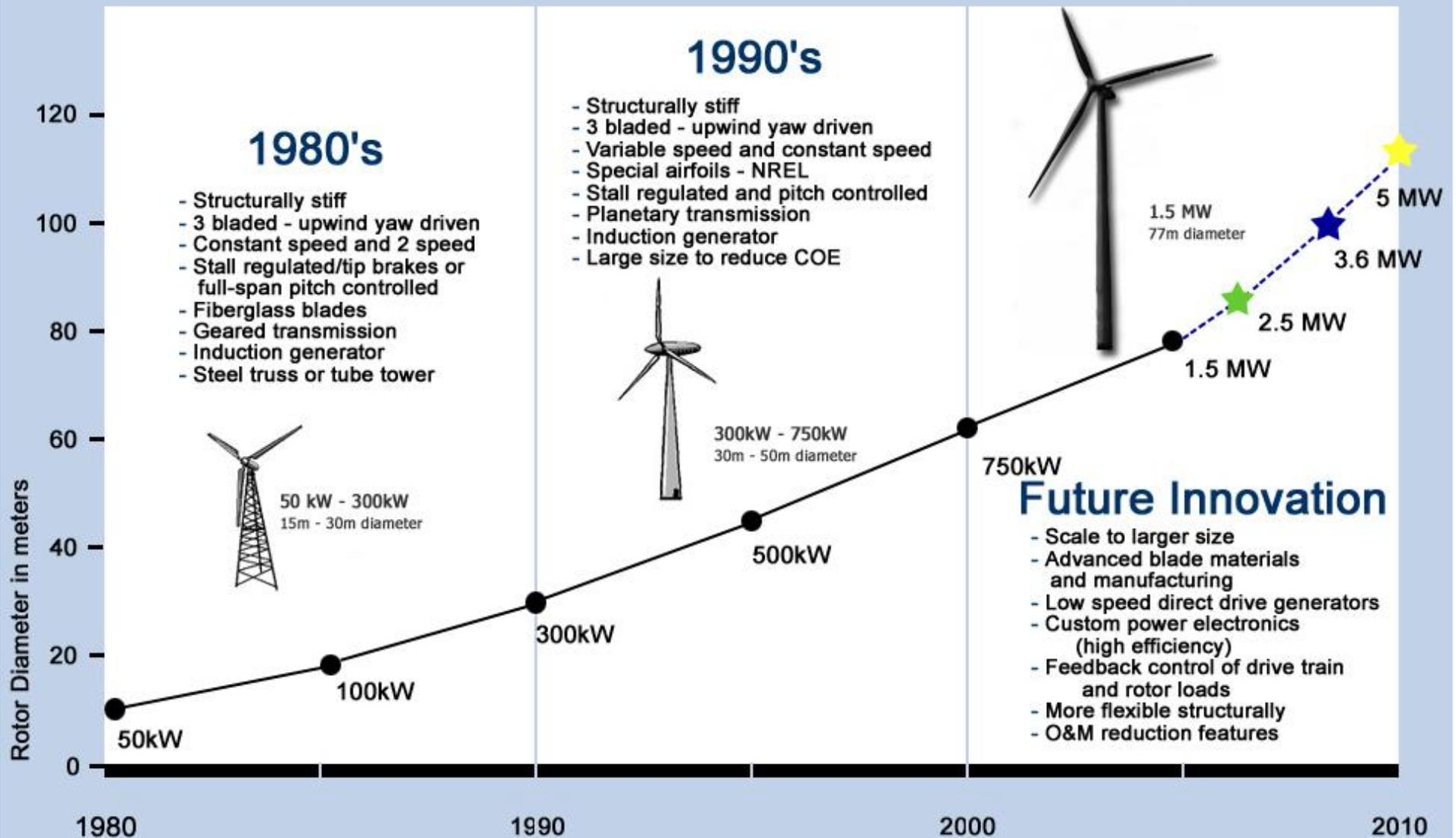


Large (660 kW - 2+MW)

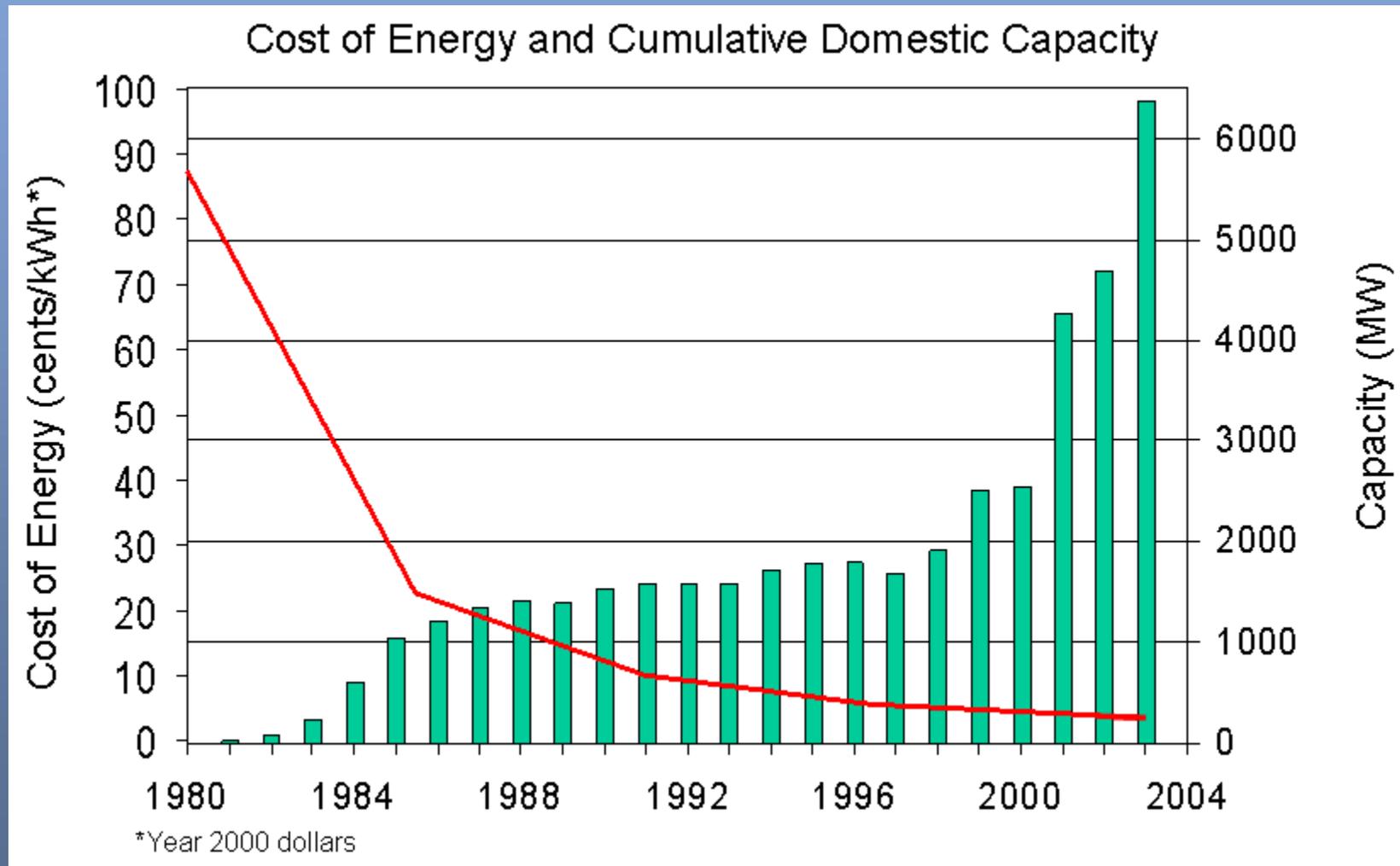
- Central Station Wind Farms
- Distributed Power
- Community Wind



