SUBMISSION

to

Senate Community Affairs Committee Inquiry

into

The Social and Economic Impact of Rural Wind Farms

by

Dennis Workman

SUMMARY OF CONTENTS

1. INTRODUCTION

In making this submission to the Department of the Senate Community Affairs Committee on The Social and Economic Impact of Rural Wind Farms I declare that I am opposed to the construction of wind farms, on rural lands, for the large scale generation of electric power for the many reasons I have set out in this submission.

In 2009 coal was being talked of as "dirty" in comparison to "clean" "green" wind power. A then member of the Legislative Council, M/s Lee Rhiannon (Greens), on 13th August 2009, referred to the NSW Minister for Mineral Resources, as a **"carbon criminal".** Being emotive and animated in the debate on climate change and renewable energy obviously pays dividends because NSW MLC M/s Lee Rhiannon is now Senator Lee Rhiannon. However it remains to be seen whether being emotive and animated results in containing the spiralling costs of electricity.

Despite the elevated feelings that abound, some sanity must be brought into this debate otherwise we, as a society, might unwittingly take a wrong turn into a one-way energy cul-de-sac from which there may be no return except as a third-world country.

One method by which NSW can achieve one of the lowest costs of CO2 avoidance is to use more efficient, Integrated Gasifier Combined Cycle (IGCC) Power stations burning black coal. By comparison the cost of CO2 avoidance of wind power is almost three times greater.

The method by which Victoria can achieve the lowest cost of CO2 avoidance is to substitute Black Coal for Brown Coal and burn it in more efficient, Integrated Gasifier Combined Cycle (IGCC) Power stations. By comparison the cost of CO2 avoidance of wind power is almost five times greater.

Another method by which Victoria can achieve the lower cost of CO2 avoidance is to use more efficient, Integrated Gasifier Combined Cycle (BCIGCC) Power Stations burning brown coal. By comparison the cost of CO2 avoidance of wind power is almost three and a half times greater.

The critical advantage that new (IGCC) coal fired power stations have over wind in combination with the older, less efficient, thermal power stations is that they can achieve the same outcome, in terms of electricity generated and CO2 produced, for a far lower cost.

Back in 2005 I believed that wind farms might be an environmentally sustainable way of generating electricity. I was also of the opinion that the energy generated would cause a corresponding reduction in the energy generated from fossil fuel sources and thus less CO2 would be produced. However I had some reservations about wind power which led me to conduct my own studies and the numbers for wind just don't add up. I now believe that wind is not an environmentally sustainable way of generating electricity. More significantly, I am no longer of the opinion that the energy generated from wind farms will cause a corresponding reduction in the energy generated from fossil fuel sources.

An article in Science Illustrated, Issue 8 2010, titled "Wind Power Storms Forward" pointed out some of the downside of wind farms:-

The threat posed to wildlife such as birds and bats.

Interference with aircraft radar systems.

Although support, in the United States, for wind farms is broad, residents and businesses often object when they are installed nearby.

Wind turbines only generate electricity when the wind blows when there is no wind there is no electricity generated. i.e. It is unpredictable*.*

Electrical grids can't handle this sort of unpredictability on a large scale. Conventional Power plants must take over when the wind dies.

More importantly the Science Illustrated article points out that ***"Wind is currently an ancillary energy source"*** says David Leeds, a smart-grid analyst at Boston based Greentech Media. *"If we can capture it we will put it into the grid. But coal and natural gas still serve as the base load source. What would change that is energy storage, a way to store excess wind energy and other renewable energy during times of high production and low demand and tap into it when we need it".*

2. WIND FARMS AND THE ELECTRICITY GENERATING SYSTEM

2.1 GEOGRAPHIC DISPERSION OF WIND FARMS

If, as claimed, by a proponent of wind power, Dr. Diesendorf in a letter to the editor Goulburn Post Wed. 9th February 2005, that ***"Wind farms with a generating capacity 20,000 MW, together with a little additional peak-load plant, could substitute for 6,600 MW of coal power",*** then it would be necessary to span the entire continent from west to east with wind turbines. According to the NSW Atlas, published by the NSW State Government in 1987, the weather systems take from 5 to 7 days to pass over the continent. A complete weather system is about a continent wide. At present the electricity grid spans a mere one third of the width of the continent, and some parts of the grid are tenuous. It is obvious that to span the continent with wind turbines then it is also necessary to span the continent with the electricity grid; an expensive undertaking, but nonetheless necessary to make wind farms work as claimed by the proponents.

For 20,000 MW of wind power to substitute for 6,600 MW of coal power means that the wind farms will have a capacity factor of 33%, the capacity factor, for the year 2010, is in the order of 31%. 33% is unlikely to be achieved because the best wind farm sites have already been "cherry picked". With a capacity factor of 31%, 21,200 MW of wind turbines not 20,000 MW, would be required to substitute for 6,600 MW of coal power if effective geographic dispersion could be achieved.

The capacity factor of 31% affects the amount of wind generating capacity required as well as the amount peak-load generating capacity required so let us adjust Dr Diesendorf's claim to bring it into line with reality. ***"Wind farms with a generating capacity 21,200 MW, together with a little additional peak-load plant, could substitute for 6,600 MW of coal power"***

A ***little additional peak-load plant*** is a pretty unqualified statement, so let us examine what it might possibly mean.

It might be possible that longitudinal (from west to east) geographic dispersion of wind farms could smooth output depending upon the extent and uniformity of dispersion. However I suspect that latidudinal geographic dispersion (from south to north) of wind farms will achieve very little smoothing at all because weather systems progress from west to east.

If 21,200 MW of wind turbines are not geographically dispersed at all, (i.e they are all in the same place) then 21,200 MW of peaking plant will be required if none of the output of those 21,200 MW of wind turbines were to be wasted. This is the worst case. Pro–rata you would need 6,600 MW of wind turbines and 6,600 MW of additional peak load plant to displace 6,600 MW of coal fired power plant. The wind farms would generate on average 2,050 MW and the peak load plant would generate, on average, 4,550 MW. The article in Science Illustrated, Issue 8 2010, titled "Wind Power Storms Forward" quotes wind power as costing $2 million per megawatt of installed capacity. That makes the wind component worth about $13.2 billion and the peak power component worth $3.3 billion totalling $16.5 billion.

According to a mathematical model I made, which assumed that a weather cycle was a continent wide, and behaved in a statistically perfect way, and wind farms of equal output uniformly spanned the continent, from west to east, and were connected by, a continent-wide robust grid, it might just be possible to make do with a ***little additional peak-load plant*****.** This is the best case scenario. Then, and only then, could you say that ***"Wind farms with a generating capacity 21,200 MW, together with a little additional peak-load plant, could substitute for 6,600 MW of coal power"*** The wind farms would generate on average 6,600 MW. With wind power costing $2 million per megawatt of installed capacity that makes ***"Wind farms with a generating capacity 21,200 MW***, worth about $42 billion; that's about the same as the National Broadband Network (NBN). And on top of that you have to spend a fortune on a continent wide grid.

However the reality is that the SE Australia grid extends for only a third of the width of the continent and some of the connectors are tenuous. Even if the connectors and grid were robust it would, according to my mathematical model, require something in the order of 11,300 MW of **additional peak-load plant** if none of the output of those 21,200 MW of wind turbines were to be wasted. Pro-rata you would need 11,300 MW of wind turbines and 5,600 MW of **additional peak-load plant** to displace 6,600 MW of coal fired power plant; 5,600 MW of additional peak-load plant **is not** a little.

