Chapter 11
Wind Energy

Introduction

Wind energy is among the world's fastest-growing sources of energy. During the last decade, wind energy growth rates worldwide averaged about 30 percent annually.[1] In the last three years, the U.S. and Texas wind energy markets also have experienced a rapid expansion of capacity. In 2007, for example, U.S. wind power capacity grew by 43 percent, while Texas' rose by 57 percent.[2]

This growth has been driven by a variety of factors including government subsidies and tax incentives, improved technology, higher fossil fuel prices and investor concerns about potential federal action to reduce carbon emissions, which could make electricity from fossil fuels more expensive.[3]

Wind power is an abundant, widely distributed energy resource that has zero fuel cost, zero emissions and zero water use. Wind's challenges are largely related to its variable nature — wind speed and direction can change by the season, day, hour and minute. For electricity grid operators the variability of wind — sometimes too much wind is blowing and at others too little — makes it difficult to integrate wind into a grid that was not designed for fluctuations. Moreover, surplus wind power cannot be stored, given current technology.

Many Texas landowners have willingly leased their lands to wind developers, but others oppose the industry. The siting of wind turbines can be problematic, due to opposition to their appearance, noise and potential hazard to wildlife. Some landowners complain that without a permitting process for wind projects, they have no way to protect their property rights.

Transmission is another significant hurdle, since the best sites for wind energy development often are far away from urban centers and the wire networks that provide them with power. Some landowners object to transmission lines traversing their ranches and farms, claiming they will lower their property values. Other critics say that wind energy, like other forms of alternative energy, is not really economically viable without substantial government subsidies and incentives.

Still, wind power can provide economic value to some property owners. Property owners leasing land for wind turbine development receive a steady income (although landowners with transmission towers and lines passing through their land receive only a one-time payment). And wind projects, like other energy projects, create construction and operation jobs and expand the local property tax base.

History

For centuries, people have used the wind to sail ships, grind grains, run small sawmills and pump water from wells. Today, however, wind power increasingly is used to generate electricity.

Rural areas used small windmills to produce electricity in the early years of the twentieth century. The widespread electrification of rural areas in the 1930s led to a decline in the use of windmills for this purpose. In the 1970s, however, an oil shortage led to renewed interest in renewable energy sources, including wind energy.[4] Lower fossil fuel prices during much of the late 1980s and 1990s made wind energy less competitive and slowed its growth.

Wind power came back strongly in 1999, spurred by factors such as government incentives, growing environmental concerns, improved wind turbine technology, declining wind energy costs, and energy security concerns. Among the most significant factors behind the growth of utility-scale wind energy is the federal production tax credit, currently 2 cents per kilowatt-hour (kWh).[5] More recently, higher fossil fuel costs and the expectation of future carbon regulation have also contributed to the growth of wind energy.

Texas' installed wind capacity rose from 180 megawatts (MW) in 1999 to 2,739 megawatts in

In the last three years, the U.S. and Texas wind energy markets have experienced a rapid expansion of capacity.

2006, an average annual increase of 48 percent (**Exhibit 11-1**). In 2006, Texas surpassed California to lead the nation in wind-generating capacity and in that year accounted for almost a third of new installed wind capacity in the U.S. Texas now has the world's largest onshore wind farm in the Sweetwater area.

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By the end of 2007, U.S. installed wind capacity had grown to 16,596 MW, enough to power about 5 million homes based on their average household consumption in 2006. In 2007, Texas had installed wind capacity of 4,296 MW, enough to power about 1 million homes, based on average electric use in 2006.[6] It should be noted that Texas homes tend to use more electricity than the average U.S. home, since electricity rather than fuel oil and natural gas supplies most of the state's residential and commercial-sector energy. In addition, hot Texas summers increase the amount of electricity used for air conditioning.[7] Consequently, in Texas a megawatt of wind energy powers about 230 homes, compared to the U.S. average of 300 homes.[8]

At least 1,557 additional MW of installed wind capacity projects came on line in West Texas in 2007, with an additional 1,396 MW currently under construction in Texas.[9] Other states with at least 200 MW of installed wind capacity at the end of 2007 included California, Minnesota, Washington, Iowa, Colorado, Oregon, Illinois, Oklahoma, New Mexico, New York, Kansas, North Dakota, Pennsylvania and Wyoming (**Exhibit 11-2**).

Exhibit 11-1
Installed Wind Capacity, 1999-2007
(In Megawatts)

Year	Texas	California	U.S.
1999	180	1,646	2,500
2000	181	1,646	2,566
2001	1,096	1,714	4,261
2002	1,096	1,822	4,685
2003	1,293	2,043	6,374
2004	1,293	2,096	6,740
2005	1,995	2,150	9,149
2006	2,739	2,376	11,575
2007	4,296	2,439	16,596

Source: U.S. Department of Energy.

As of 2007, all of Texas' utility-scale wind projects were in the western parts of the state. The McCamey area, south of Odessa and Midland, saw the first wave of wind development in Texas. West-Central Texas, encompassing the Sweetwater/Abilene area (Taylor and Nolan counties), is home to Texas' largest concentration of wind development, including three of the nation's largest wind projects.[10] The area continues to experience rapid growth and is home to the largest single wind farm in the world, FPL Energy's 735 MW Horse Hollow site, with 428 wind turbines covering about 47,000 acres of Nolan and Taylor counties.[11]

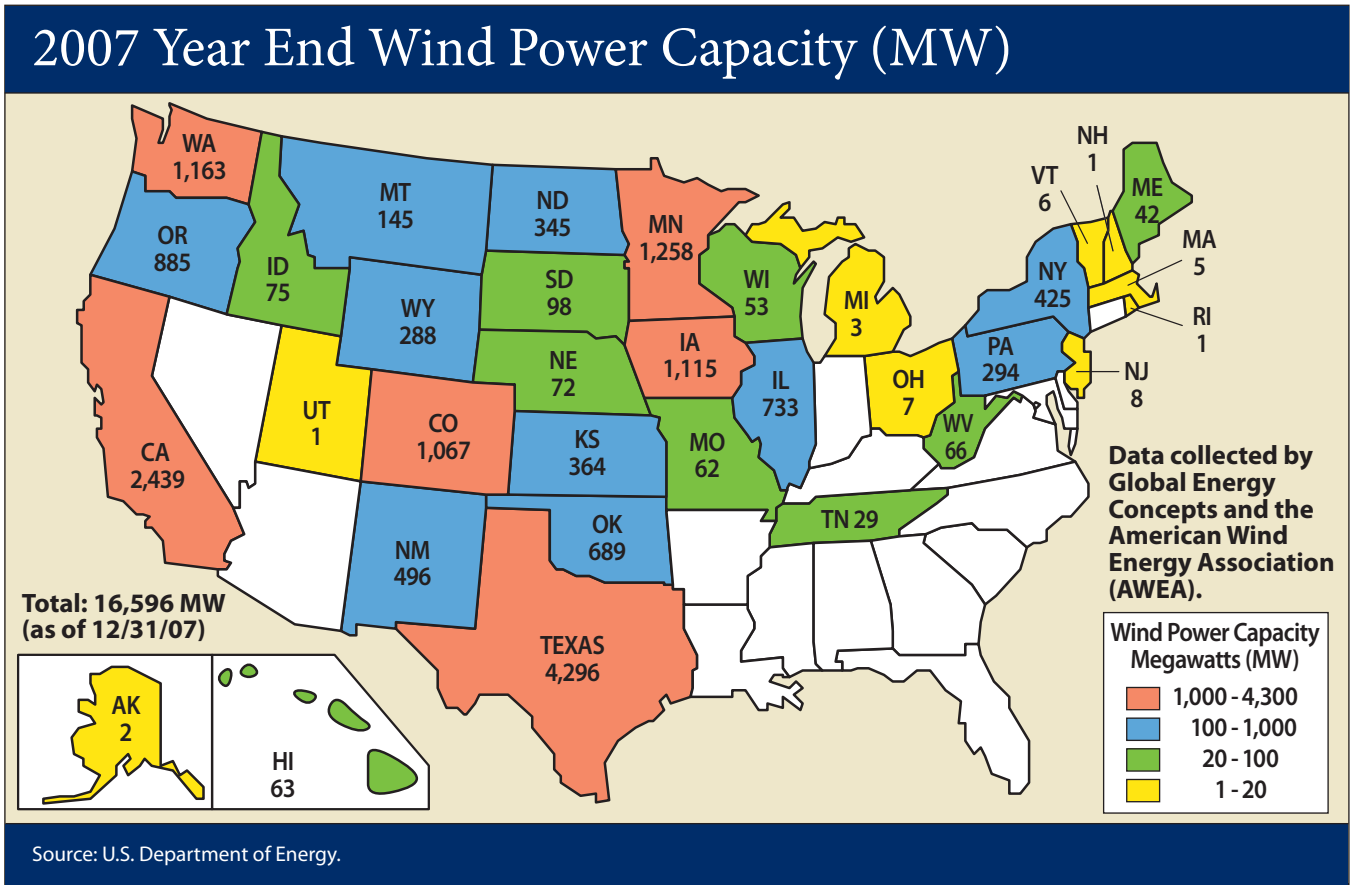
Along the Texas Gulf Coast, plans are under way to build wind farms both on land and offshore. Phase I of the Peñascal Wind Power project in Kenedy County, on land belonging to the Kenedy Ranch Trust, will generate 200 MW after its projected startup in 2008.[12] Construction on Phase I of the Peñascal project has begun, but the Coastal Habitat Alliance, a nonprofit organization dedicated to protecting the Texas Gulf Coast, sought an injunction in March 2008 to block construction of the project. It could take several months for the federal court to make a decision on this case.

To date, only European nations have built offshore wind farms, although Massachusetts, Texas, Delaware, New Jersey, New York and Georgia have active offshore project proposals.[13] The Texas offshore proposals would be only about eight miles from the electric grid, minimizing transmission expenses. But offshore wind energy development faces obstacles such as hurricane exposure, waves, seabed instability and a more difficult service environment.[14] Additional obstacles to the development of offshore wind farms include concerns about the impact to birds, marine wildlife, navigation and tourism.

Uses

Wind can be used to provide mechanical energy; Texas ranchers still use windmills to provide well water for cattle. But wind's ability to generate electricity without using water is by far its most important and promising aspect.

EXHIBIT 11-2



Source: U.S. Department of Energy.

In West Texas, where wind is abundant and water is in short supply, desalination systems powered by wind can be used to develop brackish water sources for consumption. Wind also can be used to power desalination plants along coastal areas. These desalination plants require a constant power supply and use a lot of electricity.[15] Texas Tech University and GE Global Research are working to develop a desalination test plant at Reese Technology Center in Lubbock that will be powered by wind energy.[16]

WIND POWER IN TEXAS

While wind power represents only a small portion of Texas' overall electricity production (about three percent), the state's wind capacity is growing rapidly. High wind speeds, improved wind technology, and government subsidies and tax incentives have contributed to the growth of wind power in the state. With new transmission lines planned by the Public Utility Commission of Texas (PUC) to serve parts of Texas with strong winds, wind's share of overall state capacity is likely to continue to grow in the coming years.

