

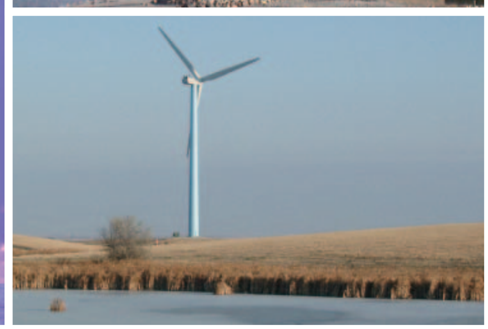
State Wind Working Group Handbook











U.S. Department of Energy
Energy Efficiency and Renewable Energy
Wind and Hydropower Technologies

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WIND POWERING AMERICA

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Introduction to Wind Powering America's State Wind Working Group Resource Handbook

The Wind Powering America team works almost exclusively with state-level partners and stakeholders in a number of sectors, with a focus on electric generation and agriculture. As a result, a variety of issues, questions, and activities that require appropriate information are regularly raised, discussed, and undertaken. To assist our state partners in their efforts to engage effectively in wind energy outreach, Wind Powering America developed a series of topical issue briefs and related PowerPoint presentations. This guidebook addresses the range of basic and technical issues such as wind resource assessment, siting, transmission, economics, utility integration, and the project development process. Policy issues are also addressed, including net metering, green power, policy options, IRP, and development on state and federal lands. We have also included information on WPA's thematic focus areas of federal loads, Native Americans, state activities, public power, and small wind.

It is WPA's intention to use this guidebook to equip the members of the state wind working groups with the necessary information and resource materials to develop and implement an effective educational/information outreach effort to the various stakeholders in the state on the issues, benefits, and policy options related to wind energy. As new issues and developments emerge, WPA intends to add to the guidebook. We encourage the Wind Working Group members to provide feedback to the WPA team on additional topics that should be addressed and other recommendations for improvements that would increase the usefulness of the guidebook.

We look forward to continuing our partnership with the state wind working groups to develop and communicate effective wind energy outreach efforts.

P.J. Dougherty, National Director

Larry Flowers, Technical Director

Wind Powering America: Goals, Approach, Perspectives, and Prospects

Larry Flowers, National Renewable Energy Laboratory
Phil Dougherty, U.S. Department of Energy

1. Goals and Objectives

Wind Powering America, a U.S. Department of Energy (DOE) initiative, is a commitment to dramatically increase the use of wind energy in the United States. Wind Powering America's (WPA's) objectives are to increase rural economic development, protect the environment, and increase energy security. Its goals are to (1) provide 5% of the nation's electricity by 2020, with near-term goals of 500 megawatts (MW) by 2005 and 10,000 MW by 2010; (2) increase the number of states with 20 MW of wind capacity to 16 by 2005 and 24 by 2010; and (3) increase the use of wind power by the federal government to 5% of its annual consumption by 2010.

2. Approach

Following the 1999 WPA initiative announcement, WPA formed a national strategy team and held a series of stakeholder group meetings to gather input on the opportunities, benefits, and challenges for WPA to achieve its goals. Four themes emerged from these deliberations: state-based activities; rural economic development; greening federal loads, and utility partnerships. A set of activities was developed to support each theme and a team composed of members from DOE, the National Renewable Energy Laboratory (NREL), and various stakeholder groups was formed to pursue each theme. General activities that support all themes include application-financial analysis tools, outreach materials, formation of strategic partnerships, and a WPA Web site.

2.1 State-Based Activities

The key activities of the state theme include development of state wind working groups, workshops, anemometer loan programs, landowner and community meetings, state wind resource maps, wind–based supplemental environmental projects (SEPS), assistance in designing policy implementation instruments, and the development of state-specific small wind consumer guides.

2.2 Rural Economic Development

The key activities of the rural economic theme include outreach to agricultural and rural development interests; economic development analysis tools; case study documentation; Native American wind interest groups; Native American anemometer loan program; irrigation pilot project; and an innovative ownership pilot.

2.3 Greening Federal Loads

The key activities of the greening federal loads theme are federal load aggregation, green tags, Federal Energy Management Program (FEMP) coordination, and a special effort to "green" the U.S. Department of Defense (DoD).

2.4 Utility Partnerships

The key activities of the utility partnerships theme are a public power outreach and recognition program, Power Marketing Administration (PMA) green tags, and targeted strategic technical analyses (e.g., wind–hydro system integration and transmission constraints).

3. Operating Principles

WPA established a set of 12 operating principles to guide program investments:

1. **Work at market margins.** WPA concentrates its efforts in "stuck" markets and avoids investing resources in markets that are fully commercial and active. Examples include states with good wind resources but little wind development, Native American reservations, public power organizations, and federal government loads.
2. **Leverage existing institutional relationships.** DOE has established organizations that focus on outreach to federal (FEMP) and state entities (DOE regional offices). DOE's PMAs are well positioned to incorporate wind into the public power market. The states have energy and environmental offices that formulate and implement policies that can impact wind development. WPA engages these existing agencies to leverage their established capabilities, contacts, and activities.
3. **Create new partnerships.** In focus areas, WPA establishes strategic partnerships with agencies/institutions that represent important stakeholder groups that have heretofore under-pursued wind development on behalf of their members. Examples of such organizational partners are the National Rural Electric Association (NRECA), the American Public Power Association (APPA), the American Corn Growers Association (ACGA), the Intertribal Council on Utility Policy (ICOUP), and the Council of Energy Resource Tribes (CERT).
4. **Pursue strategic opportunities.** In situations in which wind can significantly expand its application boundaries, WPA pursues the necessary education, analysis, pilot projects, and partnerships to implement the expansion. An example is the

supplemental environmental projects (SEP) in which air quality violators can purchase wind power in lieu of paying the fine.

5. **Develop innovative pilot projects.** In cases of new applications or ownership possibilities, WPA collaborates on the design and implementation of pilot projects that demonstrate the administrative, policy, and techno-economic aspects of the innovation. Completed pilot projects include federal load aggregation and SEP implementation. Currently, WPA is pursuing pilots on irrigation net metering, rural ownership options for small wind systems, and Native American wind working groups and installations. A pilot project must have significant regional or national replication potential for it to receive WPA investment.

6. **Replicate successes.** Following the successful completion of a pilot project, WPA will work with local, state, and regional organizations to replicate the application.

7. **Educate, equip, and support state wind working groups.** WPA recognizes the necessity of developing multi-stakeholder support of wind energy prior to the development of enabling policies. To that end, WPA helps state stakeholder groups organize and educate wind working groups to discuss the barriers to and benefits of wind energy development. This effort is aimed at developing a strategic action plan that often includes state-wide, targeted, and landowner workshops.

8. **Select and address challenging strategic markets.** Although certain institutions have great potential, there are significant institutional barriers to wind development within those institutions. WPA focuses its outreach and technical assistance on these institutions because they represent a difficult market for commercial business. Currently, the institutions WPA focuses on include the Department of Defense, Native Americans, and rural electric cooperatives.

9. **Develop and disseminate targeted information, analyses, and tools.** WPA augments the efforts of DOE's wind research program, the American Wind Energy Association (AWEA), and other wind-related organizations to identify and address gaps in technical information and tools needed for its four thematic areas. Examples include development and access to simplified spreadsheet tools for initial analyses of wind project economics, irrigation net-metering projects and economic development impacts; development and distribution of state-specific wind maps and small wind application guidebooks; and publication of a brochure that focuses on wind opportunities, case studies, and economics for rural electric co-ops.

10. **Document activities and resources.** WPA has developed a user-friendly Web site (www.windpoweringamerica.gov) on which it posts information and links for all four thematic areas. The WPA Web site also provides regional and national event calendars, wind resource maps, stakeholder interviews, analytical tools, and recent WPA presentations.

11. **Utilize existing national, regional, and local expertise.** To enhance credibility with the various wind stakeholder groups, WPA utilizes appropriate experienced stakeholders to address the issues, share their experience, and discuss opportunities in targeted workshops.

12. **Coordinate with established wind institutional resources.** WPA recognizes the established efforts, networks, and effectiveness of existing wind energy organizations, including AWEA, the National Wind Coordinating Committee (NWCC), and the Utility Wind Interest Group (UWIG). WPA coordinates and participates with these groups to ensure collaboration and to add value to its activities.

4. Stakeholder Perspectives

Because WPA values the different perspectives of industry stakeholders on the value of wind energy, it highlighted representatives of 12 stakeholder groups in its 2001 calendar in an attempt to appeal to a broad set of stakeholders (www.windpoweringamerica.gov/calendar.html).

A representative selection of these perspectives follows.

Rural Electric Cooperatives

"It seems only natural for rural utilities to do everything they can to advance both farm-based renewable energy development and rural economic development in a cost-effective way. In my opinion, wind energy is the next great chapter in the rural electrification story."
Aaron Jones, Washington Rural Electric Cooperative Association; Olympia, Washington

Municipal Electric Utilities

"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

Investor-Owned Utilities

"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, Texas

Utility Commissioners

"You don't have to be a utility commissioner to see that we need better regulatory policies to achieve the diversity, economic development, and environmental benefits of wind power."

Bob Anderson, Montana Public Service Commission, Helena, Montana

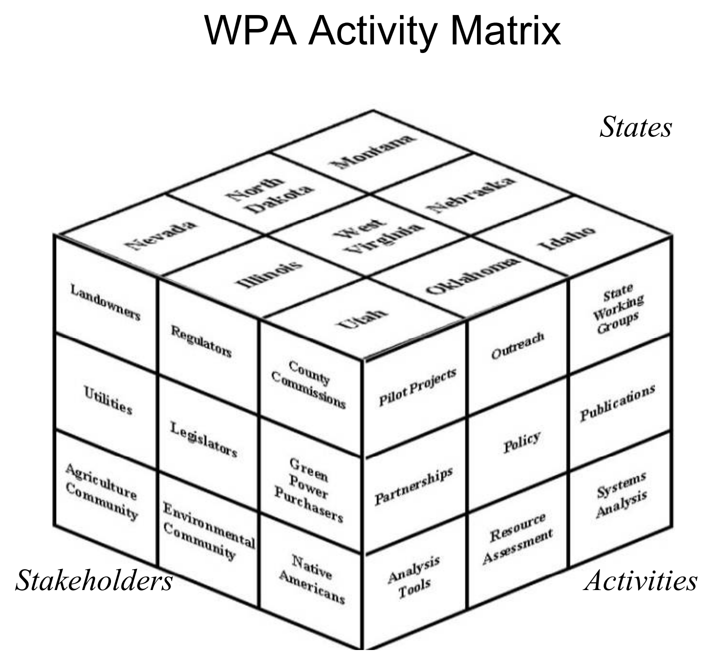


Figure 1: Wind Powering America program matrix.

County Commissioners/Rural Landowners

"Wind is a homegrown energy that we can harvest right alongside our corn, soybeans, and 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

State Legislators

"The wind offers energy independence for many Kansas residents. Federal, state, and local governments should work together to provide access to affordable energy choices."

State Representative Tom Sloan, Lawrence, Kansas

Native Americans

"In evaluating the potential of wind energy generation, Native Americans realize that wind power is not only consistent with our cultural values and spiritual beliefs, but can also be a means of achieving Native sustainable homeland economies."
Ronald Neiss, Rosebud Utility Commission president, Rosebud Sioux Reservation, South Dakota

5. Program Representation

The three key dimensions (activities, stakeholders, regional focus) of the WPA program can be represented as a cubic matrix (Figure 1).

6. Prospects

With the extension of the production tax credit (PTC), wind development will continue in 2003. AWEA estimates that 4,685 MW of wind energy capacity was installed in the United States by the end of 2002, which is close to WPA's goal of 5,000 MW installed by 2005. WPA expects the number of states that exceed 20 MW of installed capacity will expand at a pace significantly faster than originally anticipated. By the end of 2002, there were 12 states with more than 20 MW installed. Assuming the further extension of the PTC, WPA forecasts that 17 states will meet or exceed this level by the end of 2003 (1 more than the 2005 goal) and 26 will do so by the end of 2005 (two more than 2010 goal). With the successful development of the low-wind-speed turbine and progress on the state and federal policy fronts, it is not unreasonable to expect that 39 states will have a minimum of 20 MW installed by 2010. WPA also expects to see a diversified portfolio of project sizes, ownership structures, applications, and system configurations, each suited to state and regional markets, resources, policies, and conditions.

WPA will remain responsive to stakeholder interests and needs and will adapt its activities to augment the expanding commercial markets strategically.

Carpe Ventem!

Wind Energy: Technology, Markets, Economics, and Stakeholders

Larry Flowers
NREL
09 December 2002

Boone, NC

Sizes and Applications

Small (≤10 kW)

- Homes
- Farms
- Remote Applications

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

Intermediate (10-250 kW)

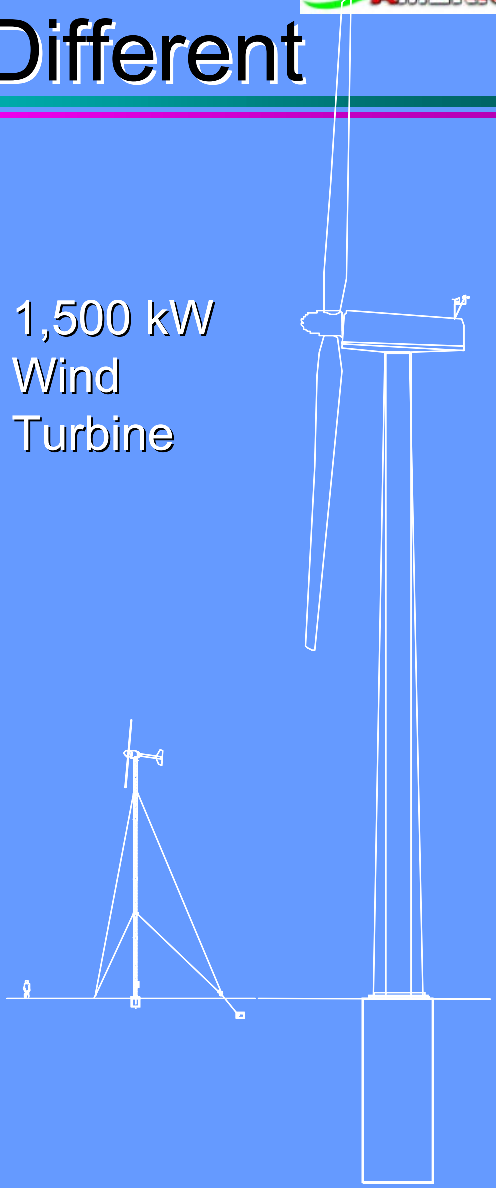
- Village Power
- Hybrid Systems
- Distributed Power

Large (250 kW - 2+MW)

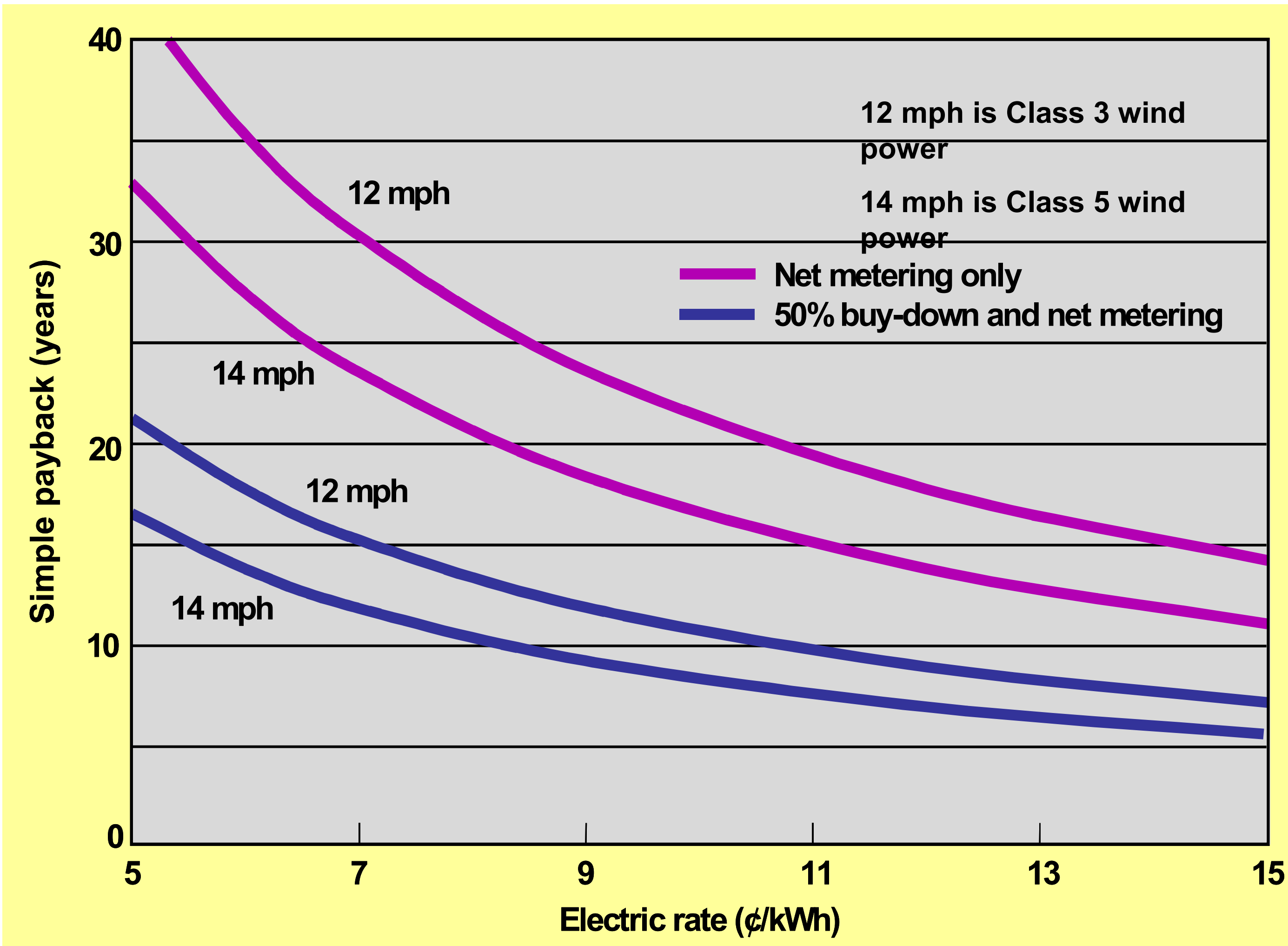
- Central Station Wind Farms
- Distributed Power

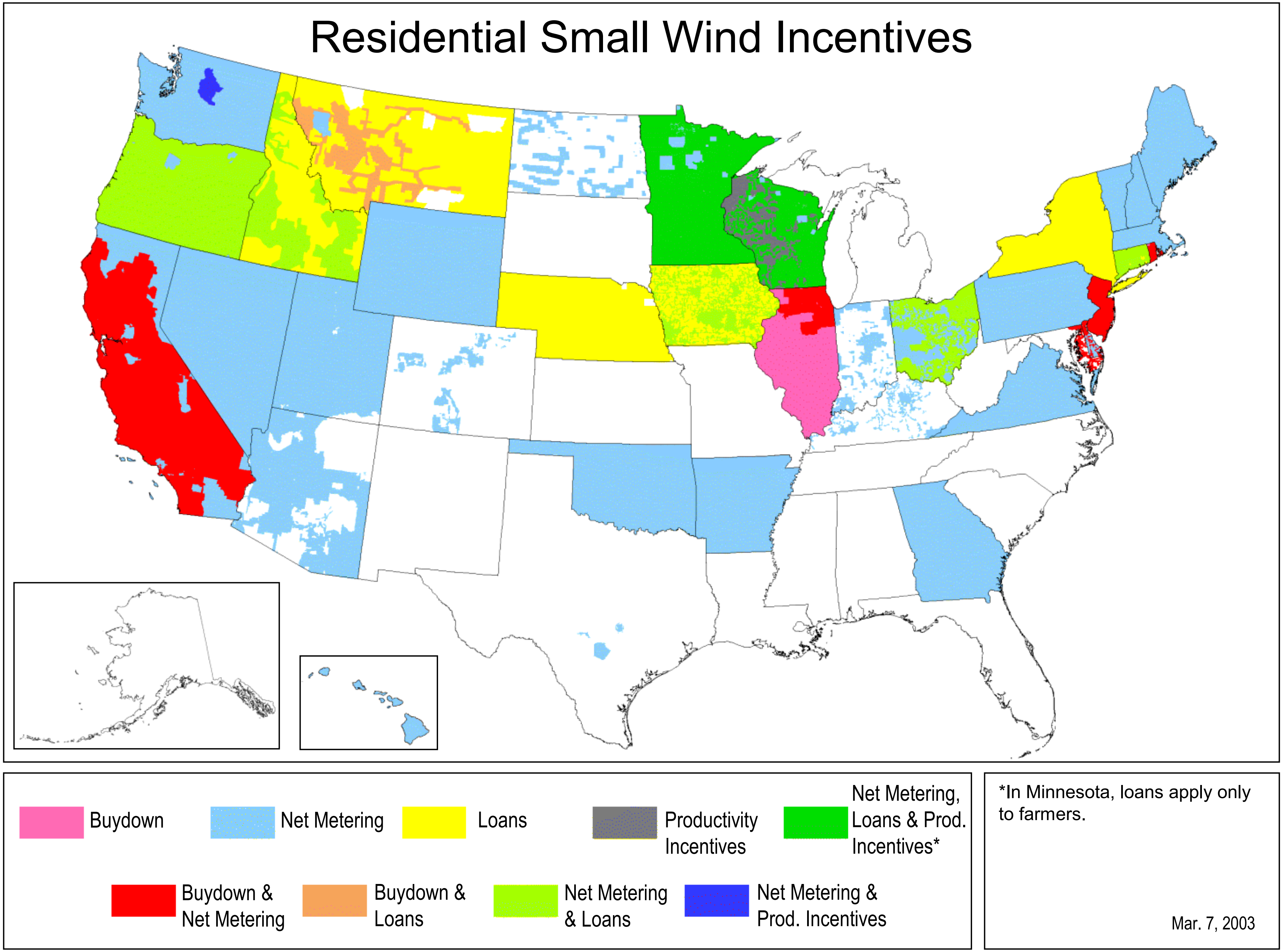
Small Wind Turbines Are Different

- Large Turbines (600-1800 kW)
  - Installed in Wind Farms, 10 - 100 MW
  - Provide Low-Cost Power to the Grid
  - < $1,000/kW
  - Require 6 m/s (13 mph) Average Wind Speeds
- Small Turbines (0.3-50 kW)
  - Installed Off-Grid or at On-Grid Facilities
  - $2,000-6,000/kW
  - Designed for Reliability/Low Maintenance
  - Require 4 m/s (9 mph) Average



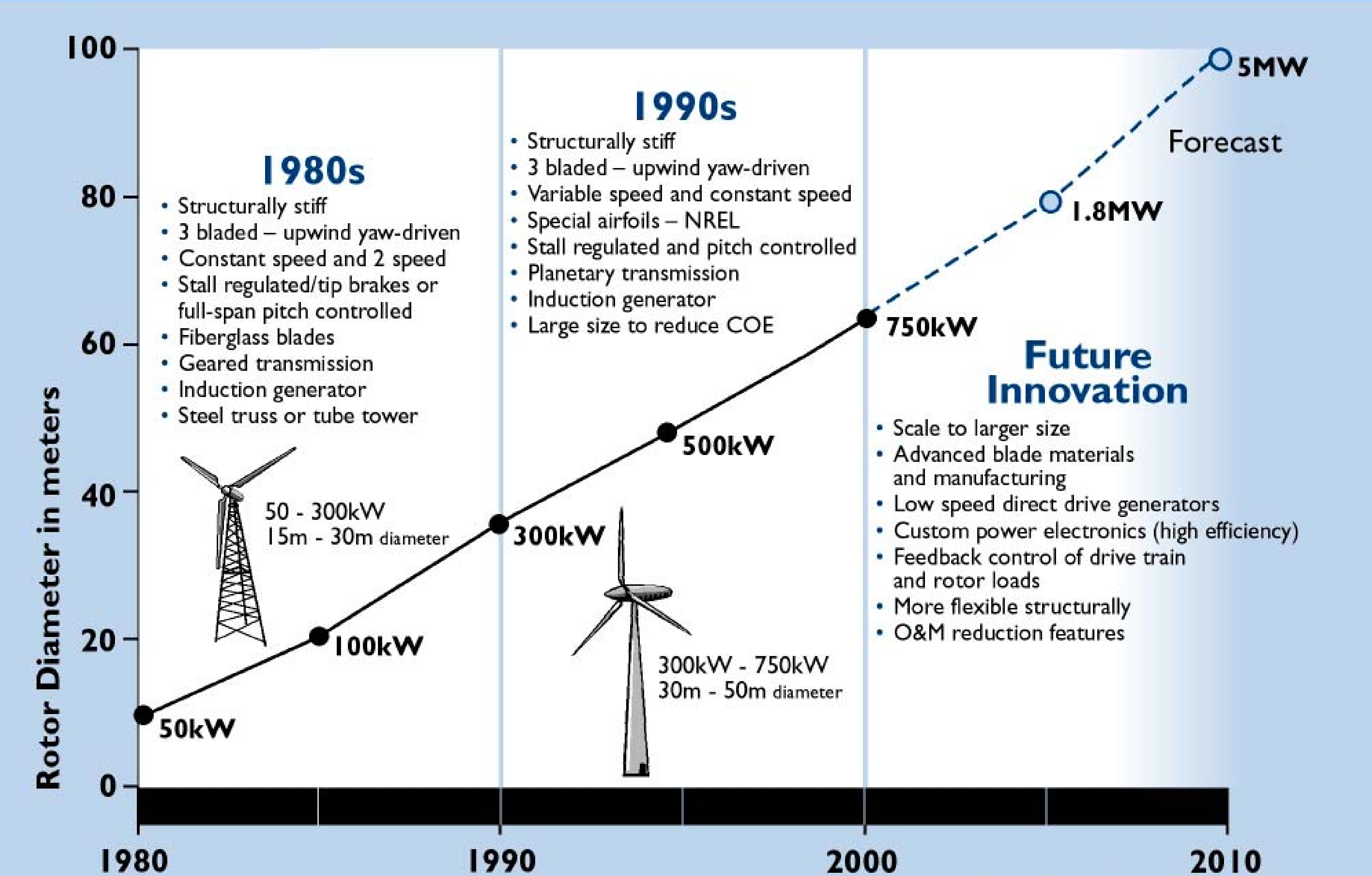
Incentives Make Small Wind Systems More Economical





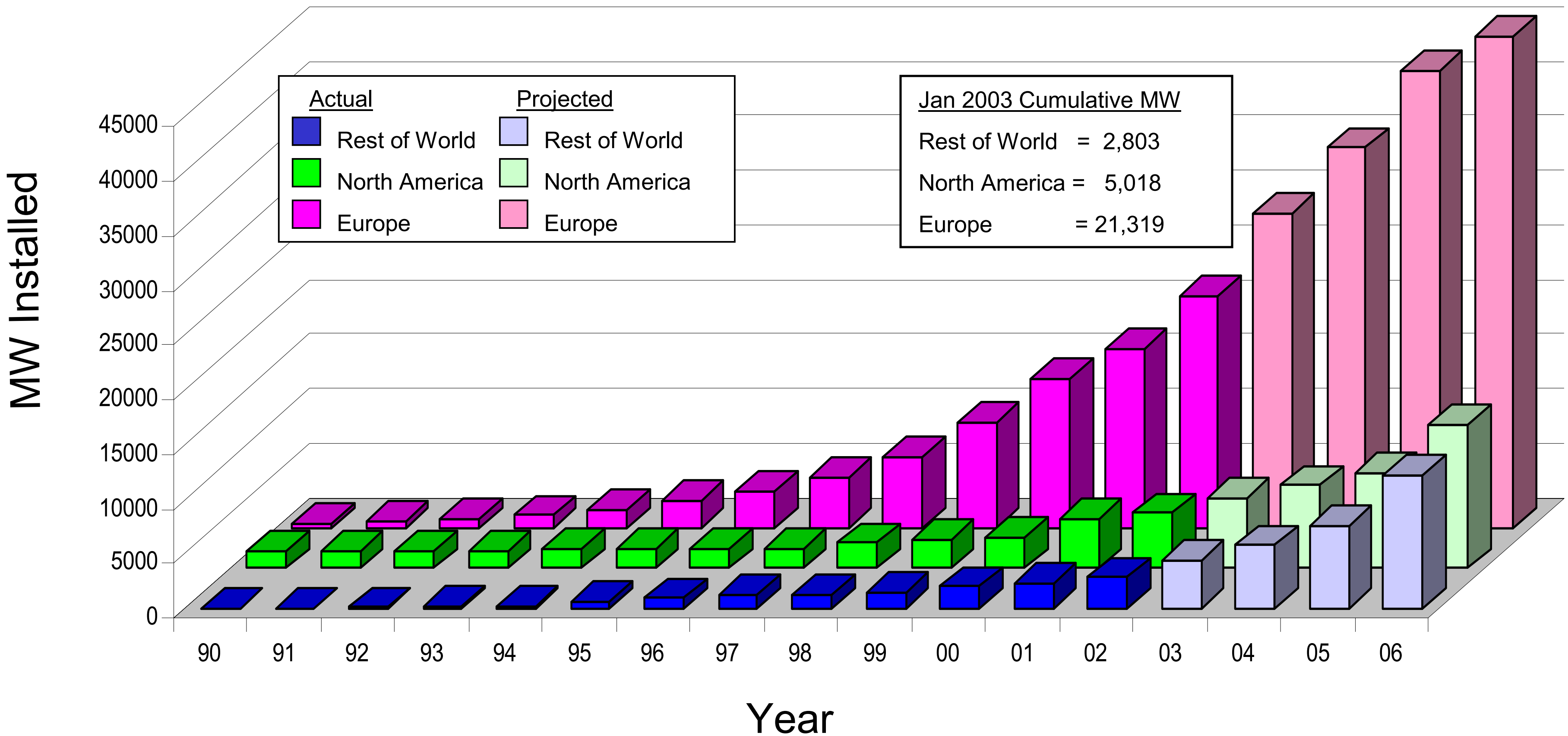
Residential Small Wind Incentives
Buydown
Net Metering
Loans
Productivity Incentives
Net Metering, Loans & Prod. Incentives*
Buydown & Net Metering
Buydown & Loans
Net Metering & Loans
Net Metering & Prod. Incentives
*In Minnesota, loans apply only to farmers.
Mar. 7, 2003

The Evolution of Commercial U.S. Wind Technology

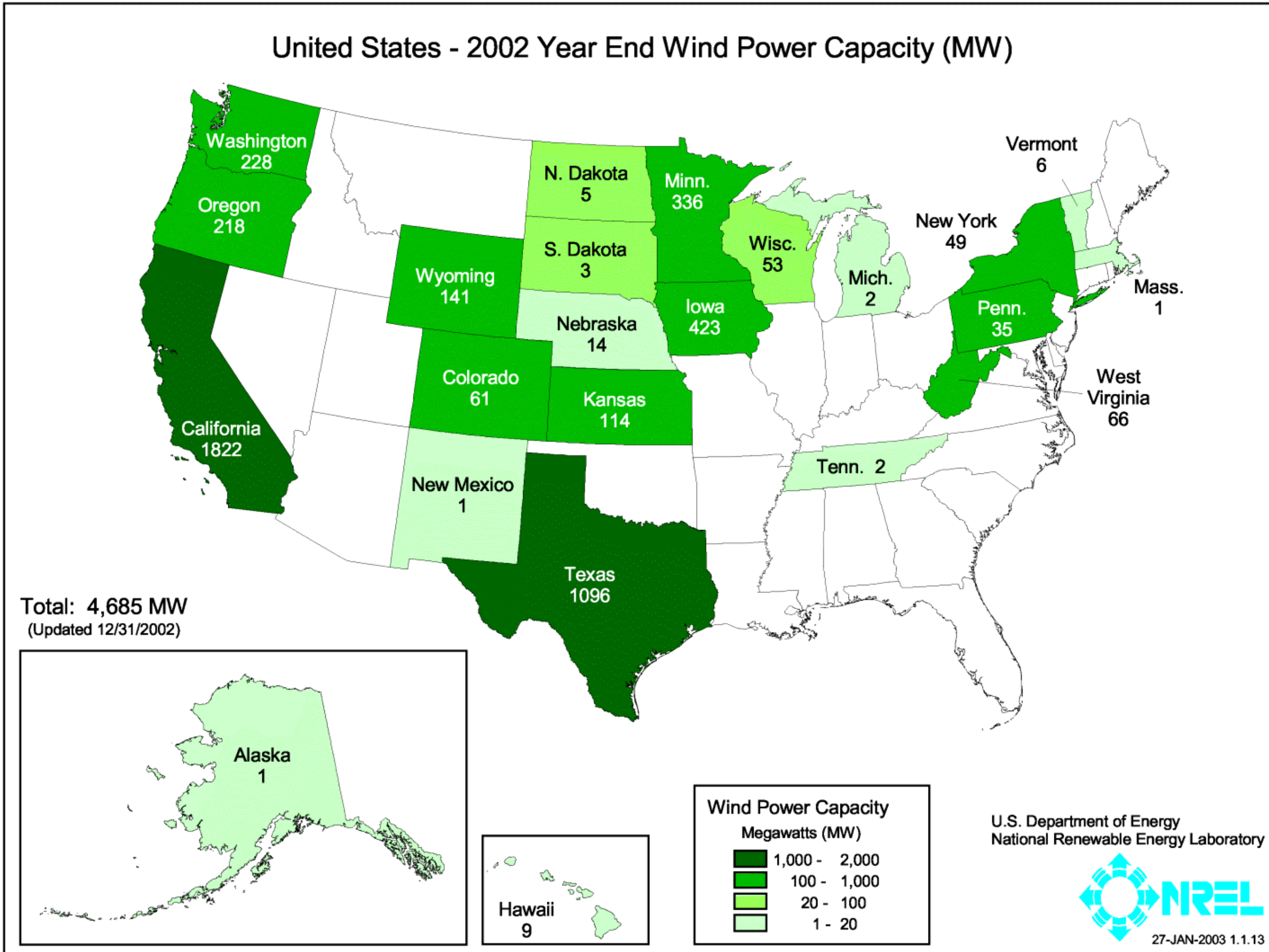


Source: Thresher & Dodge, Wind Energy Journal 1998

Growth of Wind Energy Capacity Worldwide



Sources: BTM Consult Aps, March 2001
Windpower Monthly, January 2003


United States - 2002 Year End Wind Power Capacity (MW)
Washington 228
Oregon 218
California 1822
Wyoming 141
N. Dakota 5
S. Dakota 3
Minn. 336
Wisc. 53
Iowa 423
Nebraska 14
Colorado 61
Kansas 114
New Mexico 1
Texas 1096
Mich. 2
Tenn. 2
New York 49
Vermont 6
Mass. 1
Penn. 35
West Virginia 66
Alaska 1
Hawaii 9
Total: 4,685 MW
(Updated 12/31/2002)
Wind Power Capacity
Megawatts (MW)
1,000 - 2,000
100 - 1,000
20 - 100
1 - 20
U.S. Department of Energy
National Renewable Energy Laboratory
27-JAN-2003 1.1.13

Maturing Wind Technology

- Technology has matured over 25 years of learning experiences
- Availabilities reported of 98-99%
- Certification to international standards helps to avoid “show stoppers”
- Performance and cost have dramatically improved
- New hardware is being developed on multiple fronts:
  - Higher productivity and lower costs
  - Larger sized for both land and off-shore installations
  - Tailored designs for high capacity factor, low wind speed, and extreme weather conditions

Drivers for Wind Power

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

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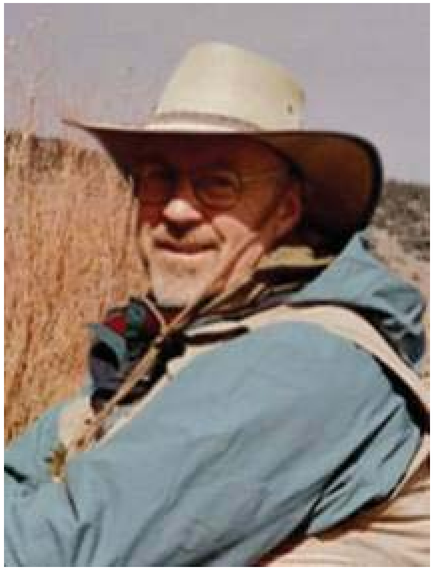
Bob Anderson, Montana Public Service Commission, Helena, Montana



Wind Economics: Determining Factors

- Wind resource
- Financing and ownership structure
- Taxes and policy incentives
- Plant size: equipment, installation, and O&M economies of scale
- Turbine size, model, and tower height
- Green field or site expansion
- What is included: land, transmission, ancillary services

Cost of Energy Trend

1979: 40 cents/kWh

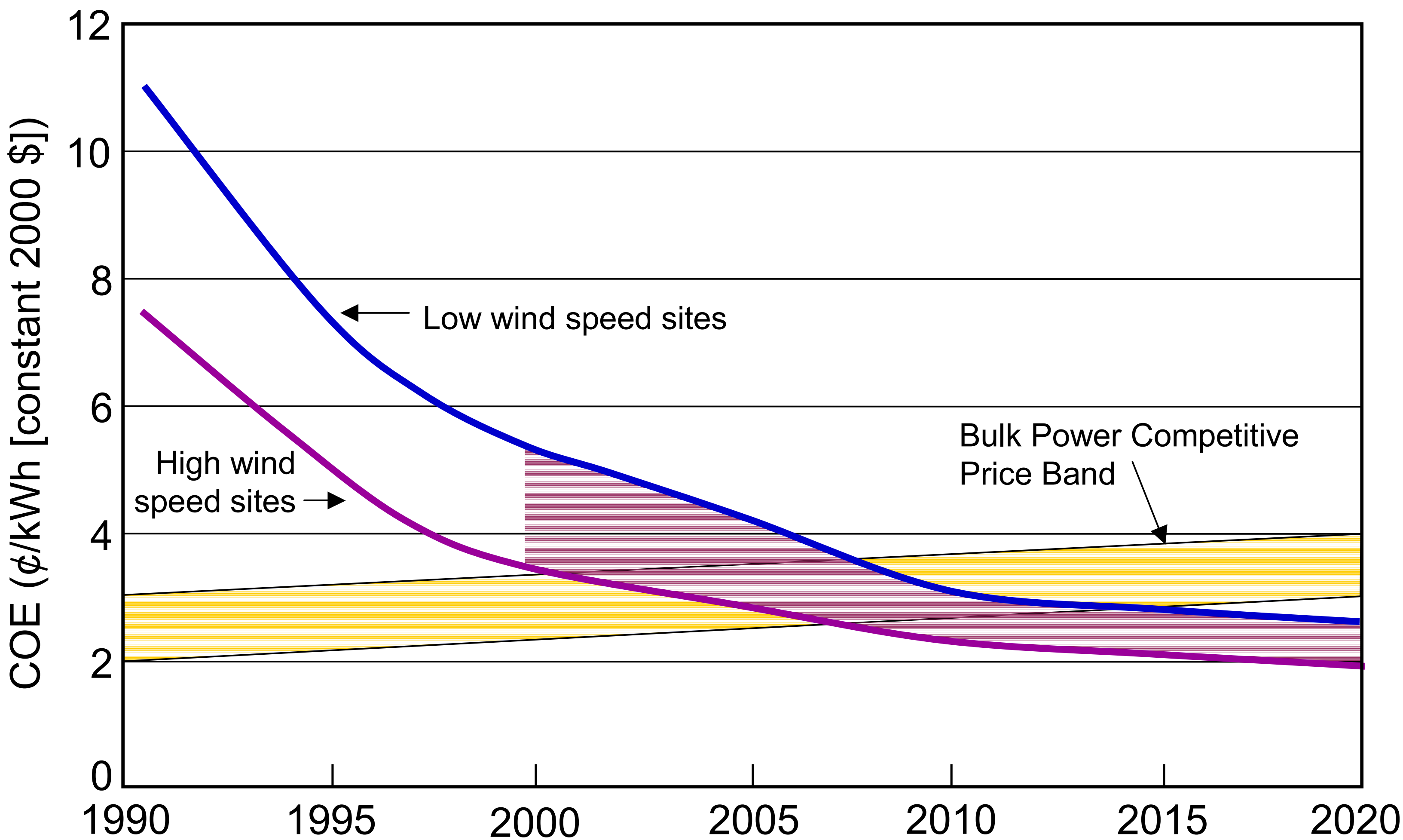
2000:
4 - 6 cents/kWh

NSP 107-MW Lake Benton wind farm
4 cents/kWh (unsubsidized)

- Increased Turbine Size
- R&D Advances
- Manufacturing Improvements

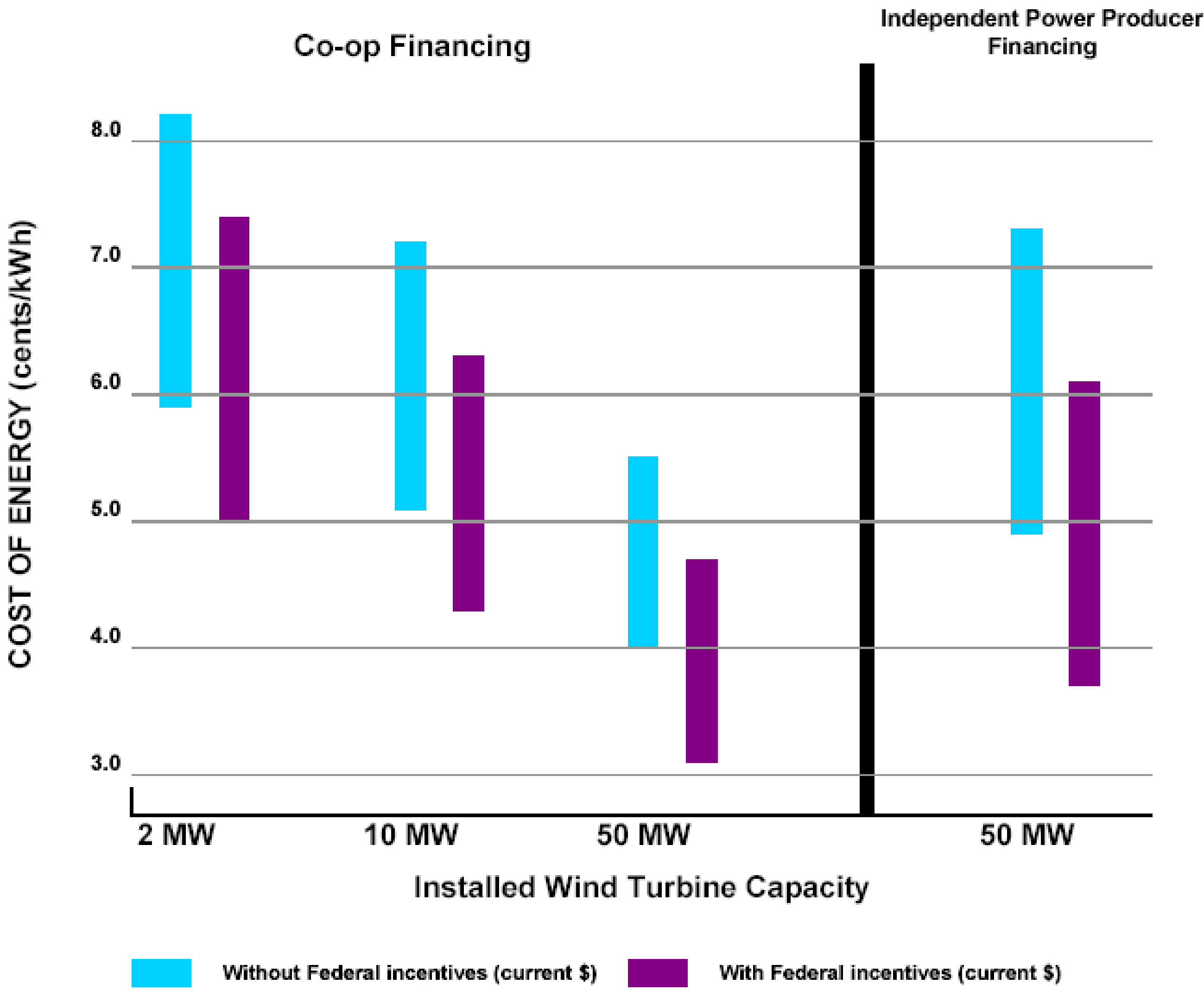
2004:
3 – 4.5 cents/kWh

Wind Cost of Energy



Co-op vs. IPP Financing

- Larger plants are significantly less expensive per kWh
- Public power can own/ install smaller plants at a comparable cost to large IPP projects
- Aggregation of demand reduces costs



"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."

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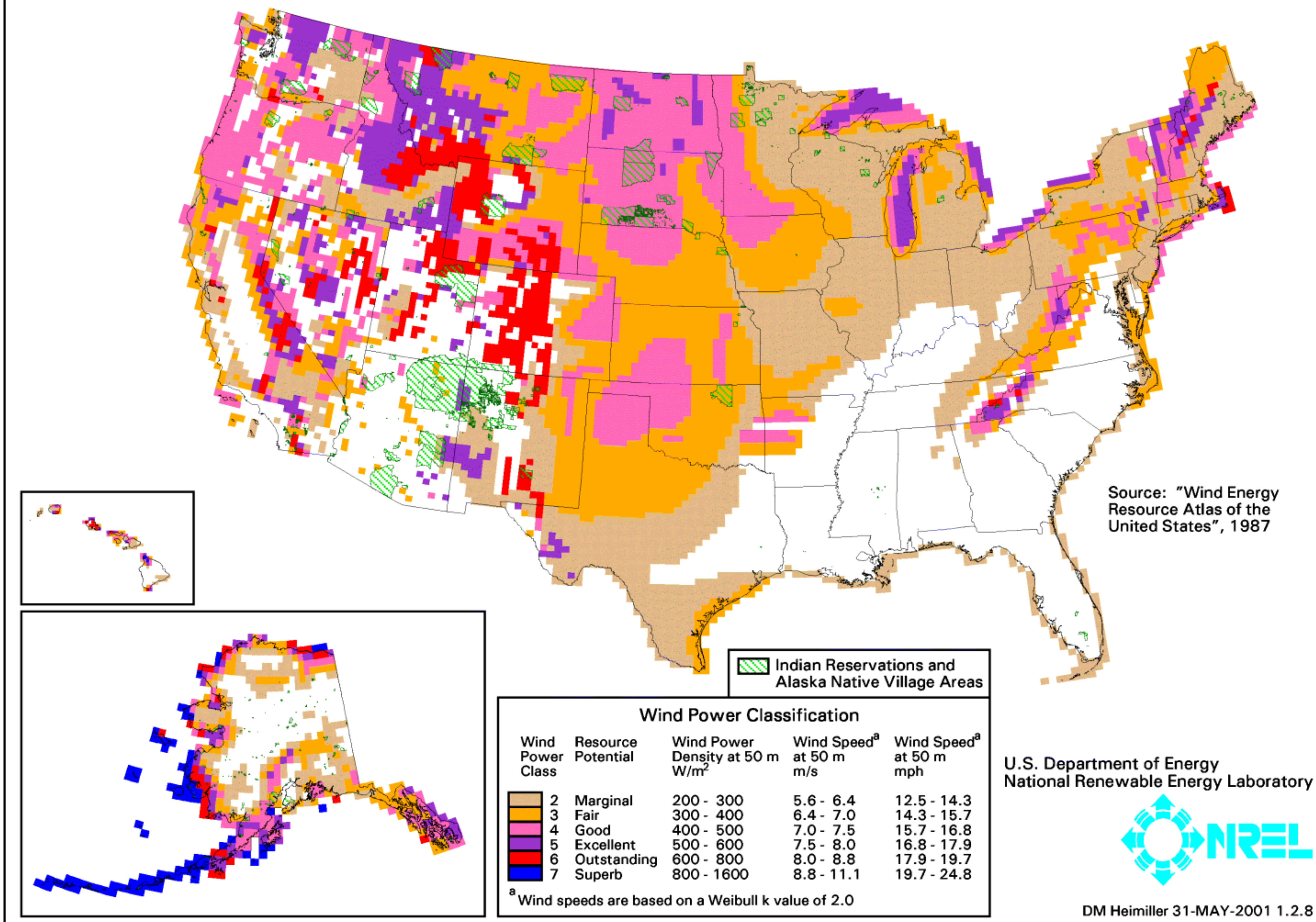
United States - Wind Resource Map



Recent Developments

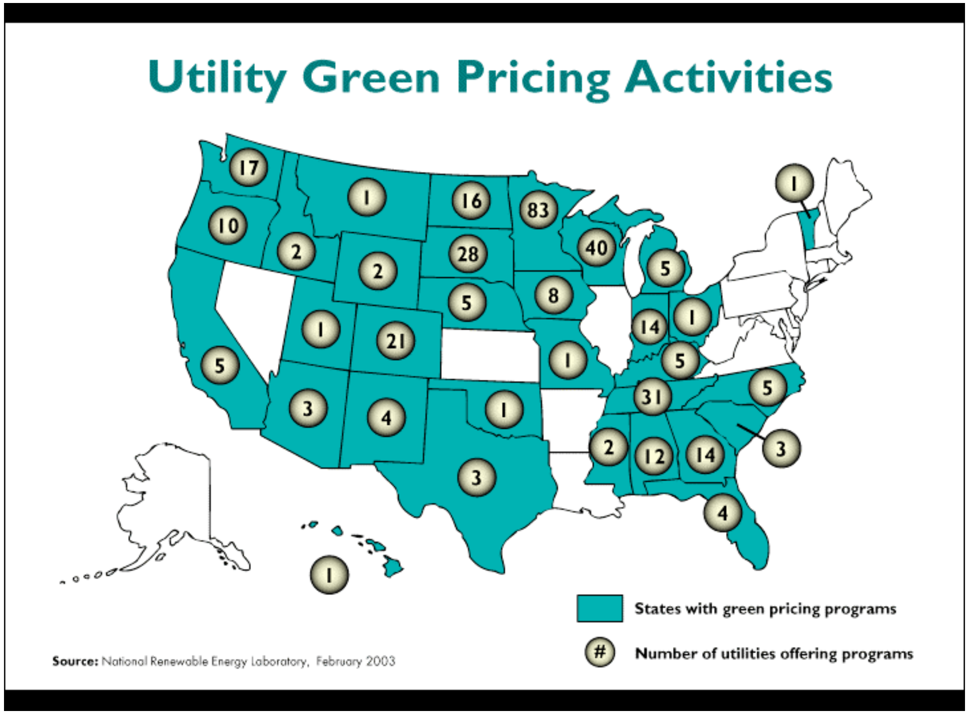
- The wind industry is delivering ~3 cent/kWh contracts, including PTC for large projects
- Several large projects under development
  - 300 MW Stateline (WA/OR)
  - 109 MW Utilicorp (KS)
  - 4>100 MW under development in West Texas
- Gas price increases and the power crisis
  - CO: 162 MW of wind wins all-source bid on economics alone
  - "wind is the lowest cost resource"
  - serious consideration of GW (BPA, Austin)
  - transmission and grid impacts to the forefront
- RUS loan to Basin Electric for Green Pricing program in S. Dakota
- NPPD RFP for 20 MW

Wind Farm Development: Driving Factors

- Wind resource
- Proximity to transmission lines/substations with excess capacity
- State policy provisions
  - property/sales tax
  - permitting and review
  - subsidies and incentives
  - renewable power purchase mandates
- Utility green power programs and customer demand
- Federal policy
  - renewal of production tax credit
  - potential purchase mandates

Green Power & Customer Choice

- More than 90 utilities in 30 states offer green pricing programs in which customers pay a premium to cover extra cost of renewable energy.
- Many utilities are offering green products to meet customer demand and diversify supply portfolio.



Map from DOE's Green Power site at www.eren.doe.gov/greenpower

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"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."

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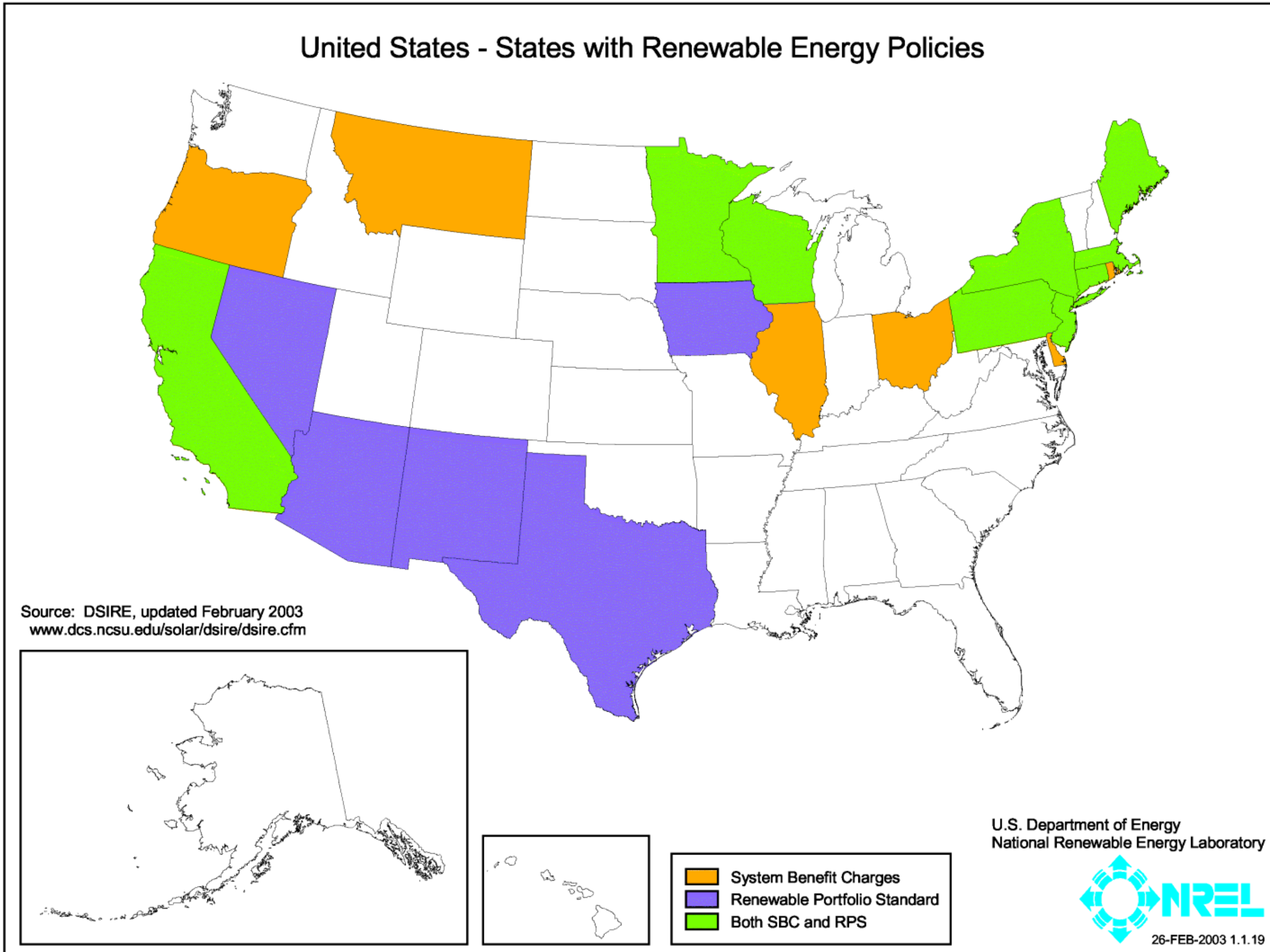
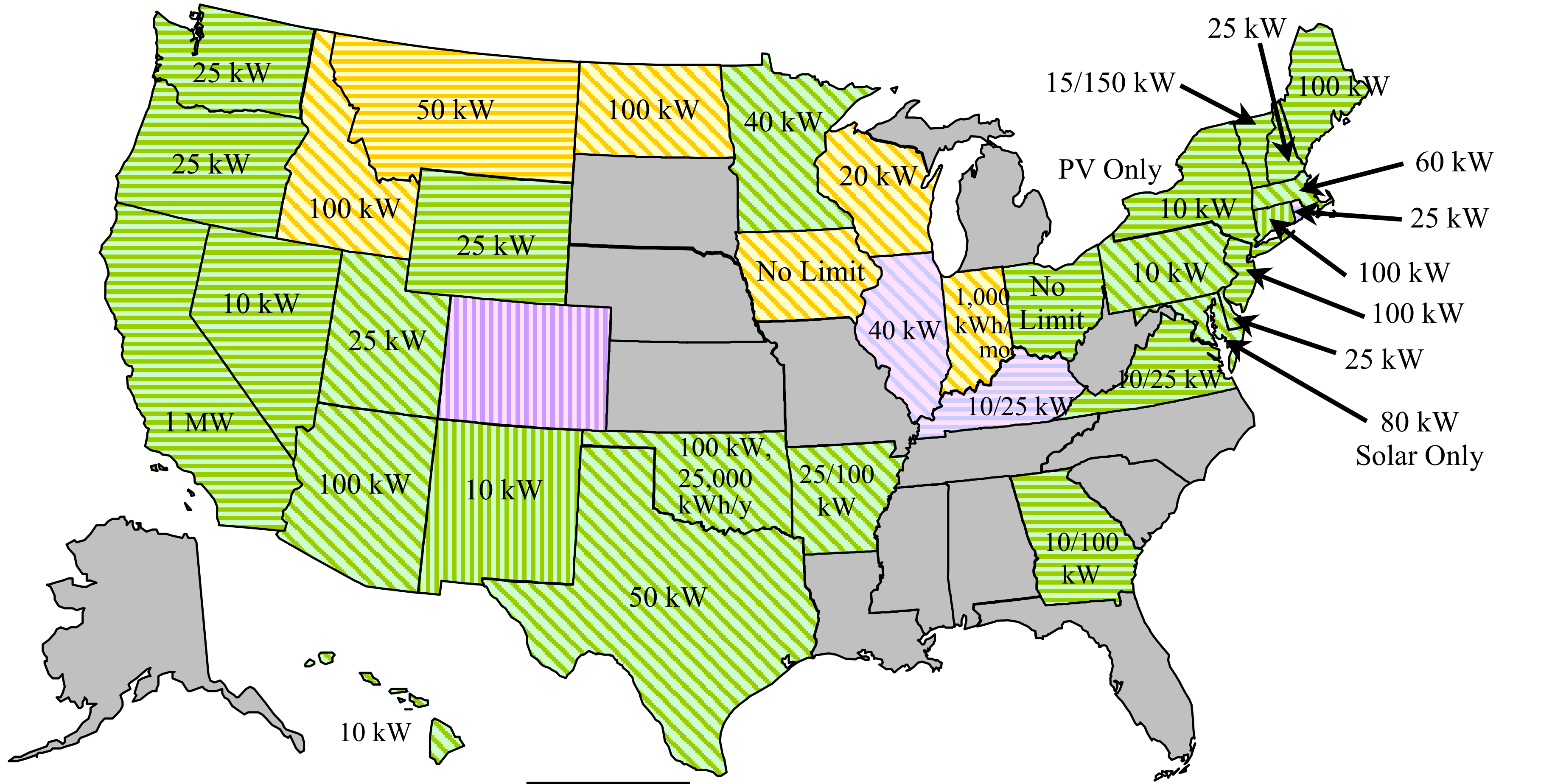

United States - States with Renewable Energy Policies
Source: DSIRE, updated February 2003
www.dcs.ncsu.edu/solar/dsire/dsire.cfm
System Benefit Charges
Renewable Portfolio Standard
Both SBC and RPS
U.S. Department of Energy
National Renewable Energy Laboratory
NREL
26-FEB-2003 1.1.19

"The wind offers energy independence for many Kansas residents. Federal, state, and local governments should work together to provide access to affordable energy choices."

