IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under s146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea

---

REBUTTAL EVIDENCE OF THOMAS BRENT LAYTON

---

1. INTRODUCTION 3
2. REGIONAL DEMAND AND SUPPLY FORECASTS 4
3. THE ROLE OF NEW ZEALAND ENERGY STRATEGY 5
4. THE ROLE OF STATEMENT OF OPPORTUNITIES 6
5. MANAWATU WIND RESOURCE 7
6. COVERAGE AND COUNTERFACTUAL OF THE ECONOMIC ASSESSMENT 7
7. TOO MANY WIND FARMS? 8
8. COSTS OF GRID ASSETS AS AN EXTERNALITY 9
9. RELIABILITY OF WIND FARM COST DATA FROM VARIOUS SOURCES 10
10. IMPACT ON FREQUENCY KEEPING AND RESERVE COSTS 11
11. CORRELATION OF WIND AND HYDRO 13
12. WIND FARM UNABLE TO BE A PEAKING PLANT 14
13. REQUIREMENT FOR BACK UP RESERVES 16
14. COST COMPARISON 18
15. CONCLUSIONS 21

1. INTRODUCTION

1.1 My name is **Thomas Brent Layton**. My qualifications and relevant experience are set out in my evidence in chief. I confirm that I have prepared this rebuttal evidence in accordance with the Environment Court Code of Conduct for Expert Witnesses (July 2006).

1.2 I am providing this rebuttal evidence to comment on and respond to some of the primary evidence presented in respect of these applications that relate to economic and electricity market matters. In particular, I will comment on the evidence of Ms Marian Whitney Melhuish, presented on behalf of Palmerston North City Council, and on the evidence of Bryan William Leyland, presented on behalf of Tararua Aokautere Guardians and Friends of Turitea Reserve.

1.3 Specifically, I shall address the following matters relating to Ms Melhuish's evidence:

(a) The balance between regional demand and supply and its relevance for assessing the Turitea Wind Farm;

(b) The lack of significance of the absence of the Turitea Wind Farm from a table of planned generation projects in the New Zealand Energy Strategy;

(c) The inappropriateness of using the Electricity Commission's Statement of Opportunities as a guide for generation planning;

(d) The relative significance of the high quality wind resource in the Manawatu;

(e) A response to the criticism of the coverage and counterfactual in NZIER's Economic Assessment Report;

(f) The alleged risks of over-investment in wind farms; and

(g) The allegation that building wind farms will require transmission investment which will give rise to externalities.

1.4 I shall also address the following matters relating to Mr Leyland's evidence:

(a) The reliability and comparability of his wind farm capital cost data;

(b) The impact of the Turitea Wind Farm on frequency keeping and instantaneous reserves costs for the New Zealand market and which parties will bear those costs;

(c) The extent to which wind energy and hydro energy sources are correlated with one another in New Zealand;

(d) The significance, or otherwise, of the Turitea Wind Farm not being a peaking plant;

(e) The extent to which construction of the Turitea Wind Farm will require back-up reserve capacity to be built; and

(f) The long run marginal cost of electricity generated by the Turitea Wind Farm.

2. REGIONAL DEMAND AND SUPPLY FORECASTS

2.1 In paragraph 36 of her Statement of Evidence, Ms Melhuish states "The Electricity Commission's 2008 Statement of Opportunities projects a reduced demand forecast for the Central Region of 1.1% per year from 2007 to 2027." A casual reader could conclude the Electricity Commission is forecasting that electricity demand will fall in the Central Region, which includes the location of Turitea Wind Farm. This is not correct. The Electricity Commission is forecasting in the 2008 Statement of Opportunities (2008 SOO) that demand in the Central Region will grow from 1,624 GWh in 2007 to 1,955 GWh in 2027.[1] This is a compound growth rate of 0.9% per year over the 20 years, not 1.1%.

2.2 Ms Melhuish's point in her paragraph 36 relates to local demand and supply of generation. I believe a better measure for this purpose would be the Electricity Commission's forecast of the growth in capacity required to meet the peak demand in the Central Region prudently. The Commission's forecast of this is also contained in the 2008 SOO. It is that the capacity will need to rise from 323 MW in 2007 to 412 MW in 2027, a compound rate of growth of 1.2% per year.[2] As Ms Melhuish notes in paragraph 37 of her evidence, the New Zealand Energy Strategy 2050 and the recent update of

[1] Electricity Commission, Statement of Opportunities, August 2008, Table 23.
[2] Ibid. Table 27.

New Zealand's net position in the first Commitment Period under the Kyoto Protocol assume higher rates of demand growth.

2.3 The more important point is, however, that electricity is produced and consumed on a national market. To look at the balance of generating capacity and expected demand within an administratively and somewhat arbitrarily defined region does not assist in the decision making required under the Resource Management Act 1991 as it does not help decide whether the proposal meets the efficiency and other requirements under the Act.

