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### **Introduction.**

This submission will probably give the superficial impression that I am 'anti' wind power. This is not the case however.

I was first involved in the design of wind turbines in 1974. I have been involved with all kinds of wind power ever since and consider the wind to be a very useful and under utilised energy resource.

I am 'anti' poorly conceived projects that bring useful technologies into disrepute.

I have lived on the Aotea harbour for about 15 yrs, 10 km directly upwind of the Whararoa Plateau in the prevailing SW wind.

Since one of my activities is as a consultant sail designer for a British company I have a great interest in the wind. In fact I was the first person to do research into the microcell structure of wind in modern times. This was in 1974, the field had been dormant since work for airships had been done in 1928.

This interest has led me to record wind data in some detail at Makomako for the last ten years.

From this record I am well aware of the wind conditions in the Raglan area and the fact that it is the least windy area of any on the west coast of NZ from Wellington to Dargaville.

My first reaction on hearing of the TE Uku project was what!! Simply because this area is one of the last you would look at on the whole west coast.

I immediately made an estimate of the wind at the plateau. Given that it is higher and further inland than my recording site. I could not get the numbers to say anything other than it was a marginal medium wind site, even by European standards.

The first thing I said to WEL at the first public meeting was to ask to see their wind data to compare it to mine.

WEL refused to let me see their data and showed no interest in seeing mine. I was dumbfounded.

You have to understand that if you are planning a wind energy project and somebody said they had 10 years of detailed wind data for the area you would normally give an arm and a maybe a leg to see it.

Call me paranoid but the only reason I could think of for this bizarre behaviour was they knew it was bad and intended to fudge their own data.

Since this first meeting I have tried many times to get WEL to release meaningful data on the wind conditions they expect or on the revenue and cash flow they expect from this site.

They have always refused saying that it was commercially sensitive. Of course this is rubbish. They could have hired me as a consultant under NDA for a nominal \$1 and shut me up straight away if they had a case that would stand up to informed scrutiny.

They have come to this hearing with more fluff and absurd claims.

I am now going to present an analysis of the actual output, useful power produced, economic and carbon balance for this project.

I have done this using wind data from a site 10 km to the south west of the plateau but corrected for the plateau's elevation and position.

I would have preferred to do this with WEL's own data for the historical wind but I was refused access to this for the last time midday on 19/11/2007.

The data I have used is poor at night but this is of no consequence for the economics of the project. Power produced between 10pm and 6am has almost no value, if a lot of wind power is installed in NZ the value may even be negative on a windy night!

The plateau could have some kind of anomalous wind condition but I doubt this as the flora and trees look as if it is a bit windier than the coast, just as would be expected.

**Estimate of Quantity and timing of electricity produced.**

Calculating the useful power from a wind turbine array is not a trivial exercise.

The fundamental is not what power you can produce, but what you can SELL.

There are two basic models, with and without cogeneration. The model with cogeneration has significantly greater output and is more economically viable.

I will only present the stand alone model as this represents the actual application. I believe that WEL would have had to apply for approval for a cogeneration plant at the same time as the wind turbines if it was part of the same project.

The bidding style for the NZ wholesale electricity market has changed since this model was made. Shorter periods of commitment are now possible but this has no net effect as new rules coming in to force will prohibit the bidding of more than 90% of maximum output from wind turbines without cogeneration.

Rather than present the output from a computer program and say “here is the answer” I intend to go over a representative day and show how the wind variations effect the potential power and useful power output. I have chosen a day that is representative of the average, that is that the average outputs for the day are about 1/365 of the expected yearly average.

The output of the whole site is the important figure so the windspeed can be averaged over the whole site for any period that it takes a representative gust cell to pass the site.

Actual power output curve of a turbine is taken from that of a Vestas V90.

Attached is a chart of a representative day. A day was chosen that gives the averages of windspeed and bid power as close as possible to the annual average.

The characteristic gust cell of this day took about 15 minutes to pass the site so a wind speed time averaged over 10 minutes was used. The turbine position assumed is not the best but is better than average for this direction. No allowance for turbine interference has been made so this an OPTIMISTIC calculation.

To estimate bid power it has been assumed that WEL will be able to predict wind well enough to achieve a bid level of 94% of actual following hour minimum. This level of prediction is high and requires the spending of real money for sensors, software and possibly manual intervention.