THE EVOLUTION OF COMMERCIAL U.S. WIND TECHNOLOGY

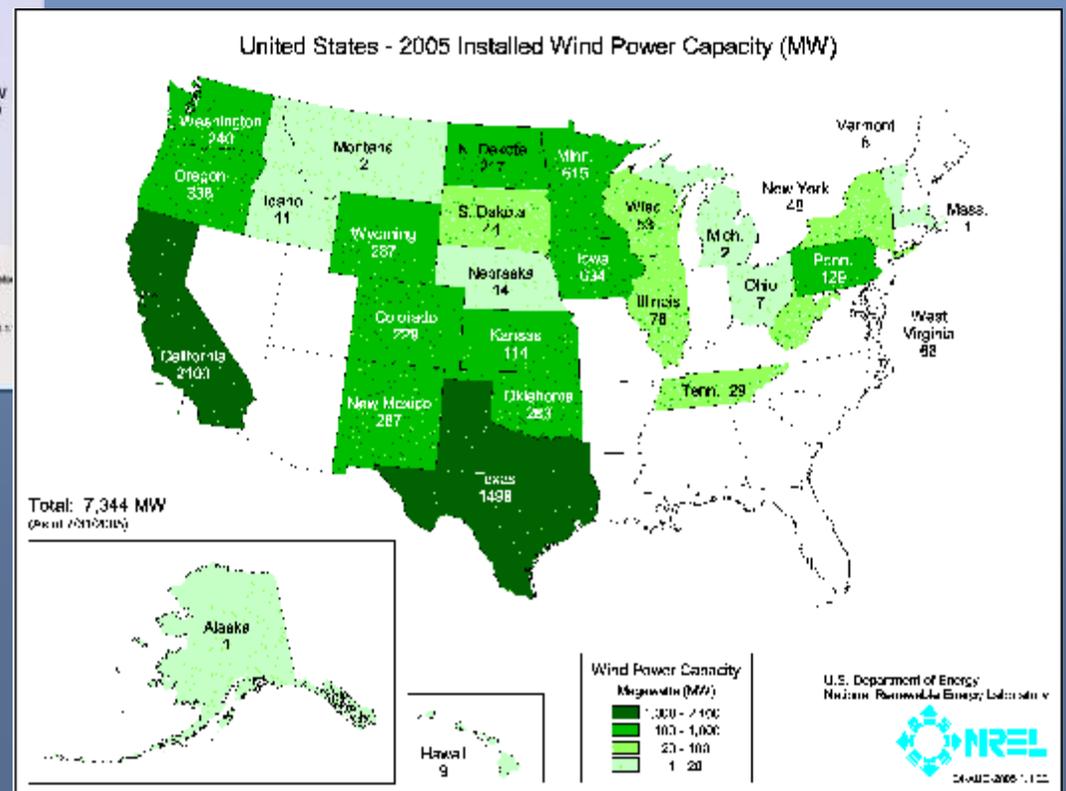
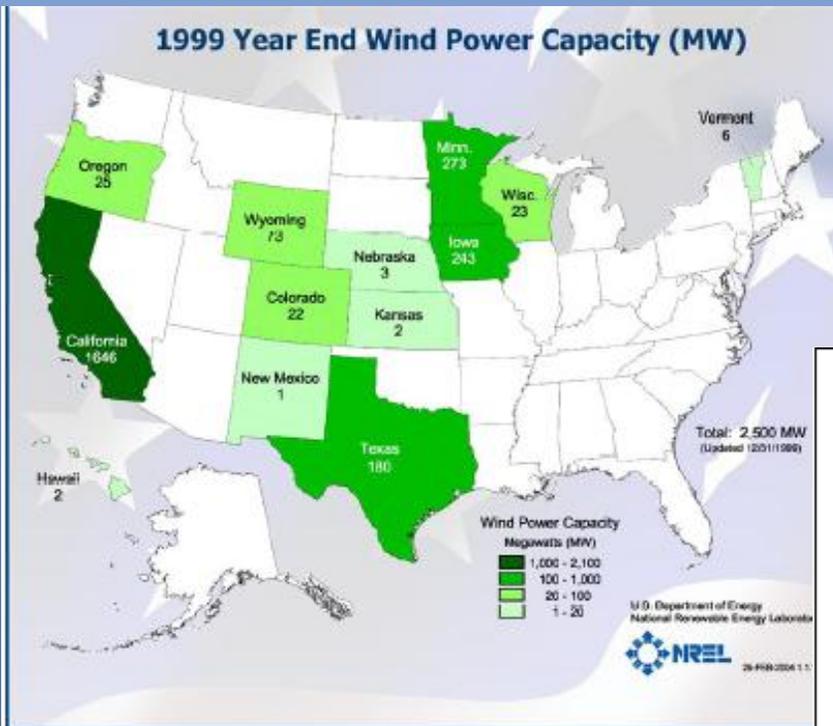


Capacity & Cost Trends



Increased Turbine Size - R&D Advances - Manufacturing Improvements

Installed Wind Capacities (1999-7/05)