3. THE ROLE OF NEW ZEALAND ENERGY STRATEGY

3.1 In paragraph 39 of her evidence, Ms Melhuish states "…*the Turitea Windfarm was not identified as a project upon which the [New Zealand Energy] strategy relied*." This gives the impression that the New Zealand Energy Strategy (NZES) is a detailed planning document setting out what plants are expected to be built and that Turitea's absence from a Table 8.1, which lists "Planned Generation Projects", indicates that it is not consistent with the strategy. This is not the case.

3.2 Since 1988, decisions about what generation plants will be built and when have been left to generators and have not been made by government officials. This change was made after a 1985 Treasury analysis of central planning in the electricity sector "*revealed a less than satisfactory situation in this area of state investment as regarding the adequacy of advice presented to Ministers, the investigation, choice, and management of projects, basic precepts of power planning and the efficient administration of state resources*."[3] According to this Treasury report, central planning had resulted in the "*unnecessary expenditure on Tongariro, Marsden B, and Whirinaki … estimated to be $0.8 -1.0 billion in constant 1983 dollars, with a corresponding economic cost of $2.3 - $3.0 billion*."[4]

3.3 The NZES is a policy document and the list of planned generation projects is included to demonstrate that there were a considerable number of projects at various stages of planning, including many aimed at tapping renewable energy sources. The list was not

[3] Treasury, *Review of Electricity Planning and Electricity Generation Costs*, 27 March 1985, paragraph 5.
[4] Ibid. paragraph 6.

meant to anoint those included and condemn those excluded in terms of consistency with the strategy and consent under the RMA.

4. THE ROLE OF STATEMENT OF OPPORTUNITIES

4.1 In paragraph 42 of her evidence Ms Melhuish claims that the demand forecasts in the 2008SOO "*feeds into "market development scenarios" which in turn enable modelling of power station development that meets the demand at least cost*." In the paragraphs which follow, she treats the 2008 SOO as if it is a generation planning document. This interpretation of the role and purpose of the 2008 SOO is incorrect. The requirement for the Electricity Commission to produce a SOO is contained in the Electricity Governance Rules (EGRs). Rule 9.1.2 of Section III of Part F states in its entirety "*the purpose of the statements of opportunities is to enable identification of potential opportunities for the efficient management of the grid including investments in upgrades and investments in transmission alternatives*." Rule 9.3 states that the SOO is provided only for information purposes. In other words, the purpose of the SOO is to provide information to assist in planning transmission grid investments and it is explicitly not intended to be a document to assist in planning generation investments.

4.2 The current Chair of the Electricity Commission, Hon David Caygill, confirmed this when he stated in the forward to the 2008 edition:

> *"The SOO is not a plan for the future development of the grid or of generation. In the sense that most people think of a central plan, the industry doesn't have one. In my view the nation is better protected against the cost of over-building, and the risks of shifts in technology and rising operational costs, by requiring generators to invest at their own risk – without any protection for incumbents. So not only is the SOO not a central plan; it should not be trying to be one."*

4.3 Ms Melhuish concludes in her paragraph 49 that "*the "averaged" 2008 SOO scenarios [are] the best guide to the wind farm development that is likely to be available to meet New Zealand's growth in electricity demand to 2040*." This treats the SOO as a reliable basis for forecasting future generation investment. This conclusion flies in the face of both the stated purpose of the SOO and the Hon David Caygill's warning about using it as a central plan. To use the scenarios in the SOO as the basis to conclude that

declining consent for Turitea would not harm the national interest, as Ms Melhuish appears to do in paragraph 50, is not appropriate.

5. MANAWATU WIND RESOURCE

5.1 In paragraphs 52 and 53 of her statement of evidence, Ms Melhuish refers to data about the potential availability of wind for generation in New Zealand contained in a Connell Wagner March 2008 report to the Electricity Commission. Her intention appears to be to suggest to the Court that there are plenty of wind options available for the country so declining consent for a wind farm in the Manawatu would not be significant. However, the detailed data in the tables, which Ms Melhuish does not report, paints a very different picture in relation to these matters.

5.2 For the very best wind farm resource, which Connell Wagner describes as Tranche 1, 36% of the North Island total is found in the Manawatu and no less than 79% in Manawatu, Wellington and Hawkes Bay. Connell Wagner also shows in the same table that if the Manawatu's Tranche 1 resource was fully exploited, only 2.9% of the total area of the region would be used for wind farms. In short, the report highlights how significant the Manawatu is as a North Island location of the highest quality wind resource the country has and how small an area in the Manawatu actually contains such high quality resources. [5]

6. COVERAGE AND COUNTERFACTUAL OF THE ECONOMIC ASSESSMENT

6.1 In paragraph 59 of her statement, Ms Melhuish claims NZIER's economic assessment report is not a full economic assessment as it covers only the energy component of the costs and benefits. She also claims that the NZIER report erred in considering thermal generation as "the next best alternative" because other alternatives would have lower cost.

