Wind Turbine Electricity Generation: An analysis of the negative factors

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Despite the fact that wind energy is considered as renewable, pollution free, carbon-neutral and a long-term energy source, wind turbine energy comes with forbidding side effects and a substantial price-tag while proposing to be a possible candidate for alternative non-polluting energy source.

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1. Introduction

Windmills or wind turbines are being used to generate electricity from wind on an increasingly larger scale. The most efficient wind turbines have less than 50% efficiency, and it is physically impossible to exceed 59% efficiency for any wind turbine (1). The electrical power output from the best available wind turbine which would have about 50% efficiency is given by the formula:

P (watts) ≈ 1.0 x R^2 (metre^2) x v^3 ([metres/ second]^3)

$$P(\text{watts}) \approx 1.0 \times R^2\ (\text{meter}^2) \times v^3\ ([\text{meters/ second}]^3)$$

Where the R is the radius of the propeller (1/2 of the diameter), and the v is the wind speed. It should be noted that this formula is only accurate for the best available wind turbines and for moderate wind speeds. For example for an extremely high quality 7m in diameter and radius of 3.5m (not a cheap and average one) given a wind velocity of 5m/s, it will produce 1.5Kw as shown below:

$P = 1.0 \times 3.5^2 \times 5^3$ watts = 1500 W

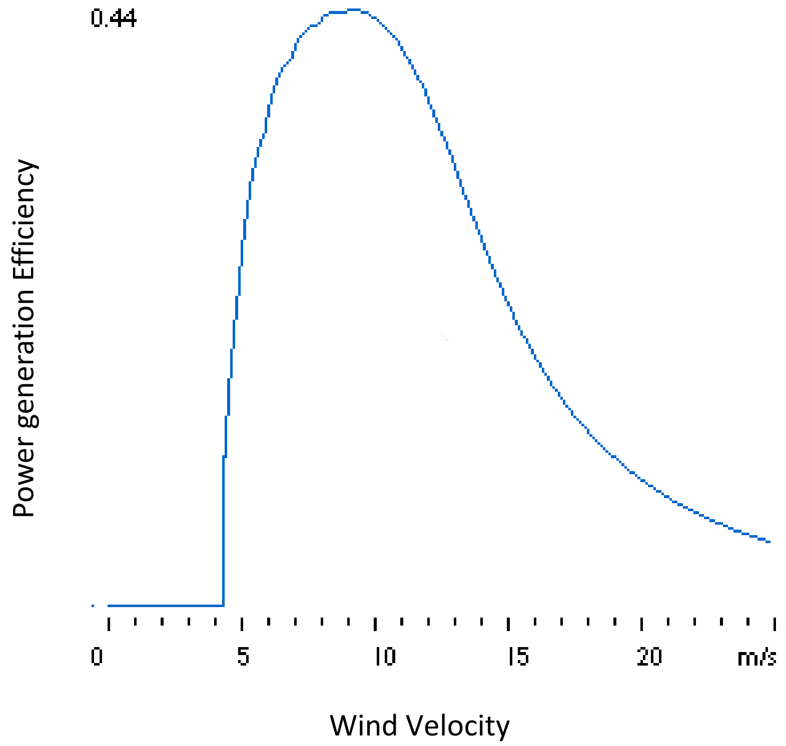
$$P = 1.0 \times 3.5^2 \times 5^3 \text{ watts} = 1500 \text{ W}$$

Most wind systems are designed to produce constant power above a certain wind speed. For example, a 200-kW system will produce power according to that formula until the wind speed reaches, say, 14 m/s, after which the wind turbine produces 200 kilowatts for all wind speeds until, say, 25 m/s, after which the machine must be shut down to avoid destruction due to inability to withstand the torsional forces exerted by the wind. Furthermore, t**he formula above is an overestimate for all but the very best wind turbines** (1).

2. Wind Turbine Efficiency

Wind turbines cannot function at more than a theoretical maximum efficiency of 59% (2). The reason is the physical structure itself, which hinders the flow of the wind. The wind turbine structure itself also exerts back pressure on the turbine blades as they act like an air foil similar to wings on a plane (2).

The efficiency of the wind turbine depends on the actual wind speed. For a typical three blade wind turbine, the efficiency curve is represented below:



Source: Oregon University, online lectures on wind energy, 2011

As the data shows, maximum efficiency of the wind turbine is reached at wind velocity of 9 m/s and this efficiency is sharply dropped as the wind velocity is increased. Consider efficient wind turbines such as Hallett. It will only operate at its rated efficiency only momentarily at wind speed of 9m/s (32 km/h) and will be below its maximum efficiency at wind speeds below and higher than 9m/s. Therefore it would erroneous to consider the wind turbine as anything more than about 20-40% efficiency on average. (3).

There are two reasons for this. The first is the optimal design of these wind turbines will have to be a match for blade ratio to its electricity generator coil that cannot exceed the wind strength. The other is that at wind speeds greater than about 25m/s (90 km/h) the turbine will have to be shut down as it will not withstand torsional forces applied by the wind.

