

Catching Wind



Wind power, which currently generates less than 1 percent of the electricity used

domestically, is being more seriously considered as an energy source by utilities across the United

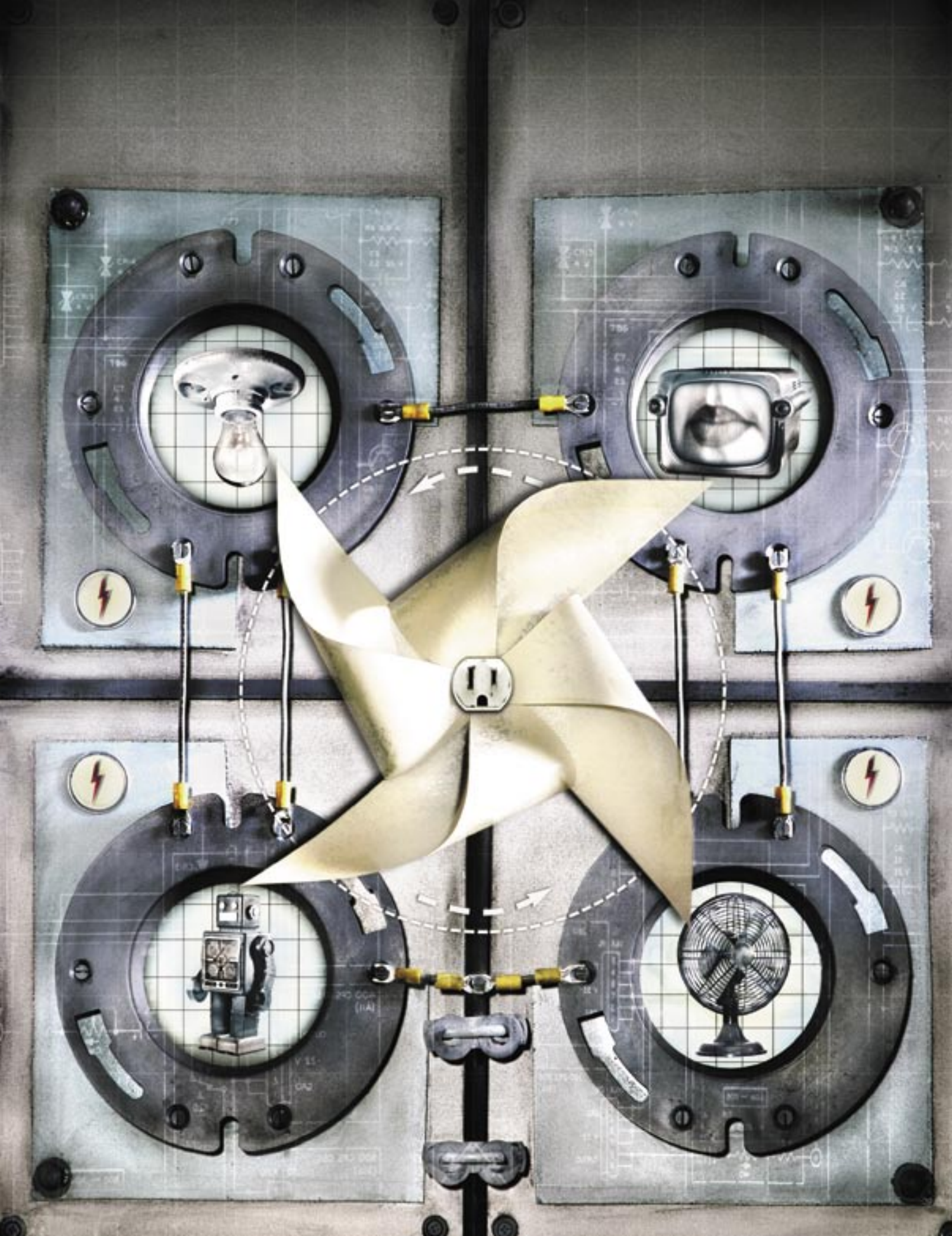
States these days. However, mainstream adoption of the technology may be hobbled by the lack

of a coordinated energy policy, as well as inconsistent planning triggered by a dependence on

federal wind energy production tax credits (PTCs) that require periodic legislative renewal.

By Al Senia

Illustrations by Tod Kapke





Although wind energy now is becoming more price competitive, thanks to improved turbine technology and enhanced economies-of-scale — as well as spiraling prices of competing energy sources like natural gas — its long-term future remains uncertain because the entire industry is mired in a boom-and-bust cycle largely caused by its reliance on the federal tax credits.

