IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	of the proposed Horizons One Plan

STATEMENT OF EVIDENCE OF TREVOR ANDREW NASH

INTRODUCTION:

1 My name is Trevor Andrew Nash. I am the Wind Generation Development Manager at Mighty River Power, a position I have held for 4 ½ years. In this role I am responsible for the investigation of wind generated electricity for the company. Of 24 years in industry, I have 19 years experience in utility-scale wind energy in the United Kingdom and New Zealand. This experience includes all aspects of wind energy including wind turbine design, research and development; site assessment; windfarm construction and operation; and in wind energy strategy, policy development, and management.

2 I hold a Bachelor of Engineering (Honours), and a Graduate Diploma in Business Administration from the University of Auckland. I am a founding member of the New Zealand Wind Energy Association and a current board member. I am a Member of the Institute of Professional Engineers New Zealand (IPENZ). I have served as the New Zealand representative to the International Energy Agency (IEA) Implementing Agreement for Co-operation in the Research Development, and Deployment of Wind Energy Systems - IEA Wind.

3 I am authorised to present this evidence on behalf of Mighty River Power, in support of their submissions and further submissions to the Horizons Regional Council (Horizons) Proposed One Plan (the Plan).

4 My evidence will outline:

- The security of electricity supply,
- the scope for wind energy in New Zealand and the Horizons Region,
- Characteristics of wind energy development with respect to regional policy statement and plan policy.

MIGHTY RIVER POWER'S ACTIVITIES

5 Mr Hunter has set out in his submissions and evidence to the Hearings Panel the generation assets and aspirations for new generation of Mighty River Power. I will focus more particularly on the wind development programme and the contribution that wind energy could play in meeting the demand for electricity in the Horizons Region and New Zealand.

EXECUTIVE SUMMARY

6 In the first part of my evidence I outline:

(a) the importance of wind in contributing to diversity in electricity generation sources, and so contributing to security of supply;

(b) the significant global increase in wind generation world-wide;

(c) the contribution that wind can make to achieving the New Zealand Energy Efficiency and Conservation Strategy target (to generate 90% of New Zealand's electricity demand from renewable energy sources by 2025);

(d) New Zealand's world class wind resource, and the factors that influence location of a successful wind farm project;

(e) potential barriers to developing wind generation projects; and

(f) economic factors that influence whether wind generation projects will ultimately proceed.

7 This evidence is intended to provide the Panel with background information regarding the developing importance and potential for wind generation in New Zealand. Given the finite availability of the premium renewable energy sources, those that become unavailable may be difficult to substitute for in the short term and may increase reliance on other fuels.

8 In the second part of my evidence, I outline the high quality wind resource in the Horizon's Region, and the significant additional potential of the Region to contribute to increased renewable electricity generation. There are a number of areas in this Region that are favourable areas for potential wind development. This is demonstrated by the level of existing activity in the Region. The Horizon's Region is arguably the most important in New Zealand for wind generation.

9 I also provide some comments on the specific environmental effects of wind farms, although this will largely be considered in other hearings on the One Plan (in particular the Land hearing).

ELECTRICITY SECURITY OF SUPPLY

10 Electricity generation from wind could assist with security of electricity supply as outlined by Mr Hunter. New Zealand needs a diversified energy base because sole reliance on particular fuels or connection to neighbouring countries for our electricity needs is not possible. Wind power could assist in reducing the vulnerability of the Horizons Region to climatic extremes in other parts of the country and reduce the deficit of electricity supplied from within the region.

