

Home and Farm Wind Energy Systems: Reaching the Next Level

AWEA Global Small Wind Industry Market Study Confirms Need for Level Playing Field

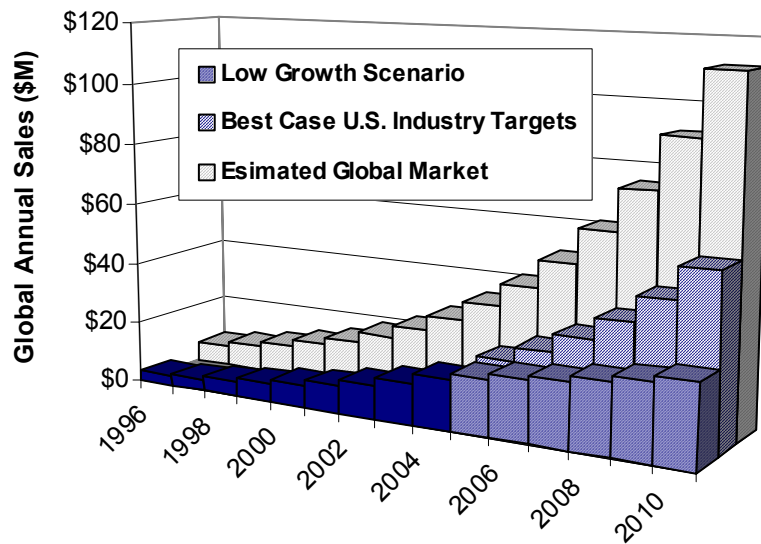
June 2005

Key Findings: Potential for 355 MW by 2010 with Favorable Policy Support

The market for home and farm wind energy systems has seen remarkable growth over the past 15 years, and the industry is poised for further substantial growth under a more supportive policy environment. Small wind companies have set ambitious growth targets continuing at 18-21% over next five years, with 2010 global annual sales potentials reaching \$110M under ideal market and policy conditions. Four U.S. firms supply at least one-third of the global demand for small wind turbines, serving one of the few remaining energy export markets. The average size of small wind turbines has doubled from 500 W in 1990 to 1 kW in 2004, indicating an increase in grid-connected on-site distributed generation applications.

AWEA's Small Wind Industry Market Study documented 30 MW of small wind capacity installed in the U.S. as of 2004, with 2005 domestic and international sales forecasts of nearly 13,000 small wind systems (up to 100 kW) totaling nearly 14 MW of installed capacity and \$25 million in sales. Our survey responses are estimated to represent approximately half the global market, indicating sales prospects of more than 150,000 small wind systems between 2006-2010 bringing total installed capacity to 350 MW with the right government policies in place to grow the small wind market. This is a growing market that the U.S. can and should dominate.

SWT Sales History & Growth Targets



However, without a federal Investment Tax Credit and improved state policies to level the playing field for small wind turbines (SWT), more modest growth is anticipated. The overall health of the SWT industry critically depends on better federal and state policy incentives: assuming a status quo policy environment, our best case targets of more than a three-fold increase between 2004 and 2010 are reduced to less than 50% under a "low growth" scenario. Manufacturers are aiming to reduce hardware costs 20% to \$1,700 per installed kW by 2010, with goals for further cost reductions as production volumes increase.

The PV industry has seen dramatic increase in the U.S. since 2000, but the small wind industry growth isn't matching the pace. Even though state and federal budgets for PV have dwarfed funding for small wind, the Solar Energy Industry Association contends that "growth policies" recommended in their PV Roadmap are required for continued substantial market expansion. Providing incentives and RD&D support for small wind turbines comparable to what is offered for solar PV and other renewable technologies is good public policy, particularly since small wind turbines are the remaining energy generation equipment still predominantly manufactured in the US and by US-owned companies.

AWEA's Small Wind Turbine Committee members are optimistic about growth prospects, with some asserting that the small wind turbine market will eventually dwarf the market for their larger cousins provided that public policy incentives and federal research funding do not continue to favor PV over wind.

Study Results

More than a dozen U.S. firms employ workers making small wind turbines and supporting an international network of small wind dealers selling turbines to thousands of consumers and small businesses every year. Small wind systems were pioneered by American industry, but America's leadership in the sector is eroding in the face of unbalanced policy support. The small wind industry can be an American success story, but it needs consistent support at the federal, state and local level comparable to that provided to other renewable energy technologies.

