Wind Energy Update

Marguerite Kelly
National Renewable Energy Laboratory

Little Rock, Arkansas - June 30, 2009

Different Sizes for Different Applications

Small (≤10 kW)

- Homes
- Farms
- Remote Applications

(e.g. water pumping, telecom sites, icemaking)

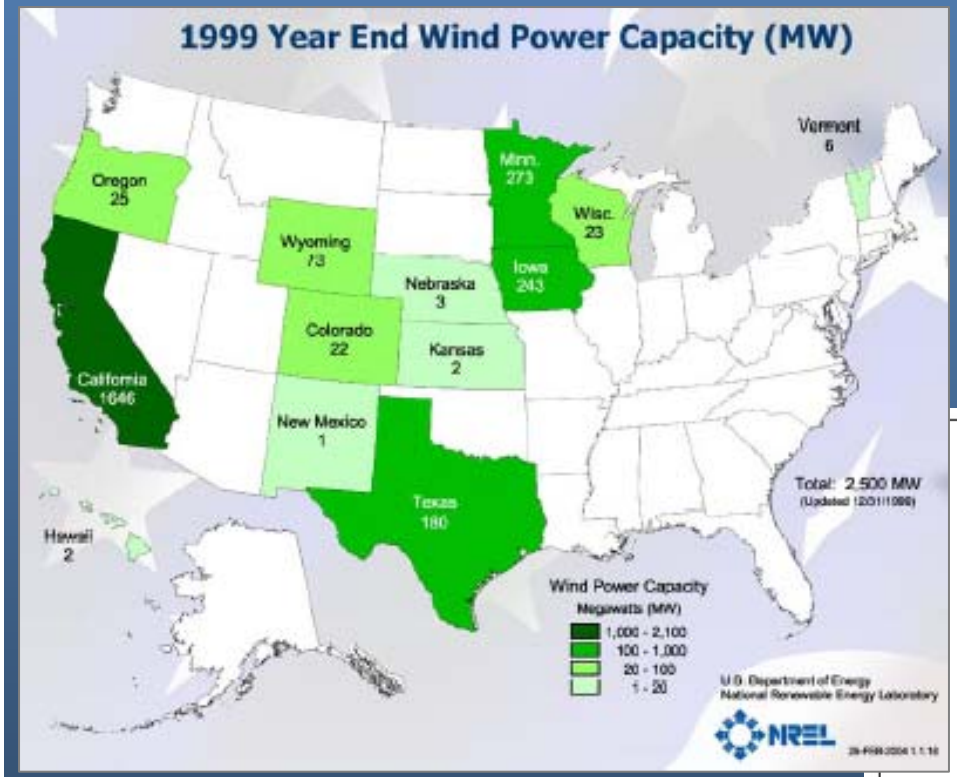
Intermediate (10-250 kW)

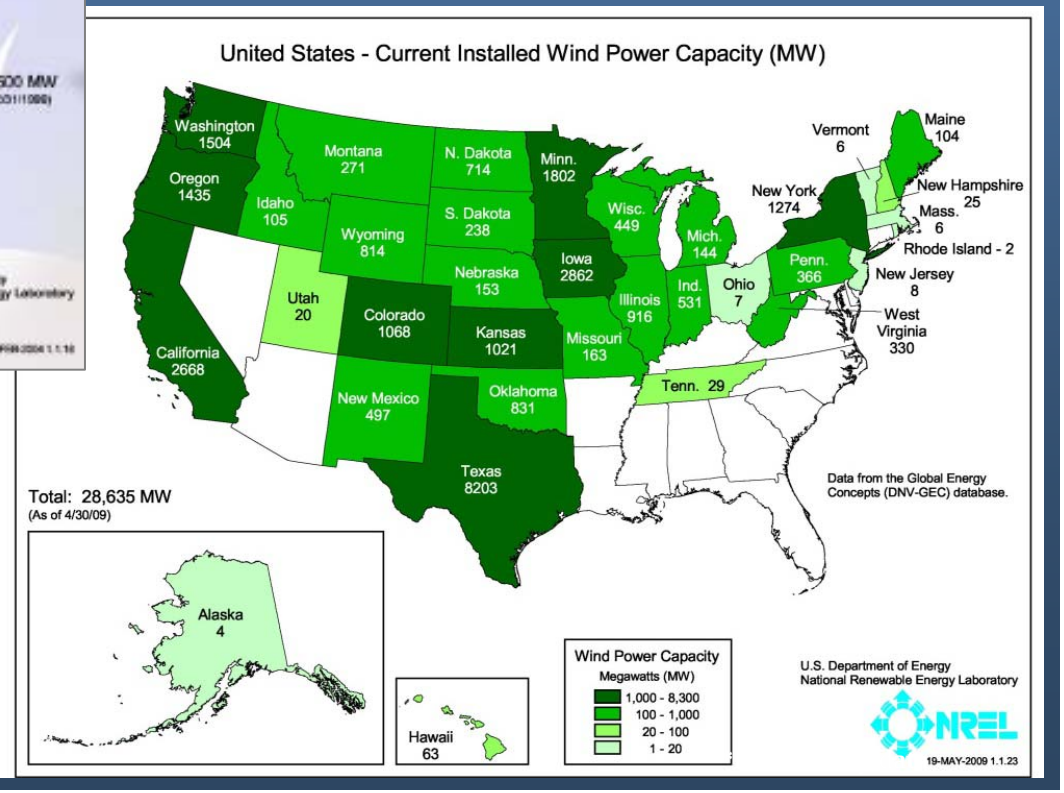
- Village Power
- Hybrid Systems
- Distributed Power

Large (660 kW - 2+MW)

- Central Station Wind Farms
- Distributed Power

Installed Wind Capacities ('99 – '09)





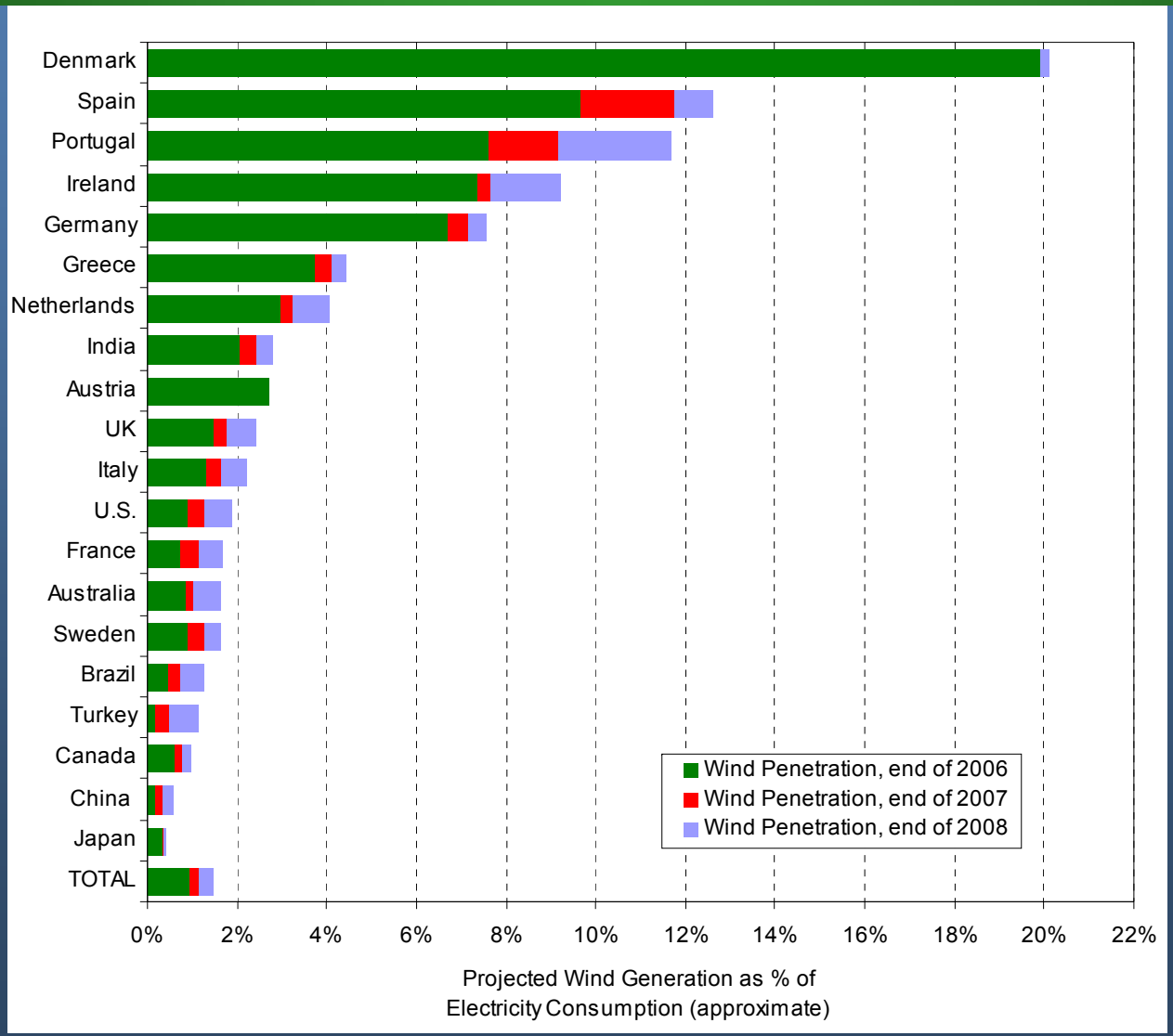
U.S. Led the World in 2008 Wind Capacity Additions, and in Cumulative Capacity

Annual Capacity (2008, MW)		Cumulative Capacity (end of 2008, MW)	
U.S.	**8,558**	**U.S.**	**25,369**
China	6,246	Germany	23,933
India	1,810	Spain	16,453
Spain	1,739	China	12,121
Germany	1,665	India	9,655
France	1,200	Italy	3,731
Italy	1,010	France	3,671
U.K.	869	U.K.	3,263
Portugal	679	Denmark	3,159
Australia	615	Portugal	2,829
Rest of World	3,999	*Rest of World*	18,106
TOTAL	**28,390**	**TOTAL**	**122,290**

