D NATIONAL INTEREST IN RENEWABLE ENERGY

1. Our submission stated;

> ***National Benefit***
>
> *4.8 The proposed development fails to offer national or local benefits that would offset the significant adverse effects of the proposed development, in particular the benefits to be derived from the use and development of renewable energy, and the mitigation of the effects of climate change.*

2. This position is further supported by the Mighty River Power's Statements of Evidence by their various experts, as shown by the following document. To make it easier to follow our arguments, the information follows the format in the Statement of Evidence by Mr Heffernan[1], Chief Executive of Might River Power Limited (MRP). The section description is copied from Mr Heffernan's evidence followed by information that rarely supports the position as written.

3.

4. Mr Heffernan outlines MRP's commercial and environmental objectives and the significance of the proposed Turitea Wind Farm for the New Zealand electricity sector. He notes that MRP as a State Owned Enterprise (SOE) has a statutory objective of being a successful business (para 2.1). One of the MRP's principal objectives is to be as profitable and efficient as comparable private companies. All businesses must make a number of assumptions while assessing the risk factors when making financial and business decisions. It is these risky assumptions made by Mighty River Power which will limit their success in realizing the national and local benefits promised.

[1] Heffernan, M D. 2009. Statement of Evidence of Martin Douglas Heffernan, Before the Board of Inquiry in the Matter of the Resource Management Act 1991 and in the matter of a Board Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

5. Mr Heffernan points out, (para 6.3),

> *While Mighty River Power's generation activities have historically been focused on hydro-electric and increasingly, geothermal generation, we are* currently planning to extend our generation portfolio to include wind farms.

6. Mr Heffernan also notes (para 6.25):

> *The Turitea project is the first significant wind farm development for the company, and I am confident that Mighty River Power has the experience, ability and resources to deliver the Turitea project.*

7. History would indicate that in New Zealand from the Te Rere Hau, Te Apiti and Tararua wind farms, there are a number of risks that these new companies (Trustpower Tararua, Meridan Energy's Te Apiti and NZ Wind Farms' Te Rere Hau) did not have the experience to foresee or mitigate until after post-construction. These included underperforming wind turbine designs, increased levels of unpredicted maintenance and the inability to deliver the amount of electricity that was predicted. By comparison to the Mighty River Power Turitea Wind Farm with 122 turbines of unspecified design to deliver between 236 MW to 366 MW compared to Te Apiti (55 turbines with a total capacity of 91 MW), Tararua 1, 2, and 3 Wind Farms (134 turbines with a total capacity of 161 MW), and Te Rere Hau (97 turbines with a total capacity of 49 MW). Thus there is a fair degree of uncertainty with regard to estimated capacity and thus likely output.

8. A careful examination of the Danish wind farm industry clearly identifies the risky assumptions that Mighty River Power has made in assuming it will be possible to consistently deliver 10% of New Zealand's electricity needs in the next 10 years.

ELECTRICITY DEMAND AND SUPPLY

VARIABLE PENETRATION OF WIND GENERATION AND EFFECTS ON SYSTEM RELIABILITY

9. Mr Heffernan notes (para 5.8) [emphasis added]:

> *It (wind) is a generation type that is currently under-utilized. I note that there is a limit to the proportion of wind generation that can safely be operated within an electricity system before **the natural variability of the resource affects the reliability** of the overall system. However, as described below, I note that this limit is yet to be reached in New Zealand.*

10. This assumption by Mr Heffernan that the natural variation of the wind and system reliability has yet to be reached in New Zealand does not match the experience nor the predictions of Transpower. In the 2009 Transpower Annual Planning Report[2], the issues with proposed wind farms are highlighted in Chapter 12, for the Central North Island Region. (Details are in the appendix.)

Currently

12.6.2 Masterton–Mangamaire–Woodville Transmission Constraint Issue

The circuits can constrain wind farm generation at Te Apiti, and limit the connection of any additional wind farm generation in the area.

12.6.4 Bunnythorpe–Mataroa Transmission Constraint Issue

This circuit can overload for some generation dispatch patterns, such as high HVDC north power flow, full wind generation in lower North Island, low Arapuni generation and the outage of a 220 kV Bunnythorpe-Tokaanu or Tokaanu–Whakamaru circuit.

Future proposals

12.9.5 Additional Generation Connected to the 220 kV Bunnythorpe-Wellington Circuits

There are several investigations and proposals for wind farms connecting to the 220 kV double circuit line between Bunnythorpe, Linton and Wellington. They could be connected at Linton or at new connection points along the line. Examples are the proposed Turitea wind farm near Linton and Puketiro (in the Wellington region).

This is a high capacity line and the effect of some additional generation on transmission capacity between Bunnythorpe and Wellington will be a small net percentage increase or decrease in transfer capacity, depending on the direction of power flow.

However, the wind generation resource under investigation is so large that, due to transmission constraints, it is unlikely to be economic to connect it all to this line.

[2] Transpower New Zealand Limited, 2009. 2009 Transpower Planning Report. http://www.transpower.co.nz/f2461,11681814/11681814_annual-planning-report-2009.pdf, 16 May 2009

11. Mr Henry [3] (para 2.9) describes the Turitea site as being within:

> *close proximity to Transpower's existing Linton substation, which provides direct access to the national grid. Mighty River Power has had discussions with Transpower, and has been advised that the Linton substation is capable of accommodating the expected transmission from the Turitea Wind Farm.*

There appears to be a gap in the 2009 Transpower Planning Report on the economic viability of the transmission constraints compared to the capability to connect.