“In the U.S. what is driving wind investment is the production tax credit,” says Chuck McGowin, a wind power specialist at the Electric Power Research Institute (EPRI). “It’s helped create a boom-and-bust situation. This year is another boom year with the credit scheduled to expire at the end of the year.”

However, the market just isn’t steady, says Tom Carbone, president of Vestas Americas, a company that provides turbines and other components for wind generation facilities. “Nobody is going to create an infrastructure for a market that is going to start up and then stop,” he says.

The PTC, which provides a 1.8-cent per kilowatt-hour credit, brings the real operating cost of wind to about 3 to 5 cents per kilowatt-hour, making it cost competitive with natural gas and other energy sources and allowing developers to submit bids that are nearly one-third lower. Many expect the PTC to again be renewed, but the required legislative action creates enough uncertainty to lead to a stampede of investment in the year before its possible expiration.

The most recent PTC extension came last October. It is set to expire at the end of 2005. Congress approved it in the Energy Policy Act of 1992, figuring it would help expand the use of wind energy and counteract incentives received by the fossil fuel industry. The credit is given to power produced during the first 10 years of a wind farm’s operation. A typical wind turbine lasts about 20 years. The wind energy company subtracts the value of the credit from the business taxes owed.

Despite the unsteady domestic market, tax credits, state policies and the changing economics of wind power are helping boost its prospects. Wind energy use is rising, shortages of turbines and other components are being reported, larger players are muscling into the industry, larger projects are being funded, and strategic acquisitions are becoming more commonplace.

“The big players are getting involved in bigger projects,” notes Tim Libson, president of Trintek Energy Consultants. “They are going from 100 megawatts [plants] to 200 to 400 megawatts at a time.”

While this illustrates that the wind energy industry

is becoming more mature, it also puts the squeeze on smaller industry players already whipsawed by rising component prices.

Still, many in the industry are becoming more optimistic as new acquisitions bring bigger multinational players into what was recently a fledgling industry. “The unknowns are increasingly being taken out of the picture,” says Michael Skelly, vice president of development for Zilka Renewable Energy, a privately held wind development firm that Goldman Sachs announced plans to acquire in March. The transaction is expected to close in the second quarter. “Energy prices in general are high, and natural gas prices are staying high,” says Skelly, explaining that this helps make wind power a more economically viable alternative.

Skelly sees the economics of wind power becoming more positive, estimating that a wind plant is about twice as expensive to build as a combined-cycle gas plant, especially now that prices of steel, turbines and other components are rising. Still, he says the annual return-on-investment averages about 10 percent when the tax credits are figured in. The price of wind energy is also stable compared to the vagaries of the natural gas market. Once wind farms are up and running, there are no additional fuel costs to worry about.

Such business realities are spurring other large players to enter the market. For example, Siemens AG in December acquired Bonus Energy A/S, a Danish manufacturer of wind systems that has installed more than 5,000 turbines in more than 20 countries. Siemens now operates Bonus as part of the Denmark-based wind power division of the Siemens Power Generation Group. In a statement finalizing the agreement, Klaus Voges, president of Siemens Power Generation, said sales from the new division are “earmarked to rise at a significantly higher rate than the world market” for wind energy, which averages 10 percent annual growth.

“The focus will be on the markets in Europe, the United States, India and China,” he added.

In fact, Siemens already is marketing wind technology in the United States. “We’re optimistic, and view the U.S. market as an important market for wind,” says Mike Revak, director of wind energy for Siemens.

Revak believes that with the PTCs and growing renewable energy initiatives by many states, the market for wind energy “is sustainable for the long-term.”

According to Revak, wind energy is definitely growing. “The market is getting bigger, the facilities are getting larger, the economics of wind projects

Wind In The News >>

Compiled from news reports collected by Energy Central, www.energycentral.com.

WORLD

Australia

A new \$71.23 million wind farm in South Australia’s south-east can generate 46 megawatts of electricity.