2.1 Wind Energy Efficiency

Wind power is suggested to be a clean and free source of electricity and to reduce our dependence on fossil Fuels with minimal or no impact on our environment, local or global. Research, however, exposes that wind power could not support the claims made by its advocates and that its impact on the environment and people's lives is far from benign. "In 1998, Norway commissioned a study of wind power in Denmark and concluded that it has "serious environmental effects, insufficient production, and high production costs" (4).

> "Denmark (population 5.3 million) has over 6,000 turbines that produced electricity equal to 19% of what the country used in 2002. Yet no conventional power plant has been shut down. Because of the intermittency and variability of the wind, conventional power plants must be kept running at full capacity to meet the actual demand for electricity. Most cannot simply be turned on and off as the wind dies and rises and the quick ramping up and down of those that can be would actually increase their output of pollution and carbon dioxide (CO2, the primary "greenhouse" gas). So when the wind is blowing at maximum efficiency rate for the turbines, the power they generate is usually a surplus and sold to other countries at an extremely discounted price, or the turbines must be shut off" (4).
>
> "A writer in The Utilities Journal (David J. White, "Danish Wind: Too Good To Be True?" July 2004) found that 84% of western Denmark's wind-generated electricity was exported (at a revenue loss) in 2003, i.e., Denmark's glut of wind towers provided only 3.3% of the nation's electricity. According to The Wall Street Journal Europe, the Copenhagen newspaper Politiken reported that wind actually met only 1.7% of Denmark's total demand in 1999. Besides the amount exported, this low figure may also reflect the actual net contribution. The large amount of electricity used by the turbines themselves is typically not accounted for in the usually cited output figures. For a discussion on this important aspect of Wind turbines see section 4.1. In Weekendavisen (Nov. 4, 2005), Frede Vestergaard reported that Denmark as a whole exported 70.3% of its wind production in 2004" (4).

"Denmark is just dependent enough on wind power that when the wind is not blowing right they must import electricity. In 2000 they imported more electricity than they exported. And added to the Danish electric bill are the subsidies that support the private companies building the wind towers" (4). Danish electricity costs for the consumer are the highest in Europe (5).

“California has some huge windmills ---some 3200 of them --- covering mountain sides in their windy areas. (Tehachapi, Altamont Pass, San Gorgonio) All together, they produce --- at a rare full wind --- about 300 MW, which is about 1/4 as much power as a moderately large nuclear power plant produces, and is less than 10% of the electricity the small state of Connecticut consumes” (1).

2.2 Viability of Wind to generate Electrical Power

In June 2008 the Economic Affairs Committee of the British parliament on “The Economics of Renewable Energy” regarding wind power concluded that “a high % of wind capacity needs to be "backed up" by thermal plant…” (6).

2.3 Wind Generation Variability

The Contribution of wind to generate electricity varies with wind speed. A typical single 3MW wind turbine generates no electricity output when wind speed is less than about 3 m/s (10.8 km/h), reaches its maximum output at about 15 m/s, and shuts down when wind speed reaches around 25 m/s to preserve its physical integrity. A single wind farm with a large number of turbines will address this issue, as wind speed will vary somewhat across the area of the wind farm. For example at an average wind speed of about 3 m/s there will be some output because the wind will be above that speed at some locations and below it at others. On the same basis, it is less likely that the wind speed will be high enough across the entire area to deliver maximum output from all wind turbines. For less than 1% a year an individual wind farm is close to full output, but for much of the year it generates far less and for about 20% of the year it generates no output (3,5,and 6). The peak output of a well-designed farm with less variation is about 80% of its estimated full capacity with optimal conditions (6).

2.4 Relationship between wind output, season and time of day, and with electricity demand

The extent to which wind speed, and thus output from wind generation, correlates with periods of high electricity demand is important in assessing the extent to which we can rely on wind generation to meet peak electricity demand. For example, winter is generally windier than the summer, however, on the coldest days (with temperatures below zero), there tends to be little to no wind, corresponding to winter anti-cyclones. Thus in these conditions, there is an increased risk of very low wind speeds, with wind generation output less than 10% of theoretical maximum, on high demand days (6).

“It is also important to recognise that the output of wind farms are correlated with each other, so that if a particular wind farm is suffering a lack of wind it is very likely that those nearby are too, and even the most distant wind farms are less likely to be generating. This is a result of weather systems such as windless anticyclones being large enough to affect all of the UK” (6).

The Economic Affairs Committee of the UK parliament stated in 2008 that “The precise correlation between UK wind generation and wind speed is complex and needs further analysis but, overall, we conclude that the relationship between the level of UK wind power output and UK electricity demand is very weak and, at best, the availability of wind generation is no better during high demand periods than in periods of lower demand” (6).

3. Negative impacts of Wind Turbines

3.1 Property Value Decreases

One such example is the case in Highland County, Virginia USA that the values amidst a 124 wind turbine, wind farm dropped by 50% (7).

Thousands of homeowners may see the value of their properties plummet after a court ruled that living near a wind farm decreases house prices in Great Britain (8). “This was reported in a landmark case; Jane Davis was told she will get a discount on her council tax because her £170,000 home had been rendered worthless by a turbine 1,000 yards away” (8). This is similar in homes also in Denmark and United States of America (9).

A 100m turbine 820m from the houses (9).