> *12.9.6 Additional Generation Connected to the 110 kV*
>
> *There are several possible wind farm sites close to the 110 kV transmission circuits which go from Mangamaire to Woodville, Dannevirke and Waipawa.*
>
> *At times the existing 90 MW Te Apiti wind farm which connects at Woodville uses all the available transmission capacity, even with the use of generation runback schemes.*
>
> *Any new generation connected to the 110 kV transmission circuits may occasionally cause generation constraints. Reconductoring the 110 kV Masterton–Mangamaire–Woodville and Bunnythorpe–Woodville circuits allow approximately 110 MW of additional generation to be connected. Higher levels of generation may require new lines.*
>
> *12.9.7 Puketoi Ranges*
>
> *There are several prospective wind farms in the Puketoi ranges, with a combined capacity of many hundreds of megawatts. There is no nearby transmission system, with the closest lines being the 110 kV transmission network (see Section 12.9.6). If wind generation is developed in this area, then it is possible that there would be a single*

[3] Henry, M A C. 2008. Statement of Evidence of Mark Alan Clive Henry, Before the Board of Inquiry in the Matter of the Resource Management Act 1991 and in the matter of a Board Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

new transmission line connecting all the wind farms to the National Grid at Bunnythorpe.

Generation from the Puketoi ranges could also connect along the double circuit 220 kV line from Bunnythorpe to Wellington. However, care would need to be taken that the total generation from the Puketoi ranges, plus other generation along the 220 kV Bunnythorpe–Wellington line does not become too high (see Section 12.9.5). It is also possible that some of the 110 kV lines may be rationalised as part of this work.

12. Further to the practical issues with the grid and the variability of wind generated electricity, the Transpower system operations manager, Kieran Devine, was reported in the Taranaki Daily News on 11 June 2008[4] as implying that the natural variability of the wind does affect the system reliability:

"The country's three major farms, clustered around the Manawatu Gorge, supplied less than one per cent of their capacity during peak load periods during the past three winters, 2005-07. The highest peaks occurred in the North Island on cold, still weekday evenings, for three to four hours, starting between 5:30 pm and 6:30 pm. This is when electricity price also hits a peak. There was not enough wind blowing at those times to turn the blades fast enough.

13. The apparently flawed peak winter performance of existing wind farms has come out of the first three years of a 10-year wind generation investigation project. Mr Devine says turbines on the Manawatu wind farms all behaved similarly, running up and down the generation scale together.

'Either there was insufficient wind at that time, or the current farms were all in the wrong locations and there's not enough wind system diversity,' he says. 'We have real concerns about the large amount of wind generation planned in the lower North Island, because the preliminary information is that they will all have very similar characteristics to the Manawatu farms and that won't help with

[4] Wood, R. 2008. Wind farms don't ease power peak. Taranaki Daily News, 11 June 2008.

winter peaks. We'd prefer they were spread around so that when one's up others will be down and it would balance itself out.'

14. Mr Devine described that power planners are just beginning to discover what wind is all about because the detail needed for wind farm management has never been required in the past.

'*In the long term, wind is very reliable, but in the short term you can never count on it being there when you need it in forward forecasting.'"*

15. The issue is not just the total percentage of total generation that defines the sustainability and "risk" levels of wind farms. Wind farm energy generation is much more complex than that as exemplified by the Danish example which Mr Heffernan alludes to (para 5.9) but does not accurately define. Subsequently it is important to understand the wind farms in Denmark to better appreciate the potential of wind farms, or not, in New Zealand.

16. The experience and expertise of the Danish Wind Industry Association provides a relevant model for wind generated power in New Zealand. As Mr Heffernan, points out, Denmark does currently produce approximately 20% of their current power from wind. The Danish government's energy policy as a vision of 50% of the electricity demand supplied by wind turbines in 2025[5], which is over two times the current capacity, the majority of which will be off shore. The company Ea Energy Analyses, in co-operation with the energy company SEAS-NVE, carried out a number of analyses for the Danish Wind Industry Association to quantify the costs and benefits to meet the 50% target.

17. A key question that the study was hired to answer is "How is it physically possible to integrate the wind power into the Danish electricity system?". The success of the integration assumed that a) the energy system reserves functions internationally across country borders, b) the main electricity grip is adequate and no new overhead lines must be created, and c) the Danish electricity market in 2025 *drops* by approximately 0.4 euro cent per kWh. In addition, the Danish government must continue to subsidize wind power and that in addition Finland, Norway, Sweden and

[5] Ea Energy Analyses, 2007, 50% Wind Power in Denmark in 2025 – English Summary. http://www.windpower.org/media(2513,1033)/081029_50pct._windpower_in_dk_in_2025.pdf 16 May 2009.

Germany have to increase their wind production to 14% of their respective countries energy consumption. The Danish model also assumes the benefit of the CO_2 quota price of €20 per tonne for the whole period and that it remains a net exporter of electricity from wind and the new turbines are located offshore in the sea.

18. The model is also noteworthy that it takes the overall annual energy costs for the needs of the electricity and heat in all the five countries, not just Denmark. And in general, the electricity producers, seen as a whole, ***will lose*** *by increased wind power* (emphasis by TAG) while consumers will reap a gain due to lower electricity prices and indirectly in the form of increased congestion rents that accrue to the transmission system operators. This Danish system is a very complicated system that cannot be superficially quoted as an example for the benefits that might occur for New Zealand.

19. The Ea Energy Analyses report emphases that this model is limited by the *"available transmission system infrastructure" and that investment is outside the model being investigated.* The other key aspect of the Danish proposal may require new biomass thermal plants to be established to handle the fluctuation of the wind energy because the variable nature of wind energy prevents balancing of the energy requirements to meet market demand, as well as continuing to use the international transmission grid.

