Board of Inquiry

Hauāuru mā raki Wind Farm Proposal

Under the Resource Management Act 1991

In the matter of applications for resource consent by Contact Wind Limited in respect of the Hauāuru mā raki Wind Farm proposal.

Statement of Evidence of Fraser Ross Clark

For and on behalf of the New Zealand Wind Energy Association

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new zealand wind energy association

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1 Introduction

1.1 My name is Fraser Ross Clark. I am employed by the New Zealand Wind Energy Association ('NZWEA') 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 represented the wind industry in other forums, such as serving as an industry representative on the Scoping Committee for Standards New Zealand's workshop considering a review of NZS6808:1998, the New Zealand Standard for noise from wind turbine generators. 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 Contact Wind Ltd., and in particular the evidence of Francis Chanel Geoghegan, Oliver Michael Manins & David Thomas Hunt.

2 About the New Zealand Wind Energy Association (NZWEA)

2.1 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.

2.2 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.

2.3 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.

2.4 NZWEA has no financial involvement in Hauāuru mā raki Wind Farm, or any other wind farm development.

2.5 The applicant, Contact Energy Limited, is a member of NZWEA.

3 Scope of Evidence

3.1 NZWEA agrees with the applicant that the Hauāuru mā raki Wind Farm project will provide a number of important benefits, both nationally and regionally. 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.
- That the project represents efficient use of a significant natural resource.
- The contribution of this project to both security of electricity supply and to security of electricity pricing (both ways in which electricity *enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety* (s5 RMA).
- Consideration of some of the factors affecting the viability and timing of the project, and the use of a consenting approach that allows a reasonable degree of flexibility in the final design and project implementation.

4 Status of the New Zealand and global wind energy industry

4.1 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.

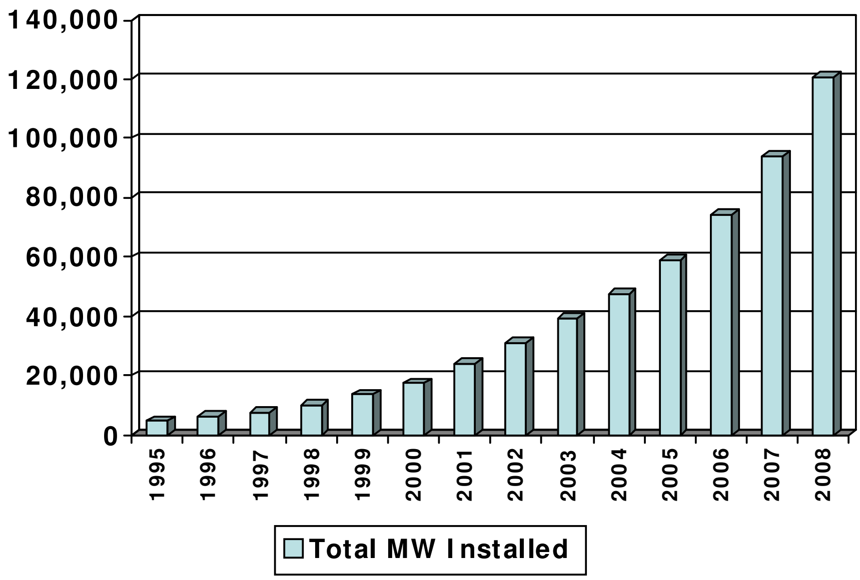
4.2 Today wind energy is one of the world's leading sources of new electricity generation. New wind generation capacity made up 43% of the total new capacity installed in the EU in 2008, exceeding all other technologies including gas, coal and nuclear power.[1] A record 8,358

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

megawatts (MW) of new capacity was installed in the USA last year, representing 42% of all new generation capacity.[2]

4.3 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.[3]

Figure 1 – Global wind energy development[3]



4.4 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 3). It should be clear from these figures that the wind energy industry is now a major global industry.

[2] '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.

[3] '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.

4.5 The first 'modern' wind energy project in New Zealand was the single 225 kW Vestas turbine that was installed on Pol Hill in Brooklyn[4], Wellington as a trial in 1993. That turbine remains in operation today.

4.6 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.

4.7 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[5], representing about 3.5% of the total generating capacity from all sources.

4.8 In the December quarter of 2008 wind energy achieved a record 304 GWh of generation, or 3.0% of total generation.[6] 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.

4.9 A further 186 MW of new capacity will be installed by early 2010[7], 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[8] - including this project - and further projects are under investigation. 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

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

[5] From data collected by the New Zealand Wind Energy Association.

[6] Taken from the MED's 'New Zealand Energy Quarterly – December Quarter 2008', released on 19 March 2009. Available from www.med.govt.nz.

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

[8] 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.

demonstrates the recognition that wind energy is an important and viable source of electricity generation for New Zealand.

4.10 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.

5 Energy, Climate Change and Government Policy

5.1 New Zealand's recently elected Government, while reviewing some of the policy implemented by the previous Government, has indicated that New Zealand will remain committed to global action on climate change, including its commitments under the Kyoto Protocol.

5.2 It is noteworthy in this sense that while the new Government has established a Select Committee to review the Climate Change Response (Emissions Trading) Amendment Act 2008, the Act itself has not been repealed. This means that New Zealand actually has a legislated Emissions Trading Scheme in place today (although it currently lacks some of the regulation required for it to fully function).