AWEA's study compiled 18 company survey responses documenting steady growth ranging from 14-25% annually over the past 15 years, from total annual sales of \$1.2M in 1990 increasing to \$15.8M in 2004. Respondents also indicated ambitious growth targets continuing at 18-21% over the next 5 years, bringing annual sales to \$55.6M in 2010 under ideal market conditions.

However, AWEA members warn that the SWT industry will likely continue to be stunted by the lack of government support. Without improved government incentives such as a federal Investment Tax Credit, stable funding for state buydown programs, state tax incentives, and net metering to help level the playing field for small wind compared to other electric generation technologies, a more modest growth scenario is anticipated, bringing annual sales to \$26.6M by 2010.

Even this lower growth isn't assured if existing state and federal programs (funded in New York, California, New Jersey, Wisconsin, and by the USDA) are not extended in order to ensure a continued market share for small wind turbines. New state programs coming available now are just balancing the recent reductions in the California SWT rebate funding levels, which has halted the momentum for sales there.

Our study documented more than \$105M in SWT sales since 1990, plus targets for nearly \$220M over the next five years. Considering the number of active companies unable to provide their data and the typical costs for tower foundations, installation, and maintenance, we estimate that these figures represent less than half the international SWT industry, indicating a \$50M global market in 2005 and growth potential to more than \$100M annually by 2010. Nonetheless, this prospective growth and the overall health of the SWT industry critically depends on better state and federal policy incentives for small turbines.

Responses document:

- More than 7,800 small turbines totaling 7.5 MW of small wind capacity sold in 2004 for \$15.8M, with approximately two-thirds installed in the U.S; 95% were manufactured in U.S. and more than 40% were exported to overseas markets.
- Forecasts indicating nearly 13,000 turbines totaling 13.8 MW and \$25M in 2005.
- Sales targets of \$194M with 75,000 turbines totaling 115 MW during 2006-2010.

Our initial analysis shows that average small wind turbine costs have decreased by 7% over the past 5 years, from \$2250/kW to \$2100/kW, and manufacturers are aiming to reduce costs another 20% to \$1700/kW by 2010. The average SWT size has doubled from 500 Watts in 1990 to 1 kW in 2004; further increases in the grid-connected market are predicted increasing the average SWT size to 1.5 kW by 2010. Survey responses document nearly 73,000 small wind turbines totaling 48.6 MW sold for \$105M over the past 15 years by the top 8 manufacturers, with an average size of 700 Watts. Under the best case growth

scenario, the respondents are targeting to sell an additional 88,000 turbines totaling nearly 129 MW and averaging 1.3 kW for \$219M by 2010, bringing the installed SWT capacity worldwide to 161,000 units totaling 177 MW.

Without a federal Investment Tax Credit for small turbines and more states including small turbine buydowns along with incentives for solar, the grid-connected market may have plateaued. Looking back at the past recent sales history compared to previously reported company goals, the SWT industry has been hindered by the lack of consistent government support and a playing field skewed toward other technologies.

State Opportunities

This summer's rule-making process for the popular Colorado Amendment 37 to diversify the state's energy supply offers important environmental, economic and energy reliability benefits as well as consumer choice. Small distributed wind systems are noticeably absent in the A-37 draft rules, as well as state policy proposals in Arizona, Maine, Texas, and other states. Community advocates have ensured small "carve-outs" for the presently more expensive solar options in numerous states. Without question, small distributed wind systems should be included in the final regulations to offer ranchers, farmers, and rural residents energy choices and to boost economic development in rural areas throughout the nation.

Wind-powered water pumpers of yesteryear are symbols of rural America's self-reliance and grit. Today, state policy makers have the opportunity to build on this legacy while tapping into an additional resource that provides cost-effective distributed generation interconnected to the local utility grid, benefiting constrained regional transmission systems.

"Even though many renewable energy systems installed today include a small wind generator, photovoltaics receive 'carve-outs' subsidies under many of the state renewable portfolio standards," notes Andy Kruse of Southwest Windpower. "Small wind is often left out of the mix which makes it difficult for the industry to compete. Small wind is an ideal compliment to solar photovoltaics as generally the available wind or solar resource offset each other. Generally when it is cloudy it is windy and when it is calm it is sunny. In the last five years, small wind technology has made tremendous strides in areas of efficiency and convenience. Today's machines can be installed in just a few hours and are virtually maintenance free. This is a direct contrast to machines of just 20 years ago which used wood blades and required bi-annual servicing."

