ELIMINATING BARRIERS TO LARGE-SCALE ADOPTION OF MICRO WIND ENERGY

Innovations in aerodynamics and fluid dynamics make micro wind turbines a practical and affordable means of on-site distributed power generation.

Wind power is not well understood as a viable option for generating electricity in homes or businesses. While distributed wind power can provide long-term energy security for consumers of electricity, small-scale wind turbines have suffered in the past from several technical hurdles. Recent design innovations have overcome these hurdles, making on-site generation of wind power both technically feasible and economically attractive. With the ability to provide clean, quiet, efficient and more reliable on-site generation, micro wind power is poised for growth in the consumer market.

Awareness lagging in consumer market

Both the price and the environmental impact of fossil-fuel–generated electricity continue to rise, making renewable energy increasingly attractive to consumers. At the same time, the fragility of our aging electricity grid in the face of more frequent extreme weather events has led to expanding interest in distributed generation and "micro grids." Energy independence is no longer just a national policy objective, but also the aspiration of a growing number of households. Yet while solar energy is popular with homeowners, residential wind power is far less common. The affordability, efficiency and reliability of wind turbines are not yet widely understood.

Distributed "micro wind" for energy security

A more decentralized power generation network is needed to mitigate the risk of a large-scale catastrophic failure of our increasingly vulnerable power grid. On-site distributed generation of electricity using wind power could reduce the strain on the power grid, improve the self-healing capability of energy networks, provide a source of emergency back-up power, and improve the security of our energy supply into the future. Micro wind power will therefore be a critical component of our 21st Century electricity networks, provided it can meet the requirements of economic feasibility and environmental sustainability.

Previous hurdles to large-scale adoption

Until recently, there were three obstacles to large-scale adoption of micro wind turbines:

- Inability to take advantage of variable wind speed and direction;
- Insufficient wind speed to generate blade lift; and
- Impracticality of rooftop siting due to weight, appearance and installation requirements.

Without the ability to demonstrate reliable performance in typical conditions and locations, micro wind turbines have lost ground to other renewable energy options available to the residential market, primarily solar photovoltaics (PV). Large-scale adoption of micro wind turbines depends upon an economic equation that makes better sense for consumers. The removal of these technical limitations can radically improve the practicality and affordability of wind-powered electricity.

Technology advances enable feasibility, scalability

For several years, South Carolina–based Firefly Power devoted itself to research and development targeting solutions to these problems. In 2012, after four separate wind tunnel tests validated performance metrics, the company began making plans to manufacture a small-scale vertical-axis wind turbine (VAWT) with three discrete but

complementary design innovations: a novel turbine design, a novel blade design, and a new carbon-fiber construction material.

The units feature a modular design, for installation singly or in groups. The vertical orientation of the turbine captures multi-directional winds and produces less acoustic noise emission than horizontal turbines, making it ideal in suburban and urban settings. A patent-pending blade design merges drag and lift technologies, and carbon fiber construction affords a superior strength-to-weight ratio. These features combine to deliver superior performance at a cost to the end user of less than US$7,000.

Unprecedented efficiency

The Firefly Power turbine generates power more efficiently and in a much smaller physical footprint than most other micro wind turbines. Its innovative carbon fiber construction significantly reduces weight, and therefore decreases the wind speed necessary to initiate rotation and output.

A high "cut-in" threshold has traditionally been a disadvantage of airfoil-based wind turbines. Traditional vertical turbines feature either "drag-type" design or a "lift -type" design. The patent-pending Firefly Power blade produces high torque, overcomes inertia and rotor drag, and lowers the "cut-in" threshold. Rotation begins at wind speeds as low as 4.5 m/s or 10.1 mph.

Lightweight strength

The Firefly Power turbine's 98% carbon fiber construction affords a superior strength-to-weight ratio. At 60 pounds, the weight of the 1.8 kW model is a fraction of the weight of competing turbines, thanks to the use of cutting-edge composite materials.

Wide application, simple installation

Existing horizontal small wind systems generally require heavy and cost-prohibitive pole mount/tower installation. The Firefly Power turbine's modular design and lightweight construction enable portability, simple DIY assembly and lower shipping costs, as well as quick, easy, secure installation on any type of building. The units are scalable by design, with the ability to increase capacity from 1.8 kW to 3.5 kW, 5 kW or 10 kW.

Distributed micro wind poised for growth

Wind power is a clean, quiet, efficient and abundant source of energy. The Firefly Power micro wind turbine minimizes or overcomes the obstacles of wind-speed variability and intermittency—and has the capacity to generate power 24 hours a day, something solar panels cannot do.

Widespread use of micro wind turbines as a source of distributed generation has the potential to greatly improve energy security for consumers as well as for industry. By removing barriers to efficiency, reliability and scalability, the Firefly Power micro wind turbine presents an attractive alternative to solar PV for consumers who want to generate their own electricity on site.

For more information

Additional information, including specifications and performance data, can be found at:

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