2010 U.S. Small Wind Turbine Market Report

YEAR ENDING 2010

AWEA AMERICAN WIND ENERGY ASSOCIATION

Cover photo courtesy of Northern Power

Photo on right courtesy of Bergey Windpower

AWEA® AMERICAN WIND ENERGY ASSOCIATION

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Foreword

The 2010 U.S. market for small wind turbines (≤100 kilowatts, or kW) was both impressive and changing. More than 25 megawatts (MW) were installed, representing a 26% growth from 2009 and an almost eight-fold increase in annual installation capacity and more than twelve-fold increase in annual revenues compared to just 5 years ago. The cumulative installed small turbine capacity increased to 179 MW (deploying 144,000 turbines).

Seven U.S. manufacturers reported annual sales over 1 MW. Twenty-two manufacturers with a U.S. presence reported sales of 51 turbine models. There was a significant shift away from micro and off-grid systems to larger, grid-connected units, continuing a 5-year trend (nine of 10 leading wind turbine models sold in the U.S. were grid-tied). While domestic sales by U.S. manufacturers accounted for an 83% share of the U.S. market, 27% of U.S. manufacturers' output went to foreign markets.

While the federal 30% investment tax credit remained an important financial incentive, the U.S. Department of Agriculture's Rural Energy for America Program (REAP) and U.S. Treasury 1603 payments supported 250 small wind installations in 30 states. State distributed energy incentives remained a major driver, especially in California, New Jersey, New York and Ohio. More than 30 states offered small wind incentives (including American Recovery & Reinvestment Act funds).

The year saw the emergence of several important institutional developments, including the Small Wind Certification Council, the North American Board of Certified Energy Practitioners program for small wind installers, four regional small wind test centers and the Distributed Wind Energy Association, all signs of a maturing industry sector.

The U.S. manufacturers report a large majority of U.S. content, and the industry represents an estimated 1,500 full-time jobs. From an environmental perspective, the 179 MW of small wind installations displace 161,000 metric tons of CO^2 annually, the equivalent of removing 28,000 cars from the highways.

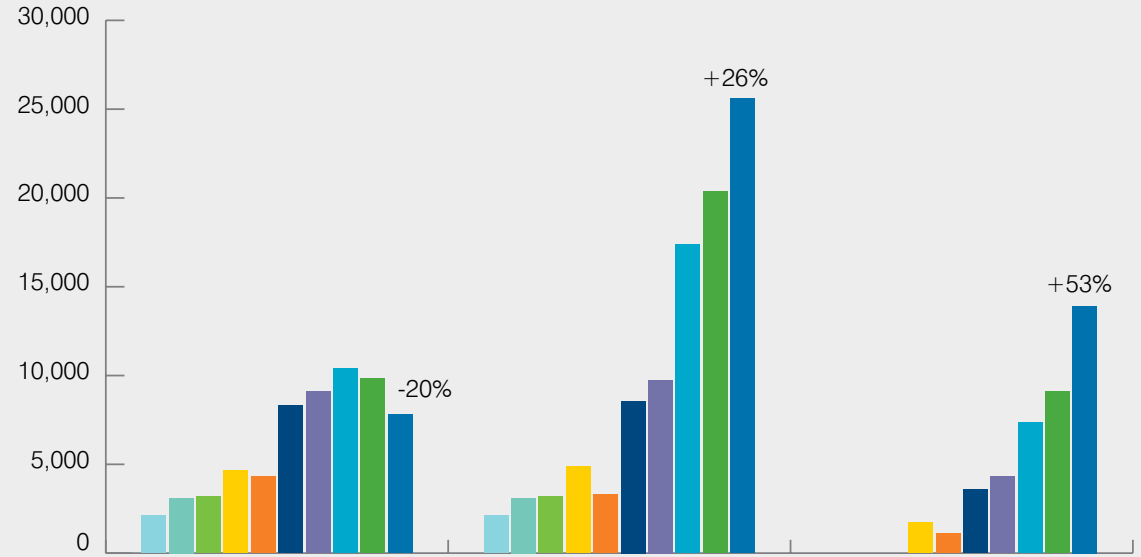
While 2010 was a strong year for the U.S. market and industry, the industry is experiencing some challenges at the time of this report's publication (2011). Some key state incentive programs have (temporarily) stalled, the 2012 REAP funding is in jeopardy, and the U.S. Fish & Wildlife Service is proposing guidelines that are inappropriate and cost prohibitive. Planning and zoning remain a serious barrier in many jurisdictions. Untested, poor quality imports have also created negative impacts on the industry and affected the products' credibility with public officials and the public. On the bright side, the export feed-in-tariff markets and power for telecommunications are somewhat offsetting the soft domestic market situation.

AWEA appreciates the cooperation of the 26 domestic and international manufacturers contributing data, which made it possible to develop the 2010 market report. We also thank the many content contributors, as well as the U.S. Department of Energy's Wind and Water Power Program for the majority of the funding for 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

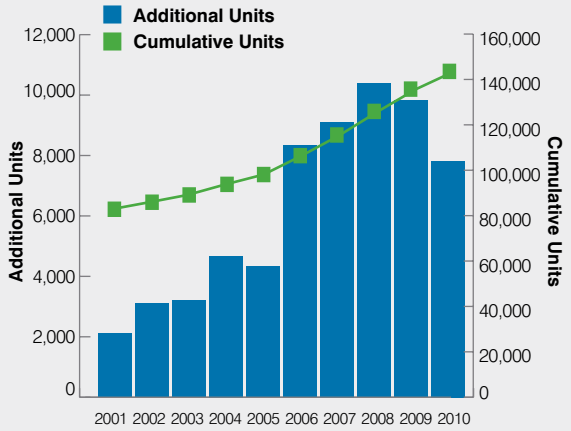
Market Highlights

Figure 1 U.S. Small Wind Turbine Market Growth



	Units	kW	Sales in 2010 $U.S. (x10,000)
2001	2,100	2,100	
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

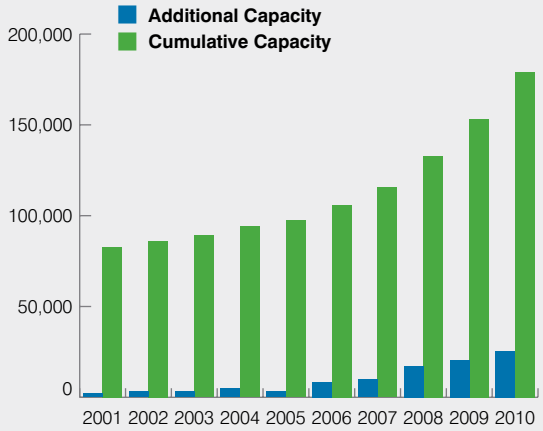
Figure 2 New and Cumulative Units (U.S.)



In 2010, the market for small wind systems grew 26%, with 25.6 megawatts (MW) of annual sales representing 7,811 turbines and $139 million (in 2010$).[1] Sales revenue grew sharply by 53%, while the 7,811 units sold represented a 20% decline from 2009.

Market Highlights

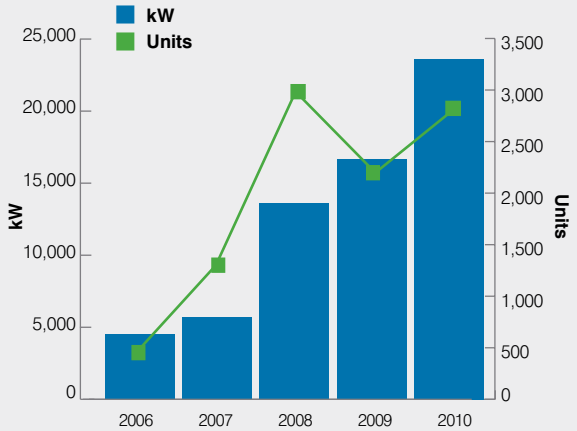
Figure 3 New and Cumulative Capacity (kW, U.S.)



The 2010 market growth increased cumulative sales in the U.S. to an estimated 179 MW of small turbine capacity, consisting of 144,000 small wind turbines.

Seven U.S. manufacturers reported sales (including exports) of more than 1 MW; an additional six non-U.S. manufacturers reported annual sales in excess of 1 MW.

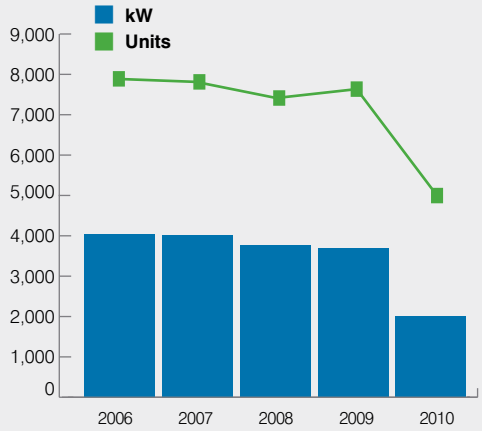
Figure 4 On-Grid Annual Sales (U.S.)



The U.S. market experienced a pronounced shift to larger, grid-connected systems. On-grid systems comprised 92% of 2010 small wind capacity additions, and in terms of 2010 turbine unit sales, 36%.

Nine of the 10 leading small wind turbine models sold in the United States were grid-connected. The shift to larger turbines also is reflected in the average size of on-grid units, which increased to 8.4 kilowatts (kW) in 2010 from 4.4 kW in 2007.

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

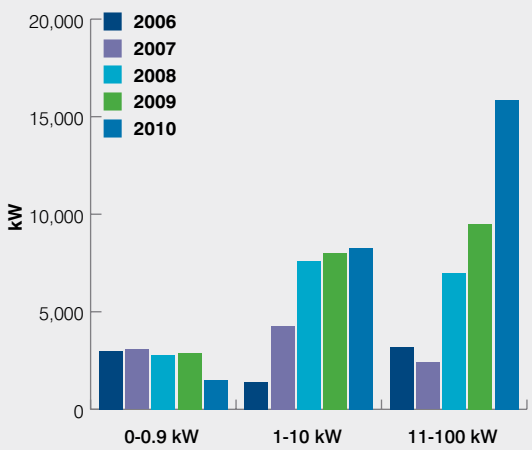


Off-grid units actually experienced a modest average size reduction, from the fairly constant 0.5 kW (2006-2009) to 0.4 kW in 2010.

Combining off-grid and on-grid sales, the average unit size has increased more than three-fold since 2007 (from 1.1 kW in 2007 to 3.3 kW in 2010).

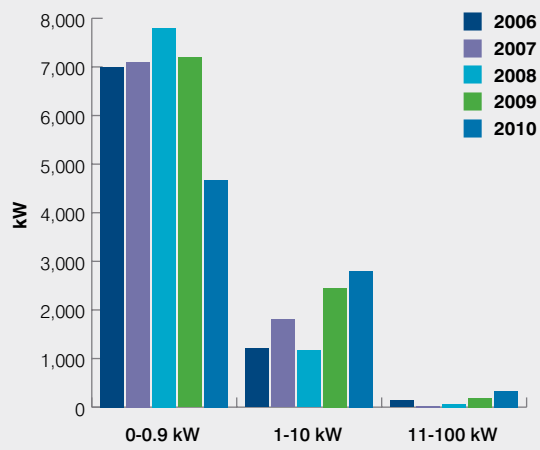
Market Highlights

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



While only slightly more than 4% of the small wind turbines sold in 2010 were larger than 10 kW, they accounted for 62% of total capacity, up from 40% capacity in 2009. Sales of turbines less than 1 kW decreased by 35%, while turbines in the 1- to 10- kW range increased sales by 14.4%, and units larger than 10 kW increased a dramatic 74%, further demonstrating the market shift.

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

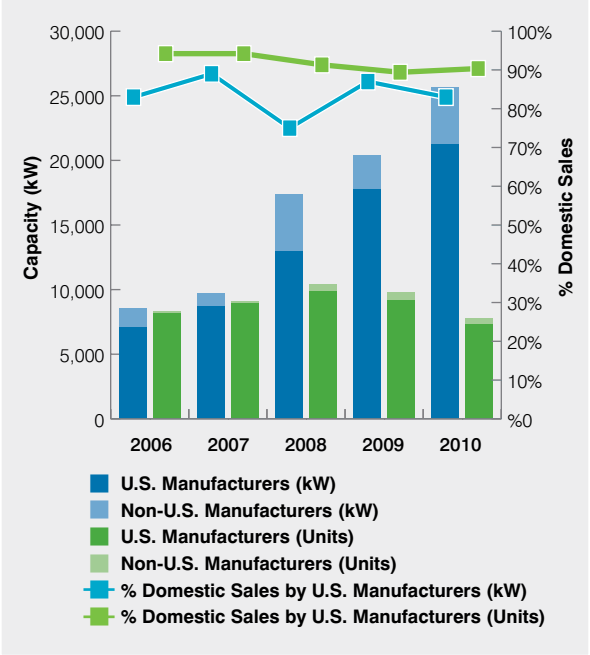


Twenty-two manufacturers with a U.S. sales presence, including imports from Europe and Canada, reported sales of 51 wind turbine models; three-fourths of the models are rated 10 kW or less, and one-fifth are rated 11 to 50 kW.

