

**IN THE MATTER** of the Resource Management Act  
1991

**AND**

**IN THE MATTER** of applications by **Mighty River  
Power Limited to Palmerston  
North City Council, Horizons  
Regional Council, and Tararua  
District Council for Resource  
Consents for the Turitea Wind  
Farm Project**

---

**Statement of Evidence of  
Fraser Ross Clark  
For and on behalf of the  
New Zealand Wind Energy Association**

---



7<sup>th</sup> Floor, Prime Property Tower  
86-90 Lambton Quay  
PO Box 553  
Wellington 6140  
Ph: 64 4 499 5046  
Fax: 64 4 473 6754  
[www.windenergy.org.nz](http://www.windenergy.org.nz)

## 1 Introduction

- 1.1 My name is Fraser Ross Clark. I am employed by the New Zealand Wind Energy Association ('NZWEA' or 'Association') as its Chief Executive and have the authority of the Association to provide this evidence on its behalf.
- 1.2 My position involves overall responsibility for all of NZWEA's activities promoting, encouraging and enabling the uptake of wind energy in New Zealand both within the wind industry and to a wide range of stakeholders including Government, regulators and the public. I have held this position since September 2006.
- 1.3 Through my role at NZWEA I have also served on the Technical Stakeholder Group ('TSG') that was responsible for the peer review of the Electricity Commission's 'Wind Generation Investigation Project' ('WGIP'). I have also recently joined the Standards New Zealand technical committee that is reviewing NZS6808:1998, the New Zealand Standard for noise from wind turbine generators as a replacement for a previous NZWEA nominee and have also represented the wind industry in various other forums and events. My role exposes me to the full range of wind industry interests and activities.
- 1.4 Prior to joining NZWEA I was employed by Todd Energy from late 2003 both as Technical Solutions Manager and as an Account Manager for some selected industrial customers of their subsidiary, Nova Gas. The major component of this role was the investigation and development of new electricity generation opportunities including projects utilising natural gas, cogeneration, wind, geothermal heat and landfill gas. I was also involved in the negotiation of a number of high-value electricity, natural gas and steam supply agreements with a range of industrial consumers.
- 1.5 During 2003 I spent several months employed by Demand Response Limited working on Fonterra's EECA-award winning dairy factory energy reduction project.

- 1.6 My energy sector experience therefore incorporates the development of new generation projects, the electricity market within which they operate and the end-use of that electricity.
- 1.7 Prior to entering the electricity sector I spent several years based in Sweden and Germany employed by Metso Panelboard. From 2001 to 2002 I was General Manager of their Energy Plant business unit that was responsible for selling, designing and installing large-scale biomass combustion plants.
- 1.8 I now have over 15 years of broad business and engineering experience following the completion of an Honours Degree in Engineering at the University of Canterbury in 1992.
- 1.9 I confirm that I have read and will comply with the Code of Conduct for Expert Witnesses (section 5 of the Environment Court Consolidated Practice Note 2006). This evidence is within my area of expertise, except where I state I am relying on what I have been told by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.
- 1.10 In preparing this evidence when considering information that is specific to this project (as opposed to wind energy projects in general) I have relied largely on the evidence in chief provided by Mighty River Power Limited ('Mighty River Power'), and in particular the evidence of Dr Layton and Mr Wong Too.

## **2 Summary**

- 2.1 Having had regard to the evidence presented by Mighty River Power in support of its application for consent for the Turitea Wind Farm, NZWEA continues to support its original submission that the project will provide a number of important national and regional benefits.
- 2.2 The Mission of NZWEA (see 3.1 below) is to promote the uptake of New Zealand's abundant wind resource as a reliable, sustainable, clean, and commercially viable energy source and NZWEA believes that its support of this project is consistent with this Mission.

### 3 About the New Zealand Wind Energy Association (NZWEA)

3.1 NZWEA is a membership-based industry association that works towards developing wind as a reliable, sustainable, clean and commercially viable energy source. NZWEA was incorporated in 1997 and its Mission and Objects are set out in the Association's Rules under the Incorporated Societies Act 1908 as follows:

#### **Mission**

The mission of the Association is to promote the uptake of New Zealand's abundant wind resource as a reliable, sustainable, clean and commercially viable energy source.

#### **Objects**

The objects of the Association are to achieve its mission ... by means of:

- (a) policy advocacy with local and central government officials and elected representatives, regulatory bodies, industry groups and other interested organisations to raise the awareness of, and develop the concept of Wind Energy in New Zealand;
- (b) organising seminars, conferences and other promotional and educational events, and to distribute information, relating to Wind Energy in New Zealand;
- (c) providing a forum for external and internal networking, discussion and co-operation amongst persons with an interest in Wind Energy in New Zealand;
- (d) promoting the economic, environmental, social and other benefits of Wind Energy in New Zealand; and
- (e) promoting research and development of Wind Energy technology in New Zealand.

3.2 NZWEA is a non-Governmental, non-profit organisation. NZWEA's activities are funded by its members and from industry events such as its annual conference.

3.3 NZWEA's membership includes 81 companies and organisations involved in the New Zealand wind energy sector, including:

- all of the major electricity generator-retailers (Contact Energy, Genesis Energy, Meridian Energy, Mighty River Power & TrustPower);
- a number of other local and international independent electricity generators;
- Transpower and several lines companies;
- a number of major international & domestic wind turbine manufacturers; and
- a range of other companies with interests ranging from site evaluation through to operations and maintenance.

A list of NZWEA's members is available at <http://windenergy.org.nz/about/members>. The views of NZWEA do not necessarily represent the views of its individual members.

3.4 NZWEA has no financial involvement in the Turitea Wind Farm, or any other wind farm development.

3.5 The applicant, Mighty River Power, is a member of NZWEA.

#### **4 Scope of Evidence**

4.1 In this evidence I will discuss:

- The current status of the wind energy industry - both in New Zealand and internationally.
- The alignment of the project with Government energy and climate change policy.
- The significance of the natural resource – the wind – that this project intends to utilise.
- The contribution of this project to security of electricity supply (where electricity “*enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety*” (s5 RMA)).

#### **5 Status of the New Zealand and global wind energy industry**

5.1 Wind energy is a mature technology. The modern wind industry is now more than 20 years old and has a vast amount of history and experience behind it.

