The Future of Wind Energy: The Saphonian

Research Report

North Texas Energy

Authors: Austen Thurmond, Roberto Villazana, and Victoria Nguyen

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Abstract

The current wind turbines being used by North Texas Energy are disadvantageous to the environment as well as to the residents living in the surrounding area. The turbines endanger the lives of birds and wildlife and produce a disruptive amount of noise. We suggest that North Texas Energy switch over to a bladeless wind turbine known as the Saphonian. The Saphonian will not only increase energy production levels twofold, but will simultaneously solve the environmental and residential issues that have arisen from the standard wind turbines.

Introduction

We are writing this research report to show North Texas Energy the opportunity that the bladeless wind turbine called the Saphonian can bring to the organization. The standard wind turbine that the organization is using today has many problems associated with it, and the Saphonian seeks to resolve these conflicts. The main problems with the standard wind turbine are that it is loud, disruptive to the people who live in the surrounding area, and it is killing animals (Caulfield; "The Wind Power Problem"). The animals that the standard wind turbine is killing include bats, birds, and eagles (Caulfield). All of these conflicts started to become a major problem when the wind turbines were placed near residential areas. The people of the nearby areas have had trouble sleeping because of the noise from the standard wind turbines, and these turbines have caused their homes to devalue ("The Wind Power Problem"). With all the deaths of innocent animals and the negative effect the standard wind turbine has had on the economy, standard turbines have become disregarded. If Saphon Energy can prove the incredible results they have obtained with the Saphonian, we believe North Texas Energy should completely transfer over to using the Saphonian instead of the standard wind turbines.

Zero Blade Technology

The Saphonian uses a technology called zero blade. This technology is based off the engineering of a sailboat. The sailboat achieves maximum efficiency through its use of the wind and this is exactly what the Saphonian aims to accomplish. With no blades or rotation involved, the Saphonian follows a back and forth 3D knot motion ("The Saphonian: Zero Blade Technology"). The process of zero blade technology starts by the Saphonian capturing the wind through the sail that is inside the turbine itself. The pistons that are connected to the sail start to move, and these

pistons convert all of the energy from the wind into mechanical energy. This mechanical energy is then converted to hydraulic pressure that can either be stored or used immediately for electricity. The component that reserves the energy is called the accumulator, and the component that converts the energy into electricity is called the generator ("The Saphonian- Zero Blade Wind Turbine"). Because the Saphonian implements the use of a sail-shaped body, rather than using blades, the aerodynamic drag coefficient (Cd) is higher than that of a standard wind turbine ("The Saphonian: Illustrations"). This higher drag coefficient is ideal because it enables the turbine to retrieve twice as much energy for the same amount of area covered. Figure 1 shows how the Saphonian, with a drag coefficient of 2.3, is able to capture more wind per covered area than the conventional turbine.