Economic Impact

The wind energy industry can provide economic benefits to some landowners and local communities. In West Texas, landowners have formed associations and selected "steering committees" to hire attorneys to contact wind developers and negotiate wind leases. In 2005, community leaders in the area formed the West Texas Wind Energy Consortium to educate landowners about the economic benefits of wind development.

The biggest benefits go to landowners who receive compensation year after year for turbines sited on their property. Adjacent landowners, however, do not receive ongoing royalty payments. Landowners who have electric transmission towers and lines pass across their land are offered a one-time payment

(based on the land's fair market value) plus damages to compensate for other effects to property values. Some landowners complain that land marred by transmission towers and lines drops in value and that the available compensation is insufficient.

For landowners with wind turbines on their property, some wind leases provide bonuses and installation payments, but the primary form of payment is in the form of royalties, also called rent, operating fees or monthly production payments, usually paid to the landowner quarterly. In 2007, the standard royalty was about 4 percent of gross revenues but the amount a landowner receives can depend on many factors, including the number and size of wind turbines installed; the area's wind capacity; the turbines' annual hours of operation; the availability of transmission lines; and the price the electric utility company pays per kWh.[17]

Wind plant construction, maintenance and operations all create jobs, which in turn generate income for local businesses and communities. The National Renewable Energy Laboratory (NREL) estimates that six to 10 permanent operations and maintenance jobs are created for every 100 megawatts of installed wind capacity. One hundred MW of installed wind capacity also creates about 100 to 200 short-term construction jobs.[18]

In October 2006, Texas Governor Rick Perry announced commitments from wind energy companies to invest $10 billion in wind projects in the state. These projects would increase installed Texas wind capacity by about 7,000 MW.[19] The investment, however, is contingent on the construction of additional transmission lines to windy areas of the state. The Electricity Reliability Council of Texas (ERCOT) has identified more than 17,000 MW of possible wind energy projects.[20]

In June 2007, the U.S. Department of Energy (DOE) chose the Lone Star Wind Alliance, a coalition of universities, state agencies and private industry, to receive up to $2 million in equipment to test large wind blades.[21] BP has donated the land and $250,000 for this project, which will be located at Ingleside, north of Corpus Christi. The construction of the blade test facility is expected to attract wind turbine and blade manufacturers to Texas.[22]

And wind-related manufacturing is growing in Texas (**Exhibit 11-3**). In 2006, TECO/Westinghouse and Composite Technology Corporation announced plans to manufacture wind turbines in the state.[23] Supply-chain companies that fabricate wind turbine towers, tower flanges and bolts and other wind turbine components are moving to Texas or expanding their operations. The growth of wind power in Texas also creates service jobs in various fields including engineering, legal and financial services and transportation.

The rapid growth in wind power that Texas has experienced since 2005 would likely slow if the federal production tax credit (PTC), which is scheduled to expire on December 31, 2008, is

EXHIBIT 11-3

Texas' Wind Business is Growing (a few examples)

Manufacturing Specialty	Manufacturing Company	Location
Nacelles*	TECO-Westinghouse	Round Rock
Wind Turbine Towers	Trinity Industries	Dallas/Fort Worth
Tower flange, bolts etc.	CAB Inc.	Nacogdoches
Steel fabrication	Wind Clean	Coleman
Carbon Fiber for Blades	Zoltek	Abilene
Blades	MFG	Gainesville
Bolting Services	Aztec Bolting	League City

* The Nacelle sits atop the wind tower and houses the gear box, shafts, generator, controller and brake.
Source: American Wind Energy Association.

not extended. (The PTC is a federal subsidy that currently provides a 10-year corporate income tax credit of 2.0 cents per kWh, effectively reducing the cost of wind power.) The American Wind Energy Association (AWEA) warns that wind energy developers and manufacturers will stop making investments in equipment and facilities if the PTC is not extended. They also note that wind energy companies are already reporting a decrease in wind energy investment due to the current uncertainty over the extension of the PTC.[24]

Supporters of wind argue that there is another economic benefit of wind energy — reduced dependence on fossil fuels. The American Wind Energy Association (AWEA) estimates that in the U.S., "by the end of 2006 wind energy use will save over 0.5 billion cubic feet (Bcf) of natural gas each day, relieving some of the current supply shortages."[25] By reducing natural gas demand, wind energy can limit the impact of natural gas price hikes to residential and commercial consumers. Critics, however, contend that wind's variability mitigates this advantage.

Consumption

ERCOT, which manages the state's largest power grid, reports that wind energy accounted for 2.1 percent of electricity generated in its region in 2006, compared with just 1.1 percent in 2004.[26] In the U.S., by contrast, wind power provided just 0.8 percent of electricity at the end of 2006.[27] By 2007, wind energy accounted for 2.9 percent of electricity generated in the Texas ERCOT region.[28]

Since ERCOT is responsible for ensuring the reliability and adequacy of the electric grid, it makes capacity calculations to determine if it will have sufficient generating capacity on the grid. Wind power is variable and ERCOT historical wind generation data reveals that there is often less wind blowing on summer afternoons that coincide with peak electrical demand. For planning purposes, ERCOT determined that next year, it can count on just 8.7 percent of its installed wind capacity to alleviate Texas' peak summer demand. It also notes that conventional generation must be available to meet forecast load and reserve requirements.[29]

According to NREL, wind energy can supply 20 percent of the nation's electricity by 2030.[30]

Production

Wind turbines convert the wind's kinetic energy into mechanical power that a generator, in turn, converts into electricity. There are two main types of wind turbines, the horizontal-axis and vertical-axis models (**Exhibit 11-4**). Most modern wind turbines have a horizontal axis, with blades resembling airplane propellers. Vertical-axis units have blades that resemble an eggbeater's. Horizontal-axis units account for almost all utility-scale turbines — 100 kilowatts or several megawatts — in the U.S. and other countries.[31]

Both small and large wind turbines can be used to generate electricity. Small turbines with a capacity to generate less than 10 kilowatts of electricity typically are used to power single homes or farms in remote or "off-grid" locations. Intermediate-sized systems, with a capacity of between 10 and 250 kilowatts, can power a village or a cluster of homes and buildings. Large, utility-scale turbines can generate several megawatts and usually are grouped together into power plants often called "wind farms," and connected to the electrical utility grid; their power is sold to utility customers.[32]

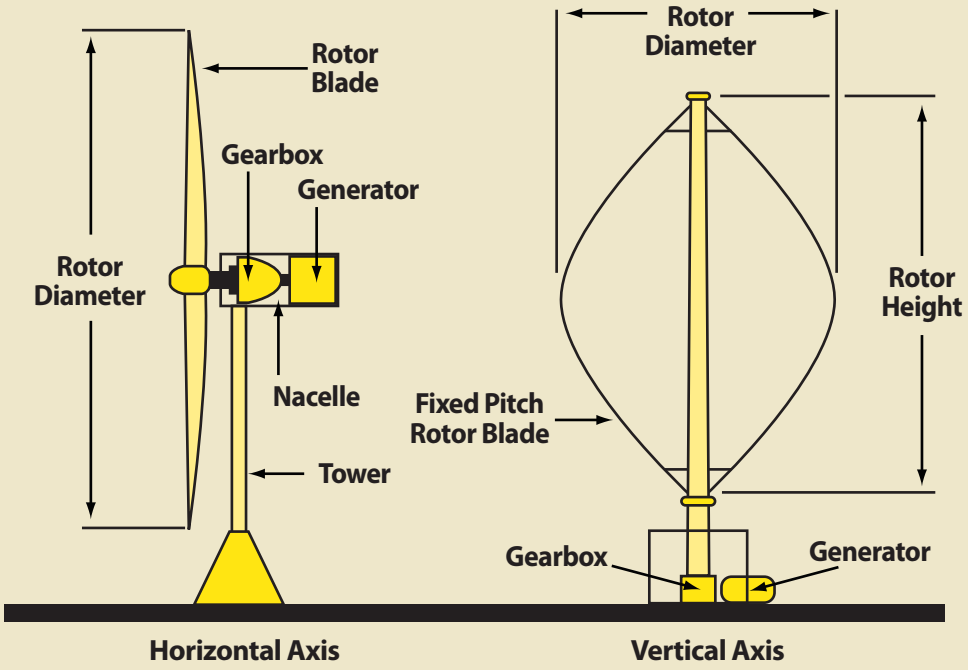
Demand for wind turbines has outstripped global supply.[33] The total development timeline of a wind farm, from initial wind assessment through construction, can require from two to five years and involves many steps.[34] Wind developers must locate sites and negotiate lease options that provide the wind company with a sufficient amount of time to allow for wind measurement, land surveys and studies including avian, environmental, geotechnical, foundation and soil tests to determine if the site is suitable for development.[35]

A wind energy lease is different from an oil and gas lease because it involves only the land surface and not the mineral rights. The average term of a wind energy lease can range from 30 to 50 years, but typically is about 35 years.[36] These long lease periods reflect the fact that creating a wind farm is a complex and expensive project with costs that can run into the hundreds of millions of dollars.[37] Furthermore, wind turbines have a lifespan of more than 20 years.[38] Wind farms are large and often encompass land from several landowners, thus requiring separate leases from each. In West Texas, most wind farms range from 2,000 acres to more than 100,000 acres.[39]

ERCOT reports that wind energy accounted for 2.9 percent of electricity generated in its region in 2007, compared with just 1.1 percent in 2004.

EXHIBIT 11-4

Horizontal-Axis and Vertical-Axis Wind Turbines



Source: American Wind Energy Association.

The wind farm development and pre-construction phase involves numerous steps, such as title research, permitting, financing, equipment purchases, the development of a power sales strategy and connection to the electrical grid. The construction phase consists of assembly and installation of the wind turbines, transmission lines, substations, roads and other improvements as required. The operational phase of power production typically lasts about 25 years.[40] However, the operational phase may be "repowered" with new equipment, as has been done recently in California, where wind projects have replaced equipment originally installed in the early 1980s.

While wind farms may extend over thousands of acres, the wind turbines themselves occupy only a small percentage of the land — generally 3 to 8 percent (one to two acres per turbine, mostly for the unit itself and associated service roads). This allows farmers and ranchers to use most of the land for other activities.[41] The land occupied is often referred to as the wind turbine's "footprint."

A wind farm also requires substantial acreage for open space between turbines, however, to maximize their efficiency in capturing the wind and to avoid turbulence that can impede airflow (**Exhibit 11-5**). The size of the turbine, land characteristics — plains, hills, ridges, plateaus and mountains — and the direction of the prevailing winds determine the distance needed between wind turbines and turbine rows. One study noted that on a flat site with a single prevailing wind, each turbine requires 26.7 acres, while a site with two prevailing winds requires 59 acres per turbine.[42] At present, neither the federal government nor the state has any spacing regulations for wind turbines.[43]

The kinetic energy of moving air provides the motive force that turns a wind turbine's generator. The wind turns the rotor blades; this motion spins

EXHIBIT 11-5

West Texas Wind Farm

Source: Cielo Wind Power.