6.2 I believe NZIER provided an economic assessment report which covered all the significant economic costs and benefits of the proposal.

[5] Connell Wagner, Transmission to Enable Renewables: Economic Wind Resource Study, March 2008, p.12

6.3 Ms Melhuish's statement about the inappropriate use by NZIER of the costs of thermal generation suggests that she has not realised that the quote from the introduction she gives refers to NZIER's discussion on pages 29 and 30 of its economic assessment report. There NZIER compares the long run marginal costs (LRMC) of electricity produced by building Turitea Wind Farm with the short-run marginal costs (SRMC) of producing extra electricity by running existing thermal generation plants more intensively. For modest increases in electricity generation, which is what this discussion relates to, this is the correct comparison.

7. TOO MANY WIND FARMS?

7.1 In paragraphs 62 to 68 of her evidence, Ms Melhuish appears to be suggesting that too many wind farms will end up being built and the result will be low prices for large consumers and higher prices for small consumers to defray the costs of constructing and maintaining unnecessary plant. She overlooks that under current market rules the individual generators bear the financial risks and costs of building capacity in excess of what the market requires.

7.2 The current situation contrasts with the period up to 1988 when New Zealand's generation capacity was built according to a central plan and there were strong incentives to overbuild and we did end up over-building. Under current arrangements generator-retailers do not have any incentive to incur unnecessary costs by building capacity ahead of demand. The example of the Clyde Dam she cites in paragraph 63 is a product of such over-building, and there is no reason for current generators to proceed with adding capacity when costs rise so high, until market conditions justify addition of such higher cost generation.

7.3 In her paragraphs 69 to 76, Ms Melhuish argues that smaller scale wind farms are as economic as large wind farms and are part of the wind generation mix. I agree that they are, and I also agree that her figure 14 shows that there is a range of costs for wind farms which is not rigidly determined by scale but also reflects specific site characteristics and shorter term fluctuations in financial conditions, exchange rates and commodity price movements. However, this does not mean that smaller scale farms are always preferable to larger ones any more than the reverse is always true. There can be economies of scale where common project costs are spread across more generating

capacity, for instance by connecting more turbines to a grid connection point or installing more turbines along a common access road built or upgraded to facilitate turbine installation. Both these factors favour more rather than fewer wind turbines at Turitea, given the configuration of the site, and extending turbines beyond the boundaries of the reserve. There can also be economies in operation and management of more turbines in a single site, although only minor. Where there is a high quality wind resource, as at Turitea, seeking consents for the largest feasible wind farm maximizes the potential benefit under favourable financial conditions. It is testimony to the quality of the wind resource and the value that can be generated from it that Mighty River Power is considering such a large wind farm.

8. COSTS OF GRID ASSETS AS AN EXTERNALITY

8.1 In paragraphs 82-85 of her evidence, Ms Melhuish argues that transmission losses and constraints will cause the effect of the Turitea Wind Farm on transmission costs to be a cost rather than a benefit, principally because the main demand load growth is in Auckland so the Turitea Wind Farm will add to the northward flow of power across the grid. Demand growth is in Auckland and needs to be met somehow; and at least some of the time will be met by South Island hydro plant. So to the extent that the Turitea Wind Farm displaces this, it reduces transmission load and losses on the grid to the south, without adding to the northward flow. If the Turitea Wind Farm displaces power from a generator further north, it will have been selected for dispatch ahead of northerly plant because it has lower combined cost of generation and transmission. At other times power from the Turitea Wind Farm will be dispatched to serve more local markets around Manawatu and Wellington, and will not add to long distance transmission loadings. Reducing commitment of transmission capacity and associated transmission losses by siting wind farms nearer Auckland, as Ms Melhuish suggests, is not necessarily more efficient, if it means forgoing the opportunity of harnessing the high quality wind resource in Manawatu.

8.2 In paragraph 86 of her evidence, Ms Melhuish argues that because the costs of shared grid assets will be spread amongst all customers this "*creates a true externality to the wind farm proponent, amounting to the present value cost of the new wind farm's contribution to bringing forward the date the new transmission investment is required*." In

making this statement Ms Melhuish has overlooked the role of the Grid Investment Test in the approval of grid upgrades by the Electricity Commission.

8.3 Under the EGR's all economic investments in the transmission grid must be evaluated using a net benefit test known as the Grid Investment Test. Only if this evaluation shows a positive net benefit to market participants, can the Electricity Commission approve economic investments in the common transmission grid and, only if the Electricity Commission has approved an investment, can Transpower charge customers for it. The costs of the assets required to connect a wind farm to the grid will be charged to the generator and any costs of reinforcing the common grid resulting from the construction of a wind farm will only be passed on to consumers if the investment has been approved by the Electricity Commission on the basis that the investment will generate net benefits to market participants as a group.

