2011 U.S. Small Wind Turbine Market Report

Year Ending 2011

AMERICAN WIND ENERGY ASSOCIATION

◂ *Photo courtesy of Gary Harcourt, Great Rock Windpower*

▾ *Photo courtesy of Bergey Windpower*

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Foreword

While the 2011 U.S. small wind turbine market (<100 kilowatts, or kW) decreased 26 percent (in MW), U.S. manufacturers' sales to domestic and export markets increased by 13.4 percent to 33 MW. In the U.S., more than 19 MW were installed, while revenues were $115 million, representing 7,300 turbines. The cumulative installed U.S. capacity increased to 198 MW, deploying 151,300 turbines.

Four U.S. manufacturers reported annual sales greater than 1 MW. Twenty-seven manufacturers with a U.S. presence reported sales of 60 turbine models. Grid-connected units dominated sales with a 91 percent share of sales capacity, continuing a five-year trend (the top 10 wind turbine models sold in the U.S. were grid-tied). While domestic sales by U.S. manufacturers accounted for an 80 percent share of the U.S. market by capacity and 90 percent of turbines sold, 54 percent of U.S. manufacturers' output went to foreign markets (representing a dramatic increase from 2010).

The 27 small wind turbine manufacturers from North America, Europe and South Africa responding to AWEA's survey reported total 2011 worldwide sales of $397 million, totaling more than 21,000 units and 64 MW.

While the federal 30 percent Investment Tax Credit remained an important financial incentive, the U.S. Department of Agriculture's (USDA's) Rural Energy for America Program (REAP) and U.S. Treasury 1603 payments supported 200 small wind installations in 30 states. State distributed energy incentives experienced turmoil but remained a major driver, especially in Alaska, California, Nevada, New York, Ohio, Washington and Wisconsin. More than 25 states offered small wind incentives (including the use of American Recovery & Reinvestment Act funds).

In 2011, the Small Wind Certification Council certified two turbine models that passed testing to the AWEA Standard, and 26 additional turbine models were scheduled for certification testing by five Regional Test Centers. The Interstate Turbine Advisory Council emerged as states collaborated to develop a comprehensive list of qualified turbines and incentive qualification guidelines.

AWEA partnered with the Distributed Wind Energy Association (DWEA) to host the annual 2011 Small and Community Wind Conference & Exhibition and collaborated on federal and state policy issues.

The U.S. manufacturers report 80 percent to 85 percent U.S. content, and the industry represents an estimated 1,600 full-time jobs. From an environmental perspective, the 179 MW installed annually displace an estimated 178,000 metric tons of carbon dioxide, the equivalent of removing 31,000 cars from the highways.

In 2011, the U.S. market and industry continued to experience challenges. Some key state incentive programs continued to be in flux, out of funding or facing curtailments; the USDA's REAP funding remains in jeopardy; and the U.S. Department of Energy's funding for small wind, state and school programs was minimal. The U.S. Fish & Wildlife Service guidelines contain language acceptable to the industry, but implementation concerns remain. Planning and zoning remain serious barriers in many jurisdictions, and competition from low-cost photovoltaics will continue to be a challenge.

On the bright side, the industry expects increased 2012 sales as the economy improves, state incentive programs are refreshed and certified turbines are installed as U.S. certification programs progress. Export markets — including European feed-in tariffs, telecom and wind- diesel applications — will continue to be important.

AWEA appreciates the cooperation of the 27 domestic and foreign manufacturers that contributed data, making the 2011 market report possible. We also thank the many content contributors, as well as the Energy Department's Wind and Water Power Program for funding the majority of the report's development. We hope you find the report interesting and informative.

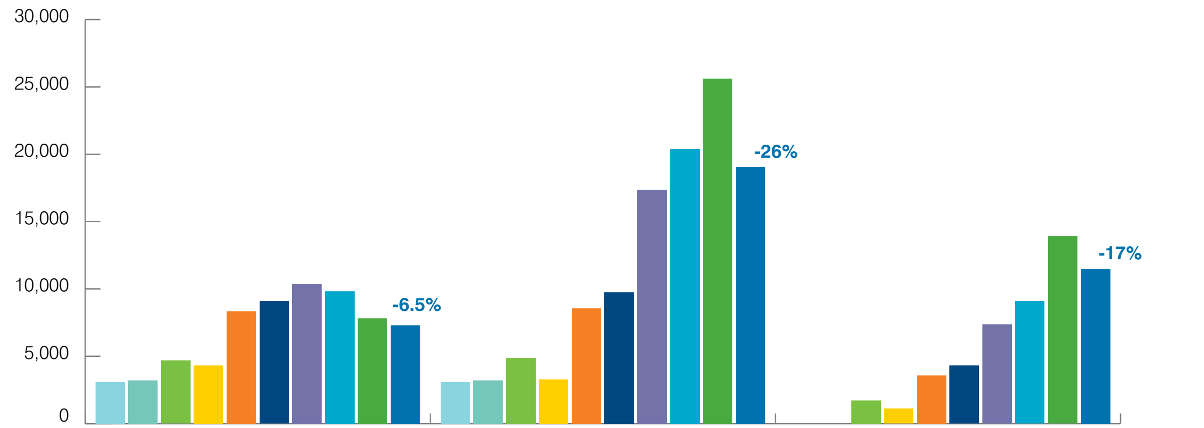
– Larry Flowers,
Deputy Director, Distributed and Community Wind,
American Wind Energy Association

Photo courtesy of Xzeres Wind Corp.


xzeres

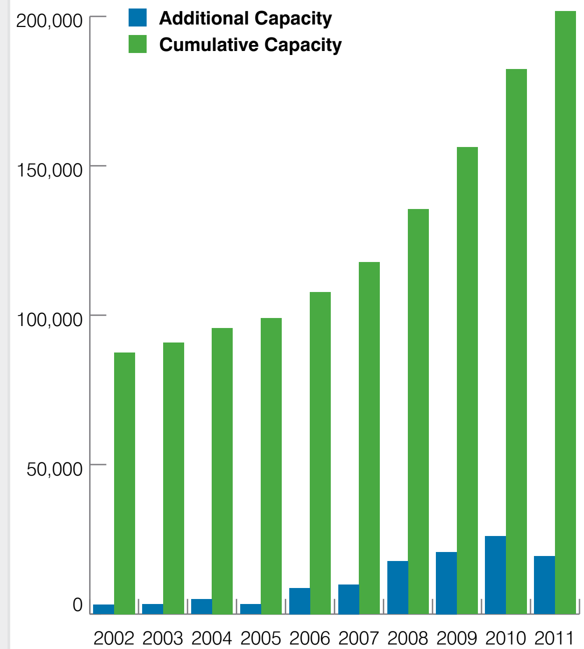
Market Highlights

Figure 1 U.S. Small Wind Turbine (≤100 kW) Market Growth



	Units	kW	Sales in 2011 $U.S. (x10,000)
2002	3,100	3,100	
2003	3,200	3,200	
2004	4,671	4,878	1,719
2005	4,324	3,285	1,105
2006	8,330	8,565	3,581
2007	9,102	9,748	4,305
2008	10,386	17,374	7,351
2009	9,820	20,375	9,096
2010	7,811	25,618	13,922
2011	7,303	19,033	11,498

Figure 2 New and Cumulative Capacity (kW, U.S.)



The 27 small wind manufacturers from North America, Europe and South Africa responding to AWEA's survey reported total 2011 worldwide sales of $397 million, amounting to more than 21,000 units and 64 MW.

In 2011, the U.S. market for small wind systems declined by 26 percent, with 19 MW of new sales capacity (representing 7,303 turbines) and $115 million in installed system revenue. Sales revenue declined by 17 percent, with units sold down by 6.5 percent.

The 2011 market growth increased cumulative sales in the U.S. to an estimated 198 MW of small turbine capacity.

Market Highlights

Figure 3 New and Cumulative Units (U.S.)

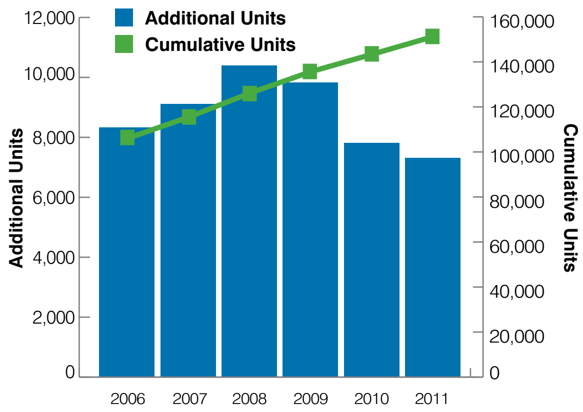


Figure 4 On-Grid Annual Sales (U.S.)

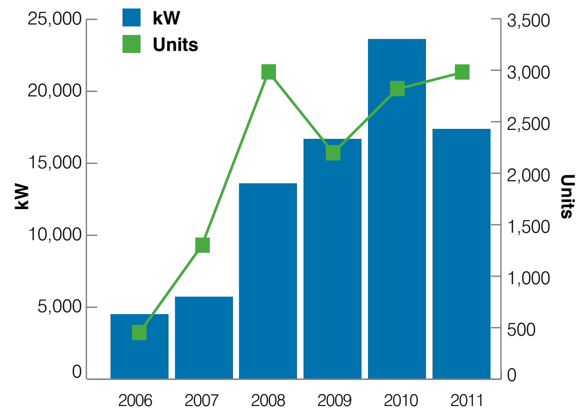
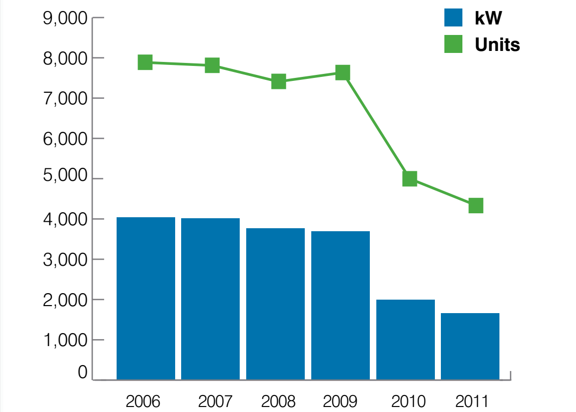


Figure 5 Off-Grid Annual Sales (U.S.)



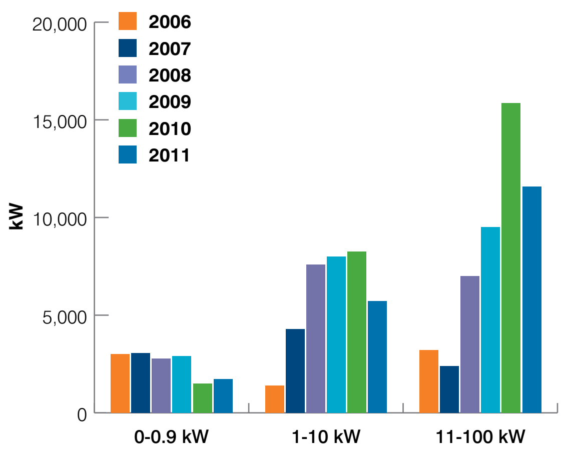
While the number of turbines sold in the U.S. declined for the third straight year, the 7,303 turbine installations in 2011 boosted total installations to 151,300 units. Four U.S. manufacturers reported sales greater than 1 MW, while an additional seven non-U.S. manufacturers exceeded that level.

While 10-kW to 100-kW on-grid sales absorbed the bulk of the 2011 U. S. market slump, grid-connected systems remained dominant, with a 91 percent market share of sales capacity, continuing the 2010 trend. The top 10 turbine models sold in the U.S. were grid-connected systems.

The U.S. market saw a modest reduction in off-grid unit sales from 2010, with both years down approximately 50 percent from 2006-2009 levels. New off-grid capacity totaled 1,651 kW, the lowest level in six years.

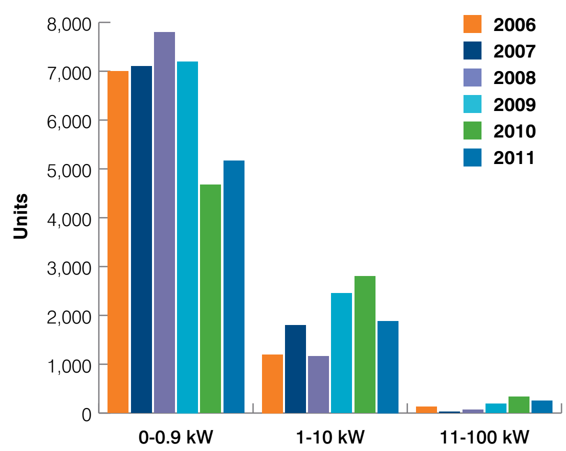
Market Highlights

Figure 6 Sales by Market Segment (kW, U.S.)



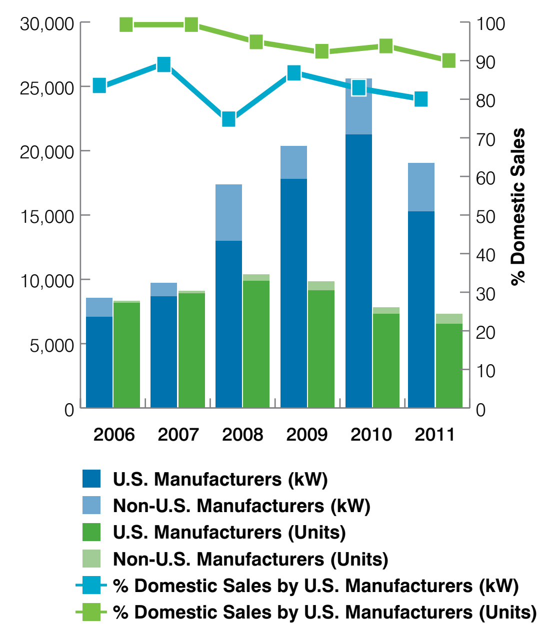
While only 3.4 percent of the small wind turbines sold in 2011 were larger than 10 kW, they accounted for 61 percent of total capacity, comparable to the 2010 market share. Sales of turbines smaller than 1 kW showed a slight increase over 2010, while sales of turbines in the 1- to 10-kW range dropped by 33 percent, and sales of units larger than 10 kW were down by 27 percent.

Figure 7 Sales by Market Segment (Units, U.S.)



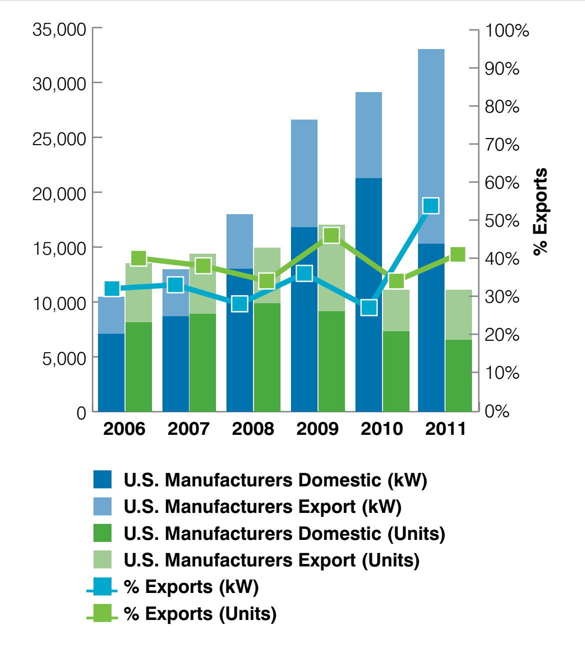
While units smaller than 1 kW saw a modest increase in 2011, unit sales in the >1-kW size experienced significant decline. Twenty-eight manufacturers with a U.S. sales presence, including those from Europe and Canada, reported sales of 60 wind turbine models; one-quarter of the models are rated less than 1 kW, half are rated 1 kW to 10 kW, and one-quarter are rated 11 kW to 100 kW.

Figure 8 U.S. Manufacturers' Share of Domestic Sales (kW and Units)



Domestic sales by U.S. manufacturers accounted for an 80 percent share of the U.S. market (in kilowatts), slightly down from 83 percent in 2010; on a unit basis, U.S. manufacturers claimed 90 percent of domestic sales, down from 94 percent in 2010.

Figure 9 U.S. Manufacturers' Exports (kW and Units)



Fifty-four percent of U.S. manufacturers' sales capacity went to foreign markets, reflecting a dramatic increase (from 7.8 MW in 2010 to 17.7 MW in 2011) and the most in the past six years; in terms of units, 41 percent of U.S. manufacturers' sales were exports, up from 34 percent in 2010. Exports were particularly important to the >1-kW sector.

U.S. manufacturers' combined domestic sales and exports were 33 MW, a 13 percent increase over 2010, continuing a six-year expansion totaling 300 percent.

- The top four U.S. manufacturers in terms of total 2011 sales were Northern Power, Southwest Windpower, Bergey Windpower and Polaris.
- The average installed cost of small wind turbines in the United States in 2011 was $6,040/kW, an 11 percent increase from 2010. U.S. manufacturers' weighted average installed cost was $5,800/kW, 18 percent lower than non-U.S. suppliers.
- Leading small wind turbines manufactured in the United States maintained 80 percent to 85 percent domestic content, continuing an increasing trend. Domestic components include power electronics, power cables, measurement equipment, gearboxes, yaw bearings, nacelles, mainframes, rear frames, hubs, blades and towers.
- The U.S. small wind industry represents an estimated 1,600 full-time equivalent jobs, including recent increases related to exports from U.S. manufacturers.
- U.S. small wind installations annually displace an estimated 178,000 metric tons of carbon dioxide (equivalent to removing 31,000 cars from service).

Photo courtesy of Gaia-Wind

Maine High School Students Plan Turbine Installation on Campus

After working toward its goal since 2004, a group of students calling themselves the Windplanners was successful in installing a Northwind 100 turbine at their school, Camden Hills Regional High School in Camden, Maine. The students gathered site data, researched wind feasibility, worked with town officials to change local ordinances, attended and testified at Public Utilities Commission hearings and raised the funds to purchase and install the 100-kW turbine.

Including controls and the monitoring system, the turbine cost approximately $390,000. Permitting, site work and installation cost an additional $175,000. For eight years the students worked to raise funds through grants, community events and private contributions. They also sold fruit smoothies to help raise money for the project.