The wind farms would generate on average 3,500 MW and the peak load plant would generate, on average, 3,100 MW. 11,300 MW of wind power, at $2 million per megawatt will cost $22.6 billion plus 5,600 MW of OCGT at $500,000 per MW will cost another $2.8 billion giving a total cost of $25.4 billion. And you still have to spend heaps to beef up the grid.

According to the article, “Wind Power Storms Forward”, (Science Illustrated, Issue 8 2010) the local placement of wind turbines is critical. The article claims that some spots on the local topography yield more than seven times the energy that other nearby places yield. This possibly explains why turbines on many wind farms are crammed into spacing far less than the NSW Wind Energy Handbook 2002 recommends. The NSW Wind Energy Handbook 2002 comes with a map of the State which shows the “sweet” localities for wind energy. The NSW State Government has more recently proclaimed Renewable Energy Precincts. But the absurdity is that the placement of wind turbines in Australia is not a structured process. Wind turbines are placed wherever developers can achieve maximum return. Rolling out the “red carpet”, by the NSW State Government, to encourage developers to stick their collective “snouts” into the wind energy “pig trough” (Sorry! Precincts), is achieved by stripping away the rights of affected land owners to object.

However the really sad thing is that Renewable Energy Precincts will do very little to achieve effective geographic dispersion; in fact it will probably achieve a concentration of wind farms in the wrong places. The wind farms of NSW, Victoria and South Australia, even though they are connected to the most extensive (by world standard) electricity grid only span a fraction of the weather systems that pass over the continent. There will be times when the light winds associated with high pressure systems will envelop most of the wind farms, and there will a dearth of electricity generated. Similarly there will be times when strong winds envelop most of the wind farms leading to a surfeit of electricity generated. This variability already happens, and it has big implications for the conventional generating plant. Firstly it will ensure that none of generating plant is displaced and secondly it will ensure overall, that generating plant will operate less efficiently. Furthermore it will guarantee that electricity prices will have to rise significantly and it may also mean that no reduction in CO2 emissions are achieved; Unthinkable though it may be, CO2 emissions might actually increase and the much maligned coal fired thermal power stations may even become more polluting. However, in her infinite wisdom, Prime Minister Julia Gillard has effectively closed off the possible construction of new, more efficient (IGCC) coal fired power stations unless they are **“carbon capture ready”.**

2.2 THE EFFECT OF WIND POWER ON THE ELECTRICITY GENERATING SYSTEM

A report commissioned and published by the Renewable Energy Foundation U.K., authored by David White, BSc,C Eng, F I Chem E, titled “Reduction in Carbon Dioxide Emissions: Estimating the Potential Contribution from Wind-power”. The report has had a major impact on my understanding of the issues. The crux of David White’s REF report, from my viewpoint, is that the additional unpredictability and variability from wind farms will reduce the efficiency of the existing coal fired plant held in reserve for wind farms.

The electricity generating system has no storage. At any instant the electricity supplied by rotating generators must match the demand. The mix of other generating plant in the electricity generating system (mainly coal fired thermal plant in the case of NSW & Victoria) already has to cope with a variable but predictable demand. Wind farms will place an additional variable and unpredictable fluctuation in output on top of that already variable but predictable demand.

David White, the author of the REF report, says that reserve generating plant, operating at such extreme conditions and anything in between, could easily operate 2% less efficiently than it otherwise would have. He conservatively estimates that CO2 emissions will increase from 0.95 to 1.1 tonne per megawatt-hour for that reserve plant. Fuel consumption will increase proportionally. This means that, when operating with coal fired thermal plant as reserve, wind power will be responsible for about 0.36 tonne of CO2 per megawatt hour of electricity it produces.

The proponents, of wind power as a sustainable energy source, have stated that ***“Wind farms with a generating capacity 20,000 MW, together with a little additional peak-load plant, could substitute for 6,600 MW of coal power”,*** *(and would avoid 19.8% CO2 emissions).* Let us then use that 20,000 MW of wind power to substitute for 6,600 megawatts of coal power and demonstrate the case in point.

At face value it does seem possible, that 20,000 MW of wind power can substitute for 6,600 MW of coal power and avoid 54,404,856 tonnes of CO2 which would otherwise be emitted. However if the reserve coal plant operates 2% less efficiently because of wind then only 34,169,256 tonnes of CO2 emission is avoided. What happened to the other 20,235,600 tonnes of CO2 emissions? It will be emitted from the reserve coal plant but in reality it belonged to wind power. Thus in a MRET scenario wind power gets the credit for avoiding 54,404,856 tonnes of CO2 emissions when in fact only 34,169,256 tonnes of CO2 emissions are avoided. Who pays for the discrepancy of 20,235,600 tonnes of CO2 emissions? The reserve coal plant pays but will pass on the cost to the consumer. **Of course we will delude ourselves and believe that 54,404,856 tonnes of CO2 emissions are being avoided when only 34,169,256 tonnes of CO2 emissions will be avoided.**

MRET's are a monstrous delusion. The proponents of sustainable energy would have you and I believe that we can make a 19.8% reduction in CO2 emissions when it is more likely to be only 12.4%. And instead of increasing electricity charges by 20.3% they will have to increase by 27.6%. In fact to achieve something approaching (18.7%) the 20% reduction in CO2 emissions, which the proponents of sustainable energy are advocating, it would be necessary to install 30% wind power. Electricity charges would have to rise by 41.4%; more than double the 20.3% originally anticipated.

But that is not all that will happen. As wind power capacity is progressively increased up to 30%, existing coal fired plant will cease being base load plant and become reserve plant for wind power. At 30% wind power all of the base load coal plant will have become reserve plant for wind. The installed capacity of wind power will then be 33,000 megawatts but the electricity generating system will not be capable of producing any more electricity than before unless additional base load plant is provided.

Wind power cannot work without other generating plant in the system capable of accommodating its fluctuations in output. It is not a symbiotic relationship where each type of generating plant needs the other in order to succeed. **It is a parasitic relationship and wind is the parasite literally sucking the efficiency out of coal fired thermal** plant and will force the coal fired thermal plant to be operated in a way it in which it was never designed to be operated.

Thus the statement by the proponents of sustainable energy is false. It would be closer to the truth to say that ***"Wind farms with a generating capacity 33,000 MW, together 33,000 MW of coal power as reserve, could substitute for 33,000 MW of base load coal- power"*** (and would avoid 12.4% of CO2 emissions)**.**

In any case wind power is one of the most expensive ways of reducing CO2 emissions; the cost per tonne of CO2 avoidance is high in comparison to other methods of electricity generation.

2.3 THE COST OF CO2 AVOIDANCE

To demonstrate the high cost of CO2 avoidance by wind power, I reproduce the text of a letter I sent, on 30th January 2007, to Gerard Walsh, Editor, Goulburn Post

Dear Sir,

Subject: Wind-farms Debate – Cost of CO2 Avoidance

It may sound absurd but the most cost effective way to reduce CO2 emissions from coal fired power stations is to build new power stations using coal as fuel. Integrated Gasifier Combined Cycle (IGCC) power stations using coal as fuel can produce electricity at, 4.4 cents and emit 0.6 kilogram CO2, per kilowatt-hour. By comparison, conventional coal-fired thermal power plant produces electricity at, 3.95 cents and emits 0.95 kilogram of CO2, per kilowatt hour. Therefore IGCC, for a cost of 0.45 cents, avoids 0.35 kilogram of CO2 per kilowatt-hour being produced. The cost of CO2 avoidance using IGCC technology is 1.29 cents per kilogram.

