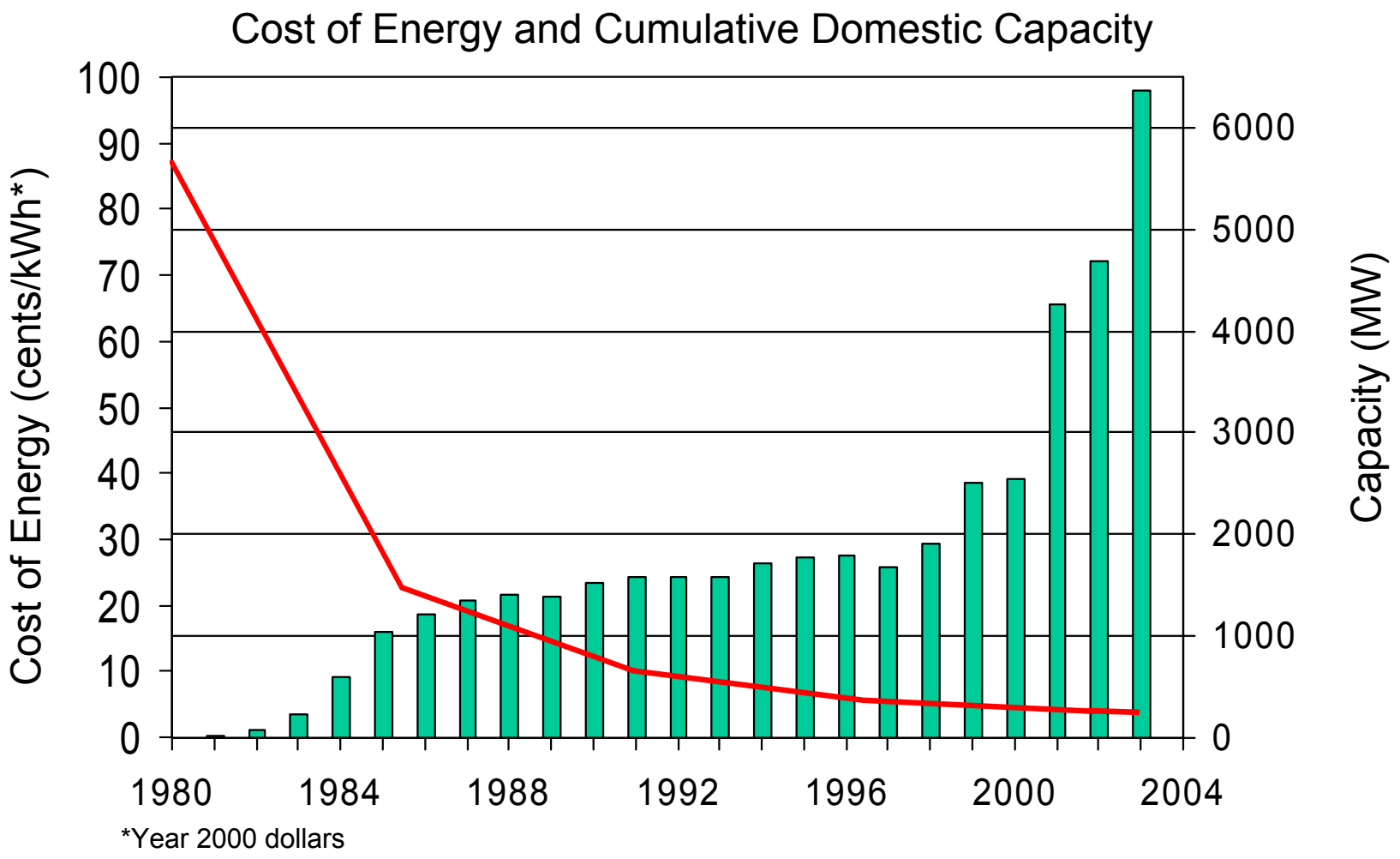
The $$ and Sense of Wind Energy

Larry Flowers
Team Leader, National Wind Technology Center

WEATS
Anchorage, AK

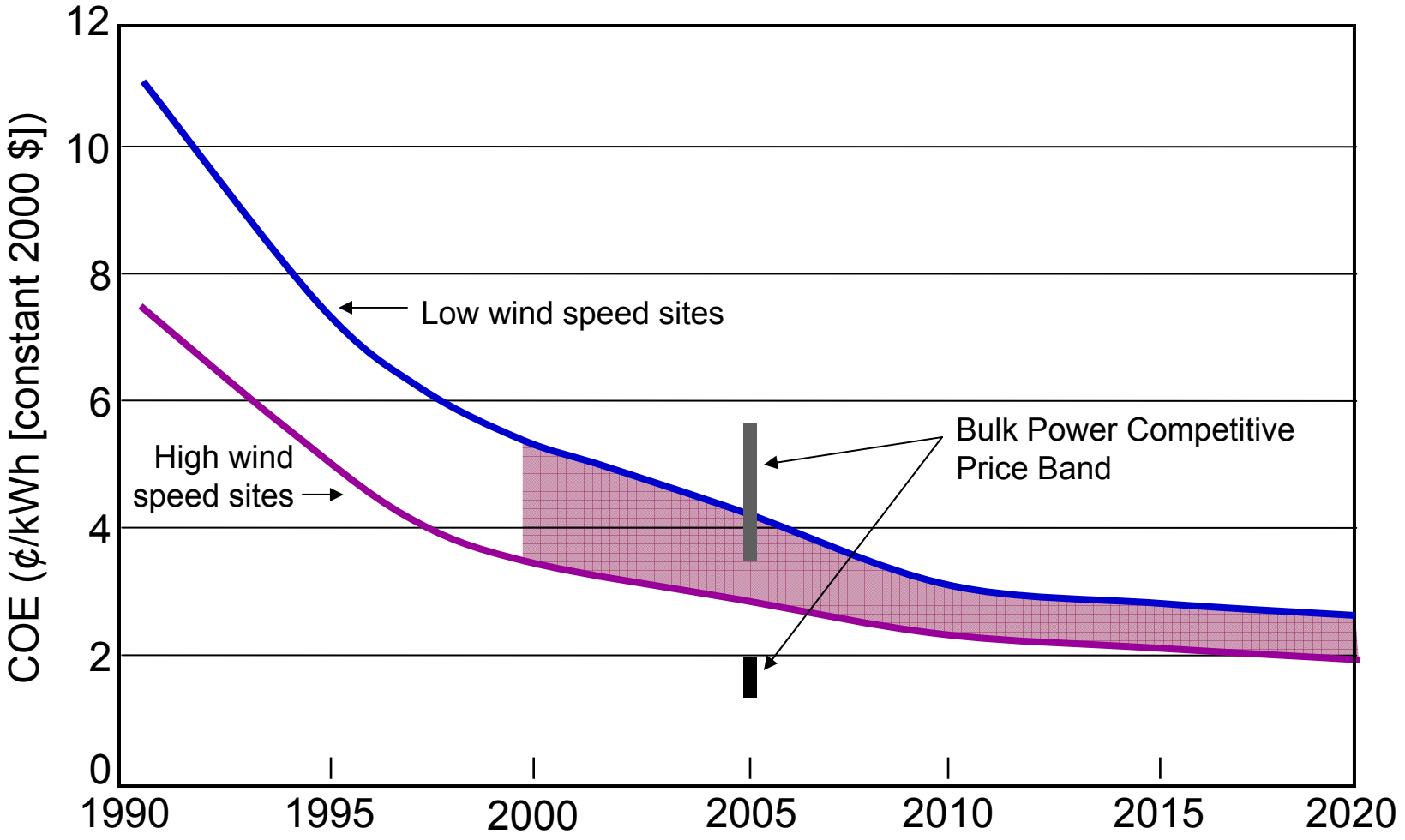
Wind energy is economically competitive

Capacity & Cost Trends



Increased Turbine Size - R&D Advances - Manufacturing Improvements

Wind Cost of Energy



Municipal Wind Power Pioneers

Austin Energy

"We at Austin Energy found that large wind energy projects are the least expensive new electric generation source. Not only is the price lower than other renewable sources, it's even lower than the fuel cost of our natural-gas-fired units.

- *Mark Kapner, manager, Conservation and Renewable Energy, Austin Energy*

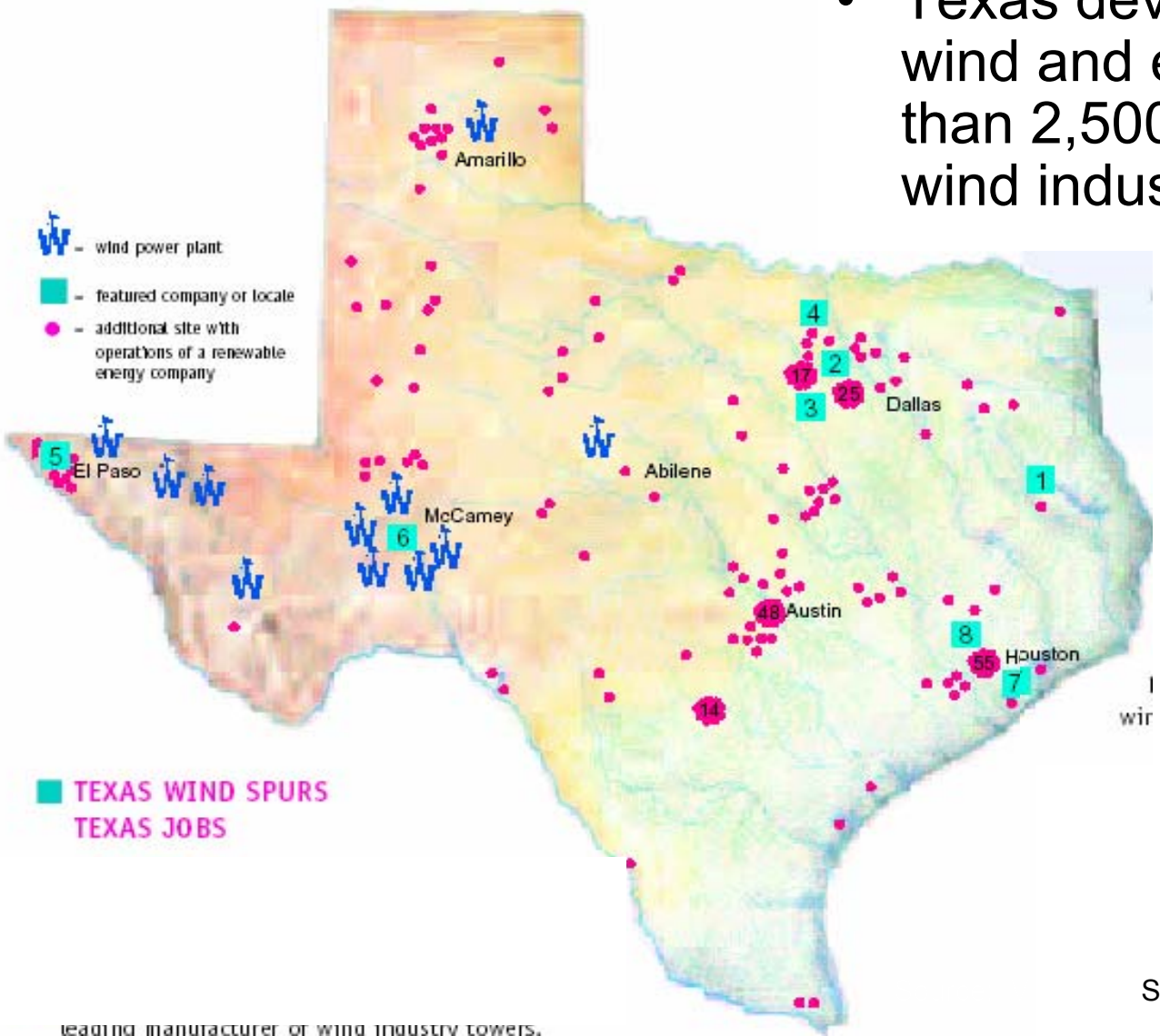
Wind energy boosts economic development

Economic Development Impacts

- **Land Lease Payments**: 2-3% of gross revenue $2500-4000/MW/year
- **Local property tax** revenue: ranges widely - $300K-1700K/yr per 100MW
- 100-200 **jobs**/100MW during construction
- 10-30 permanent O&M **jobs** per 50-100 MW
- Local construction and service industry: concrete, towers usually done locally

