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PERSONAL JOURNAL.

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Inside

A Novel Way to Reduce Home Energy Bills

Smaller, Quieter Wind Turbines Reduce Reliance on Power Grid, But Cost and Aesthetics Are Issues

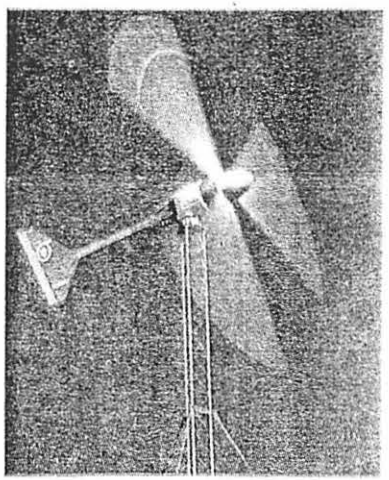
By Sara Schaefer Muñoz

IN THE LATEST BID to trim energy bills, some consumers are harnessing wind power in their own backyards—as long as their neighbors don't balk.

While wind energy is commonly associated with massive turbines churning in desolate, windy areas, a new generation of smaller systems made for areas with moderate wind is hitting the market. The latest small turbines, which resemble a ship propeller on a pole, have three blades, are up to 24 feet in diameter and are usually perched on stand-alone towers between 35 and 140 feet high. The systems have the potential to save consumers between 30% and 90% on their electric bills, manufacturers say, and promise to make no more noise than an air conditioner. But tapping so-called small wind using a high-tech windmill can be costly, and homeowners may find themselves battling zoning officials and annoyed neighbors who find the towering devices unsightly.

Interest in small wind has jumped recently: the American Wind Energy Association, an industry trade group in Washington, estimates that U.S. sales of small-wind systems totaled $17 million in 2005, up 62% from 2004. At the same time, systems designed for residential use are being supported by a growing host of state incentives to offset the cost.

Southwest Windpower, a company based in Flagstaff, Ariz., last month unveiled the Skystream 3.7, which is more efficient in light wind and less costly and quieter than past turbines. **Bergey Windpower** Co., based in Norman, Okla., recently employed new airfoil technology in its BWC Excel model to make it more efficient in wind speeds as low as nine miles per hour, and the company Abundant Renewable Energy in Newberg, Ore., this year offers two new small wind turbines, the ARE110 and the more powerful ARE442, designed to be quiet and produce more energy in low-wind areas.



Bergy Windpower's **BWC Excel turbine** *costs $45,000 to $60,000 (installed).*

Wind turbines work by collecting energy from the wind and converting it into household power. In most cases, the house is still connected to the local power network and the wind power merely supplements power from the grid. Electricity produced by wind energy is deducted from the homeowner's meter. Utilities in most states offer "net metering," giving

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Hotels Step In to Fill The Toiletry Void; Crest at Avis Counters

By Sarah Nassauer

Venus Williams with the W5 Divine Iris racket from Wilson Sporting Goods.

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Elfun International Equity (EGLBX)	International Large-Cap Core	24.16	500	0.23
Tamarack Micro Cap Value (TMVSX)	Small-Cap Value	20.55	1,000	1.07
Oakmark Global (OAKGX)	Global Multicap Core	19.92	1,000	1.20
Excelsior Value & Restructuring (UMBIX)	Multicap Core	18.87	500	1.05
Heartland Select Value (HRSVX)	Multicap Value	18.78	1,000	1.27
ICAP Select Equity (ICSLX)	Large-Cap Value	18.75	1,000	0.80
1st Source Monogram Income Equity (FMIEX)	Equity Income	17.96	1,000	1.19
Neuberger Berman Partners (NPRTX)	Multicap Value	17.18	1,000	0.86

Note: All data as of August 8, 2006.

Source: Lipper

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Homeowners Harness Backyard Wind Power

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customers credit for producing excess power. In some cases, homeowners will actually see their meter spin backward as they generate the excess.