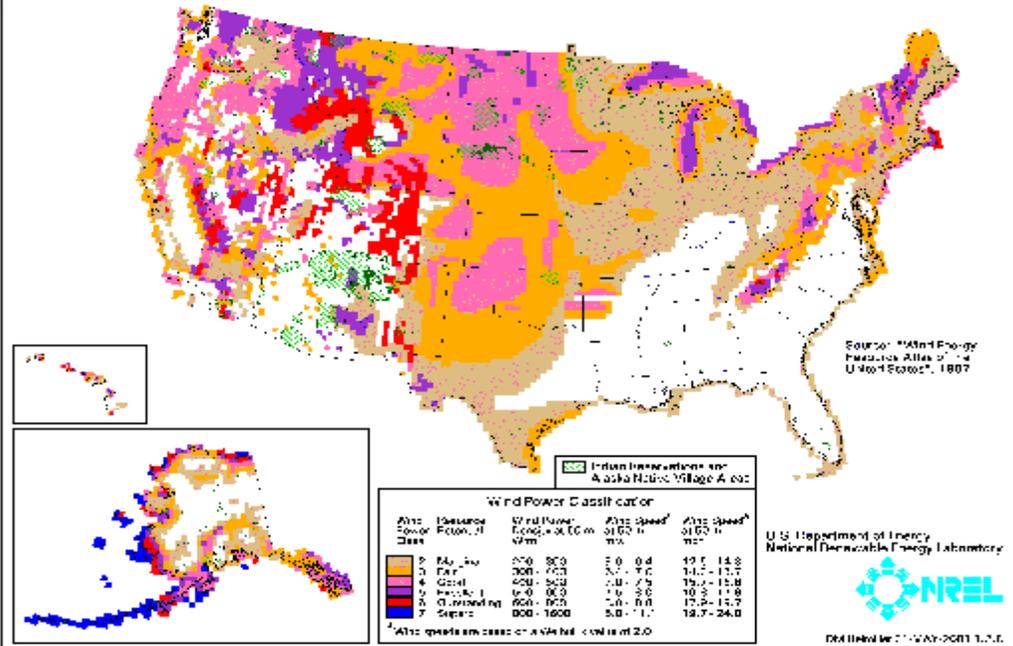


2000 POPULATION DISTRIBUTION IN THE UNITED STATES



Population density in the United States, 2000. Source: U.S. Census Bureau, 2000 Census of Population and Housing, Census 2000 Summary File 3, Table S001.

United States - Wind Resource Map



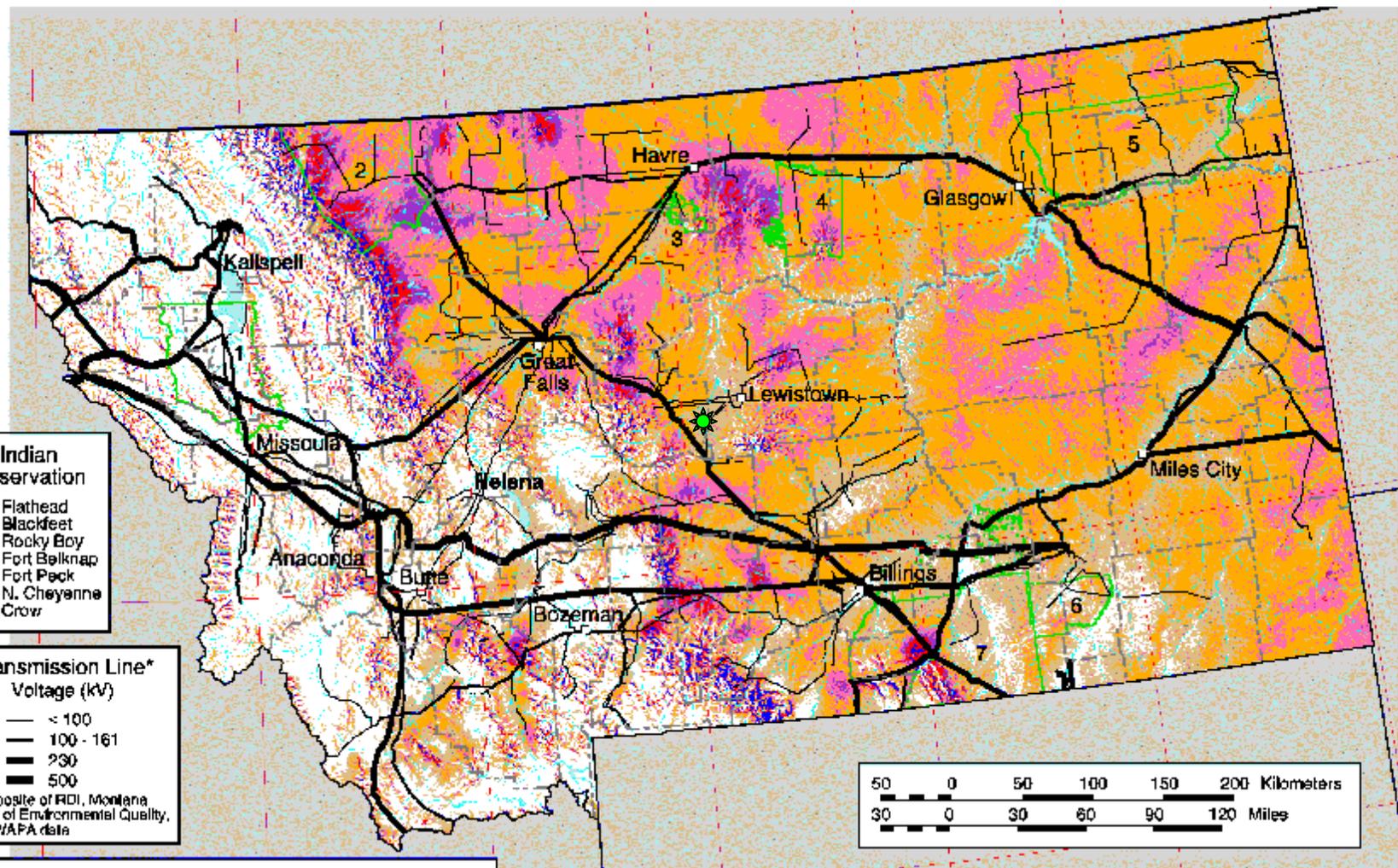
116° 114° 112° 110° 108° 106° 104°

48°

48°

46°

44°



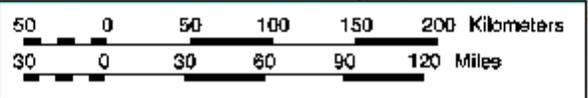
Indian Reservation

1	Flathead
2	Blackfeet
3	Rocky Boy
4	Fort Belknap
5	Fort Peck
6	N. Cheyenne
7	Crow

**Transmission Line*
Voltage (kV)**

—	< 100
—	100 - 161
—	230
—	500

* Composite of RDI, Montana Dept. of Environmental Quality, and WAPA data



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m ²	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
2	Marginal	200 - 300	5.6 - 8.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.6	15.7 - 16.8
5	Excellent	500 - 600	7.6 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.6	17.9 - 19.7
7	Superb	> 800	> 8.6	> 19.7