3.2 Massive tax benefits for wind farms at the expense of the tax payer

Despite that fact that wind power generator companies put a considerable burden on local governments and communities (as well as their flora and fauna), they receive tax benefits that are not available to other businesses particularly local small businesses that run these communities. For example in Virginia State USA, these companies are assessed on only 5% of the value of their assets where as small businesses are assessed at 60% (7).

This derives most of modern investment in the renewable sector. UBS investment in Australia (Western Australia) has netted the company substantial subsidy from the Australian Federal Government.

Wind turbines have been one of the renewable energy sources of choice for the US government, which has spent billions of taxpayer dollars subsidizing their construction and use across the country. But high maintenance costs, high rates of failure, and fluctuating weather conditions that affect energy production render wind turbines expensive and inefficient, which is why more than 14,000 of them have since been abandoned. Before government subsidies for the giant metals were cut or eliminated in many areas, wind farms were an energy boom business. But in the post-tax subsidy era, the costs of maintaining and operating wind turbines far outweighs the minimal power they generate in many areas, which has left a patchwork of wind turbine graveyards in many of the most popular wind farming areas of the US (10).

"Thousands of abandoned wind turbines littered the landscape of wind energy's California 'big three' locations which include Altamont Pass, Tehachapin and San Gorgonio, considered among the world's best wind sites."In the best wind spots on earth, over 14,000 turbines were simply abandoned. Spinning, post-industrial junk which generates nothing but bird kills." if it costs too much to run the machines in the first place, then it definitely costs too much to uproot and remove them post-construction (11).

And now that the renewable energy tax subsidies are gradually coming to an end in some places, the true financial and economic viability, or lack of wind energy, is on display for the world to see. "It is all about the tax subsidies, "The blades churn until the money runs out. If an honest history is written about the turn of the 21st century, it will include a large, harsh chapter on how fears about global warming were overplayed for profit by corporations." (12). "Without subsidies, some wind farms are fancy bird killers" (12).

3.3 Adverse effect on Tourism

Documented European studies from Scotland show that tourism and property values are significantly affected when industrial wind turbines are built in the area (13). Such harm to the local residence are unlikely to be mitigated by the Flyers Creek Wind Farm Pty Ltd (FCWFPL) set out to profit from loss to the people who live in those areas, regardless of the companies mitigation assurances (14). Would FCWFPL compensate every resident and farmer who would want to sell their property compensated for their loss by the company? And if the company undertakes to do this, **will that not add to the cost of power that they supply?** There are no such provisions in the company's costing submission (14).

3.4 Wind Turbine Effect on local Fauna

Since the proposed plan by Flyers Creek Wind Farm Pty Ltd (FCWFPL) is only speculative, the actual data from a constructed plan may be totally different form that of prediction.

FCWFPL in their submission have indicated that the impact of their wind turbines on native species (such as bats and birds) to be "minimal" (14). This is not supported by evidence from existing wind farms. "On forested ridges near bat caves (USA) large numbers of bats are being killed by industrial wind turbines. New evidence indicates the air pressure difference created as the huge turbine blades sweep by bursts blood vessels in the bat's lungs causing instant death. Invenergy first claimed their Buffalo Mt., Tennessee (USA) wind farm had a bat mortality of 20.8/turbine annually. However, the post construction study determined it was over three times that 63.9 bats killed per turbine per year" (7).

As bats are responsible for crucial activities such as control of insects, pollination of fruit plants and spreading seeds of native plants and vegetation, how would FCWFPL propose to mitigate this adverse effect on the local environment?

3.5 Wind Farms are Responsible for Significant Environmental Degradation

"In a peer-reviewed report by a Johns Hopkins University School of Medicine trained M.D. and Princeton (Population Biology) Ph.D., we discover wind energy's dirty little secret (15). Many people living within 2 km (1.25 miles) of these spinning giants get sick. So sick that they often abandon (as in, lock the door and leave) their homes. Nobody wants to buy their acoustically toxic homes. The "lucky ones" get quietly bought out by the wind developers—who steadfastly refuse to acknowledge that Wind Turbine Syndrome exists. (And yet the wind developers thoughtfully include a confidentiality clause in the sales agreement, forbidding their victim from discussing the matter further)" (15).

Dr. Nina Pierpont explains using hard data how turbine infrasound and low frequency noise (ILFN) create the seemingly incongruous constellation of symptoms she has inaugurated Wind Turbine Syndrome (15).

3.6 Wind turbines are dangerous

"There are several ways one can get killed by a wind turbine. Bird kills are just one downside. In the U. S. state of Montana, a study found that three times as many bats were being killed as birds. One reason is that bats don't need be struck by the blades to be killed. A bat's lung structure is such that the pressure change as the blade passes by ruptures lung tissue and kills the bat from the "bends".

A wind turbine is a tall tower first of all. Falls from a tower higher than 20 meters usually has a bad outcome. This means that to work on a turbine requires a safety line. This leads to another problem. Outside the turbine nacelle there are the rotating blades and a shaft. If the line gets tangled in either, the wearer is pulled off the nacelle and into the blades or shaft… Not good. Inside the nacelle, there is the rotating shaft, gears, and the generator. If a safety line, clothing, or a hand, gets caught in the rotating machinery, the resulting escalating injuries are inexorably and agonizingly fatal (16).

