AWEA Small Wind Turbine Global Market Study

2008

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SUMMARY

U.S. Small Wind Turbine Industry Fending for Itself

Policy leadership still lags, leaving industry to compete on tilted playing field

The U.S. small wind turbine market grew 14% and deployed 9.7 megawatts (MW) of new capacity in 2007. Numerous new start-up manufacturers entered the market and small wind media inquiries at AWEA were at an all-time high, reflecting this growth. However, growth paled in comparison to its market counterpart, the solar photovoltaic (PV) industry, which experienced a 53% growth (200 MW) in the same period. To explain this discrepancy, industry points to the continuing lack of a federal-level incentive for small wind, specifically a 30% investment tax credit similar to that which is available to solar PV consumers under current law. Industry expects that such a credit, which lowers the up-front cost of small wind systems to consumers, would help raise production volumes, promote increased external investment, and grow the market an estimated 40-50% annually.

> Challenges continue to be political, financial, and regulatory in nature.

Industry challenges to meeting its full potential continue to be political, financial, and regulatory in nature, not technological. A continued stagnation of favorable domestic polices may ultimately threaten the United States' long-standing dominance in the global small wind market. U.S. manufacturers still claim a domestic stronghold, but foreign markets, expanded by a host of incentive policies, have become more fertile and new opportunities abroad are being filled by U.S. and foreign manufacturers alike. Based on a 2008 AWEA survey, some foreign manufacturers have been reluctant, or unable, to enter the U.S. market due to the specter of piecemeal or absent incentives, prohibitive local zoning practices, and balkanized utility policies such as grid interconnection standards – the same barriers experienced by domestic manufacturers. The U.S. still leads in small wind production, but global market opportunities, and the resulting clean, renewable energy production, may shift into foreign states where more favorable policies exist.

AWEA, its allies, and industry members have made steady progress toward overcoming market barriers by challenging unfavorable zoning regulations, pursuing certification programs for equipment and installers, and securing private external investment. However, political leaders at the local, state, and federal levels must take a greater role to encourage growth in this segment of the U.S. economy.

See the 2007 AWEA Small Wind Turbine Global Market Study for background information.
http://www.awea.org/smallwind/documents/AWEASmallWindMarketStudy2007.pdf

TERMINOLOGY

The term "small wind" is defined as wind-powered electric generators with rated capacities of 100 kilowatts (kW) or less. A small wind system may include, as necessary, a turbine, tower, inverter, wiring, battery, and foundation. Costs associated with the installation of a small wind system may also include shipping and labor. The term "micro wind" is a subset of the "small wind" classification and is generally defined as turbines less than 1kW in capacity. These units are typically used in off-grid applications such as battery charging, on sailboats and recreational vehicles, and for pumping water on farms and ranches.

STUDY FINDINGS

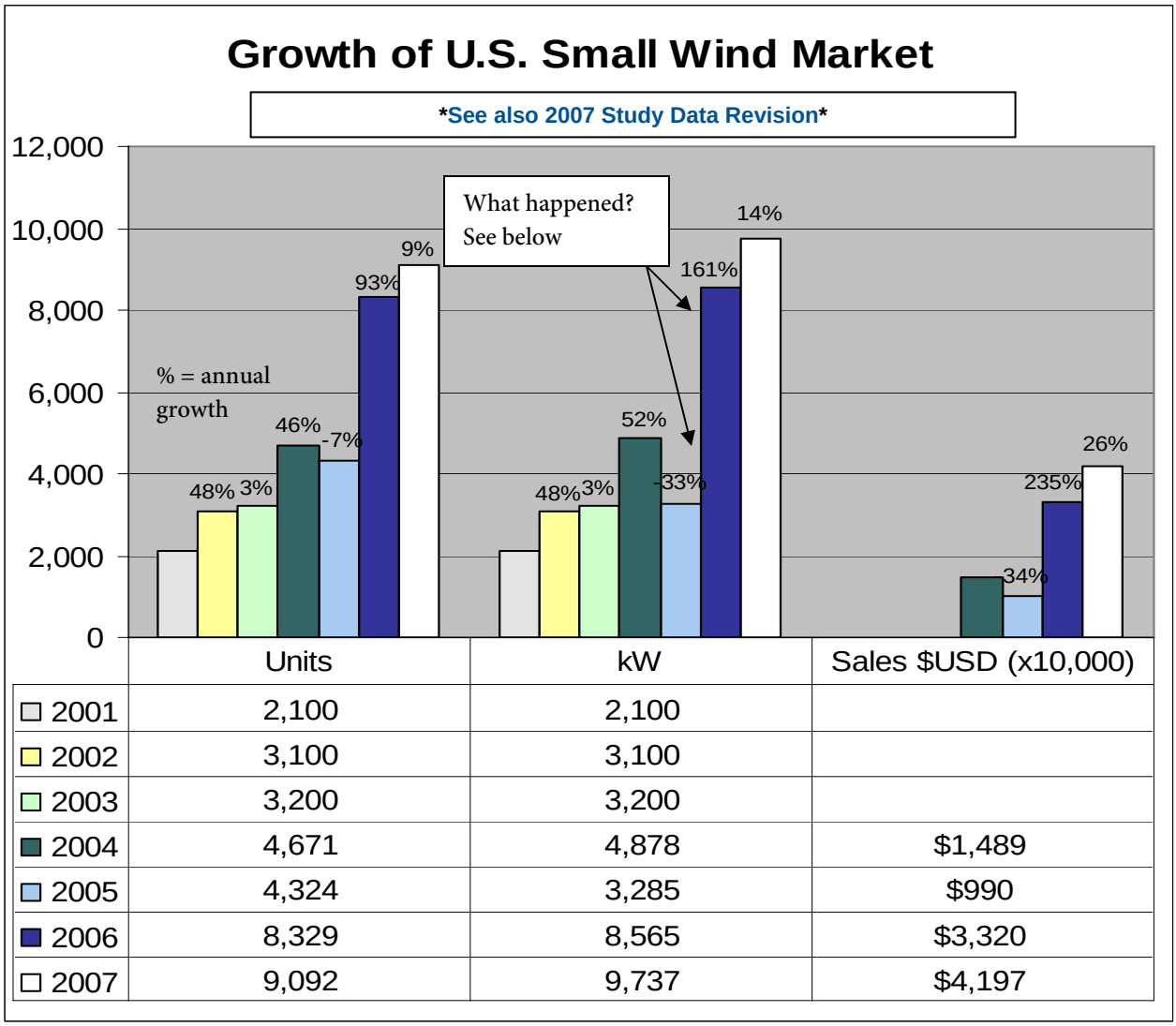
1. U.S. MARKET TRENDS

At A Glance: The market for small wind in the U.S. in 2007	
Units sold	**9,092**, of which **8,905 (98%)** were sold by U.S. manufacturers.
Growth	**14% growth** since 2006, representing **9.7 additional megawatts (MW)** of capacity
Sales	**$42,000,000**
Cumulative installed capacity	**55-60 MW**

Figures in all charts in this study represent additional units/kW/$ sold, not annual accumulation.
See the data revision to the 2007 AWEA Small Wind Turbine Global Market Study
http://www.awea.org/smallwind/documents/Data_Revision_to_the_2007_AWEA_Small_Wind_Gl

In its current (and historic) state without a federal-level incentive to assist consumers purchase small wind systems, the U.S. market continues to grow an estimated 14-25% annually. Grid-connected, residential-scale systems 1-10kW in capacity constitute the fastest growing market segment.