^a Wind speeds are approximate and based on a Weibull k value of 2.0

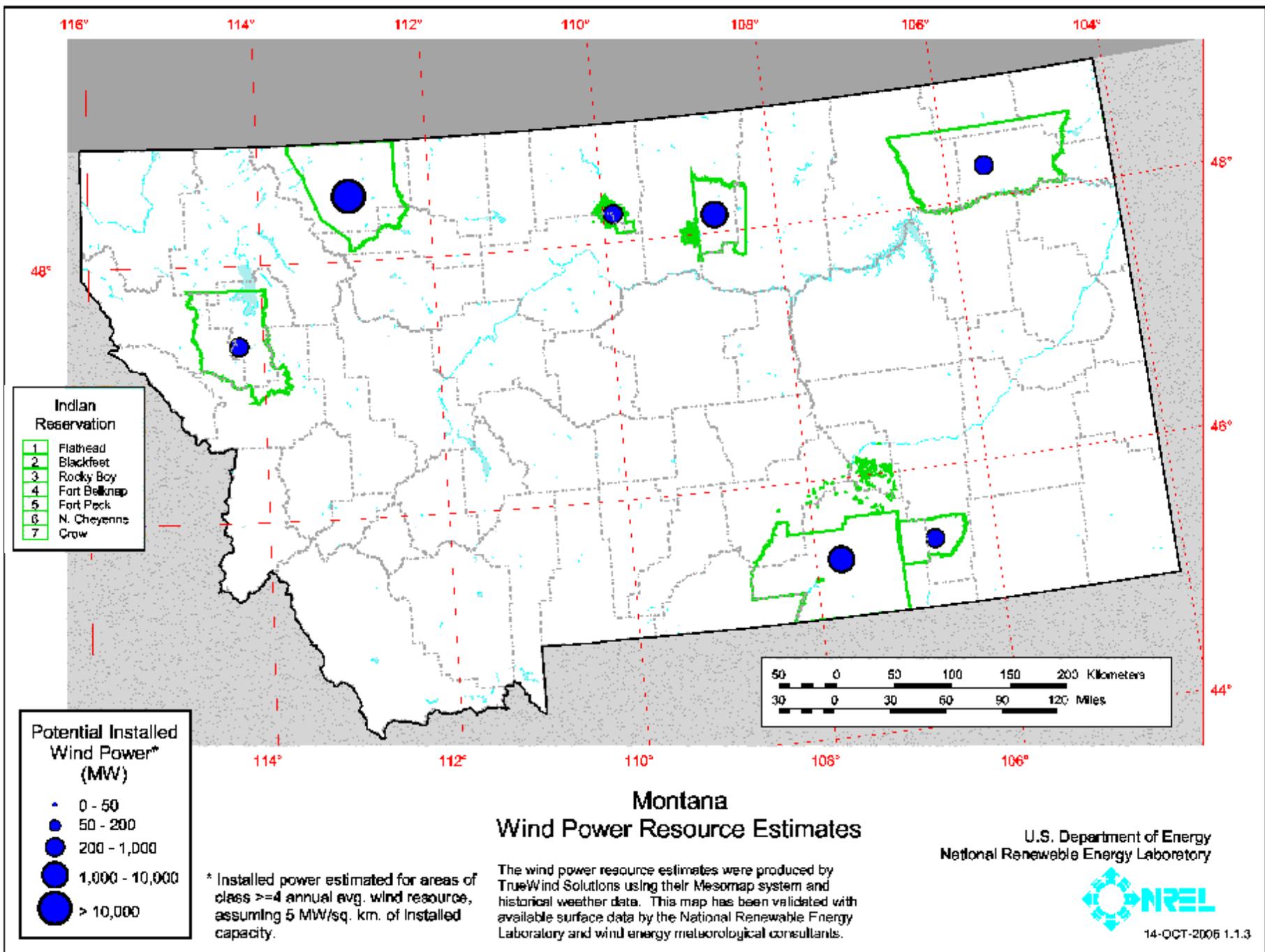
Montana Wind Power Resource Estimates

The wind power resource estimates were produced by TrueWind Solutions using their Mesomap system and historical weather data. This map has been validated with available surface data by the National Renewable Energy Laboratory and wind energy meteorological consultants.

U.S. Department of Energy
National Renewable Energy Laboratory



15-MAR-2002 1.1.1



- Indian Reservation**
- 1 Flathead
 - 2 Blackfeet
 - 3 Rocky Boy
 - 4 Fort Belknap
 - 5 Fort Peck
 - 6 N. Cheyenne
 - 7 Crow

- Potential Installed Wind Power* (MW)**
- 0 - 50
 - 50 - 200
 - 200 - 1,000
 - 1,000 - 10,000
 - > 10,000

* Installed power estimated for areas of class ≥ 4 annual avg. wind resource, assuming 5 MW/sq. km. of installed capacity.

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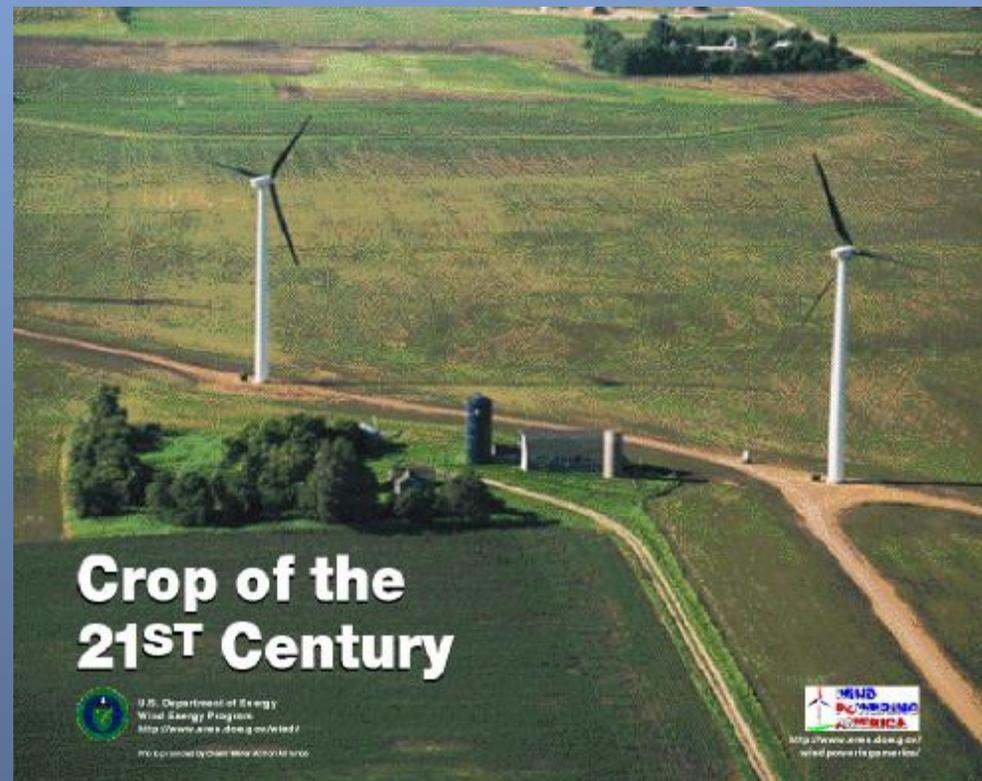