Quebec, Canada

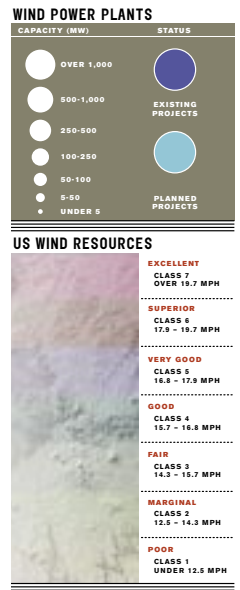
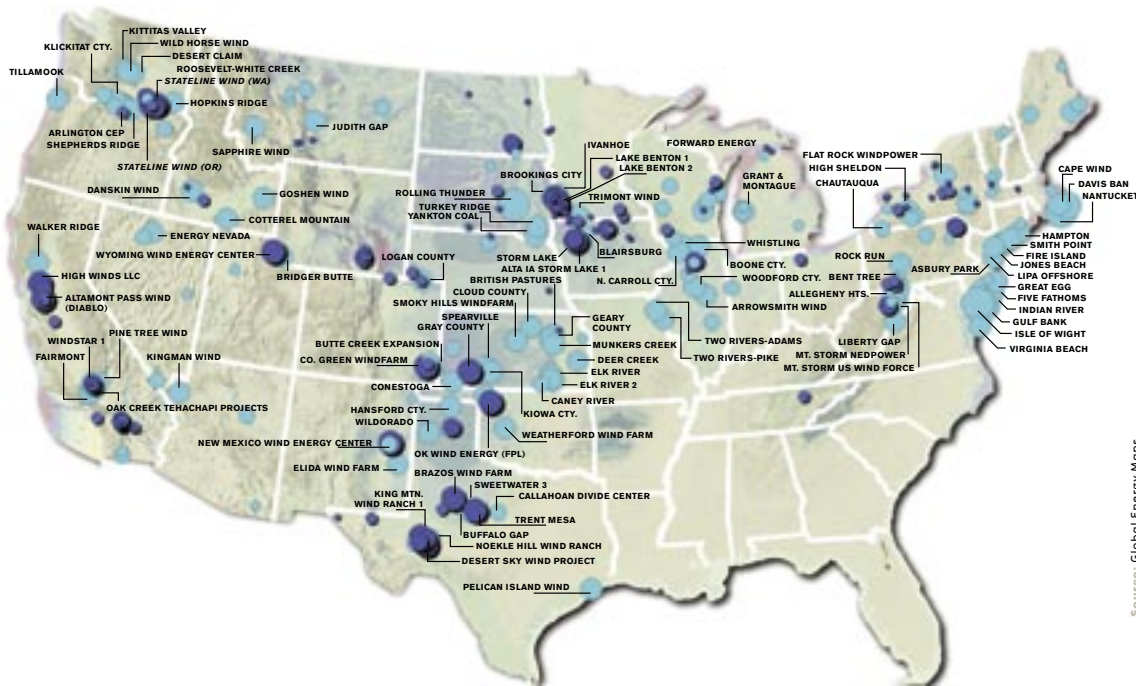
Two new wind-power projects in Quebec will involve 60 turbines and generate 108 megawatts of power. This will increase Canada’s wind generation 25 percent to 550 megawatts.

France

Boralex Inc. will build 38 wind turbines at two sites in France. They will generate 57 megawatts.

Germany

Australia’s Global Wind Partners is to acquire two German wind farm developments with a 19.5-megawatt capacity for \$30 million.



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are getting better," he says. "Even regulated utilities are looking at wind now. It's part of their overall energy portfolio."

The wind business benefits from regulations in 18 states that require utilities to provide certain percentages of their energy from renewable energy sources such as wind.

In fact, 2005 is shaping up to be a banner year for the wind business. The American Wind Energy Association expects that more than 2,000 megawatts of new wind generation capacity will be added this year — far above the 389 megawatts added in 2004. The AWA estimates there was 6,740 megawatts total installed capacity in the United States as of late January, with California having nearly one-third of that capacity at 2,096 megawatts and Texas second with 1,293 megawatts.

FPL Energy, a subsidiary of FPL Power Group, is the largest U.S. generator of wind power — with 44 wind farms in 15 states producing 2,900 megawatts or more than 40 percent of total wind generation. It expects to increase its wind production by 10 to 25 percent this year.

More utility companies are also starting to think seriously about including wind in their energy portfolios. "There's a growing interest, especially from municipal utilities because it is a way of diversifying their generation and developing renewable energy sources," says EPRI's McGowin. "They see it as a hedge against rising fuel prices."

Despite such interest, the U.S. market lags far behind Europe, which has a larger and more centralized commitment to renewable energy. One lingering problem hurting wind use in the United States is that once it's produced, wind energy is difficult to transport over long distances. The antiquated

transmission system now in place in the United States can't handle a resource like wind energy.