The recommended distance to occupied housing due to blade throw, noise, and shadow flicker from blade rotation through sunlight, is 2 km. Shadow flicker can trigger epilepsy in sensitive individuals.

There have also been many fatal accidents during the transportation and construction process. Erecting a large wind turbine requires moving very long loads on the highways, and using very large cranes to erect the components. Both processes are hazardous. There have been a total of at least 78 people killed in the wind industry as of March 31st of 2011" (16).

3.7 Wind turbines are noisy

"Small wind turbines hum. Large wind turbines, as the blades pass the tower, make a low frequency thump as well as low frequency "swish – swish" sounds that can travel for miles. One reference mentioned that the Nazis used similar sounds for torture. Farmers near wind farms in the U. K. and Taiwan have reported livestock losses reportedly from lack of sleep" (16).

3.8 Impact on Agricultural farms by Wind Farms

New York State Department of Agriculture has published its findings on the construction of three wind farms in New York and has identified several impacts to agricultural resources that can occur as the result of wind farm construction (17,18). Wind farms are incompatible with agriculture (18).

Two types of agricultural impacts may result from the construction of wind farms on agricultural and. One impact is the permanent loss of productive land as a result of the installation of the access roads and turbine towers, as well as the facilities needed for the interconnection between the wind farm and an existing electric transmission line. The other impact is the damage to the soil resources in areas disturbed during construction (17,18).

- Trenches excavated for the collector system can cause significant impact to farm fields.
- Mixing occurs because of limited work space.
- Significant volume of rock excavated from the hole for the foundation.
- Mixing of rock material with topsoil material. This type of mixing should be avoided.
- Seeding failed at the tower site because of lack of topsoil material on the surface.
- Soil and subsoil compaction.
- Topsoil damage from area adjacent to access road as a result of vehicle traffic and parking.
- Seeding failure along the access road due to a lack of topsoil.
- Poor vegetation two years after restoration because of the lack of topsoil.

- The connection between the substation and the transmission line can result in a significant impact to farm land. The addition of the guy wires and the access road results in a loss of productive farmland and a loss in efficiency during field operations.
- Crushed stone dumping in the agricultural field. This can cause damage to crops.
- The soil saturation problem caused in the field on the access road. These types of drainage problems must be corrected to prevent damage to the fields.

3.9 Wind Farm influence on Local and Global Climate change

Large-scale use of wind power can alter local and global climate by extracting kinetic energy and altering turbulent transport in the atmospheric boundary layer. The climate-model simulations that address the possible climatic impacts of wind power at regional to global scales uses two general circulation models and several parameterizations of the interaction of wind turbines with the boundary layer in wind farms. It is found that very large amounts of wind power can produce non-negligible climatic change at continental scales (19).

"A three-dimensional climate model to simulate the potential climate effects associated with installation of wind-powered generators over vast areas of land or coastal ocean. Using windmills to meet 10% or more of global energy demand in 2100, could cause surface warming exceeding 1oC over land installations. In contrast, surface cooling exceeding 1oC is computed over ocean installations, but the validity of simulating the impacts of windmills by simply increasing the ocean surface drag needs further study. Significant warming or cooling remote from both the land and ocean installations, and alterations of the global distributions of rainfall and clouds also occur. These results are influenced by the competing effects of increases in roughness and decreases in wind speed on near-surface turbulent heat fluxes, the differing nature of land and ocean surface friction, and the dimensions of the installations parallel and perpendicular to the prevailing winds" (20).

4. Economics of Wind Farm construction

So many acres of forest habitat are destroyed in construction of a modern wind project requiring miles of clearing and grading it could be argued that per kilowatt of energy produced, wind projects are more destructive than conventional plants requiring a much smaller footprint (figures 4.1, 4.2 & 4.3).

Figure 4.1

Figure 4.2

Figure 4.3

4.1 Need for External Power Source or Grid Power for Wind Turbine Operation

Large wind turbines require a large amount of energy to operate. Other electricity plants generally use their own electricity, and the difference between the amount they generate and the amount delivered to the grid is readily determined. Wind plants, however, use electricity from the grid, which does not appear to be accounted for in their output figures. At the facility in Searsburg, Vermont, for example, it is apparently not even metered and is completely unknown. The manufacturers of large turbines -- for example, Vestas, GE, and NEG Micon -- do not include electricity consumption in the specifications they provide (21).

Among the wind turbine functions that use electricity are the following:

- Yaw mechanism (to keep the blade assembly perpendicular to the wind; also to untwist the electrical cables in the tower when necessary) -- the nacelle (turbine housing) and blades together weigh 92 tons on a GE 1.5-MW turbine.

- Blade-pitch control (to keep the rotors spinning at a regular rate).

- Lights, controllers, communication, sensors, metering, data collection, etc.

- Heating the blades -- this may require 10%-20% of the turbine's nominal (rated) power.

- Heating and dehumidifying the nacelle -- according to Danish manufacturer Vestas, "power consumption for heating and dehumidification of the nacelle must be expected during periods with increased humidity, low temperatures and low wind speeds".