It may sound equally absurd but one of the least cost effective ways of reducing CO2 emissions is to build wind farms for the large scale generation of electric power. Wind power can, at face value, produce electricity at 7.95 cents per kilowatt-hour and be responsible for a negligible amount of CO2 in comparison to conventional coal-fired thermal power plant which produces electricity at 3.95 cents per kilowatt-hour and emits 0.95 kilogram of CO2 per kilowatt-hour.

Advocates of wind power have assumed that a kilowatt-hour of electricity generated by wind can displace a kilowatt-hour electricity generated by coal fired thermal power and thus save 0.95 kilogram

of CO2 per kilowatt-hour. If that assumption were correct the cost of avoiding a kilogram of CO2 is 4.2 cents for wind power compared to 1.29 cents for IGCC coal technology. The cost of CO2 avoidance, by wind power, is at least 3 times that of IGCC coal technology.

However assumption by the advocates of wind power that, a kilowatt-hour of electricity generated by wind can displace a kilowatt-hour electricity generated by coal fired thermal power and save 0.95 kilogram of CO2 per kilowatt-hour is a fallacy.

A report, commissioned and published by the Renewable Energy Foundation U.K., authored by David White, BSc,C Eng, F I Chem E, titled "Reduction in Carbon Dioxide Emissions: Estimating the Potential Contribution from Wind-power", claims that wind power adversely affects the efficiency of coal fired thermal power plant held in reserve to accommodate the unpredictable and variable output from wind-farms. CO2 emissions of the reserve plant increase from 0.95 to 1.1 kilogram per kilowatt-hour. I estimate that a kilowatt of coal power reserve capacity will be required for each kilowatt of wind power capacity. Assuming a load factor of 30% for wind the load factor for the reserve coal plant will be 70%. Using the data from David White's report I calculate that 0.35 kilogram of additional CO2 will be produced by the reserve coal fired plant for each kilowatt-hour of electricity generated by wind power. That additional CO2 really belongs to wind power.

Thus wind power, in displacing an equivalent amount of conventional coal fired thermal power, saves only 0.6 kilogram of CO2 rather than 0.95 kilogram, per kilowatt hour. Wind power is no better than IGCC coal technology which, coincidentally also produces 0.6 kilogram of CO2 per kilowatt-hour of electricity generated.

It is also necessary to adjust the cost of wind power because it was responsible for the coal fired thermal reserve power plant to use more fuel. I estimate that 7.95 cents goes up to 9.4 cents, per kilowatt-hour. The cost of producing a kilowatt-hour of electricity increases by 5.45 cents. The cost of CO2 avoidance, for wind power, is 9.08 cents per kilogram. Thus the CO2 avoidance cost of wind power is as much as 7 times that of coal using IGCC technology.

Wind power cannot work without other generating plant in the system capable of accommodating its fluctuations in output. It is not a symbiotic relationship where each type of generating plant needs the other in order to succeed. It is a parasitic relationship and wind power is the parasite literally sucking the efficiency out of coal fired thermal plant and will force that plant to be operated in a way it in which it was never designed to be operated. It should be a matter of concern for all of us that our electricity generating system will be trashed for the questionable and dubious benefits of wind power, masquerading as renewable energy.

MRET's (mandatory renewable energy targets), which Premier Iemma will legislate if he wins the election in March, unduly and unfairly favour wind power over, not only non-renewable energy sources, but they also unduly and unfairly favour wind over other sources of renewable energy such as geothermal energy. Premier I am convinced that IGCC coal technology is the way ahead for the immediate future, I am also convinced that wind power is an expensive delusion pedalled by midnight snake oil salesmen and will only achieve very limited reductions in CO2 from electric power generation at great cost.

Yours sincerely,

3. ADVERSE CONSEQUENCES OF WIND FARMS

3.1 DEMONSTRATION OF TURBINE WAKE INTERFERENCE & WAKE ROTATION

In August 2008 I gave objector's evidence to the NSW Land & Environment Court in relation to the Taralga Wind Farm to support the opposition of the Taralga Landscape Guardians to the rating of wind turbines being increased from 2 MW to 3 MW. I believe that my evidence had a material effect upon the Court's decision to order the buyout of a further 2 non-associated properties.

I conducted two demonstrations to the Court using two small fans.

The first demonstration showed that a fan has a rotating component in its wake in addition to an axial component. The demonstration also showed that the rotation could be detected for at least 8 rotor diameters downstream of the fan.

The second demonstration showed that moving the fans closer together increases the interference of the downstream fan in partial and full wake interference conditions. Moving the fans closer together also increases the arc over which partial and full wake interference conditions occur.

At 8 rotor diameters turbine spacing the arc of partial wake interference is about 8% of the total. At 4 rotor diameters turbine spacing the arc of partial wake interference is about 16% of the total. At 2 rotor diameters turbine spacing the arc of partial wake interference is about 33% in total. It was also noted that as the turbine spacing is reduced the blade distance from the upstream fan to its downstream neighbour is further reduced by a greater amount than the reduction in spacing.

I built the apparatus used in the demonstrations to the LEC to assist the Court's understanding of what happens in the wake of axial flow fans so that I could make projections about what happens in the wake of horizontal axis wind turbines.

A horizontal axis wind turbine is driven by the air stream to produce a mechanical output power to drive a generator which converts mechanical power to electric power. A wind turbine typically extracts a large portion of the kinetic energy of the air stream by reducing its axial velocity. I made a projection that a horizontal axis wind turbine would have a wake with an axial and a rotational velocity components as was demonstrated with the fan.

The demonstration showed that a fan operating in the partial and full wake of another fan resulted in increased noise. I concluded that this increased noise was due to the affected fan experiencing an air flow with a varying velocity and direction profile. I made a projection that a horizontal axis wind turbine downwind of neighbouring turbine would also experience a wake with a varying velocity and direction profile. I also projected that, as a consequence of a wind turbine operating in the partial and full wake of another wind turbine, increased noise would result.

The amount of power removed from the wind is substantial. In a research paper, by David Keith and others, titled "The influence of large-scale wind power on global climate" appearing in the Proceedings of the National Academy of Sciences, Keith used a drag co-efficient C_D in the range of 0.7 to 0.75 and a power coefficient C_P of 0.35 to 0.4. Keith states that the fraction of energy removed from the atmosphere as electricity (by a wind turbine) is C_P/C_D which yields an atmospheric efficiency of 47 to 57%. I observe that roughly as much power is lost as is converted into electrical power.

I am of the opinion that the power, lost in the wake, is largely responsible for the rotation & turbulence of the wake. Ultimately, friction will diminish the rotation to zero, and the lost power will appear as low-grade heat power in the wake.

A turbine subjected to partial wake interference, might have one part of the turbine running in free air, at say, 12 metres a second and another part will be running in turbulent air with an axial velocity of, somewhat greater than, 7 metres a second, and also having a significant rotational component. I am of the opinion that the effect of partial wake operation on the turbine will result in increased noise, and increased fatigue.

In a full wake interference situation it is evident that the drag of the upstream turbine will have extracted much of the kinetic energy from the air stream. The second and subsequent turbines in a row will generate very little power and probably a lot of noise.

The fan demonstration showed that there is rotation in a fan wake and it extends for least 8 rotor diameters. I projected that there will be rotation in a turbine wake. Coppin and co-authors, Section 6.4 " Wakes" on page 48 of the CSIRO publication "Wind Resource Assessment in Australia – A Planners Guide" say that "***.....wakes extend for a considerable distance; more than 10 rotor diameters"***.