8.4 One of the objectives of this aspect of the EGRs is to remove the risk of generators imposing externalities on consumers through requiring additional grid investment to connect their generation plant to the grid. There can be debate about whether the current EGRs achieve this objective perfectly or as efficiently as some other approaches could, but the intent and general impact of the EGRs relative to externalities of this kind is, in my opinion, quite clear. Ms Melhuish's evidence overlooks this.

9. RELIABILITY OF WIND FARM COST DATA FROM VARIOUS SOURCES

9.1 In paragraph 3.5 of his evidence Mr Leyland refers to media reports of the costs of wind farms and claims these are in his opinion "*typical of the current state of the international market*" and concludes that "*the range of costs [per kW] with current exchange rates is $3750 dollars to $4375*." He states that for the purpose of his comparisons the current exchange rate is $US0.6 per New Zealand dollar. However, inspection of Mr Leyland's text and his Exhibit 1 show the range of his data is from $2,689/kW to $5,500/kW. Mr Leyland's data is not consistent with the claim in his text.

9.2 The 100 plus percent variance between the cheapest and most expensive costs per kW provided by Mr Leyland leads me to strongly question whether he is comparing like figures with like figures. Why some purchasers would pay twice as much as other purchasers, if they were buying roughly the same thing, is not obvious. The high

variance in Mr Leyland's data strongly suggests to me that his figures are not comparable with one another and their exact meaning is unclear. In my opinion, the gathered media reports Mr Leyland has presented in his evidence do not provide a reliable base from which to draw any reasonable conclusions about the costs of wind generation capacity.

9.3 I note that in the second to last line of his Exhibit 1 Mr Leyland has taken a recent press report that Meridian Energy's wind farm at Makara will cost $NZ440 million for 143 MW of capacity (i.e. $3086/kW) to arrive at a cost in New Zealand dollars at an exchange rate of 0.6 (United States dollars to the New Zealand dollar) of $3,857/kW. Since the $440 million ($3,806/kW) is in New Zealand dollars already the restatement of the figure to take account of movements of the value of the New Zealand dollar is very curious. Possibly, Mr Leyland knows the accuracy of the $440 million, the exchange rate at which this was initially calculated and has been able to establish all other changes in costs, such as movements in the price of steel and costs of shipping have been immaterial. He does not demonstrate this, however. In short, in my opinion, Mr Leyland has presented as fact data of a dubious nature, and this is highlighted by his treatment of data relating to Meridian Energy's West Wind Project.

10. IMPACT ON FREQUENCY KEEPING AND RESERVE COSTS

10.1 In paragraphs 3.7 and 3.8 of his evidence, Mr Leyland argues that the fluctuations of output from wind farms mean that their connection to the grid makes keeping the frequency of the system in the narrow band around 50Hz more difficult and more expensive. He claims this additional expense will fall upon consumers and not the owners of wind farms. In paragraph 3.9 of his evidence, Mr Leyland argues that because of the intermittent nature of wind generation, the system operator has to keep additional thermal and hydro plant connected to the system running at less than full load and this cost falls on consumers.

10.2 Mr Leyland claims in his paragraph 3.10, that it will be most unlikely for the combined additional frequency keeping and system operation costs created by Turitea to be lower than $5 million per year.

10.3 The charging regime for ancillary services, of which frequency keeping and the provision of instantaneous reserves are two examples, are set out in Part C, Section IV of the EGRs.

10.4 Frequency keeping costs are allocated to purchasers pro rata to their off-take. Mighty River Power is a purchaser because it retails electricity as well as operates as a generator and so pays frequency keeping costs on the power it retails. However, all purchasers in each island (i.e. retailers and the large customers directly connected to the transmission grid) face the same cost per unit of electricity and retailers will factor this standard per unit cost into the prices they charge. So Mr Leyland is correct in claiming frequency keeping charges fall economically on consumers and not Mighty River Power. As is often found in economics, there is a difference between the party paying a charge (or tax) and the party bearing the charge (or tax) in an economic sense.

10.5 The costs of providing instantaneous reserves are allocated in two parts – availability costs and event costs. The availability costs are allocated to generators in each island and the HVDC owner in proportion to their injections that expose the system to the need for instantaneous reserves. The event costs are allocated to the causers of events on the basis of the reduction in the volume of electricity injected as a result of the event at a price of $1,250/MW. Event costs are rebated back pro rata to those that paid the availability costs in the three months up to and including the month in which the event cost was incurred.

10.6 The objective of the charging regime for instantaneous reserves is to guarantee that Transpower, as the System Operator, is recompensed for the costs it incurs in providing the service (hence the availability cost) but to charge the costs as much as practicable to those causing events that lead to the need for instantaneous reserves (hence the events charge and rebate of availability charges). Mighty River Power will doubtless factor into its decisions around investing in and operating the Turitea Wind Farm any alteration in its exposure to charges for instantaneous reserves running and operating such a wind farm will create. It will not be able to assume it will be able to pass these costs on to its customers and consumers in general because these costs will be specific to the character and performance of its plant and not be borne by other actual or potential generators with more predictable equipment. In short, Mr Leyland is not correct to claim that any additional instantaneous reserves charges created by the Turitea Wind Farm

will fall on consumers and not be factored into Mighty River Power's decision of whether to proceed with its construction or not.