Photo courtesy of Bergey Windpower

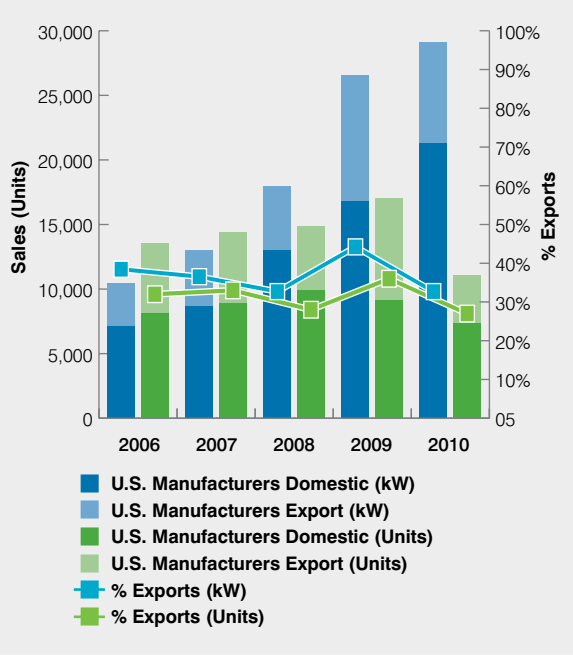
Market Highlights

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



Domestic sales in 2010 by U.S. manufacturers accounted for a 94% share of the U.S. market turbine sales, representing 83% on a capacity (kW) basis. The domestic turbine sales percentage has remained relatively flat the past 3 years, while the percentage of capacity is slightly down from 2009 (87%) but greater than in 2008 (75%).

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



Thirty-four percent of U.S. manufacturers' turbine sales (3,752 units) went to export markets in 2010, reflecting a decline from 46% in 2009, but the same percentage as in 2008. In terms of capacity, 27% of U.S. manufacturers' sales (7,848 kW) were to exports, down from 36% in 2009 but similar in percentage to 2008.

The top three U. S. manufacturers in terms of 2010 capacity sales were Northern Power, Southwest Wind Power and Bergey Windpower.

The average installed cost of small wind turbines sold in the U.S. in 2010 was $5,430/kW.

Small wind turbines manufactured in North America typically incorporate a large majority of domestic content.

The roof-top (sometimes referred to as "urban turbine") units experienced substantial sales growth in 2010 to more than 1,700 kW, or 7% of 2010 U.S. capacity sales. This represents a remarkable 430% growth reported from 2009. In terms of units, 1,074 roof-top units were sold.

The annual CO^2 savings associated with the 179 MW of installed U.S. small wind turbine capacity is estimated to be 161,000 metric tons, or the equivalent of removing 28,400 cars from U.S. highways.

Federal and State Incentives

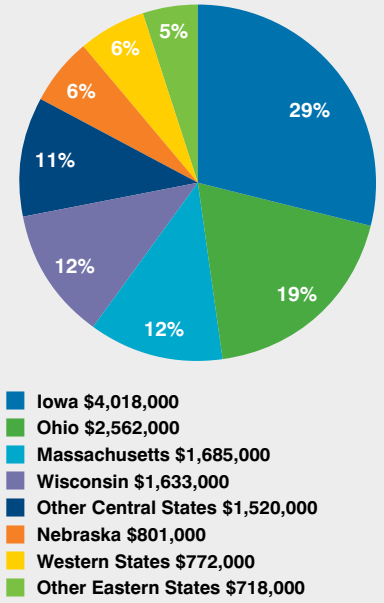
Federal, state, utility and local agencies reported more than $30 million in rebates, tax credits, grants, low-interest loans and other forms of funding assistance for small wind installations in 42 states in 2010, almost equal to the $35.6 million cumulative total reported for 2001-2009.[ii] The 2010 reported funding supported the installation of nearly 900 wind turbines totaling 12.4 MW, or approximately half the reported U.S. small wind turbine capacity sold. These figures indicate substantial growth over the 1,630 cumulative small wind turbine installations with funding assistance reported during 2001-2009, which totaled 16.8 MW, or less than one-fourth of the cumulative total U.S. sales capacity reported in the same 9-year period.

On a per-unit basis, the portion of small wind turbine sales receiving funding assistance increased from less than 5% during 2001-2009 to more than 10% during 2010. Of grid-connected small wind turbines, which comprised more than two-thirds of all 2010 small wind unit sales, more than 30% on a per-unit basis received some form of federal, state or local funding assistance.

The average size of U.S. small wind turbines receiving funding assistance in 2010 increased to 14 kW, up from an average of 10 kW for turbines funded during 2001-2009. This compares to the national average turbine size of 3.3 kW for small wind turbines sold in 2010 and 1.3 kW sold during 2001-2009. Average small wind funding levels increased 16% on a capacity basis and 57% on a per-unit basis, compared to average funding levels during 2001-2009, to $2.45 per Watt and $34,000 per turbine.

Grants and loans from the U.S. Department of Agriculture's (USDA's) Rural Energy for America Program (REAP) and U.S. Treasury 1603 payments together funded 250 small wind installations totaling 6.8 MW in 30 states. Projects in Iowa, Ohio, Wisconsin, Massachusetts and Nebraska collected more than three-fourths of this $13.7 million (see Figure 10).

Figure 10 2010 USDA REAP Grants & Section 1603 Treasury Payments for Small Wind Turbines



Federal and State Incentives

Figure 11 Small Wind Turbines Installed with Federal, State, Utility & Local Funding Assistance

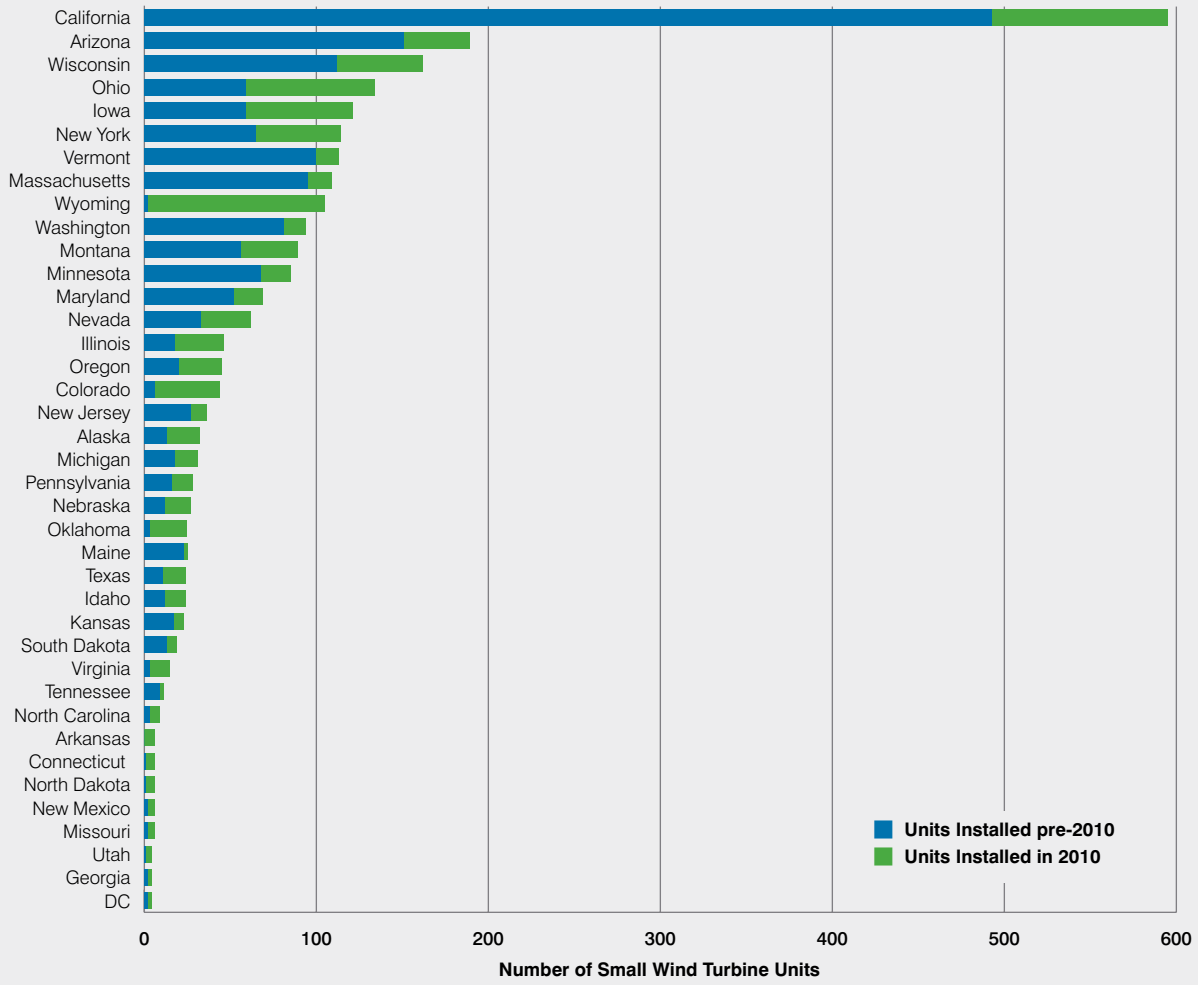
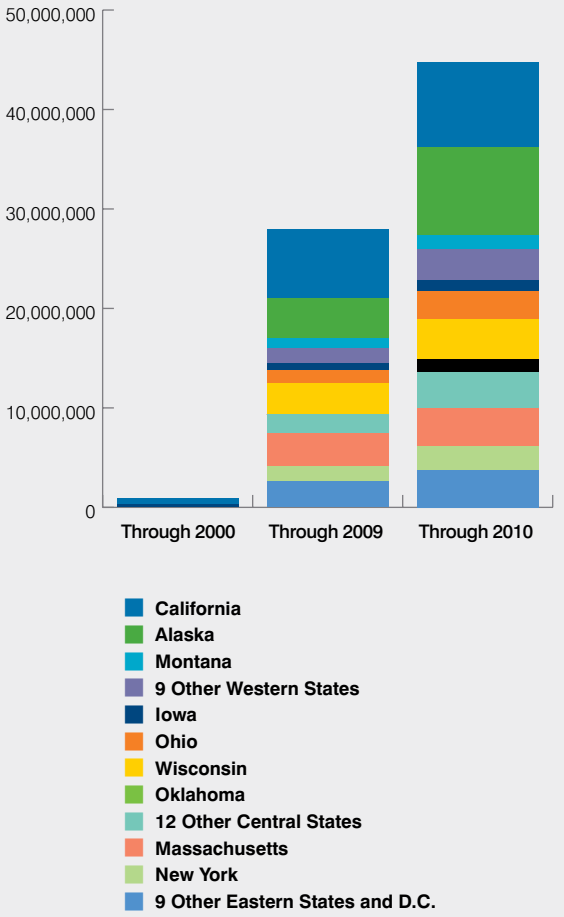