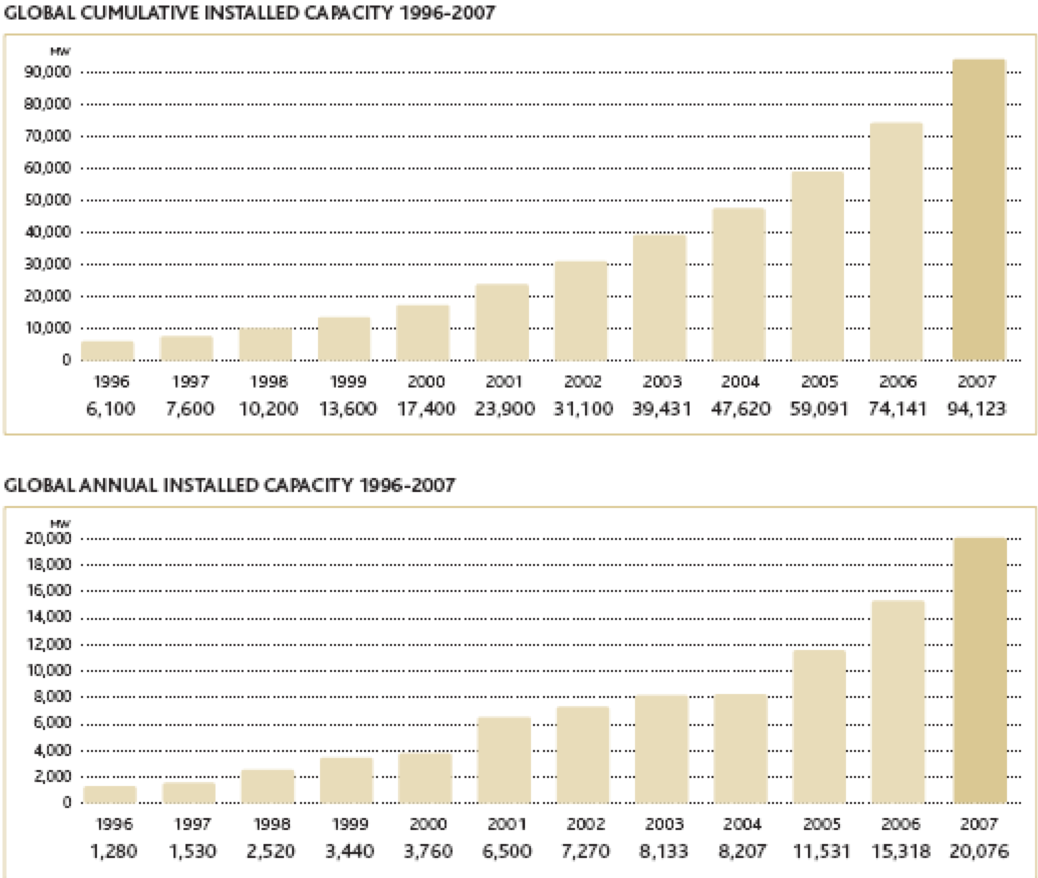
WIND ENERGY IN NEW ZEALAND

11 Worldwide there are over 100,000 wind turbines installed today. At the end of 2007 the total installed capacity was more than 94,000 MW supplying around 200 TWh or just over 1% of the world's electricity[1]. Globally the wind industry is estimated to employ around 200,000 people. 2007 represented another record year for wind energy development, which has been growing at an average rate

[1] From the Global Wind Energy Council's 'Global Wind 2007 Report', April 2008.

of 24.7% over the period from 2003-2007[2]. The more than 20,000 MW installed increased the total global capacity by 27% with an investment of around US$37 billion. In 2007, wind attracted more investment than nuclear or hydro, and accounted for more new generation capacity in Europe than any other power source.[3] In the USA wind energy was second only to natural gas in terms of installed capacity.[4] This rapid growth has continued in 2008 with total installed capacity reaching 100,000 MW by April[5]. This worldwide growth in wind energy is demonstrated in Figure 1.

Figure 1: Installed global wind capacity (cumulative and annual). Source: Global Wind



[2] Global Wind Energy Council press release 'Global wind energy market to reach 240GW by 2012', 27 March 2008. Available at: http://www.gwec.net/index.php?id=30&no_cache=1&tx_ttnews[pointer]=1&tx_ttnews[tt_news]=143&tx_ttnews[backPid]=4&cHash=03a0253dde

[3] UNEP Sustainable Energy Finance Initiative, 'Global Trends in Sustainable Energy Investment 2008', July 2008.

[4] Babcock & Brown Wind Partners, 'Presentation to Deutsche Bank Wind Energy Seminar', 2 July 2008.