Source: BTM Consult; AWEA for U.S. capacity

2008 Wind Market Report; LBL

U.S Lagging Other Countries in Wind As a Percentage of Electricity Consumption

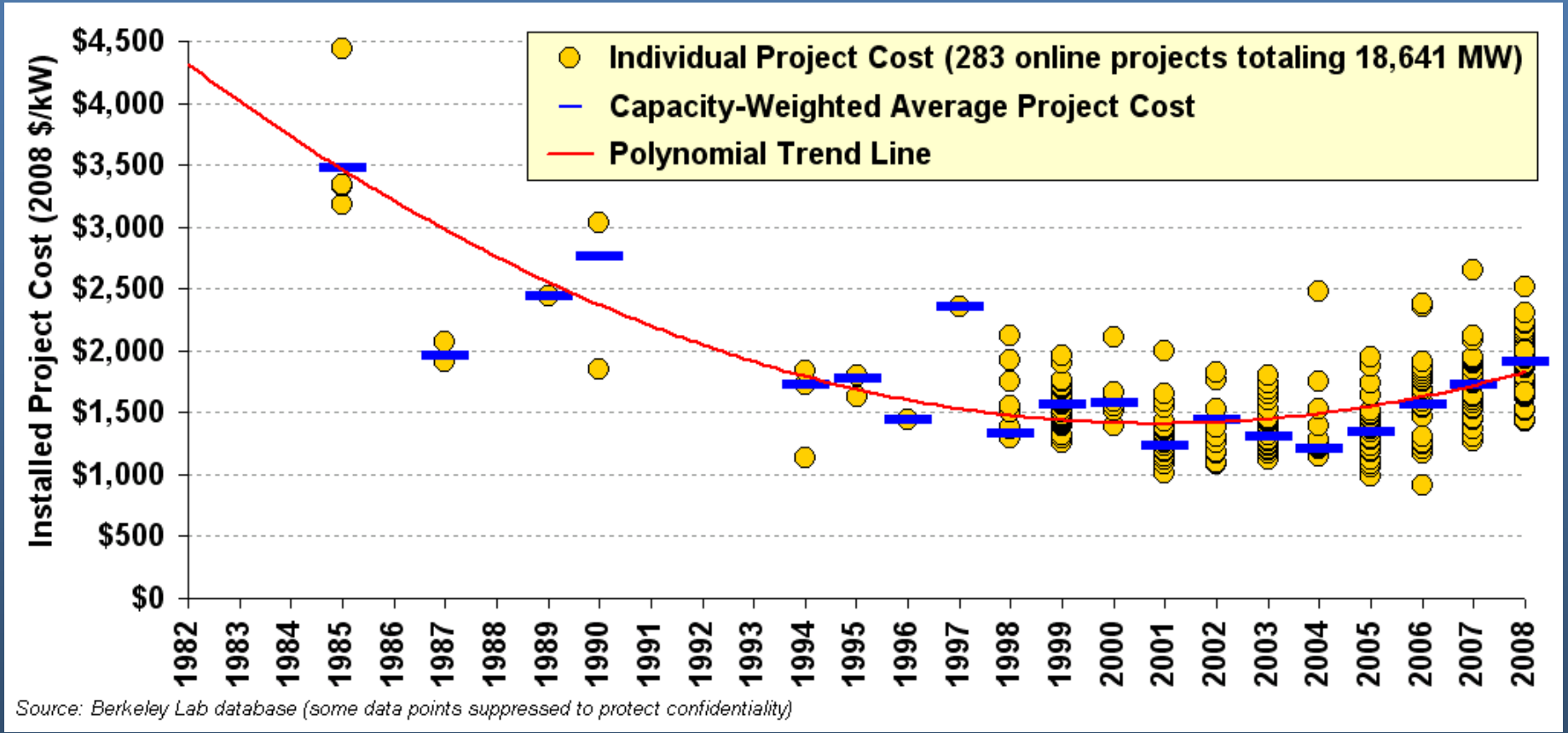


2008 Wind Market Report; LBL

Drivers for Wind Power

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

After a Long Period of Decline, Installed Project Costs Have Risen

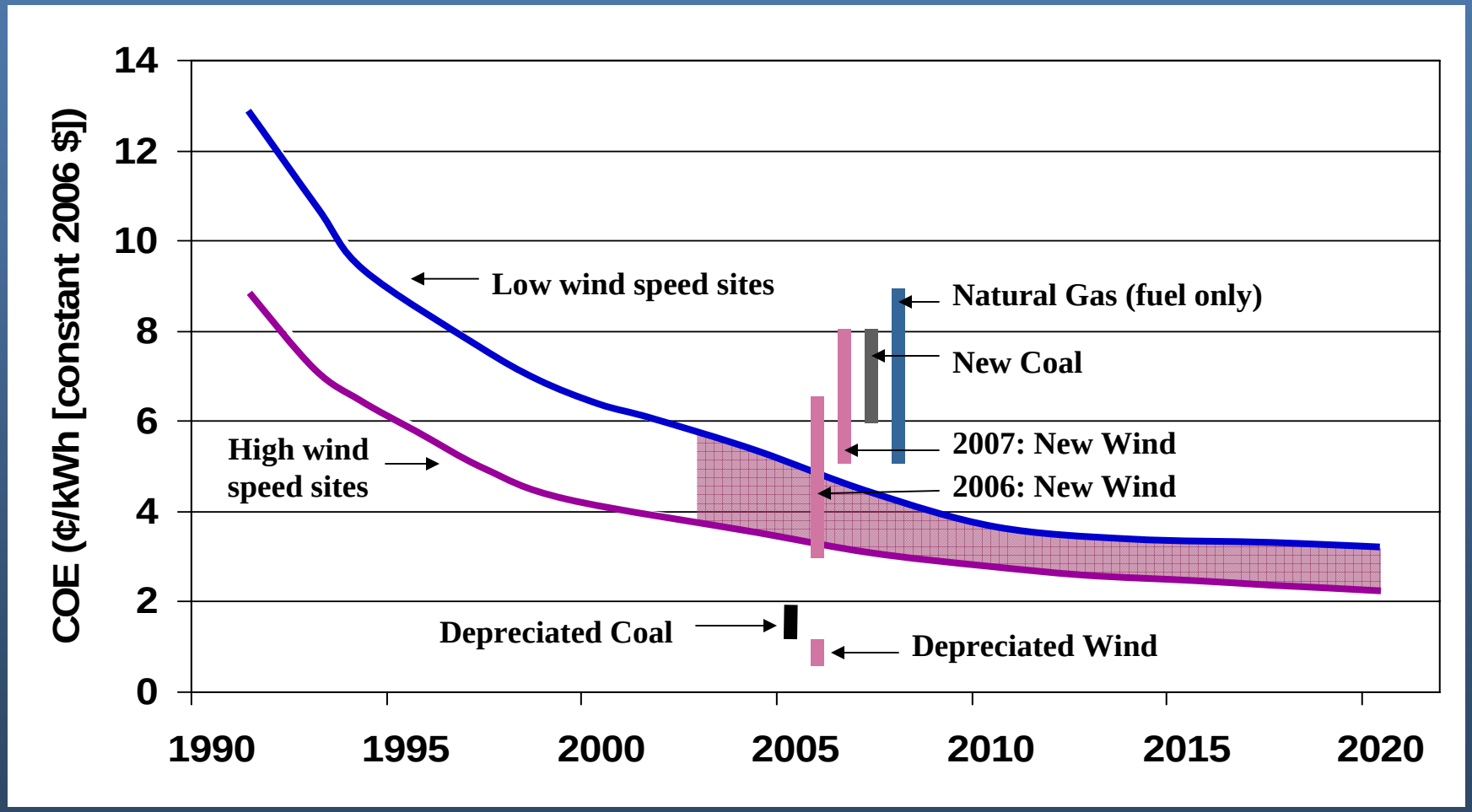


Source: Berkeley Lab database (some data points suppressed to protect confidentiality)

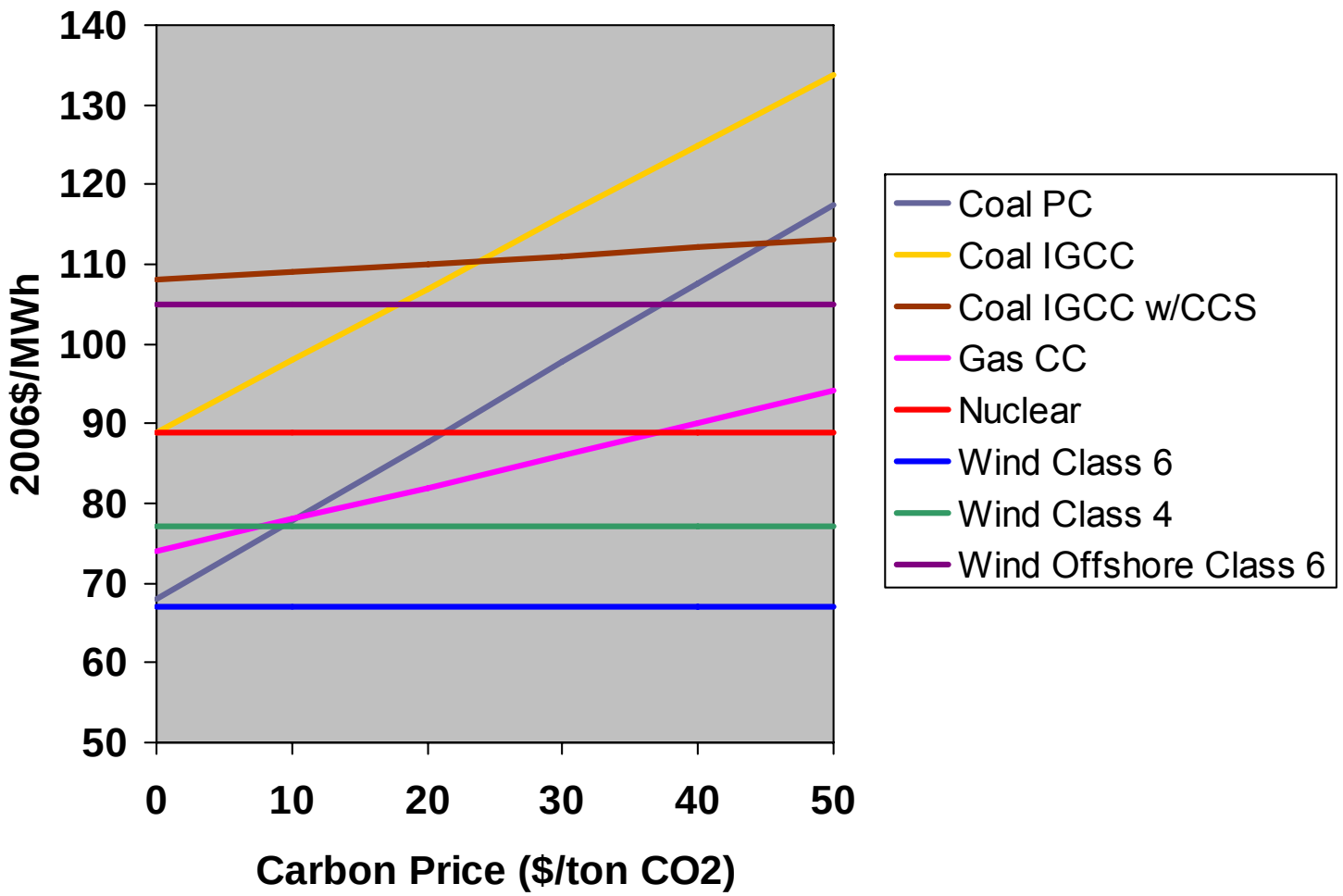
Project costs bottomed out in 2001-2004, and have risen by roughly $650/kW, on average, through 2008

2008 Wind Market Report; LBL

Wind Cost of Energy



CO_2 prices significantly increase the cost of coal

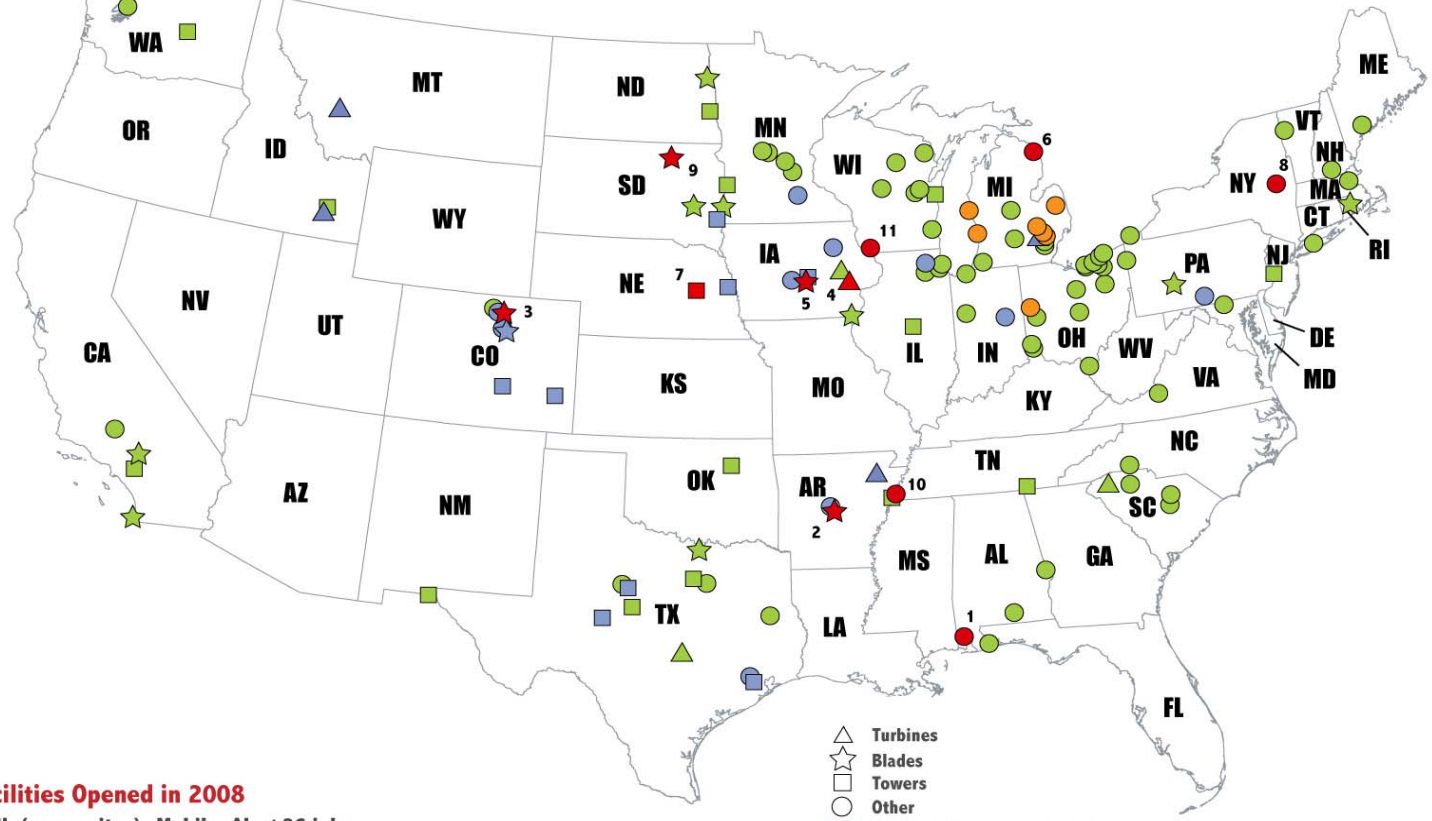


State and Federal Policy Support for Wind Has Been Strong

- State Policies
  - 28 states and DC with renewables portfolio standards
  - Growing interest in carbon reduction policies
  - Increased state/regional efforts to address transmission barriers
- Federal Policies
  - Production Tax Credit: now extended through 2012
  - MACRS: 5-year accelerated depreciation
  - More-proactive transmission build-out supported by FERC
  - More-proactive efforts on siting by Federal authorities
- American Recovery and Reinvestment Act (ARRA) of 2009
  - PTC extension through 2012
  - 30% ITC election option and temporary Treasury grants program
  - Expansion and extension of loan guarantee program
  - New CREB funding, manufacturing tax incentives, transmission funds, bonus depreciation extension, etc.