20. The west and east Danish wind power grids and electricity market depends on the integration and management of electricity with four neighbouring countries (Denmark, Norway, Sweden, Finland and Germany)[6]. The hydropower of Sweden and Norway are a power sink to handle the highly variable wind power from Denmark. According to the Sharman (2005) review, *it is unlikely that the Danish wind generation would not have been viable without this energy balancing interconnection that already existed prior to the development of the Danish wind farms.*

21. In addition, "Hydro is a good match for wind power and both of these countries are well placed to accommodate a large penetration of wind capacity in the future." (Sharman, 2005) Therefore, Denmark does not need to install peak-load plant to balance its wind power. Instead, it sells its power to the other nations and then purchases power back from its

[6] Sharman, H. 2005. Why wind power works for Denmark. Proceedings of ICE Civil Engineering, 158, 66-72, Paper 13663. http://www.incoteco.com/upload/CIEN.158.2.66.pdf 16 May 2009.

neighbours when necessary, all on lines that were developed between Norway, Sweden and Germany prior to the development of the major Danish wind farms!

22. New Zealand does not have any of the transmission capabilities or infrastructures that already exist in Denmark and Northern Europe. For Mr Heffernan to use Denmark as an example without detailing how the interdependencies and cost structures work for wind generation of electricity in Denmark is mischievious. As already noted in the 2009 Transpower Planning Report, even at 2.5% of the total energy from wind, there are problems with the grid handling the power fluctuations, and there is no provision to handle future fluctuations as the electricity from wind farms increases [emphasis added]:

> *Section 5.6* ***The nature of electricity is such that demand and supply must be balanced instanteously at all times.*** *Electricity generation capacity needs to have sufficient diversity to provide security of supply at all times, regardless of the circumstances. …The large dependence on hydro-power in New Zealand can lead to electricity supply shortfalls, during 'dry' years. Increasing the amount of wind powered generation helps to diversify New Zealand's electricity generation options.* ***The diversification of plant location also reduces the country's exposure to particular weather conditions present in a particular location.***

23. The detailed analysis of the Danish wind energy system by Ea Energy Analyses (2007) emphasizes "Large amounts of wind power may challenge the reliability of the electricity system as production changes rapidly and unexpectedly. Wind power can, however, also challenge the system's adequacy in the way that the power station capacity may be missing when consumption is high and there is no wind." The reports concurs that "*system reliability* and *system adequacy* are the more important elements of security of supply in the electricity system." (The italics are from Ea Energy Analyses).

24. The lack of wind predictability and the negative impact on the balance of demand and supply is worldwide. This very problem has prevented wind developers from wind farms in the Northern Plains of the United States for over 30 years. Rob Benbow, grid manager at Midwestern Independent

Transmission System Operator, (which is like an air traffic control tower for the electric grid in 13 states[7] describes:

> *"My biggest fear is that you see a 20 percent wind on your system, and then it comes off at a time period when you don't have any resources to replace it – that's going to, could, result in a blackout situation",*

25. The article continues,

> *"Grid operators cannot order wind plant to produce like they can other power plants. Lots of other things about wind frustrate the Benbows of the world – wind blows hardest at night when electricity demand is the lowest, there currently aren't ways to store wind for later use. 'You can put all that wind in, but I still need to have all this other generation that I need to have available – all my coal, nuclear, all the gas – for my peak load day,' Benbow adds. So when Benbow thinks about the new wind turbines and new transmission lines carrying their energy toward his control room, he sees more than clean energy. He also sees a lot of headaches coming his way."*

26. This lack of wind reliability has created the new green challenge in the United States, so that the US Department of Energy is putting more than US$600 million from the government's stimulus package into storage technologies, consistent with the Obama administration goal to create a greener energy economy.[8] As noted worldwide, "Here's the problem: Solar and wind power are intermittent. Sometimes it is sunny, sometimes it's not, and it's the same for wind. But the grid needs constant reliable sources of power."

27. The assumption stated by Mr Heffernan (para 5.6) and Mr Layton (2009)[9] (para 2.7) that

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[7] Shogren, E. 2009. The challenge: Constant current from fickle winds. NPR Morning Edition. April 28, 2009. http://www.mpr.org/templates/story/story.php?storyId=103575144"

[8] Joyce, C. 2009. A green challenge: Making renewables reliable. In all things considered – NPR. April 27, 2009. http://www.mpr.org/templates/story/story.php?story...

[9] Layton, T. 2009. Statement of Evidence of Thomas Brent Layton, Before the Board of Inquiry in the Matter of the Resource Management Act 1991 and in the matter of a Board Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

“*The large dependence on hydro-power in New Zealand can lead to electricity supply shortfalls, during ‘dry’ years, increasing the amount of wind powered generation helps to diversify New Zealand’s electricity generation options.”*

This was not the case in analysis of wind energy by Leyland (2008). He reported that during the typical dry period of March to August in New Zealand when the lake levels are most likely to be low and there is a risk of serious hydro shortage, that is when, on average, the outputs from the New Zealand wind farms, i.e. Manawatu wind farms, is 9% below annual output. This wind decrease was shown graphically with five years of wind data from 2000 to 2004 in Leyland’s (2008) Exhibit 1. Plus, consistent with the snow melt increase into the hydro lakes, the wind farms’ ouput is highest during the spring time.