Figure 12 Funding by Region

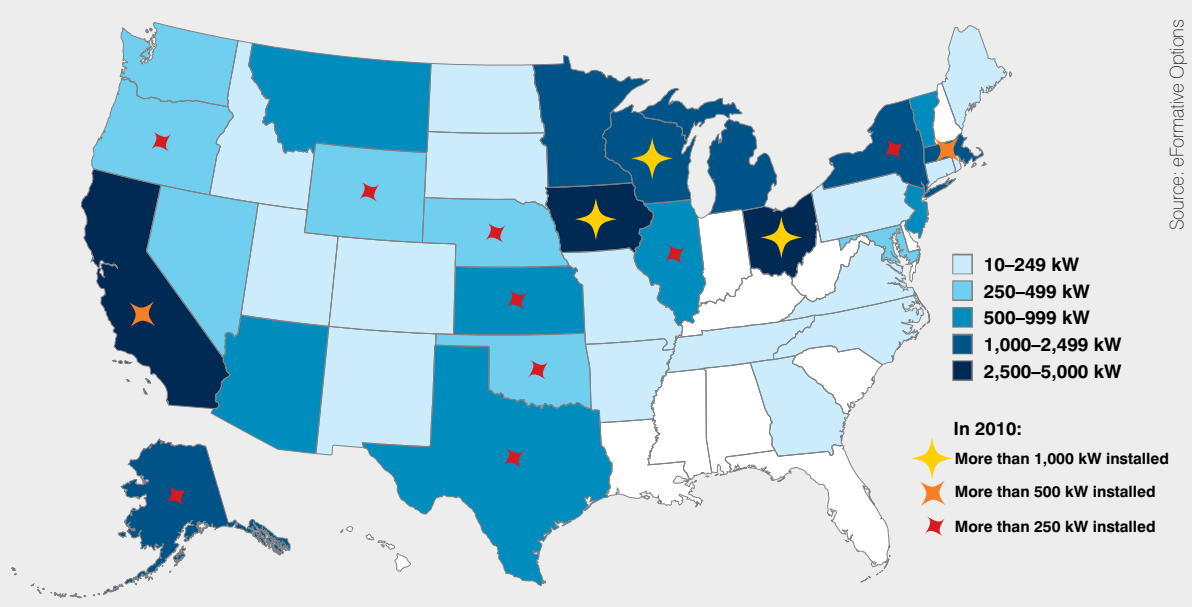


Federal and State Incentives

California and Wyoming led the states in funding the most small wind turbine installations in 2010, followed by Ohio, Arizona, Colorado and New York (see Figure 11). Prior to 2010, only four states each had 100 or more small wind turbines installed with funding assistance, and 25 states each had at least 10 such installations. By the end of 2010, those figures increased to nine states with more than 100 funded small wind turbines and 30 states with more than 10. Wyoming increased from just two small wind turbines funded prior to 2010 to more than 100 funded in 2010. California remains the undisputed leader in terms of cumulative funded small wind installations; however, Alaska's total funding provided (see Figure 12) and Wisconsin's cumulative installed capacity (see Figure 13) are now both on par with California's.

The number of states with at least 1 MW of funded small wind turbines doubled to eight during 2010, and those with at least 100 kW funded increased from 24 to 31 states. Ohio and Iowa both increased their funded small wind capacity by more than 2 MW, and Wisconsin followed closely with 1.7 MW. At the end of 2010, small wind installations had received more than $1 million in each of 14 states and more than $100,000 in 33 states, up from $1 million or more in 10 states and more than $100,000 in 26 states in 2009. Nebraska, Ohio, Colorado and Illinois saw the largest percentage funding increases during 2010.

Figure 13 2010 Year-End Distributed Wind Turbine Capacity (kW)



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

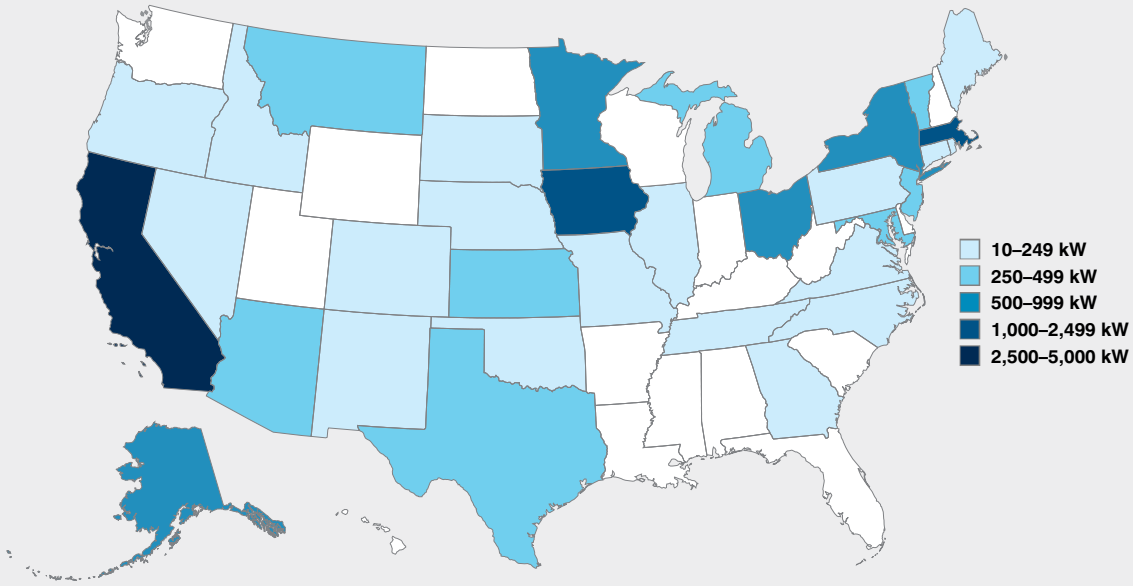
2,360 distributed wind turbines installed with $62.2 million in funding assistance totaling 26.6 MW as of 12/31/2010

A substantial number of projects in Alaska, Iowa, Wisconsin, Ohio and Massachusetts have effectively leveraged funding for commercial applications of distributed wind turbines (above 20 kW), while Wyoming, Arizona, Washington, Vermont and Maryland saw relatively large numbers of smaller, residential-scale turbines.

State cash incentive programs contributed substantially to 2010 small wind turbine sales; however, many were short-lived or experienced funding gaps. In part due to slow progress toward full certification of the majority of turbines available on the market, California and New Jersey placed temporary holds on small wind rebates in 2011. Small wind

Federal and State Incentives

Figure 14 2009 Year-End Distributed Wind Turbine Capacity (kW)



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

1,470 distributed wind turbines installed with $31.7 million in funding assistance totaling 14.2 MW as of 12/31/2009

incentives and grants were offered in more than 30 states in 2010, with at least one-third using American Recovery and Reinvestment Act funds as a primary or supplementary source. Ohio, Texas, Nevada, Minnesota, Colorado, Illinois, Arkansas, Georgia, New Hampshire, Virginia and Wyoming temporarily or permanently closed their small wind programs after they quickly became fully subscribed. Wyoming's program was open for only 10 days. Even in states not dependent on American Recovery & Reinvestment Act funding, demand has outpaced available funding, and legislatures have scaled back rebates and income tax credits (for example, in Oregon and Wisconsin).

While utilities in 43 states now offer some form of net metering, only 16 states have true "statewide" net metering policies covering all types of investor-owned, rural electric cooperatives and public utilities (California, Delaware, Georgia, Hawaii, Louisiana, Maine, Maryland, Minnesota, Missouri, Montana, Nebraska, New Hampshire, Oregon, Vermont, Washington and West Virginia). Seven states offer both statewide property tax and sales tax incentives for small wind installations (Arizona, Colorado, Iowa, Maryland, Massachusetts, Minnesota and Wisconsin). An additional 11 states offer property tax incentives and an additional six states offer sales tax incentives for small wind, roughly the same number offering such incentives in 1999.

Federal and State Incentives

State Priorities

While incentives clearly play a key role in building state markets, other factors also contribute. For example, a strong local sales force can lead to success, as can high-quality installation crews. The Distributed Wind Energy Association, launched in mid-2010 in collaboration with AWEA, identified the following top priority state markets for policy outreach and industry focus: California, Texas, New Jersey, Nevada, Oregon, Pennsylvania, Wisconsin, Iowa, Vermont, Alaska, Minnesota, Massachusetts and Illinois.

Federal and state grants are helping turbines at the top end of the small wind scale build on recent success in Alaska's remote environments to expand in the Midwest and Northeast, especially Ohio, Wisconsin, Massachusetts and Vermont. California's Self-Generation Incentive Program looks attractive on paper, but permitting challenges have slowed its implementation.

Sales of smaller commercial-scale turbines (20 to 50 kW) are taking off in Iowa, Wisconsin, Illinois and Oregon, primarily due to networks of John Deere equipment vendors and other effective local sales representatives. New York and New Jersey represent emerging markets for this sector, and California and Ohio are bright prospects. The agricultural market remains strong.

With sales volume up 50%, 2010 was the best year yet for residential wind turbines. California, New York, Wyoming and Texas experienced strong sales in the 10-kW-and-under market, followed by Vermont, Ohio, Arizona, Maine, Alaska, Nevada and Colorado. Based on state-specific financial returns calculated by a new Web tool (funded by the U.S. Department of Energy and available at www.windpolicytool.org) that compares wind policy, Oregon, Massachusetts, New Jersey and Montana also ranked highly for favorable investment returns.

Photo courtesy of Northern Power

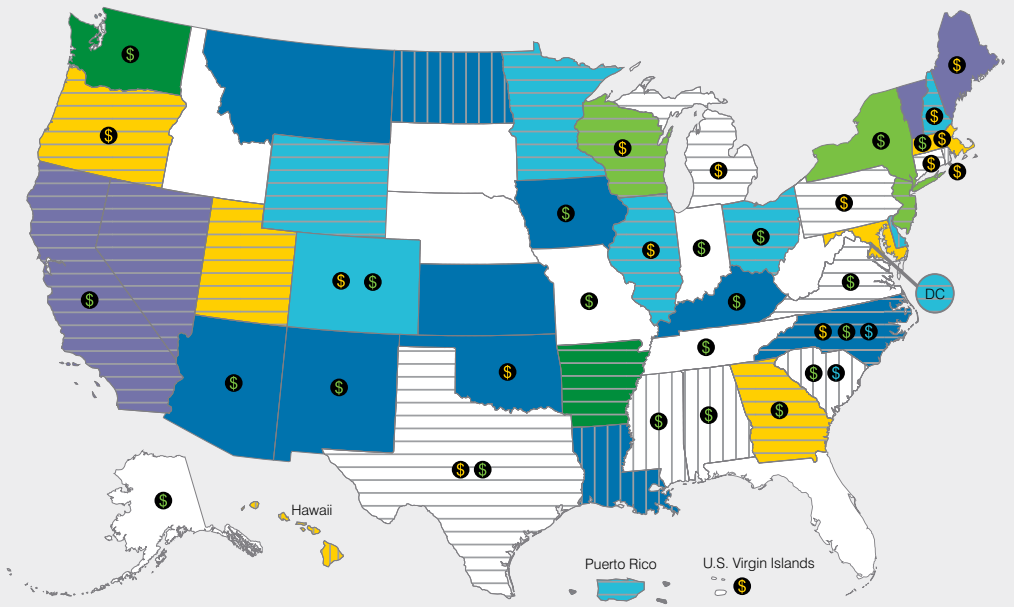
Small Wind Market Drivers

Rebates, Cash Incentives & Other Direct Financial Assistance

The primary market drivers for all renewable energy resources, including small wind, are federal, state and utility financial assistance programs: rebates, tax credits, grants and other incentives. While California and a handful of other states have offered rebates for small wind systems for well over a decade, the federal government first approved a federal Investment Tax Credit (ITC) as part of the Emergency Economic Stabilization Act of 2008. The initial 30% ITC for small wind was capped at $4,000, however. In February 2009, the American Recovery and Reinvestment Act removed the $4,000 cap on the ITC and created the 1603 program in lieu of the ITC for businesses.

These federal incentives, when combined with state rebates, grants, tax credits and favorable financing, dramatically improved the economics of smaller-scale wind generators in the U.S. Other programs profiled elsewhere in this report also improve the economics of small wind, including net metering, feed-in tariffs (provided they are set at appropriate levels), utility revenue de-coupling from company profits and real-time electricity pricing. Figure 15 shows the array of state and utility incentives available for small wind in 2010, many of which have since scaled back.

Figure 15 State Cash Incentives for Small Wind — **Available during 2010**



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

Small Wind Market Drivers

Expected Increases in Electricity Rates

Increasing U.S. demand for electric power coupled with rising fuel costs have applied steady upward pressure on wholesale and retail electric rates in most states. The variability of natural gas prices has moderated this overall trend in recent years, as has the recession. Yet more consumers are recognizing that energy prices are climbing over the long term.

Higher electric rates make distributed wind a better deal for wind turbine owners as well as the distribution utility – a classic win-win. The national average retail rate has been rising by about 1.1% per year. Some states have experienced sharp increases in their electric rates over the past decade. A fear that rates will continue to climb has many citizens looking for ways to generate their own power – or at least a portion of it. Some larger users such as municipal government operations, schools and factories view a long-term investment in a wind turbine as a way to lock in their energy costs for the life of the turbine, which is typically 20 to 25 years.

