Electricity Commission
Te Komihana Hiko

Project Plan

Wind Integration Project (WIP)

Date: 8 September 2008

1 Document information

1.1 Approvals

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Date	Version	Author	Comments and/or description of changes
8 September 08	1.0	AJ	Version for Board approval

2 Contents

3 Introduction and background

3.1 Purpose

The purpose of this wind integration project (WIP) is to develop optimal arrangements for:

- wind generation forecasting over scheduling timeframes, including
    - forecasting of wind generation risks
    - governance arrangements for wind forecasting
- the provision of pre-dispatch information to the market to enable market participants to manage wind variability
- the integration of wind into market scheduling and dispatch arrangements.

3.2 Background

Detailed background to the WIP project is set out in chapter 18 of this project plan.

Chapter 18 sets out the Government policy background as articulated in:

- the New Zealand Energy Strategy (NZES);
- the New Zealand Energy Efficiency and Conservation Strategy (NZEECS); and
- the Government Policy Statement on Electricity Governance (GPS).

Chapter 18 also sets out the Commission's objectives and outcomes as set out in legislation and in the Commission's Statement of Intent 2008–2011 (SOI).

Further background is provided in that chapter on:

- existing and proposed wind generation;
- the variability and uncertainty (forecasting inaccuracy) associated with wind generation in the scheduling timeframe;
- the flexibility existing in the electricity system to offset wind forecasting inaccuracy, and the limits of that flexibility;
- the current rules and arrangements used to schedule resources;
- the current arrangements for constraining dispatch when there is too much generation on the system;

- the wind generation investigation project (WGIP) work carried out over the last two years, culminating in decisions made by the Commission's Board in March 2008 to allocate a specified set of tasks to the Commission's workstreams; and
- an overview of plans to progress the WGIP tasks assigned to the wholesale workstream.

4 Key stakeholders

Key stakeholders that the Commission will consider during this project are:

- existing wind generators
- other existing generators, especially those who use pre-dispatch information to reschedule their generation (since they are the "users" of wind generation forecasts)
- potential future investors in wind generation and other generation
- major electricity users
- smaller consumers and demand aggregators (e.g. electricity distribution businesses)
- the system operator
- the provider of the wholesale information and trading system (M-co)
- the Minister of Energy, Ministry for Economic Development, Energy Efficiency and Conservation Authority and other government agencies that articulate or develop government policy in the electricity sector
- energy industry analysts and commentators (e.g. environmental lobby groups, Parliamentary Commissioner for the Environment).

5 Problem definition

The problems to address are:

- The variability and unpredictability of the wind resource and resulting wind generation over the scheduling timeframe creates uncertainty about the quantity of other system resources (e.g. generation) that will be needed to meet system requirements (e.g. demand).
- Present requirements for each grid-connected wind farm to provide a "reasonable endeavours" forecast may not provide the optimal quality of wind forecasting, particularly given the apparent economies of scale associated with wind generation forecasting, and the observed

correlation between output of wind farms (especially wind farms in the same region).

- The electricity system has, and will continue to need, a portfolio of flexible resources that are capable of firming wind generation, usually by making certain commitment decisions ahead of real time. In order to utilise those flexible resources efficiently, operators of those resources require pre-dispatch information about expected market conditions (especially wind generation conditions) and also information about the magnitude of risks (e.g. the risk that wind generation will be substantially lower than forecast). Present arrangements for wind forecasting and the provision of pre-dispatch information may not lead to the optimal provision of this risk information. This may lead to sub-optimal management of resources (e.g. sub-optimal commitment decisions), especially as larger quantities of wind capacity are added to the system.

- As the quantity of wind generation on the system increases, other aspects of existing scheduling and dispatch arrangements may become sub-optimal. For example, arrangements for gate closure, dispatch of wind, the restrictions on the price of wind offers, and the must-run dispatch auction may need to be reviewed.

6 Critical success factors

This project will be considered a success if:

- Substantial improvements in wind generation forecasting are observed over time.

    - For individual wind farms and for groups of wind farms that are in place prior to the completion of this project, generation forecasts will be better in the year after project completion than in the year prior to project completion. Forecasts are to be compared over several timeframes; e.g. day-ahead and 6-hour ahead timeframes.

    - Even after the project is completed, the governance arrangements for forecasting will lead to continuing improvement in wind forecasting accuracy and risk assessment (as methodologies are improved and more experience with wind forecasting gained).

- Owners of wind-firming generation report that they use the pre-dispatch information introduced by this project to manage their resources;

- As greater quantities of wind generation capacity are added to the system, owners of wind-firming generation make those resources available to manage wind contingencies to a degree that is approximately efficient given expected likelihood of those contingent events and the expected value of lost load. For example, we should not observe multiple episodes of involuntary load curtailments during/following substantial rapid reductions in wind generation.

- A survey of wind generators and wind-firming generators will show that none of those parties seek substantial changes to the offering and scheduling arrangements contained in part G of the Rules in order remove barriers to the integration of wind generation or to allow wind firming generators to manage wind variability. However, if such changes are sought, the Commission will have a clear explanation for why existing arrangements are appropriate.

A post-implementation review is planned to determine whether these success factors are present.

7 Project objectives

The project objectives are to facilitate the efficient management of generation and demand-side resources by:

- introducing optimal arrangements for wind forecasting;
- providing quality pre-dispatch information to the market; and
- reviewing scheduling and dispatch arrangements to remove any inefficient barriers to the integration of wind generation.

8 Planning drivers

The key planning drivers for this project are:

- the GPS (see the discussion in section 18.3), and in particular paragraph 50 which provides that the Commission should investigate the extent to which hydro and other generation sources can be integrated fully with intermittent wind generation.
- The Commission Board's decisions at the end of the wind generation investigation project (WGIP) to assign various projects to Commission workstreams (see the discussion in section 18.11).

9 Project scope

The key issues for the project to consider are:

1. What information on forecast wind generation is needed in the pre-dispatch timeframe (from day ahead to the beginning of the trading period) for effective decision making by market participants and the system operator? This could include central estimates of wind generation, measures of expected variability in wind generation and information on expected 'extreme events'.

2. What level of wind forecasting accuracy is currently being achieved? What level of wind forecasting accuracy can practically be achieved for different levels of effort (i.e. cost)?

3. What set of arrangements is likely to produce the highest quality forecasts for decision making purposes - for example central forecasts versus decentralised forecasts of wind speed/wind generation etc?

4. What arrangements should apply to provide incentives on parties to compile wind forecasts of appropriate quality?

5. How should information on forecast wind generation (point estimate and risks) be provided to the system operator and market participants to allow them to effectively use this information – for example, what level of aggregation should apply, how frequently should it be provided, how far ahead, what kind of further processing should be performed etc?

6. What arrangements should apply for constraining dispatch of generation when there is “too much” generation in a region? How should scarce dispatch rights be allocated?

7. What other arrangements related to offer, scheduling and dispatch in part G of the Rules may no longer be appropriate as more wind generation is connected to the system? If existing arrangements are not appropriate, what alternative arrangements should apply?

This project may lead to proposals for rule changes especially to part G of the Rules, and especially to sections II to IV of that part.

It is possible that these rule changes could introduce a centralised wind forecasting approach (as, for example, on the East Coast of Australia). If a central forecasting approach was adopted, a new service provider role would need to be established (wind generation forecaster) or there would need to be an addition to the system operator role. Any changes to service provider roles would require negotiations on the terms and conditions of that service provider contract.

As part of resolving the key issues mentioned above, the Commission will need to collect information to use in the cost-benefit analysis which must accompany any rule change proposal.

Following implementation of any changes arising from this project, a post-implementation review would be conducted to:

- assess the success of the project;
- examine the efficacy of the new wind forecasting and pre-dispatch information arrangements to see if further improvements can be made to optimise the project benefits; and
- to learn lessons from the project.

If different parts of the project are implemented progressively, a series of post implementation reviews may be conducted.