28. Wong Too (2009)[10] attempts to make the point:

> *The proposed wind farm will not be located in completely the same geographic area as the other wind farms, and its output will not be completely “in sync” with the existing wind farms. For example a weather system may affect the proposed wind farm some minutes or tens of minutes earlier or later than it does the existing wind farms. Thus the proposed wind farm will therefore add some diversity to the output of the existing wind farms (although I acknowledge that this benefit is not as great as it would be if the proposed wind farm were more distant from existing wind farms).*

29. This is contrary to the comment of Mr Heffernan (para 5.6):

> *The diversification of plant location also reduces the country’s exposure to particular weather conditions present in a particular location.*

when all four major wind farms will be on the Tararua and Ruahine ranges in the Manawatu.

[10] Wong Too, P. 2009. Statement of Evidence of Philip Wong Too, Before the Board of Inquiry in the Matter of the Resource Management Act 1991 and in the matter of a Board Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

30. In para 5.10 Mr Heffernan notes:

> *that while there are daily fluctuations in wind generation, Mr Wong Too, of the international wind consultancy from Garrad Hassan, notes that the Turitea wind farm will be generating at some level for 90% of the time. Current atmospheric weather forecasting techniques enable major variations in wind conditions to be predicted days in advance. Other forms of generation can be therefore be dispatched to cover predicted dips in output from wind farms. Further, there is the natural synergy between hydro and wind power generation in that the potential energy output from a hydro plant can be stored when the wind energy is available.*

31. There are a number of points to address with more information in Section 5.10, as some of the information is misleading or not supported by the facts.

32. Firstly, while the comment that Turitea will be generating **at *some level*** *for 90% of the time,* is probably true, it is also misleading as noted by Leyland (2008). Leyland was able to calculate that Meridan's Te Apiti wind farm in the Manawatu was able deliver at some level for 90% of the time, which translated "the wind farm seldom operated at anything near its maximum capacity" most of the time. The reason for this type of "maximum capability jargon" may be because conventional power stations report the capability to operate at maximum capacity whenever required. Conventional power stations typically report a high confidence of 95% whenever required. **By contrast a wind farm can report a high confidence of 4% of installed capacity whenever required** (Leyland, 2008) which reads somewhat differently from "deliver at some level for 90% of the time".

33. The next questionable statement is "Current atmospheric weather forecasting techniques *enable major variations in wind conditions to be predicted days in advance."* Common sense indicates that this is not a logical statement when it comes to weather in New Zealand, or elsewhere in the world. Sharman (2005) reported that both Britain and Denmark experiences difficulties with weather forecasting, and that wind forecasting to the requirements of a transmission system operator is a major challenge even as the best mean average wind speed can only be predicted to within 1 m/s. As a result the West Denmark transmission system operator, ELTRA, is making significant investments to improve wind forecasting and that it is a 10 to 15 year project. There is no evidence that New Zealand is

ahead in the weather forecasting, and particularly the wind forecasting business, as exemplified by the current issues with the Manawatu wind farms in 2008 already noted in the 2009 Annual Planning Report by Transpower highlighting current issues

> *12.6.2 Masterton–Mangamaire–Woodville Transmission Constraint Issue*
>
> *The circuits can constrain wind farm generation at Te Apiti, and limit the connection of any additional wind farm generation in the area.*
>
> *12.6.4 Bunnythorpe–Mataroa Transmission Constraint Issue*
>
> *This circuit can overload for some generation dispatch patterns, such as high HVDC north power flow, full wind generation in lower North Island, low Arapuni generation and the outage of a 220 kV Bunnythorpe-Tokaanu or Tokaanu–Whakamaru circuit.*

34. Mr Heffernan correctly points out that it is necessary to counter this lack of wind predictability with "*Other forms of generation can be therefore be dispatched to cover predicted dips* in output from wind farms. Further, there is the *natural synergy between hydro and wind power generation in that the potential energy output from a hydro plant can be stored when the wind energy is available."* The critical coupling of hydro and wind is supported by the studies on Denmark wind energy by both Ea Energy Analyses (2007) and Sharman (2005), to the point that it is <u>only</u> this hydro synergy that makes wind energy economically viable in Denmark.

35. The issue remains that hydro is the only easily "energy storage" system to handle the variability of electricity supply with wind farms. However, New Zealand does not have the readily accessible and built in access to the major hydro facilities in Norway and Sweden and Mighty River Power has noted that there are very few new additional hydro opportunities.

36. Furthermore, the New Zealand hydropower storage amounts to about six weeks electricity demand, compared to the hydro stores in Norway up to three years (Leyland, 2008; Sharman, 2005). Plus the peak time for hydro storage and wind power is in the spring in New Zealand, which means the hydro storage capacity capability in New Zealand is marginalized. If the lakes are full, then the wind power that could be stored will be lost. The alternative is to spill the hydro power and use the wind energy.

37. New Zealand also has a problem that to store the additional wind energy at peak times requires transmission down the grid to the South Island hydro lakes, where the energy is not needed. Then when the energy is needed in the North Island, the energy needs to be transmitted again back through the lines with the corresponding loss if energy on the return route. The New Zealand wind-hydro storage does not offer the synergy and balance of power that the Denmark links with the Norway and Sweden hydro lakes deliver.

38. Mr Heffernan describes in para 5.2:

> *New Zealand is an island nation. It is distant from its nearest neighbours and as such has limited capacity to rely on imported fuels. This is quite different to the situation in most other developed nations. The economics of establishing full interconnection mean that New Zealand must, with the exception of a few fuel sources that can be transported by sea, be self reliant*.