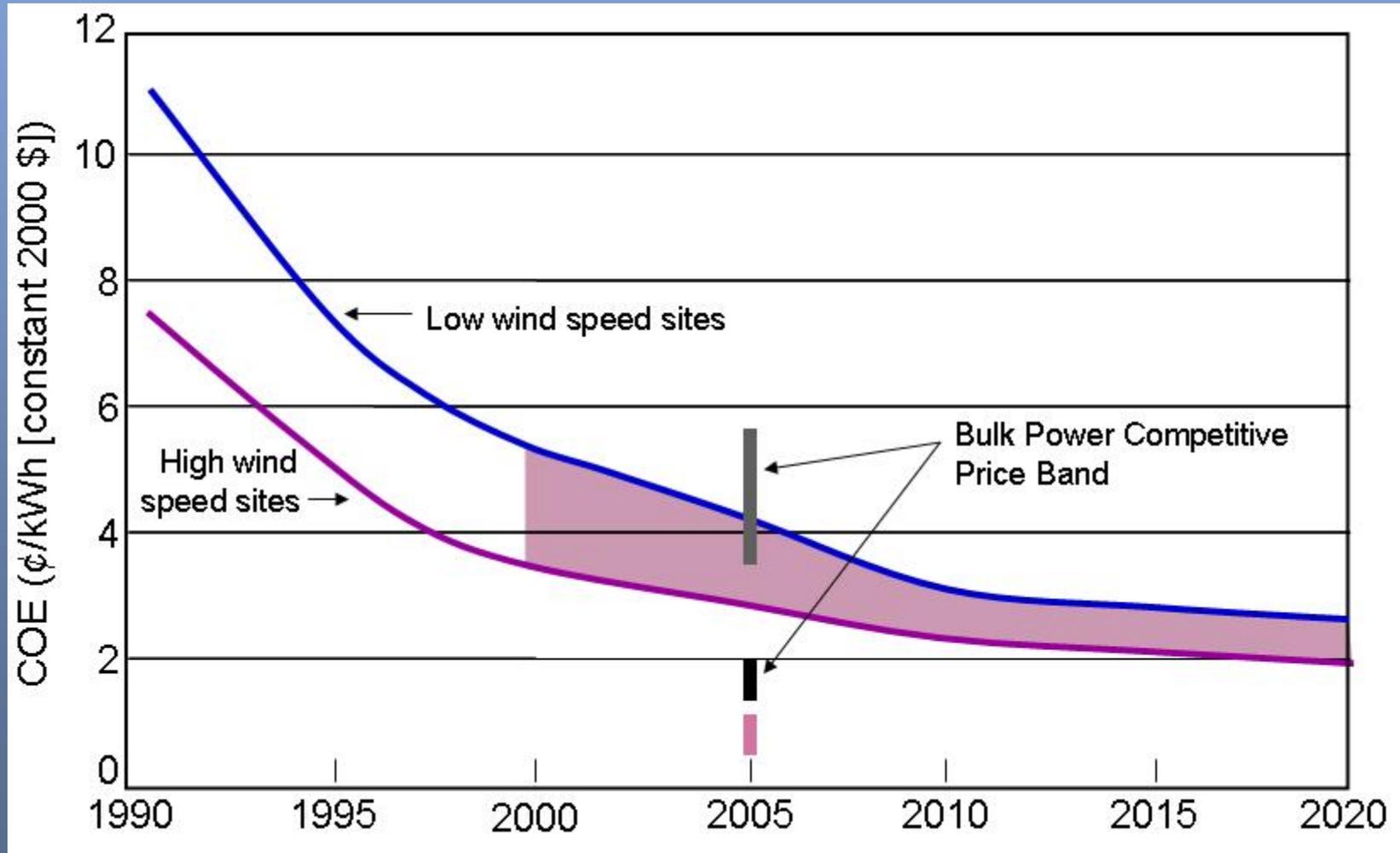
Drivers for Wind Power



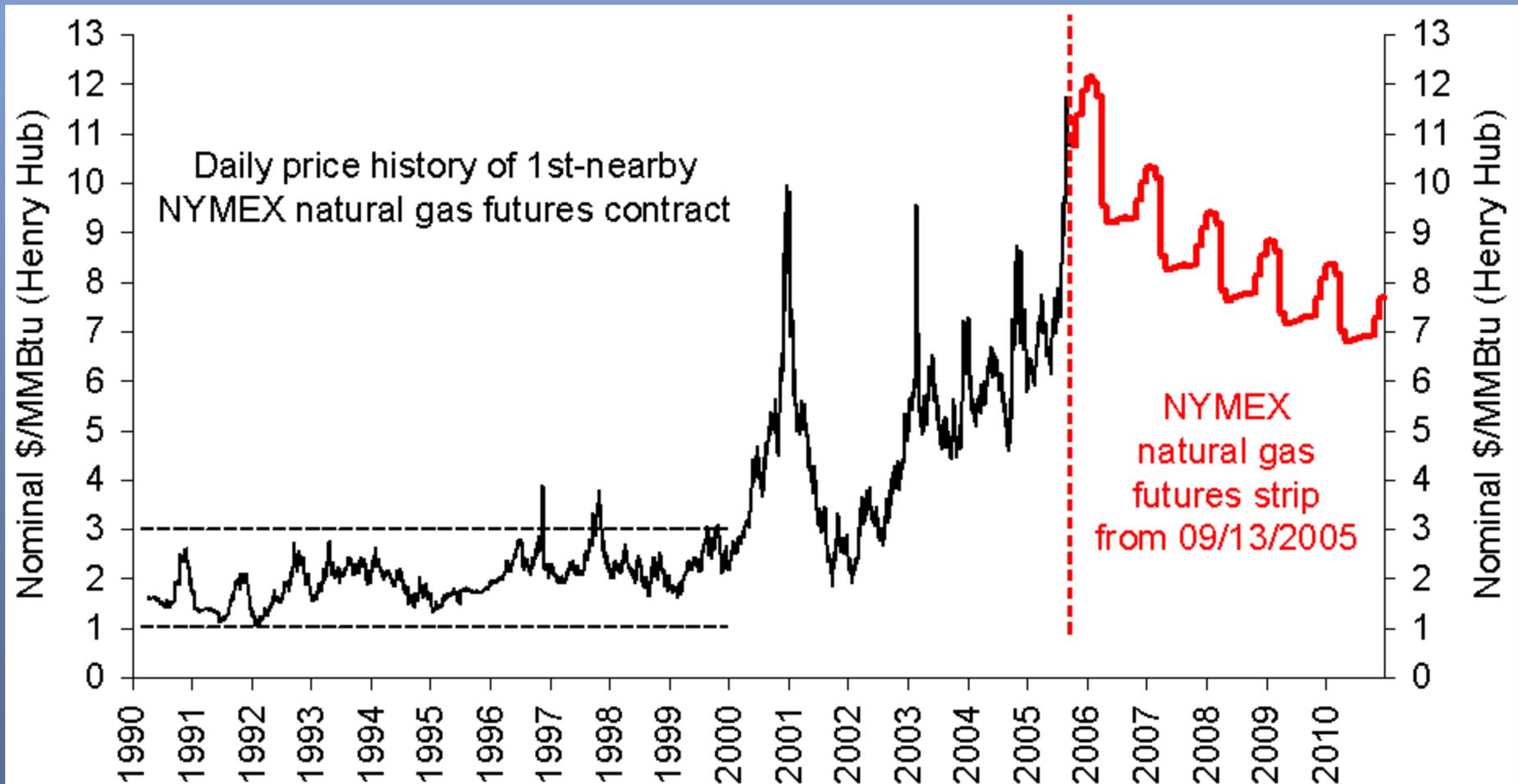
- Declining Wind Costs
- Fuel Price Uncertainty
- Federal and State Policies
- Economic Development
- Green Power
- Energy Security