The total power output is for 27 turbines, it would be normal for at least 1 of 28 turbines to be out of operation at any time.

The data this chart was derived from give:

|  |   |
|--|---|
| Average annual wind speed                | 6.12 M/S  |
| Total annual site net output (bid power) | 132412 MW (132GWH)                                    |
| Average power per turbine                | 0.54 MW. (Total for 28 is 15MW this is the real size) |
| Utilisation                              | 18%   |

These numbers are entirely consistent with utilisation values of this type of turbine achieved in German and Danish shore installations with the same gradient wind.

German values are lower than 18% but they have very strict auditing.

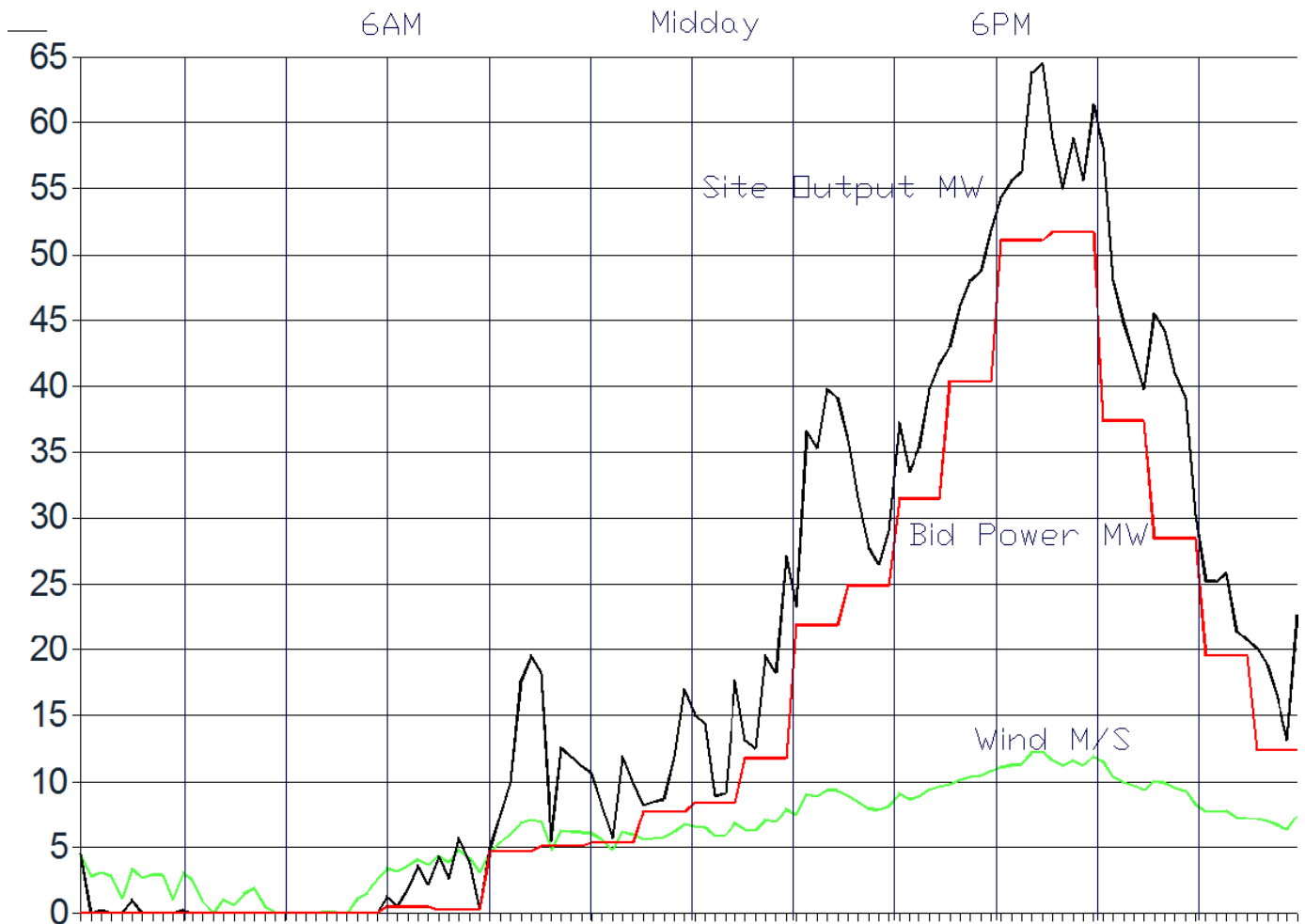
You will notice that these numbers are just over **half** of Mr. Burchetts numbers.