2008 Wind Market Report; LBL

Soaring Demand Spurs Expansion of U.S. Wind Turbine Manufacturing



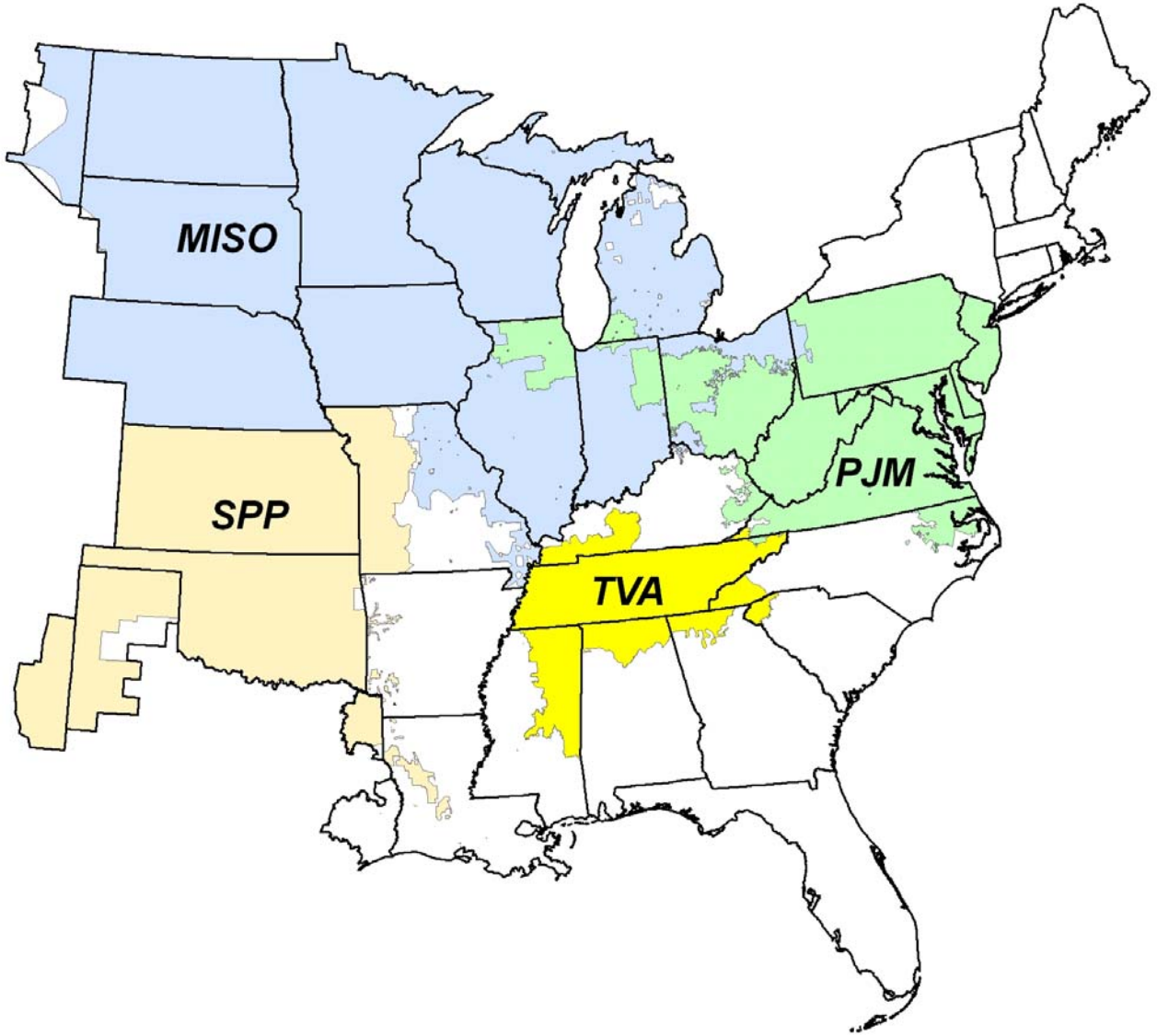
New Facilities Opened in 2008

1. Evonik (composites), Mobile, AL, +26 jobs
2. LM Glasfiber (blades), Little Rock, AR, +1,000 jobs within 5 years
3. Vestas (blades), Windsor, CO, +650 jobs
4. Acciona (turbines), West Branch, IA, +110 jobs
5. TPI Composites (blades), Newton, IA, +140 jobs
6. ATI Casting Services (casting and foundry), Alpena, MI, +20 jobs
7. Katana Summit (towers), Columbus, NE
8. GE (parts fulfillment center), Schenectady, NY
9. Molded Fiberglass (blades), Aberdeen, SD, +up to 750 jobs
10. GE (parts operation center), Memphis, TN
11. Wausaukee Composites (housings), Cuba City, WI, +61 jobs

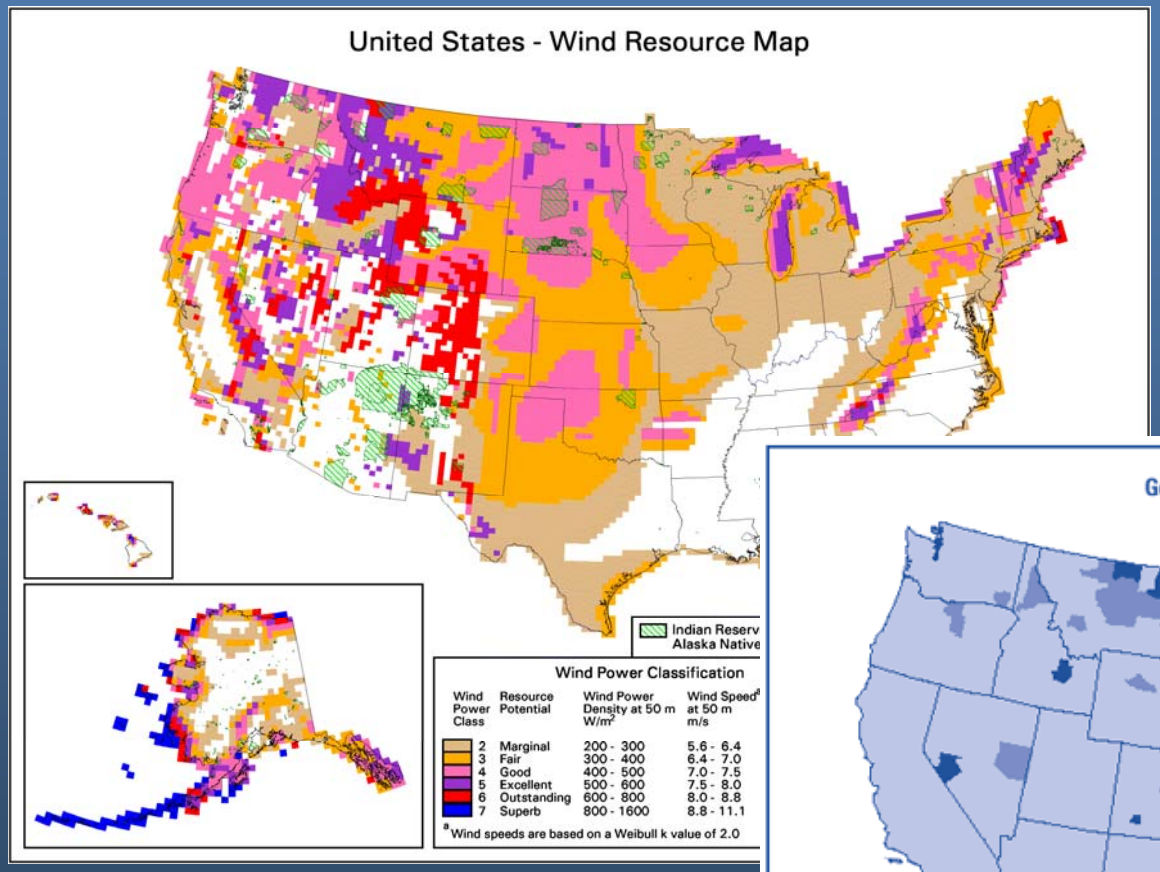
Figure includes wind turbine and component manufacturing facilities, as well as other supply chain facilities, but excludes corporate headquarters and service-oriented facilities. The facilities shown here are not intended to be exhaustive. Those facilities designated as "Turbines" may include turbine assembly and/or turbine component manufacturing, in some cases also including towers and blades.

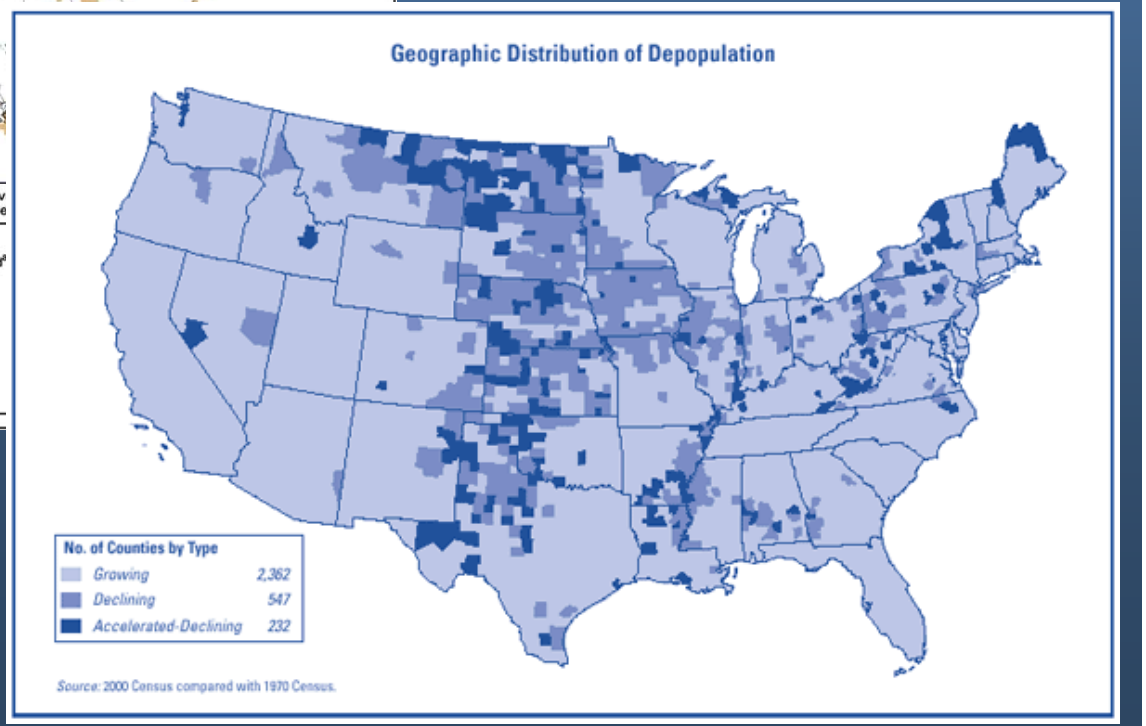
This map was created by The National Renewable Energy Laboratory for the U.S. Department of Energy. May 18, 2009

Note: Nebraska and most of South Dakota are not in MISO, but are within the study footprint.



Windy Rural Areas Need Economic Development





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

- 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)

Peetz Table Wind Energy Center, CO

- 400.5 MW (1.5-MW turbines)
- Landowner payments: $2 million/year, $65 million over 30-year period
- 300 – 350 workers during peak construction (80% local)
- **16 – 18 O&M positions**
- Total annual tax payments: $2.3 million/year (10% of total county budget); $70 million over 30 years
- Located near Peetz, CO
- Owned by FPL Energy
- Constructed in 2007

Arkansas – Economic Impacts

from 1000 MW of new wind development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $2.7 Million/yr

Local Property Tax Revenue:
- $9.3 Million/yr

Construction Phase:
- 1,900 new jobs
- $189 M to local economies

Operational Phase:
- 250 new long-term jobs
- $21 M/yr to local economies

Indirect & Induced Impacts

Construction Phase:
- 1,550 new jobs
- $129 M to local economies

Operational Phase:
- 250 local jobs
- $20 M/yr to local economies

Totals (construction + 20yrs)

Total economic benefit = $1.2 billion

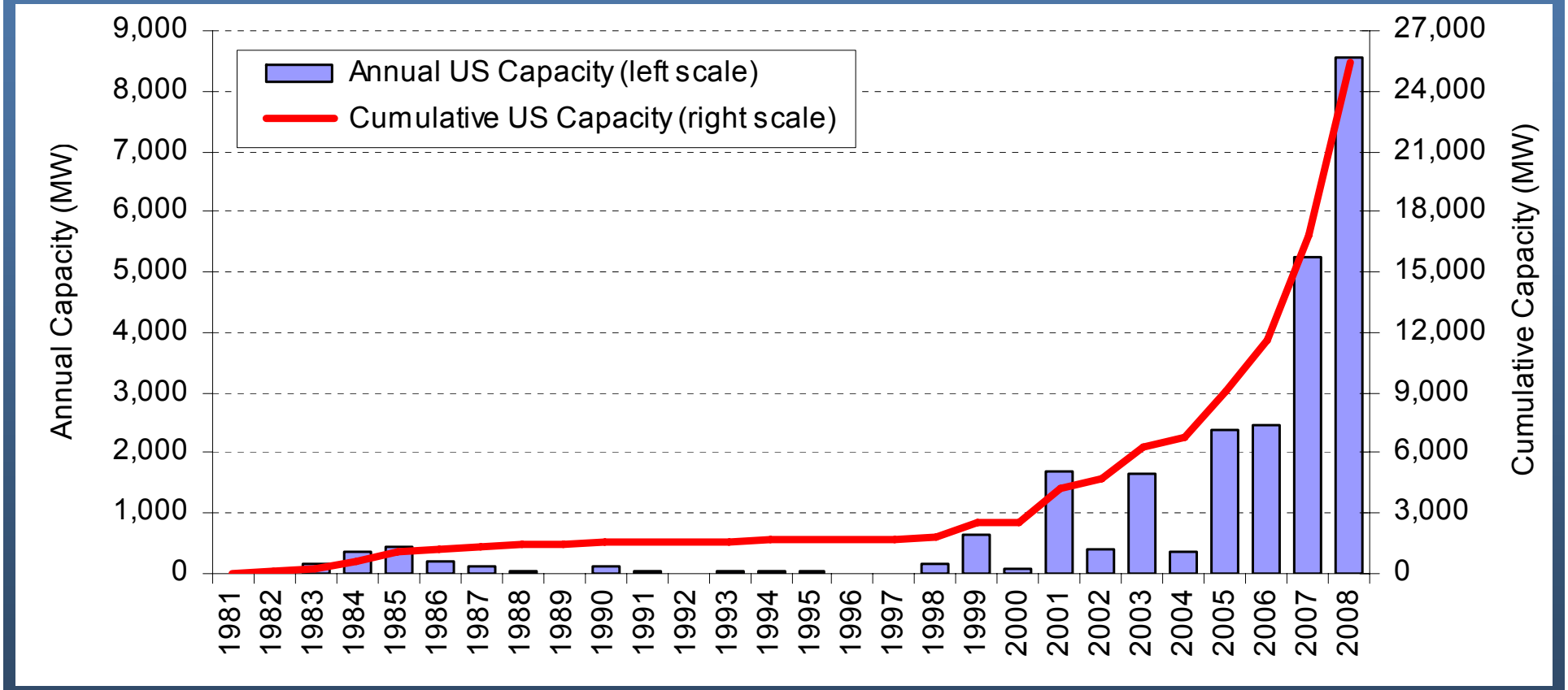
New local jobs during construction = 3,500

New local long-term jobs = 500

All jobs rounded to the nearest 50 jobs; All values greater than $10 million are rounded to the nearest million