Study Methods

Number of companies queried: We sent the survey to more than 80 companies indicating primary involvement in the small wind turbine industry (through AWEA membership profile listings, participation in AWEA SWT Committee meetings, subscription to AWEA SWT announcement lists, or previous listings as SWT equipment providers). We did not approach the hundreds of wind turbine dealers/installers affiliated with manufacturers contacted. We sent the survey via both mail and email (both Excel and Word versions) during February-April 2005, with two plus rounds of follow-up phone calls and emails.

Number of turbine manufacturer responses: A total of 13 small turbine manufacturers are represented in the responses. We received data directly from 9 manufacturers (7 based in the U.S.), and also from U.S. distributors of 4 additional manufacturers. Four manufacturers reported estimates for 1990-2010; three reported estimates for 2000-2010; two reported targets for 2005-2010; one reported estimates for 2000-2004; one reported estimates for 1995-2010; one reported estimates for 1990-2005; and one reported estimates for 1990-1999 and 2006-2010. In other words, all but two showed records of past sales; two others did not report future estimates.

Number of “industry support” company responses: We compiled responses from five U.S. companies providing consulting support to the small wind industry. Three reported revenues and expected revenues from 2000-2010; one reported only revenues from 2000-2005; and one reported only target revenues from 2006-2010.

Data verification method: Average kW and \$/kW rates were compared to identify any outlying data points. In several cases respondents were asked follow-up questions to confirm estimates and provide justification for large growth targets and assumptions built into best case forecasts. Some responses lacking solid basis in company track records were discounted or otherwise adjusted. Low growth scenario was developed based on analysis of historical trends as optimistic estimates for market environment without improved policy support.

Small Wind Industry Background

Small wind energy systems provide clean, renewable power to rural landowners, ranchers, farms, and small businesses for on-site use and help relieve pressure on the nation’s power grid, while providing domestic jobs and contributing to energy security. Wind power has been the world’s fastest growing electricity source for much of the last decade. Though utility-scale wind turbines were initially developed in California in the early 1980s, the majority of these wind turbines, often exceeding 1 megawatt (MW or 1,000 kW) in size, are now manufactured in Europe.

America’s Cinderella technology when it comes to renewable energy is small wind turbines, typically 1 to 10 kW in size (but ranging from 400 watts up to 100 kW) powering homes, farms, and small businesses. Over the past 15 years, the small wind turbine industry has been growing at an annual pace ranging from 14 to 25 percent. America pioneered this technology in the 1920s and it is the one renewable energy technology that the U.S. still dominates. American companies lead in both technology and world market share. In contrast to utility-scale wind turbines, over 90 percent of small wind turbines installed in the U.S. are still manufactured in the U.S.

When consumers think about installing their own renewable energy system, they typically think of solar photovoltaic (PV) panels. Yet well-sited small wind turbines can produce power at much lower costs than even the best-placed solar PV systems. Because small wind turbines can operate at lower wind speeds than the large utility-scale machines, much of the land area in the U.S. features enough wind to fuel a small wind turbine. Among the benefits of small wind turbines are dramatically lower electricity bills, cleaner air, enhanced national security, and, surprisingly enough, occasional increases in property values.

Between 1990 and 2004, nearly 30 MW of small wind turbine capacity was installed in the U.S. According to a new American Wind Energy Association study, small wind turbine companies have set a target of increasing this

Small Wind Turbine Industry Facts

While the solar photovoltaics (PV) industry has attracted BP, Shell, Sharp and other corporate heavyweights, no such Fortune 500 firm is currently involved with small wind turbines.

High volume manufacturing techniques similar to those used by the current solar PV industry could reduce costs of small wind turbines by as much as 30 percent.

In 2004, more than 7,400 wind turbines were manufactured in the U.S. and more than 40% were exported to overseas markets.

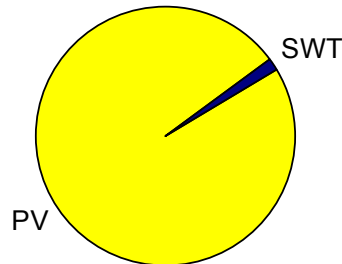
Four U.S. firms supply at least a third of the total global market for small wind turbines.

total to 107 MW by 2010. In 2001 AWEA set a long-term goal to reach 50,000 MW of small wind turbine capacity, or 3 percent of the total U.S. electricity consumption. To meet this goal, market barriers will need to be removed and new federal and state incentives will also need to be offered.