- Oil heater, pump, cooler, and filtering system in gearbox. There are typically between 1000 to 20000 gallons of oil used in wind turbines.

- Hydraulic brake (to lock the blades in very high wind).

- Thyristor (to graduate the connection and disconnection between generator and grid) -- 1%-2% of the energy passing through is lost.

- Magnetizing the stator -- the induction generators used in most large grid-connected turbines require a "large" amount of continuous electricity from the grid to actively power the magnetic coils around the asynchronous "cage rotor" that encloses the generator shaft; at the rated wind speeds, it helps keep the rotor speed constant, and as the wind starts blowing it helps start the rotor turning ; in the rated wind speeds, the stator may use power equal to 10% of the turbine's rated capacity, in slower winds possibly much more.

- Using the generator as a motor (to help the blades start to turn when the wind speed is low or, as many suspect, to maintain the illusion that the facility is producing electricity when it is not, particularly during important site tours) -- it seems possible that the grid-magnetized stator must work to help keep the 40-ton blade assembly spinning, along with the gears that increase the blade rpm some 50 times for the generator, not just at cut-in (or for show in even less wind) but at least some of the way up towards the full rated wind speed; it may also be spinning the blades and rotor shaft to prevent warping when there is no wind.

- There is also the matter of reactive power (VAR). As wind facilities are typically built in remote areas, they are often called upon to provide VAR to maintain line voltage. Thus much of their production may go to providing only this "energy-less" power.

4.2 Maintenance Complexities of Wind Turbines

> “In large rotating power trains such as this, if allowed to stand motionless for any period of time, the unit will experience "bowing" of shafts and rotors under the tremendous weight. Therefore, frequent rotating of the unit is necessary to prevent this. As an example, even in port Navy ships keep their propeller shafts and turbine power trains slowly rotating. It is referred to as "jacking the shaft" to prevent any tendency to bow. Any

bowing would throw the whole train out of balance with potentially very serious damage when bringing the power train back on line.

In addition to just protecting the gear box and generator shafts and bearings, the blades on a large wind turbine would offer a special challenge with respect to preventing warping and bowing when not in use. For example, on a sunny, windless day, idle wind turbine blades would experience uneven heating from the sun, something that would certainly cause bowing and warping. The only way to prevent this would be to keep the blades moving to even out the sun exposure to all parts of the blade.

So, the point that major amounts of incoming electrical power is used to turn the power train and blades when the wind is not blowing is very accurate, and it is not something the operators of large wind turbines can avoid.

[Also, there is] the likely need for a hefty, forced-feed lubricating system for the shaft and turbine blade assembly bearings. This would be a major hotel load. I can't imagine passive lubrication (as for the wheel bearings on your car) for an application like this. Maybe so, but I would be very surprised. Assuming they have to have a forced-feed lubrication system, given the weight on those bearings (40 tons on the bearing for the rotor and blades alone) a very robust (energy-sucking) lubricating oil system would be required. It would also have to include cooling for the oil and an energy-sucking lube oil purification system too." (23)

4.3 Incoming power is not normally recorded by Wind Farms

It would be great if engineers all share an assumption that wind turbines don't use a significant amount of power compared to their output and thus it is not worth noting, much less metering. Such an assumption could be based on the experience decades ago with small DC-generating turbines, simply carried over to AC generators that continue to metastasize. However errant such an assumption might now be, it stands as long as no one questions it (21).

Whatever the actual amount of consumption, it could seriously diminish any claim of providing a significant amount of energy. Instead, it looks like industrial wind power could turn out to be a laundering scheme: "Dirty" energy goes in; "clean" energy comes out. That would explain why developers demand legislation to create a market for "green credits" -- tokens of "clean" energy like the indulgences sold by the medieval church (21). Ego te absolvo.

One need only ask utilities to show how much less "dirty" electricity they purchase because of wind-generated power to see that something is amiss in the wind industry's claims. If wind worked and were not mere window dressing, the industry would trot out some real numbers. But they do not. One begins to suspect that they cannot.

4.4 Wind Farm Management and Maintenance and Mature Wind Farms

“Throughout the Tehachapi-Mojave area look for turbines without nose cones, turbines without nacelles (blown off and not replaced), oil leaking from blade-pitch seals, oil leaking from gearboxes, road cuts in steep terrain, erosion gullies, non-operating turbines, and “bone piles” of junk parts. One Zoned bone pile of abandoned fiberglass blades is visible on the east side of Tehachapi-Willow Springs Rd. near Oak Creek Pass. (Kern County doesn’t permit on-ground disposal of fiberglass.) While touring wind farm sites look for blowing trash and litter (plastic bags, soft-drink cups, bottles, electrical connectors, scrap bits of metal, and so on)” (23).

4.4.1 The Gearbox Issue

“While the concept of capturing the power of wind and converting it to usable energy has been around since the early Egyptians, the study of efficient wind energy is only about 50 years old, and there are still many engineering puzzles the gearbox is only one” (24). The gearbox issue in these massive wind turbine structures remains costly and unpredictable yet critical gearbox—which, though designed to operate smoothly for 20 years, is actually falling far short (24).