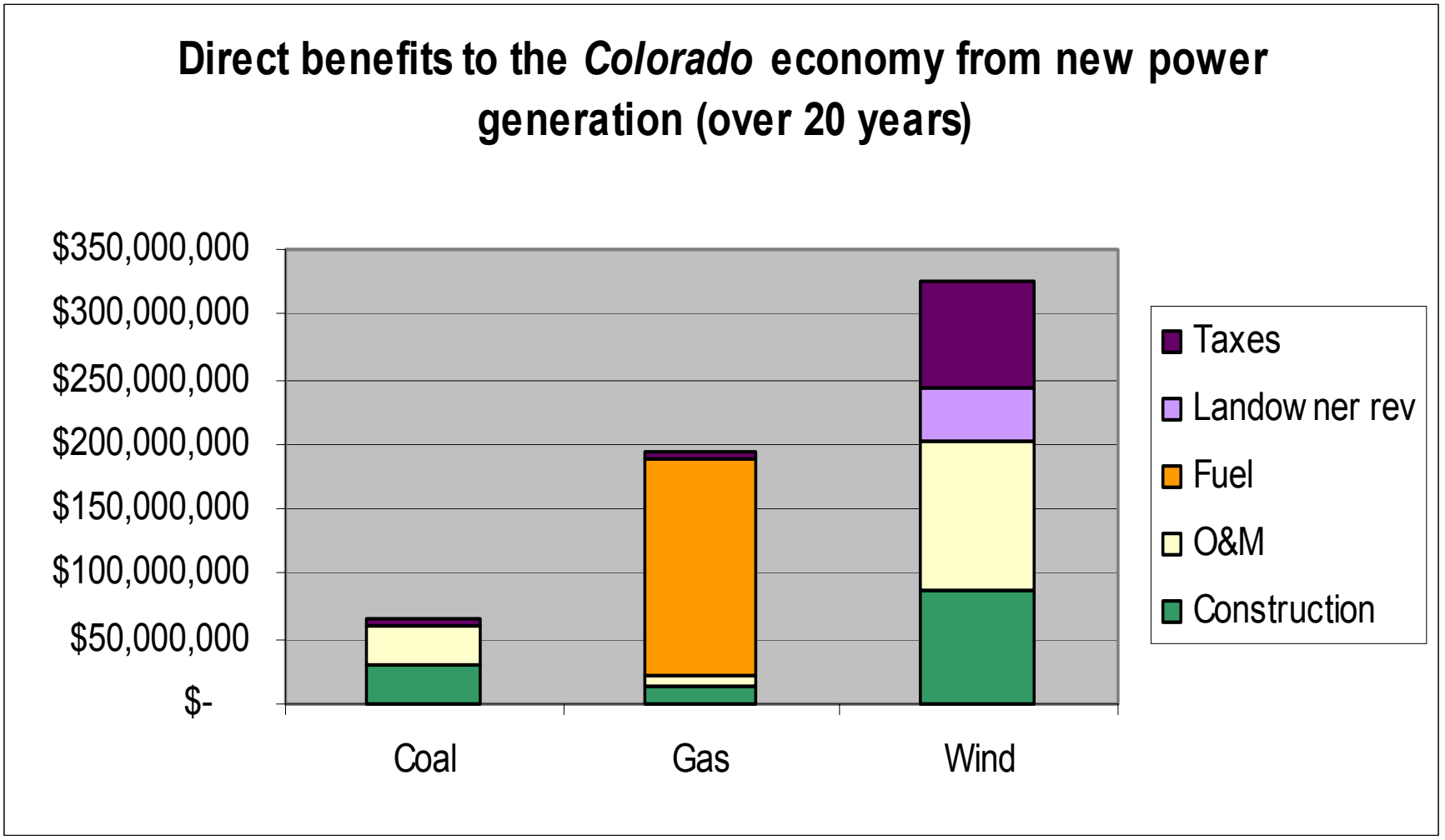
Texas Wind Spurs New Jobs

- Texas developed 913 MW of wind and employed more than 2,500 people in the wind industry in 2001



Source: Virtus, 2003

Comparative Economic Development Impacts



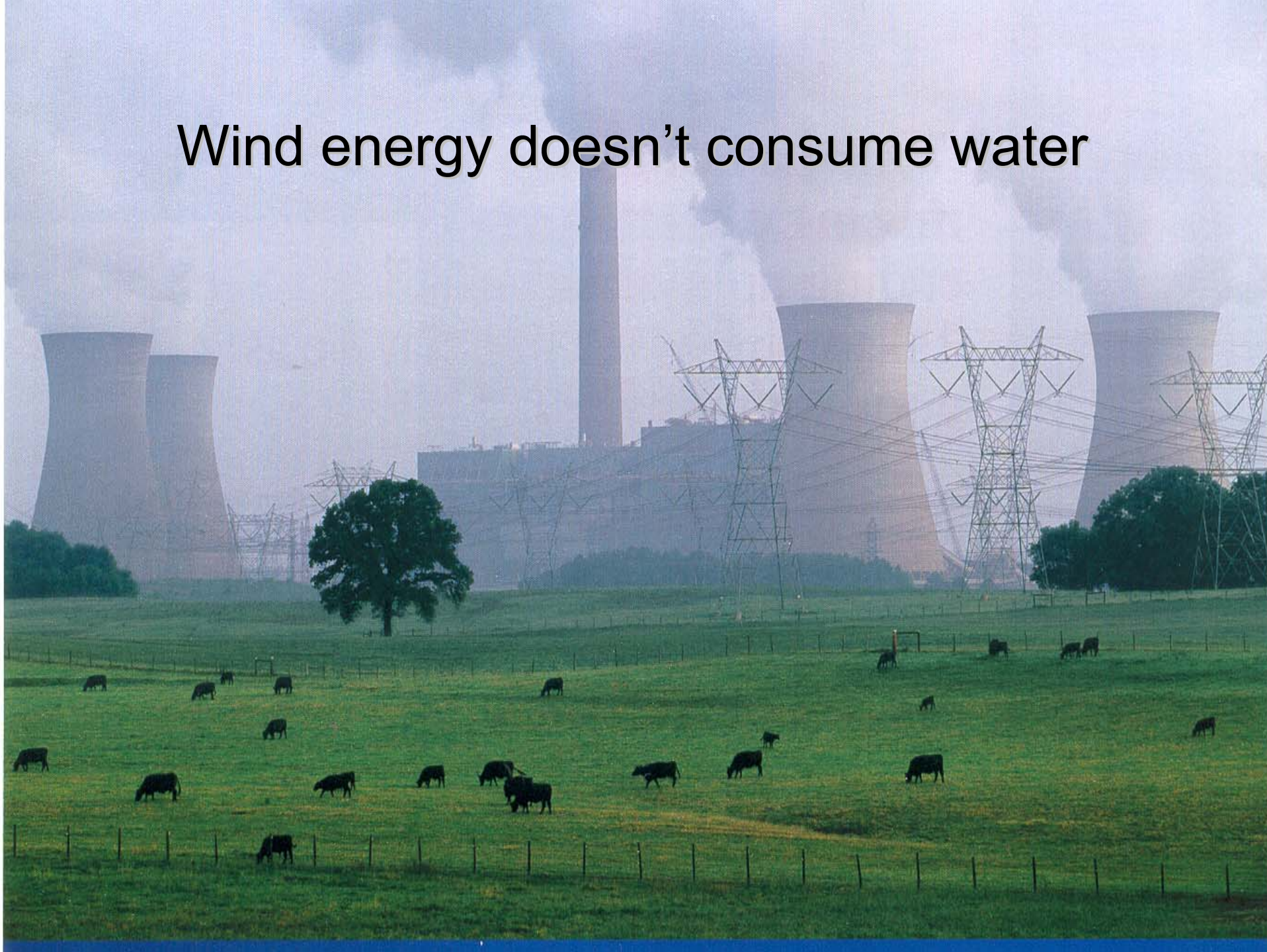
Case Study: Hyde County, South Dakota

- 40 MW wind project in South Dakota creates $400,000 - $450,000/yr for Hyde County, including:
  - More than $100,000/yr in annual lease payments to farmers ($3,000 - $4,000/turbine/yr)
  - $250,000/yr in property taxes (25% of Highmore's education budget)
  - 75 -100 construction jobs for 6 months
  - 5 permanent O&M jobs
  - Sales taxes up more than 40%
  - Doesn't include multiplier effect