5.2 Today wind energy is one of the world's leading sources of new electricity generation. New wind generation capacity made up 43% of the total new capacity installed in the EU in 2008, exceeding all other technologies including gas, coal and nuclear power.<sup>1</sup> A record 8,358 megawatts (MW) of new capacity was installed in the USA last year,

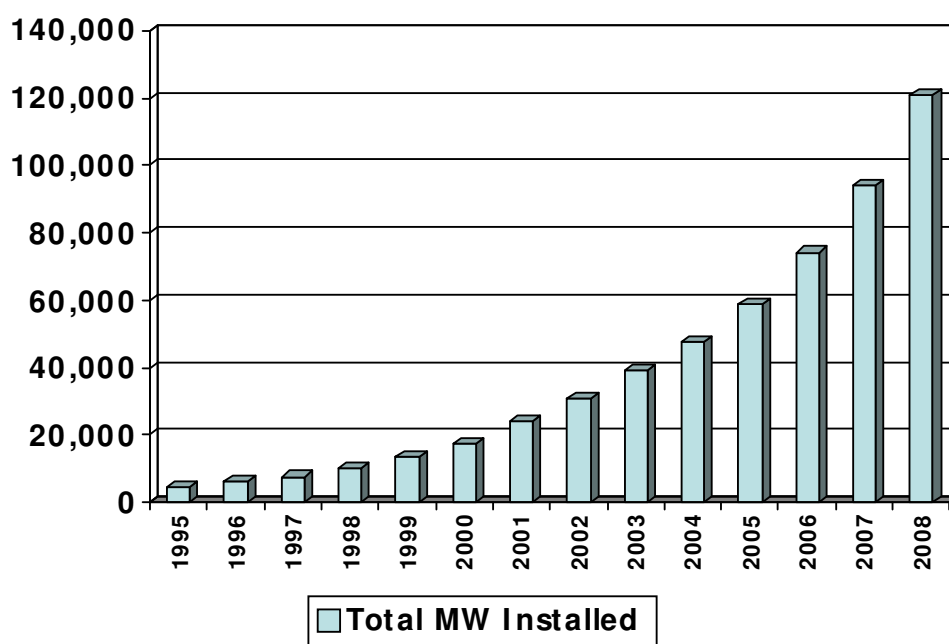
---

<sup>1</sup> 'Wind now leads EU power sector'. Press release by the European Wind Energy Association (EWEA) on 2 February 2009. Available from [www.ewea.org](http://www.ewea.org).

representing 42% of all new generation capacity.<sup>2</sup> Wind energy should no longer be considered to be an 'alternative' energy source as it is clearly now established as a 'mainstream' technology.

5.3 Global wind energy capacity has been increasing at around 25% per year over the last 6 years. While in earlier years this growth was principally in Central Europe, new development is now occurring globally. The USA led the world in new capacity installations last year, while China and India were second and third respectively. The global total is now more than 120,000 MW and over 27,000 MW of new capacity was added last year alone.<sup>3</sup>

**Figure 1 – Global wind energy development<sup>3</sup>**



5.4 Worldwide, an estimated 260 TWh of electricity was generated from wind power in 2008 – more than 6 times New Zealand's annual electricity requirements. The value of the global wind turbine market in 2008 has been estimated at €36.5 billion (both references from footnote

<sup>2</sup> 'Wind energy grows by record 8,300 MW in 2008'. Press release by the American Wind Energy Association (AWEA) on 28 January 2009. Available at [www.awea.org](http://www.awea.org).

<sup>3</sup> 'US and China in race to the top of global wind industry'. Press release by the Global Wind Energy Council (GWEC) on 2 February 2009. Available at [www.gwec.net](http://www.gwec.net).

- 3). It should be clear from these figures that the wind energy industry is now a major global industry.
- 5.5 The first 'modern' wind energy project in New Zealand was the single 225 kW Vestas turbine that was installed on Pol Hill in Brooklyn<sup>4</sup>, Wellington as a trial in 1993. That turbine remains in operation today.
- 5.6 The first commercial wind farm followed in 1996 with the Hau Nui project in the Wairarapa (3.9 MW), with the first significant project – the first stage of TrustPower's Tararua Wind Farm (31.7 MW) – following in 1999.
- 5.7 Further new capacity growth has followed, with significant increases occurring in 2004 and 2007 (when a record of 151 MW of new capacity was installed) in particular. At the end of 2008 New Zealand had 324 MW of installed wind energy capacity<sup>5</sup>, representing about 3.5% of the total generating capacity from all sources.
- 5.8 In the December quarter of 2008 wind energy achieved a record 304 GWh of generation, or 3.0% of total generation.<sup>6</sup> Wind generation also exceeded 1,000 GWh in a calendar year for the first time in 2008 (1,047 GWh) and provided 2.5% of the total from all sources.
- 5.9 A further 186 MW of new capacity is expected to be installed by early 2010<sup>7</sup>, lifting the national total by nearly 60% to more than 500 MW. Resource consent has been obtained or is being sought for over 3,000 MW of new capacity<sup>8</sup> - including this project - and further projects are under investigation.

---

<sup>4</sup> The turbine is also sometimes identified as being on Hawkins Hill, though this is actually a little further, and higher up the ridgeline.

<sup>5</sup> From data collected by the New Zealand Wind Energy Association.

<sup>6</sup> Taken from the MED's 'New Zealand Energy Quarterly – December Quarter 2008', released on 19 March 2009. Available from [www.med.govt.nz](http://www.med.govt.nz).

<sup>7</sup> Including the completion of the Te Rere Hau project in the Manawatu (43.5 MW of 48.5 MW remain to be installed), Project West Wind in Wellington (142.6 MW) and Horseshoe Bend in Teviot (2.25 MW).

<sup>8</sup> NZWEA publishes a list of projects that have either been consented, are in the consent process or that have been publicly notified on its website, [windenergy.org.nz](http://windenergy.org.nz).

5.10 All of New Zealand's major electricity generators are either operating or seeking to establish wind farms, as are a number of other independent companies. The total capacity of wind energy projects with or seeking consent exceeds that of any other generation source, and demonstrates the recognition that wind energy is an important and viable source of electricity generation for New Zealand.

5.11 The significant amount of development activity that has occurred also means that there is an ever-increasing quantity of well-researched and scientific evidence about the actual experience of building and operating wind farms, both in New Zealand and overseas which can help with the assessment of this proposal.

## **6 Energy, Climate Change and Government Policy**

6.1 Following its election in late 2008, New Zealand's current Government has indicated that New Zealand will remain committed to global action on climate change, including its commitments under the Kyoto Protocol.

6.2 Further, New Zealand retains a legislated Emissions Trading Scheme ('ETS') (although it currently lacks some of the regulation required for it to fully function). While the Government has established a Select Committee to review the Climate Change Response (Emissions Trading) Amendment Act 2008, the Act itself has not been repealed.