39. Sharman (2005) research on the issues of being an island nation, and the constraints that brings to a country's energy needs, results with a very different conclusion than Mr Heffernan proposes. "Denmark is exporting most of its widely fluctuating wind power to large neighbours while finding other solutions for supply and demand at home. As an 'island' grid based on slow-reacting thermal power stations, Britain may find its comparable wind-power aspirations more difficult to achieve." (Sharman, 2005)

40. New Zealand shares many of those same constraints as another 'island' grid, without any way to balance the well accepted and well known wind fluctuations with generating electricity. Neither Britain nor New Zealand is proposing to rely on imported fuels. Nor should New Zealand assume that our island grid systems will sustain wind farms with the assumption of sustainable energy, which has not been proven as viable given the limitation of our current systems. New Zealand has not addressed the requirement to store wind energy, most likely with hydro capability, if we are to balance the widely fluctuating wind.

IMPORTANCE OF A DIVERSE GENERATION PORTFOLIO

In para 5.5 Mr Heffernan says [emphasis added]:

> *In fact, the focus on one fuel at the expense of others merely lead us to another "crunch on another day". The key to avoiding this situation is to have a mix of fuels that are available to support an*

*integrated electricity generation portfolio to reliably meet demands **at all times".***

41. The Transpower 2009 Annual Planning Report (APR) outlines New Zealand's goal to have a mix of fuels for an integrated electricity generation portfolio. The APR provides information about:

    - the capabilities of the existing National Grid;
    - demand and generation forecasts for the next 10 years;
    - the National Grid's ability to meet future demand and generation needs;
    - National Grid investment that may be required to meet future needs for the next 10 years and beyond, by way of:
    - grid backbone transmission plans for the main North and South Island transmission corridors, and for the HVDC link; and
    - thirteen regional plans.
    - the role of the transmission grid in facilitating renewable energy; and
    - Transpower's earlier work on a long term strategic development plan for the National Grid.

    The APR represents information available up to 28 February 2009.

    6.2.2 Committed New Generation

    Table 6-2 lists the committed grid-connected generation projects. Committed projects are those which are reasonably likely to proceed and where the following are satisfied:

    - *all necessary resource and construction consents have been obtained;*
    - *construction has commenced or a firm date set;*
    - *arrangements for securing the required land are in place;*
    - *supply and construction contracts have been executed; and*
    - *financing arrangements are in place.*

    The Commission also uses the same criteria to define committed projects.

Table 6-2: Committed New Generation

Generation Plant	Region	Fuel	Installed Capacity (MW)	Grid Injection Point	Assumed Commissioning Date
West Wind	Wellington	Wind	144	Makara	2009
Te Rere Hau 2-3 [1]	Central	Wind	31	Linton	2009
Nga Awa Purua	Central	Geothermal	132	Wairakei	2009
Benmore refurbishment.	South Canterbury	Hydro	11	Benmore	2009
Centennial Drive	Central	Geothermal	23	Wairakei	2010
Stratford peaker	Taranaki	Gas – OCGT	200	Stratford	2010
Te Rere Hau 4	Central	Wind	17	Linton	2010
1 This includes the 2.5 MW installed in 2006, but which was not grid connected till 2008					

42. Only West Wind and Te Rere Hau feature in the mixture of Committed New Energy Generation for the country. However, Transpower also looks to the future with the generation of five possible scenarios. (The details of these scenarios are included in the appendix and the Turitea Wind Farm does not appear until 2021 or 2020 in Scenarios 1 and 2.)

The 2008 Statement of Opportunities (SOO) Generation Scenarios

The Commission developed five new generation scenarios for the 2008 SOO, each depicting a different future path for New Zealand's electricity industry to 2040.

The scenarios are:

- *Scenario 1: Sustainable Path*
- *Scenario 2: South Island Surplus*
- *Scenario 3: Medium Renewables*
- *Scenario 4: Demand-side Participation*
- *Scenario 5: High Gas Discovery*.
-

Individual scenarios are not intended to represent likely outcomes, but as a group represent generation patterns that may develop. For example, the High Gas Discovery scenario does not necessarily represent what the Commission expects if gas becomes the major future fuel for generation plant, but rather, it represents a pattern that may emerge.

43. Mr Heffernan describes (para 6.15):

Compared with geothermal energy, wind energy is less geographically constrained.

However, as Mr Wong Too, discusses in his evidence, there are only a limited number of sites available in New Zealand that are suitable for the development of wind farms. Suitability for a wind farm requires much more than a windy area. The wind must be of a relatively constant speed and direction. Where possible, it is desirable that the wind farm be located so that it can easily be connected to the national grid and near to potential consumers of the electricity, in order to minimize transmission losses.

44. The importance of the national grid, has been discussed in detail, especially relative the Linton and Bunnythorpe grid points. In addition, the electricity supply issues of the Auckland area was clearly emphasized when the massive Hauauru ma raki wind farm in the Waikato west coast was unlikely to proceed even if consents were granted.[11] The Contact Wind and Contact Energy counsel, Trevor Robinson, reported that the dollar cost per unit of electricity of the turbines was greater than from geothermal developments or other wind farms, which could generate more efficiently. Ironically, one of the points of the evidence was that the HMR proposal would inject electricity into the national grid north of Huntly, and avoid transmission constraints of the south in feeding directly into Auckland. Of further importance is that Judge Smith understood that it was impossible to avoid transmission system constraints because wind power was generally substituted for hydro loading, in which case the constraints to the south would still be a major issue.