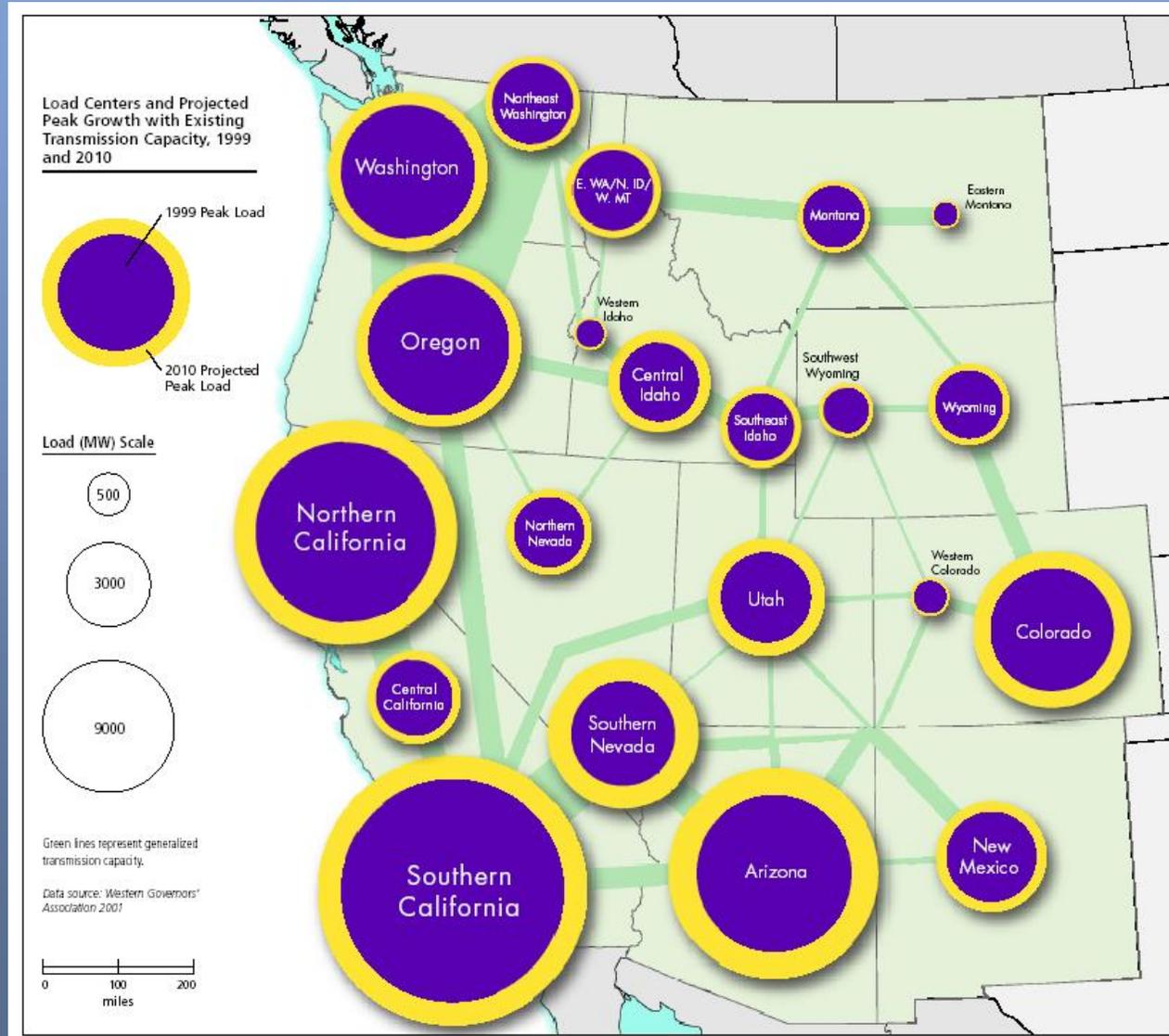
Wind Cost of Energy



Natural Gas – Historic Prices

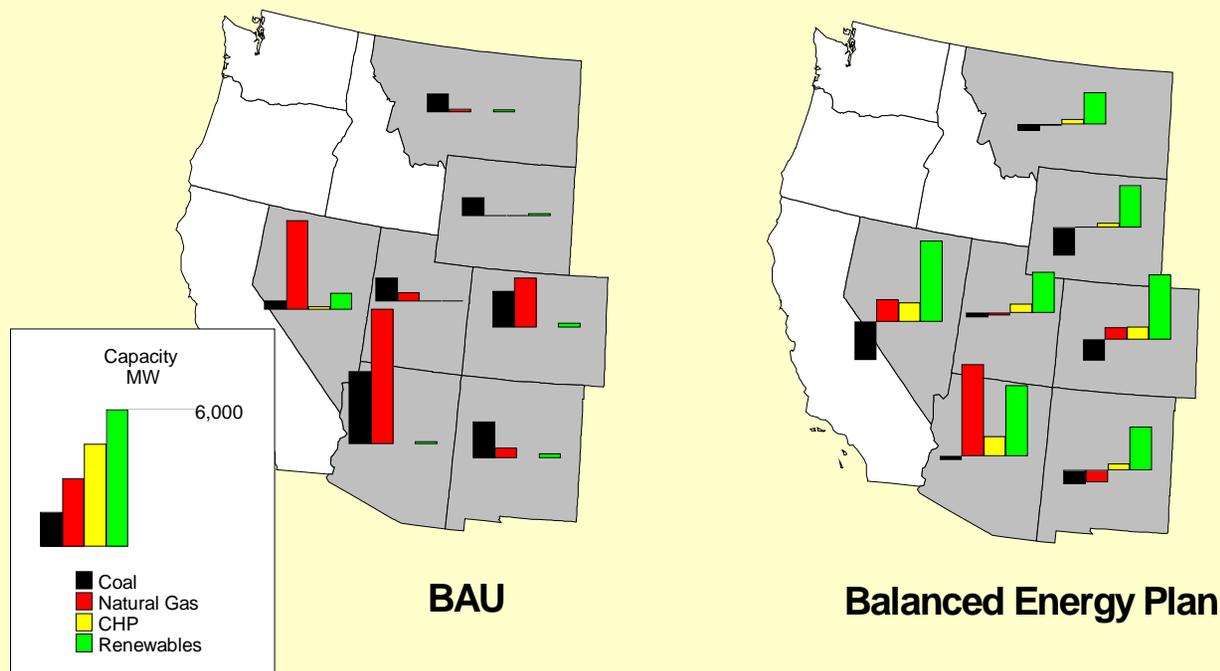


Load Growth



Interior West Capacity Additions

Net Capacity Additions by 2020 *BAU vs. Balanced Energy Plan*



BAU

- 16,000 MW natural gas
- 10,000 MW coal
- 1500 MW renewables
- 150 MW CHP

Balanced Plan:

- 15,400 MW renewables
- 3000 MW CHP
- 7800 MW natural gas
- Retires 5000 MW of coal