McGowin notes that the greatest potential for wind generation is in the less-populated central part of the country — far from where most of the energy is consumed. "North Dakota has the number one potential for wind generation," he says. "Unfortunately, there's no way to efficiently deliver the wind energy produced there to cities like Chicago or Milwaukee."

Carbone believes development of a coordinated federal energy policy would greatly help wind energy development by helping remedy the transport and tax credit uncertainties that plague the market. He points to the Canadian market as a case-in-point. Individual provinces provide incentives for clean energy projects. The federal government launched a Wind Power Production Incentive (WPPI), which is seeding wind energy projects across the country with millions of dollars. Under WPPI, power producers, utilities and energy co-operatives can receive an incentive of approximately one cent per kilowatt-hour produced by electricity from wind farms. Payments last for 10 years and begin when a plant becomes operational. Canada's wind market is less than one-tenth the size of the U.S. market, with 552 megawatts of wind capacity. However, the Canadian government has contributed to the development of nearly 60 percent of that capacity.

"There is a vision in Canada to create a strong, stable market," Carbone says. "It's a combination of incentives and programs. We need a long-term energy policy that provides for a period of sustainable growth instead of the start-and-stop approach with wind energy."

Odds are, however, that any such centralized approach to the U.S. wind energy industry is still years away.

UNITED STATES

California

The Campo Band of Kumeyaay Indians plans to erect 25 turbines on its reservation 60 miles east of San Diego, generating 50 megawatts.

Colorado

Florida Power & Light is considering construction of an \$80 million wind project involving 50 turbines on property in Adams County. Eventually, it could involve 100 turbines producing 150 megawatts. Currently, a wind installation near Lamar generates 162 megawatts.

Hawaii

UPC Wind has financed a 30-megawatt wind project on Maui that is expected to be up and running in 2006.



Boom Times For Wind Energy Suppliers



Equipment manufacturers serving the wind industry are experiencing another uptick in a classic boom-and-bust cycle. Some admit prices have risen, and others note that critical components are in short supply. In some cases, industry executives say plans for new wind energy plants are being deferred until the supply chain can handle the current upsurge in demand.

Wind In The News >>

Illinois

Gov. Rod Blagojevich wants Illinois to generate 3,000 megawatts of wind power.

A developer and Goldman Sachs have proposed installing 243 turbines capable of generating 400 megawatts of electricity. Navitas Energy Inc. has built a 50-megawatt wind facility 70 miles west of Chicago. In addition, the Crescent Ridge wind farm 120 miles west of Chicago, with 33 turbines, has started operation. The Illinois Rural Electric Cooperative is completing construction of a \$2 million wind project 70 miles west of Springfield.

Iowa

MidAmerican Energy Co. is developing a \$386 million wind farm. The project, half-finished, will produce \$300 million in tax benefits over 20 years, according to the Omaha World-Herald.

By Al Senia

"We've seen 20 percent price increases during the past year," says Michael Skelly, vice president of development for Zilka Renewable Energy, an independent Houston-based wind development company that's being acquired by Goldman Sachs.

He says the price hikes are being caused by rising steel prices, higher transportation costs caused by rising oil prices, and the strength of the Euro against the U.S. dollar. Many of the components used in wind plants are imported from Europe — where all the major manufacturers are based.

Skelly notes that the higher turbine and tower prices are passed on to the utility companies buying the power — and ultimately the ratepayers. "We pass these higher turbine costs on in some fashion," he says. "We pay to have many of the supplies shipped."

The cyclical nature of the U.S. wind industry also drives up costs, because there isn't a steady, predictable business plan, Skelly adds. That's precisely what's happening this year.

Despite the rising cost of wind plants, there's little indication that demand will drop off. Other energy prices are rising rapidly, too. Overall domestic demand for energy is rising. More utility companies, both municipal and investor-owner, are hedging their bets by including wind as part of their overall energy portfolios.

In fact, major wind plant manufacturers concede both a rise in price and backlog in demand — a reflection of the odd business dynamics at work in the U.S. market. Some have even stopped taking orders this year.

"There is a backlog in orders, and we are not committing to adding any more inventory to the North American market this year," says Tom Carbone, president of Vestas North America, a company that supplies, installs and commissions wind turbines.

Carbone says the company's turbine prices have increased about 15 percent this year due to rising costs of steel, petroleum and other basic components. It's also become more expensive to transport and erect wind towers. "In the early months of 2004, steel prices doubled," he says. "The oil price rise affects products like the resins and carbon fibers. Transportation costs are unbelievably high. It is all affecting our costs."