MIGHTY RIVER POWER'S GENERATION PORTFOLIO

45. MIGHTY RIVER POWER'S WIND DEVELOPMENT ASPIRATIONS

a. *Section 6.17* Mighty River Power believes wind can supply 10 per cent of New Zealand's electricity needs within the next 10 years and will contribute to enhancing New Zealand's economic and social aspirations.

b. *Section 6.19* To assist in realizing our wind development aspirations, Mighty River Power has invested significant time and money in developing

[11] Holloway, B. 2009. Wind farm no sure thing. Waikato Times, April 28, 2009. http://www.stuff.co.nz/waikato-times/news/2368926/...

expertise in this area and has put together an in-house team of highly qualified experts with significant wind development experience from both New Zealand and overseas.

c. *Section 2.8* With the support of highly qualified wind development team established within Mighty River Power, the company has selected seven prospects for wind generation from over 250 potential sights investigated. These prospects are located in the Wairarapa, Central North Island, Taranaki Coast, Northland, Wellington, Marlborough and Manawatu, including Turitea. A comprehensive programme of wind monitoring and feasibility investigations is underway at all these sights.

46. Much work remains to be done in determining the exact wind farm design, even the model of the turbine has not yet been chosen (para 2.4 Mr Wong Too). The wind monitoring programme, while noted as being deliberate and methodical, at the Turitea site, has only seven masts set up to cover a distance of 14 kilometres on the northern Tararua Ranges. Whether the positions of these monitoring masts are representative of the proposed wind turbine positions remains to be seen. Furthermore, the accuracy of the wind flow models tend to decrease with increasing distance from the monitoring locations, particularly in areas of complex terrains, such as the proposed Turitea Wind Farm (para 3.3, Mr Wong Too).

47. Model accuracy may also be adversely affected where the terrain at the proposed turbine locations differs significantly from the monitoring positions, as it clearly the case with the Turitea Wind Farm when comparing the location of the seven masts on the ridges to the topgraphical map of the total region. This requires a mathematical model of a “worst case” position based on “best case” mast positions (para 3.4 Mr Wong Too).

48. While Wong Too (para 5.4) reports the wind in the proposed Turitea Wind Farm the most exceptional due to the high mean wind speeds typically exceeding IEC Class 1A wind speed of 10m/s. These wind measurements are in the most arduous standard of IEC Class 1A. An IEC (International Electrotechnical Commission) Class 1A, denotes the greatest wind speed and turbulence class for wind farms. It is also noted that a number of the New Zealand wind farms require site-specific assessments of the turbine loads because the wind conditions in New Zealand do not fit into the standard IEC Classes. This would be consistent with the continual changes, break downs and new designs installed at Te Apiti, Te Rere Hau and Tararua with a wind speed of close to 10 m/s in the ranges in the

Manawatu. In short, the wind conditions at Turitea are too extreme and will result in extreme wear and tear of turbine components leading to reduced output.

49. Wong Too (para 5.4) clearly points out that the high mean wind speeds at the Turitea site are likely to mean that a site specific assessment of turbine suitability is required during the detailed design and construction phase. This can be translated that there are no current designs for these types of conditions and that Turitea Wind Farm will be the fourth wind farm in the Manawatu to be a testing ground for prototype turbines constructed overseas using hypothetical models that were not created in New Zealand for New Zealand conditions.

50. Having the most excellent wind conditions does not ensure Turitea Wind Farm will also have the most excellent turbines. There is always a trade-off between over-engineering for maximum conditions, such as Turitea, and the cost constraint of targeting for the 80:20 rule. As implied by Wong Too (2009), a number of assumptions were required when calculating the energy and economics of the Turitea Wind Farm, since the design of the turbines is yet to be determined. At this time standard turbines, 2.3MW, 2.5MW and 3.0MW, were used for the energy calculations, with the assumption that somewhere amongst these turbines, a design could be decided.

51. Wong Too (2009) assumes high capacity factors of 44% to 47% based on his company's (Garrad Hassan) proprietary model, in spite of the other Manawatu wind farms performing at less than 40%, and closer to 35%, when they also originally had optimistic high capacity factors of about 45%.

52. The Ea Energy Analyses (2007) continues to emphasize that wind power is in principle a challenge to security of supply when changes in the wind have not been predicted and when there is not enough wind to meet high demand for electricity. In the Nordic countries, interaction between wind power and hydropower increases the security of supply in all countries by ensuring that there is no lack of electricity in dry years and no lack of capacity in Denmark during calm periods.

53. The value of wind power to system adequacy is dependent on how much the wind is blowing when the demand is the highest. In 2006, the Danish wind power installations operated at approximately 35% of their maximum capacity. However, since the 35% could not be guaranteed at 35%, today **the Danish wind power only contributes to adequacy with a capacity**

value of zero (Ea Energy Analyses, 2007). [emphasis added] By contrast, evidence from the actual operation of the New Zealand power system shows the investigations tend to overestimate the wind power capacity that will be available during system peaks (Leyland, 2008). Consequently, Transpower have also assumed that no wind generation will be available during critical peak demand periods (Exhibit 9 from Leyland, 2008).