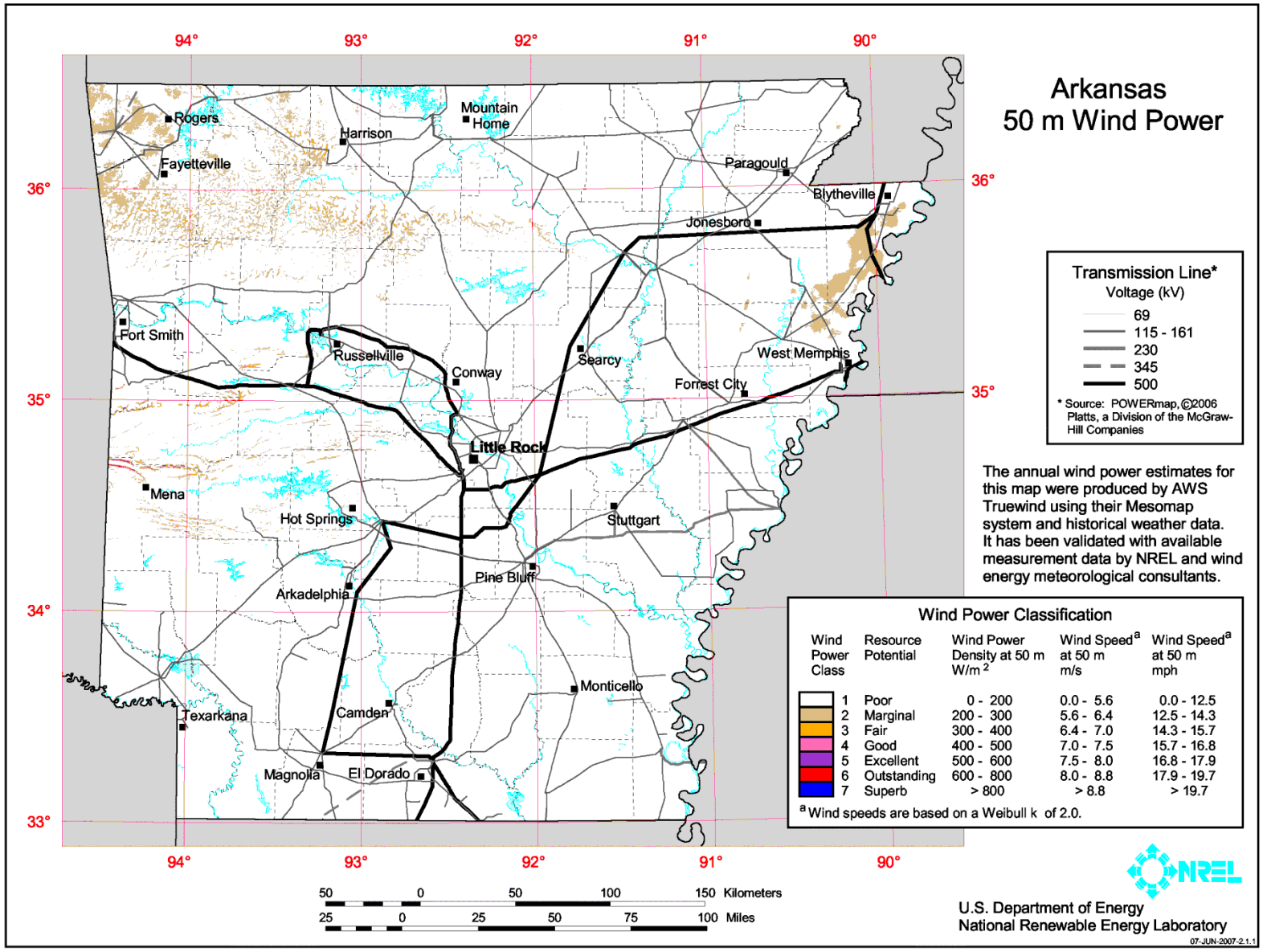
Construction Phase = 1-2 years
Operational Phase = 20+ years

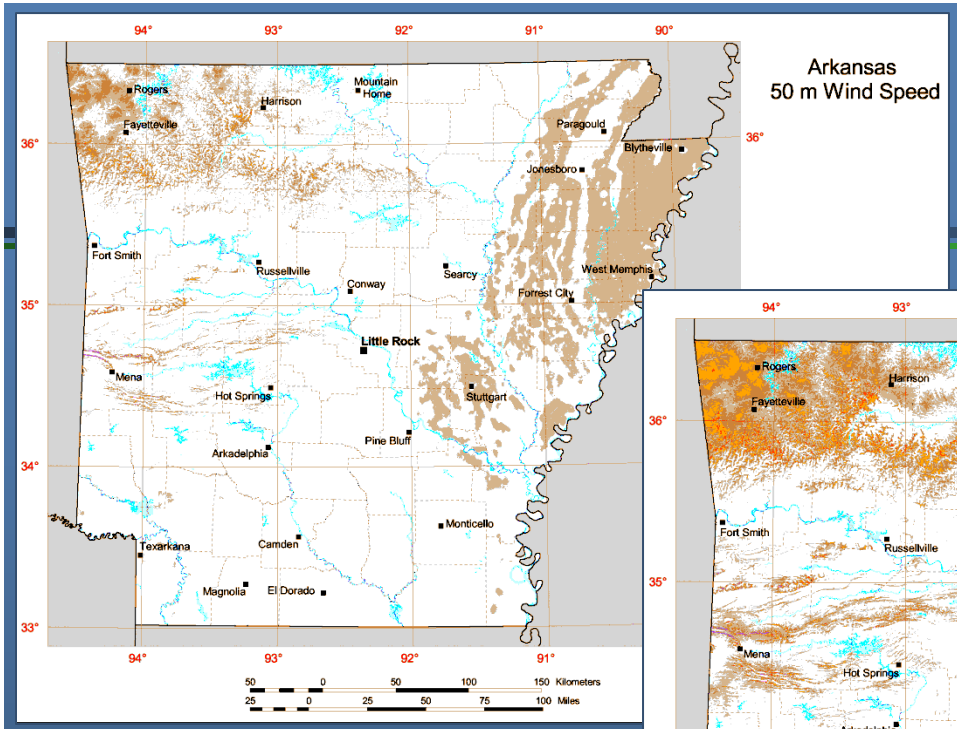
Four Years of Strong Growth:
2008: 8,558 MW Added; $16 billion Investment

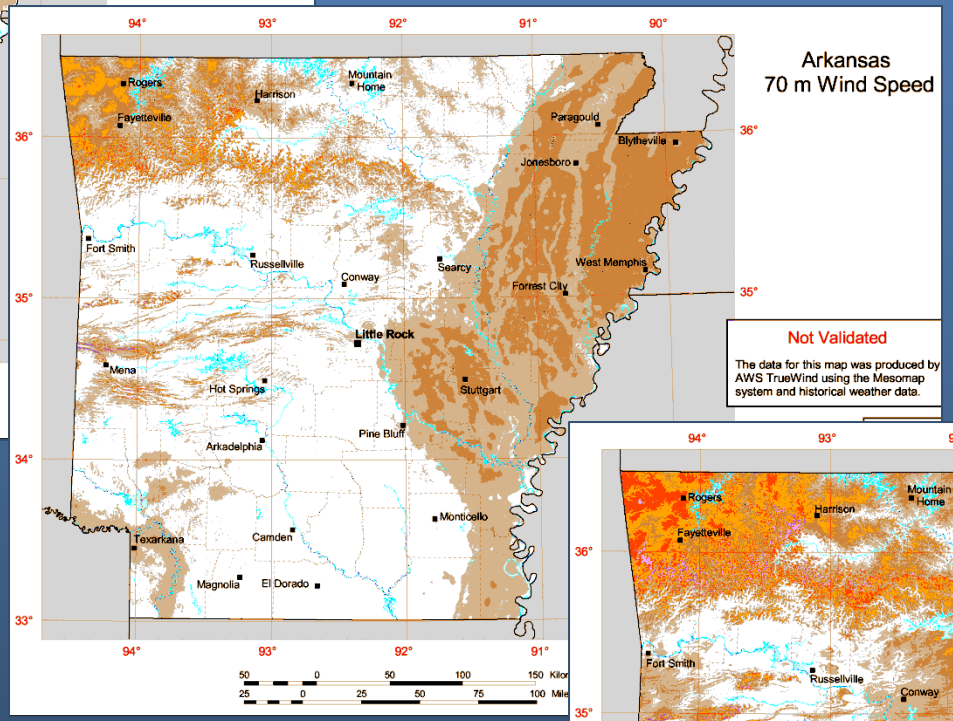


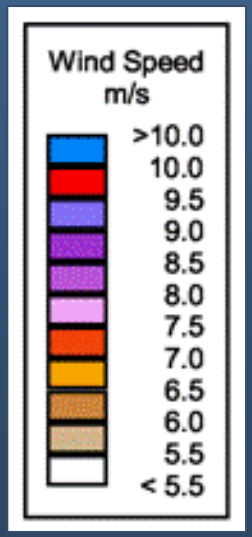
2008 Wind Market Report; LBL

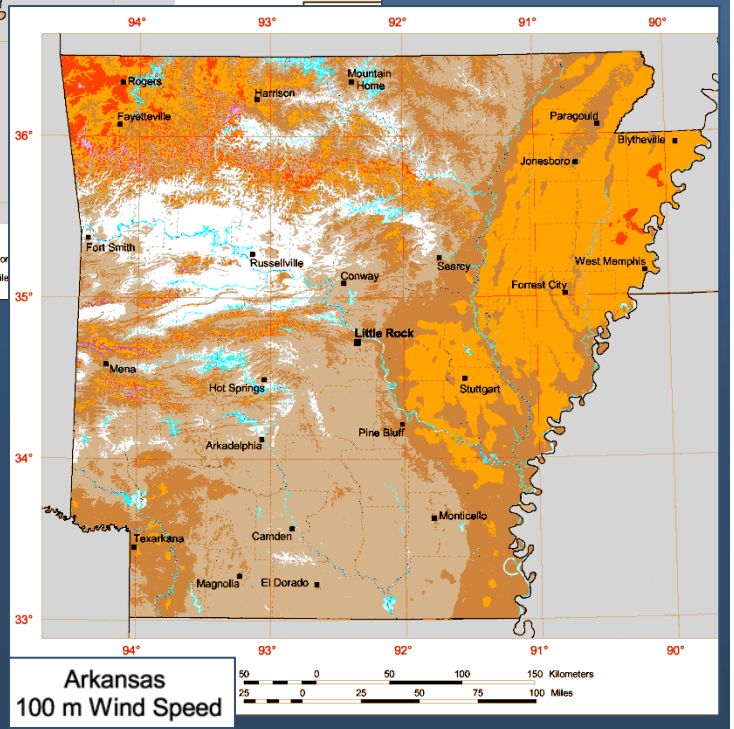
Arkansas Wind Power Map







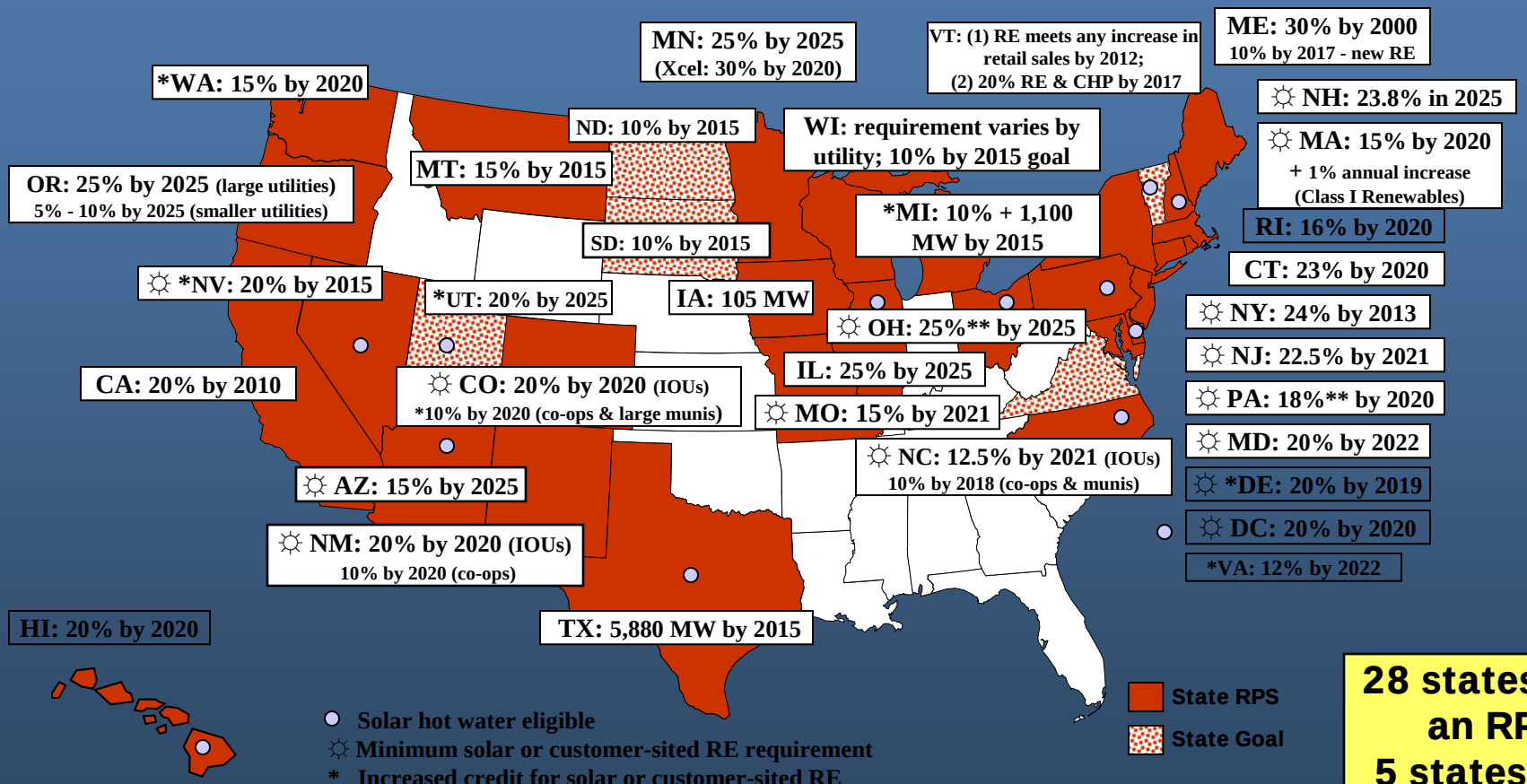




Arkansas
100 m Wind Speed

Note: 70 & 100m maps not validated

Renewables Portfolio Standards



○ Solar hot water eligible
☼ Minimum solar or customer-sited RE requirement
* Increased credit for solar or customer-sited RE
** Includes separate tier of non-renewable "alternative" energy resources