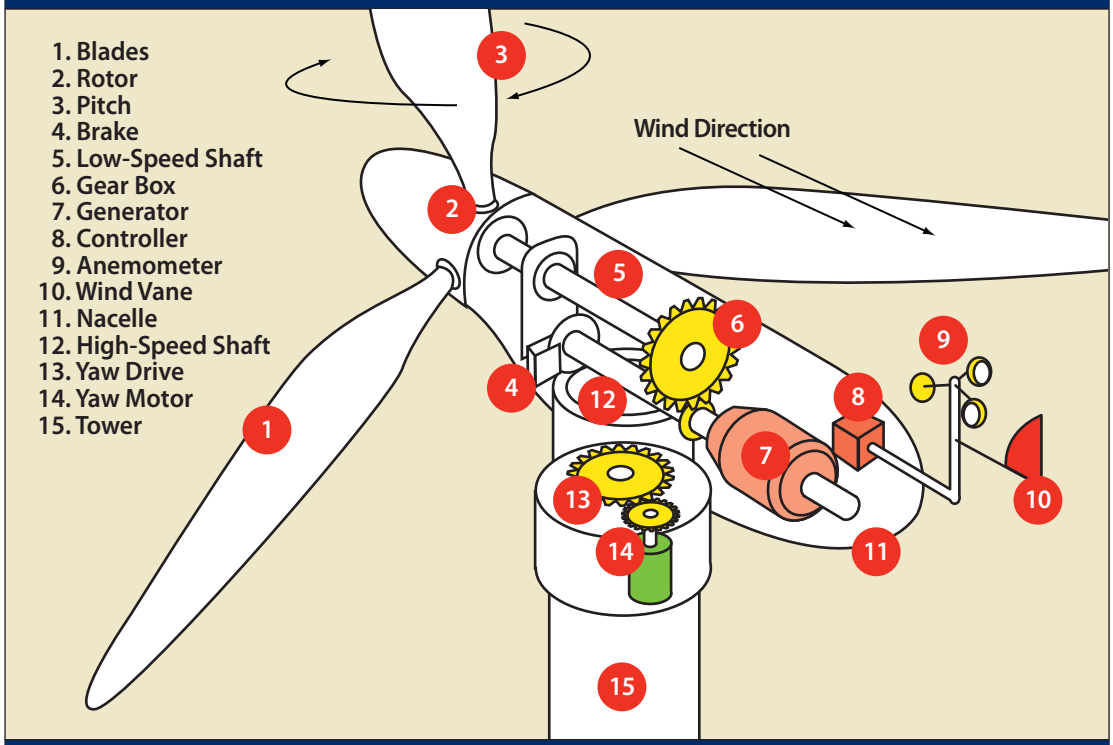
a drive shaft that in turn spins the turbine of a generator to make electricity. A gear box located along the drive shaft increases speed to match generator requirements and optimize power generation (**Exhibit 11-6**). Some wind turbines have a large generator and no gearbox. Longer rotor blades mean a larger "rotor swept area," the total area covered by spinning blades, increasing the energy that can be captured and generating more electricity.

Other factors including wind speed, the height of the wind turbine and air temperature also determine power output. The stronger the wind, the more power is available. A doubling of wind speed increases power output by a factor of eight.[44] Utility-scale wind farms generally require a minimum annual average wind speed of 13 miles per hour.[45]

Wind turbines often are located along hilltops and mountain ridges because a five-fold increase in the height of a wind turbine above the prevailing

EXHIBIT 11-6

Components of an Energy-Generating Windmill



Source: Alliant Energy.

terrain can result in twice as much wind power. While actual wind characteristics are site-specific, in general, raising the height of a wind turbine increases available wind power. Air temperature also affects wind power generation, with cold, relatively dense air generating about 5 percent more power than hot air.[46]

Today's wind industry has increased output and reduced generation costs by building taller wind turbine towers with longer blades. Both wind turbine size and output have increased steadily since the early 1980s (**Exhibit 11-7**). At that time, the tallest wind turbines were about 56 feet tall; today, some of the larger wind turbines reach heights of nearly 400 feet. The output of wind turbines also has increased steadily, rising from 50 kW in the early 1980s to 500 kW in the mid 1990s and more than 3 MW in 2006.[47]

Most wind turbines currently planned for installation in West Texas wind farms are 1 MW to 2.3 MW units. Again, a 1 MW wind turbine can generate electricity for about 230 Texas households.[48]

Capacity factor is a measure of the energy production of a power plant. Since wind is variable, blowing strongly at times and not at all at others, a wind turbine's capacity factor compares actual power produced over time with the power that would be produced by the same turbine operating at maximum output 100 percent of the time. For example, wind turbines at most locations run about 65 percent to 80 percent of the time, but during some of this time they generate at less than full capacity, further lowering their capacity factor.

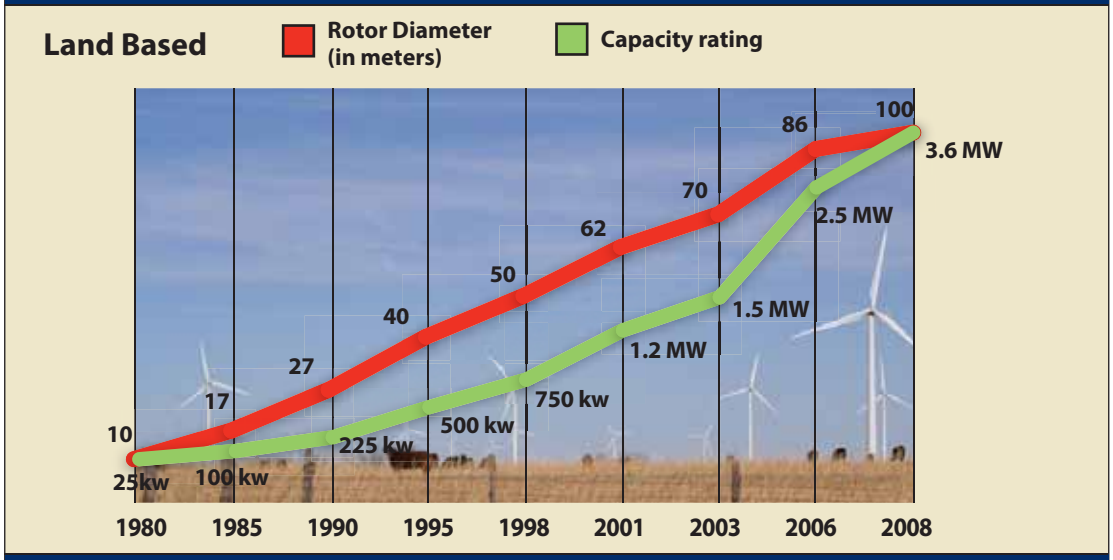
Utility-scale wind turbines typically operate with a capacity factor ranging from 25 to 40 percent, though they may exceed these amounts during windy months.[49] A recent U.S. Department of Energy (DOE) study noted that taller wind turbines, improved siting and improvements in wind turbine technology all have contributed to continuing improvements in capacity factors. For example, DOE found that capacity factors for projects installed before 1998 average 22.5 percent, compared to 36 percent for those installed in 2004 and 2005.

In Texas, the average capacity factor of wind farms installed in 2004 through 2005 is 39 percent, compared to 32 percent for projects installed between 2000 and 2001 and 19.6 percent for those

Today, some of the larger wind turbines reach heights of nearly 400 feet.

EXHIBIT 11-7

Evolution of U.S. Commercial Wind Technology



Sources: National Renewable Energy Laboratory, California Energy Commission and various wind turbine manufacturers.

installed before 1998.[50] The West Texas wind farms that generate power for the city of Austin's utility company, Austin Energy, have capacity factors ranging from 35 percent to 40 percent.[51]

Sometimes wind production can drop suddenly. On February 26, 2008, wind production in the Electric Reliability Council of Texas (ERCOT) dropped from over 1700 MW down to 300 MW within a three hour period.[52] Traditional power plant operators, who would normally provide more power on short notice, failed to provide power as promised. ERCOT was able to avoid blackouts by asking large industrial customers to cut back on power use. These demand-response customers get reduced electric rates in exchange for cutting power on short notice.

Too little wind is a problem on some days, but on other days heavy winds can generate too much power. When the wind blows hard and wind turbines produce more electricity than the grid can accommodate, the producers in West Texas shut down the wind turbines.

Another measure, the *availability factor*, gauges the reliability of power plant equipment. This measure is expressed as a percentage of the year in which the power plant is available to produce electricity. Like most complex devices, wind turbines are out of service at times, either for maintenance and repairs (a scheduled outage) or when they break down unexpectedly (unplanned outages). Wind turbine technology has improved over the last two decades, and today's machines can have an availability factor of more than 98 percent.[53] In comparison, the availability of large coal and nuclear plants average in the 90 to 95 percent range.

Transmission

Wind energy faces transmission obstacles. As noted above, some of the best wind sites are in remote areas far from population centers, making them dependent on long-distance transmission. Unlike fossil fuels and biomass, which can be transported by pipeline, road or rail, wind energy is produced on site and can only be transported to customers over electric transmission lines.

Extending transmission lines to windy areas is expensive. A recent ERCOT study estimates that building transmission lines to transport wind generated electricity from West and Northwest Texas to urban areas will cost about $1.5 million per mile.[54]

Before they can build the transmission lines, Texas utility companies must lease or buy easements from landowners. For landowners adjacent to wind farms, the expansion of wind energy to their area may mean the construction of what they view as unsightly transmission lines on their farm or ranch land, without any of the economic benefits that accrue to landowners with wind turbines on their property. Again, landowners receive only a one-time payment for the easement, which includes both the transmission lines and towers.[55]

If a landowner is unwilling to sell the land easement or thinks the amount offered is too low, the utility company can initiate an eminent domain proceeding at the county court level to settle the matter. There is growing opposition to private businesses using eminent domain to force individuals to sell their land.[56] Opposition to high-voltage transmission lines also is strong, in part because of aesthetics, property value issues and concern over any potential health problems.

Since wind is a variable source of energy production, wind power plants typically cannot control their power delivery times as precisely as do plants powered by fossil fuels. The electric system already must be capable of responding to swings in electrical usage by customers — swings of as much as 25,000 MW in a single day. Nonetheless, as previously noted, wind's variability posed a problem in February 2008, when ERCOT had to ask large industrial customers to reduce their electricity use. Advances in wind forecasting (the prediction of wind strength ahead of time) should allow wind power to be integrated with conventional resources in an optimal way.[57]

Since wind is a variable source of energy production, wind power plants typically cannot control their power delivery times as precisely as do plants powered by fossil fuels.

In fact, transmission constraints are the main obstacle to wind development nationwide. This is certainly true in Texas; the Panhandle is the state's most wind-rich area, but it lacks the lines needed to fully exploit this resource. Nationally, investment in new transmission infrastructure over the past 15 to 20 years has not kept pace with growth in electricity consumption.[58]

Furthermore, the existing network was not designed to accommodate variable forms of power. Inadequate transmission capacity near McCamey

from 2002 through 2004, for instance, often forced producers to curtail energy production to avoid overloading the transmission lines.[59] More lines were added to alleviate this problem, but some difficulties persist. Beginning in 2006, there was a resurgence of curtailment problems in West Texas as the pace of transmission development lagged the pace of new wind construction.

In some circumstances, as when some transmission lines are down for maintenance or when the power supply exceeds demand, some wind providers will offer wind power at no cost or even pay to have their electricity moved on the grid, a response commonly referred to as "negative pricing."