Green Consumer Movement

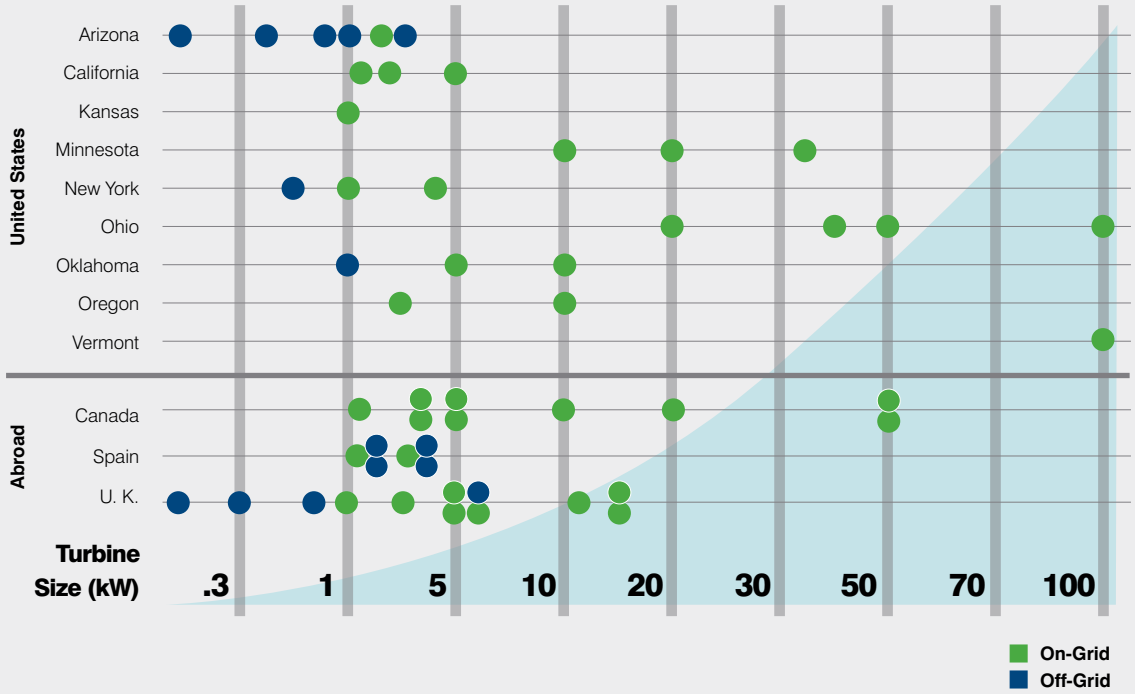
Small wind systems generate energy from wind and, unlike most conventional power plants, they do not pollute. A typical residential wind turbine will save 1.2 tons of air pollutants and 200 tons of greenhouse gases over its lifetime. More small wind means fewer pollutants in our streams, rivers and atmosphere, and fewer negative impacts on our health. Owning and operating a small wind system encourages awareness of consumption. Net-metered (and off-grid) turbine owners quickly learn the value of each kilowatt-hour as they "sell back" to the utility or as they rely solely on their systems to keep the lights on; they learn how to use those kilowatt-hours more wisely since they can monitor their daily production and usage history.

Photo courtesy of Endurance Wind Power

Small Wind Market Drivers

Distinguishing Product Features

Figure 16 On- and Off-Grid Turbine Models by Size Category Manufactured in the U.S. and Abroad



Small wind systems with rated capacities up to 100 kW typically feature rotor diameters of approximately 70 feet (21 meters) – which translates to a swept area of 350 square meters – or less. Small wind systems are typically installed on towers less than 150 feet (46 meters) tall, and they are primarily used for on-site generation at homes, farms, public facilities (e.g., schools) and businesses.

Twenty-two manufacturers with a U.S. sales presence, including imports from Europe and Canada, reported 2010 sales of 51 wind turbine models; three-fourths are rated 10 kW or less, and one-fifth are rated 11 to 50 kW. Turbines larger than 30 kW amounted to 2.9% of U.S. unit sales and 58% of capacity additions. U.S. manufacturers based in nine states offer 26 of these models, ranging from 160 Watts to 100 kW.

Manufacturers from the U.K., Canada and Spain have gained the most traction in the U.S. market, and Asian small wind suppliers are seeking to expand their presence.

While more than one-quarter of the 51 turbine models are designed for off-grid applications, nine of the 10 leading small wind turbine models sold in the United States (by sales revenue) are grid connected. All but one of the top 10 models feature a three-blade design; one utilizes a two-blade design. A wide range of tower designs and heights are offered, including tilt-up, guyed lattice, freestanding lattice and monopole.

Cut-in wind speeds of the top 10 turbine models range from 2.2 to 3.6 meters per second (5 - 8 mph), with expected capacity factors averaging 16% in Class 2 wind regimes based on manufacturer ratings and published power curves. Installed cost estimates range from $2.30 to $10 per Watt for the top 10 models, averaging $6.30 per Watt. The resulting average cost of energy levelized over expected 20-year turbine lifespans is $0.24 per kilowatt-hour, with individual turbine models ranging from $0.13 to $0.38 per kilowatt-hour.

Small wind industry leaders report delivery times of two weeks to two months for residential-scale units, and three to six months for farm and commercial turbines (larger than 20 kW). However, two of the leading global small wind turbine manufacturers have recently sold out of inventory and 2011 manufacturing capacity, indicating a favorable supply and demand balance. This is in contrast with other renewable energy markets, which currently face price pressure due to recent surges in global supply.

Photo courtesy of Southwest Windpower

Economic Value of Small Wind

The benefits of small wind deployments for the economy can be measured in several ways. Perhaps the most obvious are potential domestic jobs linked to the manufacturing, installing and selling of small wind turbines. The higher the domestic content, the greater number of jobs created in the U.S. Other key economic metrics are operations and maintenance (O&M) expenditures. Finally, exports to overseas markets also contribute to economic activity associated with the small wind turbine industry.

Small Wind Workforce Estimates

Of the top five small wind manufacturers worldwide, three are U.S. companies. These companies have experienced strong growth and employ thousands of workers and suppliers worldwide. More labor hours are required to manufacture small wind turbines than comparably priced cars — and because the wind turbines must operate under severe conditions for decades, quality manufacturing and craftsmanship are required. Small wind also creates jobs in the areas of tower manufacturing, transportation, installation and education. Installation materials, services and labor account for about 30% of total costs — these are local jobs at local small businesses. And with the increased demand for installation comes an increased demand for training, resulting in more education-related jobs.

The 2010 U.S. small wind industry represents an estimated 1,500 full-time equivalent jobs in manufacturing, installation, maintenance and sales.[iii] Based on reports of direct employees, vendors and dealers by leading manufacturers, this workforce estimate indicates that 50 full-time jobs are created per megawatt of installed U.S. small wind capacity and 30 jobs are created per megawatt of exports by U.S. small wind manufacturers. While these figures are higher than job estimates from utility-scale wind turbines, they are similar to rates determined for the Canadian small wind industry,[iv] and some U.S. small wind industry leaders have reported more than double this rate. Other factors at play in the U.S. include different ownership and development patterns that favor greater economies of scale (i.e., large wind farms instead of smaller projects owned by local communities).

As land-based wind turbines grow in scale, the corresponding number of jobs created actually declines when measured on a per-megawatt basis. This same phenomenon explains why small wind turbines create so many jobs when compared to utility-scale, land-based wind projects. Deploying wind in smaller increments for on-site power requires more labor per unit of power produced. It is clear that small wind produces more jobs per unit of installed capacity than any other power generation resource. Solar photovoltaics is in second place, with jobs-per-megawatt estimates ranging from seven to 43 jobs, with the majority of jobs created during installation.[v]

Operations & Maintenance Costs

O&M costs for small wind typically vary, with the size of the turbine being a major factor: the larger the small wind turbine, generally speaking, the higher the annual costs, although this is not always the case. Reliability is also a critical factor. A developer of small and mid-size wind turbine projects has estimated that small wind O&M costs are 2 to 5 cents per kWh. This is higher than previous estimates, and not all industry leaders agree. One manufacturer estimates O&M costs at 1.3 cents per kWh. Another believes that O&M costs have declined in recent years due to increased reliability of inverters, suggesting 0.5 to 1 cent per kWh as more accurate.

Most prefer to frame O&M costs on an annual basis, with the highest estimates for 100-kW turbines: $2,500 annually (with remote sites in Alaska as high as $3,500 annually). On the lower end, $200 to $700 per year is expected for residential-scale turbines.

Economic Value of Small Wind

Domestic Content of U.S. Small Wind Turbines

The domestic content of utility-scale wind turbines has been increasing over the past five years due to global wind manufacturing's insourcing into the U.S. alongside the entrance of non-wind U.S. companies into the wind industry. The small wind turbine story is mixed.

Most small wind turbines purchased in the U.S. feature a higher domestic content than what has historically characterized the utility-scale wind turbine market, with the majority of components coming from within the states in which their companies are based.

Unlike most of the small wind turbine U.S. manufacturers, non-U.S. suppliers import the majority of their components, especially towers and blades. Gearboxes are typically imported from Europe, with U.S. suppliers dominating steel and generators. Growing numbers of manufacturers are looking for redundant suppliers globally.

The issue of domestic content is actually more complex than a simple matter of percentages. Based on a simple component count reported by its supplier, the domestic content of a leading wind turbine is roughly 80%. However, the price of rare earth magnets (a key component for the turbine's magnetic rotor) recently escalated more than six-fold. If analyzed according to today's "component value," the domestic content has decreased substantially. See the *2010 Developments and Challenges* section for more on this issue.

PLUG-IN HYBRID VEHICLES

Plug-In Hybrid Electric Vehicles (PHEVs) are entering the mainstream and emerging as a key market driver for small wind turbines. Wind resources often increase at night due to temperature changes, and since each PHEV creates an equivalent demand on the power grid as a home, each of these vehicles garaged in a Class 2 or higher wind resource area represents a new potential small wind customer.

In virtually all markets featuring differential pricing (and those pushing PHEVs to reduce transportation-related carbon emissions), small wind looks even more viable. Smart grid deployments, which increase intelligence of grid functions through sensors and information technology innovations, also ultimately envision tapping the batteries of PHEVs to serve as a demand-response complement to the variability of both small- and large-scale wind.

PHEV batteries can be charged at night by wind power and then discharge power back to the grid.[vi] Denmark is already engaged in what is perhaps the most advanced system investigating how PHEVs can help support the stability of a power grid now dependent on 25% wind power (most of it distributed) but which is projected to reach 50% wind power penetration by 2025 (although much of this increase will be from larger-scale offshore wind turbines). A pilot project on the Baltic Sea island of Bornholm known as EcoGrid EU is integrating PHEVs into the grid to utilize extra wind energy produced at night. Programs to pay consumers for the grid services provided by the batteries of these PHEVs were launched earlier this year.[vii]

Economic Value of Small Wind

Export Market Trends

American small wind manufacturers have exported products to more than 120 countries, and exports were one-fourth of U.S. manufacturers' total 2010 sales. However, the industry faces immense challenges from international competition, particularly from Europe and China. These competitors often benefit from stronger support from their governments and robust local markets.

Export sales declined from 36% of total sales in 2009 to 27% in 2010 when measured on a capacity basis. When measured in unit sales, exports represented 46% of sales activity in 2009 and 34% in 2010. This downward trend is expected to reverse, however, in 2011.

Most U.S. manufacturers expect exports to play a much larger role in the coming months and years due to current low electric costs and scaled-back state and federal small wind incentive programs. The European Union is poised to surpass North America as small wind's top global market in 2011, and certification will be critical for U.S. products as incentive programs and consumers require more evidence of product quality.

With residential domestic sales down substantially in 2011, many U.S. manufacturers see Europe and other markets as a better bet, forecasting that as much as 70% of future revenue will come from export sales over the next two to three years.

AWEA's sales data show that U.S. small wind turbines amounted to 58% of global sales in 2010, an increase over historical trends of capturing roughly half of the world's total sales. According to a market forecast prepared by Pike Research, the U.S. small wind market is expected to grow at a compounded annual growth rate of 16% until 2015, accumulating more than 51 MW of small wind capacity that year. During that same year, the U.K. is expected to add 56 MW, a growth rate of 23% over the same period.[viii]

The small wind industry's other wild card is China, which became the world's largest wind power market in 2010, and which has historically played a critical role in reducing manufacturing costs due to low labor rates. While quality control issues still persist, China is now trying to expand its presence and market share in the international small wind arena.

