Wind Sail Energy Systems Inc
Alternative Energy Solutions

Vertical Axis Wind Turbine (VAWT)

The design is a Vertical Axis Wind Turbine. The core methodology is based around an equilateral triangle to accomplish strength, stability and balance. The design is specifically and intentionally unique to the industry insofar as:

1. The wind turbine is being designed to produce nameplate power at approximately 4 meters/second (M/S) (approximately 9 MPH) rather than the historical and current industry standard of 12 M/S (approximately 26 MPH). This will provide the industry with a Low-Wind alternative that will produce consistent name plate rated power that heretofore is not known to exist.
2. A device that is designed for linear or non-linear wind with equal power producing capability. It is also designed to be installed at 30 to 60 feet in height, essentially no taller than a common parking lot light pole or street light. The combination of these two concepts makes the device ideal for an urban installation rather than being reliant on a large open area to obtain unobstructed linear wind flow.
3. The power drive train brings a shaft from the 12 foot high spire, located atop a 20, 30, or 40 foot monopole, or 10 foot pole sections, through the center of the pole being aligned by internal bearings and couplers to the base of the device, wherein it couples to a transfer case that re-directs the energy in the rotating shaft from a vertical shaft to a horizontal shaft. The horizontal shaft then terminates with a blank coupler. This is also a specifically unique concept in the industry insofar as the Wind device is not intended to solely produce electricity. The VAWT is designed to provide power (work) to any device that can be coupled to it, whether electric generator, a transmission, a liquid handling pump, a lift, pulley, or any other device than can benefit from a rotational source of energy.
4. The air foils (sails) are designed and placed using the principals of sailing, wherein power production by the airfoils more than doubles by using a mainsail and jib arrangement of the airfoils. Just as Sailboats in the America's Cup can sail at 2 to 3 times the wind speed, the power produced from the dual airfoil arrangement per placement at 120 degrees each will be 2 to 3 times the use of a single airfoil.

The device is comprised of a structural base of sufficient size to provide a rigid structure that can be firmly affixed to a structural slab, footings, or otherwise attached to the ground, and large enough to house the aforementioned transfer case, coupler(s) and device to be connected to the coupler, which for the sake of discussion, a generator shall be discussed but not limited to. The structural frame will be covered with removable panels to provide a weather tight enclosure, but to allow for ease of service and maintenance. From the top vertical coupler of the transfer case will be attached a shaft of the desired height (10ft., 20 ft., 30 ft. etc.), that will extend a minimum of 3 ft. (or 1 meter) through a top self-aligning coupler at the top of a surrounding pole. The surrounding pole will be affixed to the top structural frame of the base to provide a rigid, weather tight enclosure for the shaft and associated bearings and couplers spaced at approximately 10 ft. intervals up the pole to keep the shaft plumb and secure but freely rotating.
The spire will have a center pole (spire pole) with an interior dimension precisely sized to slip over the approximately 3 foot shaft extension through the top bearing of the structural pole. Attached to the spire pole will be approximately 6 sets of a top and bottom plate, or a single top and bottom plate for a full height airfoil of a shape to have 3 points of attachment at 120 degrees of a circle spacing to accommodate two airfoils each (6 airfoils total per spire) and will be adjustable for trimming by mounting the airfoils at the top and bottom of each set of plates to a "Lazy Susan" type of rotating element. Once the ideal placement is established, the “Lazy Susan” plates will be locked in place using set screws to keep the unit quiet while operating. The device is designed specifically to have fixed airfoils rather than spring loaded or articulating airfoils insofar as movement = noise, and, insofar as the devices are specifically designed to be installed in an urban setting, noise will be an undesirable quality.

Wind Sail Energy Systems Inc · 568 Majestic Oak Drive · Apopka, FL 32712
Bruce H Hall · bhall@windsailenergysystems.com · 407 491 6301

Accordingly, the device will begin rotation with as little as approximately 1.0 M/S (2.25 MPH) and produce rated power at approximately 4 M/S (approximately 9 MPH).

All materials are readily available in the marketplace, and manufactured in the USA. It is the mission of Windsail Energy Systems Inc. to be 100% Made in America using United States of America materials, Manufacturers, and Corporations.

Current status:

The conceptual drawings have been completed. Details and specifications are beginning to be added to the concepts. We are at the place where we need to complete the design and build a prototype or prototypes for various scale models that will in turn produce various amounts of power at low wind conditions. Once we have the first prototype assembled, it is our intention to test the unit to failure, recording all data to completely understand what will fail, when, and under what circumstances with supporting documentation. This information will be used to develop the operating procedures, the maintenance procedures, and the generator power capability vs. turbine scale size match-up, thereby defining the nameplate rating of the turbine.

Insofar as the VAWT can accept wind from any direction at any time, (known as "dirty wind") they are specifically intended to be used in urban settings, such as in parking lots, entry plazas in shopping malls or downtown. The power is anticipated to be between 4 and 10 kW each (perhaps more with testing) and is intended to offset peak kW, not "spin the meter backwards" leaving the control of the power in the Utility company professionals hands, and utilizing an interconnection agreement rather than a purchase power agreement. There is no intended difference between the power production of the new design and the power reduction associated with a building lighting retrofit. But the net effect of KWH production will have a significant impact on sustainability and energy independence.