The advent of a 30% federal Investment Tax Credit could lead to an estimated 40-50% annual growth, similar to that experienced by the U.S. solar photovoltaic (PV) industry with the 2005 creation of such a credit. AWEA, its allies, and industry are actively advocating for legislation that would create a 30% credit for turbines 100kW and under.



	Units	kW	Sales $USD (x10,000)
2001	2,100	2,100	
2002	3,100	3,100	
2003	3,200	3,200	
2004	4,671	4,878	$1,489
2005	4,324	3,285	$990
2006	8,329	8,565	$3,320
2007	9,092	9,737	$4,197

What caused the drop in sales in 2005? *California state incentives for small wind systems decreased dramatically in 2004. The resulting decline in sales demonstrates the importance of incentives, the magnitude of the up-front cost barrier, and the size of the California market.*

What caused the apparent growth in 2006? *Sales increased in 2006, but the size of the perceived increase is primarily due to different sample sizes between the 2005 and 2007 surveys, the latter being substantially larger. No sales assumptions have been made about manufacturers who did not respond to the survey.*

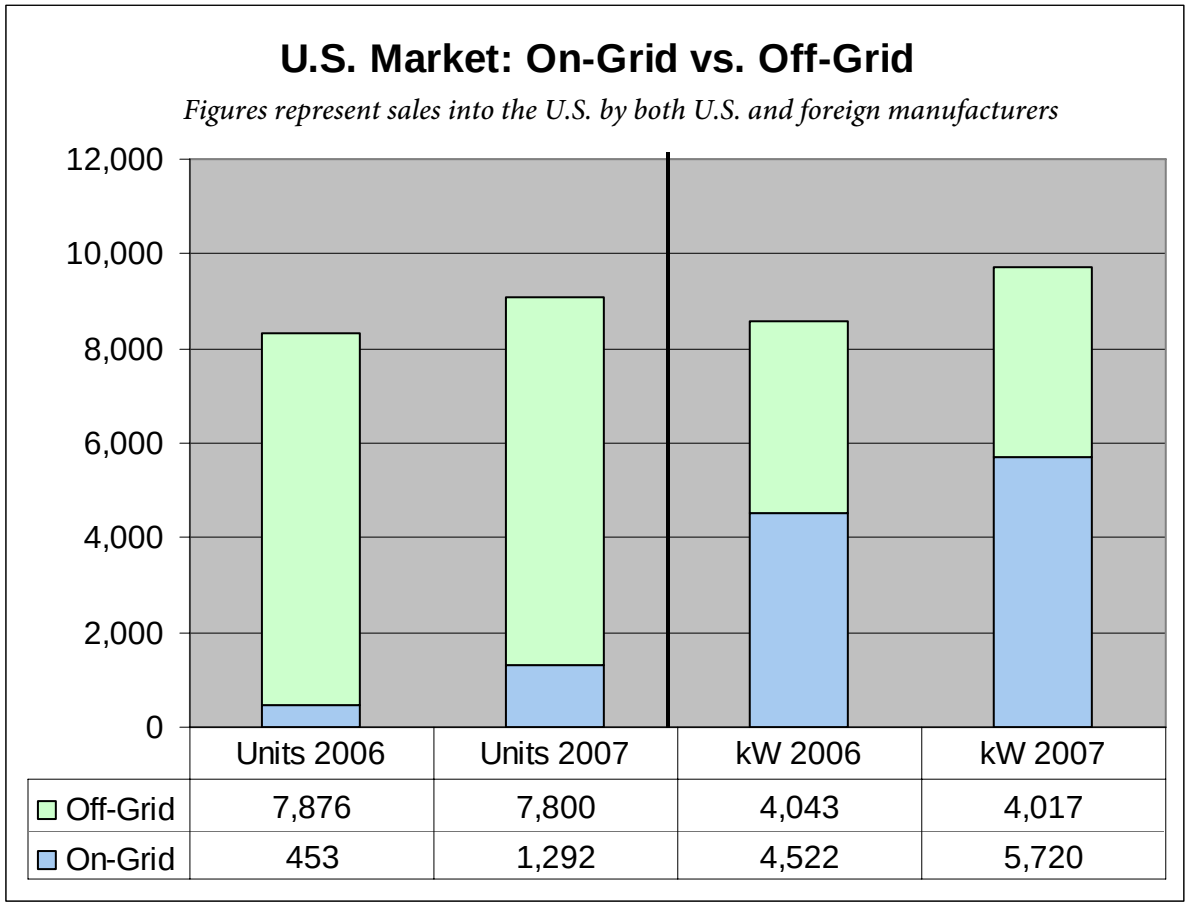
2. ENVIRONMENTAL IMPACT

A single residential-scale wind turbine displaces the carbon dioxide (CO_2) produced by 1.5 average cars.

The 55-60MW of cumulative small-wind installed capacity in the U.S. translates to:[1]

- Total Cars Offset: 10,000
- Number of Homes Powered (Equivalent): 7,000
- Carbon Dioxide (CO_2) Displaced Per Year: 60,000 tons

3. ON-GRID vs. OFF-GRID U.S. SALES

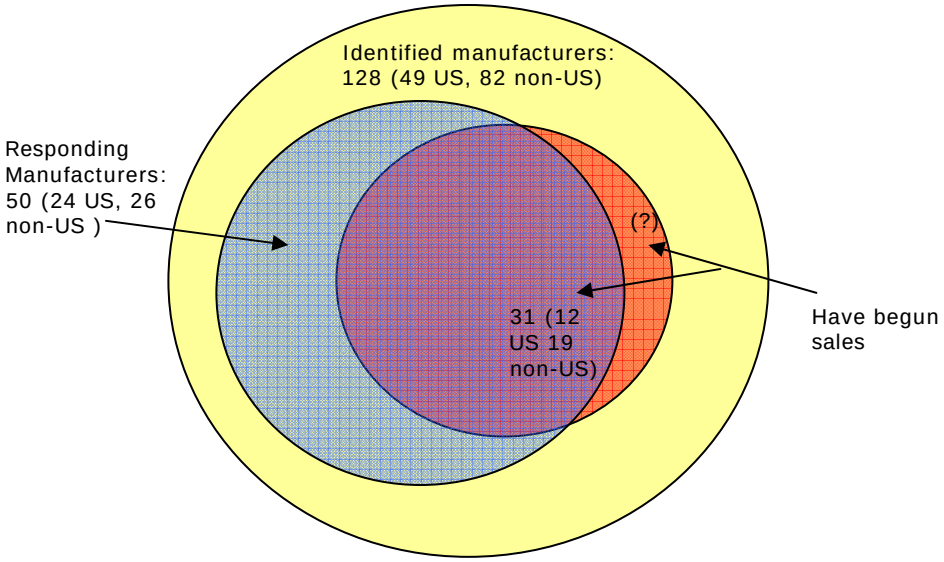


	Units 2006	Units 2007	kW 2006	kW 2007
Off-Grid	7,876	7,800	4,043	4,017
On-Grid	453	1,292	4,522	5,720

