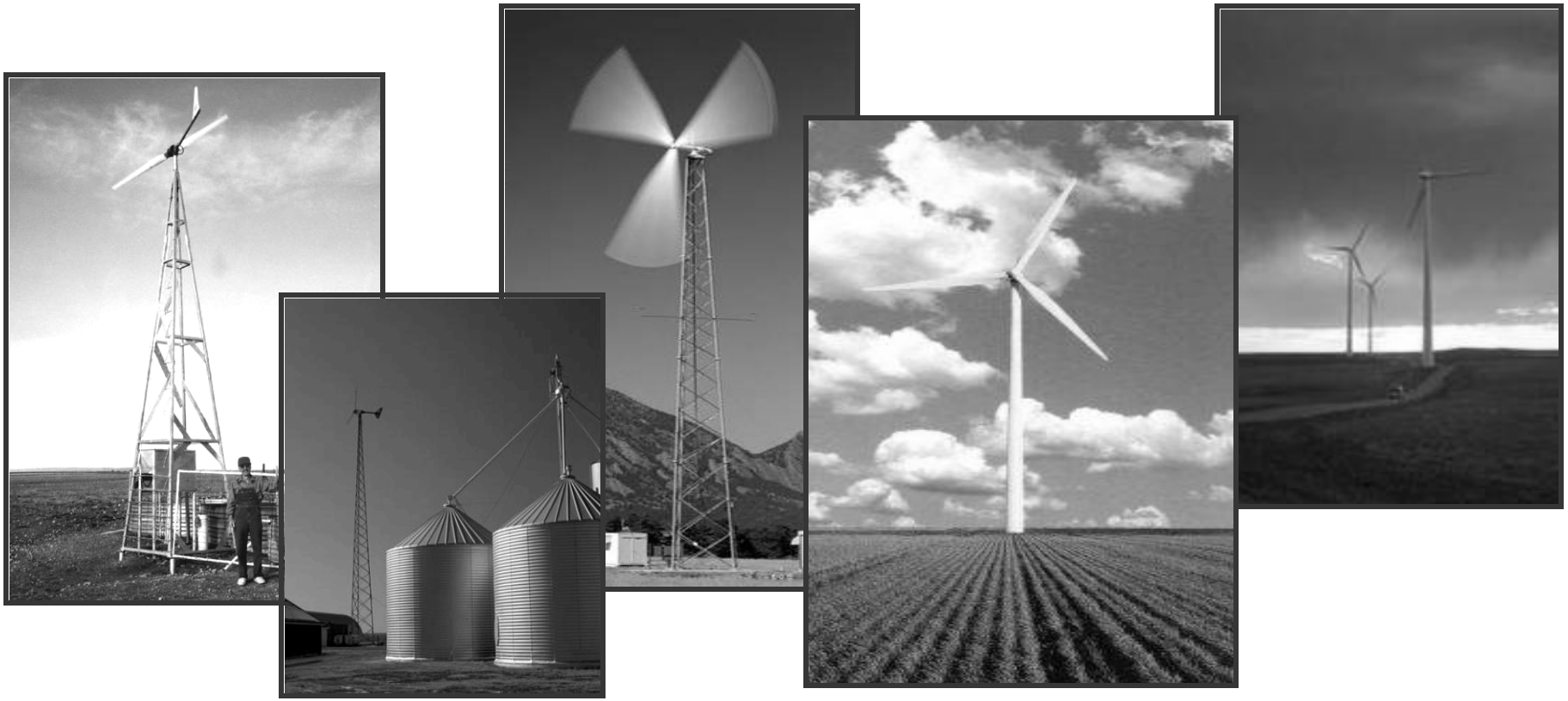
Wind Power in America: The Green Energy Land Use Issue.



Ronald H. Rosenberg
William & Mary Law School
Rocky Mountain Land Use Institute

United Nations IPCC Report
February, 2007

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.
- The understanding of [human caused] warming and cooling influences on climate has improved since [the prior assessment], leading to very high confidence that the globally averaged net effect of human activities since 1750 has been one of warming....

U.S. Electricity Comes From …

- Coal – 50%
- Natural Gas and Petroleum – 21.7%
- Nuclear – 19.3%
- All Renewable Sources – 10%

How to Reduce Greenhouse Gases and Reduce Oil Imports? Two Answers:

A. Become more energy efficient and

B. Diversify the supply of electricity.

Questions for the Day:

- How should we diversify our supply of electricity?
- Can wind power help?
- What steps need to be taken to make renewable energy a reality?