Wind energy doesn't consume water



Windy Rural Areas Need Economic Development

United States - Wind Resource Map

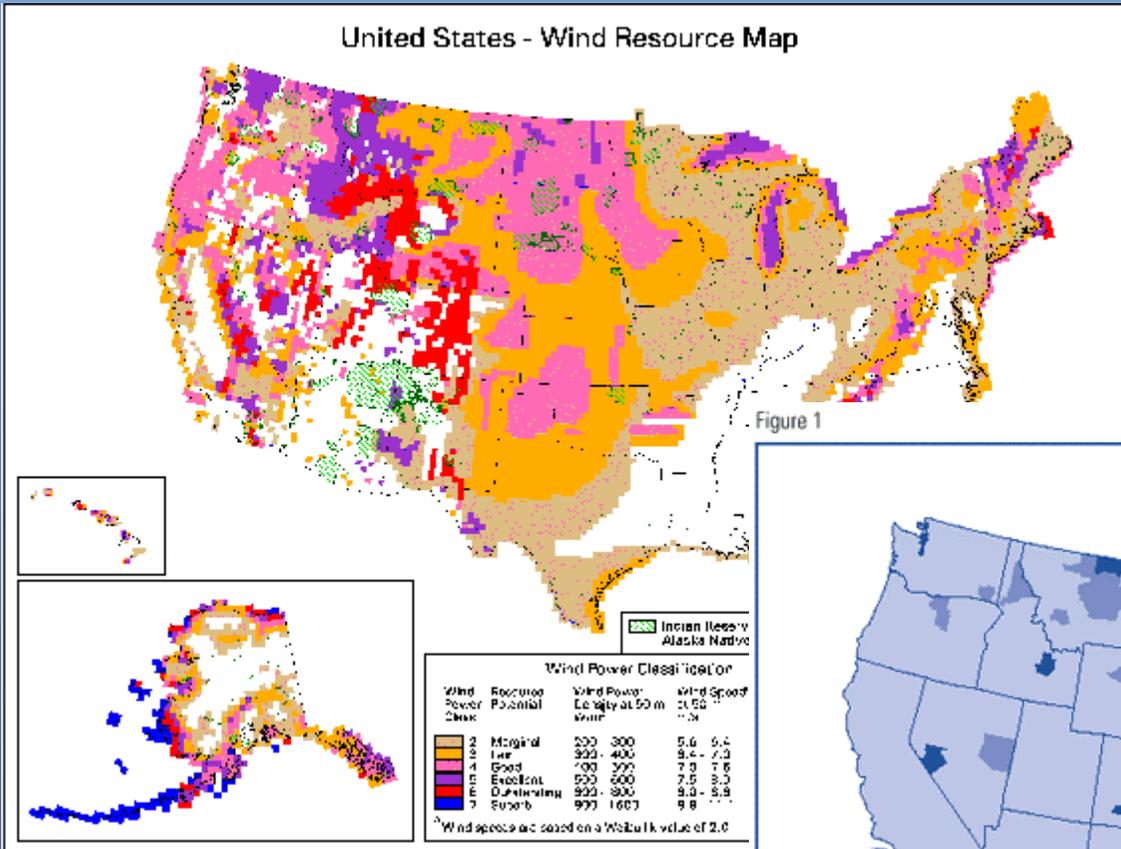
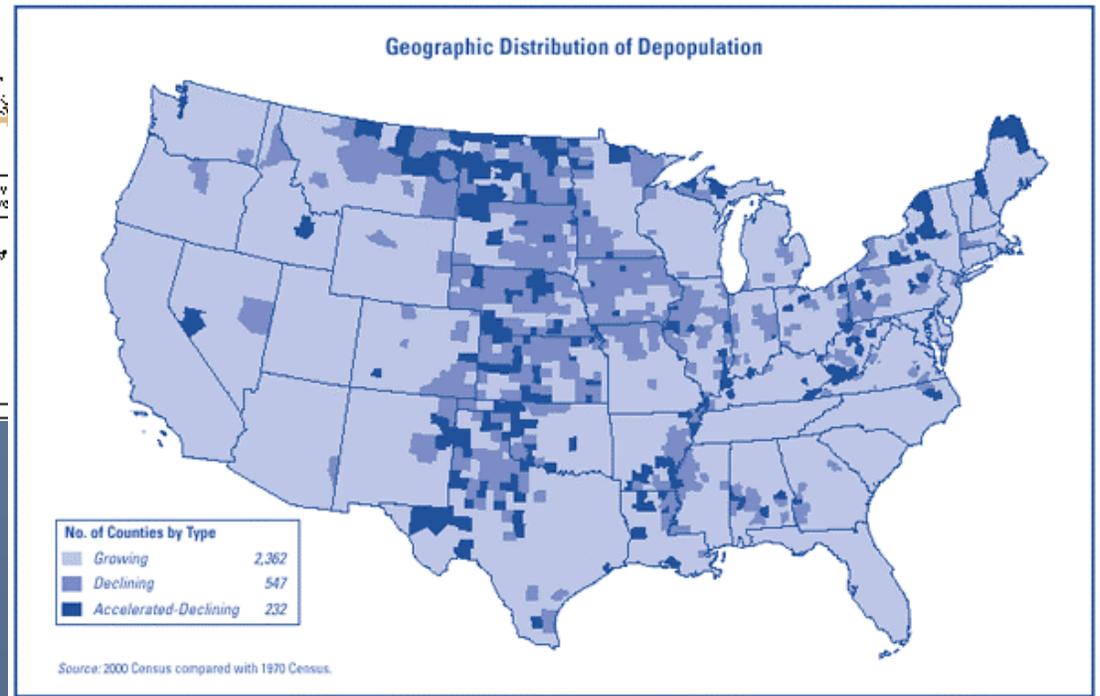