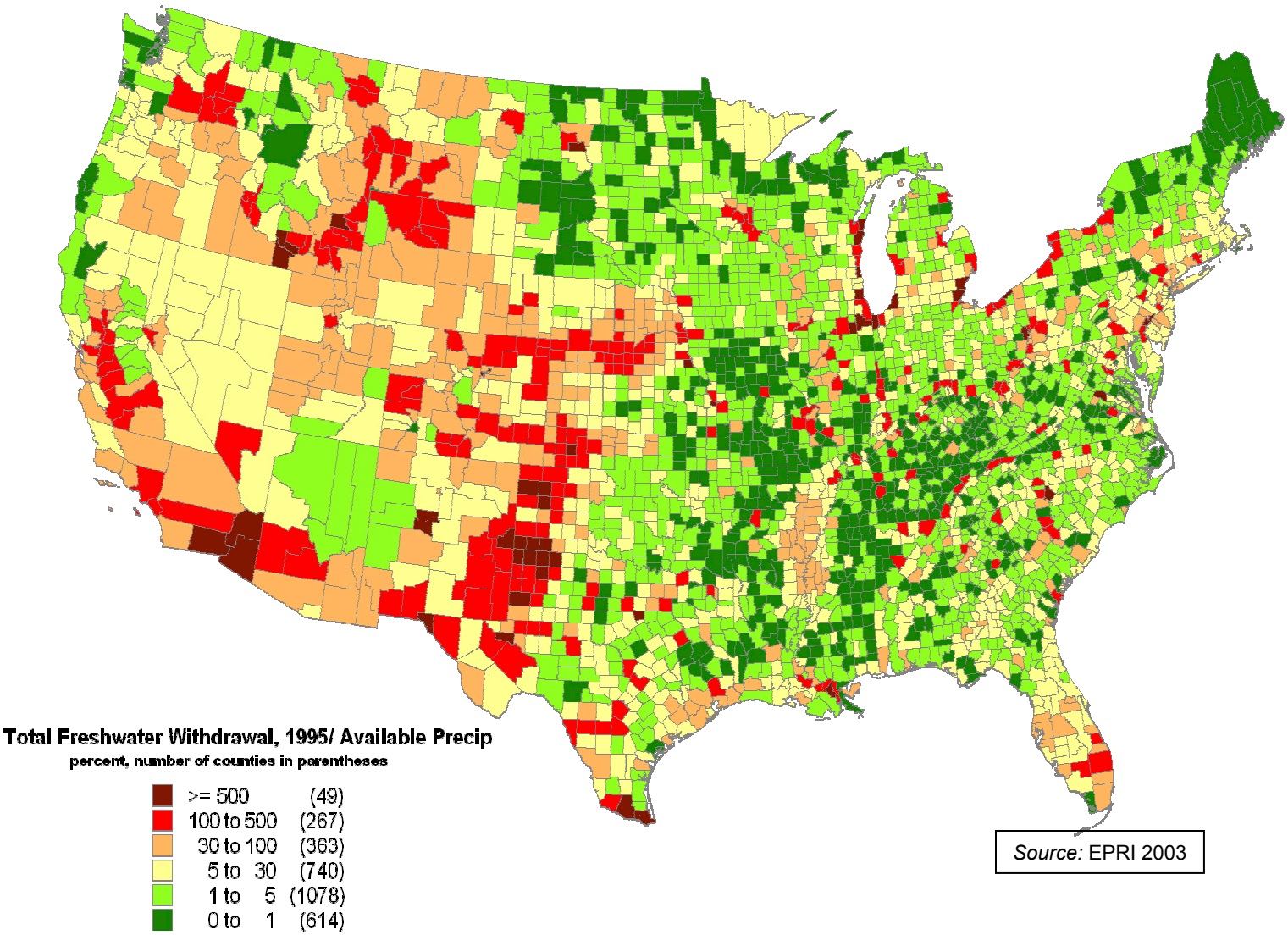
“Converting the wind into a much-needed commodity while providing good jobs, the Colorado Green Wind Farm is a boost to our local economy and tax base.”

John Stulp, county commissioner, Prowers County, Colorado

Wind energy doesn’t consume water



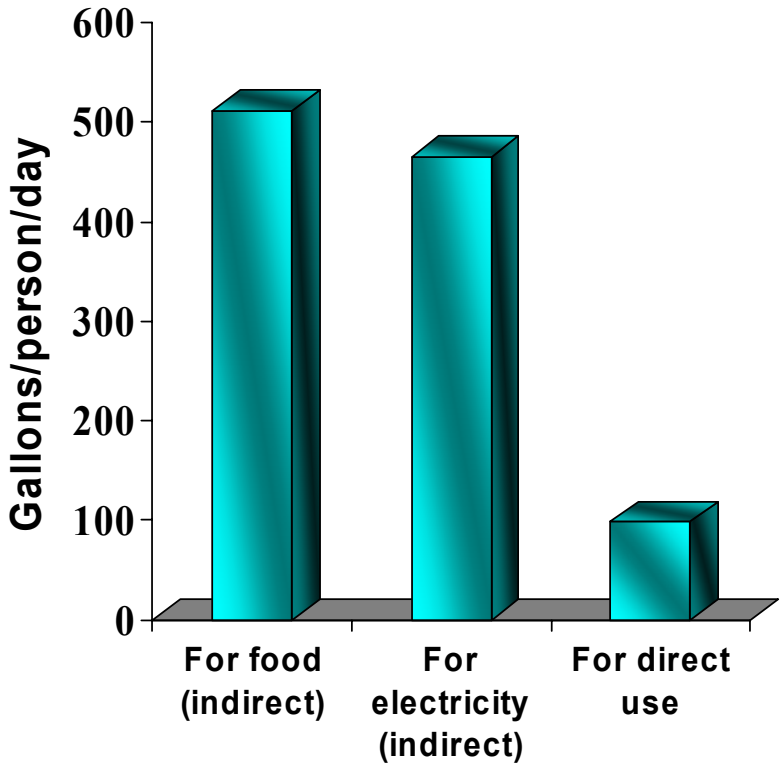
Sustainable Withdrawal Of Freshwater Is National Issue



Source: EPRI 2003

Energy Requires Water

Water required to produce household electricity exceeds direct household water use



GALLONS PER PERSON PER DAY

- 510 for food production
  - includes irrigation and livestock
- 465 to produce household electricity
  - Range: 30 to 600 depending on technology
- 100 direct household use
  - includes bathing, laundry, lawn watering, etc.

Source: from Gleick, P., World's Water 2002-2003, 2002

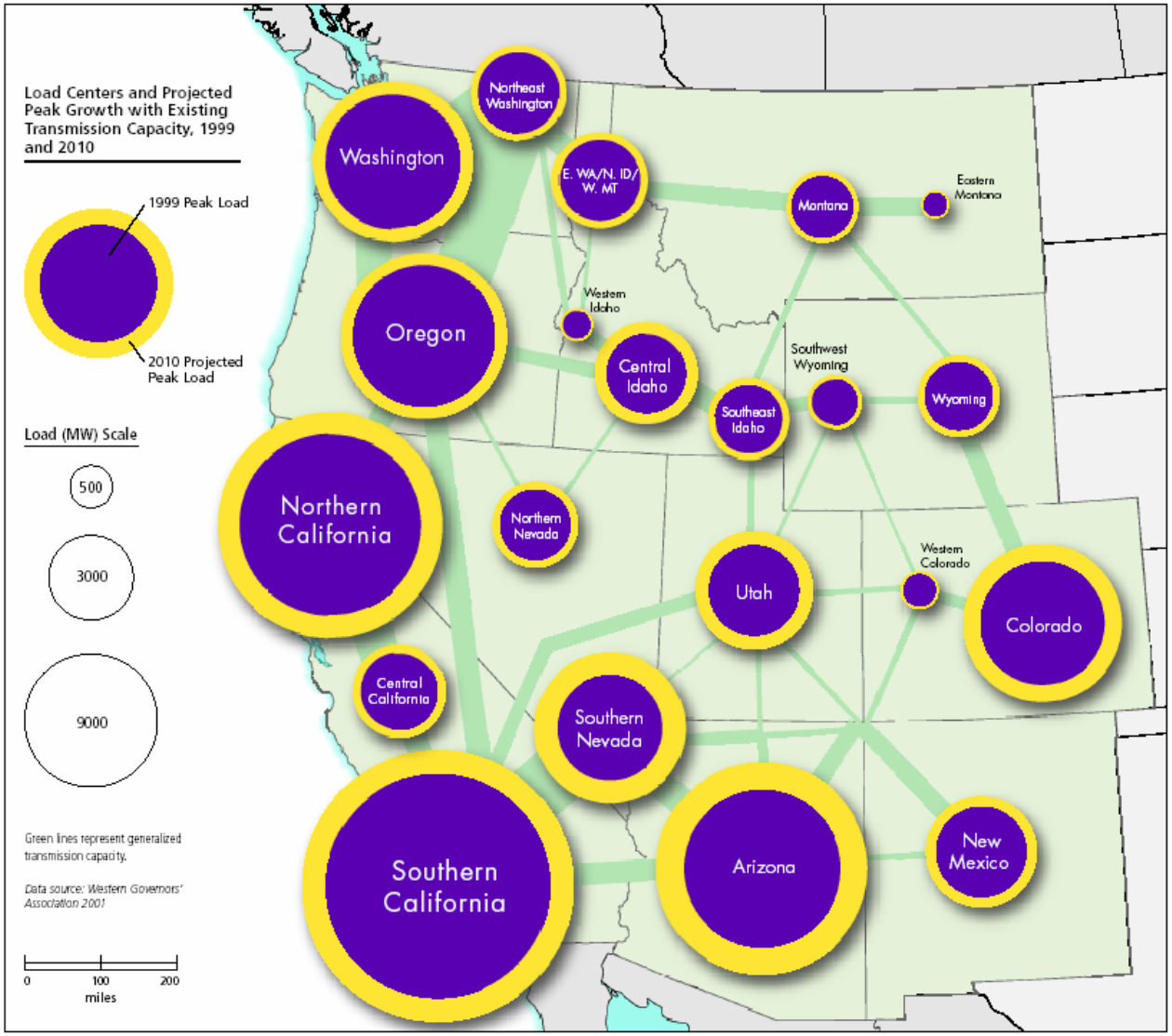
Thermoelectric Power Plants – Water Usage

In 2002, nationwide:

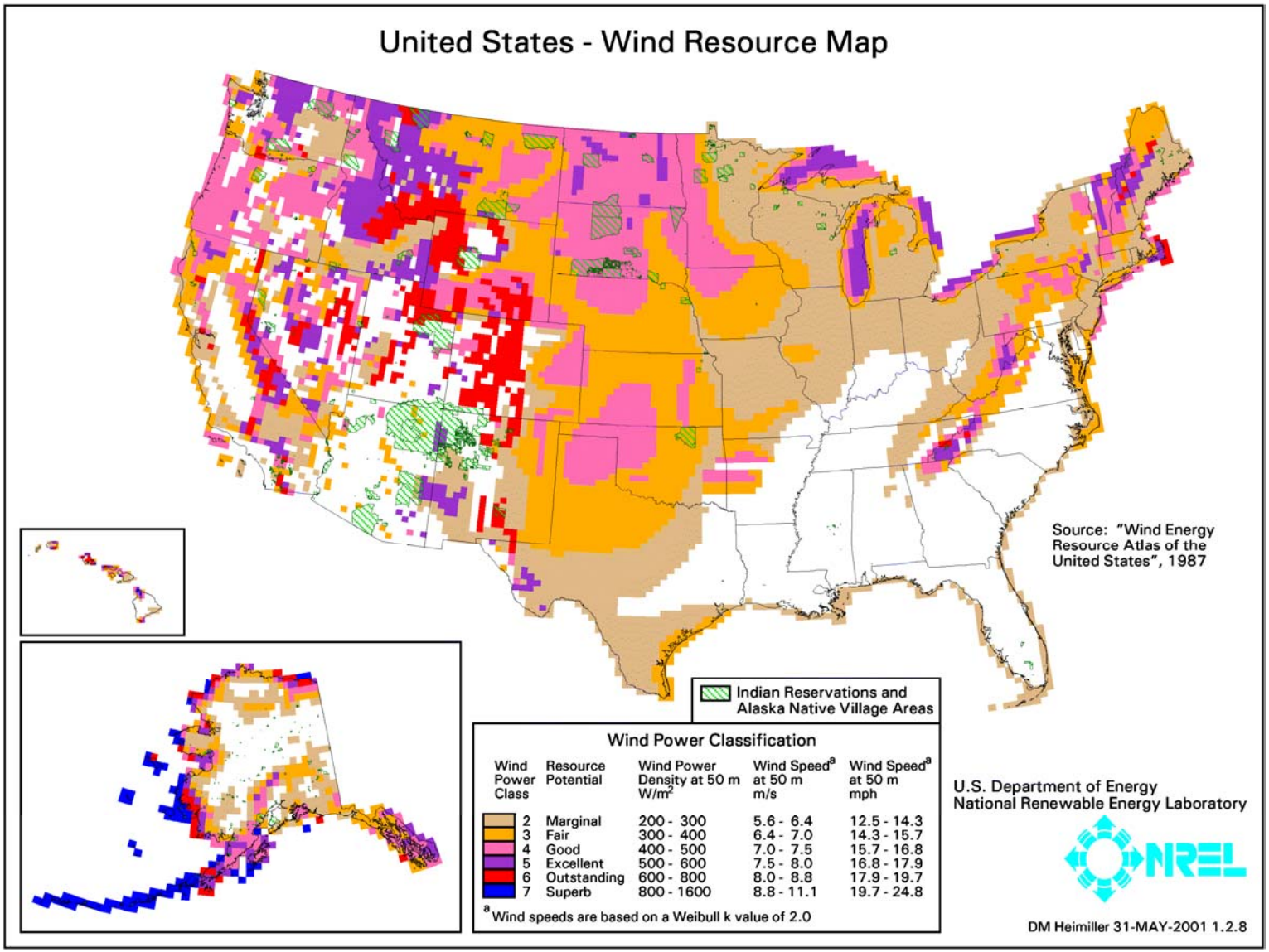
- Withdrawals of water at all thermoelectric power plants = 225 billion gallons/day
- = 252 million acre-feet
- ~ ¾ size of Lake Erie