Dutch Water Pumping

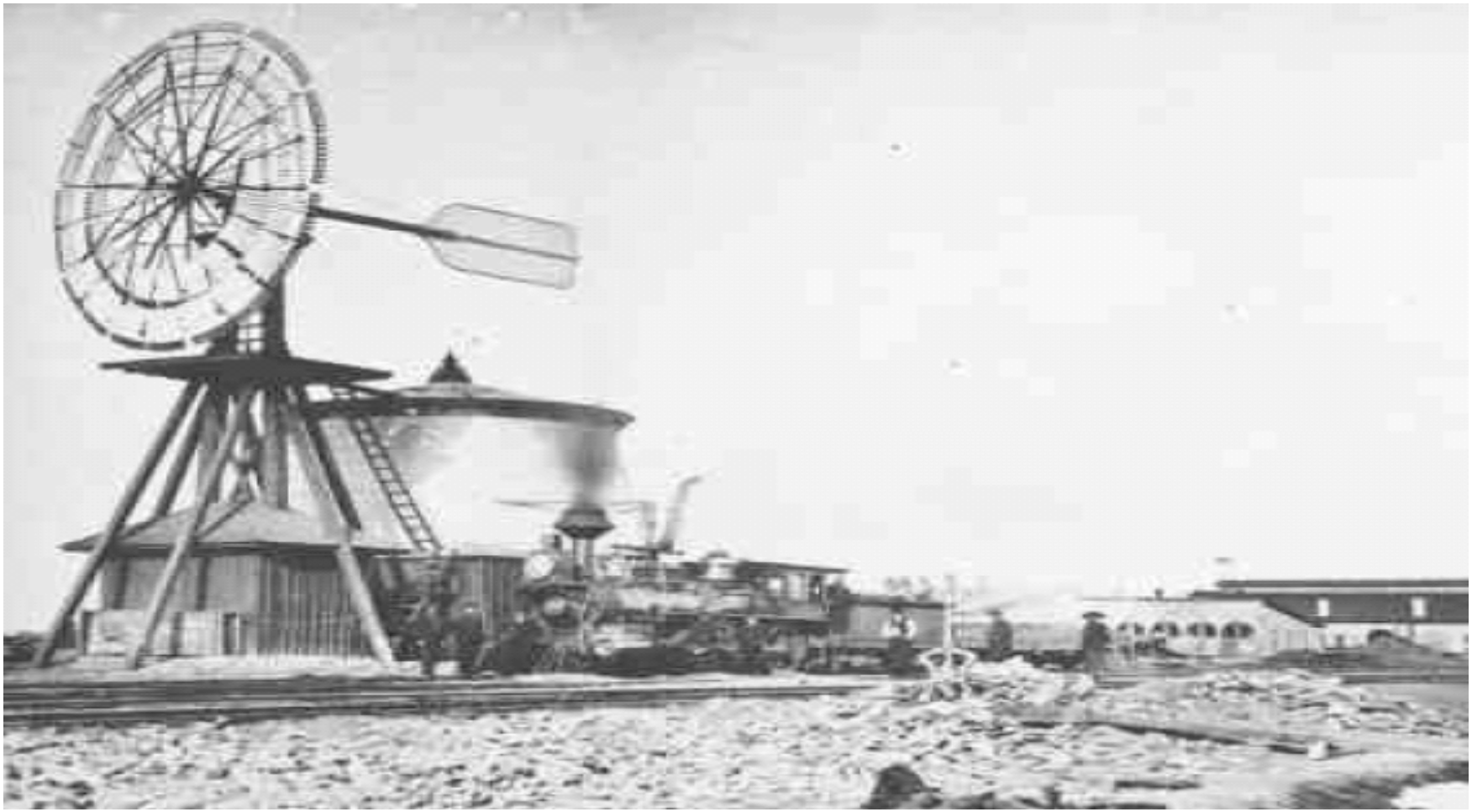
Rembrandt – “The Mill” (1650)