5.3 The Government's commitment to action on climate change was most recently demonstrated just last week 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."

And the New Zealand Minister also noted:

"We know that failure to act on climate change is not an option".[9]

[9] '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/ustralia+and+new+zealand+strengthen+climate+change+cooperation

5.4 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)[10] and the New Zealand Energy Efficiency and Conservation Strategy (NZEECS).[11] Both of these strategies were released in October 2007.

5.5 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.

5.6 While the incoming Government has announced that it intends to review the NZES during the coming year their election policy (now Government policy) has identified that they support 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*".[12]

5.7 The 'national significance' of renewable energy development, and this target is also identified in the objective of the Government's recently released '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

[10] 'New Zealand Energy Strategy to 2050', Ministry of Economic Development, October 2007. Available at http://www.med.govt.nz/templates/MultipageDocumentTOC____31948.aspx

[11] New Zealand Government, 'New Zealand Energy Efficiency and Conservation Strategy (2007)', October 2007. http://www.eeca.govt.nz/about/national-strategy/nzeecs-index.html.

[12] '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)".[13]

5.8 While this NPS is only a draft it 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 hearing process for the Board of Inquiry is currently scheduled to commence in April and is expected to run through to early July.

5.9 The need for action on emissions from the electricity sector in particular is also demonstrated in New Zealand's greenhouse gas emissions statistics. The 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[14]. This compares to an increase of around 25% (15.9 million tonnes) in New Zealand's total emissions over the same period[15].

5.10 It can be seen from these figures that New Zealand's emissions from electricity generation are increasing significantly faster than emissions from other sources. 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.

5.11 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

[13] 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.

[14] MED, 'Energy Greenhouse gas Emissions 1990-2007'.

[15] 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

Court identified this in its recent 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].[16]

5.12 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.

5.13 The evidence presented by Contact – using assumptions similar to those that have been applied for other, similar projects - suggests an anticipated emission reduction or avoidance of between 140,000 & 700,000 tonnes of CO_2-equivalents per year[17]. The emissions that this project expects to avoid would therefore be equivalent to up to 4.4% of New Zealand's current liabilities under the Kyoto Protocol (15.9 million tonnes - see footnote 6). The project will therefore provide an important and significant contribution to lowering New Zealand's GHG emission levels (and so also help us to meet our international obligations).

5.14 The Ministry of Economic Development's 'New Zealand Energy Quarterly' indicates that renewables provided around 65% of New Zealand's electricity generation in 2007.[18] The NZES notes (for example on page 72) that electricity demand is expected to continue to grow at 1.3% per year (compounding) over this period despite the expectation of significant energy efficiency gains as a result of the NZEECS. Based on this information NZWEA has estimated the requirement for new

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[16] Upland Landscape Protection Society Inc. versus Clutha District Council, Otago Regional Council & TrustPower Ltd., Decision No. C 85/2008, 25 July 2008.

[17] 'Evidence in Chief of David Thomas Hunt', at paragraph 53.

[18] Ministry of Economic Development's 'New Zealand Energy Quarterly – December Quarter 2007', available from www.med.govt.nz/energy/data/electricity

renewable electricity by 2025 at around 20,000 GWh, or an average of around 1,110 GWh per year (see Appendix 1).

5.15 To put this in context, this represents an increase in total renewable generation of around 70% in just 18 years. Over the past 18 years New Zealand's total renewable generation has only increased by around 3,000 to 4,000 GWh in total[19] (or around 15%), demonstrating the challenge of the target and the importance of all of the projects that will contribute towards it.

5.16 The incoming Government identified in their 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).

5.17 While NZWEA's estimates do not agree directly with those presented by the applicant (as discussed in the evidence in chief of David Thomas Hunt) they are of an equivalent scale and represent a similar understanding of the potential scenarios.

5.18 The Government's recently released 'Proposed National Policy Statement for Renewable Electricity Generation' also recognises the challenge inherent in achieving this target where it identifies in its Policy 1 that "*the benefits of renewable electricity generation activities, at any scale, are of national significance*". (my emphasis)[20]

5.19 The applicant has calculated that Hauāuru mā raki Wind Farm will generate up to 1,600 GWh of electricity per annum[21]. This represents about one and a half years of the estimated average annual new renewable generation requirement or around 8% of the total new renewable generation required by 2025. (This contribution will reduce

[19] 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.

[20] The proposed National Policy Statement was released on 13 August 2008 and is available at www.mfe.govt.nz/rma/central/nps/generation.html

[21] 'Statement of Evidence of Francis Chanel Geoghegan' on behalf of Contact Energy Limited, at paragraph 70.

should the applicant elect to install lower capacity turbines and/or a lesser number than the 180 for which consent has been sought).

5.20 Electricity generation from this project would make a significant contribution towards the achievement of the renewable energy target. Failure to pursue projects such as Hauāuru mā raki Wind Farm could potentially result in a need to pursue less efficient projects, or projects with greater effects.

5.21 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.

5.22 In summary, Hauāuru mā raki 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. Hauāuru mā raki Wind Farm is therefore completely consistent with Government policy and strategy.

6 The Project Represents Efficient Use of a Significant Natural Resource

6.1 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 rated output all day and every day.

6.2 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.