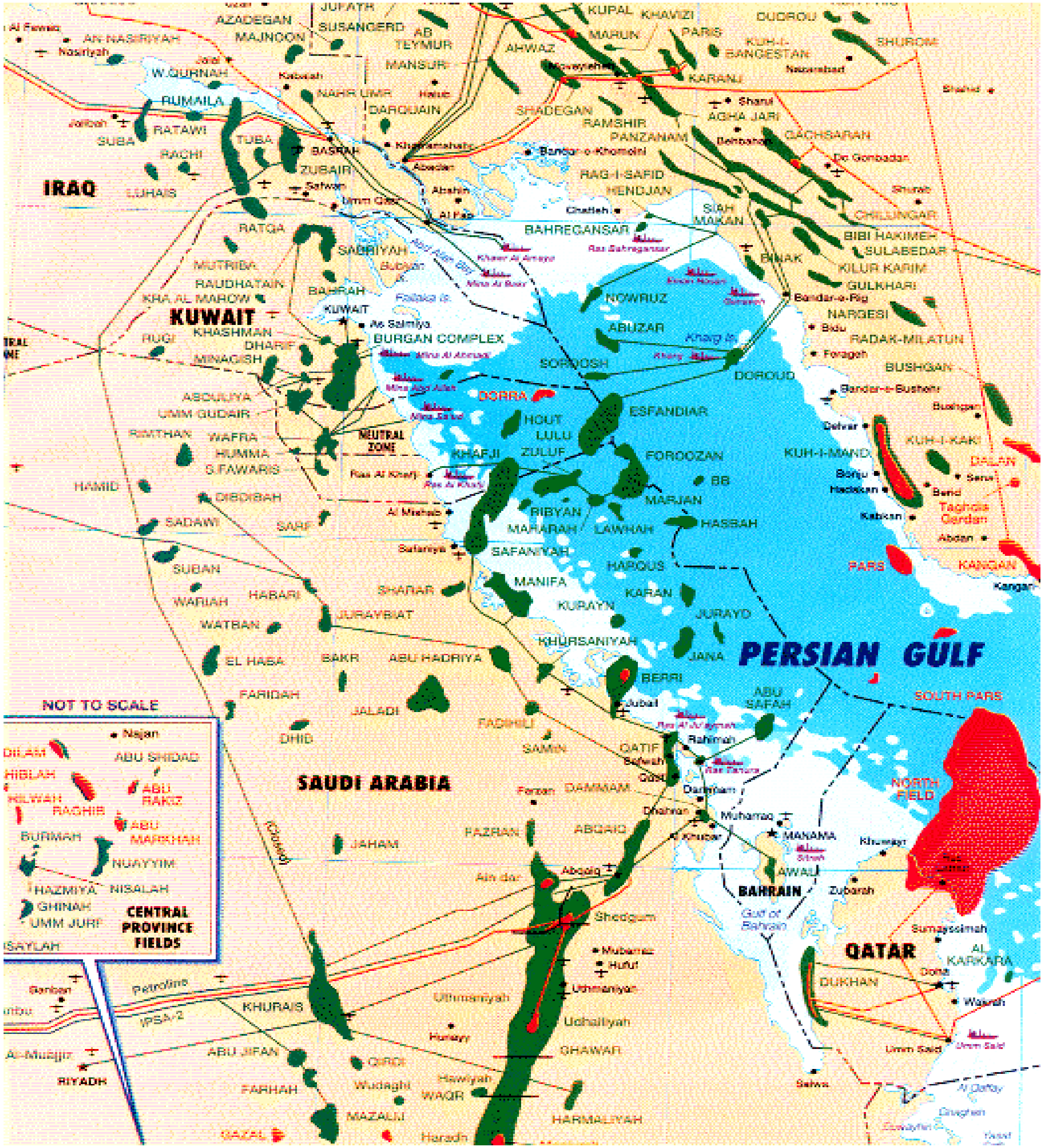
Source: Western Resource Advocates

Load Growth


Load Centers and Projected Peak Growth with Existing Transmission Capacity, 1999 and 2010
1999 Peak Load
2010 Projected Peak Load
Load (MW) Scale
500
3000
9000
Green lines represent generalized transmission capacity.
Data source: Western Governors' Association 2001
0
100
200
miles
Washington
Northeast Washington
E. WA/N. ID/ W. MT
Montana
Eastern Montana
Oregon
Western Idaho
Central Idaho
Southwest Wyoming
Southeast Idaho
Wyoming
Northern California
Northern Nevada
Utah
Western Colorado
Colorado
Central California
Southern Nevada
Southern California
Arizona
New Mexico

Wind is a homegrown energy source





PERSIAN GULF
IRAQ
KUWAIT
SAUDI ARABIA
BAHRAIN
QATAR
NEUTRAL ZONE
NOT TO SCALE
CENTRAL PROVINCE FIELDS
AZADEGAN
MAJNOON
JUFAYR
SUSANGERD
AB TEYMUR
MANSURI
AHWAZ
KUPAL
KHAVIZI
MARUN
PARIS
DUDROU
KUH-I-BANGESTAN
SHUROM
KARANJ
AN-NASIRIYAH
W.QURNAH
RUMAILA
RATAWI
SUBA
TUBA
RACHI
LUHAIS
BASRAH
ZUBAIR
NAHR UMR
DARQUAIN
SHADEGAN
RAMSHIR
PANZANAM
AGHA JARI
GACHSARAN
RAG-I-SAFID
HENDJAN
SIAH MAKAN
CHILLINGAR
BIBI HAKIMEH
SULABEDAR
BINAK
KILUR KARIM
GULKHARI
NARGESI
RADAK-MILATUN
BUSHGAN
KUH-I-KAKI
KUH-I-MAND
DALAN
PARS
KANGAN
SOUTH PARS
NORTH FIELD
BAHREGANSAR
NOWRUZ
ABUZAR
SOROOSH
DOROUD
ESFANDIAR
DORRA
HOUT
LULU
ZULUF
FOROOZAN
BB
MARJAN
HASBAH
RIBYAN
MAHARAH
LAWHAH
SAFANIYAH
HARQUS
MANIFA
KARAN
KURAYN
JURAYD
KHURSANIYAH
JANA
BERRI
ABU SAFAH
QATIF
DAMMAM
ABQAIQ
AWALI
DUKHAN
RATQA
SABRIYAH
MUTRIBA
RAUDHATAIN
BAHRAH
KRA AL MAROW
KHASHMAN
DHARIF
MINAGISH
BURGAN COMPLEX
RUGI
ABDULIYA
UMM GUDAIR
RIMTHAN
WAFRA
HUMMA
S.FAWARIS
KHAFJI
HAMID
DIBDIBAH
SADAWI
SARF
SUBAN
WARIAH
HABARI
SHARAR
JURAYBIAT
WATBAN
EL HASA
BAKR
ABU HADRIYA
FARIDAH
JALADI
FADHILI
DHID
SAMIN
FAZRAN
JAHAM
KHURAIS
ABU JIFAN
QIRDI
FARHAH
MAZALIJ
GHAWAR
HARMALIYAH
WAQR
GAZAL
DILAM
HIBLAH
HILWAH
RAGHIB
ABU RAKIZ
ABU MARKHAH
BURMAH
NUAYYIM
HAZMIYA
NISALAH
GHINAH
UMM JURF
SAYLAH
ABU SHIDAD
Najan
RIYADH
Petroline
IPSA-2
KUWAIT
MANAMA
Doha
Dhahran
Dammam
Jubail
Ras Tanura
Kharg Is.
Failaka Is.
Gulf of Bahrain
Al Khobar
Hofuf
Ras Al Khafji
Safaniya
Mina Al Ahmadi
Mina Abd Allah
Mina Sa'ud
Bandar-e-Bushehr
Bandar-o-Khomeini
Abadan
Khorramshahr
Umm Qasr
Al Fao
Umm Said
Salwa
Dukhan
Zubarah
Khuwayr
Ras Laffan
Sumaysimah
AL KARKARA
Wakrah