Gearbox designs contain more equipment designed to produce more work, and more work means the generation of more heat in the gearbox. As a result, lubricants must function at higher operating loads while helping to reduce temperatures in the gearbox (25).

More than 100 tons of steel, rotating at 3600 rpm, is supported by plain bearings on a cushion of oil that is thinner than a human hair. Lost revenue at seasonal peaks can be counted in millions of dollars. An average utility sells electricity for about $50/MW hr during nonpeak periods, and as much as $1,000/MW hr during peak periods. Poor selection and maintenance of turbine oil can result in production losses exceeding $500,000 per day (26).

4.5 Maintenance Experience

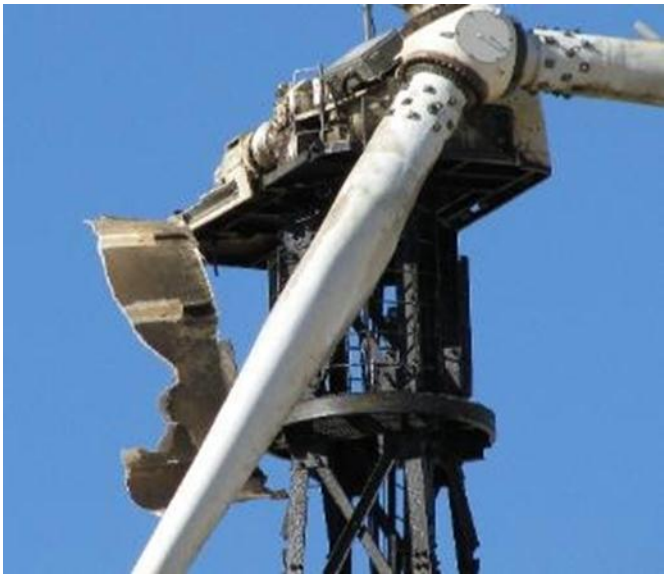
"Operational experience reveals that the gearboxes of modern electrical utility wind turbines at the MW level of rated power are their weakest-link-in-the-chain component. The typical design lifetime of a utility wind turbine is 20 years, but the gearboxes, which convert the rotor blades rotational speed of between 5 and 22 rpm to the generator-required rotational speed of around 1,000 to 1,600 rpm, commonly fail within an operational period of 5 years, and have to be replaced. That 20 year lifetime is itself a reduction from an earlier 30 year lifetime design goal" (27).

"Among insurers, who joined the market in the 1990s, wind power is currently a risky sector. German industry giant Allianz was faced with around 1,000 damage claims in the year 2006 alone. Gearboxes had to be replaced in large numbers according to the German Insurance Association. On average, an operator has to expect damage to his facility every four years, excluding malfunctions and uninsured breakdowns" (27).

Many insurance companies now are writing maintenance agreements requiring wind farms to write the replacement of vulnerable components such as gearboxes every 5 years directly into their contracts (27). A gearbox replacement can cost up to 10% of the original construction costs, enough to cut deep into the projected costs and profits.

Wind gusts lead to misalignment of the drive train and gradual failure of the gear components. This failure interval is disturbing, as it creates a significant increase in the capital and operating costs and downtime of a turbine, while greatly reducing its profitability and reliability (27). The pictures below show how the wind farms neglect to repair these structures due to high maintenance costs.

Florida's broken windmills: A California problem (28).



Kamaoa Wind Farm, Hawaii. (28).

“ Built in 1985, at the end of the boom, Kamaoa soon suffered from lack of maintenance. In 1994, the site lease was purchased by Redwood City, CA-based Apollo Energy. Cannibalizing parts from the original 37 turbines, Apollo personnel kept the declining facility going with outdated equipment. But even in a place where wind-shaped trees grow sideways, maintenance issues were overwhelming. By 2004 Kamaoa accounts began to show up on a Hawaii State Department of Finance list of unclaimed properties. In 2006, transmission was finally cut off by Hawaii Electric Company” (28).

Again, like in California, Hawaii’s turbine problem is lack of maintenance (28).

This is one of the main issues that reveal the political nature of the wind farms. They are extremely expensive to run, maintain and finally disposing and decommissioning them. And if these costs were added to the real cost of power generated by wind farms, no logic would support building them.

4.6 Fire is a hazard for wind turbines

"Electrical components can short out, overheat, or otherwise fail causing fire. Gearboxes can leak lubricants, overheat, and catch fire. Lightning can cause fire, and a wind turbine is a tall object that attracts lightning. A wind turbine contains many gallons of flammable lubricant and hydraulic fluid. To reduce weight, a wind turbine nacelle is often fiberglass or other plastic that can burn and melt, dripping flaming material onto the surroundings. Local fire departments usually respond to a wind turbine fire to simply watch it burn and control any spot fires on the ground, because they cannot fight a fire 50 or 80 meters in the air.

Wind turbines are different from other generation methods in a way that exacerbates danger. There are no on-site operators. If something goes wrong that is not monitored and/or controlled electronically, a problem can spiral into disaster faster than remote operators can physically respond to the scene" (16).