6.3 The Government's commitment to action on climate change was reiterated in March 2009, when the respective Australian & New Zealand Government Ministers with responsibility for climate change issues announced plans to explore the harmonisation of carbon emission reduction policies and noted that:

*"The Ministers agreed on the importance of taking action now to address climate change."*

During that meeting, the New Zealand Minister, the Hon. Dr. Nick Smith, also noted:

*“We know that failure to act on climate change is not an option”.*<sup>9</sup>

- 6.4 The energy sector has been identified as a key action area for reducing New Zealand’s greenhouse gas emissions. This intent is demonstrated in the Government’s New Zealand Energy Strategy (NZES)<sup>10</sup> and the New Zealand Energy Efficiency and Conservation Strategy (NZECS).<sup>11</sup> Both of these strategies were released in October 2007.
- 6.5 The two strategies place a strong emphasis on the importance of renewable energy, most significantly noting that “the government has **set a target for 90 per cent of electricity to be generated from renewable sources by 2025** (based on an average hydrological year)” (my emphasis). The NZES also identifies the need to encourage new renewable energy developments if this target is to be achieved.
- 6.6 While the current Government has announced that it intends to review the NZES during the coming year, their election policy (now Government policy) confirmed that the National Party supports both renewable energy and this target, noting that “*National will support the 90% renewables target but not let it get in the way of security of supply*”.<sup>12</sup>
- 6.7 The ‘national significance’ of renewable energy development, and the 90% target is also identified in the objective of the ‘Proposed National Policy Statement for Renewable Electricity Generation’ (‘NPS’):

*“To recognise the national significance of renewable electricity generation by promoting the development, upgrading, maintenance and operation of new and existing renewable electricity generation activities, such that 90 per cent of New Zealand’s electricity will be generated from*

---

<sup>9</sup> ‘Australia and New Zealand Strengthen Climate Change Cooperation’. Press release by Hon Dr Nick Smith, Minister for Climate Change Issues, 19 March 2008. Available at: <http://www.beehive.govt.nz/release/australia+and+new+zealand+strengthen+climate+change+cooperation>.

<sup>10</sup> ‘New Zealand Energy Strategy to 2050’, Ministry of Economic Development, October 2007. Available at [http://www.med.govt.nz/templates/MultipageDocumentTOC\\_31948.aspx](http://www.med.govt.nz/templates/MultipageDocumentTOC_31948.aspx).

<sup>11</sup> New Zealand Government, ‘New Zealand Energy Efficiency and Conservation Strategy (2007)’, October 2007. <http://www.eeca.govt.nz/about/national-strategy/nzeecs-index.html>.

<sup>12</sup> ‘National’s Energy Policy’, 14/08/08. Available from <http://www.national.org.nz/Article.aspx?ArticleId=28403>. The new Government’s commitment to the 90% target has also been identified in recent speeches and media releases.

*renewable sources by 2025 (based on delivered electricity in an average hydrological year)”*.<sup>13</sup>

- 6.8 The new Government has indicated that it supports this proposed NPS<sup>14</sup>. This demonstrates the Government’s commitment to renewable energy and its desire to reinforce the significance that is accorded to renewable energy under s7(j) of the RMA. The Board of Inquiry hearing of submissions regarding the proposed NPS commenced in April and is expected to continue until early July.
- 6.9 The need for action on emissions from the electricity sector in particular is also demonstrated in New Zealand’s greenhouse gas emissions statistics. The Ministry of Economic Development (‘MED’) has determined that New Zealand’s emissions from electricity generation increased by over 91% (3.168 million tonnes of carbon dioxide equivalents) between 1990 and 2007<sup>15</sup>. This compares to an increase of around 25% (15.9 million tonnes) in New Zealand’s total emissions over the same period<sup>16</sup>.
- 6.10 It can be seen from these figures that New Zealand’s emissions from electricity generation are increasing significantly faster than emissions from other sources.
- 6.11 While energy demand appears to have eased in recent months this is expected to be a temporary effect related to the global economic recession and demand is expected to continue to increase in the future as a result of government policies encouraging economic growth. As a result these emissions are expected to increase further unless the new demand growth is met with new renewable electricity generation.

---

<sup>13</sup> The proposed NPS and supporting documents are available from the Ministry for the Environment’s website at <http://www.mfe.govt.nz/rma/central/nps/generation.html>.

<sup>14</sup> Most recently in the ‘Opening address to the New Zealand Climate Change Centre Conference in Wellington’ by the Hon. Dr. Nick Smith MP on 20 May. Available at: <http://www.beehive.govt.nz/speech/opening+address+new+zealand+climate+change+centre+conference+wellington>.

<sup>15</sup> MED, ‘Energy Greenhouse gas Emissions 1990-2007’.

<sup>16</sup> New Zealand’s annual greenhouse gas inventory report to the UNFCCC – published on 17 November 2008 at <http://unfccc.int/resource/docs/2008/sbi/eng/12.pdf>.

6.12 On 15 April 2009 the Government released its latest projection for the liabilities that New Zealand is expected to face under the Kyoto Protocol. Those projections forecast that New Zealand would exceed its Kyoto target by 9.6 million tonnes (i.e. creating a net surplus, rather than a liability)<sup>17</sup>. This was a significant change from the 21.7 million tonne deficit forecast in 2008, mainly as a result of changes to the methods and calculations used to assess certain aspects of forestry and agricultural emissions.

6.13 The Government was however quick to note that this surplus did not signal that no further actions were required on emissions, noting the volatility of the projections but also:

*“There has been no significant change in emissions from the energy, transport and industrial sectors”.*

*“There are two important factors to recognize in the latest projections. First, these figures do not signal any progress in abating New Zealand’s gross greenhouse gas emissions which are 23 percent above 1990 levels. We are just fortunate that more than 600,000 hectares of new forests were planted in the 1990s that are growing strongly **and offsetting our continued growth in energy and transport emissions**”.*

(my emphasis)

*“These positive figures are to be welcomed but New Zealand still has a major challenge to reduce its gross greenhouse gas emissions.”<sup>18</sup>*

These comments suggest that the Government should be expected to remain committed to policy actions that seek to limit or reduce greenhouse gas emissions from the electricity sector (as a component of wider energy sector emissions). As identified above, the increased

---

<sup>17</sup> Ministry for the Environment, ‘Net Position Report 2009 - New Zealand’s projected balance of Kyoto Protocol units during the first commitment period’, April 2009. Available at: <http://www.mfe.govt.nz/publications/climate/net-position-report-2009/index.html>.

<sup>18</sup> ‘Government cautious over NZ’s Kyoto surplus’, press release by Hon. Dr. Nick Smith, Minister for Climate Change Issues, 15 April 2009. Available at: <http://www.beehive.govt.nz/release/government+cautious+over+nz%e2%80%99s+kyoto+surplus>.

utilisation of renewable electricity generation is the most probable means by which sector emissions can be reduced.