To achieve Mr. Burchetts numbers the average wind speed on the Whararoa Plateau would have to be very nearly 9 M/S. NIWA’s data shows that there is nowhere on the north or south islands of New Zealand that have a 9M/S average wind. Stuart Island manages it, just.

North of New Plymouth there is nowhere greater than 7M/S

Mr. Walters comments that NZ in the ‘roaring forties’ is true for Wellington but luckily for Raglan it is in the ‘Whispering thirties’.

Representative day for Whauraroa Plateau V90 Turbine. Averages the same as annual averages.



Now that we have sensible numbers for the output of the Te Uku project we can work out the really important numbers. I would say that I have used the most optimistic numbers I could find.

Based on 28 turbines and in 2007 NZ dollars. Useful life of 20 yrs, in this location the turbines are unlikely to last longer.

|                                      |   |
|--------------------------------------|---|
| Installed cost (2006 price)          | 168M\$  |
| Installed Cost per MW average output | 11.2M\$   |
| Interest (7% from foreign bank)      | 146M\$  |
| Insurance (UK provider)              | 42M\$   |
| Repair and maintenance               | 45M\$   |
| <br>                                 |   |
| Total Cost                           | 401M\$  |
| Total cost in foreign exchange       | 359M\$  |
| Domestic content                     | 10.1%   |
| <br>                                 |   |
| Total power sold in life             | 2648GWH   |
| Net Cost of power                    | \$152 MWH (Current wholesale prices average about \$50)   |
| Grid effect                          | Severe instability effects.   |
| Environmental effect.                | Very large negative. Visual, noise, wildlife destruction, nuclear energy used for construction. |

**Alternatives to Wind Power.**

WEL say that they have investigated alternatives to wind power. This is not true to any real extent. None of the staff of WEL or their consultants can answer even the simplest questions on obvious alternative renewables suitable for the area west of the deviation.

I have asked both the previous and current CEOs of WEL to provide information and data on the renewable they have studied but have refused even an outline.

I gave details in my submission of one alternative that was ignored.

Mr. Underhill said in a reply to one of your questions on the 19th that they had looked at wood chip generation and that there was enough wood available for “only a few kilowatts”.

Just east of the deviation is an area of 350 hectares of 12 yr pines They need a good thinning and pruning so there is the first 50000 tons of fuel. That is enough for around 85000 MWH 8 months output for the Te Uku wind turbines. More than a few kilowatts I think.

Unlike Mr. Underhill I have looked at the potential wood fuel output for the area west of the Waipa and around the Aotea and Whangaroa catchments. There is about 500,000 tons of thinning and waste available immediately. About 1.2 million tons per year could be available with about 3-4 years warning, without affecting agricultural output!

1.2 million tons/yr is 2000 GWH/yr or the same as 15 yrs output from the wind project. Not a few kilowatts again.

Wood availability is not a problem.

Here are some obvious alternatives in roughly order of economic worth.

I had intended to go into detail about these alternatives but the very short time (5 days) available to prepare this evidence has precluded this.

If the commission is in any doubt that these are real, practical alternatives I have a large amount of detailed information available on all of these options and their means of implementation which I am happy to share. Perhaps Connell Wagner would like to buy the information off me as Mr. Walter said they couldn't find an economic alternative to imported wind turbines

**Alternatives.**

Any of the following requiring wood fuel have this priced at \$70 per dry(15%) ton as this price would guarantee supply. All prices in NZ dollars.

