Refuting Fallacies about Wind power

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The following fallacies and misleading claims about wind power are being disseminated by the coal and nuclear industries and by NIMBY groups. Recently, some of them have even been repeated by Federal Government Ministers. More detailed refutations of some of the fallacies can be found in a 5-volume report by the European Wind Energy Association[1] and the fact sheets and associated background papers by the Australian Wind Energy Association[2].

Fallacy: "Wind power is one of the most environmentally damaging sources of electricity.

To the contrary, wind power has one of the lowest environmental impacts of all electricity sources. Only photovoltaics, based on either thin films or Sliver cells could possibly compete. By almost any criterion, coal is by far the worst. The reasons why wind power has very low environmental impacts are:

- It is usually installed on agricultural land that was cleared previously.
- It occupies less land area per kilowatt-hour (kWh) of electricity generated than any other energy conversion system, apart from rooftop or building-integrated solar energy, and is compatible with grazing and almost all crops (see below).
- It generates the energy used in its construction in 3-7 months of operation, yet its operational lifetime is at least 20 years[3,4].
- Therefore greenhouse gas emissions and air pollution produced by its construction are tiny and are declining with increasing size and efficiency of its wind turbines. There are no emissions or pollution produced by its operation, apart from noise over a limited range (see below).
- In substituting for coal power (see below) in mainland Australia, wind power produces a net decrease in greenhouse gas emissions and air pollution, and therefore a net increase in biodiversity.

To assess the biodiversity impacts of coal versus wind power properly, both global and local impacts must be taken into account. Global climate change resulting from the enhanced greenhouse effect is predicted to wipe out many species of animals and plants. Australian ecosystems are some of the most vulnerable to climate change. In Australia the biggest single source of greenhouse gas emissions is coal-fired power stations. By substituting for coal and other fossil-fuel power stations, wind power reduces carbon dioxide emissions and therefore saves global biodiversity.

To reduce *local* biodiversity impacts of wind farms, planning guidelines for the siting of wind developments have been put into place by the Federal, State and Local governments. Proposed wind developments must receive Federal planning approval under the Environment Protection and Biodiversity Conservation Act and also under any local regulator. These measures address the avoidance of principal bird migration routes and protection of wetlands and other specific areas of environmental importance and sensitivity.

Some of these points are expanded below.

Fallacy: "Bird kills are a common serious problem."

The main human-induced threats to birds are habitat destruction, pet cats, buildings, motor vehicles and powerlines. Only two wind farms out of thousands around the world have been a serious problem for birds, Altamont Pass in California and La Tarifa[5] on the southern tip of Spain. In the USA typical bird death rates are 2 per turbine per year, and some European studies find about one-tenth of this[6].

Australia has only limited experience with wind farms So far studies reveal an impact level even lower than predicted on the basis of Northern Hemisphere experience, and lower too than levels approved by planning authorities prior to wind farm construction. This may be because Australia's geography and bird ecology differs from that of the Northern Hemisphere: we do not experience the same concentrations of migrating birds – in particular, we lack the large numbers of night-migrating songbirds[7].

With modern wind turbines and careful siting, both bird and bat kills are rare. In comparison, on a single foggy night, about 3,000 birds were killed when they collided with the chimneys of a thermal power station in Florida, USA[8].

Fallacy: "Noise is a common problem."

Modern wind turbines are much quieter than people have been led to believe. A normal conversation can be held at the foot of a wind turbine going at maximum speed, without raising one's voice. The main sound is a 'swoosh' as each blade passes in front of the tower. A listener's perception of the sound depends on the level of background noise and declines with distance from the source. As wind speed increases, both the wind turbine noise and background noise (from wind passing through vegetation) increase as well, and the background tends to mask the wind turbine noise.

Levels of sound received by the human ear are usually measured in decibels, denoted dBA, where the 'A' adjusts for the response of the ear. Decibels are a logarithmic scale, which means that a doubling of perceived noise is equivalent to an increase of 10 dBA. Table 1 lists some indicative noise levels perceived by the normal human ear at various distances from sources.