- 6.14 Climate change is believed to be largely dependent on the concentration of greenhouse gases such as carbon dioxide in the atmosphere, but the actual mechanism and processes influencing climate change are extremely complex. Accordingly, it is impossible to identify the specific impact that this project will have on climate change. The Environment Court identified this in the interim decision on the Mahinerangi Wind Farm, noting that *“to require an applicant to demonstrate this would require a level of precision which is simply not available in terms of the current state of scientific knowledge”* [231].<sup>19</sup>
- 6.15 That decision also identifies (at paragraph 209) that by ensuring that new demand growth is met with new renewable electricity generation, carbon dioxide emissions will not increase (with resulting climate change benefits). In the event that this new renewable generation also displaces existing generation (i.e. by being dispatched in preference to more expensive sources of generation) this could result in a net reduction in carbon dioxide emissions.
- 6.16 The evidence presented on behalf of Mighty River Power – using assumptions similar to those that have been applied for other, similar projects - suggests that the development of the Turitea Wind Farm at an installed capacity of 336 MW, operating at 45% utilisation (and including transmission losses), could displace in a year around 484,950 tonnes of carbon dioxide from a gas-fired plant, or 1,148,775 tonnes from a coal-fired plant<sup>20</sup>. The project will therefore provide an important and significant contribution to lowering New Zealand’s gross greenhouse gas emission levels (and so also help us to meet our international obligations).

---

<sup>19</sup> Upland Landscape Protection Society Inc. versus Clutha District Council, Otago Regional Council & TrustPower Ltd., Decision No. C 85/2008, 25 July 2008.

<sup>20</sup> ‘Evidence in Chief of Thomas Brent Layton’, at paragraph 4.11.

- 6.17 The Ministry of Economic Development's 'New Zealand Energy Quarterly' indicates that renewables provided around 64% of New Zealand's electricity generation in 2007.<sup>21</sup> The latest Government forecast is for electricity demand to grow at an average rate of 1.5% per year (compounding) through to 2020, including allowances for improvements in energy efficiency.<sup>22</sup> Based on this information NZWEA has estimated the requirement for new renewable electricity by 2025 at around 21,350 GWh, or an average of around 1,260 GWh per year (see Appendix 1).
- 6.18 To put this in context, this represents an increase in total renewable generation of around 77% in just 17 years. Over the past 17 years New Zealand's total renewable generation has only increased by around 3,000 to 4,000 GWh in total<sup>23</sup> (or around 15%), demonstrating the challenge of the target and the importance of all of the projects that will contribute towards it.
- 6.19 The Government identified in its pre-election Energy Policy that they expected to see higher demand growth – at 2.2% - as a result of their broader economic growth policies (see footnote 11). On this basis, New Zealand's total renewable electricity generation would need to double by 2025 (see Appendix 1).
- 6.20 The proposed NPS (see 6.7) also recognises the challenge inherent in achieving this target, and the contribution that individual projects can make in this regard, where it identifies in its Policy 1 that "*the benefits of renewable electricity generation activities, at any scale, are of national significance*". (my emphasis)<sup>24</sup>

---

<sup>21</sup> Ministry of Economic Development's 'New Zealand Energy Quarterly – December Quarter 2008', available from [www.med.govt.nz/energy/data/electricity](http://www.med.govt.nz/energy/data/electricity).

<sup>22</sup> The Government's latest electricity demand projections are outlined in section 4.5 of the appendices to the Ministry for the Environment's 'Net Position Report 2009' from April 2009 (see footnote 16 for details). The figure of 1.5% is less than the recent historical average of 1.9% as heavy industry energy demand growth is expected to be somewhat less in the future.

<sup>23</sup> Renewable generation around 1988-1990 was around 24,000 to 25,000 GWh, as per the MED's 'New Zealand Energy Data File June 2008', available from [www.med.govt.nz](http://www.med.govt.nz).

<sup>24</sup> The proposed National Policy Statement was released on 13 August 2008 and is available at [www.mfe.govt.nz/rma/central/nps/generation.html](http://www.mfe.govt.nz/rma/central/nps/generation.html).

- 6.21 The applicant has calculated that the Turitea Wind Farm, with 122 x 2.3 MW turbines, will generate up to 1,146 GWh of electricity per annum<sup>25</sup>. This represents just under one year of the estimated average annual new renewable generation requirement or just over 5% of the total new renewable generation required by 2025 (as per 6.17 above). (This contribution will reduce should the applicant elect to install lower capacity turbines and/or a lesser number than the 122 for which consent has been sought).
- 6.22 Electricity generation from this project would make a significant contribution towards the achievement of the renewable energy target. Failure to pursue projects such as the Turitea Wind Farm could potentially result in a need to pursue less efficient projects, or projects with greater effects.
- 6.23 For the avoidance of doubt, in discussing the important contribution of renewable generation of all scales to New Zealand's energy and climate change objectives, I recognise that the RMA's principle of sustainable management applies and that any adverse effects of a proposed project must be considered appropriately. My intent here is to ensure that the project's benefits are adequately weighted in that assessment.
- 6.24 In summary, the Turitea Wind Farm is a new renewable energy project. The electricity that it generates can be used to both accommodate increasing demand growth (i.e. preventing increases in greenhouse gas emissions) and to substitute for existing thermal generation (i.e. reducing existing emissions). Subject to its successfully obtaining these resource consents, the project could be operational within a relatively short period. Mighty River Power's proposed Turitea Wind Farm is therefore completely consistent with Government policy and strategy.

---

<sup>25</sup> Evidence in Chief of Philip Wong Too, at Table 4.

## **7 The Project Represents Efficient Use of a Significant and World-Class Natural Resource**

- 7.1 The contribution made by a generation source to the operation of the electricity system is often measured by its 'capacity factor' (also frequently referred to as 'load factor'). Capacity factor is a measure of the actual amount of generation that occurred compared to the amount that would have been produced had the plant operated at continuously at full output over the time period of interest (typically annual), i.e. a capacity factor of 50% for a year of operation indicates that a power plant will produce 50% of the electricity it would have been able to produce if it had operated at 100% of its full rated output all day and every day.
- 7.2 No single source of generation is able to operate at a capacity factor of 100%. In the case of technologies such as wind farms and hydro dams the capacity factor is influenced mainly by the variable nature of their fuel supply (i.e. wind, rain) and for thermal plants by factors such as fuel costs and maintenance requirements. As thermal generation is often the most expensive source of generation it is often not dispatched at full capacity or only used as required, reducing the capacity factor accordingly.
- 7.3 The approximate capacity factors for some of New Zealand's existing generation technologies are listed below.<sup>26</sup>

---

<sup>26</sup> Compiled from the Ministry of Economic Development's 'Energy Data File' (June 2008) and 'New Zealand Energy Quarterly – December 2008', with adjustments as identified. Both documents are available from [www.med.govt.nz](http://www.med.govt.nz).