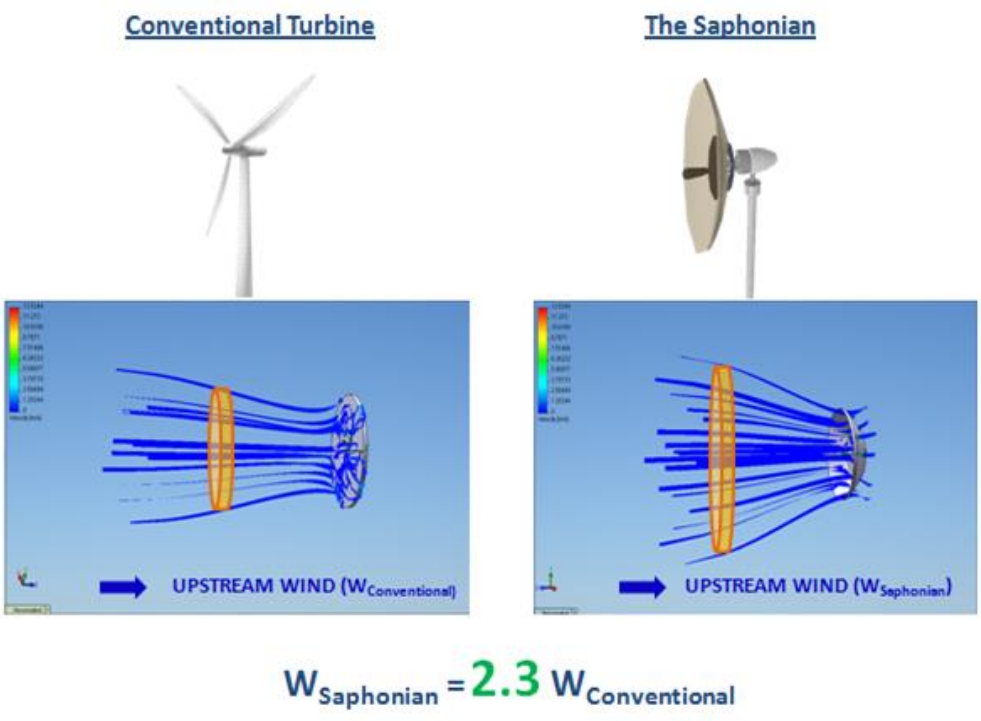

Figure 1: Drag Coefficient Comparison
"Is the Saphonian Bladeless Wind Turbine For Real or a Scam?" *Metabunk.* n.d. Web. 6 November 2014.

The Advantages and Disadvantages of the Standard Wind Turbine

The main advantages for the standard wind turbine are that it releases no pollution, the cost to operate is low, it uses a renewable source of energy, and it creates jobs for communities (Maehlum; "Benefits of Wind Energy"). These advantages are excellent and beneficiary, but the disadvantages of the standard wind turbine outweigh the advantages. The main disadvantages with the standard wind turbine are that it kills animals, it is extremely noisy, it decreases property value for nearby areas, it interrupts TV and radio signals, and it causes health problems in individuals who live in the surrounding area (Kostadinov; Saphon Energy). Because the blades are so massive in size, they require a large tower to elevate them from the ground (Justesen). This tower is costly to manufacture as well as transport. Figure 2 below shows what the standard wind turbine looks like. The enormous blades shown cause many of the disadvantages and they will need to be removed completely to eliminate the conflicts.

Figure 2: Standard Wind Turbine
"Wind Energy Basics." *Plain Wind EIS.* n.d. Web. 27 October 2014.

The Advantages and Disadvantages of the Saphonian

The main advantages that the Saphonian will bring are that it is bladeless; it will not pose a threat to animals; it is quieter than the standard wind turbine; it is projected to be more efficient than the standard wind turbine; and the manufacturing cost is projected to be much less than the standard wind turbine (Kostadinov; Saphon Energy). Without having the standard three blades, the Saphonian reduces bird, eagles, bats and other winged-animals casualties to none. Not only does the Saphonian save wildlife, but without the standards three blades, the Saphonian is much quieter than standard wind turbines (Saphon Energy). The loud noise produced by the blades of the standard wind turbine cause many people headaches, nausea and even insomnia (Saphon Energy). The Saphonian aims to be much quieter so these horrible side effects do not happen. With regards to efficiency, Saphon Energy has run tests and the Saphonian was over twice as efficient as the standard wind turbine (Tulloch). These advantages resolve many of the disadvantages that are associated with the standard wind turbines. Unfortunately, there are some disadvantages with the Saphonian as well.