In addition to fundraising, the students gained real-life experience while clearing all necessary hurdles to make the installation a reality. In September 2005, they made a presentation to the school board, which unanimously supported erecting a 140-foot meteorological tower to collect wind data. In the following month, the Windplanners appealed to the zoning board and received approval to build a tower after the board granted a special exception to the ordinance. The tower was installed in January 2006. In June 2007, the citizens of Camden voted to amend the town ordinance to allow a permanent 40-meter tower on school property. In August 2007, the data tower was removed and the data were analyzed. The school board voted unanimously to approve the project in May 2010. Locals attending a school board meeting in 2011 expressed concerns about sound, but the Windplanners did their homework, coming to the meeting armed with data to alleviate concerns. The turbine was installed in March 2011 on the Camden Hills campus by the baseball field and the track.

Sustainable Energy Developments Inc. of Ontario, New York, was the contracted installer. According to chief executive officer Kevin Schulte, turbine manufacturer Northern Power offered to forego the company's profit margin on the turbine to benefit the school. The installation contractor was required to provide some level of donation to the project, so Sustainable Energy Developments waived all of their employees' travel expenses incurred while working on the installation. Local businesses also donated the concrete and electrical work.

Schulte said that the interconnection for the Camden Hills turbine was simple because Maine has sound interconnection and net metering rules. The utility, Central Maine Power, does not require the school to pay a demand charge. According to Schulte, the turbine's expected production is 100,000 to 130,000 kilowatt-hours per year, and the turbine offsets an energy rate of 10 cents to 12 cents per kilowatt-hour. The turbine is expected to generate about 10 percent of the school's energy.

According to Schulte, the community has welcomed the turbine at Camden Hills, and the school's faculty members are incorporating the turbine into the curricula. All students are now required to design and build a wind machine and to test the efficiency of their creations as part of a class competition. The math department will use the data collected by the meteorological tower in the statistics course to study regression analysis. And questions associated with energy and sustainability are integrated into the Humans in the Environment and AP Environmental Science curricula.

To learn more about the Camden project, visit **www.fivetowns.net/subsites/windplanners/index.htm**

Photo courtesy of Sustainable Energy Developments Inc.

Wind for Schools Project Continues Progress in 2011

As the United States dramatically expands wind energy deployment, the industry is challenged with developing a skilled workforce to support it. In 2008, the U.S. Energy Department issued a report[1] describing a 20 percent wind energy future by 2030, which noted that 500,000 new annual full-time equivalent jobs would be created under this scenario. The Energy Department's Wind for Schools project focuses on K-12 and university educators and students to counter the trend of reduced numbers of U.S. students entering science and engineering fields. The project's goals are to:

- Equip college and university students with an education in wind energy applications
- Engage American communities in wind energy applications, benefits and challenges
- Introduce teachers and students to wind energy.

In 2011, 33 turbines were installed as part of the program in the following locations:

- Alaska: Northwestern Arctic Career and Technical Center in Nome, University of Alaska (Mat-Su campus) in Palmer
- Arizona: Northern Arizona University in Flagstaff, Orme School in Mayer, Saint Michael Indian School in St. Michaels, Williams Elementary/Middle School in Williams, Ponderosa High School in Flagstaff
- Colorado: Ponderosa High School in Parker
- Kansas: Eudora High School in Eudora, Jefferson West Middle/High School in Meriden
- Nebraska: Crawford Public Schools in Crawford, Creighton Public Schools in Creighton, Garden County Public Schools in Oshkosh, Hyannis Public Schools in Hyannis, Logan View Public Schools in Hooper, Pleasanton Public Schools in Pleasanton, West Holt Public Schools in Atkinson
- North Carolina: Alleghany High School in Sparta, Avery County High School in Newland, Cape Hatteras Secondary School of Coastal Studies in Buxton, College of Albemarle - Dare Campus in Manteo, College of the Albemarle - Edenton in Edenton, First Flight Middle School in Kill Devil Hills, JP Knapp High School in Currituck, North Wilkes Middle School in North Wilkesboro, Watauga High School in Boone
- Pennsylvania: Penn State in University Park
- South Dakota: Brookings School District in Brookings, Lake Andes School District in Lake Andes, Mitchell Technical Institute in Mitchell, South Dakota School of Mines and Technology in Rapid City
- Virginia: Henley Middle School in Crozet, Northumberland Middle/High School in Heathsville.

The project's results as of December 2011 are:

- Eleven states have active programs.
- At the university level, more than 60 students graduated in 2011 with active involvement in the Wind Application Centers.
- Approximately 100 turbines have been installed at host schools, impacting many thousands of students.
- Teacher-training programs have been implemented in almost all participating states.
- There is strong interest in developing programs in additional states (including Texas, Iowa and Maine) and a defined affiliate program that allows these interested schools and states to participate in the program at no cost to the Energy Department.
- New curricula for the K-12 and university levels have been developed to support educational opportunities for students. Wind for Schools also supports teacher training and curricula developed by the National Energy Education Development Project, the KidWind Project and Windwise Education.
- A wind turbine data collection and storage mechanism is under development and collecting data for 40 percent of the turbines currently installed. This is the first step to allowing data from turbines to be incorporated directly into curricula at the K-12 and university levels.

Photo courtesy of Jonathan Austin

Federal & State Incentives

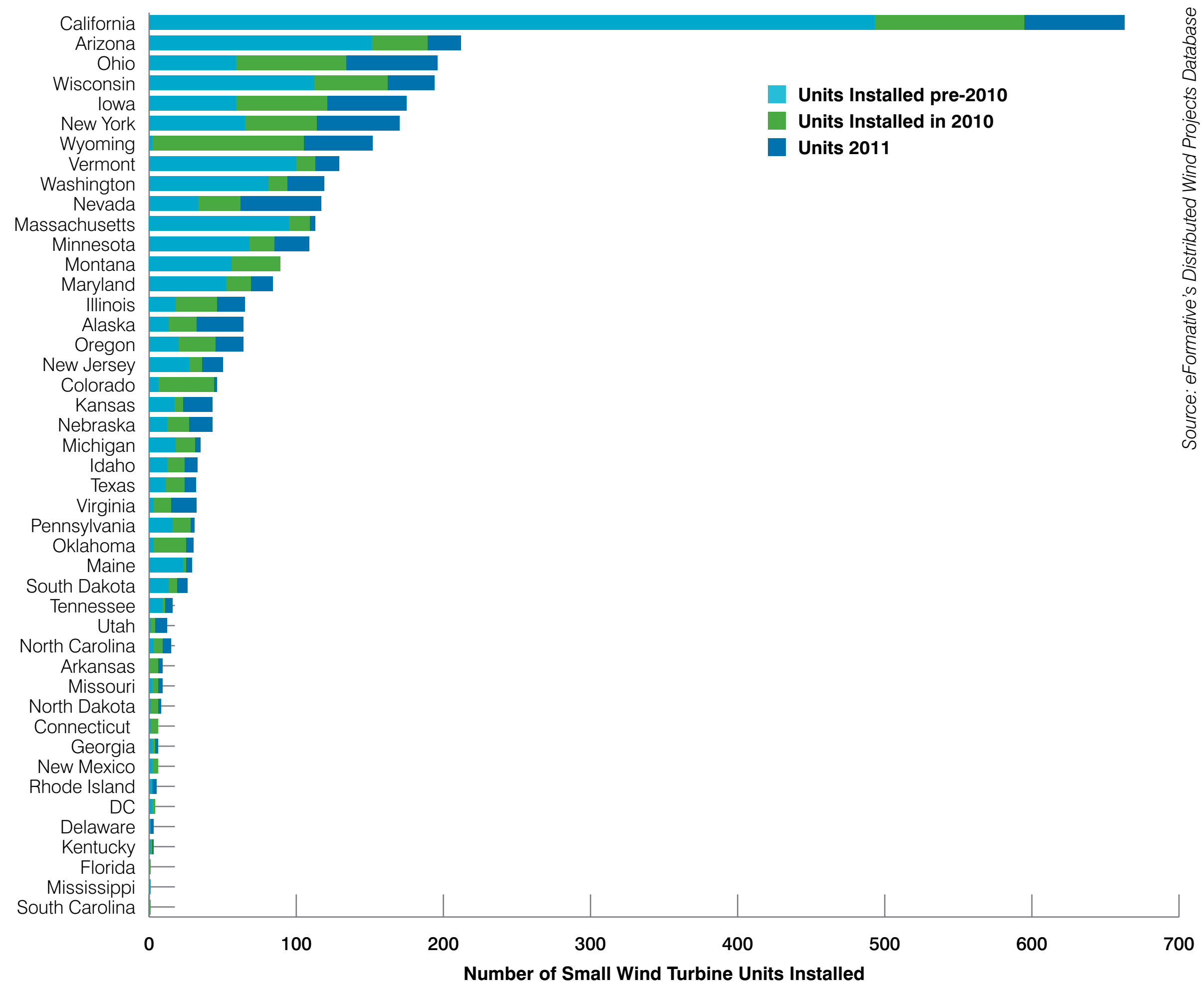
In 2011, federal, state, utility and local agencies leveraged private investment to meet on-site energy needs, reporting more than $38 million in rebates, tax credits, grants, low-interest loans and other forms of funding assistance for small wind installations in 39 states, a 27 percent increase above the $30 million reported for 2010 and exceeding the $35.6 million cumulative total reported for 2001 to 2009.[2,3]

The 2011 reported funding supported the installation of almost 700 wind turbines totaling more than 18.5 MW, including some re-manufactured turbines. While the number of units installed with funding declined from 2010, the average size of the turbines increased, leading to more installed capacity. The figures show substantial growth compared to the 12.4 MW installed with funding assistance in 2010 and the 16.8 MW of cumulative capacity installed with funding assistance during 2001 to 2009.

The average size of U.S. small wind turbines receiving funding assistance in 2011 increased to nearly 17 kW, up from an average of 14 kW for turbines funded during 2010 and 10 kW for turbines funded during 2001 to 2009. This compares to the national average turbine size of 2.6 kW for small wind turbines sold in 2011, 3.3 kW sold in 2010 and 1.3 kW sold during 2001 to 2009.

On a per-unit basis, the portion of small wind turbine sales receiving funding assistance decreased slightly to 9 percent for 2011 from more than 10 percent during 2010, still significantly more than the 5 percent that received funding

Figure 10 Small Wind Turbines Installed with Federal, State, Utility & Local Funding Assistance



during 2001 to 2009. Of grid-connected small wind turbines, more than 23 percent received some form of federal, state or local funding assistance, compared to 30 percent in 2010.

Compared to average small wind funding levels during 2010, average funding levels decreased 37 percent on a capacity basis but increased 29 percent on a per-unit basis, to $2.05 per Watt and $56,000 per turbine.

U.S. Treasury 1603 payments and grants and loans from the U.S. Department of Agriculture's (USDA's) Rural Energy for America Program (REAP) funded approximately 200 small wind installations totaling 5.8 MW in 30 states. Projects in Iowa, Ohio, Wisconsin, Massachusetts, Minnesota, Nevada and Kansas collected three-fourths of this $11.7 million (see Figure 11). REAP grants for small wind totaled less than $1.7 million in 2011, down from $8.5 million in 2010.

In 2011, 1603 payments represented less than 3 percent of U.S. small wind market revenues, compared to nearly 14 percent of the total U.S. solar market value.

California and Ohio led the states in funding the most small wind turbine installations, followed by New York, Nevada, Iowa and Wyoming (see Figure 10). Prior to 2011, nine states each had 100 or more cumulative small wind turbines installed with funding assistance. By the end of 2011, 12 states had reached that level.

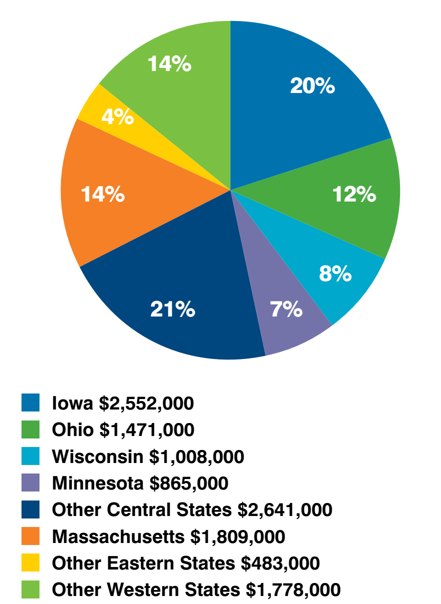
California, the dominant leader in terms of cumulative funded small wind installations, still led in 2011 with 68 new units funded. While California remains well ahead of all other states with more than 660 cumulative small wind turbines installed with funding assistance, total funding provided in Ohio and Alaska (see Figure 12) and cumulative capacity of funded installations in Ohio, Iowa and Wisconsin (see Figure 14) now exceed California's.[4]

Three more states crossed the 1-MW threshold of funded small wind turbines during 2011, bringing the total to 11 states.[5] The number of states with at least 100 kilowatts funded increased from 31 to 34 states. Ohio and Nevada increased their funded small wind capacity by more than 3.5 MW, while Alaska installed 2.5 MW and Iowa installed 1.8 MW. At the end of 2011, small wind installations had received more than $1 million in each of 19 states and more than $100,000 in 34 states, up from at least $1 million in 14 states and more than $100,000 in 33 states in 2010. Nevada, Texas, New Jersey, Ohio, Minnesota and Vermont saw the largest percentage increases in small wind funding assistance during 2011.

A substantial number of projects in Alaska, Iowa, Nevada, Ohio, Wisconsin, Minnesota and Kansas effectively leveraged funding for commercial applications of small wind turbines larger than 30 kW in 2011, while California, New York, Wyoming, Ohio, Washington, Iowa and Nevada saw relatively large numbers of smaller, residential-scale turbines.

In 2011, several states re-instituted their incentive programs (most notably California, which was on hold for eight months and reopened for just a few qualifying turbine models in November 2011). Due in part to the time-consuming process of small wind turbine certification, some state programs are still on hold or have instituted temporary criteria in lieu of certification.

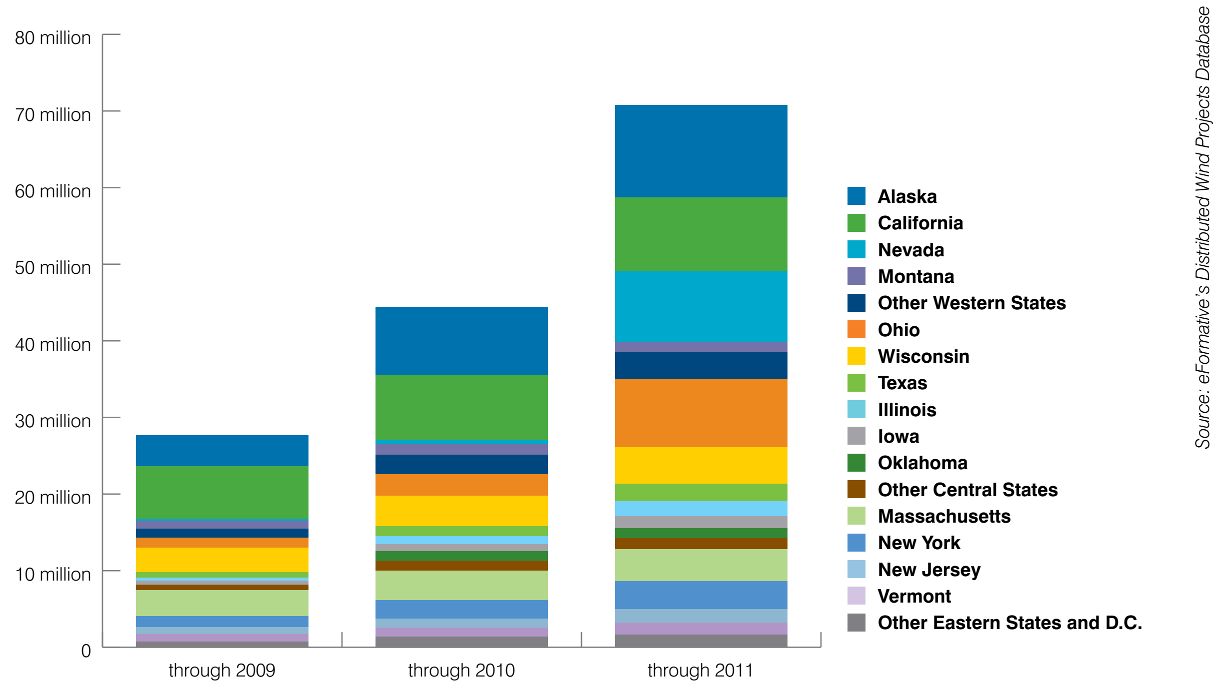
Figure 11 2011 USDA REAP & Section 1603 Grants for Small Wind Turbines



Sources: USDA and U.S. Treasury Department

Federal & State Incentives

Figure 12 Funding by Region



While state cash incentive programs contributed substantially to 2011 small wind turbine sales, many were short-lived or experienced funding gaps – a continuation from 2010. Small wind cash incentives and grants were offered in at least 25 states in 2011, with one-fifth of those programs using American Recovery and Reinvestment Act (ARRA) funds as a primary or supplementary source.

Texas, Wisconsin, Nevada, Minnesota, Colorado, Vermont, Illinois, Arkansas and Utah temporarily or permanently closed their small wind programs during 2011 after they became fully subscribed.

Even in states not dependent on ARRA funding, demand continues to outpace available funding, and legislatures have scaled back numerous tax credits and incentives, leading to a shift toward revolving loan funds and other financing support. A growing number of states and utilities are considering feed-in tariffs and standard offer contracts as well as other performance-based incentives for distributed generation rather than offering payments based on renewables.

While utilities in all but a few states now offer some form of net metering, only 16 states (California, Delaware, Georgia, Hawaii, Louisiana, Maine, Maryland, Minnesota, Missouri, Montana, Nebraska, New Hampshire, Oregon, Vermont, Washington and West Virginia) have "statewide" net metering policies covering all types of public and private utilities. Rural electric cooperatives in nine additional states (Arizona, Arkansas, Kentucky, Michigan, New Mexico, Oklahoma, Utah, Virginia and Wyoming) offer at least limited net metering.

Eleven states (Arizona, Colorado, Indiana, Iowa, Maryland, Massachusetts, Minnesota, Nevada, Ohio, Tennessee, and Wisconsin) offer statewide property tax and sales tax incentives for small wind installations. An additional 17 offer statewide property tax incentives, five allow localities to offer property tax incentives and seven offer sales tax incentives for small wind.