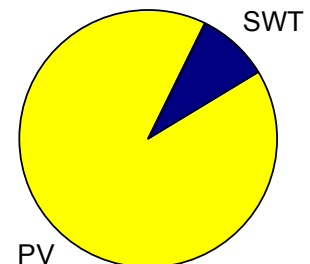
Consider the following:

- A federal production tax credit for utility-scale wind turbines has been in place for the most part since 1992. Equivalent federal tax credits have not been made available to small wind turbines since 1985.

**CEC Emerging Renewables
\$194M since 1999**



**U.S. DOE RD&D
\$88M**



- In recent years, only \$8 million of the annual federal R&D budget has been devoted to programs assisting the small wind turbine industry. By comparison, the U.S. Dept. of Energy has spent over \$80 million annually on solar-electric technology. Since 1999, the California Energy Commission has provided \$190 million in rebates for PV systems, but only \$3.4 million for small wind systems.
- A lack of standardized zoning ordinances and utility interconnection standards adds unnecessary costs and delays to small wind turbine installations.

States Playing a Leadership Role on Small Wind Industry Development

Nine states -- California, Massachusetts, Montana, New Jersey, New York, Ohio, Rhode Island, Wisconsin, and Vermont – offer rebate or buy-down incentives help overcome initial small turbine costs. The most successful program to date has been in California, but rebates there have been substantially scaled back in the last few years. California has invested \$3.4 million in small turbines since 1999, and \$190 million for PV.

Utilities in 39 states also offer “net metering,” a policy that allows a small wind turbine connected to utility lines to get full retail credit for electricity sent back to the utility. California has the most customers taking advantage of net metering for their solar PV and small wind turbines: more than 1,400.

California also passed AB 1207 in 2001, a law considered a model for the nation, which requires most cities and counties to allow wind turbines on towers of at least 65 feet on any property of one acre or more in size – and at least 80 feet on properties 5-acres or larger. Previously, many local governments in California – as well as elsewhere -- restricted tower heights to 35 feet, a restriction that severely limits power production.

Due to high electricity rates and incentive programs in New York or California, a consumer who installs a small wind turbine may recoup their initial \$16,000 to \$20,000 within 5 to 7 years. Owners then enjoy “free” electricity for the remainder of the system’s 30-year life. With these figures in mind, a small wind turbine represents a low-risk, tax-free investment that delivers annual returns ranging from 15 to 25 percent.

“Educating local governments about small wind so that they will remove or reduce the permitting barriers takes a lot of time and energy. If we want to make our energy self-sufficiency and national security goals, the federal government, as well as states, need to recognize the barriers that still exist for small wind,” points out Mike Bergey of Bergey Windpower. Bergey dreams of the day when the U.S. gets 3 percent of our electricity from small wind turbines. That would equate to 50,000 megawatts (MW), roughly the equivalent of today’s

global utility-scale wind turbine total portfolio. “Hopefully, that day will still come, but it will not happen unless the federal government re-establishes tax incentives for homeowners and farmers to complement the ones available to corporations for utility-scale wind. It’s all about consumer choice. Consumer and environmental groups need to push for equal treatment for individuals. We need political help.”

Small Wind Turbine Customer Satisfaction

The best candidates for small wind turbines are customers that have utility bills averaging \$150 per month with at least an acre of land or off-grid properties. Here are some comments from happy customers:

“The wind turbine really was a key factor in buying the home,” admitted Phil Larson of Aurora, Colorado, who, like his wife Becky Larson, is a ham radio buff. “We really liked the idea of being more self-sufficient,” added Becky. “Before the home purchase, we had thought about renewable energy a little bit, so when Phil saw the machine on the property, that pretty much sealed the deal.”

“I haven’t had to pay an Edison bill for an entire year!” exclaimed Gus Sansone of Oak Hills, California, which is located in San Bernardino County. He installed his 10-kW small wind turbine in August 2001. “It’s accomplished everything I’ve wanted it to – and then some,” added Sansone.

“Renewable energy sources such as small wind turbines are just the right thing to do,” said Dave Wiemann of Locke, New York. “I love the sustainability of wind power. Once installed, these small wind turbines should be generating power for 30 years or better,” he added. Wiemann noted that with the current configuration, his 10 kW small wind turbine already generates more electricity that he can use over the course of a year.