Wind providers have an incentive to sell power even at negative prices because they still receive the federal production tax (PTC) credit and renewable energy credits; they might lose more money if they simply stopped producing power. (At times of low power demand, some combined cycle gas turbine plants also offer negative pricing to avoid the expense involved in shutting down and then restarting a plant, although such situations are rare.)[60]

Wind is an inexhaustible but variable energy source, since there are seasonal variations in wind production; even windy areas have some days that are windier than others.

State legislation approved in 2005 should provide greater access to transmission lines and increase wind energy development. The 2005 Texas Legislature's Senate Bill 20 increased the state's Renewable Portfolio Standard (RPS) to 5,880 MW of electricity from renewable energy sources by 2015, and set a target of 10,000 MW by 2025. The new law also required the Public Utility Commission of Texas (PUC) to designate Competitive Renewable Energy Zones (CREZs), areas of the state identified as having the best renewable energy resources, and requiring the transmission infrastructure needed to deliver that energy to customers. (For a detailed discussion of renewable portfolio standards and Competitive Renewable Energy Zones, see Chapter 9.)

PUC asked ERCOT to study the potential for Texas wind development and necessary transmission improvements. The primary potential areas for wind capacity expansion identified in the study include the Texas Panhandle; the McCamey area south of Odessa; areas near Sweetwater and Abilene; and the Gulf Coast south of Corpus Christi.[61] PUC used ERCOT's study to decide which areas are most suitable for the extension of transmission capacity.

In July 2007, after evaluating about 25 areas in the state for wind power generation, PUC designated six CREZ zones as the best sites for ERCOT to develop transmission plans for between 10,000 MW and 25,000 MW of proposed wind capacity, with the costs to be covered by all Texas consumers through fees built into the cost of electricity.

On April 2, 2008, ERCOT released the CREZ Transmission Optimization Study, which provides transmission plans for four scenarios of wind generation. The estimated cost of building new transmission lines to windy parts of the state ranges from $3 billion for 12,053 MW of wind generation capacity to $6.4 billion for 24,859 MW.[62] Each scenario includes 6,903 MW of wind generation that was either in-service or had signed interconnection agreements as of fall 2007. PUC will issue final designation of transmission solutions for the CREZ areas, and decide which transmission companies will be selected to build transmission lines.

Several companies have formed partnerships to build transmission capacity for the CREZs.[63] Another company has filed a proposal with PUC to build an 800-mile transmission loop in the Texas Panhandle to connect 8,000 MW, mostly of wind power, to the ERCOT electric grid.[64]

Availability

Wind is produced by the uneven heating of the earth's land, water and atmosphere, which causes air masses to move around the planet. Wind is an inexhaustible but variable energy source, since there are seasonal variations in wind production; even windy areas have some days that are windier than others. Wind is in greatest supply along mountain and ridge tops, but other windy areas include mountain passes, hilltops, mesas and flat, wide-open areas such as open plains and shorelines.

The Pacific Northwest Laboratory (PNL), a federal research center, created a national wind resource assessment for DOE in 1986. PNL classifies wind power by class, with Class 1 consisting of very light winds and Class 7 comprising the strongest winds. PNL ranked Texas second among states for wind potential, just behind North Dakota.[65]

The Alternative Energy Institute (AEI) at West Texas A&M University has refined PNL's wind resource data, using updated information to construct an improved wind map of Texas. AEI identified three areas of Texas with significant wind power potential: the Great Plains, the Gulf Coast and specific areas in the Trans-Pecos region (**Exhibit 11-8**).[66]

Many factors including hills and trees can affect wind patterns, causing actual wind measurements to vary from those on the wind maps. Consequently, wind development companies perform their own long-term measurements with an anemometer to assess the true potential of a site.

In 1995, the State Energy Conservation Office (SECO) released a study that evaluated Texas' renewable energy resource base. This study included a thorough assessment by West Texas A&M University's Alternative Energy Institute that concluded that Texas has 524,800 MW of potential wind power capacity, enough to power about 121 million homes (**Exhibit 11-9**).[67]

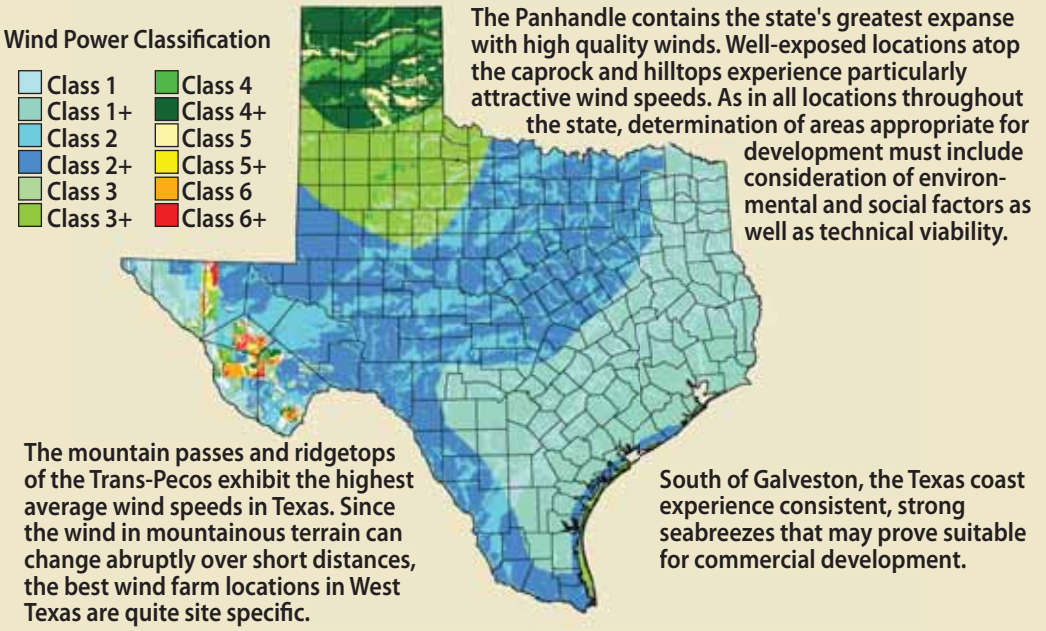
Most of Texas' potential wind capacity falls in class 3, which is characterized by wind speeds of between 15.7 mph to 14.3 mph. Even so, the state had enough class 4 wind (16.8 mph to 15.7 mph) to meet 100 percent of its electric needs in 1995. The 2007 Texas Legislature directed SECO to update the 1995 assessment of Texas renewable energy resources. This report, which will be released before the start of the 2009 Texas legislative session, will include up-to-date data on the availability of various renewable energy resources.

More recent studies also have highlighted Texas' wind potential. In December 2006, ERCOT released a report on wind generation and transmission that concluded: "there is significant potential for development of wind resources in Texas."[68] AWS Truewind, the company ERCOT hired to identify areas of the state with the best wind resources, reported that annual capacity factors of between 30 to 45 percent were common in Texas' windiest sites.[69]

Abundant, renewable and non-polluting, wind energy has been the leading renewable electric

EXHIBIT 11-8

Texas Wind Power Potential



Source: Alternative Energy Institute, West Texas A&M University.

Exhibit 11-9

Texas Wind Power: Potential Electricity Production*

Wind Power Class	Area (km2)	Percent of State Land	Potential Capacity (MW)	Potential Production (Billion kWh)	Percent of Texas Electric Consumption
3	143,400	21.13%	396,000	860	371%
4	29,700	4.38	101,600	231	100
5	5,000	0.74	21,600	48	21
6	300	0.04	1,600	4	2
Total	**178,400**	**26.29%**	**524,800**	**1,143**	**493%**

*Data is from a 1995 study of Texas Renewable Energy Resources that is currently being updated and is scheduled for release before the 2009 Texas Legislative Session.
Source: Texas State Energy Conservation Office.

resource in Texas for the past few years, and is currently attracting significant investor interest as a power plant option in ERCOT's competitive wholesale market.[70] In Texas, an additional 1,618 MW of wind generation came on line by the end of 2007 (**Exhibit 11-10**). Potential developers of another 17,000 MW of wind generation have requested an analysis of transmission capabilities.

Cost and Benefits

In the last 22 years, wind power prices per kilowatt-hour, calculated using the federal production tax credit (PTC), have declined by about 80 percent.[71] Currently, the PTC reduces the price of wind power by about 2.0 cents per kWh, making wind more attractive to electric utilities and investors.[72]

Wind energy has been the leading renewable electric resource in Texas for the past few years.

For example, in 1984 U.S. wind farms generated electricity for about 30 cents per kWh, but by 2005, prices in some areas of the nation had declined to as little as 3 cents per kWh.[73] In 2006, U.S. wind power prices ranged from 5 to 8.5 cents per kWh, *independent* of the federal production tax credit (PTC), depending on site-specific factors such as the strength of the wind resource, turbine size and development and installation costs. When the PTC is factored into the price, wind prices are even lower. For example, the 2006 U.S. wind power price, *including* the PTC, ranged from 3 to 6 cents per kWh. Texas is at the competitive end of the U.S. wind power price range.[74]

A 2007 DOE report on the wind industry concluded that Texas and the Plains states are among the nation's lowest-cost wind regions due to higher performance and lower development and installation costs. The report notes that performance depends on the strength of the wind resource, while development and installation costs "depend on a region's physical geography, population density, or even the regulatory processes."[75] Lower costs translate into lower wind power prices. Wind development costs are higher in California, the Great Lakes and along the Eastern coast.[76]

The development of taller wind turbines with larger rotor blades has contributed greatly to increased output and lower costs. Improved monitoring and analysis of wind resources have led to better siting and increased performance, while electronic monitoring of turbines and controls has helped to lower costs.