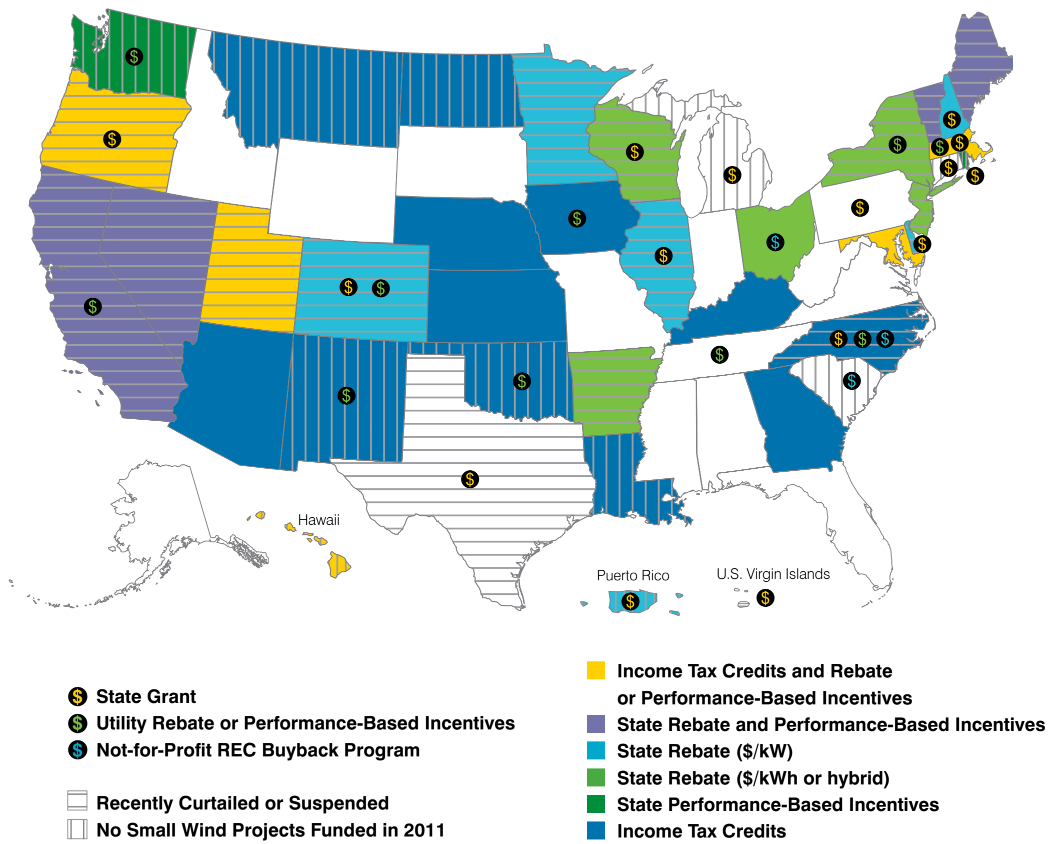
Rebates, Cash Incentives & Other Direct Financial Assistance

Federal, state and utility financial assistance programs – rebates, tax credits, grants and other incentives – are the primary market drivers for all renewable energy resources, including small wind. Thirty-five states (and Puerto Rico, the U.S. Virgin Islands and Washington, DC) offered some form of rebates, tax credits, grants and other direct financial incentives during 2011 (Figure 13).

The federal Investment Tax Credit (ITC), part of the Emergency Economic Stabilization Act of 2008, provides a 30 percent tax credit for small wind systems through 2016. The USDA has continued the REAP, which provides grants and guaranteed loans to qualified installations. The 1603 program, part of the ARRA that expired in December 2011, funded the installation of more than 140 small wind turbines in 2011. Eight state programs that used ARRA funds for incentives are discontinuing their programs or putting them on hold due to lack of funding.

While the policy landscape continues to fluctuate, these state and federal incentives have dramatically improved the economics of small wind in the U.S. Other policies and programs also improve the economics of small wind, including net metering, feed-in tariffs, revolving loan funds with favorable financing and utility revenue de-coupling from company profits.

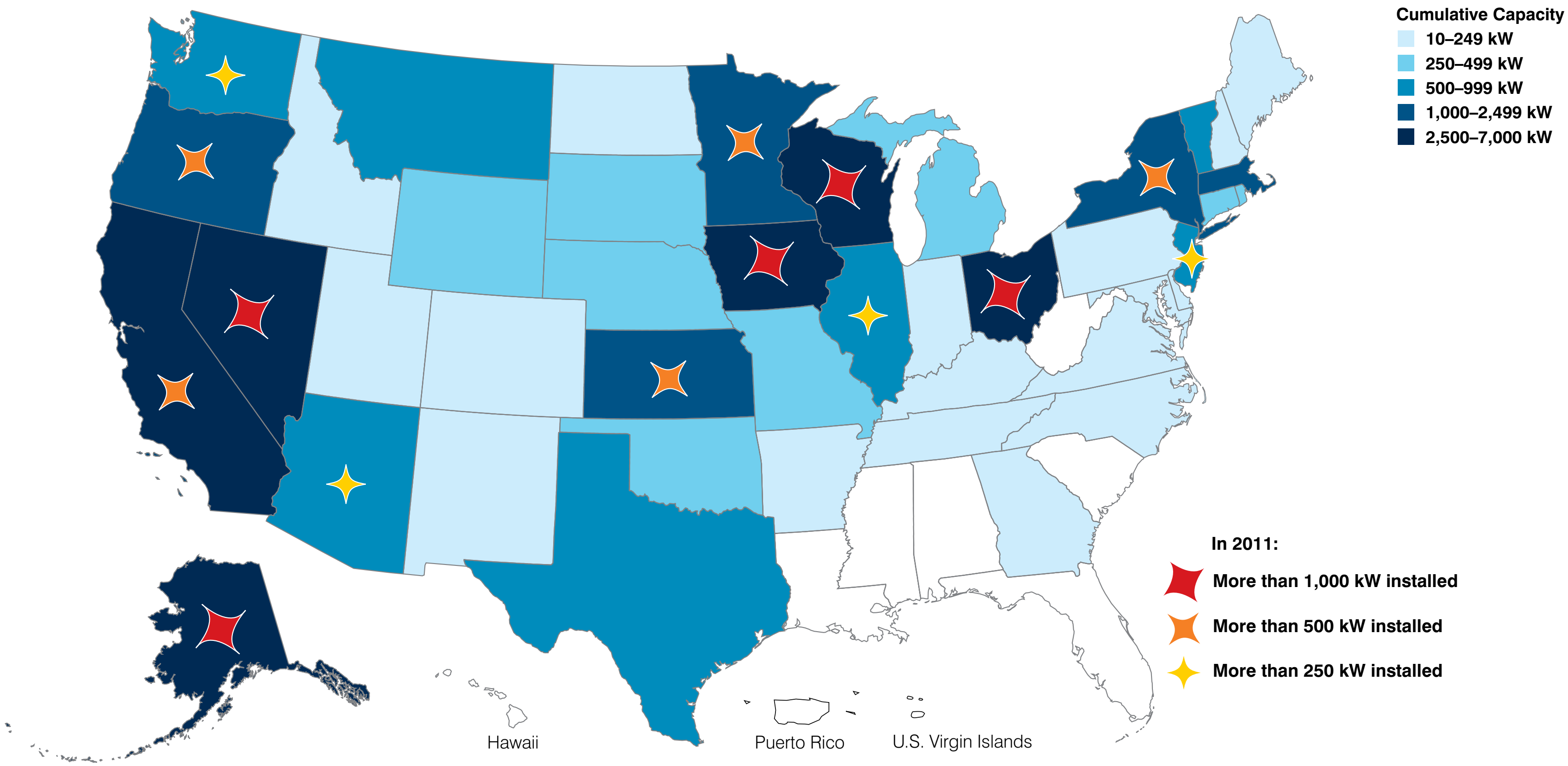
Figure 13 State Cash Incentives for Small Wind **Available during 2011**



Source: Database of State Incentives for Renewable Energy (DSIRE)

Federal & State Incentives

Figure 14 2011 Year-End Distributed Wind Turbine Capacity (kW)



Source: eFormative's Distributed Wind Projects Database

Turbines up to 100 kW Installed with Federal, State, Utility or Local Funding Assistance

Approximately 3,300 distributed wind turbines installed using approximately $110 million in funding assistance totaling 59 MW as of 12/31/2011

In late 2011 the DWEA's State Policy Committee conducted a ranking exercise considering the strength of existing state incentives and the installed small wind base, state political climates and opportunities, previous industry investments and efforts, potential market size, engaged local stakeholders and retail electric rates. The committee identified the following top priority state/provincial markets: New York, California, Ontario, Iowa, Washington, Kansas and Hawaii.

The committee also identified the following second-tier states/provinces with particular focus on state incentives not available for small wind: Massachusetts, Illinois, New Jersey, Nova Scotia, Minnesota, Maine, Ohio, Nevada, Oregon, Vermont, Alaska, North Carolina and Maryland.

State Policy Ranking

The Energy Department-funded Distributed Wind Policy Comparison Tool (released in 2011) calculates financial returns and allows ranking of small wind state policy and economic environments. The ranking highlights favorable market opportunities for distributed wind growth and finance offerings as well as market conditions ripe for improvement. The tool's dashboard-interfaced pro forma model measures the impacts of various policy combinations on small wind turbine economics within existing tax and electricity rates and is used to evaluate the "best" and "worst" current state environments for small wind returns on investment. While returns in residential, non-taxed and commercial sectors vary widely by state and the ranking exercise is dynamic, top states with favorable small wind investment returns include Oregon, Vermont, New York, Nevada, New Jersey, Montana, Massachusetts, California and Maryland.

State and utility policy-makers, county officials and other interested stakeholders can use the interactive Distributed Wind Policy Comparison Tool and accompanying guidebook (available at **www.windpolicytool.org**) to explore the best ways to improve the bottom line of consumer-owned wind turbines. Users can learn which policy improvements – including overcoming zoning and interconnection hurdles, as well as sales drivers such as rebates, tax credits and feed-in tariffs – are most needed for small wind, and in which states, to help guide efficient use of public and ratepayer funds.

Photo courtesy of Enertech

Net Metering Expansions Open Small Wind Markets

A growing number of states are enacting policies to allow meter aggregation, remote net metering and other forms of grid access for wind and solar generation; these policies allow accounting for generation that is not directly connected to the customer load or customer group, which can help resolve barriers to investment in small and community-scale clean energy. Allowing aggregation of multiple meters that may not be physically adjacent for the same customer group (subscriber group) of wind turbine owners can ease the administrative burden of net energy metering and billing for electric companies, facilitate distribution grid stress relief and may reduce the need for costly peak load power when sited strategically.

New York's new "remote" net metering law permits eligible customer-generators to designate net metering credits from equipment located on property that they own or lease to any other meter that is located on property owned or leased by the customer and is within the same utility territory and load zone as the net-metered facility. Credits accrue to the highest-use meter first, and as with standard net metering, excess credits may be carried forward from month to month. In Vermont's "group" net metering arrangement, the utility issues a single aggregate monthly bill to an assigned contact person, and the allocation of credits among group members (or meters of a single customer) is the responsibility of the individuals comprising the group. Maine allows up to 10 customers to share the output from a wind turbine by aggregating meters as long as those customers are on the same utility service. California, Oregon, Washington, Nevada, Utah, Colorado, Illinois, West Virginia, Maryland, Pennsylvania, Delaware, Massachusetts, Rhode Island and Connecticut have enacted similar policies in recent years.

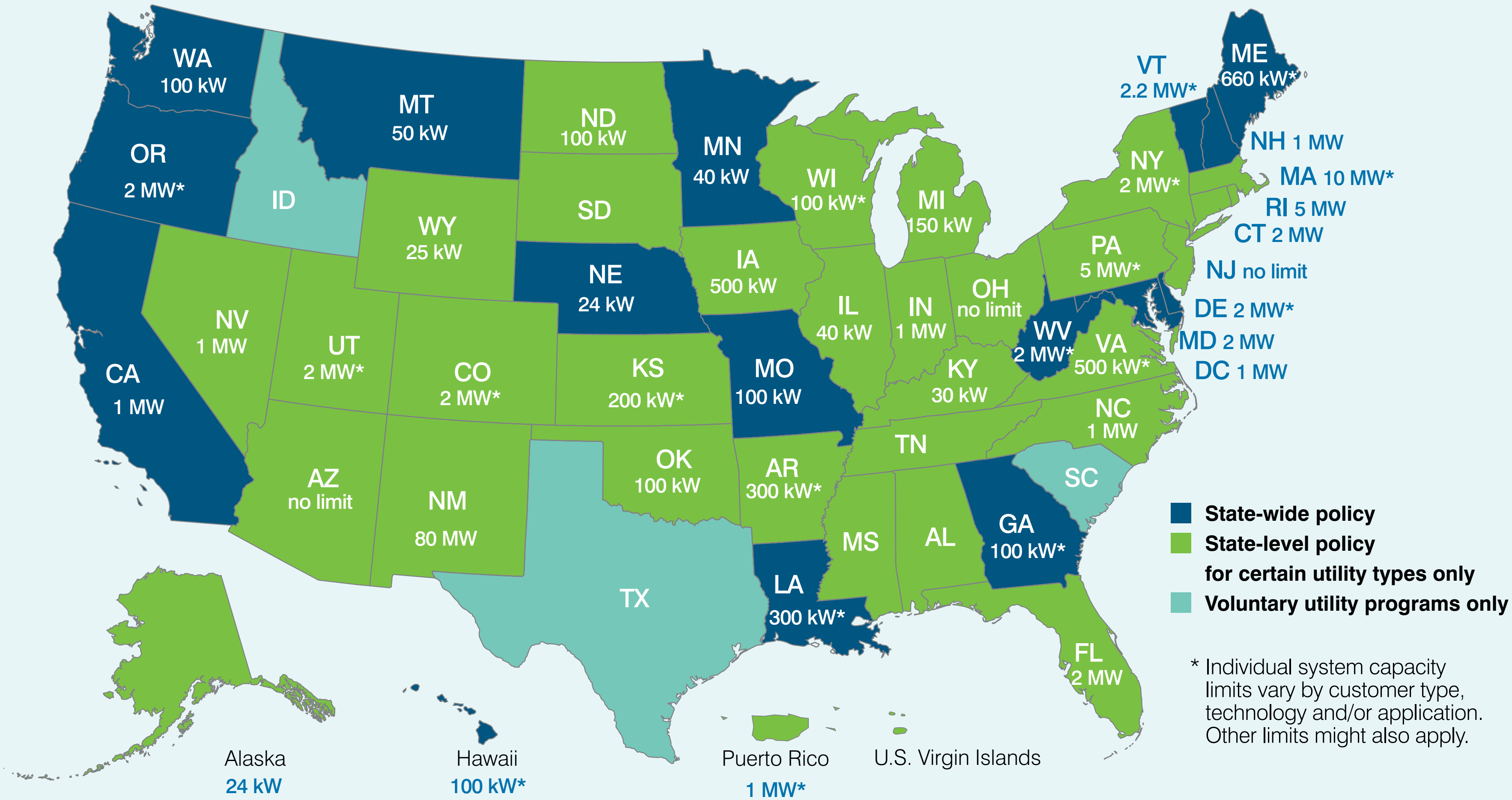
Farms, school districts, college campuses, ski resorts, municipalities, and other government agencies and industrial complexes can benefit from such laws by allowing a wind turbine placed at a windy site with minimal load to offset electric use at a less windy facility nearby. For example, the Jiminy Peak Mountain Resort in Massachusetts had 52 separate electric utility accounts, and physically connecting just nine of which cost the developer $400,000; the state's aggregated metering policy later enabled the single 1.5-MW wind turbine to reduce all of the corporation's utility bills. Some college campuses have as many as 100 meters.[6]

The historical limit of legislative and regulatory policies to the small geography of a single property or electric meter frequently prevents businesses from constructing wind projects due to poor on-site wind resources or interconnection options that make projects impractical or diminish the return on investment. While true on-site generation avoids distribution costs and provides other value, allowing multiple meters to consolidate broadens the geographic possibilities for community wind projects. However, some utilities are responding to the increase in customer-owned generation and energy conservation measures by increasing monthly service charges and standby fees to recover fixed grid costs.

Related legislative initiatives have authorized third-party ownership of community energy projects to maximize financing opportunities through federal tax and state-specific incentives. Explicitly allowing third-party ownership clarifies the availability of incentives, which draws financiers to invest in small wind and keep energy dollars local.

Photo courtesy of Ventera Wind

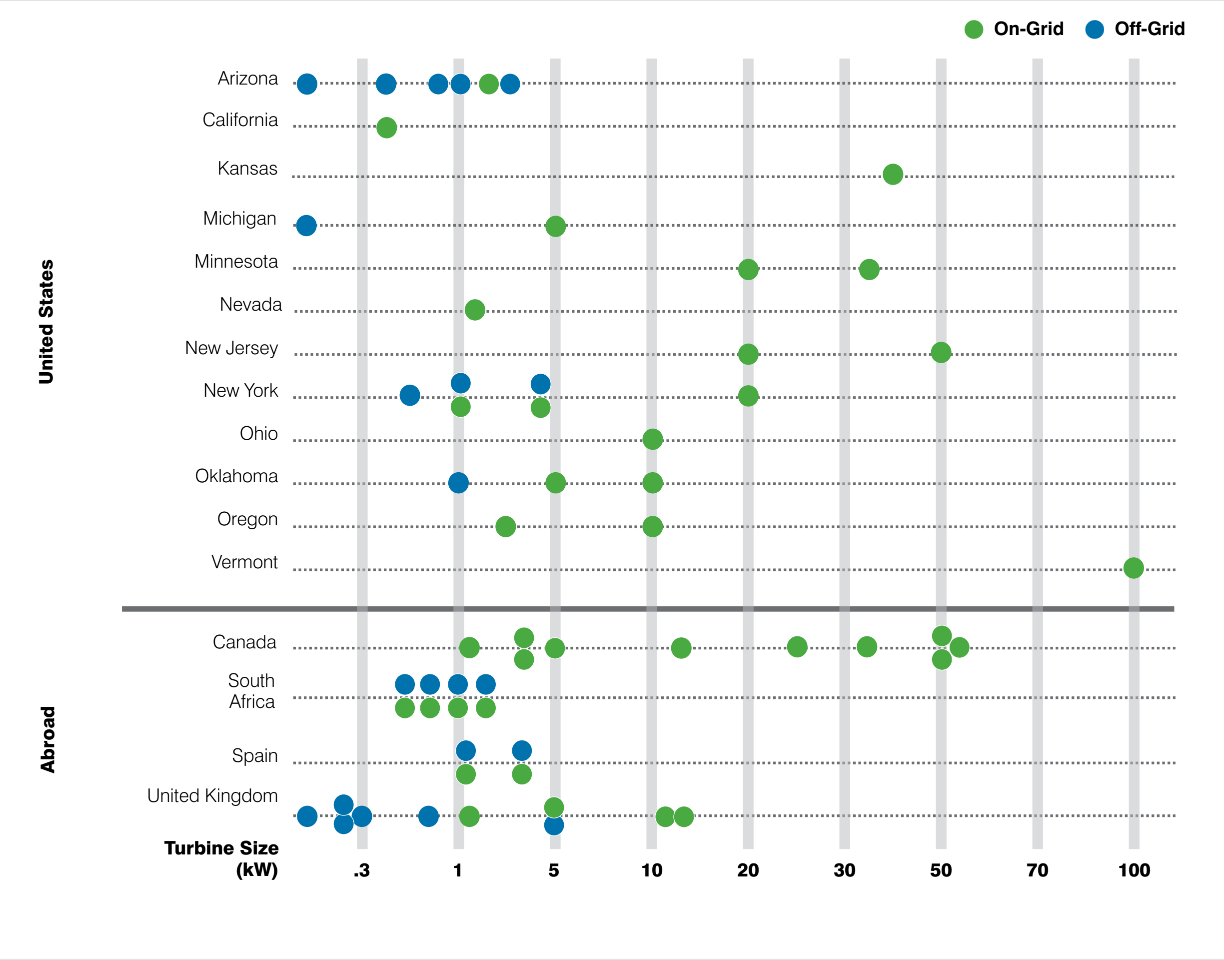
Figure 15 **Net Metering System Capacity Limits**



Source: www.dsireusa.org

Distinguishing Product Features

Figure 16 Turbines by Size Manufactured in the U.S. and Abroad



Most small wind systems with rated capacities below 100 kW feature rotor diameters less than 50 feet (15 meters) – which translates to a swept area of 200 square meters. Just two models sold in 2011 in the U.S. rated 50 to 100 kW have larger rotors, with swept areas of 290 and 346 square meters.