28 states have an RPS; 5 states have an RE goal

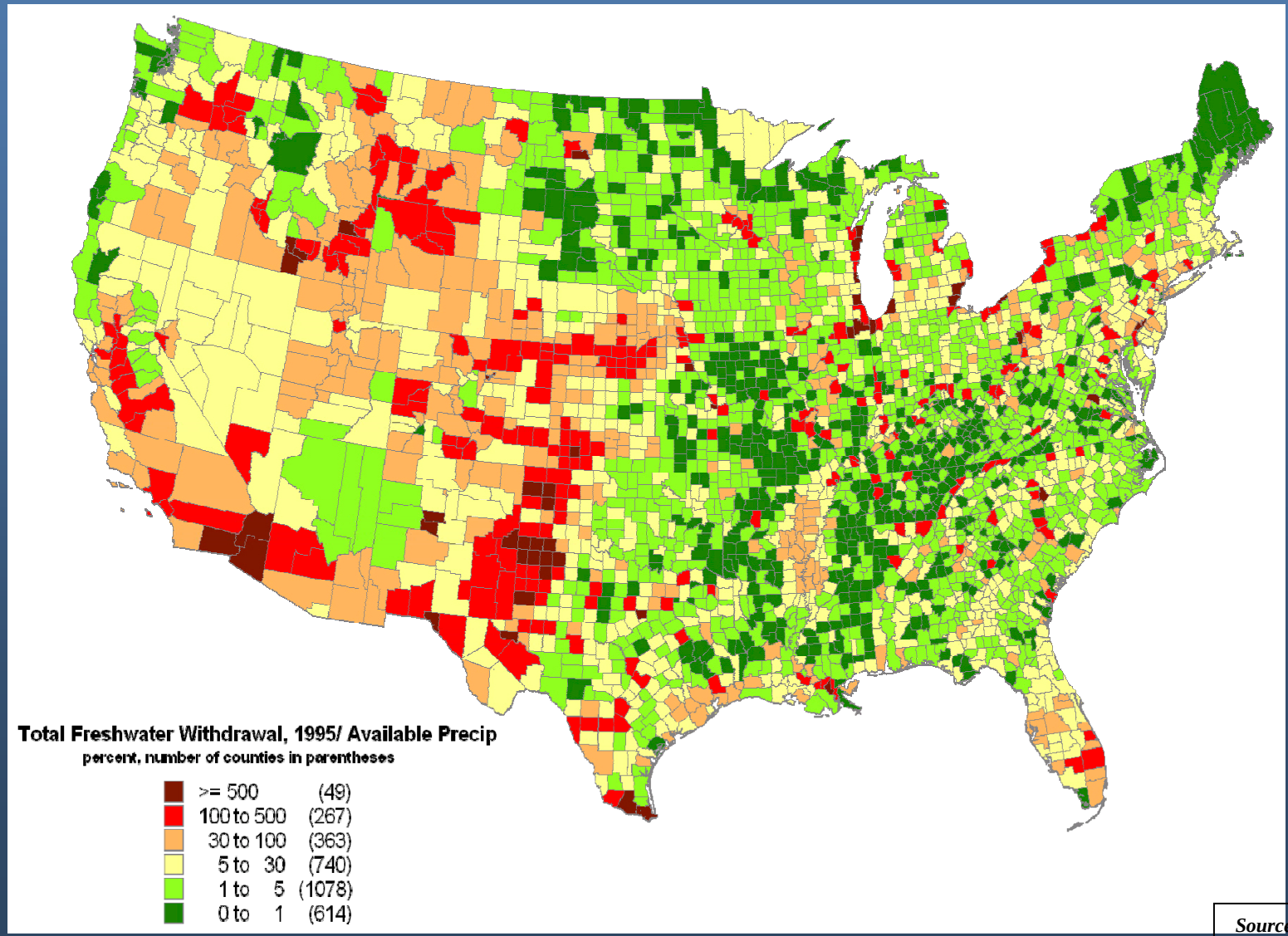
DSIRE: www.dsireusa.org

January 2009

Environmental Benefits

- No SOx or NOx
- No particulates
- No mercury
- No CO2
- No water

Sustainable Withdrawal Of Freshwater Is National Issue



Source: EPRI 2003

Energy-Water Nexus

Key Issues for Wind Power

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

Cost-Based U.S. Operational Impact Studies

Date	Study	Wind Capacity Penetration (%)	Regulation Cost ($/MWh)	Load Following Cost ($/MWh)	Unit Commitment Cost ($/MWh)	Gas Supply Cost ($/MWh)	Tot Oper. Cost Impact ($/MWh)
May '03	Xcel-UWIG	3.5	0	0.41	1.44	na	1.85
Sep '04	Xcel-MNDOC	15	0.23	na	4.37	na	4.60
June '06	CA RPS	4	0.45*	trace	na	na	0.45
Feb '07	GE/Pier/CAIAP	20	0-0.69	trace	na***	na	0-0.69***
June '03	We Energies	4	1.12	0.09	0.69	na	1.90
June '03	We Energies	29	1.02	0.15	1.75	na	2.92
2005	PacifiCorp	20	0	1.6	3.0	na	4.60
April '06	Xcel-PSCo	10	0.20	na	2.26	1.26	3.72
April '06	Xcel-PSCo	15	0.20	na	3.32	1.45	4.97
Dec '08	Xcel-PSCo	20			3.95	1.18	5.13-6.30****
Dec '06	MN 20%	31**					4.41**
Jul '07	APS	14.8	0.37	2.65	1.06	na	4.08

* 3-year average; total is non-market cost

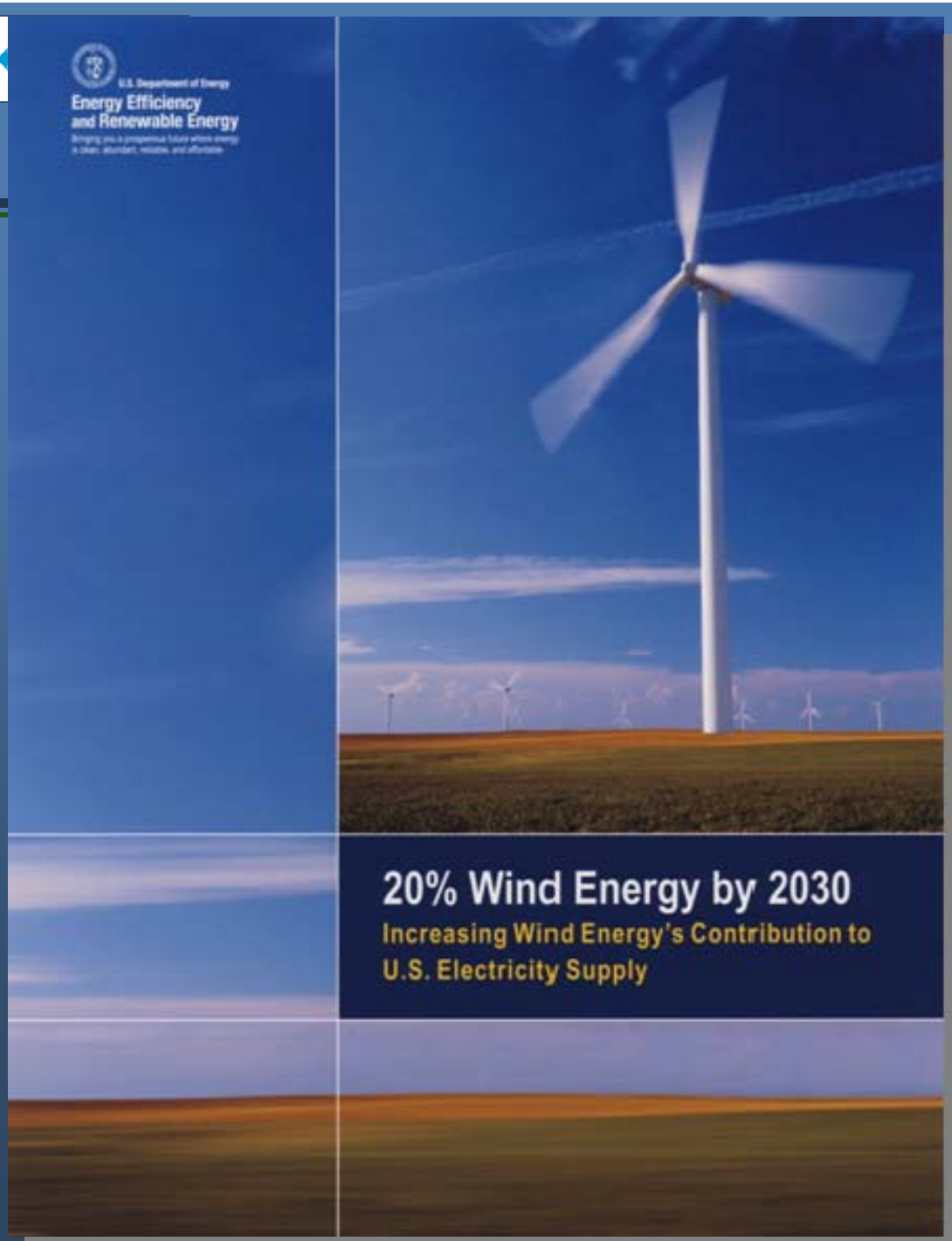
** highest integration cost of 3 years; 30.7% capacity penetration corresponding to 25% energy penetration; 24.7% capacity penetration at 20% energy penetration

*** found $4.37/MWh reduction in UC cost when wind forecasting is used in UC decision

**** Geographically diverse wind and concentrated wind

Factors that Affect Integration Cost

- Price of natural gas
- Geographic concentration of wind
- Mix of non-wind generation (flexibility)
- Size of balancing area
- Wind penetration