3.2 ADVERSE CONSEQUENCES OF WINDFARMS - CROOKWELL

There are now significant numbers of wind farms under construction or approved or proposed, and there are probably more wind farms being contemplated. I want to discuss the adverse consequences of the following wind farms:- Gullen Range Wind Farm, Crookwell I Wind Farm & Crookwell II Wind Farm

I expect that the above wind farms will have a wind rose similar to Taralga Wind Farm wind rose, where 70% of the wind frequency is from the west and north-west. **This means that properties or**

land to the east and south-east of these wind farms will be subject to the effects of the turbine wake 2.8 times more often than they would have if the wind rose had been uniform.

The Gullen Range Wind Farm, Crookwell I Wind Farm & Crookwell II Wind Farms are near the tops of ridges off the Great Dividing Range and gain the advantage of topographic effect increasing wind speed.

3.2.1 CROOKWELL WIND FARM HYPOTHESIS

The following hypothesis, or scenario, is similar to a hypothesis I gave in August 2008, as objector's evidence, to the NSW Land & Environment Court in relation to the Taralga Wind Farm to support the opposition of the Taralga Landscape Guardians to the rating of wind turbines being increased from 2 MW to 3 MW.

This hypothesis considers the possible adverse effect that wind farms, on the Great Dividing Range in proximity to Crookwell, could have on the catchment of Pejar Reservoir. Pejar Reservoir is a major public water storage for the City of Goulburn.

Let us say it is daytime and the wind is blowing a parcel of air at 18° C DB from Bigga, 700 metres elevation, up the slope towards Great Dividing Range at Crookwell 950 metres elevation. The parcel of air from Bigga arrives at Crookwell, 950 m elevation, and it has increased in velocity but it is still 18° C.

A wind turbine, 150 metres high, is placed on top of Great Dividing Range at Crookwell. The top of the wind turbine is 1100 metres high. The difference in elevation from Bigga to Great Dividing Range at Crookwell is approximately 400 metres. From rule of thumb I know that the dry bulb air temperature decreases by approximately 10° C per 1000 metres increase in elevation. By interpolation I calculate that the expected temperature decrease is 4° C. Hence the expected air temperature at the top of the rotor is 14° C.

The turbine wake is a gigantic mixer, and the air from Bigga, at 18° C at the bottom of the turbine, keeps going and is eventually caught up in the turbulent wake which has a rotational component. At the end of the wake the temperature is uniform and I would expect it to be about 16° C which is the mean of the top and bottom temperatures. The catchment of Pejar Reservoir is in the wake and it experiences the mixed air which is 16° C and is turbulent. Had the wind turbines not been atop the Great Dividing Range at Crookwell the air parcel from Bigga at 18° C would have continued on over to catchment of Pejar Reservoir at 18 ° C

So in the daytime scenario just described, the effects at the catchment of Pejar Reservoir changed from, 18°C without a turbine, to 16° C with a turbine.

At the night the conditions at ground level are calm and the DB temp drops by 12 ° C. So the temperature at ground level under the turbine is 6° C. The same conditions would also exist at the catchment of Pejar Reservoir. However there is wind at the top of the turbine the DB temp remains about the same at 14° C. The air, at 6° C at the bottom of the turbine, is induced into the wake and mixed with the air in the wake. The temperature in the wake is 10° C and it is now turbulent. The catchment of Pejar reservoir in the wake so the temperature is 10° C and turbulent. Had the turbine not been atop the Great Dividing Range at Crookwell, the air at ground level at the catchment of Pejar Reservoir would be still and the same as at Great Dividing Range at Crookwell 6° C.

So in the night time scenario, just described, the effects on the catchment of Pejar Reservoir have changed from 6 ° C and calm, without a turbine, to 10 ° C and turbulent, with a turbine. If these hypotheses turn out to be true then the Crookwell 2 wind farm will have induced local climate change on the catchment of Pejar Reservoir.

People, like myself, have no alternative but to construct scenarios or hypotheses that attempt to understand the adverse consequences wind farms have on surrounding non-associated properties because essential data such as wet and dry bulb temperatures and wind speed data are not available to the public, or conveniently, not measured.

To prove whether or not the hypothesis, is true or false, it is simply necessary to measure dry-bulb and wet-bulb temperatures, not just at hub height, but also at ground level and the uppermost tip of

the turbine blade, both upstream and 10 rotor diameters downstream of the turbine. Making a hypothesis and testing it by measurement is what scientific method is all about.

Given that wind turbines are purported to reduce CO2 emissions in electricity generation and hence reduce the effects of climate change why has it not been considered that the intruding wakes of wind turbines can have a profound effect upon local climate change on non-associated neighbouring properties and in particular the catchment of Pejar Reservoir? All of the wind turbines will thoroughly mix the stratified air arriving at the turbines into a rotating, turbulent, expanding wake. The mixing effect changes the dry bulb temperature and humidity of the turbine wake.

The CSIRO publication "Wind Resource Assessment in Australia – A Planners Guide" P.A. Coppin, K.A. Ayotte & N. Steggel, Ver.1.1, October 2003, Page 48, alludes to the structural fatigue aspect of the problem of wake interference.

"The characterisation of wakes is very important not only for the prediction of wind farm energy yields but also for the assessment of any enhanced turbine blade fatigue possibilities" and *"Depending on the prevailing conditions the deficit in velocity can persist for a considerable distance down wind of the turbine, more than 10 rotor diameters."*

However even at 10 rotor diameters the wake is mixed; it does not suddenly become unmixed or re-stratified. The airstream continues on with higher surface velocity and reduced humidity which will enhance the drying properties of the airstream on the soil and plants. Just how far downwind of the turbine the enhanced drying properties will persist is not known and has not, in so far as I am aware, been the subject of any local study. It is my contention that it should be the subject of study.

It appears that the studies of wind farms have been driven by where to site wind turbines to achieve maximum energy output. The impact of the wakes of wind turbines upon the land appears to have been conveniently ignored.

Gullen Range, Crookwell I & Crookwell II wind farms are situated to the west and northwest and north of Pejar Reservoir. The wake from those wind turbines from the prevailing westerly and north-westerly winds will impact directly on the properties in the Pejar catchment.

Although Pejar Reservoir is full at the time if writing, It is only a few years ago following the drought of 2003 that Pejar reservoir was empty. Pejar is the largest reservoir supplying the City of Goulburn. During that drought period Goulburn City's population of 22,186 persons were on Level 5 water restrictions which targeted consumption at 150 litres per person per day. Over one year, that demand equated to 1.215 gigalitres.

3.2.2 COMPARISON OF WIND TURBINES TO FROST FANS

I reproduce an abstract by the author H J Frith, titled "Trials of a wind machine for frost protection in citrus" and published on the CSIRO website

http://www.publish.csiro.au/paper/AR9550903.htm

"*A horizontal axis wind machine for prevention of frost damage, built in Australia, has been tested under local conditions in a citrus grove. It was shown to be effective in raising orchard temperature by 2°F (1.1°C) over an area of up to 10 acres (4 hectares) at a power expenditure of 12 h.p. (9 kW) (electrical input) per acre, which is comparable to results obtained with similar machines in California and with the low speed Australian type of wind machine". Australian Journal of Agricultural Research* 6(6) 903 - 912
A frost fan works by replacing cold air at ground level with warmer air from higher layers above the ground. Frost fans can also be used to dry field crops.

A 2 megawatt wind turbine extracts 4 megawatts from the wind. 2 megawatts is output as electricity and 2 megawatts is lost mostly to rotating the wake of a wind turbine. Essentially a wind turbine is a gigantic mixer of the airstream; **a wind turbine is therefore a frost fan/dryer par excellence!**

Pro-rata to a frost fan, a 2MW wind turbine has the potential to frost free 90.4 hectares. Therefore 80 x 2 MW wind turbines have the potential to frost free (or dry) 7,233 hectares of land.