6.3 The approximate capacity factors for some of New Zealand's existing generation technologies are listed below:[22]

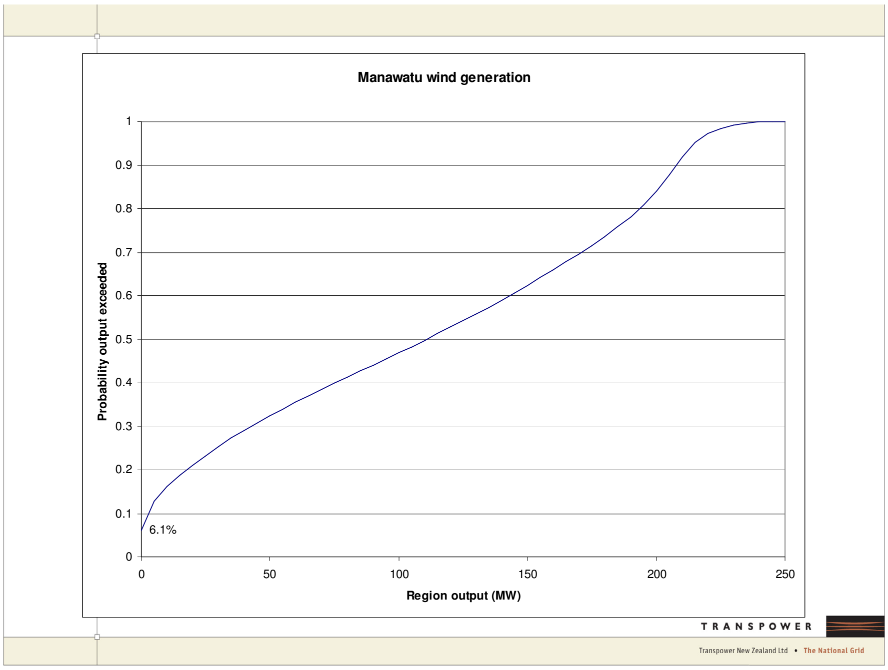
Technology	Capacity Factor
Hydro	50%
Geothermal	83%
Coal	50%
Gas	63%
All thermal	57% (coal, gas, oil)
Wind	41%

6.4 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 41% does not mean that New Zealand's wind farms are only generating electricity for 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.[23]

[22] Data is for 2007 and taken from the MED's 'NZ Energy Data File – June 2008'. As two new wind farms were being commissioned during 2007 the data for wind is based only on the last six months of 2007.

[23] 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,

Figure 2 – Output duration curve for Manawatu wind farms



6.5 I note that the applicant has indicated that they expect this wind farm to be generating electricity 85% of the time.[24] This 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.

6.6 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 an affect the yield accordingly (as described in more detail in the evidence in chief of Oliver Michael Manins for the applicant).

[24] 'Evidence in chief of Oliver Michael Manins', at paragraph 32.

6.7 Accordingly 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.

6.8 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 around half of the output of a typical New Zealand wind farm

Figure 3 – Comparison of wind energy capacity factors

Country	Capacity Factor	Annual Generation per 100 MW capacity
Tararua WF	0.46	403 GWh
New Zealand	0.41	359 GWh
Australia	0.37	324 GWh
United Kingdom	0.27	237 GWh
USA	0.26	228 GWh
Denmark	0.24	210 GWh
Germany	0.17	149 GWh
Approx. Global Average	0.22	193 GWh

Source: *Tararua* – quoted in various sources, *NZ* – MED NZ Energy Quarterly for December Quarter 2007, *Others* – WindStats Newsletter, Winter 2007

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6.9 If 2.3 MW turbines are used, the expected 1,386 GWh per year of electricity generation from the resulting 414 MW capacity of the Hauāuru mā raki Wind Farm project is equivalent to a capacity factor of around 38%[25].

6.10 The applicant has noted that the site has an average wind speed of around 8 m/s[26] and that this is a lower wind speed than found at existing New Zealand wind farm sites. The yield and capacity factor for the site can be expected to be lower accordingly. However the expected wind farm performance remains well above that found in most other wind farms internationally, and the project has a number of other attributes (i.e. proximity to the major demand centres) that will assist its viability.

6.11 The proximity of the Project West Wind wind farm to the major demand centre of Wellington was identified by the Environment Court as a "significant aspect" of its decision to grant consent to the project.[27] The related benefit of reduced transmission losses has also been identified by the Court at *Awhitu*.[28]

6.12 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;
- Using the wind resource without affecting that resource in any way.[29]

[25] If it could be operated at full capacity every second of every day a generator with a rated output of 414 MW would produce 414 x 24 x 365 / 1000 = 3,627 GWh of electricity. The expected production of 1,386 GWh is then a capacity factor of 1,386 / 3,627 x 100 = 38%. A similar calculation for the 3 MW turbine option (540 MW and 1,600 GWh per year) gives a capacity factor of 34%.

[26] "Evidence in chief of Oliver Michael Manins', at paragraph 16.

[27] Meridian Energy & others versus Wellington City Council, W031/2007, 14 May 2007 at 582.

[28] Genesis Power & EECA versus Franklin District Council, A148/2005, 7 September 2005 at 64.