The Miller and the Windmill

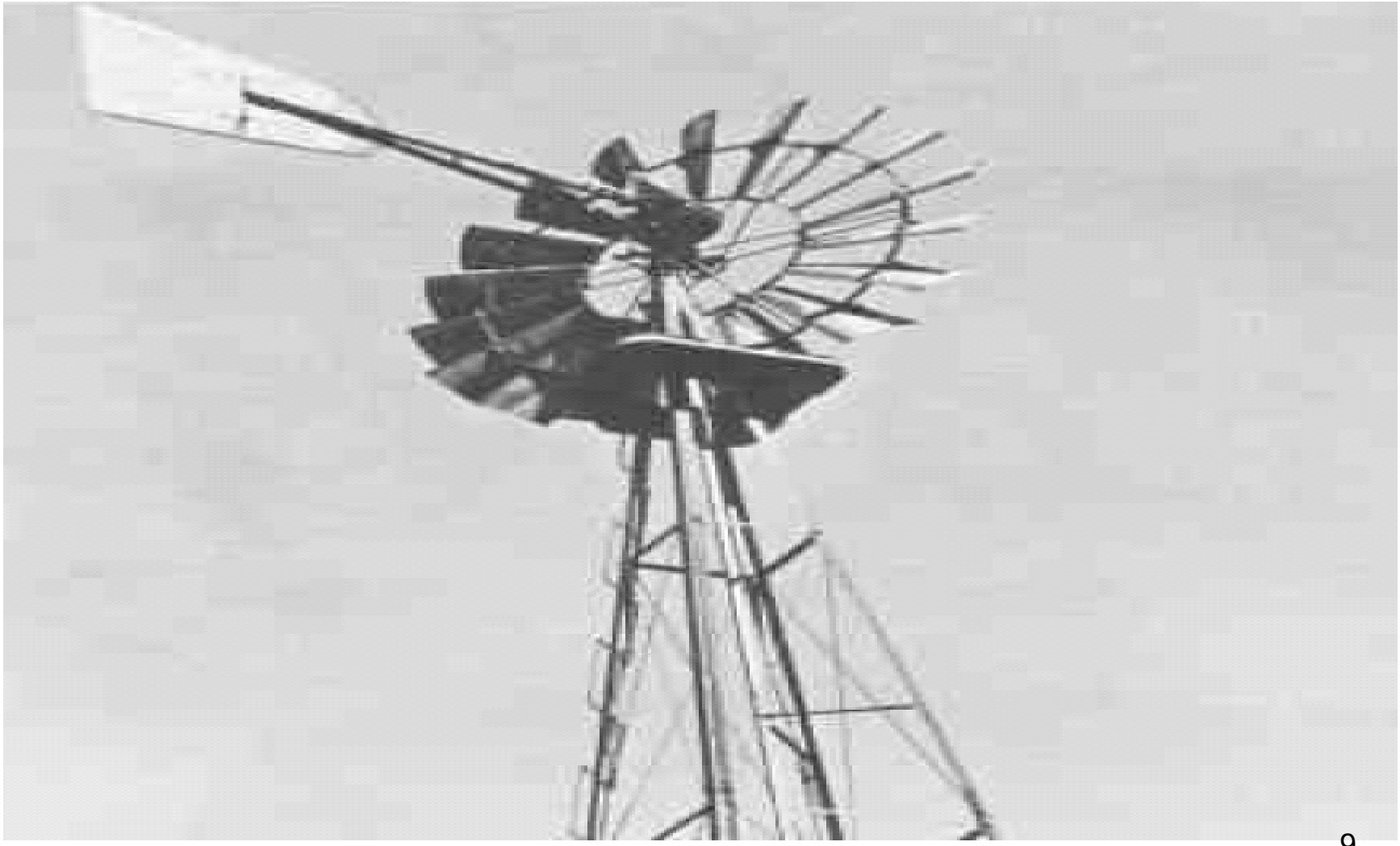
Colonial Williamsburg

Robertson's windmill, located in Colonial Williamsburg's Historic Area, is an example of a post mill, which can be turned to face the direction of the wind.