In California, 139 wind turbines from the 1980s that collectively generated about 11 megawatts of power recently were replaced with four new ones generating the same output with greater reliability.[77] In 2006, almost 17 percent of the wind turbines installed in the U.S. could generate more than 2 MW each, and the most frequently installed unit was a GE 1.5 MW wind turbine.[78]

The cost of wind-generated electricity varies depending on the site's average wind speed. In 2005, the American Wind Energy Association (AWEA) reported that, all other things being equal, a wind turbine at a site with average wind speed at the hub height (the axis of the turbine around which the blades spin) of 16 miles per hour (mph) can generate electricity for about five cents per kWh;

EXHIBIT 11-10
Texas Wind Power Projects Completed in 2007

Project Name	Location (County)	Quarter of Initial Operation	Total Capacity (in MW)	Number of Turbines	Turbine Size (in MW)	Project Developer
JD Wind IV	Hansford	Q1	10	8	1.25	John Deere Wind
Camp Springs	Scurry	Q2	130.5	87	1.5	GE Energy
Lone Star 1	Shackelford	Q2	72	36	2	Gamesa
Sweetwater IVa	Nolan	Q2	135	135	1	Mitsubishi
Sweetwater IVb	Nolan	Q2	105.8	46	2.3	Siemens
Wildorado	Potter, Oldham & Randall	Q2	161	70	2.3	Siemens
Buffalo Gap 2	Nolan & Taylor	Q3	232.5	155	1.5	GE Energy
Capricorn Ridge 1	Coke	Q3	117	78	1.5	GE Energy
Capricorn Ridge 2	Coke	Q3	144.9	63	2.3	Siemens
Lone Star 1	Callahan	Q3	110	55	2	Gamesa
Camp Springs 2	Scurry	Q4	31.5	21	1.5	GE Energy
Capricorn Ridge	Coke	Q4	97.5	65	1.5	GE Energy
Capricorn Ridge	Coke	Q4	4.6	2	2.3	Siemens
Lone Star 1	Shackelford	Q4	18	9	2	Gamesa
Lone Star 2	Shackelford & Callahan	Q4	44	22	2	Gamesa
Snyder	Scurry	Q4	63	21	3	Vestas
Sweetwater 5	Nolan	Q4	80.5	35	2.3	Siemens
Whirlwind Energy Center	Floyd	Q4	59.8	26	2.3	Siemens
2007 Total			**1,617.60**			

Source: American Wind Energy Association.

at 18 mph, it can generate electricity for about 3.6 cents per kWh; and at 21 mph the cost is about 2.6 cents per kWh.[79]

It should be noted that wind energy prices have increased since 2005, primarily due to higher costs for wind turbines. Even so, AWEA's figures illustrate that the same piece of wind equipment sited in a windier location will produce electricity at a substantially lower cost. Existing Texas wind projects are almost all within the 18 to 21 mph range at hub height. With its abundance of good sites, locations with wind speeds below 18 mph are generally considered inadequate for development in Texas.[80]

Wind energy cost also is affected by the size of the wind farm and the cost of financing. Larger wind farm projects appear to benefit from economies of scale.[81] Since wind energy is capital intensive, the cost of financing also has an impact on wind power costs. An increase in the number of banks and other investors willing to lend for wind projects in 2006 led to cheaper capital, mitigating higher wind turbine costs.[82]

After declining for several years, wind power prices rose in 2006 due to a variety of factors that include a shortage of, and higher prices for, wind turbines and components; rising steel, copper and

energy costs; rising lease and royalty costs; and a weaker dollar in relation to the Euro.[83] Europe manufactures most wind turbines and components, although some foreign turbine manufacturers have begun to locate in the U.S. such as Gamesa (Spain) in Pennsylvania, Suzlon (India) in Minnesota and DeWind (Germany) in Round Rock, Texas. GE, a leading supplier of wind turbines worldwide, continues to maintain a significant manufacturing presence in the U.S. as well as in Germany, Spain, China and Canada.[84] Also, a new U.S.-based manufacturer, Clipper Windpower, is in the process of expanding in Iowa.[85]

A recent DOE study expects wind power prices to rise further in 2008 because more recent wind turbine cost increases are not reflected in 2006 prices.[86]

After declining for several years, wind power prices rose in 2006.

Environmental Impact

Wind power does not produce waste products that require disposal or gas emissions that contribute to air pollution and global climate change. It does not consume or pollute water.

Other Risks

The whirling blades and tower of wind turbines can pose a risk to migratory birds and bats, killing them if they fly into the blades. This was discovered in 1994 at the Altamont Pass wind farm in California, which experienced large numbers of such deaths.

Consequently, several studies were conducted to determine how avian deaths could be reduced, and the lessons learned were incorporated into later wind projects. Bird deaths also prompted the wind energy industry to join with other stakeholders—environmental groups, government entities and utilities—to form the National Wind Coordinating Collaborative (NWCC) in 1994. NWCC supports the development of markets for wind power that are environmentally, economically and politically sustainable.

A 2005 study by the U.S. Forest Service found that wind turbines had a low overall impact on birds and that far more are killed by collisions with buildings/windows, high-tension lines and automobiles, and by house cats and pesticides.[87]

More recently, a 2007 National Academy of Sciences (NAS) report on the environmental impacts of wind energy projects found no evidence of significant impacts on bird populations at current levels of installed wind capacity. This study noted that of about 1 billion birds killed annually in 2003, only 20,000 to 37,000 died as a result of collisions with wind turbines. They note, however, that the continued rapid expansion of wind energy over the next 20 years may affect some species of birds and bats.

To avoid future ecological threats, the NAS study recommended the use of systematic pre- and post-construction studies to determine the impact on wildlife and to generate information for improved wind farm siting. The report also noted that the impact to forested areas, where vegetation is cleared to build wind turbines and roads, should be evaluated more thoroughly.[88]

More studies of the flight patterns of migratory birds are under way; these should discourage the placement of wind turbines in areas that interfere with bird flight paths. The wind industry also has joined with NREL, Bat Conservation International and the U.S. Fish & Wildlife Services to identify and quantify effects on bats and study ways to lessen the impact on them as well.[89] The Texas Parks and Wildlife Department is providing funds for a four-year study on bird-migration corridors along the Texas coast. The Caesar Kleberg Wildlife Research Institute at Texas A&M University at Kingsville is conducting this study and has established the Merlin Avian System — a radar system that takes vertical and horizontal measurements tracking the movements of migratory birds 24 hours per day, seven days per week — on the King Ranch, which is located in South Texas between Corpus Christi and Brownsville.[90]

Birds follow migratory routes called "flyways." Texas is part of the continent's Central flyway, which funnels migratory birds along the lower southeast Texas coast. In South Texas, opposition to wind development has arisen in large part due to concern for birds and bats. Critics of wind energy development in south Texas also say that it will have a negative impact on ecotourism. South Texas is a birding "hotspot," attracting thousands of birders to the region every year.[91]

The proposed Peñascal Wind Project on the Kenedy ranch is located along the lower Texas Gulf Coast, in the Central flyway. A Kenedy

ranch representative says they have studied the avian issue carefully and have quantitative data indicating that wind development will not have a negative impact on wildlife in the area.[92] The wind developer had avian studies performed of the site that concluded that the planned wind turbines will not interfere with bird migratory patterns.[93]

The Coastal Habitat Alliance (CHA), a nonprofit organization dedicated to protecting the Texas Gulf Coast, commissioned EDM International, Inc. to conduct its own review of the potential impact of wind turbines on avian populations. Their study reached a different conclusion. EDM claims that the wind developer's avian studies of the proposed wind sites are "fatally flawed" and concluded that, if all the sites proposed for possible wind installations on the Kenedy Ranch were developed, the project could have a significant impact on birds.[94] PPM Energy responded that EDM's study "contains factual errors, and is scientifically deficient."[95] PPM notes that the teams the wind developers used to conduct on-site bird studies over nearly three years are scientists based in Kingsville and Corpus Christi, while EDM, a Colorado consulting firm, made its review without direct on-site knowledge.

Another risk of large wind turbines is the danger of ice falls from spinning blades. Utility-scale wind turbines usually are sited at least 650 feet away from homes and public roads to minimize these situations.[96] Newer wind turbines shut down when ice builds up.

Aesthetic and Noise Impact

One of the most common complaints about wind farms is that they spoil the view. Critics say large wind turbine towers clustered into wind farms are an eyesore. Some landowners worry that locating wind turbines in pristine settings, especially where unspoiled views are the attraction, will reduce property values and have a negative impact on tourism. In 2007, a National Academy of Science (NAS) study noted that several studies have been unable to find a correlation between wind farms and lowered property values within a 10-mile radius of their sites.[97]

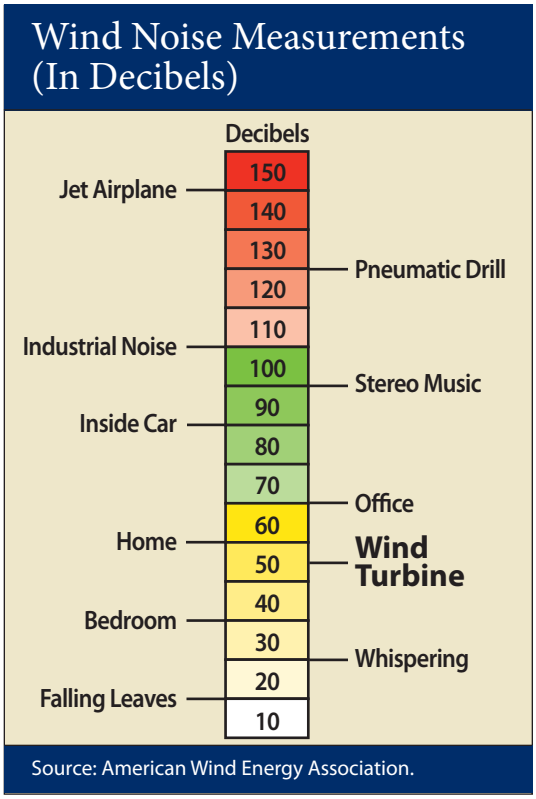
Technological advancements have resulted in utility-scale wind turbines that are quieter than the earlier models, but they still produce some noise. At a distance of 750 to 1,000 feet, a modern wind farm is said to produce about as much noise as a kitchen refrigerator (**Exhibit 11-11**).[98]

According to a 2002 NREL study, more efficient rotor blades, vibration damping and improved mechanical design have reduced wind turbine noise. This study also reported that much of the sound wind turbines emit is masked by ambient sounds or the sound of the wind itself. Finally, the NREL study pointed out that, "because of the wide variation in the levels of individual tolerance for noise, there is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction."[99] Consequently, NREL concluded that noise should be a primary siting constraint for wind turbines.

Property Values and Property Rights

More than 100 Texas counties, cities and various economic development corporations from the Panhandle and South Plains regions have passed resolutions supporting renewable wind energy and the proposed Panhandle Loop transmission

EXHIBIT 11-11



lines.[100] In areas valued for their natural beauty, however, some fear that wind turbines will reduce property values and affect tourism. This is the case in the Texas Hill Country, where on December 20, 2007, the Gillespie County Commissioners Court passed a resolution saying that they "oppose the construction and installation of industrial wind farms in Gillespie County and the surrounding Hill Country area."[101] The Fredericksburg and the Llano city councils have passed similar resolutions.

Critics of wind power also argue that landowners' property rights may be violated when their neighbors lease land to wind developers, since the large wind turbines are visible from their land and in some cases may be close to their property lines. Furthermore, they are concerned about the lack of state regulations for wind farm siting and decommissioning (the removal of wind turbines at the end of their useful lives). Texas, like many other states, does not regulate wind farm siting and decommissioning.

In Texas, there are no state guidelines for wind turbine siting.

This lack of regulatory guidance means that landowners are solely responsible for ensuring that their contracts cover issues such as the dismantling of retired wind turbines. Wind contracts typically specify only that the wind developer will post a bond to cover the costs of decommissioning. Removal generally is limited to the wind turbine structure and up to four feet of the concrete and steel pad upon which it rests. The remaining hole is filled with soil. Since the wind industry is relatively new, however, some landowners wonder whether wind developers will have the resources needed to dismantle wind turbines in the decades to come.

Some critics of wind power say that, until the government adopts wind siting regulations, the only way they can stop wind development is to file lawsuits. In Texas, landowners have filed several lawsuits in an attempt to stop the construction of wind turbines in their communities. So far the courts have ruled in favor of landowners who want to lease their land for the development of wind power. One judge noted that it is a property rights issue; individual property owners have the right to lease for oil, wind or other uses of their land.[102] More recently, The Coastal Habitat Alliance filed a lawsuit in federal court to prevent the construction of wind projects in South Texas "until a thorough environmental review with genuine public input is performed."[103]

State and Federal Oversight

Wind energy facilities in the U.S. usually are approved by local zoning boards and state regulatory authorities.[104] A 2007 survey of state fish and wildlife agencies and independent research revealed that at least six states — California, Minnesota, North Dakota, Oregon, South Dakota, and Vermont — have wind specific siting authority.[105] Federal involvement is limited, although wind turbines are subject to Federal Aviation Administration requirements; they cannot be located where they could adversely affect air traffic or radar systems.