Source	Capacity Factor	
	2007	2008
Hydro	50%	47%
Geothermal <sup>1</sup>	83%	80%
Gas <sup>2</sup>	63%	67%
Coal <sup>2</sup>	50%	51%
All fossil fuel <sup>3</sup>	56%	58%
Wind <sup>4</sup>	41%	37%
All sources	53%	52%

1. The 2008 figure includes the new 100 MW plant installed at Kawerau and the 15 MW upgrade at Ngawha.
2. The 2008 calculation assumes that Huntly – that can run on either coal or gas – only ran on coal following the commissioning of the more efficient gas-fired E3P plant on the same site in 2007.
3. Includes gas, coal, oil and waste heat.
4. The 2007 figure is for the last half of the year only as the commissioning of Tararua 3 (93 MW) and White Hill (58 MW) earlier in the year will have distorted the calculation. The 2008 figure includes 3.5 MW added at Te Rere Hau. 2008 appears to have been a below average ‘wind year’. NIWA has noted that 2008 saw “highly variable” monthly wind patterns including more winds from the North-East (as opposed to the more typical North-West)<sup>27</sup> and TrustPower has noted that generation at Tararua Wind Farm was below average from February – May, including the lowest ever March and April output<sup>28</sup>.

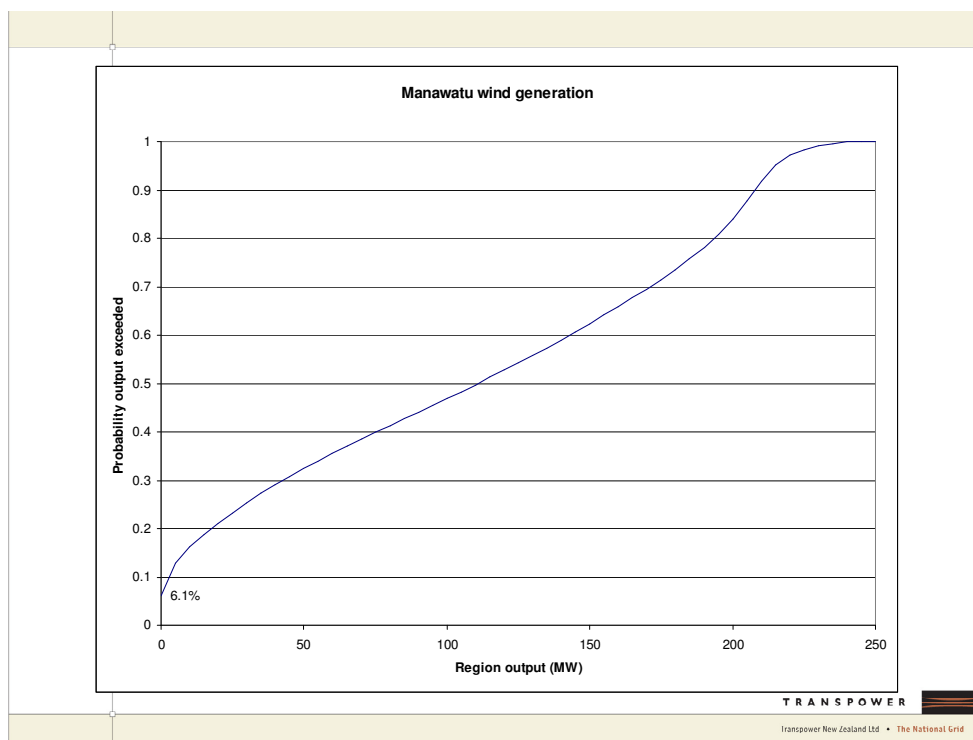
7.4 Capacity factor is not a measure of electrical efficiency, nor is it a measure of the time the generator is actually in operation. Accordingly, a capacity factor of 37 - 41% does not mean that New Zealand’s wind

<sup>27</sup> NIWA ‘New Zealand national climate summary – the year 2008’, 13 January 2009 from [www.niwa.cri.nz](http://www.niwa.cri.nz).

<sup>28</sup> TrustPower, ‘Investor Presentation, Sydney, 25 July 2008’, available from [www.trustpower.co.nz](http://www.trustpower.co.nz).

farms are only generating electricity for 37 - 41% of the time. New Zealand wind farms would typically be expected to be in operation (though not necessarily at their rated output) for around 85-95% of the time. As an example, data collected by Transpower indicates that the wind farms in the Manawatu are generating electricity around 94% of the time:

**Figure 2 – Output duration curve for Manawatu wind farms<sup>29</sup>**



7.5 I note that the applicant has indicated that they expect this wind farm to be generating electricity at least 90% of the time<sup>30</sup>. This is then entirely consistent with the performance seen at the existing wind farms in the region.

7.6 This performance is significant for the electricity system in the sense that our demand for electricity exists for 100% of the time. Accordingly the wind farm will make an important contribution to meeting our minute-to-minute, hour-to-hour and day-to-day electricity supply requirements.

<sup>29</sup> From 'Reviewing the effects of wind generation – three years on', presentation by Graeme Ancell of Transpower at the New Zealand Wind Energy Conference, 9 April 2008. Available at <http://www.windenergy.org.nz/events/conferences/NZWEC08/conference08.html>.

<sup>30</sup> 'Statement of Evidence of Philip Wong Too' at paragraph 2.4.

- 7.7 It should be noted that the capacity factor of a wind farm can also be significantly influenced by the choice of wind turbine. The different power generation curves of different turbine models will influence the yield (i.e. GWh of production) for a given wind regime. Similarly, as wind speed typically increases with height, the different hub heights of different turbine models can also influence the yield. Different models might also require different turbine spacing (typically related to the rotor diameter), influencing the number of turbines that can be located on a site (especially on elevated ridgelines with limited locational flexibility) and this can affect the yield accordingly.
- 7.8 As a result the capacity factor of a site can be an imprecise measure of the relative merits of a wind farm site. For the developer (and as a flow-on effect for the consumer) it is the yield (GWh) and production cost (\$ per MWh) that are the significant drivers for the economic viability of a site.
- 7.9 While capacity factor may not provide an accurate tool for comparing individual wind farms, it can be useful for comparing the aggregate wind resource in different regions. Capacity factors will typically be higher in regions with good wind resources (i.e. higher and more consistent wind speeds) and in this respect the New Zealand wind resource is world-leading. To place the benefits of New Zealand's high capacity factors in the correct context, the global average output of a 100 MW wind farm is about 193 GWh, or only just over half of the output of a typical New Zealand wind farm<sup>31</sup>:

---

<sup>31</sup> New Zealand data as per paragraph 7.3, all other global data derived from 'Windstats Newsletter', Vol. 20, No. 1, Winter 2007 (ISSN 0903-5648).