10 Project approach

10.1 Four separate parts

The project can be divided into four separate parts, although there are substantial interrelationships between the parts:

- Methods for forecasting wind generation and the value of improved forecasting
- Governance for wind forecasting
- Pre-dispatch information and systems
- Other wholesale market integration issues

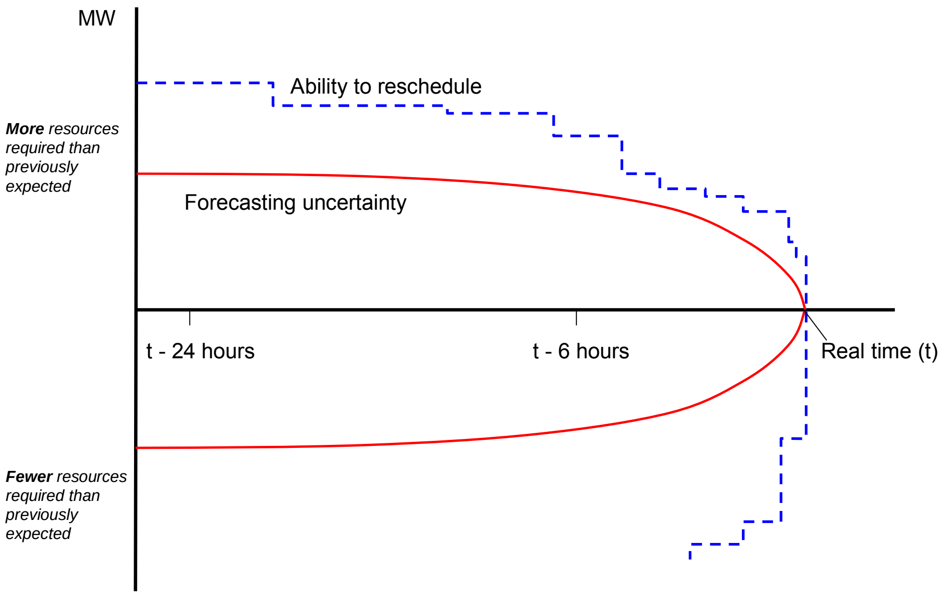
These parts can be progressed largely in parallel.

10.2 Methods for forecasting wind generation and the value of improved forecasting

Framework: forecasting uncertainty and ability to reschedule

The following diagram provides a conceptual illustration of the scheduling problem.

Chart 1: Forecasting uncertainty managed by ability to reschedule



The inherently unpredictable nature of the wind resource (and other sources of uncertainty such as demand) creates uncertainty about the magnitude of real time system requirements that need to be met by scheduled/dispatched resources. As real time approaches, this uncertainty diminishes, although the nature of wind variability means that there can still be quite a substantial amount of uncertainty even quite close to real time. The solid red line illustrates this forecasting uncertainty for a given level of confidence (although that confidence level is not specified in chart 1).

This line is conceptual: no megawatt values are shown on chart 1. The shape of the "forecasting uncertainty" curve will depend on many factors including the quantity of wind generation on the system and the 'unsettledness' of weather conditions at any point in time. The curve is not necessarily symmetrical about the x-axis: for example, there may be greater uncertainty associated with a (say) 300MW drop in wind generation *below* the forecast quantity than a 300MW increase *above* that forecast quantity.

Uncertainty is managed by the ability of flexible system resources (particularly hydro generation and peaking thermal plant) to reschedule. A certain amount of resources will be available to reschedule even at very short notice. For example, the system operator may be able, at very short notice, to schedule and subsequently dispatch more generation from a hydro generation plant located immediately next to controlled hydro storage. However, other generators may require some notice prior to the beginning of the trading period to allow them to arrange to increase production above their previously scheduled quantity. Different resources have different rescheduling timeframes. Slow-start thermal plant may take many hours to start up from cold. The ability of system resources collectively to reschedule is illustrated by the dashed blue line in the diagram above.

Again, this "ability to reschedule" line is conceptual only. Its shape will depend on what resources are connected to the system, their availability status (e.g. cold or warm) and on the level to which they have already been scheduled. In general, system resources will find it harder to provide *increased* generation (or lower demand) than previously anticipated as compared with providing *less* generation (or increased demand). This is why the blue dotted line in the bottom part of the diagram is shown to move away from the x-axis quite rapidly.

The system is robust to the specified level of forecasting uncertainty provided that the solid red line is always within the envelope defined by the dotted blue line.

Preliminary work

The Commission intends to hold fact-finding discussions with a number of parties who are currently forecasting wind generation for existing wind farms. These discussions will aim to identify:

- what techniques are currently being used to forecast wind generation; and
- what improvements have recently been made to operational wind generation forecasting or are being considered for implementation over the next one to two years.

The Commission will also summarise, update and extend where possible, work to date on the possible size of forecasting errors under different wind generation scenarios. This will include investigating the extent to which Meridian's forecasts for the Te Apiti wind farm have improved since 2005, since it was those offers (from 1 November 2004 to 31 December 2005) that were used as the basis of the work by Garrad Hassan to quantify the size of the forecasting problem under the different WGIP wind investment scenarios. If Meridian's forecasts have improved substantially since 2005, then the forecasting risks specified by Garrad Hassan will tend to be overstated. This work may also involve examining the accuracy of forecasts formed for other wind farms.

This will provide more information about the conceptual solid red line in chart 1. It will help the Commission understand the nature and extent of wind forecasting uncertainties that may emerge in future.

The Commission will also put together information on the flexibility of New Zealand's current generation portfolio. This information relates to the dashed blue line in chart 1.

This information will be used to quantify the value of any potential improvements to wind generation forecasting under different wind investment scenarios. It will also help to identify whether there is likely to be more value in improving forecasts within certain bands of time prior to real time. For example, there may be more value in improving forecasts made 6 hours prior to real time if system flexibility declines substantially within that last 6 hours.

Finally, the Commission will investigate how other countries have approached the problem of determining the most appropriate arrangements for wind generation forecasting. This will not so much involve investigating the actual arrangements introduced in those countries – more the process they used to arrive at the decision about the most appropriate arrangements.

Expert advice on forecasting methods

The preliminary work described above will be used to prepare terms of reference for seeking expert advice on methods for forecasting wind generation. It is envisaged that the Commission will seek advice on:

- the characteristics of wind generation forecasting methodologies that are likely to work well in New Zealand
- the level of improvement in wind generation forecasting that might be expected for different levels of effort (i.e. cost), and the likely costs of various wind generation forecasting arrangements
- the implications of different methodologies for the extent to which wind forecasting processes could be centralised or decentralised.

The Commission expects that this work will be peer reviewed and will draw on New Zealand's existing expertise in wind generation forecasting.

The Commission notes that it may be challenging to identify a party who has both the necessary expertise to deliver this advice and no conflicts of interest. It is envisaged that the expert would be sought through a tender process, and that overseas experts would be informed of the opportunity. There might also be a role for an "advisory group" of local experts, although this is likely to be more in a review role. The Commission's modelling team has recently issued a request for proposals for the creation of an historical synthetic dataset of regional wind speeds. It is possible that work on the WIP project could be carried out as an extension of that work.

Review priority of further work

The work described in this section on methods for forecasting wind generation and the value of improved forecasting will enable the Commission to develop an indication of the costs and benefits that might arise from changes to wind forecasting arrangements. It is envisaged that the Commission would review, at this point, the priority of further work on the WIP project.

10.3 Governance for wind forecasting

The Commission expects to develop, drawing on advice from the Wholesale Market Advisory Group (WMAG), a consultation paper outlining high level options for the governance of wind generation forecasting. The phrase "governance of wind generation forecasting" includes the following issues:

- Which roles should be centralised as opposed to decentralised?
- Who should pay for wind forecasting?
- Should wind generators be able to "opt out" of any centralised arrangements?
- What incentive structure should be in place to encourage high quality forecasting?
- What information should participants provide to a central forecaster?
- Who should be responsible under the Rules for any central wind generation forecasting, or for procuring the forecast? (e.g. The system operator? A separate service provider?)

In preparing the list of options (and possibly in selecting a preferred option) the Commission would draw on the work carried out as part of the first stage of the project on methods for forecasting wind generation and the value of improved forecasting (see above).

After considering submissions on the high level options, the Commission expects to develop a set of detailed proposed rule changes. Stakeholders would be consulted on those rule changes before the Commission made a recommendation for rule changes to the Minister.

Seminars or other opportunities for face-to-face communication with stakeholders would be used.