State Representative Tom Sloan, Lawrence, Kansas

Net Metering by State



Monthly Net Metering
Annual Net Metering
Varies by Utility or Unknown

None
Individual Utilities
Investor-Owned Utilities Only, Not Rural Cooperatives
Investor-Owned Utilities and Rural Cooperatives

Revised: 15 Aug 02

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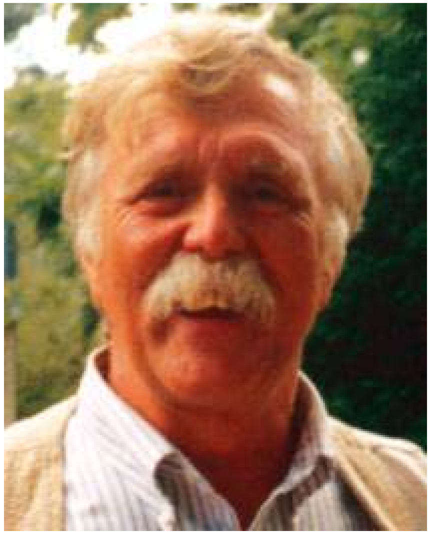
Aaron Jones, Washington Rural Electric Cooperative Association, Olympia, WA

Economic Development Opportunities

- Land lease payments: 2-3% of gross revenue $2500-4000/MW/year
- Local property tax revenue: 100 MW brings in on the order of $1 million/yr
- 1-2 jobs/MW during construction
- 2-5 permanent O&M jobs per 50-100 MW
- Local construction and service industry: concrete, towers usually done locally
- Investment as equity owners: production tax credit, accelerated depreciation
- Manufacturing and assembly plants expanding in U.S. (Micon in IL, LM Glasfiber in ND)



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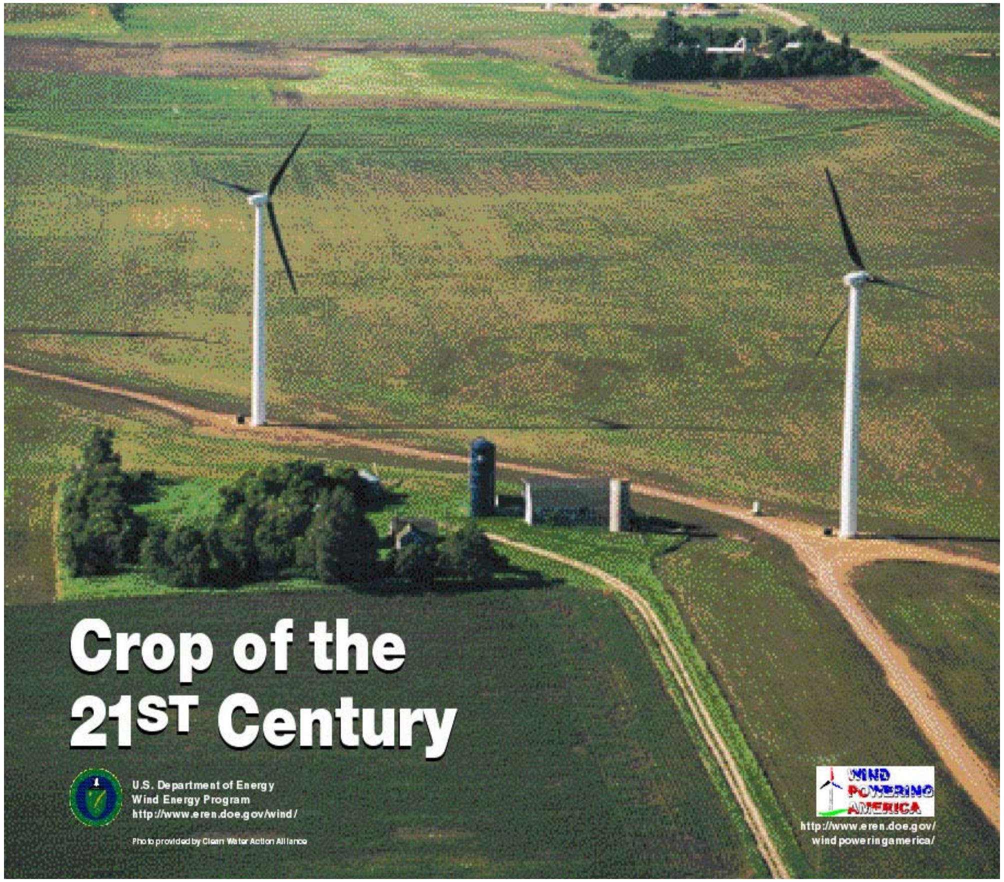
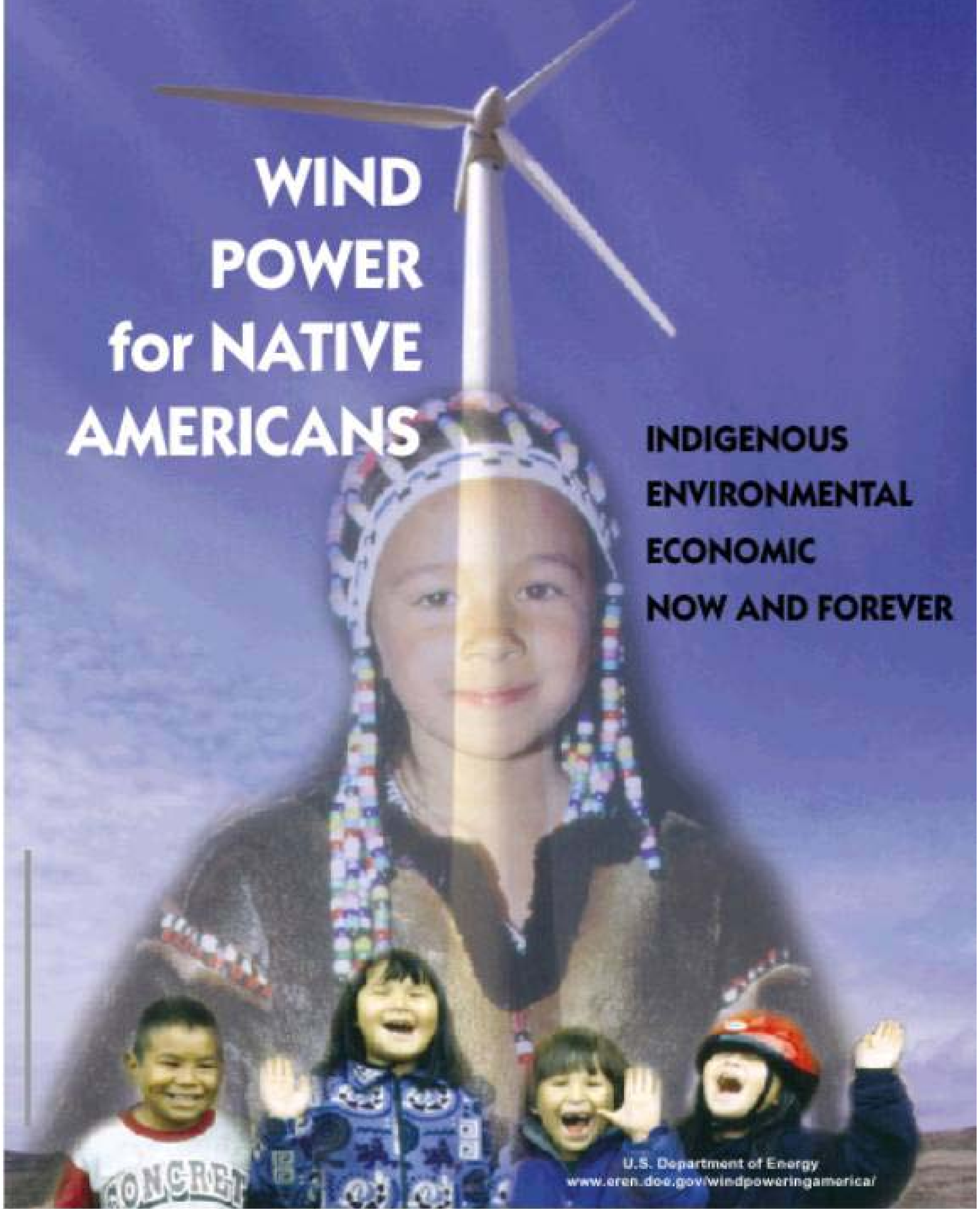
David Benson, farmer and county commissioner, Nobles County, Minnesota

Key Issues for Wind Power

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

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Ronald Neiss, Rosebud Utility Commission president, Rosebud Sioux Reservation, South Dakota

Carpe Ventem

www.windpoweringamerica.gov

Wind Development

Wind Resource Assessment: The First Step

Karen Conover, Global Energy Concepts

The first step in developing a wind project is to locate and quantify the wind resource. The magnitude of the wind and the characteristics of the resource are the largest factors in determining a potential site's economic and technical viability. There are three basic steps to identifying and characterizing the wind resource: prospecting, validating, and micrositing.

The process of locating sites for wind energy development is similar to exploration for other resources, such as minerals and petroleum. Thus, the term *prospecting* is often used to describe the identification and preliminary evaluation of a wind resource area. Prospecting includes identifying potentially windy sites within a fairly large region—such as a state, county, or utility service area—and investigating the development and general suitability of these sites for wind energy projects. Wind maps provide a good starting point for obtaining a general sense of a region's wind characteristics. Wind maps are available on a national scale and in greater detail for many states. Such maps can easily miss good wind sites, however, and are inappropriate to use alone for site selection purposes. For example, many sites with higher wind speeds are found within areas specified as a lower wind speed class. An experienced meteorologist can help determine whether a more detailed look is warranted.

Once a general sense of the wind resource characteristics is obtained, additional information can be garnered from a variety of sources to help identify less obvious resources or obtain more information on favorable sites. Topographic maps are used to identify passes, ridges, and other features that may enhance the wind speed. The following features may provide insight into the quality of the wind resources:

High Wind Speeds

- Gaps, passes, and gorges
- Long valleys extending down from mountains
- High-elevation plains and plateaus
- Exposed ridges and mountain summits
- Coastlines and immediate inland strips with a minimum of relief and vegetation
- Upwind and crosswind corners of islands.

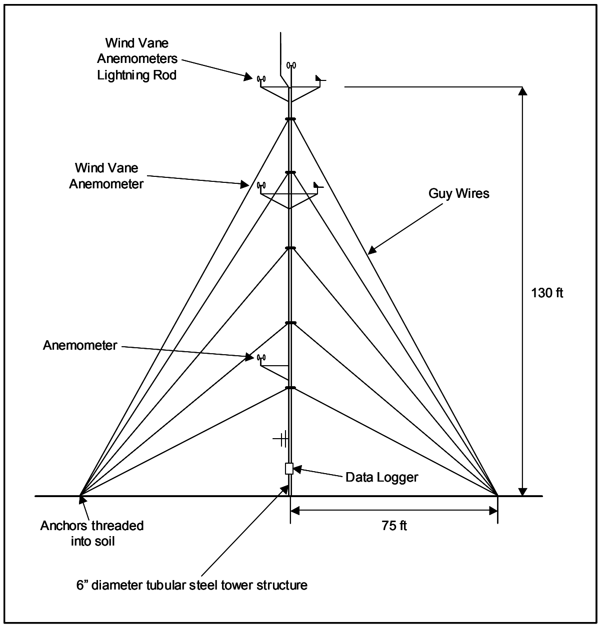
Low Wind Speeds

- Valleys perpendicular to the prevailing winds
- Sheltered basins
- Short and/or narrow valleys and canyons
- Areas of high surface roughness (e.g., dense vegetation).

Existing wind speed data can also help provide a picture of the wind characteristics in a region. Existing data is available from weather stations, airports, and other organizations. Most existing and publicly available wind data have been collected for purposes other than wind energy, and the source and accuracy of existing data should be considered before using it. Nonetheless, such data is often valuable for generally characterizing the resource and providing a long-term record for correlations with short-term data. The data may also provide important information about the seasonal and diurnal pattern of the wind in a particular vicinity.

For areas that appear promising based on the maps, existing data, or topography, a site visit generally provides additional insight to the development potential. In areas where no data exist, terrain or vegetation indicators may be used to identify a suspected resource. Valuable information may also be gained by talking to farmers or ranchers who live in the area. A site visit also provides an opportunity to survey the location to site a meteorological tower and begin the validation process.

Validating is the process of obtaining high-quality data to verify the magnitude and characteristics of the wind resource at a site. It begins with the development of a monitoring plan and includes the installation of wind measurement equipment as well as the analysis of site-specific wind and other data. During this phase, instrumented meteorological (met) towers are deployed to collect time-series data. Measurement sensors typically include anemometers at multiple heights (for wind speed), wind vanes (for direction), temperature gauges, and barometers (for pressure). For wind energy purposes, it is important to collect data at heights as high as possible to be able to identify the wind characteristics likely to be experienced by a wind turbine in that location. It is also necessary to collect wind speed data at multiple heights so that the wind shear (variation in wind speed with height above the ground) can be determined.



Wind has seasonal and diurnal patterns. As a result, monitoring programs must last for a minimum of one year. Longer monitoring programs will help to reduce the uncertainty in the data because of year-to-year variations. Data is commonly sampled at intervals of one second or more and averaged in increments of ten minutes or, at most, one hour.

Micrositing is a more detailed level of investigation and analysis usually conducted using a combination of complex modeling tools and high-density met tower data. Micrositing is intended to identify the best location for individual wind turbines within a project site. Shorter data collection periods are common if long-term data is available for the vicinity.

Siting Issues

Karin Sinclair, National Renewable Energy Laboratory

Although energy produced from commercial wind farms in the United States is generally viewed as environmentally benign, environmental and other siting issues can be raised during the permitting process. In many cases, issues brought forth during the permitting process for wind turbines can be similar to issues raised for permitting other development projects; in other cases, the issues are unique to the wind technology.

The successful development of a wind project is typically the result of balancing the project's economic viability and overcoming any siting issues. If a project will cost too much as a result of environmental or community issues, the developer will probably terminate pursuit of the wind project—as would be the case with any other type of development project.

The Siting Subcommittee of the National Wind Coordinating Committee (NWCC) developed a guidebook to siting issues (*Permitting of Wind Energy Facilities: A Handbook,* see References). The document includes an overview of the permitting process, the typical steps required in siting a wind development, and a detailed discussion on specific topics, including land use, noise, birds and other biological resources, visual resources, soil erosion and water quality, public health and safety, cultural and paleontological resources, solid and hazardous wastes, and air quality and climate. The document also includes a number of case studies.

The importance of any of the issues covered in the document will vary by site. In some areas, none of these topics will be considered an issue. In others, one or more may be so important that the project could be difficult to permit. Therefore, each site must be evaluated on its own merits. Early assessment on the part of the developer is critical to determining how many and which of these topics could be issues that need to be addressed.

Noise Impacts

Much of the noise generated by wind facilities is masked by ambient or background noise of the wind itself. Individuals living in close proximity to a wind turbine may be impacted by noise from the turbine. Consideration of adjacent land uses should be taken into account when evaluating potential development sites.

Visual Impacts

It is difficult to quantify the visual impacts of a wind farm because this is such a subjective issue. Computer modeling tools can be used to simulate how a landscape will look with wind turbines. Views can be developed from multiple vantage points. Existing natural and cultural features will also influence the interpretation of the extent of the visual compatibility of wind turbines.

Public perception plays a large role in determining visual acceptability of wind turbines. The size of the turbines, number of turbines, and wind farm design (spacing of turbines and physical arrangement of the turbines on the landscape) influence visual impacts. Federal Aviation Administration regulations may require the installation of lights on the turbines, potentially adding to the visual impacts.

Avian Issues

Of the three environmental topics (noise, visual, and biological), concerns about the impacts of commercial wind farms on biological/bird and bat populations are frequently raised. Two primary areas of concern are (1) possible litigation resulting from the killing of even one bird if it is protected by the Migratory Bird Treaty Act (MTBA), the Endangered Species Act (ESA), or both; and (2) the effect of avian mortality on bird populations. To properly address these concerns, the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) supported scientifically based avian/wind power interaction research from 1992–2002. In 1999, NWCC's Avian Subcommittee published *Studying Wind Energy/Bird Interactions: A Guidance Document*, which summarizes metrics and methodologies for determining or monitoring potential impacts on birds or bats at existing and proposed wind energy sites. The level of rigor required for the evaluation of a proposed site will vary depending on the complexity of and the issues at that site.

In some cases, site evaluation can be accomplished by gathering existing information on vegetation, habitat, and wildlife/habitat relationships and conducting a reconnaissance study. This existing information may be adequate to determine whether a site is suitable for a wind development and sufficient to meet the regulatory requirements. Additional on-site information gathered through the use of on-site surveys and monitoring might be required. Information required to adequately assess the site may include bird utilization and abundance, seasonal variations of site usage, species of special concern, breeding birds, and migrating birds, among other things.

The U.S. Fish and Wildlife Service (USFWS) may grant a permit that allows the incidental take of an endangered species under the ESA, but the MBTA prohibits the take of migratory birds, including species listed under the ESA. Through its Division of Law Enforcement, the USFWS has the authority to take action against violators. Wind farms that violate the law without making an effort to significantly reduce the level of avian fatalities are at risk for enforcement action by the USFWS.

Findings from NREL research completed over the past several years suggest that numerous factors affect avian/wind turbine interactions. Topography, weather, habitat, habitat fragmentation, urban encroachment, habitat loss, species abundance, distribution and behavior, and turbine location are some of the more important factors that may influence bird interactions with wind turbines. The nighttime activity of owls, migratory birds, and bats can also be a risk (Thelander 2000, Harmata 1998).

NREL's Avian Research studies have been conducted at various sites across the country. The results of these studies indicate that avian issues should not be a concern for future land-based wind farm development because potential problems can be identified and dealt with before micrositing (determining the specific location of the turbines and turbine strings across the wind resource area) occurs. As wind resources are developed across the country, developers will need to assess potential avian impacts *before* forging ahead with development. If fatalities occur in the developed wind resource area, it is important to consider the number of bird fatalities in proportion to the local population size. The absolute number of fatalities may not be as important as the impact on the population. For example, if 10 birds of a particular species are killed, it is important to know if this is out of a local population of 30 or 3,000. The overall impact of 10 birds being killed will be different depending on the size of the local population.

The wind industry continues to address avian issues on a site-specific basis. A study commissioned by the NWCC compares avian impacts from wind turbines with impacts to birds from other impact sources and concludes that although wind turbine collisions may account for 10,000-40,000 fatalities each year, other sources cause far more impact. For example, communication towers may cause 4 million to 50 million fatalities each year, and collisions with buildings and windows may contribute from 98 million to 980 million fatalities each year. The report also states that the National Audubon Society estimates avian fatalities due to house cats at 100 million birds per year. This report, Avian Collisions with Wind Turbines: A

Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States, gathers information through a literature review with the purpose of putting wind turbine impacts to birds in perspective with impacts from other significant sources of avian impacts.

Other Biological Issues

Any development project can affect the biological resources of the development site. This includes plants and animals that live, use, or pass through the site. The permitting or regulatory agency may require an assessment of these resources as part of the site evaluation.

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Siting

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NWCC Web address: http://www.nationalwind.org/.

National Wind Technology Center avian literature database: http://www.nrel.gov/wind/avian_lit.html.

Avian Reports

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Thelander, Carl. *Avian Risk Behavior and Fatalities at the Altamont Wind Resource Area, March 1998 to February 1999*. http://www.nrel.gov/docs/fy00osti/27545.pdf.

The Wind Energy Project Development Process

Dale Osborn, Distributed Generation Systems, Inc.

To finance and construct a wind energy project, five areas must be addressed: (1) detailed wind data for the site being developed, (2) the right to access and use the land on which the project will be constructed, (3) permission to construct and operate the project from local permitting authorities, (4) rights to interconnect to the transmission or distribution system and to transport (wheel) that energy to its purchaser, and (5) a power purchase agreement between the owner of the project (seller) and the power purchaser (buyer). If any of these issues are not contractually supported with the proper documentation, the project is unlikely to obtain financing. An exception may be made for entities that will balance-sheet finance the project. That entity assumes the risk for potential project failure resulting from any inadequate information in items (1)-(5).

Wind Resource

The quantification of the wind resource and the robustness of that resource is the single most important economic variable in evaluating competing wind sites; the stronger and more consistent the wind resource, the greater the value of the site. Topographical features such as ridges and plateaus, which are higher in elevation, usually have a better wind resource than the surrounding area. However, very high elevations have lower air density, which reduces the expected output of a project.

Wind measurements are taken using a meteorological (MET) tower. MET towers can be purchased with varying heights, although generally, the taller the tower, the better the information. In order for the wind resource assessment to be sufficient, data must be collected hourly at varying levels on the tower for one year. This time period may be shorter if other wind information has been collected within reasonable proximity. This data may be correlated with the MET tower information, and predictable output projections may be derived.

Lease or Easement Agreement

The project developer must obtain a lease or easement agreement that grants the developer (a) a right of access to and across the property for the purposes of construction, operations, and maintenance of the project; (b) a right to transmit the electricity off the property; and (c) a term sufficient for the financing of the project, usually at least 25 years. The lease or easement agreement between the landowner and the developer may include certain limitations on the construction project and reclamation provisions to restore the land at the termination of the lease.

The landowner may be compensated for land use in several ways. The most important is the royalty to be paid during the operational phase of the project. This amount is usually defined in the lease agreement as a fixed fee per kilowatt-hour produced or as a percentage of the gross revenue of the project. The fixed fee guarantees annual revenue to the landowner, and the percentage of gross revenue provides an opportunity for the landowner to share in any economic upside if the price of energy goes up or the project produces more than expected. The land lease or easement agreement is a complicated document, and a landowner should consult experts before signing any agreement.

Permitting

Obtaining land use permits to construct a wind facility may be complex, time consuming, and expensive, or simple, quick, and inexpensive. Within this spectrum of permitting possibilities, federal- and state-controlled lands are much more difficult than privately owned land because of the permitting and public hearing processes usually required for public lands. Wind resources being equal, privately owned land is preferred.

Local zoning regulations may impose permitting requirements similar to those required on public lands. The local planning department will define the zoning district in which a project area is located and will provide the documentation for the land use permitting process. The process usually includes a definitive time period to administer the permit application. If the project site is located in an area zoned for agriculture or a non-zoned area, the process can be as short as a few days or as long as several months, depending on local planning and zoning ordinances.

Interconnection and Wheeling

The owner of the three-phase transmission system must allow for the interconnection of the wind facility if there is capacity on the wires to accept the energy. The cost of such an interconnection varies widely among utilities. The utility will require system protection devices between the wind facility and the transmission lines. This is justifiable and can be implemented in several ways for different costs. An experienced engineering firm can analyze these variables and recommend the best technical and economic solution. Moving the energy from the project location to the buyer through the transmission system is called wheeling. There is a fee paid to the transmission system owner for providing this service. The fee may be negotiated, but it is usually a tariff filed by regulators at the state or federal level.

All of these arrangements between the utility and the developer are documented in an interconnection and wheeling agreement.

Power Purchase Agreement (PPA)

The PPA is the asset of the project that can be financed. It guarantees that a buyer will purchase the energy from the seller at a negotiated price for a specific period of time, thereby creating a predictable long-term cash flow. The buyer must be a good (investment grade) credit risk for the developer to obtain project financing. Many developers spend large sums obtaining items (1) through (4) and may not be able to obtain a PPA. Under those circumstances, the investment in the project is lost. The PPA is by far the most difficult project stage to complete and without it, there is no project. The availability of PPAs depends on regulatory and legislative requirements and on the purchaser's economic motivations.

In summary, the following items are necessary to complete a wind facility, but they may not be sufficient for financing:

1. A high-quality wind resource assessment for at least one year
2. A long-term lease or easement agreement with the landowner
3. A land use permit, if required, from local, state, or federal agencies
4. An interconnection and wheeling agreement with the local transmission or distribution provider
5. A power purchase agreement with a creditworthy buyer.

In some regions, additional items may be required to complete a wind project. Many wind industry experts are available to provide development expertise, and they should be consulted as necessary.

The Wind Project Development Process

Distributed Generation Systems, Inc.

The Wind Project Development Process

Site Selection

- **Evidence of Significant Wind**
- **Preferably Privately Owned Remote Land**
- **Proximity to Transmission Lines**
- **Reasonable Road Access**
- **Few Environmental Concerns**
- **Receptive Community**

Land Agreements

Term:
Expected Life of the Turbine

Rights
Wind Rights, Ingress/Egress Rights, Transmission Rights

Compensation:
Percentage of Revenues

Assignable
Financing Requirement

Indemnification

Reclamation Provision

Wind Assessment

Corollary Data
Military Installations, Commercial Airports

Install Meteorological Tower

Collect Hourly Wind Speed and Direction Data

Minimum One Year of Data

Quality Report by Recognized Meteorologist

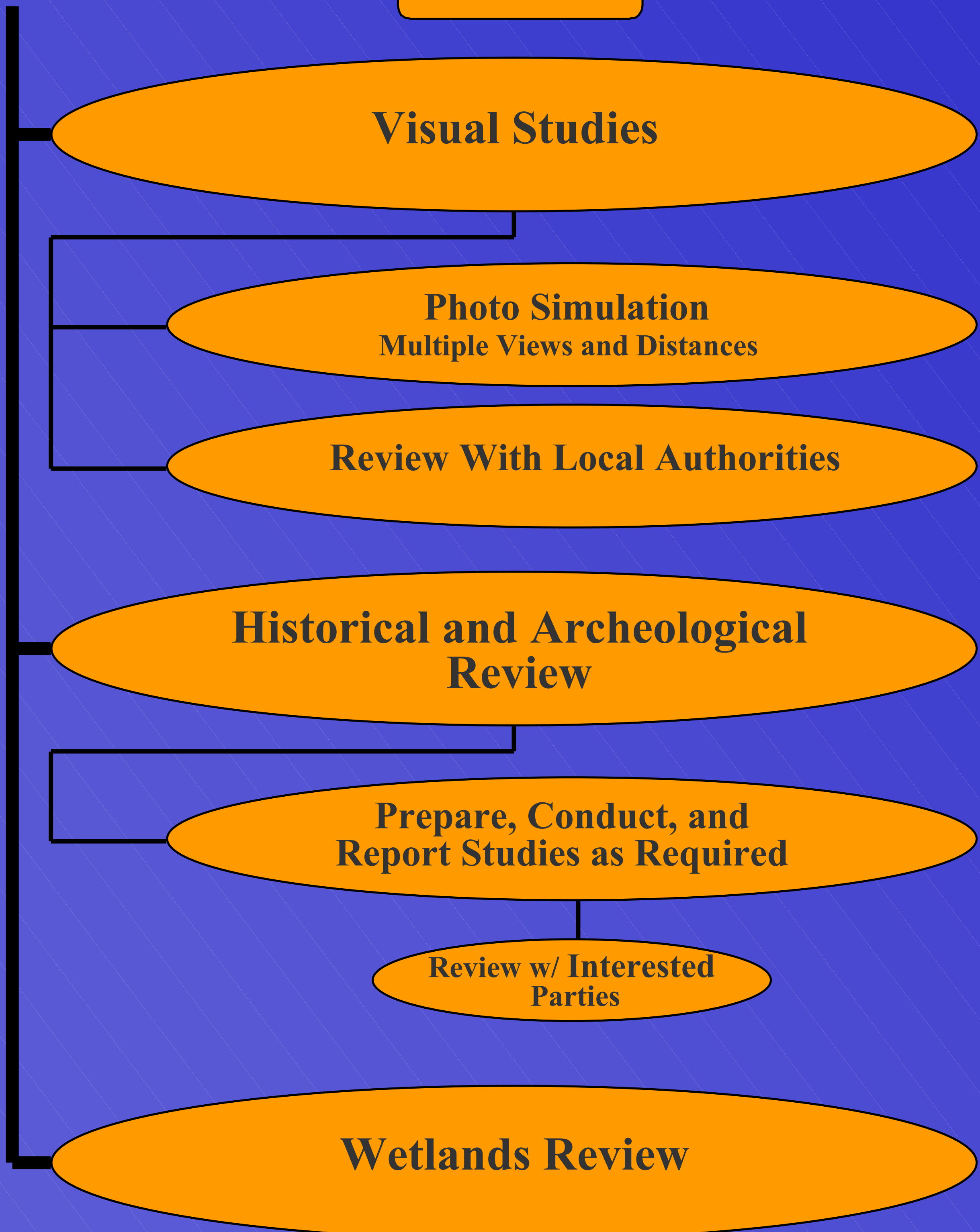
Output Projections for Several Turbine Designs

Environmental Review

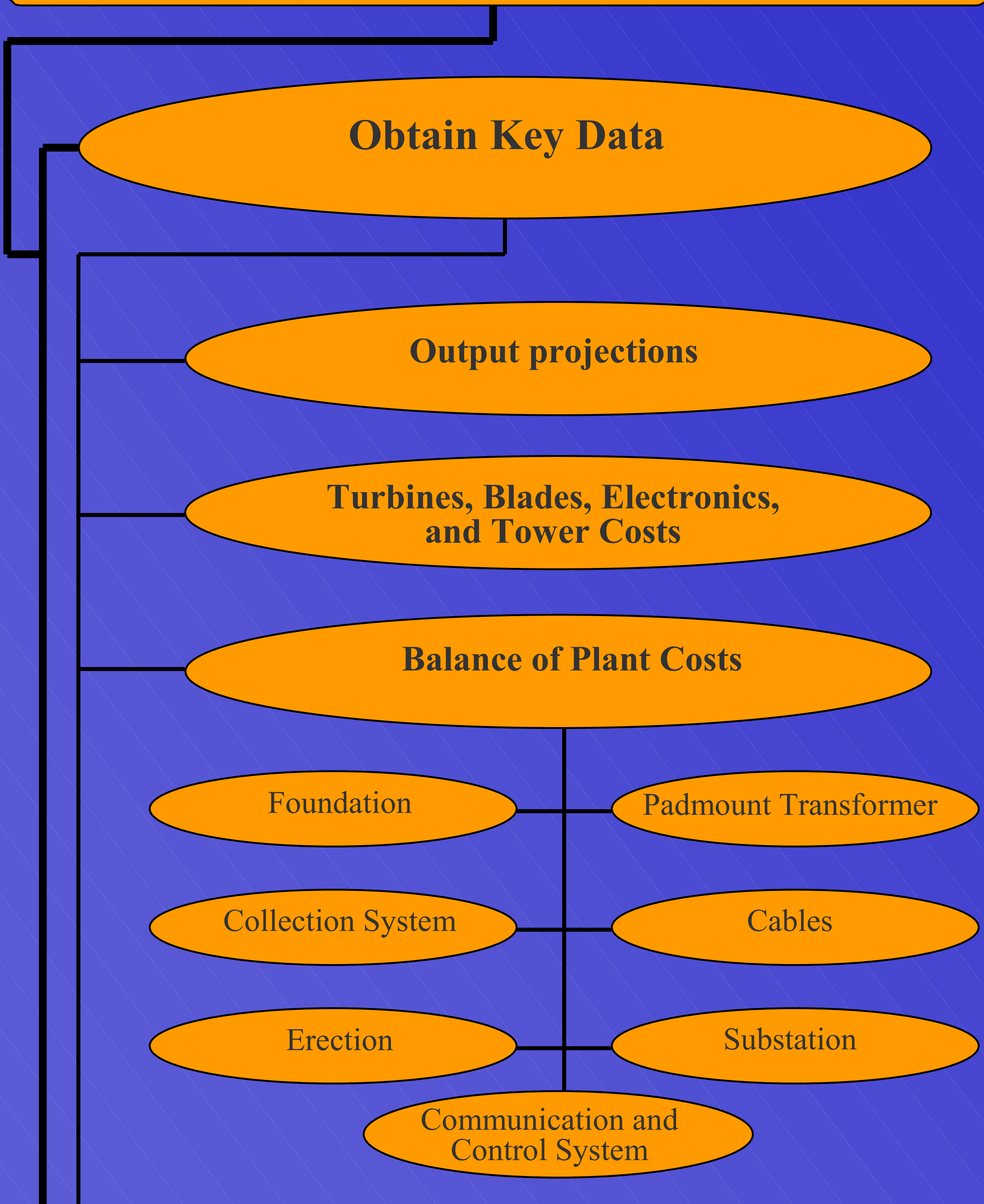
- **Cursory Review for Endangered Species**
- **Avian Studies**
  - **Raptors**
  - **Migratory Birds**
  - **Review With Interested Parties**
    - Local Audubon
    - Federal Authorities
    - Local Stakeholders
    - State Authorities
  - **Prepare, Conduct, and Report Studies as Required**

Environmental Review

Continued



Economic Modeling



Economic Modeling

Continued

- **Taxes**
  - Sales
  - Income
  - Property
    - Depreciation Schedule
- **O&M Estimates**
- **Finance Assumptions**
  - **Tax Credits**
  - **Equity Rate of Return**

Economic Modeling

Continued

- **Debt: Rate and Term**
  - Coverage Ratios
- **Debt/Equity Ratio**

Interconnection Studies

- Capacity Limitation
- Load Flow Analysis
- Voltage Controls
- System Protection

Permitting

- Local, State, Federal
  - Public Land
  - Private Land
- Land Use Permit
- Building Permit

Sales Agreements

- **Power Purchase Agreement**
  - **Kilowatt Price**
    Real or Nominal Levalized
  - **Term**
  - **Credit Worthy Buyer**
- **Facility Sales Agreement**
  - **Turn Key Price**
    Complete Wind Power facility

Financing

- **Source of Equity**
  Rate of Return 16-18%
- **Source of Debt**
  Market Rates
  - **Term of Debt**
- **Assignable Documents**
- **Third Party Due Diligence**

Turbine Procurement

Power Curve

Output Projections

Capital Cost

Turbine, Tower, Blades, and Electronics

Turn-key Construction Cost

Padmounts, Interconnection, and Erection

Warranties

Equipment and Maintenance

Construction Financing

Construction Contracting

Turn-key Contract

- Excavation
- Trenching
- Foundation Assembly
- Concrete
- Cabling
- Tower Assembly and Erection
- Turbine Installation
- Interconnection to Utility
- Commissioning

Operations & Maintenance

- Fixed Cost per Turbine per Year
- Fixed Price per kWh Produced
- Availability Warranties
- Penalties for Non-performance

Wind Power Development Issues from an Electric Power Perspective: Electrical and Institutional

Edgar A. DeMeo

Renewable Energy Consulting Services, Inc.

(EPRI Wind and Renewables Programs 1976-1998)

Currently DOE-NREL Liaison to UWIG and NWCC

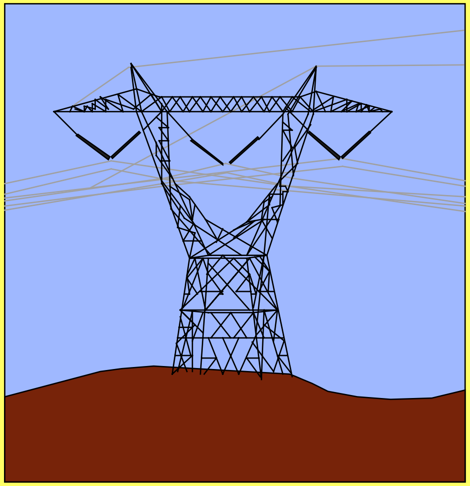
Wind Power's Natural Characteristics

- ***Remote:*** Wind resources often distant from major markets
- ***Variable:*** Plant output varies with variations in the wind
- ***New:*** Operators more comfortable with established power technologies

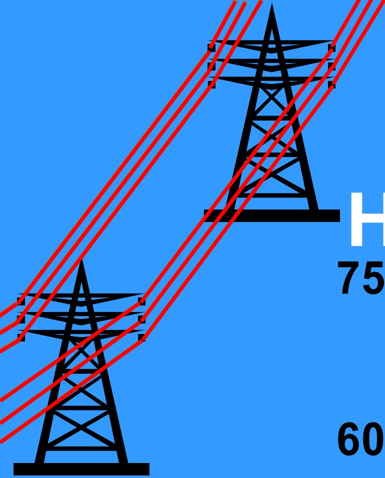
Key Issue: Should wind be disadvantaged by its natural characteristics ?

Remote: Transmission Is Required

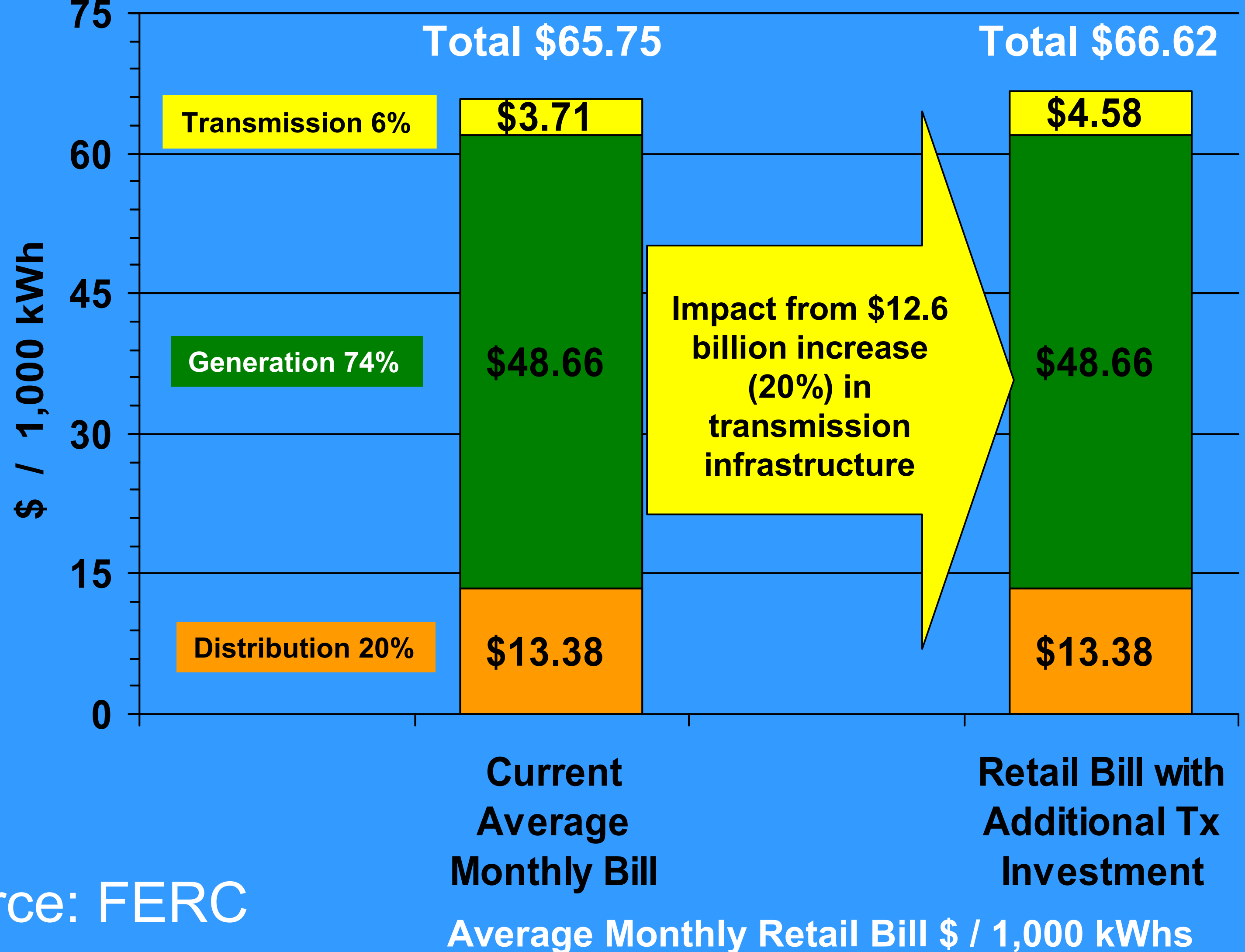
- *New Transmission:* siting and approval highly contentious
- *Cost Allocation:* wind plant or overall system?
- *Return on Investment:* commensurate with risk?
- *Landowners Compensation:* revenue stream?


Key Policy Issue: Is the transmission system a common carrier operating in the public interest ?



LARGE TRANSMISSION INVESTMENTS HAVE VERY SMALL RETAIL BILL IMPACTS



Source: FERC

Variable: Transmission Access

<u>Firm Transmission Rights</u>

- Blocks for specified times
- Underutilized by wind
- Too costly

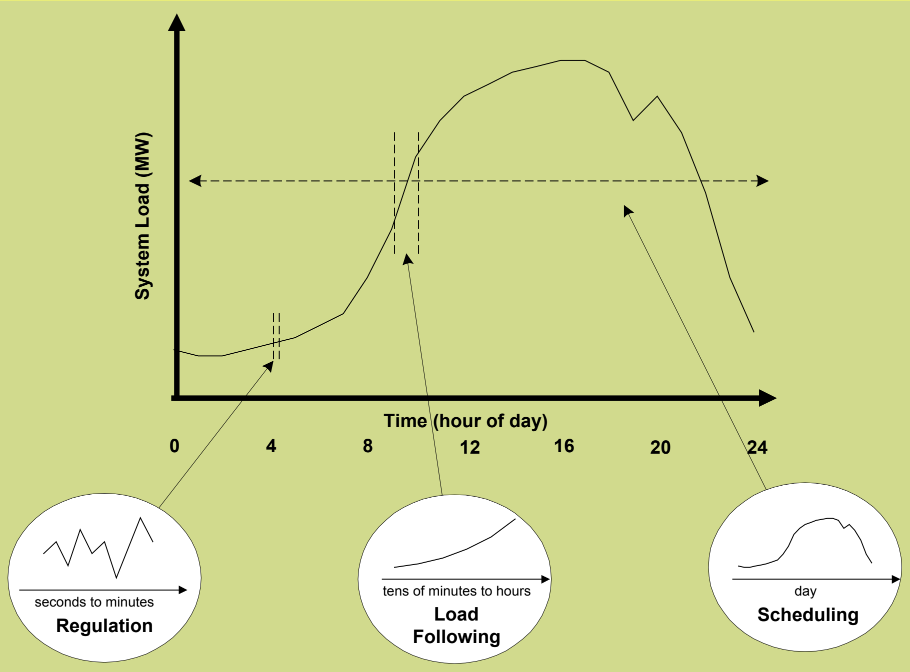
<u>Non-Firm Rights</u>

- Can be curtailed, but often OK for wind
- Not available long-term
- Insufficient assurance

Middle ground? Flexible-firm?

Wind plant financing requires reasonable assurance of path to energy marketplace

Variable: Power-System Operation Impacts



- Regulation -- seconds to a few minutes -- similar to variations in customer demand (loads)
- Load-following -- tens of minutes to a few hours -- usage follows predictable patterns, wind less so
- Scheduling and commitment of generating units -- one to several days -- wind impacts unclear

Wind controlled by nature, not power plant operators!

Variability Can Increase Operating Costs

- Committing unneeded generation
- Scheduling unneeded generation
- Allocating extra load-following capability
- Violation of system performance criteria
- Increased cycling operation
- **These are reflected in *ancillary services* costs**

Incremental cost added by wind's variability:
Is it ~0.1¢/kWh or ~1¢/kWh?
Utility Wind Interest Group case study:
cost near bottom of range

New: Contrasting Approaches to Change

Europe Wind power is environmentally preferred. How can we best accommodate it within the existing power system?

U.S. How can we integrate wind into the existing system with minimal impact on traditional rules and procedures?

Wind needs fair--not preferential--treatment in electricity services markets. This is most likely with leadership from the public policy sector.

Who Should Take the Lead?

Power Utilities? No

- Main job: Keep the lights on!
- Natural aversion to change

Legislators and Regulators?

- Encouragement of wind and other renewables is a public policy issue

Bottom Line: States can make a commitment to wind power without fear of breaking the bank!

Wind Power's Impacts on the Operation of Electric Utility Systems

Ed DeMeo, Renewable Energy Consulting Services, Inc.

Wind power plants generate electricity when the wind is blowing, and the plant output depends substantially on the strength of the wind. Because the wind cannot be accurately predicted over daily periods and it often fluctuates from minute to minute and hour to hour, electric utility system planners and operators are concerned that wind plant variations may increase the operating costs of the system as a whole. This concern arises because the system must maintain an instantaneous balance at all times between the aggregate demand for electric power and the total power generated by all power plants feeding into the system. Utility operators and automatic controls perform this highly sophisticated task routinely—based on well-known operating characteristics for conventional power plants and a great deal of experience accumulated over many years.

Wind Power Impacts on Operating Costs

System operators are concerned that variations in wind plant output will force the conventional power plants to provide compensating variations to maintain system balance, thus causing the conventional power plants to deviate from operating points that are chosen to minimize the total cost of operating the entire system. The concern is certainly valid. The question is: To what extent does the variability of the wind increase operating costs? The operators' concerns are compounded by the fact that conventional power plants are generally under their control, whereas they have no control over wind plants because they are controlled by nature.

Another concern expressed by utility operators who are unfamiliar with wind plant operating characteristics is that the output of a wind plant will change from full power—say 100 MW—to zero in one second or less, causing a huge transient impact on the system. Practical experience with many wind plants has alleviated this concern. Wind plant output does not change that rapidly. Even a single wind turbine has sufficient mechanical inertia to damp rapid changes in the wind. More important, a wind plant generally consists of a number of turbines, and the spatial variations in the wind over the area of a typical plant are sufficient so that variations in output from the entire plant are much less pronounced than those from a single turbine. Hence, the plant output shows substantial smoothing relative to output from a single turbine. Consequently, wind plants have no adverse impact on the power system's stability. System stability can be upset by abrupt events that happen within a fraction of a second, such as a sudden outage of a major power plant, loss of a transmission line, or abrupt connection of a large electrical load like an arc furnace in a steel mill. Abrupt events such as these do not occur with a wind plant unless its connection to the electrical grid suffers a fault. In such a case, the wind plant is similar to a conventional power plant.

Impacts in the time frame from a few seconds to a few days can be significant, however. Utility operators tend to address the system-balance issue in the following different approximate time frames:

- Regulation: one second to a few minutes
- Load following: a few minutes to a few hours
- Scheduling and commitment of generating units: a few hours to a few days.

Regulation

Customers are continually turning appliances, production processing equipment, and other electrical loads on and off. Consequently, the system constantly experiences random variations. These are routinely handled without difficulty by the system through generating units that are assigned this function. Operating these plants in the regulating mode incurs costs to the system. Wind plants add to these variations, but in a random and uncorrelated manner. In principle, they will add to the regulating burden and hence to the cost of regulation. To date, however, studies with wind plant penetrations in the range of 5% to 20% of system load estimate this cost impact to be minimal to negligible.

Load Following

Aggregate utility loads generally follow fairly predictable daily and weekly patterns. For example, loads will increase in the morning hours as people wake up, businesses begin their operations, and manufacturing processes ramp up. Conversely, loads will drop off later in the day. These variations are handled by load-following generating units that are ramped up and down by system operators or by automatic equipment. The presence of wind power in the generating mix will generally increase the requirement for load-following generation because the behavior of the wind over a several-hour period is generally not as predictable as customer load patterns. This increase results in increased operating costs. However, studies to date suggest that for low to medium wind penetrations (up to about 5% of system load), the resulting cost impact is on the order of 0.05 cents/kWh of wind energy.

Scheduling and Commitment

Large thermal power plants generally require lead times of several hours to as much as a day to reach system service readiness. Consequently, operators need to make decisions about plant operations hours before the plants will be needed. Plants that are already warm or can be started quickly need to be scheduled. Those that have not been brought up to operating temperatures need to be committed. These decisions will be affected by assumptions made about wind plant operation. If the wind could be forecast accurately, reliable assumptions would be possible. However, even with perfect forecasting, variations in wind plant output would necessitate more variations in conventional plant output than would be needed if the wind plant outputs were steady. These additional variations imply additional costs because the conventional plants would be operated more often under non-optimum conditions and because maintenance costs are likely to increase. However, those knowledgeable in power plant operations feel such additional costs would be small compared to those resulting from imperfect wind forecasting.

For example, suppose a thermal plant has been fired up to serve expected load during the next day because no wind is expected. If the wind actually blows the next day, then the additional thermal plant is not needed and the cost associated with firing it up were unnecessary. Conversely, a decision to rely on wind power that does not materialize causes extra expense to obtain makeup power—often from spot markets at high costs. Today, wind forecasts are generally accurate for about half an hour up to one or perhaps two hours. Although the ability to forecast is improving, accuracy over periods of a day or two is not likely in the foreseeable future.

Several preliminary studies of forecasting-error impacts have been conducted. These suggest that, for wind penetrations of 5% to as much as 20%, the operating-cost impacts of "bad" decisions caused by errors in forecasts are in the range of 0.15 cents to 0.5 cents per kWh of wind-generated electricity. These studies have incorporated several conservative assumptions, so the impacts may actually be overstated.

Conclusion

Results to date, coupled with actual experience from operating wind plants, suggest that system operating-cost impacts are not a showstopper for wind. To strengthen this conclusion, and to determine conditions under which it may not apply, additional studies are needed. These studies should examine such effects as (a) different mixes of conventional generation; (b) a range of wind penetrations; (c) a sliding scale of forecasting accuracy (i.e., very accurate for an hour or two, and decreasing in accuracy out to 48 hours); and (d) differing assumptions on the purchase of makeup energy and the sale of excess energy.

Reference

Daniel L. Brooks, et al. “Assessing the Impact of Wind Generation on System Operations at Excel Energy North and Bonneville Power Administration,” proceedings of WindPower 2002, May 2002.

Some Common Misconceptions about Wind Power

Ed DeMeo, RECS, Inc.
Brian Parsons, National Renewable Energy Laboratory
Presented May 22, 2003, to the All States Wind Summit, Austin, Texas

1. **Wind plants are controlled by nature and not by utility operators. Hence they can't be relied on; 100% backup from dispatchable generation is required.**

   Responses:

   - True, wind plants are not dispatchable in the conventional sense. However, electricity demand is also not controlled by utility operators. The utility system is designed to accommodate fluctuating loads, and additional incremental variability imposed by adding amounts of wind up to at least 10% to 15% of system generating capacity is small and has not been costly – as discussed further in the next item.

   - No power plant is 100% reliable. During an outage, backup is provided by the entire interconnected utility system. The system operating strategy strives to make best use of all elements of the overall system, taking into account the operating characteristics of each generating unit and planning for contingencies such as plant or transmission line outages. Wind's need for support of this type from the rest of the system will differ *in degree* from that required by conventional plants, but not *in kind*. Wind simply needs to be integrated into the overall system operating strategy.

   - Wind's ability to support growth in utility loads will in general be less as a percentage of nameplate rating than that of conventional dispatchable plants. All power plants can be characterized by an effective load carrying capability that is a fraction of the rated power output. Its magnitude depends on a statistical evaluation of contributions made by the plant to overall system needs during the entire year. Contributions during periods of high system load are most important. In general, the fraction for typical fossil-fueled plants ranges from about 70% to about 90%. For a wind plant, the range is typically 20% to 40%. Hence a wind plant generally can't be relied on to serve as much load growth as a conventional plant of the same rating, but its effective load carrying capability is not negligible. Historically the Mid-Continent Area Power Pool and recently The PJM RTO have recognized this in their system reliability calculations and rules by incorporating a simplified, historic-performance-based calculation to assign reliability ratings to wind power plants.

- ❖ Many wind plants are being installed to reduce fuel consumption by and emissions from conventional power plants. In fact, this is the primary value of wind power today. When the wind blows, the conventional plants can be turned down, thus reducing fuel combustion and emissions. In these cases, wind is only providing energy, so the issue of load carrying capability is moot. The existing conventional plants provide system reliability, and there is no cost associated with additional backup for system reliability. The only incremental costs are those associated with minute-to-minute and day-to-day operation, generally referred to as ancillary services costs.

2. Since wind is not dispatchable, the ancillary services required to accommodate its variability will make wind energy uneconomical.

Responses:

- ❖ Wind's variability does increase the day-to-day and minute-to-minute operating costs of a utility system because the wind variations do affect the operation of other plants. But investigations by utility engineers show these costs to be relatively small – less than about 2 mills/kWh at penetrations under 5%, and possibly rising to 5 mills at 20% penetration.

- ❖ The biggest "reserve" in the integrated utility system is called first contingency or n-1 reserve. The grid is designed to withstand the loss of the single largest element (big generator or transmission line tripping off). Until a single wind plant approaches the level of the first contingency loss, incremental operating costs are likely to increase only slowly as wind penetration increases.

3. If wind energy displaces energy from existing coal plants, then rates will go up.

Responses:

- ❖ Rates for electricity from wind plants being installed today are comparable to wholesale electric power prices of 2.0 to 3.0¢/kWh. Estimates for energy from a new wind plant slated for North Dakota are below 2.5¢/kWh. The incremental cost of wind power, if any, will be negligible when distributed among all customers. Several studies looking at the rate impacts of wind have considered the costs of various renewable portfolio standard percentages from 5% to 10%, and average residential bill impacts are predicted at 5-25¢/month. In fact, some studies predict the accompanying decrease in demand for conventional fuels will reduce fuel prices enough to fully compensate for slightly higher costs for renewables. Many of these studies are several years old, and wind plants continue to be installed at lower and lower prices, so any price increment derived by assuming low (and stable) conventional fuel prices is shrinking.

4. Yes, but wind needs a production tax credit (PTC) of 1.8¢/kWh over 10 years (about a penny over 30 years) to achieve these economics.

Responses:

- ❖ That's true, but the tax credit for wind only compensates for subsidies provided for conventional energy technologies that are paid in our tax and health-care bills – not in our energy bills. These hidden costs have been estimated at levels comparable to the value of the PTC.

- ❖ Examples: public-health costs for treatment of respiratory diseases; nuclear accident liability limitation; nuclear waste management; oil and gas depletion allowances; maintenance of oil access by the USDOD.

5. New natural gas power plants will provide cheaper energy than wind plants.

Responses:

- ❖ This is not likely at today's gas prices, and these prices are rising with time. At $3/MBTU, the fuel cost alone is 2.5 to 3¢/kWh, and capital and O&M costs add a comparable amount. And gas prices have spiked to over $10/MBTU in the past three years. Betting on low gas prices over the foreseeable future is highly risky, while energy costs from wind plants will be relatively stable over time.

- ❖ Gas price volatility is not going away. Planned power plant construction countrywide is nearly 100% gas fired and the success of these plans is heavily dependent on natural gas production meeting growing demand. The economics of these plants are based on low gas prices into the future. Witness the CA power crisis and the impact of price volatility on the general health of our economy.

6. The production tax credit and accelerated depreciation are helpful only to big, out-of-state developers. The economic benefits aren't local, and rural electric cooperatives and municipal utilities can't receive the same benefits.

Responses:

- ❖ It's true that only entities that pay federal taxes can use the tax credits to reduce their tax liability. But those tax credits result in lower wind energy costs for the benefit of all electricity customers. However, if local entities assume equity positions in wind plants, then they can receive the tax-credit benefits. Whether or not the wind-plant equity is locally held, wind plants result in jobs for the local community and the need for local services—both during construction and during operation. And to the extent debt financing comes from local sources, debt-service payments stay within the local community.

- In some cases, a number of farmers have joined together in a cooperative arrangement to build and own a wind plant. In aggregate, they can have enough tax liability to make full use of the tax credits.

- In other cases, an external entity with a tax appetite can hold majority ownership – even as much as 99% – for 10 years while the tax credits apply, with the remainder of ownership vested in the cooperative. After the initial 10-year period, the ownership portions can be shifted so that the cooperative becomes the majority owner. In this way, the cooperative is the major owner in the long run, the external entity gets its return on investment over 10 years with the aid of the tax credits, and the overall cost of energy from the plant over its operating lifetime is lower than it would have been if the cooperative were the sole owner.

7. In many rural areas, local load growth is small, so export of wind energy is the only option. But often no transmission capacity is available.

Responses:

- It's true that transmission availability is often the major factor limiting wind development. However, a community wishing to do so could provide a substantial portion of its local energy needs from wind and then cut back on imports from the transmission and distribution grid. In some cases, this would violate terms of the contract with the wholesale supplier, but in other cases it would not.

- The transmission problem is often driven by historic methods of evaluating and allocating the power-carrying capability of the wires. Historic use rights are often fully committed in an administrative sense. Electrically, there is often actual capability that goes unused much of the year. Changes in evaluation and allocation rules associated with transmission reform are expected to allow further generation expansion without requiring additional wires.

8. Large, utility-grade wind turbines can't be installed on the distribution grid without expensive upgrades and power-quality issues.

Response:

- In situations with weak distribution grids (long lines with thin wires and few customers—maybe even single-phase), this is often true. However, in many cases, wind generation can be connected to the distribution system in amounts up to about the rating of the nearest substation transformer. One study of a rural mid-western county estimated that several tens of MW of turbines could be installed on the local distribution grid with a minimum of upgrade expense and minimal power-quality impacts.

9. **All-source requirements imposed by the regional G&T wholesaler preclude wind installations by distribution co-ops.**

   Responses:

   - ❖ In some cases, this is true without modification of current contracts. Sometimes an exception can be granted, and G&T's can be responsive to the distribution co-op's desires. After all, the distribution co-ops are their customers and often part owners as well.

   - ❖ Some G&T's (e.g., Tri-State and BPA) allow distribution co-ops to generate a portion of their electricity locally from renewables without penalty. However, rules for backup energy in the event the local generator doesn't deliver may need to be modified to avoid substantial demand charges.

   - ❖ In most cases, the major barrier to wind plant additions by a distribution co-op is the absence of experience with generation of any kind.

10. **Small projects that might be suitable for co-ops or small municipal utilities are uneconomic.**

   Responses:

   - ❖ Small projects generally have a higher cost per MW than larger wind plants. However, the incremental costs on customers' bills are likely to be small. The energy premium for a small project is unlikely to exceed 50%. If the project provides a small portion of the community's needs—say 2%—then the premium is reduced to about 1% if distributed among all customers. Most folks don't lose sleep over a 1% impact.

   - ❖ The real value of small projects stems from utilities and communities obtaining experience with and learning about the technology and its positive environmental and economic impacts.

   - ❖ Some communities have succeeded in covering the premiums for energy from a small project by offering a green-priced product to their ratepayers or green tags to a broader customer base.