L N G
Source: BG

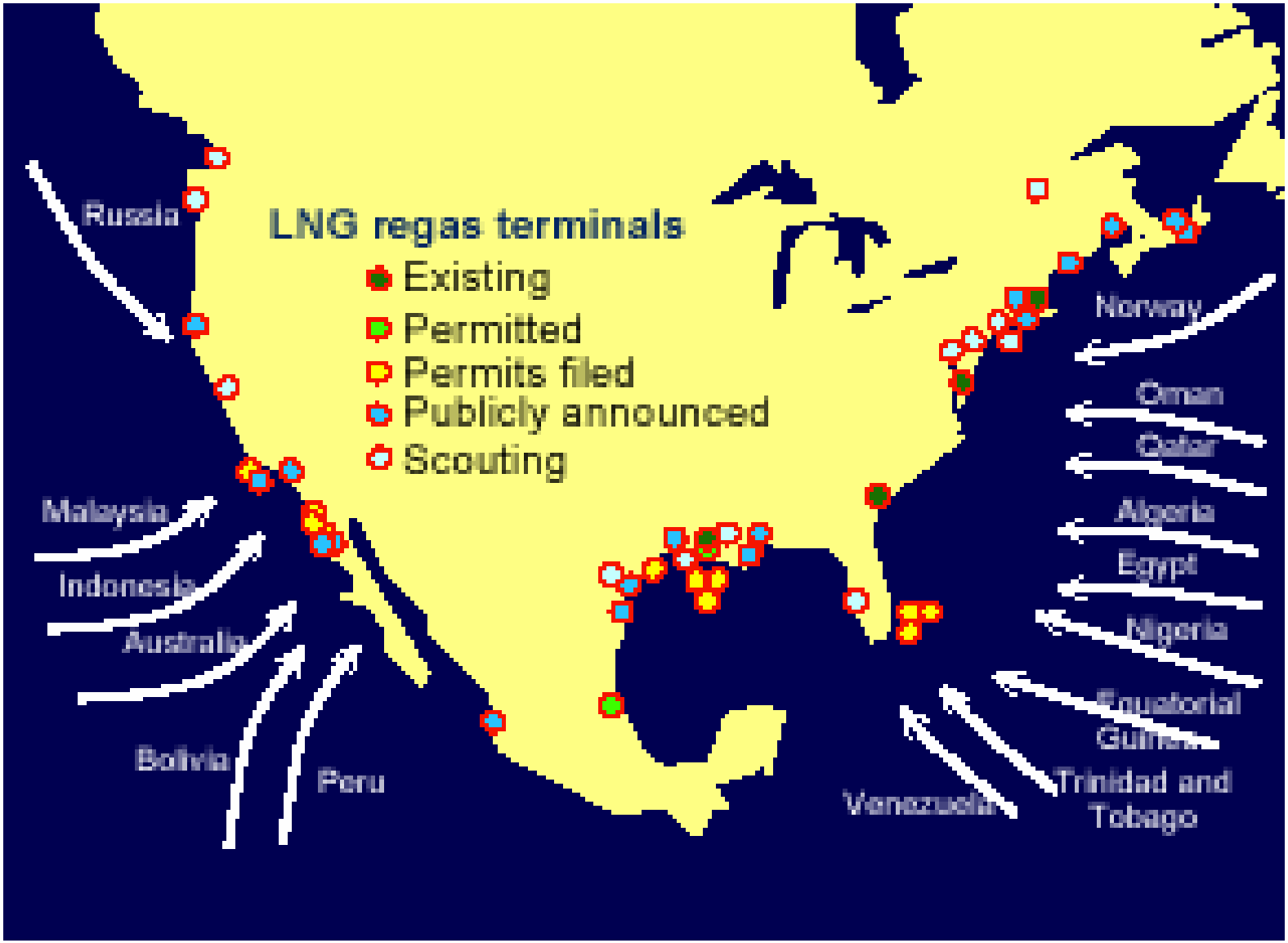
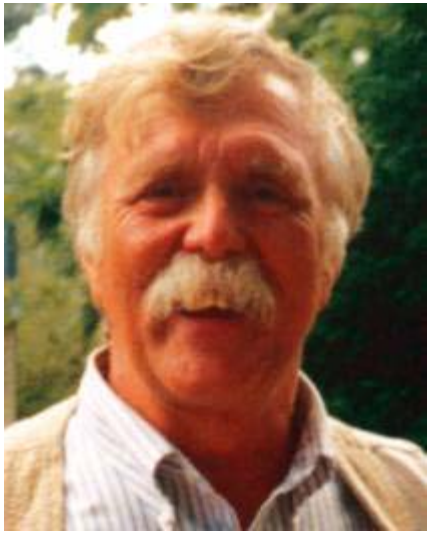


Figure 5: Growth in North American LNH regas projects

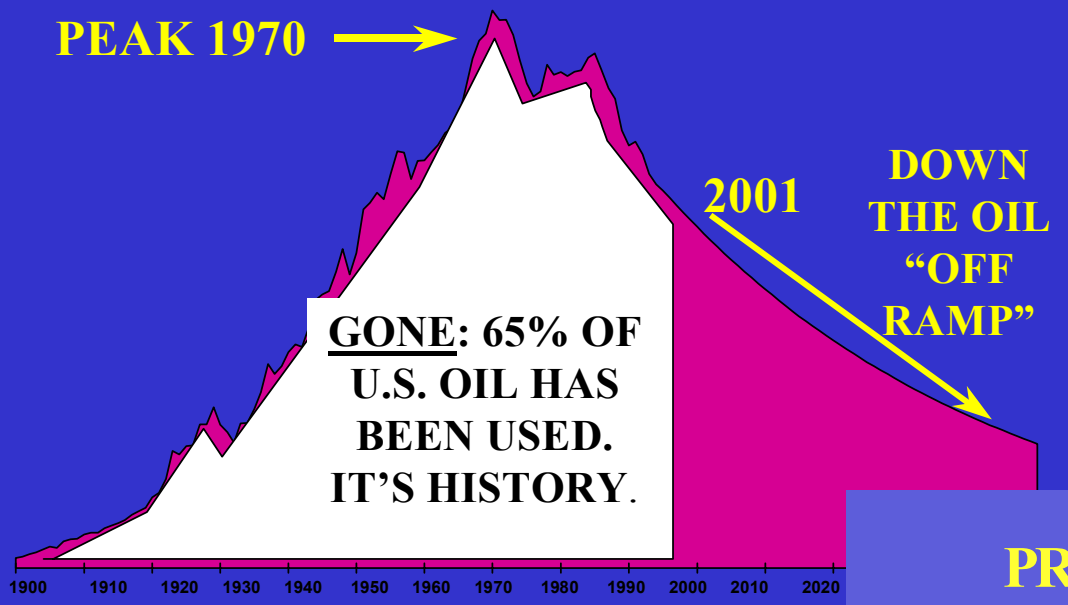


"Wind is a homegrown energy that we can harvest right along side our corn or soybeans or other crops. We can use the energy in our local communities or we can export it to other markets. We need to look carefully at wind energy as a source of economic growth for our region"

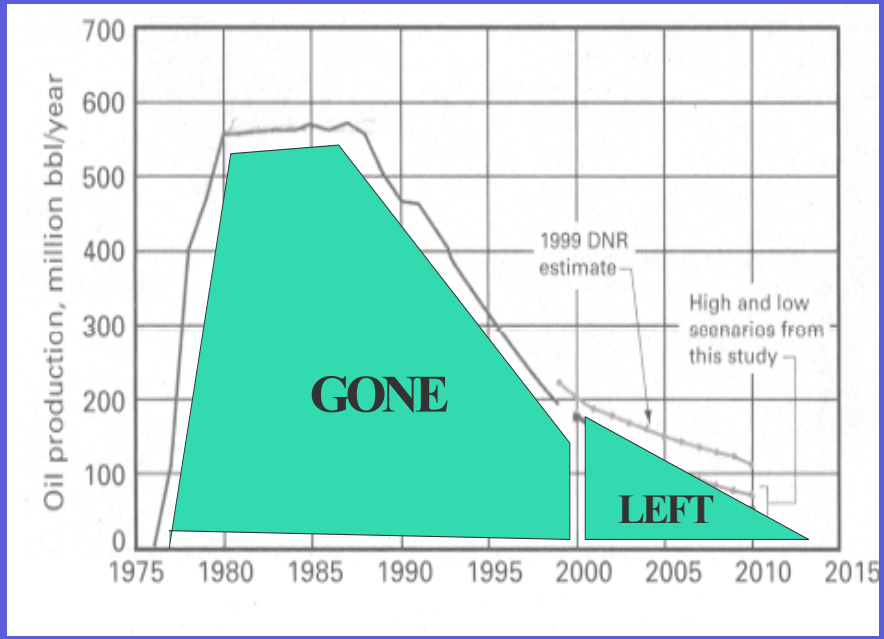
David Benson, Farmer and County Commissioner, Nobles County, Minnesota

Wind energy is inexhaustible and infinitely renewable

U.S. OIL PRODUCTION 1900 TO 2050



PRUDHOE BAY PRODUCTION



Methane Madness

"In 1997, 600 rigs kept production flat.

In 2001, 1000 rigs were needed to keep production steady.

In 2002, production fell 3%.

US producers will find it very difficult to reverse these trends."

Raymond James

Wind energy has many environmental benefits

Environmental Benefits

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

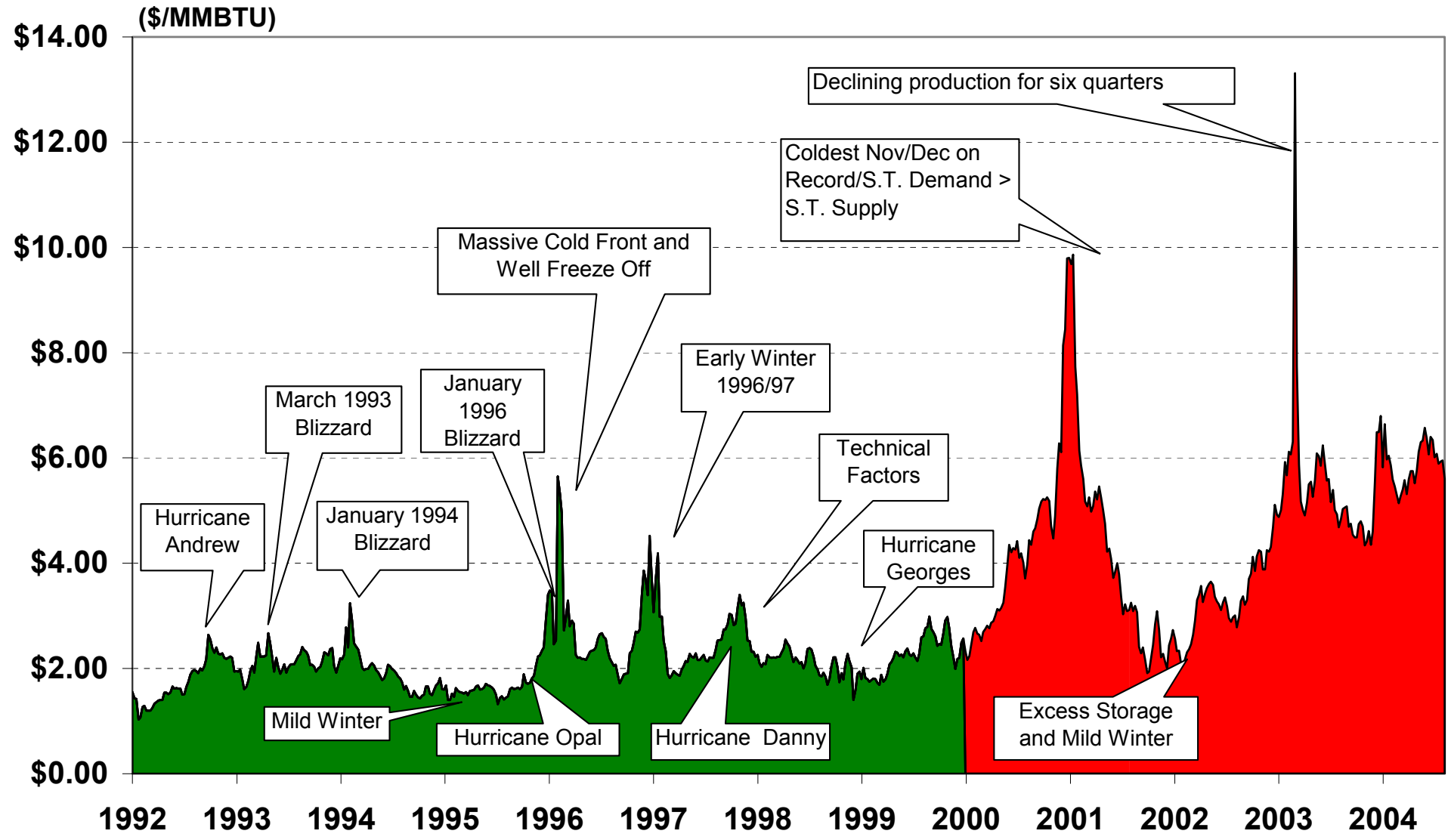
Municipal Wind Power Pioneers

Waverly Light and Power

"The development of wind energy by Waverly Light and Power has been an important, environmentally correct step for our community, and continues to provide leadership for expansion of wind energy generation in the Midwest. We strongly believe that public power can play a significant role in the global reduction of greenhouse gasses by expanding and promoting wind energy and using programs like Iowa Energy Tags."