The main disadvantages of the Saphonian are that it is in the prototype phase; there is a lack of information; and Saphon Energy has not spoken regarding how they have conducted their experimental tests (Clarke). Although the Saphonian is in the prototype phase, Saphon Energy is already developing the third prototype and making improvements from the previous models (Tulloch). There is not a lot of information on all the Saphonian models because it is not available to the consumer, and Saphon Energy is in the process of finding investors for manufacturing ("The Saphonian- Zero Blade Wind Turbine"). The biggest disadvantage of the Saphonian is Saphon Energy's silence regarding how they have conducted their test. The biggest claim they have made is that the Saphonian surpassed the Betz Limit through experimental test

("The Saphonian: Test and Results"). If the Betz Limit is actually surpassed, that must mean the formulas are wrong, and if so, why haven't any of the formulas been corrected? This is a major claim by Saphon Energy and it is one of the main reasons why people are very skeptical with the Saphonian. However, Betz Law is based on assumptions involving flow, the number of blades, and air characteristics (Justesen). By changing any of these characteristics, the assumptions upon which Betz Law was made are also changed (Justesen). Figure 3 shows the chart Saphon Energy created and the efficiency levels they have acquired through experimental tests. The Betz limit explains that a wind turbine cannot obtain more than fifty-nine percent efficiency, but this chart expresses that the Saphonian can achieve over eighty percent efficiency ("What is Betz Law?").

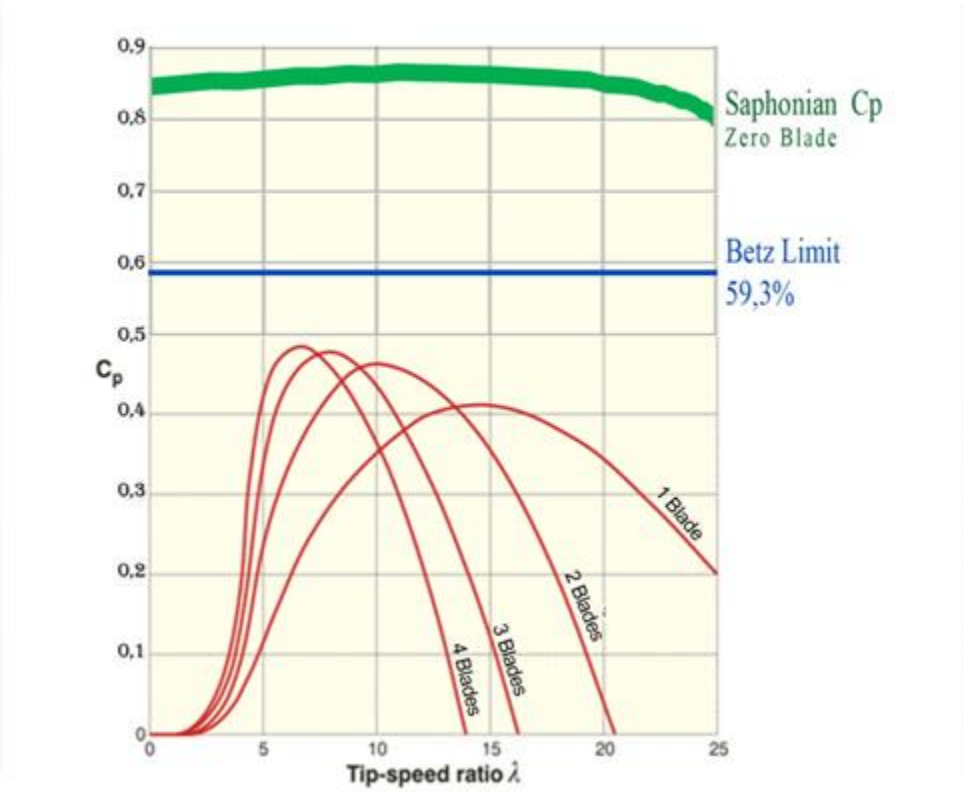

Figure 3: Efficiency

"The Saphonian: Test and Results" *Saphon Energy*. Same Team. n.d. Web. 27 October 2014.