11. **Wind turbines kill birds and thus have serious environmental impacts.**

   Responses:

   - ❖ Bird kills have caused serious concern at only one location in the U.S.: Altamont Pass in California. This is one of the first areas in the country to see significant wind development. Over the past decade, the wind community has learned a great deal about siting wind plants in ways that avoid locations that might pose problems for birds. Modern wind installations are simply not raising avian concerns.

- One to two bird kills per turbine per year is at the high end of the range observed in U.S. wind installations. The majority of deaths are common species. Compared to bird deaths resulting from other manmade structures, highway traffic, and housecats, bird kills by wind plants are numerically insignificant and are not expected to impact bird populations. Of course, deaths of endangered species are of greater concern, but again the only location with a suggestion of this problem is Altamont. And even in that case, experts disagree on the severity of the problem.

- Environmental impacts are relative. All energy technologies have some negative environmental impacts. Society makes tradeoffs when making power plant choices. Wind plants may result in some bird fatalities or other unwanted impacts on wildlife and their habitats. Coal plants cause premature human deaths from respiratory problems. Maintaining open channels for free flow of oil causes military deaths. Society needs to choose from these alternatives, and it cannot assess a single energy technology in isolation.

12. Many people say they'd be willing to pay more for clean, renewable energy, but when the time comes to sign up for a green product, only a few actually do this.

Responses:

- Green pricing is a relatively new thing, and early customer percentages are not out of line with new offerings of other products. Successful green-pricing programs demonstrate concrete actions—not just vague promises—and seek a minimal premium. If folks are asked to pay too much—say, a premium of 50% or 100%—then unless they are fanatical supporters of clean energy, they shy away because they know that the clean energy benefits will be shared by all—even the free riders. Also, people in general need multiple exposures to something new before they decide to buy.

- Willingness to pay doesn't necessarily mean costs should be covered through a green-priced product offering. If most people in a community say they'd be willing to pay a premium for clean energy, then the justification exists for a rate-based project whose premium, if any, would be shared by all. In most cases, the premium would be truly negligible. In this case, there is no need to conduct the effort or incur the marketing costs associated with a green pricing program.

Wind Energy Economics

Michael Milligan, National Renewable Energy Laboratory

Introduction

Economic evaluations of wind plants include detailed estimates of costs and benefits. A number of factors influence the economics of a wind plant: the characteristics of the wind resource, the size of the project, the financing methods and firm structure, and unique requirements such as interconnection with the grid or special siting (offshore wind farms, for example).

The cost of wind turbine hardware, including the interface to the transmission system, can usually be accurately estimated. However, disagreements can occur over how to correctly allocate the cost of new transmission and other joint-use facilities, whether to use accounting or economic costs (or benefits), and which method to use to determine potential operating cost impacts of wind plants. A number of assumptions must be made in a cost-benefit analysis, such as how to discount future revenue/costs to the present; how to estimate the future rate of inflation; and how to calculate the risks, both positive and negative, that are influenced by wind power plants.

The economics of a wind power plant can also be affected by power market structure. For example, some power pool operating rules impose high penalties on generators that can't be accurately scheduled. Penalties that are intended to be punitive can be high, significantly eroding the economic viability of the wind plant. The impact of penalties that are cost-based is not so severe. In California, the Independent System Operator has a special tariff for wind plants that elect to participate in the program. In return for paying a small forecasting fee, hourly imbalances (the difference between actual generation and predicted generation) are netted over the month and charged a weighted average price. This practice has also been proposed by the Federal Energy Regulatory Commission in its Standard Market Design.

Costs

Over the past several years, the cost of wind energy has declined dramatically. Figure 1 illustrates this decline. The cost of energy (COE) is a function of the technology, quality of the wind site, and financing structure of the wind plant owner. Some economies of scale are also involved in the construction process. For example, obtaining permitting, developing infrastructure such as site access, and providing cranes to erect the turbines involve relatively high fixed costs, regardless of the size of the project. Larger projects can therefore benefit because these costs are spread among more turbines (and therefore, more energy production).

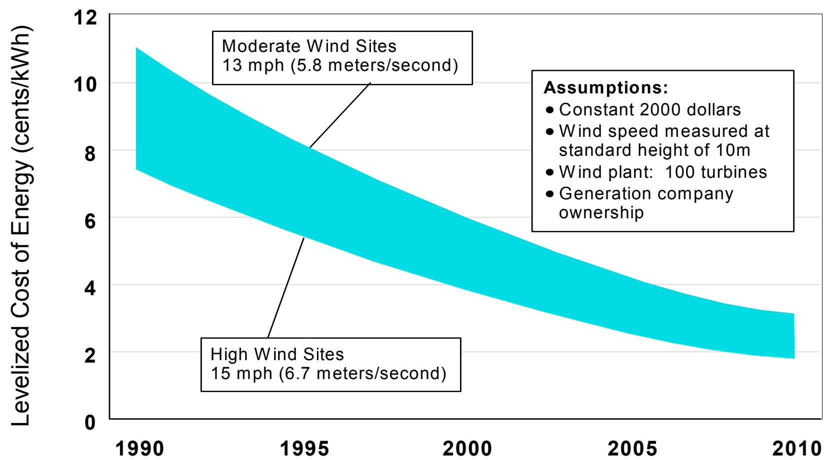


Figure 1. Declining costs of wind energy.

If joint-use facilities or other cost allocations among different plants are not involved, assessing accounting costs is often straightforward. The primary costs of wind plants are fixed costs that are incurred during project development. The major cost components include land (lease or purchase), the rotor assembly (including hub), tower, generator, power electronics, controls and instrumentation, drive train components, and yaw system. Land costs often include an upfront payment of $1,000-$3,000, and annual landowner lease payments are typically between $1,500 and $2,000 per turbine. Because wind power doesn't use fuel, the primary ongoing costs are operation and maintenance expenses. To integrate wind power plants into the electrical supply, the additional ancillary services may be required (regulation and load-following services) that can be provided other power plants to compensate for wind's volatility.[1]

Obtaining transmission access can also involve a cost, although this is highly dependent on the power purchase agreement, transmission line loading, ownership of the line, operational jurisdiction of the transmission system, and other

[1] Power systems already experience significant variability, and wind plants can increase this variability. However, conventional power plants do not need to match the wind variations one-for-one, and these costs are estimated to be in the range of $3-5/MWh. Examples include PacifiCorps' Integrated Resource Plan and the Utility Wind Interest Group (UWIG) study on wind integration costs.

financial characteristics of the project. In many cases, transmission use is assessed with a two-part rate based on capacity and energy. If transmission rates are based on locational marginal pricing (LMP) on a congested system, significant variations in rates at different times and locations can occur.

Once cost estimates have been established, they must be spread over the estimated life of the project (usually 20 years). Based on estimates of annual wind energy production, average energy cost can be calculated. So that the real cost of wind can be estimated in current dollars, estimates of future inflation must be established, along with an estimated discount rate to discount future costs to the present. The project cost will normally be quite sensitive to these assumptions, so it is often useful to vary the parameters so that their influence on project economics can be assessed.

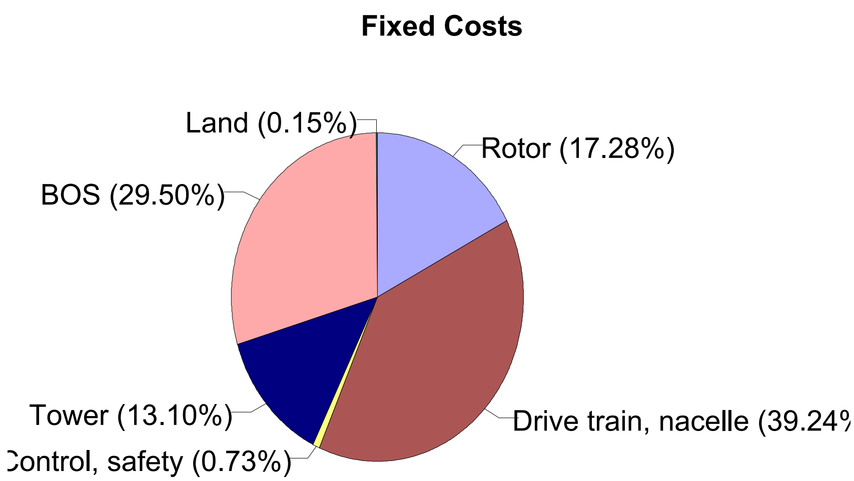


Figure 2. Breakdown of major fixed cost components.

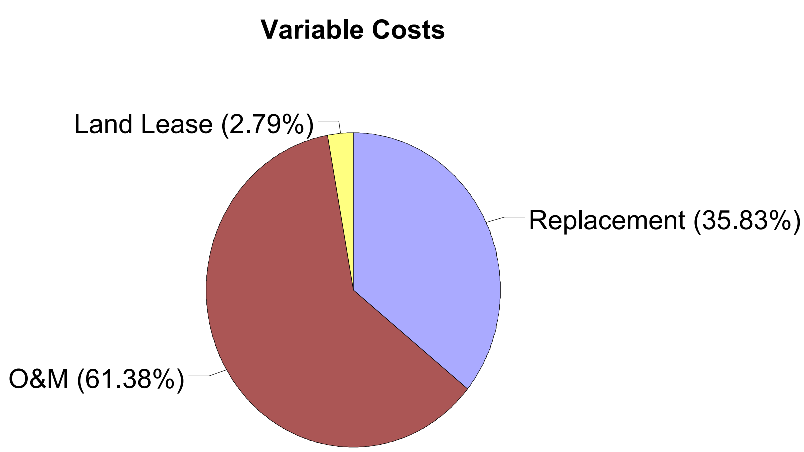


Figure 3. Breakdown of major variable cost components.

Costs are also highly dependent on the method of financing (mix of debt/equity) and whether the project owner is an investor owned utility (IOU), rural electric cooperative (REC), or non-utility generator (NUG).[2] In addition to the different interest rates that each of these entities would pay, only IOUs and private NUGs qualify for the Federal Production Tax Credit (PTC), whereas RECs qualify for the Renewable Energy Production Incentive (REPI). Wiser and Kahn find significant differences in financing costs that arise from these alternative arrangements. Figure 4 illustrates the range of possible costs for different financing arrangements. The graph also illustrates the important impact of the size of the project on average energy cost. For small projects, it is not possible to capture various economies of scale related to the cost of permitting, construction, and grid connection.

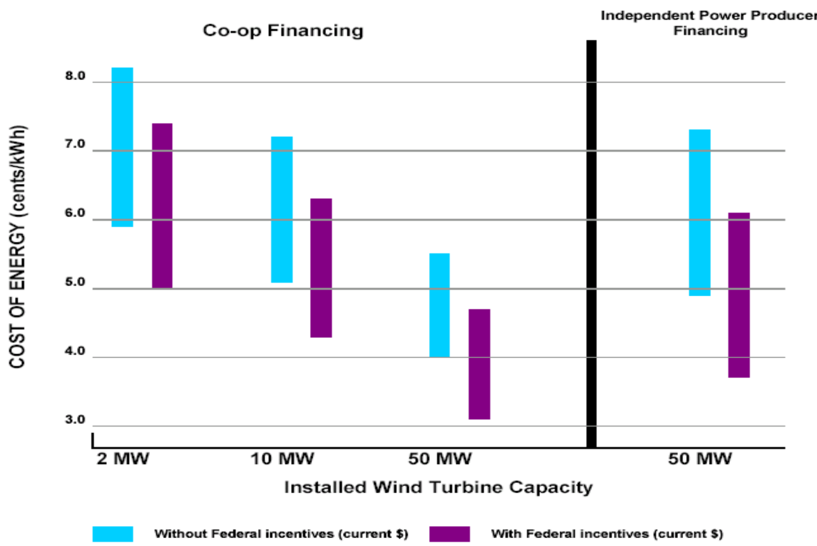


Figure 4. COE as a function of financing structure and project size.

Economic costs include accounting cost, plus any additional costs that may not be taken into account by the market. For wind farms, these costs are typically believed to be small and difficult to measure. They could include the negative visual impact of a wind farm or increased traffic during the construction of the wind plant.

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[2] Wiser, Ryan; Kahn, Edward. "Alternative Windpower Ownership Structures: Financing Terms and Project Costs." Lawrence Berkeley National Laboratory, LBNL-38921.

Benefits

Perhaps one of the most obvious benefits of wind is that it reduces the need to use conventional fuels for power generation. Accurately determining the dollar value of this fuel saving can be difficult, particularly given the varying level of restructuring of power markets in the United States. In regulated markets, the value of fuel saving can be estimated by running an electricity production simulation model to determine which power plants' operation would be curtailed by the wind plant and by how much. Different regions have different fuel mixes and different operating characteristics, so the value of this fuel offset can vary significantly across the country. In restructured markets, a similar type of model can be used after adapting it to the local market conditions. The economic incidence[3] of these benefits will also vary widely. For example, an IOU that uses large amounts of wind will save on its fuel bill, whereas in a restructured market, an NUG with a conventional plant may reduce its output (and therefore sales and profits) because a wind NUG could bid a lower cost of energy for some hours of the year.

One significant example of the difference between accounting cost and economic cost is the environmental damage caused by many conventional power sources. Because pollution costs are not incurred directly by power generators, companies don't have an incentive to reduce pollution unless specific regulatory agencies require it. Specific estimates of the monetary value of pollution are complex to evaluate. However, plausible ranges can be established, such as those developed in Minnesota.[4] Wind power plants can reduce fuel usage by conventional power generation, which will in turn reduce emissions of NO_2, SO_2, and other pollutants, depending on the fuel involved. The economic benefit of the emission reduction induced by the wind plant can be estimated using a range of monetary values for the various pollutants.

A conventional generator consumes large amounts of fuel over its lifetime, which can be 20-30 years or more. During that time, significant fuel price increases over and above the rate of inflation can occur. For example, in February 2003, natural gas prices on the New York Mercantile Exchange increased from $6.60/MBTU to $10.90/MBTU, a 65% increase. To help guard against the risk of fuel price volatility, various risk-mitigation strategies are pursued that provide a hedge against possible

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[3] Economic incidence refers to the final "resting place" of a change in cost or benefit after all market adjustments and corresponding physical adjustments have been taken into account.

[4] See http://www.me3.org/projects/costs/ for an example of estimates of the environmental cost of conventional power generation.

rising fuel costs. This hedging activity incurs a real cost, and this cost is normally excluded from the analysis of conventional generation costs. Because wind plants don't consume fuel, there is no risk of fuel price increases; therefore, there is no need to pursue the associated hedging activities. The hedging value provided by wind plants has been estimated to be approximately $0.005/kWh.[5]

Wind power plants can provide an economic stimulus to the local economy. The range of impacts depends on a number of factors, including the size and characteristics of the local economy, sources of capital, ownership of the plant, and the size of the wind plant. Much of the economic impact occurs during the construction period of the wind plant. In rural areas, it is common for farmers to receive lease payments for wind turbines that are located on the farmland. Significant tax revenues can also be generated by the wind plant, depending on the local tax structure and the size of economic development incentives that are granted to the developer.

In addition to offsetting the fuel used by conventional power plants, wind plants can reduce the need to build new conventional generation, which is called capacity credit. Capacity credit can be assessed using detailed power production simulation models. Because wind plants don't provide constant power output, the capacity value of a wind plant is some fraction of its rated capacity, and it can range from 20%-40% of rated capacity (percentage values outside of this range are also possible). One of the key determinates of the capacity value is the quality of the wind resource and its temporal match with the electricity demand.

Other Issues

Evaluating the economics of a wind power plant is a reasonably complicated undertaking and is subject to a number of important assumptions. When comparing the economics of a wind plant with the economics of another technology, it is important to compare "apples to apples." For example, comparing the cost of a new wind plant to the cost of existing generation is not valid because most old power plants have fuel contracts that were locked in at low prices, and new gas or coal plants will not be able to duplicate those contracts. When new generation is built, regardless of the technology, additional transmission capacity is often required. This is particularly true in the western regions of the United States. Allocating transmission costs to specific generators is a

[5] Bollinger, Wiser, Golove. "Quantifying the Value that Wind Power Provides as a Hedge against Volatile Natural Gas Prices," Windpower 2002.

complex process because new transmission can provide other benefits and because transmission is an example of a joint-use facility. Small assumptions can lead to differing cost allocations. The specific conventional fuel reduction benefits of a wind plant will also depend heavily on the local fuel mix. This extends to emission reduction benefits as well.

Because wind is an intermittent power source, this variability can impose additional costs on the system relative to a conventional power plant. This variability must be analyzed in the context of the entire power system, which already has significant variability. Wind forecasting technology can help reduce the impact of wind's variability on the system.

Economic Development Benefits of Wind Power

Steve Clemmer, Union of Concerned Scientists

The potential economic benefits of continued growth in the wind industry are huge. The U.S. Department of Energy's "Wind Powering America" initiative has set a goal of producing 5% of the nation's electricity from wind by 2020. DOE projections show that achieving this goal will create 80,000 new jobs during the next 20 years, provide $1.2 billion in new income for farmers and rural landowners, and add $60 billion in capital investment in rural America.

New Jobs

Wind power creates new high-paying jobs in a wide variety of industries. This includes direct jobs installing, operating, and maintaining wind turbines, as well as jobs at manufacturing facilities that produce wind turbines, blades, electronic components, gearboxes, generators, towers, and other equipment. Indirect jobs in the industries that support these activities are also created.

According to AWEA, the U.S. wind industry directly employs more than 2,000 people and contributes to the economies of 46 states. The Danish Wind Turbine Manufacturer's Association estimates that wind power creates 22 direct and indirect jobs for each MW of installed capacity—five jobs per MW for installing the turbines and 17 jobs per MW related to manufacturing.

Operating and maintaining wind turbines can provide a long-term source of highly skilled jobs for local communities. New wind projects directly create about one operation and maintenance job for every 10 MW of installed capacity. Additional jobs are created in local businesses that supply goods and services to these projects, and these employees spend their paychecks in the local economy.

The degree to which wind power creates new jobs in a state or local economy will depend on how much of the labor, materials, and services are supplied by local businesses. Furthermore, the rate of job creation per unit of capacity is likely to decline over time as the industry grows and is able to manufacture wind turbines in larger volumes and at a lower cost. However, this will make wind power more affordable, which will lead to additional economic growth.

Although only a handful of states have fossil fuel reserves, most states have the potential to generate a significant portion of their electricity needs from wind power. For states that import most of their energy, wind power provides an opportunity to create jobs by keeping more energy dollars at home. For example, a study by the New York State Energy Office found that wind energy creates 27% more jobs in the state than the same amount of energy produced by a coal power plant and 66% more jobs than a natural gas power plant.

Landowner Revenues

Many people will benefit from the clean air and economic growth brought about by wind power development, but farmers and other rural landowners may benefit the most. The best wind resources tend to be located in rural areas and on farmland in the plains states. Wind power can provide a new cash crop for farmers and ranchers. Large wind turbines use only about one quarter-acre of land, including access roads, so farmers can continue to plant crops and graze livestock right up to the base of the turbines.

One of the easiest and most attractive ways for farmers and other landowners to benefit from wind power is to allow wind developers to install large wind turbines on their land. Although leasing arrangements vary widely, royalties are typically around $2,000 per year for a 750-kilowatt (kW) wind turbine, or 2% to 3% of the project's gross revenues. Given typical wind turbine spacing requirements, a 250-acre farm could increase annual farm income by $14,000 per year, or more than $55 per acre. In a good year, those 250 acres might yield $90 worth of corn, $40 worth of wheat, and $5 worth of beef per acre. Thus, lease payments from wind power can provide a stable supplement to a farmer's income, helping to counteract swings in commodity prices.

Another option is for a farmer or group of local landowners to own one or more wind turbines. These "wind co-ops" are common in Europe, but there are only a few examples in the United States. However, in the 2002 farm bill, Congress included new incentives to form wind co-ops and help farmers finance wind projects. A 1996 study by the Southwest Regional Development Commission in Minnesota found that local ownership of 200 MW of wind power could generate 300 more jobs and $7.8 million more income over a 30-year period than receiving land lease payments from wind developers.

Local ownership of wind projects presents some challenges, however. Purchasing one or more large wind turbines can be a substantial investment for even a large farm operation. Smaller wind farms may also have to compete with larger, multiple-turbine wind farms, which often have lower production costs due to economies of scale in manufacturing and installation. However, farmers may be able to team up with a rural electric co-op to finance a project and sell the wind power to its customers.

Tax Revenues

Wind power can also provide significant property tax revenues for rural areas. While local property tax rates vary widely, payments generally range from 1% to 3% of the project's value. At 1%, property tax payments would provide approximately $10,000 per MW of installed wind capacity for rural communities each year. These revenues can be used to build new schools, roads, bridges, and other infrastructure.

Wind projects pay property taxes that are often two to three times higher per unit of energy than conventional power plants because they are more capital intensive. To help level the playing field, some states give wind power an exemption or partial exemption from property and other taxes. Many wind projects also pay state business, sales, and income taxes.

Throughout the United States, wind power is creating a new source of jobs and income that could help revitalize state and rural economies while providing a clean, inexhaustible source of energy.

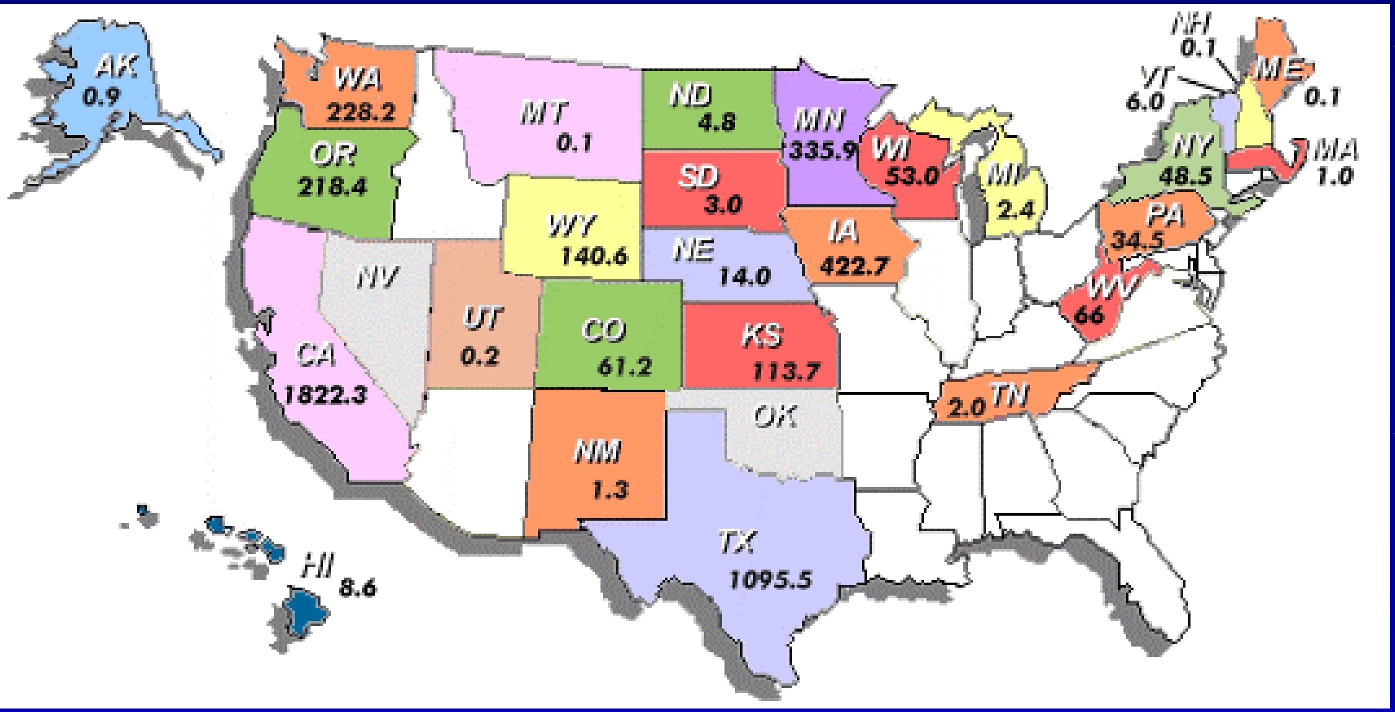
Union of Concerned Scientists

The Economic Development Benefits of Wind Power

Steve Clemmer
Senior Energy Analyst
Union of Concerned Scientists

Harvesting Clean Energy Conference
Boise, ID
February 10, 2003

U.S. Wind Power Capacity (Megawatts)

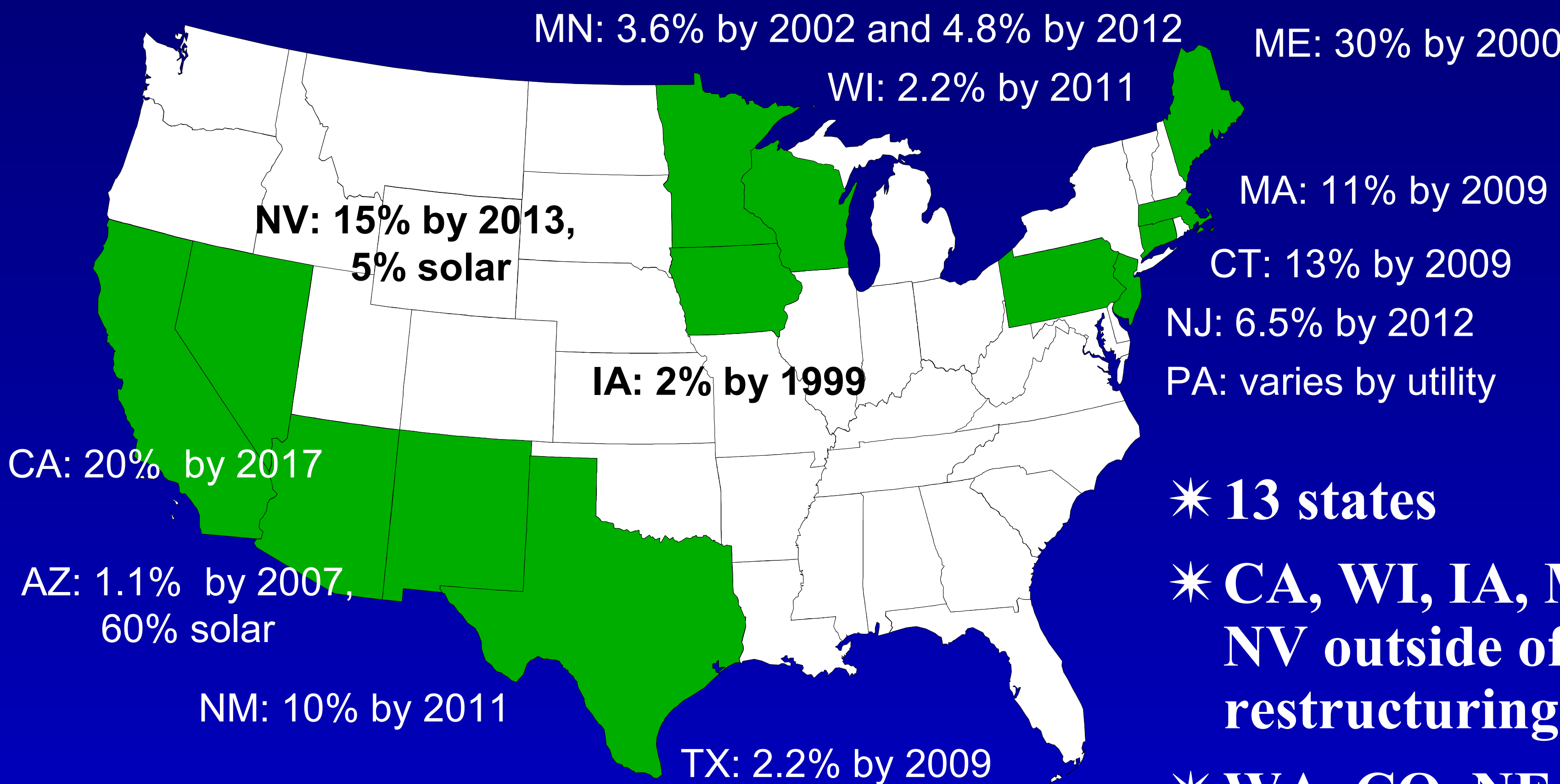


- 66% growth & $1.7 billion investment in US in 2001
- ~30% annual average growth rate globally since 1995

- Total Capacity = 4,685 MW

Source: American Wind Energy Association

Renewable Energy Standards



- 13 states
- CA, WI, IA, MN, NV outside of restructuring
- WA, CO, NE, IL VT, MD up next??

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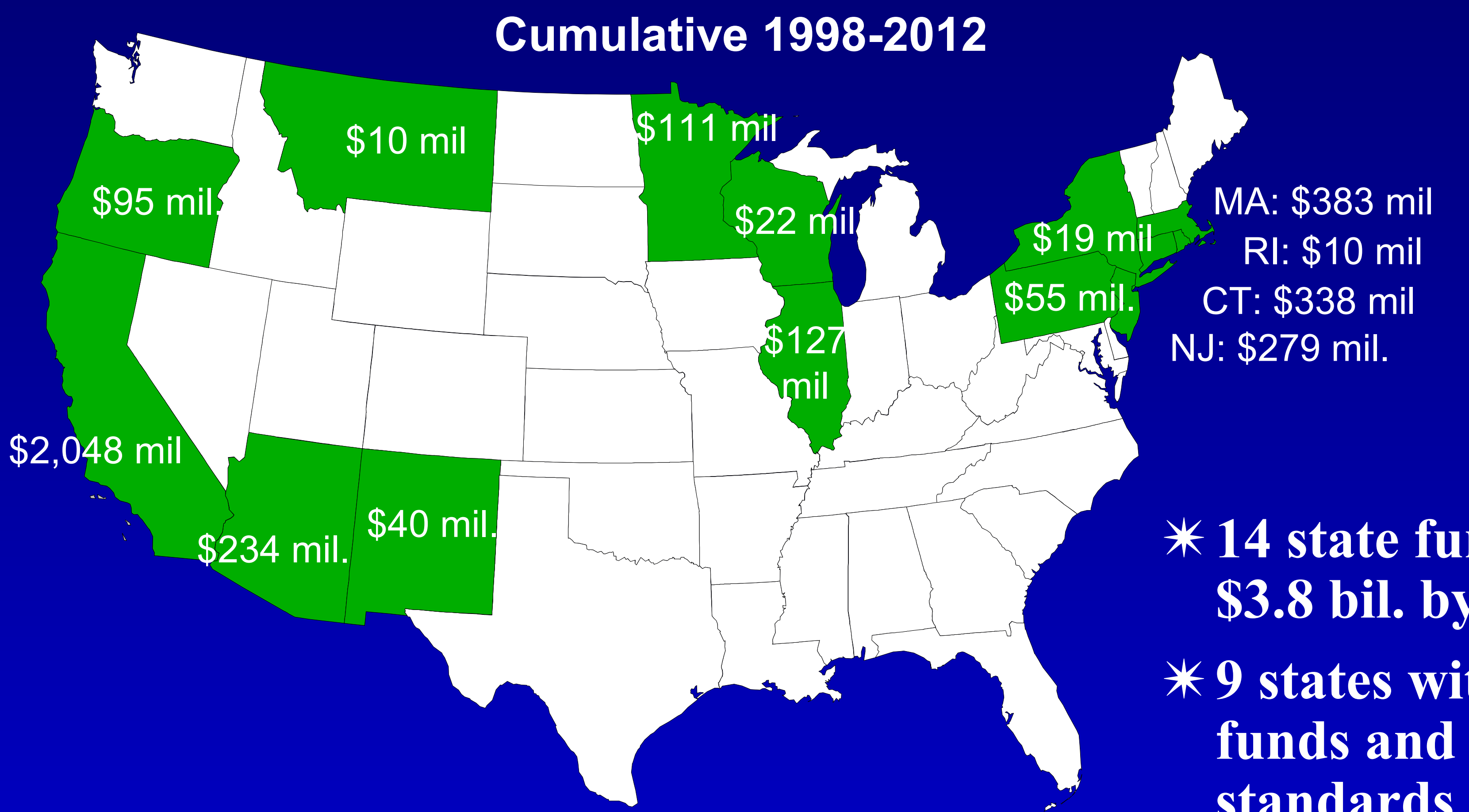
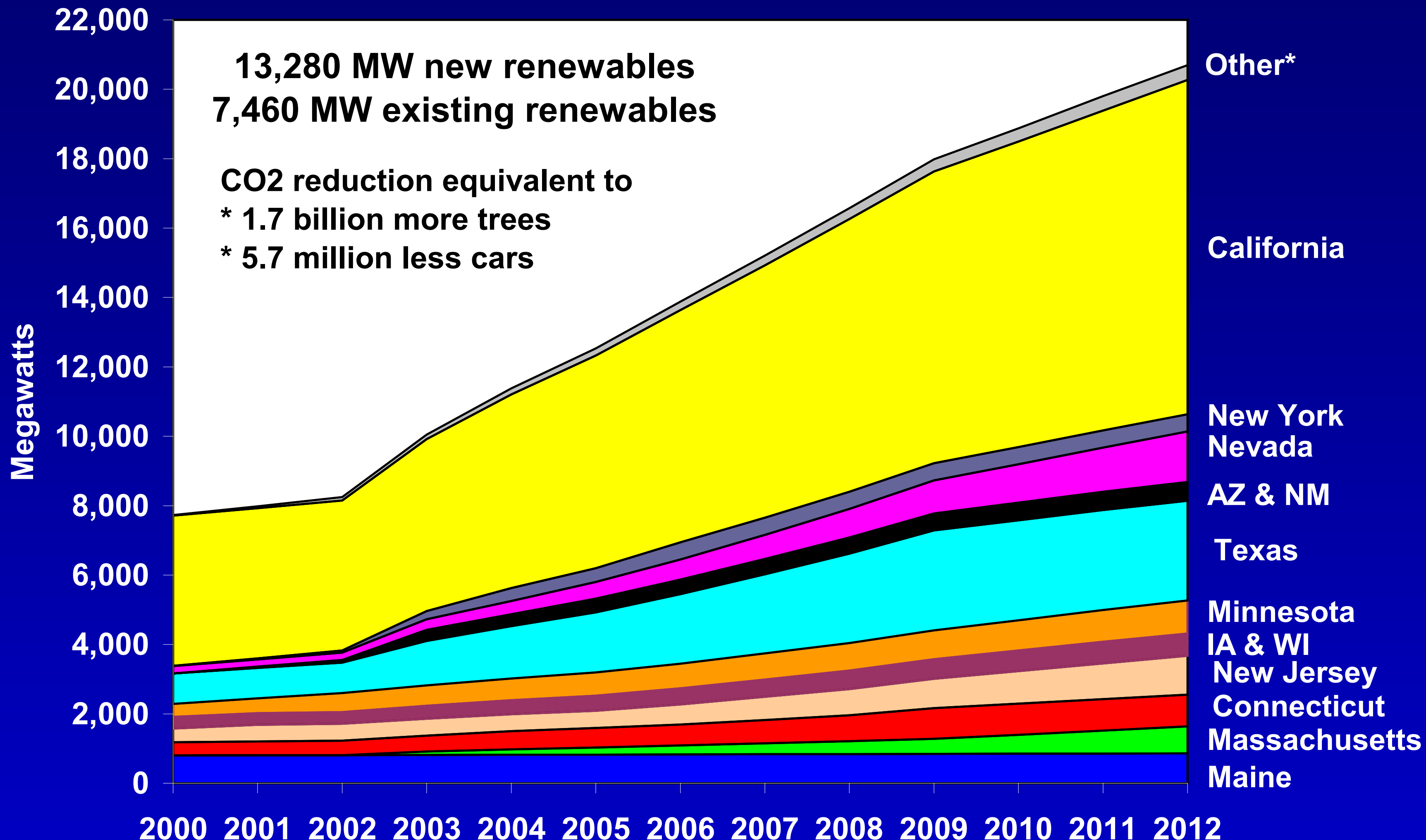
Renewable Energy Funds



- 14 state funds = $3.8 bil. by 2012
- 9 states with funds and standards

Renewables Expected from State Standards and Funds



*Includes Illinois, Montana, Oregon, Pennsylvania and Rhode Island.

Union of Concerned Scientists

Wind Power Provides Rural Economic Benefits

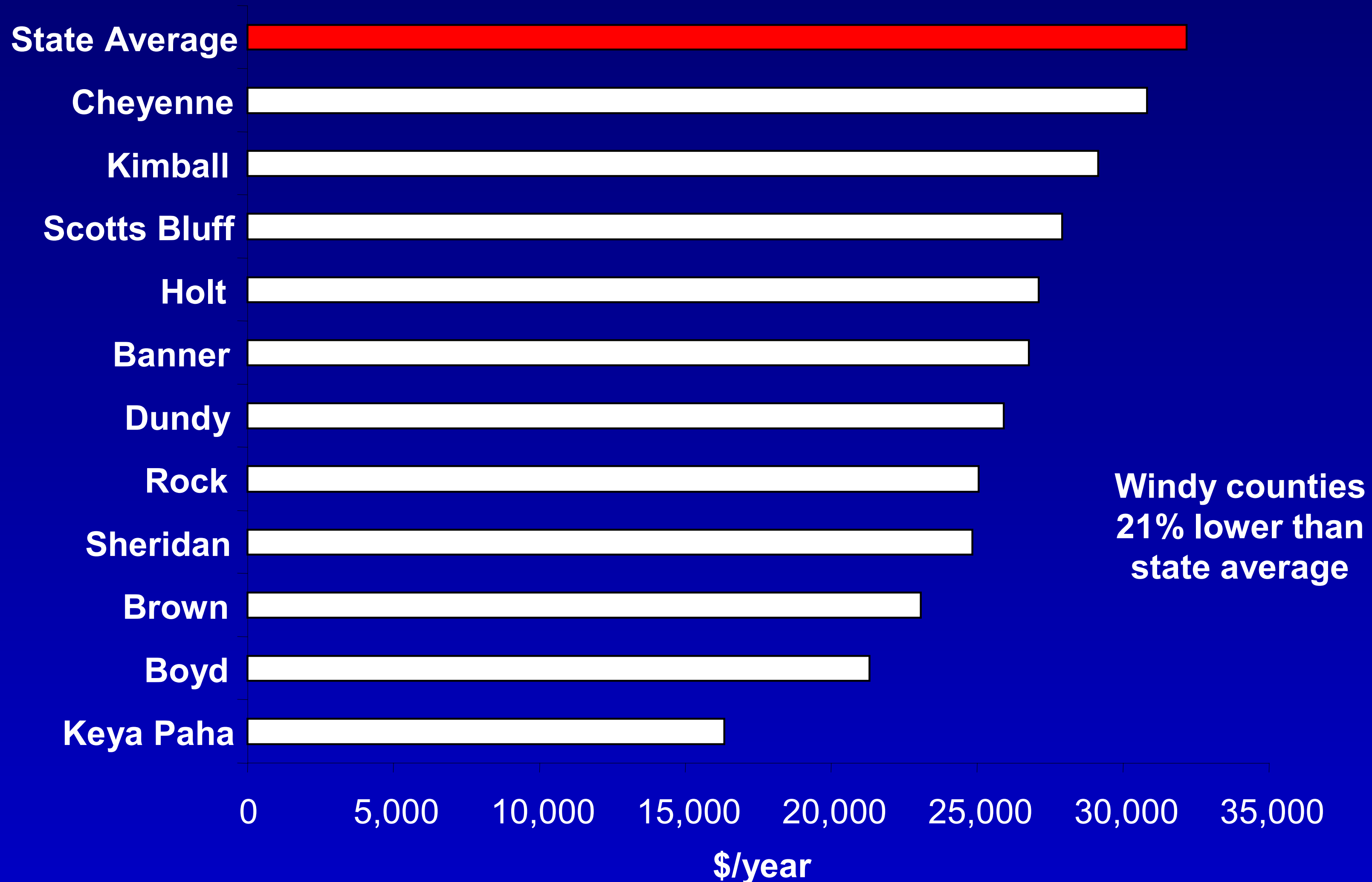
- **240 MW of wind in Iowa**
  - $640,000/yr in lease payments to farmers ($2,000/turbine/yr)
  - $2 million/yr in property taxes
  - $5.5 mil/yr in O&M income
  - 40 long-term O&M jobs
  - 200 short-term construction jobs
  - Doesn’t include multiplier effect
- **107-MW wind project in MN**
  - $500,000/yr in lease payments to farmers
  - $611,000 in property taxes in 2000 = 13% of total county taxes
  - 31 long-term local jobs and $909,000 in income from O&M (includes multiplier effect)

Union of Concerned Scientists

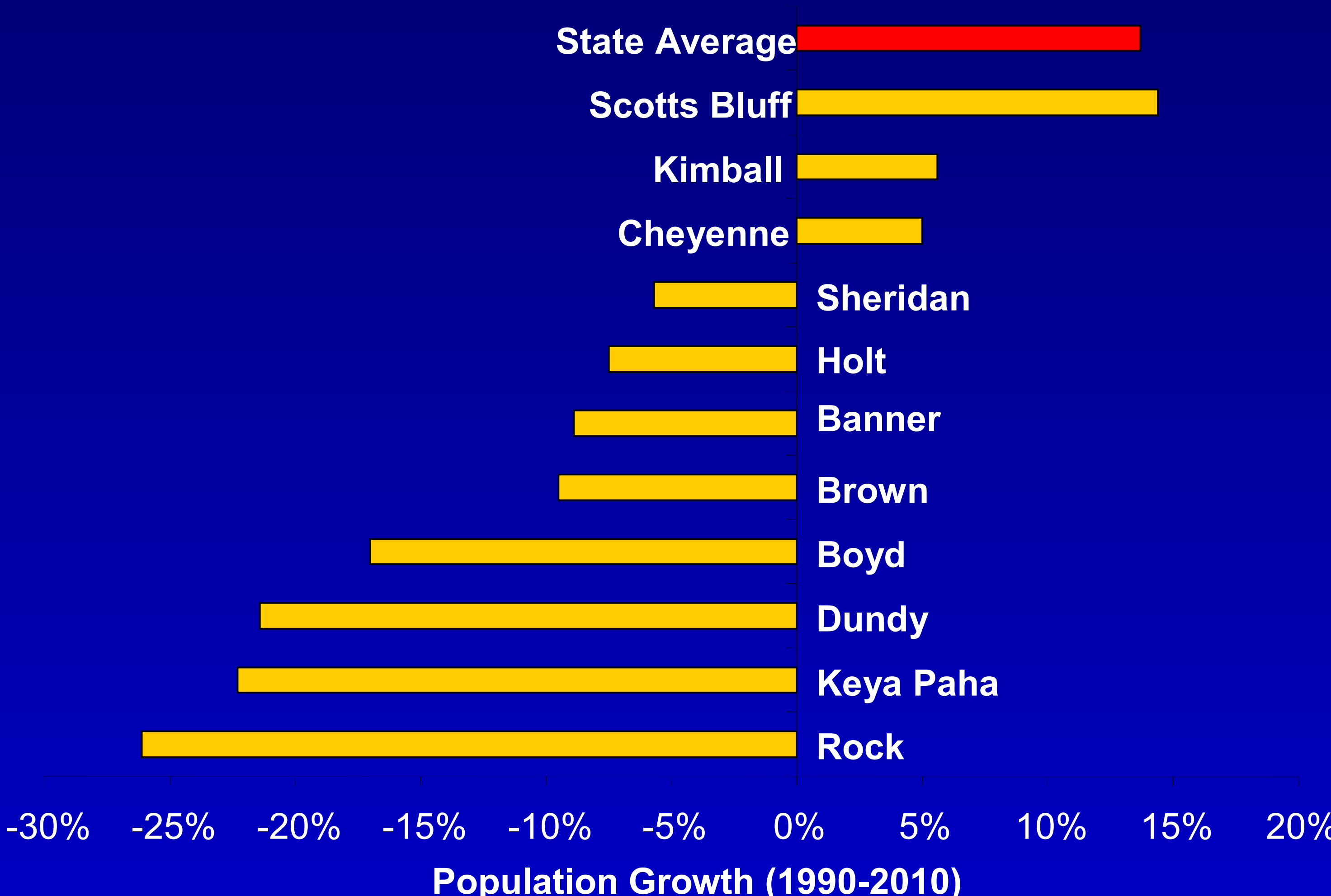
Wind Power Creates New Manufacturing Jobs

- Danish wind turbine manufacturer (Vestas) announced plan to build plant in Portland, OR
  - 1,000 new jobs
- Wind turbine blade plant in ND (LM Glasfiber)
  - 130 jobs = 20% of ND lignite coal industry
- Towers manufactured in several states, including WA, ND, NE, WI, and LA

Median Income Lower in Nebraska's Windiest Counties



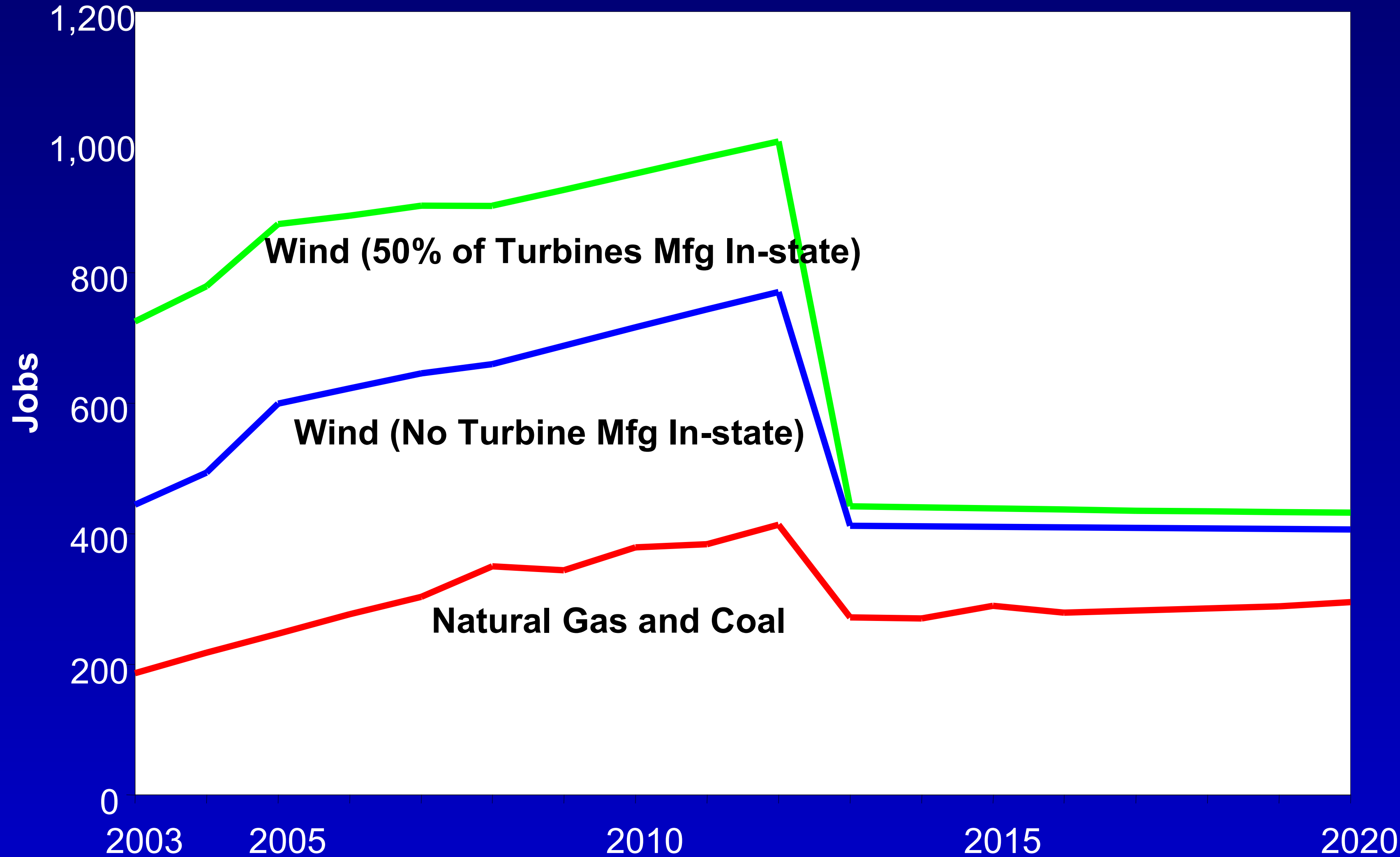
Population Declining in Windiest NE Counties, While State Grows



Net Benefits of 10% NE Electricity from Wind by 2012

- 360 more jobs, $8 million more in income, and $35 million more in GSP than coal and gas
- $2.2 million in royalty payments to farmers and landowners ($2,000/turbine/year)
- $5.2 million in property tax revenues for rural communities
- Net benefits to state economy = $15 million per year over a 20-year period

NE Jobs from Wind Power vs. Gas and Coal



Union of Concerned Scientists

Economic Benefits of Proposed Wind Project in Kittitas Co, WA

- 390 MW from 265 turbines
- Construction: 185 jobs and $12 million in income
- O&M: 53 long-term jobs and $4 million/yr in income
  - includes $1.2 million in land lease payments @ $4,500/turbine
- $2.9 million/yr in property taxes
  - 11% increase over current revenues
- Views of wind turbines will not negatively impact property values

Source: ECONorthwest, Economic Impacts of Wind Power in Kittitas County, Oct. 2002.

Union of Concerned Scientists

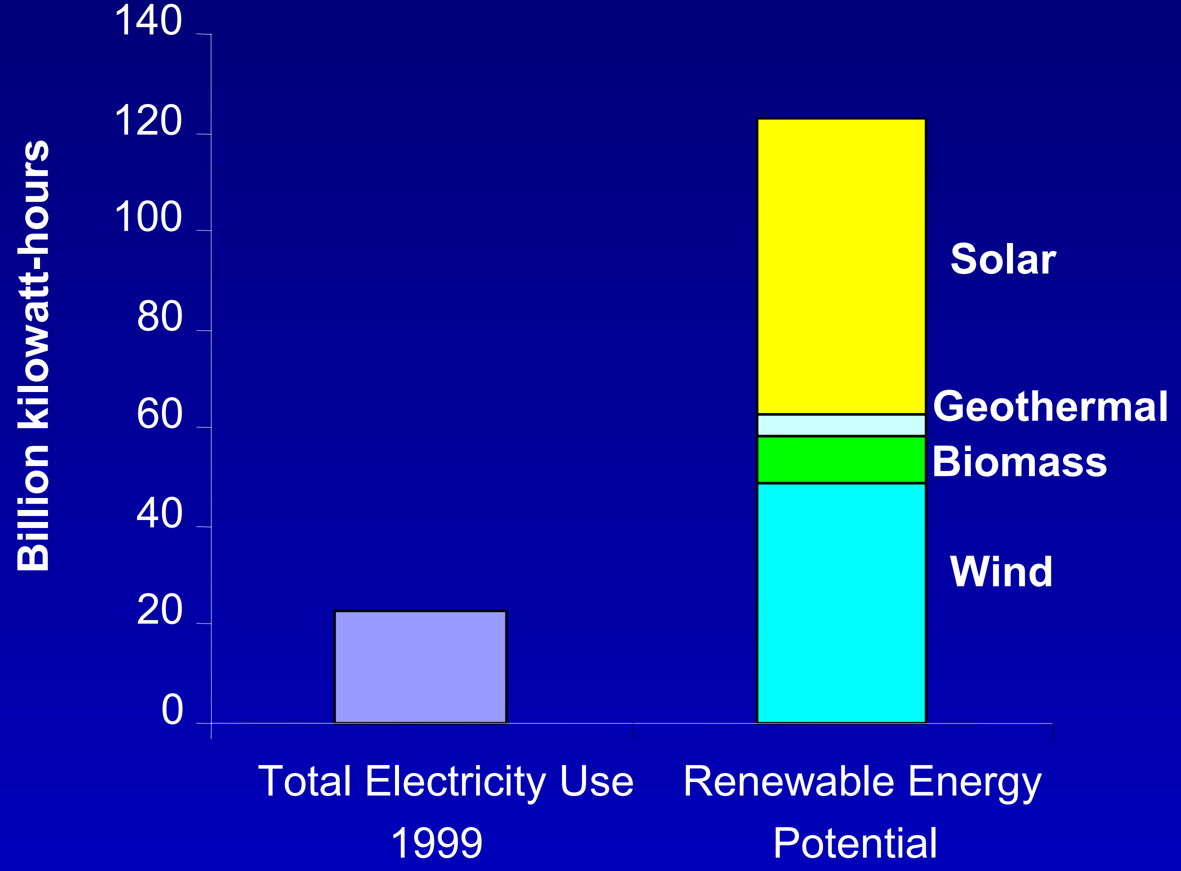
Regional Benefits of a National Renewables Standard of 20% by 2020

- Non-hydro renewables = 30% of Northwest electricity use by 2020
- $7 billion in new investments
- $400 million in property tax revenues for rural areas
- $100 million in land lease payments from wind power
- $2.8 billion from exporting renewable energy credits
- $3 billion savings on consumer energy bills
  - 7% lower electricity prices and 14% lower natural gas prices than business as usual
- 35% reduction in carbon dioxide emissions

Source: UCS, *Renewing Where We Live: What a National Renewable Energy Standard Means for the Northwest*, 2002.

Union of Concerned Scientists

Idaho's Non-Hydro Renewable Energy Potential



- 2.7 times current use from wind, biomass, and geothermal
- More than 5 times current use with solar

Source: Energy Information Administration; Renewable Energy Atlas of the West, 2002.

Union of Concerned Scientists

Economic Benefits of 10% ID Electricity from Wind by 2013

- 10% in 2013 = ~1,000 MW of wind or 100 MW/year
- Construction impact (annual average)
  - 310 jobs, $8 million in income, $31 million in gross state product
- Operation and maintenance impacts
  - 630 jobs, $20 million in income, $40 million in gross state product
- $4.25 million/year in property taxes
- $4 million/year in land lease payments
- Key assumptions:
  - no turbines and 50% of towers are manufactured in state
  - 25% of financing from local sources
  - 1% property tax rate; assessed value = 50% of total cost
  - $4,000/MW lease payment

Union of Concerned Scientists

Conclusions

- State policies are a key driver for wind energy development
- Wind power can provide significant economic benefits for farmers, ranchers, and rural areas
- Idaho could reap significant economic and environmental benefits by adopting strong policies for renewable energy

Wind Transmission Issues

Ron Lehr, National Association of Regulatory Utility Commissioners

Lack of sufficient transmission to meet market demand for wind energy is one of the most significant barriers facing wind energy development today. In some cases, high quality wind resources are located far from load centers. Owners of competing generation resources—usually utilities or government agencies—control existing transmission. Because the existing transmission was built to serve current generation levels and locations of sources and loads, there is very little excess transmission capacity available to serve the development of wind resources. Gaining access to transmission services for wind energy can be complex, time-consuming, expensive, and futile.

Because it regulates the wholesale, bulk power, and interstate transmission systems, the Federal Energy Regulatory Commission (FERC) is both the source and salvation for many transmission issues. Since the Energy Policy Act (EPAct) of 1992, open access has been an issue before FERC. A series of long orders has not yet achieved the goal of open access, but some progress is evident. FERC is working on a standard set of rules for interconnections between generators and the transmission system. Interconnection agreements can consume substantial time and effort, which FERC seeks to streamline.

The open access transmission tariffs that transmission providers have filed with FERC limit services available to wind, retain high costs for transmission services, and include penalties that hurt wind economics and require impossible controls. These limits on service, high rate levels, and penalties can make costs for transmission services prohibitive.

There has been a long period of institutional self-examination, confusion, and delay since FERC decided to require Regional Transmission Organizations. FERC's new mega-rulemaking in favor of Standard Market Design makes it likely that the period of institutional uncertainty will continue in the foreseeable future. In this atmosphere, little regional transmission planning has occurred, and no consensus exists on the case that supports either public or private approvals or investments in additional transmission.

Importance

For development of some remote, high-quality, low-cost wind resources, additional transmission capacity will most likely be required. Without it, the net costs of wind investment will be higher.

Options for Resolution

1. **Develop wind closer to loads.** Use machines that are designed for cost-effective operation in lower-quality wind sites.

2. **Connect at the distribution level.** At this level, clusters of turbines in small distributed patterns avoid transmission service requirements (see www.nationalwind.org, "Distributed Wind Power Assessment," page 33 for Tom Wind's Iowa case study. The study showed that wind can be connected at the distribution level in small clusters without great costs).

3. **Separate the ownership of generation and transmission by utilities and government agencies.** Require open access to transmission services on a common-carrier basis.

4. **Plan for, invest in, and provide sufficient transmission services to allow wind to meet market demand.** Participation in transmission planning should expand to include all those with a stake in the outcome, including public officials, non-profit groups, landowners, and individuals impacted by transmission investment. Returns on investment must be sufficient to recompense investors, and the business case for taking the investment risk must be clear and convincing. Investment should be at a level and pace that is current with demand for wind-generated electricity—any less would deny wind the opportunity to compete in a fair market.

5. **Reform the transmission planning process, interconnection rules, and interconnection agreements.** Provide transmission services to generation resources like wind that can be planned, financed, and constructed in short periods of time to reduce time, costs, and hassles. Do it better, faster, cheaper.

6. **Do not penalize wind with imbalance charges unrelated to costs.** Do not require wind to nominate strict production schedules to control area operators in the absence of agreements about wind forecasting, data collection and communications, and costs and benefits.

Allow imbalances to be settled over monthly periods so wind variations can offset each other.

7. **Create transmission services that can be curtailed.** Firm transmission is not universally available or economically attractive to wind because wind at capacity factors of 30% to 40% pays much more for firm transmission than higher capacity factor generators. By allowing long-term access to services that can be curtailed or non-firm services (currently limited to one-year service contracts by tariff), wind developers could decide whether the amount and timing of interruptions of their transmission service would be economically feasible given their wind farm's performance over time.