A traditional global market has been to power cell phone towers in China, Africa and other parts of the world. Developing countries in South America and elsewhere are a major emerging market for U.S. exports.

Other Economic Benefits

Small wind systems provide economic benefits for the turbine owner, the community and the utility. Turbine owners benefit through reduced utility bills, tax incentives and renewable energy credits. In addition to local jobs, the community also benefits from revenue derived from permit fees, sales tax and, in some cases, property taxes. Utility benefits include decreased distribution and maintenance costs, decreased fuel required to run plants, decreased demand on the distribution system, emission mitigation and increased ability to meet renewable portfolio standard requirements. Small wind systems supply power close to the point of consumption. This reduces the burden on the electric distribution system and increases energy security.

2010 Developments & Challenges

Small Wind Industry Stabilizes the U.S. Market with Standards

In recent years, underdeveloped turbine prototypes have entered the marketplace and, in some cases, have received state incentive funds. During 2010, small wind industry members worked to implement standards to help stabilize the U.S. market with small wind certification and to help consumers, state energy offices and other stakeholders understand small wind turbine technology.

Although state energy office personnel may not be technology experts, they often find themselves in a position to make determinations about whether products are worthy of receiving incentives. To assist with the avalanche of questions regarding small wind technology, state energy offices initially funded the non-profit Small Wind Certification Council (SWCC). The privately held international testing and certification organization Intertek is also undertaking a small wind turbine testing and certification program in the U.S. Both the SWCC and Intertek certify small wind turbines with a rotor swept area of 200 m^2 or less, based on the American Wind Energy Association voluntary consensus Standard 9.1, Small Wind Turbine Performance and Safety Standard.

Standard 9.1 is a subset of the International Electrotechnical Commission's (IEC's) standards for small wind turbine design (61400-2), power performance (61400-12-1 Annex H) and acoustics (61400-11). Certifying a turbine to AWEA's 9.1 Standard requires power performance, acoustics, duration and system safety and function test results as well as analysis and models of the design loads specified in IEC 61400-2.

In addition to ensuring quality turbines here in the United States, certification could result in additional markets for U.S. small wind turbine manufacturers. The international small wind turbine community is discussing the viability of reciprocal national standards and an international label, which would allow easy access to several country incentives. This could be accomplished by developing another IEC standard revision and a common consumer label developed under IEA Task 27.

In addition to implementing turbine standards, industry volunteers worked to establish installer credentials. In 2010, the North American Board of Certified Energy Practitioners (NABCEP) administered its first small wind installer credential, building on the successful NABCEP credential programs for photovoltaics and solar thermal installers.

As the U.S. small wind market has expanded, many state inspectors have struggled to determine how small wind installations complied with the National Electric Code (NEC). To address this issue, volunteer experts worked with a NEC working group to develop a new section of the code specifically addressing small wind turbines. Article 694, Small Wind Electric Systems, was adopted in the NEC in 2011.

Finally, the Telecommunications Industry Association is developing a tower standard for small wind turbines, and Underwriters Laboratories is developing an electrical standard for small wind turbines and converters.

REGIONAL TEST CENTERS

In support of small wind turbine certification testing, the U.S. DOE and the National Renewable Energy Laboratory (NREL) have developed four Regional Test Centers to test small wind turbines to AWEA and IEC standards. The Regional Test Centers are Windward Engineering, Kansas State University & Colby Community College, the Alternative Energy Institute at West Texas A&M University, and Intertek. For each turbine, the Regional Test Centers will conduct the following tests: duration, power performance, safety & function and acoustic noise emissions. 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. DOE and NREL are contributing funds and technical assistance for certification testing of two small wind turbines at each Regional Test Center. At the time of this writing, testing of one turbine is complete with a test report in development, and three turbines are under test. Testing of the remaining four turbines will begin in FY 2012.

For further information:

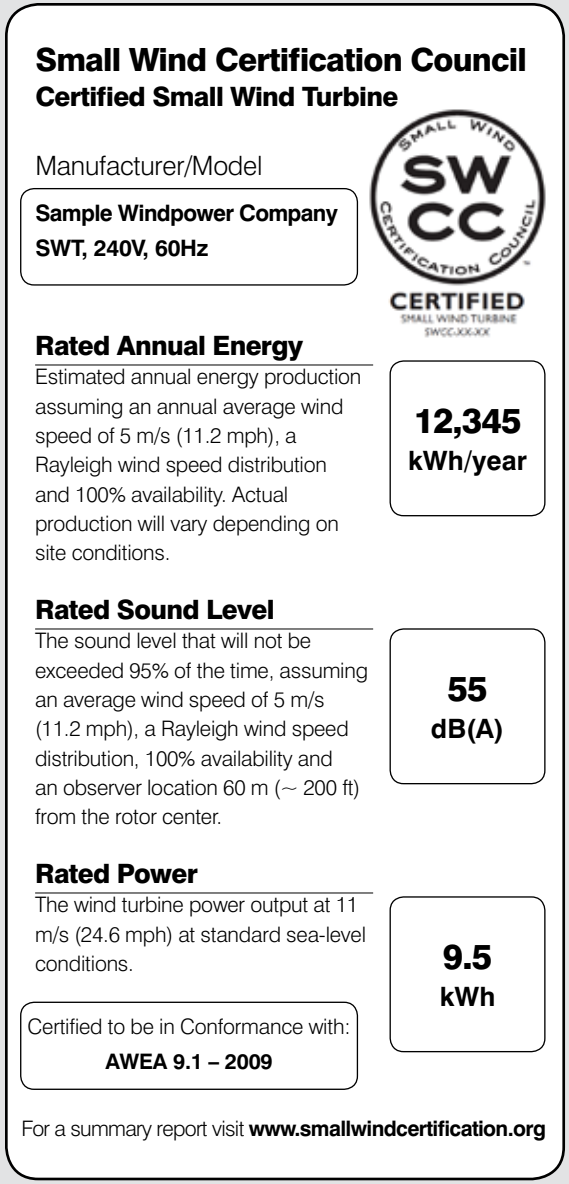
Intertek (Syracuse, New York)
http://www.intertek.com/wind/awea-standard

Kansas State University/Colby Community College (Colby, Kansas)
http://www.ece.ksu.edu/psg/HighPlainsSWTC/index.html#

West Texas A&M/Alternative Energy Institute (Canyon, Texas) http://www.windtestcenter.org/

Windward Engineering (Spanish Fork, Utah)
http://windwardengineering.com/our-work/projects-2/nrel

2010 Developments & Challenges



Case Study: SWCC Provides Consistent Ratings for Small Wind Turbines

Although launched by a consortium of state energy offices, the SWCC is now an independent non-profit certification body that certifies small wind turbines that meet or exceed the requirements of the AWEA Small Wind Turbine Performance and Safety Standard.[ix] Designed to promote consumer confidence and mainstream acceptance of small wind technology, SWCC certification standardizes North American reporting for turbine energy and sound performance.

SWCC issues easy-to-understand labels (see example at left) with rated annual energy output, rated sound level and rated power for certified turbines. The labels also confirm that certified turbines meet durability and safety requirements of the AWEA Standard. SWCC publishes power curves, annual energy performance curves, measured sound pressure levels and other technical information for each model certified.

SWCC does not conduct tests; it verifies and certifies test results submitted by testing organizations. Electricity-producing turbines with a swept area up to 200 meters^2 (2,150 feet^2), or a rotor diameter of about 16 meters (52 feet), are eligible. Depending on the turbine design, this maximum size is approximately 50 to 65 kW. Both horizontal- and vertical-axis turbines are eligible to apply for certification.

SWCC has recently taken several actions to advance the market's transition and to allow "apples to apples" comparison for consumers and funding agencies. Recognizing that state small wind incentives are often based on power performance ratings and the length of time needed to achieve all the required turbine tests, SWCC's board of directors recently approved offering a new optional service to applicants: Limited Power Performance Certification for small wind turbine models that have completed power performance testing in accordance with SWCC requirements and the AWEA Standard. The power performance tests for the limited certification can be completed relatively quickly, and the applicant may apply for full certification once the duration tests have been completed.

SWCC also established a Conditional Temporary Certification option and awarded the status to a few turbines previously tested and certified under the U.K.'s Microgeneration Certification Scheme. SWCC has also begun posting the names of applicants who have begun testing of their turbines and submitted test data and analyses to SWCC for review.

SWCC offers tailored recommendations for state agencies and utility incentive programs with options to consider for incorporating certification requirements and structuring incentives. Incentive managers have indicated that certification could help expand their programs for small wind by providing greater assurance of safety, functionality and durability of the projects they fund. Certification can also help inform consumers about their choices.

Wind for Schools Project Supports Industry Workforce Development, but the Program's Future Is Uncertain

Small wind turbines are playing an important role in introducing the next generation to wind power as a source of clean, domestic energy, as well as possible job opportunities. According to the U.S. DOE's report *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to the U.S. Electricity Supply*, workforce development to support the wind industry's expansion to a sustained 16 gigawatt-per-year level will require tens of thousands of new jobs in manufacturing, technology, business, construction and operations.

To support this workforce development need, DOE's Wind Powering America initiative launched its Wind for Schools project in 2007 in six states (Colorado, Idaho, Kansas, Montana, Nebraska and South Dakota) and in 2009 expanded it to five additional states (Alaska, Arizona, North Carolina, Pennsylvania and Virginia). Under the program, small wind turbines are installed at rural K-12 schools, and appropriate wind curricula are provided to select teachers. The school is often a center of activity in rural towns, and the turbines receive substantial exposure. The KidWind Project and the National Energy Education Development Project train teachers from the host and neighboring schools in the wind energy curricula. The turbines are owned by the host school, which is required to supply some of the equipment funds.

State and federal sources are used to supplement the school's contribution, and local in-kind labor, equipment and supplies are often employed.

Each Wind for Schools state forms a Wind Applications Center (WAC) at one of its universities to implement the program, and through class and field work students learn the wind development process. The student team, managed by the WAC leader, works with school officials and the local utility to assess alternative sites, perform utility tariff economic analysis, evaluate the wind resource, compare power curves of different turbines, meet with local planning and zoning officials, answer community questions, participate in the installation and interconnection of the turbines and monitor the turbine's performance. This experience helps the students understand each step of the wind development process and will hopefully interest some of them in wind energy careers. Each WAC team is involved in the installation of three to five turbines each year.

To date nearly 30 MW of distributed wind turbines have been installed at more than 250 K-12 schools, universities and other educational facilities. Over the next decade, it is estimated that these 11 state Wind for Schools programs will directly engage 700 to 1,000 engineers and more than 10,000 rural K-12 students in wind energy. These numbers could triple if the program expands to 30 states, but funding for WAC operations is highly uncertain as of the writing of this report.

Photo courtesy of The KidWind Project

KIDWIND CHALLENGE INTRODUCES STUDENTS TO WIND ENERGY

The KidWind Challenge is a student-oriented wind turbine design contest. During the challenge, students spend time designing and constructing their own wind turbines with the goal of creating a project that is both efficient and elegant. Student teams eventually convene, and the performance of their turbines is evaluated.

Although turbines are judged and prizes are awarded at the KidWind Challenge, the event is about learning — immersing students in the science of how a wind turbine works through the process of design and re-design. The KidWind Challenge also provides students an opportunity to explore jobs and careers in the wind industry along with the chance to speak with and learn from wind industry professionals.

In 2010, the KidWind Project organized five challenges in New York and one in Texas. In 2011, there were more than 12 challenges across the country in New York, Minnesota, Iowa, California and Alaska. In 2012, KidWind will hold regional challenges throughout the U.S., which will lead to a national championship. Learn more at **http://learn.kidwind.org**.