The 30 turbines of the Bannister group of the Gullen Range wind farm extend for 6 kilometres north to south, and have the potential to frost free (or dry) 2,700 hectares. To do this, the drying effect of their

wakes, in the prevailing wind, could easily extend 4.5 kilometres eastward. Pejar Dam is only 12 kilometres east of this group of wind turbines. Therefore the frost free (or drying) effect could extend well into the Pejar Catchment.

Pejar is the uppermost public water supply reservoir in the Wollondilly Catchment. The Wollondilly River flows into Warragamba Dam. The Wollondilly contributes a major portion of the inflow into Warragamba Dam; Sydney's largest reservoir.

One has to wonder how much the catchment of the head waters of the Wollondilly River will suffer from the wind farms in that area. Gullen Range (80 x 2MW), Crookwell I (8 x 0.6 MW), Crookwell II (46 x 2 MW) totalling 257 MW installed capacity with the potential to frost free (or dry) 11,600 hectares of the Pejar Catchment. The Pejar Catchment area is 14,200 hectares.

I anticipate that the people of Goulburn City would regard Pejar Dam as **critical infrastructure**. I also anticipate that the people of Goulburn City would also regard any infrastructure that impacted adversely on their vital water storage infrastructure as **critically-flawed-infrastructure.** And yet the NSW State Government has approved Gullen Range and Crookwell II wind farms; Crookwell I wind farm has been operating for some years.

A potential problem analysis taking into account the probability and severity of the **adverse consequences** of the Gullen Range and Crookwell II wind farms upon the water supply catchment for the city of Goulburn has never been considered let alone performed.

3.3 EFFECTS ON LOCAL CLIMATE

There has been little research done into the effects of wind turbines on local climate. One such study was conducted by S Baidya Roy and others at Princeton University in the U.S. I have reproduced below an article from Science News, Oct. 16, 2004, p. 246.

Change in the Weather? Wind farms might affect local climates by Sid Perkins

Large groups of power-generating windmills could have a small but detectable influence on a region's climate, new analyses suggest.

Windmills once were quaint several-story-high mechanisms that pumped water or ground grain. They've since evolved into sky-scraping behemoths that can each generate electrical power for more than 100 homes.

Some modern turbines are 72 meters tall and have rotor blades that are about 25 metres long, says S. Baidya Roy of Duke University in Durham, N.C. Future windmills may reach higher than 100 m, and their rotor blades may measure 50 m long, he notes.

All such turbines disrupt natural airflow to extract energy from wind. To investigate potential effects of a wind farm that includes thousands of windmills, Roy and his colleagues used a detailed climate model based on wind speeds, temperatures, and ground-level evaporation in north-central Oklahoma during a 2-week period in July 1995. In their scenario, the researchers considered a 100-by-100 array of windmills spaced 1 kilometer apart.

The simulation suggests that during the day, while sun-induced convection handily mixes the lower layers of the atmosphere, such a wind farm wouldn't have important climatic effects.

In predawn hours, however, when the atmosphere typically is less turbulent, a large windmill array could influence the local climate. For example, at 3 a.m., the average wind speed at ground level was 3.5 meters per second (m/s) in the absence of windmills. Adding the wind farm would increase the average wind speed to 5 m/s. Also, the 10,000 windmills would increase the temperature across the area by about 2°C for several hours.

Averaged over an entire day, the wind speed at ground level would go up about 0.6 m/s and the temperature would jump 0.7°C.

Turbulence caused by the rotating blades would shunt some of the high-speed winds typically found 100 m off the ground down to Earth's surface, says Roy. Those surface winds would boost evaporation of soil moisture by as much as 0.3 millimeter per day.

The researchers describe their simulation in the Oct. 16 Journal of Geophysical Research (Atmospheres).

The findings may stimulate scientists to validate the analysis with real-world tests, says Neil Kelley, a meteorologist at the National Renewable Energy Laboratory in Golden, Colo. In general, says Kelley, the simulation agrees with atmospheric data he gathered at a wind farm in California.

The above article, although written over six years ago, points to wind turbines on a large scale having a small but detectable influence upon local climate, however the turbines used in this study are dwarfed by the proposed Taralga wind farm turbines and the turbines of the Taralga Wind Farm as spaced much more closely than the turbines in the model. However, today the 3MW turbines of the Taralga wind farm are small in comparison with the 5MW 160 metre high turbines currently available. And these are small in comparison to the 20MW 200 metre high turbines projected to be available by 2030.

Enhanced evaporation at the rate of 0.3mm per day, over the 11,600 hectares of Pejar catchment made frost free by the wind turbines, has the potential to reduce the inflow into Pejar reservoir by 9 gigalitres per year. The storage capacity of Pejar reservoir is 9 gigalitres. The potential reduction in inflow is 7 times Goulburn City's 1.215 gigalitre per annum Level 5 demand.

3.4 EFFECTS ON GLOBAL CLIMATE

An article in the Canadian publication, The Globe and Mail (9th Nov 2004), by Stephen Strauss, sounded an ominous warning on how wind farms might affect global climate. *Canadian and US Scientists used computer simulations to show that using wind farms for large scale electric power generation could* ***"…….create a significant temperature change over the earth's land masses.*** *While the precise trade-off between the climate change from wind farms versus that from carbon-based power systems is still a matter of contention, the fact that wind power isn't climate neutral leaps out of the simulations.* ***"We shouldn't be surprised that extracting wind energy on a global scale is going to have a noticeable effect. ... There is really no such thing as a free lunch,"*** *said David Keith, a professor of energy and the environment at the University of Calgary and lead author of the report, which appeared in the Proceedings of the National Academy of Sciences. Specifically, if wind generation were expanded to the point where it produced one-10th of today's energy, the models say cooling in the Arctic and a warming across the southern parts of North America should happen. The exact mechanism for this is unclear, but the scientists believe it may have to do with the disruption of the flow of heat from the equator to the poles.*

Depending on how much energy is ultimately generated by wind power, the study's simulations say these changes could range from one-third of a degree to 2 degrees Celsius. One unexpected finding to the study is that the hotter temperate zone / cooler Arctic effect exists in the simulations if the wind farms are concentrated in a few spots or scattered across the world".

There are a couple of questions that need to be asked. Does the simulation translate to the southern hemisphere by the models saying "a cooling in the Antarctic and a warming across the southern parts of Australia should happen"?

What will be the consequences if wind power generation were increased by twice as much, as the 10% used in the global simulation, to 20% forecast by Dr. Diesendorf in his letter to the editor Goulburn Post Wed. 9th February 2005?

Some people may regard wind as a nuisance, like the lady who says "it mucks up my hair" however the kinetic energy of the wind has an important job to do in transporting heat energy from the hot equatorial regions to the cold polar regions of the planet by the process of atmospheric circulation. The wind is a part of a heat energy transportation system. The global simulation conducted by Dr. David Keith and others shows, that wind farms on a large scale, may interfere with atmospheric circulation and the climate. That is to say that wind turbines will interfere with the global transport of heat energy.

The research paper "The influence of large-scale wind power on global climate" by David W Keith and others acknowledges that they (the authors) ignored the adverse effect that turbine generated turbulence might have on the atmospheric efficiency of wind turbines and the effect that additional turbulence may increase the turbulent transfer of heat and moisture. The research concedes that they (the paper's authors) may have underestimated the climate impact of wind farms per unit of electricity. *"Including the effects of turbine-generated*

turbulence might significantly lower the effective atmospheric efficiency by increasing turbulent momentum transport and thus inducing additional drag on the ground downstream of the turbines. Additional turbulence will also increase turbulent transport of heat and moisture . Both effects are ignored here, and thus, we may underestimate the climate impacts per unit electricity".