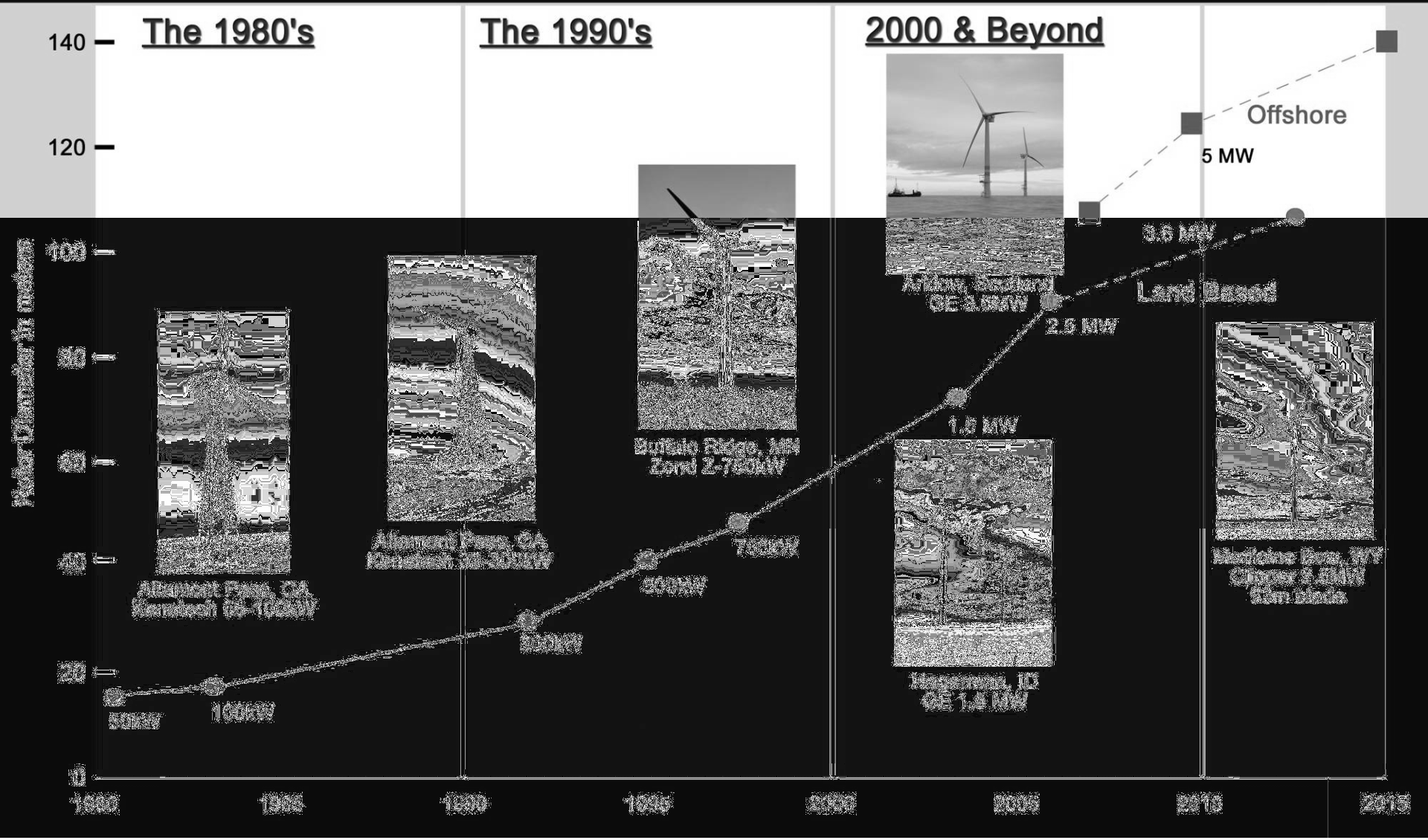
Water Pumping for Railroads



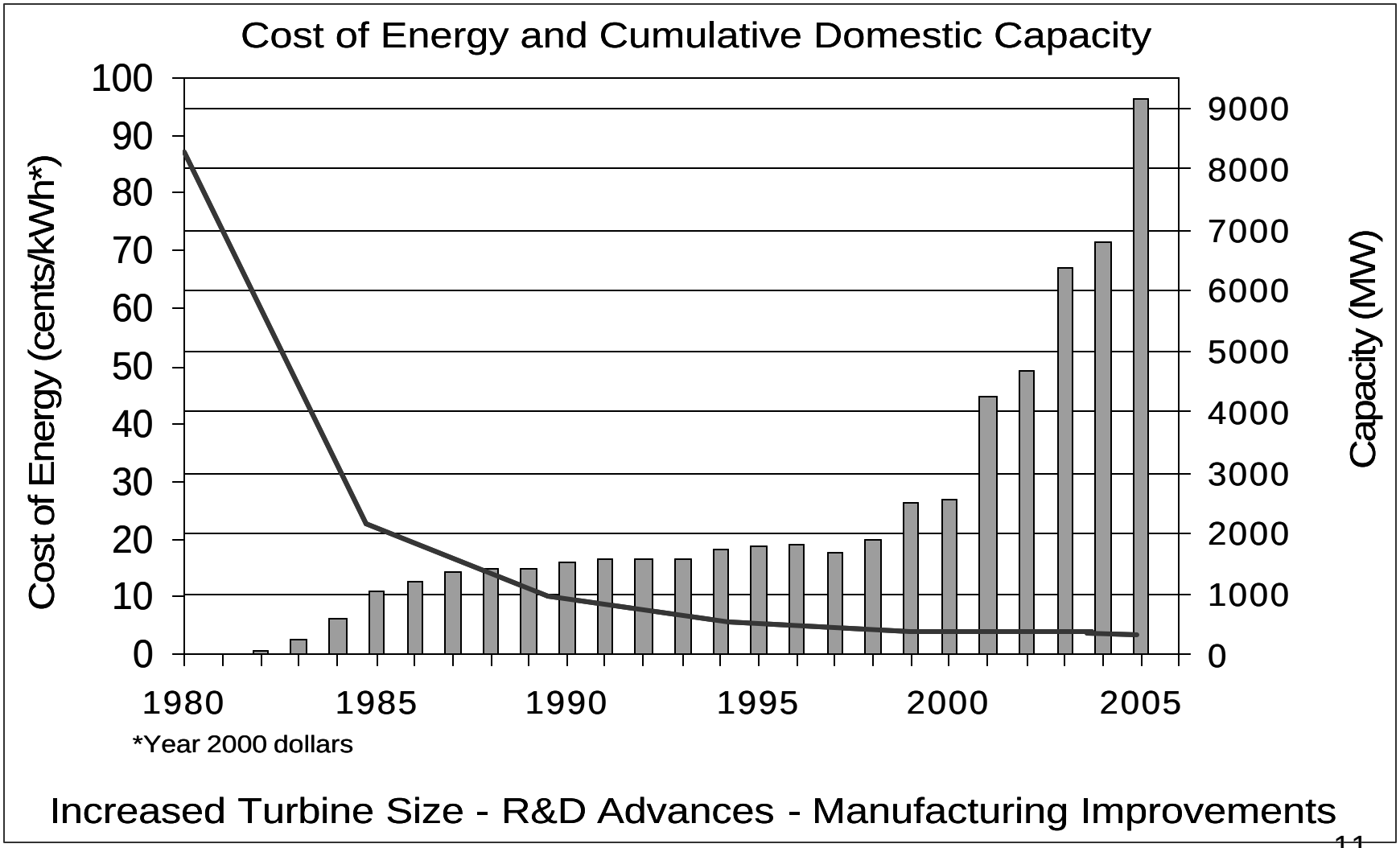
Farm Water Pumping on the Great Plains



Evolution of U.S. Commercial Wind Technology



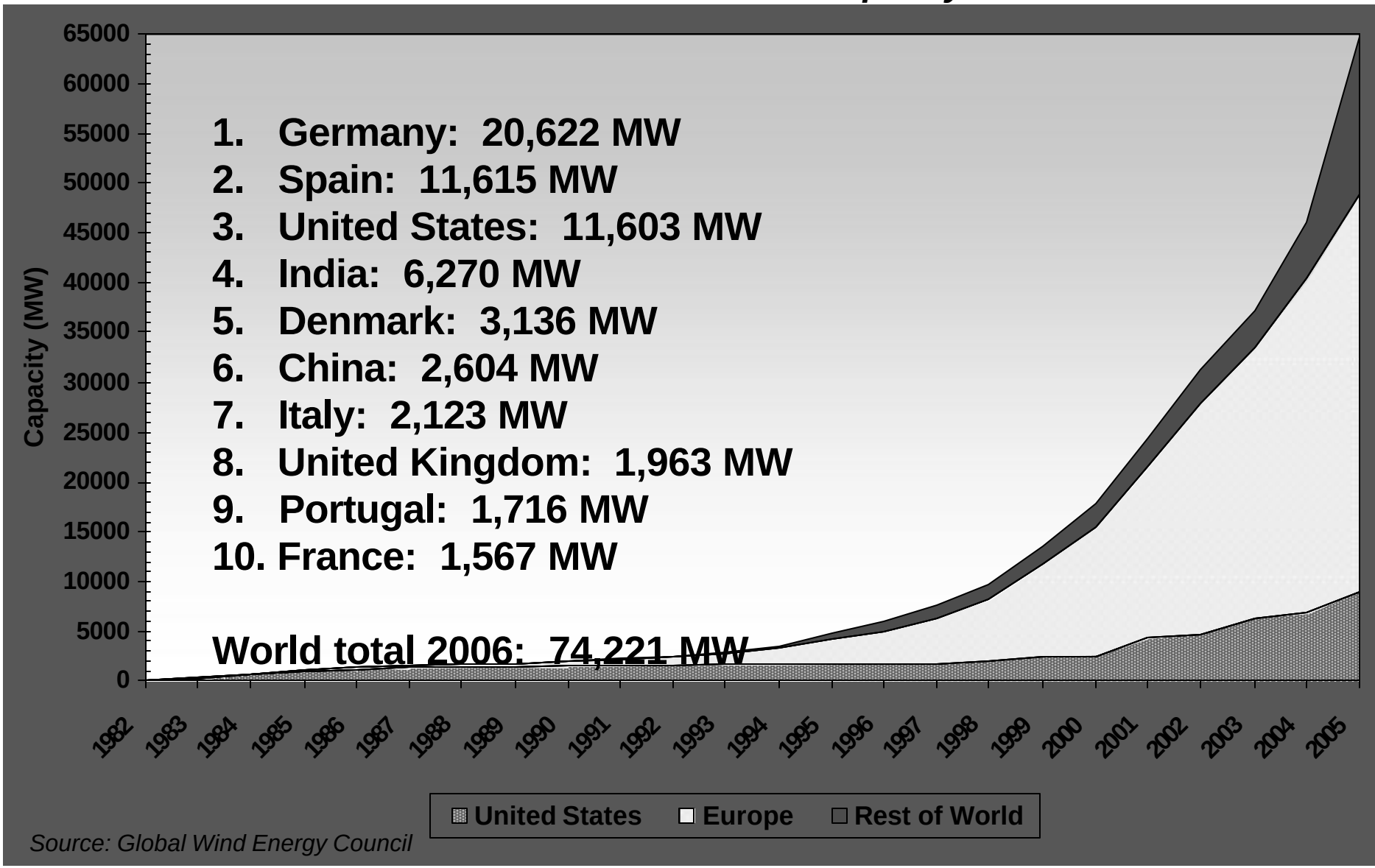
Capacity & Cost Trends



Increased Turbine Size - R&D Advances - Manufacturing Improvements

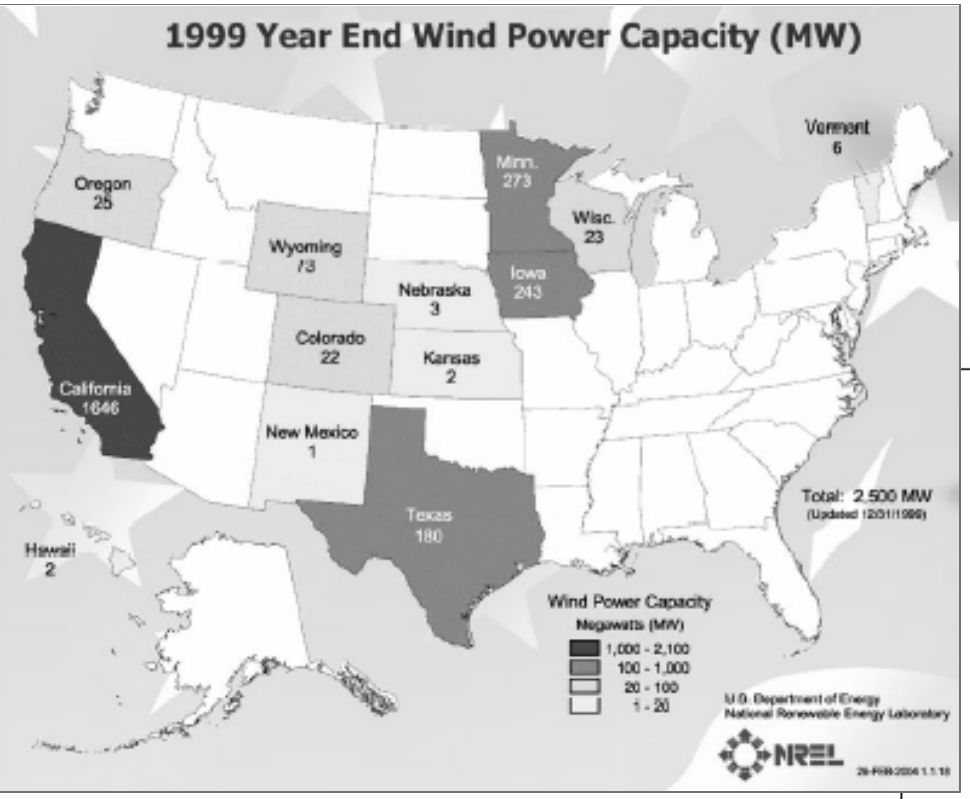