[5] European Wind Energy Association (EWEA) press release, 'Global wind installations pass 100 GW, and are predicted to rise to 240 GW by 2012', 1 April 2008. Available at: http://www.ewea.org/index.php?id=60&no_cache=1&tx_ttnews[tt_news]=1311&tx_ttnews[backPid]=259&cHash=cde5d628f4

12 Within New Zealand there is a national strategy (New Zealand Energy Efficiency and Conservation Strategy (NZEECS)[6]), which encourages increased investment in the use and development of renewable energy. The target set in the NZEECS is to generate 90% of New Zealand's electricity demand from renewable energy sources by 2025. Mr Hunter will discuss the significance of this target and the significant contribution needed from new renewable energy generation to achieve it. The contribution renewable sources of energy can make varies significantly on both a national and regional basis due to factors such as the nature of the resource (i.e. wind, geothermal, hydro, etc.) and related factors such as latitude, topography and the hydrological cycle. The efficient and effective use of renewable sources of energy is also location specific as the infrastructure required to harness the energy needs to be located close to the energy source. In addition, greater emphasis is now being given to maximising the opportunity for generation of energy within each region to overcome transmission losses and meet regional demand for electricity. Due to the diversity and extent of the renewable resources that are available renewable energy has the potential to provide New Zealand with a more sustainable supply of electricity.

13 New Zealand has a world class wind resource suitable for generating electricity. It is situated in the "Roaring Forties", where the winds are known for their strength and persistence and are unhindered by land mass. Being a narrow island, there is good exposure to coastal winds while our ranges and areas of elevated terrain give localised wind speed accelerations.

14 New wind projects are feasible where cost of energy is at or below the cost of other fuel options and electricity price forecasts. The key driver for siting wind energy developments is the wind resource available at a site. Wind energy potential is highly sensitive to the site wind speeds and these are strongly influenced by location and elevation. Accordingly sites in valleys, forests, and

[6] NZEECS has been prepared as a requirement of the Energy Efficiency and Conservation Act 2000. The Strategy's purpose is to promote energy efficiency, energy conservation and renewable energy and move New Zealand towards a sustainable energy future. The 2007 strategy places emphasis on energy efficiency and anticipates a more aggressive programme for electricity generation from renewable energy sources.

low lying inlands locations where wind speeds are lower generally do not have an economic wind resource.

15 Other requirements for successfully developing wind energy projects include:

- *Location and access* – A good site requires proximity to the grid or local network (and so to consumers) and access to a route to connect to that grid or network as well as suitable road access for construction and the delivery of the large turbine elements. Additional benefits can accrue to the project if connected to a local lines network rather than the national grid due to the resulting reduction in transmission requirements. While offshore marine locations can have a very good wind resource the development cost are in the order of 100-200% more to build than conventional onshore developments and this, together with challenges around maintenance access means that such projects are unlikely in New Zealand in the medium term.

- *Transmission capacity* – Like any form of generation, wind generation requires sufficient transmission capacity (both local and regional) to carry the generated electricity. In many instances the transmission system can be upgraded to increase its capacity without the need for new lines to be built.

- *Turbine price and efficiency* - Wind turbine technology has been getting larger, cheaper (in terms of the cost per unit of electricity produced) and more efficient. At a given site, a single modern wind turbine annually produces 180 times more electricity and at less than half the cost per kilowatt-hour (kWh) than its equivalent of 20 years ago.[7] Some of these gains are being offset by international trends in commodities (such as the price of steel), wind turbine supply and demand and changes in the currency exchange rate. These factors are also affecting other sources of electricity generation.

[7] Advisory Council of the European Wind Energy Technology Platform, 'Wind Energy: A Vision for Europe in 2030', September 2006.

16 As Mr Hunter describes in his submission to the Overview Hearing, Mighty River Power is also a significant operator of hydro electricity generation in the North Island and is well placed to utilise the synergy between wind and hydro generation.

17 Potential barriers to developing generation projects include:

- The cost and length of time for technical and environmental investigations to firstly determine project feasibility, and secondly to support an application for resource consent. For wind energy projects this includes wind measurement studies, which are usually conducted over a minimum 2 – 3 year period. These studies typically require the use of measurement masts with heights similar to those of the turbine towers (30 – 100 metres). Any land use or district plan changes that over this time that restrict the ability to develop the wind farm would adversely affect the viability of a project.

- Risks associated with the uncertainty of the timing and outcome of the resource consent process and the potential implications of conditions (if granted). In recent times, wind development proposals seeking resource consents have faced small but strong local opposition concerning the perceived adverse visual and noise effects, with most proposals being appealed to the Environment Court. These factors have time and cost implications.

- As noted above, international trends in commodities, wind turbine demand and changes in the currency exchange rate may adversely influence the project economics. Similar effects on other technologies or their fuel sources can also affect a project's viability compared to other potential projects. These may or may not be temporary effects.