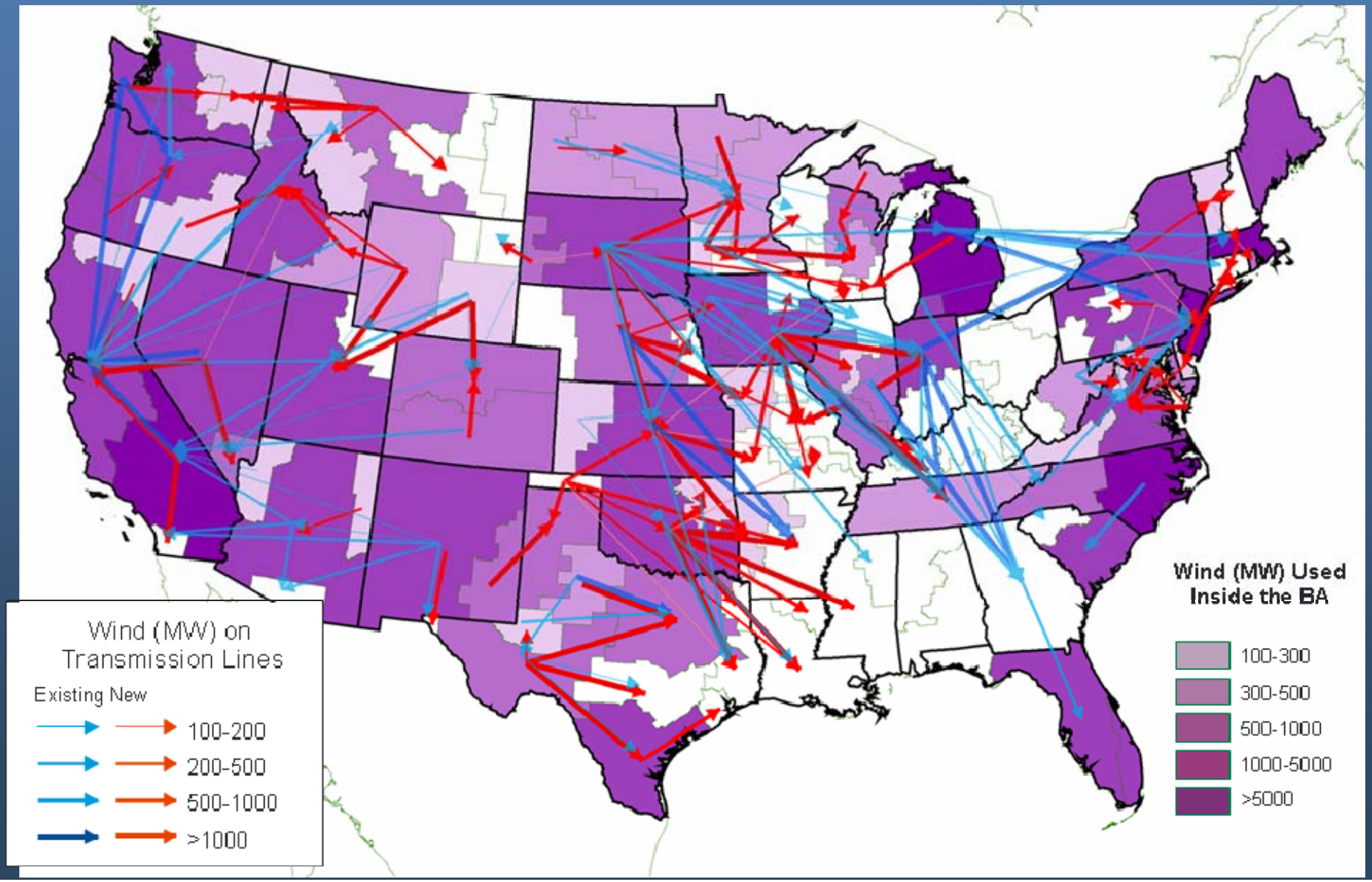


WIND POWERING AMERICA

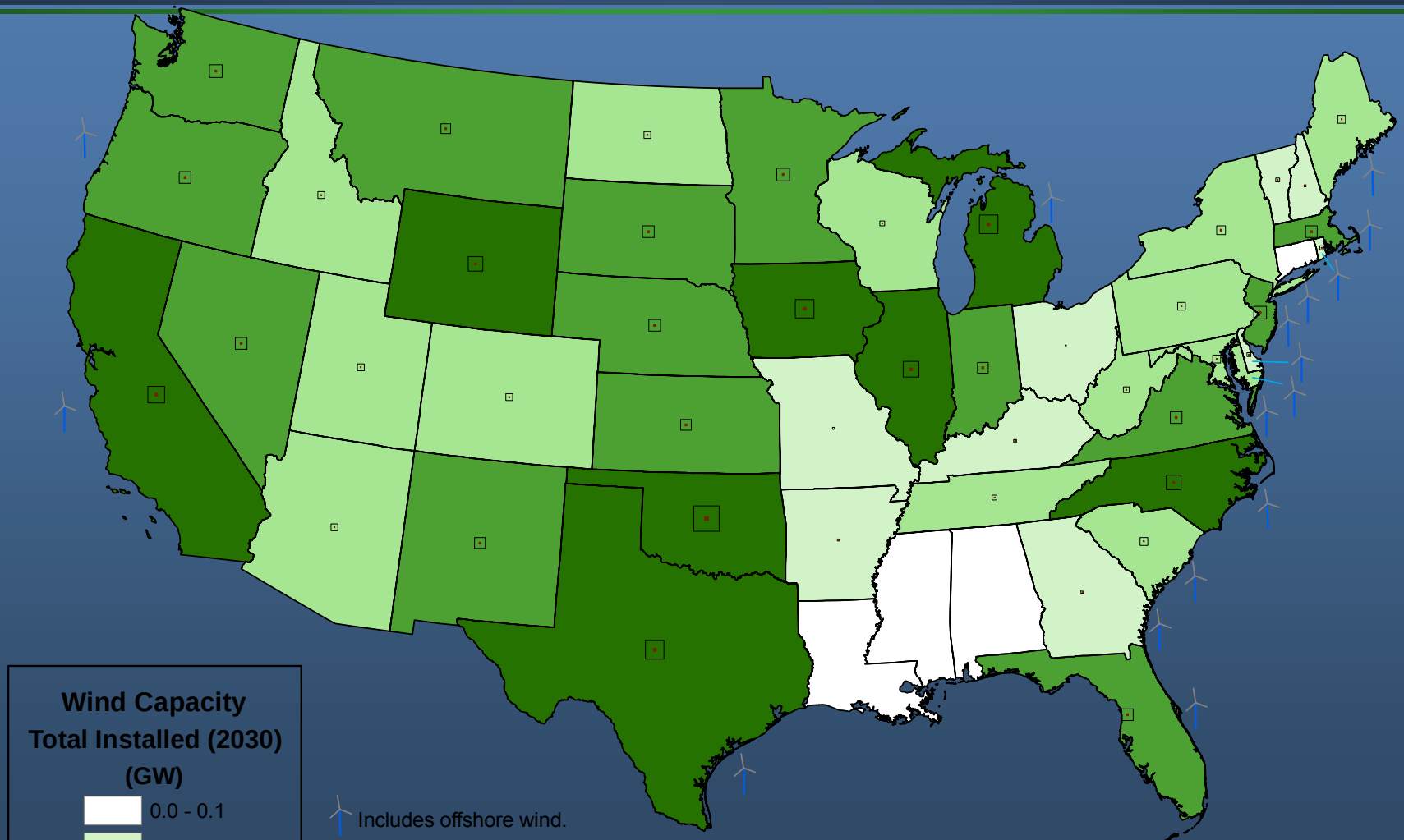
"The future ain't what it used to be."

- Yogi Berra

Need for New Transmission: Existing and New in 2030

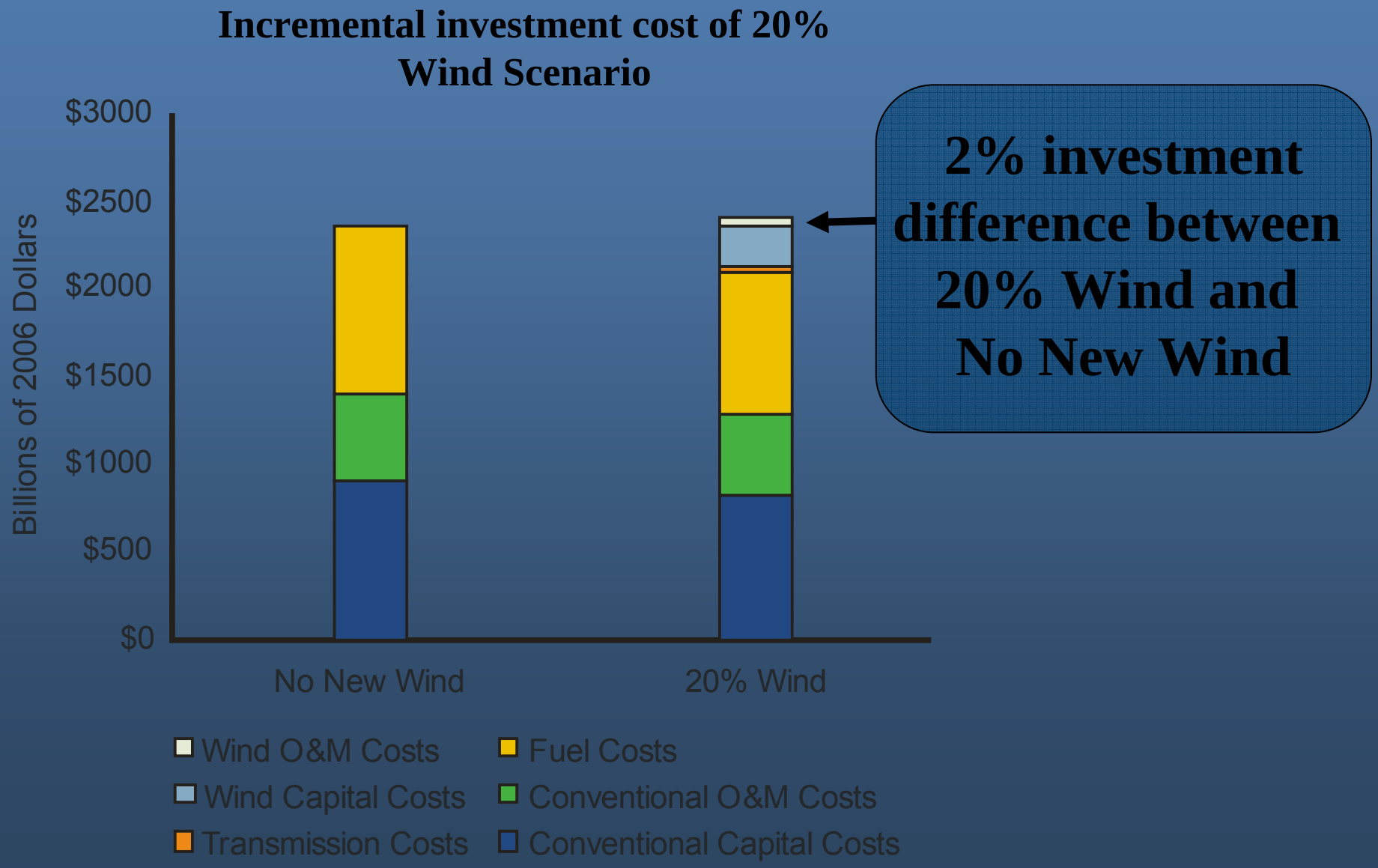


46 States Would Have Substantial Wind Development by 2030



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).

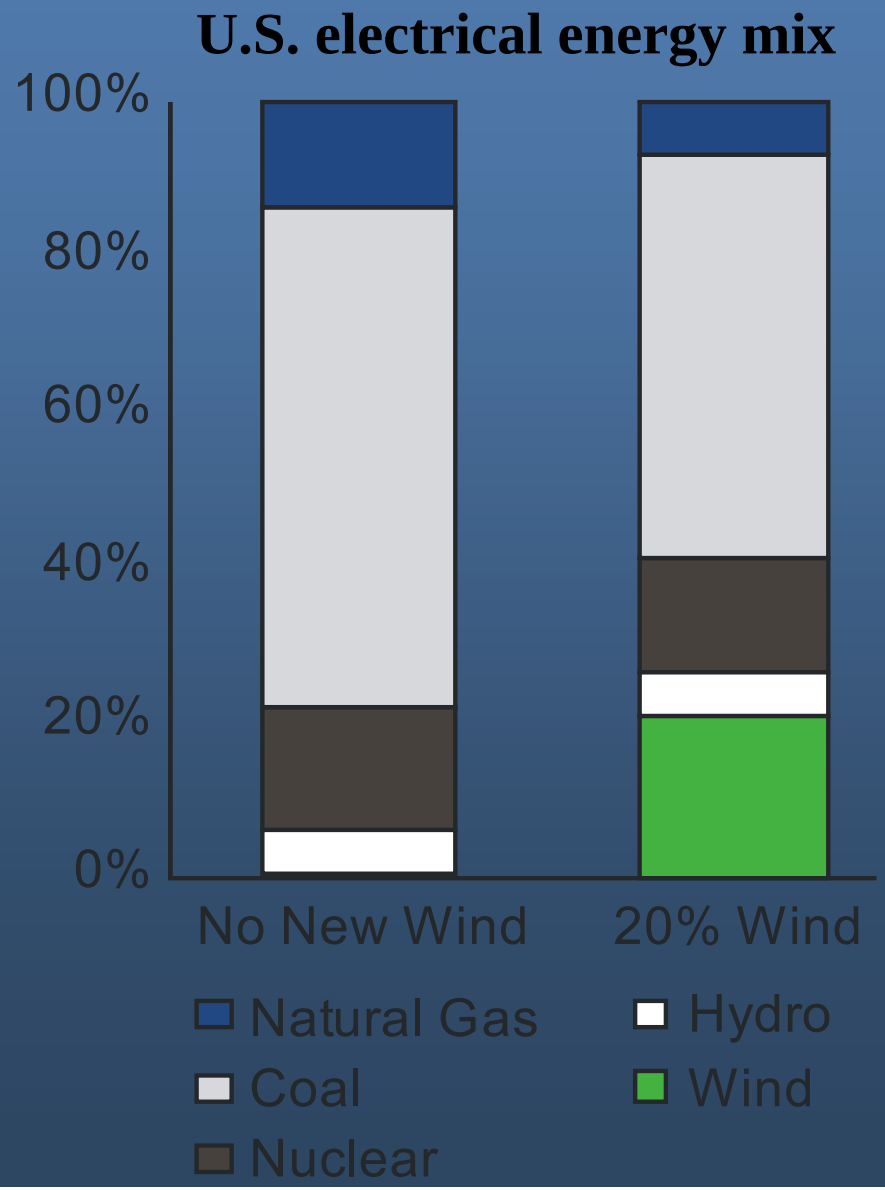
Economic Costs of 20% Wind Scenario



2% investment difference between 20% Wind and No New Wind

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

National (U.S.) – Economic Impacts

Cumulative impacts from 2007-2030

From the 20% Scenario- 300 GW new Onshore and Offshore development

Wind energy's economic "ripple effect"

Direct Impacts

Payments to Landowners:
- $782 M

Local Property Tax Revenue:
- $1,877 M

Construction Phase:
- 1.75 M FTE jobs
- $ 293 B to the US economy

Operations:
- 1.16 M FTE jobs
- $122 B to the US economy

Indirect & Induced Impacts

Construction Phase:
- 4.46 M FTE jobs
- $651 B to the US economy

Operations:
- 2.15 M FTE jobs
- $293 B to the US economy

Totals (construction + 20yrs)

- Total economic benefit = $1,359 billion
- New jobs during construction = 6.2 M FTE jobs
- New operations jobs =3.3 M FTE jobs