Addressing Data Claims and Doubts

We understand the skepticism that people are having toward the Saphonian because Saphon Energy has not released to the public how they have gotten their ground breaking results. Some individuals are going as far as saying it is a complete scam (Clarke). The team behind Saphon Energy is incredibly talented, and they all have a strong background in their respective fields. The three main people involved with the creation of Saphon Energy are Anis Aouini, Hassine Labaied, and Belgacem Aouini. Anis Aouini is the main creator of the Saphonian, and he has strong credibility in the field of scientific engineering. He graduated from INSAT in Tunisia and this college is among the top of the field in engineering in Tunisia ("About us: Team"). Labaied has an extensive background in finance management and twelve years of experience in banking ("About Us: Team"). Labaied's finance experience is a major advantage because it draws investors. Anis Auoini expressed in an interview that organizations are starting to come to Saphon Energy with interest in investing so that the company can start manufacturing the Saphonian (Heilbron). Anis Aouini and Hassine Labaied were the runner's up for the 2013 Innovation Prize for Africa for the Saphonian, and Saphon Energy received a total $25,000 to continue working on the project ("2013 Winners"). Belgacem Auoini is both an electrical and mechanical engineer. Belgacem has over forty years of experience in these respective engineering fields involving power production ("About Us: Team"). The team behind Saphon Energy has the experience and the credibility to make an effective product, and we believe the Saphonian's test results will be accurate when they are demonstrated to the consumer.

Benefits for the Organization and the Employee

The Saphonian could bring huge benefits to both the organization and the employee. The main benefits that the Saphonian could bring to the organization include becoming more efficient, more environmentally friendly, helping save the organization a large amount of money, and gaining support from interest groups. Through Saphon Energy's experimental test, the Saphonian not only proved to be over twice as efficient as the standard wind turbine, but it also broke the Betz Limit ("The Saphonian: Test and Results"). Betz Limit is a law that states the maximum amount of energy that we can generate from a wind turbine is fifty-nine percent ("What is Betz Law?"). If Saphon Energy can prove they did this, then this will be a breakthrough in scientific engineering. Saphon Energy claims that the Saphonian can generate up to eighty percent efficiency ("The Saphonian: Test and Results"). This would save North Texas Energy a massive amount of money, and it would allow the organization to spend money in other areas of need. Another way in which the Saphonian will help the organization save money is through the cost of the unit. Saphon Energy claims the Saphonian will cost up to forty-five percent less than the standard wind turbines of today ("Bladeless Turbine: The Future of Windy Energy?"). This will decrease the price per unit that North Texas Energy will have to spend on wind turbines.

The two main interest groups that the organization could gain support from are the animal rights activists and the environmentalists. Many animal rights activists despise the standard wind turbines of today because they pose a huge threat to animals and forests (Schulz). The standard wind turbines are killing such a large number of bald eagles that President Barrack Obama had to sign a law that states wind companies will be not persecuted by the law for killing all of these bald eagles (Cappiello). Having the Saphonian at North Texas Energy will eliminate this problem and prevent such harm to innocent animals. This could change animal rights activists'

perspective of North Texas Energy, and we could gain a large number of supporters. The Saphonian would also help our organization gain environmentalist supporters through its promotion of green energy (Heilbron).

The Saphonian would bring advantages to the employee as well. Any employees living near our current wind turbines will no longer be affected by the horrible side effects of the turbines. Also, with an increase in energy production and sales, the organization will be able to afford to raise the salary of all worthy or longstanding employees. The Saphonian will not only benefit the organization economically, but also the employees, for North Texas Energy would not be the company it is today without its hardworking and diligent employees.

Conclusion

We strongly believe in the Saphonian because it fixes the problems associated with the standard wind turbines; it offers great benefits; and it has a strong capable team behind it. The standard wind turbines of today are causing many problems, and the Saphonian seeks to resolve these issues. There are doubts, but we believe these doubts will be put to rest once the prototypes are finished and the Saphonian is demonstrated to the consumers. If the results are proven as we expect, the Saphonian will help save North Texas Energy money and will assist the company in growth for years to come.

Glossary

The Accumulator – The mechanical energy converted to hydraulic pressure that can either be stored or used immediately for energy.

Betz Limit (Betz Law) – A law that states the maximum amount of energy that can be generated from a wind turbine is 59.3%.

Drag – The retarding force acting on a body (as an airplane) moving through a fluid (as air) parallel and opposite to the direction of motion.