Wind Transmission: Context and Future

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Introduction

- Transmission System History
- Wind Transmission Today
- Wind Transmission Issues

Transmission System History

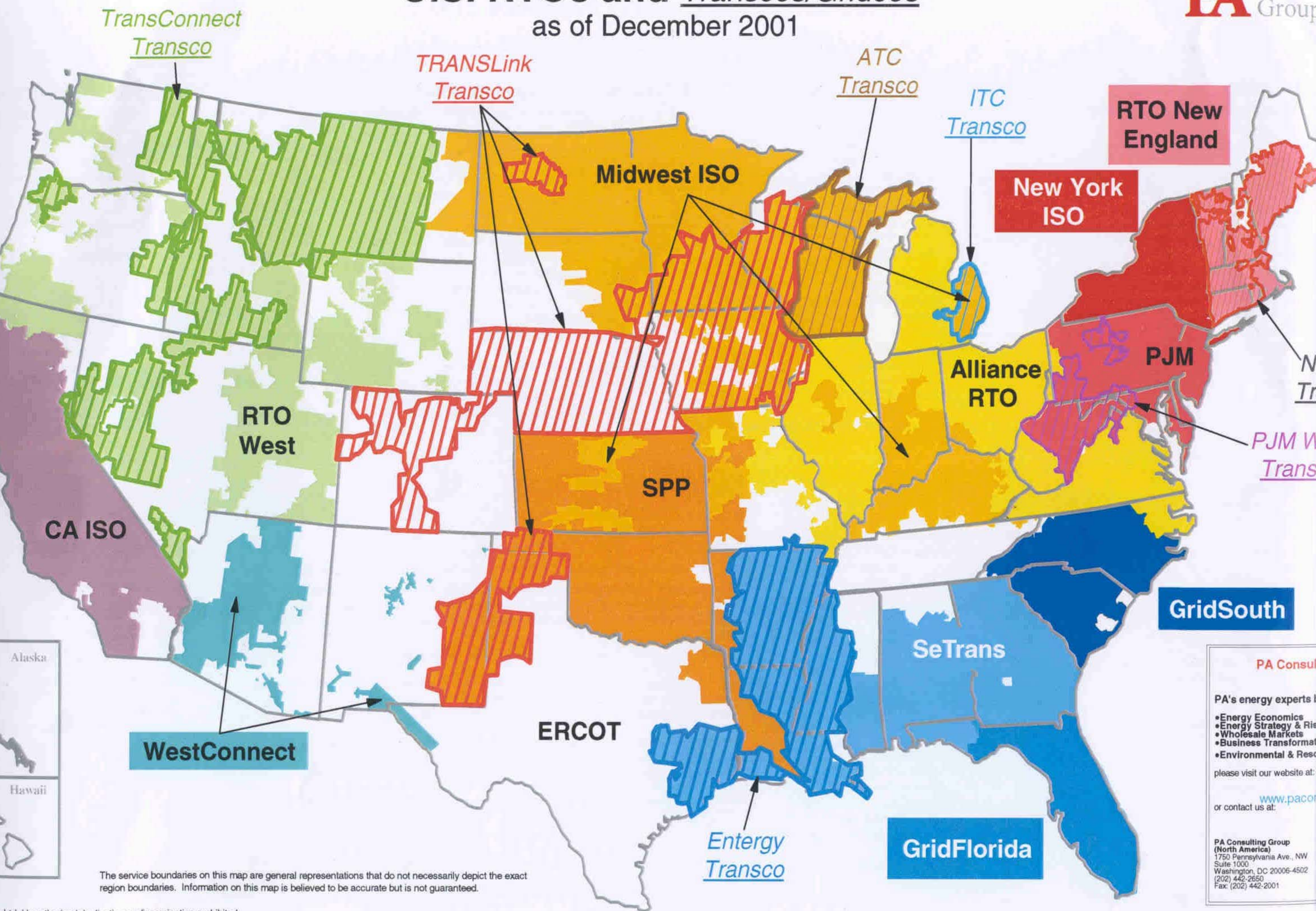
- City generators
- City generators interconnect: reliability
- Federal dams: hydroelectric power to market
- Mine Mouth Coal Plants
- Three Big Grids: East, West, TX
- NERC: reliability planning and reporting
- FERC: federal regulators, interstate commerce

Wind Transmission Today

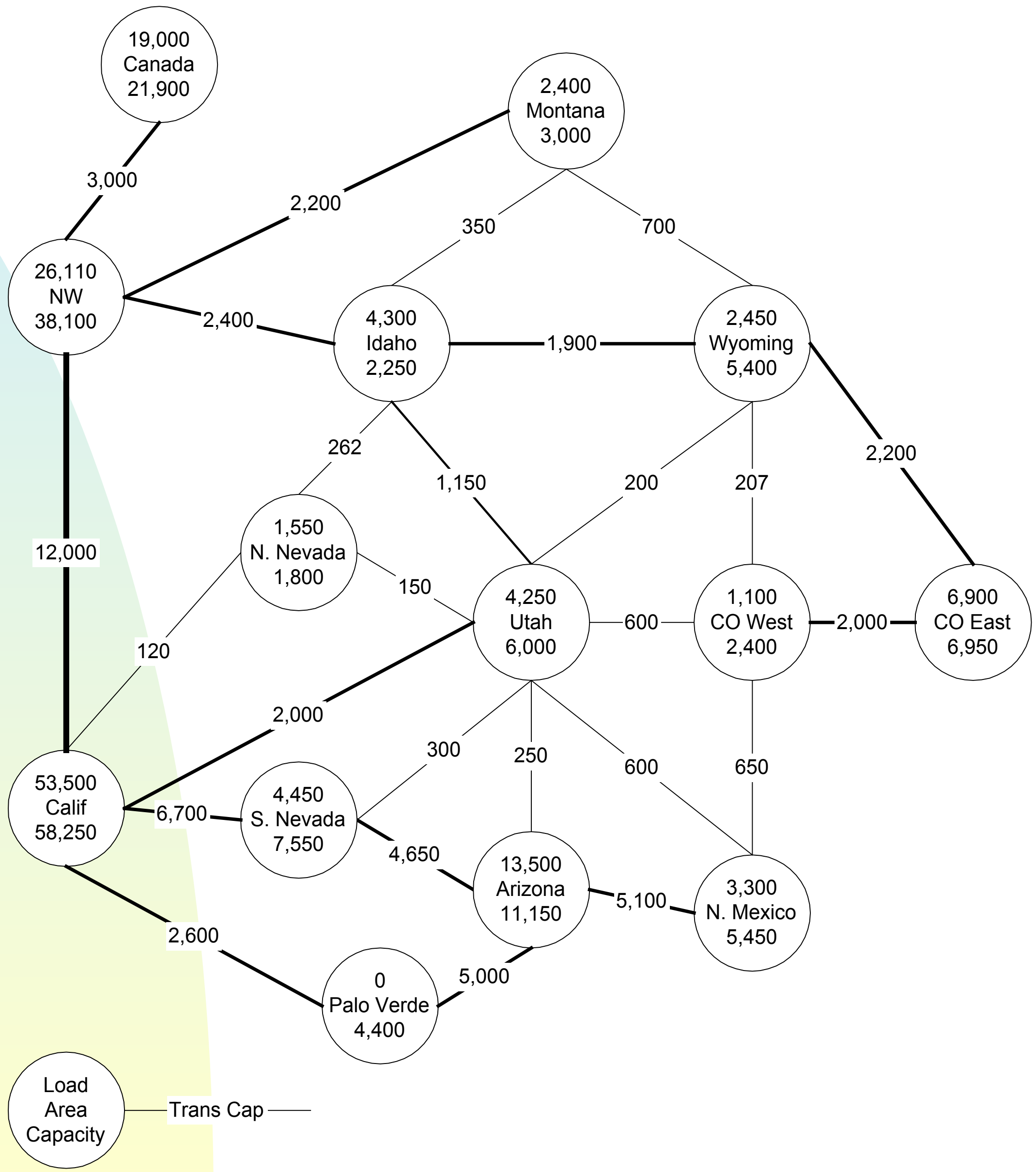
- State interconnection rules and “network” transmission service
- 92 EPACT: “open access”
- Transmission “haves,” “have nots”
- FERC transmission tariffs, SMD
- Regional Transmission Organizations (RTO)
- Interconnect studies, “queues”
- Physical congestion vs. contract rights

U.S. RTOs and Transcos/Gridcos

as of December 2001



Interior West Transmission Areas
Peak Loads, Generating and Transmission Capacities for 2002



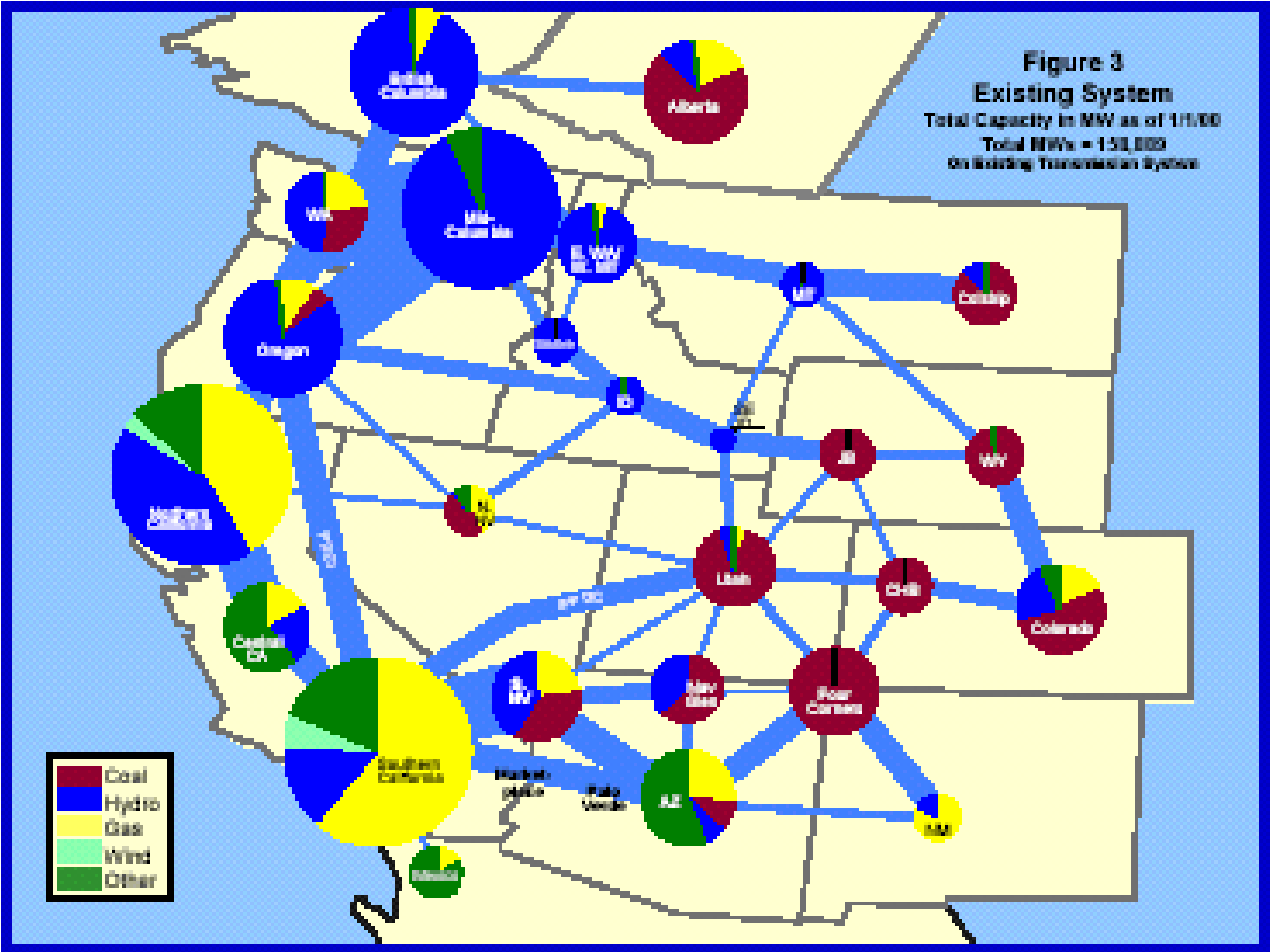


Figure 3
Existing System
Total Capacity in MW as of 1/1/00
On Existing Transmission System
British Columbia
Alberta
WA
Mid-Columbia
Oregon
MT
Colstrip
Idaho
ID
JB
WY
Northern California
N. NV
Utah
Colorado
Central CA
S. NV
Four Corners
Southern California
Market place
Palo Verde
AZ
NM
Coal
Hydro
Gas
Wind
Other

Wind: New, Variable, Remote

- New--less than 1% of electric generation
  - Wind now competes on economics with gas; beats coal
  - Wind has environmental and risk management advantages
  - Wind technology continues to improve
  - Electric system planners and operators are unfamiliar

Variable

- Available when the wind blows--30-40% capacities at good sites
- Can be forecasted, based on weather--like electric loads
- Diverse sites reduce variability
- UWIG study--back up costs low
- Market: commit generation ahead or pay imbalance penalties
- “Fixed/non-firm” service lacking

Remote from Loads

- Best wind sites are not populated
- Transmission will be required

WGA Emergency Ad-Hoc Transmission Study

- Response to California meltdown
- BAU scenario--all gas
- Diversity scenario--gas, coal, wind
- Follow-up report on “who pays”
- Regional Siting Method with Feds
- www.westgov.org

WECC Wind Development Plan

State	Online	Developable @ $2.50 gas	Developable @ $4 gas	Five Year Build-Out	Ten Year Build-Out with Transmission
Arizona		400	600	100	300
California	1716	2000	3500	1000	1750
Colorado	61	900	34000	300	900
Idaho		1500	2500	200	750
Montana		15000	60000	750	5000
Nevada		3000	4500	250	800
New Mexico	1	1000	6500	400	900
Oregon	157	500	3800	400	500
Utah		1500	2000	200	800
Washington	178	1500	3000	900	1300
Wyoming	141	25000	60000	500	7000
Total	2254	52300	180400	5000	20000

WECC Action Agenda

- WECC MIC SSG-WI Renewables Scenario
- West Wind Development Scenario
- LAW Fund Clean Energy Plan
- Business Case for Transmission
- Regional Political Consensus
- NWCC WECC Transmission Workshop (www.nationalwind.org)

Landowners' Frequently Asked Questions about Wind Development

Jay Haley, P.E.

1. How much money can I make?

Based on wind projects in southern Minnesota and northern Iowa, landowners can expect to receive annual land-lease payments ranging from $2,000 to more than $4,000 per turbine. The amount depends on the size of the wind turbine and how much electricity it produces as well as the selling price of the electricity. The same turbine will produce more in one location than another depending on the annual average wind speed at the site. The payments typically represent from 2% to 4% of the annual gross revenue of the turbine.

2. How many turbines can be placed on a section of land?

Approximately 10 megawatts (MW) can be placed on a section of land. Wind turbines are usually spaced 5 to 10 rotor diameters apart. The spacing criteria allow approximately twelve 750-kilowatt (kW) turbines or six 1.5-MW turbines on a section of land. Developers usually place the turbines as close together as possible to reduce the costs for wire and roads, but they do not want to create wake losses by placing the turbines too close together.

3. Is my land a good wind site?

A small increase in wind speed results in a large increase in power output from the turbine, so developers want to find the windiest sites. The wind speed increases with altitude and is slowed down by surface roughness elements such as trees, rough hilly terrain, and buildings. For example, a high plateau surrounded by land with relatively low surface roughness out to a distance of 5 miles or more would be a good wind site. The site must also be accessible to large cranes and other construction equipment and be near the transmission grid.

4. How do I get wind turbines on my land?

Work with your community to attract developers interested in working in your area. When planning large wind farms, developers rely on meteorologists to determine the best locations for the turbines. Developers want maximum energy capture at the lowest installed cost.

5. How much will I have to invest?

In most cases, wind developers finance, own, and operate the wind farms. The local landowners are not expected to provide financial support. The landowner’s role is typically to lease land to the developer for an annual fee.

6. Will my property taxes increase?

Installing a wind turbine may increase the property value because turbines produce long-term income. Most land-lease agreements have provisions stating that the wind developer will cover any increase in the landowner’s property tax.

7. Can turbines be sited on Conservation Reserve Program (CRP) land?

Yes, wind turbines can be sited on CRP land. The square footage occupied by the turbines and access roads may have to be removed from the CRP agreement if the landowner is receiving land-lease payments.

8. Can turbines be sited on grassland easements?

The U.S. Fish and Wildlife Service has developed guidelines that will allow one wind turbine per 160 acres of land that is under the grassland easement program. However, there are some restrictions. Interested landowners should contact the U.S. Fish and Wildlife Service for details.

9. What are the steps leading to wind development?

Typically, wind developers need a power purchase agreement, a good wind resource, low-interest financing, and low transmission upgrade or construction costs. The steps leading to wind development include:

- Prospecting for good wind sites
- Negotiating land-lease agreements
- Monitoring wind speeds
- Investigating transmission access
- Negotiating power purchase agreements
- Arranging financing.

10. What does the local utility think?

In the past, most utilities did not favor wind development because of its high cost and low reliability. Over the years, incremental design improvements have lowered costs and increased reliability to the point at which wind energy is the least-cost form of new generation, and reliability is better than 99%. Today, utilities across the country are involved in wind projects as a means of diversifying their portfolios, lowering their exposure to the risk of fluctuating fuel costs, and responding to consumer demand for wind energy.

11. How much do wind turbines cost?

Wind farms cost approximately $1 million per megawatt of installed capacity.

12. How much does a wind farm earn?

A 1.5-MW wind turbine will produce approximately 5,000,000 kWh per year—enough to power about 500 homes. At $0.04/kWh, the turbine would earn $200,000 per year in gross revenue.

13. Who owns the wind farm?

Investors typically own wind farms.

14. How much wind is needed?

Wind farm development becomes economically viable in wind regimes that have at least a 16-mph annual average wind speed (at the hub-height).

15. How much electricity do they generate?

A 1.5-MW wind turbine will produce approximately 5,000,000 kWh per year, which is enough to power about 500 homes.

16. Do wind turbines harm birds?

Birds collided with wind turbines on some of the early California wind farms, so the wind industry has carefully studied almost every wind farm project built since. The resulting studies indicate that the California experience was due to a unique set of circumstances that contributed greatly to the problem. Better siting practice has helped the industry avoid repeating the mistakes made in California.

17. How tall are wind turbines?

Modern wind turbines are placed on towers that range in height from 56 meters (184 feet) to 100 meters (328 feet). The blades are usually around 100 feet long, so at the top of its arc, a blade tip could be more than 400 feet in the air.

18. Are wind turbines noisy?

Modern wind turbines are very quiet. The noise produced by a wind turbine is a combination of the “swoosh” of the blades flying through the air and the hum from the gearbox and generator. The overall noise level has been compared to that of a modern refrigerator. When standing near a modern wind turbine, the background noise of the wind rushing past your ears will usually drown out any noise from the wind turbine.

19. How do turbines operate?

Wind turbines are sophisticated machines with computer controls. A typical operating sequence is as follows:

When the wind speed reaches the cut-in speed of the turbine (usually around 10 mph), the turbine blades will spin up to operating speed, usually around 14 to 29 rpm (varies by turbine model), and start generating electricity. As the wind speed increases, the generator output increases. When the wind speed increases to the rated wind speed (usually around 30 to 35 mph), the generator will output its nameplate-rated capacity (i.e. a 750-kW turbine would now output 750 kW). As the wind speed continues to increase, the generator output will remain at the rated capacity (i.e. 750 kW) until the wind reaches the cut-out speed (usually around 55 to 65 mph). At this wind speed, the turbine will deploy its tip-brakes and then apply its disk brake, stopping the blades in a few revolutions. It will then rotate itself 90 degrees out of the wind and park itself. If the wind speed drops to a level below the cut-out speed for a sufficient length of time, the turbine will point itself back into the wind, release the brake, and resume power production.

20. What happens when the wind doesn’t blow?

The existing system consists of two types of generating equipment, base-load equipment (coal-fired generators) that run at the same output level all the time, and load-following equipment (natural gas-fired generators) that are designed to vary their output to match the fluctuating load (lights and appliances going on and off). When wind turbines put electricity onto the grid, the natural-gas-fired generators respond by lowering their output. This automatic system is capable of compensating for wind energy added to the grid. Studies indicate that wind energy penetration levels of at least 10% on the grid are feasible under current control systems. In reality, it will be many years before we see wind penetration levels approaching 10%.

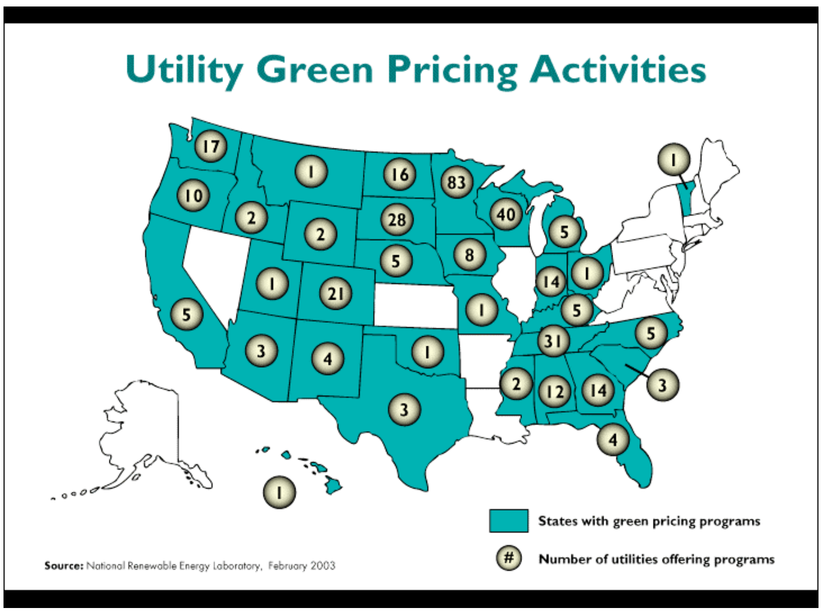
Policy

Green Power: An Emerging Market for Renewable Energy

Lori Bird and Blair Swezey, National Renewable Energy Laboratory

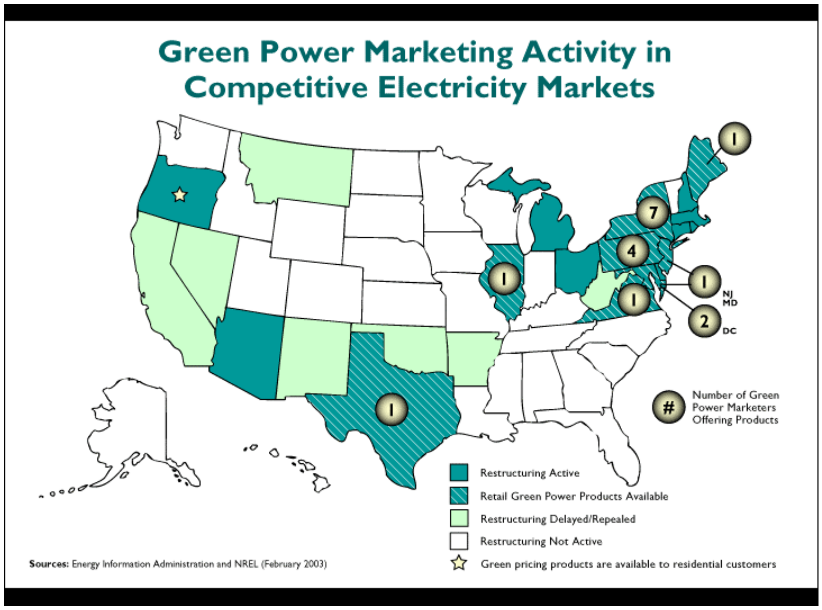
For the first time, consumers can use market-based purchase decisions to affect how electricity is generated. The availability of "green power" products empowers consumers to purchase electricity generated from renewable energy sources that are less damaging to the environment. Consumers usually pay a premium for green power.

There are two distinct markets for green power in the United States: regulated and restructured. In regulated markets, a single utility may provide a green power option to its customers through "green pricing," which is an optional service or tariff offered to customers. These utilities include investor-owned utilities, rural electric cooperatives, and other publicly owned utilities. As of February 2003, more than 300 utilities in 32 states offer green pricing or are in the process of preparing programs.



In restructured, or competitive, electricity markets, retail electricity customers can choose from among multiple electricity suppliers, some of which may offer green power. Electricity markets are open to competition in nearly a dozen states. A number of other states are phasing in competitive choice by allowing some customers to choose their electricity supplier.

Consumers can also purchase green power through "renewable energy certificates." These certificates represent the environmental attributes of renewable energy generation and can be sold to customers in either type of market, whether or not they already have access to a green power product from their existing retail power provider. Twelve companies are actively marketing renewable energy certificates across the United States.



Utility market research shows that a majority of customer respondents are likely to state that they would pay at least $5 more per month for renewable energy. And business and other nonresidential customers are increasingly interested in green power—about one-third of all green power sales are to nonresidential customers, including businesses, colleges and universities, and government entities.

New Renewables Capacity Supported by Green Power Markets

Green power is supplied from a variety of renewable energy sources, including wind and solar energy, biomass, and geothermal. More than 1,400 MW of new renewables-based generating capacity has been installed or is planned because of customer demand created in green power markets.

(as of December 2002)

Source	MW	%
Wind	1215.4	*86.0*
Biomass	121.2	*8.6*
Geothermal	60.4	*4.3*
Small Hydro	10.5	*0.7*
Solar	6.1	*0.4*
Total	**1413.6**	***100.0***

Green power is supplied from a variety of renewable energy sources, including wind and solar energy, biomass, and geothermal. More than 1,400 MW of new renewables-based generating capacity has been installed or is under development because of customer demand created in green power markets.

Role of Wind in Green Power Marketing

- Wind represents 93% of the capacity installed to meet consumer demand for green power.
- Nearly half of the utility green-pricing programs are supplied exclusively with wind power, and 80% include wind in their green-pricing supply portfolios.
- Of the green-pricing programs with the highest participation rates, 9 out of 10 offer wind power.
- Of the green-pricing programs with the lowest price premiums, 7 out of 10 are marketing wind power.

Supporting New Wind Development through Green Power Marketing

Utility-Scale Wind Systems

Green power marketing can provide a supplemental revenue stream to support the development of utility-scale wind energy facilities. For example, wind power purchases by universities and other customers in the Mid-Atlantic states are helping to support about 150 MW of new wind projects in the region. And in the Pacific Northwest, about 400 MW of new wind projects are being supported in part through premiums paid by green power customers.

Small Wind Systems

Green power marketing can be used to support small wind systems. In Washington, for example, Chelan County Public Utility District's customers can donate a fixed amount each month to support the development of small-scale, grid-connected wind energy projects within the county. The funds are distributed annually to customers that install systems of up to 1 MW in size.

Wind on Tribal Lands

Wind energy facilities can be constructed on tribal lands with the help of consumers interested in clean energy sources. For example, Vermont-based NativeEnergy has a program through which participants support the development of a 750-kW wind turbine on a reservation in South Dakota.

Renewable Energy Certificates

An increasing number of organizations support the development of new wind projects by selling green energy certificates, or green tags, in wholesale or retail markets.

Nationally, Aquila sells certificates generated from its 110-MW Gray County, Kansas, wind facility to large customers, and Sterling Planet is marketing green certificates supplied in part from new wind resources located throughout the country to residential and other customers. In the Pacific Northwest, the Bonneville Environmental Foundation serves a variety of businesses, government agencies, and utilities with green tags from several new wind facilities in the region.

Renewable Energy Policy and Green Marketing

Green power marketing can be used in conjunction with other policy mechanisms, such as system benefits funds and renewable portfolio standards (RPS), to support the development of new wind capacity. Wind energy projects have been supported through a combination of public benefits funds and customer premiums in states such as California, New York, and Pennsylvania. In states with RPS policies, green power marketing can offer customers the option of purchasing all of their electricity from renewable sources, rather than only the fraction required under the RPS. For example, customers in Texas can choose to purchase 100% wind energy for their electricity needs, whereas the state RPS requires utilities to include up to 3% renewables in their supply portfolios.

Status of Green Power Marketing in the U.S.

Lori Bird
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National Renewable Energy Lab
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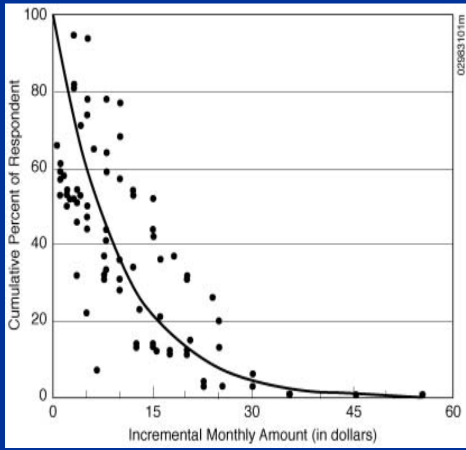
Market Research Findings

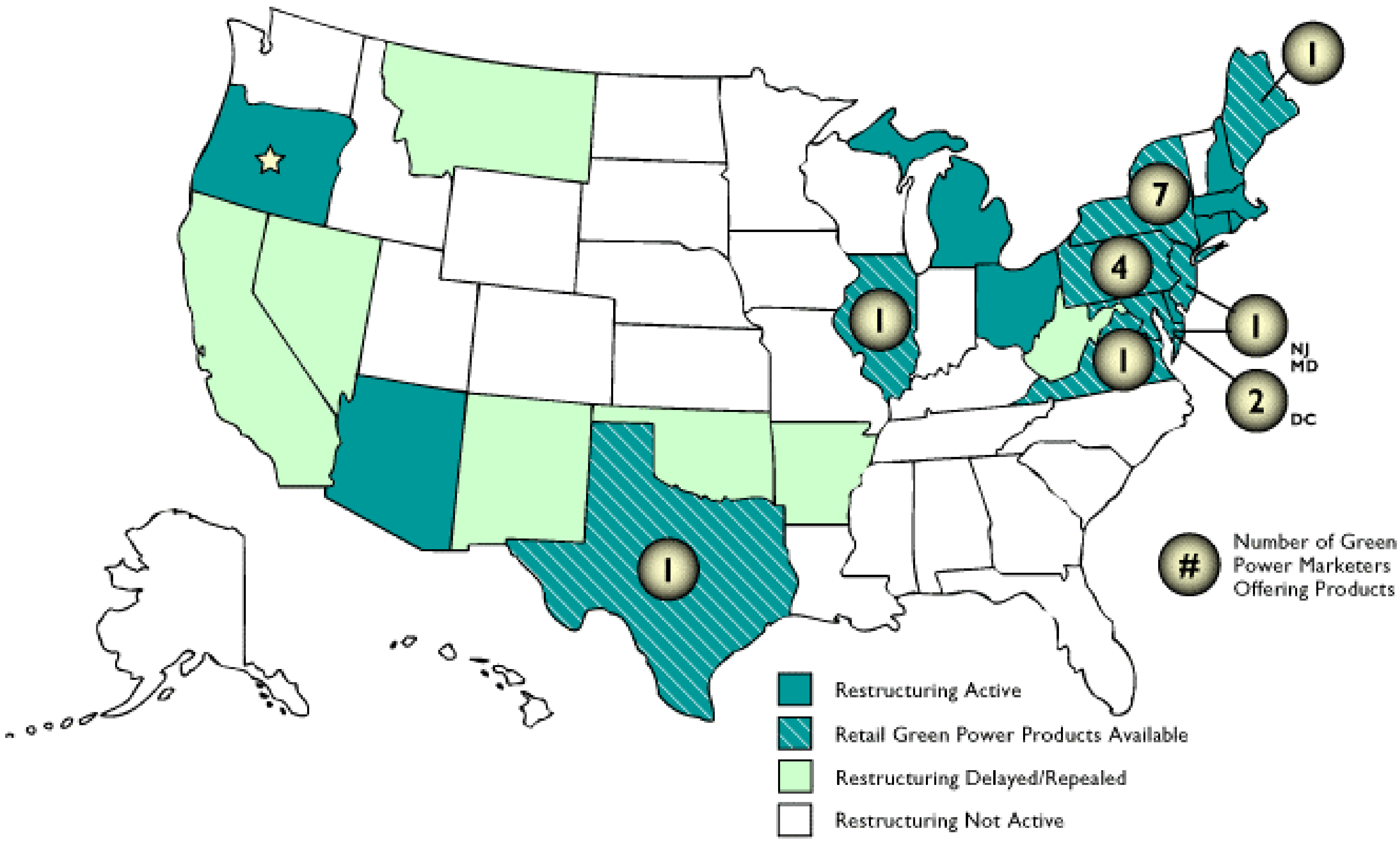
- **NREL "Willingness to Pay" Analyses**
  - **National surveys**
    - **56% to 80% of Americans say they are willing to pay more for environmental protection or for renewable electricity.**
  - **Utility surveys**
    - **52% to 95% of residential customers were willing to pay more for power from renewable sources.**
- **Roper Green Gauge Report**
    - **51% would be WTP 7.6% more for electricity generated from less polluting renewables**
- **Utility Field Studies**
    - **With 100% awareness, green power demand could be 10% to 20% of households.**



Markets for Green Power

- **Competitive markets** – green marketing
- **Certificate-based products** – only the renewable attributes are sold
  - Available to all customers
  - Customers do not have to switch suppliers
- **Regulated markets** – green pricing

Green Power Marketing Activity in Competitive Electricity Markets



Sources: Energy Information Administration and NREL (February 2003)

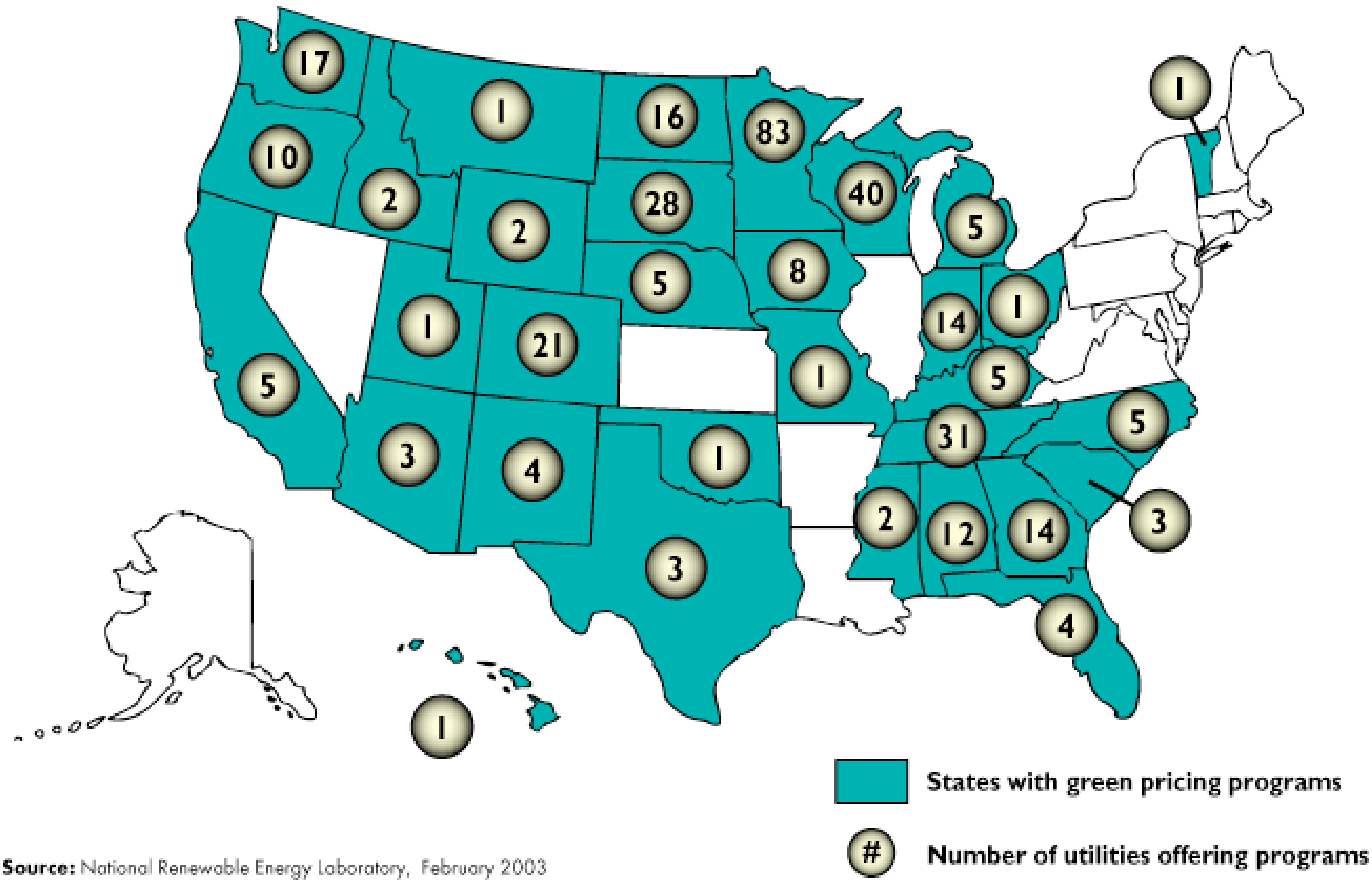
Green Power in Competitive Electricity Markets

- In the Northeast:
  - Universities and others are supporting development of 150 MW of new wind capacity
  - In NY, 6 new marketers launched products in 2002
  - Both green marketers exited Connecticut
  - Recent surge of interest in DC area
- In Texas:
  - 6% of customers who switched opted for green power
- In the Pacific Northwest:
  - Green power sales have tripled in last year
  - 400 MW of new wind supported in part by green market

Renewable Energy Certificate (RECs) Marketers

- About a dozen companies market RECs
  - Ex. 3 Phases, Aquila, Bonneville Environmental Foundation, Community Energy, Renewable Choice Energy, Sterling Planet, Sun Power Electric
- Being used to support both small-scale and large-scale renewable projects
- About 6,000 U.S. customers purchase RECs
- Significant REC sales to utilities and non-residential customers, particularly in Pacific Northwest and Northeast (50 MW+?)

Utility Green Pricing Activities



Source: National Renewable Energy Laboratory, February 2003

Green Pricing Policies

- **Most utility green pricing programs are voluntary**
- **5 states require utilities to provide customers with green power options**
  - **Iowa, Minnesota, New Mexico, Oregon, and Washington**
- **Some states have established green power purchasing targets for government agencies ("lead by example"):**
  - **MD (initially 6%, increased to 20%)**
  - **NJ (12%)**
  - **NY (10% by 2005, 20% by 2010)**
  - **PA (5%)**
  - **Chicago + 48 local agencies (20% = 80 MW by 2005)**
  - **Seattle (5% = 175 MW by 2004)**

Response to Utility Green Pricing Programs

- 270,000 customers participate in utility programs
  - Including 3,800 non-residential customers
- Average participation rate of 1%
  - Leading programs achieved participation rates of 3-5%
- Annual sales of about 890,000 MWh (100 aMW)
  - About 25% of sales are to non-residential customers
- $15.3 million in annual revenues from green power sales
- Price premium
  - Median 2.5¢/kWh, Average 2.9 ¢/kWh
- Average residential customer spends about $5.00/month
- Average customer acquisition costs = $47/customer

Top Utility Green Pricing Programs: Green Power Sales

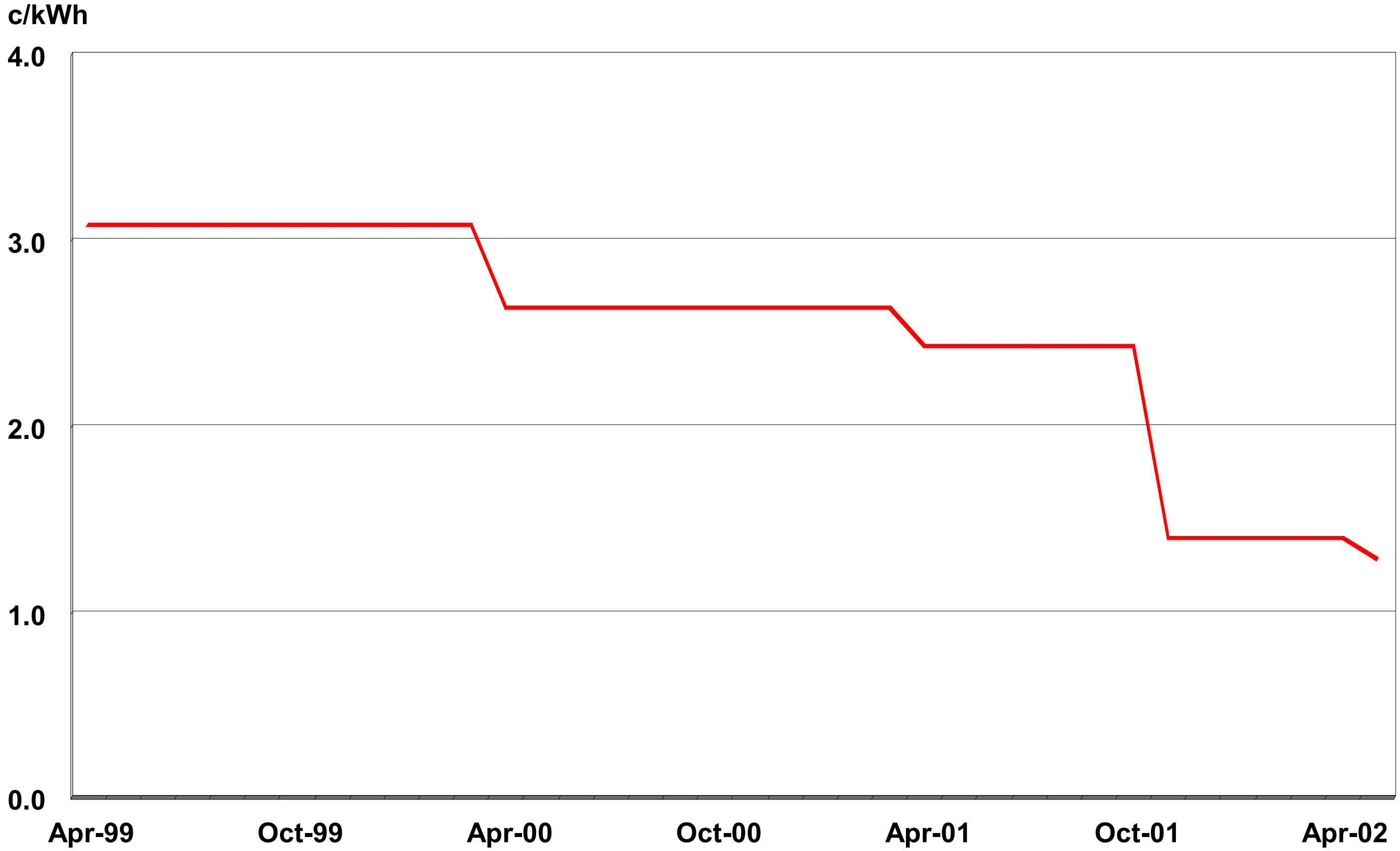
Rank	Utility	Resource	Sales (kWh/year)	Sales aMW
1	Austin Energy	Wind/PV	251,520,000	28.7
2	Sacramento	Landfill gas,wind, PV	104,000,000	11.9
3	Xcel Energy	Wind	103,564,000	11.8
4	Los Angeles	Wind, landfill gas	66,666,000	7.6
5	Portland/GM	Wind, geothermal	65,051,000	7.4
6	PacifiCorp/GM	Wind, geothermal	55,615,000	6.3
7	TVA	Wind/PV/biomass	35,955,000	4.1
8	We Energies	Landfill gas, wind, hydro	35,161,000	4.0
9	Puget Sound	Wind, PV	20,334,000	2.3
10	Madison G&E	Wind	15,593,000	1.8

Source: National Renewable Energy Laboratory

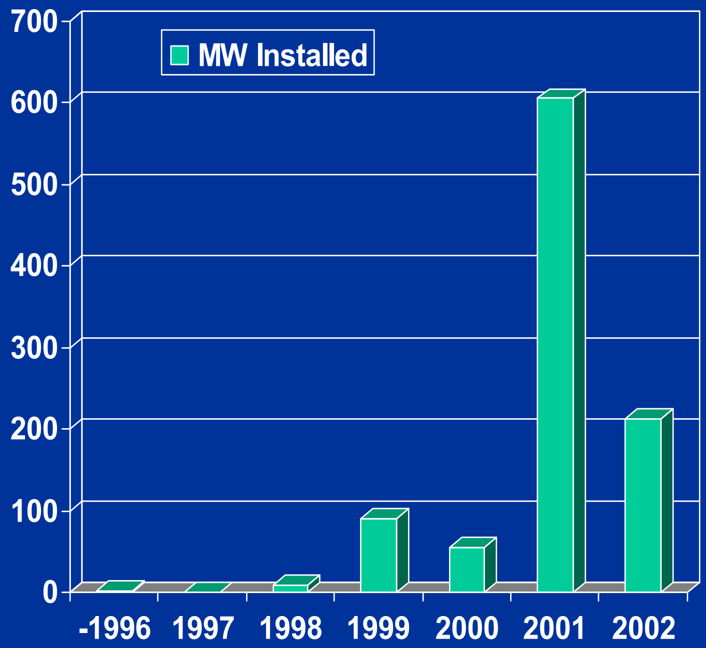
Key Elements of Successful Green Pricing Programs

- **Creating Value**
  - **Personal recognition**
  - **Visibility**
  - **Educational benefits**
  - **Price stability**
- **Program Implementation**
  - **Minimize the premium**
  - **Offer power from new renewable resources**
  - **Simplicity in message and design**
  - **Tenacity in marketing**
  - **Strategic partnerships**

Effective Premium for EWEB Wind Power

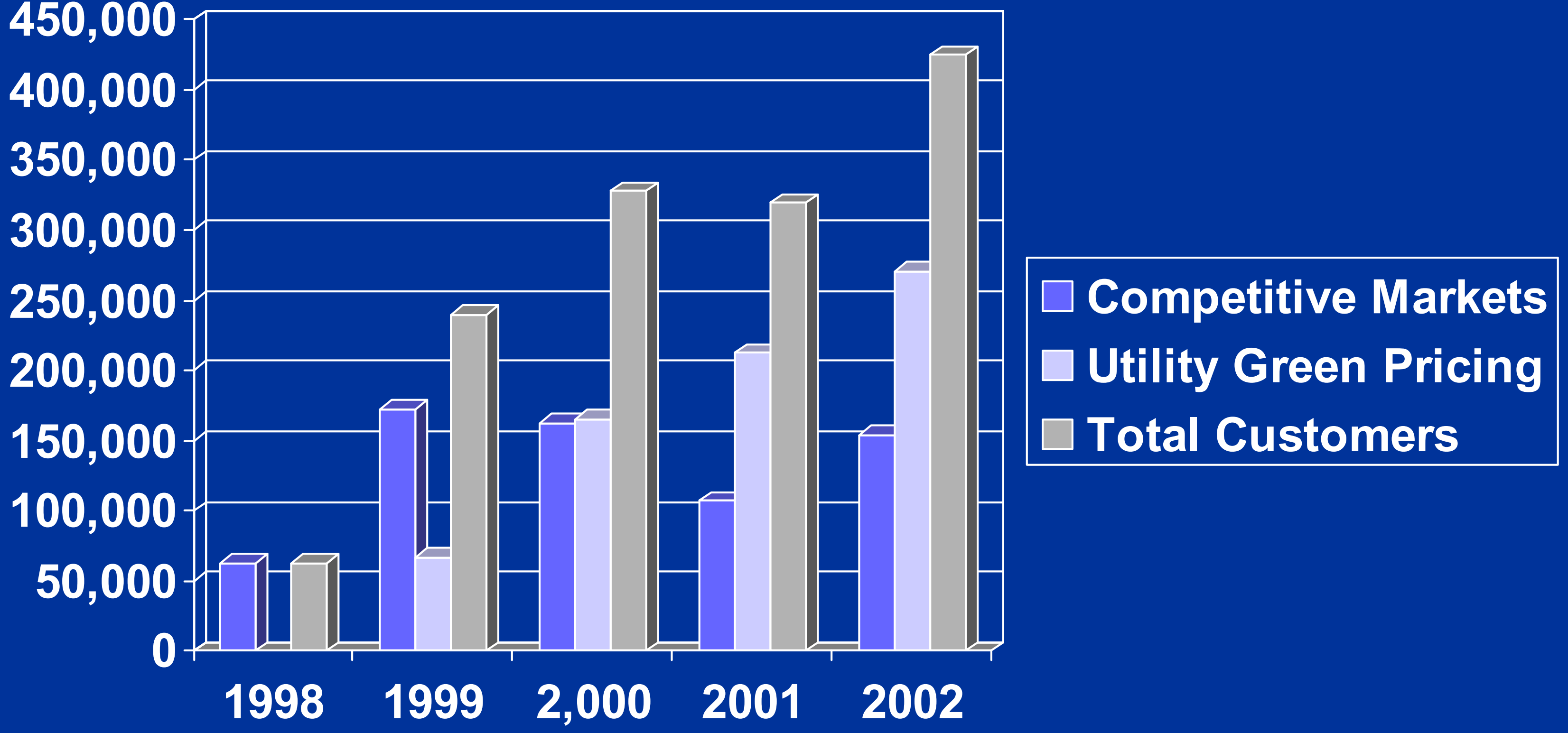


Green Power Market Summary



- Nearly 40% of U.S. customers have direct access to green power
- Also, about a dozen companies are actively marketing RECs
- More than 400,000 U.S. customers purchase green power (about 1%)
- 84 corporations have joined the Green Power Partnership, representing >530,000 MWh/year
- 980 MW new capacity installed to serve green power customers
- Another 450 MW planned

U.S. Green Power Customers



Recent Issues and Trends

- Increased number of partnerships between green power marketers and utilities
  - Green Mountain and Pacificorp, Portland (Oregon)
  - Community Energy and NYSEG (New York)
  - Sterling Planet and Tallahasse (Florida)
- Continued growth in utility programs spurred, in part, by state policies
- Marketers are retracting from stagnant restructured markets (i.e., Connecticut)
- Sales to universities and other large purchasers are driving competitive market sales

GREEN POWER Network

THE clearinghouse for information on the electric power industry's green power efforts.

The *Green Power Network* provides news and information on green power markets and utility green pricing programs. You will find links to green power providers and product offerings. Information on consumer and policy issues that impact the development of green power markets has also been provided.

http://www.eere.energy.gov/greenpower

Integrated Resource Planning: An Opportunity for Wind Advocates

Ed Holt, Energy Smart Consulting

Although the scope varies from state to state, utility regulation generally encompasses review of utility load forecasts, certificates of need for new generation facilities, resource planning and acquisition (including power purchase agreements as well as build to own), transmission and distribution planning, rate cases (cost of service studies and cost allocation to different rate classes), utility rate design, and fuel cost adjustments.

Many states that regulate investor-owned utilities are guided by integrated resource planning (IRP) requirements. As illustrated in Figure 1, IRP integrates many aspects of utility planning.

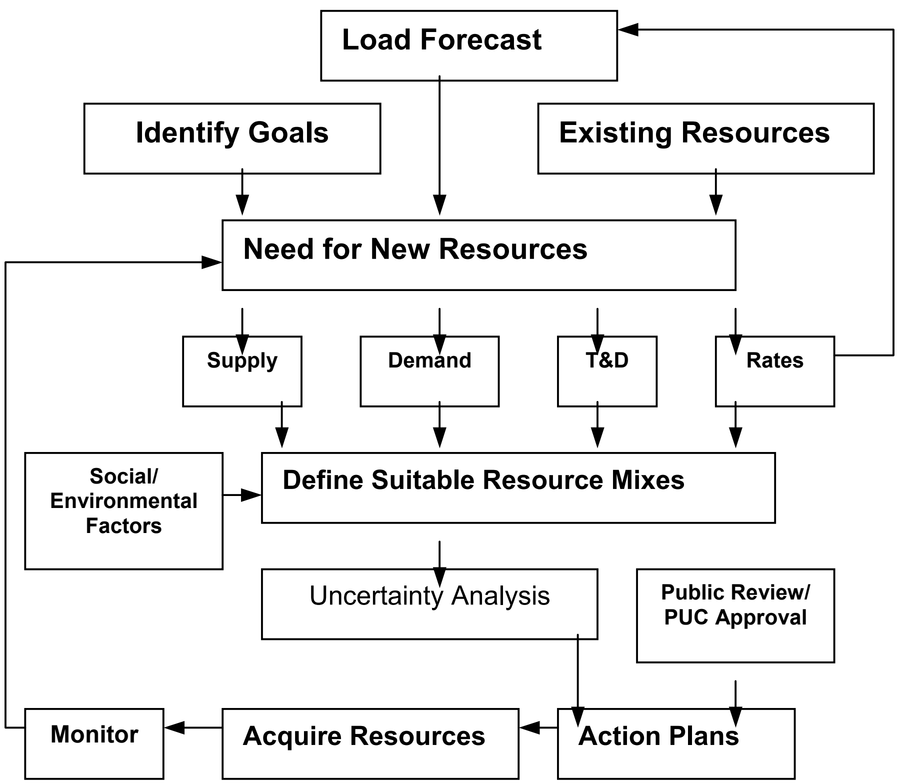


Figure 1. Integrated resource planning flow chart.
Source: Hirst 1992.

Integrated Resource Planning

Although IRP is frequently thought of in the context of long-term resource planning, it can also be used as a framework for utility planning and regulation. This planning process can be used to identify the lowest practical cost at which a utility can deliver reliable energy services to its customers, taking into account demand-side and supply-side resources, portfolio diversity and risk management, and environmental costs and benefits.

Analyzing avoided cost provides the common economic framework for comparing disparate resources such as base-load plants, peaking plants, intermittent resources like wind, and demand-side resources. Avoided cost analysis provides the means to compare the costs of alternative energy resources and decide which are cost effective and which are not, but it is commonly misunderstood.

Avoided cost is what a resource is worth to a utility, or the most a utility should be willing to pay for it. To figure this out, a utility should look at the specific operating characteristics of the resource under consideration and compare it to existing or planned resources that it would displace. A resource that provides electricity at a cost lower than its avoided cost is cost-effective and worth acquiring.

Public Participation

From a process standpoint, IRP gives interested parties an opportunity to participate through a regulatory proceeding. By helping to investigate the range of analysis and resources under consideration, wind advocates can ask questions and propose alternatives for consideration. Participating in the regulatory process can be time consuming, but at a minimum, stakeholders can review and comment on draft IRPs.

IRP in Restructured Markets

In theory, competitive markets add energy resources to the electric system in response to price signals. In practice, markets are imperfect and frequently ignore non-traditional alternatives. If capital cost is the primary consideration, for example, generation developers may flock to combined-cycle natural gas plants. Without a broader framework in which energy investment decisions are made, the market will exclude non-monetized values such as environmental costs and benefits, demand-side and renewable energy resources, portfolio diversity, and the value of distributed resources.

Portfolio management is a new term being discussed by regulators for restructured states. Like IRP, portfolio management allows the economic comparison of resources with very different characteristics, but the responsibilities for implementation and opportunities for public participation may be different.

First, someone with a public interest in the entire market and grid should take responsibility for long-term strategic oversight. This often falls to a state government agency, but it may be shared with regional transmission organizations. The portfolio architecture established by these actors would broadly include things such as grid interconnection standards, transmission policies affecting access and pricing, and the public interest in environmental values associated with renewable energy and energy efficiency.

Second, a provision must be made for customers who don't actively choose a supplier, through what is called default generation supply. The default supply provider may be the distribution utility, or it may be selected through a competitive bid process. In either case, regulators will determine the factors to consider in default supply.

Finally, the agency responsible for portfolio management should use the planning process to inform and coordinate the various participants in restructured markets. Periodic review by regulators can provide additional opportunity for public review and comment.

References

Hirst, Eric. (1992). *A Good Integrated Resource Plan: Guidelines for Electric Utilities and Regulators*. Oak Ridge National Laboratory.

Harrington, Cheryl, et al. (1994). *Integrated Resource Planning for State Utility Regulators*. The Regulatory Assistance Project.

Harrington, Cheryl, et al. (2002). *Portfolio Management: Looking after the Interests of Ordinary Customers in an Electric Market That Isn't Working Very Well*. The Regulatory Assistance Project.

Wind Powering America

Integrated Resource Planning: An Opportunity for Wind

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What Is IRP?

- IRP is a framework to guide utility planning and regulation
- For wind advocates, IRP is important as a key to long-range resource planning
- IRP minimizes the total $ spent on resources and maximizes the benefit for the total $ spent
- IRP should consider:
  - demand-side and supply-side resources
  - portfolio diversity and risk management
  - environmental costs and benefits

Avoided Cost

- For evaluating alternative resources, avoided cost is at the heart of IRP
- Avoided cost allows utilities to compare disparate resources:
  - base load plants
  - peaking plants
  - intermittent resources like wind
  - energy efficiency programs
- Analysts then decide which are cost-effective

Avoided Cost Is Misunderstood

- Avoided cost is a measure of benefits
- It is not a single number because it varies with the resource being considered
- Each resource has different characteristics and therefore different benefits
- Avoided cost of each resource is what that resource is worth to a utility (the most a utility should be willing to pay for it)

Avoided Cost: Concluded

- The operating characteristics of a specific resource under consideration should be analyzed and compared to the resource that it would displace in the utility's resource mix
- A resource that provides electricity at a cost lower than its avoided cost (benefits) is by definition cost-effective and worth acquiring
- All cost-effective resources should be acquired because they will maximize the benefits for the total $ spent

Public Participation

- IRP can be a lengthy and technical regulatory process, but…
- It gives interested parties a chance to participate
- Wind advocates can seek opportunities to:
  - help scope the range of analysis and resources under consideration
  - review and comment on the analysis and results
  - propose alternatives for consideration

Important IRP Considerations

- Left to itself, the market will ignore non-monetized costs and benefits
- IRP calls for explicit consideration of:
  - environmental costs and benefits
  - portfolio diversity and risk management
  - fuel cost uncertainty (or the absence of fuel cost)
  - value of distributed resources
- Wind advocates should ask for these factors to be included

Portfolio Management

- Portfolio management is a new term similar to IRP in restructured markets
  - responsibilities for implementation and opportunities for public participation may be different
- Responsibilities are not yet clear but may be shared by state government(s) and regional transmission organizations
- State regulators still have resource portfolio oversight for serving customers who don't choose--default generation supply

State Policy Options for Utility-Scale Wind Plants

Ryan Wiser and Mark Bolinger, Berkeley Lab

Although dramatic cost reductions have allowed wind power to become the least-cost energy option in some regions of the United States, state policies still play an essential role in stimulating wind power development in most areas. The range of available policy options for large-scale wind projects is broad. Some of the prominent state-level approaches used in the past to promote wind power include renewable energy purchase mandates, renewable energy funds, tax incentives, resource planning, and environmental credit markets. Each of these options, along with its advantages and disadvantages, is briefly described below.

Renewable Energy Purchase Mandates

Renewable energy purchase mandates include traditional set-asides directed at individual utilities in a regulated setting and renewables portfolio standards (RPS) that require all retail suppliers to serve a minimum portion or their load with eligible renewable energy. Examples of traditional purchase mandates can be found in Iowa and Minnesota. In Iowa, certain in-state investor-owned utilities are required to develop 105 average megawatts (MW) of eligible renewables. In Minnesota, Northern States Power (now Xcel Energy) is required to develop 425 MW of wind by 2002 and another 400 MW by 2012 as part of a radioactive waste settlement agreement. Meanwhile, 11 states—Arizona, California, Connecticut, Maine, Massachusetts, New Jersey, New Mexico, Nevada, Pennsylvania, Texas, and Wisconsin—have enacted some form of RPS.

Of all the state policy types discussed here, renewable energy purchase mandates will likely have the largest impact on wind development. Set-asides and RPS policies are attractive in some states because they create a strong demand for wind-generated electricity, offer incentives for wind power cost minimization through a competitive process, can be used in regulated and restructured market settings, and rely on the private market to make renewable energy investment decisions. In other states, however, political considerations make purchase mandates difficult to implement in legislatures.