The research paper by Keith and others also acknowledges that the winds mediate much larger energy fluxes by transporting heat and moisture. *"Although the generation and dissipation of kinetic energy is a minor (<=0.3%) component of global energy fluxes, the winds mediate much larger energy fluxes by transporting heat and moisture. Therefore, alteration of kinetic energy fluxes can have much greater climatic effects than alteration of radiative fluxes by an equal magnitude."*

According to (Appendix E, Fig. E.3, "Energy – an Introduction to Physics" – Robert H Romer, Freeman & Co San Francisco ISBN 0-7167-0357-2) The rate of energy transfer of water vapour in the earth's atmosphere is twenty times that of the rate of energy transfer to wind and currents.

Thus a 2 MW wind turbine, which strips 4 MW of kinetic power, from the wind, could have at least twenty times that effect, i.e 80 MW, on the mediating (moisture and heat carrying) power of the wind.

I have noted recently the willingness of Professor Ross Garnaut to publicly use the passage of monster tropical cyclone "Yasi" through northern Queensland as a prelude of what is to come with a changing climate. Professor Garnaut may be right. In the same vein as Professor Garnaut, I don't see how worldwide proliferation of wind farms can possibly ameliorate a changing climate and I am of the opinion that, irrespective of where they are located, they too may aggravate a changing climate and make their contribution to the formation of more intense tropical cyclones in the future.

The effect of wind farms spread across South Eastern Australia, is to intercept, with turbines, the prevailing wind on its journey from the equatorial regions to polar regions. The process slows the wind, by stealing much of its kinetic energy, and loads the wind with low-grade heat energy, being a consequence of the inefficiency of the process, and then sends the wind on its way, crippled and degraded. According to Dr. Keith a wind turbine producing 2 megawatts of electricity will place 4 megawatts of drag on the wind. It follows then that the 2 megawatts of the winds kinetic energy is turned into low-grade heat.

By reducing the velocity of the wind, we have reduced the ability of the wind to go as far as it did before. In other words we are degrading the wind. However that is not all that we do to the wind. The 2 megawatts of electricity a turbine converts into electricity is led somewhere else by cables and is used. Most of it ends up as low grade heat and adds to the 2 megawatts of heat that was lost due to the inefficiency of the process.

Thus a 2 megawatt turbine will strip 4 megawatts of kinetic power from the wind and load up what is left of the wind with 4 megawatts of low grade heat.

An entirely possible and logical consequence of degrading the wind and loading it up with heat is that Antarctica gets colder and the temperate zone, Southern Australia, where we live, gets hotter, because we have short-circuited the global heat energy transportation system.

3.5 TURBINE WAKE – DEFICIT IN WIND VELOCITY

A wind turbine with a 103 metre diameter rotor, at a wind velocity of 12 metres per second, has an input power of 8.7 megawatts. Assuming that the wind turbine has an atmospheric efficiency of 50 %, of the 8.7 megawatts input wind power 3 megawatts is converted into electricity, a further 3 megawatts is lost due to inefficiency of the turbine and ends up as low grade heat in the turbine's wake. The wind exiting the rotor has an output power of 2.7 megawatts and an axial velocity of 6.7 metres per second. The wake has rotation, it is also turbulent, and has an axial velocity significantly slower than the free air stream.

The CSIRO publication "Wind Resource Assessment in Australia – A Planners Guide" P.A. Coppin, K.A. Ayotte & N. Steggel, Ver.1.1, October 2003, Page 48 had this to say about wind velocity in the wake. ***"Depending on the prevailing conditions the deficit in velocity can persist for a considerable distance down wind of the turbine, more than 10 rotor diameters."***

For a wind turbine to produce power, there must be wind, and if there is wind to produce power then there will be a wake. It is my contention that the wake is an integral part of a wind turbine, and the effects of the wake on non-associated properties must be considered; up to this point they have not been considered.

4. THE HAZARDS OF HOSTING AND NEIGHBOURING A WIND FARM

Farmers who are approached by wind farm developers are not told the whole story; they are probably told everything that the developer wants them to know, such as how “clean” & “green” wind turbines are. They are probably told the equivalent number of cars the turbines will take off the road. They are told how much they will be paid for hosting wind turbines on their properties. They are almost certainly not told that the wind turbines make incessant low frequency noise and vibration. They are almost certainly not told that their farm houses will be made uninhabitable by noise. They are almost certainly not told that their farms will be dried out by the turbine wake. They are probably not told that they will achieve the odium of polecats with their neighbours. They are probably conned into signing a contract with a clause that forbids them to speak against the wind farm development and are forever muzzled. What appears to be occurring is deception by omission. Farmers faced with such a situation need sensible honest advice, and they need protection from exploitation by slick salesmen. State Governments that are overly eager to facilitate wind farms appear as though they could not care less. If State Governments did care, then they would ensure that such odious practices were stamped out and that any deceptive contracts, entered into, were rendered null and void.

There is something distinctly odious and un-Australian about the secretive way in which wind farm developers go about signing-up hosts for wind farms that causes community friction the moment that a wind farm development is made public. Suddenly the owners’ of surrounding non-host properties are faced with the reality that their wind farm host neighbour(s) have secretly signed-up to a deal, perhaps many months before, which they are forbidden to discuss.

It is a rotten deal which will profoundly change the lives of the non-host property neighbours. The reality sinks in that they will have to look at, and endlessly experience the vibrations, noise and feelings, of living amongst a forest of wind turbines blighting their surrounding landscape; a landscape that they may love. They may regard the landscape as part of their ”little piece of paradise”. Suddenly their paradise is smashed to pieces; their aspirations squashed flat. Then comes the realisation that the little nest egg of land that they were sitting on to fund a reasonable quality of life in their retirement may not be worth anything like they thought it might be worth. Their land may no longer be subdividable it may not even be saleable. It is a devastatingly, cruel series of crushing blows visited capriciously on unsuspecting citizens by an uncaring society and complicit government, that has randomly singled them out for sacrifice, via the wind farm developers, to the dubious cause of renewable energy from the wind. Their community is ruptured, support gives way to antagonism and acrimony, long-time friends become bitter enemies.

Is Australia a country where the principle of a “fair go” is cherished or has it become a country where government sponsored “rorts” are the norm? The present process is secretive and unfair. The process must be changed. The process must be made transparent and fair. The process must restore the basic common law right of affected citizens to sue for damages the neighbours hosting wind farms, the developers’ of wind farms and the complicit Governments.

Neighbours who adjoin or who are in close proximity to a wind turbines and who will be grievously affected by a wind farm development, should not have to ‘pony-up’ with huge sums of money, to take their cases to the courts, in an attempt to stop their lives, their livelihood and their assets being trashed, in a similar way that Waubra residents, Trish Godfrey and Carl Stepnell have experienced.

A real life story of a farmer who wants “out” of an agreement with a wind farm developer appeared in “The Courier” on 18th January 2011.

Waubra resident tells court of wind farm "hell"

18 Jan, 2011 12:00 AM

Former Waubra resident Trish Godfrey yesterday told an Adelaide court how her dream home became “hell on earth” after wind farm turbines were turned on.

Ms Godfrey said she suffered sleep deprivation, headaches and nausea before moving out in April 2010 when Acciona purchased her property.

"It was like you had a hat on that's too tight and you have a pain that just gets worse and worse, and you can't take it off," Ms Godfrey said. "There was pain most of the time."