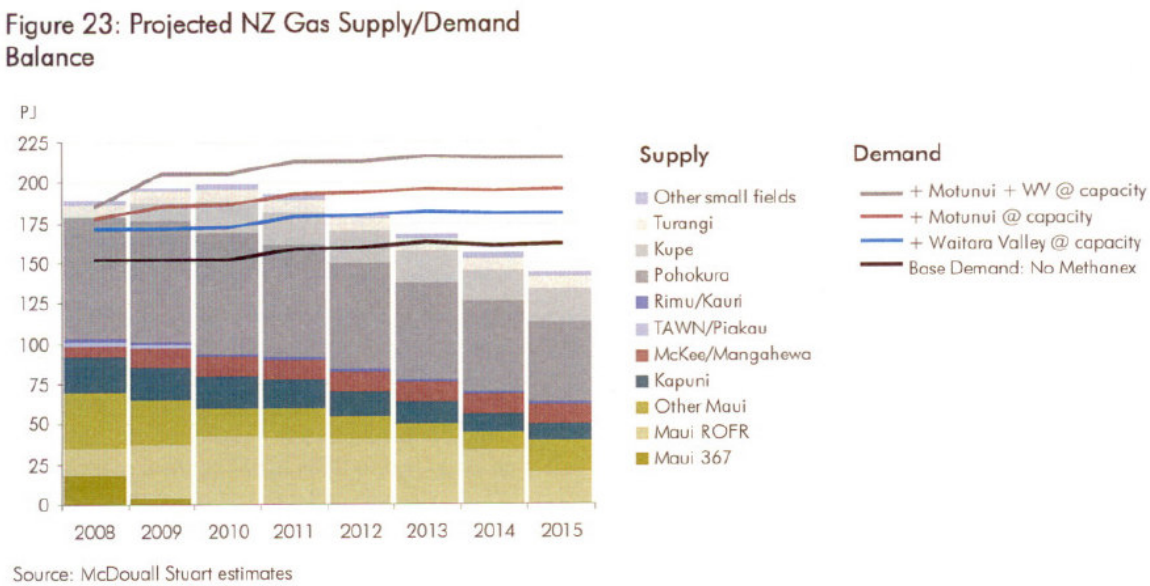
[29] Upland Landscape Protection Society Inc. vs. Clutha District Council, C85/2008, 25 July 2008 at 238.

7 Security of Electricity Price

7.1 Electricity prices in New Zealand are set at the price level required for the last generator that is necessary to meet demand to be dispatched. This plant is often a fossil fuel generator that offers their electricity at a price that enables them to recover the cost of their fuel. Except in the case of Huntly, that fuel is natural gas.

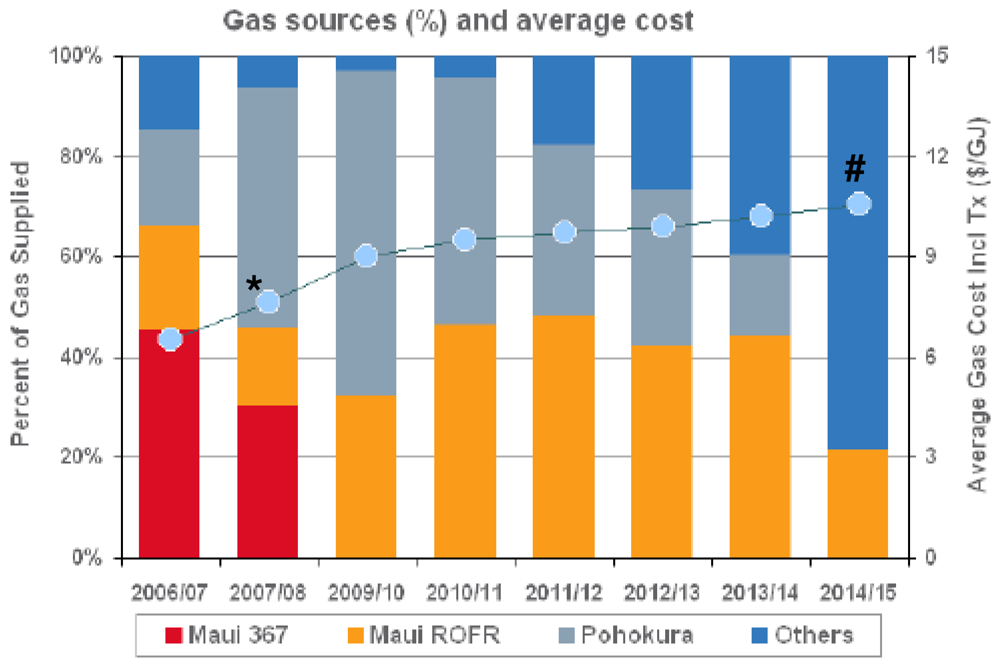
7.2 Historically the price for natural gas has been relatively low, with long-term prices set during the development of the Maui gas field. However as supplies from that field have dwindled (and been replaced to a limited extent by smaller fields with higher development costs) the price of natural gas has risen significantly – a trend that is expected to continue.