<b>Country</b>	<b>Capacity Factor</b>	<b>Annual generation per 100 MW capacity</b>
New Zealand	37 – 41%	324 – 359 GWh
Australia	37%	324 GWh
United Kingdom	27%	237 GWh
USA	26%	228 GWh
Denmark	24%	210 GWh
Germany	17%	149 GWh
Approximate global average	22%	193 GWh

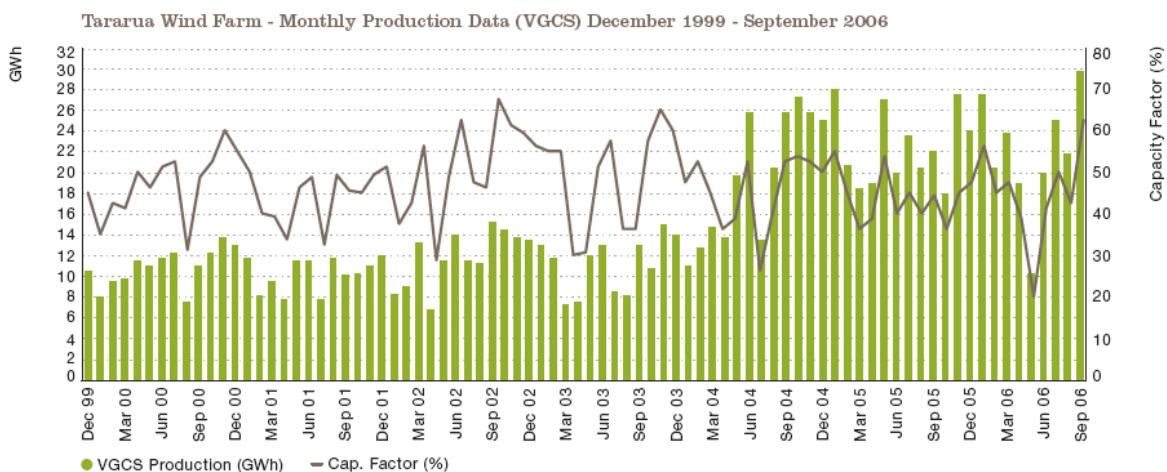
7.10 While the overall performance of New Zealand's wind farms is noteworthy compared to others around the world, the performance of the existing wind farms in the Manawatu – and for the proposed project – are even more significant and represent the utilisation of a natural resource that is outstanding from a global perspective.

7.11 Published electricity generation data for the nearby Tararua Wind Farm suggests the following performance<sup>32</sup>:

Year (to end-March)	Installed capacity (at end-March) MW	Electricity generated GWh	Capacity Factor %
2003	31.7	141	51
2004	31.7	140	50
2005	68.0	260	44
2006	68.0	268	45
2007	68.0	274	46
2008	161	546	39

7.12 This is also consistent with the monthly data presented in the attached graph (where the capacity factor is identified by the grey line):

**Figure 3 – Capacity factor for Tararua Wind Farm<sup>33</sup>**



<sup>32</sup> Generation data has taken from TrustPower’s Annual Reports for 2007 and 2008 (both available from [www.trustpower.co.nz](http://www.trustpower.co.nz)). Installed capacity figures are based on Stage 2 commissioning during 2004 and Stage 3 during 2007. The low capacity factor to end-March 2008 is likely to have been influenced by the commissioning of Tararua Stage 3 during that 12 month period.

<sup>33</sup> Taken from page 12 of the TrustPower ‘Annual Report 2007’, available from [www.trustpower.co.nz](http://www.trustpower.co.nz).

7.13 Other information presented by Trustpower suggests that they expect the wind farm to generate an annual average of 620 GWh in its current 161 MW configuration<sup>34</sup>. This is equivalent to a capacity factor of 44%. As identified at 7.9 above, this is approximately twice the global average.

7.14 Published data for the Te Apiti Wind Farm, that is located to the north of Tararua Wind Farm suggests a similarly high level of performance<sup>35</sup>:

Reporting period	Generation (GWh)	Capacity Factor (%)
12 months 05/06	291	37%
12 months 06/07	323	41%
12 months 07/08	322	45%
6 months 08/09	162	41%

7.15 For the Turitea Wind Farm project - using 2.3 MW turbines - the expected 1,146 GWh per year of electricity generation from the resulting 280.6 MW capacity is equivalent to a capacity factor of around 47%<sup>36</sup>.

7.16 As discussed at 7.5 above, this performance is consistent with that seen at the other wind farms in the region and – at more than twice the approximate global average capacity factor – significant on a global scale. This expected performance is also consistent with what would be expected from a wind farm site with wind speeds of around 10 metres per second that are expected at the project site.

---

<sup>34</sup> This figure is quoted in a 'Presentation to Investor Briefing, May 2008' and on their webpage for the Tararua Wind Farm (both available via [www.trustpower.co.nz](http://www.trustpower.co.nz)).

<sup>35</sup> From Meridan Energy's 'Interim report for the period to 31 December 2008', Annual report for the year ending 30 June 2008' and 'Annual report for the year ending June 2007'.

<sup>36</sup> 'Statement of Evidence of Philip Wong Too' at paragraph 6.5.

- 7.17 While the expected performance at this site is consistent with that of the other wind farms in the region, sites with wind resources of this quality, and that might be expected to be suitable for development are expected to be rare on a national basis.
- 7.18 For example, Meridian Energy – who owns and operates more than half of New Zealand’s existing wind energy capacity – expect around just 2,000 GWh of potential generation from sites with this quality of wind resource<sup>37</sup>. On this basis this project would represent more than half of this potential.
- 7.19 The limited availability of other suitable sites with wind resources of this type can also be seen in the expected performance of other sites that have or are seeking resource consent, a number of which anticipate capacity factors in the range of 35 – 40%.
- 7.20 It is important to note that there are a range of factors that might influence the relative merits of wind energy projects, such as their fit with the generation and customer portfolio of the developer and proximity to demand centres, transmission infrastructure and customers. It can also be seen from paragraph 6.17 that a range of projects are likely to be needed in order to meet rising electricity demand and the renewable electricity target. Accordingly the identification of the capacity factors of these sites is not intended to identify them as being less significant for New Zealand’s electricity supply (and they are also still significant on a global scale).
- 7.21 This specific project has some additional characteristics that add to its significance, through its proximity both to a major demand centre (Palmerston North and the wider Manawatu region) and to existing transmission infrastructure that has sufficient capacity to accommodate the output from the project. Its location in the North Island should also help to reduce transmission losses when the demand in the upper North

---

<sup>37</sup> Meridian Energy’s ‘Options, Choices, Decisions – 2009 Update’ from April 2009 suggests ‘only a handful’ of sites with wind speeds of 8.5 m/s or more will be able to be developed and estimates the total viable potential from these sites as 2000 GWh per year.

Island (the source of New Zealand's greatest electricity demand) exceeds regional supply by displacing electricity that would otherwise need to be transported from further south.