18 There is some debate regarding the wind energy's potential contribution to New Zealand's electricity supply. The Government's New Zealand Energy Strategy (NZES) identified that 9,200 GWh per year of available wind generation (around

22% of present demand) was available at a cost of less than $90 per MWh.[8] Meanwhile an Electricity Commission study suggested that 50,780 GWh of potential wind generation (i.e. 20% more than existing demand) was available at a cost of $75-$90 per MWh.[9] Recent steel price increases have raised these costs by around 10%, although other fuel technologies are similarly affected. The ability of wind energy's full potential to be realised will be dependent on a number of factors ranging from consenting to the costs of competing technologies.

19 The New Zealand Wind Energy Association currently estimates[10] that in 2025 there could be approximately 2,500 to 3,000 MW of additional wind energy capacity installed, generating over 9,000 GWh of electricity per annum. This estimate has been made with consideration of the constraints of economics (including those of competing technologies), transmission and consenting that will affect the uptake of wind energy.

20 It is within this market context that new electricity generation projects, including new windfarms are assessed, approved and constructed incrementally by generation companies. At Mighty River Power, electricity technologies at the economic margin include geothermal, wind, small-hydro and thermal generation. In other words, candidate projects using various technologies will become economically viable on a progressive basis as the forecast for future electricity price increases or as the cost of electricity generated using these technologies improves.

21 The New Zealand public has expressed a preference for renewable energy technologies such as wind and hydro, over thermal technologies such as gas and coal.[11]

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[8] From Table 9.1 of the New Zealand Government's 'New Zealand Energy Strategy to 2050 – Powering Our Future', October 2007.

[9] 'Transmission to Enable Renewables – Economic wind resource study' (Revision B Final), completed by Connell Wagner for the Electricity Commission, 25 March 2008.

[10] NZ Wind Energy Conference 2008, "The Way Forward", Fraser Clark, NZWEA

[11] Research conducted by Nielsen for EECA, 'Public perceptions of renewable energy' May 2008, available from http://www.eeca.govt.nz/renewable-energy/documents/renewable-energy-nielsen-research-report-may-08.pdf

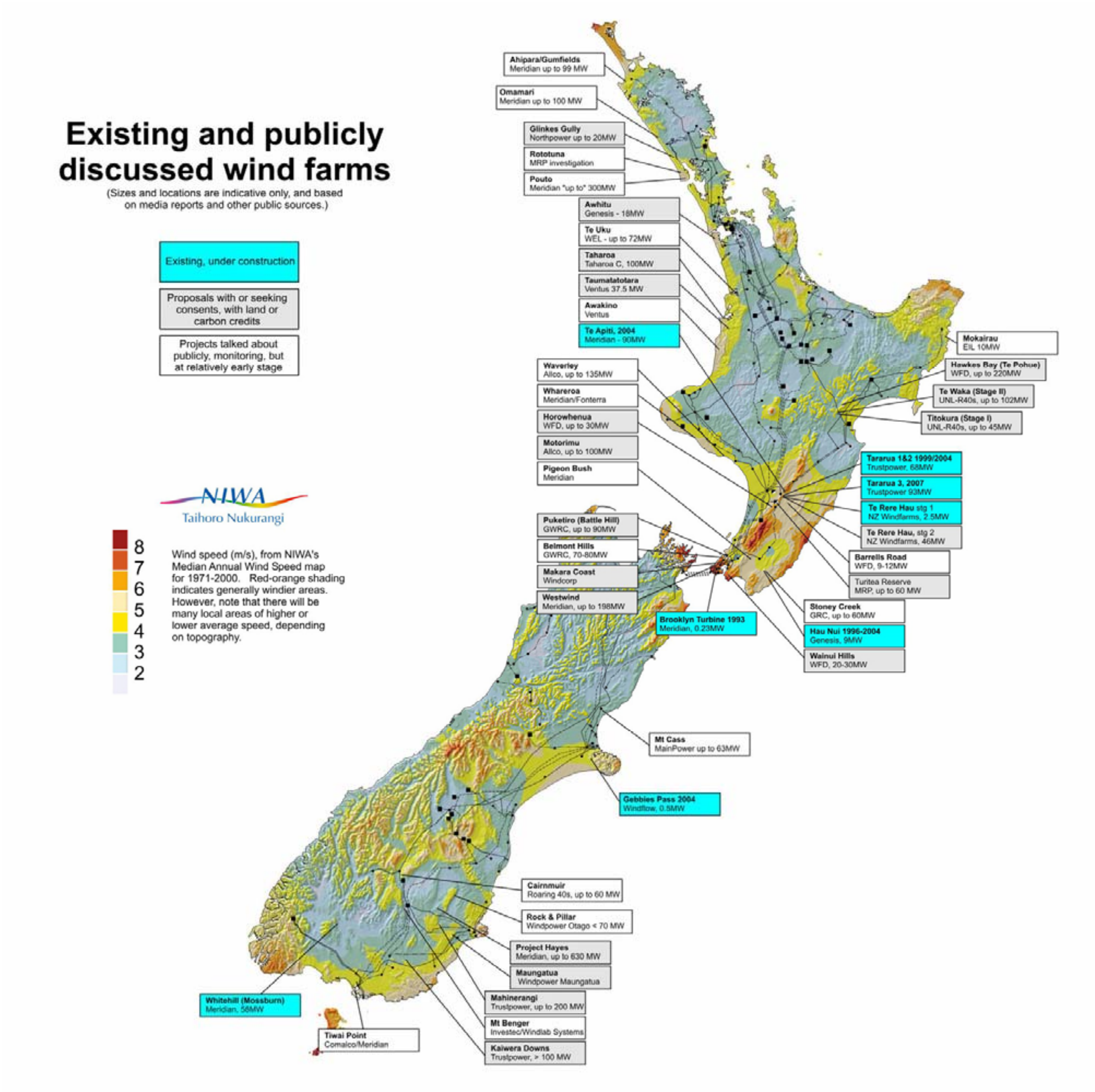
22 Cost trends for wind generation are subject to change. The purchase prices for wind turbines, and hence the unit costs of wind energy generation, have increased since 2005 due to significant increases in steel costs, a large and sustained increase in worldwide demand for wind turbines and rationalisation occurring in the wind turbine manufacturing industry. The rising costs of steel and other related commodities have also been affecting the cost of other technologies such as gas and steam turbines.