“End-user customers are beginning to see the significant, direct economic benefit of displacing high priced diesel and natural gas when the wind is blowing,” explained Jim Heath of Entegri Wind Systems. “With large wind turbine and solar PV manufacturers scrambling to keep up with demand as many states rush to diversify their energy sources, the small wind industry is ready to play an important role. Cash paybacks of 5 to 10 years are now achievable in many specific applications, thanks to strides made in small turbine reliability, noise, and cost reductions over the past decade.”

Sources for Background Information on Small Wind Turbines

“*Evaluating State Markets for Residential Wind Systems: Results from an Economic and Policy Analysis Tool*” <http://eetd.lbl.gov/ea/ems/reports/56344.pdf>

The U.S. Small Wind Turbine Industry Roadmap, a 20-year industry plan for small wind turbine technology, can be downloaded from: www.awea.org/smallwind. This website also includes a host of other good information developed for potential small wind turbine owners.

Small Wind Turbine Applications: Current Practice in Colorado documents several successful case study installations in a state lacking a robust financial support system for small wind: NREL/CP-500-27080. Contact Jim Green at (303) 384-6913 or Jim.Green@nrel.gov.

Small-Scale Wind and Net Metering Policies is a document developed by the National Renewable Energy Laboratory (NREL) and the National Conference of State Legislatures. Contact Trudy Forsyth at (303) 384-6932 or trudy_forsyth@nrel.gov or see <http://www.eere.energy.gov/greenpower/markets/netmetering.shtml>

Making Connections: Case Studies of Interconnection Barriers and Their Impact on Distributed Power Projects, is a comprehensive study funded by the U.S. Department of Energy Distributed Power Program:

<http://www.nrel.gov/docs/fy00osti/28053.pdf>. Another NREL study on customer-sited wind systems can be found at: <http://www.nrel.gov/docs/fy02osti/32352.pdf>.

Another good U.S. Department of Energy link is: www.eren.doe.gov/windpoweringamerica/small_wind.html.

For information about the California Energy Commission's buy-down rebates, check out their website at: www.consumerenergycenter.org/buydown/ or contact their Energy Call Center at 800-555-7794. For more information on wind incentives in New York, access www.PowerNaturally.org. For other states, see the nationwide Database of State Incentives for Renewable Energy (DSIRE) at www.dsireusa.org.

Key Small Wind Turbine Manufacturers

Commercially proven U.S. equipment providers¹ include:

Manufacturer	Contact info	Models (Rated Capacity)
Abundant Renewable Energy www.abundantre.com	Robert Preus, (503) 538-8292 robert@abundantre.com	AWP 3.6 (1 kW)
Bergey Windpower Co. www.bergey.com	Michael Bergey, (405) 364-4212 mbergey@bergey.com	BWC XL.1 (1 kW), BWC EXCEL (10 kW)
Entegrity Wind Systems www.entegritywind.com	Jim Heath, (505) 984-2722 j.heath@entegritypartners.com	EW15 (50 kW)
Energy Maintenance Service www.energymys.com	Steve Scott, (605) 272-5398 steve@energymys.com	E15 (35 kW or 65 kW)
Lorax Energy www.lorax-energy.com	Henry duPont, (401) 466-2883 hdp@lorax-energy.com	FL 25 (25 kW), FL 30 (30 kW), FL 100 (100 kW)
Northern Power Systems www.northernpower.com	Lawrence Mott, (802) 496-2955 lmott@northernpower.com	NPS 100 (100 kW)
Solar Wind Works www.solarwindworks.com	Chris Worcester, (530)582-4503 chris@solarwindworks.com	Proven WT600 (600 W), WT2500, (2.5 kW) WT6000 (6 kW), WT15000 (15 kW)
Southwest Windpower Co. www.windenergy.com	Andy Kruse, (520) 779-9463 andy@windenergy.com	AIRX (400 Watts), Whisper 100 (900 W), Whisper 200 (1 kW), Whisper 500 (3 kW)
Wind Turbine Industries Corp. www.windturbine.net	Steve Turek, (952) 447-6049 wtic@windturbine.net	23-10 Jacobs (10 kW), 31-20 Jacobs (20 kW)

¹ Certified or qualified by recognized agencies as meeting established standards and recommended business practices (see www.powernaturally.com/Programs/Wind/qualified_wind.asp?i=8 and www.consumerenergycenter.org/cgi-bin/eligible_smallwind.cgi), business members of AWEA agreeing to Code of Ethics and Anti-Trust Compliance Guidelines, and determined by AWEA's Small Wind Turbine Committee as commercially available with multiple publicly accessible operational installations in the U.S.