WMAG is expected to provide advice to the Commission on governance arrangements for wind generation forecasting.

10.4 Pre-dispatch information and systems

In parallel with the Commission's consideration of governance arrangements, the Commission expects to consider what information should be provided to the market to support the efficient management of resources (e.g. in order to support optimal commitment decisions).

Two broad options appear to be available:

- Provide wind generation forecast information to the market

  This approach involves providing the wind generation forecast information directly to participants. In Australia, plans are in place to provide regional P10, P50 and P90 (probability of exceedance) wind generation forecasts to the market in the pre-dispatch timeframe.

- *(Possibly in addition)* Provide multiple pre-dispatch schedules based on different wind scenarios

  This approach would process different wind generation scenarios through scheduling software to show how different scenarios would affect each generator's scheduled quantity, and how they would affect market prices.

The Commission expects to work closely with WMAG and with users of the information (e.g. owners of wind firming generation) to identify the broad kinds of information market participants could use.

System operator input will also be important. Wind generation forecasting information will need to be produced by or for the system operator to assist with managing security. For example, the system operator might use a process similar to the current "Standby Residual Check" to determine if there is enough offered generation to cover the loss of a large proportion of forecast wind generation, and notify market participants if insufficient generation is offered. Information used by the system operator is also likely to be useful for other market participants. The system operator will also contribute expertise on the capability of existing market systems (e.g. scheduling systems), and the likely costs of various potential enhancements.

The Commission expects to develop a proposal for rule changes (regardless of whether a centralised or decentralised approach to wind generation forecasting is adopted) that would set out obligations on the system operator and/or any central wind forecaster for publishing market information in relation to wind generation forecasting, wind risks, and the implications for market schedules. The Commission expects to produce a high level consultation paper followed by a consultation paper outlining detailed proposed rule changes.

10.5 Other wholesale market integration issues

The Commission will also review some aspects of the way in which wind generators offer and are dispatched, and the flexibility given to other generators to revise their offers (reschedule) to manage wind unpredictability. In particular, the Commission will review:

- the process by which wind generators offer their generation, including the limitations on the price at which that generation is offered
- the "gate closure" restrictions on bid and offer revisions within the last two hours before the beginning of the trading period
- the way in which wind generation is dispatched
- procedures for constraining dispatch when there is too much generation, including a review of the must-run dispatch auction and whether upward ramp rate limitations should be imposed on wind generators.

It is envisaged that the possibility of block dispatch of wind with other generation will *not* be considered as part of the WIP project. That issue will more appropriately be addressed as part of the first principles dispatch review (refer to section 13).

11 Advisory group roles

The Project Manager will seek advice from the Wholesale Market Advisory Group (WMAG)[1] as input into this project. It is intended that WMAG would provide advice at a relatively high level with particular emphasis on how best to integrate increasing volumes of wind generation into the market.

There might also be a role for a more technical "advisory group" of local experts with specialist skills in wind forecasting. If required, it is envisaged that this group would have a review role, providing advice on the work performed by the expert consultant (refer to section 10.2).

12 Deliverables and milestones

The deliverables and milestones of the later part of this project will depend to some extent on the outcome of earlier parts of the project. However, an indicative set of deliverables and milestones is contained in the following table:

Deliverables and milestones	Start date	Completion date
Stage 0 - Planning phase	July 2008	
• Board confirms project plan		Sep 2008

[1] Or other appropriate advisory group, depending on the outcome of the Commission's Advisory Group Review.

Deliverables and milestones	**Start date**	**Completion date**
Stage 1 – Advice on wind forecasting methodologies	Oct 2008	
• Complete terms of reference for a seeking expert advice on wind forecasting methodologies, and appoint an expert		Dec 2008
• Commission receives finalised expert advice on wind generation forecasting methodologies in the New Zealand context		May 2009
Stage 2 – Governance of wind forecasting **Stage 3 – Pre-dispatch information** **Stage 4 – Other wholesale market integration issues** *(Run in parallel)*	Jan 2009	
• High level consultation paper published		Jul 2009
• Detailed consultation paper published including proposed rule changes		Mar 2010
• Rule changes proposed to Minister		Sep 2010
• Rule changes gazetted		Nov 2010
• First wind forecasts prepared under new regime		Mar 2011
• Post-implementation review	Jul 2011	Dec 2011

13 Related projects

Other projects that are being progressed within the Commission may have some influence on the WIP project or may provide additional context for the WIP work. Those projects are:

- Demand side bidding and forecasting (DSBF) project

  This project will propose amendments to the Electricity Governance Rules to require the system operator to prepare a central forecast of demand at most grid exit points for each trading period over the following 36 hour schedule period. That information will be combined with bids by large electricity users (for which central demand predictions might not be very accurate) to form schedules which are expected to be more accurate and informative than the existing pre-dispatch schedules.

Central forecasts of demand are expected to be more accurate than existing bids because a central forecaster can utilise economies of scale. The central forecast is expected to incorporate weather forecasts as an input. At present, it appears that most bids do not incorporate short term weather forecast information.

The Commission published an update paper[2] in August 2008. That paper outlined a rule change proposal but noted that the proposal could not be implemented until after Transpower's Market Systems Project (MSP) was implemented and ready for further development, which is unlikely to occur before 2010.

- Market design review

The purpose of the market design review is to review the performance of the electricity market, and identify any high level modifications that may be desirable to improve its performance. The Commission published an options paper[3] in July 2008 setting out options for market modifications and inviting submissions.

This project will make decisions about *high level* market design. Lower level design issues (including detailed rule changes) will be a matter for the Commission's existing workstreams to manage. It is possible that the market design review will result in the creation of new projects within the Commission's wholesale workstream. It is also possible that the market design review might lead the Commission to review this project plan, and in particular to expand it to cover additional matters identified by the market design review.

- First principles dispatch review (FPDR)

The purpose of the FPDR is to review the role that dispatch plays in managing short-term system coordination, and to identify potential options to make short-term coordination more efficient through improved dispatch arrangements. The project will include a review of dispatch arrangements for wind generation, which will also be covered, at least in part, by the WIP project. Consequently these projects will need to be well coordinated.

The project has not yet commenced, but is expected to begin during 2008/09.

- Frequency keeping developments

Frequency keeping is a prime focus of the Commission's common quality development plan, given the high and increasing costs of frequency keeping and the relatively onerous technical requirements of

[2] "*Update Paper - Demand-side bidding and forecasting*" (20 August 2008) – see http://www.electricitycommission.govt.nz/pdfs/opdev/wholesale/dsbf/update-paper-Aug08.pdf.
[3] "*Market Design Review – Options Paper*" (8 July 2008), see http://www.electricitycommission.govt.nz/consultation/MDRoptions.

providing that service. The Commission's immediate activities centre around improving the selection and payment of frequency keepers while it investigates the possibility of introducing an AGC-based frequency regulation market.

Frequency keeping developments will deal with wind variability and uncertainty over a very short time frame (up to perhaps 5 or 10 minutes). The WIP project is focussed on managing wind uncertainty over scheduling timeframes: that is, from perhaps 36 hours prior to the trading period through to the beginning of the trading period.

- Creation of historical synthetic wind speed data

  The Commission's modelling group is creating an historical dataset of synthetic wind speeds with a resolution of around 10 minutes. This is conceptually equivalent to the existing datasets of hydrological inflows dating back to 1932. The Commission's top priority is that the data accurately reflect the variability of real wind flows, including the between-site correlation structure. The Commission may use this data for analysis such as calculation of the capacity contribution of wind, assessment of the diversity of wind in a particular generation scenario, and estimation of the contribution of wind at a particular time of day in a particular season. The Commission intends to publish these datasets for the benefit of participants.

- Transmission to enable renewables (TTER) project

  In order to facilitate the coordination of renewable and transmission investment, the Commission initiated the TTER Project to:

  - enable participants to better understand how the current framework (part F of the Electricity Governance Rules 2003) can be utilised to support the integration of renewables; and

  - provide an up to date "map" of renewables location and sizes which would feed in the next Statement of Opportunities and be used by Transpower in its next Annual Planning report.