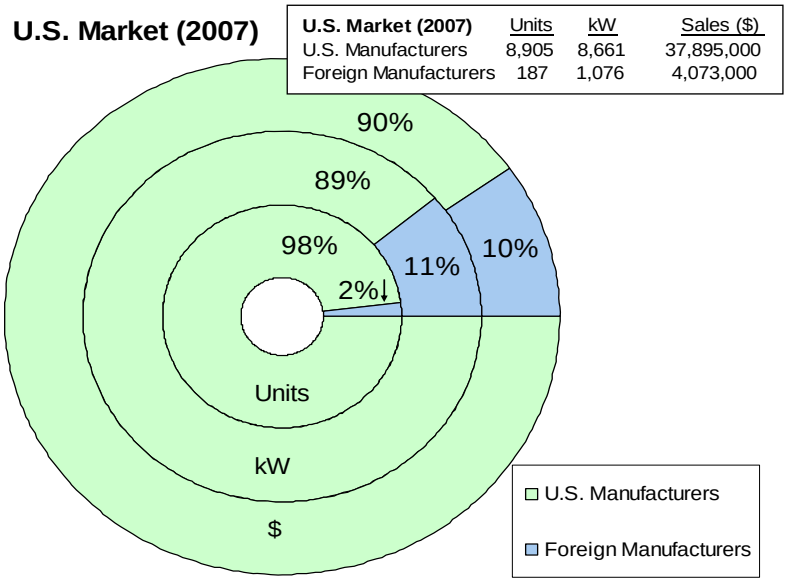
[1] A well-sited 10kW turbine generates about 1,090 kWh/month in 12mph average winds. In the turbine's expected lifetime of 20 years, it can displace approximately 340,000 lbs. of CO_2. Each kWh of energy produced in the U.S. results in 1.55 pounds of CO_2 emitted into the atmosphere - on average, reflecting the current U.S. electricity production mix. Source: Department of Energy, Energy Star Useful facts and Figures. http://www.energystar.gov/index.cfm?c=energy_awareness.bus_energy_use The U.S. Environmental Protection Agency estimated in 2000 that the average passenger car emits 11,450 lbs. of CO_2 per year. http://www.epa.gov/OMSWWW/consumer/f00013.htm Average annual home energy use in the U.S. is 10,565 kWh.

4. MANUFACTURER PROFILE

- U.S.: At least 49 U.S. companies manufacture, or plan to manufacture, small wind turbines. Of the 24 U.S. manufacturers that responded to this survey, 12 (50%) had begun sales. Extrapolating, approximately 25 U.S. manufacturers have begun sales.



- Non-U.S.: At least 84 non-U.S. companies manufacture small wind turbines. Extrapolating, approximately 60 non-U.S. manufacturers have begun sales.
- Exports account for approximately 40% of U.S. manufacturers' sales.
- Many non-U.S. manufacturers sell only regionally. Of the few manufacturers that have entered the U.S. market, most are based in the U.K., Canada, or Germany.



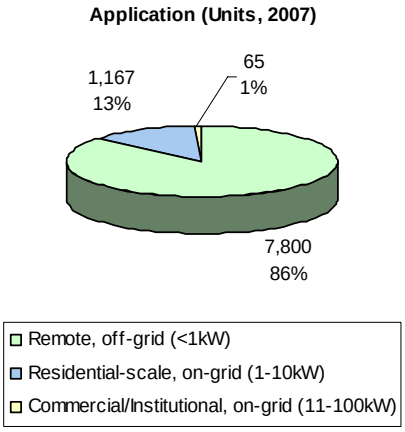
These percentages remain relatively unchanged over at least the past two years:

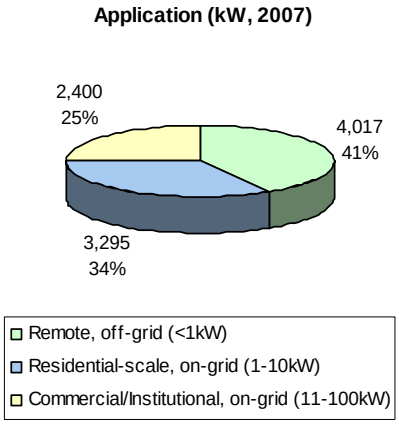
U.S. Market (2006)	Units / %	kW / %	Sales ($) / %
U.S. Manufacturers	8,159 / 98%	7,100 / 83%	28,000,000 / 84%
Foreign Manufacturers	170 / 2%	1,403 / 17%	5,300,000 / 16%

U.S. Market (2007)	Units / %	kW / %	Sales ($) / %
U.S. Manufacturers	8,905 / 98%	8,661 / 89%	37,895,000 / 90%
Foreign Manufacturers	187 / 2%	1,076 / 11%	4,073,000 / 10%

5. WHERE SMALL WIND TURBINES ARE BEING SOLD

The market remains predominantly homes, farms, ranches, small businesses, industry/factories, public and private facilities, and schools. Small wind systems continue to be sold in all 50 states, and U.S. manufacturers export to over 120 countries. However, serious markets in the U.S. exist only in states that offer incentives to help consumers afford their still high up-front cost. The market is then often further restricted, even in states with incentives, to towns and counties that have enacted zoning ordinances and permitting processes that allow for the practical, affordable installation of small wind systems.





All turbines under 1kW, and 90% of turbines equal to 1kW, were assumed to be off-grid where confirmation was unavailable. Several models sold are adjustable to either on- or off-grid purposes.

6. MARKETING MESSAGES

Demand is driven primarily by concerns over global warming, a desire to become "personally energy independent," and rising and unpredictable costs of traditional forms of energy, particularly natural gas.

Industry is working to breach markets related to the green building industry, small businesses, and the public sector. Marketing messages toward these and other market segments include:

Econ-omics	Financial hedge Financial stability Financial gain	**Specifically for Green Builders**	"Zero Energy Home" Complements with solar Possible rebates for developers and homeowners Lower/zero electricity bills for 20 yr + life of turbine Investment Installation costs built into price of the home Defining character of neighborhood "Renting vs. owning" electricity
Practicality	Emergency backup / "hazard mitigation" Only option? Complement to solar PV Readily obtainable Reliable Off-grid uses Military need[2]		
Values-Based	Environmental Independence Image enhancement Power to choose Self-reliance Do-It-Yourself Iconic		

7. U.S. JOBS

Extrapolated from a sample of the five largest U.S. manufacturers, approximately 350-400 individuals are employed for the direct production of small wind systems in the U.S. This figure does not include the hundreds of dealers and installers located throughout the U.S., in every state. Nor does this estimate include retailers, component vendors, consultants, testing facilitators, or individuals further throughout the supply chain.

- Full-time jobs in US: 300

[2] Example: The 2006 "priority 1 request" by U.S. Marine Corps Maj. Gen. Richard Zilmer that the military increase its usage of renewable energy sources in the field. See: http://www.defenseindustrydaily.com/commanders-in-iraq-urgently-request-renewable-power-options-02548/

- Part-time jobs in US: 95
- Approximate growth since 2006: 20%, which is commensurate with 2007 growth of U.S. installed capacity.