Ms Godfrey broke down in tears as she gave evidence at the Environment Resources and Development Court.

Dairy farmer Richard Paltridge is appealing a decision to grant Acciona approval to build a 46-turbine wind farm near his property, south of Mt Gambier.

Ms Godfrey said her symptoms began about a month after turbines were turned on, then got progressively worse.

"I said to my husband I'm not sick but I don't feel well," she said.

"It felt like I had a cold coming on all the time.

"My sleep patterns were changing. I was waking up two, three, four times a night. I couldn't explain it. I couldn't get my head around what was going on.

"You put it down to everything but what it is."

Ms Godfrey said she and her husband Victor, a dental surgeon, went on holiday to Darwin and the symptoms stopped, then resumed when she returned home.

"You get back and it starts all over again," she said. "It all came back with gusto."

Under questioning by George Manos for Mr Paltridge, Ms Godfrey said the 10-acre property was her "dream" home, where she and her husband intended to retire.

She said she planted 750 to 1000 boundary trees, about 30 fruit trees and 17 vegetable beds in the 10 years they lived there.

Ms Godfrey said she had been led into a false sense of security in a meeting with David Shapiro of Wind Power, the company that set up the Waubra project and sold it to Acciona.

"He told us there would be a couple of turbines on Quoin Hill, a couple on Big Hill and a few behind us," Ms Godfrey said.

"He said there would be no lights, no wires and no noise."

Ms Godfrey said 63 turbines could be seen from her property and it became "hell" to live there.

She said the noise "pressed in" on their home. "It was anywhere from a low whooshing sound, a sweeping swoosh some days, and when the wind was coming from the north it was like a jumbo jet in the back paddock," she said.

Former Waubra resident Carl Stepnell told the court yesterday he and his wife's symptoms of chest pains, heart palpitations and sleep deprivation ceased after the couple moved away from the family farm to Ballarat in November.

"We feel as though we've got our health back," Mr Stepnell said.

Mt Stepnell said his wife also suffered depression while living close to the turbines.

"Her whole appearance ... it was scary to see how bad she was," he said. "She was really down, depressed ... shocking."

Mr Stepnell said his five-year-old son attended Waubra Primary School until the family moved.

"I see a big difference in his behaviour," he said.

"He is nowhere near as emotional ... he was pale. (Now) he's like a normal five-year-old."

According to preliminary studies conducted by Dr. Sarah Laurie of the Waubra Foundation, wind farms are making people, who live in the vicinity of them, sick. In most cases the symptoms, that people exhibit, disappear when they are removed from the vicinity of wind turbines. Many people who have lived in the vicinity of wind turbines have left their farms to live somewhere away from them.

Those who stay are those who cannot afford to leave. Wind farms appear to be causing an exodus of farmers from the land. It appears that people co-existing healthily with wind farms is not possible.

There have been Government inquiries; but they have come to nothing.

The Campbell inquiry of the Howard Government which I and many others made submissions to; came to nothing.

The Environment Minister Peter Garratt of the Rudd Government promised Guidelines for Rural Wind Farms; nothing eventuated.

The NSW Legislative Council held and inquiry into Rural Wind Farms and made a report. As a consequence of that Legislative Council Inquiry the NSW State Government promised that the Department of Planning would issue Guidelines for Rural Wind Farms by the end of 2010. It is now 2011 and no Guidelines for Rural Wind Farms have been issued; nor are they likely to be because the NSW Parliament has been prorogued by Premier Kristina Kenneally.

By comparison, in the same span of years, the NSW Government has introduced NRET's. The Rudd Government introduced MRET's despite the fact that Professor Ross Garnaut in his report advised against doing so. Professor Garnaut advocated letting market forces determine the penetration of renewable energy into the market. In the current term of the NSW Parliament, the State Labor Government has deemed wind farms to be **critical infrastructure** and they have also deemed certain specific areas to be **renewable energy precincts.**

Wind energy sweet spots are where there is a favourable wind site, where there is an easy connection to the electricity grid, where there is a renewable energy precinct red carpet rolled out inviting wind farm developers to "pig out" on the spoils of the overvalued, intermittent electricity they generate. The sweet spots are where there are people. The same people who have paid for their electricity grid to be extended to them. The State Governments have given the developers the right to usurp the people's electricity grid and if the grid is not strong enough then it has to be strengthened, not at the developer's expense but at the people's (the consumer's) expense.

Exploitation of the wind energy sweet spots by the developers may lead to imbalance in the electricity generating system. Imbalance caused by the massive amounts of wind power that can arrive at a time when it is least needed and disappear when it is most needed. That is the time the electricity generating system teeters on the edge of collapse; it is also the time when wholesale electricity prices can soar to $10,000 per MWh ($10 per kilowatt-hour). Guess what? The same wind farm developers are there ready and waiting with their inefficient, cheap, open cycle gas turbines to supply the electricity short-fall, caused by the wind turbines, for $10,000 per MWh. Wow! What a rort! These "Gordon Gecko" developers simply can't go wrong and our politicians have made it that way. However, the Government doesn't pay from consolidated revenue; **the Federal Government has mandated that you and I pay**, through our electricity bills, to these parasites and phonies that masquerade as saviours of the planet with their "clean", "green" energy. In my vocabulary "clean" and "green" are words that have become cliches made meaningless by the puerile hype of the developers.

Once again the State Governments in question appear as though they could not care less. If the State Governments did care, then they would ensure that the health, and the basic rights, of the people, neighbouring wind farms was not compromised; they would ensure the Owners' of properties affected by wind farm developments were adequately compensated; especially if they, the complicit State and Federal Governments, believe that the pathetic amount of renewable energy from wind farms is so dammed important in solving the problem of climate change.

Is this DEMOCRACY or DEVOCRACY ? Is this government of the people, for the people, by the people or is it government of the politicians, for the developers, at the expense of the people?

5. CONCLUSIONS

Global warming and climate change may make many places hotter and wetter, but South Eastern Australia is forecast to become hotter and drier as a consequence of global warming and climate change. To that gloomy forecast we might need to add the global heating effects of wind farms and if you live near them you might need to add the local heating and drying effects as well.

Many localities where wind farms are being sited will have less rain by 2040 according to Bureau of Meteorology forecast mean rainfall trends. The local effect downwind of wind farms, could account for as much as 110 mm evaporation of soil moisture.

Many localities where wind farms are being sited, according to Bureau of Meteorology forecast mean temperature trends, will be hotter by the year 2040. The global effects or wind farms could add between 0.33°C and 2°C and the local effects of wind turbines could add a further 0.7°C. Therefore the localities where wind farms are being sited could be between 1.0°C and 2.7°C hotter by the year 2040. This is local climate change and a significant portion of it will probably be attributable to wind farms.

I observe that there are few voices speaking out in support of leaving the wind alone so that it can do its job as “mother nature” intended it to do. I don’t hear any voices urging caution before conducting another large scale experiment on the planet Earth’s atmosphere. Do the people who advocate wind farms understand why there is wind and the role of wind in maintaining the habitability of Planet Earth?

Do the people who peddle wind farms ever contemplate that there may be severe consequences by stripping a significant portion of the energy from the wind? It seems not. It seems to be just another resource to plunder and to make a profit from.

I find it alarming that we have embarked upon yet another climatic experiment without really knowing what the consequences will be. There appears to have been little research done into the effects of large-scale wind farm developments on global and local climate.

Large scale wind farms for power generation are a similar experiment to those experiments we have been conducting by burning fossil fuels or making synthetic refrigerant gases like the outlawed “freons”. Those same outlawed “freons” still contribute to holes in the ozone layer and are also potent greenhouse gases.