In Texas, there are no state guidelines for wind turbine siting.[106] Counties can discourage but cannot prohibit power plant development. The Texas Parks and Wildlife Department will review a wind energy project against a draft set of guidelines for wildlife protection, if asked. The 2007 Texas Legislature considered a bill — HB 2794 — that would have required a permitting process for wind energy projects, but it did not pass.

Subsidies and Taxes

Most energy technologies benefit from government incentives, and wind energy is no exception. The U.S. wind power industry has relied heavily on the federal production tax credit, which was first adopted in 1992 and currently provides a two-cent per kilowatt-hour (kWh) credit against the corporate income tax for electricity generated in the first 10 years of a wind turbine's operation.[107]

The sensitivity of wind industry's growth to changes in government policy is apparent from the history of the PTC. Congress has allowed the credit to expire three times in seven years before extending it for only one or two years at a time. As can be seen in (**Exhibit 11-12**), each time the credit expired, growth in wind capacity slowed considerably.

Wind development companies and wind equipment manufacturers have complained that these interruptions create uncertainty in the market, discourage investment and may contribute to rising costs. Furthermore, this uneven government support for wind has discouraged manufacturers from investing in new factories in the U.S., opting instead to import product as needed.[108]

The uninterrupted PTC from 2005 to the present and an expanding market for wind power now are attracting wind component manufacturing to the U.S.[109] In December 2006, Congress extended the PTC through the end of December 2008. The wind industry continues to lobby for a lengthier extension of the PTC to encourage long-term investment in the industry.

Texas' Renewable Portfolio Standard also is credited with encouraging the growth of the state's wind energy industry. The RPS creates demand for all renewable energy sources — such as wind, solar, biomass, hydropower and geothermal power — by requiring companies that sell electricity to retail customers to support renewable energy generation.

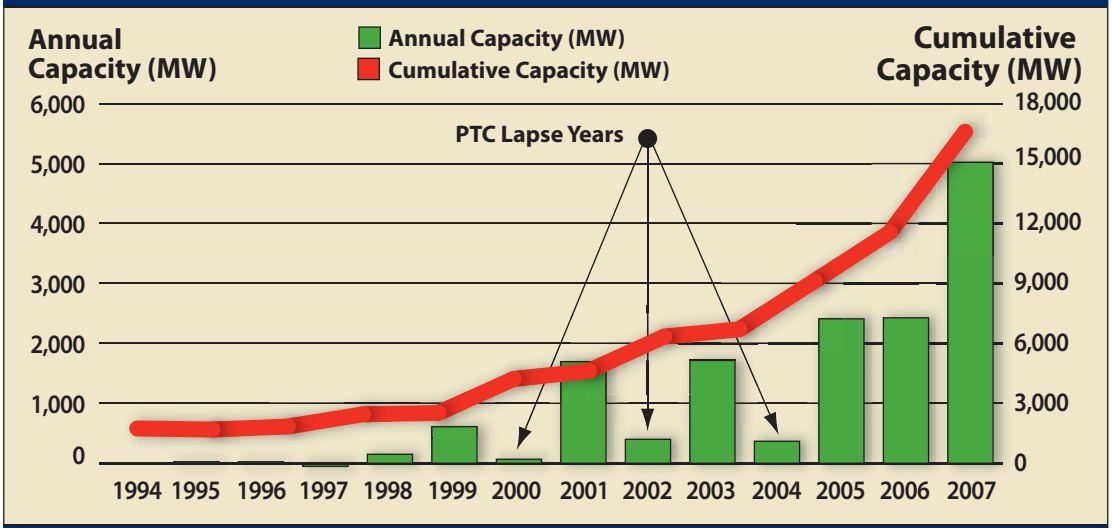
Texas established its RPS in 1999, and as noted earlier, the 2005 Texas Legislature increased the state's total renewable-energy mandate to 5,880 MW by 2015 and a target of 10,000 MW in 2025.[110] To meet the RPS targets, utility companies may buy or trade renewable energy credits (RECs). One REC represents one MWh of qualified renewable energy generated and metered in Texas. ERCOT administers the REC market for the state of Texas. As of February 2008, 25 states and Washington D.C. had implemented an RPS, while four states had enacted voluntary renewable portfolio goals. (see Chapter 9 of this report for further discussion of the RPS and REC).

Other incentives also have helped the industry grow. For example, Texas exempts wind-powered energy devices generating electricity for on-site use from the property tax.[111] Furthermore, the 2001 Legislature authorized school boards to reduce the property value of large renewable electric energy projects such as wind farms. Since this incentive became law, Texas school districts have approved more than 70 wind energy projects for reduced property values.[112]

Whether county governments and school districts can continue to grant abatements and property value limitations is in question, however, due to a January 29, 2008, Texas Attorney General opinion concerning Section 312.402(a) of the Tax Code. The opinion concluded that "fixtures and improvements owned by the wind turbine company as personal property would not be 'real property' that may be the subject of a tax abatement agreement under section 312.402(a)."[113] On February 27, 2008, the Texas Comptroller of Public Accounts raised a different issue with respect to school district tax limitation agreements under Chapter 313 of the

EXHIBIT 11-12

U.S. Annual Wind Energy Capacity Additions



Source: U.S. Department of Energy.

Tax Code, which could also affect wind farms. The Office of the Attorney General has until August 26, 2008, to respond to the Comptroller's request for an opinion on this matter.

More information on subsidies for wind can be found in Chapter 28.

Texas is the largest market for installed wind capacity in the U.S.

Other States and Countries

Texas is the largest market (with 4,296 MW by the end of 2007) for installed wind capacity in the U.S. California is second, with 2,439 MW of installed wind capacity, followed by Minnesota with 1,258 MW, Washington with 1,163 MW and Colorado with 1,067 MW.[118] Only 15 states had more than 200 MW of wind capacity at the end of 2007. Texas added over 1,500 MW of installed wind capacity in 2007, more than any other state.[119]

At the end of 2007, the world's total installed wind energy capacity was 94,123 MW, up from 74,141 MW in 2006.[120] Europe accounted for 57,136 MW of this capacity. Germany uses the most wind power, with an installed capacity of 22,247 MW; U.S. is second, with 16,596 MW. The addition of just over 5,000 MW of installed wind capacity in 2007 moved the U.S. ahead of Spain — with 15,145 MW — to become the second-largest producer of wind energy.[121]

While the U.S. ranks as one of the nations with the most total installed wind capacity, wind energy accounted for slightly less than 1 percent of all U.S. power generation in 2006 (**Exhibit 11-13**).[122] In Denmark, by contrast, wind energy accounted for more than 20 percent of the nation's total power requirements. Spain and Germany produced about 9 percent and 7 percent of their electricity from wind, respectively.

In some parts of Spain, wind energy consistently supplies 20 percent of electric loads. On March 20, 2007, Spain's electricity network authority, Red Electrica, reported that during a particularly gusty period the country's wind energy generation had reached an all-time high, producing 27 percent of its total power requirements.[123] Similarly, wind supplies 35 percent or more of northern Germany's power.[124]

According to the Global Wind Energy Council, more than 48 countries had policies or laws promoting renewable energy in 2006.[125] The two main types of incentives used to promote renewable energy are minimum price systems and quota systems. *Fixed-price systems* include tax credits and feed-in tariffs, which guarantee that a utility or grid operator will pay a minimum price per unit of electricity to a private generator of renewable electricity. In the *quota system*, the government simply determines the amount and quantity of electricity that a utility must buy from renewable energy sources.

Most European countries, including Germany, Spain, France and Portugal, have adopted feed-in tariffs. In Germany, the 8.53 cents per kWh tariff decreases to 5.39 cents after several years, depending on the quality of the site. Spain's wind power producers can choose between a fixed feed-in tariff — 6.3 to 7.0 cents per kWh based on capacity — or a variable tariff that has a fixed-price component and also factors in the average market price of electricity. France has a fixed tariff price of 8.36 cents per kWh for the first five years that drops thereaf-

Austin Energy Committed to Renewable Energy

Some electric utilities offer "Green Pricing" programs, an optional service that provides the consumer the choice of supporting renewable energy sources such as wind and solar, often by agreeing to pay a premium on their electric bill. Austin Energy, the city of Austin's utility, offers a GreenChoice program that initially charged a slightly higher rate but then keeps the rate fixed for up to 10 years since, once built, the cost of wind power is very predictable due to the fact that utilities acquire it via fixed-price purchase contracts.

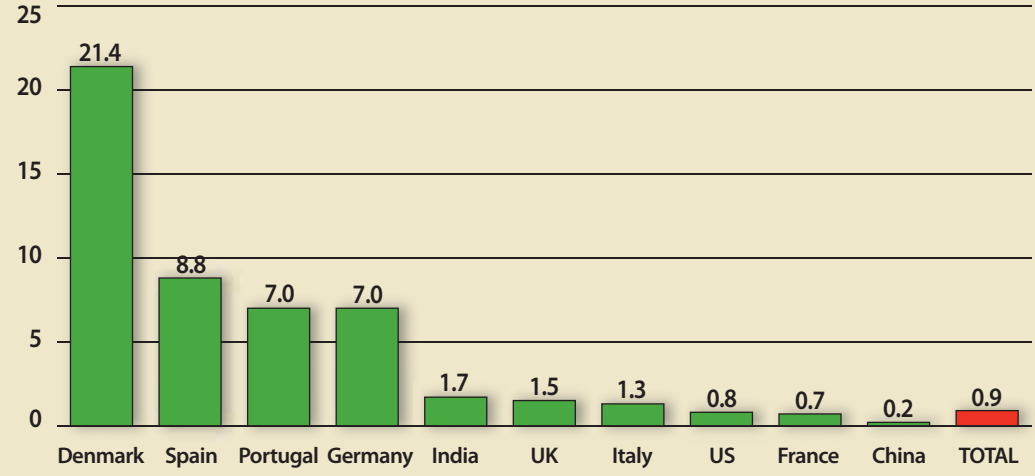
In January 2006, higher natural gas prices and escalating coal delivery costs meant that, for the first time, the green power charge was lower than the fuel charge paid by consumers who did not subscribe to the GreenChoice program.[114]

NREL has ranked Austin Energy's green power program as first in the nation among utility programs for renewable energy sales, for five consecutive years.[115] Austin GreenChoice sales of mostly wind-generated power reached 580 million kWh in 2006.[116] Other Texas utilities, including CPS Energy in San Antonio and El Paso Electric, offer similar "green pricing" programs.[117]

Austin Energy also has net metering standards that have made it easier for owners of small-scale wind turbine projects and solar energy systems to sell excess electricity back to the utility and buy more power only as they need it. Austin Energy net metering allows these customers to use the electric grid, in effect, as a storage battery, since any excess electricity is fed back to the utility grid.