In states where politics allow the creation of RPS policies, the policies must be designed carefully to have the desired effect. Experience shows that effective RPS policies in restructured markets require a strong level of political support and regulatory commitment, clear and well-thought-out renewable energy eligibility rules, predictable long-term renewable energy targets that ensure new wind power supply, standards that are achievable given permitting and transmission challenges, credible and automatic enforcement, and credit-worthy electricity suppliers that are in a position to enter into long-term contracts with renewable energy generators. Texas is typically identified as the “model” for an effective RPS. The design of an RPS policy is typically easier in a regulated setting than in a competitive setting. The key issues should focus on utility cost recovery and standardized power-purchase contract terms.

Renewable Energy Funds

Most often funded through system-benefits charges (a small surcharge on electricity rates) but occasionally through regulatory or merger settlements, state renewable energy funds provide major support for utility-scale wind development. Present in 15 states (most are restructured), these funds are expected to generate $3.5 billion for the development of renewables from 1998 through 2012. Production incentives (cents/kWh supplemental financial payments) are the most common form of incentive employed by renewable energy funds in support of utility-scale wind power, although up-front grants, forgivable loans, and subordinated debt have also been used. To date, nine states have obligated $160 million to support 1,630 MW of new wind power. As of the date of this publication, 148 MW had been installed.

Several lessons have been learned from experience with renewable energy funds. First, certain types of state support—such as up-front grants and subsidized financing—appear to trigger the “double-dipping” provisions of the federal production tax credit (PTC), thereby reducing the value of the PTC. Second, receipt of a state incentive does not guarantee that a wind project will secure financing; renewable energy fund administrators must remain mindful of the need for a project to secure a long-term power purchase agreement as well. Despite some limitations, renewable energy funds can provide useful supplemental income to wind power projects, providing essential cash flow for project development.

Tax Incentives

Various types of tax incentives have been used at the state level in support of utility-scale wind projects. Whereas investment tax credits were common in the past, property and sales tax reductions and exemptions are now most common, with *state* production tax credits also gaining popularity. As with other types of incentives, tax incentives can reduce the cost of wind power. However, state tax incentives alone have seldom been sufficient to stimulate significant wind power development.

Tax incentives can provide a useful supplemental revenue stream to wind plant owners. States contemplating tax incentives for wind, however, might keep several considerations in mind. First, although far from clear, state tax incentives might trigger the "double-dipping" provisions of the *federal* PTC, thereby reducing the value of the PTC to the wind project. Second, a wind developer or project owner may not have sufficient in-state tax liability to take full advantage of a state income tax incentive (note that this concern only applies to *income* tax credits, not to sales and property tax incentives). Allowing wind plant owners to carry forward the incentive into future tax years or to trade the incentive to other in-state taxable entities would address this issue. Finally, granting wind projects a property tax exemption could result in a lower level of local community support for wind power.

Resource Planning

In some parts of the United States, the cost of wind power is arguably competitive with the cost of fossil-fueled generation. In areas of the Pacific Northwest, the Midwest, and Texas, wind projects are selling their output at 3 cents/kWh or less. In such cases—particularly in regulated states—wind should be considered as a potential least-cost resource within an integrated resource planning (IRP) framework. Fairly treating wind power in utility resource planning involves fully considering the costs (e.g., cost of firming) and benefits (e.g., price stability and environmental benefits) of wind power within an integrated planning context, which typically occurs within public utilities commission proceedings. In one such IRP proceeding in Colorado, regulators deemed a wind plant to be the least-cost supply option, given the volatility of natural gas prices, and ordered the local utility to add wind power instead of gas-fired generation. As was the case in Colorado, however, such regulatory battles will typically be hard-fought and controversial because utilities are often inclined to resist wind power. Wind energy integration issues and forecasts of future natural gas prices are common areas of debate.

Environmental Credit Markets

If designed properly, state and regional policies that limit the emissions of pollutants such as NOx could present opportunities for wind power. In most permit trading programs, however, credits or permits are allocated only to polluting forms of generation, thereby denying the ability of non-polluting forms to directly benefit. Several states, including

Indiana, Maryland, Massachusetts, New Jersey, and New York have designed emissions trading programs to include limited set-asides for eligible renewable forms of generation. These programs can offer a modest additional revenue stream to wind projects.

More Information

General Wind Power Policy References

- The Database of State Incentives for Renewable Energy (DSIRE): http://www.dsireusa.org/.
- "Strategies for Supporting Wind Energy: A Review and Analysis of State Policy Options": http://www.nationalwind.org/pubs/strategies/strategies.pdf.
- The American Wind Energy Association's energy policy Web page: http://www.awea.org/policy/index.html.

Tax Incentives

- "Analyzing the Interaction Between State Tax Incentives and the Federal Production Tax Credit for Wind Power": http://eetd.lbl.gov/ea/EMS/reports/51465.pdf.
- The Database of State Incentives for Renewable Energy (DSIRE): http://www.dsireusa.org/.
- "Strategies for Supporting Wind Energy: A Review and Analysis of State Policy Options": http://www.nationalwind.org/pubs/strategies/strategies.pdf.

RPS

- "The Renewables Portfolio Standard: A Practical Guide": http://www.naruc.org/committees/ere/rps.pdf.
- "The Renewables Portfolio Standard in Texas: An Early Assessment": http://eetd.lbl.gov/ea/EMS/reports/49107.pdf.
- "Renewable Resources: The New Texas Energy Powerhouse": http://www.seedcoalition.org/pdf/TxEnergyPowerhouse.pdf.
- The Union of Concerned Scientists: http://www.ucsusa.org/index.html.

Renewable Energy Funds

- Lawrence Berkeley National Laboratory case studies and reports on the activities of renewable energy funds: http://eetd.lbl.gov/ea/ems/cases.
- The Clean Energy Funds Network: http://www.cleanenergyfunds.org/.

Portfolio Planning

- "Colorado Public Utility Commission's Xcel Wind Decision": http://www.nrel.gov/docs/fy01osti/30551.pdf.

- "Integrating Renewable Energy Technologies in the Electric Supply Industry: A Risk Management Approach": http://www.clean-power.com/research/riskmanagement/iret.pdf.
- "Quantifying the Value that Wind Power Provides as a Hedge Against Volatile Natural Gas Prices": http://eetd.lbl.gov/ea/ems/reports/50484.pdf.

Environmental Credit Markets

- "A Guide to the Clean Air Act for the Renewable Energy Community": http://www.repp.org/repp_pubs/articles/issuebr15/caaRen.pdf.
- "The Clean Air Act Amendments of 1990: Opportunities for Promoting Renewable Energy": http://www.nrel.gov/docs/fy01osti/29448.pdf.
- National Renewable Energy Laboratory Energy Analysis Forum: "Analysis Related to the Role of Renewable Energy Technologies in Air-Quality Improvement": http://www.nrel.gov/analysis/ea_forum.html.
- "Better Aligning the Nation's Clean Air and Clean Energy Goals: Designing a Power Sector Multi-Pollutant Reduction Strategy that Maximizes Benefits for Energy Efficiency and Renewable Energy": forthcoming paper from the Center for Clean Air Policy.

State Wind Power Policy Update: RPS, SBC, IRP, and Tax Incentives

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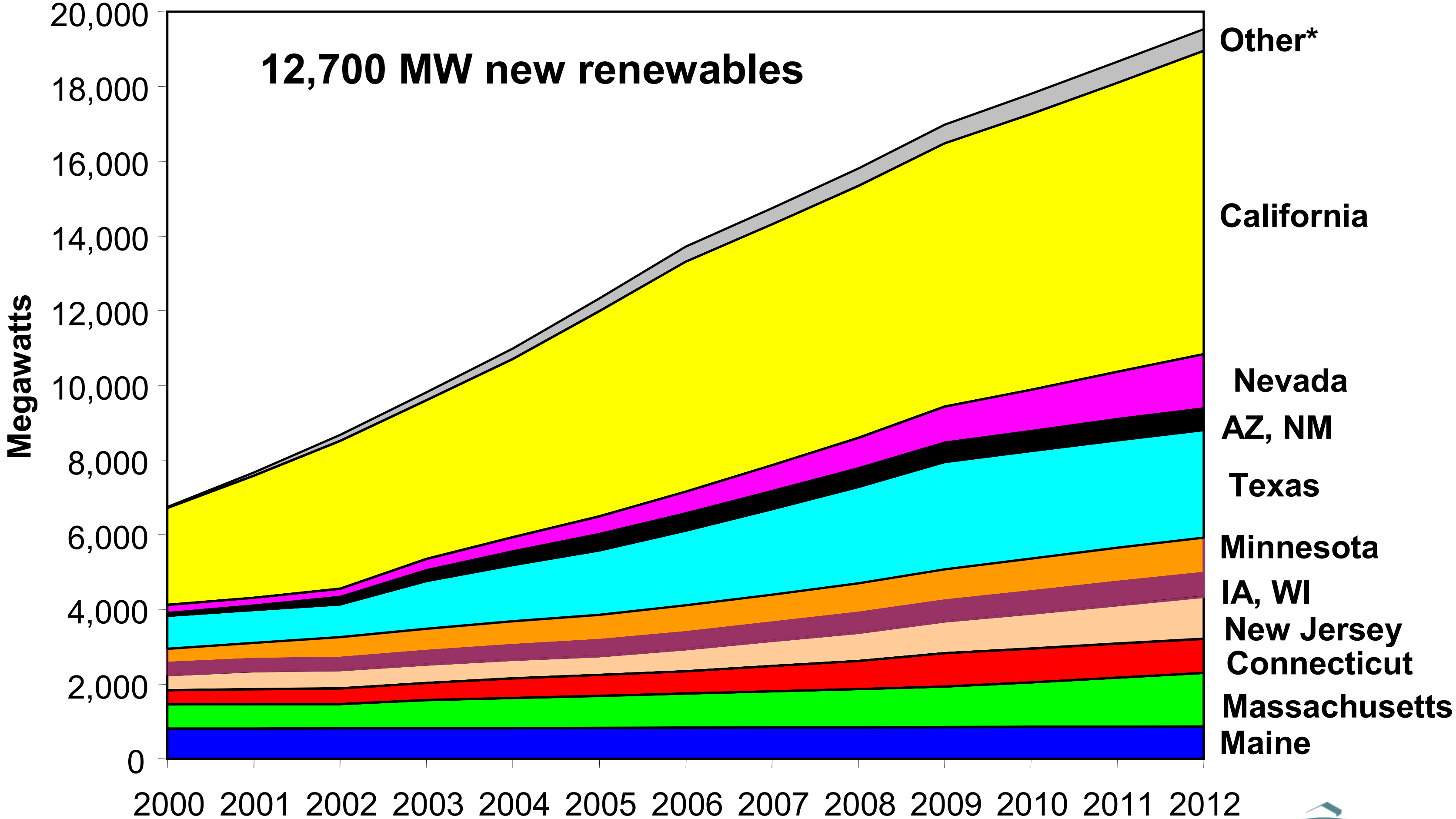
2001 Wind Project Development Was Largely Driven by State Policy

2001 Wind Project Installation = 1,696 MW

- 120 MW received system-benefits charge (SBC) incentives
  - CA – 66 MW
  - NY – 30 MW
  - PA – 24 MW
- 1,136 MW were brought online in a state with an RPS or at least in part due to an RPS in a nearby state
  - TX RPS – 912 MW
  - MN Mandate – 54 MW
  - WI RPS – 30 MW (WI), 82 MW (IA)
  - NJ RPS – 24 MW (PA), 30 MW (NY)

The Future Impact of State Purchase Mandates and Renewable Energy Funds



Source: UCS

*Includes Illinois, Montana, New York, Oregon, Pennsylvania, and Rhode Island.

Renewables Portfolio Standard

WHAT IS IT???

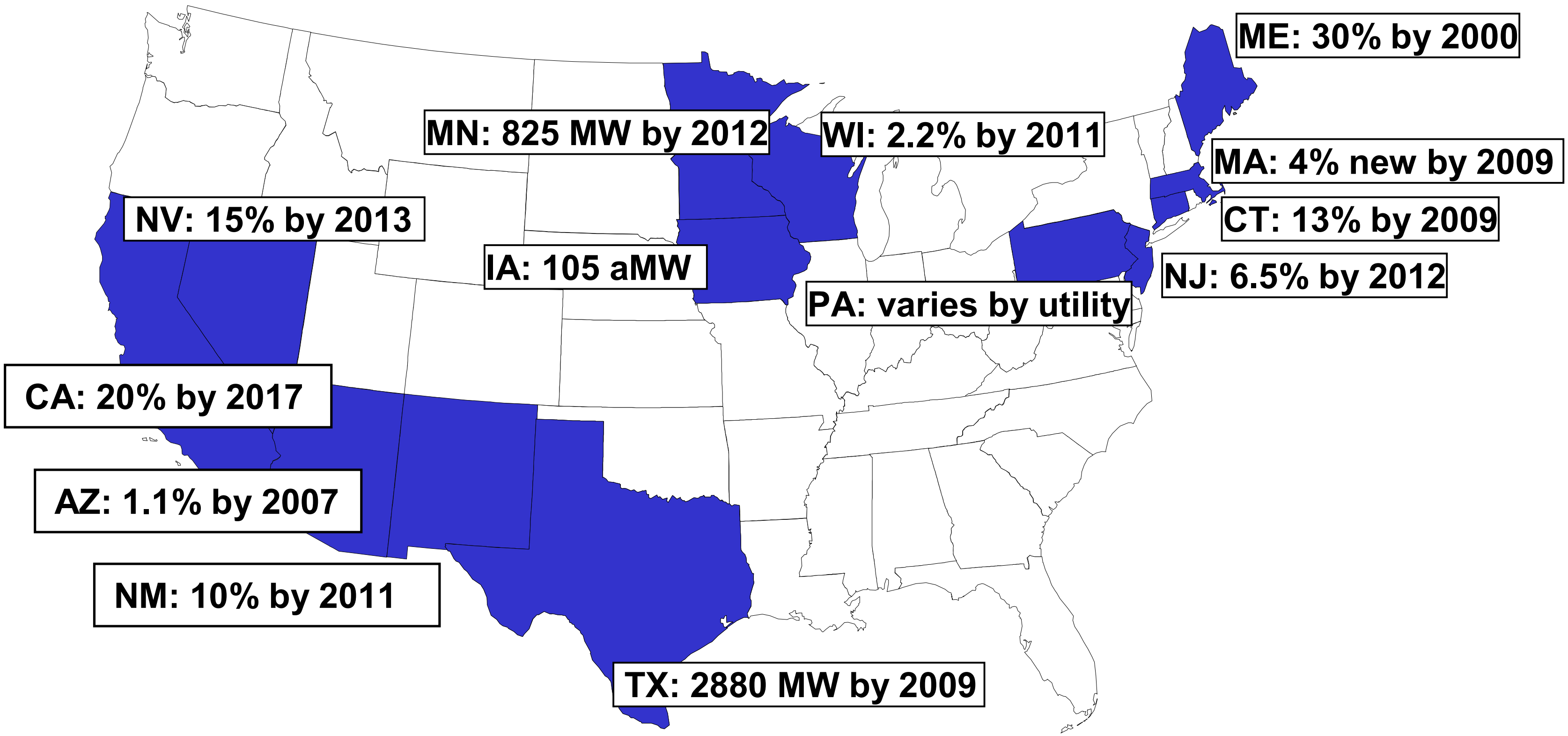
- Requirement on retail suppliers…
- to supply a minimum percentage of retail load…
- with eligible renewable energy.

Sometimes accompanied with a tradable REC program to ease compliance

State RPS Policies Differ

- Standard levels
- Resource eligibility
- Treatment of existing plants
- Tiers and bands
- Start and end dates
- Application of standards
- Enforcement/penalties
- Renewable energy credit (REC) trading
- Implementation status

State Renewables Portfolio Standards and Purchase Mandates – 13 States



- Renewable energy “goals” established in Illinois, Minnesota, and Hawaii

Texas Was the First U.S. State to Get the Details Right

- **Specify the Mandate**

  (400 MW by 2003, 850 MW by 2005, 1,400 MW by 2007, 2,000 MW by 2009; translated into energy-based targets starting in 2002 that increase to ~2.5% by 2009 and remain constant until 2019)

- **Assign Responsibility**

  (electric retailers serving competitive markets)

- **Compel Performance**

  (large automatic penalties – 2x REC price or 5 cents/kWh)

- **Track Compliance**

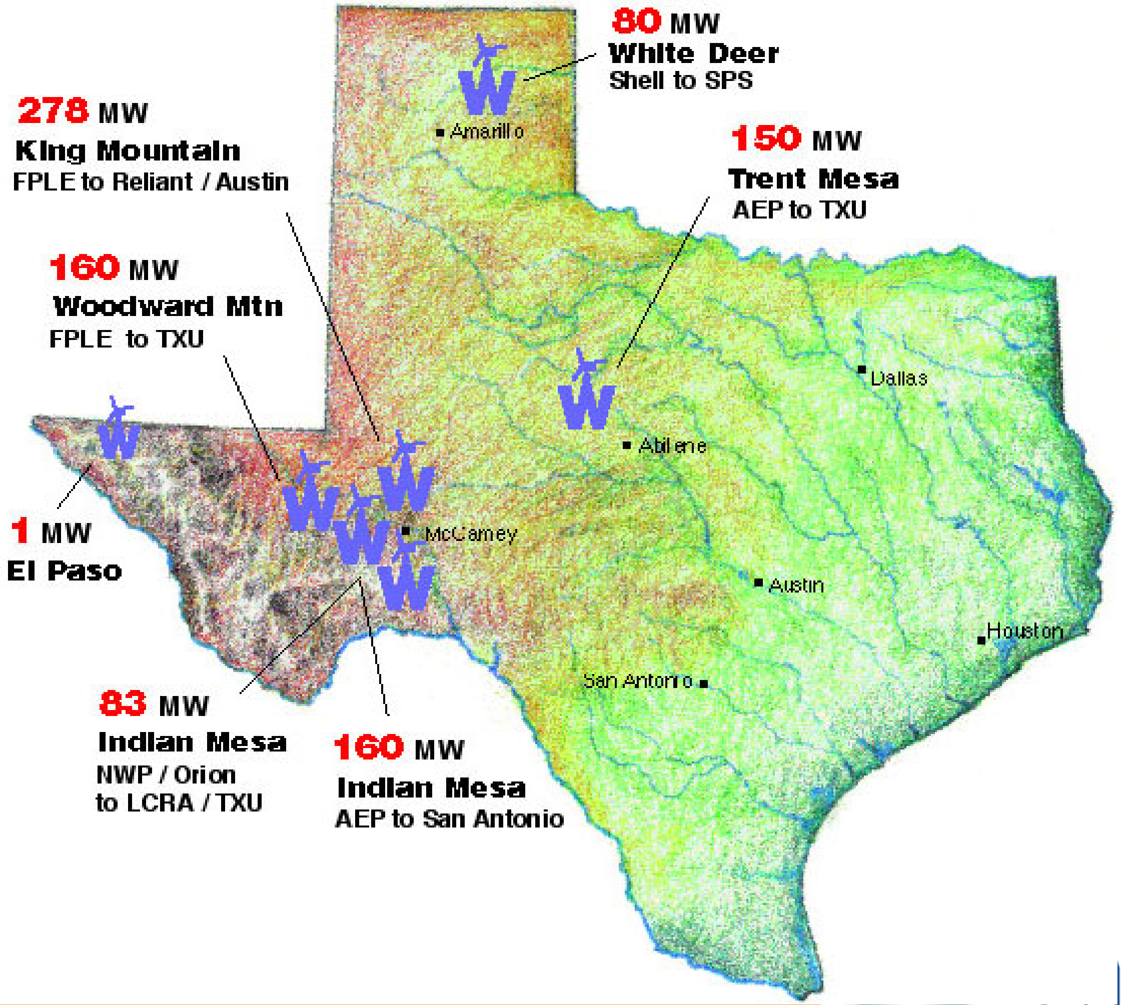
  (tradable RECs with flexibility in compliance)

- **Manage the Details with Clear Rules**

  (renewable resource eligibility, compliance flexibility, etc.)

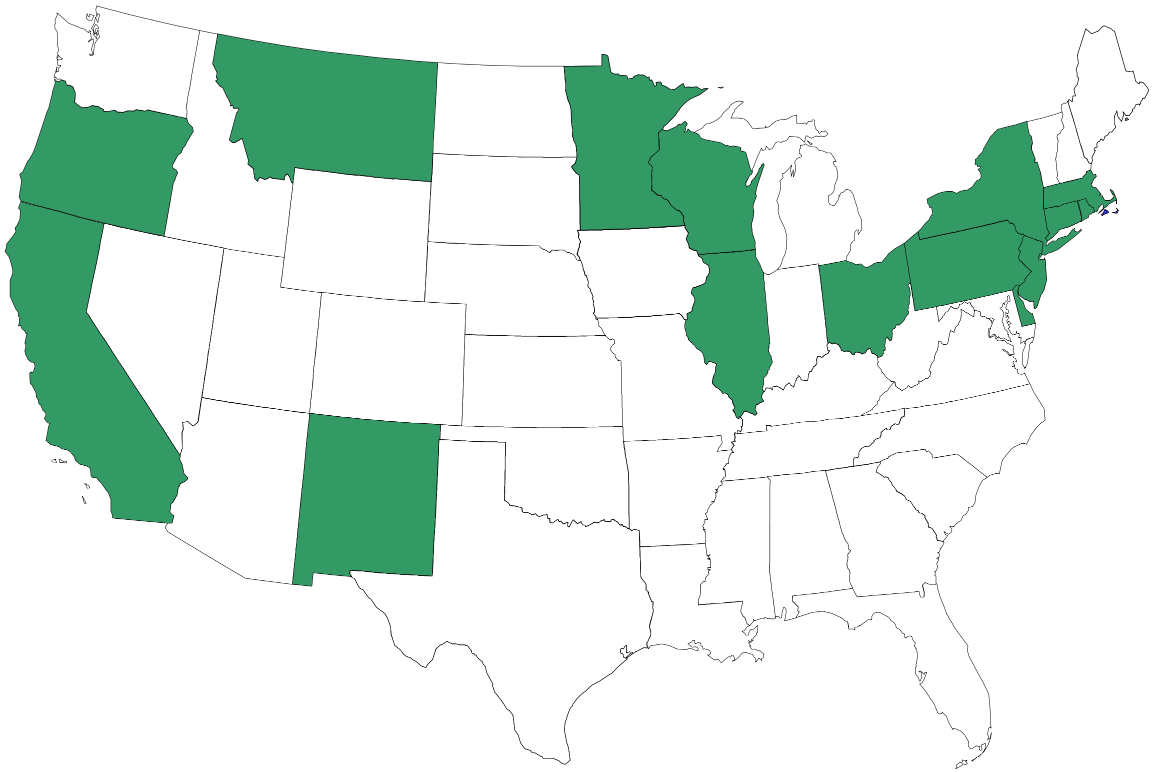
The Texas RPS: A Success Story

- Propelled state to largest market for wind in US
- 912 MW of wind installed in 2001, easily exceeding 400-MW target in 2002
- 2,660 MW of additional wind has applied for grid expansion
- Hundreds of MW planned in 2003



State Renewable Energy Funds

- Often funded with a small additional charge on electric rates: system-benefits charge
- Sometimes funded through other means



Funding Levels Vary by State

State	Annual Funding ($ million)	Funding Duration
CA	$135	1998 – 2012
CT	$15 → $30	2000 – indefinite
DE	$1 (maximum)	10/1999 – indefinite
IL	$5	1998 – 2007
MA	$30 → $20	1998 – indefinite
MN	$9	2000 – indefinite
MT	$2	1999 – July 2003
NJ	$30	2001 – 2008
NM	$4	2007 – indefinite
NY	$6 → $14	7/1998 – 6/2006
OH	$15 → $5 (portion of)	2001-2010
OR	$8.6	10/2001 – 9/2010
PA	$10.8 (portion of)	1999 – indefinite
RI	$2	1997 – 2003
WI	$1 → $4.8	4/1999 – indefinite

State Renewable Energy Fund Support for Wind Power

- Grants and production incentives for large projects
- Grants to customer-sited, small wind power projects
- Incentives to stimulate green power demand
- Customer education
- Resource and transmission studies

Direct Incentives for Large Renewable Energy Projects Are Substantial

- **Total Obligated Funds:** ~$300 million from 9 states
- **Funding Types:** Various forms of grants, production incentives, and loans
- **Total Capacity:** ~2000 of RE capacity, more than 1,600 MW of which is wind power (rest is geothermal, LFG, some biomass and hydro); 350 MW installed so far
- **Incentive Levels**: Vary greatly, but average 0.7¢/kWh on equivalent 5-year production incentive basis

Portfolio Management, IRP, and Set Asides

- New policies such as RPS and SBC can be used, but are not essential, in still-regulated markets
- Some states have been successful through various forms of portfolio management and set asides
  - Minnesota wind power mandate – 425 MW wind so far
  - Iowa wind power mandate – 250 MW wind
  - Colorado – 162-MW project ordered on economics alone
  - Oregon and Washington – BPA and PacifiCorp considering large amount of incremental wind additions

IRP: Lessons Learned

- At the least, wind should be looked at as a potentially cost-effective resource option in light of fuel price volatility and future environmental regulations
  - CA CPA: Hundreds of MW of wind LOIs at $45/MWh for 10-year contract terms
  - Montana: 150-MW wind bid reportedly priced at 3 cents/kWh
  - Texas and NW: wind projects come in at well below 4 cents/kWh, and sometimes below 3 cents/kWh
- Legislative direction often required to push PUCs and utilities into making these investments

Tax Incentives

- Production or investment tax incentives
  - PTC: Increasing experience at the state level (OK, NM, MD)
  - ITC: A number of states use ITCs for smaller projects
- Sales tax reduction
  - Several states exempt or reduce sales tax for small or large projects
- Property tax reduction
  - Several states exempt or reduce property tax for small or large projects
- Key issue: double-dipping
  - Whether these state incentives will trigger the federal PTC double-dipping provisions remains unclear; guidance from the IRS is essential
  - If double-dipping is triggered, value of state tax incentives is often reduced by ~40%

Conclusion

- The basket of possible policy options is large
- Multiple approaches may be necessary to simultaneously spur large-scale development and small-system installation
- RPS, SBC, and portfolio management/IRP options are most effective at the state level
- Other approaches (including state tax incentives) unlikely to spur substantial development alone

Small Wind Policy Options

Heather Rhoads-Weaver, NW Sustainable Energy for Economic Development (SEED)

State policy options can play an essential role in encouraging home and business owners to install small wind energy systems to provide all or a portion of their energy needs. Current policy options include zoning ordinances, utility policies, and financial incentives.

Zoning Ordinances

Many zoning ordinances contain restrictions. Although not intended to discourage the installation of small wind turbines, these restrictions can substantially increase the amount of time and costs required to obtain necessary construction permits. By designating small wind energy systems as a specific permitted use subject to certain requirements, local jurisdictions (counties, cities, townships) can effectively standardize and streamline the process of permitting small wind turbines within their jurisdiction.

Ordinances designating small wind energy systems as a permitted use typically comprise a definition of what constitutes a "small wind energy system"—e.g., listing system components and establishing the maximum rated capacity of systems that may qualify. The definition may also specify that the system be intended primarily to reduce on-site consumption of utility power. The ordinance also defines the requirements such systems must meet. These typically include appropriate height restrictions (which may vary as a function of property size), minimum set-back, maximum noise levels, and compliance with various standards such as the Uniform Building Code, FAA regulations, and the National Electric Code.

EXAMPLES

An example of model zoning ordinance can be found at http://www.awea.org/smallwind/documents/modelzo.html.

Examples of zoning ordinances:

Minnesota
http://www.revisor.leg.state.mn.us/stats/500/30.html.

Montana
http://www.deq.state.mt.us/energy/Renewable/NetMeterRenew.asp.

Nebraska
http://www.ies.ncsu.edu/dsire/library/docs/incentives/NE01R.htm.

Utility Policies

Net Metering

Net metering is an easily administered mechanism for encouraging direct customer investment in renewable energy. Under this policy, electric customers installing their own grid-connected wind turbines would be allowed to interconnect their turbines on a reverse-the-meter basis with a periodic load offset. Under current law in most states, qualifying facilities (QFs) under the Public Utility Regulatory Policy Act (PURPA) and other state-defined renewable generators are allowed to use electricity they generate to offset their simultaneous electricity consumption at their facility. Any excess generation, however, is purchased at a lower wholesale or avoided cost rate, and any excess consumption is purchased at a higher retail rate. This difference can be significant. Net metering allows these customer-generators to “spin the meter backward,” using their excess generation to offset retail purchases during other parts of the billing period rather than selling it back at a lower wholesale rate. The customer is billed only for the net electricity consumed over the entire billing period. The effect is to increase the effective value of the excess generation, often by a factor of three to four. In most states with net metering, excess generation beyond what the customer uses to offset consumption during the billing period is sold to the utility at avoided cost or granted back to the utility without payment to the customer.

Net metering generally involves the use of a single, reversible meter—similar to those used by most residential customers and many small commercial and agricultural customers—which usually spins forward to measure electricity flowing from the grid but can also spin backward to measure electricity returned to the grid.

Customer-generators favor net metering because it increases their effective return on investment by allowing them to use excess generation to offset retail purchases rather than sell it at the lower avoided cost price and because it simplifies metering and interconnection requirements. As a form of distributed generation, net metering may offset the need for distribution-line upgrades, a potential economic benefit to the local utility.

From the utility’s perspective, the primary justification for net metering is that it eases the administrative burden of handling small, customer-sited generation and reduces the need to read a second meter and issue monthly checks for purchases of small amounts of electricity. Other utilities oppose net metering on principle because it implies paying customers above-wholesale prices for nondispatchable energy (a higher revenue requirement for kWh purchases has traditionally translated into a rate increase for all utility customers). Like energy-efficient appliance purchases, customer efforts to offset load with on-site wind generation reduce electric sales (although if the utility is experiencing load growth in its service territory, this may not be a concern). If measured as an absolute loss of revenue, without any offsetting administrative or accounting savings, the "cost" of net metering to utilities is minimal, even for market penetration several orders of magnitude larger than any state has experienced to date.

Net metering policies historically have been applied to vertically integrated electric utilities in which the same entity that bought and sold power also managed the grid. These functions are likely to be separated as the electric industry is restructured, raising a number of issues about how best to implement net metering. Because distributed resources provide potential benefits to the distribution system, some states have decided it is appropriate to apply net billing policies to distribution companies and to blend any net program costs into distribution service charges. Some states are considering requiring energy service providers, rather than the local distribution utility, to offer net metering. In other states, the arrangement is simplified even further by allowing month-to-month carryover of any net excess generation so that any power produced above what the customer uses is credited to the next monthly bill, rather than sold to the utility. Under this approach, the customer never "sells" energy and the utility (or energy service provider) never "buys" electricity. In any case, the enactment and implementation of net metering laws must be reconsidered in accordance with changes to electric industry structure and regulation (National Wind Coordinating Committee State Policy Options report, pp. 66-68).

EXAMPLES

Model net metering legislation can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/utilities_2a.asp.

Examples of net metering programs:

Iowa
http://www.ies.ncsu.edu/dsire/library/docs/incentives/IA02R.htm.

Massachusetts
http://www.ies.ncsu.edu/dsire/library/docs/incentives/MA01R.htm.

NorthDakota
http://www.ies.ncsu.edu/dsire/library/docs/incentives/ND01R.htm.

Line Extension Policies

Extending electrical transmission and distribution lines to remote, unserved areas is expensive. Line extension costs average about $10 per foot, but they vary substantially depending on the type of line extension and the nature of the terrain.

Utility customers historically have subsidized line extensions for new customer hookups. These subsidies have been rationalized as a means for capturing economies of scale associated with interconnecting greater numbers of customers or as a means for encouraging growth and new construction in urban and rural areas alike. Under most line extension policies, customers are granted a free footage allowance within which the costs are borne entirely by the utility (and ultimately, its customers). Additional subsidies often are available for distances exceeding the free footage allowance.

Line extension subsidies artificially reduce the cost of utility power to new customers, thereby increasing the relative cost of grid-independent or remote power systems, many of which rely upon renewable energy resources such as wind energy. Remote power systems already are cost-effective for many applications—including rural homes and vacation cabins, livestock watering wells, and communications facilities—that are too far from existing power lines to economically justify a line extension (even when partially subsidized). Reducing or eliminating line extension subsidies would result in prices that more accurately reflect actual costs, which in turn would improve the prospects for remote power systems to compete on a direct-cost basis with utility power. At a cost of $10 per foot, for example, reducing a free footage allowance from 1,200 feet to 300 feet shifts $9,000 in costs from utility ratepayers to the individual customer seeking the new hookup. Customers who face substantial increases in the cost of line extensions are more likely to consider remote power systems as an attractive alternative. Thus, changes in line extension policies could result in a significant expansion of the market for remote power systems that use wind and other renewable energy resources.

Other changes to line extension policies could further improve the prospects for use of renewable energy. Related policies that have been proposed or adopted include (1) requiring utilities to provide customers with information regarding remote power systems as an alternative to costly line extensions, and (2) allowing utilities to market, finance, and install remote power systems as an alternative to costly line extensions.

EXAMPLES

A model of a line extension policy can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/utilities_2b.asp.

Examples of line extension policies:

Texas
http://www.puc.state.tx.us/renewable/index.cfm. The Texas Public Utility Commission Web site includes a brochure designed to inform customers of alternatives to line extensions, including wind and solar stand-alone systems, and to provide them with some guidance in assessing whether those alternatives would be appropriate.

New Mexico
http://www.ies.ncsu.edu/dsire/library/includes/tabsrch.cfm?state=NM&type=Line&back=regtab&CurrentPageID=7. Because of New Mexico Public Utility Commission Case Number 2476, electric utilities in the state are required to provide information on alternative energy systems to remote customers with less than a 25-kW load who request line extensions. This requirement applies when the cost of the requested line extension is greater than 15 times the estimated annual revenue from the line extension. In such cases, utilities must provide customers with information on suppliers of alternative energy systems.

Arizona
http://www.ies.ncsu.edu/dsire/library/docs/incentives/AZ04R.htm.

Standard Contracts
Standard, long-term power purchase contracts with predefined interconnection requirements—and perhaps with fixed power purchase rates—could be provided to all sellers of renewable energy that meet certain size, type, and ownership

requirements. The application of standard contracts for small and distributed wind systems can simplify negotiations and reduce transaction costs for the selling and purchasing parties, speed the contracting process, improve prospects for project financing, and ensure that all sellers are treated equitably.

This policy would require a determination of contract terms and conditions, including contract length, payment stream, curtailment provisions, and backup power and interconnection requirements. Standard contracts also could include a long-term power purchase rate, but the rate is unlikely to be set high enough to significantly offset investment costs. This is particularly true because the value of self-generation lies in offsetting the retail rate, rather than building an oversized system to sell excess power. But for those systems that do produce excess power, more attractive buyback rates would improve overall economics (NWCC, pp. 66-68).

Interconnection Agreements

Predefined interconnection requirements are a particularly important component of standard contracts for small and distributed wind projects. Utilities historically have been responsible for maintaining the safety and reliability of the grid and have used this responsibility to maintain strict control over the terms and conditions for interconnection to the grid by nonutility generators. Some nonutility generators, however, have alleged that utilities have used their control over interconnection to impose unreasonably strict or unnecessarily expensive requirements for interconnection. For small distributed generators, who have neither the expertise nor the resources to negotiate on an equal footing with the utilities, these requirements can be onerous enough to discourage them from pursuing their projects. The use of standardized interconnection requirements can eliminate the need for individual negotiations, reduce transaction costs, and ensure equitable treatment. The development of predefined interconnection requirements can be simplified by relying on nationally recognized standards such as those developed by the Underwriters Laboratories (UL); Institute of Electrical and Electronic Engineers (IEEE); and the National Fire Protection Association, drafters of the National Electrical Code (NEC) (NWCC, pp. 61-62).

EXAMPLES

For a model of an interconnection agreement, see NARUC's model interconnection procedures/agreement: http://www.nrri.ohio-state.edu/programs/electric/distributedgeneration/data/national/modelfiles/modelprocedures.htm.

Southern Cal/Edison's example of an interconnection agreement:
http://www.sce.com/NR/sc3/tm2/pdf/Rule21.pdf.

Financial Incentives

Investment Tax Credits (Personal Income Tax)

Tax credits for renewable energy projects can support investment by enhancing after-tax cash flows. Historically, investment tax credits (ITC) have been one of the predominant approaches taken at the state and federal levels to stimulate renewable energy development. Specifically, state ITCs can be used to increase wind development by reducing the state income tax burden of wind power investors. The credit allows the investor to reduce its tax obligation by some portion of the amount invested in a wind project. The tax credit can be used in the first year of production, or it can be spread over a number of years (NWCC, p. 25).

EXAMPLES

A model tax credit can be found at
http://www.awea.org/smallwind/toolbox/IMPROVE/incentives_3a.asp.

Examples of tax credits:

Hawaii
http://www.state.hi.us/tax/announce/2001ann16.htm.

Utah
http://www.nr.utah.gov/energy/credits.htm.

Idaho
http://www.ies.ncsu.edu/dsire/library/docs/incentives/ID01F.htm.

Investment Incentives (Grants/Rebates)

A direct cash payment gives wind project owners additional benefits compared to an equivalent-size tax incentive. First, the inability of some investors to absorb the full value of a tax credit is a substantial barrier to the effective use of tax incentives to support renewable energy development. A direct cash payment has no similar problems. Direct cash payments can be made even more powerful through cost-sharing, in which the government pays part of plant or wind system costs directly because the private investor would not pay taxes on the cost-shared portion.

Investment incentives are valuable in reducing the effective capital cost of renewable projects. Grants may be more appropriate for on- and off-grid, small-scale systems in which most of the power produced is used on-site. Compared with a yearly production incentive, a grant might be a more efficient support mechanism for small-scale wind installations, even those that are grid-connected (NWCC, pp. 45-46).

EXAMPLES

A model investment incentive can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/incentives_3b.asp.

Example of an incentive in Illinois:
http://www.commerce.state.il.us/bus/gri/grants_energy.html.

Revolving Loan Funds

Debt costs significantly affect the levelized cost of energy from wind power systems. Smaller-scale (residential, agricultural, or commercial) renewable energy facilities can be affected even more than utility-scale projects by loan terms and conditions because of the higher installed cost per unit of capacity of smaller systems. Private bank loan terms and conditions for these smaller renewable facilities are likely to be even more costly and restrictive than for larger-scale systems.

State governments can provide low-cost capital to renewable energy projects to support their development. This can be done directly through a state agency or by making arrangements with private lending institutions, local authorities, or electric utilities. Direct loan programs have taken and can take many shapes, including economic development bonds, government and utility loans, community development programs, and green bonds. These programs can be used to support renewables by providing lower-cost debt than is available in the private markets (i.e., lower interest rates or terms that are more favorable). For smaller-scale systems, these programs also may reduce the transaction costs of arranging a private loan (SPO, p. 50).

EXAMPLES

A model of a revolving loan fund can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/incentives_3c.asp.

Sales Tax Reductions

Reductions in state sales taxes can be used to support wind development by decreasing the tax burden (i.e., the tax payment per kWh of electric production) associated with owning a wind power facility. In general, due to their high capital costs and low operational costs, the per-kWh sales tax burden on renewable energy facilities is high relative to fossil-fuel-fired facilities. This is because the fossil fuel inputs to generation facilities generally are exempt from sales taxes, whereas sales tax is paid on wind turbines and other equipment. Sales tax incentives could be in the form of full exemptions or reductions in tax rates and could be applied to small-scale residential wind systems. By exempting renewable energy facilities from sales taxes or reducing the tax rates, the installed and levelized cost of wind power can be decreased. State legislatures have the authority to implement these policies. The enactment, implementation, and enforcement of such policies may occur independent of electric industry structure and regulation.

EXAMPLES

A model of a sales tax reduction can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/incentives_3d.asp.

Examples of sales tax reductions:

Iowa
http://www.legis.state.ia.us/IACODE/2001/422/45.html.

Minnesota
http://www.commerce.state.mn.us/pages/Energy/ModTech/taxincentives.htm.

Property Tax Reductions

Reductions in property taxes can be used to support wind development by decreasing the tax burden (i.e., the tax payment per kWh of electric production) associated with owning a wind power facility. Property taxes can represent a more significant cost than sales taxes, depending on the relative tax rates and assessment methods. Property taxes could be in the form of full exemptions, reductions in tax rates, or changes in assessment methods, and they could be applied to small-scale residential wind systems. Property taxes typically are levied as a percentage of the assessed value of a facility or parcel, including improvements, and are set at the state or local level. Small wind systems are considered improvements. By reducing the property tax rate, altering the assessment method, or exempting a wind facility from property taxes (more applicable to utility-scale wind projects than to residential wind systems), wind costs can be significantly decreased, depending on the local tax rate. The enactment, implementation, and enforcement of this policy may occur independent of the electric industry structure and regulation (NWCC, pp.32-33).

A property tax reduction can help stimulate individual investment in small turbines (NWCC, Table 9, p. 34).

EXAMPLES

A model property tax reduction can be found at http://www.awea.org/smallwind/toolbox/IMPROVE/incentives_3e.asp.

Example of a property tax reduction in Illinois: http://www.ies.ncsu.edu/dsire/library/docs/incentives/IL01F.htm.

Reference

National Wind Coordinating Committee (NWCC). (1999). “Strategies for supporting wind energy: a review and analysis of state policy options.” http://www.nationalwind.org/pubs/strategies/default.htm.

National Renewable Energy Laboratory

Zoning for Small Wind



Jim Green

National Renewable Energy Laboratory

Operated for the U.S. Department of Energy by Midwest Research Institute • Battelle • Bechtel

Zoning for Small Wind Turbines

- Short towers (up to 35 ft) usually can be installed with only a building permit
  - Based on firefighting limitations in the early 1900s
- Taller towers may require a “special use review” by the zoning commissioners
  - Cost to the turbine owner can run up to $3,000
  - Process can linger for several months
- *Zoning approval may be difficult or impossible to get for urban and suburban locations*
- Zoning is usually easier to obtain in rural areas

NREL

Utility Poles

NREL

Transmission Lines

Cell Phone Towers

How Do Wind Turbines Compare?

Windmills… Or Not?

Adams County, Colorado

Zoning Issues (I)

- Property size
- Tower height (… as a function of property size)
- Setbacks
  - Site plan
- Maximum capacity or size
- Building code compliance
  - Drawings of tower and foundations/footings
  - Engineering analysis, wet or dry stamp? Cost?
- National Electric Code compliance
  - One-line electrical drawings

Zoning Issues (II)

- Compliance with FAA regulations
  - FAA Advisory Circular AC 70/7460-2K
  - No warning lights required under 200 ft total height
  - Height limits may apply within 3 miles of any runway
- “Approved” wind turbines (design safety)
  - Certification to national/international standards
  - Evidence of reliable one-year operation
- Notice to the utility and/or interconnection agreement
- Notice to neighbors

Zoning Issues (III)

- TV/radio interference
  - Not a problem for wood or fiberglass blades
- Noise
  - Apply existing rules
  - Exception for utility outages or severe storms?
  - Sound level decreases with distance^2 from the source
- View protection
- Attractive nuisance
  - No handholds/footholds for first 12 ft above ground?
- Signage/labeling

NREL

Zoning Issues (IV)

- Abandonment
- Permitted use, conditional use, special use, or variance?
- Use varies by zone?
- Is a public hearing required?
  - Hearings place a significant additional burden on the applicant to prepare and defend the application
- Permit for a wind turbine creates legal precedent for cell phone towers?

NREL

California Small Wind Zoning Law

- AB 1207, passed in 2001
- All zoning jurisdictions required to have a small wind zoning ordinance within 6 mo.
- Applied to "non-urban" areas
  - Population densities < 1,000 /square mile
- Minimum restrictions stated
- If not, small wind turbines permitted as "use by right"

Zoning Information on the Web

- Zoning discussion from the American Wind Energy Association
  - http://www.awea.org/faq/sagrillo/index.html#Zoning%20Issues
- Kern County, California, zoning code
  - http://ordlink.com/codes/kerncoun/
  - Title 19, numerous chapters

Closing Thoughts

- The primary opportunity for small wind turbines will be in rural and less densely populated areas
  - Wind resource
  - Space for turbine installation
  - Zoning
- Zoning costs and antiquated zoning rules are ongoing problems in many locations

Net Metering

Jim Green, National Renewable Energy Laboratory

Among the policy options available to encourage the use of small renewable energy systems, net metering is one of the most appealing and is widely used by states. A key part of this appeal seems to be the greater sense of fairness it gives to utility customers who are generating their own electricity. Currently, there are net metering laws or regulations in more than 30 states. It is a low-cost, easily administered method to encourage consumer investment in renewable energy technologies.

Net metering is a utility metering practice in which utilities measure and bill for the net electricity consumption or generation of their customers with small generators. This is typically done with a single, bi-directional electric meter. The electric meter will turn backward when the generator is producing energy in excess of the customer's demand and forward when the customer's demand exceeds the energy generated. This enables customers to use their own generation to offset their consumption during a billing period. This offset means that, in effect, customers receive retail prices for the excess electricity they generate. It allows customers to "bank" their excess energy and use it at a different time than it is produced, giving customers more flexibility and allowing them to maximize the value of their production. This is especially useful for intermittent renewable energy technologies such as wind. Consumers do not have to alter their consumption or install energy storage devices to maximize the value of their wind generation. It allows all (or a substantially bigger portion) of the customer-generated electricity to command a retail value and thus increase the economic value of the wind turbine.

Without net metering, customers must enter into a net purchase and sale agreement with their utility. In these cases, the utility always installs two uni-directional meters to separately record the total energy from the utility used by the customers and the total excess energy produced by the customers. These customers pay retail rates for the energy they use, and the utilities reimburse customers at the utility's avoided cost for the excess energy they produce. The difference between a utility's retail rate and its avoided cost can be substantial, often a 5-cent to 10-cent differential per kilowatt-hour (kWh).

Net metering programs exist because of state (sometimes utility) initiatives. Federal law already encourages cogeneration and renewable energy technologies by requiring utilities to interconnect with self-generators and to purchase power generated by them. Many individual states have taken the further step of requiring net metering to be offered as an option for customers with smaller renewable energy generators.

The key elements of net metering legislation/rules are as follows:

- **Require all utilities to offer net metering.** In states where the net metering authority comes from legislation, this is usually the case. In states where the net metering authority comes from public utility commission rulings, only the investor-owned utilities are usually affected. But these utilities typically have urban service territories, and the opportunities for small wind power are primarily in rural areas. Thus, net metering based on legislation is usually more beneficial for wind power.
- **Require a simple interconnection agreement/process with no or minimal fees.** This is important to prevent the interconnection process from being overly long, costly, or complicated.
- **Prohibit additional liability insurance above standard homeowners insurance.** This provision is closely tied to the element below.
- **Indemnify the utility for damages caused by net-metering customers.** Utilities typically seek such legal protection.
- **Stipulate that no additional technical standards or testing can be required beyond those already nationally recognized.** The existing national standards include provisions for safe interconnection to the utility. In particular, the generation devices must be able to detect a utility outage and stop delivering electricity (or generating a voltage) to the utility grid as long as the outage continues.
- **Identify the maximum eligible generator size.** Most states have selected a maximum generator size that is eligible for net metering. This maximum size varies widely (from 10 kW up to 1 MW). A larger maximum size allows more customers to benefit from net metering. A 10-kW limit is adequate to allow most homes and farms and some small businesses to generate sufficient energy to offset most or all of their electric power consumption. Larger maximums, say 50 or 100 kW, will allow consumers such as large retail stores, moderate-sized businesses, and schools to benefit. California’s maximum size of 1 MW allows even large manufacturing plants an opportunity for net metering. And Ohio and Iowa have no size limits—any size wind turbine may be used for net metering.

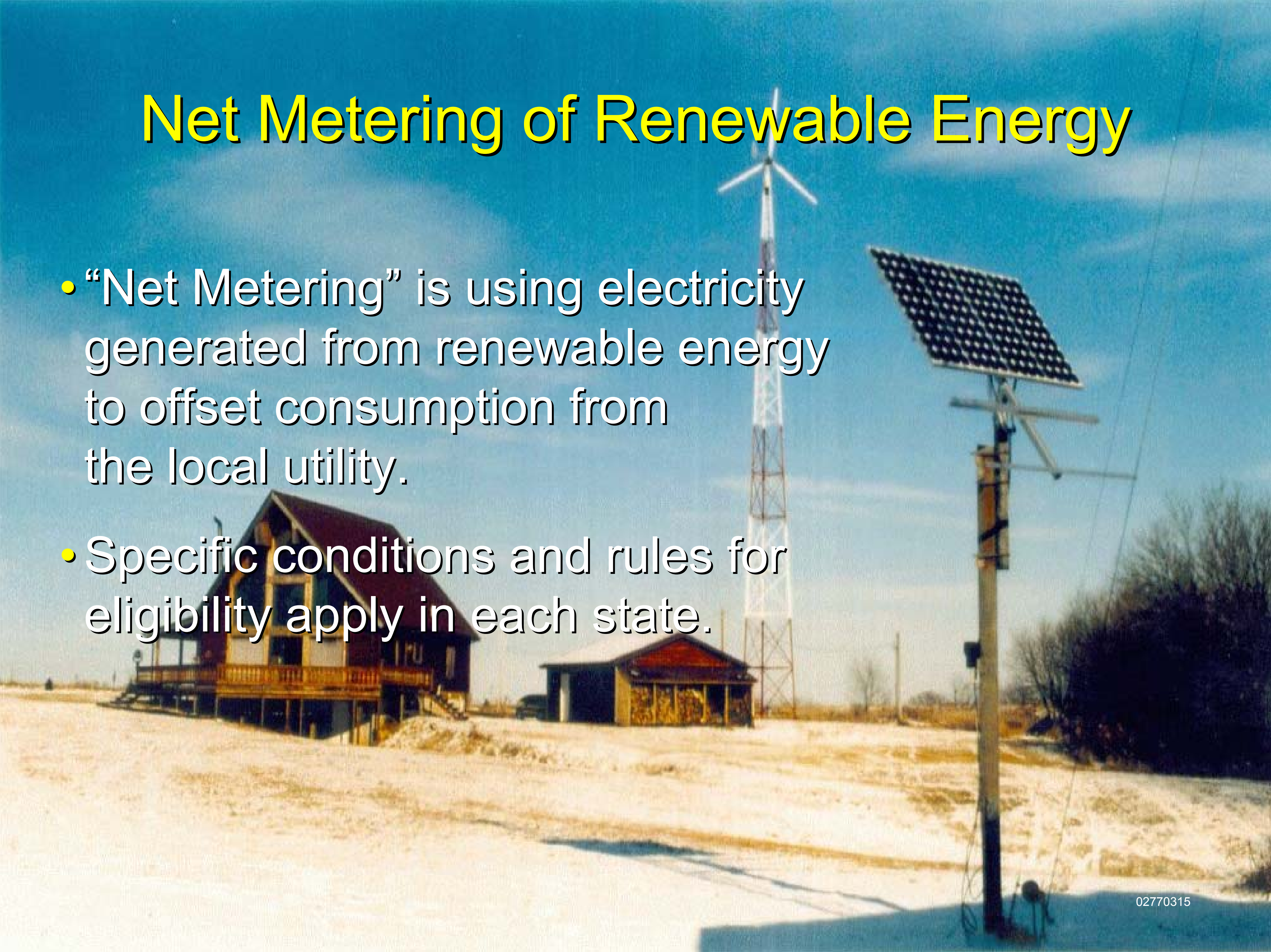
- **Define the net-metering period as annual, not monthly.** Preferably, monthly credits for excess energy will roll over to the following month. This is an important consideration for wind power because of the seasonal variability of the wind resource.
- **Identify a method for handling net excess generation.** At the end of the net-metering period, either monthly or annually, the unused credits for excess energy are treated in one of two ways. In about half of the net-metering states, this excess is purchased. The payment is usually at the utility's avoided cost, although two states do require that the retail rate be paid. The remaining states stipulate that the excess is simply granted (given) to the utility. Giving the credits to a utility's low-income assistance program (as is done in Oregon) is a creative alternative that may help to maintain a sense of fairness for the net metering customer.
- **Allow only standard monthly charges.** Net-metering customers should be charged the same fixed, monthly fees as other customers in the same customer class.

More Information

Information about net metering:
http://www.eren.doe.gov/greenpower/netmetering/index.shtml.
http://www.dsireusa.org/.

Analysis of net metering (and other incentives) as a policy option for states:
http://www.nationalwind.org/pubs/strategies/default.htm.

An overview paper on net metering:
http://www.crest.org/repp_pubs/articles/issuebr2/issuebr2.pdf.


Net Metering of Renewable Energy
• "Net Metering" is using electricity generated from renewable energy to offset consumption from the local utility.
• Specific conditions and rules for eligibility apply in each state.
02770315

Net Metering of Renewable Energy

Energy consumed immediately: retail rate

Excess energy used to ***offset*** consumption at another time: retail rate

Net excess energy (determined monthly or annually): retail rate, avoided cost, or given to the utility

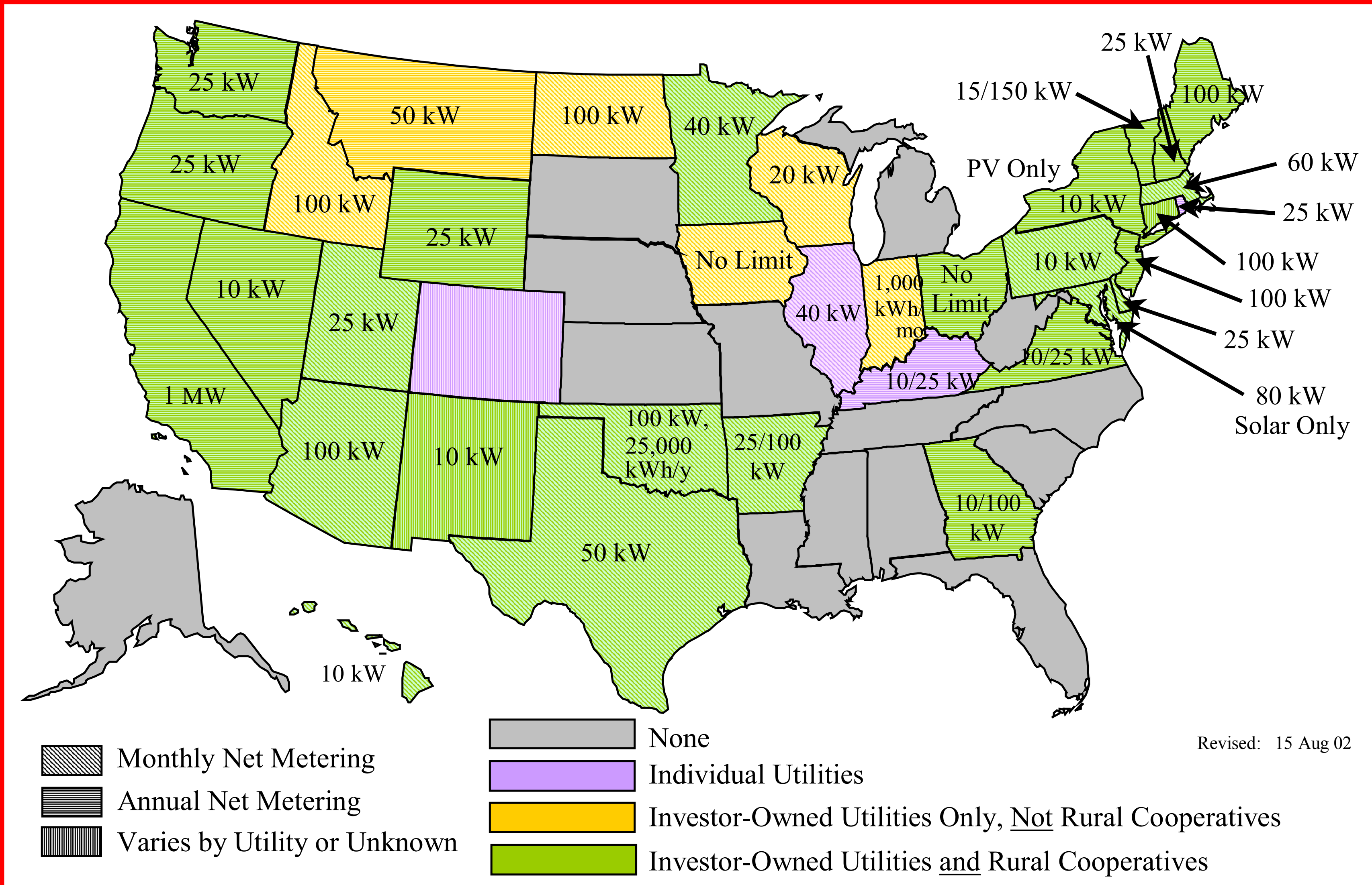
NREL

Net Metering of Renewable Energy

- Excess wind power turns the electric meter backward
- Bill is based on the "net" consumption/generation (monthly or annually)

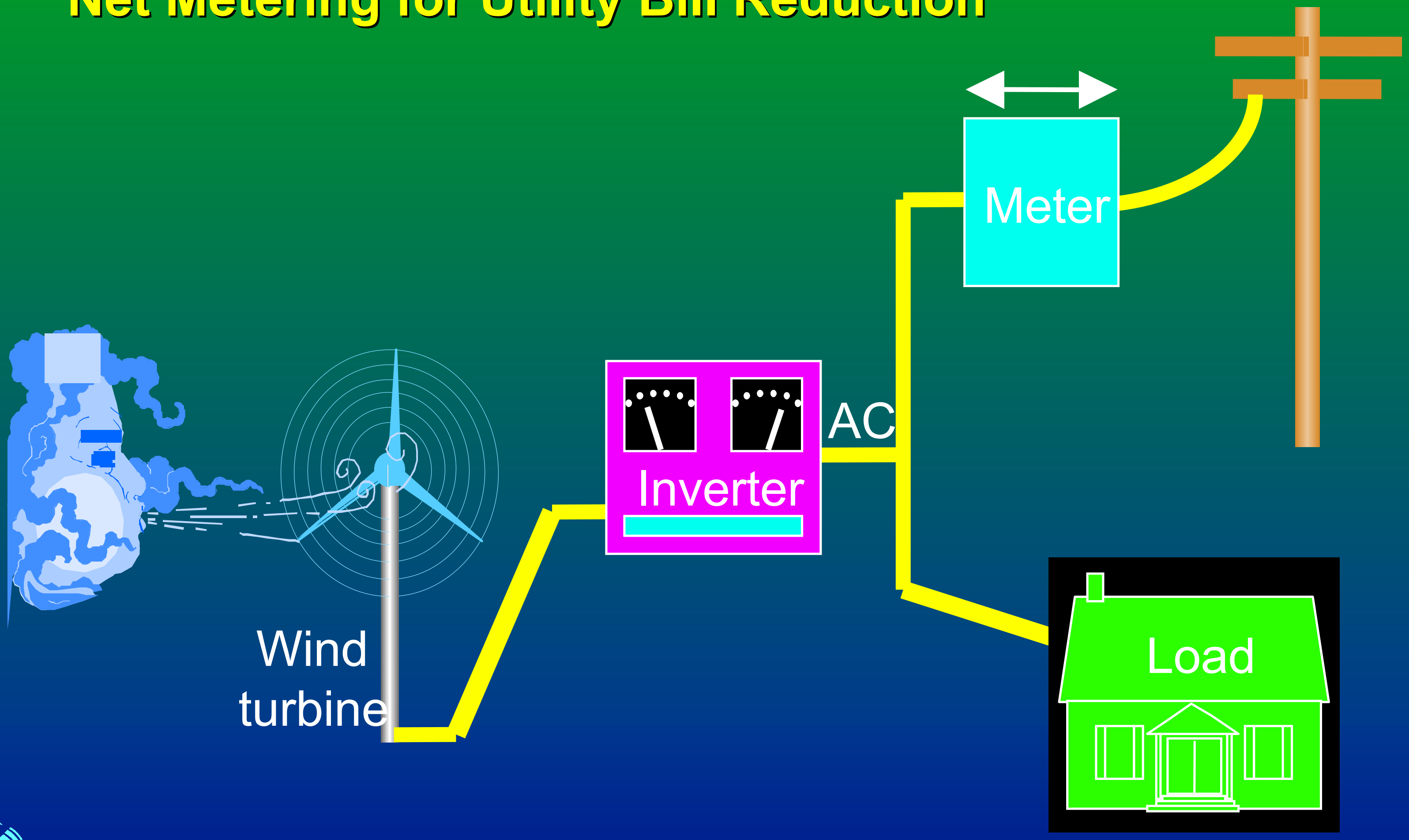
- Net metering of wind energy is available:
  - to all rural customers in 24 states
  - to some residential customers in 10 other states

Net Metering by State



On-Grid Wind System

Net Metering for Utility Bill Reduction



Wind on Federal Lands

Ed Cannon, National Renewable Energy Laboratory

The federal government controls nearly 650 million acres, or about 28%, of the land in the United States. It controls more than half the land in the western part of the country (more than 60% in Utah and 80% in Nevada). Roughly 96% of federal land is administered by four agencies. The federal agencies with the largest land holdings are:

- Bureau of Land Management (BLM): 264.7 million acres (41%)
- National Forest Service (NFS): 191.6 million acres (29%)
- U.S. Fish & Wildlife Service (USFWS): 91.6 million acres (13%)
- National Park Service (NPS): 78 million acres (12%).