Small wind systems are typically installed on towers less than 160 feet (49 meters) tall and are primarily used for on-site generation at homes, farms, public facilities (e.g., schools), telecommunications sites and businesses. A wide range of tower designs and heights are offered, including tilt-up, guyed lattice, freestanding lattice and monopole.

A broader range of manufacturers sold more small wind turbine types in 2011 than in 2010. Twenty-seven small wind manufacturers with a U.S. sales presence, including imports from Europe, Canada and South Africa, reported 2011 sales of 60 models, compared to 22 manufacturers reporting sales of 51 models in 2010.

U.S. manufacturers sold 10 off-grid wind turbine models in 2011, compared to seven in 2010; 12 off-grid turbine models were imported to the U.S. in 2011, compared to eight in 2010. While more than one-third of the small wind turbine models sold in the U.S. in 2011 are designed for off-grid applications, all 10 of the leading small wind turbine models sold during 2011 in the United States (by sales revenue) are grid connected. All of the top 10 models utilize three blades, one in a vertical-axis design.

Distinguishing Product Features

U.S. manufacturers based in 12 states offer 28 of the 2011 models, up from nine states and 26 models in 2010. Eight of the 2011 top 10 models are manufactured in the United States.

Six new turbine models entered the top 10 sold in the U.S. in 2011, with rated capacities ranging from 1 kW to 40 kW. The average rated capacity of the 2011 top 10 models was 27 kW, similar to the 2010 average. Cut-in wind speeds of the top 10 models range from 2.2 to 3.5 meters per second (5 to 7.8 miles per hour). Installed cost estimates range from $2.30 to $10 per Watt for the 2011 top 10 models.

Changes in rated capacity, ownership or manufacturing location affected more than half of the small wind turbine models sold in the United States, reflecting a dynamic supply. One-quarter of the 2011 models sold are rated less than 1 kW, half are rated 1 kW to 10 kW, and 22 percent are rated 11 kW to 50 kW.

Small wind industry leaders report typical delivery times of one week to two months for residential-scale units, and four to six months for farm and commercial turbines (larger than 30 kW). However, some leading global small wind turbine manufacturers sold out of inventory and 2011 manufacturing capacity, indicating a favorable international market supply-and-demand balance. This is in contrast with other renewable energy markets, which face continued price pressure due to global oversupply. Leading small wind suppliers are looking to expand capacity and decrease lead times.

Photo courtesy of Seaforth

2011 Developments & Drivers

International Markets

Even though the U.S. small wind market contracted in 2011, manufacturers' sales increased by 13 percent on the basis of expanded exports. Small wind turbine exports exceeded domestic sales for the first time in almost a decade and are expected to remain strong in 2012. For manufacturers, having a global reach is important because it helps smooth the "boom and bust" market cycles in domestic and regional markets.

According to figures recently compiled by the World Wind Energy Association (WWEA),[7] the U.S. remains the largest historical market for small wind with 179 MW installed (2010), closely followed by China with 166 MW. The U.K. is a distant third with 43 MW, but that is expected to change in the next several years as its strong feed-in tariff market generates thousands of new grid-connected small wind installations. (See *U.K. Small Wind Turbine Market Surpasses U.S. Market in 2011* on Page 24 for more information on that market.)

The world small wind turbine market remains highly competitive. WWEA reports more than 330 manufacturers offer wind turbines up to 100 kW. The top five countries by number of small turbine manufacturers are the United States, China, Germany, Canada and the U.K. With the exceptions of Germany and Canada, there are correlations between supportive federal policies and the level of domestic manufacturing. The WWEA predicts the worldwide small wind market will increase from 95 MW in 2011 to 700 MW in 2020, or approximately 25 percent per year.

This growth will likely be concentrated in grid-connected distributed generation markets driven by robust incentives such as tax credits, rebates and feed-in tariffs. As noted earlier, feed-in tariffs play a particularly important role in the U.K. market but also in Nova Scotia and Italy. Japan is expected to offer a significant feed-in tariff for small wind in 2012 as it moves to offset some nuclear power with renewable energy and conservation. Off-grid markets will also grow but at a lesser rate. The remote home market has slowed in response to lower photovoltaic (PV) prices. International rural electrification utilizing renewable energy has stalled due to reduced support from donor agencies and the multilateral development banks.

One potential bright spot is telecommunications, where wind and solar hybrid power systems have been shown to lower operating costs for remote sites by up to 90 percent. The Groupe Speciale Mobile Association estimates this market could be worth up to $8 billion, with concentrations in Africa and Asia. (See *Telecommunications Industry a Huge Potential Market for Small Wind* on Page 23.)

The U.K. is clearly the best small wind turbine market in 2012, giving the U.K. manufacturers a significant boost and creating opportunities to foreign manufacturers participating in the Microgeneration Certification Scheme or offering turbines rated above 50 kW. Japan could be a breakthrough market if it avoids the "one feed-in tariff rate for all wind turbines" that killed the small wind market in Ontario. China is losing momentum as government support for small wind wanes and foreign small wind investors leave the market due to its difficult business environment.

Photo courtesy of Kingspan Wind

Telecommunications Industry a Huge Potential Market for Small Wind

A huge potential market awaits small wind turbine manufacturers in the telecommunications industry, which is experiencing explosive growth. During the past seven years, there has been a dramatic increase in the number of telecom installations in off-grid regions around the world. These off-grid sites have historically relied on diesel fuel to power the installations, especially air conditioning to keep electronics cool. Stiff competition in this growing industry is impacting profit margins, and so are rising energy costs.

Island nations in particular struggle with high energy costs. For example, Fiji's fuel costs are 14 percent of the nation's gross domestic product. Most of the islands in Indonesia and the Philippines are diesel-powered. The telecom companies already have infrastructure in place in these off-grid areas and are concerned about maintaining profits if diesel costs continue to increase. In fact, industry consortia have been organized to address reducing energy costs at telecom sites.

A recent World Bank energy forum also focused on the telecom industry, noting that in many rural areas of the world these installations often are the first steps toward globalization, enabling communications and bringing energy into these areas. Cell phone credits are used as a form of currency in many areas, and large telecom companies realize that the next big markets are these rural off-grid regions, such as sub-Saharan Africa.

"These advances in rural areas will cease if a solution to high fuel prices cannot be found," said Andy Kruse, co-founder of Southwest Windpower and vice president of business development for Endurance Wind Power.

According to a recent report published by mobile communications industry experts Groupe Speciale Mobile Association, as of 2010 there were 253,438 off-grid diesel generators around the world operating telecom sites and 775,500 diesel generators in weak grids or off-grid sites. While at Southwest, Kruse patnered with engineers to design telecom towers that instead incorporate solar and wind, as well as battery banks.

Industry specialists are working with tower companies to develop designs to best integrate wind and photovoltaics into telecom sites and support towers.

Part of the marketing plan is selling turbines to the third parties who sell energy to telecom companies. World telecom markets include India, South America (especially Chile and Argentina) and China. Small wind turbines may also be cost-effective solutions for on-grid telecom markets in Europe in areas with green initiatives or high electricity costs.

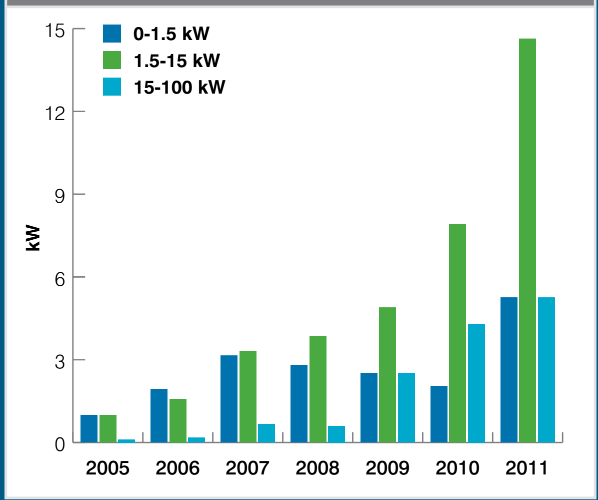
Photo courtesy of Southwest Windpower

U.K. Small Wind Turbine Market Surpasses U.S. Market in 2011

RenewableU.K.'s 2011 small wind market report revealed that the U.K. market for small wind turbines (<100 kW) surpassed the U.S. market, with 22 MW installed in 2011 compared to 19 MW in the U.S. The U.K. experienced a 153 percent increased installed capacity compared with 2010, while the U.S. suffered a 26 percent reduction.

The strong U.K. market is good news for U.S. small wind manufacturers as they take advantage of the attractive feed-in tariff mechanism, which has been in place since April 2010 and offers fixed tariffs for 20 years based on system capacity. The tariffs are currently under formal U.K. government review. Besides the pending feed-in tariff reductions, the chief barrier in the U.K., as in the U.S., is permitting; approximately 11 percent of permit applications are rejected, and the average application processing time is four to six months.

Figure 17 U.K. Small Wind



Source: Small & Medium Wind, UK Market Report, April 2012; RenewableUK

RenewableU.K. estimates that 2012 will be a boom year, with a 144 percent projected increase in small wind installations over its 2011 record year. So while the U.K. market appears robust for now, that may change depending on how its feed-in tariff scheme is modified in the coming months (current proposals suggest a 15 percent to 40 percent reduction in feed-in tariff value, depending on kilowatt rating).

Photo courtesy of Kestrel Wind Turbines

Energy Costs Increase

Despite a substantial dip in natural gas prices and the lingering recession, rising fuel costs and nuclear plant outages have applied steady upward pressure on wholesale and retail electric rates in most states. The national average residential retail rate increased by 4.4 percent between January 2011 and January 2012, exceeding annual consumer inflation of 3.2 percent and with a few states experiencing sharp increases. The largest increase (22 percent) occurred in Hawaii, where oil is the predominant fuel for electricity generation. Utah, Wyoming and Virginia posted average revenue increases of more than 10 percent, and the Dakotas, Nebraska, Kansas, West Virginia and North Carolina saw increases of more than 5 percent.[8]

Climbing and variable energy prices drive interest in distributed wind, particularly in the agricultural sector and among consumers motivated to seek energy independence. Investments in on-site wind turbines offer a way to stabilize energy costs over the long term.

Photo courtesy of Evance Wind Turbines Ltd.

Canadian Manufacturers Expand Beyond U.S. Market

Exports to the United States dominated sales from Canadian small wind turbine manufacturers in the recent past, comprising more than two-thirds of their revenues during 2008 to 2010. That changed in 2011, when small wind sales from Canadian manufacturers[9] to the U.S. decreased by more than 20 percent while total Canadian sales revenues rose significantly – more than 57 percent up from 2010 – due to substantial increase in demand from Europe and Asia. Leading Canadian suppliers expect to see continued flat or negative U.S. sales growth in 2012 while experiencing even larger growth in international markets.

The average installed cost of Canadian small wind turbines in 2011 was US$6,620 per kilowatt, a 16 percent increase from 2010 and 14 percent higher than the average installed cost from U.S. manufacturers.

The average rated capacity of Canadian small wind turbines sold in the U.S. has increased over the past four years, a trend seen more sharply in Canadian sales outside the U.S, with the 2011 average at 30 kW. Canada's domestic small wind markets remain sluggish despite aggressive feed-in tariffs in Ontario and Nova Scotia. Unfortunately, due to tariff levels and sizing constraints, neither policy has spurred local small wind turbine markets. Ontario's does not provide for a "small wind" tariff but rather lumps all wind together at a relatively low rate that has recently dropped even further. While Nova Scotia's small wind rate was more aggressive, its implementation has been hampered by a swept area limit and certification requirements.

However, Canada's electricity prices are increasing in numerous provinces, including Ontario, where half the electricity system's generating capacity – including almost every nuclear reactor – must be replaced or rebuilt within the next 10 years.[10] Ontario is working to phase out coal, and Canadian environmental advocates are striving to follow the lead of Japan and Germany in working toward nuclear-free futures. Alberta energy prices are forecast to rise by 50 percent between 2010 and 2016, and BC Hydro forecasts a rate increase of 32 percent between 2011 and 2014. Rates in Nova Scotia and Saskatchewan have already risen by more than one-third since 2002. Such increases in energy prices and new generation can help level the playing field and build demand for Canada's domestic distributed wind market.

Interest in remote wind-diesel and micro-grid wind installations is surging in Canada's northern communities, with rising fuel costs serving as the primary driver. After studying renewable resources for several years, Diavik Diamond Mine in Canada's Northwest Territories began construction in November 2011 of four 2.3-MW wind turbines, reducing its diesel consumption by 10 percent and offsetting some of the risks associated with reliance on diesel.

Figure 18 U.S. and Non-U.S. Sales of Small Wind Turbines (up to 100 kW) from Canadian Manufacturers

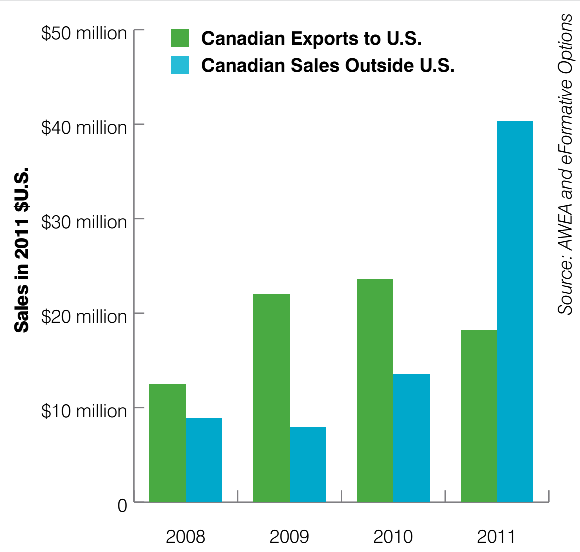
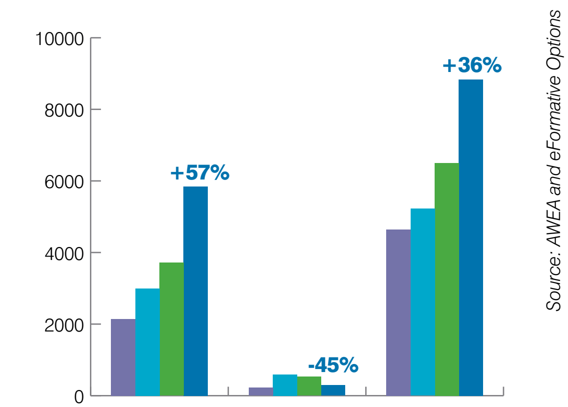


Figure 19 Global Sales from Canadian Small Wind Turbine Manufacturers (up to 100 kW)



Year	Sales in 2011 $U.S. (x 10,000)	Units	kW
2008	$2,138	221	4,643
2009	$2,994	596	5,224
2010	$3716	530	6,502
2011	$5,848	293	8,838

Industry Encourages Energy Department to Increase Funding for Small Wind R&D Priorities

U.S. small wind industry leaders appreciate the support from the Energy Department's Wind Program for testing, certification and related international standards development for small wind turbines. However, they encourage the Department to apply additional resources to the following research and development priorities:

- **Performance prediction.** With many of the key small wind states moving toward performance–based incentives, improved tools and techniques are needed. With the newly operating Regional Test Centers gathering data on a variety of small turbines in different wind regimes, topography and ground cover, the data are available to the National Renewable Energy Laboratory (NREL) to evaluate the performance predictive capabilities of the publicly available tools. Such an evaluation would provide important information to the Interstate Turbine Advisory Council and the state fund managers, as well as the network of manufacturers, dealers and installers.
- **Certification and standards.** The Small Wind Certification Council is performing a critical service to the state incentive programs and the buying public; continuing its support is of great value to the industry. Expanding current intentional standards to 100-kW rotor diameters is a necessary next step in completing the small wind portfolio of fully certified turbine options.
- **Permitting technical assistance.** Permitting remains the major implementation barrier to small wind. As most planning decisions are made locally by uninformed officials, zoning ordinances are often developed based on poor information regarding small wind's attributes and impacts. The Energy Department and its network of national laboratories are a credible source of information. They can provide objective information on many of the critical issues in siting and permitting small wind, such as height restrictions, setbacks, sound, health impacts, wildlife impacts, property values and visual impacts. Both proactive (conducting outreach to organizations such as the National Association of Counties) and reactive (responding to local permitting authorities on new or revised ordinances) efforts are necessary. Initiating and documenting research on small wind issues would be helpful, including direct or contracted expert participation in national, regional, state and local siting forums.
- **Design codes.** Most of the modern wind turbine design codes do not accurately reflect small wind turbine performance or are too complicated and costly to apply. The industry recommends that the Energy Department direct NREL to convene industry and lab experts to develop improved small wind design codes.
- **Product improvement.** As the cost of PV declines and its reliability increases, small wind manufacturers are pressed for improved product performance and economics. Energy Department competitive research awards would be useful in helping drive down the energy cost of distributed wind energy.
- **Military and foreign assistance applications.** The Energy Department is in a unique position to help establish industry-government liaisons with the appropriate agencies to elevate interest and address the technical and administrative issues preventing appropriate, significant implementation of small wind systems.
- **Education.** The 20 Percent by 2030 wind scenario future requires wind industry workers of all kinds: construction workers, electricians, meteorologists, skilled manufacturing laborers, developers, engineers, businessmen, researchers, designers, lawyers, finance professionals, educators and many others. The Energy Department's Wind for Schools project has been exceptionally effective in training engineers and introducing wind and related careers into the K-12 classroom. Expanding this program from 11 states to 30 to 35 would expose the next generation to the opportunities and benefits of wind energy. The Department's support of the KidWind Project's state competitions engages youth, teachers and the school community with a highly effective hands-on wind learning experience.
- **Market metrics and roadmap.** The Energy Department should continue to support the development of an annual small wind market report. The last small wind roadmap was developed in 2002; it should be updated as a path forward for the next decade.