8. TECHNOLOGY ADVANCES

The industry is diverse and manufacturers vary widely in degree of maturity. Over 300 different models (in various stages of development) exist worldwide, of which 100 are engineered by U.S. manufacturers.

Specific design advances include:

- Active pitch controls to maintain energy capture at very high wind speeds
- Vibration isolators to dampen sound
- Advanced blade design and manufacturing methods
- Operation capability in lower wind speeds
- Alternative means of self-protection in extreme winds
- Adapting a single model to either on-grid or off-grid use
- Slower rotor speeds (to reduce sound levels)
- Software and wireless display units
- Inverters integrated into the nacelle (rotor hub)
- Rare earth permanent magnets rather than ferrite magnets
- Induction generators in place of power electronics
- Electronics designed to meet stronger safety and durability standards
- Systems wired for turnkey interconnection
- More visually attractive
- Integrating turbines into existing tower structures, such as utility or light poles

9. COSTS

Small wind turbine costs (U.S.)

$ per W of capacity	$3-5
$ per kWh of production	$0.10 - $0.15

Calculations do not assume state or federal incentives.

Though rare, for certain applications the cost of energy ($/kWh) can be as low as $0.06 per kWh.

Costs can vary widely due to the following factors:

- Availability and quality of state incentives and state/utility net metering policies

- Average annual wind speed – a 10% increase in wind speed results in a 33% increase in available power
- Prevailing costs of traditional electricity:[3] installations tend to be most cost effective in regions where the cost of electricity exceeds $0.10 per kWh
- Sales and property tax rates and incentives
- Cost of equipment and installation
- Raw manufacturing materials: rising global prices of aluminum, copper, and steel have impacted manufacturing costs, though larger (100kW+) turbines experience a proportionally greater impact. Approximately 90% of a turbine is made of steel.
- Operations & Maintenance (O&M) costs: the "fuel" (wind) is free and infinite, but routine maintenance costs average $0.01-$0.05 per kWh. Another calculation approximates O&M costs to 1% of the retail cost of an installation, accrued annually. [4]
- Insurance
- Financing method
- Permitting costs: can range from $0 to $1,000+ depending on the zoning jurisdiction
- Application: installations for businesses may benefit from special tax incentives

10. MARKET BARRIERS

Barriers for the small-turbine market continue not to be technological, but rather financial, political, legislative, and regulatory. Efforts toward obtaining a federal investment (up-front) tax credit for small-turbine consumers have been progressive, though to date no such incentive yet exists.

Studies consistently identify cost as the single largest factor affecting the industry's growth. However, zoning and permitting hurdles follow as a very close second. As in many foreign markets (see "The Global Market"), challenges result from government policies that, conflictingly, provide incentives for small wind yet fail to streamline the permitting process for their potential owners. AWEA and industry members are actively advocating to remove these and other barriers to the market so that small wind can compete more fairly within the distributed generation market.

[3] For a listing of these regions see the U.S. Department of Energy's Energy Information Administration Web site at www.eia.doe.gov

[4] See: Sagrillo, Mick. "Wind System Operation and Maintenance Costs." Factsheet from AWEA *Windletter*, December 2002 http://renewwisconsin.org/wind/Toolbox-Homeowners/Operation%20and%20maintenance%20costs.pdf

Policies and incentives to help lower the up-front cost to consumers will, industry predicts, significantly help to raise production volumes and lower costs while helping to secure outside investment. Rebate programs and investment tax credits (ITCs) have proven to work at the state level in the 20+ states that currently offer them (to varying degrees). Industry points to the success of the solar photovoltaic (PV) industry's federal ITC and its resulting 40-55% annual growth since the credit's 2005 enactment (see "Comparison with Solar PV").

Small wind systems are commonly marketed as long-term investments. Lower (faster) payback periods – the time needed to recoup the cost of an investment – can therefore expand the market to those who may not plan or desire to own a property for a long period. The payback period for a small wind system currently ranges broadly between six and 30 years, depending on many factors (see "Costs"). However, homes in the U.S. are owned for an average of only six years.[5] Reducing the payback period of a residential turbine into a range of <6 years would therefore likely benefit the market. Investment would be discouraged by any payback period longer than the time for which the home is owned.[6]

11. POTENTIAL NEAR-TERM MARKET FACTORS

The following issues may impact the U.S. small wind turbine market in the near future:

Enactment of the Small Wind Certification Council (SWCC). By 2009 this third-party independent program will begin to certify small[7] wind systems to a performance, safety, reliability, and sound standard created by the American Wind Energy Association (AWEA). At least a dozen states have indicated that they will require turbines to be SWCC-certified in order to be eligible for their incentive programs. Ahead of the U.S., the British Wind Energy Association has adopted a standard to which turbines will be tested, which is a modification of the standard created by AWEA.[8] The Canadian industry also plans to adopt a very similar standard.

[5] Jennifer L. Edwards, et al. http://repositories.cdlib.org/lbnl/LBNL-56344 p.39.
This study did not specifically address the effect on the simple payback period of combining these two factors.
[6] A 2006 study by the Lawrence Berkeley National Laboratory estimates that a 30% federal investment tax credit with no cost cap could reduce the simple payback period of a system by an average of 4.5 years, and a state property tax exemption can similarly reduce this period by four years. See: National Association of Realtors. "The 2006 National Association of Realtors Profile of Home Buyers and Sellers." 2006.
[7] Precisely, turbines with swept areas of <200m^2 which translates to approximately 60kW of capacity.
[8] British Wind Energy Association: http://www.bwea.com/small/standard.html

Industry expects that a certification program will bolster the credibility of the industry and in turn also help to ease zoning and permitting challenges, and possibly reduce consumers' insurance costs.

Enactment of a Federal Investment Tax Credit (ITC). Though no federal-level incentive currently exists for small wind systems, AWEA, its allies, and industry are actively lobbying for the instatement of a 30% consumer tax credit, similar to that which exists for solar photovoltaics (PV) under current law.[9] Such legislation could spur 40-50% annual growth in the industry.

Rising energy prices. A 2007 study[10] identified energy costs as the "biggest cost increase" for small and medium-sized businesses over the previous two years, exceeding healthcare, payroll, rent, and equipment costs. Energy costs have spurred roughly half of global small businesses (those with 50-500 employees) to become more concerned about environmental issues and enact environmental policies. Prevailing regional energy price is one indicator of market potential for small wind in the U.S. (see "Costs").

Increased public awareness. Small-wind media inquiries at AWEA reached a record high in 2007. Equipment dealers and manufacturers report that a sharp increase in favorable press, even if for competitors' products, has helped to generate sales for their businesses. Media coverage helps to present small wind as a realistic option for individuals, companies, and organizations, and conveys that the technology is increasingly mainstream. Some dealers note that increased national attention to global warming has also "made marketing easier."[11] (See "Marketing Messages.")

Grant programs. Some states and organizations offer grant programs for small wind systems, though manufacturers report that in general their effectiveness is mixed. By nature, grant programs are competitive and have a limited amount of available funds to sustain a limited number of applicants. Applications for the U.S. Department of Agriculture's federal grant program[12] involve particularly long processing periods due to the high number of applicants and the involvement of multiple government agencies.