About one-third of BLM land (89 million acres) is in Alaska. Of the remaining 21 million acres of federal land, nearly 20 million acres are administered by the Department of Defense (DOD), making it the fifth largest federal land manager.

Although large tracts are set aside for wilderness areas, wildlife refuges, and parks, a huge amount of federal land is still available for development. Because of their different missions, the various federal land management agencies have widely differing procedures for permitting the lands for wind energy development. The agencies of most interest to wind developers are BLM, DOD, and NFS. Except for showcase wind turbines at visitor centers and similar small wind applications, it is unlikely that lands administered by the USFWS and NPS will be used for significant wind projects in the near future.

BLM

In 2001, the Secretary of the Interior directed the department to examine the procedures for permitting new energy projects on lands under its administration. The BLM has since moved aggressively to streamline its permitting procedures and has used wind projects as the pilot technology. In a few short months, permit applications for wind prospecting and wind project development on BLM lands have increased from a small handful to more than 150.

DOD

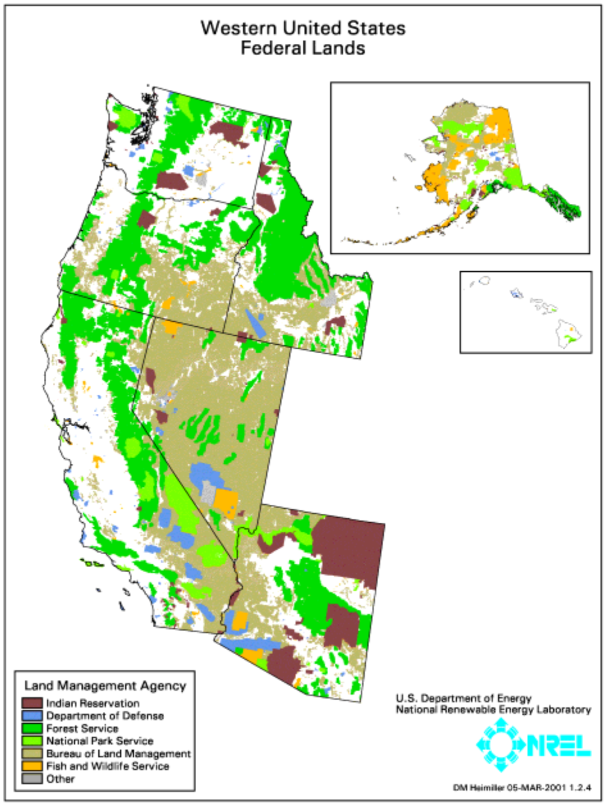
In FY 2002, the Military Construction Bill contained a set-aside of $6 million for studying renewable energy potential (wind, solar, and geothermal only) on or near military bases in the United States. DOD bases with the best potential for economically viable wind energy projects will be identified, and a list of the bases will be published. Meanwhile, individual bases with large land areas and good wind potential can be approached individually to explore the possibility of commercial wind energy development. Successful projects will not only avoid interference with the base's mission, but will also find creative ways to compensate the base for land use that will benefit the local military units. (Funds from traditional land leases go directly to the U.S. General Fund, not to the base.)

NFS

The NFS has expressed a willingness to follow a procedure similar to that used by BLM to identify appropriate lands for wind energy development and ease the permitting process.

NPS

The NPS held an Energy Summit in Phoenix, Arizona, in January 2003. The purpose of this summit was to raise awareness and provide education about (1) energy development activities in and around parks in the western United States (including extraction, processing, transmission, and generation); (2) potential impacts and impact-reduction strategies of energy development; (3) planning and decision-making processes; and (4) opportunities for reducing energy consumption. The Summit is targeted to park superintendents and management chiefs from the ten western states.


Western United States
Federal Lands
Land Management Agency
Indian Reservation
Department of Defense
Forest Service
National Park Service
Bureau of Land Management
Fish and Wildlife Service
Other
U.S. Department of Energy
National Renewable Energy Laboratory
NREL
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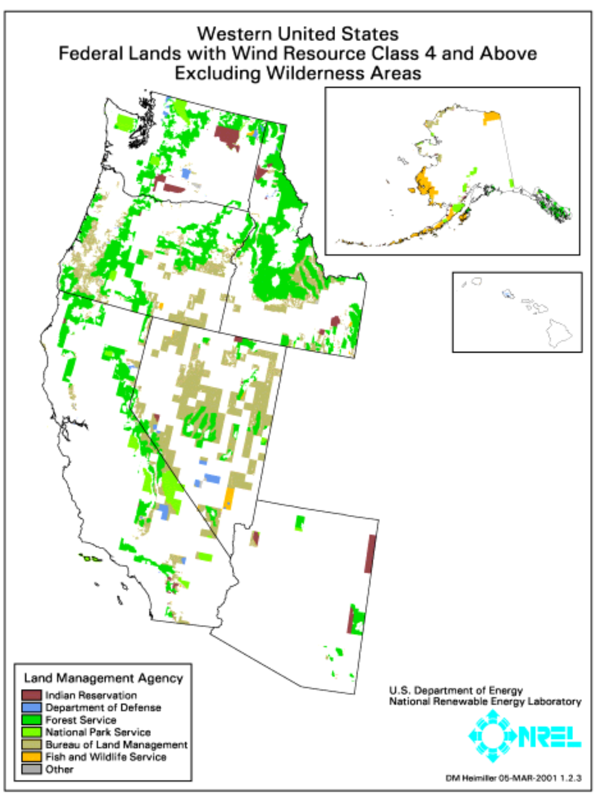
Western United States
Federal Lands with Wind Resource Class 4 and Above
Excluding Wilderness Areas
Land Management Agency
Indian Reservation
Department of Defense
Forest Service
National Park Service
Bureau of Land Management
Fish and Wildlife Service
Other
U.S. Department of Energy
National Renewable Energy Laboratory
NREL
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Wind on State Lands

Terri Walters, National Renewable Energy Laboratory

In considering wind development, one important landowner should not be overlooked: the state government. Most states manage a variety of lands, but the primary target for wind development is state-managed “trust lands.” Trust lands, which are used primarily to generate revenue for public schools, were historically given to the states by the federal government in exchange for the states not taxing federal property.

The trust lands program began with the establishment of the school lands program under the Articles of Confederation in 1785. As stewards overseeing trust land management, state land officials walk a tightrope, providing revenue and benefits today while ensuring the same opportunity for future generations. Twenty-three western states alone manage more than 447 million acres of land.[15]

Wind development can be an attractive solution to states that have viable wind resources on their trust lands. Wind can provide much higher revenue per acre than other typical sources of revenue. An added benefit is that harvesting the wind doesn’t deplete any finite resources. The amounts listed below are examples of annual revenue per acre taken out of service.

Examples of Land Revenue in Texas[16]

Type of Land Use	Annual Revenue
Cotton	$250/acre
Grazing cattle	$5/acre
Oil well	$1,500/acre
Wind turbine	$2,000/acre

Several western state land offices are already pursuing wind development on state trust lands. The first such wind project was a joint project in west Texas by the Texas General Land Office and the Lower Colorado River Authority, a public utility in central Texas.

State wind working groups should determine whether their state trust lands have potential for wind development. If so, including the state land office in the state wind working group will help the land officials access further information about wind potential.

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[15] Western State Land Commissioners Association, www.wslca.org.

[16] Mike Sloan, Vera & Associates, Austin, Texas.

Resources for State Land Officials

In addition to involvement in state wind working groups, resources are available to state land officials who are interested in learning more about wind.

Peer Network

The Wind Powering America initiative has created a peer network for state lands and wind development. Any land official is welcome to join the WPA Wind and State Lands working group. This peer network allows states to learn from each others' experiences and provides access to technical assistance, including monthly conference calls, shared resources via e-mail, and other educational opportunities. As of April 2003, more than a dozen states have participated in this effort.

Web Resources

The Wind Powering America Web site now has a page specifically designed for state land officials (http://www.windpoweringamerica.gov/state_lands.html). This site includes copies of state policies and wind lease agreements, wind studies relevant to state lands, contact information for the Wind and State Lands working group, and presentations from the April 2003 Workshop on Wind and State Lands.

Analysis of State Land Potential

The National Renewable Energy Laboratory (NREL) has offered to help analyze state lands for potential wind development. By overlaying wind resources with land use, transmission capacity, and load centers, this analysis can target the portions of state land that warrant further study. NREL has already provided this analysis for the federal Bureau of Land Management (BLM) and the state land office in Montana. This service is free to states where wind resource assessment maps are current and verified.

Inclusion in Federal Land-Use Study

The BLM, which is updating its land use analyses throughout the West, has offered to include adjacent state trust lands in the public land analyses without cost so that the states can have additional information to help determine whether wind or other renewable energy development is appropriate on their trust lands. States can access further information on this opportunity at the Web site listed above.

Workshops

At the request of several state land officials, a workshop on wind and state lands was held in April 2003. Presentations and materials from this workshop are available at the WPA Web site listed above. If there is enough interest from states, another workshop will be held in FY 2004.

More Information

- Wind Powering America Resources for State Lands: http://www.windpoweringamerica.gov/state_lands.html.
- Western State Land Commissioners Association: www.wslca.org.
- Eastern Lands and Resources Council: www.elrc.org.

Supplemental Environmental Projects

Karin Sinclair, National Renewable Energy Laboratory

Introduction to SEPs

The U.S. Environmental Protection Agency (EPA) is responsible for enforcing compliance with Federal environmental laws and regulations. Through settlement agreements, violators are required to rectify violations and pay a civil penalty. The settlement agreement may also include Supplemental Environmental Projects (SEPs).

Under EPA's SEP Policy, companies are encouraged (participation is voluntary) to fund environmentally beneficial projects to mitigate all or part of penalties imposed as a result of an emissions violation. Because SEPs must result in direct environmental benefits, they can provide pollution prevention and environmental justice. SEPs are applicable to all civil judicial and administrative enforcement actions and are an alternative to standard fines in enforcement actions.

Enforcement actions take place at the federal and state levels. States are responsible for implementing the SEP Policy to handle state-specific violations. State-specific penalties typically range from $10,000 to $500,000. Federal penalties can be millions of dollars. In FY 1999, violators spent $3.4 billion to correct violations as a result of enforcement actions. In addition, EPA assessed $166.7 million in civil penalties. Of the total penalties assessed in 1999, $236.8 million was spent on SEPs.[17]

The EPA's SEP Policy affords both near-term and long-term opportunities for providing a sustained and quantifiable contribution to meeting EPA's objectives. SEPs can include both energy efficiency and renewable energy projects (EE/RE). Wind projects can play a unique role in meeting EPA objectives. SEPs can provide capitalization for wind development. The U.S. Department of Energy and the National Renewable Energy Laboratory are working to support the development of wind SEPs at the state and federal levels with the expectation that these successful examples will be used to foster replication of wind SEPs across the country.

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[17] Annual Report on Enforcement and Compliance Assurance Accomplishments in 1999, EPA 300-R-00-005, July 2000.

Purpose of EPA SEP Policy

"The primary purpose of this Policy is to encourage and obtain environmental and public health protection and improvements that **may not otherwise have occurred** without the settlement incentives provided by this Policy."[18]
Generally, SEP funds cannot be used to support projects that are required by legislative or regulatory bodies, such as meeting renewable portfolio standards. Further, projects already planned by the defendant are not eligible. SEP funds provide resources that would not otherwise be available. They can be used to support the development of a project that would otherwise not be economically viable or for locations where financing may be difficult, such as on tribal lands.

In specific cases, however, "SEPs may include activities which the defendant/respondent will become legally obligated to undertake two or more years in the future, if the project will result in the facility coming into compliance earlier than the deadline."[19]

If public notice is made about the project, the violator must explicitly indicate the project was done in response to an enforcement action. To help ensure the violator does not realize economic gain from a SEP, a multiplier is calculated and applied to the penalty to take into consideration all expected financial benefits (such as the federal Production Tax Credit or Renewable Energy Production Incentive, tax benefits, other incentives or subsidies, gains from sale of commodity, etc.). Although the multiplier is often 1.5 or 2, as a result of all the benefits that are available to wind projects, the penalty multiplier could be as high as 5. For example, a $100,000 penalty could result in a project investment of up to $500,000. The violator would be required to initially invest $500,000 in the project but would get back some of this in incentives/benefits as listed above, resulting in a net investment of $100,000.

Colorado Wind SEP

In 2000, the Colorado Department of Public Health & Environment revised its SEP policy to explicitly allow renewable energy SEPs. In that year, it negotiated a settlement with a large industrial company for violating state air quality regulations. The settlement resulted in a wind-

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[18] EPA Supplemental Environmental Projects Policy. Effective May 1, 1998; emphasis added.

[19] Ibid.

related SEP, funded by a civil penalty of approximately $303,000. The full penalty amount was deposited with the local utility in an escrow account and used to pay for wind premiums from wind development for at least 5 years.

StEPP

The Strategic Environment Project Pipeline (StEPP) is a nonprofit, government-preferred organization. The first of its kind in the country, StEPP works with states and the EPA to facilitate EE/RE projects using enforcement settlement funds, directing some of the penalty funds that would have gone into the state or federal general funds into EE/RE projects. StEPP will "review and recommend appropriate projects, contract for project implementation, escrow the funds allocated to that project, manage the project, then assess and report measurable project outcomes."[20]

The State of Colorado has entered into an agreement with StEPP to aggregate Colorado enforcement penalty funds. StEPP will select projects with the greatest environmental benefit for the investment dollar and oversee the implementation of the projects. StEPP is prepared to work with other states and regions.

References

Colorado SEP policy:
http://www.cdphe.state.co.us/SEPPolicy.pdf.

EPA SEP Guidance documents:
http://www.epa.gov/Compliance/planning/data/multimedia/seps/guiddoc.html.

EPA SEP Policy:
http://www.epa.gov/Compliance/civil/programs/sep/sepinfo.html.

StEPP Foundation: http://www.steppfoundation.org/.

[20] StEPP flyer

RENEWABLE ENERGY PROJECT IDEAS
for Supplemental Environmental Project (SEP) Settlements

Introduction

Because of their beneficial impact on the ambient air – and consequently, on the public health – **renewable energy projects (REPs)** are a promising option for SEP settlement negotiations of many kinds of violations.

This list of project concepts is offered in the spirit of brainstorming and runs the gamut from capitalizing wind installations, to purchasing the environmental attributes of "green" power, to funding selected aspects of wind project development, to underwriting the associated training and marketing required for the development of REPs.

In recognition that (a) green power programs might not exist in many jurisdictions and (b) the penalty amount of many SEPs is insufficient to develop a REP, "green tags" are identified as a viable alternative for some project concepts listed below.[1]

Some concepts might not be permissible under the SEP rules in some jurisdictions.

1 **Purchase wind-generated or other renewable energy power (or green tags) for violator's consumption or use.**[2] The penalty is placed in an escrow account with the power provider or green tag broker, to pay for the power or tags over a specified time. Earnings on the escrow account are invested in additional power or green tags. This approach was taken in Colorado where, pursuant to a SEP negotiated between an industrial violator and the CO Dept. of Public Health and Environment, penalty funds were placed in an escrow account with the local electric utility and earmarked for its wind energy program over a five-year period. In this case, the penalty amount was sufficient to capitalize an additional turbine not already planned by the utility.

2 **Buy down the renewable energy cost "premium" for a project that otherwise would be uneconomical to develop and, therefore, would not occur.** This approach can be especially attractive if the "developer" is a community or school or some other kind of governmental or volunteer organization interested in "clean and green" as community service or improvement. Where wind energy is not quite cost-competitive, the premium is generally not exorbitant but is sufficient to create a barrier to project development.

3 **Establish a buy-down fund for REPs.** The fund subsidizes initial investment in projects to supplement the energy supplies of local or state agencies. REPs (and/or energy efficiency projects) can be installed at schools, community centers, libraries, and other government buildings. This permits maximum flexibility in siting REPs, which is useful if state regulations require SEPs to be undertaken at or near the site of the environmental violation.

4 **<u>If a generation and transmission provider (G&T) is the violator</u>, invest in a member coop's mini wind farm.** This would allow the coop to acquire needed experience with wind energy. It also would provide the coop's customers with a measure of clean energy, plus price-hedging and other benefits of greater fuel diversity.

5 Purchase or buy down green tags for groups that philosophically support "green" but are unlikely to be able to purchase green tags themselves. Examples of such groups might include Low-Income Home Energy Assistance Program (LIHEAP) recipients, senior citizen centers, faith-based organizations, hospitals and nursing homes, schools and colleges, etc. SEP funds can be placed in an escrow account to pay the specified green tags over an agreed-upon time.

6 Fund development of a high-resolution map of the state's wind resources. High-resolution maps can be one of the first steps in exploring the opportunity for developing wind energy projects. Though not an expensive activity, the absence of these maps can constitute a barrier to wind development. The estimated $50,000 price tag for a map could be the precursor to developing a wind SEP.

7 Establish a fund to support the initial assessment costs of wind projects. SEP funds are pooled and used to underwrite feasibility studies, without which projects cannot go forward. Feasibility studies include assessment of environmental impacts, economic benefits, interconnection issues and financing.

8 Fund a local or statewide anemometer loan program. SEP funds purchase anemometers that are made available for loan. This reduces the cost of the site-assessment phase of wind development projects and arguably contributes to improved project economics. (One option would be to run the program through a university.)

9 Fund a wind technician assistance center at a university. This could be funded in connection with an anemometer loan program and could be managed by a university, perhaps through the agricultural extension service. By providing needed training, arguably this could boost the development of clean energy and the resulting environmental benefits.

10 If a utility is the violator, invest in a professional green energy marketing campaign through a third party (such as the Land and Water Fund of the Rockies). This targeted marketing can be used to provide discounted or fully subsidized green tags to disadvantaged groups. SEP funds can be placed in an escrow account with the third party managing the activity, ensuring that the utility does not benefit from this activity. (Because of its focus on marketing rather than project development, this concept might not qualify as an acceptable SEP in some jurisdictions.)

The foregoing are sample concepts, intended to jump-start thinking on the important subject of REPs in SEPs.

For assistance in taking the first steps toward ACTION, contact the SEP Support Team at the U.S. Dept. of Energy (DOE) and the National Renewable Energy Laboratory (NREL):

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[1]*"Green tags," or renewable energy credits (RECs), are the environmental attributes of clean energy. They are purchased separate from the actual power. This option is desirable in a number of situations – for example, in jurisdictions in which there is no green power to purchase, or if the violator operates where emissions are capped or across several states. Key benefits of green tags are that they are easy to negotiate and are easily applied to small or large penalty amounts.*

[2]*Strictly speaking, electrons from all generating sources flow together over the grid. Electrons generated by the wind are indistinguishable from those generated by coal, natural gas, oil or split atoms. However, if the utility serving the violator generates some of its electricity from "green" sources, arguably the violator and its community receive "green" energy when a green program is supported.*

EPA's SEP: *Supplemental Environmental Projects*

- Alternative to standard fines
- Can fund clean energy projects
- Created by 1998 EPA rule

The SEP Concept

- In settlement phase of state regulatory process, violator is given opportunity to voluntarily make investment in environment-friendly effort in lieu of standard penalty.
  - Must comport with EPA guidelines for SEP
- Federal EPA's environmental nexus requirement is satisfied.
  - At Federal level, nexus is broadly defined.

National Renewable Energy Laboratory

SEP Purpose

"The primary purpose of this Policy is to encourage and obtain environmental and public health protection and improvements that ***may not otherwise have occurred*** without the settlement incentives provided by this Policy."

» (*EPA Supplemental Environmental Projects Policy*. Effective May 1, 1998; emphasis added)

Categories of SEPs
Relevant to Clean Energy

- Public health
- Pollution prevention
- Pollution reduction
- Environmental restoration, protection
- Assessments and audits
  - pollution prevention
  - environmental quality
  - environmental compliance

Case Study: Colorado

- CDPHE assessed civil penalty of $316K against industrial violator of AQ regs.
- In settlement proceedings,CDPHE offered polluter opportunity to underwrite 5-year SEP.
- Polluter agreed to purchase wind
  - From existing program of local utility
  - $303K paid *up front* into interest-bearing escrow account held by local utility

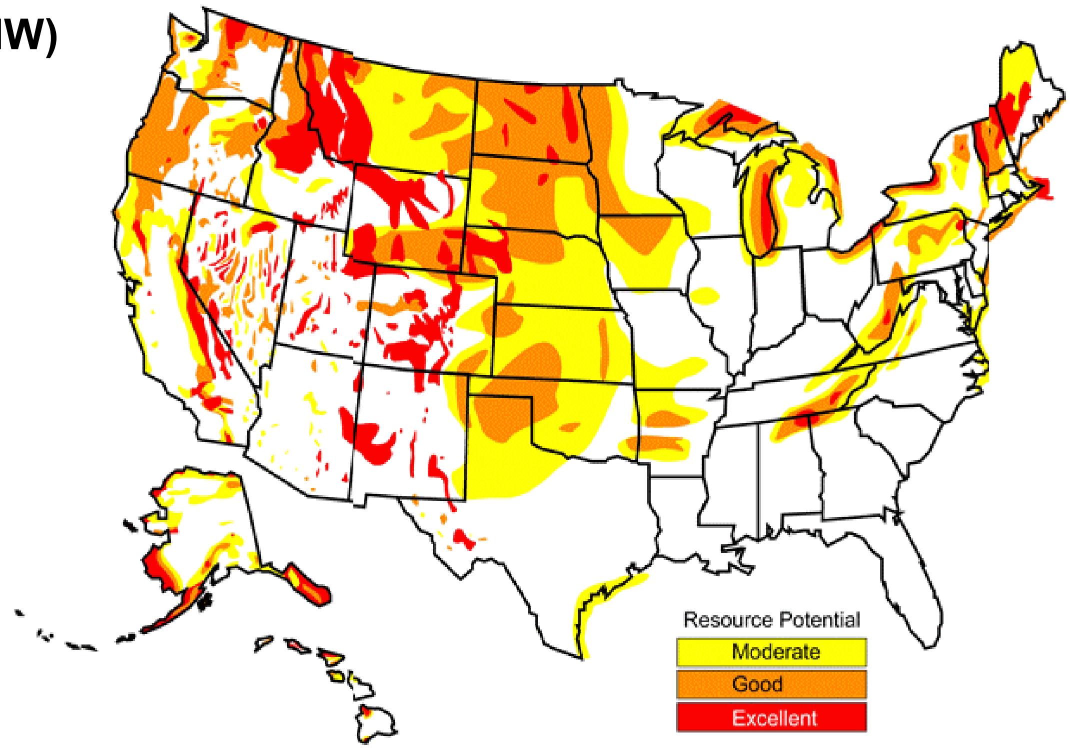
Colorado SEP
Air Emissions Avoided

- *CO_2*: 3,640 tons/year
- NO_x: 97 tons/year
- SO_2: 73 tons/year

- *Equals…*
  – 1,820 tons/coal NOT burned each year

U.S. Wind Energy Potential

Rank	State	Installed Capacity (MW)
1	North Dakota	1
2	Texas	188
3	Kansas	2
4	South Dakota	0
5	Montana	0
6	Nebraska	3
7	Wyoming	73
8	Oklahoma	0
9	Minnesota	272
10	Iowa	242
11	Colorado	22
12	New Mexico	1
13	Idaho	0
14	Michigan	1
15	New York	0
16	Illinois	0
17	California	1599
	Other	96
	Total	2500



World Class Wind Potential

Germany's Potential: 100 GW
North Dakota's Potential: 250 GW

Source: AWEA

Opportunities for Renewable SEPs

- New project
- Expand existing project
- Renewable Energy Credits (RECs)

Are SEPs for You?

Threshold Questions:

- Environmental enforcement actions pending or anticipated?
- State regulators receptive to concept?
- Any “deal breakers” in state regulations?
- Adequate clean energy resource base?
- Nexus between energy project and environmental violation?

StEPP Foundation

Strategic Environmental Project Pipeline -

Funds renewable energy, energy efficiency, and pollution prevention projects with significant, measurable environmental benefits.

NREL National Renewable Energy Laboratory

Who Qualifies

- Any organization
- Non-profit and government preferred
- Must provide measurable environment and community benefit
- Greatest environmental benefit for the investment $$

StEPP FOUNDATION

Eligible Projects

- Media driven
  - Air
  - Water
  - Land
  - Waste
  - Energy
  - Multimedia

Wind Powering America

Federal Loads

Ed Cannon, National Renewable Energy Laboratory

The U.S. government is the largest single electricity user in the country, consuming more than 55 million megawatt-hours (MWh) in fiscal year 2001. The Department of Defense alone accounted for nearly 30 million MWh. The electricity used each year by the federal government is roughly half that used by the entire nation of Turkey or The Netherlands. The table below lists the ten largest federal electricity users.

Agency	MWh/year
Department of Defense	29,963,593
U.S. Postal Service	5,065,788
Department of Energy	4,818,348
Veterans Administration	2,938,108
General Services Administration	2,833,044
Department of Transportation	1,737,516
National Aeronautics & Space Administration	1,680,382
Department of Justice	1,245,700
Housing & Human Services	878,037
Tennessee Valley Authority	615,999

Source: Federal Agency Annual Energy Management Data Reports

In 2000, President Clinton issued Executive Order (EO) 13123 directing federal agencies to improve their energy efficiency and to use more renewable energy. Although the order stopped short of setting a specific goal for renewable energy, it did direct federal agencies to coordinate and establish an appropriate goal: 2.5% of each agency's electricity will come from renewable sources by 2005. That goal is still in force because executive orders remain in effect during successive administrations, unless specifically superceded by new orders from the President. If we conservatively assume that total federal electric consumption will remain fairly constant through 2005, then 2.5% of that annual consumption would be about 1.38 million MWh. That's roughly equal to the output from 525 MW of installed wind turbine capacity. This implies that, in addition to the already rapid growth in U.S. installed capacity, an additional 500 MW or more must be added just to meet EO 13123 goals.

Despite the mandate of EO 13123, convincing individual agencies and their field operations to actually purchase electricity from renewable sources can be daunting. No additional funding was provided to the agencies to help them comply with the order. The EO does specify that agencies can apply the moneys saved by reducing their utility bills (e.g., through energy savings measures or utility price decreases).

However, many agencies have already captured the “low-hanging fruit” of energy savings and must rely on energy savings performance contracts (ESPCs) to identify and implement further savings measures. Most ESPCs are structured so that all or nearly all the energy savings are payable to the energy services contractor (ESCO) for several years to pay back the ESCOs investment, operating costs, and reasonable profits. In short, the savings are not immediately available to the federal agency to spend on renewable energy purchases. To comply with the executive order, agencies often find that they must divert money from their already limited budgets to pay any premium cost.

Most agencies recognize the obligation to meet the 2.5% goal by 2005. Furthermore, they seem to be increasingly concerned about the need to act before 2005 to safely meet the goal in time. Recently, a few notable purchases of renewable energy were announced by federal agencies that had been reluctant to pay any premium for electricity; these purchases are most likely due to the looming deadline of the EO. The Defense Energy Support Center (DESC), which purchases energy primarily for the Department of Defense, and the General Support Agency (GSA), which purchases energy primarily for non-military federal agencies, have begun to routinely include renewable energy options in their electrical energy solicitations. When the electricity prices are presented to the customer agencies, those federal agencies can select from a range of renewable energy options depending on the funds available. In cases in which the new base price for electricity (i.e., the price not including premiums for renewable energy) is lower than on the previous contract, the resulting “surplus” in the electricity budget can be used to add renewable energy to the mix, as provided in EO 13123. DESC recently negotiated a contract in Texas in which the price of electricity for a 2-year contract with 5% renewable content was less than the price for a 1-year contract with no renewables.

Tradable Renewable Energy Certificates (TRECs), or “green tags,” are often proposed as an easy mechanism to provide renewable energy to federal agencies in locations where renewable sources are not abundant or where renewable energy is not available from accessible suppliers. Although TRECs are conceptually valid—renewable energy is generated on behalf of the customer and the customer pays the associated premium cost of that renewable energy—some federal agencies find the concept fiscally problematic. These agencies believe that funds allocated for utility purchases can be used only for that purpose. TRECs are not literally utility electricity, since the energy is not specifically transported to the local area where the TRECs are purchased. As a result, these agencies have deemed it inappropriate to purchase

TRECs with utility funds. One possible solution is to fund the TREC purchases from other funds, such as environmental funds. However, this workaround negates the beneficial provision in EO 13123 whereby agencies can apply utility savings to the purchase of renewable energy. A better solution appears to be working in concert with the agencies' electricity suppliers to somehow bundle the TRECs with utility electricity so that the agencies receive a single bill for both. Most of the agencies that have objected to purchasing TRECs separately with utility funds have indicated that TRECs billed on the utility bill are no different than a renewable energy premium and are, therefore, acceptable.

DOE's Federal Energy Management Program (FEMP) assists federal agencies with meeting their renewable energy goals. FEMP representatives at DOE regional offices and at the National Renewable Energy Laboratory are available to aid federal agencies and installations in examining their renewable energy options and finding the best solution to meet their renewable energy goals.

Native American Wind Opportunities and Issues

Bob Gough and Pat Spears, Intertribal Council on Utility Policy (COUP)

The United States is home to more than 700 nations, tribes, bands, villages, regional corporations, and communities of indigenous peoples, from Alaska to Hawaii and the Pacific and Caribbean Islands. Native American tribes on reservation lands in the lower 48 states comprise the largest and most diverse of these indigenous peoples. Consideration of wind energy opportunities and issues for Native Americans must recognize this diversity, including cultures, histories, beliefs, relationships to surrounding communities, control of and access to resources, governmental and social organization, land tenure and jurisdiction, and energy infrastructure.

This overview highlights wind energy opportunities and key issues, primarily in terms of Native American governments on the reservations in the contiguous 48 states. These opportunities and issues must be viewed in light of the unique circumstances of each group of indigenous peoples. Native American governments serve very young and rapidly growing populations within defined territories. With limited natural resources, they look toward renewable energy generation for ecologically sustainable economic development.

Native American Wind Opportunities

Tremendous Wind Resources

Sufficient wind resources are available on a majority of reservations for many local residential and commercial uses, and many have class 4 (good) to class 6 (outstanding) wind power levels that could easily support large utility-scale development. In the northern Great Plains, perhaps the richest wind regime in the world, the tribal wind power potential exceeds 300 gigawatts across six states. This is equivalent to about half of the total installed electrical generating capacity in the United States.

Federal Trust Responsibility

Native American tribes enjoy a unique legal relationship with the U.S. federal government, including a variety of federal fiduciary and trust responsibilities. Federal agencies have legal and financial obligations to assist in the assessment, protection, and development of tribal resources, and in certain cases are required to consult with tribal governments regarding federal policies and actions that may directly affect specific tribal rights and resources.

Native American Governmental Authority

Native American governments hold regulatory authority for developing and managing their resources and economies in partnerships with federal agencies such as the U.S. Department of the Interior's Bureau of Indian Affairs. Native American governments can establish utility commissions and authorities and can form governmental and commercial subsidiary entities to develop, regulate, and manage their resources. Native American organizations can be designed to meet and promote informational and commercial needs and activities under tribal and federal charters for their collective economic benefit. Native American governments can exercise permitting authority and can promulgate tribal renewable portfolio standards, net metering, and other renewable energy policies to support such development within their jurisdictions.

Aggregated Land Ownership Patterns

Native Americans hold more than 100 million acres of land in the United States, much of it open, windswept, and remote from major urban electrical load centers. Because of the small footprints of the turbines, a wind facility can be sited without interfering with farming or grazing uses. Extensive, contiguous communal land holdings can allow for greater flexibility and minimized transaction costs in siting, placement, and permitting of wind turbine arrays for economically optimal power production.

Heightened Energy Interests

Western Native American tribes are developing a new working relationship with power marketing administrations (PMAs), such as Bonneville and Western, through the purchase of firm hydropower allocations. These federal PMAs operate integrated transmission grids that cross almost all of the western reservations and connect them to the national grid system. Tribes have a heightened awareness of reservation energy issues through both the accounting of reservation loads and the integrated planning requirements of accepting federal hydropower allocations. Tribes are becoming more aware of the value of their renewable energy resource potential.

Transmission and Green Tags

Native lands located along federally owned and operated transmission grids hold significant physical and commercial advantage for distributed tribal wind generation. This extensive distribution system could be utilized as an efficient collection system. Under a tribal "green tag" concept, reservation-generated power can be delivered directly to a federal grid, and the environmental attributes of the wind power (the green tags) can be sold separately. PMAs can serve as a single federal purchasing agent of green energy produced by tribes to meet federal green power demand. Green tags can help overcome transmission constraints, both physically and economically. No physical delivery of the energy to remote loads would be required. This allows distant federal facilities lacking access to low-cost renewable energy to be served by the most cost-effective green power generated in the best wind regimes.

Native American Wind Issues

Need for Energy Self-Sufficiency

Although often rich in natural resources, Native American communities are the poorest in America. Their communities are likely to be the site of energy resource extraction (coal, gas, oil, uranium, and hydropower). They are likely to be limited end-use consumers of relatively higher-priced energy services, rather than the integrated participants in the overall energy economy. Native peoples are disproportionately affected by America's energy industry relative to the benefits received from their contributions to the national energy economy. Reservation households are 10 times more likely to lack electrification than households in mainstream America, and those that do have access to electricity pay a significantly higher proportion of their household incomes.[11] Native leaders have an obligation to provide for the sustainable homeland economic development of their resources for the benefit of their people. As sovereigns, they do not wish to be completely dependent on the policies, practices, and resources beyond their jurisdictions. Wind energy can provide a means for locally owned and operated renewable energy generation, ecologically sustainable development, and self-determination.

Protection of Environmental and Cultural Values and Resources

Protecting tribal land and resources is a primary legal and cultural responsibility of any tribal government. Among energy development options, such as hydropower dams or coal and uranium mining, wind has the least physical impact on the local environment. This accords with cultural values of sustainability, a respect for the Earth, and a desire to minimize the manipulation and despoiling of the environment. Concerns about wind development for Native Americans involve not only an assessment of how siting and construction may affect a

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[11] Energy Information Administration, Department of Energy. "Energy Consumption and Renewable Energy Development Potential on Indian Lands, Executive Summary." http://www.eia.doe.gov/cneaf/solar.renewables/page/pubs.htm. April 2000.

community's limited natural resources, such as plants and animals and their habitats, but also an assessment of the impact on existing cultural resources. The usual concerns about threatened and endangered species are taken one step further to include plants and animals that are highly valued within the reservation boundaries. Disturbance to the habitat of an eagle or hawk, for example, may have a symbolic impact as well as biological implications. Disturbance to hillsides or ridges on the reservation may disrupt unique historical sites, religious beliefs, and cultural and spiritual practices. Native American control of development, particularly the siting process, offers greater protection for burials and sacred sites (which are often located on hilltops and ridges) and other valued cultural resources, such as medicine plants and revered places. Native Americans have enforceable federal legal protections to many such resources within and beyond their reservation boundaries.

Project Financing

Native American peoples and renewable energy technologies are "new kids" on the energy industry "block." Most Native American communities do not provide their own electricity. Consequently, they lack control and access to their own community as a rate base and the support of guaranteed or long-term power purchase contracts. Intermittent generation behind the meter on tribal loads, such as casinos, schools, or other facilities, may be subject to demand charges that can make an interconnected project economically unfeasible and thus unfundable.

Lack of Federal Renewable Energy Incentives

Two federal renewable incentive programs—Production Tax Credit (PTC) and Renewable Energy Production Incentive (REPI)—have driven renewable energy development outside of the Native American community. Neither is directly applicable to tribal-owned development because tribal governments do not have federal income tax liabilities (a requirement for using the PTC), and tribes are not subdivisions of a state (a requirement for utilizing the REPI).

Grants, Loans, and Partnerships

However, Native American governments do have access to a variety of financing mechanisms, ranging from grants for demonstration projects to low-interest rural utilities service loans, loan guarantees, and tax-exempt bonding for commercial projects and for establishing power authorities as fundamental governmental services. They may participate in joint venture partnerships with other groups (Native American and non-Native American) in creative project ownerships to provide for more investment opportunities and revenue sharing. Native American groups may also lease lands to outside parties and collect rents and royalties.

Need for Infrastructure and Capacity Development

Native American communities often lack the technical training, the access to financing, and the infrastructure capacity to effectively utilize their energy resources in ways that are fully consistent with their cultural values or ways that could lead to the successful development of sustainable homeland economies. Mainstream development models based on private corporate enterprise are unlikely to flourish in the reservation context. Tribes have responsibilities—stemming from familial relationships, social welfare obligations, and governmental responsibilities—that are rooted in history and culture and are often not included in the corporate business model. But tribal models building on cultural values and historical experience and operating in concert with financial and technical assistance from the U.S. government or private sources may be the best way to ensure successful and lasting tribal resource development. Native peoples can choose from a variety of models and options that support sovereignty and self-determination through economic success and environmental sustainability.

Native American Wind Development

Three Keys to Tribal Success

Tribal leaders face many decisions regarding resource development. They must consider their options carefully, making the best use of their natural resources, of their existing tribal capacity and authorities, and of the available federal programs for technical and financial assistance. Recent economic development studies note that sustainable, self-determined economic development requires that Native Americans build on their sovereignty. They can do this by creating culturally and historically appropriate institutions that can plan, develop, and carry out economic policies and projects to support local employment, expand businesses, and promote sustained access to capital.[12] One study focusing on Native American economic success stories identified three keys to successful economic development:

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[12] Cornell, S.; Kalt, Joseph P. "What Can Tribes Do? Strategies and Institutions in American Indian Economic Development." American Indian Studies Center, University of California, 1992.
"Expanding Job Opportunities for Alaska Natives (Interim Report)." Institute of Social and Economic Research, University of Alaska, Anchorage, Nov. 1998.

- Sovereignty: tribes make their own decisions regarding approaches to economic development and the utilization of resources
- Culture: tribal decisions are made in light of the tribe's historical traditions and social values
- Institutions: tribes creatively design and establish culturally appropriate entities to formulate and execute business decisions that are kept separate from those involving tribal governance. [13]

"The effectiveness of federal programs is intricately linked with the ability of tribes to incorporate the programs into their economic development plans."[14] In the context of renewable energy opportunities, there is a reciprocal burden to strategically shape Native American economic development projects in ways that can effectively utilize the available federal programs for the assessment and sustainable development of their renewable resources; that can gather accurate information, select appropriate technologies, and develop internal capacity to advance culturally responsive and ecologically sustainable economies; and that can creatively assess, develop, and manage their activities in the institutional environments in which new opportunities may arise.

Conclusion

Developing tribal wind resources requires 1) outstanding wind resources on tribal lands; 2) leasing, permitting, regulatory, and management authority; and 3) access to federal and private capital. Two critical areas must be addressed to support tribal wind energy generation: 1) the provision of development costs necessary in planning, environmental assessment, and financing a project; and 2) the need for policy that supports economic equity in the provision of wind power for reservation housing and facility loads and access to off-reservation markets without excessive demand and transmission costs by public and private entities. The solutions to these problems lie in a broad understanding of the issues by tribal, federal, state, and business leadership. This understanding will allow the use of clean wind energy in an equitable blend of true costs in a sustainable economy.

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[13] Jorgensen, M.R.; Taylor, J. "Patterns of Indian Enterprise Success: A Statistical Analysis of Tribal and Individual Indian Enterprise Performance." The Harvard Project on American Indian Economic Development, Feb. 2000.

[14] "Economic Development: Federal Assistance Programs for American Indians and Alaska Natives." GAO Report to Congressional Requesters. GAO-02-193, Dec. 2001.

Agricultural Community Stakeholders

Roya Stanley, National Renewable Energy Laboratory

Agricultural lands in the United States are ripe for generating and utilizing renewable energy resources. With net farm and ranch income down and drought conditions throughout much of the United States, farmers and ranchers and others in the agricultural community are taking a serious look at how wind energy can become their new cash crop.

The agricultural community includes not only farmers and ranchers, but also rural community leaders such as banks, rural economic development organizations, rural businesses, agriculture cooperatives, agricultural extension, Chambers of Commerce, schools, county government, and other groups that make up rural America.

Farmers and ranchers are represented by hundreds of agriculture commodity and livestock groups. Some of the major groups include the National Corn Growers Association, American Soybean Association, National Association of Wheat Growers, National Cattlemen's Beef Association, National Pork Producers Council, and the American Dairy Association. Many national groups have state and local chapters.

Some of these groups have taken an interest in wind energy on the national level. For example, the American Corn Growers Foundation (ACGF) is a member of the American Wind Energy Association and sponsors major wind energy conferences. ACGF has developed the educational Wealth From the Wind program and formed an American Agricultural Wind Coalition. For additional information on ACGF's efforts, access www.mindfully.org/Energy/2003/Wind-Energy-Renewable7mar03.htm.

Rural utilities and co-ops serve the agricultural community, and Wind Powering America has an initiative for these stakeholders. DOE/NREL's *Wind Power For America: Rural Electric Utilities Harvest New Crop* brochure targets this audience: http://www.nrel.gov/docs/fy02osti/31584.pdf. For more information, see the *Wind Power and Rural Electric Utilities* section.

Identifying Agriculture Stakeholders

Agricultural leaders and groups are often active participants in their communities and play important roles in developing economic opportunities as well as local and state policies and laws. State Wind Working Groups may identify potential agricultural stakeholder partners in their area by contacting state and local agricultural agencies such as USDA's Cooperative State Research, Education, and Extension Services (CSREES), the Farm Bureau, and the Farmer's Union (the latter two often have state branches and local offices).

CSREES handles research, education, and extension grants. CSREES state partners may provide State Wind Working Groups with information on area agricultural-based groups and provide suggestions on media opportunities and how to best reach the agricultural groups. For information on state CSREES partners and contacts, access http://www.reeusda.gov/1700/statepartners/usa.htm.

Other ways to identify potential agricultural stakeholder partners include conducting Internet research and observing agricultural-related news from television, radio, and newspaper. Visits to area rural community eateries or coffee shops may lead to conversations about local agricultural groups and leaders.

Once stakeholders are identified, Wind Working Groups may contact them and discuss opportunities for partnering. Wind Working Groups may invite the stakeholders to become members of their Working Groups as well as offer to become involved in the agricultural groups' activities. Once the connection is made, Wind Working Groups have a variety of resources available for outreach.

Resources and Information Distribution

State Wind Working Groups may use a variety of wind energy information tools to provide outreach to the agricultural community.

The Wind Powering America Team is developing materials designed for the agricultural community that include a brochure, table-top exhibit, and a sample PowerPoint presentation. Once completed, these products will be available through Wind Powering America. State Wind Working Groups may use these materials for outreach to the agricultural community through rural-based events and media.

Wind Working Group members may offer to attend and ask to be added to agricultural group event agendas as speakers and panelists. Events may include annual meetings, workshops, conferences, and state and county fairs. The Wind Powering America Team can provide talking points and examples of presentations. The team can also provide a listing of major national agricultural group event schedules. Brochures and the table-top display may be used for event exhibits.

Separately or in conjunction with events, State Wind Working Groups may use the rural media to spread the word about wind energy benefits. The agricultural community gets its information through television, radio, Web sites, e-mail, newsprint, and agricultural-related documents. Wind Working Groups may do TV or radio interviews and submit articles to newpapers, newsletters, or farm journals and magazines. Wind Powering America can provide talking points for interviews and share information on articles states have submitted to newspapers and farm trade publications.

Wind Powering America can also provide information that is audience-specific. Most agricultural groups will want to know about wind energy costs, and there are many sources for economic benefits information. One source is a Union of Concerned Scientists economic model, which uses state-specific information and numbers to determine financial benefits from utility-sized wind turbines. It is being developed to accommodate county-specific information.

Wind Powering America can provide assistance on developing agricultural community stakeholder identification and strategic outreach plans. Wind Working Groups may contact their U.S. Department of Energy Regional Office representative to determine how Wind Powering America and the National Renewable Energy Laboratory can assist.

Key Messages for Agricultural Community Stakeholders

Resource materials and other outreach efforts may include messages that communicate the economic, energy, and environmental benefits of wind power. Those messages are:

- Wind energy provides an additional source of income for rural communities, benefiting county and local services including schools, health care facilities, and roads.
- Landowners with wind development on their property receive $2,000 - $5,000 per turbine.
- Wind energy uses less water than fossil fuel power plants.
- Turbines do not take up much land. Crops can be grown and livestock grazed right up to the base of the machine.
- In states where laws or rules require a utility to provide a certain amount of renewable energy, farmers and ranchers have seen an increase in interest from wind developers. In some instances, the requirement is in

the form of a Renewable Portfolio Standard. For more information, see the *State Policy Options for Utility-Scale Wind Plants* section.
- Homegrown energy makes the homeland more secure.

Wind Energy Provisions in the 2002 Farm Bill

One new opportunity for funding wind energy in rural areas comes from the 2002 Farm Bill passed by Congress. This bill provides direct grants and loans for wind energy systems and allows wind energy to qualify for existing U.S. Department of Agriculture (USDA) rural development assistance programs. Specifically, the bill:

- Establishes a grant, loan, and loan guarantee program to assist farmers, ranchers, and rural small businesses in purchasing renewable energy systems and making energy efficiency improvements. This program makes $23 million available each year for five years. On April 8, 2003, the USDA announced that the 2003 funds were available. The USDA will accept project applications through June 6, 2003, for this year's funds. The full solicitation can be accessed at http://www.rurdev.usda.gov/rd/nofas/2003/rep040803.txt.
- Extends loans and loan guarantees under the Consolidated Farm and Rural Development Act to wind energy systems. For details on the existing program: http://www.rurdev.usda.gov/sd/b&i_loan_guarantee_program.htm.
- Defines wind power located on ranches and farms as a "value-added agricultural product." This designation allows for grants up to $500,000 per project for feasibility studies, business plans, marketing strategies, and seed capital. For more information, see http://www.rurdev.usda.gov/rbs/coops/vadg.htm.
- Allows farmers to install wind turbines on Conservation Reserve Program (CRP) lands (subject to the approval of the USDA). CRP payments are not reduced based on this activity. The USDA can specify the number and location of turbines and will only allow if consistent with CRP goals for the land.

More Information

U.S. Department of Energy's National Renewable Energy Laboratory: http://www.nrel.gov/wind/.

American Wind Energy Association: http://www.awea.org/.

The USDA Farm Bill information can be accessed at: http://www.usda.gov/farmbill/index.html.

Environmental and Energy Institute (EESI) in Washington, DC, is a nonprofit organization keeping track of USDA's efforts on energy provisions of the Farm Bill: www.eesi.org.

Wind Energy and the Agricultural Community

- With farm and ranch income down and current drought conditions, many farmers and ranchers are taking a serious look at how wind energy can become their new cash crop.
- The agricultural community can benefit from wind's many economic, energy, and environmental attributes.
- The agricultural community plays an important role in wind energy development.

How Wind Energy Benefits the Agriculture Community

- Wind energy provides an additional source of income for rural communities, benefiting county and local services (schools, health care facilities, roads, etc.).
- Landowners with wind development on their property receive $2,000 to $5,000 per turbine/year.
- Wind energy uses less water than fossil fuel plants.

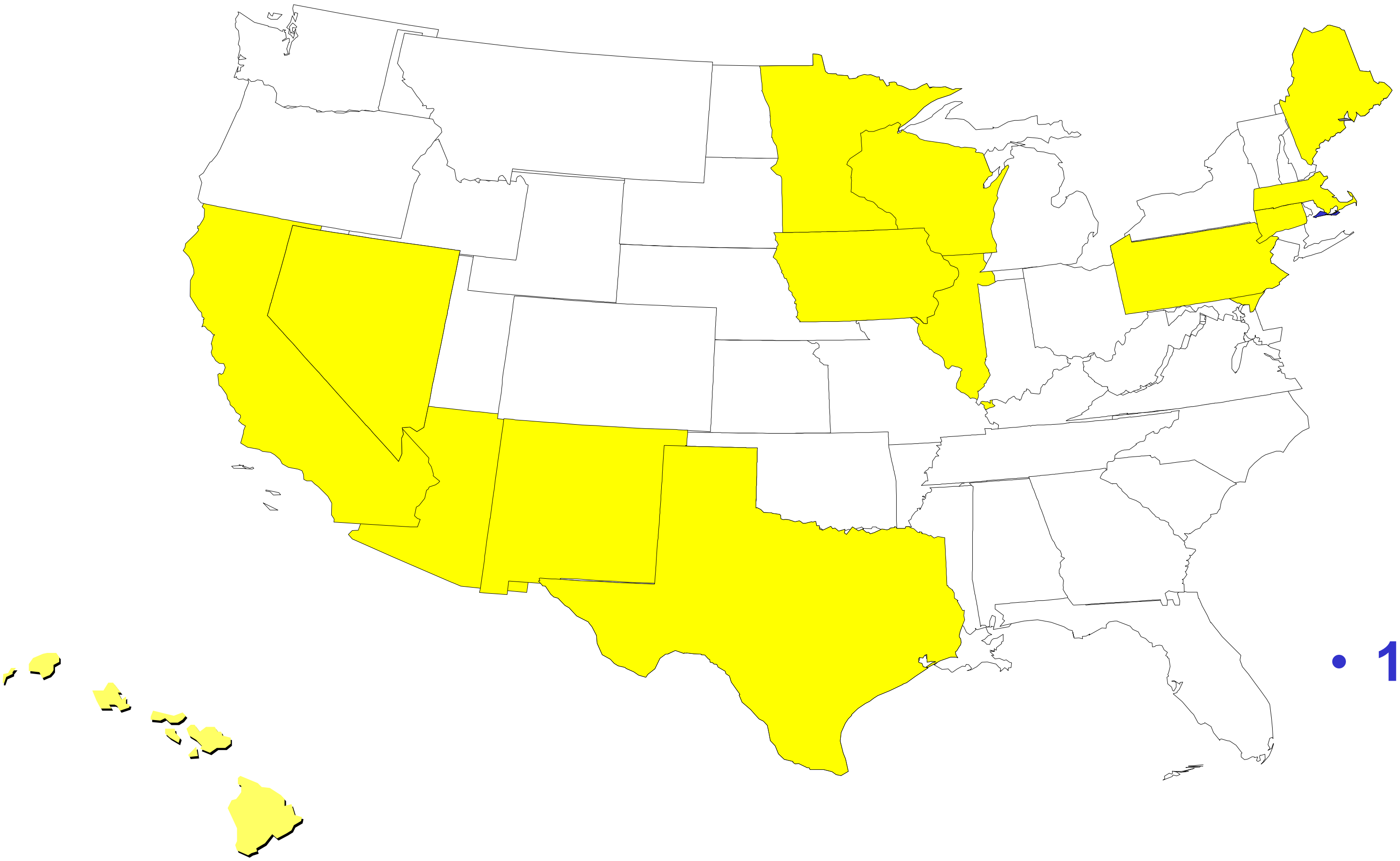
How Wind Energy Benefits the Agricultural Community

- Wind turbines do not take up much land. Crops can be grown and livestock can be grazed right up to the turbine base. Turbines do not interfere with daily operations.
- Homegrown energy makes the U.S. more secure.

How Wind Energy Benefits the Agricultural Community

- In states where laws or rules require a utility to provide a certain amount of renewable energy, farmers and ranchers have seen an increased level of interest from wind developers.
- In some instances, the requirement is in the form of a Renewable Portfolio Standard.

Renewable Portfolio Standards



- **16 states**

Revenue for the Community

- In Carbon County, Wyoming, revenue from property tax on the Foote Creek Rim Wind Plant provides 30% of the county budget.
  - This plant is large enough to power 50,000 average U.S. homes.

Wind Development at Spirit Lake, Iowa

- 1993: Installation and operation of Spirit Lake wind turbine results in \$20,000 to \$25,000 profit per year.
  - Result: Visible success encouraged lawmakers to move forward by requiring utilities to adopt 105 MW of renewable energy.

Wind Energy in Iowa: the Economic Benefits

- Wind farms near Clear Lake and Storm Lake pay 115 landowners to site their wind turbines.
  - About $2,000 per turbine (approx. $640,000 per year)
- Pays $2 million per year in taxes to counties.
- 200 people employed for six months to build wind farms.
  - 40 people employed currently to maintain.

Waverly, Iowa Propels Adoption of Renewable Energy

- 1993 – installed single wind turbine on leased farm land to offset rising energy costs.
- The results were so successful that in 1999, two additional turbines were purchased.

Waverly, Iowa

Benefits from the Three Turbines Include:

- Reduced CO_2 emissions by 3,580 tons/year.
- Saves 10,000 barrels/year of oil.
- Produced revenue for local land owners.
- Lowered consumer electricity costs.
- Created local jobs for installation and maintenance of turbines.

Waverly, Iowa

The success of this project has been widespread.

Farmers are “lining up” to host a turbine on their land.

- Glenn Cannon, general manager, Waverly Light and Power.

U.S. Department of Agriculture's Farm Bill

- One new opportunity for funding wind energy in rural areas comes from the 2002 Farm Bill passed by Congress.

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USDA Farm Bill

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USDA Farm Bill

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USDA Farm Bill

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USDA Farm Bill

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More Information

- U.S. Department of Energy's (DOE) Wind Powering America: http://www.eere.energy.gov/windpoweringamerica/
- U.S. DOE's National Renewable Energy Laboratory: http://www.nrel.gov/wind/
- American Wind Energy Association: http://www.awea.org/
- USDA Farm Bill information can be accessed at: http://www.usda.gov/farmbill/index.html

Municipal Utilities and Green Power

Randy Manion, Western Area Power Administration

As we continue in an era of fuel price volatility and risk in energy markets, the value of sound resource planning—hedging against a previously unforeseen range of possible market scenarios—is higher than ever. In addition, the importance of customer service and of delivering value to customers is higher than ever. Renewable energy—wind power—has valuable characteristics that can enable municipal utilities to address both of these concerns.

In the face of new and emerging market conditions, municipal utilities across the country find themselves at a crossroads. Load requirements are expected to continue increasing, while in many cases, existing supply contracts will end within the next few years. Further, customers throughout municipal utility service territories express consistently high levels of interest in renewable energy alternatives. In most cases, the preferred renewable technologies are solar and wind; given the cost advantage of wind, it is frequently the renewable of choice.

Municipal Utility Green Power Programs

Investor and publicly owned utilities around the country have begun offering renewable energy or green power options (generally referred to as green pricing programs) to their customers. The National Renewable Energy Laboratory (NREL) ranked utility green pricing programs based on a variety of criteria. They found that municipal utility green pricing programs were consistently among the most successful, regardless of the criteria used.

Los Angeles Department of Water and Power (LADWP): Green Power for a Green LA

The LADWP program is ranked in the top five in all categories. This program offers a low-cost, broad-based product to its customers. For a $3.00 monthly fee, residential customers can opt to receive 20% of their power requirements (about 100kWh per month) from renewable energy.

Austin Energy: Green Choice

Austin's 61 wind turbines, located in Upton County, Texas, have a total capacity rating of 70 MW and will provide enough energy to meet the needs of 20,000 homes. Austin Energy has enrolled more than 6,500 participants, or approximately 2% of its customer base, in its Green Choice Program. Austin Energy customers who subscribe to Green Choice will see the normal fuel charge on their power bill replaced by a green power charge. Because of Austin Energy's 10-year power supply contracts for wind and methane gas, the green power charge will remain fixed until 2011. Although the green power charge will never change for subscribers, other customers who choose not to participate in the Green Choice program will be subject to the fluctuations in fuel adjustment charges. Green Choice customers pay a premium of 1.1 cents per kWh.

Waverly Light and Power

In July 2002, NREL awarded its first Paul Rappaport Renewable Energy and Energy Efficiency Award to Waverly Light and Power for its contribution to the development of wind power in Iowa. Waverly began its wind program in 1991 when the city faced a power supply crisis. Since Waverly installed its first turbines in 1993, Iowa's wind power capacity has grown to more than 300 MW. Iowa now ranks third in states with installed wind capacity, behind California and Texas.

Benefits to Municipal Utilities and Their Customers

More utilities are recognizing that wind power provides significant benefits to the utility and its customers. First and foremost, customers want renewables. Customer interest in renewables has been established repeatedly in customer surveys across the country. Second, wind power provides price stability benefits. Again, it has been amply demonstrated that price risk mitigation is important to a utility's financial stability and is highly desired by risk-averse customers. Third, renewables provide significant local, regional and national environmental benefits. Finally, wind contributes substantially to local economic development, a benefit that will be of great importance to all municipalities.

Municipal Utilities' Concerns with Using Wind Power

Municipal utilities have traditionally expressed three major concerns with incorporating wind power into their resource mix.