Prices of the latest systems depend on their peak capacity, measured in how many kilowatts they produce under optimal conditions. The Skystream, for example, has a capacity of 1.8 kw and starts at around $8,500 fully installed, whereas a 10 kw ARE442 on the highest tower offered can run up to $80,000 with installation. The higher the kilowatt capacity, the more electricity they produce.

Local zoning rules are thwarting some people who want to put up a small wind system. Many gated communities or neighborhood associations prohibit structures like wind turbines, and most municipal governments restrict building heights and may not grant variances for a wind tower.

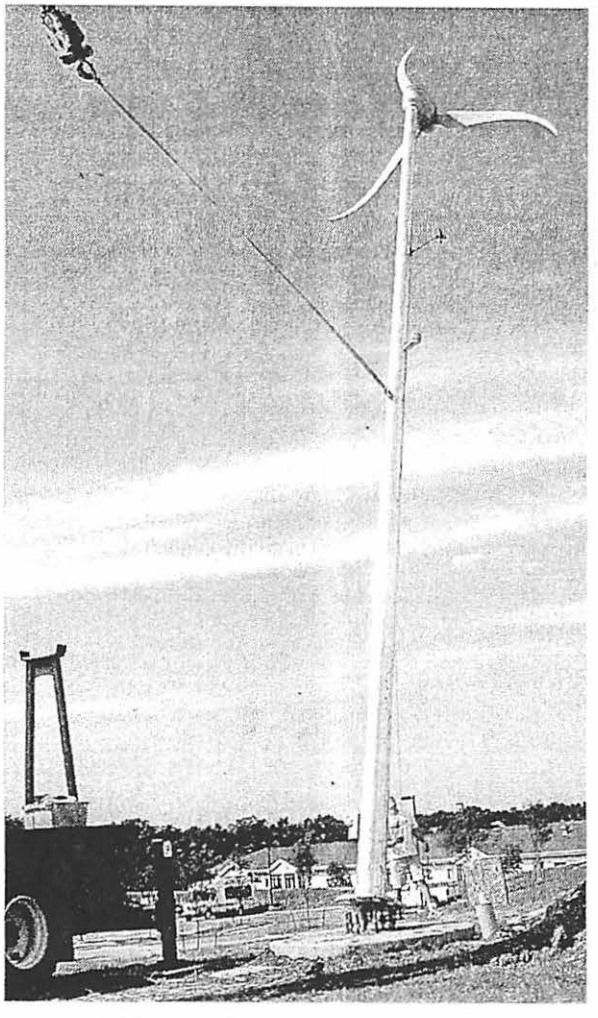
Even if a system gains approval, neighbors can protest. When William Targosh applied with his local government to put a wind turbine and tower on his 11-acre property in Lansing, N.Y., he says the installation was delayed for almost a year because of protests from other residents, who worried the device would lower property values and threaten birds. (Manufacturers say collisions with birds are rare.) He reduced the height of his 120-foot turbine tower by 20 feet, sacrificing efficiency, he said. But once it was up, he says it cut his power bills by about 35%.

Despite the focus on large-scale wind farms and other renewable energy sources in recent years, the market has been slower to embrace residential wind power. In the past, wind turbines were seen as unwieldy and impractical for residential use, and researchers and manufacturers instead focused on commercial devices that could be more profitable. In addition, the industry says small-wind systems have been handicapped by a lack of federal incentives. While consumers can get a 30% federal tax credit up to $2,000 for solar electric and water heating systems, no similar program exists for residential wind systems. But some lawmakers trying to change that: Bills proposed in this year in both the U.S. House and Senate would offer a 30% credit for residential wind systems.

"Small wind" is generally defined as noncommercial systems that have a capacity of 100 kilowatts, though systems installed for residential use are usually 10 kw or less. Despite the segment's growth, small wind still makes up just a sliver of overall U.S. wind-energy capacity, which was nearly 10,000 megawatts as of June 1, or enough to serve 2.5 million households, according to the American Wind Energy Association.