Figure 1

Geographic Distribution of Depopulation



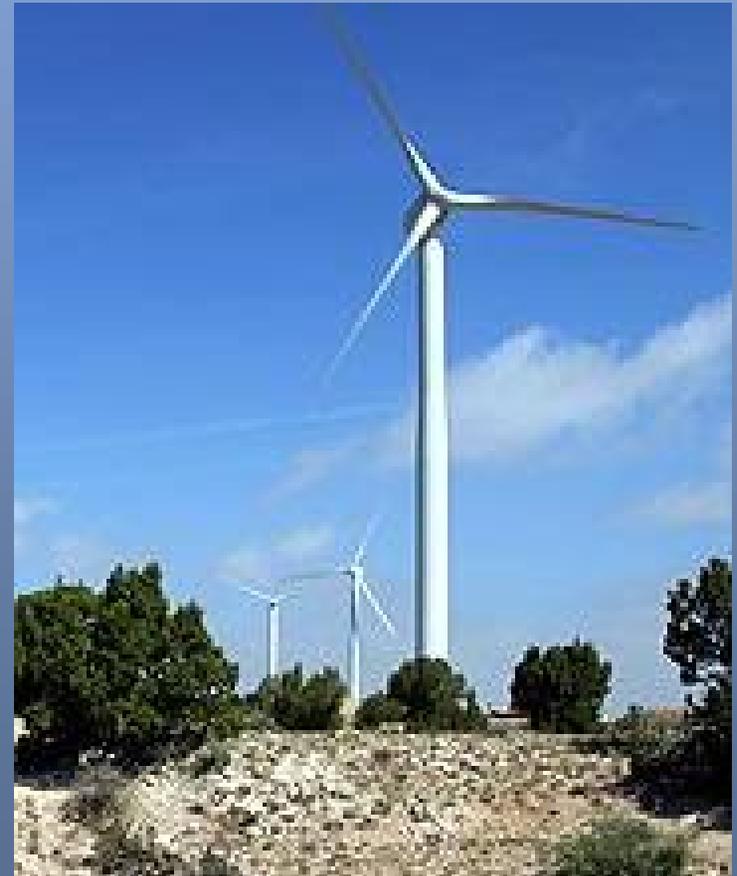
Economic Development Impacts



- 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
- 2-6 permanent O&M jobs per 50-100 MW
- Local industry: concrete, towers, electrical services
- Manufacturing and Assembly plants expanding in U.S. (e.g. IL, CA, ND, PA)

Case Study: New Mexico

- 204-MW wind project built in 2003 in DeBaca and Quay counties for PNM
- 150 construction jobs
- 12 permanent jobs and \$550,000/yr in salaries for operation and maintenance
- \$550,000/year in lease payments to landowners
- **\$450,000/year in payments in lieu of taxes to county and school districts**
- Over \$40M in economic benefits for area over 25 years





Case Study: Prowers County, Colorado



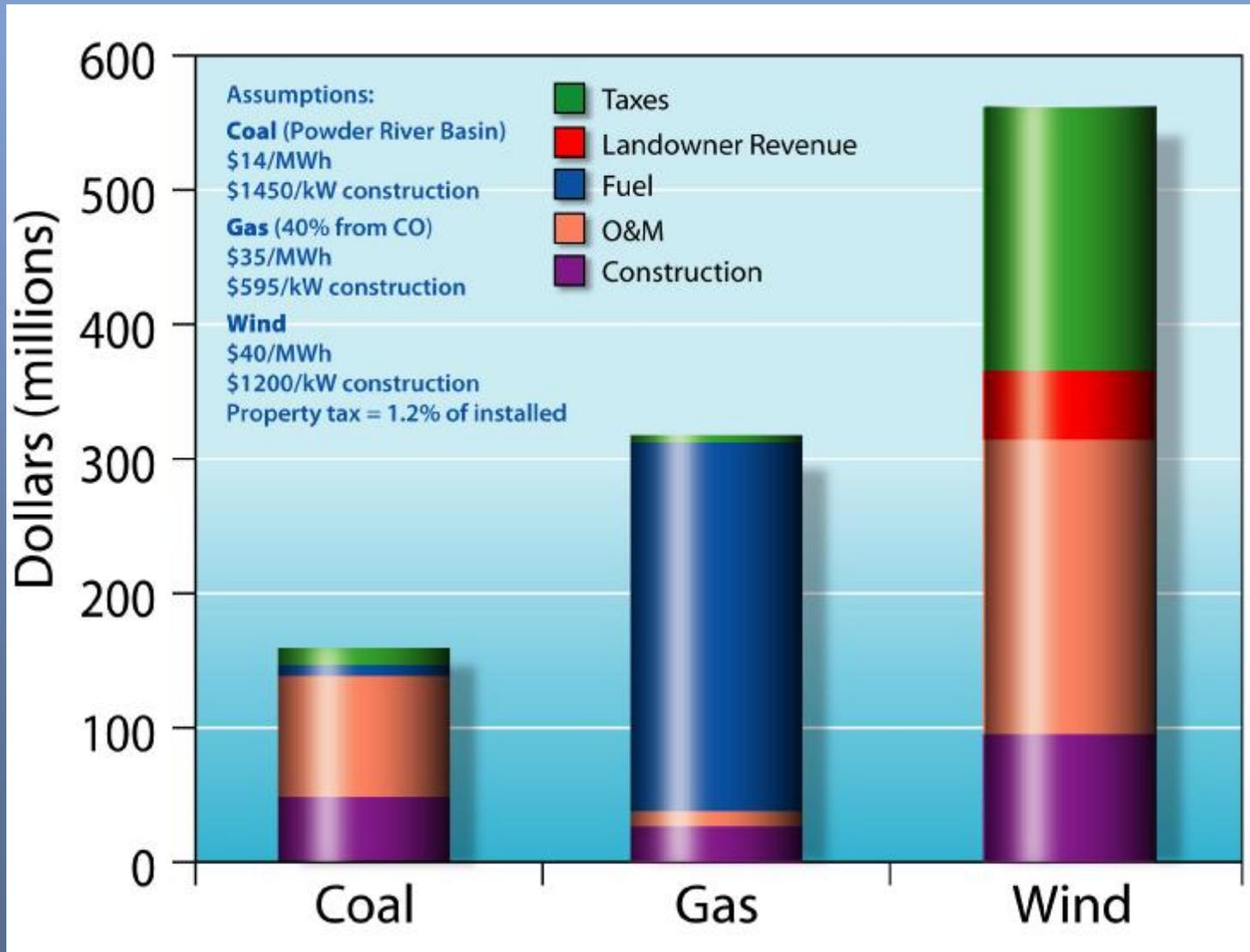
- 162-MW Colorado Green Wind Farm (108 turbines)
- \$200M+ investment
- 400 construction workers
- 14-20 full-time jobs
- Land lease payments \$3000-\$6000 per turbine
- **Prowers County 2002 assessed value \$94M; 2004 assessed value +33% (+\$32M)**
- **Local district will receive 12 mil tax reduction**
- Piggyback model



“Converting the wind into a much-needed commodity while providing good jobs, the Colorado Green Wind Farm is a boost to our local economy and tax base.”

John Stulp, county commissioner, Prowers County, Colorado

Comparative Economic Development Impacts



Key Issues for Wind Power



- Policy Uncertainty
- Siting and Permitting: avian, noise, visual, federal land
- Transmission: FERC rules, access, RTO formation, new lines
- Operational impacts: intermittency, ancillary services, allocation of costs
- Accounting for non-monetary value: green power, no fuel price risk, reduced emissions



Wind Energy Economic Security **Benefits**

Wind energy is an **indigenous**, homegrown, energy resource that contributes to national security.

Wind energy is **inexhaustible** and infinitely renewable.

Wind displaces electricity that would otherwise be produced by burning natural gas, thus helping to **reduce gas demand** and limit gas price hikes.

Wind energy is the **least cost** new energy source.

Wind energy boosts rural **economic development**.

Unlike most other electricity generation sources, wind turbines **don't consume water**.

Wind energy has many **environmental benefits**.

Wind energy can be used in a **variety of applications**.

Wind energy is the fuel of **today and tomorrow**.





Carpe Ventem!

www.windpoweringamerica.gov