54. *Surely this is not the type of electricity delivery we need as a country when embarking on these bold assumptions on how wind energy will meet our target to have 90% renewable energy by 2025, if we can only put in zero capacity value during critical peak demand periods. And with Mighty River Power implying this allows security of supply.*

55. **The approach of Transpower to assume no wind generation during critical peak demand periods**, appear to be at odds with the assertion of Mr Pollock in para 118

> *"I consider that the proposal is consistent with the objectives and key policies of the NPS (National Policy Statement)"*

which he previously explained as only applies to the assets of Transpower as operator of the national grid. Mr Pollack goes on to say (para 120)

> *"In my opinion little weight can be accorded to the specific provisions of this document (i.e. the NPS for Renewable Electricity Generation, proposed on 6 September 2008) given its early stage of development.*

56. Leyland (2008) also emphasizes the extra frequency keeping costs are higher with wind plants than other plants such as hydro due to the unpredictable with wide fluctuations.

a. Mr Heffernan describes how (para 6.17)

> *Mighty River Power believes wind can supply 10 per cent of New Zealand's electricity needs within the next 10 years and will contribute to enhancing New Zealand's economic and social aspirations.*

57. The Turitea Wind Farm promises to supply 2.1% to 3.4% of the renewable energy. Thus, other sites are therefore targeted for development by the applicant in order to supply the remaining 7% to 8% necessary by 2019 in addition to the Turitea Wind Farm. These additional sites are outlined by Mr Heffernan in para 6.21 and 6.22:

Mighty River Power began investigating potentially feasible wind generation sites in 2003. During these initial investigations, more than 250 potential sites were originally considered. Of these 250, seven prospects were selected as potentially viable for wind generation.

These prospects include sites in the Wairarapa, Central North Island, Taranaki coast, Northland, Wellington, Marlborough and Manawatu (including Turitea). A comprehensive programme of wind monitoring and feasibility investigation is underway at all of these prospects.

58. However, Mr Pollock (2009) clearly insists that

> "I consider it inappropriate and unnecessary to consider alternative locations for the wind farm given the quality of wind resource available on the site."

There are alternatives sites and we envisage that they are likely to cause less significant and adverse effects than the proposed Turitea site.

NATIONAL SIGNIFICANCE OF THE TURITEA WIND FARM

Section 8.1 The Turitea Wind Farm…will consist of up to 122 wind turbines and, *depending on the final turbine technology selected,* will have a generating capability of 280-336 MW. Once operational, the Turitea Wind Farm will generate between 1000-1365 GWh per year, providing enough renewable energy to power approximately 140,000 homes. In terms of the electricity needs of a city, the wind farm will provide sufficient energy for the size of New Plymouth.

59. The average capacity figure for most current wind farms are around 0.31 (White Hills), 0.34 (Te Apiti) (Leyland, 2008), 0.20 (West Denmark, Sharman, 2005). Wong Too (2009) offer higher figures of 0.40, for the same time period for Te Apiti and 0.44 and 0.45 for Tararua. Therefore the assumptions on the actual figures become even more critical.

60. Assuming the optimistic figure of 336 MW is used, as was typically the case in the Statements of Evidence by Pollack (2009)[12], Wong Too (2009)

[12] Pollack, G. 2009. Statement of Evidence of Gregory Francis Pollock, Before the Board of Inquiry in the Matter of the Resource Management Act 1991 and in the matter of a Board Inquiry appointed under s146 of the Resource

and Henry (2009) emphasizes the most optimistic figure based on a capacity figure of 0.45. The lower figure of 0.33 proposed by Layton (2009) as part of his Statement of Evidence for Mighty River Power, is clearly closer to the actual performances of the plants in the Manawatu as reported by Leyland (2008).

61. The more optimistic number of 336 MW being publicized by Mighty River Power, without reference to the anticipated range that could be lower. This was clearly the case in the Turitea Wind Farm Update May 2009 enclosed in the free local Manawatu newspaper, The Tribune, on 17 May 2009 delivered to all of the district. There was no mention of the lower 0.33 estimate of energy delivery of 812-1108GWh reported by Layton (2009) and conveniently omitted by Heffernan, which would decrease the capacity to power 112,000 homes.

62. While it is nice to think of the energy going to the lower or central North Island, it is clearly stated by Layton (2009) that the demand growth is not in the Central Region, but to other regions with demand, i.e. Auckland, and that the benefits of the additional generation are more national, than local, in scope. So while Mr Pollock (para 242) emphasizes:

> *the Turitea Wind farm will generate electricity close to the source of demand (that is, the North Island)'*

that is in comparison of being in the North Island, rather in the South Island.

63. Mr Heffernan describes (para 8.2):

> *Generation from Turitea wind farm will contribute significantly to meeting New Zealand's ongoing electricity demand. Based on an historical demand growth of 2% per annum the wind farm will satisfy the requirements for at least one year of demand growth.*

64. As reported by Mr Layton (para 3.6):

> *'the Turitea Wind Farm, at its maximum 336 MW capacity will deliver 2.3% to 3.1% of the annual generation for New Zealand,*

Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

Just slightly more energy than New Zealand needs to satisfy the growth rate. Using this definition of significant, it is suggested that there will be a necessity for the installation of approximately 122 3MW turbines in New Zealand every year, in order to meet the growth at 2% per annum. If all seven of sites identified as ‘world-class’ by Mighty River Power are installed annually for the next seven years, and if they are as good as the Turitea proposal is presumed to be, New Zealand has only just met the 2% per annum energy growth, and the best wind resources will have been exploited. This is a very risky approach, given Transpower’s historic approach to put in wind farm capacity as zero for peak times.

65. Mr Heffernan describes (para 8.3):

> *This proposal will contribute significantly to the Government’s current renewable energy objectives, including its goal of achieving 90% renewable energy by 2025. It will also assist in minimizing New Zealand’s greenhouse gas emissions.*

As explained by Dr Layton, it the Turitea Wind Farm is installed at it potential installed capacity (336MW), at 45% utilization, it could displace in a year around 0.5 million tonnes of CO_2 that would otherwise be emitted from a gas fired plant, or over 1 million tonnes from a coal fired plant.