7.22 The proximity of the Project West Wind wind farm to the major demand centre of Wellington and the efficient use of physical resources through its location close to existing transmission infrastructure were identified by the Environment Court as "significant aspects" of its decision to grant consent to that project<sup>38</sup>. The related benefit of reduced transmission losses has also been identified by the Court at *Awhitu*<sup>39</sup>.

7.23 The Court has also identified at *Mahinerangi* that projects of this type provide these benefits while also:

- Not utilising any finite resource, other than the site itself;
- Involving only minimal displacement of other productive uses of the land; and
- Using the wind resource without affecting that resource in any way<sup>40</sup>.

7.24 Accordingly this project represents an opportunity to efficiently and effectively use a significant and outstanding natural resource - with a number of resulting benefits - that would otherwise go unutilised.

## **8 Security of Electricity Supply**

8.1 When references are made to the expression "security of supply" it is important to take into consideration the timescale that is providing the context for the discussion. The expression has been used to refer to timescales ranging from the risk of instantaneous events (i.e. the unexpected shutdown of a major generator) right through to periods of months (i.e. "dry years").

---

<sup>38</sup> Meridian Energy and others versus Wellington City Council, W031/2007, 14 May 2007 at 582.

<sup>39</sup> Genesis Energy & EECA versus Franklin District Council, A148/2005, 7 September 2005 at 64.

<sup>40</sup> Upland Landscape Protection Society Inc. versus Clutha District Council, C85/2008, 25 July 2008 at 238.

- 8.2 The electricity system is complex and dynamic and the different components of the system – loads, transmission and generators – make differing contributions to its security requirements. These requirements include elements of energy supply (GWh), capacity (MW) and stability (frequency, voltage). No one component of the system can perform all of these roles.
- 8.3 The Electricity Act 1992 (s172N) sets the principle objectives for the Electricity Commission and the specific outcomes that the Commission must seek to achieve. The Government Policy Statement on Electricity Governance ('GPS') sets out the objectives and outcomes the Government wants the Commission to give effect to.
- 8.4 The current GPS identifies the 'Security of supply objective for the Electricity Commission' and notes that the previous "1 in 60 dry year" standard has been replaced by a "winter energy margin" that is similar to, but more clearly defined than the 1 in 60 standard. The GPS sets the margin at 17% for New Zealand overall.<sup>41</sup>
- 8.5 Wind energy is also a reliable source of generation in that it varies little on a long-term basis. The available energy from the wind typically only varies by around 5 to 10% annually, compared to around 20% for hydro generation. Accordingly wind energy, by displacing sources of generation that can store their fuel (i.e. gas, coal, hydro) and by having this relatively low annual output variation, makes an important contribution to ensuring that the energy margin component of the security of supply objective - that relates to the "dry year" timescale - can always be achieved.
- 8.6 The 2008 winter saw a lot of discussion regarding risks to electricity supply. Persistent dry weather lowered lake levels, reducing energy storage well below the historical average. At the same time the shutdown of the New Plymouth thermal power plant (subsequently made available again on a restricted basis) and restrictions in the capacity of

---

<sup>41</sup> From 'Government Policy Statement on Electricity Governance', May 2009. Available from the MED website, [www.med.govt.nz](http://www.med.govt.nz).

the HVDC link resulted in lowered reserve supply margins. During late January and early February these reserve supply margins were reduced further by a 6 week maintenance shutdown of the Stratford CCGT and cooling water restrictions at Huntly. Energy storage was also reduced as the hydro dams had to be run harder than they might otherwise have been in order to meet demand. Spot electricity prices rose significantly as a result.

- 8.7 When this dry weather continued a public electricity savings programme was pursued for several weeks over winter. Lake levels in the South Island only returned back towards their historical average around September, enabling the savings programme to be ended.
- 8.8 These issues have highlighted a need for investment in new electricity generation projects and for diversification away from the current reliance on hydro generation.
- 8.9 In this context the Turitea Wind Farm has an important contribution to make. As discussed above, the use of wind energy enables water to be stored behind the hydro dams for future use. The increased lake levels provide an additional security margin both in terms of energy supply (i.e. that energy is available for use at a later date) and in terms of having capacity available to meet short-term peak demands.
- 8.10 This water storage can take place over a period of several months (for example, high wind farm output during the spring snow melt can help to enable more of that water to be captured for use later in summer or early in winter rather than that water being used instantaneously).
- 8.11 The MED's Energy Data File indicates that there is over 9,100 MW of installed generation capacity in New Zealand, of which over 5,300 MW is hydro.<sup>42</sup> New Zealand's peak electricity demand is around 6,300 MW, so it can be seen that issues regarding security of supply do not relate to a lack of capacity but rather to a lack of energy (in the form of water stored behind the dams). Projects such as the Turitea Wind Farm, which

---

<sup>42</sup> Energy Data File, Ministry of Economic Development, June 2008.

diversify and increase New Zealand's sources of energy, can only help to reduce these security of supply concerns.

8.12 Transpower, the owner and operator of the transmission system has identified the value of diversity in its Annual Planning Report:

*"A power system made up of a high level of renewable electrical energy generation becomes more robust when additional generation is both resource diverse and location diverse, i.e. it is not all one type and from one area."*<sup>43</sup>

8.13 It is true that the Turitea Wind Farm will not produce electricity when there is insufficient wind available for generation. It may also be the case that this coincides with a period of peak demand. However the project will be producing electricity for at least 90% of the time<sup>44</sup>. All of the electrical energy that is produced (1,146 GWh per year with 2.3 MW turbines – see 7.15) will be consumed. Accordingly, while it represents only a limited source of capacity, wind energy represents a valuable and realisable source of energy.

8.14 I also note that the Electricity Commission, in their 2008 Statement of Opportunities makes specific reference to the subject of generation capacity on a windless day. That document includes the following comments:

*"The PSA (Power Systems Analysis) also identified possible generation capacity shortfalls associated with a windless day throughout the country, coincident with peak winter demand.*

*Three conditions were tested.*

- Ability to meet peak demand with no wind generation.*
- Ability to meet peak demand with no wind generation, but with Otahuhu B (360MW) running.*
- Not able to meet peak demand without wind generation.*

---

<sup>43</sup> Transpower, 'Annual Planning Report 2009', March 2009 at paragraph 2.3.

<sup>44</sup> 'Statement of evidence of Philip Wong Too' at paragraph 2.4.

***In all generation scenarios there appears adequate generation to cover peak winter demand on a nationwide windless day***.<sup>45</sup> (my emphasis).