The simulation studies by David Keith and others suggest that large scale deployment of wind power may result in increased temperatures in some parts of the world ranging from one-third of a degree to 2°C, depending on how much energy is ultimately generated by wind power. I suggest that any increase in temperature will have a generally adverse effect on efficiency of thermodynamic processes such as, steam turbine power plants, refrigeration plant and internal combustion engines. The point I make about all this is that if wind power makes up a 10% of the energy generation mix it can have a small adverse effect upon the remainder of the energy generation plant driven by thermodynamic processes, and energy consuming plant using thermodynamic process. Although the effect on process efficiency may be small (less than 0.5%) the capacity of plant affected could be more than 20 times that of wind power.

A feature of wind-power, that recurs time and time again, is the potentially adverse “knock-on” effect of wind-power on other processes. The “knock-on effects of wind-power range from several times larger than wind power to orders of magnitude larger than wind power. To me that is a cause for concern. I suggest that before we imprudently plunge further, into the deepest end of the pool of unknowns, we must conduct a very thorough study of the possible adverse consequences of wind farms for large-scale power generation on both local and global climate, from the perspective of Australia.

James Lovelock, the scientist who made the connection between the “freons” and holes in the ozone layer is sometimes referred to as the father of the greens. James Lovelock is on record as saying that we should be building nuclear power stations to combat climate change.

I am of the opinion that a wind farm, in SE Australia, of 6.6 gigawatts net capacity, i.e. 21.2 GW installed capacity, comprising at least 10,600 2MW wind turbines, **cannot achieve effective geographic dispersion.** As a consequence 5.6 gigawatts of additional peak-load plant will be required, but I don’t believe that it will be supplied in anything like the amount required. It will be **a little additional peak-load plant.** An inescapable consequence is that 21.2 GW of wind power will, unmercifully “push around” the rest of the electricity generating system and lead to loss of efficiency and reduced life in the rest of that generating plant.

A wind farm of 6.6 gigawatts net capacity , comprising at least 10,600 2MW wind turbines, in SE Australia, is not a small undertaking; it is equivalent to six 1.1 gigawatt conventional coal fired thermal power stations or six 1.1 gigawatt nuclear power stations. 10,600 turbines, if spaced as recommended by the NSW SEDA guidelines would stretch for 4,500 kilometres if arranged in a single line. That is equivalent distance from Perth WA to Mallacoota Inlet Vic via the coast.

The cooling water make-up requirement for 6 x 1.1 gigawatt 50% efficient thermal power stations would be would be in the order 16 gigalitres per year. However large thermal power plants should be sited near the seaboard and use seawater as coolant and thus not place a demand on coastal and inland rivers.

The cooling water make-up requirement for 6 x 1.1 gigawatt 30% efficient nuclear power stations would be would be in the order 37 gigalitres per year. However large nuclear power plants should be sited near the seaboard and use seawater as coolant and thus not place a demand on coastal and inland rivers.

By comparison 10,600 2 megawatt wind turbines in SE Australia with an average total output of 6.6 gigawatts, if operating with an atmospheric efficiency of 50 %, will not consume any cooling water but will create a moisture deficit in their wakes of at least16 gigalitres. But the problem could be even far greater than that because the turbine wakes will remove water from the soils and plants in their path as a result of enhanced mass transfer brought about by the rotating air mass in the wake increasing the wind velocity at ground level and also bringing drier air from higher levels into contact with the plants and soil.

The environmental consequences 10,600 x 2 megawatt wind turbines could be severe, even catastrophic. State Governments have been prepared to encourage these developments to proceed on an unplanned, divisive, destructive, ad hoc, chaotic basis against the wishes of the communities where they are being sited, contrary to Local Council guidelines, and in total ignorance of the possible adverse consequences both globally and locally.

Science that selectively considers the beneficial aspects of wind farms without looking for and taking into account the adverse consequences is not science. The people who engage in such practices are not scientists but charlatans.

6. RECOMMENDATIONS

I make the following specific recommendations applicable to wind turbines for large scale power generation:-

A moratorium should be placed on the construction of any new wind turbines in Australia, until further research, is conducted to determine that the adverse consequences of wind turbines in Australia on the local climate and environment do not outweigh the benefits claimed for wind farms.

Wind farms should not be permitted to be built near to water catchments of public water supplies until it can be conclusively demonstrated that their effect on rainfall run-off into reservoirs is negligible. Nor should wind farms be permitted to be built in water catchments of reservoirs for irrigation and river regulation until it can be conclusively demonstrated that their effect on rainfall run-off into reservoirs is negligible.

Wind farms must bear the costs of for any inefficiency they may cause to the existing electricity generating system. In particular wind farms should not treat the existing electricity generating system as a storage battery.

Any future development of wind farms must be balanced so that effective geographic dispersion is achieved as the population of wind turbines grows. Achieving this may require that expensive and extensive very long distance electricity transmission lines are constructed. Wind farms must pay for the additional electrical plant and transmission lines required to integrate them into the electricity generating and distribution system.

An agreement by a landholder to a developer for the hosting of wind turbines on a land owner's property shall be registered like a property title, and it shall not be secret. The landholder hosting the wind turbines shall be made aware that their land may be adversely affected, and the intrinsic value of his/her land may be reduced. They should also be made aware that the dwelling(s) on their property

may be made uninhabitable by the development. Furthermore a landholder hosting a wind turbines, on their land, shall be made aware that they will not be able to sub-divide their properties ; they should also be made aware that neighbours, not hosting wind turbines on their land, may not be able to subdivide their land either and may possibly sue for damages in a Court of Law.

Wind farms should not be treated any differently than any other development. Wind farms shall not be deemed to be **critical infrastructure** nor should there be **renewable energy precincts**. The NSW State Parliament should repeal the legislation creating **critical infrastructure** and the legislation creating **renewable energy precincts.**

The Federal Government should repeal the legislation creating **Mandatory Renewable Energy Targets** (MRET's) and allow market forces, in conjunction with a carbon pollution reduction scheme or a carbon price, to determine the penetration of renewable energy into the market

In NSW & Queensland, for the immediate future, priority should be given to the construction of new black coal fired thermal power stations of the Integrated Gasifier Combined Cycle (IGCC) type to replace older and less efficient coal fired base load power stations.

In Victoria, for the immediate future, priority should be given to the construction of new brown coal fired thermal power stations of the Brown Coal Integrated Gasifier Combined Cycle (BCIGCC) type to replace older and less efficient brown coal fired base load power stations.

In all states, for the immediate future, priority should be given to the construction of new gas fired thermal power stations of the Gas Turbine Combined Cycle (GTCC) type for the generation of shoulder load power.

Any new open cycle, grid connected, gas turbines should not be approved except for emergency or stand-by use.

The Standards Association of Australia shall be requested to prepare an Australian Standard for Wind Turbines and Wind Farms. The Standard shall specify minimum separation distances from non-host properties. The "5r-8r" rule, of the SEDA guidelines shall be incorporated in the Standard and made mandatory. In no case shall turbines be spaced no closer than 5 rotor diameters across the prevailing wind and 8 rotor diameters in the direction of the prevailing wind. The boundary of a property not associated with the wind farm development shall be no closer than 20 rotor diameters to a wind turbine. The Australian Standard shall set out the minimum standards and requirements for wind farms. The Australian Standard for Wind Farms shall be referenced by State Legislation to give it legal standing. The regulatory authority for the Australian Standard shall be the Shire or Municipal Council, where the wind farms are being built.

*****

Dennis Workman

7th February 2011.