66. According to Dr Layton (para 7.6), there is a:

> *specific target to raise the proportion of electricity generation obtained from renewable resources to 90% by 2025, from around 70% at present*

67. Dr Layton (para 7.8) also highlights that while the current government will support the 90% renewable target, they will not let the target get in the way of security of supply, or economy for the sake of a number. It is also noted that New Zealand will continue to need the constant reliability of thermal generation. (www.national.org.nz) Both these statements are quite significant, since the Turitea Wind Farm, which is proposed to be the largest in New Zealand, will only supply 2% to 3% more renewable energy, at the risk of not being able to provide security of supply due to the lack of ability to supply at peak critical demand.

68. Dr Layton (para 6.29) carefully explains that Turitea Wind Farm would reduce CO_2 emissions between 0.35 million tones and 0.5 million tonnes from a gas fired plant or 0.8 million to 1.1 million tonnes, which while it sounds impressive is only 1.6% to 2.2% and 3.9% to 5.3%, respectively, of the 21.7 million tonnes of CO_2 equivalent of New Zealand’s emissions over

the first Kyoto commitment period. The uncertainty and later government's estimate re-establishment of 9.6 million tonnes of CO_2 less than the target, gives further uncertainty on how much wind farms may contribute to the economic value of emission reductions.

69. As noted by Layton (2009), assuming New Zealand continues to honour its international commitments under Kyoto, wind farms are better than new thermal plants, although the benefit may be relatively small. However, any data on hydro plants and their impact on CO_2 emissions is lacking from Dr Layton's Statement of Evidence. We can assume that a hydro plant would be closer to a wind farm than a thermal plant for CO2 emissions and the impact on New Zealand's greenhouse gas emissions. Again, Mr Heffernan only highlights the most optimistic of the figures from the application and does not provide a context to the magnitude of those figures of the overall picture, as in this example the green house gas emissions.

70. Mr Heffernan describes (para *8.4):*

> *Due to its location close to demand, the generation of electricity at Turitea will offset more expensive generation (in terms of transmission losses) from the South Island. This has the potential to put downward pressure on wholesale electricity prices, resulting in financial benefits for consumers in the region and in the nation, in terms of lower energy costs.*

71. According to Layton (2009) at the lower utilization of 33%, the LRMC (long run marginal cost) of the Turitea Wind Farm at $94/MWh is worse than a new gas-fired plant ($86/MWh) and slightly better than a coal-fired plant ($102/MWh). As already established the 33% figure is closer to reality under the Manawatu wind conditions compared to the aspirational, approximate 45% capacity figure that all the Manawatu wind farms initially have proposed. Leyland (2009) makes the point that when the value of the emissions reductions are included the Turitea Wind Farm is closer to a new gas-fired plant. While these figures are competitive between thermal and wind energy, no figures are provided for hydro power. It is noteworthy to note that Mr Pollock, Mr Henry and Mr Heffernan do not refer to any of the more conservative and realistic estimates backed by actual wind farm data from the Manawatu, when reporting mainly the most optimistic of Mr Layton's evidence on renewable energy and New Zealand commitments under the Kyoto Protocol.

72. Mr Heffernan describes (para 8.5)

> *The significant increase in regional self-sufficiency will also improve regional energy security by reducing load on existing transmission infrastructure, as explained further by Dr Layton. This will result in national benefits in terms of energy availability and the ability to defer other infrastructure upgrades (in particular to the national grid).*

73. When reviewing Dr Layton's information more carefully, it is clear that he is only commenting on the applicants intentions:

> *"That Mighty River Power wants to build the plant at Turitea indicates that, even taking into account transmission losses, it is the best option available to it, and one that it thinks will be relatively efficient compared with other possible locations for plant, given the quality of the wind resource available elsewhere."*

This statement is relative only to Mighty River Power and their options for energy, not the total national benefit, implied in Mr Heffernan's statement.

74. Dr Layton evidence is carefully worded:

> *"My evidence shows that wind-powered generation on favourable locations, like Turitea, is a cost competitive compared with new gas-fired generation and significantly superior to new coal-fired generation, even without the benefits of reducing greenhouse gas emissions."*

He only refers to generation and not the total package of energy production including the balancing of the irregularity of wind and how that must be integrated into the national grid with the requirement of storage to make that wind generation most viable.

75. Mr Heffernan describes (para 4.3)

> *Our Business Principles.*
>
> *(b) We acknowledge the complex inter-relationships between economic performance, community expectations, and charging social and environmental aspirations. We assess the implications of our business decisions for all stakeholders and aim to manage our social, environmental and economic impact accordingly*.

76. Mr Pollock (para 265), goes so far as to state

"The generation of electricity and its secure supply is imperative to the social and economic wellbeing of New Zealanders and New Zealand Businesses. The generation of electricity is therefore by implication an opportunity to allow people to provide for their overall wellbeing."

As a representative of Mighty River Power, Mr Pollock, has taken the target of providing electrical energy in a sustainable responsible manner, to a level of responsibility for the overall wellbeing of people, which is beyond the scope of Mighty River Power. Clearly, his statements overstep the mark of a responsible company providing electricity. He further overstates the case that the Turitea Wind Farm is

'strategically located in a centre of significant electricity demand'.

This definition of centre of significant electricity demand is not supported by the evidence of Dr Layton and others who are much more circumspect with such wide sweeping statements when it comes to energy and wind farms.

CONCLUSION

77. Based on this review of the development of renewable energy for the national benefit, we maintain our original position, which is:

4.8 The proposed development fails to offer national or local benefits that would **offset the significant adverse effects of the proposed development,** in particular the benefits to be derived from the use and development of renewable energy, and the mitigation of the effects of climate change.