Energy Department Continues Support for Distributed Wind, Including Wind for Schools

The U.S. Energy Department acknowledges that the distributed wind industry faces the following challenges:

- Lack of sophisticated design tools specially tailored for small wind development
- High installed system costs
- Lack of breadth of product standards. Standards are needed for small (>200 m2 rotor diameter), mid-size and built-environment turbines
- Reliability issues that inhibit market growth and distribution.

To address these challenges, the Energy Department is working to strengthen the distributed wind industry by offering methods and tools to develop safe and reliable turbines, to support efficient product engineering and certification, to reduce deployment barriers (e.g., siting, permitting and environmental) and to promote via industry engagement and outreach to enable 20 percent wind by 2030. The Energy Department's current efforts for distributed wind include the following:

- Certification testing support. Testing on the following turbines was completed through 2011: Gaia 11 kW, ARE442 (now Xzeres 442, 10 kW), Ventera VT10, Mariah Windspire (1 kW) and the Entegrity EW50. Testing for the Viryd CS8 and the Cascade Engineering Swift (1 kW) is in progress
- Regional Test Center support, including for the Small Wind Association of Testers Workshop (see page 33 for more information on the Regional Test Centers). The Energy Department's goal is to have 40 certified small wind turbines by 2020
- Support for industry partners (i.e., government, industry, international). Examples include support for FOA recipient Windustry and the Community Wind across America conference in Albany, New York, in October 2011; support for wind site assessor credentials; and engineering forensic analysis of turbine failures. Other Energy Department partnerships exist with the American Solar Energy Society Wind Division, NREL's JEDI Small Wind module team, IEA Task 27 and the IEC 61400-2 3rd Revision
- Validation and expansion of standards, including other rotor configurations and fatigue loading
- Cost of energy analysis and system modeling, assessing the potential for distributed wind technology advances to reduce the levelized cost of energy
- Solicitation for value engineering for manufacturers (midsize and small). Plans include a process to competitively award U.S. small wind turbine manufacturers with a strong commitment to improving their ability to compete in the global small wind market space and to maintain U.S. leadership in the small wind market sector through assisting manufacturers with certification testing, component improvements or manufacturing process improvements
- Support for built-environment wind research. Literature research is ongoing, and instrumentation and deployment sites are being identified
- Support for open source codes and computer tools, such as furling dynamics, blade preliminary design, vertical-axis wind turbine aeroelastic and structural dynamics modeling.

See page 11 for information about the Wind for Schools project supported by the Energy Department.

Small Wind Industry Faces Financing Challenges

Enabled by the expansion of the federal ITC and driven by substantial price drops and increased consumer interest, the PV third-party financed market is taking off. Faced with a lack of equity in the housing market, Federal Housing Administration (FHA) loans that require property liens and complex requirements from traditional banks, the small wind market is exploring new financing models such as aggregated lender pools, credit union and 401(k) loans and credit card promotions. Acknowledging the barrier of high upfront costs for many consumers wishing to purchase small wind equipment, the small wind industry is focusing on the need for construction bridge and long-term loans at attractive rates. Small turbine industry leaders are encouraging dealers to finance a majority of their sales; in today's economy, more than two-thirds of home improvements and heating, ventilation and air conditioning upgrades are financed.[11]

Third-party systems are dominating residential PV markets, with multiple providers financing more than 50 percent of systems in key states, including California, Arizona, Colorado and New Jersey. Under the two forms of PV third-party finance, the Power Purchase Agreement (PPA) and lease models, financiers who own the system — rather than the property owner or homeowner — are often able to utilize tax benefits unavailable to homeowners. With a PPA, the customer pays a small set-up fee and signs a 20-year contract to purchase solar generation monthly on a kilowatt-hour basis, such as at 75 percent of the utility's retail rate with no escalator. Under a lease, the customer pays a fixed monthly amount. Due to the definition of utility, some jurisdictions do not allow residential solar PPAs but may allow leases. Typically customers recoup their upfront payment in the first two years and garner $300 or more in savings every year thereafter, with no operations and maintenance (O&M) or warranty concerns. The third-party owner covers annual O&M costs, expected to average $20/kW/year.

Small wind faces numerous challenges for participating in third-party finance. Financiers require replicable packages and high volume, and small wind turbines' performance and O&M costs are variable. In exploring the feasibility of third-party financing for residential wind turbines using the Distributed Wind Policy Comparison Tool (described on page 17), the model may be possible in windy areas with high residential electric rates and other supporting policies, such as Hawaii, Connecticut, New York, Alaska, New Hampshire, Rhode Island, New Jersey, Vermont, Maine and California.

Southwest Windpower has launched a new Green Financing program with a simplified FHA Title 1 secured 20-year home improvement loan at competitive rates with a monthly payment of $147. For customers with good credit scores, the Policy Tool shows this package increases the net present value of projects in Oregon, Massachusetts, Hawaii, Vermont, California and Maryland.

The small wind industry has recognized that improved financing packages are urgently needed to aid U.S. residential market growth, as tax credits and performance incentives often require at least short-term support. A growing number of finance partners are showing interest in the sector, and several state clean energy funds are considering launching revolving loan programs.

Model Zoning Ordinance

Incomplete understanding of small wind technology has led local zoning boards across the country to apply ordinances regulating utility-scale wind farms to smaller distributed wind projects. This, in turn, has caused unreasonable and prohibitive regulations and delayed or banned installations. Frequent challenges for small wind include requirements related to height restrictions, setbacks, sound, engineering, aesthetics and environmental impact. To update and expand AWEA's 2008 Model Small Wind Zoning Ordinance and address recommendations in the 2010 AWEA Market Report for highlighting best practices and a framework for standardized zoning policy, the DWEA Permitting and Zoning Committee developed a Model Zoning Ordinance that recommends permitted use regulations for small wind turbines.[12]

Photo courtesy of the National Renewable Energy Laboratory

2011 Developments & Drivers

Published in January 2012, the model ordinance is intended to "promote the safe, effective and efficient use of small wind energy systems installed to reduce the on-site consumption of utility-supplied electricity" and encourage responsible and safe installations with proper siting and tower heights. It is designed to be used by counties, towns, municipalities, jurisdictional and neighborhood associations, state and federal incentive agencies, wind turbine installers, property owners, advocates and others to serve as a guide to facilitate small wind.

Several jurisdictions, including local planning commissions in Delaware, New Jersey, Pennsylvania and Virginia, have already incorporated or reviewed at least parts of the model ordinance.

The most significant aspect of the model ordinance is the categorization of small wind turbines as a permitted use, significantly streamlining the zoning and permitting process. This not only allows for reduced time and cost to the jurisdictional authority but also avoids the addition of unnecessary, non-value-added cost to property owners wishing to install small wind turbines. That being the case, permitted use is the preferred and most appropriate category in almost all cases.

The model ordinance defines best practices for turbine siting while ensuring that neighbor property rights and safety concerns are addressed. Its criteria address common issues such as sound, tower height, setbacks, decommissioning and compliance with building, electrical and Federal Aviation Administration codes and regulations. In addition, the ordinance recommends that turbines comply with national certification. Permissive zoning represented by this model ordinance should only be extended to the highest-quality small wind turbines, as demonstrated by compliance with national and international standards. Non-compliant wind turbines should be subject to greater scrutiny and/or restrictions.

A group of installers, manufacturers and educators from across the country drafted the ordinance, after consulting with administrators, planning commissioners, city attorneys and turbine owners.

The full Model Zoning Ordinance and related fact sheets designed to help educate neighbors, local government officials and others about small wind turbines can be downloaded at **www.distributedwind.org**.

Working safely at heights is of critical concern to the industry; as part of its Installer's Toolbox, DWEA is developing a guide, Best Practices for Small Wind: Tower Climbing Safety. This document, to be released in mid-2012, will address concerns for worker safety related to small wind energy systems installed on tall towers.

Because complying with local zoning ordinances is important to the successful implementation of small wind turbines, yet those ordinances are often understated or overly restrictive, AWEA developed a database of local ordinances for key small wind states. Using Internet research as a starting point and making phone and email inquiries for clarifications, information on critical zoning issues of height, setbacks, sound, ground clearance, flicker, turbine capacity, decommissioning and wildlife/environmental issues were documented, as well as electronic references.

Only jurisdictions with wind ordinances were included. Washington, Oregon, California, Colorado, Illinois, Wisconsin, Ohio, New York, New Jersey and Massachusetts were characterized. Additionally, a pilot effort was made to develop a graphical representation of the most important zoning elements, combined with details on sound and setbacks that are multi-dimensional. The next step is to develop the process to keep the data current as local zoning expands and changes. The database will be included in the revised small wind section of the AWEA website in 2012.

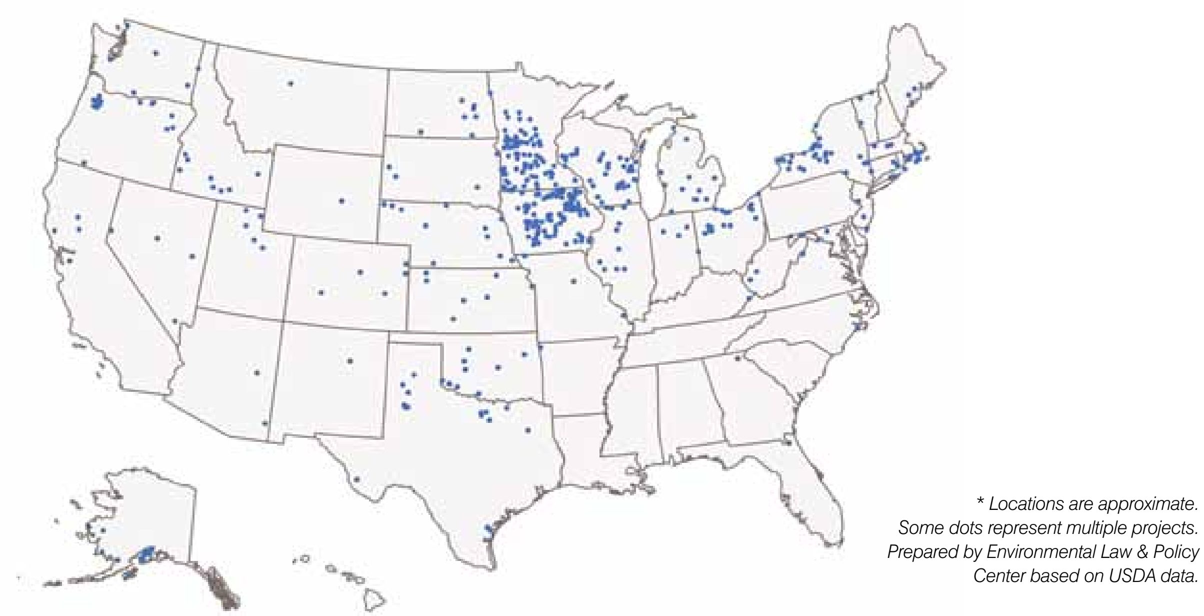
REAP Is Most Popular Farm Bill Energy Program, But Future Funding Is Uncertain

Since its inception in the 2002 Farm Bill, REAP has opened new markets for wind power in agricultural and rural communities. Through its network of state Rural Development offices, the USDA manages REAP, providing grants and loan guarantees to agricultural producers and rural small businesses to install renewable energy systems. REAP is the only Farm Bill program focused solely on energy development for rural small businesses, farmers and other agricultural producers. The grants are limited to $500,000 or 25 percent of project costs, whichever is less. REAP also provides seed money funding for feasibility studies to help launch locally owned projects.

In 2011, REAP approved 55 awards for wind power development projects in 23 states. Additionally, REAP's new feasibility study program granted awards for 15 wind projects in six states, thereby continuing to sow the seeds for new community wind projects.

With the increasing pressure to reduce federal spending, financial support for REAP has been reduced in annual appropriations. From 2010 to 2012, REAP funding was reduced by 75 percent. These disproportionate cuts occurred as the Congress considers reauthorization of a new Farm Bill with deep spending cuts. This new Farm Bill is expected to reduce funding by approximately $23 billion. In Farm Bill proposals issued to date, the Energy Title is allocated minimal funding. But in each case, REAP receives the most funding. In the Farm Bill proposal to the Super Committee, REAP would have received about $25 million in mandatory funding over five years, the most of any energy program. Bipartisan Senators on the Agriculture Committee led a successful amendment to provide $800 million in funding over the life of the next Farm Bill, with REAP receiving the highest amount ($241 million). As this publication goes to print, the fate of the Farm Bill is unknown.

Figure 20 Wind Projects Funded by the Renewable Energy for America Program, 2003-2011



The small wind industry strongly supports REAP as a means for rural businesses and facilities to take advantage of their local wind resource for energy security and environmental sustainability.

2011 Developments & Drivers

U.S. Fish & Wildlife Service Releases Wind Energy Guidelines

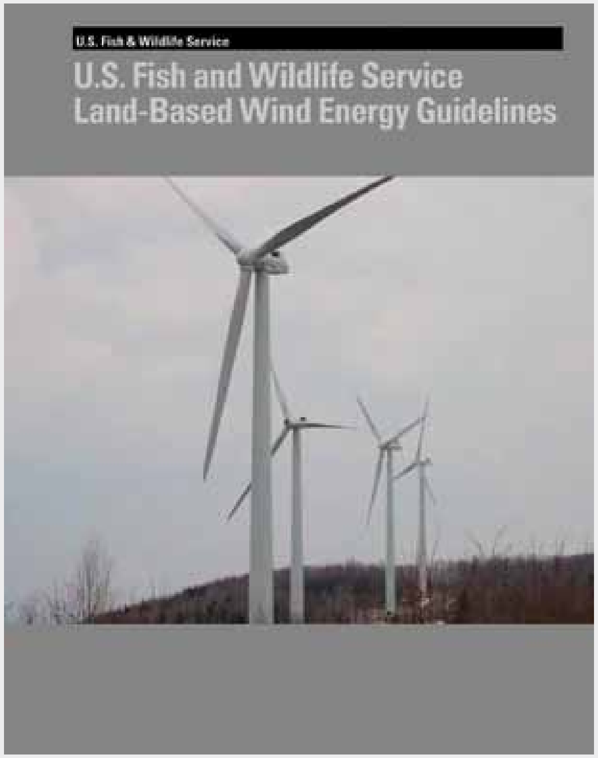
The U.S. Fish & Wildlife Service (FWS), as part of the U.S. Department of Interior, has oversight of regulations governing the development of renewable energy projects on public lands, but its policies and regulations can also have direct impacts on development of private lands. While the mission of the FWS is to protect wildlife and habitats, the Department of Interior has multiple missions, one of which is to promote renewable energy development on public lands.

In February 2011, FWS released a draft document related to wind turbine siting: *Draft Voluntary, Land-Based Wind Energy Guidelines*. This guidance document significantly deviated from the consensus recommendations developed by the Federal Advisory Committee (FAC), which included representatives of the wind industry, states, wildlife conservation organizations, scientists, tribes and federal officials. AWEA submitted comments on the Land-Based Wind Energy Guidelines and comments in May 2011 stating that the guidelines should not apply to distributed and community-scale wind energy projects. In July 2011, FWS released a revised version of the guidelines in response to the public comments received and held a meeting to receive feedback from the FAC and the public. AWEA again submitted comments on this revised version in August, reiterating that the guidelines should not apply to distributed and community-scale wind energy projects and that the costs associated with adhering to the guidelines are prohibitive for smaller-scale projects and would stall or prevent the development of small-scale wind energy.

In September, AWEA again submitted comments on a new revised draft of the guidelines, recommending a temporary exclusion for this class of wind turbines and projects for a two-year period while the limited existing studies and additional data are collected and scientifically reviewed. During this period, guidelines appropriate to this class of installations would be cooperatively developed, using a similar multi-stakeholder process that has been applied to the commercial wind farm applications. This recommendation was not adopted in the final guidelines document.

FWS released the final version of the guidelines in late March 2012.[13] Final wording as it relates to small wind turbines includes:

- "The Service anticipates that many distributed or community facilities will not need to follow the Guidelines beyond Tiers 1 and 2." (Executive Summary, p. vi)
- "The Guidelines are designed for 'utility-scale' wind energy projects…A developer of a small or community-scale wind project may find it useful to consider the general principles of the tiered approach to assess and reduce potential impacts to species of concern, including answering Tier 1 questions using publicly available information. In the vast majority of situations, appropriately sited small wind projects are not likely to pose significant risks to species of concern. Answering Tier 1 questions will assist a developer of small or community wind projects, as well as landowners, in assessing the need to further communicate with the Service, and precluding, in many cases, the need for full detailed pre-construction assessments or monitoring surveys typically called for in Tiers 2 and 3. If landowners or community/small wind developers encounter problems locating information about specific sites they can contact



www.fws.gov/windenergy/docs/WEG_final.pdf

the Service and/or state wildlife agencies to determine potential risks to species of concern for their particular project." (p. 6)

- "Developers of distributed or community-scale wind projects are typically considering limited geographic areas to install turbines. Therefore, they would not likely consider broad geographic areas. Nevertheless, they should consider the presence of habitats or species of concern before siting projects." (p. 12)

Small wind industry leaders appreciate AWEA's efforts to make these changes and DWEA for its active support. The industry is satisfied that distributed wind has been differentiated from large-scale wind in the guidelines to a sufficient degree that they can, for the most part, live with. The industry will continue to work with the FWS during the implementation and stakeholder training to help ensure that small wind's potential wildlife impacts and pre-installation evaluation and post-installation monitoring protocols are commensurate with the size and scope of the small wind projects.

Small Wind Turbine Testing Progress

Formal certification testing is being conducted or completed for 28 small wind turbine models seeking to sell to the U.S. market, including through the five small wind Regional Test Centers project. Testing activities and discussions are providing invaluable lessons learned, and the 2011 launch of the Small Wind Association of Testers is a sign of a maturing industry.

Four Regional Test Centers supported by the Energy Department and NREL – in Kansas, New York, Texas and Utah – commenced operations in 2011 to test eight small wind turbines to AWEA and International Electrotechnical Commission standards. For each turbine, the Regional Test Centers are conducting the following tests: duration, power performance, safety and function and acoustic sound emissions as specified by the AWEA small wind turbine standard.