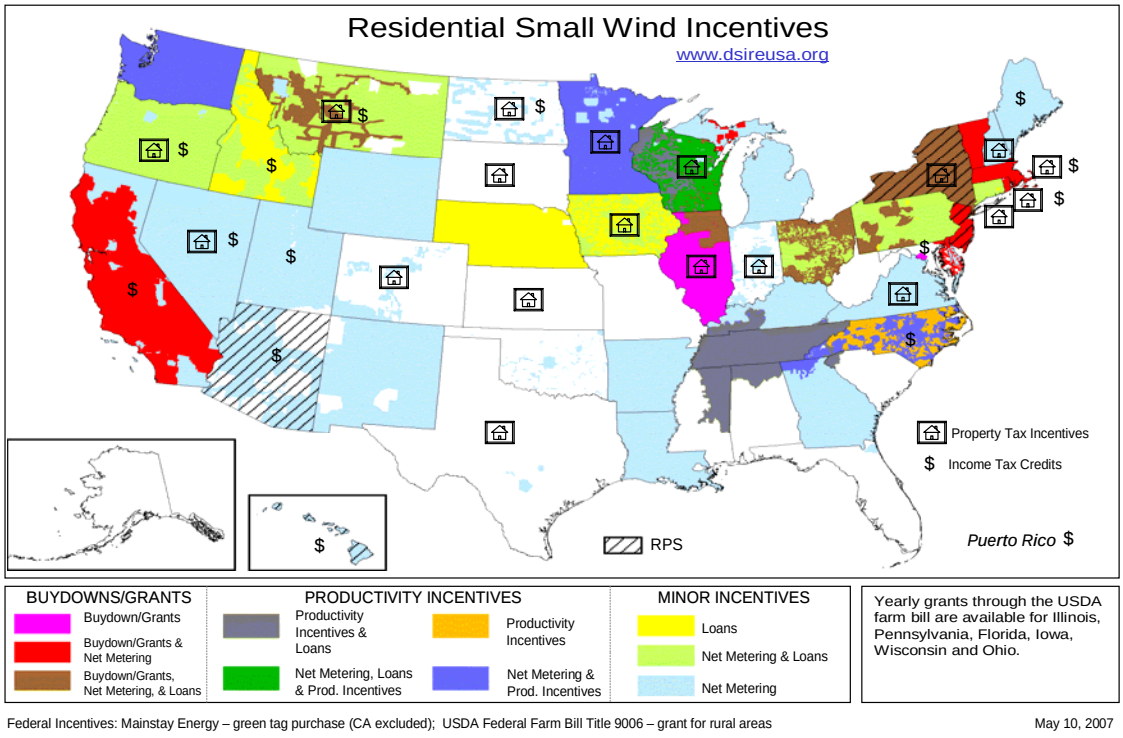
Industry also reports that reliance on grants can cause a "boom/bust cycle" for a business since grants are usually offered only periodically. This can result in a surge in sales in

[9] Energy Policy Act of 2005
[10] IBM global survey, May 2007. http://www-03.ibm.com/press/us/en/pressrelease/22553.wss, accessed April 2008.
[11] 2008 AWEA survey
[12] Known as "Section 9006." See www.farmenergy.org for more information.

some months and a drought in others, which stresses business operations. Nearly all small wind manufacturers report that they favor rebate programs and tax incentives.

External investment. At least five manufacturers of small wind systems (globally) have attracted external investment, signifying in part the growth potential of the industry. Investment of this capital has largely been allocated to internal research and development, marketing, and political advocacy at local and national levels.

State rebate programs. The single most effective driver for the industry has been, and continues to be, financial incentive programs offered by select states. The following map indicates the existence and location of incentives pertinent to small wind. (Note: in early 2008 the Ohio incentive program was terminated, and new programs were enacted in Louisiana and Kentucky. These changes are not reflected on the 2007 map below.)



Many of the incentives offered by states are awarded as a percentage of a turbine's capacity (in kilowatts/kW) and are designed to encourage the production of clean, renewable energy. Therefore, some states, specifically Massachusetts, have begun monitoring the performance (output, in kWh) of a sampling of subsidized installations. To some industry members, this underscores the importance of careful siting and tall towers, which have a major impact on a turbine's performance. Siting and tower height,

in turn, are directly affected by local zoning regulations that dictate where, how, and if a turbine can be installed. Industry advocates point out the frequent conflict between these two public policies and hope that this new attention to turbine performance will help to remove overly restrictive zoning and permitting barriers.

Installer certification. To a large degree, the productivity and economic success of a small-wind installation depend on its siting and installation. The U.S. and U.K. small wind industries have begun to pursue programs to certify installers of small wind systems, similar to that which exists for the U.S. solar industry.[13] Currently, each manufacturer is responsible for training installers of its products. Due to the forces of self-interest, this practice of self-regulation has worked successfully for decades. However, pressure in part from state incentive program administrators and local zoning officials has spurred pursuit of an independent program through the North American Board of Certified Energy Practitioners (NABCEP) to train and certify installers.

State feed-in tariffs / buy-back rates. As of May 2008, five U.S. states (California, Minnesota, Illinois, Rhode Island, and Michigan) have introduced ground-breaking legislation that would create a "feed-in tariff" or "buy-back rate" program to promote renewable, distributed generation technologies like small wind. Modeled after policies initiated – and spreading – in Europe, these policies are designed to encourage customer-sited generators (as opposed to utilities) to generate renewable energy in excess of their personal need, sending any surplus back into the utility grid to be used by a neighbor. The policy achieves this by establishing a fixed, premium price at which a utility must "buy back" excess generation from the small wind system (or other) owner. This price is higher than that which the utility charges consumers for its centrally generated electricity, which in the current U.S. energy supply mix is predominantly comprised of coal and natural gas.

Based on European experiences, the advent of such a policy at the state (or national) level could accelerate the U.S. market for small-scale renewable energy proportional to the level of the established price.

Zoning and Permitting. Poorly crafted local zoning and permitting regulations hamper clean energy production, discourage customers and investment, and repel industry-related businesses.

States that offer incentives based on system capacity or some other reflection of expected energy output have a vested interest in system performance. For small wind, this most

[13] http://www.nabcep.org/wind.cfm

often means ensuring that zoning practices in incentive states allow turbines to be tall enough so that they can perform as intended.

One major zoning hurdle has been restrictive neighborhood/community association covenants that, intended or not, prohibit on-site renewables like solar PV and small wind. Some states[14] have enacted laws banning these kinds of restrictions, though they are frequently ignored or unpublicized.[15] In 2008 nearly 60 million Americans live in community associations, up from 10,000 in 1970, and growth is expected to continue.[16]

Some manufacturers look to pilot or demonstration projects as a way to acclimate a locality to the concept and presence of small wind turbines. Such an investment can be an effective, though costly and not preferred, means of addressing zoning and permitting barriers.[17]

Utility policies. Utility interconnection and net metering policies remain critical to localized industry growth. The small wind industry expects a special section for small wind will be created in the next edition of the National Electric Code (NEC) in 2011 to promote safety by explicitly listing requirements, to guarantee the possibility of utility grid interconnection, and to demonstrate the maturation of the industry. Under existing NEC regulations, electrical safety has historically not presented a significant challenge to the industry but proponents of this advancement cite a need to establish small wind in the Code as a precaution and investment in the industry's future.

Global factors. see "Costs" and "The Global Market."