In addition, there are some projects being managed by other parties that may be relevant to the WIP project:

- The system operator's market services project (MSP)

  The system operator is currently developing new market systems, including changes to the software and hardware used for running scheduling and dispatch systems. The Commission expects that MSP will be completed and ready for subsequent further development by the time the WIP project is completed.

- Transpower's consideration of wind uncertainty and how to manage security

  The Commission expects that the system operator will consider the impact that wind uncertainty will have on the processes that the system operator uses to manage security, such as the issuing of notices to market participants and the circumstances in which reserve requirements might be reduced to free up energy for managing the risk of unscheduled falls in wind generation. The Commission expects to closely coordinate with the system operator on this work, given its influence on the management of wind uncertainty.

- Meridian's work on quantifying the additional system costs of wind power in New Zealand

  Meridian Energy has engaged Professor Goran Strbac from the Imperial College in the UK to carry out a study over the last two years to quantify the additional system costs associated with wind power in New Zealand.

  Professor Strbac's work has been published and made available to the Commission.

14 Project resources

14.1 Commission Staff

The project will be managed for the Commission by the Project Manager.

The project is expected to draw on assistance from Commission staff in the wholesale workstream. A member of the Commission's modelling team will also be available as a resource.

The Commission's internal legal resources would also be used as necessary.

14.2 Concept Consulting Group

The Commission's resources will be augmented by Concept Consulting Group, which will provide a substantial level of resources under the Market Support Agreement (Wholesale).

Concept's involvement will be led by David Hunt, with Concept providing support in the following areas:

- providing advice and input on high level direction and related issues;
- support to the project manager, especially day-to-day activities;
- undertaking analysis of specific issues for the Commission and/or inclusion in consultation documents;

- assisting in the preparation of consultation and decision documents, and other stakeholder materials as required; and

Concept will provide resources for the wholesale workstream up to the retained levels specified in the market support contract, and beyond those levels with mutual agreement. The Commission's Director Wholesale (Tim Street) will determine Concept's priorities with respect to different projects within the wholesale workstream in accordance with the contract.

14.3 System operator

The system operator will provide significant resources to this project. These resources will be managed in accordance with the Contract currently being negotiated between the Commission and the system operator as part of the system operator service provider agreement negotiations. In the early stages of the project resources may be limited because of MSP, but senior system operator personnel will still be available.

As the project progresses the resources provided will have expertise in the following areas:

- Management of system security over pre-dispatch timeframes, including the operation of SPD
- The capabilities of the upcoming market systems for scheduling and managing security
- The Electricity Governance Rules.

The Commission envisages that a system operator representative will participate as a member of the project team (see section 14.4) and will act as coordinator for the wider system operator input into the project. It is also likely that the representative will attend advisory group (both WMAG and any experts group, see section 11) meetings as required when wind issues are discussed.

From time to time, it is anticipated that the system operator will provide advice and analysis on specific topics related to this project. Whenever this is required, the Commission will agree a specific job sheet with the system operator, which, amongst other things, will set out the work to be performed, the timeframe for completion and the estimated cost.

Overall, it is expected that the system operator average level of resource will rise to the equivalent of a half of a full time equivalent (FTE) for this project. This will cover both the time of the system operator representative and resourcing required to complete any specific advice and analysis (as described above).

14.4 Project team

A project team will appointed by the Project Manager. The Project Team will carry out most of the day-to-day work on the project. The Project Team will consist of some or all of the personnel described above from the Electricity Commission, Concept Consulting and the system operator.

14.5 Other External Advisers

Advice will be sought as required from WMAG. Consulting expertise may be engaged to prepare advice, as described above, on wind forecasting methodologies and the potential for improvement in wind generation forecasting in New Zealand.

Advice from other external specialist advisors will also be sought as necessary.

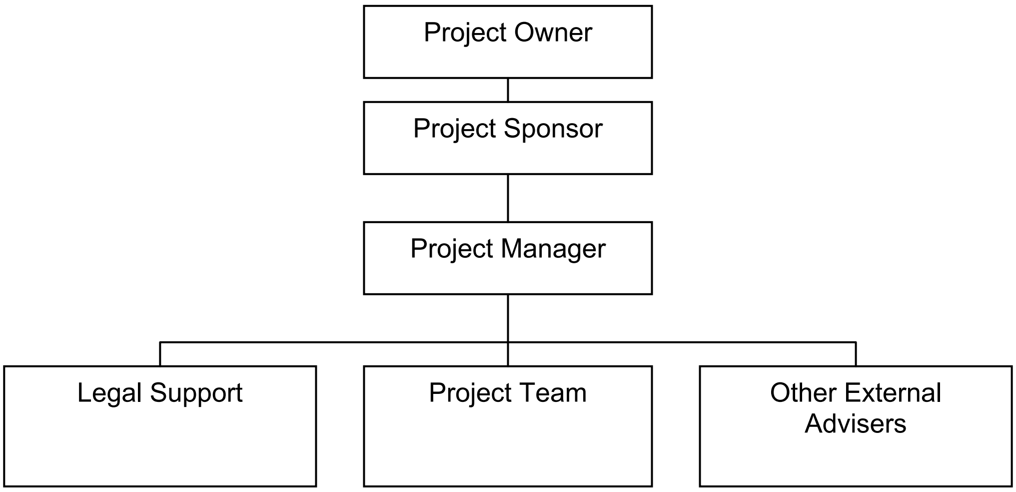
14.6 Budget

The Commission has allocated a budget of $300,000 for external advice during the 2008/09 financial year to work on offer and dispatch rules under the project code W16. A further $90,000 is allocated to cover the variable costs associated with work performed by the system operator on that project. The WIP project will be progressed using that allocated budget (although the WIP project is not expected to use *all* that budget – other work will also continue be progressed using that budget).

The WIP project will continue during the 2009/10 financial year and to a lesser degree during the 2010/11 financial year. It is envisaged that a budget will be sought for those financial years for the work on offer and dispatch rules (W16) and that the budget for that project will continue to be used to fund the WIP project.

15 Roles and responsibilities

The following high-level diagram illustrates how the project will be governed and managed.



The following table provides a brief overview of the roles of various parties. Roles may change from time to time during the project as the needs change or as more information comes to light.

Role	Who	Responsibilities
Project Owner	General Manager	Has ultimate authority for the project. Regular review meetings with Project Manager and Sponsor, and key Project Team members
Project Sponsor	Director, Wholesale	Reviews project progress with the Project Manager
Project Manager	Adviser Wholesale (Laurie Counsell)	Oversees day-to-day management of the project. Works with the Project Team to produce project deliverables. Oversees allocation and co-ordination of tasks and responsibilities. Monitors the project and reports progress. Ensures adequate resources are applied. Ensures project is co-ordinated with other related projects, teams and stakeholders. Manage project costs within budget and/or make representation for additional funds.
Project Team	Personnel from the Commission, Concept Consulting and the system operator	Undertakes the day-to-day activities of the project. Works with the Project Manager to produce project deliverables. Prepare project plans and workstream coordination material (e.g. sub-briefs). Prepares progress reports. Assist with project co-ordination with other related projects, teams and stakeholders.
Specialist Advisors	Not known at this stage	Provide advice to the Project Manager as required.
Legal Support	EC legal team	Provide legal advice to the Project Manager as required.

16 Communication plan

The communication plan outlines how consultation will be undertaken and how decision makers will be kept informed of progress.

The table below provides the framework for the communication plan:

Audience	Communication activities	Person responsible
Stakeholders (Generators including wind generators, major users, system operator, etc as identified in 4 above)	Release of Project Plan Release of consultation papers Possible briefings after consultation papers released	Project Manager
Project Team	Regular meetings to be held on an as needed basis.	Project Manager
Electricity Commission Board	Board paper seeking approval to project plan Board papers seeking approval to publish consultation papers. Board papers seeking agreement on recommended rule changes or substantial pieces of external work (e.g. by system operator or a consultant)	Project Manager

17 Risk assessment

The following table sets out the identified high-level risks to the success of this project. The key audience for this analysis is the Project Manager who is responsible for the management and mitigation of risk associated with this project.