The test reports will be placed in the public domain along with the test reports from NREL's Independent Testing program for the benefit of the small wind turbine testing community, state officials, consumers and other interested parties. As of the end of 2011, testing of one turbine model was complete with a test report in development, and four additional Regional Test Center turbines are under test. Testing of the remaining three turbines begins in fiscal year 2012.[14]

Learn more about NREL's Regional Test Centers at **www.nrel.gov/wind/smallwind/regional_test_centers.html**

Photo courtesy of Wind Turbine Industries Corp.

2011 Developments & Drivers

Small Wind Certification Council
Certified Small Wind Turbine

Manufacturer/Model

Bergey Windpower Company
Excel 10 (240 VAC 1-phase, 60 Hz)

Rated Annual Energy
Estimated annual energy production assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density and 100% availability. Actual production will vary depending on site conditions.

13,800 kWh/year

Rated Sound Level
The sound level that will not be exceeded 95% of the time, assuming an average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density, 100% availability and an observer location 60 m (~ 200 ft) from the rotor center.

42.9 dB(A)

Rated Power
The wind turbine power output at 11 m/s (24.6 mph) at standard sea-level conditions.

8.9 kWh

Certified to be in Conformance with:
AWEA Standard 9.1 – 2009

For a summary report and SWCC Certificate visit
www.smallwindcertification.org

Small Wind Certification Council
Certified Small Wind Turbine

Manufacturer/Model

Southwest Windpower
Skystream (240 VAC 1-phase, 60 Hz)

Rated Annual Energy
Estimated annual energy production assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density and 100% availability. Actual production will vary depending on site conditions.

3,420 kWh/year

Rated Sound Level
The sound level that will not be exceeded 95% of the time, assuming an average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, sea-level air density, 100% availability and an observer location 60 m (~ 200 ft) from the rotor center.

41.2 dB(A)

Rated Power
The wind turbine power output at 11 m/s (24.6 mph) at standard sea-level conditions.

2.1 kWh

Certified to be in Conformance with:
AWEA Standard 9.1 – 2009

For a summary report and SWCC Certificate visit
www.smallwindcertification.org

First Full Certifications to AWEA 9.1 Issued

The small wind industry accomplished a major milestone in late 2011: the first full certifications of two turbine models that passed testing to the AWEA Standard 9.1-2009 (see consumer ratings labels by the Small Wind Certification Council, or SWCC); in addition, three models that were tested and analyzed in the U.K. received conditional temporary certification.

The SWCC is on track to help the Energy Department meet its new programmatic metric to reach 40 turbine designs certified by 2020, with initial milestones of five models certified in FY12 and seven more in FY13. Certification is helping to prevent unethical marketing claims, ensuring consumer protection and building credibility.

Twenty organizations in North America now offer field testing for small wind certification, and the SWCC has conducted six test site evaluations. The SWCC has received and processed 41 Notices of Intent to Apply for Certification and has signed agreements confirming testing and analysis plans for 29 turbine models.

The SWCC is also playing a key role in addressing a well-recognized market barrier in updating small wind turbine standards and achieving international harmonization of testing and certification. Active ongoing participation in technical committees enables this coordination of standards. SWCC is working with other certification programs in Europe, Asia and North America to minimize the differences among country-specific requirements. Learn more at **www.smallwindcertification.org**.

Intertek operates a second North American small wind turbine certification program. Intertek, a National Recognized Test Laboratory, operates a test facility dedicated to testing small wind turbines and also certifies small wind turbines to the AWEA 9.1 standard. Intertek is currently testing turbines from 11 manufacturers and will be issuing certifications based on the test results. Additional information is available at **www.intertek.com/**

ITAC Develops Unified Turbine List

The Clean Energy States Alliance convened meetings during 2011 to launch the Interstate Turbine Advisory Council (ITAC) to identify, discuss, review and collect information on small wind turbines with the goal of creating a unified list of small wind turbines eligible for state incentive program funding.

In addition to requiring certification to the AWEA Standard, ITAC reviewed manufacturers' consumer and dealer services, marketing consistency with third-party testing, turbine operational history, turbine warranty, and manufacturers' response to technical problems, failures and customer complaints. As a collaborative and common inventory of turbines, the unified list announced in May 2012 will assure customers that taxpayer or ratepayer funding supports the installation of reliable and safe technology. The ITAC process will also improve program consistency, transparency and benefits. Learn more at **www.cleanenergystates.org/projects/ITAC**.

Small Wind Installers Certification

Small wind installers certification initiated in late 2010 and administered by the North American Board of Certified Energy Practitioners achieved moderate success in 2011. Successful analogous credential programs for solar thermal and photovoltaic installers exist. Future attempts to build a broad cadre of certified small wind installers may depend on greater consumer education, refining testing eligibility, policy interventions and industry support such as reduced group insurance premiums.[15]

Small Wind Siting Tools Improving

To receive funding from a growing list of state, federal and utility programs, many small wind projects are required to predict how much energy turbines are expected to produce at proposed sites. Incentive program administrators and customers want installed systems to be successful, and access to accurate site-specific wind estimates, coupled with verified turbine performance data, has been identified as key to ensuring that success.[16]

The most accurate method of estimating wind turbine performance over its useful life is conducting a professional on-site measurement campaign and then conducting a long-term correlation analysis, but this method is usually not economically feasible for small wind projects.

Instead, small wind turbine production has traditionally been estimated using low-cost solutions such as short, uncorrelated measurement campaigns or by simply referencing wind maps, published by state and federal agencies or provided by AWS Truepower, 3Tier and others.

Unfortunately, these lower-cost solutions have generally underperformed in terms of accuracy. With short-term site measurements, annual variability is not usually accounted for, leading to significant errors where the differences in wind, between seasons and years, are not properly understood. With wind maps, the ability to account for "micro-scale" terrain, land cover and obstruction effects around the turbine is limited, leading to substantial errors in estimating energy production. These errors have in some cases brought into question the consistent performance and value of small wind turbines.

In late 2011, the Energy Trust of Oregon conducted a study comparing meter readings from small wind systems funded through its program to the original estimates. The study found that on average, the projects generated less than 50 percent of the amount of forecasted energy based on wind maps, reflecting an over-prediction of more than 150 percent. In response, Energy Trust and other agencies made immediate program changes to encourage better siting and have adopted new wind assessment tools to estimate production, while keeping costs within the scope of small wind project budgets.

2011 Developments & Drivers

Software and consulting service providers such as Wind Analytics, Meteodyn and Cadmus Group have developed wind assessment tools that address long-term variability and micro-scale errors, taking into account surrounding terrain and obstructions and utilizing site-specific shear factors based on site-specific geographical characteristics.

Blind tests of the Wind Analytics system were also compared to actual production of Energy Trust-funded sites in late 2011. The study found an average under-prediction of about 22 percent when compared to actual turbine production. Energy Trust has since contracted with Wind Analytics to provide wind energy production estimates for all applicants at new sites for the small wind program. Other agencies and utilities across the country are considering similar approaches, increasing confidence in the investment value of small wind turbines. The New York State Energy Research and Development Authority (NYSERDA) now uses the NYS Small windExplorer developed by AWS Truepower to determine estimated energy production for the basis of incentives. (See *NYSERDA Emerges As Leading State Small Wind Incentive Program* on page 37.) At most sites with a year or more of production, the prediction has been ±20 percent of actual.

Photo courtesy of Southwest Windpower

NYSERDA Emerges As Leading State Small Wind Incentive Program

In 2011, NYSERDA cemented its reputation as a leading state small wind incentive program. When NYSERDA's small wind program manager Mark Mayhew joined the program in 2008, NYSERDA received more applications for PV in a week than the small wind program received in a year. He set out to improve the small wind program.

The NYSERDA incentive is now based on expected kilowatt-hours. "When I inherited the program, we used a nameplate kilowatt multiplier with tower-height adders to determine the amount of the incentive," Mayhew said. "We changed that and now base the incentive on the estimated production at the site, based on computer modeling. The money for the program comes from the New York State RPS, and the goal is to increase the amount of renewable energy generation. So we base the incentive on the same metric. We require production readings for the first two years. There is no penalty if you don't meet projections, but we use the readings to do a better job predicting production for future projects."

To estimate production at a site, NYSERDA uses the New York State Small wind-Explorer, which was developed by AWS Truepower under contract to NYSERDA.

"When we compared the projections to actual one-year data, the tool's projections were plus or minus 20 percent based on AWS wind maps," Mayhew said.

"The nice thing about basing incentives on estimated production is that the sites with better wind resources get more funds and consequently the opposite," he continued. "When we started the program, we required a minimum wind speed of 10 MPH. But when using the estimated wind resource, consumers are eligible for something. We looked at the worst locations for siting a wind turbine, and we found a location where a consumer would receive a $100 incentive. We hope that would be a disincentive."

The NYSERDA incentive breakdown is as follows: $3.50 per kilowatt-hour for the first 10,000 kilowatt-hours; $1 for each kilowatt-hour from 100,000 to 125,000; and then 30 cents for each kilowatt-hour over that. NYSERDA will not pay more than 50 percent of the installation cost and not more than $400,000 total.

"We define on-site wind as anything behind the meter, as long as the customer can use all the power the system generates. The program does have a hard cap of 2,000 kilowatts. It does not matter whether the installation is sited at a consumer's house, an industrial facility or a school; the program is the same for all," he said.

The largest application in Mayhew's program is an 850-kW machine at an industrial site that is expected to generate 2 million kilowatt-hours per year. Dairy farms have been major participants in the program, perhaps because sites in certified ag districts are exempt from many permitting requirements, resulting in fewer obstacles during the planning process. School projects could benefit tremendously from the NYSERDA incentive, with some rural schools eligible to use state aid plus the NYSERDA incentive to fund a project.

In 2011 the NYSERDA small wind program used its entire budget of $4.3 million, which encompasses 73 approved projects from October 2010 to the end of 2011 (turbines are installed or are in process). The projects range from a Skystream 2.1-kW turbine to a Gamesa 850-kW turbine. A list of eligible turbine models can be found on the NYSERDA website; for turbines less than 200 meters, NYSERDA uses the Interstate Turbine Advisory Council's list.

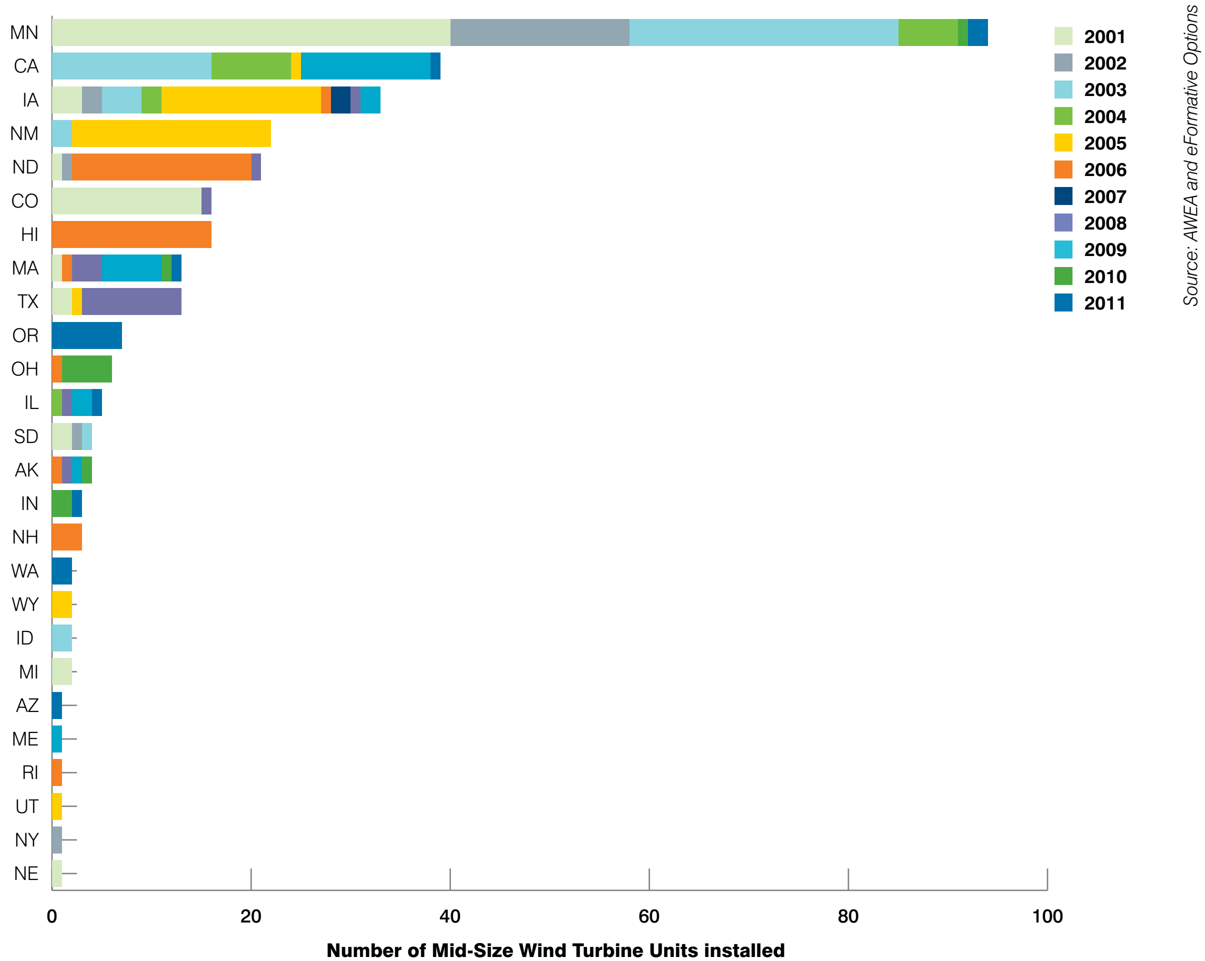
The incentive is offered as an upfront payment in two portions: 65 percent when the equipment is delivered onsite and 35 percent upon interconnection; the payment is made to the installer, who must pass it on to the customer per the installer's contract.

Mayhew said that NYSERDA's small wind incentive budget is $3 million per year. The small wind budget is funded until 2015, and any funds left over from other programs could be applied to small wind if the program can use it. (The program received an additional $1.5 million for 2012.)

Learn more about NYSERDA's small wind incentives at **www.nyserda.ny.gov/Page-Sections/Renewables/Small-Wind.aspx**

Mid-Size Wind Sector Grows in 2011

Figure 21 Mid-Size Wind Turbines (101 kW to 1 MW) Installed by State



Manufacturers and developers of mid-size wind turbines (from 101 kW to and including 1 MW) report installations of 17 mid-size turbines in 2011 totaling more than 9.7 MW in six states.[17] This represents an increase in U.S. mid-size wind turbines of 45 percent on a capacity basis and 70 percent on a unit basis over 2010 installations.

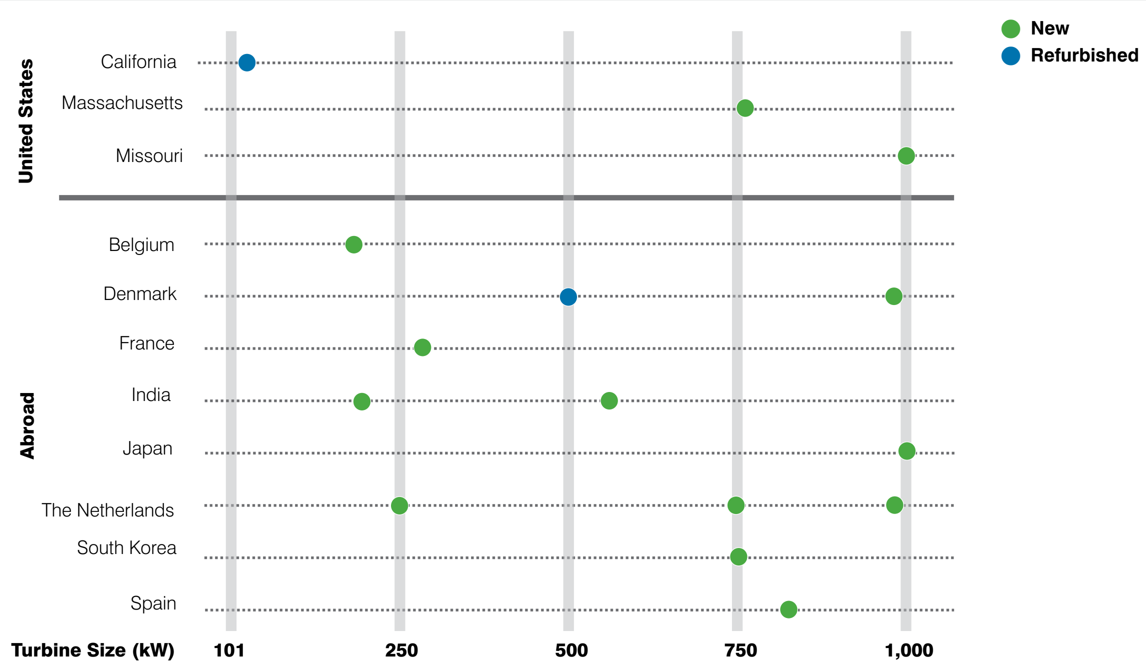
Cumulative U.S. mid-size turbine installations since 2001 reached nearly 240 MW, representing more than 320 units installed as of the end of 2011.

Mid-size wind turbines' annual U.S. average capacity rating peaked at 950 kW in 2005 and averaged 570 kW in 2011 with the re-emergence of several models in the 120-kW to 500-kW range. The average wind turbine capacity rating for all U.S. wind projects sized from 101 kW up to 20 MW has nearly doubled, from 850 kW in 2001 to 1.6 MW in 2011, primarily due to the availability of multi-megawatt turbines for distributed wind projects.

For installations of mid-size turbines up to and including 1 MW, Minnesota, California and Iowa have been the historical leaders, with half of the units in this segment installed from 2001 to 2011. Oregon was the only state to see significant mid-size wind turbine installations in 2011; Minnesota, California, Massachusetts, Illinois, Indiana, Washington and Arizona installed just one or two mid-size turbines each.

Construction of several mid-size wind turbine projects in Indiana, Ohio, Alaska, Rhode Island, New York and Iowa is continuing in early 2012, already exceeding 2011 installations nationwide.

Figure 22 Number of Mid-Size Turbines by Size Category



Fourteen wind turbine suppliers with a presence in the U.S. mid-size sector, including imports, reported sales of 15 turbine models in 2010, 2011 and the first quarter of 2012. A majority of U.S. mid-size wind projects have used turbines manufactured abroad. European and Asian manufacturers have dominated the U.S. mid-size wind market.