In any event, there has been such a rush to take advantage of the existing Production Tax Credit (PTC) for wind, which is set to expire this year, that the company isn't accepting new orders for the remaining part of this year and into the next.

Citing an order backlog in the United States and other markets, the Vestas Group, the Denmark-based parent company, recently adjusted its business expectations upward for this year because of booming worldwide demand. The company recently reported that 234 units of its V80-1.8 megawatt wind turbine were on order in the United States, and it upgraded its projected financial results for the year.

Carbone adds that the current upswing, part of the industry's periodic cycle, is noticeably more intense than in the past year, thanks to the rising commodity and transportation costs. "It is something that happens every two years, but this is a bit unusual," he says.

Pete Duprey, general manager of marketing for GE Energy's wind business based in Amsterdam, says, wind turbine prices are rising because of increased material cost as well as the short timeframe to satisfy demand caused by the federal tax credits. "Manufacturers don't want to invest in an on-again, off-again situation," he explains.

Another problem is that during the boom times, the supply chain is stretched, which tends to increase prices. (GE Energy would not specify the extent of its price increases, but some customers say the range is standard for the industry — about 15 to 20 percent.)

GE Energy announced last October it had secured contracts to supply more than 750 megawatts of wind turbines for new projects in the United States, touting order commitments exceeding \$1.3 billion. Duprey notes that GE's worldwide wind business totaled \$500 million and is expected to quadruple to \$2 billion in 2005. "The United States is a big chunk of that," he adds.

Duprey and other industry executives note the key materials used in wind turbines include steel (used for the tower, frame, gearbox and generator), and fiberglass (used in the blades) Steel costs are up more than 100 percent since last year. Fiberglass resin



Photo courtesy of: Siemens Wind Power

Wind In The News >>

Kansas

enXco, a California company, is planning to develop a wind facility that would initially generate 50 megawatts and eventually produce 200 megawatts from 134 wind turbines. The \$289 million project is expected to be operational in 2006. A separate \$190 million development with 100 wind turbines is expected to generate up to 150 megawatts.

Minnesota

Researchers are studying whether a wind turbine can efficiently produce hydrogen by splitting water. They will utilize a wind turbine that fills half of the energy needs at the University of Minnesota-Morris.

Montana

State regulators have approved NorthWestern Corp.'s purchase of 135 to 150 megawatts of wind-generated electricity. The power will come from a \$150 million wind farm which will have 100 turbines each with a capacity of about 1.5 megawatts.

Nevada

Nevada Power supports legislation that would encourage homeowners to install wind turbines on sites of one acre or more.

New Mexico

Construction is beginning on a 120-megawatt wind farm. It will be New Mexico's third wind installation. Wind powered turbines now generate 267 megawatts.

New York

ScottishPower and Zilkha Renewable Energy of Houston plan to construct a 198-megawatt wind facility upstate. It is expected to quadruple the state's wind capacity. The state has passed a law mandating that one-quarter of its energy be provided by renewable sources by 2013. In a separate deal, AES Corp. and EHN, a renewable energy company, have announced plans to develop 350-megawatts of wind generation. And local officials have approved a proposal to build a \$380 million, 195 turbine wind development in Martinsburg, Harrisburg and Lowville, in the central part of the state.

North Dakota

Glasfiber, a Danish firm, has completed a second plant expansion in Grand Forks. The company, which annual manufactures blades capable of generating 500 megawatts, in March signed contracts for projects totaling 2,400 megawatts over 10 years. FPL Energy, has announced plans to develop 34 turbines capable of generating 49.5 megawatts in northern Burleigh County, in the central part of the state. Oklahoma Oklahoma, with 176 megawatts of wind capacity, expects wind generation to produce an added 256 megawatts by 2007.

Oregon

The University of Oregon plans to buy \$11,400 in "green tags" from the Eugene Water & Electric Board to use wind power for its Erb Memorial Union for a year. And the city of Portland plans to use wind generated power at a leaf composting facility. By 2007, the city wants all its offices powered by renewable energy.

South Dakota

The governor has signed legislation to encourage development of wind generating projects in the state.

Texas

CPS Energy had acquired 100 megawatts of electricity from a wind farm to be built in West Texas.

Vermont

The state plans to provide \$300,000 worth of grants for wind power demonstration projects.

Washington

Puget Sound Energy is building a 150-megawatt wind project in the southeastern part of the state that will use more than 80 wind turbines.

