

Next-Generation Vertical Axis Wind Turbine

A next-generation renewable energy technology for microgrid applications, distributed power generation, and floating wind systems. This innovative Carleton design provides high-performance energy generation from a compact system that is comparatively simple and cost-effective to install and maintain.



Faculty Leads:

Edgar Matida, Hamza Abo el Ella, Tarik Kaya, Ahmed Abdulla

Development Stage:

Prototype

Protection Status:

US 10,844,835 B2 - granted

Publications:

Experimental validation including wind-tunnel testing

[Link](#)

Simulated performance up to 17m

[Link](#)

Seeking:

Development & Pilot Partners
Licensees

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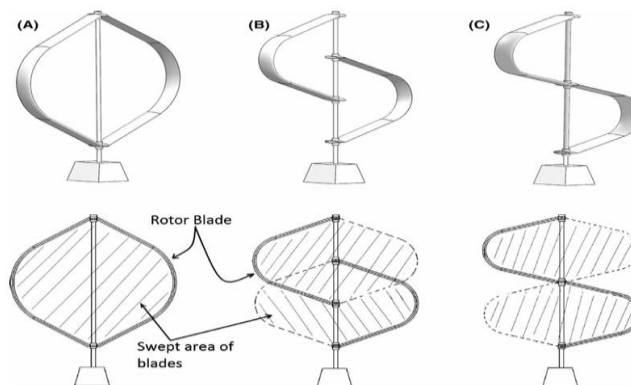
Carleton University,
Ottawa, Canada

Vertical Axis Wind Turbines (VAWTs) have been proposed as an ideal renewable energy solution for microgrids, distributed power generation, and offshore applications. Conventional Horizontal Axis Wind Turbines (HAWTs) are failing to address these opportunities due to their high center of gravity, steel and concrete-intensity, logistical challenges associated with transport of blades, and high costs of installation and maintenance. VAWTs provide many advantages for the target applications, including:

- Low center of gravity
- Continuous alignment to the wind without yawing and pitching systems
- Lower deployment, installation and maintenance costs
- Improved performance in low-wind conditions
- Increased stability and improved resilience to harsh conditions
- Low footprint systems for flexible siting

Existing VAWTs, however, are inefficient due to the vortices created by the complex aerodynamic interaction of the blades (blade-wake interactions – BWIs). This reduces the overall efficiency of the turbine and decreases the power that it can generate.

Carleton researchers have developed a novel VAWT architecture that minimizes BWIs, a key factor limiting turbine efficiency. The optimized configuration provides a **10–15% improvement in aerodynamic performance (peak power coefficient)** while enabling **smaller and lighter blades**. Experimental results show that the patented configuration **outperformed a conventional VAWT by up to 14% in peak power** across a range of turbine sizes and rotational conditions. The Carleton Shifted-Troposkien-Shape Vertical Axis Wind Turbine (STS-VAWT) design overcomes the limitations of conventional VAWTs and unlocks new opportunities for renewable energy generation and power system stabilization.



Vertical axis wind turbine (VAWT) configurations:
(A) conventional VAWT (Troposkien Shape),
(B) novel 50% STS-VAWT (50% Shifted Troposkien Shape-VAWT),
(C) novel 100% STS-VAWT

Key milestones achieved to date:

- Working prototype developed and performance validated in wind tunnel
- Simulated performance at turbine scale up to 17 m
- Granted US patent
- Full experimental setup for prototype development and validation at Carleton University

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Development plan towards commercialization (seeking partners):

- Design and material optimization
- Build, integration and validation of 2m prototype (Phase I)
- Modular design of fully integrated deployable system
- Build, integration and pilot-scale testing of 10 kW turbine (Phase II)
- Techno-economic analysis, cost optimization, and engineering design for scale

Target markets and applications:

- Microgrids and distributed power generation
- Deployable systems to power mining operations and related industries
- Renewable power generation in cold climates
- Floating or fixed offshore platforms

Northern/remote communities, mining operations



Deployable turbine for energy independence:

- Simple, deployable system
- Low installation and maintenance costs
- Suitable for microgrid integration and/or battery storage
- Enables sustainable generation in previously non-viable locations (reducing reliance on diesel generators)
- Supports development of distributed and smaller-scale wind projects

Offshore/floating platforms



Stability and cost advantages for offshore wind:

- Alignment to wind direction without complex yawing or tilting
- Lower center of gravity for increased platform stability
- Reduced rotor weight, lower structural loads compared to incumbent HAWTs
- Key components in base rather than nacelle – significantly reduced maintenance/lifecycle costs compare to incumbent HAWTs

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