**Aotea Harbour Tidal Barrage.**

|                                      |   |                         |
|--------------------------------------|---|-------------------------|
| Average power output and type        | 6.7 MW  | Predicable intermittent |
| Availability                         | 60%   |                         |
| Installed cost                       | 11.2M\$   |                         |
| Installed Cost per MW average output | 1.67M\$   |                         |
| <br>                                 |   |                         |
| Total Cost                           | 11.2M\$   |                         |
| Total cost in foreign exchange       | 1.3M\$  |                         |
| Domestic content                     | 88%   |                         |
| <br>                                 |   |                         |
| Total power per year                 | 59GWH   |                         |
| Net Cost of power                    | \$30 MWH  |                         |
| Effect on grid                       | Stability enhancement, embedded.                |                         |
| <br>                                 |   |                         |
| Environmental effects                | Small negative. Small positive may be possible. |                         |

Wood chip internal combustion Microgeneration. (typical installation).

|                                      |                                  |
|--------------------------------------|----------------------------------|
| Average power output and type        | 0.2 MW On Demand                 |
| Availability                         | 95%                              |
| Installed cost                       | \$70000                          |
| Installed Cost per MW average output | 0.35M\$                          |
| Total Cost for 5 year life           | 0.39M\$                          |
| Total cost in foreign exchange       | 0.09M\$                          |
| Domestic content                     | 76%                              |
| Total power per year                 | 1.3 GWH                          |
| Net Cost of power                    | \$60 MWH                         |
| Effect on grid                       | Stability enhancement, embedded. |
| Environmental effects                | Big positive, lots more trees.   |

Siemens AG Power Generation Group. Wood chip steam plant.

|   |                              |
|---|------------------------------|
| Average power output and type                 | 44 MW On Demand              |
| Availability                                  | 98%                          |
| Installed cost                                | 195M\$                       |
| Installed Cost per MW average output          | 4.4M\$                       |
| Total Cost for 20 year life (probably longer) | 632M\$                       |
| Total cost in foreign exchange                | 320M\$                       |
| Domestic content                              | 49%                          |
| Total power per year                          | 308 GWH                      |
| Net Cost of power                             | \$102MWH                     |
| Effect on grid                                | Large stability enhancement. |
| Environmental effects                         | Positive, more trees.        |

I can't see why WEL continue with this wind power project. All the above will be eligible for more price support than wind turbines so that can't be the reason.  
 If they want a big prestige project then the Siemens plant is the obvious candidate. This would also provide power independence for the Waikato for the foreseeable future. And it is cheaper to install.  
 The microgen would provide a big cash injection to the local economy.

**Carbon and nuclear derived energy balance.**

Mr. Burchett makes some very wild claims as to the Carbon emission/sequestration status of the Te Uku wind power project. He implies that 168,000 tons of carbon emission will be saved per year and that this will be a short term gain. I assume he means it will go immediately into carbon credit.

I will calculate this from standard publicly available figures and then compare it to the alternatives already mentioned.

I will assume that the turbine itself is built using all non nuclear power, in fact a significant part of the power to manufacture the materials comes from nuclear power.

|                                       |                        |
|---------------------------------------|------------------------|
| Manufacture of turbine head and tower | 2180 tonnes CO2        |
| Transport to NZ                       | 110 tonnes CO2         |
| Mounting and construction             | <u>1400 tonnes CO2</u> |
| Total per turbine                     | <b>3690 tonnes CO2</b> |

**Project total 103320 tonnes CO2 emitted**

Most of this will be emitted a year before the first KW is supplied.

As too which type of power will be displaced. It is not clear how the increase of wind power will displace other generation. It will certainly not displace Huntly as this capacity will be vital to balance the grid if there is much wind power on it.

There is currently 2107 MW Max power of wind turbines (including this project) either built, under construction or under consent process in NZ. This is a number that the current grid configuration cannot possibly handle.

With modifications and upgrade, which will be expensive. The grid may be able to cope with this quantity of erratic power but only with all of New Zealand’s fast response generation on line as well.

Mr Burchett claims that the Hydro Stations will be kept spinning in motor mode (using power) but my conversations with engineers at Transpower suggest that Huntly and the Gas turbine capacity will be the main balance. We may have the ridiculous situation that our green and renewable hydro plants are not being used and venting water because there is a lot of wind power on line.

And just in passing, if we are so short of electricity why have the government just contracted a vast amount at low price for aluminium smelting. This is only done in countries with cheap power to spare.

So if this project replaces any power it will be gas turbine, thermal or hydroelectric. I will assume half gas 30% thermal and 20% hydro.

This gives an emission displacement of 0.1 tons of CO2 per MWH. From the Ministry for the Environment figures.