The systems aren't for city dwellers or residents of tightly packed suburbs. Those interested in small systems should have at least a half-acre of property, wind speeds of at least 10 mph and electric bills of $60 a month or more to make installing the system worthwhile, manufacturers say. It's helpful if they live in states with programs that can help offset the costs. California, Massachusetts, New Jersey, New York, Pennsylvania, Ohio and Wisconsin are among the states offering incentives. New York started a program in 2003 that gives consumers up to 50% cash back on the costs of a residential wind system and also offers low-interest loans. In California, people who purchase small wind systems can receive rebates based on the system size; for example, a $50,000 10 kw system can be eligible for a rebate of $22,500.

Some homeowners in areas with rising power bills say they will recoup the cost of their system within a few years. Arthur Larrivee, a real-estate appraiser in Dartmouth, Mass., this summer paid around $16,000 for two Bergey wind turbines equipped with solar panels to nearly eliminate the $150 a month it costs him to power his 1,600 square-foot home. Mr. Larrivee says he will receive about $9,000 in tax credits and rebates, and with the local utility's credit program for excess power, combined with what he will save on electric bills, he will earn back the rest of his investment in three to five years. "The wind is blowing all day long and it's free—why shouldn't I use it?" he says.



Southwest Windpower's **Skystream 3.7 system,** *pictured during installation, costs $8,500 to $11,000 (installed).*

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12 pages

WIND POWER AND WILDLIFE IN COLORADO: AN INFORMATIONAL RESOURCE GUIDE

good source for links

January 2006

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and
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This resource guide contains a collection of information intended to serve as a starting point for gaining a more complete understanding of issues related to the wind power development and wildlife conservation in Colorado. A large number of agencies and organizations are involved in these issues, and thus general descriptions and links to additional information (reports, websites, etc.) are listed here.

Although much information has been captured here, there is likely additional information that may be relevant to your area of interest. Furthermore, issues related to wind power developments are evolving rapidly and we expect new information to become available and for some information to change. We encourage you to use this resource guide as a launching point for further investigation.

Inclusion of information or listing of organizations is not intended to represent endorsement of specific actions, policies, or points of view. Users are encouraged to critically evaluate all information.

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Harnessing Wind Power in the City

A new, smaller design approaches wind energy from a different direction.

Pedestrians often stop in front of Frank Mauceri's home and office on Chicago's North Side, mouths ajar and eyes raised to the sky. He understands the impulse, as he too is often mesmerized by the dual, 10-foot sails silently spinning on his rooftop.

These elegant objects are actually a new class of vertical-axis windmill. They are able to produce electricity in the variable winds of urban environments, unlike the traditional turbines used at large wind farms. By using the twisted-ribbon shape of a helix, these generators overcome the barriers that have impeded the adaptation of other windmill types to small-scale home use, such as noise, impact and price.

Though a few different designs are being tested, helical turbines all basically work the same way. A helix-shaped blade constructed of a flexible yet rigid material is mounted vertically to a rotor. The helix's shape allows the turbine to catch wind from many more directions than a horizontal turbine and funnel that wind into a circular motion. This harvested energy is translated into electricity that can be used at home or sent back into the electrical grid to offset utility bills.

"The design has been around since the early '90s," says Ken Morgan of Helix Wind, a new company marketing a helix turbine. But it has only recently been engineered and designed to a level that is marketable to individual consumers.

Traditional wind turbines, which utilize the familiar, paddle-shaped blade, make loud whistling or humming sounds because the blades spin up to 10 times faster than the surrounding wind. The noise is loud enough that wind farms are consistently met with community opposition. Helical turbines, though, are nearly noiseless because they spin at the same speed as the wind blowing into them.

Mauceri's two Aeroturbines, designed by the Chicago company Aerotecture International, have been running atop his Chicago home since July 20, 2007.

"They're silent," he says. "And we haven't had any bird kills."

The number of birds killed by wind-farm turbines has been measured by the American Wind Energy Association to be as high as 10 birds per megawatt per year. Wallace P. Erickson, an environmental consultant with Western Ecosystems Technology Inc., published a paper in 2002 that attributed as many as 28,000 bird deaths to wind farming per year. While 28,000 may sound like a large number, it is only a small fraction – less than 0.01 percent – of the 860 million birds killed annually by buildings, power lines, cats and automobiles, according to Erickson's paper.

