Wind Turbine Design Correction

Current mainstream wind turbine designs are based on incorrect aerodynamic calculations. This is not a small mistake. It is a massive error and obvious once understood. A global industry employing thousands of physicists, aerodynamicists, engineers and chemists has misunderstood the most fundamental principle involved in capturing energy from wind.

The error is in using the same aerodynamics as an aircraft.

In aviation, drag must be minimized to increase performance. The faster an aircraft goes, the more drag is created and the more fuel is used. An aircraft has to penetrate air efficiently. This is why long thin wings are used by sailplanes. They are designed to maximize efficient penetration of air without an engine.

Drag increases by the square with velocity.
Aircraft must reduce drag to increase efficiency.

In wind power, the goal is to convert wind force into useable energy. The faster the wind blows, the more energy is available. A wind turbine is anchored in a stream of air. Air can be deflected around an obstacle with no penalty. This can significantly increase the amount of energy available despite creating drag.

Force increases by the square with velocity.
Wind turbines can use drag to increase efficiency.

These concepts are diametrically opposed so the error could not be more incorrect. This is a disturbing and baffling discovery. How could something so blatantly obvious be missed by the entire global wind industry?

This question has far greater ramifications.

To maximize true wind force efficiency, kinetic energy must logically be extracted from as many molecules passing through a given area as possible. Currently, only the outer 30% of a typical wind turbine blade produces any meaningful torque and involves less than 5% of the total disk area.

Aerodynamic efficiency is utilized but no attempt is made to divert or accelerate the air at all. In other words, the drag side of the equation is completely ignored.

Ironically, a mountain ridge is a good example of converting drag to energy. Wind is forced to go over the ridge, thereby compressing and accelerating the air. If the ridge is considered to be part of the design, by placing a wind turbine near the top of a ridge, it becomes obvious that a fixed obstacle (drag) can efficiently increase the amount of energy available. Just doubling wind speed amplifies available energy by 4 times.

When considered from this perspective, the difference between aircraft and wind turbines becomes obvious. The idea of using a few long thin blades to maximize aerodynamic efficiency is ridiculous. Why try to efficiently penetrate the air when you are anchored to the ground?

The primary goal of a wind turbine is to convert the kinetic energy of air molecules into electrical energy.
An "efficient" wind turbine produces energy by first maximizing and then extracting energy differential between the air and the ground.

So what is an efficient design? Once the basic principle is understood, there are many approaches. In simplest terms, the goal is to accelerate every available molecule and direct it to the region of greatest leverage – like the outside ring of a rotating turbine in the example above. Even though this design is not optimized, torque is considerably higher, cut in speed far lower and wind direction can vary significantly with little efficiency loss. This is despite the fact that the blades appear to point directly into the wind.

Remember that wind force increases by the square with velocity. Small changes in wind velocity therefore have a large impact on available energy. In this example, the flat plate obstacle is the "ridge", forcing air to divert and accelerate before passing through the energy extraction blades at the perimeter – the area of maximum leverage. The more the air is accelerated and focused, the more energy is available. Additionally, by creating a low pressure void behind the obstacle, or by vortexing etc, air can be accelerated even more. Yet again, the only penalty for doing so is drag, which is compensated for by anchoring to the ground.

Extracting energy from rivers and tides

This primary knowledge becomes even more effective when applied to extracting energy from river and tidal forces. Air can compress. Water cannot. This means that any constriction in water flow is translated directly into increased velocity. Constrict a wide slow river into a narrow channel and you have "rapids". Triple the speed and you have nine times the force. Focus all of that force towards a point of maximum leverage and the results are predictable. Density of water is approximately 770 times greater than air.

Conclusion

1. Far more energy can be extracted from both wind and water sources at far lower cost and effort if we use both lift <u>and</u> drag to achieve useful force.
2. It is possible for thousands of PhD's in a broad range of disciplines to make diametrically incorrect assumptions at a fundamental level.

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