Presuming an urban office building has a main breaker sized at 800 amps and 277/480 volts. This is equivalent to 665,088 Watts, or 665 kW. Presuming a desired 30% reduction of demand, it will be necessary to install approximately 200kW in wind turbines. Presuming a 10 kW rated capacity per turbine, the site would receive 20 VAWTs. Appreciating that the kW is only one portion of a utility bill, we must consider that the turbine will operate 24 hours per day, while the building is offline at night. As a consequence, presuming an “average” wind sufficient to produce rated capacity 24 hours per day for a month, kWh is 144,000 kWh, where power used is likely 230,400 kWh at 50% load factor and 20% de-rating of the 800 amp switch. Consequently, a 30% kW production produces a possible 62.5% kWh offset. A 30% reduction of the kWh would only require the installation of approximately twenty - 4kW VAWTs.

The aforementioned calculation is speculative and flawed. But is the simple math that current wind turbine manufactures use to sell their products. Because the Fan Laws of Physics are a “reverse cubed relationship” from wind speed to power production, using average wind speed is flawed insofar as there is such a dramatic difference in power production for each minimal difference in wind speed. It is not a direct relationship.

Wind is variable, and is always changing. To attempt to anticipate the effects of wind and the calculation for power production in a real model I have created a financial calculation model that:

- Considers the variables of:
    - The kW nameplate of the VAWT
    - The design wind speed

- The target minimum (a value of 0, the NOAA published value, or the generator cut-in) wind speed
    - The target Maximum wind speed (not extreme wind gusts, but a normal maximum sustained wind speed, or the NOAA published maximum, or wind turbine cut-out speed based on test criteria)
    - The existing kW peak for a 12 month period at the installation
    - The existing kWh at the installation
    - The existing annual spend at the installation.
    - The operating hours of the installation.
- The model first selects a random integer between the minimum wind speed and the maximum wind speed for every minute of a year, to produce 525,600 random wind speeds. In the model, each time a variable is changed in the financial model page all of the random values change as well, so the averages and remaining calculations change also. Just as the wind is always changing, so is my spreadsheet calculation. This section then provides an average of the 525,600 values.
- The second calculation applies the fan laws to the random integer that represents wind speed and the rated kW to derive the effective kW production for each random wind speed value, for each of the 525,600 data points individually, and provides a Sum.
- The third calculation applies the average $/kWh (converted to $/kW-minute) that is the current amount paid at the installation to each of the 525,600 derived kW data points individually, and provides a Sum.

Recognizing that the Sum of the calculations is still presumptuous insofar as it does not anticipate each millisecond or microsecond of variable wind conditions that is the true nature of wind, it at least attempts to simulate a realistic approximate of wind versus power production rather than relying on averages or presumed sustained wind conditions.

Using my model as applied to the former example (800 amps, 277/480 volt power, 50% load factor, presuming $0.12 per kWh, and presuming minimum 0 mph wind and normal maximum 20 mph wind with a VAWT rated capacity of 4 kW at 9 MPH (or 4 M/s), for each turbine in this hypothetical model, the results are as follows:

Project Name				
Project Address				
VAWT Rated Capacity	4.00	kW		
VAWT Design Wind Speed	8.95	MPH	4.00	M/s
Min Wind Speed(Local)	4.00	MPH	1.79	M/s
Max Wind Spped (Local)	25.00	MPH	11.18	M/s
Calculated Average Wind Speed	15.96	MPH	7.13	M/s
Number of VAWT installed	1.00			
Project Cost	70,000.00			
Cost per Turbine	70,000.00			
Cost per kW	17,500.00			
Estimated annual kWh produced	233,977.55	kWh		
Average cost per kWh (Local)	0.12	/kWh		
Annual energy dollars offset	28,077.31			
Existing Facility consumption (Local)	3,686,659.00	kWh		
Existing Facility Cost (Local)	442,399.08			
Percent Reduction in Consumption	6%			
Percent reduction in Load Factor	4%			
Number of turbines necessary to achieve 30% reduction in consumption (kWh)		4.73		
Utility Rebates (Local)	-			
Total Federal Incentives (Local)	-			
Total Federal Credits/Grants (Local)	-			
Simple Payback/ROI	2.49	Years		
IRR Year 5	33%			
NPV Year 5	56,570.48			
IRR Year 10	43%			
NPV Year 10	173,503.39			

Accordingly, where the existing methods would call for an approximate 20 - 4 kW turbines to produce 80 kW load at 12 M/s (26 MPH) wind, our device is designed to accomplish the same 80kW load using 5 turbines, because of the ability to produce the 4kW nameplate rated power at 4M/s (9 MPH) wind. This is not "smoke & mirrors", but rather the fan laws of physics, given proper consideration, and applied principals of sailing that produces these results.

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Insofar as we are finally Patent Pending (No. 61/712,512 - VERTICAL AXIS WIND TURBINE) for the Low Wind VAWT design and concepts, we are free to pursue the development of a prototype and the aforementioned testing. Once complete, we will proceed with manufacturing. Accordingly, we will be soliciting for a Grant to help fund the project and bring it to market sooner rather than later.

Thank you for your kind consideration.

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