- Glenn Cannon, general manager, Waverly Light and Power

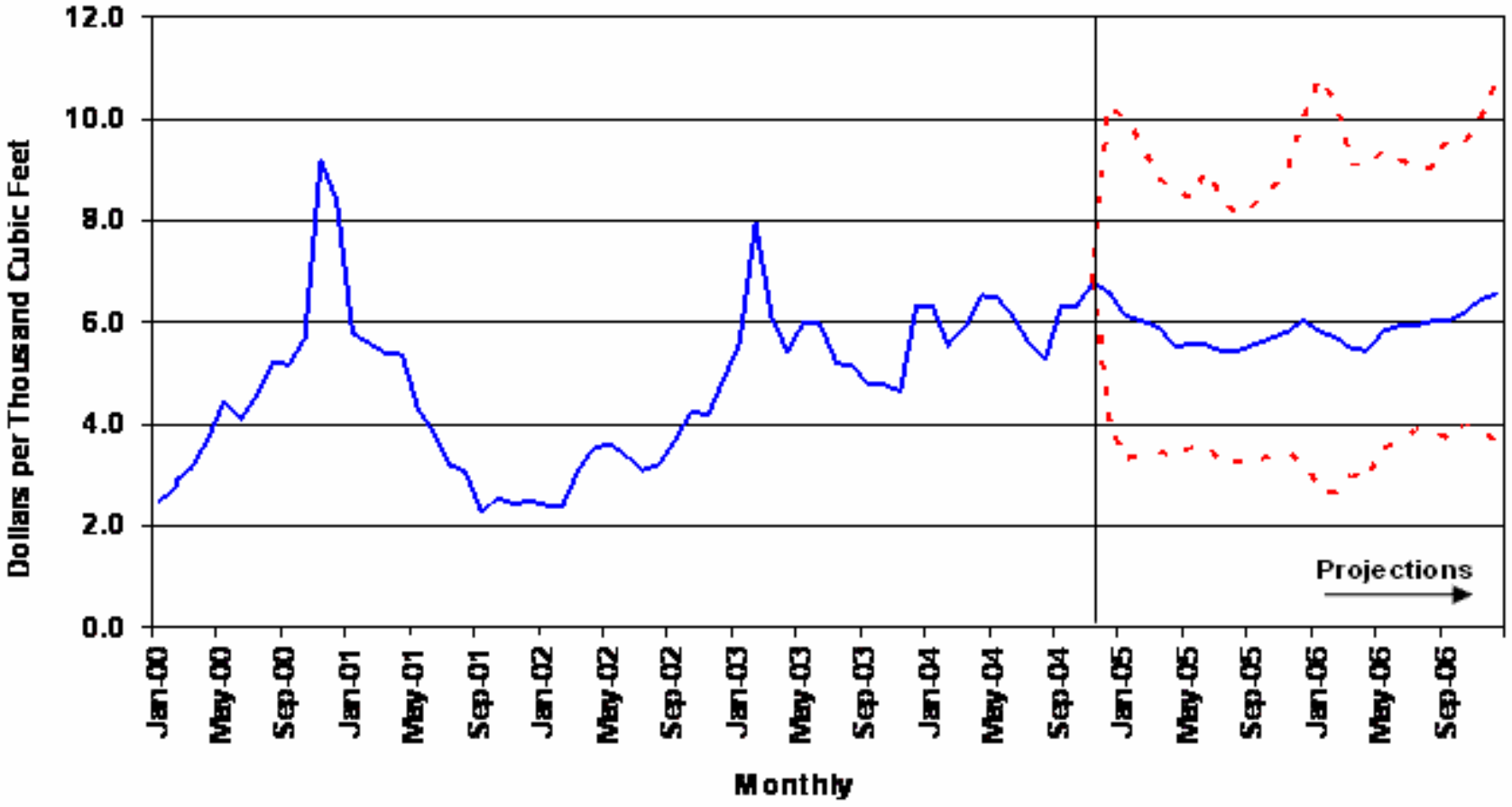
Wind reduces risk associated with volatile fuel prices



Source: NGW and EVA, Inc.

U.S. Natural Gas Spot Prices

(Base Case and 95% Confidence Interval*)

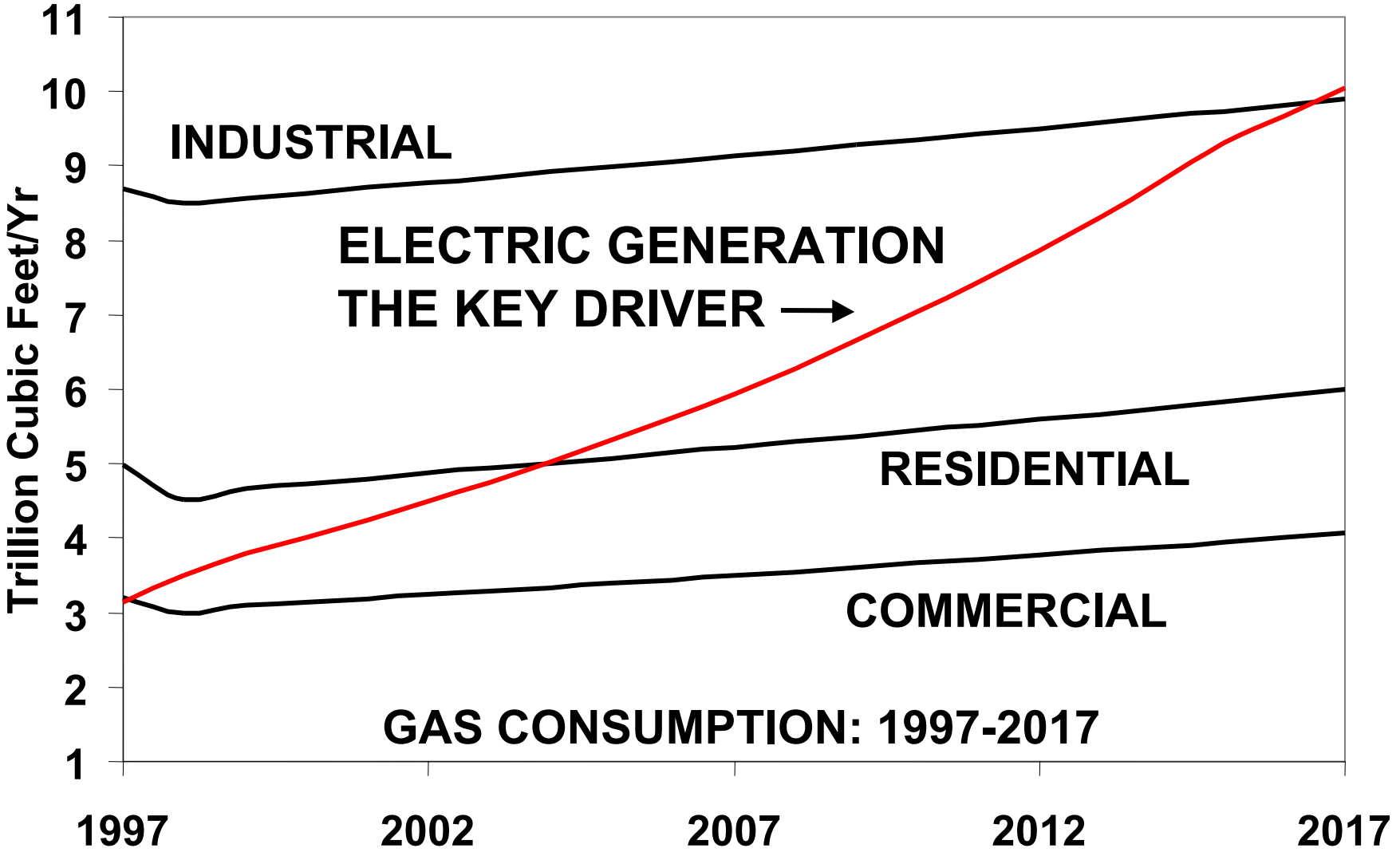


*The confidence intervals show +/- 2 standard errors based on the properties of the model. The ranges do not include the effects of major supply disruptions.

Sources: History: Natural Gas Week; Projections: Short-Term Energy Outlook, January 2005

www.eia.doe.gov

The “Dash to Gas”



Carbon Risk

EPRI CONCLUDES:

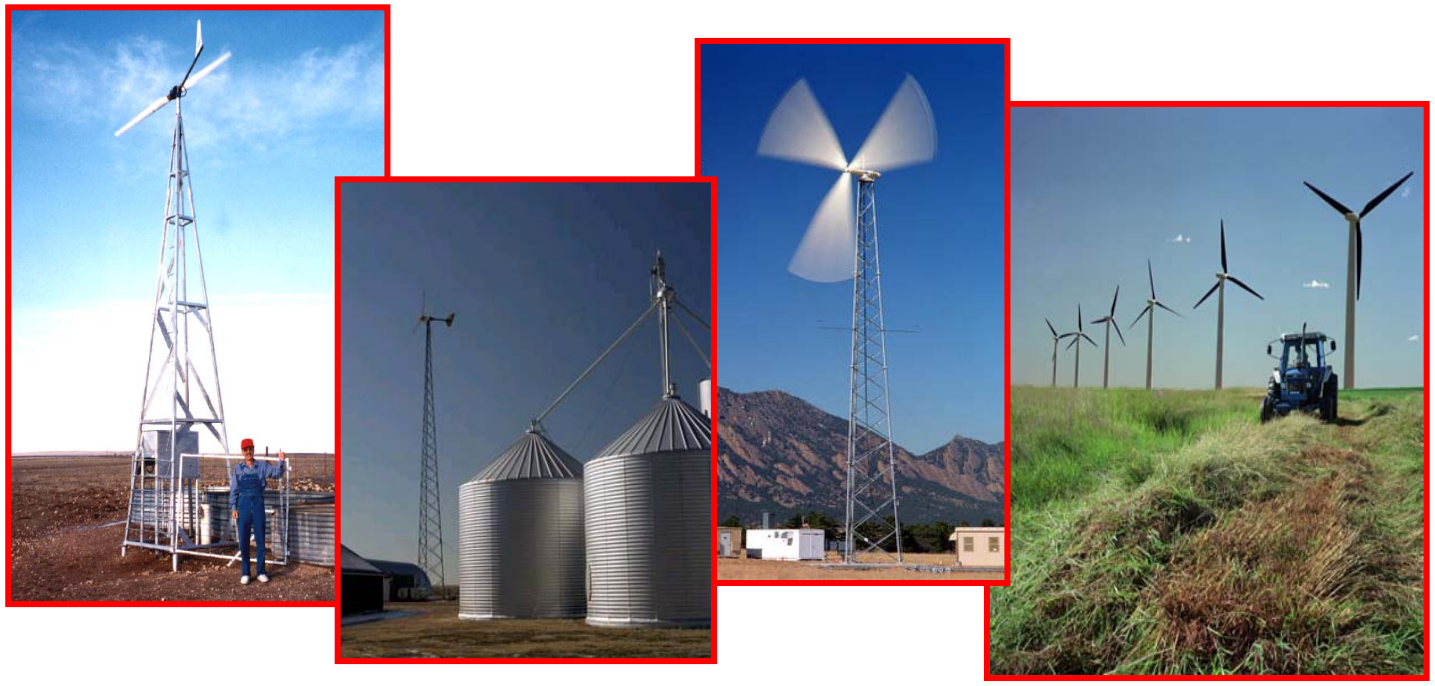
- Better technology alone is not enough, also need emission limits
- Carbon Dioxide Will Get a Value
- $3 to $10 per ton, Rising Over Time
- $10/MWH for Coal, $6 for Gas

WIND POWERING AMERICA

"Wind energy adds diversity to our generation fleet and provides a hedge against fossil fuel price increases. In addition, the development of renewable energy resources is widely supported by the public and our customers."