Drag Coefficient – The factor representing the drag acting on a body.

The Generator – The component that converts the energy into electricity.

Prototype – An original model on which something is patterned.

Saphon Energy – A clean-tech company specialized in developing and promoting a breakthrough innovation named, "The Saphonian, The Zero-Blade Wind Converter".

The Saphonian – A bladeless wind turbine using zero-blade technology created by Saphon Energy.

Zero-Blade Technology – Bladeless, rotationless, and follows, instead, a back and forth 3D knot motion, largely inspired by sailboats.

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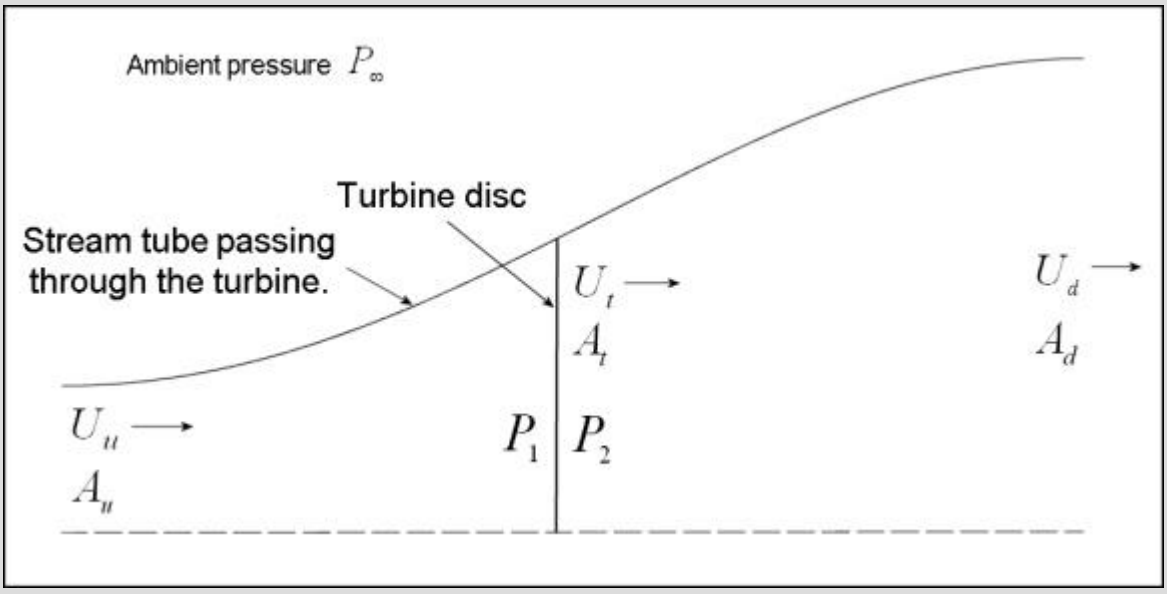
Appendix

17. The Betz limit - and the maximum efficiency for horizontal axis wind turbines. Can it be exceeded and does it apply to vertical axis wind turbines?

The simplest model of a wind turbine is the so-called actuator disc model where the turbine is replaced by a circular disc through which the airstream flows with a velocity U_t and across which there is a pressure drop from P_1 to P_2 as shown in the sketch. At the outset, it is important to stress that the actuator disc theory is useful (as will be shown) in discussing overall efficiencies of turbines but it does not help at all with how to design the turbine blades to achieve a desired performance.