- 8.15 Accordingly the Electricity Commission also appears to accept that the electricity system should be able to cope for any situation where there is no wind generation anywhere in the country on any given day.
- 8.16 The Electricity Commission has also undertaken a study to investigate the potential impact of a high level of wind penetration into the New Zealand electricity system, known as the WGIP. The study is based upon the expectation that wind energy will form a significant part of the country's generation requirements.
- 8.17 NZWEA was fully engaged in this project, and I was also a representative on the project's TSG that peer reviewed the various reports that were prepared.
- 8.18 These reports indicated that while increased amounts of wind energy would have an impact on the system, the issues that were raised (pre-dispatch, dispatch and low voltage fault ride-through) were those that could have been anticipated and would not be expected to create significant additional costs.
- 8.19 As well as considering the impact on general system operation (i.e. scheduling and dispatch) the project also considered the full range of reliability-related issues, including impacts on asset loadings, voltage stability and quality, frequency and transient stability. No significant issues were identified by these studies.
- 8.20 As a result of the WGIP a number of tasks, including the development of a wind energy forecasting system, have now been included in the Electricity Commission's ongoing work programme, but no limits or constraints to wind energy development have been identified or proposed.

---

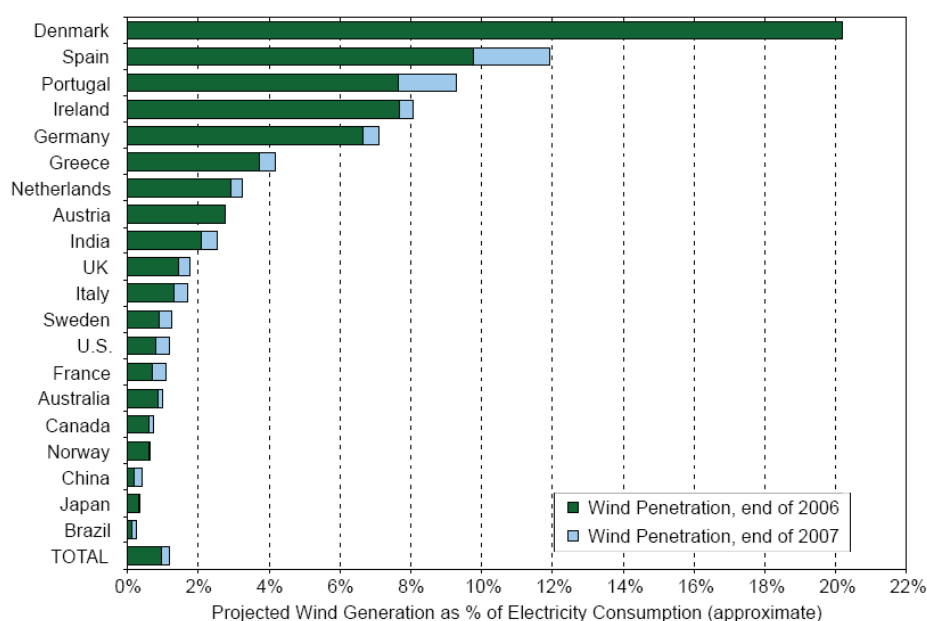
<sup>45</sup> Electricity Commission, '2008 Statement of Opportunities', August 2008 at paragraph 11.5.

- 8.21 It should be noted that this study considered the possibility that a further 2,000 MW of wind power might be connected to the network in the next 10 years. It is generally accepted that a penetration of up to 20% can be achieved in a transmission system before system issues might arise.
- 8.22 With the penetration of wind into the New Zealand system currently only around 3% there are not expected to be any issues with the operation of the network that cannot be managed using existing processes for the upcoming wind farm connections that will potentially include the Turitea Wind Farm.
- 8.23 Transpower, the grid System Operator, has also identified that there are no technical reasons to limit the penetration of wind onto the electricity system and that the power system has some inherent capacity and flexibility that should enable increased wind uptake. While identifying that additional plant to balance or 'firm' variable wind generation may be required at some point in the longer-term future they have noted that:
- "...the maximum level of wind in the system is likely to be set by economic considerations rather than technical integration issues"<sup>46</sup>.*
- 8.24 Several other electricity systems in other parts of the world, including some such as Spain, Portugal and Ireland that have very limited interconnection into other transmission networks are already operating with wind penetrations well in advance of the existing penetration in New Zealand, as shown in Figure 4.

---

<sup>46</sup> Transpower, 'Annual Planning Report 2009', March 2009 at section 2.3

**Figure 4 – Wind penetration levels<sup>47</sup>**



Source: Berkeley Lab estimates based on data from BTM Consult and elsewhere.

8.25 A wide range of views exist as to what the ultimate technical and economic maximum limits for wind energy penetration might be. However as countries around the world continue to seek ways to increase the amount of wind generation on their networks, new technologies and solutions are continuing to be developed. What is considered to be the limit today will be lower than the limit tomorrow.

8.26 It has also been suggested that the integration of wind energy into the New Zealand electricity system will be easier to achieve than in other systems due to the presence of a significant quantity of flexible hydro generation and the high capacity factors of New Zealand’s wind farms.<sup>48</sup>

Fraser Clark

**New Zealand Wind Energy Association**

<sup>47</sup> US Department of Energy, ‘Annual Report on U.S. Wind Power Installation, Cost and Performance Trends: 2007’, May 2008.

<sup>48</sup> ‘The system impacts and costs of integrating wind power in New Zealand’, the report on a study conducted by G. Strbac et al from Imperial College London, June 2008.

## **Appendix 1: Estimation of total new renewable generation requirement to achieve the 90% target**

The New Zealand Energy Strategy<sup>2</sup> sets a target of 90% of electricity generation occurring from renewable sources by 2025. The latest Government projections are for average new demand growth of 1.5% per year (see paragraph 6.16 for details). On this basis - and with reference to the actual generation data from 2008 - NZWEA has estimated the demand for new renewable generation as follows:

2008 total electricity generation:	42,245 GWh (from MED <sup>20</sup> )
=> 2025 total generation:	54,410 GWh (1.5%/yr growth)
=> 2025 total renewable generation:	48,970 GWh (at 90% of total)
- 2008 total renewable generation:	- 27,619 GWh (from MED <sup>20</sup> )
<b>=&gt; New renewable generation by 2025 =</b>	<b>21,350 GWh</b>

This represents an increase of 77% over existing renewable generation, or the equivalent of approximately 10 Benmore hydro schemes<sup>49</sup>.

This means that over the 17 years between 2008 and 2025 that the average amount of new renewable generation required each year is approximately:

$$= 21,350 / 17 = \mathbf{1,260 \text{ GWh per year}}$$

The Energy Policy<sup>12</sup> of the recently elected National Party predicts annual demand growth of 2.2% per year (consistent with recent growth) while also broadly supporting the 90% target (see 6.6). On this basis a similar calculation suggests a requirement of **27,420 GWh** of new renewable generation (i.e. 100% increase), or an average of **1,610 GWh per year**.

---

<sup>49</sup> Meridian Energy's Annual Report for the year ending 30 June 2008 identifies that Benmore generated 1,975 GWh of electricity in the 2007/08 year.