Minnesota Mid-Size Case Study: Juhl Wind

Minnesota community wind power developer and pioneer Dan Juhl and his company Juhl Wind Inc. installed two 750-kW Unison wind turbines in Winona County, Minnesota, in late 2011. The $4.8 million project received $2.8 million of American Recovery and Reinvestment Act funding. The direct-drive Unison turbines deployed in the project were only the third of their type to be installed in the U.S. The project produces enough electricity for 375 homes and demonstrated the viability of wind in the area. The project operates with a 35 percent to 38 percent net capacity factor.

The Winona County Wind Project is one of six mid-size wind farm projects that Juhl Wind has completed over the past two years, several of which were partially financed with American Recovery and Reinvestment Act funds. The success of the Winona County Wind Project prompted the Gundersen Lutheran Health System to install two wind turbines in Lewiston, Minnesota (also in Winona County). The Gundersen Health System has a goal of becoming 100 percent energy independent by 2014. Since 1999, Juhl has completed 21 community wind projects totaling 195 MW. The company has 21 more projects in the Midwest in the works.

2011 Developments & Drivers

The KidWind Project Celebrates Major Accomplishments

The KidWind Project trained more than 1,000 teachers and hosted 18 KidWind Challenges in 2011, marking another productive year. KidWind also celebrated its 10th anniversary in 2011; it grew from a one-man operation to a 20-employee company that has trained more than 7,000 teachers and engages more than 500,000 students each year. KidWind shipped more than 60,000 experimental turbines to classrooms all over the world and now has a network of 70 master trainers in the U.S., Canada, Ireland and Chile.

One of KidWind's major U.S. projects in 2011 was establishing a partnership with the national 4-H organization. The 4-H National Youth Science Day is the premier national rallying event for 4-H science programming, bringing together youth, volunteers and educators from the nation's 111 land-grant colleges and universities and the Cooperative Extension System to simultaneously complete the National Science Experiment. In 2011, the experiment was called Wired for Wind, and KidWind provided significant materials and support to make this event a success. In October 2011, more than 100,000 students in the United States used KidWind equipment to experiment with blade design and test the performance of their small wind turbines.

Other 2011 program highlights include:

- KidWind hosted challenges in six states (Alaska, California, Iowa, Kansas, Minnesota and New York) for more than 200 student teams.
- KidWind hosted free teacher workshops in more than 20 states.
- Thirty WindSenators (from 12 new states, Chile and Canada) joined the outreach network at KidWind's annual expert training at Colorado State University.
- The Dundalk Institute of Technology in Ireland hosted the first overseas WindSenators training. In 2012, the Institute will host three more training sessions.
- KidWind launched a new website (**http://learn.kidwind.org**) and a Web-based Kidwind Challenge that allows students from all over the world to share their turbine experiments and experiences from their classrooms.
- KidWind released major upgrades to many of the best-selling educational product lines.

Photo courtesy of The KidWind Project

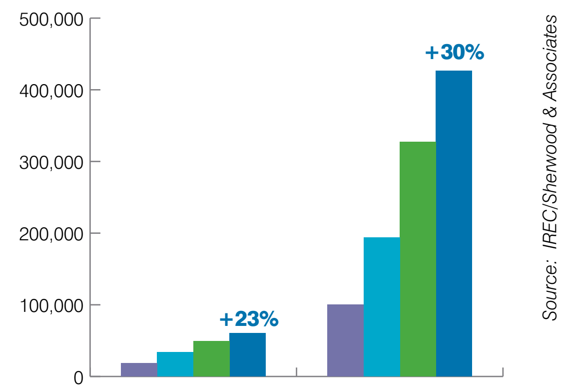
Solar PV Costs Continue Decline and Boost Market for Distributed Generation

The U.S. solar energy industry achieved a new record for installations and growth in 2011: nearly 1.8 GW of PV installations, more than double 2010 with 318 MW installed on residences and 1,620 MW in commercial and utility applications across more than 62,600 systems.[18] The commercial PV market grew 137 percent to reach 840 MW of installations, representing almost half of 2011 installed capacity but only 11 percent of installations.[19] The utility PV market installed 680 MW in 2011, a 139 percent increase over 2010. Despite holding the lion's share of total installations (more than 88 percent), grid-connected PV installations of 100 kW or less grew by only 21 percent, down from 45 percent growth in 2010.

U.S. Treasury 1603 payments played a large role in the commercial and utility increase, helping fund approximately 30 percent of the non-residential PV installations during 2011.[20] Improved capital markets, third-party financing and state renewable portfolio requirements with solar mandates, including Solar Renewable Energy Credits, were major drivers in PV non-residential and utility-sector growth.

Driven primarily by state incentives and policies, the PV market continued its historic concentration in California and New Jersey. However, the PV market also continued expanding across the country, with substantial increases in New Mexico, Arizona, Pennsylvania and Colorado in 2011.

Figure 23 U.S. <100 kW Solar PV Market Growth



Year	Installations	kW
2008	18,300	100,300
2009	33,900	194,000
2010	49,200	327,000
2011	60,300	426,100

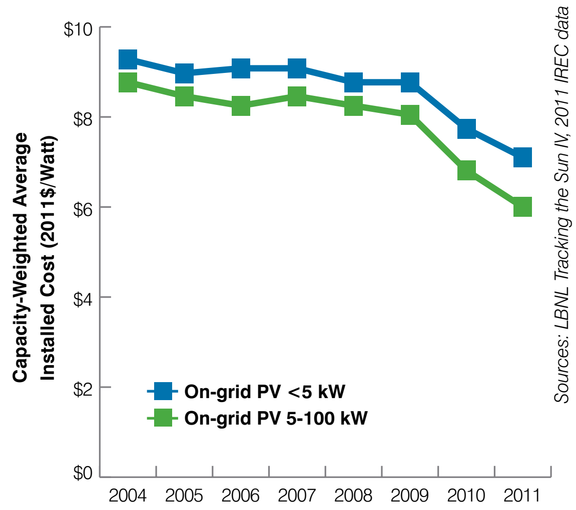
California, New York, Wisconsin, Nevada, Ohio and Oregon experienced substantial increases in both PV and small wind capacity in 2011; however, several states with strong small wind sales (including Alaska, Iowa, Minnesota and Kansas) were not top 2011 markets for PV. Areas without state, utility or local incentives or policy mandates continued to see relatively few PV installations as federal incentives also were still generally insufficient to create strong PV markets.

U.S. grid-connected small wind installations in 2011 correspond to 4 percent of 2011 grid-connected PV installations (up to 100 kW) on a capacity basis and 5 percent on a unit basis. This change from 2010 reflects the increase of average 2011 PV project size in this sector to 7.1 kW per installation (compared to 5.8 kW for grid-connected small wind). PV sales have also shifted from remote, off-grid installations to larger grid-connected systems, which now comprise a majority of the PV market. The "utility" PV sector, or projects selling on the utility side of the meter mostly through feed-in tariff programs, saw the largest capacity increases in PV projects up to 100 kW in 2011, although most of the growth in installations was in the commercial and residential sectors.

PV prices have declined by more than 50 percent since 1998, and the average pre-incentive cost of residential and commercial solar PV systems decreased 11 percent in 2011. Since the beginning of 2010, the average price of a PV system has dropped by more than 35 percent. The average price of solar panels alone declined by more than 50 percent in 2011. Driven in part by a global oversupply, the sharp fall in prices is beneficial to PV customers but has put a serious strain on solar manufacturers worldwide.[21]

2011 Developments & Drivers

Figure 24 Distributed Solar PV Cost Trends



PV installation labor, balance of system costs and overhead also continued decreasing, demonstrating that state and federal policies are effectively further driving down costs. As a result of the lower per-Watt costs, the average size of direct cash incentives for PV from states and utilities as well as dollar-per-Watt value of the federal tax incentive have continued to decrease. The average installed cost of residential PV installations in 2011 was significantly lower in Germany ($3.10 per Watt) than in the U.S. ($6.18 per Watt). U.S. PV sales represent just 7 percent of the global PV market, and U.S. PV manufacturers continue to face stiff competition due to global supply outpacing demand. The downward global pressure on prices has driven prices below costs for some suppliers, causing industry turbulence with high-profile bankruptcies. However, that dynamic is changing with new 30 percent U.S. tariffs on Chinese products.

Chinese imports are thought to have played a significant part in these market changes.[22] In response to a formal complaint filed by SolarWorld and six anonymous parties, the U.S. International Trade Commission unanimously found that by selling modules below their cost of manufacturing and marketing, China's silicon PV trade practices were unfair and harming U.S. industries. The ruling allows the U.S. Commerce Department to continue its duty investigations on Chinese PV imports and determine appropriate sanctions in 2012.

The U.S. Energy Department's SunShot Initiative awarded more than $437 million in 2011 to hundreds of projects focused on reducing hardware and balance-of-system costs, increasing reliability and spurring rapid adoption of solar technology. Balance-of-system hardware includes all non-module components used in solar power installation for residential, commercial and utility markets and represents a major opportunity to achieve significant cost reductions. In addition, as part of the SunShot Initiative, the Energy Department established three Regional Testing Centers to validate the performance of PV systems, verify and validate models used to predict performance, collect detailed operations and maintenance data and investigate the role of various environmental/climatic factors on the reliability, durability and safety of PV technologies. The SunShot Initiative aims to decrease the total costs of solar energy systems by 75 percent by the end of the decade.

Smart Charging Electric Vehicles Store Wind

Two 2011 studies focused on how hybrid and electric cars could help smooth gusts of wind power entering the electric grid, improving economics for both small- and large-scale wind.

The Pacific Northwest National Laboratory estimated that converting 13 percent of the region's light-duty vehicles to hybrids and full-electric vehicles with smarter charging could balance large increases in wind generation. New grid-friendly plug-in systems respond to price signals so cars can charge when demand is down and supply is up.

In Denmark, a study on Bornholm Island, where one-third of the electricity used is from renewable energy, found that smartphone apps helped electric vehicle owners stagger

Small Wind Jobs and Economic Development Impacts

How many jobs are currently supported by small wind? How does small wind contribute to the domestic economy? To answer these vital questions, NREL is creating a model to estimate employment and other economic impacts from small wind projects in the United States, building on similar efforts with other energy technologies. The number of requests for such a model has steadily increased over the past few years as increasing jobs and economic impacts become an important objective of state and local governments. From policy-makers to manufacturers and local advocates, stakeholders need to know about the economic contributions from all industries, including small wind.

NREL has developed a preliminary Jobs and Economic Development Impacts (JEDI) model for small wind based on data from manufacturers, installers and turbine owners. The input-output model estimates jobs and other economic impacts on a state-by-state or nationwide basis. Those wanting to conduct a more localized analysis can purchase county and regional data. With the newly developed model, users will initially be able to choose from four small wind turbine size categories and enter their project's location (specific state) and basic cost data. The model will show jobs and other economic impacts to that state. Results will be most accurate when the model user inputs project-specific and local share data.

For example, if the turbine was manufactured in the same state, or if anemometer testing was performed by a local company, the economic impact from the project will be higher than if out-of-state turbines are used and out-of-state labor is used for siting, installing or testing. The new small wind JEDI model estimates jobs from a specific project or projects.

When the model is finalized, it will be available to the public at no cost and easy to download (**www.nrel.gov/analysis/jedi**). After industry scrutiny, testing and peer review, the final model will be released in summer 2012. NREL is encouraging comments and accepting new data on small wind manufacturing, installation and operations data to make the model more accurate. No company data will be released.

JEDI models exist for utility-scale wind, solar power, ethanol, marine hydrokinetic power, natural gas and coal and are available at the website listed above. Data collection and model development are funded by the Energy Department.

Rare Earths and Magnets: Prices Falling, Future Outlook Unclear

It's been a wild ride over the past few years for small turbine manufacturers, with the cost of neodymium, the primary rare earth element used in permanent-magnet generators, soaring due to export restrictions by China. China controls more than 95 percent of the world's rare earth production.

Although prices have decreased 40 percent and more for neodymium metal and oxides over the past six months, volatility is likely not over yet. The market outlook for rare earths, and for the permanent magnets that utilize them, is currently clouded by rapidly unfolding developments, as companies and nations around the world struggle with the problem presented by a single country exerting control over so much of the global supply of key industrial materials. Recent developments include:

- New rare earth producers, many of them small, have entered the market in response to the dramatic run-up in prices. Rare earth mines in Sweden, the United States and elsewhere that were driven out of the market by low-cost Chinese producers are reopening. Of the new producers, the most significant is Molycorp's Mountain Pass, California facility, which at one time was the world's primary source of rare earth minerals.

- In April 2012, Molycorp announced that a new assay had increased the estimated size of the resource at Mountain Pass by 36 percent. Company officials are currently ramping up production there. In March, the company also announced that it had acquired Neo Material Technologies, a Canadian company with factories in China that manufactures products using rare earths.

- Japan, the European Union and the United States filed a complaint with the World Trade Organization regarding China restricting rare earth exports and the fact that producers of magnets and other products with factories in China have access to lower prices on rare earths.

- In April 2012, China established a rare earth industry association. The association, which includes 155 Chinese companies producing rare earth oxides, is viewed by industry analysts as an attempt by the government to exert even more control over production and exports.

- Many manufacturers of products that use rare earths have elected to set up factories in China, and the country's domestic demand for the minerals is increasing rapidly. Some analysts forecast that China will be a net importer of rare earths by 2015.

According to one small turbine manufacturer, the cost of the rotor for his company's machine rose to six times its original price last year and has now decreased by approximately 40 percent. "I doubt we are at the bottom, but I also doubt we will ever see the very cheap prices we once experienced," he said. "We had to increase our prices significantly last year, and it certainly has had an impact on sales." He said that as a result, his company is focusing more on high-value applications such as the market for remote telecommunications equipment, much of which is currently diesel-powered.

▲ *Photo courtesy of Northern Power Systems*

◄ *Photos courtesy of Bergey Windpower*

Turbine Installation on Martha's Vineyard Exceeds Expectations

In November 2011, Clarissa Allen and Mitchell Posin, owners of Allen Farm in Chilmark, Massachusetts, became the proud owners of the tallest wind turbine on Martha's Vineyard, an Endurance E3120 on a 120-foot tower. The 50-kW turbine was commissioned on Thanksgiving Day.

The installation was also memorable for Gary Harcourt, co-owner and manager of Great Rock Windpower, who installed the turbine with his team. The turbine at the Allen Farm was the 50th wind turbine the Great Rock team has installed and the twelfth turbine on the Vineyard. According to Harcourt, the Allen Farm turbine is the "crown jewel" for him. It's located on a beautiful rolling hill, with gorgeous ocean views, on the sheep farm that has been in Allen's family for 300 years.

Harcourt, a cabinetmaker for 25 years, became involved in the small wind business back in 2007, installing Endurance wind turbines on Martha's Vineyard. The Great Rock team installs other turbines beside the Endurance; his 12 installations on the island encompass two 50-kW machines, eight 5-kWs, one 6-kW and one 2 1/2 kW.

"The offshore controversy adds another layer of anti-wind sentiment," Harcourt said. "Every turbine we put up is pretty much a battle."

Harcourt first spoke to Allen and Posin in 2007 about installing their turbine. The Chilmark zoning board of appeals upheld a building permit for the Allen Farm turbine in January 2011. It was issued under a Massachusetts agricultural exemption that allows working farms to bypass the normal permitting process.

"According to Massachusetts state law, a farm cannot be unduly hampered with zoning bylaws," Harcourt said. "So for the most part, anyone can build anything they want on a farm as long as it relates to farming. The anti-winders put up a fight and contested the permit at a big hearing. Eventually we were successful because of the statute."

Another glitch in the permitting process resulted when it was realized that the turbine produces more electricity than the farm uses. Massachusetts has shared net metering, so to secure approval of the building permit, the Allens had to be able to use 51 percent of the electricity generated on their farm. They sell the remaining 49 percent to the local Home Port restaurant in Menemsha. The Allens use their electricity to power the farm outbuildings, including their lambing operation, and the aerators that Posin uses for his compost tea business.

Allen and Posin financed the project through Martha's Vineyard Savings Bank. They also received a $100,000 grant from the Massachusetts Clean Energy Center, the maximum grant for a small turbine based on predicted energy. The Clean Energy Center also funded the met tower.

In December 2011, NSTAR Electric & Gas Corporation approved the interconnection, and the turbine began producing energy. Harcourt said that he predicted lower performance than the actual. Favorable siting is one reason the turbine exceeds the production expectations: it is sited on a hill with great access to winds from all directions, and there are few trees and buildings in the immediate area.

According to Harcourt, an anti-wind group petitioned the town to pay for a third-party study of how much energy the turbine would produce and how much energy the farm would use to determine whether the Allens would use the required 51 percent. Harcourt was able to use the study, which predicted higher performance than he did, when the local banker called him for project information while processing the loan application for the turbine. Allen and Posin are thrilled with their turbine.

You can track the energy production of the Allen Farm turbine at **www.powerdash.com/systems/1000440/**

◂ *Photo courtesy of Ivy Ashe for the Vineyard Gazette, 2011*

Photo courtesy of Endurance Wind Power ▸

Alaska Village Project to Save 60,000 Gallons of Diesel Fuel Per Year

Despite the severe climate, the warming tundra, rising energy prices and moving into the cash economy, life in rural Alaska continues. Traditional ways of life in rural Alaska remain strong as the indigenous people continue whaling, commercial and subsistence fishing, hunting and trapping as their ancestors have done before them.

As part of the villages' economies, autonomous wind-diesel systems are helping to stabilize energy prices and reduce diesel fuel consumption in many rural Alaskan villages. In 2011, the Alaska Village Electric Cooperative, Inc. (AVEC) installed four Northern Power 100-kW turbines in Emmonak and constructed a 10-mile intertie to Alakanuk. With a combined population of 1,460, the primarily Yup'ik Eskimo villages are located at the mouth of the Yukon River in western Alaska. Residents are expected to see the full benefit of wind turbine technology when the crews finalize the necessary upgrades to the old control technology in the existing Emmonak AVEC power plant. Planned improvements will be completed in 2012 and are expected to save 60,000 gallons per year of diesel at more than $4 per gallon. Additionally, excess wind generation contributes heat to a local heat recovery system that displaces fuel needed at the local water treatment plant. Like most Alaskan villages, Emmonak and Alakanuk have winter peaking loads, primarily driven by the school, the water/sewage system, and homes, matching nicely with the robust winter wind resource. However, in summer, fish processing requires commercial-scale cooling and ice-making. Engineering the 60-foot steel pilings with a prefabricated concrete sectional foundation for each turbine to dampen vibrations was a necessary innovation to deal with difficult geotechnical and logistical conditions. The project was financed by a combination of the Alaska Renewable Energy Fund and AVEC's internal construction capital. When electricity costs more than $.50/kWh, the "free" fuel from the wind turbines is a welcome, stabilizing alternative to diesel. The four turbines at Emmonak bring AVEC's fleet to 34 turbines at 11 sites, serving 15 villages. AVEC was recognized by Wind Powering America with its wind pioneer award in 2008.