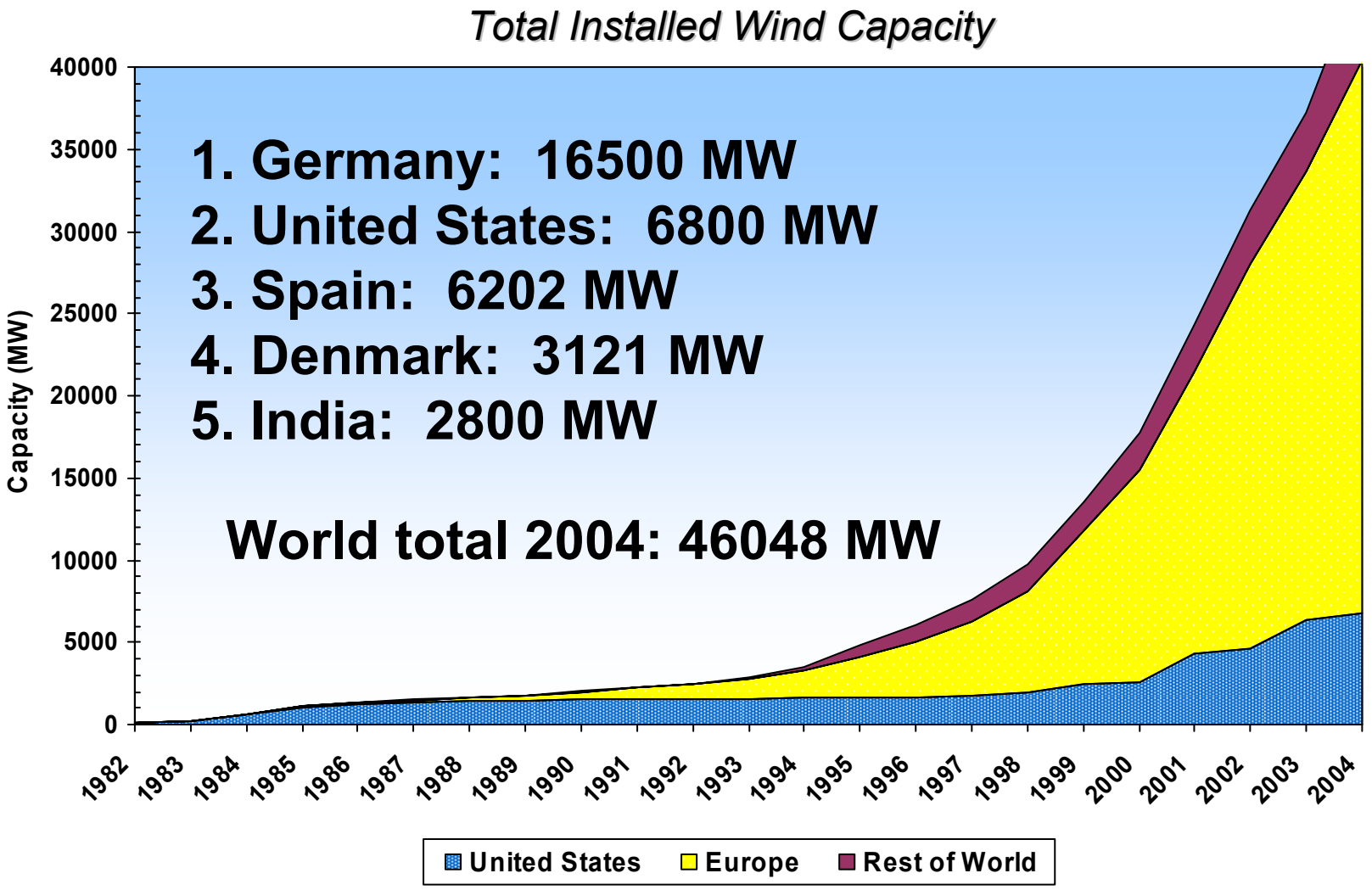
Rick Walker, director, Renewable Energy Business Development, AEP Energy Services, Inc., Dallas, TX

Wind energy can be used for a variety of applications



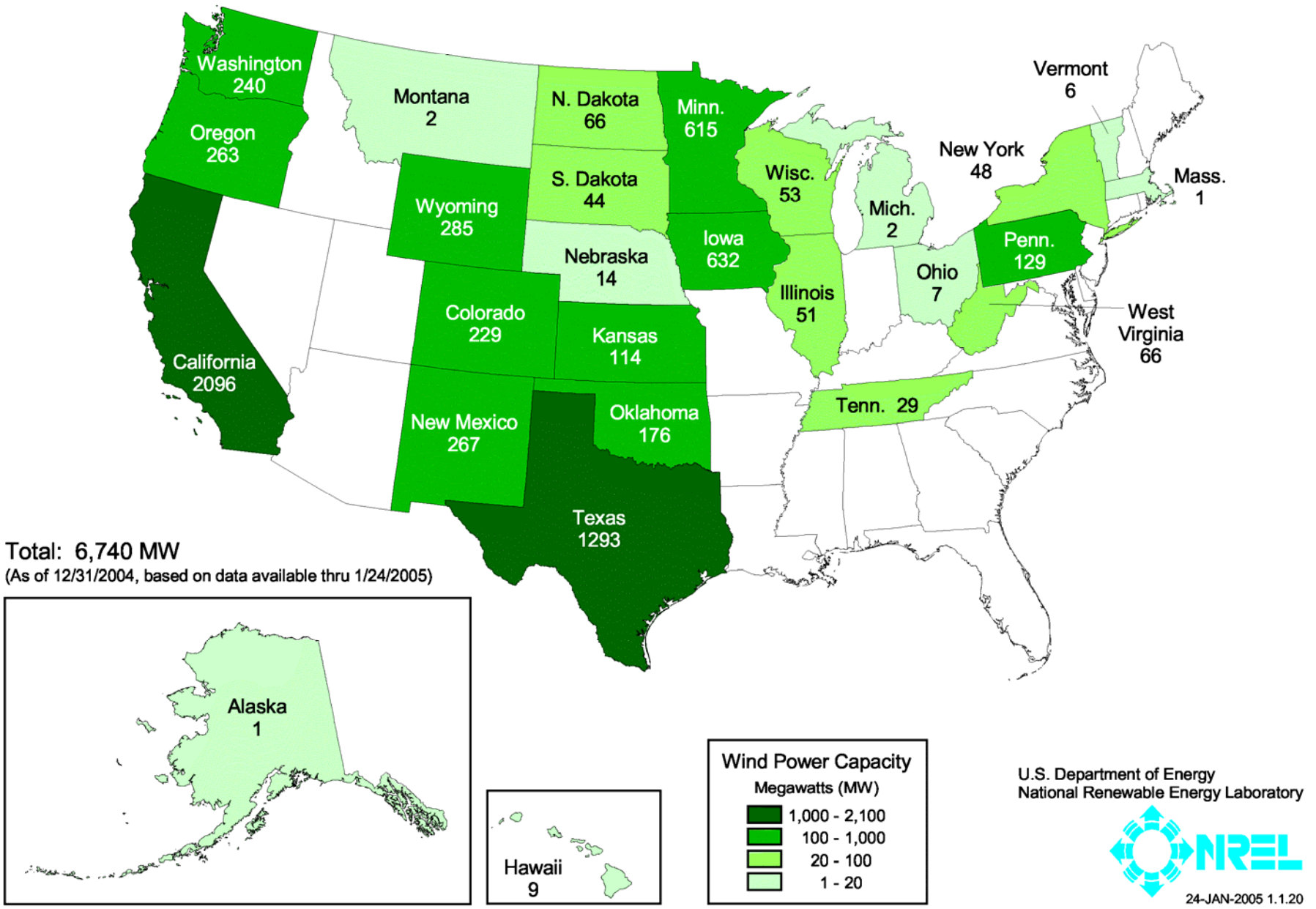
People want renewable energy

World Growth Market



Source: WindPower Monthly

United States - 2004 Year End Wind Power Capacity (MW)