For more information

Heather Rhoads-Weaver, AWEA Small Wind Advocate, 206-567-5466 or cell 206-755-2064,
smallwind@awea.org

Key AWEA weblinks on small wind turbines:

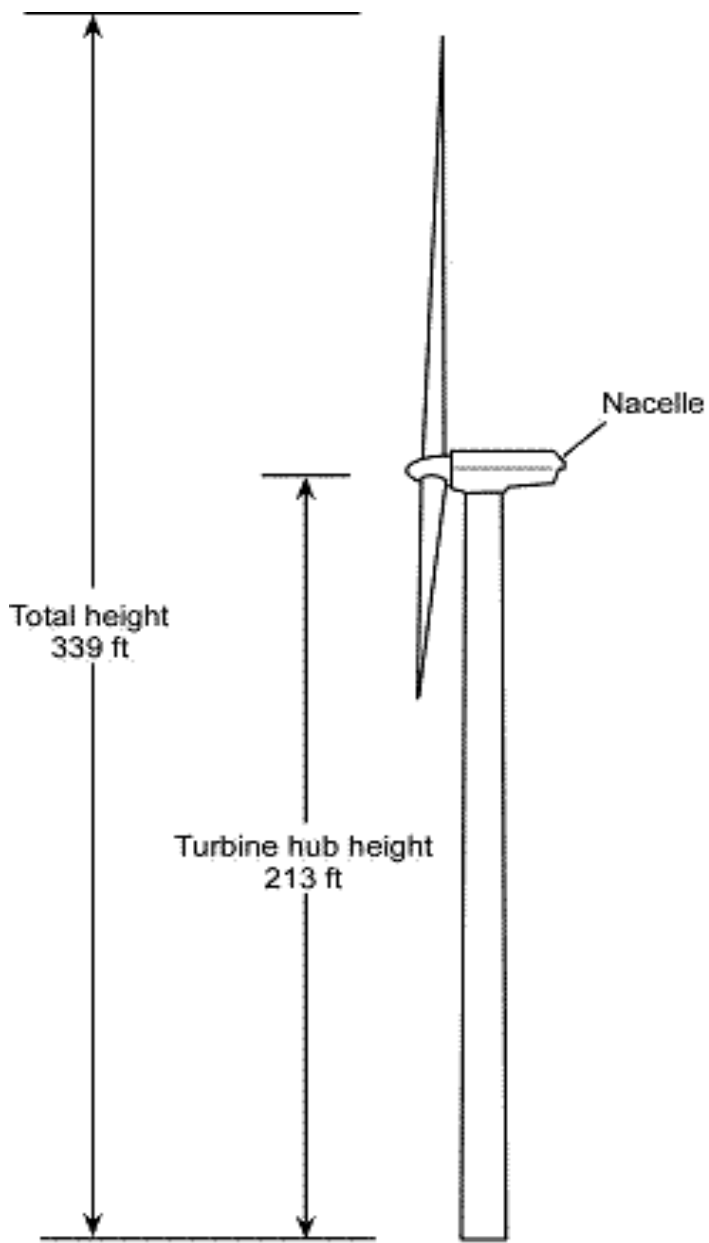
www.awea.org/faq/tutorial/wwt_smallwind.html

www.awea.org/smallwind.html

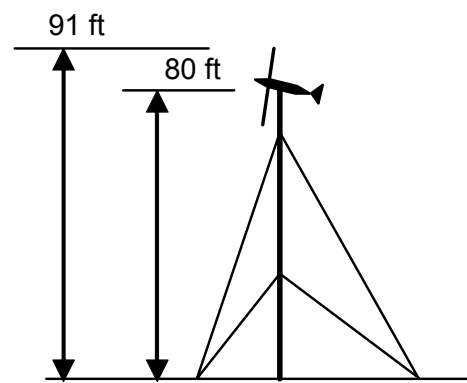
www.awea.org/smallwind/success_stories.html

www.awea.org/smallwind/toolbox/default.asp

www.awea.org/Graphics_Library/graphic_library.htm



1.5 MW, 77 m rotor, 65 m tower



10 kW, 7 m rotor, 24 m tower