All monetary values are in 2006 dollars.
Construction Phase = 1-2 years

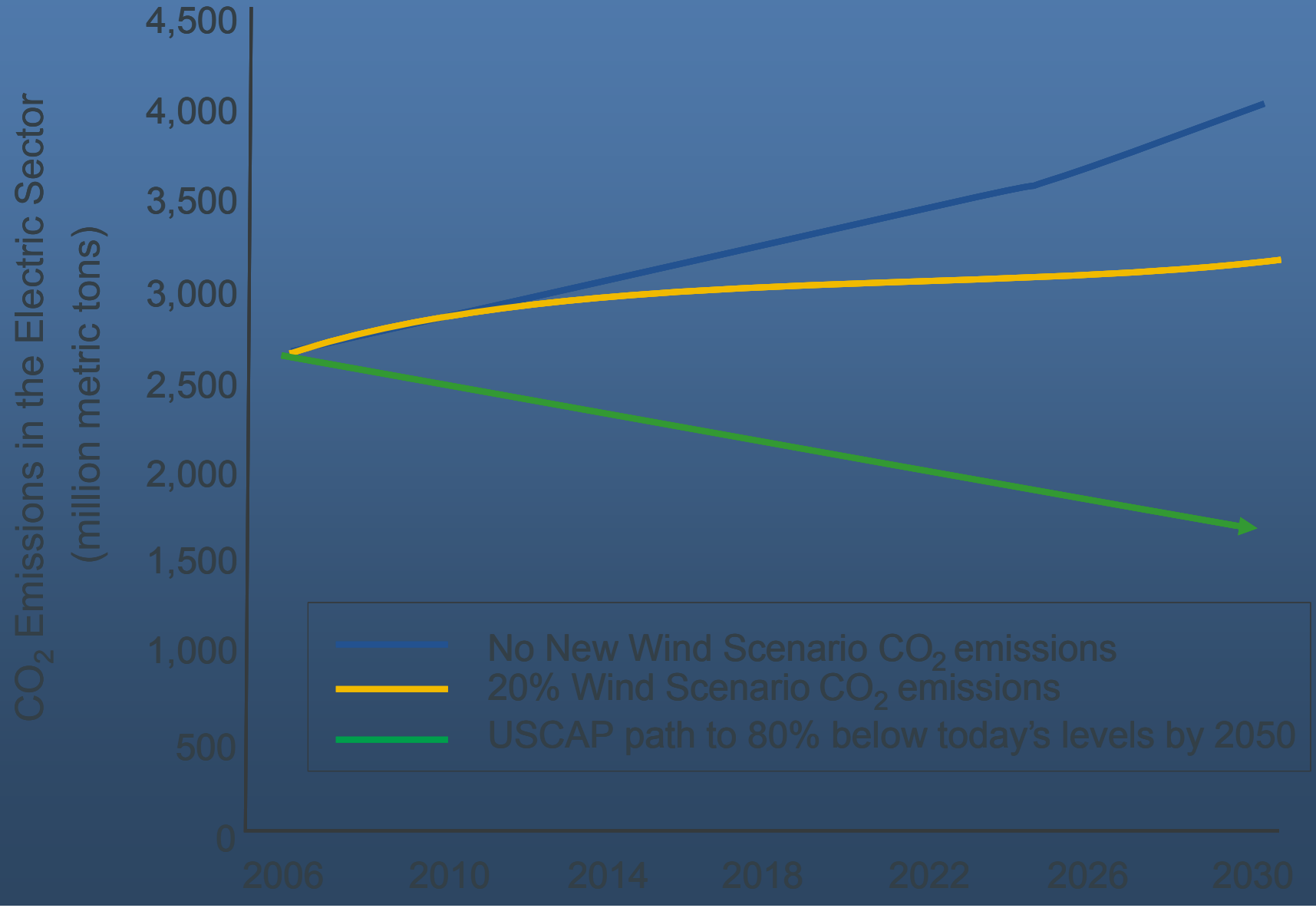
Jobs Supported by the 20% Scenario

Over 500,000 jobs would be supported between 2007 and 2030

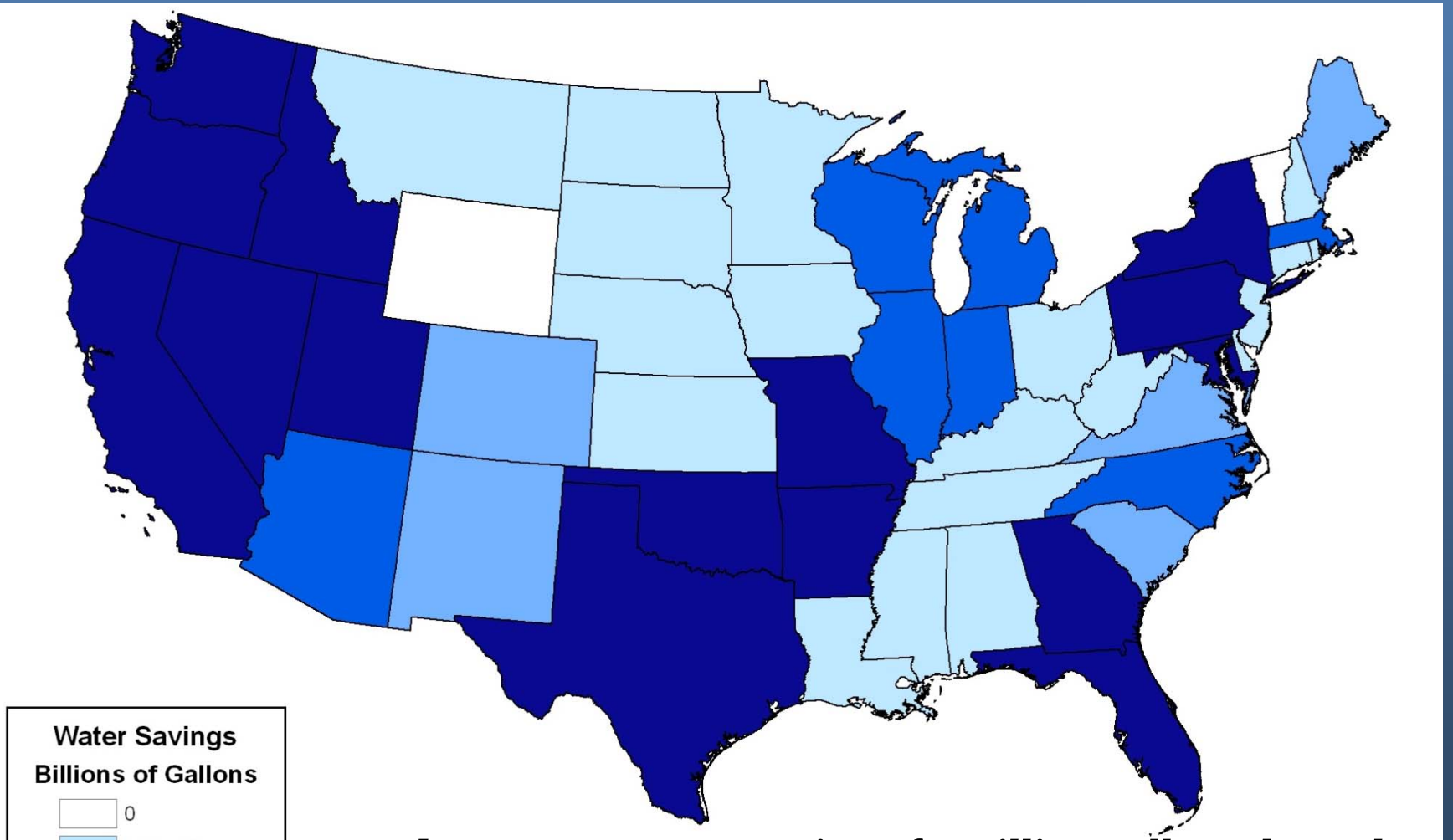
Over 500,000 jobs supported by the industry in 2030

Approx. 180,000 directly employed by wind

CO2 Emissions from the Electricity Sector



Cumulative Water Savings from 20% Scenario

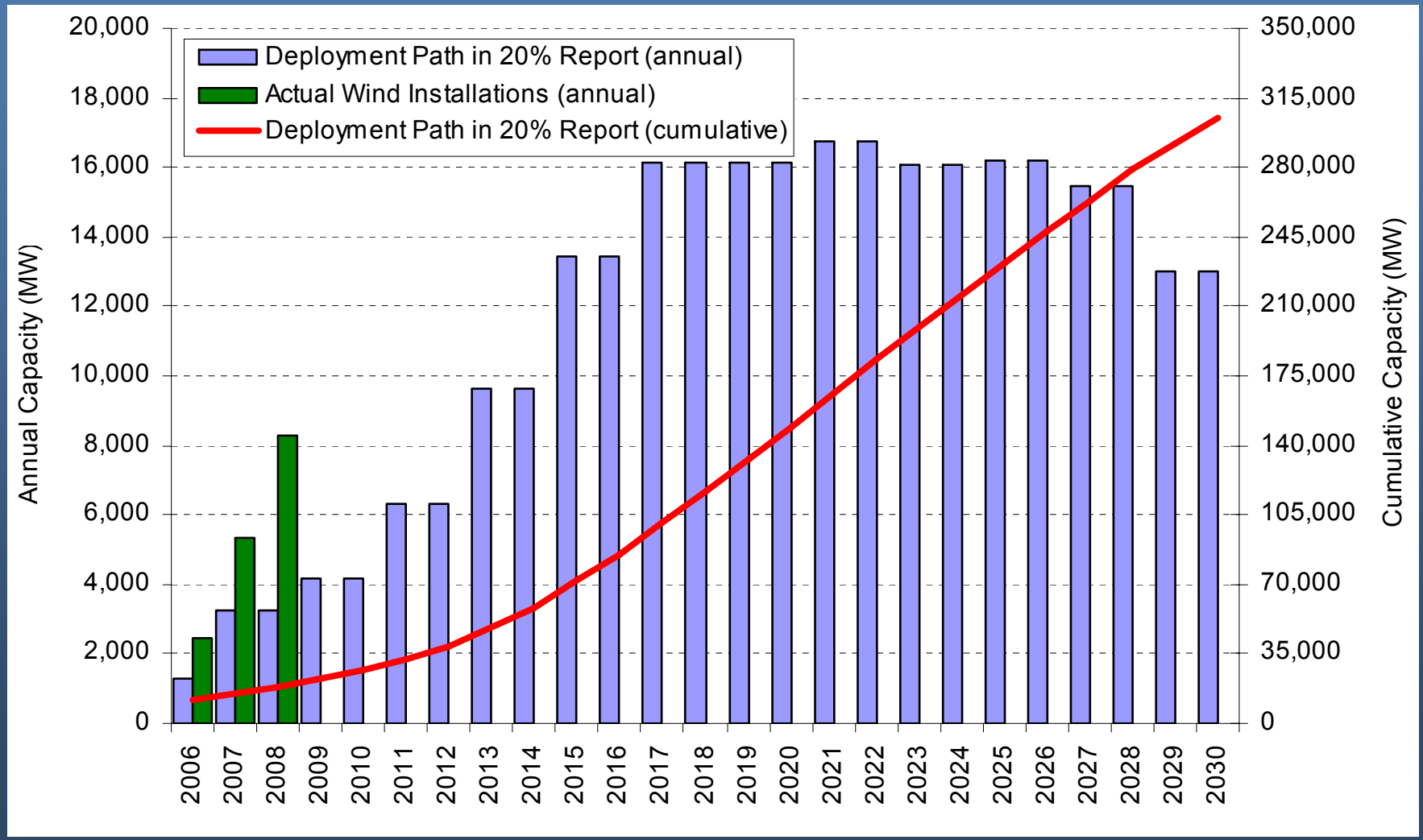


Reduces water consumption of 4 trillion gallons through 2030 (represents a reduction in electric sector water consumption by 17% in 2030)

Results: Costs & Benefits

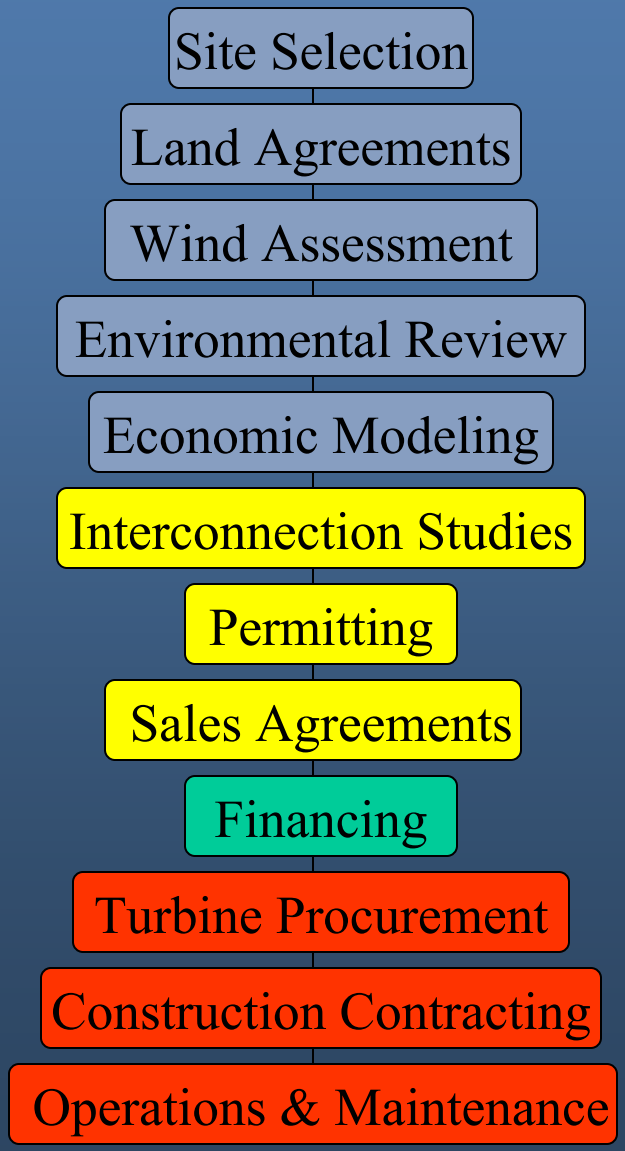
Incremental direct cost to society	**$43 billion**
Reductions in emissions of greenhouse gasses and other atmospheric pollutants	825 M tons (2030) **$98 billion**
Reductions in water consumption	8% total electric 17% in 2030
Jobs created and other economic benefits	140,000 direct $450 billion total
Reductions in natural gas use and price pressure	11% **$150 billion**
Net Benefits: $205B + Water savings	

Progress Toward 20% Wind



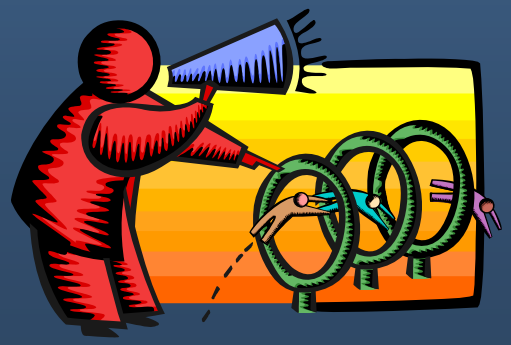
2008 Wind Market Report; LBL

The Wind Project Development Process



Steps to Implement a Small Wind Project

1. Assess your electricity consumption, cost, and utility tariff
2. Wind resource & micro-siting
3. Select turbine size (model) and tower height
4. Incentives & economics
5. Zoning (including neighbor notification)
6. Utility interconnection agreement
7. Building permit
8. Order turbine and tower
9. Installation
10. Commissioning