23 Figure 2 shows a high level wind resource map of New Zealand and overlays the existing wind farms and new wind developments that were in the public arena, as of mid-2007. There have been several changes subsequently in terms of new projects seeking consent or being consented or declined.

24 Figure 2 also shows that there is a reasonably diverse geographic spread of existing, new and potential wind developments. Currently, there is approximately 322 MW of installed wind generation, with a further 173 MW under construction. These new projects will bring New Zealand's total installed capacity to just under 500 MW by the end of 2009. There is over 2,000 MW of potential future wind development that is either consented, seeking consents or under appeal with many more sites being investigated[12]. This represents about 10 years worth of annual load growth. Of these future projects, just under 330 MW has been consented but not yet developed.

[12] All of these figures have been taken from the New Zealand Wind Energy Association's website with these details available at http://www.windenergy.org.nz/FAQ/proj_dom.htm

Figure 2 – New Zealand Wind potential and Known Developments (as at mid-2007)[13]



25 In summary, wind energy is becoming increasingly economic as a source of new electricity generation supplies. It is also well supported by the New Zealand public and is consistent with government policy (NZES, NZEECS and New Zealand's obligations under the Kyoto Protocol). A number of potential windfarm projects are now economically viable, and viability is expected to continue to increase in the future. There are a number of factors that could influence the uptake of wind energy including shifts in price forecasts (based on

[13] Map prepared by Transpower in 2007 based on publicly available information. The map also includes wind speed estimates at 10 metres elevation prepared by NIWA. The map is available at http://www.windenergy.org.nz/FAQ/map2007.htm.

fuel supply and price, dry years, etc.), investments into other generation technologies, exchange rate variations, emissions policy and pricing, and the availability of the best wind sites according to land designation, landowner willingness and resource consents. Given the finite availability of the premium renewable energy sources, those that become unavailable may be difficult to substitute for in the short term and may increase reliance on other fuels.