4.7 What to do when the turbines wear out?

"The usual annual funds planned for maintenance and repair for a wind farm is 4 or 5% of the cost of installed equipment. The planned life is usually 20 to 30 years. This should be thought of as the half-life of a wind farm. In this period, half of the turbines will have catastrophically failed. Usually in older wind farms, after half have failed, the others are decommissioned and eventually abandoned. If the permitting agreements have not called for removal, old wind farms are often just abandoned by owners. This is happening in Hawaii and California currently "(16).

5. Cost of wind power

To calculate the costs, per MWhr, of wind power require knowledge of the costs of the finance needed to build the wind farms and the costs of running them. It seems that the most important variable in the price of wind power is the cost of obtaining the finance for building the wind farms.

5.1 Estimated costs of generation for Brown Hill Range Wind Farm

The cost of power is very dependent on the cost of capital (29). This determines the selling price of the electricity generated by the wind farms and not the amount of actual energy generated by the wind.

SKM (Sinclar Knight Merz) produced a report for AGL entitled 'Economic Impact Assessment of the Hallett Wind Farms' in which they gave costs of development, construction and operations of the first two of AGL's Hallett wind farms. This report was based on data up to June 2010, so the annual operating costs are based on a very short record; the first Hallett wind farm (Brown Hill Range, Hallett#1) was commissioned in June 2008.

The estimated costs of generation for Brown Hill Range given in the table at the right are based on the SKM report. Estimates for the cost of power from all the Hallett Wind Farms are at Generation costs at Hallett (29).

Cost of power from Hallett #1, based on SKM report

Estimated costs of generation for Brown Hill Range Wind Farm	
Capital cost	$233m
Annual cost of capital at 7.5%	$17.5m
Annual cost of operations	$6.75m
Total annual costs	$24.2m
Annual generation	327 000 MWh
Cost of producing electricity	$74/MWh

Therefore, the cost that is quoted by the companies is the annual cost of the plant and not that of the power generated by the wind farm. This cost will be increased to match the economic activity of the state (GDP), will increase as the result of maintenance costs once the turbines are out of warranty, will increase to cover wind farm operation costs if the power generated by the farm falls short of theoretical estimation.

5.2 Economics of the Wind Power Generation

In Texas and Denmark, wind farm operators often pay the grid operators to take their generated power. They can do this because the subsidies they receive from the government allow a small profit. This happens because the wind power is distant from the cities that need it, and transmissions costs are higher than what the power is worth. In Texas, the power is in the “panhandle” in the north, and the power is needed in Dallas/Ft. Worth and Houston in the central and south of the state. In the U. S., Subsidies include a 5-year accelerated depreciation schedule, as well as tax rebates, and Renewable Energy Credits. The accelerated depreciation schedule means that operators will sell the wind farm after five years; the next owner will take the depreciation for another five years, and sell it again. If the new owner is a European company, they get “carbon offset” credits for an additional subsidy (16).

In Denmark, wind power is backed by hydroelectric power in Norway and Sweden. When the wind is blowing, Norway and Sweden will back off their hydroelectric power production to save water in the reservoirs. Hydroelectric power is cheap, so Denmark gets little or nothing (sometimes less than nothing) for the wind power they are exporting. When the wind stops, Denmark then imports power from Norway, Sweden, and the rest of Europe at the spot price. As in the U. S., subsidies allow this to work, giving the operators a profit, no matter which way the wind blows (16).

Wind power is a huge scam. There is no other way to describe it. If it were not for subsidies, no one in their right mind would build a wind farm.

6. Status of Play in Australia

At first glance, it may be difficult to understand why any fair-minded person would disagree with greening of the energy supply. However, a closer look at recent events reveals a different picture. Australia may not be greeting wind power generation with open arms. The recent events in Victoria shed light on the future trend regarding this technology.

6.1 State Government Precedent on Wind Farms

On August 2011, The Victorian state government announced the most restrictive planning laws for wind farms in Australia. Baillieu's government has amended the planning laws to give the households "power to veto" wind turbines within two kilometres of their homes and turbines will also be banned within five kilometres of 21 Victorian regional centres (30).

"Turbines will also be banned in the Macedon and McHarg ranges, in the Yarra Valley, on the Mornington and Bellarine peninsulas, and within five kilometres of the Great Ocean Road and the Bass Coast" (30). This is an ardent indication that wind farms will have a great impact on tourism which intern will have significant influence on regional and state income as well as associated health problems (30).

Victorian government Planning Minister Matthew Guy said: "the changes restored certainty and fairness to local communities. It is important that while wind energy develops, it does not do so [to] the detriment of rural and regional Victorians," (30).

The changes ratified by the Victorian state government are not unique to that state, but they are in line with planning laws passed in New Zealand and Britain (31).

"Mr Guy said the two-kilometre buffer for households was chosen after studying planning schemes in New Zealand and Britain" (30).

6.2 Federal Government Precedent on Wind Farms

"Although the renewable energy sector has been given a degree of support through government programs like MRET, there appears to be growing opposition to the wind industry within the Federal Government. In April 2006, the Federal Environment Minister, Ian Campbell, took the unprecedented step of blocking a wind farm proposal under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act). It was only the fourth time a development proposal had been refused approval under the EPBC Act. It was also the only one of sixty wind farm referrals to be refused under the Act since it commenced" (35, 36). The Minister claimed his decision to block the development at Bald Hills in Victoria was made on the basis of the threat to the endangered orange-bellied parrot, but it appears that the real reasons were the degree of local opposition and the desire to manipulate the situation for political gain.