Wisconsin

Developers plan to install 250 or more turbines in Fond du Lac and Dodge counties north of Milwaukee by 2006. Wind turbines currently generate about 53 megawatts of power in the state. In three years, that could increase to 1,000 megawatts.

is petroleum-based, and the increase in oil prices has impacted its cost. All of this is occurring at a time when demand is rising because of the PTCs.

Tim Libson, president and principal consultant of Trintek Energy Consultants, says the price increases and product shortages have caused some developers to step back from new wind investments because they fear economic losses if prices go much higher. "Basically, a power price is negotiated. Then, the turbine price rises 15 percent, and the economics no longer make sense. It could throw a lot of smaller wind developers into real turmoil," he says.

On the other hand, some of the smaller plant manufacturers could end up benefiting from the inability of the major players to meet demand. They have an opportunity to capture market share – if they succeed in staving off other new international entrants eyeing the U.S. wind energy market.

For example, Siemens' recent acquisition of Bonus Energy of Denmark has potentially set up another U.S. player, although officials said that no large U.S. orders had been booked as of April. Mitsubishi, another recent U.S. entrant, still has a small market share.

If the PTC is renewed – or perhaps made more permanent than just two years – the market would stabilize and these new players could be positioned to gain market share. If the tax credits expire, however, the U.S. wind market would likely wither in the short term. Meanwhile, the order backlog seems likely to extend into 2006. "A lot of the wind projects this year could get deferred or even cancelled because of the lack of turbines," Libson notes. "Now people are trying to get turbines for next year."

The uncertainty over the PTCs could cause further confusion in an already unpredictable marketplace.



Wind's Technology Magnet



"You build 'em, we'll break 'em" could be one of the mottos for the National Wind Technology Center (NWTC) — the only facility in the world equipped to test every part of a wind turbine by taking it to its limit. Testing wind turbine blades for endurance is one of the many services NWTC provides to support the research and development of advanced wind energy systems.

By Robert Thresher



Photo by: Warren Gretz



Photo by: National Renewable Energy Laboratory

Operated by the National Renewable Energy Laboratory (NREL), the NWTC, based in Golden, Colo., is designed not only to be a center for research, but also a technology magnet for a rapidly growing industry. It's a place where NREL scientists work side by side with wind turbine developers to create the advanced wind systems of the future; where wind plant operators and utilities can come for technical assistance; and where wind turbine system and component manufacturers can come for research and test support that is second to none.

Funded under the U.S. Department of Energy's (DOE) Wind and Hydropower Technologies Program, NWTC provides its industry partners with support in applied research and engineering analysis in the following areas: subsystem and component engineering and testing; systems and controls analysis; structural, dynamometer, field, and certification testing; utility integration analysis; resource assessment; and outreach.

Through its industry partnership with Clipper Wind Power, NREL's research and development efforts helped accelerate the development of Clipper's new multimewatt advanced wind turbine that began field testing at Medicine Bow, Wyo., in March. Past industry partnerships were instrumental in producing the early prototypes that led to the GE Energy 1.5-megawatt wind turbine that is marketed around the world, while ongoing collaborations are working to produce advance prototypes for land-based and offshore applications.

A Unique Location

Sitting on 305 acres at the foot of the Colorado Rockies, the NWTC is ideally situated for research and development testing of wind turbines because it experiences two distinct wind patterns. First, strong

westerly winds sweep across the Continental Divide during the fall and winter. These winds accelerate as they blast over the ridges and down through the canyons along the Colorado Front Range, occasionally reaching speeds of up to 120 miles per hour and providing the severe environment needed for testing wind turbines. The second wind pattern occurs in late winter and spring, when smooth, stable, easterly and northeasterly winds blow in from the Great Plains. These winds are equally important because they are ideal for testing the performance of wind turbines under typical Midwestern conditions.

Dynamometer Test Facility

The NWTC's dynamometer test facility gives the U.S. industry an edge over strong European competition because it's the only facility of its kind in the world. The 2.5-megawatt dynamometer is used to conduct a range of wind industry system tests that cannot be duplicated in the field, offering wind industry engineers a unique opportunity to conduct accelerated life endurance tests on a wide range of wind turbine drive trains and gearboxes at various speeds using low or high torque. A few months of endurance testing can simulate 30 years of use and a lifetime of braking cycles, thus helping engineers determine which components are susceptible to wear. Tests conducted on the dynamometer include: gearbox accelerated gear life, lubrication, and wear; wind turbine control simulations; transient operation; and generator and power system component efficiency and performance.