See also: "Policies to Promote Small Wind Turbines: A Menu for State and Local Governments." AWEA 2008. www.awea.org/smallwind/pdf/Policies_to_Promote_Small_Wind_Turbines.pdf

12. COMPARISON WITH THE SOLAR PHOTOVOLTAIC (PV) INDUSTRY

Over 80% of all grid-connected, small wind systems 10kW of capacity and smaller include some solar photovoltaic (PV) component, indicating the two technologies share

[14] These states include Arizona, California, Colorado, Florida, Hawaii, Indiana, Iowa, Massachusetts, Nevada, Utah, and Wisconsin.
[15] Damian Pitt. "Taking the Red Tape out of Green Power." Network for New Energy Choices, September 2008.
[16] Community Associations Institute http://www.caionline.org/about/facts.cfm Accessed May 2008.
[17] See: "In the Public Interest: How and Why to Permit for Small Wind Systems." AWEA, June 2008.

very similar markets. The solar PV market remains considerably larger, however, due at least in part to unequal policy treatment at state and federal levels.

Costs

Residential (on- or off-grid 2kW system)	Small Wind	Solar PV[18]
$ per W of capacity	$3-5	$9*
$ per kWh of production (cost of energy)	$0.10 - $0.15	$0.40
Commercial-scale (on-grid 50kW system)	**Small Wind**	**Solar PV**
$ per W of capacity	$3-5	$6.80
$ per kWh of production (cost of energy)	$0.10 - $0.15	$0.27

**All estimates for both technologies exclude incentives*

Manufacturing volume, not technological advancement, has been the single most important driver in reducing solar PV costs. This volume has at least in part been spurred by federal and state incentive programs, and the small wind industry expects similar results should a federal incentive be enacted that includes small wind.

Performance

	Small Wind	Solar PV	Utility-Scale Wind
Equipment Life Expectancy	20+ yrs	20+ yrs	20+ yrs
Capacity Factor[19]	15%	17-19%[20]	34%

Market trends

Annual installed capacity for solar PV has more than doubled since 2005. As with small wind, solar PV sales are largely limited to states with incentives, even with a federal tax credit in place.[21] This national incentive has done more to increase the market in states with preexisting incentives rather than distributing the market to states without them.[22]

Zoning height restrictions do not affect solar PV installations to the extent they do small wind, but the PV industry faces strong zoning and permitting challenges, particularly from homeowners' associations (see, "Market Barriers: Zoning and Permitting").

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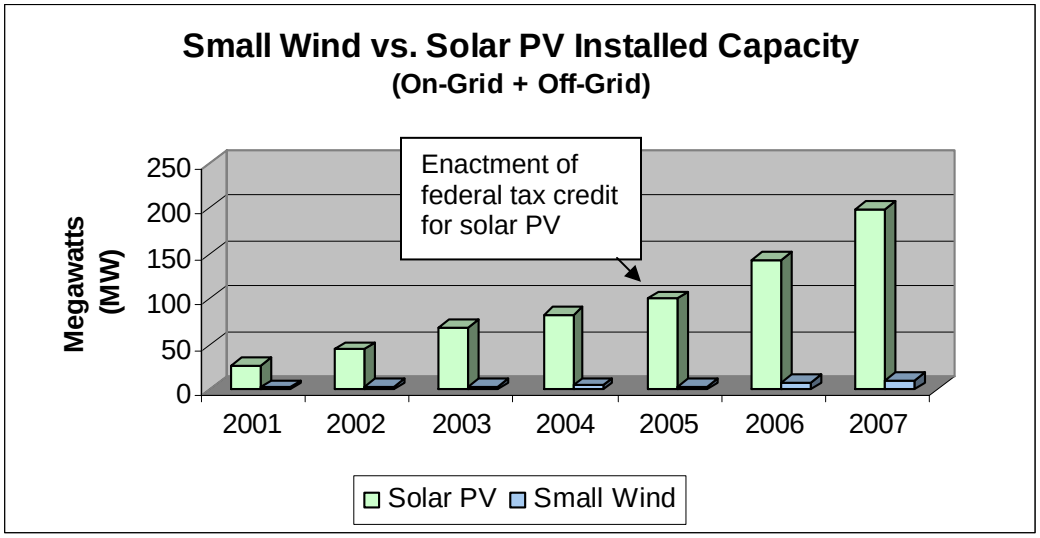
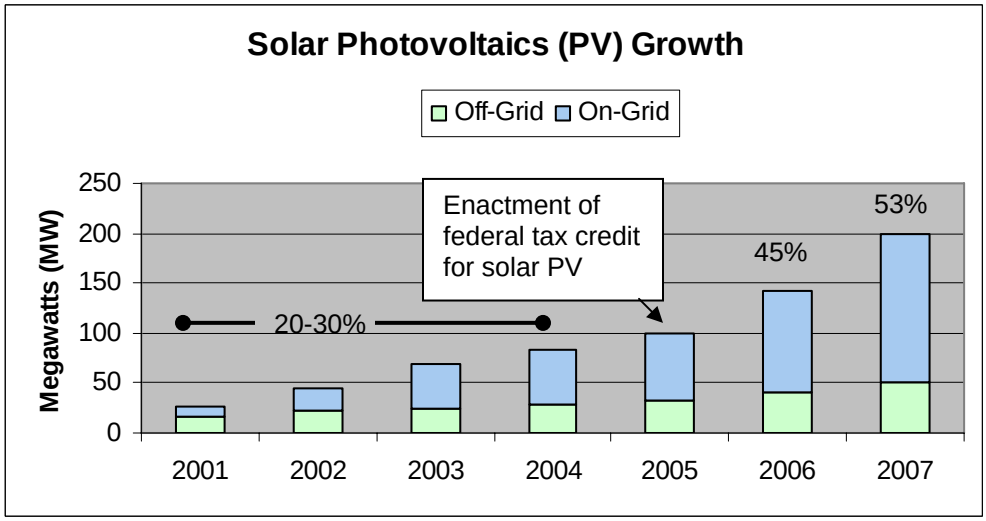
[18] See: http://solarbuzz.com/StatsCosts.htm Accessed May 2008.
[19] Capacity factor is the percentage of time at which a power generator operates at its potential rate of output.
[20] Limited in part by hours of daylight
[21] Energy Policy Act of 2005
[22] The market for solar water heating technologies, however, did expand to states without preexisting incentives. Solar water heating installations in the continental U.S. increased 2.4 times with the federal tax credit. Source: Larry Sherwood, Interstate Renewable Energy Council