Wind Power Worldwide

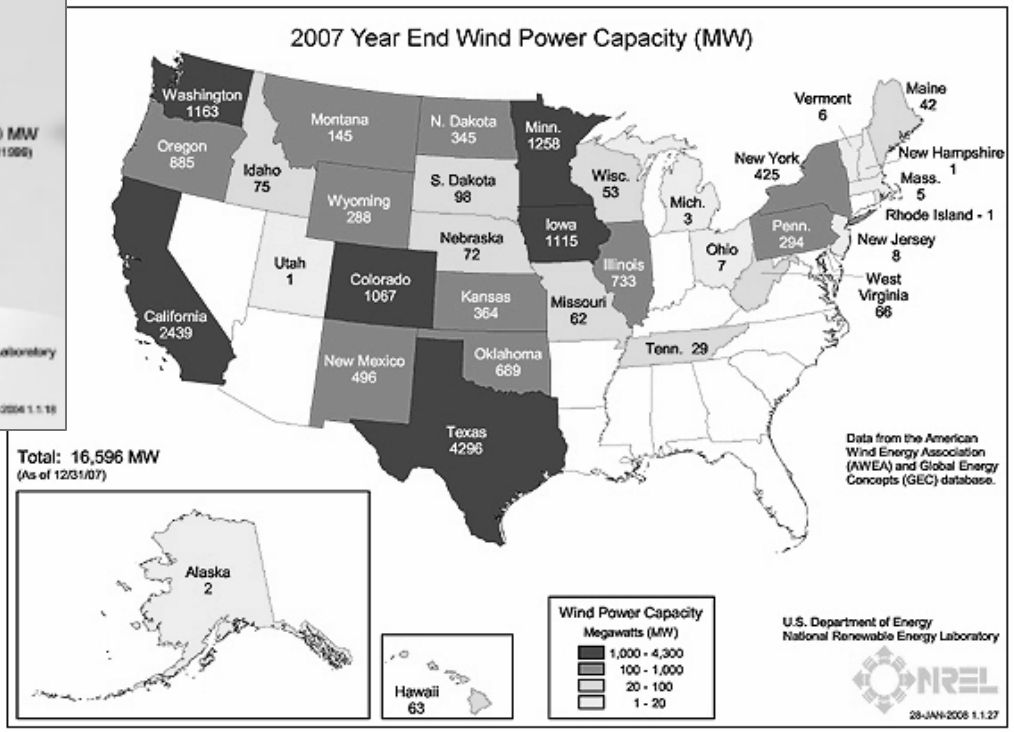
Total Installed Wind Capacity



Source: Global Wind Energy Council

Wind Power in America
1999-2006





The Top 20 States

for wind energy potential, as measured by annual energy potential in the billions of kWhs, factoring in environmental and land use exclusions for wind class of 3 and higher.