The power developed by the wind turbine is

$$Power = (P_1 - P_2) A_t U_t \qquad (1)$$

where A_t is the turbine disc area. Volume flow continuity gives

$$A_u U_u = A_d U_d = A_t U_t \qquad (2)$$

From momentum conservation, the force exerted on the turbine is equal to the momentum change between the flow far upstream of the disc to the flow far downstream of the disc. Thus

$$(P_1 - P_2) A_t = Mass\ flow \times Velocity\ difference = \rho A_u U_u (U_u - U_d) \qquad (3)$$

The final basic equations are Bernoulli's equation applied upstream and downstream of the actuator disc

$$P_\infty + \frac{1}{2}\rho U_u^2 = P_1 + \frac{1}{2}\rho U_t^2 \qquad (4a)$$

$$P_\infty + \frac{1}{2}\rho U_d^2 = P_2 + \frac{1}{2}\rho U_t^2 \qquad (4b)$$

where P_∞ is the ambient pressure in the flow both far upstream and far downstream of the actuator disc.
From equations (4a),(4b), (3) and (2)

$$(P_1 - P_2) = \frac{1}{2}\rho\left(U_u^2 - U_d^2\right) = \rho\frac{A_u}{A_t}U_u(U_u - U_d) = \rho U_t(U_u - U_d) \qquad (5)$$

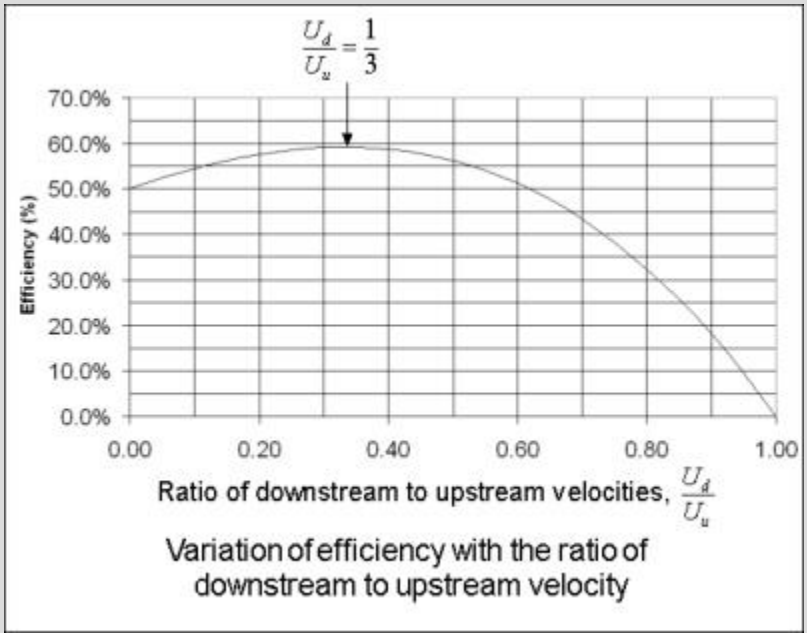
whence

$$\boxed{U_t = \frac{1}{2}(U_u + U_d)} \qquad (6)$$

i.e. the velocity through the actuator disc is the mean of the upstream and downstream velocities in the stream tube.
Finally, from equations (1), (5) and (3), the efficiency is given by

$$\boxed{\eta = \frac{Power}{\frac{1}{2}\rho A_t U_u^3} = \frac{1}{2}\left(1 - \frac{U_d}{U_u}\right)\left(1 + \frac{U_d}{U_u}\right)^2} \qquad (7)$$

The figure below shows the variation of efficiency (often referred to as the power coefficient, cp) with the ratio of downstream to upstream velocity. By differentiating equation (7), it is easy to show that the maximum efficiency oocurs when $U_d/U_u=1/3$ (i.e. when $A_d/A_u=3$). The efficiency is then $\eta=16/27 \approx$ 59%. This is the maximum achievable efficiency of a wind turbine and is known as the Betz limit - after Albert Betz who published this result in 1920. There are assumptions in the above anlysis such as the neglect of radial flow at the actuator disc but these have only a small effect on the final limiting result.



Variation of efficiency with the ratio of downstream to upstream velocity

The point to note here is that as you reduce the downstream velocity in the expectation of increasing the power extracted from the wind, the area of the upstream stream tube that passes through the turbine reduces in size. In the limit as the downstream velocity is reduced to zero, the area of the upstream stream tube that passes through the turbine is just half the turbine area and the efficiency is thus 50%.