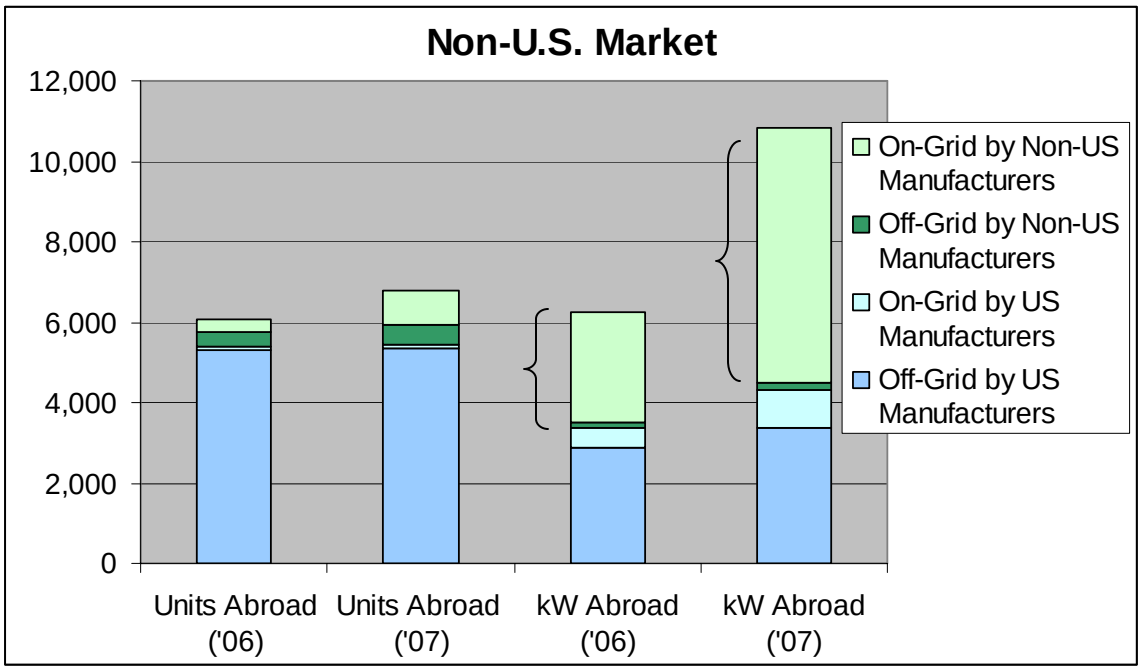
Figures (%) represent growth in the on-grid market in the U.S. Source: of PV data Larry Sherwood, IREC

13. THE GLOBAL MARKET

Over 25 countries are home to small-turbine manufacturers, though the global market is led by the U.S., the United Kingdom, Canada, and Germany. Disadvantageous currency exchange rates have begun to affect the profitability of U.S. exports, though the relatively high cost of electricity in Europe has helped to fuel growth overseas.[23] Lagging U.S. policy may also affect competitive growth for the U.S. industry, though market barriers tend to be similar worldwide. (See "Market Barriers"). Based on a 2008 AWEA survey, some foreign manufacturers have been reluctant, or unable, to enter the U.S. market due to the specter of piecemeal or absent incentives, prohibitive local zoning practices, and

[23] For global electricity prices see the U.S. Department of Energy's Energy Information Administration's Web site at: http://www.eia.doe.gov/emeu/international/electricityprice.html

balkanized utility policies such as grid interconnection standards – the same barriers experienced by domestic manufacturers. These similarities may provide an opportunity to examine the long-term effects that various policies have on the market.



Some of this perceived growth can be attributed to the increased number of responding manufacturers. However, the number of responding manufacturers increased proportionally for both U.S. and non-U.S. companies, which may partially correct any resulting error margin.

Canada

The Canadian industry is weighted toward the manufacture of commercial-scale small turbines (20-100kW), which is assisted in part by the relative abundance of provincial net metering policies. Net metering exists in eight of the 10 Canadian provinces and a feed-in tariff (buy-back rate) of 11 cents/kWh is available for small wind in Ontario (solar PV receives 42 cents/kWh under the same law). Some Canadian manufacturers report that rebates are more simple to administer than feed-in tariffs, but that governments tend to prefer the latter because they reward production rather than capacity/size.

However, as in the U.S., zoning hurdles impede growth. At least 17 manufacturers (varying in degree of maturity) are based in Canada and are optimistic about the effect that the forthcoming product certification program will have on zoning problems and a variety of other market barriers. The standard used by this certification program was adapted by that developed collaboratively by U.S., U.K., and Canadian interests.

United Kingdom

U.K. national law requires that renewables be considered in all new buildings[24] and that climate be a material consideration in any new community planning.[25] However, implementing the laws has been a challenge since their enactment in 2004. Combined with the fairly high concentration of population in urban areas, these policies have led to an explosion of interest in installing small wind systems in cities and on rooftops, and will likely create a strong niche market for turbines 1.5kW and under. Reports, though, indicate that success with this application has not been high, primarily due to the physical properties of wind in densely built environments (see, "Bibliography: Urban Wind Resource Assessment").

National Policy

The national Carbon Emissions Reduction Targets (CERT) law allows generation – such as that by small wind turbines – to contribute toward meeting carbon dioxide reduction targets. The European Union's (E.U.) Renewable Energy Binding Target requires 20% of the E.U.'s electricity, heat, and transportation needs to be met with renewable energy sources by 2020. For the U.K., this amount is 15%.

Carbon dioxide (CO_2) emissions regulations for buildings will tighten over the next decade:

- 2010 – Buildings will be 25% free of carbon emissions (25% "zero carbon")
- 2013 – 44% zero carbon
- 2016 – 100% zero carbon, and all homes will be zero carbon
- 2018 – 100% zero carbon government buildings
- 2019 – 100% zero carbon commercial buildings

Zoning regulations

Similar to the U.S. and Canadian markets, zoning and permitting are significant challenges.[26] Industry is working with government to relax planning requirements for small wind turbines across the U.K., through linking permitted development rights to the government backed Microgeneration Certification Scheme (MCS). The MCS, which is linked to the BWEA Small Wind Turbine Standard, accredits installer and certifies products to distinct standards. Other zoning policy developments in the U.K. include:

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[24] Planning Policy Statement 22. See: http://www.planningportal.gov.uk/england/professionals/en/1021020428382.html

[25] Planning Policy Statement 1. See: http://www.planningportal.gov.uk/england/professionals/en/1020432883348.html

[26] See http://www.awea.org/smallwind/toolbox2/zoning.html and "In the Public Interest: How and Why to Permit for Small Wind Turbines." AWEA, 2008. www.awea.org/smallwind.

- Carbon reduction policies and practices ("Merton Rule"[27]) now require all new buildings to derive at least 10% of their energy consumption from on-site (or near site) renewable technologies.
- "Permitted use" zoning legislation is being considered in England, Wales, Scotland, and Northern Ireland.

Financial

- "Zero carbon" homes are exempt from property tax ("stamp duty land tax").
- Beginning in April 2008, microgeneration technologies, including small wind systems, will receive double Renewable Obligation Credits (similar to Renewable Energy Certificates/Credits in the U.S.) equal to ~£40 (~$80) per MWh.
- The Low Carbon Building Programme[28] provides government grants for the installation of microgeneration technologies, including small wind turbines, for a variety of both private and public building applications. Industry members indicate that this program's success has been mixed since its enactment in April 2006.
- National feed-in tariff legislation is slated for consideration in summer 2008.

Other

- The U.K. Government has begun to consider distributing "smart" energy meters to all domestic customers. These home electricity meters are designed to increase customer awareness about personal energy consumption habits.

Salient Findings from the 2008 British Wind Energy Association (BWEA) Annual UK Small Wind Turbine Market Report[29]

U.K.