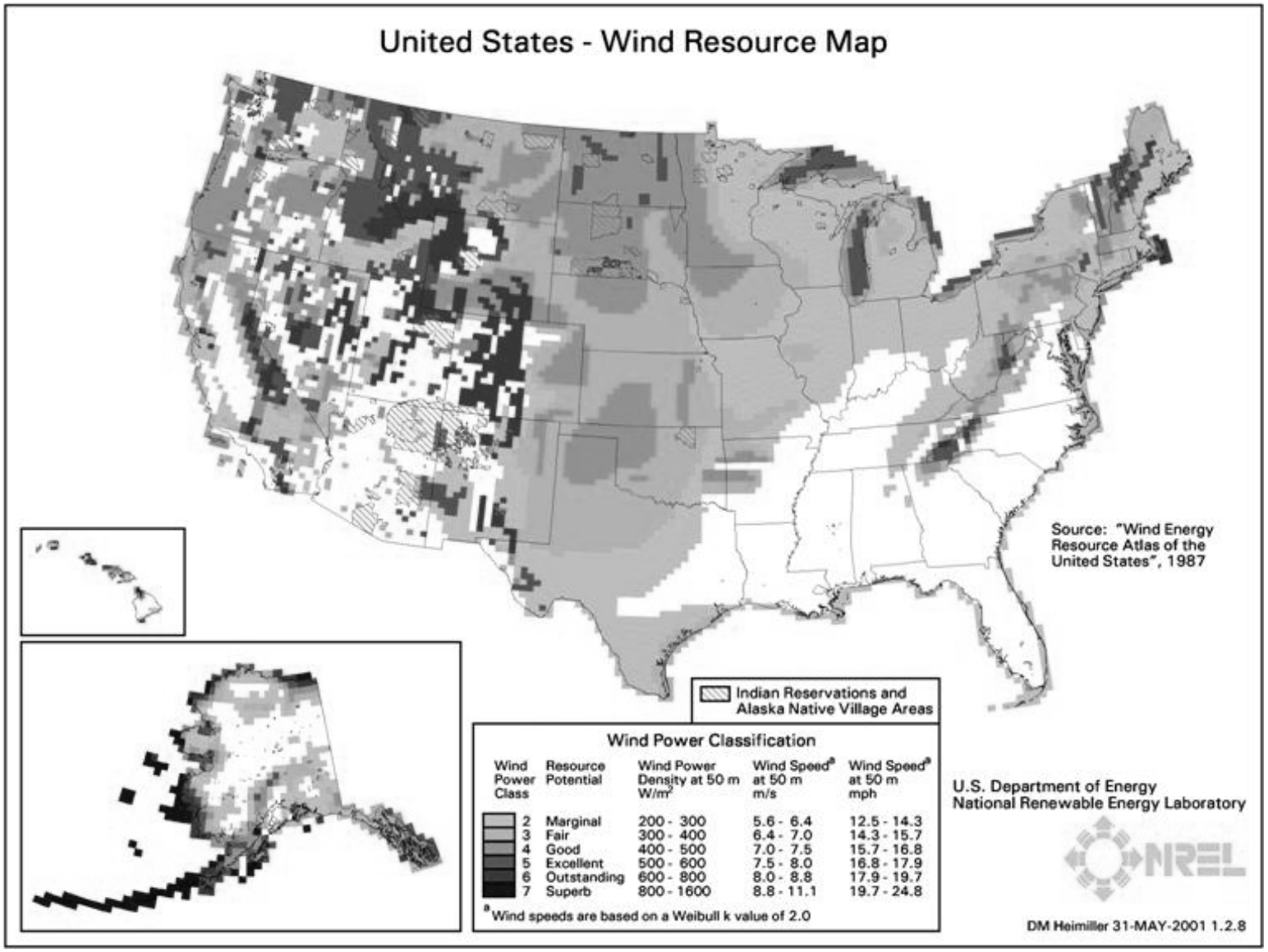
1.	North Dakota	1,210	11.	Colorado	481
2.	Texas	1,190	12.	New Mexico	435
3.	Kansas	1,070	13.	Idaho	73
4.	South Dakota	1,030	14.	Michigan	65
5.	Montana	1,020	15.	New York	62
6.	Nebraska	868	16.	Illinois	61
7.	Wyoming	747	17.	California	59
8.	Oklahoma	725	18.	Wisconsin	58
9.	Minnesota	657	19.	Maine	56
10.	Iowa	551	20.	Missouri	52