Figure 4 – Projected gas supply/demand balance[30]



[30] McDouall Stuart 'New Zealand Energy Sector Report 2008', March 2008

Figure 5 – Anticipated gas supply prices[31]



** Gas price for 2007-2008 was $7.18 per GJ (up from $5.78 for the previous 12 months (from footnote 27).*

 # Estimate for 2014-2015 is about $10.50 per GJ (estimated by NZWEA from the graph).

7.3 These higher gas prices flow on to electricity prices. Rising gas prices are widely accepted as being the main cause of the significant electricity price inflation that has been experienced over the last few years.

7.4 NZWEA has estimated the impact of the gas price increase indicated in Figure 5 above at around $25 per MWh (see Appendix 2). As a reference, New Zealand's average electricity price (real) increased by $4.60 per MWh over the 2007 calendar year[32].

7.5 New renewable projects such as Hauāuru mā raki Wind Farm are not exposed to this type of fuel supply and price risk. The fuel source for this project, the wind, is free. Costs of operation come only from overheads

[31] Graph taken from Contact Energy's 'Interim Financial Results – Six month period ended 31 December 2008', shareholder presentation of 24 February 2009. Available from www.contact-energy.co.nz. The annotations have been made by NZWEA.

[32] Derived from Table J.1b: Electricity Prices (Real 2007 Prices) from the MED's 'New Zealand Energy Data File June 2008', available from www.med.govt.nz.

and fixed costs. Indeed, as the project repays its financing, the marginal cost of operation reduces significantly. Accordingly, unlike fossil fuel generation, with its exposure to fuel price risk, the cost of wind energy generated from an established wind farm is known and predictable over its entire 20-25 year operating lifetime.

7.6 Under the rules of the electricity market, wind energy is required to offer its electricity at a price of $0.01 per MWh (or alternatively it can choose to enter the "must-run" auction and offer at $0 per MWh). This generally means that wind energy will always be dispatched first and will also then displace a more expensive form of electricity.

7.7 This displacement of more expensive generation can lower the spot price of electricity, creating savings for consumers. As an example in Denmark, where wind also has priority of dispatch, wind energy was calculated to have saved €4.5 per MWh (approx. NZ$9 per MWh) in 2005 when compared to the price if no wind generation was in operation.[33] While no similar study has yet been undertaken based on actual experience in New Zealand the principle of wind displacing more expensive forms of generation should produce the same type of outcome.

7.8 This effect was identified in a recent NZIER report that concluded – even while using a limited data set – that the combination of wind and hydro power working together would help to suppress spot prices[34].

7.9 Accordingly, new renewables projects such as Hauāuru mā raki Wind Farm when installed today (or coming years) will provide us with greater security as to what the future electricity price will be.

[33] 'Wind almost free in Denmark', Windpower Monthly, Vol. 23, No. 11, November 2007.

[34] NZIER, 'Exploring wind-hydro correlation - Report to New Zealand Steel and the Major Electricity Users' Group', 5 September 2008.

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").

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 outs 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 (as also identified in the evidence of David Thomas Hunt).[35] While the Government has recently released a draft of a revised GPS for consultation the "winter energy margin" and related objectives have been retained.

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

[35] From 'Government Policy Statement on Electricity Governance', May 2008. Available from the MED website, www.med.govt.nz.

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 this security of supply objective - that relates to timescales relevant to “dry years” - can always be achieved.

8.6 Last 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 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 Hauāuru mā raki Wind Farm has an important contribution to make. As discussed above, and elsewhere in this submission, 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 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.[36] 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 Hauāuru mā raki Wind Farm, which diversify and increase New Zealand's sources of energy, can only help to reduce this 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 renewables (or renewables only) would be more robust if the renewables generation were both:

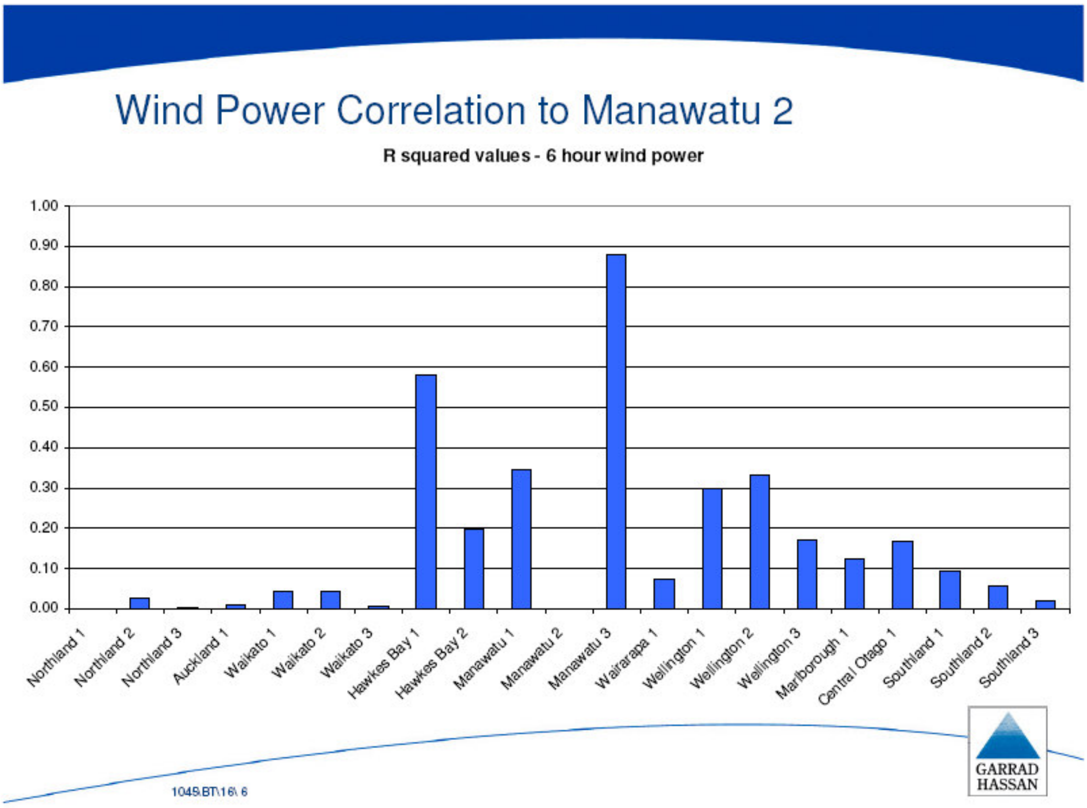
- *Location-diverse (e.g. spread throughout the system – not all dependent on one local resource).*
- *Resource-diverse (e.g. not all the same type whether wind, hydro, tidal, etc.).*[37]