Risk #	Description of risk	Description of impact	Level of impact	Likelihood of occurrence	Mitigation strategy
1.	Timetable slippage or rapid connection of large quantities of wind generation	If large amounts of wind generation are connected to the system before the completion of the project, and if existing wind forecasting arrangements are inadequate, price volatility could increase substantially and, in the extreme, some load could be cut off if wind generation falls unexpectedly	Med	Low	The initial stage of the project is being given a high priority within the wholesale workstream. Commitments to building wind farms will be monitored to ensure that, if large quantities of wind appear likely to be connected to the system, the project plan (including the timetable) can be re-evaluated to ensure that any urgent wind forecasting issues are addressed.
2.	Appropriate expertise on wind forecasting methodologies can not be obtained	It may be difficult without appropriate expertise to make a judgement on the extent to which wind forecasting can be improved with various levels of effort (cost)	Med	Med	Overseas expertise could be sought. Alternatively, more reliance could be placed on local expertise even where that expertise is subject to conflicts of interest, provided that adequate means are available to manage those conflicts.
3.	Market Services Project requires more system operator resources	Delays input by system operator staff into the WIP project	Low to med	Med	Partly managed through Commission's contract with the system operator. Other non-system-operator resources may be able to take up some of the slack.

18 Further background on the WIP project

18.1 New Zealand Energy Strategy (NZES)

In October 2007, the Government released the New Zealand Energy Strategy. That document outlined a number of measures to advance sustainability and economic transformation, and to help New Zealand respond to climate change. Key actions that are relevant to electricity generation from wind are:

- The government has set a target for 90 per cent of electricity to be generated from renewable sources by 2025 (based on delivered electricity in an average hydrological year);
- The government outlined its intention to introduce an emissions trading scheme (ETS). The stationary energy sector will be part of the ETS from 2010;
- The government outlined an intention to limit new baseload fossil fuel generation over ten years;

  Note that this limitation is contained in clause 67 of the Climate Change (Emissions Trading and Renewable Preference) Bill as reported back by Parliament's Finance and Expenditure Committee on 16 June 2008.

- The government outlined its intention to prepare a National Policy Statement for renewable energy under the Resource Management Act

  Note that the Ministry for the Environment published a *Proposed National Policy Statement for Renewable Electricity Generation* in August 2008.

- Better coordinate transmission and renewables investment

18.2 New Zealand Energy Efficiency and Conservation Strategy (NZEECS)

The NZEECS is a detailed action plan for increasing the uptake of energy efficiency, conservation and renewable energy programmes across the economy.

Section 5.2 of the NEECS is titled "Promoting the uptake of renewable electricity". One of the action points listed in section 5.2 is:

> "*Identify market arrangement changes to enable additional wind generation to be integrated into the electricity system* – Identify options, including wind forecasting, to successfully integrate higher proportions of wind generation into the system over the next five to 10 years."

18.3 Government Policy Statement on Electricity Governance (GPS)

On 20 May 2008, the Minister of Energy signed an updated GPS. One of the functions of the Electricity Commission is to give effect to GPS objectives and outcomes (see s172O(1)(j) of the Electricity Act 1992). Key passages from the GPS relevant to wind generation are:

- Paragraph 49 of the GPS provides that the Government's objectives in relation to renewable electrical energy include:
  - undue barriers to investment in renewables should be reduced or removed
  - the efficient uptake of renewable generation should be promoted
- Paragraph 50 of the GPS provides: "The Commission should investigate the extent to which hydro and other generation sources can be integrated fully with intermittent wind generation in order to ensure that the maximum economic potential of wind generation can be achieved. This work should also include consideration of the changing role of older thermal generation plant."
- Paragraph 79 of the GPS provides: "The Commission should promote and facilitate efficient and well-functioning markets and related arrangements for… dispatch and pool rules".

The GPS also notes (at paragraph 13) that the Government expects the Commission to contribute to programme design, delivery and monitoring in relation to the NZES and NZEECS. The GPS states: "the Commission will need to make provision for delivering these actions in its planning processes and accountability documents, such as the Output Agreement and Statement of Intent."

18.4 Statement of Intent 2008–2011 (SOI)

The SOI notes at page 75 that it is a high priority to complete the wind project and other enhancements to the electricity system to enable it to operate effectively under a regime of increased renewables.

18.5 Commission's objectives and outcomes

The Commission's objectives and outcomes are specified in section 172N of the Electricity Act 1992 as follows:

S172N	Principal objectives and specific outcomes		
	(1)	The principal objectives of the Commission in relation to electricity are—	
		(a)	to ensure that electricity is produced and delivered to all classes of consumers in an efficient, fair, reliable, and environmentally sustainable manner; and
		(b)	to promote and facilitate the efficient use of electricity.
	(2)	Consistent with those principal objectives, the Commission must seek to	

		achieve, in relation to electricity, the following specific outcomes:	
		(a)	energy and other resources are used efficiently:
		(b)	risks (including price risks) relating to security of supply are properly and efficiently managed:
		(c)	barriers to competition in the electricity industry are minimised for the long-term benefit of end-users:
		(d)	incentives for investment in generation, transmission, lines, energy efficiency, and demand-side management are maintained or enhanced and do not discriminate between public and private investment:
		(e)	the full costs of producing and transporting each additional unit of electricity are signalled:
		(f)	delivered electricity costs and prices are subject to sustained downward pressure:
		(g)	the electricity sector contributes to achieving the Government's climate change objectives by minimising hydro spill, efficiently managing transmission and distribution losses and constraints, promoting demand-side management and energy efficiency, and removing barriers to investment in new generation technologies, renewables, and distributed generation.

Almost all of the “specific outcomes” mentioned in s172N(2) appear to be relevant to the project outlined in this project plan.

18.6 Existing and proposed wind generation

At present, there are three wind farms in operation in New Zealand that are greater than 10MW in capacity.

- TrustPower’s Tararua wind farm (166MW) has been constructed in stages.
  - Stage I (36MW) was commissioned in 1999.
  - Stage II (37 MW) was commissioned in 2004.
  - Stage III (93MW) was commissioned in September 2007.
- Meridian’s Te Apiti wind farm (91MW) has been in operation since July 2004.
- Meridian’s White Hill wind farm (58MW) was commissioned in October 2007.

Those wind farms have a combined MW rating of 315MW. They are the only wind farms currently providing offers (forecasts) into the market under part G of the Rules.

Two further wind farms are currently under construction. They are:

- Meridian’s “West Wind” wind farm (143MW) is being constructed on Quartz Hill and Terawhiti Station west of Wellington. It is due for completion by the end of 2009.

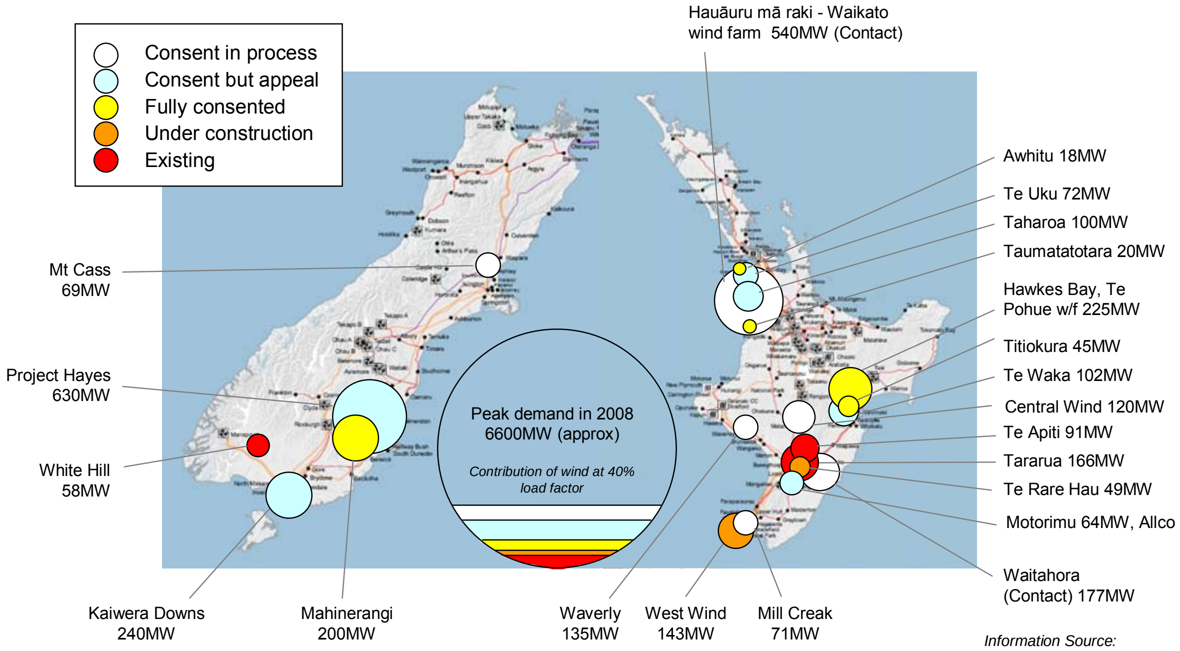
- New Zealand Windfarms' Te Rare Hau wind farm (49MW) is being constructed near Palmerston North. The consent allows for up to 97 turbines, each of 0.5MW capacity. Stage I (2.5MW) has been in operation since 2006. Stage II (14MW) is currently under construction, and orders have been placed for at least some of the turbines for stage III (the final stage). The wind farm is expected to be completed by the end of 2009.