- Over 6,500 small wind turbines have been deployed in the U.K. since 2005, with over 3,500 of these deployed in 2007 alone.
- Deployment of turbines 50kW and smaller increased by over 80% between 2006 to 2007, with 120% further growth forecast for 2008.
- Roughly half of all small turbines deployed in 2007 were on-grid, though this share is expected to increase sharply over the next two years.
- Approximately 25% of small turbines deployed in 2007 were for building-mounted applications. This share is expected to increase strongly over the next two years.

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[27] The 'Merton Rule' is the groundbreaking planning policy, pioneered by the London Borough of Merton, which requires the use of renewable energy onsite to reduce annual carbon dioxide (CO2) emissions in the built environment. www.themertonrule.org

[28] http://www.lowcarbonbuildings.org.uk/home/

[29] http://www.bwea.com/small/index.html

International

- Approximately 40% of U.K. manufacturers' sales were exports (as is the case for U.S. manufacturers) and export is expected to remain a high share of total production over the next two years.

14. URBAN INSTALLATIONS

Interest has increased in installing small wind turbines in urban or densely-built environments, or even on rooftops, as opposed to on an acre or more of unobstructed land. The American Planning Association, local and national media, and a number of green building organizations have begun to take an interest in this application type as a way to generate renewable, on-site electricity for city buildings.

In 2007 fewer than 100 units were sold for urban or rooftop purposes in the U.S., representing less than 50kW of total installed capacity. In these terms, rooftop/urban installations represent approximately 1% of the U.S. market, yet this number has increased slightly since 2006. The market for building-integrated or urban applications has grown rapidly in the U.K., due at least in part to national legislation linking on-site renewable energy generation to greenhouse gas reduction targets for buildings (see, "The Global Market: United Kingdom"). A corresponding increase in urban wind resource studies has also arisen from the region (see. "Bibliography").

RESPONDING MANUFACTURERS

The table on the following page lists those manufacturers of small wind turbines (100kW and below) that responded to the 2008 AWEA Global Market Survey. Not all manufacturers have yet begun sales. Appearance on this list does not necessarily indicate endorsement of any kind.

2008 Manufacturer Survey Respondents

* = did not respond to 2007 survey

† = AWEA member (as of 5/2008)

U.S. Manufacturers	Location
Abundant Renewable Energy†	US - OR
Aerocity, LLC*	US - NY
Aerotecture International, Inc.	US - IL
AeroVironment†	US - CA
ARI Renewable Energy Company*	US - VA
Bergey WindPower†	US - OK
Distributed Energy Systems Corp. †	US - VT
EarthTurbines, Inc. †	US - VT
Endurance Wind Power, Inc. †	US - UT
Energy Maintenance Service	US - SD
Energy Smart, LLC*	US - AZ
Entegrity Wind Systems†	US - CO /Canada
Fourwinds Enterprises†	US - FL
Helix Wind*†	US - CA
Mariah Power†	US - NV
Marquiss Wind Power*†	US - CA
PacWind, Inc. †	US - CA
Southwest Windpower†	US - AZ
TMA, Inc. †	US - WY
Ventera*†	US - MN
Viryd Technologies, Inc.* †	US - CA
Wind-Sail	US - CA
Wind Energy Group, Inc.* †	US - CA
Wind Harvest International	US - CA
Wind Turbine Industries†	US - MN

Non-U.S. Manufacturers	Location
Flowtrack	Australia
Atlantic Orient Canada Inc.	Canada
CleanField Energy†	Canada
Windterra	Canada
Wind Energy Solutions*	Canada/ Netherlands
Windmission	Denmark
Eoltec	France
AirCon	Germany
Marc Power*	Germany
Windkraft*†	Germany/US
Unitron*	India
Coriolis Wind*	Israel
Ropatec	Italy
Solwind, Ltd.	New Zealand
Enwia*	Poland
Kestrel Wind Turbines	South Africa
African Wind Power	South Africa
Windeco*	Spain
Morphic Group*	Sweden
Hannevind*	Sweden
Jetpro Technology Co. Ltd.*	Taiwan
Iskra	UK
Gaia-Wind†	UK/Denmark
Gazelle Wind Turbines	UK
Samrey Generators & Turbines	UK
Proven Energy, Ltd. †	UK
Ampair Microwind	UK

METHODOLOGY

All sales data was obtained directly from manufacturers through telephone interviews or e-mail contact. Thirty more U.S. and 34 more non-U.S. manufacturers were identified in this survey than the 2007 survey. (See, "Manufacturer Profile")

Growth trends were identified with the help of an industry-wide online AWEA survey conducted in February 2008. Responses came from a wide spectrum of the industry,

including researchers, component vendors, manufacturers, engineers, consultants, utilities, local government offices, engineers, dealers/distributors/installers, and others.

This study's growth projections hinge on forecasted future legislation, particularly a federal investment tax credit, and are therefore dependent on the relatively high uncertainty of Congressional action. Accordingly, the emphasis of this study is placed on actual historical sales to provide for the most accurate, albeit instantaneous, evaluation of the industry.

Sales in dollar amounts are based on the retail installed total cost of the system (not just the turbine and tower) to reflect the economic impact of the industry more comprehensively.

GLOSSARY

(Installed/Rated/Nameplate) Capacity: A measure of a rate of electricity generation at a specific instant in time at a given wind speed. A "10 kilowatt (kW)" turbine, for example, produces electricity at a rate of 10kW at a given wind speed—for example, 25 mph. Capacity is the most common measure of a turbine's size.

Interconnection: The process of linking a generator, like some types of small wind systems, to the electric grid. Interconnection requires permission from the local utility, and rules for doing so often differ on a case-by-case basis.

Investment Tax Credit (ITC): A form of financial incentive that a state or federal government can implement to help consumers reduce the up-front ("investment") cost of an expensive one-time purchase, such as a small wind system. Typically, a portion of the system's purchase price can be taken as a credit against (subtracted from) the purchaser's income tax payment.

Kilowatt (kW): A measure of a rate of electricity production. A wind turbine's size (its production "capacity") is measured in kilowatts and represents the rate at which the turbine can produce electricity at a given wind speed.

Kilowatt-hour (kWh): A measure of an amount of electricity produced over time. A home's electric bill, for example, is expressed in kWh to reflect an amount of electricity consumed during the previous month.

Net Metering (Net Energy Billing): A policy implemented by some states and electric utilities to ensure that any extra electricity produced by an on-site generator, such as a small wind system, can be sent back into the utility system for fair credit. For example, if a home's

(utility-connected) small wind turbine produces more electricity than the home can use, the excess electricity is sent back into the distribution system to be used by someone else. This excess generation can cause the small-turbine owner's home electric meter to spin backwards to indicate essentially "negative" electricity usage, effectively "banking" excess production. Net metering (net energy billing) allows such a customer to be credited at the end of the billing period, usually a month or sometimes a year, for any "net" consumption or production of electricity. Since a single meter is used to measure in- and out-flow, the customer automatically receives compensation from the utility for any excess electricity produced at the full retail electricity rate.

Net Metering, Annualized: Annualized net metering is a form of the net metering policy (see: Net Metering) that averages a user's net electricity consumption or production over the span of one full year, rather than a shorter period. Doing so accounts for seasonal variations in electricity usage, thereby allowing for more accurate measurement of consumption or production.

Permitting: The process of obtaining permission from a local governing body to perform a construction or similar project, such as installing a small wind system, on one's property.

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