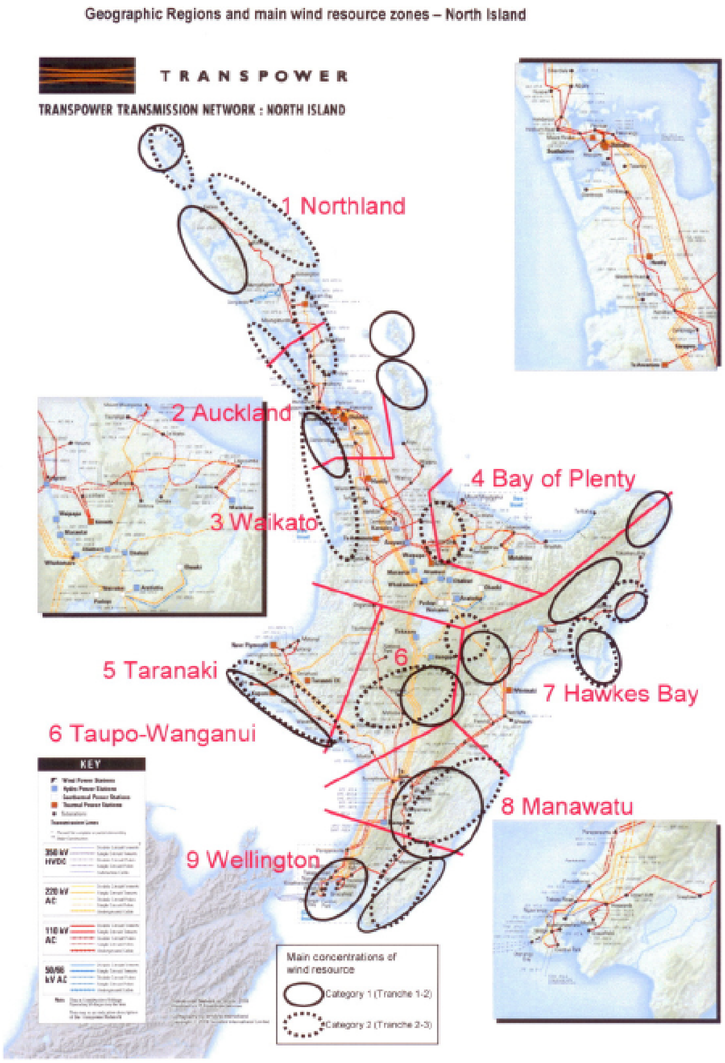
SITING OF WIND ENERGY DEVELOPMENTS WITHIN THE HORIZONS REGION

26 Wind is an attractive natural resource available within the Horizons Region as an energy source. EECA's Renewable Energy Assessment for the Manawatu-Wanganui region dated 20 July 2006 states:

> *"If carefully planned, approximately 200-400 MW of additional wind capacity could be installed over a number of years with environmental impacts that were broadly acceptable to local communities. This excludes the existing 160 MW and the 140 MW under construction. The technically available potential is much larger."*