But for home users, the idea of any number of dead birds littering the lawn or roof is less than attractive, and bird safety was one of the big reasons for the Mauceris' excitement over their helical turbines.

Price was also an issue for the Mauceris. Aerotecture's 510v, one of the two models Mauceri has on his roof, costs about $15,000. One turbine offered by Helix Wind, which generates 2 kilowatts

of power, costs less than most people pay for a used car - about $8,000, according to Ken Morgan. Both Helix Wind and Aerotecture International expect turbine prices to go down in the future as well.

With a small array of solar panels to augment them, and the ability to sell extra electricity back into the grid, the two Aeroturbines on Mauceri's roof produce enough power to completely offset his annual electricity bill, he says.

"You might be able to pay off a $3,000 to $6,000 investment in 7 1/2 to 15 years [with your energy savings]," says Daniel Brands, an environmental scientist hoping to design his own helical generator.

The financial benefits of wind power depend on domestic energy consumption and the kind and quality of wind available. With this in mind, Helix Wind's Web site includes a payback calculation to help individuals gauge how long it would take for a turbine purchase to pay for itself.

But while a small turbine might be individually affordable, some experts argue that individual production is neither the cheapest nor the best way to reap the benefits of wind energy. George Douglas, a spokesman at the National Renewable Energy Laboratory in Boulder, Colo., says the lab is investing in some small-wind technologies. But overall, NREL scientists believe they can have the "largest impact" on national energy usage by continuing to improve the big turbines that generate much more power and can be grouped in high-wind locations, such as ridge lines or offshore.

In its mission statement, the NREL sets the goal of increasing wind power production in the United States to 20 percent of the nation's energy usage, a percentage that reflects the lab's assessment of the limit of infrastructure and usable land-space. Small wind, Douglas says, does not offer the kind of efficiency that large wind does, and efficiency is the key to reaching that 20 percent goal.

On the other hand, Helix Wind's Ken Morgan says that offering the option of energy independence is worthwhile regardless of what is happening with big wind. Helix Wind is dedicated to providing and enhancing that option. These small helical turbines make home and urban energy production possible. And even if it is not part of that national 20 percent, a turbine can be a significant part of one household's energy signature.

Mauceri stresses that though the energy savings are great, his turbine purchase involves more than just penny pinching. The effect on the environment from using clean energy is also worth something, says Mauceri. "This was always supposed to be a green project," he adds.

Plus, he feels that his family's turbines also serve an educational role by encouraging people to think about alternative energy options.

"People come to our door to ask about them," says Mauceri. With the eye-catching machines churning away on his roof, Mauceri's home is "the tallest structure in the neighborhood.

Source: www.scienceline.org

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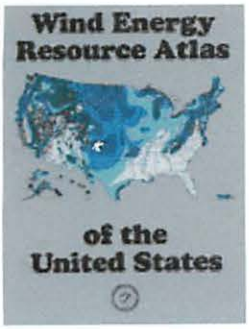

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Poster Track
BL3: Poster Session
Tuesday, 28 February 2006, 14:00 - 15:30

BL3. DESIGN OF A 12 KW VERTICAL AXIS WIND TURBINE EQUIPPED WITH A DIRECT DRIVEN PM SYNCHRONOUS GENERATOR

Presenting author: **Andreas Solum**
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Co-author(s): Paul Deglaire, Sweden (1) Sandra Eriksson, Sweden (1) Magnus Stålberg, Sweden (1) Mats Leijon, Sweden (1) Hans Bernhoff, Sweden (1)
(1) Uppsala University Sweden

Summary

A design of a 12 kW vertical axis wind turbine is presented, covering blades, generator, shaft, bearings, struts and junctions. Emphasis is put into the overall concept, choice of airfoils and generator. Aerodynamic, electrical and structural mechanics models are used as design tools. The aim of this concept is overall simplicity. Design aspects for all parts of the turbine are thoroughly evaluated.
The construction is expected to start in September 2005.