2010 Developments & Challenges

REAP's Future in Jeopardy

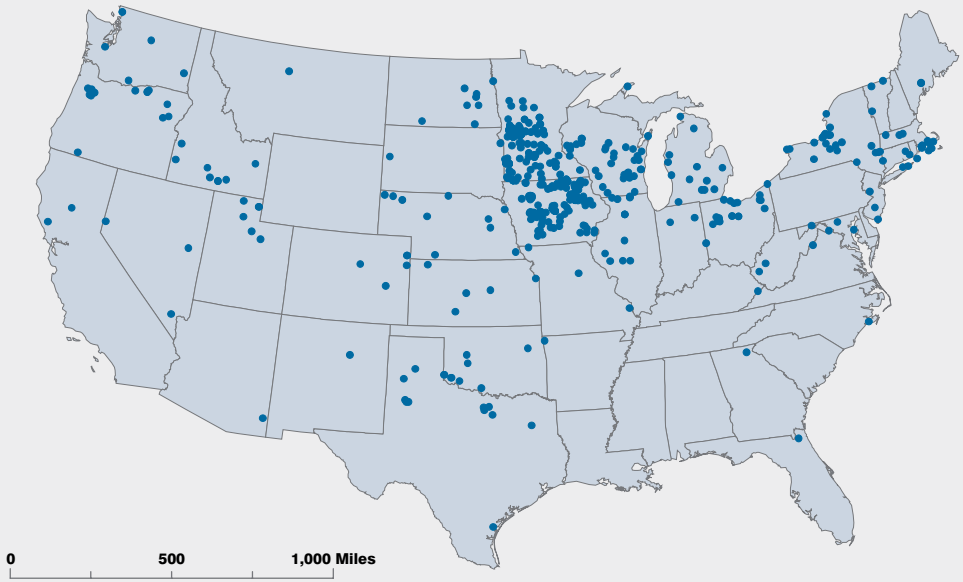
For farmers and rural businesspeople who want to build and invest in wind energy systems, the Rural Energy for America Program (REAP) is one of the only financing options available to cut capital costs. The U.S. Department of Agriculture (USDA) manages REAP through its network of state Rural Development offices. Since its inception in the 2002 Farm Bill, REAP has helped to fund nearly 600 distributed and other locally owned wind projects in many states.

REAP funds grants (up to $500,000 or 25% of project costs, whichever is less) and loan guarantees for wind power and other renewable energy systems and energy efficiency improvements. REAP also helps to fund feasibility studies for planning projects.

REAP is the only Farm Bill program focused solely on energy development for rural small businesses, farmers and other agricultural producers. REAP can be especially useful for community wind projects in which each turbine in a multi-turbine project is owned by a different corporation with different owners.

Farmer and rural business demand for REAP's funding continues to far outpace available funds. Wind projects remain very popular, especially since the USDA clarified last year that applicants could use REAP in combination with the 1603 program.

Figure 17 Rural Energy for America Program State Awards



Locations are approximate. Some dots represent multiple projects.
Prepared by Environmental Law & Policy Center based upon USDA data.

Despite REAP's popularity and economic, energy and environmental benefits, the program's future is in jeopardy as Congress approaches reauthorization of the Farm Bill. No funding is allocated to REAP beyond 2012, and even that funding is in question. Funded at $100 million in 2010, REAP's budget was trimmed to $75 million in 2011.

More worrisome is that the 2012 House agriculture spending bill nearly zeros out REAP, reducing funding to only $2.3 million. The Senate has yet to act on 2012 spending, and as of this writing REAP's final 2012 appropriation is unknown.

2010 Developments & Challenges

Rare Earth Materials in Short Supply

China has a near-monopoly on rare earth minerals such as neodymium and dysprosium that are used in permanent-magnet generators. However, this potentially serious constraint on the U.S. small wind turbine supply is about to be bypassed. China's domination of the global rare earth market and the growing demand for rare earths in products like hybrid automobiles has led to China restricting exports and also to dramatic price increases in recent years, squeezing profit margins for U.S. small turbine manufacturers. Manufacturers have responded by modifying product designs to use smaller quantities of the minerals, seeking to source rare earths from other countries or purchasing supplies in advance as a hedge. But, in an economics textbook case of supply responding to commodity price increases, relief is on the way.

U.S. rare earth producer Molycorp said in June that it raised the $781 million needed to fund an ambitious plan to expand mining at its site in Mountain Pass, California. Earlier in the year, company officials told AWEA that increased output is expected from the Mountain Pass mine, from a current level of 3,000 to 5,000 metric tons per year to 20,000 metric tons per year by the end of 2012 and as much as 40,000 metric tons per year by 2013. That would be a major addition in a global market where demand for rare earth oxides is currently 125,000 metric tons per year. Lynas Corp., a firm with rare earth mines in Australia, is also pushing hard to boost production.

Industry Launches Distributed Wind Energy Association

The Distributed Wind Energy Association (DWEA) is a collaborative group comprised of manufacturers, distributors, project developers, dealers, installers and advocates, whose primary mission is to promote and foster all aspects of the American distributed wind energy industry.

More information on DWEA can be found at www.distributedwind.org

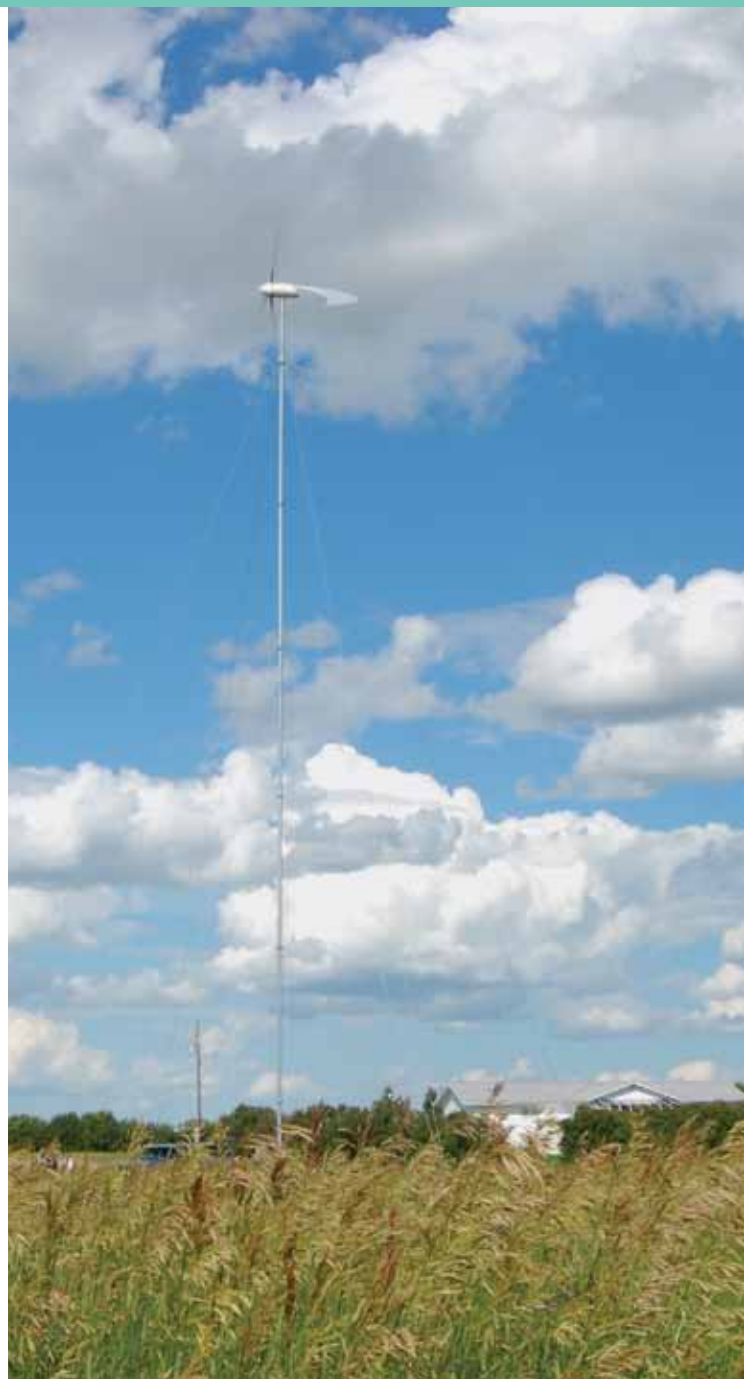


Photo courtesy of Endurance Wind Power

2010 Developments & Challenges

U.S. Wind Industry Assesses Deployment Barriers to Distributed Wind Energy

In October 2010, the U.S. DOE hosted a workshop to identify and assess distributed wind deployment barriers and how the barriers might be reduced through federal policy action, federal interagency collaboration or other federal action. Workshop participants were divided into small and mid-size wind turbine groups to discuss deployment barriers in five topic areas: interconnection, net metering policies, zoning ordinances, permitting requirements, and government incentives. A sixth topic area was added to the mid-size track: underdevelopment in the mid-size market.

Workshop participants stressed that each of the policy recommendations must be carried out in accordance with the following principles:

- Policy for renewable distributed generation should be technology neutral (i.e., not designed to show bias toward wind over solar energy or vice versa) while respecting differences in cost and resources of each technology.
- Policy must be in effect for longer periods of time and have quality assurance requirements to reduce risk and build investor confidence.
- Policies affecting renewable energy must result from consensus across government agencies to ensure broad-based support for renewable energy and efficient and effective policy implementation.

The report is available at http://www1.eere.energy.gov/windandhydro/pdfs/dwt_workshop_report_06-30-11.pdf.

Topic Area	Associated Barriers
Interconnection	Delays are caused by complex interconnection processes that vary by state and utility. There are few nationally accepted model procedures for all utilities, including public power entities.
Net Metering Policies	Public power entities such as rural electric cooperatives and municipal utilities typically lack net metering policies or have net metering policies that prohibit projects from being adequately compensated for generation.
Zoning Ordinances	An incomplete understanding of distributed wind technology often leads local zoning boards to apply ordinances for utility-scale wind technology to distributed wind projects, which can produce outdated and unnecessarily prohibitive regulations for siting distributed wind projects and delay or prohibit project deployment.
Permitting Requirements	Permitting requirements at federal, state and local levels can significantly delay and often thwart projects.
Government Incentives	Technology-exclusive, short-term incentive programs and limited access to financing hinder project economic viability and deployment.
Underdeveloped Mid-size Market	Lack of awareness regarding market potential and technical characteristics of mid-size turbines among lawmakers, regulators and consumers has led to a lack of supportive policies, turbine supply shortages and difficulties in securing project financing.

2010 Developments & Challenges

DECLINING SOLAR PV COSTS BOOST MARKET FOR DISTRIBUTED GENERATION

Reflecting strong consumer uptake and financial incentives, U.S. grid-connected solar photovoltaic (PV) installations doubled in 2010 compared to 2009, with 262 MW_{DC} installed on residences and 631 MW_{DC} in commercial and utility applications across more than 50,000 systems.[x] While utility-sector PV capacity quadrupled over 2009, "small" grid-connected PV installations of 100 kW or less grew by 45%, representing approximately one-third of 2010 installed capacity and more than 95% of installations.[xi]

U.S. Treasury cash payments played a large role in this increase, funding at least 40% of the non-residential PV installations during 2010. Improved capital markets and state renewable portfolio requirements with solar mandates, including Solar Renewable Energy Credits, were major drivers in PV's non-residential and utility sector growth. The American Recovery & Reinvestment Act funded many government solar installations at both the federal and state levels, and this funding used to create or enhance state financial incentive programs largely benefited PV.

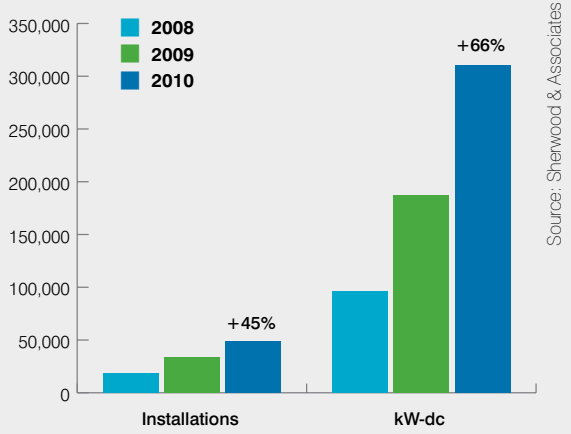
More influenced by state incentives and policies than with the amount of available solar resources, the PV market has historically been concentrated in California and New Jersey. The PV market is now diversifying across the country, with substantial increases in Nevada, Arizona and Colorado. California, New York, Massachusetts and Ohio experienced substantial increases in both PV and small wind capacity in 2010; however, Wisconsin, Iowa, Alaska, Minnesota, Kansas and other states with strong small wind sales were not top 2010 markets for PV. Relatively few PV installations are in locations without state, utility or local incentives or policy mandates, as federal incentives are generally insufficient to create PV markets by themselves.

U.S. grid-connected small wind installations in 2010 correspond to 8% of 2010 grid-connected PV installations up to 100 kW on a capacity basis and 6% on a unit basis. This difference reflects the average PV project size in this sector of 6.3 kW per installation, compared to 8.4 kW for grid-connected small wind turbines. PV sales have also shifted from remote, off-grid installations to larger grid-connected systems, which now comprise the largest sector of the PV market.