8.13 The evidence in chief of David Thomas Hunt identifies that the Hauāuru mā raki Wind Farm provides a high level of "location diversity" (i.e. there is a low level of short term correlation between this site and other wind farm locations in Wellington and the Manawatu). This analysis is consistent with work under taken by Garrad Hassan for the Electricity Commission using wind speed measurements from a number of sites around the country that showed even lower correlations:

[36] Energy Data File, Ministry of Economic Development, June 2008.

[37] Transpower, 'Annual Planning Report 2008', March 2008 at paragraph 2.3.

Figure 6 – Correlation of theoretical wind farm power output to a wind farm in the Manawatu[38]



8.14 Geographic diversity is now widely acknowledged internationally as having an important role to play in maximising wind energy's contribution to power systems, and so to security of supply. The diversity benefits provided by this project would be expected to provide similar benefits here in New Zealand.

8.15 It is true that the Hauāuru mā raki 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 85% of the time. All of the electrical energy that is produced (up to 1,600 GWh per year) will be consumed. Accordingly while it represents only a limited source of

[38] Taken from the presentation 'Wind energy scenarios for New Zealand; diversity, variability & forecast accuracy', by Philip Wong Too and Dougal McQueen of Garrad Hassan at the New Zealand Wind Energy Conference in March 2007.

capacity, wind energy represents a valuable and realisable source of energy.

8.16 I also note that the Electricity Commission, in their recently published 2008 Statement of Opportunities made a 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.

In all generation scenarios there appears adequate generation to cover peak winter demand on a nationwide windless day*".*[39] (my emphasis).

8.17 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

8.18 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. That study was called the Wind Generation Integration Project ('WGIP'). The study is based upon the expectation that wind energy will form a significant part of the country's generation requirements.

8.19 NZWEA was fully engaged in this project, and I was also a representative on the project's Technical Stakeholder Group ('TSG') that provided peer review of the various reports that were prepared.

[39] Electricity Commission, '2008 Statement of Opportunities', August 2008 at paragraph 11.5.

8.20 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.

8.21 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.

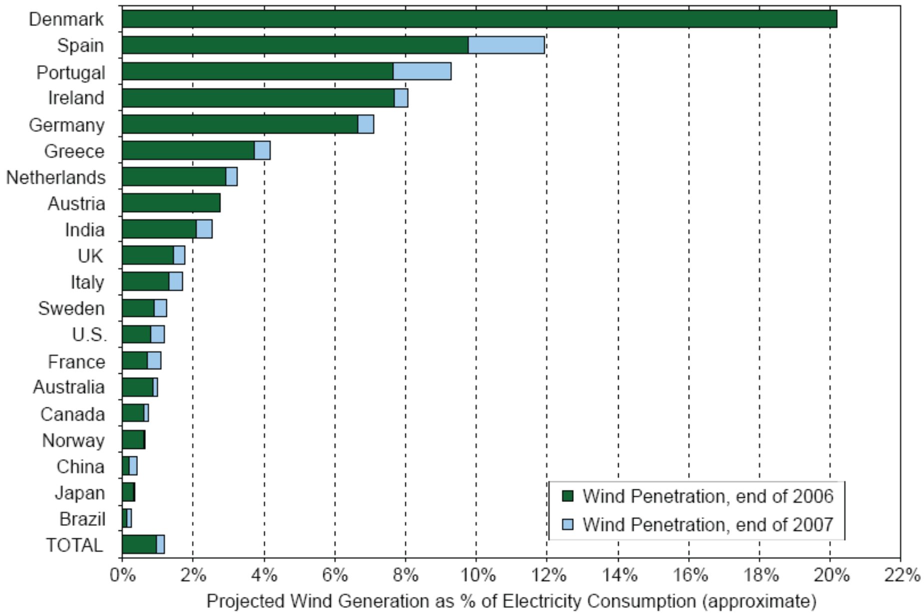
8.22 As a result of the WGIP a number of tasks, including the development of a wind energy forecasting system, have now been included in the Electricity Commission's ongoing work programme, but no limits or constraints to wind energy development have been identified or proposed..

8.23 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.