EXHIBIT 11-13

Approximate Wind Power as a Percent of Electricity in Countries with the Most Installed Wind Capacity, 2006



Source: Berkeley Lab estimates.

The federal production tax credit has been the main driver behind wind energy expansion.

ter. Portugal's feed-in tariff has rates between 7.5 and 7.9 cents per kWh for 15 years. Britain and Italy have a quota system. In 2004 and 2005, the price of wind electricity was 15.5 cents per kWh in Italy and 10.1 cents per kWh in Britain.[126]

OUTLOOK FOR TEXAS

Texas' wind industry has benefited from substantial wind resources and significant federal and state incentives. Furthermore, higher fossil fuel prices and more efficient wind turbines have made wind power more competitive with conventional power sources.

The state's wind industry is prospering, but it faces several potential hurdles. Another lapse in the extension of the federal production tax credit could slow the industry's growth, as could a continuing shortage of wind turbines. Furthermore, inadequate investment in new transmission lines, siting and permitting issues and opposition to wind development all could slow the rapid pace of the industry's growth.

The federal production tax credit has been the main driver behind wind energy expansion. The growth of wind power has paralleled the availability of the PTC, slowing in the years (2000, 2002 and 2004) in which the credit was allowed to lapse.[127] The wind industry is asking the U.S. Congress to extend the PTC — currently set to expire in 2008 — for five or more years. Industry advocates say the PTC is important for the continued development of the wind energy industry and the expansion of wind turbine manufacturing in this country.[128] Property tax breaks for wind projects in Texas also have contributed to the industry's growth here.

At this writing, a wind turbine shortage has driven up prices and caused lengthy delays in wind projects. In the last year, Pennsylvania, Iowa and Minnesota successfully attracted foreign companies to build wind turbine factories in their states.[129] Even so, it will take several years for these new factories to ease the current shortage.

Local opposition to wind power usually centers on the danger posed to birds and bats, noise, aesthetics, land values, economic impact on tourism and landowners' property rights. A decline in support for the wind industry at the state and local levels could impede its expansion.

At the national level, the wind industry opposes any legislation that would require federal approval for each wind turbine in the U.S. According to AWEA, such a requirement could bring wind project development to a halt.[130]

Transmission continues to be perhaps the most significant barrier to wind energy development in parts of West Texas, including the Panhandle. PUC is designating CREZs that will develop additional transmission infrastructure.

Texas has abundant wind resources. Its Renewable Portfolio Standard goals and the selection of CREZs to expedite transmission improvements should continue to drive the growth of wind energy in the state.

Endnotes

1 Andrew Swift and Jamie Chapman, "A Primer on Wind Energy: Meteorology, Technology, Economics and Transmission," presented at the University of Texas School of Law 2007 Wind Energy Institute Conference, Austin, Texas, February 2007, p. 1.

2 U.S. Department of Energy, "Wind Powering America: Installed U.S. Wind Capacity," http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_installed_capacity.asp. (Last visited April 20, 2008.)

3 Lawrence Berkeley National Laboratory, *Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States*, by Ryan Wiser, Mark Bolinger and Galen Barbose (San Francisco, California, 2007), p. 1, http://eetd.lbl.gov/EA/emp/reports/63583.pdf. (Last visited November 26, 2007.)

4 Andrew Swift and Jamie Chapman, "A Primer on Wind Energy: Meteorology, Technology, Economics and Transmission," p. 1.

5 Lawrence Berkeley National Laboratory, *Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States*, p. 1. http://eetd.lbl.gov/EA/emp/reports/63583.pdf. (Last visited November 26, 2007.)

6 U.S. Department of Energy, "Wind Powering America: Installed U.S. Wind Capacity."

7 U.S. Department of Energy, Energy Information Administration, "State Energy Profiles-Texas," http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=TX. (Last visited April 8, 2008.)

8 Interview with Mike Sloan, founder and president, Virtus Energy, Austin, Texas, November 8, 2007.

9 American Wind Energy Association, *AWEA 2007 Market Report* (January 2008), p. 2-11, http://www.awea.org/Market_Report_Jan08.pdf. (Last visited February 8, 2008.)

10 Interview with Mike Sloan.

11 The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, by Roderick E. Wetsel, H. Alan Carmichael and Lisa Chavarria (Austin, Texas, February 26, 2007), p. 1; and interview with Mike Sloan.

12 Presentation by Patrick A. Nye, American Shoreline, Inc., at the University of Texas School of Law 2007 Wind Energy Institute Conference, Austin, Texas, February 26-27, 2007, p. 2.

13 U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, (Washington, D.C., May 2007), p. 5, http://www1.eere.energy.gov/windandhydro/pdfs/41435.pdf. (Last visited November 26, 2007.)

14 GE Energy, "Offshore Wind Energy," (February 26, 2007), http://www.clemson.edu/scies/wind/Presentation-Grimley.pdf. (Last visited December 6, 2007.), p 4.

15 U.S. Department of Energy, "The Wind/Water Nexus," p. 3, http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/wpa_factsheet_water.pdf. (Last visited November 15, 2007.)

16 David Talbot, "Using Wind to Extract Fresh Water," Technology Review (December 6, 2006), http://www.techreview.com/Energy/17862/. (Last visited November 14, 2007.)

17 The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, pp. 7-8.

18 National Renewable Energy Laboratory, *Wind Energy Update* by Larry Flowers (Golden, Colorado, January 23, 2008), p. 22, http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/wpa_update.pdf. (Last visited February 4, 2008.)

19 Sara Parker, "Wind Energy in Texas Gets $10 Billion Boost," *Renewable Energy Access.com* (October 4, 2006), http://www.renewableenergyaccess.com/rea/news/story?id=46145. (Last visited November 12, 2007.)

20 Electric Reliability Council of Texas, *Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas* (Austin, Texas, December

2006), p. ES- 3, http://www.ercot.com/news/presentations/2006/ATTCH_A_CREZ_Analysis_Report.pdf. (Last visited November 12, 2007.)

[21] U.S. Department of Energy, "Department of Energy to Invest up to $4 Million for Wind Turbine Blade Testing Facilities," http://www.energy.gov/news/5163.htm. (Last visited November 26, 2007.)

[22] Vicki Vaughan, "Texas Awarded Wind-Turbine Research Center," *San Antonio Express-News* (June 25, 2007), http:www.mysanantonio.com/business/stories/MYSA062507windtechnologycenter.129f4432.html. (Last visited April 20, 2008.)

[23] Round Rock Economic Development Partnership, "Strategic Alliance Agreement Brings Wind Turbine Manufacturer to Texas," November 27, 2006, http://www.texasone.us/site/News2?page=NewsArticle&id=5429. (Last visited April 28, 2008.)

[24] American Wind Energy Association, "Legislative Affairs: Production Tax Credit Extension," http://www.awea.org/legislative/. (Last visited March 4, 2008.)

[25] American Wind Energy Association, "The Economics of Wind Energy," http://www.awea.org/pubs/factsheets/EconomicsOfWind-Feb2005.pdf. (Last visited April 20, 2008.)

[26] E-mail communication from Linda Shirey, senior planning analyst, Electric Reliability Council of Texas, June 12, 2007.

[27] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006* (Washington, D.C., May 2007), p. 5, http://www.nrel.gov/docs/fy07osti/41435.pdf. (Last visited July 9, 2007.)

[28] Electric Reliability Council of Texas, "Energy by Fuel Type for 2007," Austin, Texas, January 31, 2008. (Spreadsheet.)

[29] Electric Reliability Council of Texas, "ERCOT Response to U.S. Rep. Joe Barton," Austin, Texas, March 29, 2007. (Press release.) http://www.ercot.com/news/press_releases/2007/pr_print_1_131040_131040.html. (Last visited April 20, 2008.)

[30] National Renewable Energy Laboratory, Wind Energy Update, p. 59.

[31] American Wind Energy Association, *The Most Frequently Asked Questions About Wind Energy* (Washington, D.C., 1999), p. 1, http://www.awea.org/pubs/factsheets/FAQ1999.PDF. (Last visited August 17, 2007.)

[32] National Renewable Energy Laboratory, *Renewable Energy: An Energy Destination for the West* by Bob Noun (Golden, Colorado, June 21, 2002), p. 5, http://ecenter.colorado.edu/greening_cu/css2003/presentations/energy1.pdf. (Last visited April 21, 2008.)

[33] Keith Johnson, "Renewable Power May Yet Yield Windfall," *The Wall Street Journal* (March 22, 2007), Page A8.

[34] Airtricity, Inc., "Developers' Roundtable: Wind Deals in Texas," by Andy Bowman, presented at The University of Texas School of Law 2007 Wind Energy Institute conference, Austin, Texas, February 2007.

[35] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 3.

[36] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 6.

[37] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 2.

[38] Airtricity, "F.A.Q.s: Land Owners," http://www.airtricity.ca/en/faqs/landowners.html. (Last visited November 20, 2007.)

[39] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 4.

[40] Airtricity, Inc., "Developers' Roundtable: Wind Deals in Texas."

[41] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 5.

[42] Global Energy Concepts, AWS Truewind, LLC, *Wind Power Project Site: Identification and Land Requirements* (Albany, New York, October 2005), p. 9-10, http://www.powernaturally.org/Programs/Wind/toolkit/13_windpowerproject.pdf. (Last visited March 3, 2008.)

[43] The University of Texas School of Law and the Oil, Gas and Energy Resources Law Section of the State Bar of Texas, *Current Issues in Texas Wind Energy Law 2007: Leases, Ownership of Wind Rights and Litigation*, p. 5.

[44] State Energy Conservation Office, "Wind Power Basics," p. 2, http://www.infinitepower.org/pdf/FactSheet-13.pdf (Last visited December 17, 2007.)

[45] American Wind Energy Association, *The Most Frequently Asked Questions About Wind Energy*, p. 3.

[46] State Energy Conservation Office, "Wind Power Basics," p. 3.

[47] National Renewable Energy Laboratory, *Wind Energy Update*, p. 1.

[48] Interview with Mike Sloan.

[49] American Wind Energy Association, *The Most Frequently Asked Questions About Wind Energy*, p. 4.