Table 1: Indicative perceived noise levels from various sources[9]

Source or activity	**Noise level** (dBA)
Threshold of pain	140
Jet aircraft at 250 m	105
Pneumatic drill at 7 m	95
City traffic	90
Truck at 50 km/hr at 100 m	65
Conversation or busy general office	60
Car at 65 km/hr at 100 m	55
Busy road at 5 km	35-45
Wind turbine at 350 m	35-45
Quiet bedroom	30
Rural night-time background	20-40

Noise is rarely a problem beyond a distance of 400 m and yet very few dwellings in Australia are within 400 m of a large wind turbine. Personally, I recommend a set-back of at least 500 m from a residence. Licence conditions for wind farms should, and mostly do, set objective, measurable noise limits. On the rare occasions where these limits are surpassed, e.g. resulting from a faulty turbine or sound propagation resulting from peculiar topography, affected residents can have the problem fixed or the offending turbine shut down

Fallacy: "To substitute for one 1000 MW coal-fired power station, wind power would need vast areas of land." An specific example from Foreign Minister, Alexander Downer is: "it has been estimated that you would need a wind farm occupying 3200 square kilometres to produce the equivalent energy of a medium-sized power station."[10]

Wind farms are highly compatible with agricultural and pastoral land. While they span approximately 25 ha per megawatt (MW) of installed capacity, only about 1% to 3% of that land (0.25-0.75 ha/MW) is occupied by their towers and access roads, while 97% to 99% of the land can continue to be used for crops or grazing. For comparison, a 1000 MW fossil-fuelled power station has an average power output of about 850 MW. To substitute for this, about 2600 MW of wind power capacity would have to be installed, spanning 65,000 ha (650 square km), but only occupying physically 650-1950 ha (6.5-19.5 square km). An open cut coal mine to serve the coal-fired power station could occupy 100 km^2, which is 10,000 ha.

Fallacy: "Wind farms don't work."

If this myth were true, wind farm developers would go bankrupt, because they are paid for generating electricity, not just for erecting wind turbines.

Fallacy : "Wind turbines are inefficient."

Large wind turbines convert into electricity about 45% of the wind passing through the area swept out by the blades[11]. For comparison modern coal-fired power stations only convert into electricity about 35% of the energy stored in the coal.

The disseminators of the fallacy appear to believe that wind turbines are 'inefficient' because they have lower capacity factors than conventional base-load power stations. (The capacity factor is average power output divided by rated power, expressed as a percentage.) Capacity factor is not a good measure of efficiency of performance, because it depends on the operational strategy of the whole electricity generating system. For instance, conventional peak-load plants have much lower capacity factors (2-10%) than wind farms (typically 30%, with a range 20-40%), but they are not labelled as 'inefficient'. Snowy Hydro has a typical capacity factor of around 17%.

Misleading claim: "Wind farms are subsidised."

This claim is true but misleading, because coal-fired electricity receives much greater *de facto* subsidies through the refusal of many governments to include the costs of coal's massive environmental and health damage in the price of coal-fired electricity. Coal also receives huge direct economic subsidies in several countries.

Incidentally, nuclear power in the UK and USA is generally more expensive than wind power and receives much bigger subsidies. Cumulative subsidies to nuclear power in the USA have been estimated at about US$80 billion. In the UK subsidies to nuclear power were over £1 billion per year in the 1990s;

in addition the cost of decommissioning existing UK nuclear power stations has been estimated by a Parliamentary Committee in 2006 at £90 billion.

Fallacy: Wind power is expensive.

Wind power at 7.5-8.5 c/kWh in Australia is the least expensive of all the proposed greenhouse friendly sources of electricity. Dirty coal is artificially cheap (3.5-4.0 c/kWh in eastern Australia; 5.5-6.0 c/kWh in W.A.), but genuine environmentalists oppose all new dirty coal-fired power stations. The price of electricity from base-load natural gas power stations is typically 4.5-5.0 c/kWh, but it still has half the CO_2 emissions of coal and gas reserves in eastern Australia are very limited and are not sufficient for substituting for much coal. Projected prices of so-called 'clean coal' (i.e. coal power with CO_2 capture and burial) and nuclear power start at about 9 c/kWh. Neither 'clean coal' nor nuclear power could be installed in the near future in Australia. Indeed, 'clean coal' may not be commercially available for 20 years or more. Australia has a large potential for hot-rock geothermal, but its cost is uncertain and it is unlikely to be ready for commercial operation for 12-15 years.