8.24 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 Hauāuru mā raki Wind Farm.

8.25 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.

Figure 7 – Wind penetration levels[40]



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

8.26 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.

8.27 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.[41]

Comments on Contact Energy's evidence in chief

8.28 The evidence of Francis Chanel Geoghegan (at 47), having referred to the variability in wind energy output notes that large thermal plants "already" disconnect from the system during faults. This could lead to the misleading conclusion that wind energy is already causing faults or

[40] US Department of Energy, 'Annual Report on U.S. Wind Power Installation, Cost and Performance Trends: 2007', May 2008.

[41] '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.

instability on the system. I assume that Mr Geoghegan was noting that the power system already has to respond to faults or volatility from other sources. As he notes later in this paragraph the system is able to manage any variability that wind energy is currently introducing into the power system. The Electricity Commission's WGIP, as referred to above, concluded that the electricity system will be able to accommodate a greater quantity of wind generation.

8.29 The evidence of David Thomas Hunt (at 33) raises the prospect of wind energy output declining during drought years, based on a limited set of data from 2008. It should be noted that data from one year would generally not be considered as being indicative of longer trends (noting for example that 1 in 60 year events are used when considering hydro inflows), and that limited geographic diversity currently exists. A different conclusion was reached in a report by NZIER (see 7.8) that concluded that "*wind speeds, as well as wind power generation, are therefore positively correlated with lake levels in some catchments and negatively correlated with lake levels in other catchments*". While under these circumstances a correlation between wind speed and drought cannot be ruled out, we are also a long way away from being able to rule it "in".

8.30 I also note in relation to the above comments that the variability of wind power is of a different order to that of hydro (see 8.4) and the share of generation is much lower, so it is also unlikely to have anything like the same level of impact on electricity supply as a "dry year" scenario.

8.31 At paragraphs 34-35 Mr Hunt refers to the possible need for 'back-up' resources to accommodate wind energy variability. It is important to note that <u>all</u> forms of generation require some form of 'back up' (or "reserve generation") as no single source of generation is 100% reliable. Similarly the system also keeps 'back-up' generation available to accommodate variations associated with electricity demand. The system as a whole benefits from having a diverse range of generation types and locations, all connected by the transmission network - as the level of back-up required is less than would be the case if the electricity had to be supplied to each major load centre independently. As discussed above, I agree with Mr Hunt's conclusion that the system will benefit from increasing geographic diversity.

9 Global Developments and Implications for New Zealand

9.1 As discussed previously, global installed wind energy capacity now exceeds 120,000 MW and increased by over 28% in 2008 alone. This growth has been driven by energy policies and legislation being applied in response to both energy security and climate change concerns, but also by energy companies increasingly identifying that wind energy is a mature and viable technology that is readily available.

9.2 IEA forecasts suggest that global electricity demand is expected to increase at 1.5 – 2.5% per year. Climate change and energy security concerns should see much of this demand met by renewables generation. With wave and tidal energy systems still several years from large-scale commercialisation and utility-scale solar generation comparatively expensive, wind energy is a cost-effective and proven solution that is available today. Accordingly the demand for wind energy is expected to continue to grow. Over 27 GW (27,000 MW) of new capacity was installed in 2008 with conservative forecasts expecting this to reach as much as 58.5 GW (58,500 MW) per year by 2013.[42]

9.3 Growth in the global wind industry has implications for the New Zealand industry. Global demand for wind turbines has been close to or has exceeded the available supply. All of the major turbine manufacturers and their component suppliers are actively increasing their supply capacity. At the same time costs for turbine materials such as steel, copper and the oil-based resins used in the blades have risen due to demand in developing economies such as China, and demand in other high-growth industries such as mining. Turbine costs have risen accordingly and would be expected to have an influence on the relative commercial viability of this project.

[42] 'International Wind Energy Development – World Market Update 2009 – Forecast 2009-2013' – press release by BTM Consult Aps announcing the release of their annual report on 25 March 2009. Available at http://www.btm.dk/world-index.htm.

9.4 The current global economic recession has had some impacts on the wind industry. Some developers are now experiencing difficulties obtaining project finance. This has reduced the global demand for turbines which in turn is expected to have flow-on effects for turbine prices. The recession has also seen a reduction in many commodity prices and that are also expected to eventually flow through to turbine prices.

9.5 The concurrent devaluation of the New Zealand dollar against the Euro (in particular) and US dollar is expected to offset some of these gains for New Zealand investors. It is also unclear how long the (slight) reduction in demand will remain, with renewable energy forming a key component of several countries' economic stimulus packages.

9.6 In New Zealand there are currently no specific mechanisms for increasing renewable energy uptake. The carbon credits that were made available for earlier wind energy projects are no longer available.

9.7 New projects, such as Hauāuru mā raki Wind Farm must compete directly with all other forms of electricity generation, including fossil fuel generation that does not currently face any costs for its greenhouse gas emissions. While the incoming Government is undertaking a review of the Emissions Trading Scheme (ETS) they have signalled that it expects the ETS to remain in place. The ETS will have an influence on the relative viability of both existing and new generation projects and on all of the different technologies.

9.8 Bearing all of this in mind, the applicant's proposed approach to this project - that identifies it as one of a number of potential development options, with different characteristics and drivers to the other options under consideration - appears to be reasonable.