[50] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 18.
[51] Interview with Mark Kapner, senior strategy engineer, Austin Energy, Austin, Texas, April 3, 2007.
[52] Electric Reliability Council of Texas (ERCOT), "ERCOT Demand Response Program Helps Restore Frequency Following Tuesday Evening Grid Event," Austin, Texas, February 27, 2008. (Press release.) http://www.ercot.com/news/press_releases/2008/nr02-27-08.html. (Last visited April 20, 2008.)
[53] American Wind Energy Association, *The Most Frequently Asked Questions About Wind Energy*, p. 5.
[54] Interview with Bill Bojorquez, Electric Reliability Council of Texas, Austin, Texas, June 12, 2007.
[55] Email from Larry Dollgener, Lower Colorado River Authority, Austin, Texas, April 4, 2008.
[56] Reason Foundation, "Supreme Court Unleashes Eminent Domain in Cities," (April 2005), http://www.reason.org/apr2005/housing_land_use.shtml. (Last visited April 2, 2008.)
[57] Interview with Mike Sloan.
[58] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p 20.
[59] State Energy Conservation Office, "Wind Energy Transmission," http://www.seco.cpa.state.tx.us/re_wind-transmission.htm. (Last visited June 6, 2007.)
[60] Interview with Dan Jones, Independent Market Monitor, Electric Reliability Council of Texas, Austin, Texas, April 3, 2008.
[61] Electric Reliability Council of Texas, *Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas*, p. ES-1.
[62] Electric Reliability Council of Texas, Competitive Renewable Energy Zones (CREZ) Transmission Optimization Study, (Austin, Texas, April 2, 2008), p. 3 & pp. 19-26.
[63] Sandy Smith, "Putting Wind on the Wires: A Texas Tale," *Utility Automation & Engineering T&D*, http://uaelp.pennnet.com/Articles/Article_Display.cfm?ARTICLE_ID=287480&p=22. (Last visited November 26, 2007.)
[64] "Sharyland Utilities Seeks to Build 800-Mile 345-kV Electric Transmission Loop," *Transmission & Distribution World* (February 19, 2007), http://tdworld.com/news/sharyland-panhandle-loop/. (Last visited September 6, 2007.)
[65] Christopher T. Ellison, "Transmission Chickens and Alternative Energy Eggs," Presentation to the Harvard Electricity Policy Group, 46th Plenary Session, March 16, 2007, p. 8, http://www.ksg.harvard.edu/hepg/Papers/ellison_transmission_031607.pdf. (Last visited September 7, 2007.)
[66] Texas State Energy Conservation Office, "Texas Wind Energy Resources." http://www.infinitepower.org/reswind.htm (Last visited August 20, 2007.)
[67] Texas State Energy Conservation Office, "Texas Wind Energy Resources."
[68] Electric Reliability Council of Texas, *Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas*, p. ES-1.
[69] Electric Reliability Council of Texas, *Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas*, p. ES-2.
[70] Interview with Theresa Gage, government relations manager, Electric Reliability Council of Texas, Austin, Texas, November 12, 2007.
[71] National Renewable Energy Laboratory, *Wind Energy Update*, p. 3; and National Renewable Energy Laboratory, "Wind Energy Myths," http://www.nrel.gov/docs/fy05osti/37657.pdf. (Last visited February 8, 2008.)
[72] Lawrence Berkeley National Laboratory, *Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States*, p. 3. http://eetd.lbl.gov/EA/emp/reports/63583.pdf. (Last visited November 26, 2007.)
[73] National Renewable Energy Laboratory, Wind Energy Update, p. 2; and U.S. Department of Energy, "Wind Energy Myths."
[74] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p 11.
[75] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p 11.
[76] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p 11.
[77] Tom Fowler, "BP Ready to Catch the Wind; Division has a Bevy of Projects in the Works," *The Houston Chronicle* (January 12, 2007), p. 1.
[78] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 7.
[79] American Wind Energy Association, "The Economics of Wind Energy."
[80] Interview with Mike Sloan.
[81] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 15.
[82] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006,* p. 9.
[83] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 10.
[84] General Electric, "GE Energy's 2x5xl Wind Turbine Technology Selected For Largest Wind Project In Turkey," July 3, 2007, http://www.gepower.com/about/press/en/2007_press/070307.htm. (Last visited November 26, 2007.)

[85] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 7.

[86] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 11.

[87] Wallace P. Erickson, Gregory D. Johnson, and David P. Young Jr., "A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions," U.S, Forest Service Gen. Tech. Rep. PSW-GRT-191 (2005), http://www.dialight.com/FAQs/pdf/Bird%20Strike%20Study.pdf. (Last visited August 14, 2007.)

[88] National Academy of Sciences, *Environmental Impacts of Wind-Energy Projects* (Washington, D.C., May 2007), p. 2, http://www.cleanenergyfunds.org/Publications/NAS-NRC_wind_energy_final.pdf . (Last visited November 15, 2007.)

[89] Bat Conservation International, "Introduction: Bats and Wind Energy," http://www.batcon.org/home/index.asp?idPage=55. (Last visited August 15, 2007.)

[90] Interview with Kathy Boydston, program coordinator, Texas Parks and Wildlife Department, Austin, Texas, August 29, 2007.

[91] Mitchell Mathis and Daniel Matisoff, "Valuing Nature in Texas: A Characterization of Ecotourism in the Texas Lower Rio Grande Valley," (Houston, Texas, March 2004), p. 5, http://files.harc.edu/Projects/Nature/EcotourismCharacterization.pdf. (Last visited February 28, 2008.)

[92] Mark Babineck, "Ill Wind Divides Historic Ranches," *Houston Chronicle* (February 26, 2007.)

[93] Glenn Perrigo, Texas A&M University-Kingsville, and Jim Sinclair, Texas Environmental Services and Analysis, "Penascal Wind Turbine Project," November 2005, http://files.harc.edu/Documents/EBS/TREIA2005/PenascalWindTurbineProject.pdf; and interview with Kathy Boydston.

[94] EDM International, Inc., "Bird and Bat Collision Assessment: Proposed Kenedy County Wind Projects," http://www.coastalhabitatalliance.org/reports/Collision-Report-Final-12-18-07.pdf. (Last visited February 1, 2008.)

[95] PPM Energy, "PPM Energy's Response to EDM's Report on the Proposed Penascal Project," January 14, 2008.

[96] FPL Energy, "Frequently Asked Questions," http://www.fplenergy.com/renewable/contents/faqs_wind.shtml. (Last visited November 26, 2007.)

[97] National Academy of Sciences, *Environmental Impacts of Wind-Energy Projects*, p. 2.

[98] U.S. Department of Energy, "Wind Energy Myths."

[99] Renewable Energy Research Laboratory, Department of Mechanical and Industrial Engineering, University of Massachusetts at Amherst, *Wind Turbine Acoustic Noise*, by Anthony Rogers, James Manwell and Sally Wright (Amherst, Massachusetts, June 2002, amended January 2006), p. 3, http://www.wind-watch.org/documents/wp-content/uploads/rogers-windturbinenoise_rev2006.pdf. (Last visited November 26, 2007.)

[100] Texas House Committee on Regulated Industries, "Panhandle and South Plains Wind Energy Resolution," Austin, Texas, February 20, 2007.

[101] Gillespie County Commissioners Court, "Gillespie County, TX Economic Development Commission Resolution on Industrial Wind Farms," Fredericksburg, Texas, December 20, 2007.

[102] Thomas Korosec, "Wind Farms Generate Opposition," *Houston Chronicle* (February 5, 2007).

[103] The Coastal Habitat Alliance, Inc., "Texas Coast Wind Generation Sites Pose Severe Threat to Migratory and Resident Birds," Austin, Texas, January 2, 2008. (Press release.)

[104] National Academy of Sciences, *Environmental Impacts of Wind-Energy Projects*, p. 1.

[105] U.S. Fish & Wildlife Service and Association of Fish & Wildlife Agencies, *Wind Power Siting Regulations and Wildlife Guidelines in the United States* (Denver, Colorado, April 2007), http://www.fws.gov/Midwest/eco_serv/wind/guidance/AFWASitingSummaries.pdf. (Last visited February 7, 2007.)

[106] U.S. Fish & Wildlife Service and Association of Fish & Wildlife Agencies, *Wind Power Siting Regulations and Wildlife Guidelines in the United States*.

[107] Database of State Incentives for Renewable Energy, "Federal Incentives for Renewable and Efficiency, Renewable Electricity Production Tax Credit (PTC)," http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US13F&State=federal&currentpageid=1&ee=1&re=1. (Last visited November 26, 2007.)

[108] Lawrence Berkeley National Laboratory, *Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States*, p. 5. http://eetd.lbl.gov/EA/emp/reports/63583.pdf. (Last visited November 26, 2007.)

[109] American Wind Energy Association, "Legislative Affairs: Production Tax Credit Extension," http://www.awea.org/legislative/. (Last visited March 4, 2008.) and Interview with Mike Sloan.

[110] Tex. Util. Code Ann. §39.904.

[111] Database of State Incentives for Renewable Energy, "Renewable Energy Systems Property Tax Exemption," http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=TX03F&state=TX&CurrentPageID=1. (Last visited November 26, 2007.)

[112] Interview with Gary Price, Senior Analyst, Texas Comptroller of Public Accounts, Austin, Texas, February 17, 2008.

[113] Texas Attorney General, *Opinion GA-0600* (Austin, Texas, January 29, 2008), http://www.oag.state.

tx.us/opinions/opinions/50abbott/op/2008/pdf/ga0600.pdf. (Last visited April 3, 2008.)

[114] Austin Energy, "Green Choice #1 in Nation—Again," http://www.austinenergy.com/About%20Us/Newsroom/Press%20Releases/2007/greenChoice.htm. (Last visited September 7, 2007.)

[115] Austin Energy, "Green Choice #1 in Nation—Again."

[116] U.S. Department of Energy, "Top Ten Utility Green Power Programs as of December 2006," http://www.eere.energy.gov/greenpower/resources/tables/topten.shtml. (Last visited September 7, 2007.)

[117] U.S. Department of Energy, "Green Pricing Utility Programs by State," http://www.eere.energy.gov/greenpower/markets/pricing.shtml?page=1. (Last visited September 7, 2007.)

[118] U.S. Department of Energy, "Wind Powering America: Installed U.S. Wind Capacity."

[119] U.S. Department of Energy, "Green Pricing Utility Programs by State."

[120] Global Wind Energy Council, "Global Wind 2007 Report," Brussels, Belgium, January 4, 2008, p. 9. http://www.gwec.net/uploads/media/Global_Wind_2007_Report_final.pdf. (Last visited April 9, 2008.)

[121] U.S. Department of Energy, "Wind Powering America: Installed U.S. Wind Capacity," and Global Wind Energy Council, *Global Wind 2007 Report*, p. 10.

[122] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 5.

[123] "Spain's Wind Energy Generation Reaches New High, Exceeding All Other Forms," *Wind Energy News* (March 20, 2007), http://windenergynews.blogspot.com/2007/03/spains-wind-energy-generation-reaches.html. (Last visited November 26, 2007.)

[124] Global Wind Energy Council, *Global Wind Energy Outlook 2006* (Brussels, Belgium, September 2006), p. 9, http://www.gwec.net/fileadmin/documents/Publications/GWEC_A4_0609_English.pdf. (Last visited November 26, 2007.)

[125] Global Wind Energy Council, *Global Wind Energy Outlook 2006*, p. 51.

[126] German Wind Energy Association, *Minimum Price System Compared with the Quota Model: Which System is More Efficient?* (Osnabruck, Germany, June 2005), p. 3, http://www.wind-works.org/FeedLaws/Germany/BWE%20Minimum%20price%20system%20compared%20with%20the%20Background_Systeme_eng.pdf. (Last visited September 7, 2007.)

[127] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 21.

[128] American Wind Energy Association, "Extend the Production Tax Credit (PTC): Urge Your Senators to Extend PTC," "AWEA Legislative Priorities: Production Tax Credit Extension," http://www.awea.org/legislative. (Last visited April 28, 2008.)

[129] U.S. Department of Energy, *Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006*, p. 21.

[130] American Wind Energy Association, "AWEA to Hill Committee: Bill Would Shut Down Wind Energy Industry," *Wind Energy Weekly* (May 25, 2007), http://www.awea.org/windenergyweekly/WEW1242.html#Article1. (Last visited September 7, 2007.)