Fallacy: "To maintain a steady state of voltage and frequency requires much additional expense."

New types of large wind generators, that are already coming on line, with variable speed drives and power electronics, can control voltage and frequency *locally* at no extra cost. Furthermore, sudden changes in wind speed, or a sudden shut-down or start up of large amounts of wind power capacity, can be ameliorated by installing wind farms separated by large distances in different wind regimes, and by using computer control to stagger start-ups and shut-downs of individual wind turbines in a wind farm.

Fallacy: "Efficient energy use is sufficient to reduce greenhouse gas emissions."

Efficient energy use is certainly necessary and plays a vital role in the scenario study, *A Clean Energy Future for Australia*[12]. In that study it was found that cost-effective efficient energy use could just balance the growth in CO_2 emissions resulting from economic and population growth, but is not sufficient to achieve the large greenhouse gas reductions of 60% or more that are needed to protect the Earth's climate. Clean energy supply is also essential.

A variant of the above fallacy is:

Fallacy: "Since the rate of growth of electricity demand is higher than the rate of growth of renewable energy supply in some States, they should stop building renewable energy and focus their efforts on efficient energy use and demand reduction."

This fallacious recommendation assumes incorrectly that we have to choose between the implementation of efficient energy use and demand reduction on one hand and renewable energy on the other. In reality, the two courses of action are complementary, requiring different strategies, and both must be implemented simultaneously for effective reduction of CO_2 emissions.

Lower cost renewable energy technologies (wind and bioenergy) need an expanded Mandatory Renewable Energy Target (MRET)[13] and some form of carbon pricing (either a carbon tax or emissions trading scheme) in order to compete with dirty coal. With these policies we can build up manufacturing and market share. High-cost renewable energy technologies (e.g. direct solar) need increased funding for research, development and demonstration, and a temporary feed-in tariff for increasing market share.

Holding back renewable energy will not assist efficient energy use at all, because the latter does not need additional funding (although it will benefit slightly from carbon pricing). Efficient energy use already offers a huge range of cost-effective measures that are currently held back from widespread dissemination by market failures, not by price. Therefore, efficient energy use needs regulations and standards by State and Federal Governments to increase the energy efficiency of buildings (existing as well as new), appliances, equipment and industrial processes. Demand reduction also needs policies to stop the construction of new dirty coal-fired power stations.

Fallacy: "Solar electricity could replace wind power."

Not yet. Although solar electricity has huge potential in Australia, the generation cost of grid-connected solar power (around 40-50 c/kWh) is currently about 5 to 7 times that of wind power and more than 10 times that of coal power in eastern Australia. However, the gap between the cost of residential rooftop solar power and retail electricity from the grid is smaller, a factor of 3 to 4. Solar electricity will be able to play a greater role when time-of-day electricity rates and smart meters are introduced and its price is brought down by R & D, leading to improved technology, and increased market share.

Solar electricity can make a large contribution in low latitudes (e.g. Qld, NT and northern W.A.) and wind power at higher latitudes (e.g. Tas., southern NSW & southern coasts of Vic., S.A. and W.A). Thus the two renewable energy sources are complementary in a geographic sense.

Claim: "Wind farms are ugly. They should be located in valleys or industrial zones where they cannot be seen from the distance."

Wind turbines must be located at sites that are exposed to the wind, since wind power increases with the cube of the wind speed[14]. Strong and consistent winds are rarely found in valleys. In industrial zones, other buildings slow the wind, making these zones unsuitable for wind power. By its very nature wind power has a visual impact, which most people accept and a small minority dislikes. To resolve these differences, community consultation on individual wind farm proposals and State planning processes with clear guidelines are needed. Several public opinion surveys have found that the majority of respondents who originally opposed a wind farm in their district find them acceptable several years after their installation. Many respondents say that the alleged environmental impacts, noise and bird kills, are not a problem, despite initial fears promoted by NIMBY groups.

Fallacy: "Since wind power is an intermittent source, it cannot replace coal-fired power unless it has expensive, dedicated, long-term storage."
A variant is: "Wind farms don't reduce CO_2 emissions, because coal-fired power stations have to be kept running to back up the fluctuations in wind".