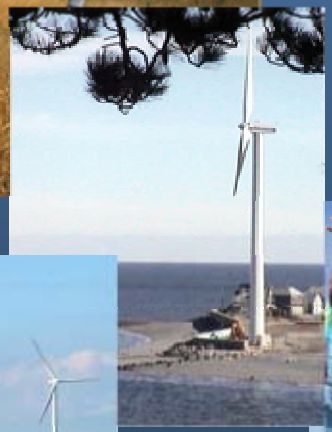
Wind Stakeholders

Carpe Ventem

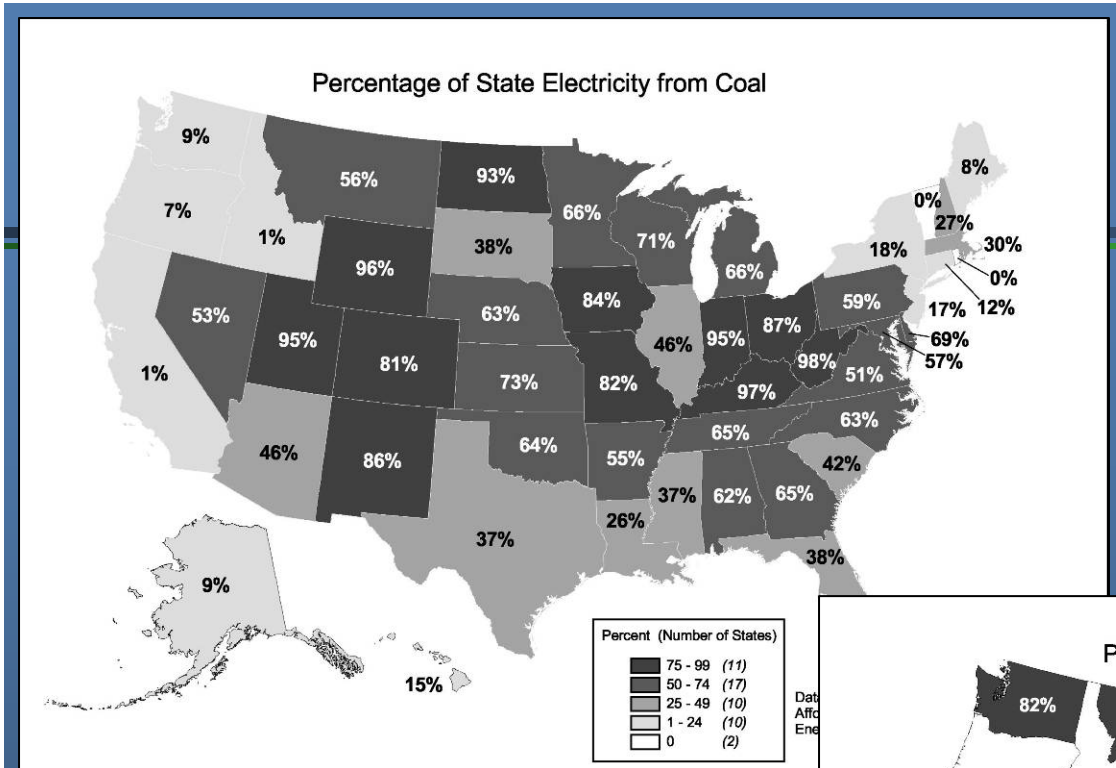


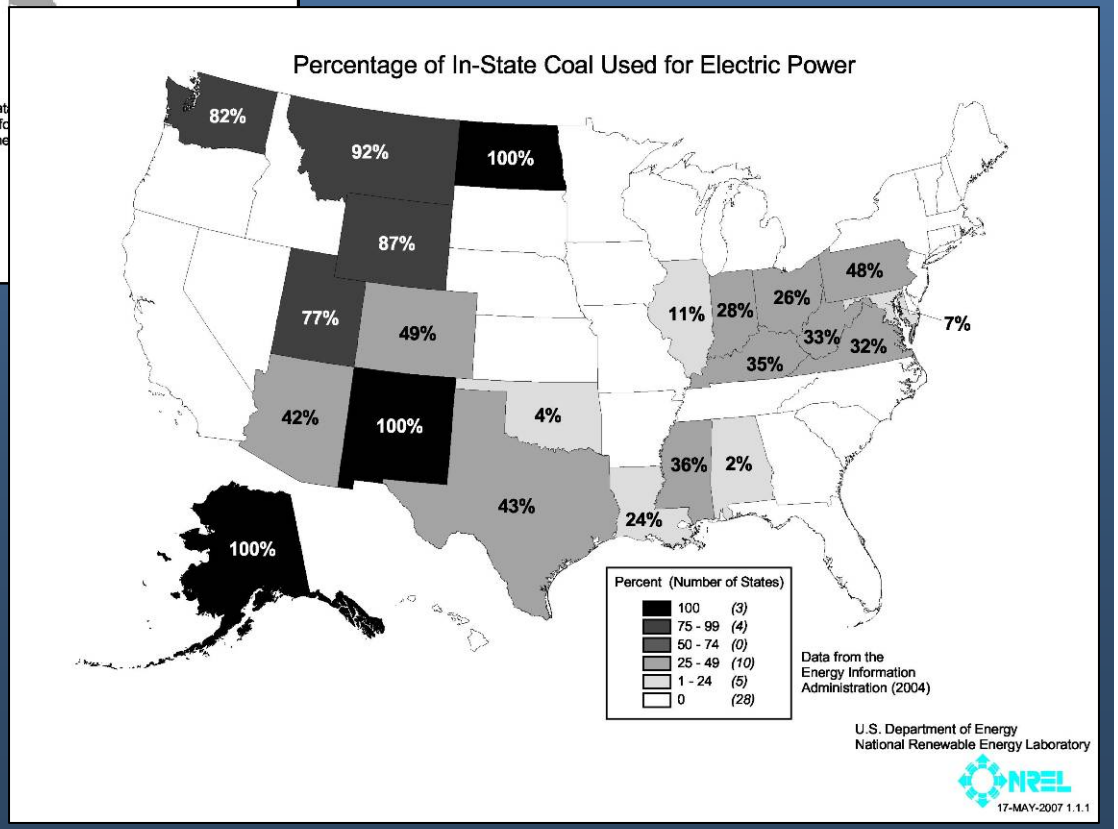




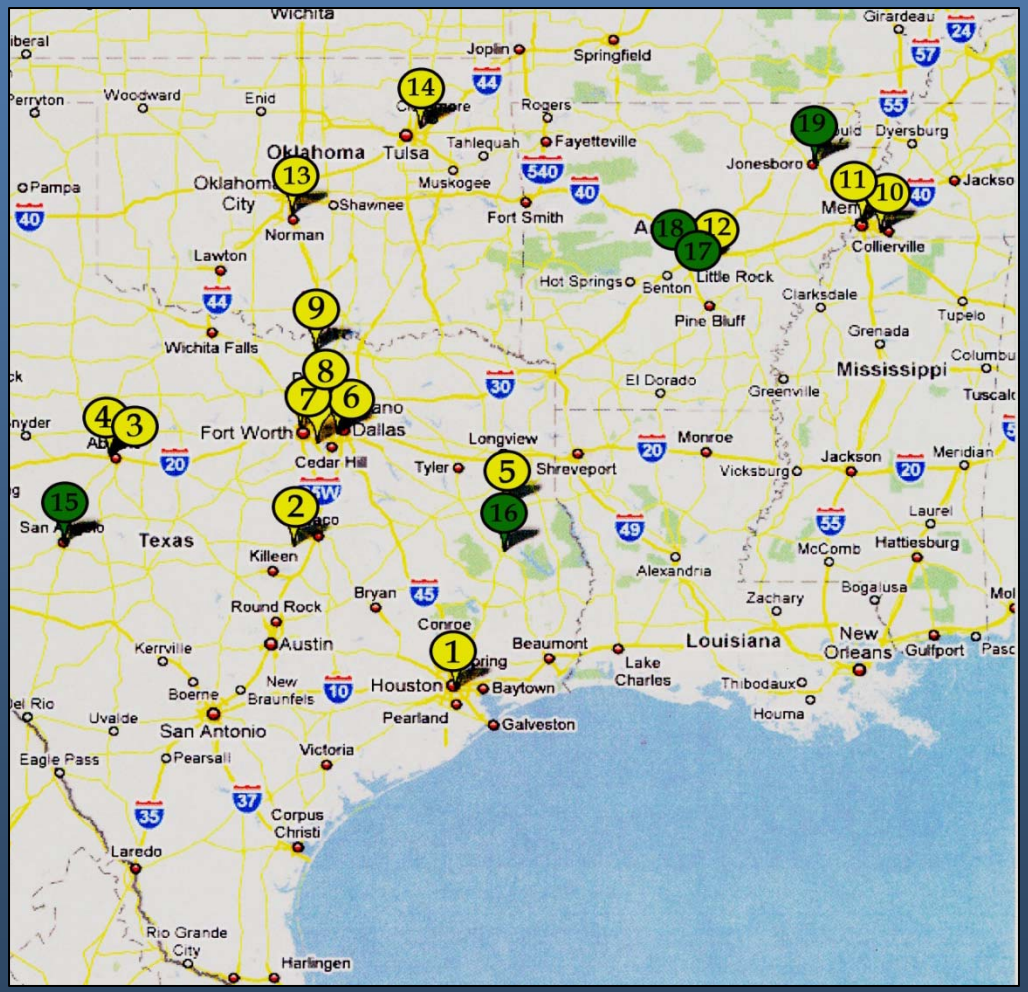




www.windpoweringamerica.gov


Percentage of State Electricity from Coal
9%
56%
93%
66%
8%
7%
0%
27%
1%
38%
71%
18%
30%
96%
66%
0%
53%
84%
59%
17%
12%
95%
63%
87%
46%
95%
69%
81%
98%
57%
1%
73%
82%
51%
97%
63%
46%
86%
64%
55%
65%
42%
37%
62%
65%
26%
37%
38%
9%
15%
Percent (Number of States)
75 - 99 (11)
50 - 74 (17)
25 - 49 (10)
1 - 24 (10)
0 (2)


Percentage of In-State Coal Used for Electric Power
82%
92%
100%
87%
48%
11%
28%
26%
7%
77%
49%
33%
32%
35%
42%
100%
4%
36%
2%
43%
24%
100%
Percent (Number of States)
100 (3)
75 - 99 (4)
50 - 74 (0)
25 - 49 (10)
1 - 24 (5)
0 (28)
Data from the Energy Information Administration (2004)
U.S. Department of Energy
National Renewable Energy Laboratory
NREL
17-MAY-2007 1.1.1

Arkansas and Surrounding States
Wind-Related Economic Development: Manufacturing



Opened and Announced
Wind Turbine Component Manufacturers
Located In Arkansas or Surrounding States

1) RBC Bearings
2) RTLC Wind Towers
3) Zoltek
4) Tower Tech
5) CAB Inc
6) Diab Inc
7) Trinity Structural Towers
8) All-Pro Fasteners
9) Molded Fiber Glass
10) Thomas & Betts
11) GE Parts Operation Center
12) LM Glasfiber
13) Bergey Wind
14) DMI
15) Martifier
16) Lufkin Industries
17) Polymarin
18) Wind Water Technology
19) Nordex

LM Glasfiber
Little Rock, AR
Blades

- At the end of 2008, LM Glasfiber Little Rock employed ~ 600 people and were ahead of pace in their hiring of 1,000 workers by 2014.
- In January, 2009 LM Glasfiber announced that they were laying off 150 workers at Little Rock due to the national credit crisis.
- In June, 2009 the company announced that they will be laying off an additional 80 workers.

- The company still employs ~ 300 workers.
- Wages at the plant range from $12.15/hr - $15.50/hr.

Nordex
Jonesboro, AR
Turbines

- Announced in October, 2008.
- Expected to employ 700 people at an average wage of $17/hr by 2012.
- Construction on the facility was expected to begin in July, 2009.
- Production is expected to start by 2010.
- The facility is expected to have an annual capacity of 750 MW.

- The Jonesboro facility will focus on manufacturing of the N90 (2.3/2.5 MW) and N100 (2.5 MW) turbines.

Polymarin / Wind Water Technologies

Little Rock, AR

Blades / Nacelles

- Announced in October, 2008.
- Polymarin is a subsidiary of Emergya Wind Technologies. They will manufacture blades and are expected to employ 630 people at an average wage of $15/hr by 2012.
- Wind Water Technologies is a supplier to Emergya Wind Technologies. They will manufacture nacelles and are expected to employ an additional 200 people at an average wage of $15/hr by 2012.
- Both companies will be moving into a former Levi Strauss distribution center.
- The start date for production has been delayed due to the national credit crisis and equipment issues.
- Currently ~ 4 people are working at the site.

Diab Inc

Desoto, TX
Cores for Blades

- Employs ~175 workers.
- Has manufactured cores for blades since 1997.
- Wind-related components = approximately 40% of all production.
- ~ 30 individuals work on manufacturing custom kits for wind energy industry.

- Average wage for employees is ~ $13/hr.

DMI Industries
Tulsa, OK
Towers

- Facility opened March 2008.
- Prior to the national economic downturn, DMI had announced plans to expand the Tulsa facility.
- In January 2009, the company announced that it would be laying off 50 workers.
- The company still employs ~215 workers.

- The 500,000 sq ft facility was originally built for Griffin Wheel, a railcar manufacturer that never moved in.

RTLC Windtowers Inc
McGregor, TX
Towers

- In February, 2008, RTLC Industries Inc. announced that they were creating a new subsidiary that will manufacture wind towers.
- The plant will start with 75 workers, but has the potential to expand to 400.
- The facility was expected to be operational in January, 2009.
- The plant is expected to produce 200-400 towers per year.
- According to reports, the city of McGregor agreed to put in rail lines and sold the land to RTLC at a discount, based on the number of expected jobs.

Bergey Wind Power
Norman, OK
Turbines

- The company was founded in 1977.
- The Norman facility employs 42 people.
- The company manufactures ~ 1 large turbine per day.

- The company moved into a former beer distribution plant in August 2005.
- The new facility tripled Bergey's manufacturing capacity.

Tower Tech Systems
Abilene, TX
Towers

- Held a ribbon-cutting ceremony on June 9, 2009.
- The 146,000 sq ft facility was built on a 42-acre site, allowing for 20 acres of storage.
- ~ 120 people currently work at the facility with the potential of an additional 30 being hired.
- According to reports, the Development Corporation of Abilene provided ~ $4.7 million in incentives.
- According to reports, 70% of the jobs will pay between $40,000-$50,000 per year.

RBC Bearings
Houston, TX
Bearings

- RBC announced in October, 2008 that they would had selected Houston, TX to locate their new manufacturing facility that will make slewing ring bearings for the wind industry.
- The 80,000 sq ft plant was scheduled to be operational in May, 2009.