10.7 Even if one accepted Mr Leyland's claims about reserve costs falling upon consumers, there is the other matter of whether the cost of this and frequency keeping would be at least $5 million per year. The correct economic principle is that only incremental or marginal costs of frequency keeping and reserve requirements determined at the opportunity cost of the resources used should be attributed to Turitea Wind Farm in any assessment of its benefits and costs.

10.8 The dedication each half-hour of a plant capable and willing to vary its output up and down to maintain frequency within a narrow band around 50Hz, despite the continuous fluctuations in load off-take and generator injections, is required in the North Island, irrespective of whether Turitea is built or not. The incremental costs of providing this service because an additional 336 MW wind farm is connected to the grid are unlikely to be large. The cost is not driven so much by the fluctuations as by the need to have a plant dedicated to providing the service.

10.9 Similarly, the incremental costs of providing instantaneous reserves arising from the Turitea Wind Farm are unlikely to be large because reserves are required anyway. In general, the system operator provides reserves in each island at any particular point in time to cover the largest event in the island that could give rise to a need for reserves, should it happen. So, only when the disconnection or fluctuations of Turitea's output is perceived by the System Operator to be the largest event in the North Island, will it increase the level of instantaneous reserves over what they would otherwise be. Moreover, even when Turitea is perceived to be the largest risk, the increment attributable to it will only by the margin by which the Turitea risk exceeds the next biggest in the opinion of the System Operator.

11. CORRELATION OF WIND AND HYDRO

11.1 In paragraphs 4.1 to 4.5 of his evidence, Mr Leyland argues that wind blows at the wrong time of the year in New Zealand to be of much use in meeting New Zealand's energy needs because when it blows is when we tend to have filled lakes and when we have low lakes it tends not to blow. This issue was investigated at some length by

NZIER in a report it published last year.[6] In the report the relationship between wind speeds, lake levels and spot prices at selected sites around New Zealand, including Palmerston North, are analysed.

11.2 The conclusions of this report are relevant to Mr Leyland's claims:

> *"Together, these findings imply some but not full complementarity between wind and hydro power – wind speeds tend to be higher when some lake levels are lower, but also when other lake levels are higher. This results in part from some existing diversification in hydro resources, whilst the sites for which we examined wind flows proved to have low diversification".*[7]

11.3 The results provide evidence for wind speeds in the Manawatu to be negatively correlated with electricity prices and positive correlation between wind speed in the Manawatu and lake levels in the North Island. However, they also show negative correlation between Manawatu wind speeds and key South Island lake levels; that is Manawatu wind speeds tend to be relatively high when lake levels in the south are relatively low.[8] So some of Mr Leyland's observations are supported by this much more detailed analysis, but the analysis suggests the extent of his concern is very significantly overstated by his failing to take a wider picture than a narrow regional one.

12. WIND FARM UNABLE TO BE A PEAKING PLANT

12.1 Mr Leyland's principal complaint about wind generators (in paragraphs 5.1 to 5.19 of his evidence) appears to me to be that they are not ideally suited to be used as peaking plants – plants that can be called upon to run when electricity demand meets its daily peak. In his view this is because they cannot be relied upon by the system operator to be available to be used when needed.

12.2 In response, I would point out that it is widely recognized that the New Zealand electricity system does not have the problem of ensuring there is enough generation capacity to meet peak demand. Having sufficient generating capacity is a common concern in many other systems around the world. New Zealand's total potential generating capacity is

[6] NZIER, *Exploring Wind-Hydro Correlation*, September 2008.
[7] Ibid. p. ii
[8] Ibid. p.18.

over 80 TWh but its annual consumption is only around 43 TWh. We have more than enough capacity to meet peak demand levels on any one day, provided we have the fuel to generate the power. Fuel in this context includes water for hydro-stations and wind for wind farms.

12.3 That a station can only run when it has fuel is not unique to wind farms. It applies to all types of generation and for hydro stations there is in New Zealand a basic uncertainty about the supply of water from year to year. This does not mean that hydro-power stations are of no use, or constructing them is a waste of resources. As for hydro so for wind.

12.4 In the course of putting forward his objection to wind because it is not useful as a peaking plant, Mr Leyland has made several statements about the current market arrangements which are incorrect.