Following the Bald Hills decision, the Federal Agriculture Minister, Peter McGauran, said in June that the claims about the energy and environmental benefits of wind energy were 'fraudulent' and that wind farms 'are not producing any electricity of any measurable amount'. He also argued that because of the 'deleterious effect' of wind farms on neighbours and 'rural communities', they should not be allowed to proceed unless they have strong community support (McGauran cited in ABC 2006).

The Agricultural Minister's comments about wind farms reflect some of the anxieties expressed by anti-wind groups. The main arguments put forward by opponents of wind farms are that wind energy is expensive, it is inefficient and unreliable because it is dependent on a variable source of energy, it does not significantly reduce greenhouse gas emissions, wind turbines are a fire risk and a source of noise pollution, and wind farms have deleterious impacts on biodiversity, landscape values, heritage and property prices (3).

7. Discussion

Wind farms have been opposed by land owners, concerned at the possible adverse health effects, excessive noise, falling property values and the visual eyesore of the turbines, some as tall as a 45-storey building. Others worry about their effects on birds, which can be killed by the wind turbulence created by the blades slicing through the air.

Critics also argue that wind turbines cannot exist without back-up power provided by generators (4, 5).

The Productivity Commission says the most effective form of abatement in Europe has been the switch from coal to gas-fired electricity, which has been prompted by its emissions trading system.

This has been achieved at an effective cost of about $20 a tonne of carbon. Subsidies to wind or solar production can stop this switch from occurring (32).

The Flyers Creek Wind Farm proposal suggests that the wind turbine power generation at Flyers creek is a standalone power generator. There are two reasons as to why this is not so.

First is the fact that a wind farm is not a continuous power generation plant as the wind velocity, its presence and its strength are the key limiting factors in determining the power output. This alone must be factored as a probability as the British study (6) suggests optimal power generation for a wind farm occurs 10% of the time in a given year (6).

Second, is the fact that every wind farm is coupled to a substation that is powered by fossil or nuclear fuel so, not only it is not used anywhere in the world as a standalone power station, but also it is considered as an addition to a continuous power plant. Thus, for the period of the time that conventional fossil fuel plant is used the carbon and pollution generation generated by the power plant must be entered into consideration.

Environmental impact of any technology must be based on its “big picture” impact and assessment is only possible when the whole project is evaluated on all its constituent parts are integrated in real time as it makes the impact assessment impossible. So, is wind power technology works as a whole with 10% efficiency continuously (see section 2 & 2.1) and 90% of the time it does not work as a whole (standalone technology), scientifically and critically it means that this technology either does not work or it has increased cost of running or it is simply inefficient. And if we factor in this inefficiency and scale it to the theoretical description of the technology as a standalone power generator functioning efficiently, then, it will render the technology unfeasible. In a multifactorial assessment, if a product or technology is 100% efficient at 10% of the time, it will have to be deemed as 90% inefficient and therefore unfeasible as the **limiting factor** is continuous power generation, then the rest (90%) of the required power will have to be sourced from additional technologies. Thus the cost must contain the production and maintenance of two sources rather than one. This crucial aspect is missing from FCWFPL submission to the local council and the NSW state government (33).

8. Additional Consideration

The FCWFPL proposes that they will mitigate any negative factors arising out of their activities. Firstly how could they propose that they will address a class action against them in case of causing increase in leukaemia due to emission of huge electrical and magnetic field on the surrounding population? This may not occur in a short time, but may be of consideration in a long term (34). This is not dissimilar to James Hardy’s Industries and production of Asbestos.

As Infigan commercial activity has shown, wind farm project has cost them and their shareholders considerable amount of money (35). Infigan's share price fell 16.5% to 35.5cents, with a full year loss of 71.1% (35). Furthermore, Infigan recorded incurred a debt of 1.31 Billion dollars with a market capitalisation of 207.3 million. Infigan has stripped their shareholders of financial gain with such a decision to invest in wind farms. Given the evidence before us what would FCWFPL would provide as an answer to the banks and shareholders bankrolling this idea?

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9. Conclusion

A decision to use wind in power production is made by financial investors. Their decision is made totally on the money they can raise as an industry. They equally ignore impacts on the local communities and their environment. This behaviour is similar to fossil fuel and mining industries who are the recipients of over 10 billion dollars per year with substantial windfalls from the current carbon tax in Australia. These industries do not consider the human perspective and their short term profit seeking behaviour is dismissive of the long term effect on physical, psychological and environmental consequences of their actions. They are like Tobacco companies.

Finally, If we add the cost of:

- environmental damage both long and short term, damage to flora and fauna
- damage to human health
- decrease in property prices near wind farms
- low output due to chaotic nature of weather and wind
- high danger and maintenance costs
- huge cost of disposal and decommissioning of mature farms
- the need for external power for operation and continuous power supply

We will realize that this is one very expensive electricity generation scheme and the investors are not showing the real cost of this technology to the community.

As George Bernard Shaw said, "the lesson we learn from history is that we never learn from history".

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