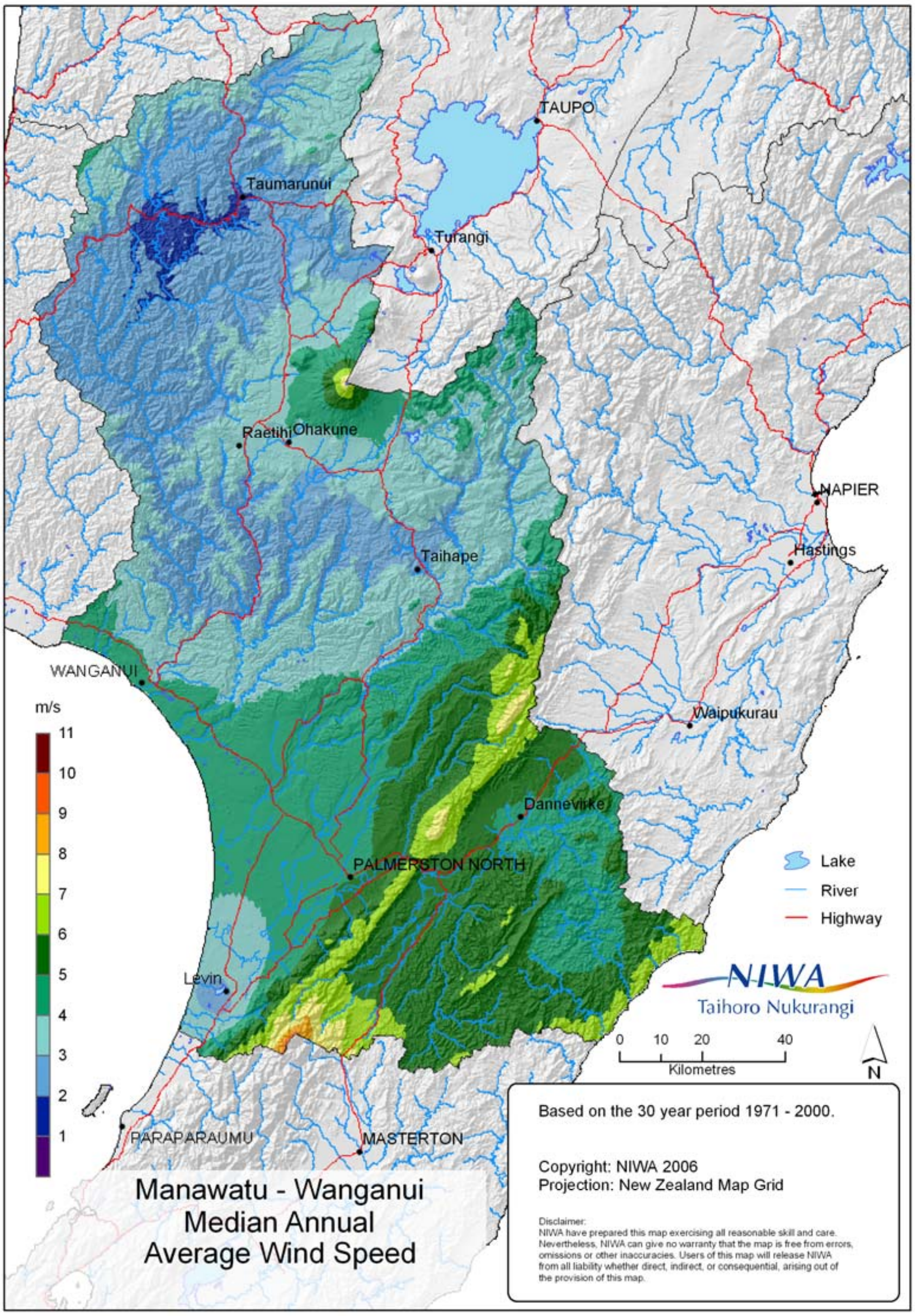
27 Estimates made since this EECA report was published have identified that there is significant additional wind energy potential in the region. An Electricity Commission study recently identified 560 MW (1,960 GWh per year) in the Taupo-Wanganui region and 3,230 MW (11,320 GWh per year) in the Manawatu that could potentially be developed at a cost of $75 to $90 per MWh (see footnote 9). An additional 800 MW (2,450 GWh per year) and 1,790 MW (5,490 GWh per year) respectively could potentially be developed at a cost of $90 to $105 per MWh. The general areas where this resource is available is shown in Figure 3 below, where "Category 1" refers to potential costs of $75-90/MWh and "Category 2" to costs of $90-$105/MWh.

Figure 3: North Island Wind Energy Potential (see footnote 9 for reference details)



28 It can be seen from figure 3 above and figure 4 below there are a number of areas in the Horizons Region that are favourable areas for potential wind development. These areas include; the Ruahine and Tararua Ranges, the central plateau south of Mount Ruapehu, and areas east of the Tararua Ranges (such as the Puketoi Range) to the east coast. It should also be noted that there are limitations associated with mapping at this scale. There is considerable investment required in monitoring wind resources on a site by site basis to prove the resource for development purposes.

Figure 3: Wind Resource Map of the Manawatu-Wanganui Region[14]



[14] Map prepared by NIWA and available from https://secure.niwa.co.nz/climate-explorer. Note that the map should be used to consider the general wind resource only and is not suitable for identifying potential wind farm sites, The data is only at 10 metres elevation (i.e. well below the higher speeds at turbine height) and has been calculated by simple interpolation only (i.e. it does not consider effects such as the acceleration of wind due to terrain, etc.).

29 The best wind sites are in exposed locations, typically ridgelines and hilltops and seldom in valleys, forests and low lying inland locations that are typically relatively sheltered. Mighty River Power has monitored the wind resource on the Tararua Ranges and found it to be a constant and high quality wind source. The Horizons region offers some of the highest capacity factors in New Zealand and also globally, with many sites offering 40% or higher against global benchmarks of 20-25%. The wind resource here in simply world class.