12.5 *"The system now runs much closer to the margin so it has problems meeting energy and peak demand requirements during a dry year*" (Paragraph 4.3) In fact, the dry year security margin has been increasing since 2003, is at a higher level than it was in the 1970s and is forecast to increase further in the next 5 years, provided proposed plants are consented.[9]

12.6 "*At the beginning of each day, the system operator must develop a schedule for generation that will ensure the system will meet peak demand. When doing this the system operator can only schedule plant that is 100% sure to be available*." (paragraph 5.1) "*The System Operator's policy of assuming that there will be no output from wind farms when scheduling generation for the day, is realistic and prudent*." (Paragraph 5.12) The scheduling and dispatch process relating to each half-hour goes through several rounds prior to dispatch actually taking place and the availability of plant can vary up to two hours for non-intermittent generators and, under certain circumstances, up until real time for intermittent (i.e. wind) generators. If only plant which is certain to operate at the start of the day was dispatched, as Mr Leyland claims, then wind would never be dispatched, and it clearly is.

[9] Forthcoming MED discussion paper on market performance

12.7 "*If, for example, the effective capacity of all wind farms in New Zealand is 500 MW, and if, as already demonstrated, the actual output of the wind farms is less than this for more than 90% of the time, then the wind farms would be "using up" some of the system reserve capacity 90% of the time. For about 10% of the time, the wind farm would be using up all the system reserves*." (paragraph 5.14) However, as I have already discussed, the reserve requirement in an island is based on the need to cover the largest event in the island not, as this description suggests, on the level of generation from intermittent sources i.e. wind.

13. REQUIREMENT FOR BACK UP RESERVES

13.1 Mr Leyland claims in paragraph 6.1 of his evidence that the maximum effective capacity of Turitea Wind Farm during a dry hydro year is no more than 250 MW and that it will require 165 MW of additional back up capacity to be built to provide this output.

13.2 Wind generators are obviously intermittent generators because they can only produce electricity when the wind is blowing at speeds within the range they can operate. This does not mean, however, that a decision to build a wind farm requires the simultaneous construction of additional back-up generating capacity to operate when the wind is not blowing in its operating range at the wind farm site. A decision to add wind powered generating capacity to existing generating capacity cannot reduce the ability to meet current demand, even though the wind farm will not produce all the time. So there is no logical link from building a wind farm to having to build other additional capacity, in the short term.

13.3 The wholesale electricity market provides a vehicle for the System Operator to select among all the offers to generate from plant located throughout both islands the combination of offers that minimises the total cost of meeting consumer demand and providing instantaneous reserves, given transmission losses and grid constraints. The price paid to all generators who operated is based on the highest offer price accepted by the System Operator. The actual offer price or price of each generation plant affects its place in the stack of offers for dispatch but, except when the plant is the "marginal" plant that sets the price, offer prices do not determine revenue.

13.4 Wind farms, because they are intermittent generators, are required under the EGRs to be offered at $0.01/MWh, if offered at all.[10] This means that in most instances wind farms will generate when they can generate and, when they do generate, they displace other generators with higher offers.

13.5 Investors in wind farms are aware of the offer rules that apply to them and factor into their decision to invest that they will have to accept the market prices at the times wind conditions permit them to generate. Generators with other plant make their offers so as to maximise their profitability, given the prices they expect as a result of the offers of others and the level of demand and the SRMC of operation of their plant.

13.6 If, and when, a significant proportion of the total generating capacity in the country becomes wind-powered, market prices are likely to display periodic peaks when total wind-powered generator output drops significantly relative to demand. These price spikes will, however, provide the appropriate signal for an investor to build an efficient back-up plant to offer at the times of these price peaks.

13.7 We are a long way from having a level of wind-powered generation at which reductions in output would be a material issue for the electricity system. According to a 2005 study by two major New Zealand engineering consultancy firms with significant involvement in the New Zealand electricity sector, the New Zealand system should technically and operationally be able to cater for 35 percent of all capacity and 20 percent of all production being wind.[11] The latest year for which data are available is 2007. In that year wind's share of capacity was 3.5% and its share of electricity production was 2.2.[12] The operation of the wholesale market will provide the right signals and incentives to provide back-up capacity efficiently, if the need ever eventuates. Moreover, the operation of the market will continue to ensure that total electricity demand is satisfied at least overall cost to consumers, including the provision of back-up generation capacity.

---

[10] EGR, Part G, Section II, Rule 3.6.3. There is also a special provision in the EGRs which allows all generators to be offered in at $0.00/MWh subject to specified conditions. See Part G, Section IV, rules 2.13 and 2.14.

[11] See Energy Link Ltd and MWH NZ Ltd, *Wind Energy Integration in New Zealand: Summary*, 2005, p.7.

[12] The Ministry of Economic Development's *Energy Data File* 2008, due for updating in July 2009, gives wind's share of installed generation as 3.5% (Table 5) and its share of actual generation at 2.2% (Table 3).