Both these statements are wrong and have been answered in more detail in a separate article. The short answer is:

With or without wind power, there is no such thing as a perfectly reliable power station or electricity generating system. Electricity grids are already designed to handle variability in both demand and supply. To do this they have different types of power station (base-load, intermediate-load and peak-load) and reserve power stations. Wind power adds a third source of variability that can be integrated without major technical difficulties into such an already variable system. The total wind power generated by several dispersed wind farms varies smoothly and therefore cannot be described accurately as 'intermittent'. As the penetration of wind power increases, so do the additional costs of reserve plant and fuel used for

balancing wind power variations. When wind power supplies up to 20% of electricity generation, these additional costs are still relatively small[15,16,17,18].

Of course, to completely replace a 1000 MW coal-fired power station, either by retiring an existing station or deferring a new one, sufficient wind power capacity has to be installed (2600 to 2700 MW). Opponents of wind power hypocritically claim that there is insufficient wind power to replace a coal-fired power station, while opposing the construction of wind farms.

Endnotes

[1] European Wind Energy Association 2003, *Wind Energy: The Facts*. Vols 1-5. www.ewea.org/index.php?id=91 (accessed 3/7/2006).
[2] www.auswea.com.au/WIDP/factsheets.htm
[3] E.g. Danish Wind Industry Association 1997, *The Energy Balance of Wind Turbines*, www.windpower.org
[4] Energy balances calculated by Vestas, the world's largest manufacturer of wind turbines, can be accessed at www.vestas.com/uk/environment/2005_rev/energybalance.asp (accssed 4/1/06).
[5] This wind farm, situated on the southern tip of Spain opposite Gibralter, is in the middle of one of the main bird migration routes between Europe and North Africa.
[6] European Wind Energy Association 2003, *Wind Energy: The Facts*. Vol. 5: Environment, pp.182-184, www.ewea.org/fileadmin/ewea_documents/documents/publications/WETF/Facts_Volume_4.pdf
[7] Australian Wind Energy Association, *Wind farms and Bird and Bat Impacts*. www.auswea.com.au/WIDP/assets/8Bird&BatImpact.pdf
[8] Maehr DS, Spratt AG and Voigts DK 1983, Bird casualties at a central Florida power plant, *Florida Field Naturalist* 11(3): 45-49. (http://futureenergy.org/FloridaFieldNatural.pdf, accessed 5/1/2005)
[9] Australian Wind Energy Association 2004, *The Noise Emissions associated with Wind Farms in Australia*. Background paper. www.auswea.com.au/WIDP/assets/6Noise.pdf (accessed 4/7/2006).
[10] Downer, A 2006, cited in *Sydney Morning Herald*, 24 May, p.1.
[11] The maximum theoretical extraction of wind power is 59%.
[12] Saddler H, Diesendorf M and Denniss R 2004, *A Clean Energy Future for Australia*. Clean Energy Future Group, Sydney and Melbourne. wwf.org.au/ourwork/climatechange/publications/
[13] Initially the level of a carbon tax or the price of tradable emissions permits is likely to be too low to assist renewable energy sources to compete with dirty coal, although it would assist natural gas to compete with coal. Hence a MRET is needed as well and must be kept until the carbon price makes it redundant.
[14] E.g. doubling the wind speed gives $2^3 = 8$ times the wind power.
[15] ILEX, 2002, *Quantifying the System Costs of Additional Renewables*. ILEX/UMIST, www.dti.gov.uk/energy/developep/080scar_report_v2_0.pdf/.
[16] Carbon Trust and DTI, 2004, *Renewable Networks Impact Study: Annex 1 – Capacity Mapping and Market Scenarios for 2010 and 2020.* www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=CT-2004-03 (accessed 6/7/06).
[17] Dale, L., Milborrow, D., Slark, R. and Strbac, G., 2004, Total cost estimates for large-scale wind scenarios in UK. *Energy Policy* **32**, 1949-1956.
[18] UKERC 2006, *The Costs and Impacts of Intermittency*. UK Energy Research Centre, www.ukerc.ac.uk/content/view/258/852 (accessed 27/8/2006).