Source: *An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States, Pacific Northwest Laboratory, 1991.*

What is possible in the “not so distant” future?

- 20% by 2020 – President Bush
- 6% by 2020 – Department of Energy

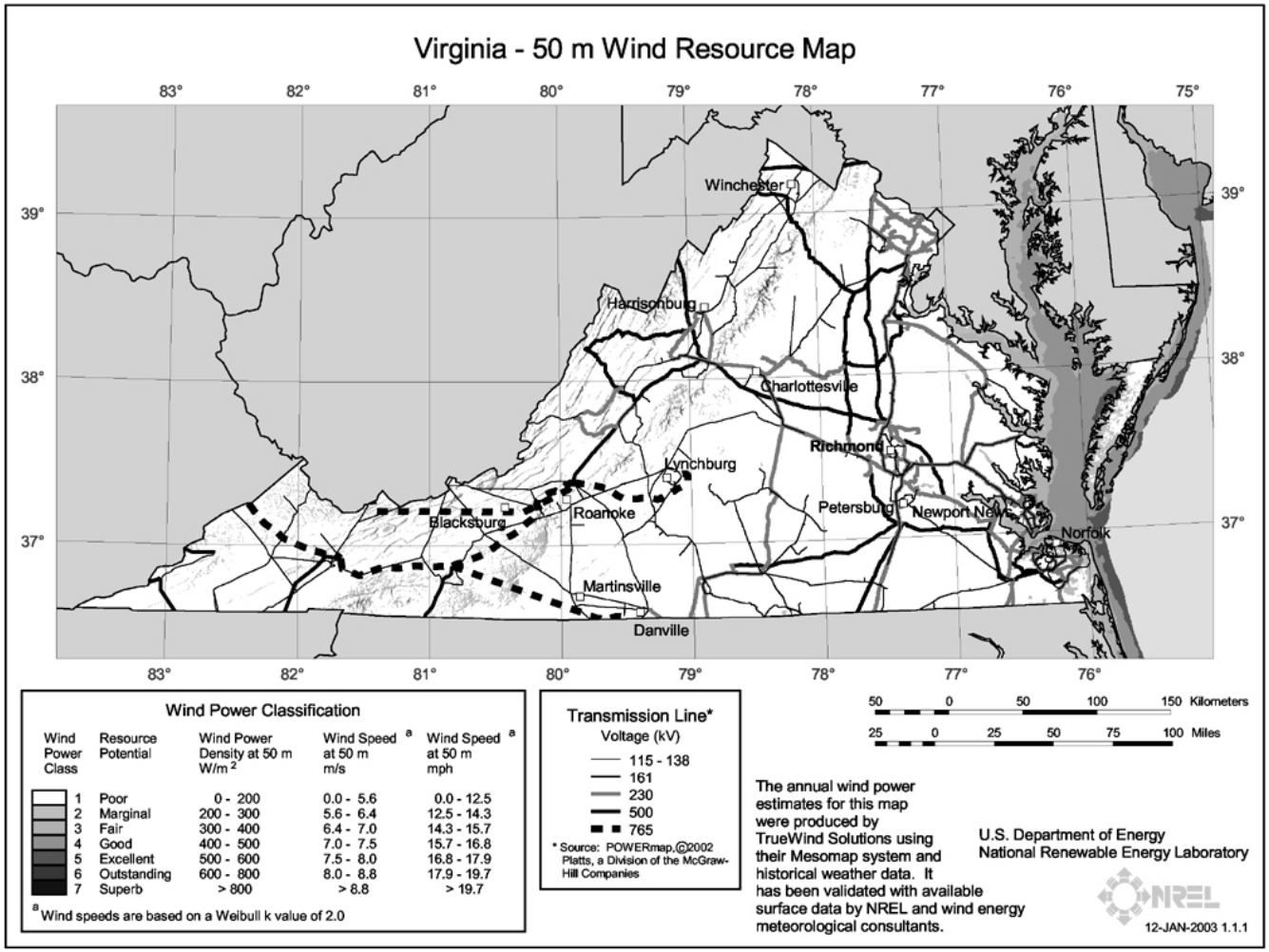
Wind Resource Atlas- U.S. DOE



U.S. Wind Energy Projects – Colorado (As of 01/16/2008)

