WiSys TECHNOLOGY FOUNDATION

WiSys Ref: T170048

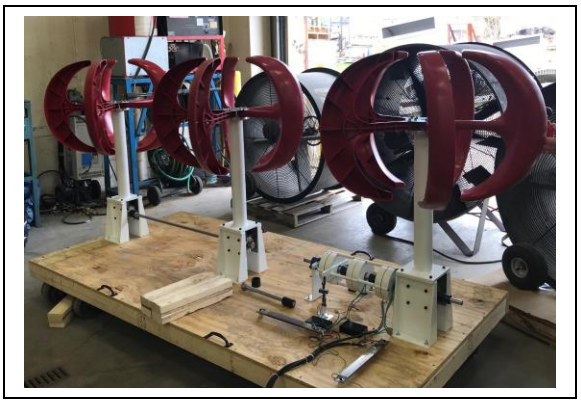
Integrated Vertical Axis Wind Turbine System Generates More Power from Less Wind with Smaller Turbines

Market and Background

The global wind turbine market was valued at $50 billion in 2017 and is estimated to reach more than $80 billion by 2024. Within this same period, the vertical axis wind turbine market is projected to grow from $12.6 billion to $16.3 billion. Major drivers of these increases include growing sensitivity toward environmental issues, rising investments in renewable energy, favorable government policies and declining costs of wind power generation.

Although horizontal axis wind turbines currently dominate the wind power industry, their vertical axis counterparts offer several advantages. For example, vertical axis systems are powered by wind coming from all 360 degrees and are better suited for turbulent, small and inconsistent wind situations. They can also be scaled to smaller sizes and installed at relatively high densities, making them more compatible with residential and urban settings than horizonal systems. In addition, vertical systems are generally lighter weight and allow key electronic and mechanical components to be placed at ground level for easier installation and maintenance. Despite these advantages, vertical axis wind turbines have been underutilized. The main reason for this is that vertical systems have been perceived to be less efficient at producing energy than horizontal systems.

Research and Development Status:



An assistant professor of engineering technology at the University of Wisconsin-Green Bay has developed an innovation that improves the power generation efficiency of vertical axis wind turbine systems and reduces installation and maintenance costs. Conventional wind generation systems are currently limited by a configuration requiring one turbine to one power generator and drive train. The novel technology presented here removes this limitation by combining multiple vertical axis turbines with a single generator and drive train. This approach allows a reduction in size, weight and inertia of each turbine and a reduction in electrical and mechanical infrastructure. The result is a system that operates in less wind and generates more power per multi-turbine tower. In addition to increased capacity for electricity generation, other benefits related to this integrated turbine technology include ground level installation and maintenance of fewer generators and electrical components, options to reduce noise, and lower transportation barriers and costs.

A system prototype of this invention has been developed, tested at low wind speed, and has demonstrated an increase in mechanical power. This 1-kilowatt prototype consists of three mechanically connected vertical axis turbines integrated with one common driveshaft and single electric generator. A 2.4-fold increase in accumulated mechanical power over a conventional single turbine system has been shown, and it is anticipated an even greater increase can be achieved. Ongoing prototype testing will involve integration with electrical components and testing at higher wind speeds.

Prototype Performance	Conventional VAWT (1 generator: 1 turbine)	Integrated VAWT (1 generator: 3 turbines)	Integrated System Advantages
Mechanical Torque	1X	2.4X	Power capacity is increased through integration of multiple turbines.
Cut-in Wind Speed	5 meters/second	4 meters/second	Electricity can be generated at lower wind speed.
Rotational Stability	Less stable with variation of load	More stable with variation of load	Maintains more uniform rotational speed with variation in load.

Applications:

- Small and large-scale residential and commercial power generation
- Smart cities
- Military, disaster relief agencies and others in need of portable electricity generation
- Locations where daylight hours are limited (alternative to solar)
- Offshore installations
- Locations with low wind speed
- Pumping water
- Grinding grains

Key Benefits:

- Increased wind power capacity
- Reduction in turbine size
- Reduced number of generators and electronics
- Ground level placement of generator, electronics and gearbox
  - Cost savings in installation and maintenance
  - Option to reduce noise through underground installation of mechanicals
- Reduce turbine transportation barriers; smaller turbines
- Power generation at low wind speeds

Intellectual Property:

A PCT application is pending for this technology. For more information, please contact Jennifer Souter at jennifer@wisys.org or by phone at 608-316-4131.

Development and Commercialization Needs:

WiSys is currently seeking strategic partners in the wind power generation industry that are interested in further developing this innovative integrated vertical axis wind turbine system for small- and large-scale applications, ultimately providing a route to market for commercialization.