Photo courtesy of Alaska Village Electric Cooperative

Markets

To capture the opinions and attitudes of industry leaders on the small wind markets, policies, challenges and opportunities, AWEA staff interviewed a cross-section of the small wind industry, including domestic and international manufacturers and developers. Their views (not AWEA's) are summarized in the following sections.

- The extended weak economy affected all sectors, but residential applications were hit hardest because homeowners remained reluctant to invest in their properties, especially in the more populated states.
- Selected commercial and institutional applications — including wastewater, businesses and schools — deployed turbines in the 10- to 100-kW range. Commercial applications require favorable economics and a combination of a good wind resource, state and federal incentives and above-average utility tariffs. Non-profits, such as schools, have to be creative in the use of financial incentives since they can't directly use the federal 30 percent ITC.
- Although federal facilities have aggressive department-wide renewable energy goals, installations remained challenging because of cumbersome administrative processes. Border stations, in particular, showed promise, but proved to be administratively challenging (see *Wind Powers U.S. Border Station* on page 53).
- Historically attractive state incentive programs in California, New Jersey, Ohio, Wisconsin, Nevada and Alaska were curtailed or shut down as a result of turbine performance problems or changing political and financial landscapes. California, the single largest market for small wind, was shut down for most of the year.
- Excellent wind states — including Iowa, Kansas and Texas — were good markets for >10-kW turbine applications, especially in the agricultural sector, as a result of the 30 percent federal ITC, good commodity prices, enabling permitting policies and good wind resources.
- After midyear 2011, New York emerged as one of the best state markets for small wind with its progressive, performance–based incentive scheme (see *NYSERDA Emerges As Leading State Small Wind Incentive Program*, Page 37).
- Several states created enabling policies such as virtual or aggregated net metering or feed-in tariffs that will help improve small wind economics.
- Innovative virtual net metering in selected states has been helpful to small wind economics.
- Federal incentives such as the American Recovery & Reinvestment Act, REAP and the 1603 Treasury payment were not deployed as effectively as in 2010.
- Off-grid and offshore oil and gas installations provided an attractive market for smaller turbines.
- PV economics (including state and utility solar-specific policies and incentives), ease of siting and effective financing schemes continued to be challenging to both residential and commercial-scale small wind applications.
- Leading North American small wind manufacturers moved more product overseas than they sold in the U.S. Export markets, especially United Kingdom and Italy feed-in tariffs, were strong for all turbine sizes (although larger turbines have an advantage). Despite its siting challenges, the UK market was the number-one small wind market in the Western Hemisphere (see Page 24). Canada lacks federal incentives, although if modified Nova Scotia and Ontario feed-in tariffs could be attractive (the Nova Scotia feed-in tariff is limited by rotor size, and Ontario's feed-in tariff does not distinguish among turbine sizes). While telecom remains a growth opportunity for small wind, it slowed in 2011 primarily because of PV penetration and competition; however, the telecom industry continues to seek reduced operating costs driven by diesel prices. The emerging economies (e.g., Brazil, Russia, Indonesia and South Korea) show promise for village power applications, although PV competition slowed the telecom market.

Industry Perspectives

2011 Developments

- The SWCC began certifying small wind turbines based on third-party testing against the AWEA standard. These certifications will be used by states to qualify turbines for their incentive programs.
- AWEA partnered with the DWEA to host the annual 2011 Small and Community WINDPOWER Conference & Exhibition in Des Moines, which attracted more than 850 participants. The AWEA/DWEA team collaborated on a number of federal (e.g., REAP, ITC and the USFWS siting Guidelines) and state policy issues.
- ITAC emerged as states collaborated to develop a comprehensive list of qualified turbines and incentive qualification guidelines. ITAC's efforts, in addition to the SWCC certification process, should help reduce the performance and reliability problems experienced by small wind state incentive programs in 2011.
- The California incentive program was reinstated later in 2011; New York emerged as a leading state market for small wind.
- Domestic and export markets continued to strengthen and expand for >20-kW turbines.
- Installers' legal vulnerability was exhibited in New Jersey. From a business perspective, turbine performance and reliability problems may cause stress in installer-manufacturer relationships. There may be a need for specialty insurance.
- Tower safety has always been a priority in the industry. As the industry grows, the need for a best practices document for tower safety became apparent; a small wind installers' committee has initiated work on the document with an expected publication date of mid-2012.
- The use of social media for both marketing and rallying policy support saw expanded use by companies, organizations and advocates in 2011.
- DWEA continued to mature and increase its membership, as well as demonstrate policy leadership.

2011–2012 Challenges

- Federal policy. The ITC remains critical to make economics work for most sectors. USDA REAP awards to small wind projects were minimal in 2011, and the 2012 Farm Bill is under severe budgetary pressure. The U.S. Treasury 1603 program helped non-residential projects hosted by for-profit enterprises, but it doesn't apply to residential applications; some 1603 projects started during the fourth quarter of 2011 will be completed in 2012. Most American Recovery & Reinvestment Act funding had been applied to 2009 and 2010 projects and will have been expended by the end of 2011. While the final voluntary USFWS guidelines noted the difference between small and large-scale wind turbine applications, the implementation of the USFWS guidelines to small turbine applications remains a concern. The industry is engaging IRS/Treasury to consider requiring certification for ITC qualification.
- State policy. Even with the federal ITC, the industry needs stable and equitable state incentives to effectively compete with utility rates and PV. In some states, solar renewable energy certificates, Renewable Portfolio Standard set-asides and disproportionate PV incentive funds created an unlevel playing field for small wind. The implementation of third-party certification into state incentive programs will help minimize the performance and reliability problems encountered in 2011.
- Financing. PV has more innovative and effective financing options because of perceived reliability, performance predictability and volume. The discontinued Home Equity Line of Credit (HELOC) program was effective for residential applications. It has been difficult to get local banks interested in HUD loan guarantees. Third-party leasing of residential and commercial PV systems propelled the PV market; however, primarily due to small wind's less predictable long-term performance, this model has yet to become significant in the small wind sector.
- As PV installed costs have become competitive with small wind and as natural gas prices remain low and keep utility rates from rising, there will be pressure to reduce the cost of energy from small wind turbines while not sacrificing reliability or durability.
- While many U.S. utilities have engaged with wind farm development, a large number of utilities remain resistant to small wind interconnection and economics. Continuing to educate and engage rural businesses, agricultural organizations and school networks in the value of local, distributed wind generation will help reduce utility resistance.

- The small wind industry must continue to improve its image through product reliability, certification, proper siting/installation and outreach (e.g., the Energy Department's Wind for Schools project and Wind Powering America initiative).
- Local permitting and zoning remain the key local barrier to consistent and timely deployment. Dealers and installers continue to work with local officials to educate them on appropriate setbacks, height restrictions, sound levels, visual and property value impacts, wildlife impacts, health effects and the differences between large and small turbines. While there is an industry desire for state permitting authority (e.g., Wisconsin), "home rule" most often prevails; model ordinances (see *Model Zoning Ordinance* on Page 29) are helpful for municipal and county officials trying to develop small wind ordinances from scratch. While there is some evidence that local resistance diminishes as more turbines are installed, there remains significant vocal opposition, armed with misinformation, especially in semi-urban areas.
- Performance prediction of small wind systems is important for state incentive programs, financing and customer confidence; there remains a need for improved predictive tools and certified site assessors and installers.

2012 Prospects

- In general, the industry expects a rebound and increased 2012 sales as state incentive programs are re-established, using certified turbines as the SWCC program progresses and ITAC guidelines focus on performance and reliability. An improved economy would help consumers re-focus on energy, the environment and economic prosperity. Most North American manufacturers reported strong fourth-quarter order volume that will be deployed in early 2012. PV economics and financing will continue to be a serious challenge. Export markets — including European and Canadian feed-in tariffs, telecom and diesel-electric applications — will continue to be important.

Photo courtesy of Polaris America

Harvest the Wind Network

Like the Phoenix rising from the ashes in ancient Egypt, a wind energy business arose from the devastation of a tornado in Greensburg, Kansas. In 2007, BTI, a Kansas-based John Deere dealership since 1944, decided that while most of the town was leveled, their 36 employees and their customers remained, so they would help rebuild the town and their business as a “green” community. Having no local power from May to November, the Estes family installed a 5-kW Endurance turbine to help provide local electricity for the rebuilding process. Locals began stopping by to inquire about the turbine. At the same time, employees from federal agencies, including the Energy Department and NREL, went to Greensburg to assess the opportunities for renewables and energy efficiency and to offer technical and financial assistance. BTI, in the spirit of Midwestern entrepreneurship, dug into the distributed generation products and legacy. Fourth-generation Haley Estes left the bright lights of New York City to return to Greensburg and travel around the world talking with turbine manufacturers, dealers and users of distributed wind systems. BTI began selling small turbines to their John Deere customers. This small start led to their reaching out to John Deere dealerships in 45 states and three Canadian provinces, which resulted in the formation of 15 dealer groups with 200 storefront locations. They named the group Harvest the Wind Network. In classic John Deere dealership fashion, quality products and excellent customer service were the groups’ wind business foundations. Each hired a full-time, trained wind specialist to help customers with the wind feasibility analysis and after-sales customer service. They have since expanded beyond their agricultural customers to all rural business applications. Additionally, they identified the need for larger and a greater variety of turbine sizes. They now offer four turbines, ranging from 50 kW to 1.65 MW, developing partnerships with Endurance, Northern Power Systems, Gamesa and Vestas. One of their operating principles is to work with local construction crews during installation. So while rebuilding their Greensburg dealership, they attained a LEED Platinum designation, and their 50-kW wind turbine has proven to be a significant contributor to the now net-zero facility. The BTI-Greensburg John Deere dealership has become a model for other new Deere dealerships. So as Shakespeare said in 1604, “all’s well that ends well,” which certainly played out in Greensburg, Kansas.

Photo courtesy of BTI

Wind Powers U.S. Border Station

Out of adversity comes opportunity. Following 9/11, the U.S. initiated a program to expand and upgrade its border stations with Canada and Mexico. Federal agencies have aggressive clean energy and carbon reduction goals, and the federal government's General Services Administration (GSA) is responsible for many of the federal government's buildings, including energy procurement. While the U.S. operates 168 border stations, in GSA's New England Region, there are 47 land ports of entry (LPOEs), ranging in size from 2,000 to 100,000 square feet. With more sophisticated electronic equipment being deployed in these stations, the loads are increasing.

Staff at the GSA's Boston office had been evaluating the wind energy opportunity since 2001. The combination of the remote Jackman, Maine LPOE upgrade and the availability of ARRA funds led Roman Piaskoski, Chief of the Energy, Utilities & Environment Branch, to implement a distributed wind generation pilot project consisting of two Northern Power Systems 100-kW units. The turbines were installed in September 2011 but were not interconnected and online with Hydro-Quebec (H-Q) until April 2011. With a measured wind speed of 6.1 mps (13.7 mph) at 37-m (69-ft.) hub height, the two units are expected to produce 400 kWh per year. The project goal was for the turbines to supply 50 percent of the Jackman LPOE's annual electricity.

The permitting was relatively straightforward as the site is GSA property and not close to residential areas. It received Federal Aviation Administration and Maine Department of Environmental Protection approvals, with no public resistance.

However, as can happen with first ventures, the project faced challenges, even with proven equipment. H-Q had existing net metering regulations for generators <60 kW and >1 MW, and so the 100-kW turbines landed in H-Q's blind spot. GSA had initially considered 10-kW units until the Jackman LPOE was dramatically upgraded, and H-Q assumed that GSA proceeded with the original turbine capacity. With the two 100-kW units, H-Q required the installation of a remote shutdown system with a dedicated phone line. Factor in the language differences and less-than-ideal communications, and the result was a six-month delay between installation and operation. In addition, the installer implemented a special ice-melt system, which failed, caused frequent system shutdowns and eventually resulted in the need for a new set of blades. (Northern Power did not endorse the system.)

Since resolving these issues, the Energy, Utilities & Environment Branch has been pleased with the turbines' performance and Northern's technical assistance and maintenance. Piaskoski believes that the pilot successfully demonstrates that wind energy can contribute to GSA's energy and environmental goals through application to LPOEs in windy locations. He recently presented the project at the GovEnergy conference as a successful wind pilot project. While the decreasing GSA budget may not be sufficient to expand the number of LPOEs, an opportunity remains for wind to participate in the upgrading and greening of existing facilities.

Photo courtesy of Northern Power Systems

Endnotes

1. The report is available at www.nrel.gov/docs/fy08osti/41869.pdf
2. Reported funding assistance does not include depreciation and some financing programs and tax credits that are not aggregated by state or federal agencies.
3. As compiled in eFormative's Distributed Wind Projects Database; 2011 sources include Rich Stromberg, Alaska Energy Authority; Arizona Corporation Commission; California Energy Commission; Jessica C. Quinn, Delaware Division of Energy and Climate; Tracey Williams, Georgia Environmental Finance Authority; HECO; Gabriela Martin, Illinois Clean Energy Community Foundation; Wayne Hartel, Illinois Department of Commerce and Economic Opportunity; Keith Kutz, Iowa Energy Center; John Pearce, Iowa Utilities Board; Ruth Douglas Miller, Kansas State University; Dana Fischer, Efficiency Maine; Cindy Szczesniak, Maryland Energy Administration; Peter McPhee, Massachusetts Clean Energy Center; Mark H. Clevey, Michigan Energy Office; Lise Trudeau, Minnesota Department of Commerce; Danielle Jensen, Nebraska Energy Office; Matt Newberry, NV Energy; B. Scott Hunter, New Jersey Clean Energy Program; R. Dwight Lamberson, New Mexico Public Regulation Commission; Mark Mayhew, New York State Energy Research & Development Authority; Bob Leker, North Carolina Commerce Department; Preston Boone, Ohio Department of Development; Monty Taylor, P&K Wind Energy; Betsy Kauffman and Chris Dearth, Energy Trust of Oregon; Kerry Campbell, Pennsylvania Department of Environmental Protection; Julian Dash, Rhode Island Economic Development Corporation; Brian Rounds, South Dakota Wind for Schools; Matthew A. Brown, Tennessee Valley Authority; Chris Tallackson, Utah Office of Energy Development; Andrew Perchlik, Vermont Clean Energy Development Fund; Ken Jurman, Virginia State Energy Office; Phil Lou, Washington State University Energy Program; Rich Hasselman, Wisconsin Focus on Energy; Shannon Stanfill, Wyoming State Energy Office; Trudy Forsyth, Charles Newcomb, and Julie Jones, National Renewable Energy Laboratory; Anthony Crooks, U.S. Department of Agriculture; U.S. Treasury 1603 public records.
4. State data reflect year of installations (including refurbished turbines) rather than the year new turbines were sold as reported in market highlights section; e.g., Alaska saw minimal sales of new turbines in 2011 but significant installations.
5. State-reported installations do not necessarily correlate with manufacturers' sales data.
6. Kevin Schulte, SED
7. *2012 Small Wind World Market Report*, www.wwindea.org
8. U.S. Energy Information Administration
9. Including Cleanfield, Endurance, Raum, ReDriven and Seaforth.
10. Tim Weis, the Pembina Institute.
11. Sources: eFormative interviews with Scott Stanberry, Southwest Windpower; Ben Higgins & Daryl Zeis, REC Solar; Bev Guasti, Guasti Wind & Solar; Padma Kasthurirangan, Niagara Wind & Solar; Tal Mamo, Talco Electronics; and Chris Lamonia, Calco Green and Jennifer Jenkins
12. Roger Dixon, Skylands Renewable Energy; Lisa DiFrancisco, North Coast Energy Systems; Mick Sagrillo, Sagrillo Power & Light
13. Available at www.fws.gov/windenergy/docs/WEG_final.pdf
14. Tony Jimenez, National Renewable Energy Laboratory (NREL)
15. Karin Sinclair, National Renewable Energy Laboratory (NREL)
16. Russell Tencer, Wind Analytics; Betsy Kauffman, Energy Trust of Oregon; Mark Mayhew, NYSERDA
17. As compiled in AWEA's U.S. Wind Projects Database (www.awea.org/learnabout/industry_stats/us_projects.cfm), supplemented by a survey of members of DWEA's Mid-Size Committee, state agencies and other industry members conducted by eFormative Options. Sources include Aeronautica, Cascade Community Wind, Elecon, Energy Trust of Oregon, EWT Americas, Gamesa, Global Wind Power, Harvest the Wind Network, Iowa Energy Center, Kenersys, Mitsubishi, Nordic Windpower, Nordtank, Ohio Department of Development, Powerwind, Sustainable Energy Developments, Turbowinds, Unison, Vergnet, Vestas and Wind Energy Solutions BV.
18. Interstate Renewable Energy Council (IREC)
19. Interstate Renewable Energy Council (IREC)
20. Sherwood Associates (ASES slides)
21. Solar Energy Industries Association (SEIA)
22. Andy Kerr, Home Power Magazine, Apr/May 2012

Acknowledgments

Resources

American Wind Energy Association	www.awea.org
Database of State Incentives for Renewable Energy (DSIRE)	www.dsireusa.org
Department of Energy Wind Program	www.eere.energy.gov/wind/index.html
Distributed Wind Energy Association	www.distributedwind.org
National Renewable Energy Laboratory's Regional Test Centers	www.nrel.gov/wind/smallwind/regional_test_centers.html
North American Board of Certified Energy Practitioners (NABCEP)	www.nabcep.org
Small Wind Certification Council	www.smallwindcertification.org
Wind Powering America	www.windpoweringamerica.gov

The following companies participated in AWEA's 2011 U.S. Small Wind Turbine Market Report survey:

U.S.-based: ACME Wind Turbines, Bergey Wind Power, DyoCore, Enertech, Next Generation Power Systems, Northern Power Systems, Polaris America, Southwest Windpower, Urban Green Energy, VAWT Power, Ventera Wind, Windspire Energy, Wind Turbine Industries and Xzeres Wind.

International: Ampair, Cleanfield Energy, Eclectic Energy, Endurance Wind Power, Evance Wind, Gaia-Wind, Kestrel Wind Turbines, Kingspan, Raum Energy, ReDriven Power, Renewable Devices, Seaforth Energy and Sonkyo Energy.

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