30 The wind energy potential of the Horizons Region is also demonstrated by the level of existing activity in the region:

Operating wind farms	
Tararua (Stages 1 – 3)	161 MW
Te Apiti	91 MW
Te Rere Hau	2.5 MW (plus 30 MW under construction & consent for 48.5 MW)
Consented wind farms	
Motorimu	64 MW (plus 32 MW under appeal)
Publicly discussed wind farms	
Turitea (Tararua Ranges) and Puketoi (Mighty River Power)	
Project Central Wind, north of Taihape (Meridian Energy)	
Waitahora Wind Farm, Puketoi Ranges (Contact Energy)	
And at least 3 other sites not disclosed	

31 At Mighty River Power we have completed an extensive analysis of most areas of the country to identify prospective windfarm locations. Viable sites need to be in high wind areas and as near to grid as possible. Benefits of generating near consumers are signalled through differences in average nodal spot prices – these generally increase northward. For these reasons the lower North Island currently offers the best economics for wind power, and sites in the upper North Island (that have lower wind speeds) would become economic when electricity prices increase sufficiently.

32 As Mr Hunter has stated, the electricity demand within the Horizons Region exceeds the existing generating capacity of the region, which is currently provided mainly by hydro and wind sources. Having more generation in the region would help to reduce total transmission system losses. Wind power could further assist in reducing the vulnerability of the Horizons Region to the generating and transmission constraints in other parts of New Zealand.

33 *Specific Environmental Effects: Earthworks* – Provisions of the Regional Plan that relate to the specific effects on the environment most often associated with windfarm development are addressed in evidence by other witnesses to be presented on each module of the One Plan hearing process. I would however like to make some comment of a more general nature on two issues, earthworks and land use.

34 Construction earthworks are a consideration for any wind energy development, particularly on an elevated site. Most sites suitable for wind energy development are usually already devoid of tall vegetation, so limited vegetation clearance is typically required. Earthworks required for the construction of a wind project include the tower foundations and road access for heavy machinery to access turbine sites. Roading generally follows the contour of the landform so that it does not generate unfavourable scarring and lines at an acute angle to the contour. Existing roads and tracks are also used wherever possible to minimise the impacts. The land required for tower platforms and access tracks also occupy a relatively small percentage of a site thereby further limiting the area of disturbance. In addition, earthworks are temporary in nature and construction methods can be employed to manage the effects from

sediment or erosion. In the post-construction phase, the heavy machinery roading access can be reduced to a single lane light vehicle track, as well as the reinstatement and regrassing of construction sites, and roading cuts and batters. These are matters that are readily addressed by resource consent conditions and are commonly addressed through a sediment and erosion control management plan as outlined in the Mighty River Power legal submissions relating to the Land hearing.

35 Wind farms must be located where the wind resource is. The footprint for a wind farm however can respect the landform and in many cases the existing use of the land can continue in conjunction with the wind farm. In a pastoral farming situation land can continue to be productively used. A relatively small portion of a site is used for windfarm infrastructure post-construction. Access roads constructed for a windfarm can often also facilitate more effective use or management of land.

36 Turbines will have a defined "life" before they need to be removed or replaced. By the time turbines need to be replaced, New Zealand's economy and electricity market (both electricity generation and electricity demand) may be vastly altered from where it is today. Turbines will only be replaced if it is economically feasible to do so. Land occupied by turbines that are removed can be readily rehabilitated enabling the land to continue to be used for rural purposes or alternative developments. The ability for windfarm land to be returned to its previous rural state is in contrast to most other forms of development.

37 Overall, there is limited flexibility in the location of potential wind development sites, which is dictated by the wind resource, site and physical constraints (including grid constraints). However there is usually some flexibility to modify the siting of turbine sites *within* the general site envelope to minimise site-specific effects.

CONCLUSIONS

38 Today wind energy already provides around 2.5% of our electricity requirements. It is expected to play a significantly greater role in meeting our increasing demand for electricity in the future.

39 There is a high quality wind resource in a number of different parts of the Region. Indications from both current wind generation activity and wind monitoring suggest that the Tararua, Ruahine and Puketoi Ranges have a wind resource that rivals any experienced internationally. There are areas of significant potential in other elevated and coastal areas of the region.

40 The viable wind resource is finite, and must be captured where the wind is located. Wind energy development can be undertaken in a way that retains the landform and enables rural land use to continue alongside the wind farm.

41 It is a flexible technology allowing masts and turbines to be replaced or relocated and land to be rehabilitated where removed. While there are economies of scale required for any development, construction can be incremental allowing for additional units to be added to meet demand when required. This flexibility is an added benefit of this form of renewable energy, in addition to the benefits already outlined by Mr Hunter in his evidence.