9.9 It is clear, for example, that the project will not be able to proceed without resource consent. Once the project holds resource consent it will then be in a position to respond to market drivers that might influence its viability.

9.10 As the evidence of Mr Manins identifies, the capital cost of the imported wind turbine technology can represent more than 70% of a project's total cost. Within the last 2 years the exchange rate for the New Zealand dollar against the Euro has dropped from around €0.58/NZ$ to around €0.41/NZ$ today (about -40%), which would have the effect of increasing project costs by around 30% accordingly.

9.11 This exchange rate effect will be influencing the viability of all new generation projects, but wind energy projects are particularly affected as capital costs have a proportionately high impact on project economics (unlike other technologies where fuel cost is an important consideration).

9.12 The counter to this, however, is that a swing in the exchange rate in the other direction will also have a proportionately higher impact (as does any reduction in interest rates). Taken together with there being no fuel price risk, no fuel supply risk and no carbon risk, the relative viability of this project could move considerably within the timeframes that the applicant has identified for consenting, development and construction.

10 Consenting Flexibility

10.1 As identified above, wind turbine supply is a very dynamic market and it is important that a project gives itself the flexibility to pursue different options when the time comes to make this investment.

10.2 Technology has also been developing rapidly. For example, 10 years ago the average wind turbine size in the USA was 0.71 MW, while in 2007 this average had reached 1.65 MW.[43]

10.3 As the number of constraints that are applied to the consent conditions for a project is increased these might reach the point where they preclude it from adopting the most efficient design for the site (both in terms of economics and the use of the resource). The potential implications of some of these constraints - such as tightly defined turbine locations - are identified in the evidence of Mr Manins.

[43] US Department of Energy, 'Annual Report pm U.S. Wind Power Installation, Cost, and Performance Trends: 2007', May 2008.

10.4 It is recognised that some constraints are needed in order to avoid, remedy or mitigate specific adverse effects, but these may still be able to be addressed while still providing sufficient flexibility to allow the most efficient project to be developed.

10.5 That technology and understanding of a site's characteristics can evolve over time was demonstrated at *West Wind*, where Meridian Energy was able to revise the size and location of certain turbines in response to a Court Minute issued during their deliberation, having completed further analysis of the potential project in the interim[44].

10.6 Meridian was able to propose some alternative locations, including some at sites outside the 100 metre diameter turbine location zones that they had sought in their consent application. The Court identified that they could consider these changes where they did not increase the scale or intensity of the activity; mitigate the adverse impacts of the activity and would not have drawn any further submissions.

10.7 Upon careful deliberation the majority of those revisions were accepted, suggesting that the scope for permissible variations was in fact broader than the 100 metre diameter originally sought. It should also be noted that the primary concern in that instance related to the adverse effects on amenity values on residents living within relatively close proximity (1 – 4 km). Where any affected dwellings are a greater distance away from the wind farm it may be that they are less sensitive to the extent of flexibility in final design of the development, but that is a matter that is more appropriately addressed by landscape experts (with this being the principal potential off-site effect at that distance).

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27 March 2009

[44] See footnote 27. The Court's decision of the revised layout is discussed in paragraphs 460 to 581.

Appendix 1: Estimation of total new renewable generation requirement under the NZES

The New Zealand Energy Strategy[2] sets a target of 90% of electricity generation occurring from renewable sources by 2025 and assumes new demand growth of 1.3% per year. On this basis - and with reference to the actual generation data from 2007 - NZWEA has estimated the demand for new renewable generation as follows:

2007 total electricity generation:	42,372 GWh (from MED[4])
=> 2025 total generation:	53,460 GWh (1.3%/yr growth)
=> 2025 total renewable generation:	48,150 GWh (at 90% of total)
- 2007 total renewable generation:	- 28,210 GWh (from MED[4])
=> New renewable generation by 2025 =	**19,940 GWh**

This represents an increase of 70% over existing renewable capacity, or the equivalent of approximately 10 Benmore hydro schemes[45].

This means that over the 18 years between 2007 and 2025 that the average amount of new renewable generation required each year is approximately:

= 19,940 /18 = **1,110 GWh per year**

The Energy Policy[3] 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 4.5). On this basis a similar calculation suggests a requirement of **28,210 GWh** of new renewable generation (i.e. 100% increase), or an average of **1,570 GWh per year**.

[45] 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.

Appendix 2: Estimation of impact of rising gas prices on electricity prices

Information presented by Contact Energy in their recent investor presentations suggest that they expect natural gas prices to rise by approximately $3.30 per GJ from the current level of around $7.18 per GJ by their 2014/15 financial year (see chart at Figure 5).

Contact has also reported an overall average heat rate (kJ of gas consumed per kWh of electricity generated) across all of their natural gas generation of 7,607 kJ per kWh[46].

On this basis the anticipated increase in the cost of electricity generated from gas would be approximately:

$= 3.30\ \$/GJ \times 1 \times 10^{-6}\ GJ/kJ \times 7{,}607\ kJ/kWh \times 1 \times 10^{3}\ kWh/MWh$

= $25.10 per MWh

(where 1 GJ = 1,000,000 kJ and 1 MWh = 1,000 kWh).

[46] Contact Energy, 'Sustainability Report 2008', August 2008 at page 18.