14. COST COMPARISON

14.1 In his paragraph 7.12, Mr Leyland takes issue with the cost estimates presented in my evidence in chief, referring to a number of sensitivity calculations he has made by changing the capital cost, life expectancy, capacity factor and discount rate. It is not surprising that he arrives at higher costs than my estimates. He adopts a higher capital cost of $3,500 per kW installed, apparently drawing on the international comparison from media reports which, as I discussed earlier, has dubious reliability for informing the likely cost of wind farms in New Zealand. Moreover, and this is of particular relevance for a request for approval with a ten year consent period, the New Zealand exchange rate is highly volatile, as is the world price of steel, a major input into the cost of wind generators. In addition, the state of the market for wind farms and the prices manufacturers ask undoubtedly varies depending on the balance of demand for new plant world-wide and the availability of capacity to build plant. Since the costs of wind energy are largely set at the time the costs of the capital expenditure are entered into, calculation of the economics of a wind farm using today's costs is not a good basis on which to decide that a farm is definitely uneconomic. Movements in exchange rates, global demand for wind farms and/or prices of steel at any time during the consent period could turn a plant that looks a reasonable proposition into a very good investment for the investor and New Zealand economy.

14.2 Mr Leyland applies a 10% discount rate as if assessing a private investment with due allowance for risks to the private investors. This is not appropriate when considering the costs and benefits for a proposed development for the country at large, which should be the focus of an assessment under the RMA.

14.3 He also claims that a 30 year life span is too long for wind turbine equipment which has not been in existence long enough to demonstrate its durability over such a timeframe. While each new wind farm is unique and will include a number of refinements and modifications in design that will not have stood the test of time until they are actually built and operated, there are windfarms in the world still operating that were installed in the 1980s. Moreover, a characteristic of a wind farm's economics is that most of its costs are fixed around the time the investment takes place. The marginal costs of operation are very low. An economic corollary of this cost structure of high upfront costs and low variable operating costs is that there are strong economic incentives to extend the

operating lives of plant by undertaking refits of aging parts etc. This is because the costs of output from extending the life of such a plant is usually significantly less than the costs of output from building a new replacement plant. In short, if the engineering life of a plant of this type is 20-years or so, its economic life will typically be considerably longer.[13] Mr Leyland, and PB Associates whom he cites in this context, appear to have overlooked this factor when considering the likely life of a wind generator and have adopted an engineering perspective instead of an economic one.

14.4 My estimate of the long run marginal cost at Turitea Wind Farm was $69 per MW hour on the basis of a 30 year life span, but if the expected life were reduced to 20 years, as Mr Leyland prefers, the LRMC would increase to around $77, still less than the corresponding LRMC of new gas fired or coal fired generation plant ($86 and $102 respectively), even before allowing for the costs of emissions from these thermal plant.

14.5 Mr Leyland also downgrades the expected utilisation or capacity factor to 40%. A combination of 40% utilization and 20 year life span would lift the LRMC of Turitea above that of gas-fired generation to a little over $87, but only just, as a utilisation of 40.6% would be sufficient to bring Turitea below that of gas. Such minor changes become immaterial if the cost of greenhouse gas emissions is included in the generation costs of thermal plant, as this would lift the LRMC of even a gas plant to around $94 per MW hour. As discussed in my primary evidence, Turitea would need to achieve a relatively low utilization around 35% for its LRMC to exceed the emission inclusive LRMC of gas-fired plant, an outcome that seems unlikely given that nearby wind farms have achieved consistently higher utilization, close to 45%.[14]

14.6 All these estimates are intended to illustrate is that the proposed Turitea Wind Farm is capable of competing with alternative technologies that might be considered for

[13] A Michigan Technical University paper entitled "The Economics of Wind Power" adopts the 30 year expected life even though it recognises that (engineering) estimates range from 20 to 30 years. See www.social.mtu.edu/GORMAN/Economics.htm. Denmark has a long and extensive involvement with wind power and the Danish Wind Industry Association on its webpage refers to the design lifetime of wind farms being 20 years to guide engineers so that "Their calculations have to prove that their components have a very small probability of failure before 20 years have elapsed." See http://www.windpower.org/en/tour/econ/oandm.htm. Clearly this suggests a much longer economic life and for some plants the Danes are now discussing the likelihood that major components in terms of costs of large offshore windfarms will last up to 50 years.

[14] See Appendix C of the Parsons Brinkerhoff Associates Draft Electricity Generation Database, Statement of Opportunities 2006.

expanding generation capacity. It is not necessary for a wind farm to offer the same short term reliability as a thermal plant, or be saddled with the additional cost of back-up generation as Mr Leyland appears to prefer.

14.7 A factor overlooked by Mr Leyland in his evidence is that Mighty River Power will be required under the EGR's to offer any output from the Turitea Wind Farm at $0.01/MWh. All intermittent generators, of which wind farms are the principal examples, are subject to this market requirement as a quid pro quo for being allowed to vary their offered output up until the time of actual dispatch. Apart from when there are exceptional circumstances, other generators are only allowed to vary offers up to two hours before the start of a trading period. This means that all the financial risks of the relative competitiveness of Turitea Wind Farm fall on Mighty River Power. As a result, it is highly incentivised to carefully consider the relative efficiency of Turitea Wind Farm before proceeding. That it is committed to securing consents for Turitea Wind Farm indicates that the company regards it a good use of its resources. It is not the purpose of the RMA to judge whether the company is correct in its assessment, but rather to identify if there are significant adverse effects that need to be offset against the substantial benefits of the proposed wind farm in displacing higher cost generation and associated emissions elsewhere.