PV prices have declined by more than 50% since 1998, and the average pre-incentive cost of residential and commercial solar PV systems decreased 17% in 2010, the most significant annual reduction since the Lawrence Berkeley National Laboratory began tracking data.[xii] Reductions in the costs of installation labor, balance of systems, overhead and other non-module costs fell 18% from 2009 to 2010, indicating that state and federal policies that accelerate deployment and remove market barriers are effectively 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 both steadily increased since their peak. The average installed cost of residential PV installations in 2010 was significantly lower in Germany ($4.20 per Watt) than in the U.S. ($6.90 per Watt), where cumulative grid-connected PV capacity in the two countries through 2010 totaled roughly 17 GW and 2.1 GW, respectively.

U.S. PV sales represent just 5% to 10% of the global PV market, and U.S. PV manufacturers are facing stiff competition due to recent increases in global supply outpacing demand. The downward global pressure on prices is driving prices below costs for some suppliers, leading to industry turbulence. Demand for small wind turbines, on the other hand, appears to be outpacing supply, supporting inflation-related cost increases with U.S. suppliers continuing to play a leading role in the global market.

Figure 18 U.S. ≤ 100 kW Solar PV Market Growth



A 2010 poll of state incentive program managers, policy makers, small wind turbine manufacturers and owners found that substantially more state funds were used for PV than small wind due to more burdensome siting and permitting issues for small wind (e.g., urban and suburban roof-top PV); less site variability in solar resource; more aggressive state goals for solar; and a more mature market for PV than small wind.[xiii] From a dense market perspective, the economics of on-site PV systems are appealing. In addition, small wind turbines have not benefited from many of the technology improvements developed for large-scale wind turbines, whereas large PV projects are directly driving down the costs for small PV installations. However, in sites with favorable wind resources and incentives, small wind is able to achieve strong financial returns and may benefit from the successful distributed generation market PV is building.

Industry Perspectives

In order 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.

Priority Markets

The distributed wind industry prioritizes state markets by wind resource, electricity prices, available incentives, enabling policies, political climate, strength of local advocacy and dealer networks, reasonable zoning requirements and potential market size (number of potential installations). Also, because small wind product offerings range in size from smaller than 1 kW to 100 kW, the market/application sector emphasis changes; this affects the perceived strength of a particular state market. New York and California appear to score high on most of these criteria and were judged the leading state markets in 2010. Ohio, Wisconsin and Pennsylvania had attractive incentive programs, favorable political climates and good local advocacy and dealer networks. Other attractive states with favorable incentives, market size or enabling policies include Texas, Minnesota, Nevada, Massachusetts, Vermont, New Jersey, Oregon, Iowa, Illinois and Alaska. (See *State Priorities* on page 13 for an additional discussion of state markets and related policies.)

As of the writing of this report, a number of state incentive programs had stalled in 2011 because of a changing political climate or performance issues of unproven turbines that qualified for certain state incentive programs (see *Small Wind Industry Stabilizes the U.S. Market with Standards*, page 21).

Applications

The statement "one size doesn't fit all" characterizes the diversity of applications served by small wind products. Off-grid and grid-connected homes dominate the demand for turbine systems smaller than 20 kW. In the past several years, the residential market has shifted to somewhat larger turbines.

Partly fueled by American Recovery & Reinvestment Act funds, applications at schools and universities experienced significant growth in a variety of turbine sizes. The need for an educated and trained workforce to support the growing wind energy industry has spawned an awakening in the K-18 educational system, resulting in wind turbine installations, wind energy curricula in the classroom and wind project competitions (see *KidWind Challenge Introduces Students to Wind Energy*, page 23).

Municipalities also exhibited increased volume, using favorable financing terms and incentives available to public entities (although they are precluded from some federal incentive programs). Powering water treatment facilities is an example of an emerging municipal application. A special municipal projects case is village power systems; while prevalent in the developing world, wind-diesel systems are also important in Alaska, where volatility in diesel prices threatens the economic viability of isolated Native communities (see *Remote Alaskan Villages Fight Rising Diesel Prices with Wind*, page 37). This application has enormous overseas potential, provided the business model for product and service delivery can be sustainably implemented.

Industry Perspectives

Wind turbines to offset electrical loads for small business, commercial enterprises and hospitals experienced growth as well (turbines larger than 5 kW).

The farm market, long considered a potentially large wind opportunity, experienced modest growth, especially in the wind-rich Midwest, primarily deploying 50-kW to 100-kW turbines to offset large electrical loads associated with animal confinement operations, grain processing and dairies.

Although utilities are making significant investments in large-scale wind projects, there have been very few direct sales of small turbines to utilities (Alaska is an exception). The suburban and rural distribution utilities have traditionally received their electricity from centralized facilities and usually have an ownership relationship to same. This relationship has created an institutional barrier to local ownership of small, distributed generation.

A seriously underdeveloped market with significant potential for small wind is on-site military installations. The U.S. military is the largest electricity user in the world, and it has some fairly aggressive renewable energy goals. Mission compatibility, siting, competitive economics and other priorities are barriers that must be overcome to fully capture this opportunity.

The preferred business model for residential sales is through local dealers and developers, although marketing and sales through big-box retailers were added to the mix in 2010. A number of business models were employed to serve the non-residential, small wind markets. Whether a turbine was sold outright to the host as a net-metered application, leased with a buy-back arrangement or developed via an "inside the fence" power purchase agreement, the preferred arrangement includes a system maintenance agreement.

Photo courtesy of Endurance Wind Power

Industry Perspectives

Export Markets

Small wind turbine exports were a bright spot in 2010 that somewhat offset the soft North American market conditions. Two distinct but strong overseas markets dominated offshore sales for North American manufacturers: Europe's feed-in tariff markets and telecommunications. Feed-in-tariffs in the U.K. and Italy and emerging favorable enabling policies in Denmark, France, Spain and Portugal have spurred exports of the entire small wind product spectrum. The telecom markets in Asia and Africa are booming and experiencing an excellent uptake of U.S. small wind products in sizes smaller than 20 kW. A third emerging market is the international village diesel retrofit market, especially in the growing economies of China, India and Russia. In addition to the international village power wind-diesel opportunity, there are many other "foreign assistance" small wind possibilities, capitalizing on the intentional presence of and infrastructure funding by the U.S. Agency for International Development.

Barriers

It has been said that installing wind energy systems is not for the faint of heart. These products with so many acknowledged positive, local environmental and economic benefits also have a number of institutional and informational barriers to rapid adoption. The most significant include permitting and zoning, utility resistance, competitive economics, fragile incentive programs, financing and burdensome regulations. In addition, in some states only selected installation locations have adequate wind resource and land area to power a wind turbine, as opposed to the solar resource that is more accessible, especially in urban areas.

Still, the small wind market potential is considerable, with a large number of loads in appropriate sites where wind turbines can provide electricity at night and during short winter days to diversify the supply of on-site distributed generation.

Photo courtesy of Bergey Windpower

Industry Perspectives

Utility acceptance: Utilities are focused on reliability, reasonable rates, safety, adherence to regulations and, in the case of investor-owned utilities, returns to their stockholders. It is only recently (after more than 30 years of operating wind farms) that certain utilities have willingly accepted and invested in large-scale wind as part of their resource portfolios. Many utilities view small wind installations as a loss of load, a loss of control of part of their generation, or in the case of net-metering, as cross-subsidization. In recognition of this institutional challenge, a number of federal and state policies have been implemented to encourage adoption of distributed renewable energy generation, including the Public Utility Regulatory Policies Act, standard interconnection regulations, state renewable portfolio standards and net metering. There is a sense among the North American small wind industry that under the current economic and political climate, the utility sector is re-examining some of these policies. Many rural electric cooperatives, which are self-regulated (not usually subject to state public utilities commission oversight) and in many states not required to meet the state renewable portfolio standard, remain a particular challenge to small wind installations (although some co-ops have exemplary small wind programs; see Guadalupe Valley Electric Cooperative's story in the sidebar at right).

GUADALUPE VALLEY ELECTRIC COOPERATIVE LEADS THE WAY WITH AN EXEMPLARY SMALL WIND PROGRAM

In 2009, Guadalupe Valley Electric Cooperative (GVEC) members became interested in wind energy after seeing heavy media coverage on national climate change initiatives and rising fuel prices. In response, GVEC began taking steps to make implementing residential wind power both convenient and financially feasible, as well as considering the role of wind power in meeting member needs from a wholesale perspective.

To help members take advantage of wind technologies as quickly as possible, GVEC revised its Renewable Generating Tariff in early 2009. The revision made it more convenient for members to install renewable technology in their homes and businesses, benefit from using their own generation and sell any excess back to GVEC.

In mid-2009, GVEC introduced an energy efficiency rebate program and became an authorized wind turbine dealership. A renewables rebate features an incentive of up to $6,000 toward the installation of a residential wind turbine. This rebate, combined with the 30% government tax credit, reduced the price of implementing wind power from around $15,000 to approximately $9,000, offsetting the upfront costs of installation. To back affordability with reliability, GVEC became a residential wind turbine dealership and authorized installer through its GVEC Home subsidiary. With this offering, GVEC has the opportunity to help its members purchase and maintain their investment from a trustworthy source driven by energy conservation and service.

Throughout 2009, GVEC implemented a wind pilot project, installing three wind turbines across its service territory with plans for more in the future. With the ongoing study, GVEC will pinpoint production of the units to eventually determine a realistic payback scenario for its members and provide education on how wind power works. Cooperative staff give presentations to local civic groups and trade associations and use brochures, press releases, signage, articles and radio spots to relay the message that GVEC supports wind power on many levels.

GVEC believes that wind power will also play an important role in meeting the future energy needs of the membership from a wholesale perspective, so it obtains a portion of its overall wholesale energy needs from wind power through power purchase agreements between wind farm owners and wholesale power suppliers. Wind power supplies approximately 4% of GVEC's wholesale energy needs.

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RENEW WISCONSIN'S SMALL WIND TOOLBOX PROVIDES ANSWERS

RENEW Wisconsin developed the Small Wind Toolbox in response to questions and concerns from permitting authorities, prospective owners, installers and the public about the facts behind small wind turbine installation issues commonly raised at hearings and in the media. Some of the issues and concerns are legitimate, while others are not. However, people outside of the small wind industry likely have limited background information to help discern facts from fiction.

The fact sheets in the Small Wind Toolbox attempt to address these common questions and concerns. All have been reviewed, edited and published by a variety of organizations or publications. Concerns should always be treated as legitimate, regardless of their veracity, because a small wind turbine proposed in a community may be that community's first encounter with the technology. For example, one of the frequently asked questions is, "Do small wind turbines kill birds?" The fact sheets review our understanding of the issue, analyze the supporting and conflicting data and make appropriate recommendations.

Although some of the 148 fact sheets in the Small Wind Toolbox are specific to Wisconsin, most address issues that are not specific to any site, state or municipality. Permitting and zoning officials have welcomed the Small Wind Toolbox because the fact sheets provide concise, unbiased reviews of common issues or questions. Installers and potential owners frequently use them as supporting information when applying for a building or zoning permit. Planning commissions have used the fact sheets when drafting zoning ordinances that regulate the siting and operation of small wind systems. For further information, visit **http://renewwisconsin.org/wind/windtoolbox.htm**.

Permitting and zoning: Although single small wind turbine applications are very different from large utility-scale projects (e.g., size, land use, visual and wildlife impacts), they are often identified or confused with their larger-scale cousins. This misunderstanding creates permitting challenges and often adds significant time and expense to what could be a straightforward installation. Hand-in-hand with the permitting process are local zoning requirements, which often address height restrictions, setbacks, sound levels, tower designs, wildlife impacts and the subjective area of aesthetics. The industry supports the development and application of appropriate zoning ordinances; without them, the permitting process is often undefined and open-ended. Model ordinances developed by multi-stakeholders at the state level can serve as guides from which local jurisdictions can work to adapt sample provisions to local concerns (see *Wisconsin Develops Model Ordinance for Small Wind Systems* sidebar, page 33).

Often local townships and municipalities have the final word on land use (commonly referred to as "home rule"), and it is a heavy burden on local officials to separate truth from fiction when balancing the benefits and concerns of all interested parties in a small wind turbine project. (For more information, see *RENEW Wisconsin's Small Wind Toolbox Provides Answers* sidebar at left). What often is thought of by advocates as a "permit by right" requires a "special use" permit. Zoning and permitting rank as the number-one barrier to rapid, broad and economical application of small wind to both residential and commercial sectors.