"Wind power is more expensive than available fossil fuel options." Several factors have emerged to address this concern. First, the cost of wind power has dropped dramatically in recent years and, in some locations, wind is equal to the low-priced fossil fuel alternative on a levelized cost basis. Second, the lack of price volatility for wind generation reduces the costs of hedging fossil fuel price risk. Finally, in light of customer preferences, wind power can play a significant role in supplying value and satisfying customer needs.

"Because wind power is intermittent, the costs of transmission and ancillary services are increased." This important issue is currently under intensive study. A variety of groups, most notably the Utility Wind Interest Group, are presently engaged in detailed studies assessing the impacts of wind generation on utility operations. Early results suggest that the costs of incorporating wind generation into utility resource portfolios are much less than traditionally believed. Although not definitive, the Bonneville Power Administration recently eliminated their generation scheduling imbalance penalty for wind generation (see the section on utility integration).

"Our utility is not familiar with wind technologies." For municipal utilities that are concerned about their lack of extensive experience operating wind generation technologies, power purchase agreements are a viable financial and practical option. In addition, many municipal utilities are coming to the conclusion that wind power will be a significant component of their future resource portfolios and are making the decision to learn about this technology now.

More Information

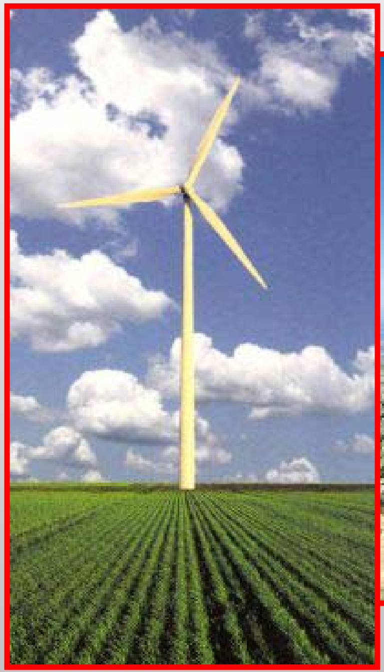
http://www.resource-solutions.org/PRP.htm.

Wind Powering America
http://www.eren.doe.gov/windpoweringamerica/public_power.html.

http://www.es.wapa.gov/renew.

Green Power Network
http://www.eren.doe.gov/greenpower.

Wind Energy for Municipal Power Systems




State Working Group Handbook

A Very Reliable Source of Power

Sizes and Applications

Small (≤10 kW)

- Homes
- Farms
- Remote Applications

  (e.g. water pumping, telecom sites, ice-making)

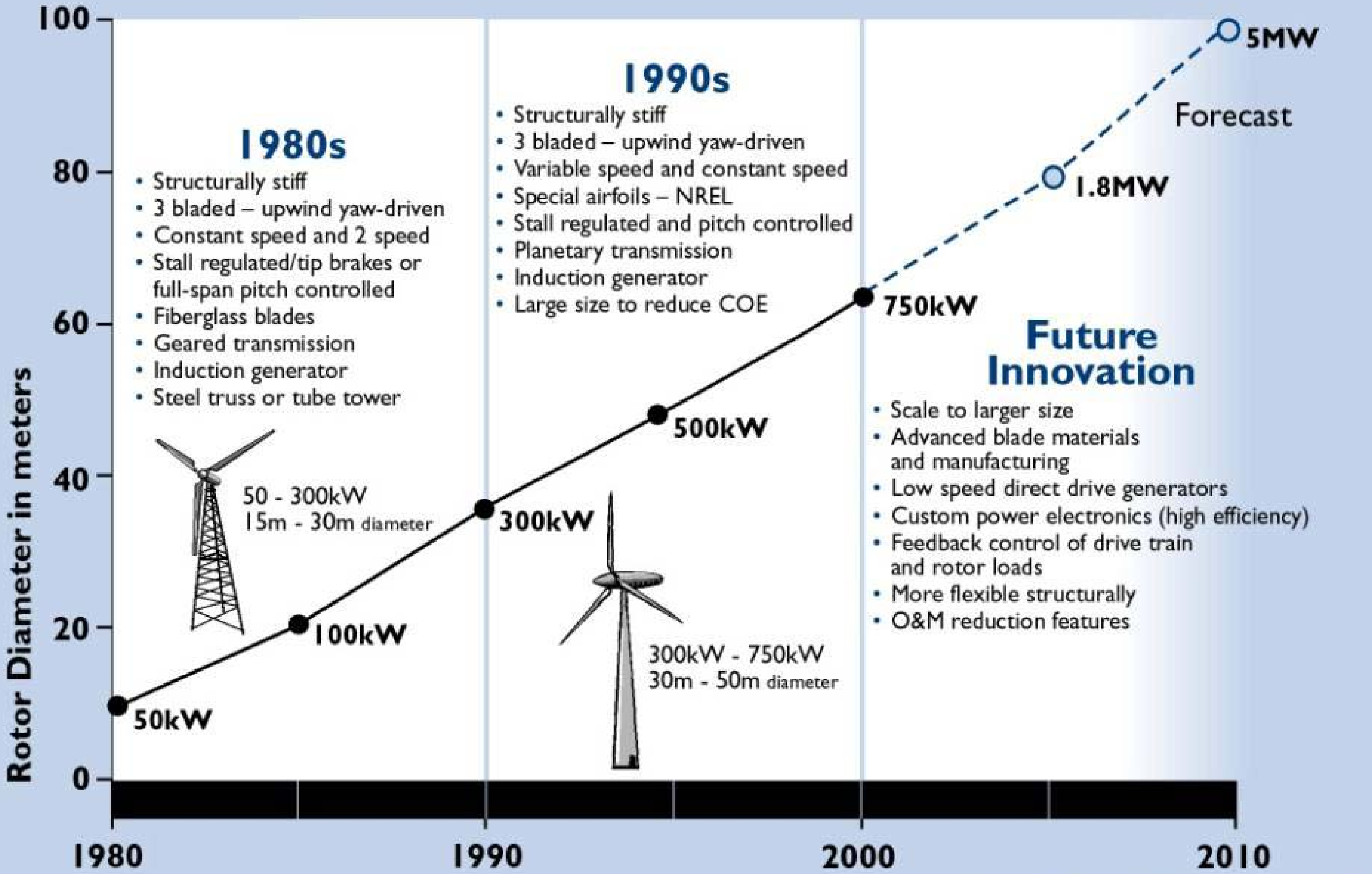
Intermediate (10-250 kW)

- Village Power
- Hybrid Systems
- Distributed Power

Large (660 kW - 2+MW)

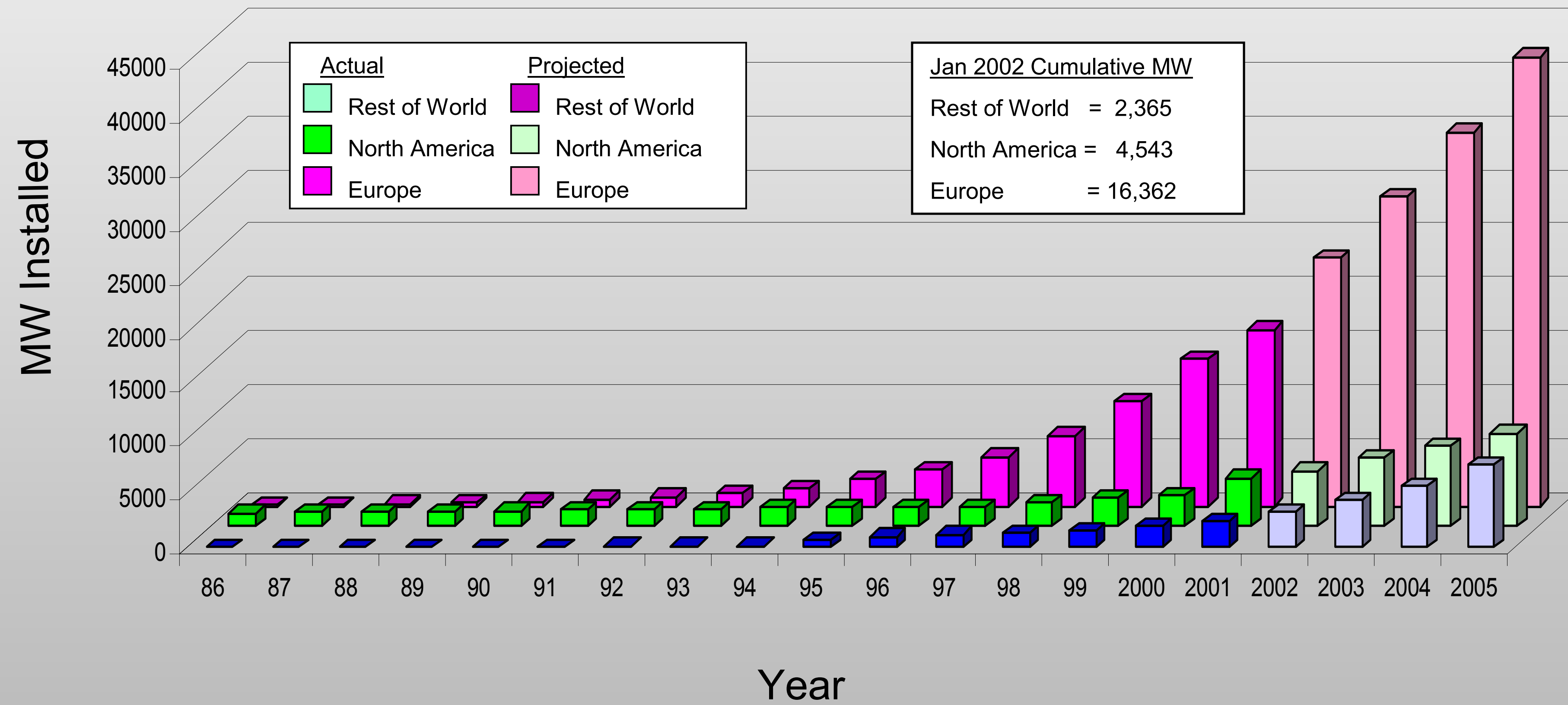
- Central Station Wind Farms
- Distributed Power

NREL The Evolution of Commercial U.S. Wind Technology



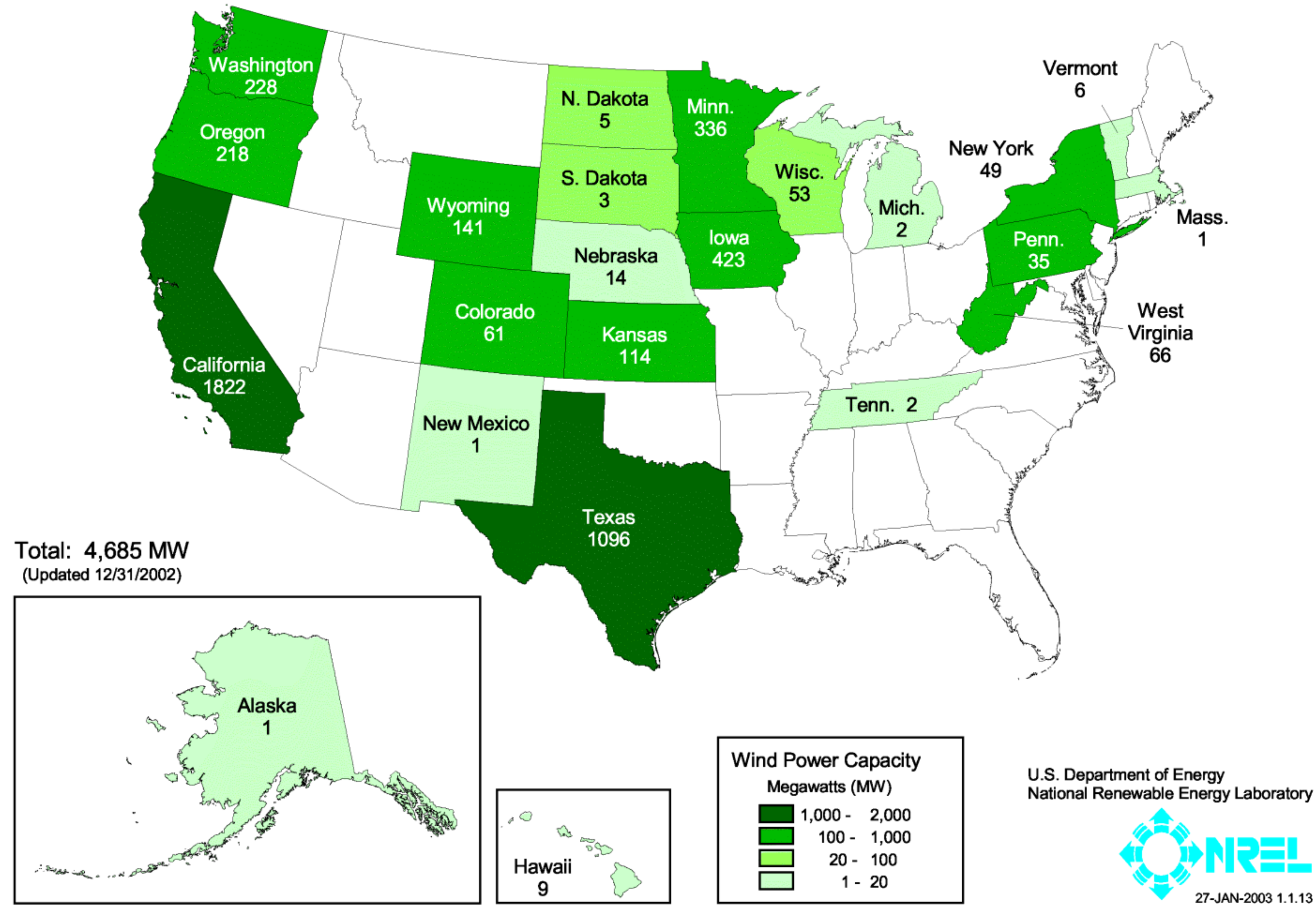
Source: Thresher & Dodge, Wind Energy Journal 1998

Growth of Wind Energy Capacity Worldwide

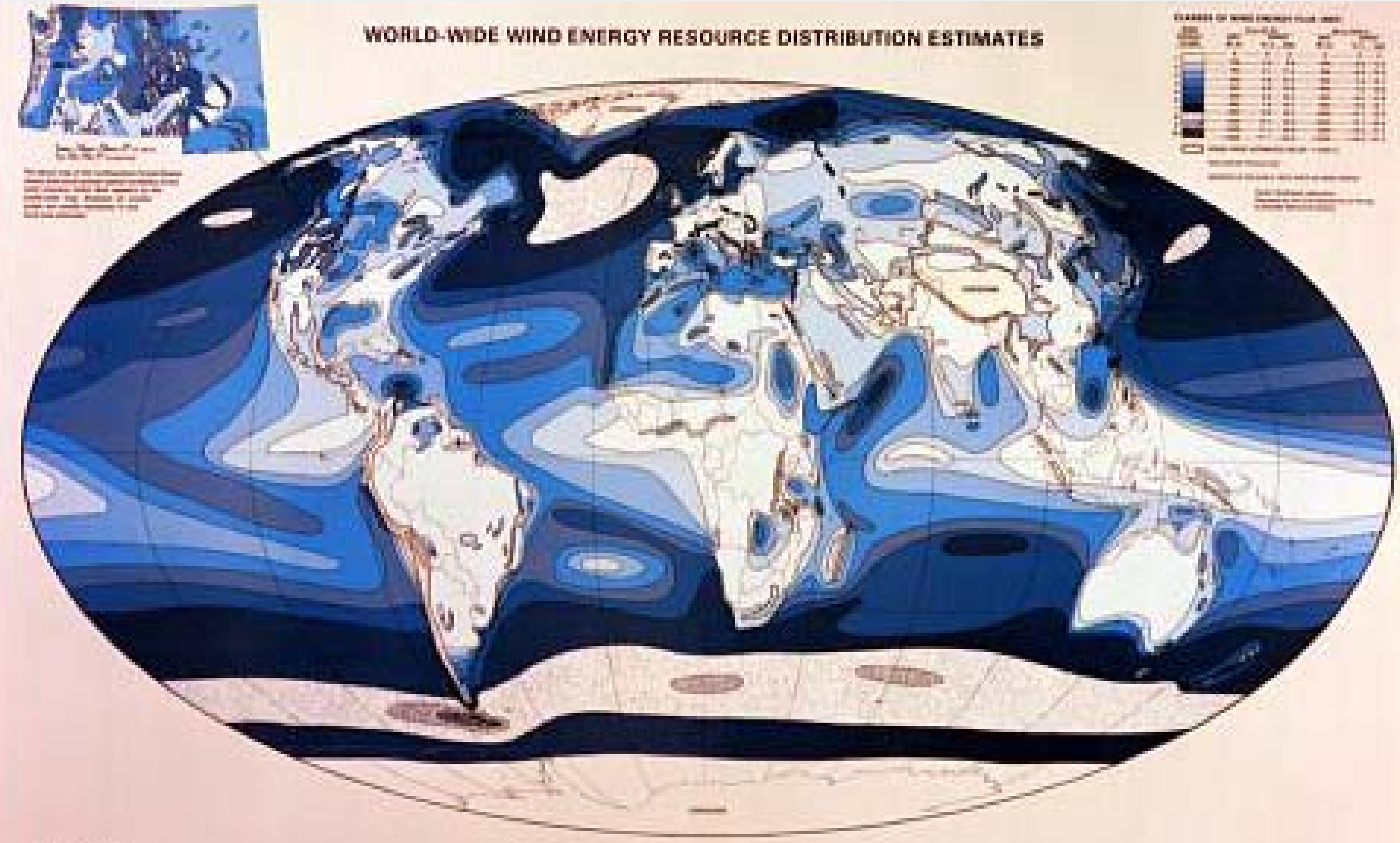


Sources: BTM Consult Aps, March 2001
Windpower Monthly, January 2002

United States - 2002 Year End Wind Power Capacity (MW)



What Causes Wind?



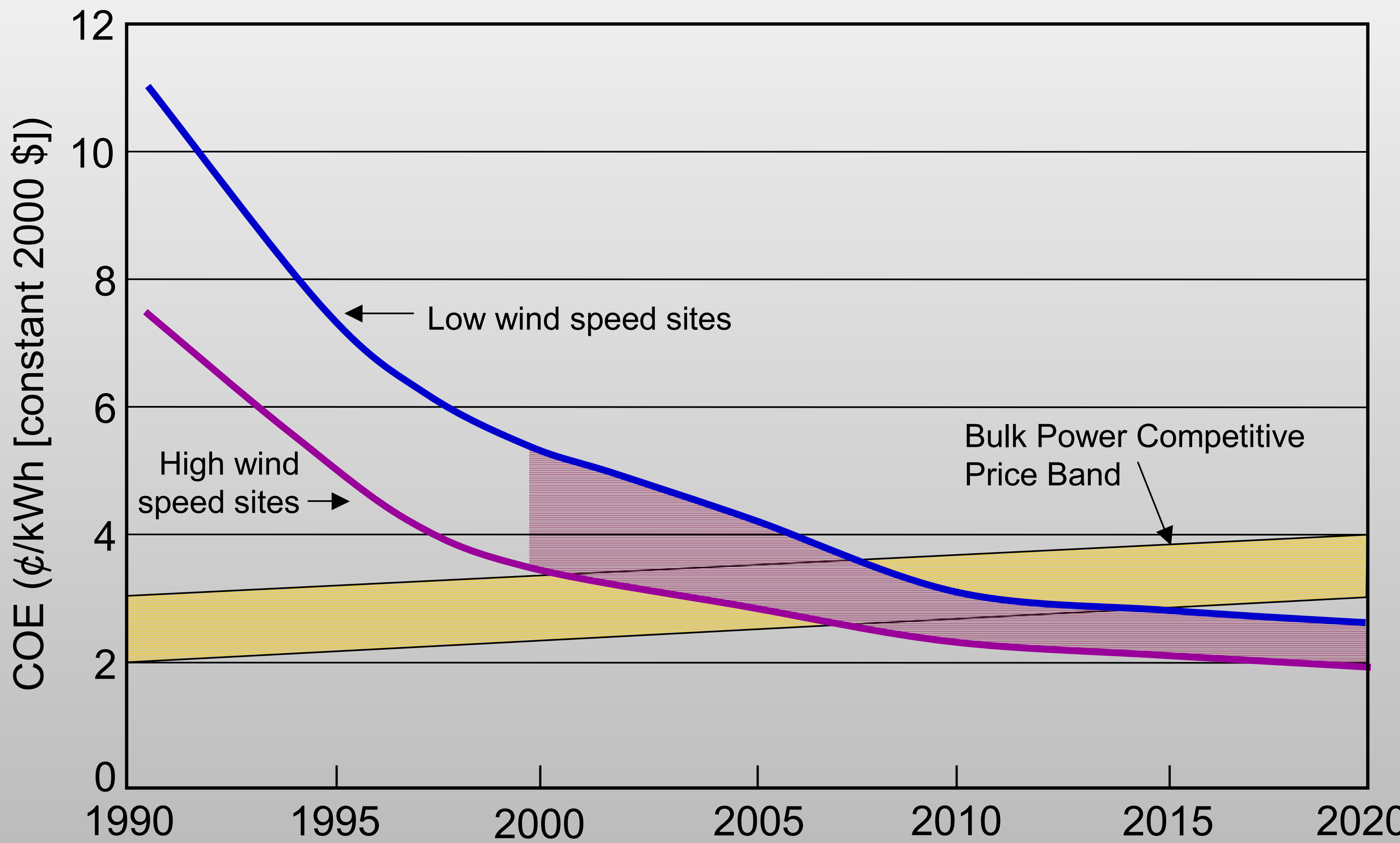
Drivers for Wind Power

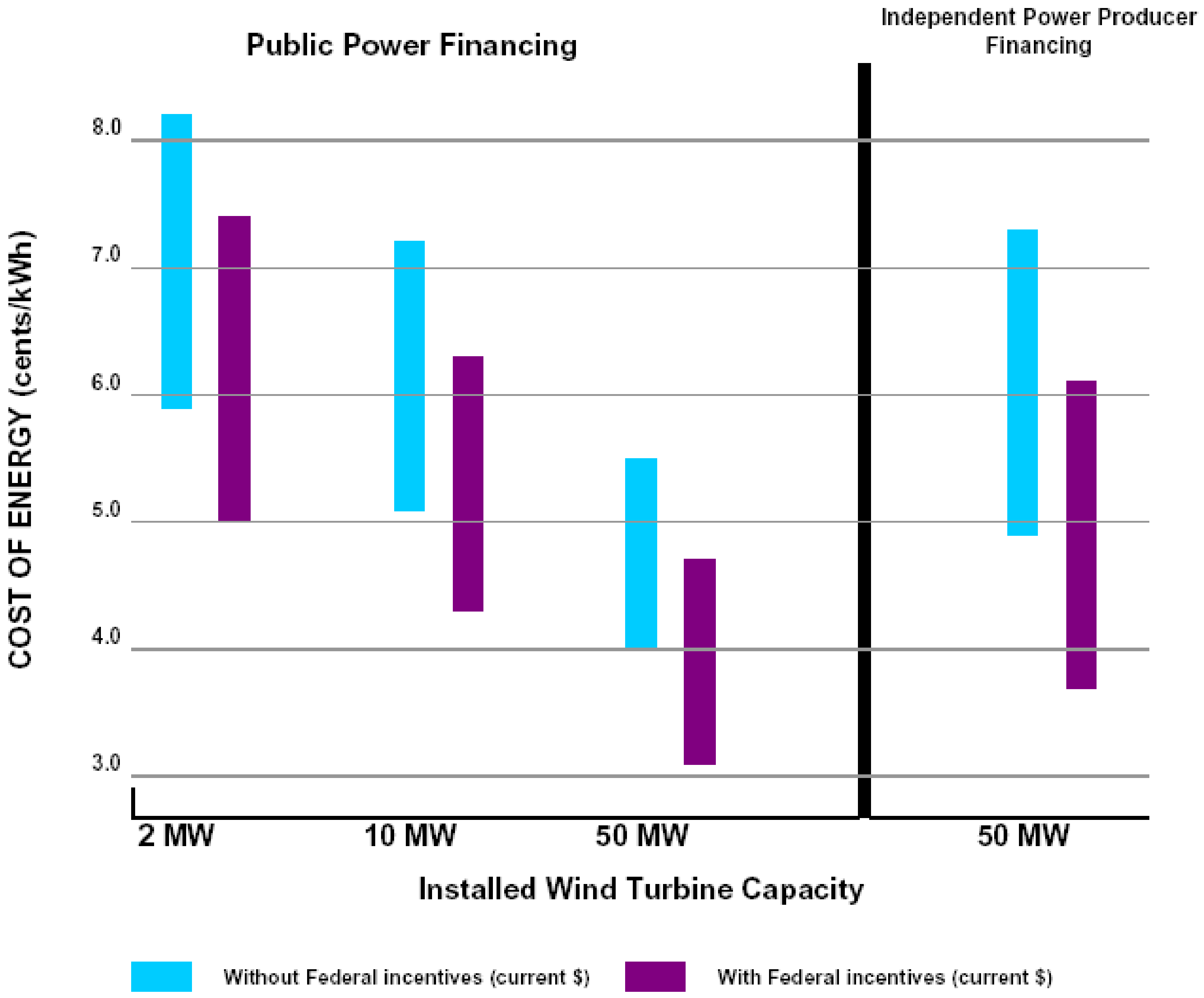
- Declining Wind Costs
- Fuel Price Uncertainty
- Federal and State Policies
- Economic Development
- Green Power
- Energy Security

Wind Economics – Determining Factors

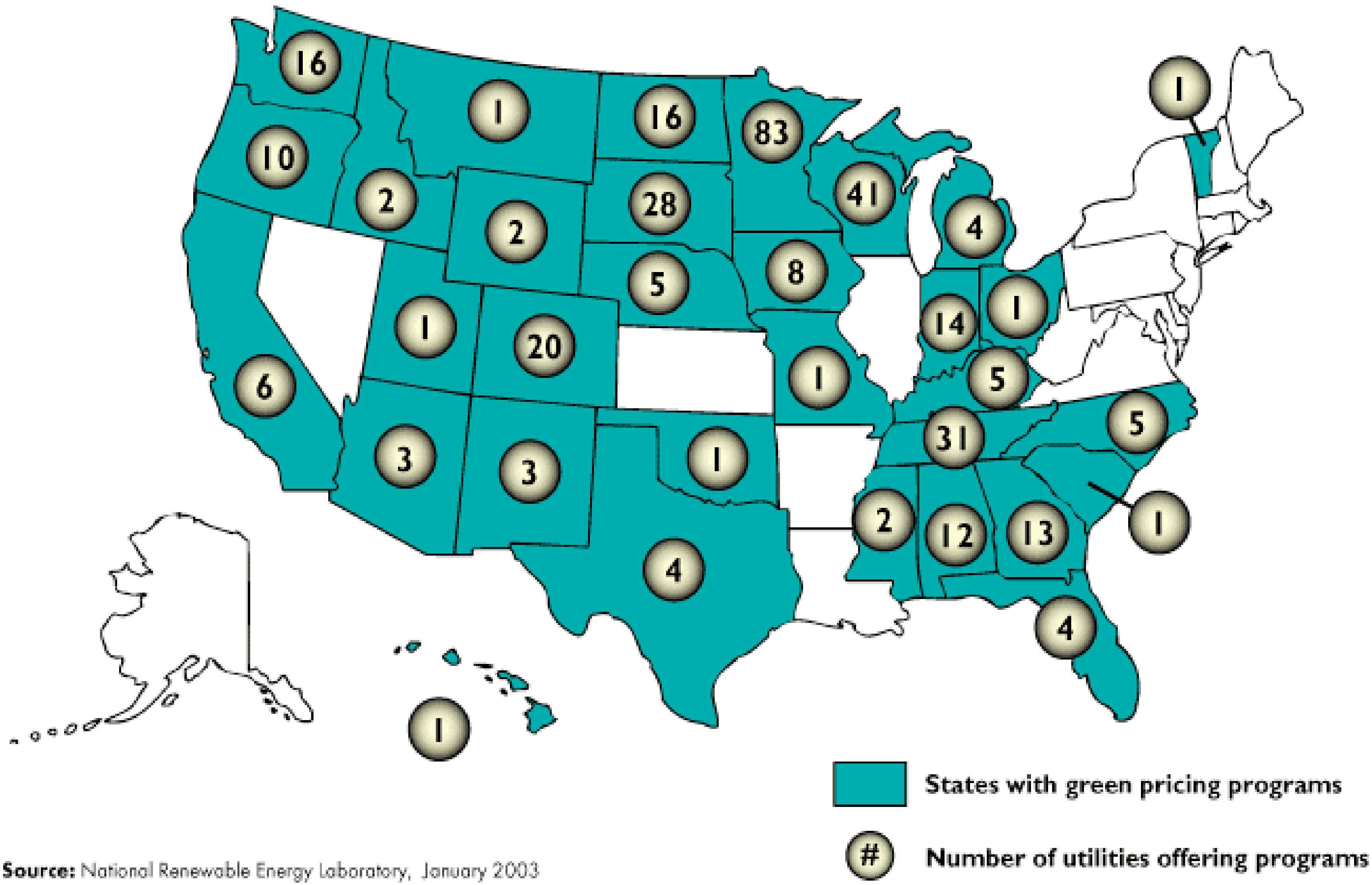
- Wind resource
- Financing and ownership structure
- Taxes and policy incentives
- Plant size: equipment, installation, and O&M economies of scale
- Turbine size, model, and tower height
- Green field or site expansion
- What is included: land, transmission, ancillary services

Wind Cost of Energy




Public Power Financing
Independent Power Producer Financing
COST OF ENERGY (cents/kWh)
8.0
7.0
6.0
5.0
4.0
3.0
2 MW
10 MW
50 MW
50 MW
Installed Wind Turbine Capacity
Without Federal incentives (current $)
With Federal incentives (current $)

Utility Green Pricing Activities

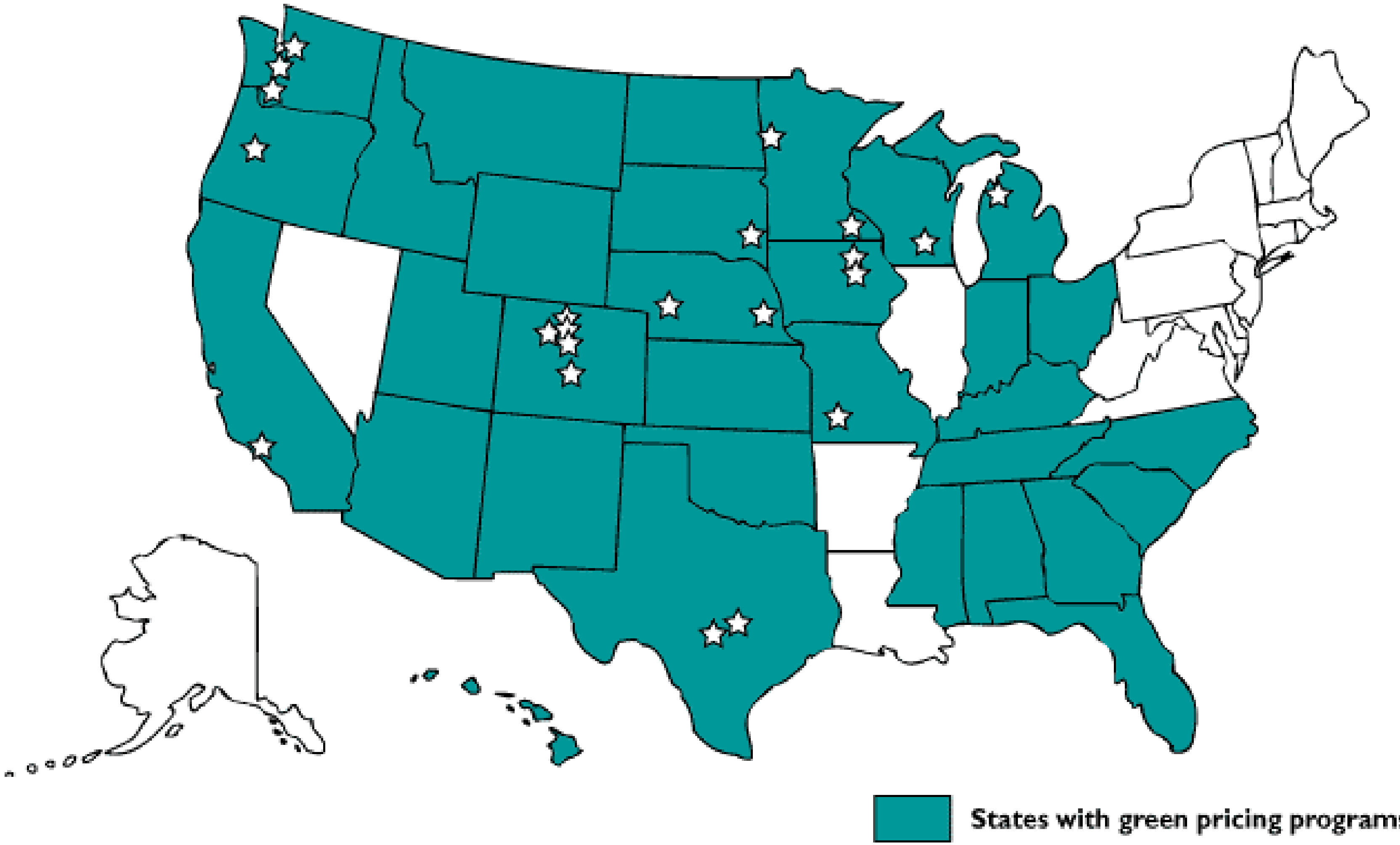


Source: National Renewable Energy Laboratory, January 2003

Economic Development Opportunities

- Land lease payments: 2%-3% of gross revenue $2,500-4000/MW/year
- Local property tax revenue: 100 MW = about $1 million/yr
- 1-2 jobs/MW during construction
- 2-5 permanent O&M jobs per 50-100 MW
- Local construction and service industry: concrete, towers usually done locally
- Investment as equity owners: production tax credit, accelerated depreciation
- Manufacturing and assembly plants expanding in U.S. (Micon in IL, LM Glasfiber in ND)

Municipal Wind-Based Green Pricing Activities



Source: National Renewable Energy Laboratory, July 2002

Wind-Powered Munis

- Austin Energy, TX
- Cedar Falls Utilities, IA
- City Public Service of San Antonio, TX
- City Utilities of Springfield, MO
- Clark Public Utilities, WA
- Colorado Springs Utilities, CO
- Estes Park Power & Light, CO
- Eugene Water & Electric Board, OR
- Fort Collins Utilities, CO
- Lincoln Electric System, NE
- Longmont Power & Communications, CO
- Los Angeles Dept. of Water & Power, CA
- City of Loveland Water & Light, CO
- Missouri River Energy Services, SD
- Moorhead Public Service, MN
- Municipal Energy Agency of Nebraska, NE
- Seattle City Light, WA
- Southern Minnesota Municipal Power Agency, MN
- Tacoma Power, WA
- Traverse City Light & Power, MI
- Waverly Light and Power, IA
- Wisconsin Public Power Inc., WI

Municipal Wind Power Pioneers

Hull Municipal Lighting Plant

- **Project Location: Hull, MA**
- **Capacity: 660 kW**
- **Expected Generation: 1.5 million kWh per year**

"After the old high school windmill went out of service, the Citizens for Alternative Renewable Energy approached us about installing a state-of-the art wind turbine. Once Hull Light got involved, the project became a reality within a relatively short time span."

-John Macleod, operations manager, Hull Municipal Light Plant

Municipal Wind Power Pioneers

Waverly Light and Power

- **Project Location: Northeastern Iowa**
- **Capacity: 2.4 MW**
- **Expected Generation: 5% of the utility's annual energy requirements**
- **Green Power Certificates: Iowa Energy Tags, 2500 kWh each**
- **Premium Cost: 2.0 cents/kWh ($50/2500 kWh)**

"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 gases by expanding and promoting wind energy and using programs like Iowa Energy Tags."

- Glenn Cannon, general manager, Waverly Light and Power

Municipal Wind Power Pioneers

Moorhead Public Service

- **Project Location: Moorhead, MN**
- **Capacity: 1.5 MW**
- **Expected Generation: 1% of Moorhead's electricity needs**
- **Green Pricing Program: Capture the Wind, 900 participants (7%)**
- **Premium Cost: 1.5 cents/kWh**

"Moorhead Public Service is a municipal utility, owned and governed by our customers. When our customers expressed interest in a utility wind program, we felt it was our job to find a way to deliver it."

- Christopher Reed, Moorhead Public Service, Moorhead, Minnesota

Municipal Wind Power Pioneers

Municipal Energy Agency of Nebraska (MEAN)

- **Project Location: Kimball, NE**
- **Capacity: 10.5 MW**
- **Expected Generation: 2% to 3% of MEAN's total energy requirements. More than 15 municipalities purchase power from the project**

"The governing bodies of our municipal members should be commended for making the commitment to provide their communities with an environmentally clean form of energy. The MEAN Wind Project at Kimball will be a great benefit to the environment and will be a cost-effective source of renewable energy for these communities and their ratepayers."

– Richard Duxbury, executive director, NMPP Energy

Municipal Wind Power Pioneers

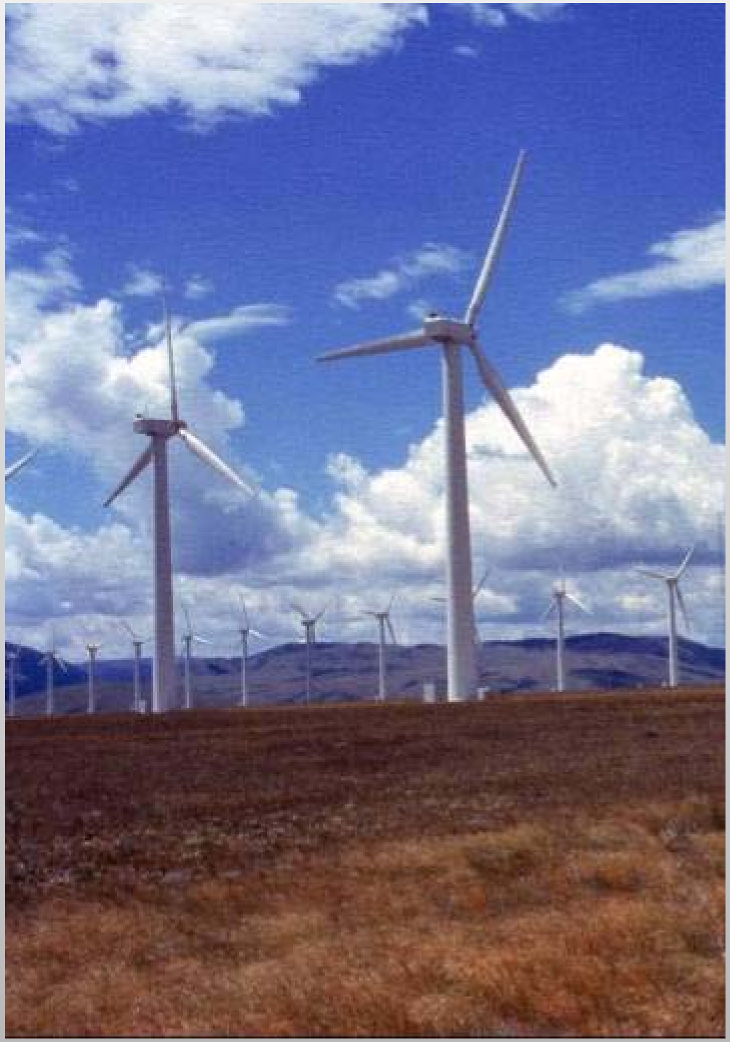
Austin Energy

- Project Location: Upton County, TX
- Capacity: 79 MW
- Green Pricing Program: Green Choice, 6500 participants (2%)
- Premium Cost: 1.1 cents/kWh, 10-year fixed rate

"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. We're learning how to handle the non-dispatchable and somewhat unpredictable nature of wind energy."

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

Municipal Wind Power Pioneers



Eugene Water and Electric Board

- **Project Location: Wyoming**
- **Capacity: Owns 8.8 MW of 41-MW project**
- **Green Pricing: EWEB Windpower, 2500 participants**
- **Premium Cost: 1.29 cents/kWh, fixed rate (premium has declined by about 60% over time)**

"The Eugene community, through EWEB's elected commissioners, holds a very high standard when it comes to environmental issues. Clearly, wind power is a significant component in creating a sustainable energy future. We pursue renewable energy resources, such as EWEB Windpower, and energy conservation in an effort to limit the impact of less environmentally friendly generation sources, both locally and globally."

- Randy Berggren, general manager, Eugene Water and Electric Board

Utility Partnerships

- PMA Green Tags
- Transmission Analysis
- Public Power Workshops
- Co-Op Outreach
- Green Pricing Support
- UWIG Brochure
- Wind-Hydro Analysis

Carpe Ventem

www.windpoweringamerica.gov

Wind Power and Rural Electric Utilities

Randy Udall, Community Office for Resource Efficiency

Our nation's 930 rural electric cooperative utilities serve 35 million people in 46 states. These rural utilities own and maintain 2.3 million miles of line and have assets worth $70 billion.

Rural electric cooperatives, or "co-ops," started in the 1930s because large investor-owned utilities were unwilling to serve rural areas. Farmers and ranchers joined together, forming co-ops to finance and build electric lines to serve their areas. The movement was a tremendous success, and today, rural co-ops provide power to 75% of America's land area.

A typical rural electric association (REA) has 2,000 to 20,000 members and a sprawling service territory. Most REAs do not generate their own electricity—they buy it from larger power wholesalers that are often organized on the cooperative business model. These generation and transmission utilities include Tri-State Generation and Transmission, which serves co-ops in Colorado, Wyoming, Nebraska, and New Mexico and Basin Electric, which serves cooperatives in the Dakotas and Montana.

REAs are owned by their members/customers and governed by an elected board of directors that is responsible for key policy decisions. Rural utilities work hard to keep their rates low, which is a challenge because of the low population densities in sprawling service territories.

A Natural Partnership

Wind power and rural electric cooperatives are natural partners. Technological advances have drastically reduced the cost of wind energy to 3-6 cents per kilowatt-hour (kWh), depending on location and wind resource, fostering a worldwide boom in wind power and creating exciting new economic opportunities. As wind technology continues to advance, wind energy may soon drop to 2.5 cents per kWh. Wind energy is poised to become a cornerstone of rural America's economic revitalization.

A glance at a wind resource map shows that the nation's best wind sites are in areas served by rural electric utilities. The Great Plains, which is dominated by co-ops, has been called the "Saudi Arabia of wind power." Three states—North Dakota, Texas, and Kansas—have enough wind to meet the nation's entire electricity needs. Other states with excellent wind resources include Oklahoma, Nebraska, Iowa, Minnesota, Colorado, New Mexico, Wyoming, Montana, South Dakota, North Dakota, Oregon, Idaho, and Washington.

The Co-op Challenge

Although wind power is an exciting new opportunity for farmers, ranchers, and rural electric cooperatives, most rural electric utilities have been initially reluctant to embrace wind energy. Reasons for this include:

- Some REAs in the western Great Plains have lost customers and experienced declining loads. Unlike urban investor-owned utilities, many REAs do not need new sources of power.
- REAs typically do not own generation, so they may be reluctant to own and operate wind turbines. Transmission constraints also limit the amount of wind power that can be shipped to distant markets.
- Most REAs get the bulk of their electricity from coal-fired power plants. Coal is abundant and inexpensive in the heartland. It is difficult for a small wind project to compete with a 20-year-old coal plant. Many rural cooperatives have an “avoided cost” of 2 cents per kWh—much less expensive than new wind projects.
- Many REAs have a conservative culture that tends to undervalue the environmental benefits of wind power.

Wind Power Pioneers

In the past few years, however, a number of rural co-ops have begun to purchase wind power. These pioneers include:

Great River Energy

Minnesota’s second largest utility, Great River generates power for 29 rural cooperatives. Great River plans to get 10% of its electricity from renewables by 2015. As a first step, the company is adding 21 megawatts (MW) of wind generation.

Holy Cross Energy

This REA serves 48,000 customers in western Colorado. It is buying 5 MW of wind power for the 2,200 families, 115 businesses, and 12 local governments that participate in Holy Cross’ landmark green-energy program.

East River Electric Power Cooperative

A distribution cooperative in South Dakota, East River recently installed two large wind turbines near Chamberlain. The capital to purchase the turbines was provided by the Rural Utility Service, a federal lending agency.

Basin Electric

Serving more than 100 co-ops, Basin Electric recently announced plans to build an 80-MW wind farm on the South Dakota/North Dakota border.

Utility Wind Development Group

A group of electric cooperatives is working to develop wind projects in Oregon, Washington, Idaho, Nevada, and Northern California. According to one participant, this cooperative business model is the best way to "milk the wind."

Kotzebue Electric Association

Kotzebue is installing wind turbines in remote Inuit communities to reduce the high cost of producing electricity using diesel fuel. As many as 70 Alaskan villages could benefit by using wind power.

Harvesting the Wind

Harnessing the "homegrown" energy that sweeps across America is an exciting new business opportunity for rural electric utilities. Wind Powering America's goals are to install more than 10,000 MW by 2010 and provide 5% of the nation's electricity with wind by 2020. If we achieve these goals, rural America will gain $60 billion in capital investment, $1.2 billion in new income for farmers and ranchers, 80,000 new jobs, and millions in taxes for city, county, and state coffers. With political support, these economic benefits are likely to drive the development of wind energy forward in rural electric service territories.

Against this backdrop, rural interest in wind power is exploding. The Rural Utility Service, a U.S. Department of Agriculture agency that lends low-interest money to co-ops, has begun to finance wind energy projects. Cooperatives are eligible for the federal Renewable Energy Production Incentive, or they can partner with private companies to take advantage of the wind Production Tax Credit. The growth of markets in "green tags" or "wind energy credits" will also benefit rural areas.

More Information

National Rural Electric Cooperative Association
4301 Wilson Boulevard
Arlington, Virginia 22203
703-907-5500
http://www.nreca.org.

Appendices

Wind Energy Information on the Web

Tom Gray, American Wind Energy Association

General Information

American Wind Energy Association (AWEA): http://www.awea.org/.

National Renewable Energy Laboratory (NREL) and National Wind Technology Center (NWTC): http://www.nrel.gov/wind.

U.S. Department of Energy Wind Powering America Initiative: http://www.eren.doe.gov/windpoweringamerica.

U.S. Department of Energy Energy Efficiency and Renewable Energy Network (EREN): http://www.eren.doe.gov/RE/wind.html.

National Wind Coordinating Committee: http://www.nationalwind.org/.

Utility Wind Interest Group (UWIG): http://www.uwig.org/.

Wind Resource Information

Wind Resource Atlas of the United States: http://rredc.nrel.gov/wind.

Wind in Illinois: http://www.eren.doe.gov/windpoweringamerica/where_is_wind_illinois.html.

Wind Power Maps (Northwestern U.S.): http://www.windpowermaps.org/default.asp.

National Climatic Data Center: http://www.ncdc.noaa.gov.

University Programs & Research Institutes

University of North Dakota/Energy and Environmental Research Center: http://www.eerc.und.nodak.edu.

Sandia National Laboratories: http://www.sandia.gov/wind.

U.S. Department of Agriculture/Agricultural Research Service (Bushland, Tex.): contact rnclark@cprl.ars.usda.gov.

International Wind Energy Associations

Australia: Australian Wind Energy Association (AusWEA): http://www.auswea.com.au/.

Canada: Canadian Wind Energy Association (CanWEA): http://www.canwea.ca/.

Denmark: Danish Wind Industry Association: http://www.windpower.dk/.

Europe: European Wind Energy Association (EWEA): http://www.ewea.org/.

Finland: Finnish Wind Power Association: http://www.tuulivoimayhdistys.fi/.

Germany: Bundesverband WindEnergie e.V. (BWE): http://www.wind-energie.de/.

India: Indian Wind Energy Association: http://www.indianwindpower.com/.

Ireland: Irish Wind Energy Association: http://www.iwea.com/.

New Zealand: New Zealand Wind Energy Association (NZWEA): http://www.windenergy.org.nz/.

South Africa: South African Wind Energy Association: http://sawea.www.icon.co.za/.

United Kingdom: British Wind Energy Association (BWEA): http://www.bwea.com/.

State Information

Listing of state and local sites: http://www.eren.doe.gov/RE/wind-state.html.

Your region and state's wind energy potential: http://www.nrel.gov/wind.

A useful listing of Web sites on energy issues in your state: http://www.serve.com/commonpurpose/yourstate.html.

Database of state incentives for renewable energy: http://www.dsireusa.org.

Your state's energy profile: http://www.eia.doe.gov.

Utility deregulation in your state: http://www.eia.doe.gov/cneaf/electricity/chg_str/regmap.html.

How much do your electricity purchases pollute in your state? http://www.edf.org/programs/energy/green_power/x_calculator.html.

Pollution in your state: http://www.scorecard.org.

Acid rain emissions data for power plants: http://www.epa.gov/airmarkets/arp.

Global warming in your state: http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html.

Information for Teachers and Kids

National Energy Education Development (NEED) Project: http://www.NEED.org.

PicoTurbine Renewable Energy Windmill and Solar Projects: http://www.picoturbine.com.

Landowner Issues

Windustry: http://www.windustry.com.

Sustainable Energy for Economic Development (SEED):

Northwest SEED: http://www.nwseed.org.

Minnesota SEED: http://www.me3.org/projects/seed.

Wind and Renewable Energy

Center for Renewable Energy and Sustainable Technology/Renewable Energy Policy Project (CREST/REPP):

CREST Web site: http://www.crest.org.

REPP Web site: http://www.repp.org.

Land and Water Fund of the Rockies: http://www.lawfund.org.

Minnesotans for an Energy-Efficient Economy (ME3): http://www.me3.org.

Renewable Northwest Project (RNP): http://www.rnp.org.

Texas Renewable Energy Industries Association (TREIA): http://www.treia.org.

Union of Concerned Scientists (UCS): http://www.ucsusa.org/.

Renewable Energy

REASN (new, comprehensive interactive Web site on renewable energy maintained by the National Renewable Energy Laboratory's Renewable Energy Analysis Studies Network): http://www.nrel.gov/reasn.

The Source for Renewable Energy (searchable directory of wind and renewable energy companies and products worldwide): http://energy.sourceguides.com/index.shtml.

Climate Change

Climate change links portal: http://www.climateark.org/links.

Green Power

Green Power Network (the most comprehensive site on green power in the U.S., maintained by the National Renewable Energy Laboratory for the U.S. Department of Energy): http://www.eren.doe.gov/greenpower.

Rating Organizations

Center for Resource Solutions/Green-E: http://www.green-e.org.

Environmental Resources Trust: http://www.ert.net/.

Power Scorecard: http://www.powerscorecard.org.

Regional Green Power Promotion

Clean Energy Challenge: http://www.rnp.org/htmls/greenbus.htm.

Interstate Renewable Energy Council: http://www.irecusa.org.

American Green Network http://www.americangreen.org.

Georgians for Clean Energy: http://www.cleanenergy.ws.

Montana Green Power: http://www.montanagreenpower.com.

Renew Wisconsin: http://www.renewwisconsin.org.

Southern Alliance for Clean Energy: http://www.tngreen.com/cleanenergy.

Environmental Advocacy/Energy

Environmental Defense: http://www.environmentaldefense.org/programs/Energy.

Natural Resources Defense Council: http://www.nrdc.org/air/energy/default.asp.

Clear the Air: (joint project of Clean Air Task Force, National Environmental Trust, U.S. PIRG Education Fund): http://www.cleartheair.org/.

Sustainable Energy Coalition: http://www.sustainableenergy.org.

Wind Energy Discussion Groups and Listserves

Renewable energy: http://groups.yahoo.com/group/renewable-energy.

Home wind energy systems: http://groups.yahoo.com/group/awea-wind-home.

International wind energy: http://groups.yahoo.com/group/intl-wind-network.

Wind-diesel hybrid systems technology: http://groups.yahoo.com/groups/wind-diesel.

Prepared Testimony before the Natural Resources Committee of the Nebraska State Legislature

Lori Bird, National Renewable Energy Laboratory

February 5, 2003

Introduction

My name is Lori Bird, and I am a Senior Energy Analyst at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL is a national laboratory operated for the U.S. Department of Energy (DOE), and is the nation's leading center for renewable energy research. At NREL, I specialize in the area of renewable energy policy and green power market analysis.

I appreciate the opportunity to be here this afternoon. Let me begin by stating that the National Renewable Energy Laboratory takes no position with respect to any legislation on these subjects now pending before the Nebraska Legislature. My testimony is meant to provide information only and will cover policies that address the consideration of environmental externalities in electric generation resource decisions and state policies requiring renewables in the generation mix.

Renewable Energy Values

Let me start by explaining why renewables are important. Renewables bring important values to our energy mix. The most important of these are economic and environmental benefits. Because renewable energy is derived primarily from natural sources that are continually replenished, greater use of renewable energy sources contributes to a cleaner and more sustainable energy system. For example, greater reliance on wind energy and other renewables avoids airborne emissions associated with fossil fuel combustion.

Development of the state's indigenous renewable energy sources can displace imported fuels, thereby reducing the outflow of state income required to pay for these fuels. Renewables development can also provide local benefits in terms of job creation and increased tax revenues.

Greater use of renewables can help lessen the risk of fossil fuel supply disruptions and price fluctuations. And some renewables-based technologies, such as wind and solar, can be deployed in a modular or distributed fashion with short lead times, which decreases risk in both the timing and the magnitude of new generation investments.

Impediments to Renewables

Despite the reduction in costs and technological improvements that are being realized with renewable energy, in Nebraska, there is little contribution being made from renewables, aside from hydropower, which represents about 6% of total supply. The recent addition of a 10.5-MW wind energy facility by the Municipal Energy Agency of Nebraska has increased total in-state wind energy capacity to 14 MW, but the contribution of wind power to the overall resource mix still remains small, at about 0.2% of total capacity. Coal generation accounts for just more than 60% of state electricity supply, and one-third comes from nuclear power.

There are two fundamental impediments to realizing greater use of renewables in the electric sector. Perhaps the most important of these is that renewables tend to be more costly than traditional fossil fuel generation. This is compounded by the fact that most renewables have disproportionately higher initial costs because with renewable technologies, we are substituting up-front investments in capital equipment to access these resources for fuel purchases that will occur over 30 years with fossil plants. Also, many of the "non-cost" values of renewables identified earlier are not reflected adequately in decisions about new energy development.

The Critical Role of State Policies

Renewable electric development in the 1980s was driven by state policies implementing the federal Public Utility Regulatory Policies Act. Under this act, states set the terms and conditions under which utilities were required to purchase power from non-utility generators using renewable energy as their primary fuel source.

Externalities Policies

During the early 1990s, states turned to more comprehensive planning concepts such as "least cost planning" and "integrated resource planning," which provided a broader framework for comparing both the direct and indirect costs and benefits of generation resource options. States and utilities alike began to look at externalities in addition to the direct comparative costs of different generation options. Externalities are costs or benefits to society not included in the price of a good. Externalities from electricity generation include air pollution, greenhouse gases, water use and water quality impacts, land use impacts, fuel price instability, economic development impacts, and energy security.

A variety of methods can be used to incorporate externalities in electric generation resource planning; these include qualitative consideration, weighting or ranking, percentage adders, and monetization (based on control costs or damages). Of these, monetization is the most complex and data intensive. Qualitative consideration of externalities has the advantage of simplicity and ease of implementation but suffers from subjectivity and a lack of transparency. Quantitative approaches are less subjective and are more easily replicated but are more complex and controversial, particularly with respect to methodology.[6]
As of 1995, public utility commissions in more than half of U.S. states considered environmental externalities in resource planning, most commonly through the integrated resource planning process. Of those, seven states—California, Massachusetts, Minnesota, Nevada, New York, Oregon, and Wisconsin—developed monetized externalities values.[7]

While the inclusion of externalities should lead to the most cost-effective resource selection for society as a whole, such policies can face implementation challenges. As mentioned earlier, the methods and uncertainty associated with determining quantified externality values can be controversial, and the authority of public utility commissions to use such values has been questioned. In Massachusetts, for example, the state's Supreme Court found the use of monetized externalities by the Massachusetts Department of Public Utilities was beyond the agency's statutory authority. Further, although consideration of externalities should help to level the playing field for renewables, it may or may not affect actual resource-planning decisions. A 1995 study by the DOE found that "the requirement to incorporate externalities in the resource planning process had negligible impacts on the planned resource mix of the utilities in each of the three states" examined in the study.[8]

With the advent of electric industry restructuring in the late 1990's, some states have moved away from integrated resource planning and the consideration of externalities. Many of these states have turned to other renewable energy policy mechanisms more appropriate for a less regulated market environment, such as systems benefits funds or renewable portfolio standards, which I will turn to next.

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[6] Fang, M. J. and P.S. Galen. *Issues and Methods in Incorporating Environmental Externalities into the Integrated Resource Planning Process*, National Renewable Energy Laboratory, NREL/TP-461-6684, November 1994.
[7] Source: EIA, *Electricity Generation and Environmental Externalities: Case Studies*, DOE/EIA-0598, September 1995.
[8] EIA, 1995.

Renewable Portfolio Standards

A renewable portfolio standard (RPS) establishes a minimum renewable energy requirement for the state's electricity mix. Under an RPS, every electricity supplier must provide and maintain a fixed percentage of its supply from renewables. Unlike other policies that simply encourage renewable energy development, an RPS will lead to the development of a predetermined amount of renewable energy by a specified date, if penalties or appropriate enforcement tools are established. Having a firm enforceable standard facilitates development by enabling developers to obtain power purchase contracts and financing for new renewable energy projects.

The least-cost renewable resources will be used to meet the standard, unless goals for particular renewable energy technologies are established. Arizona, for example, requires that solar energy be used to meet half of its RPS target. Other states, such as New Jersey, have grouped renewable technologies into separate tiers and set specific goals for each tier.

The renewables obligation can be made tradeable so that all electricity suppliers need not become renewable energy providers. This provides compliance flexibility. For example, utilities could contract with dedicated renewables developers to meet their renewables obligation. Such a trading scheme would enhance the value of renewable energy resources in the state and at the same time use market forces to minimize the costs of developing and maintaining the portfolio. The trading element of the portfolio standard is patterned after the sulfur dioxide (SO_2) trading program contained in the Clean Air Act Amendments of 1990.
Currently, 13 states have adopted RPS policies or similar renewable energy mandates, although implementation plans are still being developed in some states. The level of the portfolio standard varies from a low of 1% in Arizona to 30% in Maine. Although many states initially adopted RPS policies as part of electric industry restructuring, more recently, RPS policies have been created by states with regulated markets, such as Wisconsin, or states that have delayed or suspended restructuring activities, such as California, Nevada, and New Mexico.

Texas has perhaps the most successful RPS policy to date, as measured by the amount of renewable energy capacity brought online. The Texas RPS, which was established as part of the state's electricity restructuring law in 1999, requires the addition of 2,000 MW of new renewables by 2009. Compliance flexibility has been integrated by the development of a renewable energy credit-trading program, which is administered statewide. Thus, retail electricity providers can obtain their share of renewable energy either directly or by purchasing credits. The policy also contains strong enforcement mechanisms to ensure compliance.