Before NREL's dynamometer facility was completed in 1999, the only way to verify operating integrity was to test a field prototype under severe conditions.

Industrial User Facility

The Industrial User Facility (IUF) at the NWTC is the center for collaborative activities within the wind industry. The building includes office space for industry researchers working with wind program technical staff, experimental laboratories, computer facilities for analytical work, and space for assembling components and turbines for atmospheric testing. The facility also houses control rooms, a high bay, and several smaller test bays that protect proprietary information while companies disassemble turbines to analyze, test, and modify individual components.

In the high bay, NWTC researchers conduct a full range of structural evaluations including ultimate static-strength, fatigue, vibration, and nondestructive tests. Wind turbine companies

■ [Above]
Vibration tests help researchers analyze new blade designs at the National Wind Technology Center.

■ [Below]
Robert Thresher stands atop a drivetrain for a 2.5-megawatt Clipper Windpower wind turbine being tested in Golden, Colo.

also use the facilities to verify and improve new blade designs, analyze blade structural properties, and help improve manufacturing processes.

In 2004, the NWTC tested the longest blade in the facility's history for industry partner TPI Composites. The 45-meter blade was 10 meters longer than the facility was designed to handle. To accommodate the blade, the NWTC made temporary upgrades that will become permanent in 2005.

Working With The Industry

The federal Wind Energy Program has worked with members of the wind energy industry for more than two decades to develop efficient, reliable, cost-effective technologies. Although their efforts have helped reduce the cost of wind energy at prime wind sites from 80 cents (current dollars) per kilowatt-hour (kWh) to between 4 and 6 cents per kWh, researchers believe that the cost of wind energy can be reduced by an additional 30 percent to 50 percent with continued research.

The NWTC works with industry in a public/private contracting environment to research, design, and build advanced wind turbines. The facility maintains an outstanding performance record for working with the wind industry to advance wind turbine science and lower the cost of wind-generated energy. Companies are competitively selected to partner with the NWTC when they have particular design challenges, when they wish to cost-share development of state-of-the-art wind turbines, and when they want to document their turbine's performance through rigorous testing.

Flexibility is the key to government/industry collaborations at the NWTC, where companies get the support they need and can take full advantage of the center's capabilities. Some companies provide their own engineering expertise and only require access to facilities. Others have NWTC engineers conduct tests on equipment, then report on the results. Dedicated to making its equipment and facilities available to industry through a cooperative agreement that's convenient, affordable, and protects their intellectual property, the Center's efforts support the DOE's goal of ensuring that federally sponsored technology development reaches the marketplace. By encouraging industry's efforts to develop better wind turbines, the Center is helping to create a stronger domestic economy and new jobs in the wind industry.

Robert Thresher is director of the National Wind Technology Center in Golden, Colo.

Future Wind Research

Twenty-five years of research and development efforts have dramatically increased wind turbine capacities, which have grown from 50 kilowatts to 2,000 kilowatts, and reduced the cost of energy by more than 80 percent. Today a single 1.5-megawatt wind turbine can power hundreds of homes, and wind farms are cropping up around the world.

The total global wind energy capacity at the end of 2004 was 47,317 megawatts, and the United States claims 6,740 of that – enough to power 1.6 million average homes. The average size of utility-scale wind turbines manufactured today is 1.2 megawatts, and the largest U.S. manufacturer of those turbines is GE Energy. GE's 1.5-megawatt turbine is a descendent of prototypes developed under the U.S. Department of Energy Wind Program based at the National Wind Technology Center (NWTC) in Golden, Colo.

To become competitive, wind turbines will need to be even larger and more efficient than today's machines. Most of today's 6,740 megawatts of wind capacity is generated by technologies that require higher wind speeds – 6.7 meters per second (15 mph) at a height of 10 meters (33 ft). As the industry grows, high wind speed areas that are close to the load centers and hence, economical to develop, are being gobbled up, leaving only hard-to-access sites and sites with lower wind speeds. Developing land-based wind energy technologies that can produce electricity in low wind speed areas – 5.8 m/s (13 mph) at a 10-m height – will be key to ensuring industry growth for the next 3 – 6 years. The goal of the Wind Program is to help industry develop land-based technologies that will produce electricity at these lower wind speed areas for 3 cents per kilowatt-hour by 2012.

But developing bigger better machines will be only part of the wind energy success story. There's enough wind in the Great Plains alone to generate more electricity than our country currently uses. Unfortunately, our transmission grid is already heavily loaded and cannot support the addition of that much wind energy.