14.8 In Exhibit 6, (Exhibit 2 in his revised evidence) Mr Leyland's provides estimates the LRMC of new thermal power stations. The table uses $5.51/GJ as the price of natural gas and between $2.30/GJ and $4.25/GJ for coal. In my opinion, the price of gas and the lower prices of coal are unrealistically low in the New Zealand market. More realistic figures for new power stations would be $7.00/GJ to $7.50/GJ for gas[15] and $4.00/GJ for the cheaper coal sources.

14.9 In his paragraphs 8.4 and 8.5, Mr Leyland has combined his gas and coal fired power stations cost estimates derived using these low fuel cost figures with his overstatement of the costs of Turitea Wind Farm to arrive at his calculations of the prices of "carbon" to

[15] The Electricity Commission in its Statement of Opportunities published in August 2008 described gas at $7/GJ as "cheap gas". See p.92. In the December 2007 quarter the average price of gas to industrial users was $6.47/GJ but this average price was affected by residual gas from Maui supplied under long term contracts at around $3.25/GJ. These supplies would not be available for a new power plant. The average price for commercial users was $19.25/GJ. See Ministry of Economic Development, *Energy Data File* June 2008, Tables E.7b & c.

make Turitea comparable in terms of cost. As a result of compounding errors in both aspects of his calculation, Mr Leyland has arrived at grossly inflated figures for the price of "carbon" required of $81/tonne and $195/tonne. The fact is that as my evidence shows the Turitea Wind Farm is a relatively efficient means of generating additional electricity without taking into account any of the economic benefits of reduced greenhouse gas emissions.

15. CONCLUSIONS

15.1 It appears to me that the intent of Ms Melhuish's evidence is to convince the Board of Inquiry that it should decline consent of Turitea Wind Farm because there are plenty of alternative sites that can and will be built. I think it is clear she would prefer smaller-scale community-based and owned wind farms somewhere other than on the proposed site and preferably not in the Manawatu which already has a number of plants.

15.2 Mr Leyland's evidence has a similar intent in implying that the costs of the Turitea Wind Farm have been under-stated, that there are numerous other effects that would reduce the apparent benefits presented for the wind farm, and that it is an unduly costly means of generating electricity. This is also asking the Board to deliberate on the best investments for the electricity system rather than focusing on whether the natural and physical resources at Turitea will be more efficiently and sustainably managed with a wind farm to harness its nationally significant wind resource or without one.

15.3 The fundamental difficulty with what I believe to be Ms Melhuish's and Mr Leyland's proposal is that the Board of Inquiry is not a modern day Electricity Planning Committee deciding from all the possible options what generation capacity is necessary, what kind of generation plants should be built and where they should be put.

15.4 The Board's role under the RMA is to decide whether a particular proposal should be allowed to proceed, if its promoters decide to do so within the time frame and conditions imposed by any consent. It decides this on the basis of whether its environmental impacts are likely to be acceptable relative to its other benefits. The Board cannot require a particular plant be built or dictate when it will be built, other than by setting an upper limit on the term of the consent. Mighty River Power acting in response to the

commercial drivers on it decides the size and scale of the proposal to be assessed and will decide whether and when to proceed with construction, if consent is granted.

15.5 The reason we have this divided structure of decision making is not an accident. It is a deliberate choice of public policy made in response to the horrendous economic consequences of the central planning model as applied to electricity generation prior to 1988. New Zealand is still suffering from the costs of that approach, as Ms Melhuish rightly points out in paragraph 63 of her evidence by referring to the costs of electricity produced by the Clyde dam.

15.6 One consequence of the divided decision making structure is that the Board must evaluate any proposal before it against an alternative world in which the only difference is that the proposal does not proceed. Since the Board cannot determine what other proposals may be presented to it, or another decision maker under the RMA, and cannot ensure any consented proposals will actually be built, the Board cannot reach a satisfactory conclusion by comparing a proposal before it with some other hypothetical competing proposal that is not before it. However, this is effectively what I believe Ms Melhuish and Mr Leyland are inviting the Board to do.

15.7 This constraint on what the Board should consider does not mean, however, that we will end up with socially and economically sub-optimal decisions being made in this area. In the case of electricity, the need for generators to compete to provide electricity in the wholesale market is intended to ensure that generators put up the economically best options from their perspective and that among the consented projects (i.e. those with acceptable external effects on the environment) only the most economically efficient will proceed.

Thomas Brent Layton

5 June 2009