> **Note about quoted MW capacity of wind farms:** In many cases when consent is granted for a wind farm, the consent allows up to a specified number of turbines. Sometimes the consent allows for different choices of turbine type, so the final MW rating of the wind farm may be uncertain. Usually the maximum MW capacity figure is quoted in those circumstances. In addition, the developer may choose to construct fewer turbines than allowed for in the consent. In this paper, where there appear to be firm plans to install fewer turbines than the consented number, the MW rating is scaled back to reflect the smaller number of turbines. Finally, it should be noted that the granting of consent does not necessarily mean that the development will proceed.

As at 2 September 2008, consents have been granted for over 2200MW of wind generation (although more than half of this is subject to appeal to the Environment Court). Adding on the amount of wind for which applications for consent have been made takes the total to over 3300MW of wind generation.

The following diagram provides an indication of the amount and location of wind generation that has been constructed or is at various stages of the consenting process. The amount of wind generation that has been consented or is in the consenting process is very large relative to the existing quantity of wind on the system.

Chart 2: Size and location of wind farm proposals that are at least at consent stage



Information Source: NZWEA and other websites

Assuming an average load factor of 40 percent (i.e. wind generation averages 40 percent of its nameplate MW rating), the amount of wind generation that currently exists or is in the consenting process amounts to 20 percent of peak demand in 2008. Wind has the potential to become a very significant source of generation in the New Zealand electricity system.

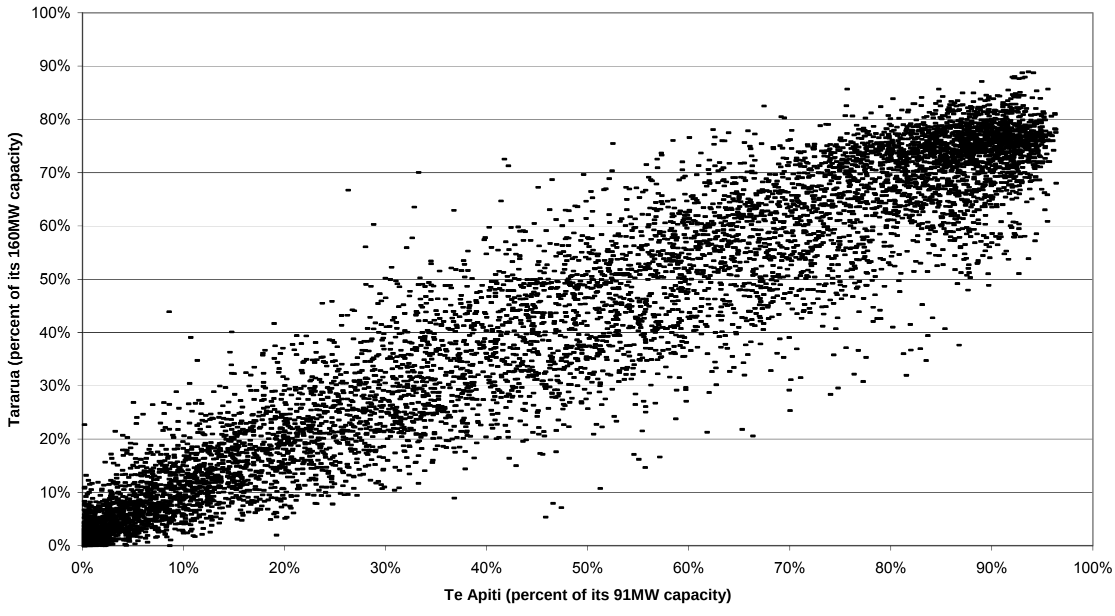
18.7 Variability and forecasting inaccuracy in scheduling timeframe

Wind generation output from a particular wind farm at any particular time is determined by the wind conditions at the time (unless generation is deliberately reduced below the level that the available resource could support). Not only is there considerable variability in wind generation from a wind farm, but the level of output at any given time is also difficult to predict in advance. Any method of forecasting wind generation will inevitably contain an element of uncertainty.

The generation output at two different wind farms may be correlated, especially if they are geographically close. If multiple wind farms are uncorrelated, then as more wind farms are added to the system, the absolute size (in MW) of the average wind generation forecasting error would rise quite slowly, and the size of that error as a proportion of total installed wind capacity would decrease. However, to the extent that there is correlation between wind farms, the absolute size (in MW) of the average forecasting error would increase substantially with the addition of more wind capacity, increasing the challenge of integrating wind into the system.

There appears to be a very substantial correlation between the half-hourly metered outputs of the Te Apiti and Tararua wind farms as shown in the following chart that uses data from October 2007 to March 2008.

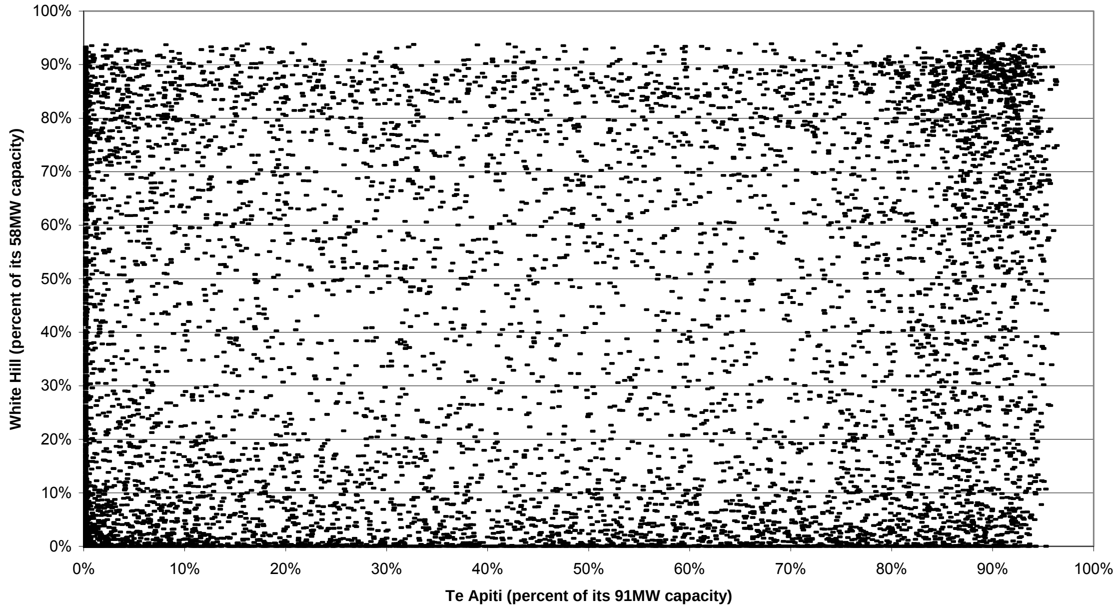
Chart 3: Correlation between Te Apiti and Tararua wind farm output



The correlation coefficient between the output of these two wind farms is above 96 percent. They are located very close to each other near Palmerston North.

However, similar data that compares Te Apiti generation with the output of Meridian's White Hill wind farm near Mossburn in Southland shows very little correlation. The correlation coefficient is less than 12 percent.