Long-term industry growth will depend on developing deepwater, offshore wind technologies.

Higher quality wind resources (reduced turbulence and increased wind speed), proximity to loads, increased transmission options, potential for reducing land use and aesthetic concerns, and relaxed size constraints on transportation and installation are a few of the advantages of offshore wind energy development. Researchers estimate that there is more than 100 gigawatts of capacity off the coast of New England alone, but most of those resources are located in deeper waters (depths greater than 30 meters). The Wind Program's near-term offshore wind energy goal is to help industry develop technologies for shallow water (less than 30-meter depth) that will produce electricity for 5 cents/kWh by 2012. With adequate R&D funding, long-term offshore objectives would focus on developing the technologies needed for deepwater wind energy applications such as cost-effective, highly reliable floating platforms and anchoring systems.

- Robert Thresher

Japan Moves To Harness Wind



The sunshine glares on Izena Island, a small island in Okinawa Archipelago located 1000 miles southeast of Tokyo. It's a perfect spring day, yet some inhabitants would prefer typhoons to the nice weather. That's because it's their job to survey wind resources on the island and analyze complicated wind conditions.

By Hideo Shindo



Photos courtesy of: Hideo Shindo and NEDO

Dispatched from Fuji Heavy Industries Ltd., these researchers are funded by an independent administrative agency called the New Energy and Industrial Technology Development Organization (NEDO). This organization is a non-profit, semi-government entity created to undertake comprehensive research and development activities in the fields of new energy technologies as well as advanced industrial technologies.

With an annual budget of \$2.5 billion, NEDO spent approximately \$34 million for development, demonstration and introduction of wind power generation technologies in Japanese fiscal year (JFY) 2004. Prior to that, it invested about \$194 million in research and development of wind power technology since 1981. The Japanese government has also chipped in about \$540 million to help local government and private companies implement this technology since 1997.

Japan has long suffered from scarce natural and energy resources, depending primarily on imported oil. As a result, its willingness to develop and introduce new types of energy is extremely high. For example, Japan is the world leader in terms of production as well as introduction of photovoltaic solar power generation, dominating almost half of the world market share. However, it falls to ninth place in the wind power generation arena. Renewable energy (except hydropower generation) amounts to only 1 percent of the total primary energy supply in Japan.

The Advisory Committee for Natural Resources and Energy, an advisory panel for Japanese Ministry of Economy, Trade and Industry (METI), has established a challenging target to increase this share to 3 percent by 2010. With respect to wind power generation, the target



is to increase the operating wind capacity from 677 megawatts at the end of JFY 2003 to 3,000 megawatts in JFY 2010.

To achieve this goal, is it still necessary for the government to show strong leadership in the R&D of wind power generation technology? According to one NEDO expert, R&D of windmill technology is almost finished. So what's next?

One reason why there has not been a large deployment of wind power generation in Japan so far compared to Europe is the fact that wind directions and its strength change unpredictably in Japan besides its narrow land mass.

The main objective of the Inaze wind experiment is to conduct a thorough survey on such variable wind conditions and develop a wind power generation system suitable to the Japanese climate.

Are there any other technological challenges remaining in this field for Japan or NEDO? An expert of grid connection technology in NEDO raises three challenges: cost reduction, improvement of reliability, and future generation technology R&D. Cost reduction is necessary not only in terms of production of windmills but also in their installation and maintenance. Improved capacity load by selecting best locations with most potential is also important for cost reduction. A reduction of the number of accidents and malfunctions as well as the impact of fluctuation of wind power generation on power grids will be key factors toward making wind technology more reliable. Introduced in 2003, the Renewable Portfolio Standards Law has resulted in a remarkable increase in private and local government purchase of windmills in Japan. The operating wind capacity in Japan increased eightfold from 1999 to 2003. Providers of wind power generation equipment are not limited to Japanese manufacturers such as Fuji Heavy Industries or Mitsubishi Heavy Industries. European and U.S. manufacturers have also been playing a considerable role in the Japanese wind power market — that will definitely be one to watch in the future. ☒

Hideo Shindo is the chief representative of Japan's New Energy and Industrial Technology Development Organization office in Washington.

■ [Above]

The Iwaya wind farm, located in Aomori Prefecture in northern Japan.

■ [Below]

Kazamidori, Japan's first offshore wind facility, located on Hokkaido Island and operated by Setana Town.

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Hibikinada Wind Farm, located in Kitakyushu on Kyushu Island.