Total: 6,740 MW

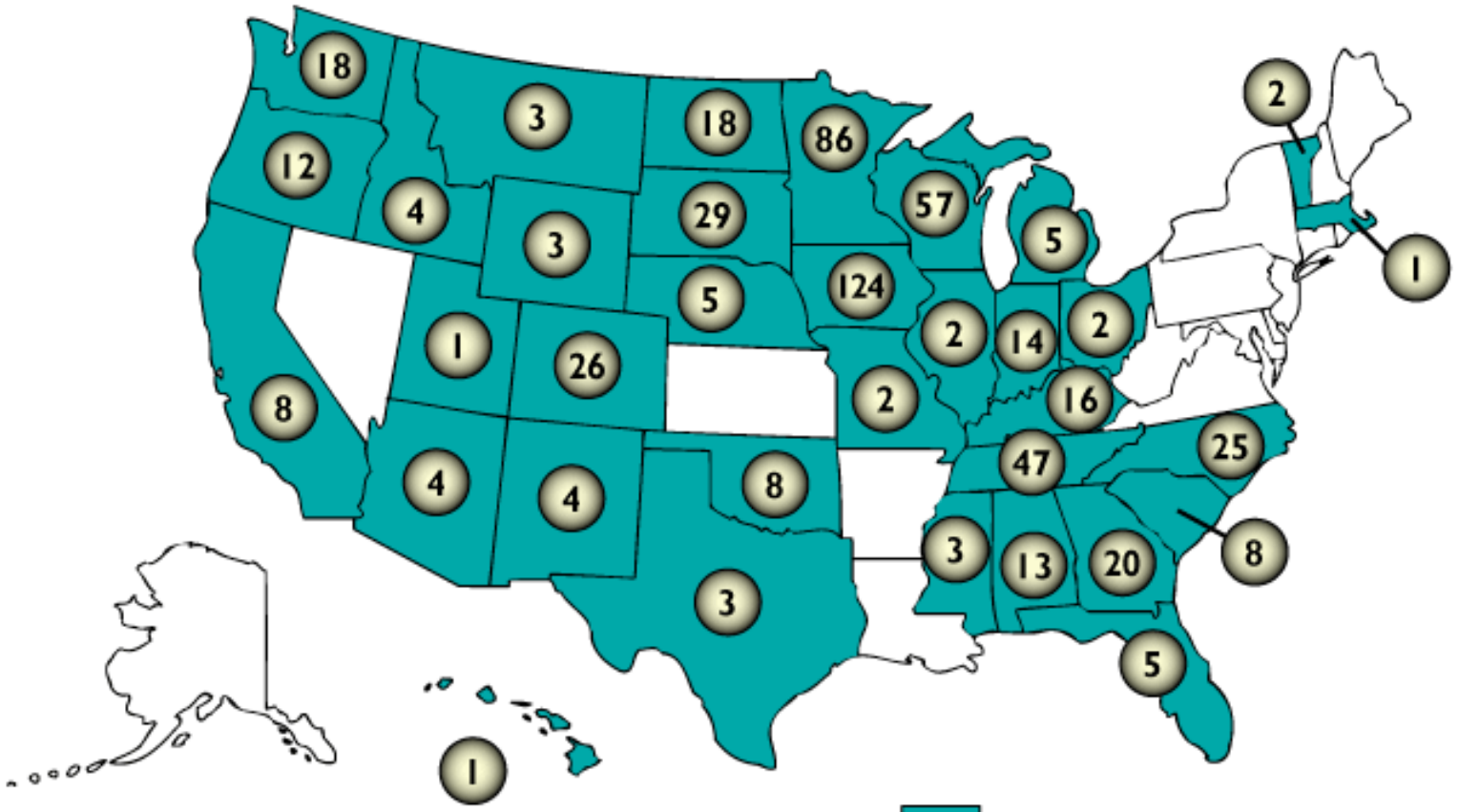
(As of 12/31/2004, based on data available thru 1/24/2005)

U.S. Department of Energy
National Renewable Energy Laboratory

NREL

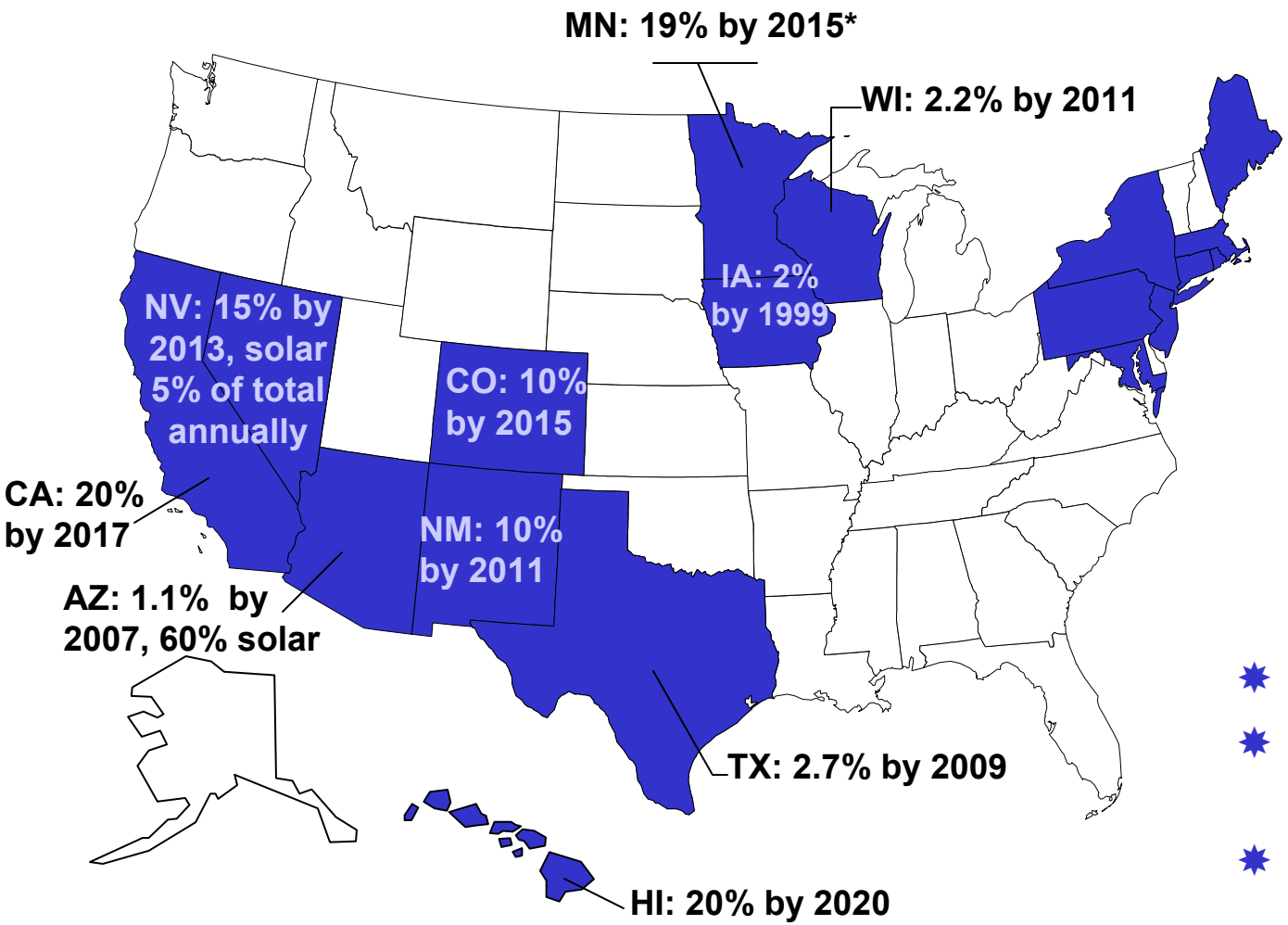
24-JAN-2005 1.1.20

Utility Green Pricing Activities



Source: National Renewable Energy Laboratory (September 2004)

Renewable Electricity Standards



ME: 30% by 2000
MA: 4% by 2009
RI: 16% by 2019
CT: 10% by 2010
NY: 24% by 2013
NJ: 6.5% by 2008
PA: 8% by 2020
MD: 7.5% by 2019
DC: 11% by 2022

- 18 states + D.C.
- 9 states outside of restructuring
- 6 states increased standards

* MN has a minimum requirement for one utility, Xcel Energy

WIND POWERING AMERICA

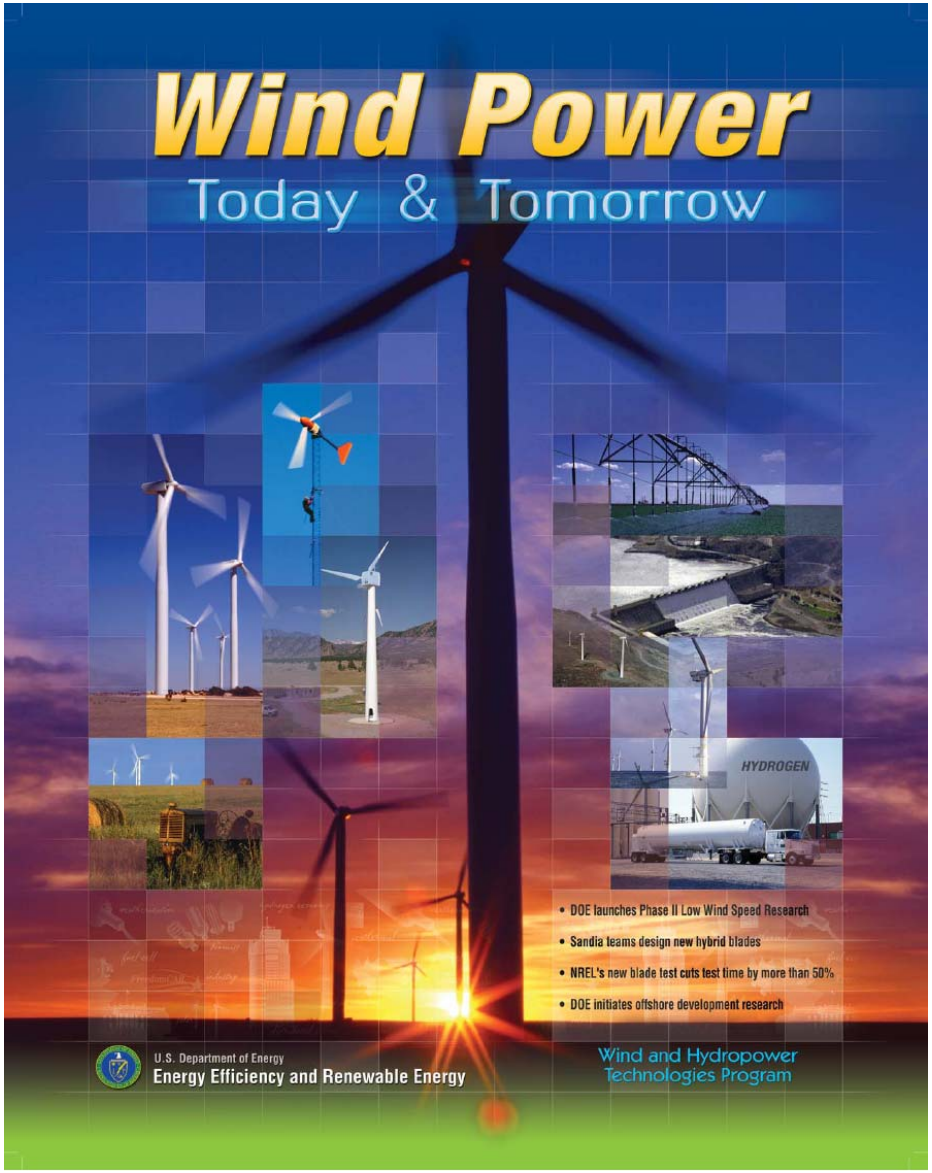
“Our customers wanted this wind program and it was our job to deliver it. It has turned out to be a huge source of community pride. The turbines are a visible landmark showing the Moorhead Community’s commitment to a better world for our children.”

Christopher Reed, Moorhead Public Service, Moorhead, Minnesota

“In my 44 years in the municipal utility business, no utility project has ever generated more customer support and interest than our wind turbine project.”

Nick Scholer, former manager of Algona Municipal Utilities, Algona, Iowa

Wind energy is the fuel of today and tomorrow



Humanity's Top Ten Problems for next 50 years

1. **ENERGY**
2. WATER
3. FOOD
4. ENVIRONMENT
5. POVERTY
6. TERRORISM & WAR
7. DISEASE
8. EDUCATION
9. DEMOCRACY
10. POPULATION

2003	6.3	Billion People
2050	9-10	Billion People

Source: Nobel laureate, Richard Smalley