Industry Perspectives

WISCONSIN DEVELOPS MODEL ORDINANCE FOR SMALL WIND SYSTEMS

Wisconsin's Small Wind Energy System Ordinance illustrates the burgeoning trend of states creating statewide model small wind policies to help streamline the zoning and permitting process. The regulations presented in the ordinance ensure the safety of the public and minimize the visual obtrusiveness of the small wind energy system without severely restricting the areas in which systems may be installed or significantly increasing their cost. Systems with a nameplate capacity of 100 kilowatts or less and a height of 170 feet or less are considered to be small wind energy systems and are permitted under the requirements of the ordinance.

Highlights of the model ordinance include setback requirements equal to the total height of the system from property lines, road rights of way and overhead utility lines as well as regulations to prevent unauthorized access to the equipment. The ordinance also includes aesthetic standards such as the prohibition of artificial lighting and unnecessary signage, and administrative regulations such as definitions and requirements for abandonment of the system and the procedure for acquiring a building permit.

Wisconsin's model ordinance provides counties and municipalities in Wisconsin a small wind policy that promotes the growth of small wind energy generation in the state while protecting the health and safety of the public.

Read Wisconsin's model ordinance here:
http://renewwisconsin.org/wind/Toolbox-Zoning/Small%20Wind%20System%20Model%20Ordinance%2012-06.pdf

Photo courtesy of Southwest Windpower

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A related obstacle to broad acceptance of small wind, both for the public at large and the state and local officials, is the poorly sited, installed or manufactured turbine. These are monuments to failure and can poison the market, often for years. Good zoning and rigorous but fair incentive qualification requirements can minimize the number of poor installations.

Fragile incentive programs: The utility-related policies have been augmented by state (and federal) incentive programs that attempt to address the economic challenge that distributed renewable energy generation, including small wind, has in competing with conventional, subsidized electricity prices. Small wind does not enjoy the scale factor that utility-scale wind has experienced in the past decade, which has accounted for substantial reduction in cost and resultant dramatic growth. On the other hand, small wind is most often installed on the customer side of the meter and thus competes with retail electricity rates, not wholesale rates. The instability of states' buy-down and production incentive programs (see Federal and State Incentives on page 9) and the uncertainty of annual federal appropriations (i.e.., the USDA and DOE) are considered serious barriers to long-term, stable growth of the small wind industry.

Financing: Because even small wind turbines are capital purchases, they most often require financing. Residential systems often require the homeowner to acquire a second mortgage, and in the current economic downturn, that puts a significant, often unacceptable, risk and burden on the homeowner. For commercial and industrial (e.g., farms) systems, long-term (more than 10 years) local financing is not available. Loan guarantees, like those offered through the USDA's programs (see *REAP's Future in Jeopardy* on page 24), are effective for agricultural producers and rural businesses, but they are not available for residential or public facility applications. This challenge has been met with some innovative financial arrangements involving leaseback deals in which pools of investors with tax appetites own the turbine system for a period of time before selling it back to the host facility or institution.

Photo courtesy of the National Renewable Energy Laboratory

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Federal Policy

Industry leaders agree that long-term, stable federal policy is important for the continued growth of the U.S. distributed wind industry. The 30% ITC has been a critical piece of federal policy. The USDA's REAP and Community Facilities Direct and Guaranteed Loan Program (Title 9009) are currently threatened (see page 24). These programs have been important for rural applications of small wind; maintaining the funding for these USDA programs is a high priority. A national renewable electricity standard would be valuable for small wind. Federal loan guarantees would be helpful where state incentive programs are based on performance (rather than capacity) and for residential systems (possibly modifying the Federal Housing Administration's Title I Home Improvement Loans). The Public Utility Regulatory Policies Act (PURPA) is an important Federal Energy Regulatory Commission policy, establishing regulations requiring utilities to interconnect and purchase small and modest renewable systems at avoided cost. Tariff design and avoided-cost determination can be serious barriers at the state level.

The industry is quite concerned with recent developments in U.S. Fish & Wildlife Service guidelines for wind-wildlife interactions. In its guidelines, the agency did not make distinctions between small and single-turbine applications and large-scale wind farm installations. The lack of distinctions in the guidelines is scientifically inappropriate and economically debilitating. Industry leaders have recommended to the federal advisory committee that small and single-turbine installations receive a 2-year reprieve while existing studies are collected and new data are developed on small and single-turbine installations that in turn can be reviewed by a group like the federal advisory committee to develop guidelines specific to this distinct segment of the wind industry. The industry is also concerned with the continuing shift in the U.S. DOE's wind program resources away from distributed wind and related Wind Powering America outreach and educational activities. The industry appreciates DOE's continuing support of the international standards and certification efforts, the Small Wind Certification Council (see *SWCC Provides Consistent Ratings for Small Wind Turbines* on page 22), the North American Board of Certified Energy Practitioners' installer certification program, as well as the development and nurturing of the four regional test centers (Kansas, New York, and two in Texas). While the current core technology seems adequate, DOE and its network of national laboratories could address a number of challenges to help grow the small wind industry. The industry would like DOE to support priority state-based small wind working groups and networks to educate local planning, permitting and zoning officials; provide input on state incentive programs; defend against utility attacks on net-metering and PURPA; support school education initiatives and debunk small wind applications myths for state and local officials.

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Photo courtesy of Northern Power

Additionally, industry members recommend that DOE support:

- Development and validation of high-resolution wind maps for 20-meter to 40-meter heights
- Comparison, improvement and validation of site assessment tools
- Expansion of the Wind for Schools project to more states and larger turbines
- Development of science-based information and documents on common wind issues that small turbine installations must address during the permitting process, including wildlife impacts, sound, safety and setbacks
- Development and promotion of tools to improve the speed and quality of the permitting and zoning process
- Development of an advanced manufacturing initiative, cost-shared certification, increased turbine reliability and taller towers
- Development of an increased number of quality turbine offerings
- Development of a North American Board of Certified Energy Practitioners certification for small wind site assessors.

The small wind industry is aware of the substantial difference in DOE funding between wind technologies and PV. DOE's dramatic investment in PV, both in technology and barrier reduction, coupled with solar-specific set-asides in state renewable portfolio standards and solar-specific renewable energy certificates, seriously tilt the policy environment away from small wind (especially for turbines smaller than 10 kW), which already is at a disadvantage in the siting and permitting process. The current policy landscape favoring PV research and installations primarily benefits urban residents while denying similar benefits to farmers and rural small businesses with ample wind resource and appropriate sites to capture it.

State Policy

The industry recognizes the importance of state polices in encouraging small wind deployment. The industry supports policies such as annualized net-metering (for all utilities), an expansion of renewable portfolio standards solar set-asides to include small wind, model zoning and rigorous turbine quality and reliability incentive programs. Properly designed feed-in tariffs are a long-term policy desire. Because state policy is so important to the near- and long-term viability of the industry, an entire section of this report is devoted to it (see page 9).

Competition from Imports

Increasing numbers of untested imports are entering the North American market. The primary short-term concern of the North American-based industry is the quality and reliability of these products. There have been instances in which certain imports received state incentives and prematurely failed, resulting in suspended state programs and a bad image for small wind products. Testing and certification, diligence in qualifying turbines for incentive programs and performance-based incentives will, in time, reduce this problem. The 600% price increase in neodymium (primarily produced in China) has also created a competitive challenge for U.S. small turbines driven by permanent magnets (see *Rare Earth Materials in Short Supply*, page 25).

Industry Perspectives

2011 Prospects

The industry has mixed perspectives on the 2011 small wind climate. Clearly the residential market is softer than the 2010 market because of the uncertain economy and the current public loss of focus on energy and the environment. The temporary curtailment and re-development of some key state incentive programs also hurt 2011 sales. Some manufacturers are reporting flat sales in 2011, while others are forecasting reduced domestic sales. Some state programs remain strong, and overseas sales, as mentioned earlier, are helping the overall 2011 picture. The agricultural sector market is growing, partly due to strong commodity prices and resulting income that farmers are investing into on-farm capital items.

REMOTE ALASKAN VILLAGES FIGHT RISING DIESEL PRICES WITH WIND

Only accessible by small aircraft and snowmobiles in the winter, the tight-knit communities of Kasigluk, Old Kasigluk and Nunapitchuk are known for their fishing, snowmobiling and high fuel prices. The small villages' remote locations made reliable and affordable energy a challenge for Alaska Village Electric Cooperative (AVEC) and the 500 or so Yup'ik Native Alaskan families it serves.

AVEC is a non-profit electric utility owned by the residents of 53 remote villages throughout western Alaska. To power these homes, AVEC used more than 150 diesel generators that cumulatively ran more than 400,000 hours per year—equaling 950 diesel truck trips around the world. The 5 million gallons of diesel fuel used to power these were stored in bulk fuel tank facilities that needed regular maintenance, repairs and upgrades. With skyrocketing fuel prices and storage expenses, electricity became so expensive that villagers often had to make difficult decisions between powering their homes and purchasing food. That's why AVEC took the bold initiative to start introducing wind power to some of the remote villages that it serves. Three Northern Power 100 turbines were installed. The results?*

- Energy produced per year: 593,000 kWh
- Percentage of electrical needs met: 21.9%
- Electricity savings: $201,000 per year
- Diesel fuel displaced: 45,048 gallons
- Economics: 5-year payback
- Carbon emissions offset: 432 tons per year.**

With more manageable electricity costs, the Yup'ik people won't be forced to abandon their cultural pride and ancestral homes in favor of affordable power elsewhere. Using the wind that has blown across the tundra since their ancestors first settled the area has led to long-term improvements that will help Kasigluk and Nunapitchuk survive in the face of urbanization and a volatile energy future.

Meera Kohler, AVEC CEO and president, said: "The skyrocketing cost of diesel last year resulted in the average AVEC consumer paying a fuel charge of almost 37 cents per kilowatt-hour. Now residents of Kasigluk and Nunapitchuk are paying 12 cents less, thanks to the wind turbines."

*These are estimated results based on average wind speeds in a specific area. Wind speeds vary; therefore, actual results may vary.
**CO^2 offset estimated by using EPA's eGRID 2007.

Photo courtesy of Northern Power.

Endnotes and Resources

Endnotes

[i] Sales represent total installed costs.

[ii] Reported funding assistance does not include depreciation and some financing programs and tax credits not aggregated by state or federal agencies.

[iii] Confirmed with 2011 interviews of U.S. small wind industry leaders conducted by eFormative Options LLC.

[iv] 2010 CanWEA Small Wind Market Survey. www.canwea.ca/pdf/SmallWind/canwea-smallwindmarketsurvey-e-web.pdf.

[v] Peter Asmus, *Harvesting California's Renewable Energy Resources: A Green Jobs Business Plan*, February 2009: www.energy.ca.gov/2009publications/CEERT-1000-2009-022/CEERT-1000-2009-022.PDF.

[vi] On August 22, 2011, *North American Windpower* published a story regarding an August 2011 study by the University of Calgary's School of Public Policy, titled "Study Shows Benefits of Using Wind Power for Plug-In Hybrid Vehicles."

[vii] "Ambitious EU Project to Harvest Wind Energy." www.energinet.dk/smartgrid.

[viii] Pike Research, *Small Wind Power: Distributed Wind Energy for Residential and Commercial Markets*, 4th quarter, 2009.

[ix] Available at www.smallwindcertification.org/for-applicants/awea-standard.

[x] Sherwood, Larry. U.S. Solar Market Trends 2010. http://irecusa.org/wp-content/uploads/2011/07/IREC-Solar-Market-Trends-Report-revised070811.pdf.

[xi] Sherwood & Associates.

[xii] Barbose, G., N. Darghouth, R. Wiser. Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010. LBNL-5047E. September 2011. http://eetd.lbl.gov/ea/emp/reports/lbnl-5047e.pdf.

[xiii] eFormative Options.

Resources

American Wind Energy Association	www.awea.org
Database of State Incentives for Renewable Energy (DSIRE)	www.dsireusa.org
National Renewable Energy Laboratory's Regional Test Centers	http://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

Endnotes and Resources

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U.S.-Based

ACME
Bergey Windpower
DyoCore
Enertech
Helix Wind
Next Generation Power Systems
Northern Power Systems
Polaris America
Southwest Windpower
Urban Green Energy
Ventera Energy
Wind Turbine Industries
Xzeres Wind

International

Ampair
Cleanfield Energy
Endurance Wind Power
Evance Wind
Gaia-Wind
Proven Energy
Raum Energy Inc.
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Renewable Devices
Seaforth Energy Inc.
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Unitron Energy
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