Chart 4: Correlation between Te Apiti and White Hill wind farm output



Wind unpredictability can be considered over a number of different timeframes, and there are different ways of managing unpredictability over those different timeframes. Wind variability over very short time frames (up to a few minutes)[4] is managed by frequency keeping arrangements which come within the ambit of the Commission's common quality and system operation workstream. Wind variability over slightly longer time periods (from a few minutes to 30 minutes) can be managed by dispatching offered generation. Dispatch arrangements come within the ambit of the Commission's wholesale workstream. Over longer time periods, wind unpredictability can be managed by market participants ensuring that sufficient resources are either offered or capable of being offered to meet system requirements in a wide variety of possible wind conditions. It is uncertainty across this longer timeframe that is the subject of the project outlined in this paper.

18.8 Limited flexibility in system to manage wind forecasting inaccuracy

The variability of wind can be managed by maintaining flexible system resources, namely, generation or demand-side response that can ramp up or down to balance the wind variability so that system requirements are met. Wind forecast errors (i.e. wind unpredictability) can be managed by maintaining system resources that are able to reschedule once it becomes apparent that the wind forecast is likely to be inaccurate.

[4] Over short time periods, wind variability and wind unpredictability are essentially the same because the only practicable forecast of wind generation over that timeframe is a persistence forecast.

Hydro generation has a very substantial role in the New Zealand electricity system, providing 55 percent of electricity generation in the 2006 calendar year. Many New Zealand hydro generation schemes have controllable upstream storage providing a substantial amount of flexibility to ramp up and down to meet system requirements. The ability of a hydro generator to reschedule will depend on the length of time it takes for water to become available at a generation station after being released from upstream storage, and on the resource consent restrictions relating to river flows.

Some thermal generation stations such as combined cycle gas turbines (CCGTs) and geothermal stations tend to operate in a baseload role, providing little flexibility to increase generation in response to system conditions. However, thermal plant that is not operating in a baseload role can typically provide additional generation if required, although it may take some time to ramp up a thermal generating unit, particularly if it is "cold" (i.e. has not been running recently). A Huntly unit might take perhaps 12 hours to start up from cold, but if it is "warm" (i.e. if it has been operating quite recently) it may be able to reach full output much more quickly, perhaps in a few hours. If a Huntly unit is currently running at a low level of output, it can be ramped up to full capacity (250MW) in less than half an hour. Other thermal units will have different flexibility characteristics. The extent to which a thermal generator can reschedule will depend on its current "commitment" status (i.e. cold, warm, running).

Note that hydro and thermal generators that are able to reschedule their generation (that is, revise their existing offers) will have an incentive to do so based on their continuously revised expectations of market conditions. If market conditions are tight, final prices are likely to be high. Generators will want to be injecting as much electricity as possible at those times to maximise profit. Generators will also have an incentive to operate their plant in a flexible way, and to invest in improving flexibility, so that they are able to capture additional value by rescheduling. In this way, spot prices will influence the "mix" of generation resources that are constructed in New Zealand.

Demand-side response is another flexible system resource that can contribute to managing the unpredictability of wind generation. If electricity loads are able to reschedule quickly enough, they will be able to reduce electricity usage when prices are high. Spot prices will provide the incentive to respond.

A key point to note is that the ability of a resource to reschedule will depend on how much notice it has of revised forecasts of market conditions. If forecasts of market conditions change substantially close to real time, few generators may have the ability to reschedule at such short notice. The sooner that market participants get revised forecasts of upcoming market conditions, the more options will be available for generators to reschedule.

A further important point to note is that flexibility to reschedule may be limited at times of high system demand because plant that might otherwise provide flexibility may be operating close to full capacity and therefore unavailable to provide additional generation.

If New Zealand's electricity system had unlimited, low cost flexibility to reschedule system resources in response to wind forecasting inaccuracies, then there would be little value in improving wind generation forecasting. Historically, New Zealand's hydro-dominated generation fleet has provided sufficient flexibility to manage unpredictable wind generation. However, the limits of that flexibility may be tested by the scheduling uncertainties associated with large quantities of wind generation investment possible over the next 5 to 10 years.

Large amounts of wind generation investment will mean that system flexibility over the schedule period (within the 36 hours leading up to real time) will become increasingly important.

18.9 Present arrangements for scheduling

At present each grid-connected wind farm must, by 1pm each day, submit offers containing a reasonable endeavours forecast of generation for each half hour trading period for the following trading day. That forecast can be revised at any time as better information about expected wind conditions comes to hand. The forecast generation output of each wind farm for each trading period must be revised some time within the two hours prior to the beginning of the trading period, and this revision must use a persistence forecast methodology.

Wind generators must offer their generation at either $0.00/MWh or $0.01/MWh. They can offer at $0.00/MWh only if they have successfully obtained the right to do so through the must run dispatch auction. These arrangements make wind generation “price taking”.

Other grid connected generators are also required to provide offers during the schedule period and may revise those offers (quantities or prices) at any time prior to two hours before the beginning of the trading period. After this “gate closure”, a generator is restricted in how it can revise its offers. In general, after gate closure generators are not allowed to revise offer prices, and may revise offer quantities only if they have a bona fide physical reason for doing so (e.g. a plant breakdown), or if the system operator declares a grid emergency and requests increased offer quantities.

The system operator matches offers to demand bids, through prescribed market processes, to establish pre-dispatch schedules (PDS), at 2 hourly intervals, taking transmission system and ancillary service requirements into account.

Market participants receive forecast prices and the quantities they are expected to generate for each half hour over the PDS horizon. Market participants may use the PDS as an indication of future market conditions and may revise their offers (reschedule) based on the feedback they receive from the PDS.

18.10 Constraining dispatch when there is too much generation on the system

Another situation that may arise as the quantity of wind generation investment increases is that at certain times, either nationally or within a region, the quantity of wind generation and “must-run” generation offered may be greater than the forecast demand. In this case, some generation will need to be scheduled down.

The same situation can happen during dispatch. If the quantity of wind or must-run generation that is seeking to inject electricity into the system is greater than demand, some generation would need to be dispatched down.

At present the must run dispatch auction outlined in section IV of part G of the Electricity Governance Rules 2003 plays a key role in rationing dispatch when there is excess generation.

18.11 Wind Generation Investigation Project (WGIP) work to date

The Commission commenced a strategic wind generation investigation project (WGIP) in late 2005 to assess the likely impact of wind generation development over the following 5 to 10 years. The study aimed to identify power system and market implications of additional wind generation and how those implications could be resolved to enable the development of wind generation on a "level playing field" with other generation sources.

The WGIP had four stages:

- develop scenarios;
- determine implications of the scenarios for the power system and electricity market;
- identify and assess options to address identified issues; and
- develop recommendations.

The Commission consulted on scenarios in December 2005 to provide a range of views on the quantity of wind generation investment that could potentially occur over the next ten years, and where that generation may be located. Four scenarios were used in the second stage of the project, which aimed to investigate the effects of wind variability and unpredictability, and the effects of the technical capability of wind generators.

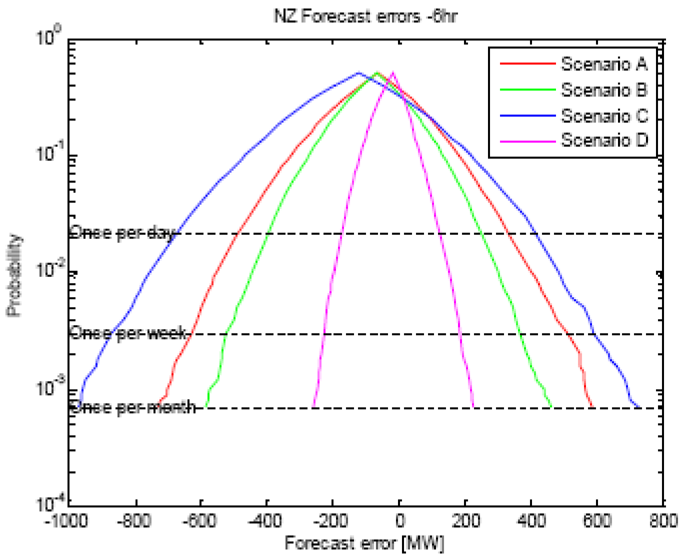
Table 1: Location of wind generation in wind generation development scenarios

Island	Scenario A	Scenario B	Scenario C	Scenario D
North	1150MW	950MW	1600MW	370MW
South	100MW	300MW	650MW	50MW

One of the investigations looked at the effects of the unpredictably of wind generation output on pre-dispatch processes. The analysis indicated that large wind forecasting errors (greater than 40% of total installed wind generation capacity for 6 hour ahead forecasts) could be expected to occur on a monthly basis. Wind generation forecast errors could be expected to start to exceed load forecast errors as the largest source of scheduling uncertainty, even in scenario D with quite low levels of wind generation investment. For higher levels of wind investment, wind forecasting errors can be expected to considerably exceed demand forecasting errors. The construction of the Te Rere Hau and West Wind wind farms is currently under way, and once those wind farms are operational there will be 510MW of wind generation in the North Island and 58MW in the South Island (not including small wind farms less than 10MW).