Full description

A design of a three bladed vertical axis wind turbine is presented. The design is based both on modelling and experience from a previously built and tested 1 kW unit. The suggested turbine is an H-rotor, also called a straight bladed Darrieus rotor. The construction does not require any yaw mechanism, pitch regulation or gearbox. In addition all electrical equipment, including generator, can be placed on the ground. This reduces the weight that has to be supported by the structure and simplifies maintenance. The turbine shaft will be supported by guy wires, eliminating the need of a tower. Furthermore, the turbine shaft is directly connected to the generator. Circular insulated cables replace the conventional rectangular conductors in the stator. The overall strength of this concept is simplicity.

A three dimensional double multiple streamtube model is used to model the turbine. Variable induced velocities and expansion, rotation and dynamic stall effects are included. The design of the struts and junctions as well as the straight blades, suitable for stall control is proposed. The aerodynamic model has been coupled with structural mechanical calculations and the results are then used for the shaft and generator design.

The generator has been designed by solving magnetic field equations using finite element calculations. The permanent magnet synchronous generator has surface mounted magnets. It has been dimensioned to ensure a reliable electric braking of the wind turbine in high wind speeds without reaching the thermal limit of the generator.

The construction of the wind turbine will give important experimental experience, which probably will make future constructions more efficient and perhaps even simpler than the presented H-rotor.

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BL3. AN ANALYTICAL METHOD TO PREDICT THE VARIATION IN PERFORMANCE OF AN H-DARRIEUS IN SKEWED FLOW AND ITS EXPERIMENTAL VALIDATION

Presenting author: **Carlos Ferreira**
DUWIND - TUDelft Technical University of Delft, Wind Energy - Aerospace Faculty - TUDelft, Netherlands

Co-author(s): Gerard Van Bussel, Netherlands (1) Gijs Van Kuik, Netherlands (1)
(1) DUWIND - TUDelft

Summary

Wind energy in the built environment is one of the most challenging topics in today's wind energy research.

Yet, the placement of wind turbines in the built environment requires knowledge regarding the performance of the turbines in skewed flow conditions.

This paper describes the development of a simple analytical method to predict the variation in optimal performance of a Vertical Axis Wind Turbine in skewed flow. The method is applied to predict variation in thrust, torque, tip speed ratio and generated power. The predictions are validated against experimental results, achieving an high correlation between experimental and theoretical results.

Full description

Wind energy in the built environment is one of the most challenging topics in today's wind energy research. Due to the characteristics of wind around buildings, the VAWT-Vertical Axis Wind Turbine (in particular the H-Darrieus concept) is considered one of the most suited wind energy conversion systems for the built environment.
Previous work in DUWIND (Mertens et al.) has shown that placing wind turbines at buildings will cause the VAWT to operate in skewed flow conditions. This poses new challenges for two reasons:
-previous research on the performance of VAWT in skew is almost inexistent at the exception of the work by Mertens et al.
-the operation in skew has an important positive impact in the performance of the VAWT, where higher power outputs can be achieved in comparison to the non-skewed case

A new analytical method has been developed at DUWIND to assess the influence of the skew angle in performance. Previous attempts by Mertens et al. have tried to achieve this by a numerical method. The present method avoids the cost of computing the behavior of the flow in different skew angles, by predicting the ratio between the power coefficient at a given skew angle and the power coefficient at zero angle of skew. It does not, however, compute the absolute value of the parameters. This should prove to be sufficient since the estimation of the value for zero skew is already extensively developed.
The present method is based in four assumptions:
1. The effect is, until a certain range of skew angle, mainly an inviscid effect
2. The variation in forces generated by the H-Darrieus (torque and thrust) due to skew is proportional to the amount of inflow momentum perceived by the H-Darrieus
3. Non-linear effects due to the skew angle between the wake and the unperturbed flow direction can be neglected for the loading conditions studied

4. The H-Darrieus in skew can be analyzed in the perspective of a virtual H-Darrieus in zero skew for which the momentum of the unperturbed incoming flow is the one prescribed by assumption 2.

The method is validated against the experimental work by Mertens et al and new experimental work done in order to validate the methods prediction of thrust. The high correlation between the method's prediction and the experimental result attests the usefulness and efficiency of this method.