Name	Location	Power Capacity (MW)	Units	Turbine Mfr.	Developer	Owner	Power Purchaser	Year Online
Cedar Creek	Weld County	221	221	Mitsubishi	Babcock & Brown/BP America	Babcock & Brown/BP America	Xcel Energy	2007
Cedar Creek	Weld County	79.5	53	GE Energy	Babcock & Brown/BP America	Babcock & Brown/BP America	Xcel Energy	2007
Peetz Table Wind Energy Center (4Q)	Logan County	136.5	91	GE Energy	FPL Energy	FPL Energy	Xcel Energy	2007
Peetz Table Wind Energy Center (3Q)	Logan County	264	176	GE Energy	FPL Energy		Xcel Energy	2007
Twin Buttes	Bent County	75	50	GE Energy	PPM Energy		Xcel Energy	2007
Spring Canyon		60	40	GE Energy	Invenergy	Invenergy	Xcel Energy	2006
Aurora Wal Mart		0.05	1	Bergey Windpower	Aurora Wal Mart	Aurora Wal Mart	Aurora Wal Mart	2005
Lamar Wind Energy Project	Prowers County	1.5	1	GE Energy	Arkansas River Power Authority	Arkansas River Power Authority		2004
Lamar Wind Energy Project	Baca County	1.5	1	GE Energy	Arkansas River Power Authority	Arkansas River Power Authority		2004

Wind Resource Map for Virginia



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

Typical Applications
Farms, Homes, Businesses

Off-Grid Water Pumping with Wind

- Supplies water for 120 head of cattle
- 1 kW, 9-ft rotor, 30-ft tower

- Produces ~ 2,000 kWh/yr
- Offsets ~ 1.5 tons CO2/yr
- Costs ~ $4,000 installed

Supplementing Grid Power

- Connected to utility grid through house/farm wiring
- 3 kW, 15-ft rotor, 23-ft tower*
- Produces ~ 5,000 kWh/yr
- Offsets ~ 3.8 tons CO2/yr
- Costs ~ $10,000

** due to zoning restrictions (not recommended)*

Typical Applications
Farms, Homes, Businesses

Offsetting All Utility Power

- "Net metering" utility power
- 10 kW, 23-ft rotor diameter, 100-ft tower
- Produces ~ 15,000 kWh/yr
- Offsets ~ 14 tons CO2/yr
- Costs ~ $35,000

Selling Power Back to Utility

- Excess power sold to utility
- 50 kW, 49-ft rotor, 90-ft tower

- Produces ~120,000 kWh/yr
- Offsets ~ 91 tons CO2/yr
- Costs ~ $150,000

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Arguments in Favor of Wind Power

1. Security of a domestic energy source.
2. Fuel price certainty at zero- no inflation.
3. Declining kWh costs with utility sized wind farms.
4. Economic benefits to rural communities.
5. Environmental benefits- no water use, no solid or hazardous waste, no air pollution or greenhouse gases.
6. Encouraging state and federal policies.

Arguments Against Wind Power

1. Operational problems- radar, EMF, noise, ice, shadows, lighting, etc.
2. Environmental impacts- bird, bat and other animal impacts, soil erosion, wetlands,.
3. Land use conflicts- aesthetics/visual effects, cultural resources, tourism, recreation, transportation, construction effects, decommissioning.

What is needed: A Process for Considering Specific Sites

- What factors are relevant to these decisions?
- How are they to be compared?
- Who decides on siting questions?
- Careful site selection and project design will affect the future growth of the wind power industry.
- Experience with wind power will be important to public acceptance.

Wind Power Siting Methods

- 1. Local Control Through Zoning & Land Use Controls.
- Examples: Texas, Hawaii, Kansas, Mass., Mich., & Oregon.

Wind Power Siting Methods

- 2. State Control Through State Agency:
  - Public Utility Commission.
  - Environmental or Natural Resource Agency.
  - Energy Facility Siting Commission.

  Examples: Ala., Alaska, Arizona, Ark., Colo., Conn., Fla., Hawaii, Iowa, Ky., La., Me., Md., Mass., Minn., Missouri, Neb., Nev., N.H., N.Mex., N.C., N.Dak., Ohio, Oregon, R.I., S.Dak., Tenn., Utah, Vt., Va., Wash., W.Va., Wis., and Wyo.

State Law Siting Control.

- 3. Specialized Wind Siting Authority: Colorado, Minnesota, North Dakota, Oregon, South Dakota, and Vermont.

State Law Siting Control.

- 4. State Environmental Impact Review (State Little NEPAs):
- CA, Conn.,Ga., Hawaii, Ind., Md., Mass.,Minn., Mont., N.J.,N.Y., N.C., S.D., Va., Wash., and Wis.

State Law Siting Control.

- 5. State Environmental Law.
- A. Endangered Species.
- B. Water & Wetlands.
- C. Historic Preservation and Cultural Resources.
- D. Stormwater.
- E. Agricultural Land Preservation.
- F. Highway/Transportation.

Carpe Ventem

Seize the Wind