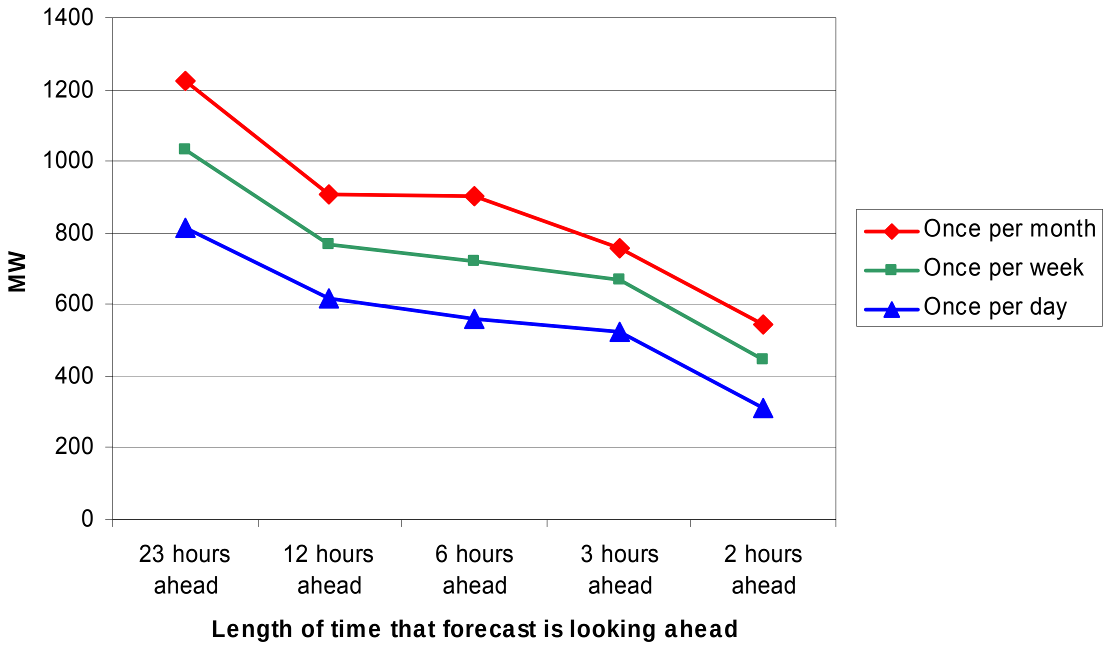
Chart 5 below shows the estimated frequency of 6-hour ahead forecast errors for wind convolved with demand under each of the four scenarios. Scenario C has the most wind generation and scenario D has the least.

Chart 5: Estimated frequency of forecasting errors for different scenarios (forecasts of national wind generation formed 6 hours ahead)



The investigation also noted that wind generation forecasting errors can be expected to reduce with the forecast lead time. Chart 6 below shows, for forecasts of North Island wind generation under scenario C, how the estimated size of errors associated with various return periods declines as real time approaches.

Chart 6: Size of return period forecasting error for different forecast horizons (forecasts of North Island generation under scenario C)



Source: Adapted from data contained in "*Wind Power Variability and Forecast Accuracy in New Zealand*" (March 2007), Garrad Hassan, pages 37 and 38.

This analysis compared the half-hourly output of Meridian's Te Apiti wind farm with Meridian's offers for that wind farm in place 2, 3, 6, 12, and 23 hours prior to the beginning of each trading period. Data was used from 1 November 2004 to 31 December 2005.

It is important to note some of the limitations of this analysis. Estimated forecast errors under the different scenarios were developed by extrapolation from the Te Apiti forecast errors using inter-regional wind correlation factors calculated from analysis of regional wind data. Garrad Hassan notes that its analysis reflects forecasting methods being used by Meridian Energy in 2005 to develop Te Apiti generation offers, and that it is likely that improvements in meteorological methods will have been made since then.

The effect of substantial estimated wind generation forecast errors on the pre-dispatch processes would be to reduce the accuracy of the pre-dispatch schedules and make managing power system security more difficult. Inaccuracy in pre-dispatch schedules would complicate generators' decision making, particularly regarding when to commit slow starting thermal plant. It would also become more difficult to identify security issues (e.g. a shortfall of offered generation to meet forecast demand) within a sufficient amount of time to allow generators to offer more generation.

Management of this unpredictability over the scheduling timeframe was the issue accorded the highest priority in the third phase of the WGIP.

The third phase of the WGIP was the examination of a number of options for addressing each of the identified issues. The Commission published a discussion paper on high level options on 19 October 2007.

After consideration of those options and submissions on the discussion paper, the Commission developed a work programme to respond to the challenges created by wind generation investment. Work was allocated in March 2008 to the different workstreams within the Commission.

The projects that the Board allocated to the wholesale workstream are described in the following table:

Table 2: Projects identified by WGIP and assigned to the wholesale workstream

Priority	#	Task	Description
Higher	1	Wind forecasting	Investigate wind forecasting tools (and incentives) to improve wind generation forecasting accuracy, including the possibility of centralised forecasting as for demand.
Lower	2	Dispatch efficiency	Review dispatch efficiency / performance to establish if improvements in dispatch latency (delay) might improve system response to wind generation variability.
	3	Constraining dispatch	Review backstop rules for constraining dispatch for system security purposes, as a backstop real time system security measure. Are the current dispatch rules adequate or do additional / specific criteria need to be included in the Rules?
	4	Scheduling	Review market information to enable and facilitate better use of hydro and thermal scheduling / flexibility
	5	Signal need for flexibility	Investigate whether the market will effectively signal/ value increasing flexibility.
	6	Barriers to compensating for wind uncertainty	Investigate whether undue barriers to commercial arrangements to compensate for wind uncertainty exist.
	7	Other market interventions	Investigate other more substantial market interventions (e.g. warming contracts, centralised unit commitment, greater SO powers to direct, day ahead financial commitment regimes, capacity mechanisms etc)

In addition, further projects that relate to management of the pre-dispatch issues identified by the WGIP were assigned to other workstreams as follows:

Table 3: Additional projects emerging from WGIP and relating to pre-dispatch issues

Priority	#	Project	Workstream responsible
	8	Collect and analyse wind generation forecasting data to better understand forecasting uncertainties	Modelling

Priority	#	Project	Workstream responsible
	9	Review current dispensations/ cost allocation regime in relation to technical performance obligations (to ensure a reasonably level playing field between wind and other generation types)	Common quality
	10	Consider role of demand response options and reliance on instructed load curtailment in emergencies	Load management project and common quality

18.12 Plans to progress wholesale projects emerging from WGIP

The wind integration project (WIP) described in this paper is intended to cover items 1, 3, 4 and 8 from the tables above.

Project 8 was assigned by the Board to the modelling group, but Commission staff have agreed that it would be appropriate to manage this work within the WIP project (within the wholesale workstream). Modelling staff will be closely involved in the WIP project.

Other items assigned to the wholesale workstream will be managed by linking them into existing wholesale projects such as the market design project or the first principles dispatch review.

Items 9 and 10 relate to the pre-dispatch timeframe but to a large extent are conceptually and practically separate from the WIP project.

19 Appendices

There are no appendices to this project plan.