Per annum this is  $132412 * 0.1 = 13241$  tonnes of CO2 per annum displaced.

Therefore this project will take  $103320 / 13241 = 7.8$  years to get into carbon credit. This is within the range of 3-10 years that is commonly expected (except by wind power lobbyists).

However this is not the end of the story. It is not proper to discount how these projects will be paid for.

Over US\$200M will need to be earned to pay for these turbines. For GDP to remain constant an increase in foreign currency dollar or Euro earnings will be needed of the order of US\$10M per year.

The only practical mechanism open to NZ at the moment in an expansion of dairy output. This is currently usually done by felling central exotic forest to free up the now fertile land that it is on.

About 275 Hectares of deforestation will be required for each turbine. From MAF figures this is:

$275 * 800 = 220000$  tonnes C per turbine = 6.16 million tons carbon = 22 million tonnes CO2 emission.

Life time rate  $21850000 / 2648000 = 8.25$  tons CO2 = **2.27 tons C emitted per MWH.**

### **Carbon Balance of alternatives.**

Time limits apply again, I have more data on this subject as well.

#### Aotea Harbour Tidal Barrage.

Construction 13000 tonnes CO2 emitted.

Power is high quality and reliable so would replace all forms of generation. A general average figure will be used (excluding the awful wind power one!)

$$59000 \text{ MWH} * 0.4 = 23600 \text{ tonnes CO2 per year.}$$

Therefore the Aotea tidal barrage will go into carbon credit in about 6 months and displace 6500 tons of carbon emission per year thereafter.

$$\text{Rate } 6500/59000 = .11 \text{ tons C saved per MW}$$

#### Wood chip internal combustion Microgeneration. (typical installation).

Construction and transport 4.6 tonnes CO2 emitted.

In operation about 5 hectares of forest would have to be planted to supply the wood.

This in the time to first harvest this would sequester about 600 tonnes C.

Ongoing operations would continue sequestration from root and debris of about 80 tonnes C per year.

Therefore if fuel trees were planted at the same time as ordering the equipment it would be in credit immediately and would sequester at the rate of about 110 tons C/yr

Power is high quality and reliable so would replace all forms of generation. A general average figure will be used.

$$1300 \text{ MWH} * 0.4 = 520 \text{ tons CO2 per year.}$$

The total positive carbon balance of this project is 253 tons C positive per year.

$$\text{Rate } 0.4 \text{ tons C saved per MW}$$

#### Siemens AG Power Generation Group. Wood chip steam plant.

Construction and transport 86000 tonnes CO2 emitted.

In operation about 2000 hectares of forest would have to be planted to supply the wood.

This in the time to first harvest this would sequester about 220000 tonnes C.

Ongoing operations would continue sequestration from root and debris of about 35000 tonnes C per year.

Therefore if fuel trees were planted at the same time as ordering the equipment it would be in credit immediately and would sequester at the rate of about 35000 tons C/yr

Power is high quality and reliable so would replace all forms of generation. A general average figure will be used.

$$308000 \text{ MWH} * 0.4 = 123200 \text{ tons CO2 per year.}$$

The total positive carbon balance of this project is 68800 tons C positive per year.

Even if dairy land was formed to pay for this an equal area on poor land could be planted to provide fuel.

$$\text{Rate } 0.22 \text{ tons C saved per MW}$$

## **Summary.**

There is no possibility of any national or public benefit from WEL's Te Uku wind power project.

By objective measure it looks like an economic and power supply disaster as well as an environmental disaster.

Importing and placing these wind turbines will cause significant economic damage to New Zealand.

Operating these wind turbines will cause disruption to electricity supplies and deliver relatively small amounts of power.

The manufacture, transport, placement, and financial arrangements for these wind turbines will cause large emissions of carbon dioxide. This is contrary to stated government policy.

Far better alternatives exist for renewable electricity generation. At least four options exist that:

Cause far less environmental damage, and may even cause environmental improvement.

Generate Electricity far more cheaply and with a much higher domestic content.

Enhance the quality of supply and stability of the national grid.

Both save Carbon emissions and sequester Carbon from the atmosphere.

The Te Uku wind power project does not have an advantage in any of these areas over any of the options.

The application should be refused on the grounds of its potential damage to the economy of New Zealand.