Today, more than 1,100 MW of wind energy capacity has been installed, and landfill gas development has accelerated to meet the standard. Thus, more than half of the RPS goal has been met well ahead of schedule. And compliance has been achieved at relatively low cost. Renewable energy credits, which indicate the cost of compliance, have traded at about 0.5¢/kWh or less. In addition, investment in renewable energy facilities has provided significant rural economic development benefits, as much of the capacity has been installed in rural areas.

Local economic development benefits include job creation, landowner royalties, school tax revenues, and other county tax revenues. A recent report by the National Wind Coordinating Committee estimates the economic development benefits of one of the recently developed wind energy projects in Texas.[9] According to the report, the 30-MW Delaware Mountain wind project in Culbertson County, Texas, resulted in the creation of 26 construction jobs and 11 jobs for continued operation and maintenance of the wind facility. Landowner revenues have totaled about $60,000 annually, with an average landowner receiving $1,500 per turbine annually (although there are other projects in which the landowner payments have been higher). The project also generated $240,000 in school tax revenues and another $155,000 in other county taxes and payments in 2002. The Delaware Mountain project represents only 3% of wind capacity already installed to meet the RPS. Thus, the total economic development benefits achieved by the wind farm installations to date could be on the order of 35 times these estimates, if the local benefits of this project are representative of others.

Regarding the cost of implementing an RPS policy, the U.S. DOE's Energy Information Administration (EIA) recently issued a report analyzing the impacts of a federally mandated RPS proposed in Congressional legislation. According to EIA, a federal RPS requiring 10% renewables by 2020 is expected to have only a small impact on retail electricity prices compared with total electricity costs. Further, the report states that costs

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[9] National Wind Coordinating Committee, *Assessment of the Economic Development Impacts of Wind Power*. Prepared by Northwest Economic Associates, January 2003.

will be “mostly offset by lower gas prices that result from reduced gas use.”[10]

Concluding Remarks

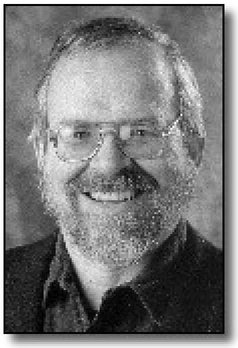
In summary, the costs of generation from renewable electric technologies have come down over the past two decades but not far enough to compete head to head with the current low market costs of fossil fuel generation. Thus, states that want to promote greater renewable energy development need to seek innovative policies to help overcome market barriers.

[10] Source: U.S. DOE, Energy Information Administration, *Impacts of a 10% Renewable Portfolio Standard* SR/OIAF/2002-03, February 2002.

[Published by SolarAccess.Com]

Utility Integration of Wind Power

by Tom Gray



Tom Gray

RE Insider - March 31, 2003

Wind power is a reality today. More than 2,000 MW of wind generation - enough to serve more than 600,000 average American homes - were installed in the United States in the past two years alone. With continued government encouragement to accelerate its development, this increasingly competitive source of energy can provide at least six percent of the nation's electricity by 2020, revitalizing farms and rural communities - without consuming any natural resource or emitting any pollution or greenhouse gases.

Perhaps because of its growing success, wind is increasingly becoming the target of critics within the traditional energy community.

While wind generates only a small fraction (about 0.3 percent) of U.S. electricity today, another way of looking at that number gives a different view: to generate the same amount of electricity using coal would require a train of coal cars more than 500 miles long, each year.

Perhaps because of its growing success, wind is increasingly becoming the target of critics within the traditional energy community. They are disturbed by the fact that the wind does not blow all of the time, making a wind plant's generation highly variable and thus quite different from other utility generating options.

As someone who has been actively promoting wind energy since the late 1970s - spending the bulk of that time with the American Wind Energy Association (AWEA), the wind industry's only national trade group - I've had a unique opportunity to follow the progress of the "case against wind," in all of its various forms, over time.

Many of the negative assertions that have been made about wind over the past two decades have had a grain of truth. Yet despite its modest drawbacks, the wind energy industry has continued to advance steadily, weathering a difficult policy environment, and now stands as the "poster child" of the energy crises of the 1970s.

This is not because thousands of people have been hoodwinked into ignoring the real facts about wind. It is because those facts are much more positive than critics suggest. Sometimes, common sense really is a helpful guide: wind energy is attractive because it is clean, and it is growing because its costs have declined steadily.

In this article, I would like to look at several common complaints about wind, and then dwell briefly on some little-recognized benefits of wind-generated electricity.

Complaint: The wind doesn't blow all the time, so it's unrealistic to count on it to supply all of our electricity needs.

Response:

· Why should we require of wind what we don't require of any other energy source? We don't expect coal, or nuclear, or hydro to do it all. Why should we expect that of wind? Why would we not opt instead for a mixed portfolio of all five renewable energy sources, taking advantage of their regional availability and their complementary characteristics?

· Simply because it is impractical to generate all electricity from wind, it does not follow that we should not make reasonable efforts to increase the amount of wind in the utility generating mix. Wind is far cleaner than the average of that mix and cheaper than most new alternatives, and is therefore desirable from a public policy point of view.

· The amount of wind in the U.S. generating mix, and in many regional portfolios, can be substantially increased with little or no operating difficulty. Wind today stands at roughly 0.6 percent of national generating capacity, and 0.3 percent of electricity supply. Grids in California and Texas today operate with roughly 10 times that level of wind energy without difficulty. Grids in Denmark, Germany, and Spain operate with roughly 100 times that level of wind energy and only now are beginning to think about "special" investments in order to allow further expansion of wind energy.

Complaint: Electric utilities need "dispatchable" power plants (plants that can be turned on and off as required) to respond to electricity demand.

Response:

· Critics often suggest that because of its variability, wind cannot serve a given, steady amount of consumer demand. But it's not that simple. In fact, electricity demand is a constantly moving target. The more accurate picture is one of a number of generating plants moving on and off-line throughout the day to meet that constantly shifting target. At any one time, only some 15 percent of the total generating capacity on-line is consciously "dispatched" to keep load and generation in balance. Obviously, a variable generating source fits into the latter picture much more readily. In fact, at relatively low "penetrations" (where wind is providing less than, say, 10-20 percent of the electricity on a system in any given hour), its variability is essentially lost within the larger, shifting variability of the system. The rule of thumb - admittedly rough - is that until wind provides 10 percent to 20 percent of the electricity on an annual average basis, it can be accommodated without significant added equipment on most transmission grids.

· When nuclear power was first introduced in large amounts to the U.S. utility system, a number of "special" investments and changes in operations procedures were required to accommodate it and the possibility it brought, of large, "lumpy" plants suddenly going out of service and imperiling system stability. Wind power is simply another new energy source, with different operating characteristics, that will require its own set of changes to be fully integrated.

Complaint: Because it is too costly, wind energy is being heavily subsidized.

Response:

· Wind is not too expensive for widespread commercial application - new wind plants can and do compete with new generating plants using other technologies. Today, most new generating plants constructed in the United States are fueled by natural gas. Yet, new wind plants are cheaper than new gas plants once the existing stores of natural gas (roughly seven years) are used up and new capital must be spent to discover more domestic natural gas or import it from areas of the world with a surplus.

· Utilities in Texas, required by state law to install 400 MW of new renewable generating capacity by January 1, 2003, instead installed more than 900 MW of wind alone a year early. Why? Because it cost less than they had anticipated and less than other alternatives they were considering.

· Federal subsidies for wind are dwarfed by those for competing sources. One recent study[1], for example, found that federal subsidies of all types for wind, solar, and nuclear over the past 50 years had totaled US$150 billion - and that nuclear received 95 percent of the total.

Complaint: Since a wind plant would generate only 30-40 percent of its total rated electric capacity over a given period of time, the capital and operating costs of a conventional plant for the other 60-70 percent of its operation should be included in wind's costs.

Response:
· Is this how the economics of, for example, a gas peaker plant that operates, on average, less than 10 percent of the time are calculated? No.

· The correct way to assess the cost of a wind plant is, first, to calculate its life-cycle levelized cost of energy (total kWh generated over the plant lifetime, divided by total costs, adjusted for inflation), and second, to add or subtract any additional utility system costs that are specifically required to modify the system to achieve the same reliability as would have existed but for the wind plant. The latter incremental costs will indeed slowly rise as more and more wind is added to a system, and that is as it should be.

· A real-world example of a high-wind utility system can be seen in western Denmark, where the utility ELTRA obtains more than 100 percent of its electricity from wind during some low-load hours of the year (the surplus is exported), and where wind constitutes more than 50 percent of required system capacity and non-dispatchable small combined-heat-and-power plants constitute another 30 percent. If the criticism were correct, such a system should be either inoperable (due to its lack of dispatchability), fantastically expensive, or both. Neither is the case. ELTRA is indeed planning to make changes to its system to improve its operations and to accommodate new offshore wind farms, but there is no indication that a wholesale shift away from wind is needed or desired.

Complaint: When the wind blows, other power plants must be throttled back in response. Such throttle-backs cost consumers and should be included as an extra cost of wind energy.

Response:
· In fact, the "throttle-backs" ALWAYS SAVE money. The plant that throttles back is, by definition, the highest-cost, least-efficient plant on the system at the time the wind picks up. The incremental wind energy, by definition, costs almost zero and avoids the expense of fuel consumption on these "marginal" plants.

· In addition, the criticism assumes that emissions reductions have no value. If in fact they do have value - in reduced human health and environmental cleanup costs - then the throttle-backs doubly BENEFIT us all. The plants that are throttled back to make room for the "free" incremental wind energy are almost always the dirtiest as well as the highest cost plants. When the average U.S. utility generating mix is used to generate as much electricity as a single 1 MW wind turbine, 10 tons of sulfur dioxide and 6 tons of nitrogen oxides are emitted each year, as well as 2,000 tons of carbon dioxide, the leading greenhouse gas.

· As indicated above, power plants must throttle back anyway, and shut down, and come on-line again, to meet fluctuating customer demand during the course of a normal day. The question is, what additional variability does a new wind plant contribute to that already-dynamic situation? Only that added variability - and any operations costs associated with it - can fairly be assessed against the wind plant.

These are some common complaints about wind. But this promising new energy source offers a series of benefits for utilities that are often unrecognized. For the benefit of policymakers, here is a brief check list to be considered [2]:

1. Wind's fuel cost is constant, providing added value as a hedge against sudden, unexpected increases in the cost of other fuels such as is currently occurring with natural gas.

2. Cost-competitive with traditional generation technologies.

3. No emissions to manage.

4. No flammable or hazardous fuels to manage.

5. No high-pressure steam to manage.

6. No water resources to manage.

7. Breeds new life into a power business that is otherwise matured (leading to new innovations, etc.).

8. Will require that the national transmission grid be improved, making power in general more reliable.

9. An upgraded transmission network (required for the wind industry) will allow the competitive wholesale market to work more effectively.

10. A new industry attracting a well-paid professional work force (engineers, skilled technicians, etc.).

11. Wind power offers new opportunities in rural areas, many of which are in economic decline.

12. The limited onsite operations support required by wind farms will not overtax the limited resources available in a rural setting.

13. Wind farms bring new opportunities for tourism to local rural communities.

14. Wind farms create a new tax base in rural areas.

15. Wind farms will create demand for new support organizations (more heavy lift cranes, more independent electricians, etc.).

16. An expanded U.S. wind industry will attract manufacturers that are currently overseas.

17. The wind industry will create new ways to look at grid power management that will open the door for other emerging technologies (electricity storage, etc.).

18. Wind power will create the demand for more education support systems ("wind smith" training programs, expanded engineering programs, etc.).

19. Wind farms will help to safeguard the nation's energy supply by increasing the number of dispersed generation stations (not an attractive target for terrorists).

20. The wind industry will lead to new alliances that will create greater understanding overall (alliances between environment groups and energy companies, etc.).

21. Successes with government wind policies will lead to similar policy innovations for other industries.

22. Wind plants improve the nation's energy security because they do not require imported fuel.

23. Wind plants improve the nation's energy security because they do not require a fuel transportation infrastructure.

24. No fuel waste residues to manage.

25. Wind plants are compatible with existing land uses (farming, ranching) in many rural areas.

26. No fuel resource depletion.

27. Wind farms are modular and can be installed as demand expands, reducing investment risk.

28. Wind farms are modular, reducing the probability of overall plant outages due to equipment failure.

29. Wind plants can be installed quickly if required in response to energy market conditions.

30. No fuel resource extraction (with attendant management issues and costs).

31. Adds diversity to generation portfolio, reducing business risk.

32. Wind farms can help preserve family farms by providing added income.

33. Where hydro is the dominant generation source, wind farms can help to extend hydro supplies in times of drought.

The bottom line? Wind energy's success in the marketplace, quite simply, reflects the attractiveness of the technology. On balance, it is the most attractive new energy source available to the utility industry today.

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References:

[1] Federal Energy Subsidies: Not All Technologies Are Created Equal, Marshall Goldberg, Renewable Energy Policy Project 2000. Available on the Web at http://www.repp.org/repp_pubs/articles/resRpt11/subsidies.pdf

[2] Many of the items in this list were originally suggested in 2002 by Steve Williams, a communications consultant formerly employed by American Electric Power.

About the Author:

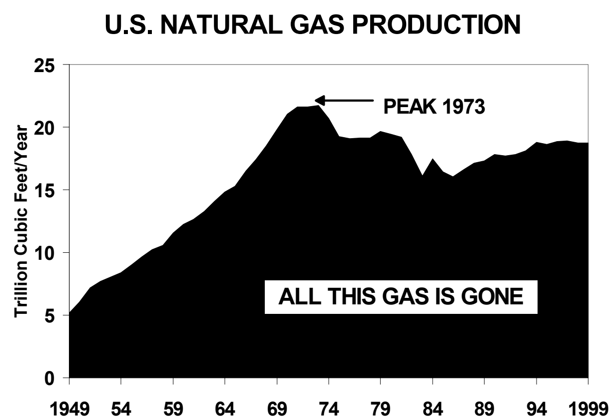
Tom Gray is Deputy Executive Director and Director of Communications for the American Wind Energy Association, which he joined in 1980 as manager of its then newly-developed wind energy standards program. He has served AWEA in a number of capacities over the years, including a nine-year stretch as Executive Director (1981-1989). He currently directs its communications operations (newsletters, news releases, publications, Web site, Internet chat lists, etc.) and is also responsible for following avian-wind power interaction issues. Gray has a B.A. from Haverford (Pa.) College and a J.D. from the Catholic University of America.

METHANE MADNESS:

A NATURAL GAS PRIMER

In 2000 the wellhead price of natural gas skyrocketed 400%. This was the sharpest energy price increase the nation had ever seen, outdoing even the oil spikes of the 1970s. The price hikes hit hard, hammering homeowners, business, and industry, contributing to rolling blackouts in California, weighing on the stock market, and unleashing a frenzy of new drilling. It was, one expert wrote, a "train wreck." So what comes next? The stakes are high; 70% of new homes are heated with natural gas, and the nation's electric utilities have wagered $100 billion that it is the "fuel of the new millennium." But what if they are wrong? Was this winter's crisis a passing anomaly, or the tip of an iceberg? This Natural Gas Primer examines the past, present, and future of our most versatile fuel.

SUPERIOR FUEL A transparent vapor, lighter than air, natural gas provides one-fourth the nation's energy. What we call gas is mostly methane, a wonderful molecule, ubiquitous and invisible, a polite servant which does many tasks well. Natural gas can heat your home, dry your clothes, grill your steak, run a car or a power plant. It is critical to agriculture, both as an energy source for food processing and as a key feedstock for fertilizer. About 45% of the nation's gas goes to industry—pulp and paper, cement and asphalt, chemicals, plastics, and petroleum refining. Gas is also the cleanest fossil fuel, producing about half as much carbon dioxide per unit of energy as coal. The nation has 320,000 gas wells. Per capita, we use about a dumpster's worth of gas each day. Each year, 280 million Americans use as much natural gas as 3 billion people in Europe and Asia.



The U.S. consumes 28% of the globe's natural gas. But unlike oil, which we import from 25 nations, 99% of our gas is produced in North America.

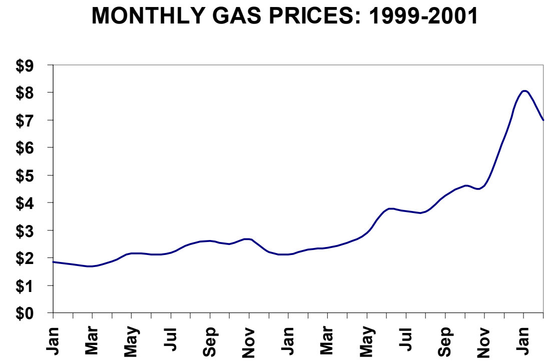
THE PAST AT A GLANCE Gas is the "youngest" of the fossil fuels; its use has risen 1000-fold since 1900. Domestic production was negligible before 1920, rose sharply after World War II, peaked in 1973, dipped during the "gas bubble" of the 1980s, and has flat-lined since. In the past 80 years, we've consumed about 950 trillion cubic feet. By some estimates, almost half the gas that will ever be produced in this country has already been burned. Easy come, easy go. Half gone, half left. Much of the "gone" was cheap and easy to produce. Much of what's left will be relatively more expensive and difficult to extract. The Big Easy is over.

PERILS OF CONVENTIONAL WISDOM The roots of the current energy crisis date back twenty years. The 1979 Oil Shock unleashed a frenzy of petroleum exploration and in the early 1980s, 80,000 wells were spudded each year. As it turned out, we didn't find that much oil, but we did find a lot of gas. A glut was born. Between 1983 and 1996, the real price of gas fell by 46%. Everyone grew complacent. Industry, government, and environmentalists alike proclaimed that gas would be cheap and superabundant far into the future. Whatever your politics, this was comforting news. Want to run millions of cars with natural gas? No problem. Order 180,000 Megawatts of gas-fired power plants to run the Information Economy? Makes perfect sense. As gas got cheaper and cheaper, frivolous uses joined essential ones. Snowmelt your driveway? Sure, why not? Install radiant tubing under golf course greens? Go for it. Little by little, wishful thinking morphed into conventional wisdom just in time to get blindsided by a perfect storm.

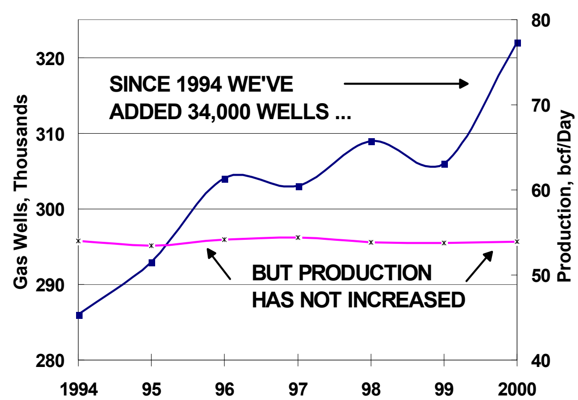
THE PERFECT STORM The metaphor was coined by Matt Simmons, an investment banker to the energy services industry who writes *World Oil* magazine's annual review of petroleum developments. Last year, as oil prices tripled and natural gas prices quadrupled, he advised the Bush campaign about our energy predicament. "An energy crisis is descending over the world," Simmons wrote. "The situation is grave. The world has not run out of oil and North America has not run out of natural gas. What we are short of is any way to grow our energy supply. North America has no excess natural gas capacity. What we do have is extremely aggressive decline rates, making it harder each year to keep current production from falling. A massive number of gas-fired power plants have been ordered. But the gas to run them is simply not there."

CINDERELLA STORY Gas and oil are both hydrocarbons, and they are often found together in the same reservoir. But in the early years of the Oil Era, gas was considered the ugly stepchild of the petroleum family, a safety hazard with no market value, and drillers cursed when they found it. In many parts of the world gas is still worthless, you literally can't give it away. Here in North America, gas sold for 30¢ per thousand cubic feet as recently as 1974. At that price, a winter's heat for a Denver home would cost thirty bucks. But those days are history.

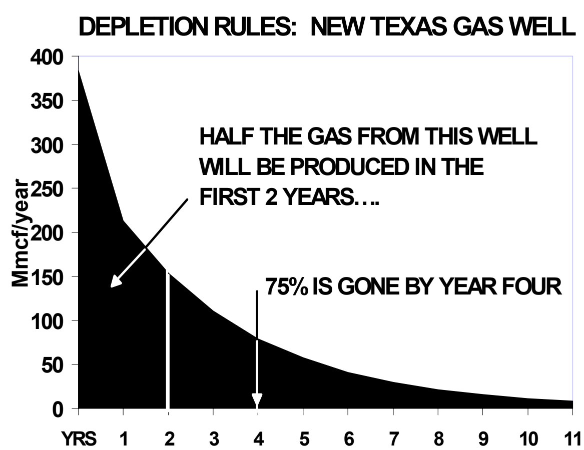
PROFANE BILLS In much of the U.S., the average home consumes its volume in methane each winter month. That much heat used to cost $80; this past winter, the cost nearly doubled. In December 2000, wholesale gas prices briefly touched $10 per thousand cubic-feet. In January 2001, prices averaged $8, and homeowners in Chicago, Boston, and Denver were hammered by $200 utility bills. But the shock to the national billfold didn't end there. Farmland Industries shut down some of its fertilizer plants because using pricey natural gas to make cheap fertilizer didn't make sense. Higher gas prices helped to torpedo California's ill-fated experiment with electricity deregulation, driving its two largest utilities to the brink of bankruptcy. By spring 2001, wellhead gas prices had receded from their dizzying heights, but were still twice what they were twelve months earlier.



DRILLING WITH CHARLIE One reason gas prices have skyrocketed is that there are only 1,350 drilling rigs searching for gas in North America. It takes 10 men to run a rig, they rotate 12-hour shifts night and day, one week on, one week off. Visiting a drilling site is to witness a remarkable display of American guts, ingenuity, and know-how. But, when you've only got 1,350 drill bits trying to meet the energy appetites of 280,000,000 Americans….is it any surprise the roughnecks are falling behind? During the last 15 years, while the rest of American prospered, the petroleum industry got hammered by wild swings in oil prices. More than 600,000 people were laid off, and as a result the oil patch lost a generation. Today the workforce is dominated by men in their fifties and kids in their teens. One driller named Charlie Brister, a thoughtful veteran who's been laid off four times, says this: "We live in the most energy intensive civilization the world has ever known, and yet the average American knows nothing about energy. But things may have to get a lot more critical before the public is ready to hear the truth. You piss everyone off if you try to explain to a typical Republican that 'There's not enough oil in the U.S. for us to be self sufficient' or tell a typical environmentalist that 'Wind and solar cannot meet 100% of our energy needs.'"

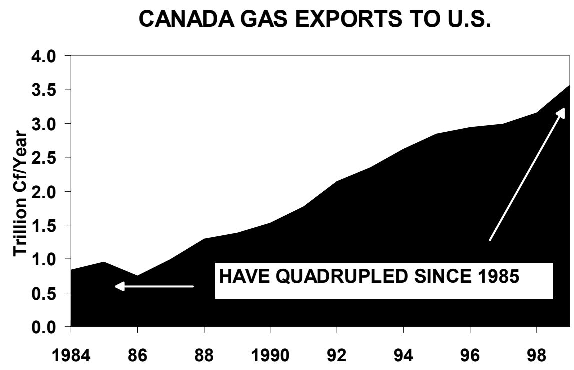


THE DEPLETION TREADMILL In June 1999, a disturbing article was published in *Oil & Gas Journal.* It described how Texas, which produces one-third of the nation's gas, must drill 6,400 new wells each year to keep its production from plummeting. That's 17 wells each *day.* As recently as 1998, the state only needed to drill 4,000 wells to keep annual production steady. The reason for the change? As drillers target ever-smaller pools, new wells experience steeper depletion rates. Indeed, a typical new well has an astounding first-year decline of 56%, which is another way of saying it begins dying soon after it is born. No one likes talking about depletion; it is the crazy aunt in the attic, the emperor without clothes, the wolf at the door. But the truth is that drillers in Texas are chained to a treadmill, and they must run faster and faster each year to keep up.



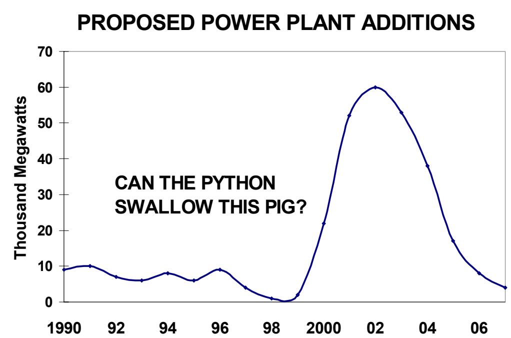
Only China and Canada drill more wells than Texas. But steep decline curves limit Texas' ability to expand gas production.

CANADA TO THE RESCUE? The United States is the world's largest importer of natural gas. But unlike oil, which we buy from 25 nations, 99% of our gas is produced here in North America. Domestic supplies meet 85% of our needs, the other 15% comes from Canada. Most Canadian gas is produced in Alberta, although significant new fields have been found near Nova Scotia. The Canadians have historically been eager to ship methane south, and today half the country's gas is exported to the States. But last winter, as Canadian gas bills doubled, a debate over this practice began. Canada is, after all, a frigid country and some Canadians are beginning to suggest capping the amount of gas sent to the "damn Yankees" so that future generations will have adequate supplies. Gas fields in western Canada are aging like those in Texas, and the Canadians are wrestling their own depletion demons, running their own treadmill. It takes 20 new wells per day, nearly 7,500 per year, to keep Alberta's production from declining.

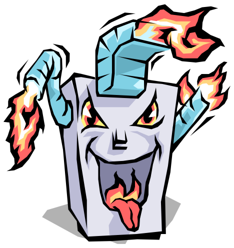


GAS ON ICE As traditional fields decline, Canadian and U.S. producers are dusting off plans to tap Arctic gas. There's lots of gas on Alaska's North Slope and at the Mackenzie River Delta. But to tap either field will require a feat of civil engineering, snaking 2,000 miles of steel pipe across tundra, permafrost, and muskeg, doable but not quick or cheap. Current estimates are that Arctic gas is at least 6 years and $8 billion away. And no miracle cure, either, since a five-foot pipe could provide only about 5% of our current consumption. Other supply options? The shallow Gulf of Mexico is in steep decline, but the deepwater Gulf is producing increasing amounts. Coalbed methane from Wyoming and Colorado is now meeting 7% of the nation's needs. New England has begun to receive gas from Nova Scotia. The industry wants to drill in areas that are now off-limits, including offshore California, the eastern Gulf of Mexico, and parts of the Rockies. It is also possible to import liquefied natural gas, chilled to minus 260° F, on special tankers. The U.S. now gets about 1% of its gas this way, a percentage that should increase to 3% by 2010.

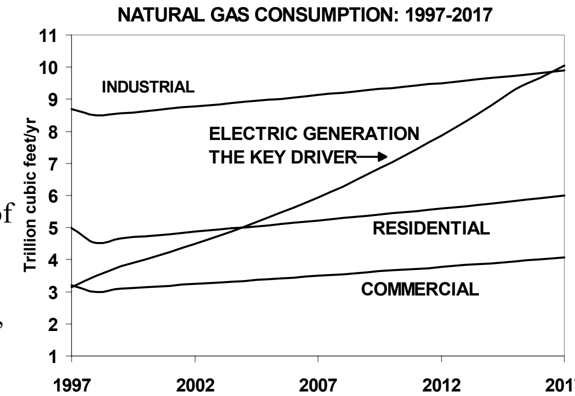
POWER SURGE The nation's long-standing glut of natural gas and electrical capacity, along with the world's spare oil capacity, vanished simultaneously in spring 2000. Prosperity and the Internet are partly responsible. Fueled by cheap energy, the U.S. economy grew 60% since 1986, an astounding 5% in 2000 alone. Gas consumption grew 36% over that period. But it was the demand for electricity—up 5.4% in 1998, an astounding rate for such a large economy— that has had the biggest impact on gas prices. To meet our growing electricity needs, utilities have ordered 180,000 Megawatts of gas-fired power plants to be installed by 2005. It was a logical thing to do: gas is the cheapest, cleanest way to convert fossil fuel to electricity. But if ordering one gas turbine makes perfect sense, ordering 1,000 is a recipe for disaster. No one in the utility industry asked the key question: can we produce enough gas to run all those plants? Many experts think the answer is no.



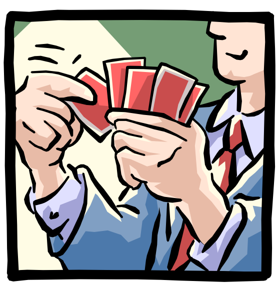
PIPELINES & CAVES During the summer, gas is pumped into underground caverns for use the next winter. This schedule is now being crimped by Sunbelt air conditioners, whose demand for gas-fired electricity is soaring. Gas used to keep us warm; now we ask it to keep us cool, too. Since the storage system was never sized for the A/C load, we've depleted our storage cushion. In March 2001, gas-in-storage reached its lowest level in history. Pipelines are another critical part of the gas puzzle. Without a pipeline, natural gas is worthless, a constraint first recognized by the Chinese. They were drilling for gas in 1000 A.D.—but their pipeline materials were limited to bamboo. American pipelines today could stretch to the Moon. Most date to post-World II, when Gulf Coast supplies were tied to markets in the Midwest and New England. Since pipelines are prone to corrosion, beer keg-sized diagnostic tools called "pigs" are pushed through the lines to search for weak spots, not always in time. In August, 2000, a pipeline exploded in New Mexico, killing 10 people, and crimping gas deliveries to California. Many aging pipelines need to be rebuilt, replaced, or expanded to deliver more gas to urban areas, where the new fleet of gas-fired power plants will be moored. In December 2000, gas delivered to L.A. briefly fetched $69, equivalent to $400 for a barrel of oil.



A WICKED HANGOVER In hindsight, the 1990s were the Big Bonfire, an unprecedented energy binge. As natural gas and gasoline prices shrunk, new houses and cars grew gargantuan. Soccer moms bought SUVs and Americans consumed their body weight in natural gas and oil every five days. Happy Hour is now over, and we are nursing a wicked hangover. The road ahead is strewn with energy potholes and related economic hazards. For decades natural gas has been our most versatile fuel and obedient servant. Versatility is a virtue, but it is also a curse for it allows everyone to make methane plans without "checking the gas tank." According to the Energy Information Administration, by 2005 we may need 20% more natural gas than we use today; by 2015, 50% more. But U.S. production has flat-lined for fifteen years, and Canada is treading water, too. So where's the new gas going to come from?



TRILLION DOLLAR GAMBLE With no debate, and little consideration of the long-range implications, the nation has embarked on a "dash for gas." This chart shows how future gas prices will be driven by skyrocketing demand for gas-fired electricity. To meet the electricity sector's gluttonous appetite—forecast to triple by 2015—we will need to build a pipeline to Alaska, double the number of drilling rigs, and open large swaths of federal land now off-limits to drilling. But even that may not be enough. In truth, the dash for gas may be the ultimate pipe dream, a dangerous delusion, a risky chimera, an ill-considered "vision in search of reality." If it turns out that we can't find sufficient gas to run hundreds of new powerplants, then what? Pick from this list: build new coal or nuclear plants; get serious about renewables, particularly wind power, now cheaper than gas; or invest real money in energy efficiency. Coal is our most abundant fossil fuel, but it also carries the specter of climate change; no nuclear plants have been ordered in 22 years; renewables are increasingly cost-effective but intermittent. Efficiency is a proven winner, but it's not a "free lunch." All solutions require time and capital. During the interim, we may soon hit an "energy ceiling," beyond which consumption can not grow.



HOLD 'EM OR FOLD 'EM President Bush has been dealt a tough hand. Indeed, he has inherited the most severe and complicated energy challenge the nation has ever faced. The average American family will spend more than $3,000 on electricity, oil, and natural gas this year. The economy is going south. Wall Street is struggling. Blackouts threaten to become a way of life, and not solely on the Left Coast. Two-thirds of the nation's oil and almost half the nation's natural gas have been burned. The world is almost out of spare oil production capacity. The President's instincts are to find more energy wherever he can. He wants to play the "ANWR card," drill in the Arctic National Wildlife Refuge, which would have no effect on the nation's energy posture for at least five years. But if events have conspired against Bush, they have also created an historic opening. The former oilman has a tremendous opportunity, perhaps even an obligation, to do what no President has ever done: level with the American people about our energy challenges and, as important, our efficiency opportunities. Just as the fervent anti-communist, Richard Nixon, was the only American politician who dared make peace with Communist China, Bush's background enables him to speak truth to power. This fireside chat is long overdue. "As a former oilman, I'd like to believe that we can drill our way out of the current crisis," the President might say. "But our oil and gas fields are aging, and no one can turn back the clock. Any attempt to solve the nation's energy problems by increasing energy supplies without reducing the growth in energy demand is doomed to failure. Yes, we need to drill more wells and tap new supplies, but we also must become much more productive in our use of energy. Indeed, our prosperity depends on it. Tonight I am proposing an eight point, bipartisan plan to make America the most energy efficient country on Earth…" Farfetched? Perhaps. But even a great nation can deny reality only so long. If Bush doesn't ante up, his successor will.

MORE INFORMATION? This pamphlet is designed to provide a quick introduction to our natural gas predicament. If you need additional information, we've compiled our favorite sources, articles, and web sites in a Natural Gas Resource Summary. View it at www.altenergy.org/core or request a hard copy at core@aspeninfo.com .

THE AUTHORS This Natural Gas Primer is published by the Community Office for Resource Efficiency. It was written by Randy Udall, CORE's Director, with the able assistance of Steve Andrews, a Denver energy analyst. To contact the authors: rudall@aol.com, sbandrews@worldnet.att.net. Or write CORE, Box 9707, Aspen, CO 81612.

Renewable Portfolio Standards and Environmental Externality Policies

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Nebraska State Legislature
February 5, 2003
Lincoln, Nebraska

Renewable Energy Benefits

- Clean energy production
  - Air quality benefits
  - Reduced greenhouse gas emissions
- Fixed, predictable costs
- Use of local or in-state resources
- Local economic benefits
- Waste reduction
- May help meet peak demand

Incorporating Externalities in Electric Generation Resource Decisions

- An externality is a cost or benefit to society not included in the price of a good
- Externalities from electricity generation include:
  - air pollution, greenhouse gases, water use/water quality, land use, energy security, etc.
- Methods for incorporating externalities in electric generation resource planning:
  - qualitative consideration, weighting or ranking, monetization (based on control costs or damages), percentage adders

State Externalities Policies

- As of 1995, utility commissions in more than half of U.S. states considered environmental externalities in resource planning
- 7 states developed monetized externalities values (CA, MA, MN, NV, NY, OR, WI)
- With restructuring, some states have moved away from Integrated Resource Planning and consideration of externalities

Source: EIA, Electricity Generation and Environmental Externalities: Case Studies, September 1995.

Sample State Externalities Values

Sample Monetized Environmental Externalities Adders cents/kWh, $1992					
	California	Massachusetts	Nevada	New York	Wisconsin
Coal – pulverized	2.2	4.0	4.0	0.6	1.7
Natural Gas – CC	0.7	1.5	1.4	0.1	0.7
Natural Gas – CT	1.1	2.4	2.4	0.2	1.2
Wood – steam	1.9	5.2/0.9	4.8/0.7	0.3/0.1	2.7/0.1
Landfill Methane	1.7	3.2/-2.8	3.0/-2.9	0.4	1.0/-2.7

Source: Swezey, Porter, and Feher (1994) National Renewable Energy Lab

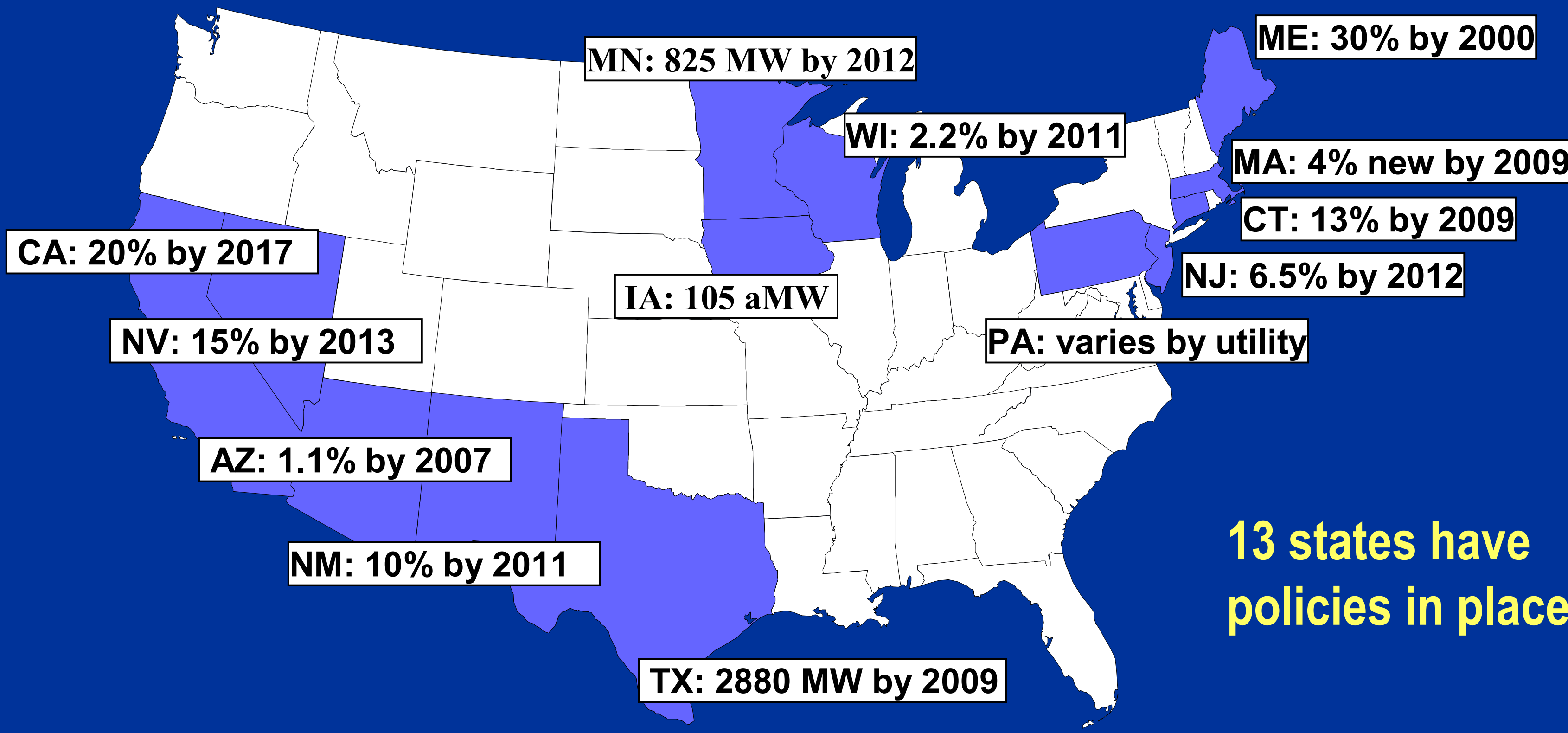
Externalities Policies: Characteristics and Issues

- Societal impacts and benefits can be taken into account during the resource planning phase
- Inclusion of externalities can lead to most cost-effective resource selection for society
- Determination of quantified values can be controversial (methods, uncertainty, etc.)
  – Massachusetts Supreme Court found that the MA Commission's use of monetized externalities was beyond its statutory authority
- Resource plans may or may not be affected

Renewable Portfolio Standard (RPS)

- RPS requires a minimum percentage of electricity to be generated from renewables
- Characteristics:
  - Uses market forces to promote development of least-cost renewable resources
  - Determines amount of renewables to be supplied
  - Can be targeted to support specific resources (e.g., Arizona policy encourages solar)
  - Can help renewable energy suppliers obtain power purchase contracts and financing
  - Credit trading provides compliance flexibility

Renewables Purchase Obligations



13 states have policies in place

Sources: Lawrence Berkeley National Laboratory and National Renewable Energy Laboratory

Recent Experience: Texas RPS

- Texas RPS policy design
  - Target of 2,000 MW of new renewables by 2009
  - Predictable standard with compliance flexibility
  - REC tradability with statewide administrator
  - Strong enforcement mechanisms
- Outcomes
  - More than 1,000 MW of wind installed to date
  - Much of capacity installed in rural areas
  - Landfill gas development accelerated
  - REC price ~ 0.5 cents/kWh or less

Economic Development Impacts of Wind Energy Development in Texas

- 30 MW Delaware Mountain wind project in Culbertson County, installed in 1999
  - Project represents 3% of wind capacity installed to date to meet the RPS
  - 26 jobs created for construction, 11 jobs created for operation and maintenance
  - Landowner revenues total $60,000 annually (average of $1,500 per turbine annually)
  - $240,000 annually in school tax revenues
  - Plus $155,000 annually in other taxes and payments

Source: National Wind Coordinating Committee, Assessment of the Economic Development Impacts of Wind Power, January 2003

Analysis of RPS Costs

- Recent U.S. DOE analysis of federal RPS requiring 10% renewables by 2020 found:
  - "Retail electricity price impacts are expected to be small" compared with total electricity costs
  - Costs will be "mostly offset by lower gas prices that result from reduced gas use"

Source: U.S. DOE, Energy Information Administration, "Impacts of a 10% Renewable Portfolio Standard" SR/OIAF/2002-03, February 2002.

IEEE 1547
Interconnection Standard Update

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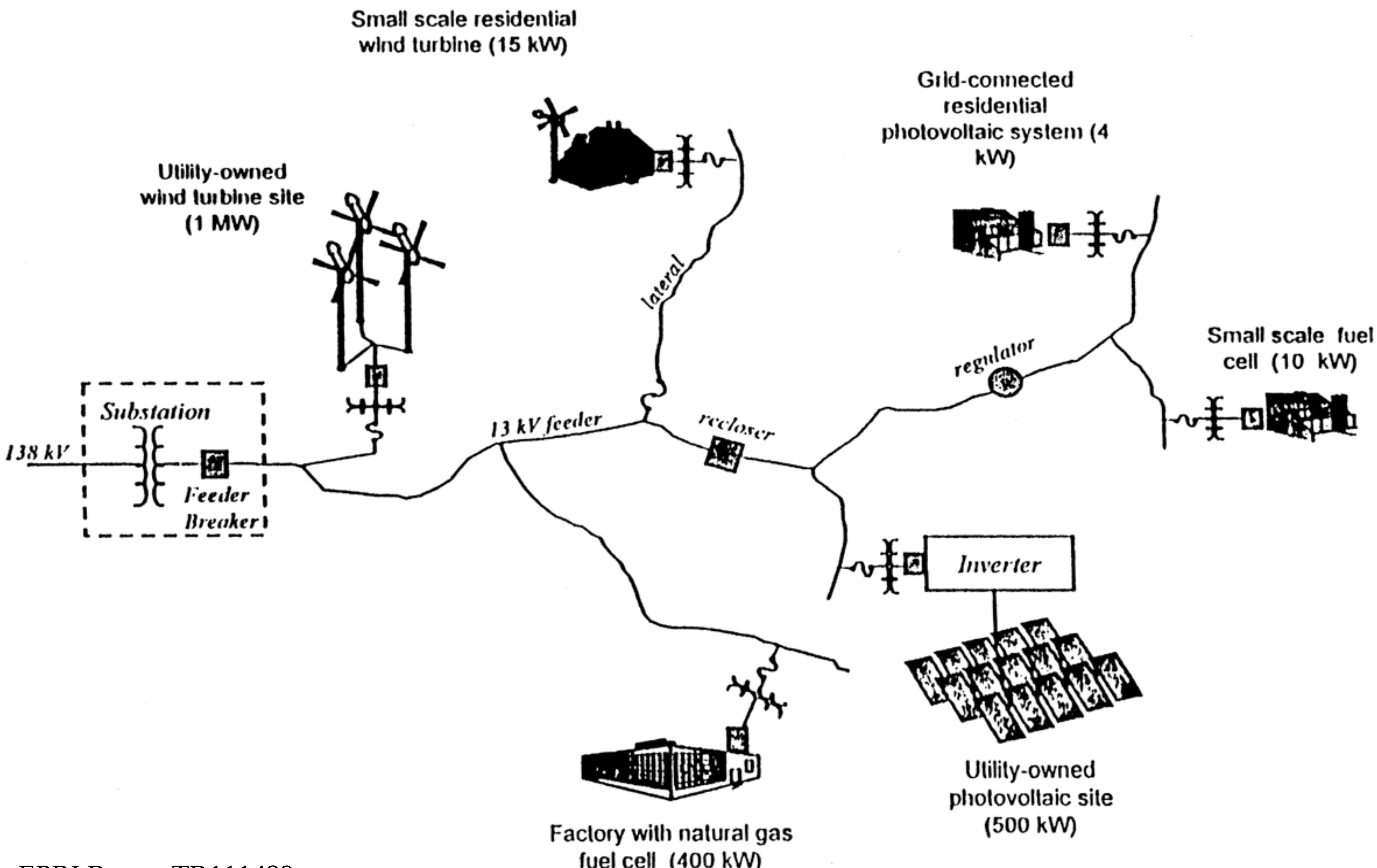
Utility Grid of the Future?



Source: EPRI Report TR111489

Electric Power Systems Not Designed for Distributed Generation

- Utility Concerns:
  - EPSs designed for one-way operation
  - Safety and grid stability are dominant concerns
  - Distrust of customer-supplied protective relays
- Customer/Manufacturer Concerns:
  - Utility interconnection costs can be a "deal breaker" for smaller projects
  - Interconnection requirements are far from standard
  - Interconnection requirements may be hard to understand, or appear unreasonable

1547 Development Overview

- Industry groups began pushing for interconnection standard in late ‘90s
- IEEE SCC21 Working Group began work on a consensus standard in 1998
- Nearly 5 years, 10 drafts, 2 ballots, 352 working group “members”
- Successful Working Group ballot, Feb. 03
- To the IEEE Standards Boards June 03
- Anticipated publication summer 03

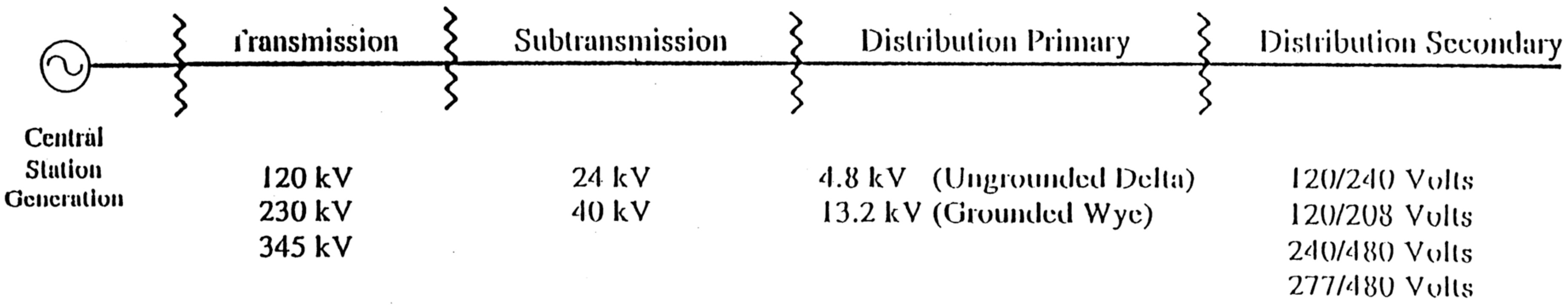
IEEE 1547

Title: Standard for Interconnecting Distributed Resources with Electric Power Systems

Purpose: Provide a uniform standard for interconnection of distributed resources with electric power systems and requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection

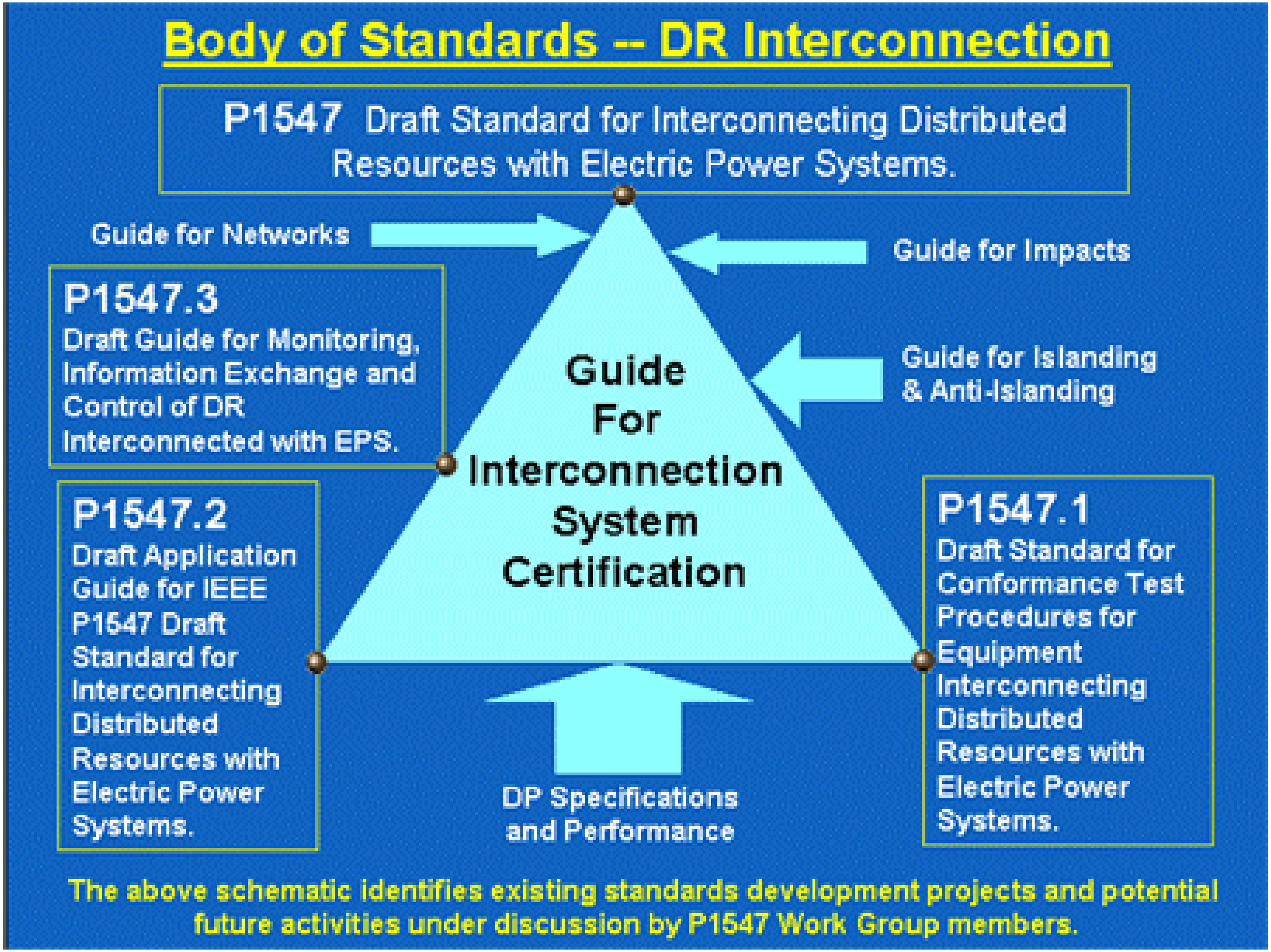
Limitations: Distribution-connected generation $\leq$ 10 MVA

Transmission and Distribution System Voltages



Wind Farm
Interconnections

Distributed Generation
Interconnections
per IEEE 1547


Body of Standards -- DR Interconnection
P1547 Draft Standard for Interconnecting Distributed Resources with Electric Power Systems.
Guide for Networks
Guide for Impacts
P1547.3
Draft Guide for Monitoring, Information Exchange and Control of DR Interconnected with EPS.
Guide For Interconnection System Certification
Guide for Islanding & Anti-Islanding
P1547.2
Draft Application Guide for IEEE P1547 Draft Standard for Interconnecting Distributed Resources with Electric Power Systems.
P1547.1
Draft Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.
DP Specifications and Performance
The above schematic identifies existing standards development projects and potential future activities under discussion by P1547 Work Group members.

Impacts for Wind Power

For Distribution-Connected Wind Turbines…

- Anti-islanding protection functions
- Testing of discrete interconnection functions
  - Production testing
  - Commissioning testing
  - Periodic field testing
- Integration of protective relays into the turbine controller?
- Small turbines with grid-connected inverters will see minimal impact (IEEE 929 compliant)

1547 Implementation

A legal authority must invoke the standard:

- In most cases… state PUCs
- Some group must initiate the action: utility(s), industry, or the PUC itself
- FERC is issuing interconnection rules which may influence state PUCs
- Regional ISOs may invoke 1547 via contractual authority

Wrap Up

- IEEE approval and publication of 1547 is anticipated during 2003
- Widely expected to become the basis for interconnection of distributed generators
- Manufacturers are already gearing up with 1547-compliant products
- Supporting standards are in development (test protocols) by IEEE and UL

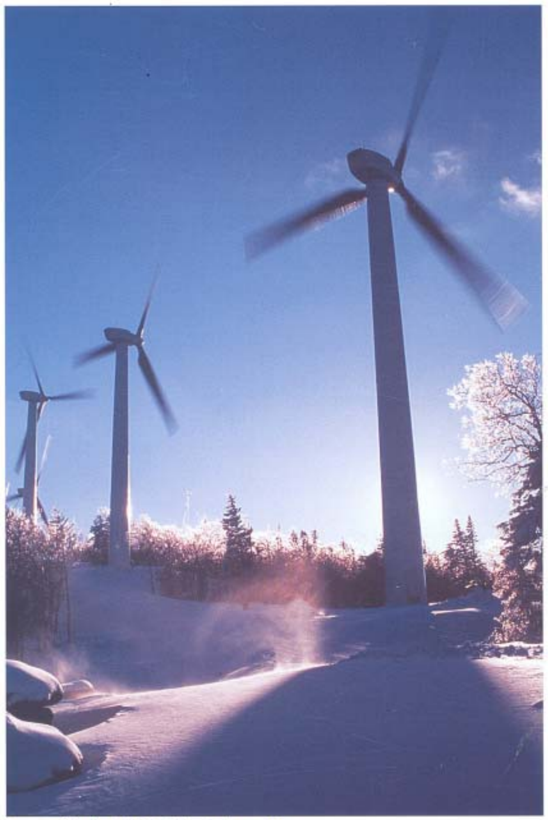
Environmental Issues Sometimes Associated with Wind Turbines

- Noise impacts
- Visual/aesthetics
- Biological, esp bird/bat impacts

NWCC Permitting Handbook

Permitting of Wind Energy Facilities

A HANDBOOK

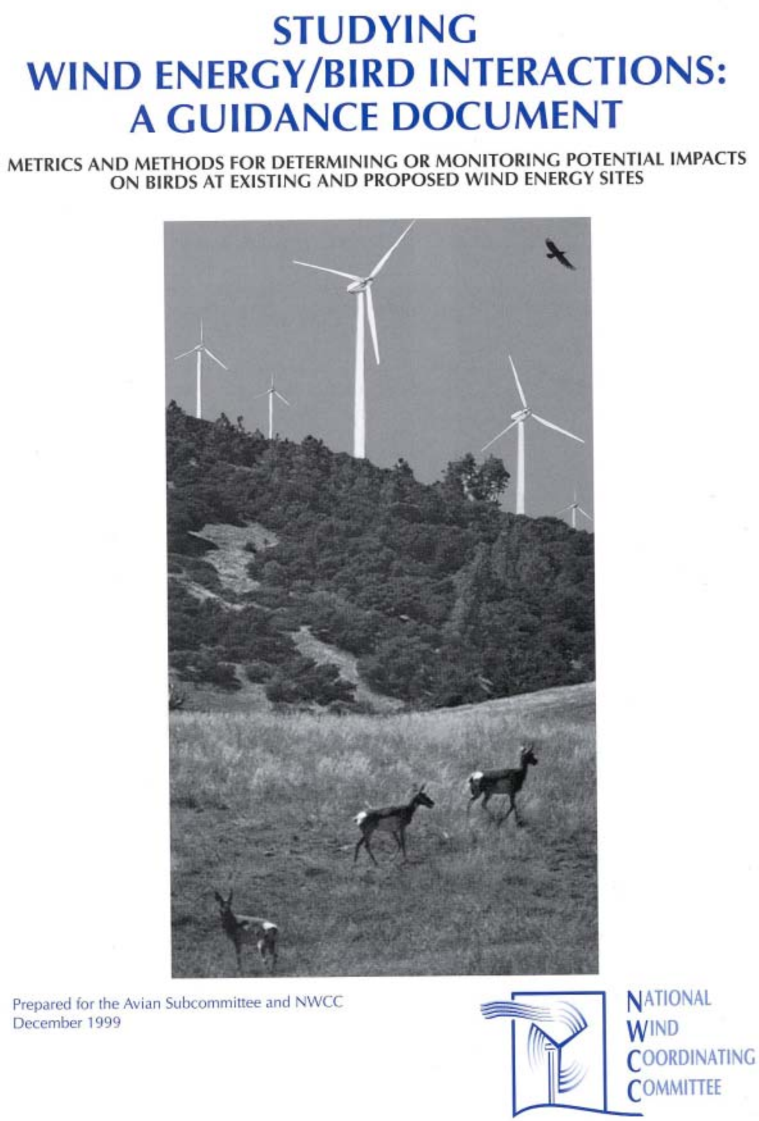


Prepared by the NWCC Siting Subcommittee
Reprinted August 1999

NATIONAL WIND COORDINATING COMMITTEE

Permitting decisions should assure necessary environmental protection and respond to public needs. This NWCC document provides information on various permitting issues which should be addressed. Revised August 2002.

NWCC Avian Guidance Document



Assessing the suitability of a proposed wind farm site with regard to avian concerns is an important component of overall site evaluation. This NWCC document provides guidelines for conducting avian assessments.

Potential Avian Impacts

- The potential impact of wind turbines on birds, including resident, breeding, and migratory species, has frequently been a concern at both proposed and existing wind power sites. The concern is driven by two primary factors: 1) possible litigation over the killing of even one bird if the species is protected by the Migratory Bird Treaty Act and the Endangered Species Act, and 2) the effect of avian mortality on bird populations.

Avian Impacts with Wind Turbines

- Data suggest the most significant avian wind-turbine interaction problem in the U.S. is in the Altamont Pass WRA, CA.

- There is no reason that avian issues should be a concern for future wind farm development; any potential problem should be identified and dealt with before micrositing occurs.

Informed Micrositing is Critical

A Major Conclusion

Facilities developed following the NWCC guidelines have not experienced significant avian impact issues.

Numerous factors may affect avian/wind turbine interactions

- Topography
- Weather
- Habitat
- Habitat fragmentation
- Habitat loss/urban encroachment
- Species abundance, distribution, and behavior
- Turbine location