

## Grid upgrading fundamental to energy supply

**There is no getting past the fact that New Zealand needs a robust and reliable National Grid. It is essential for security of electricity supply to our main centres of population and industry - a fact that was well-recognised 50 and 60 years ago when high voltage transmission lines were being installed from Bluff to North Auckland.**

The Grid is especially important in a country with such valuable renewable energy resources and large distances between these and major centres of energy demand. As a company concerned with ensuring New Zealand has a secure and sustainable energy future, Meridian Energy supports a comprehensive upgrading of the electricity transmission network.

The Grid has served us all well in past decades. But capacity constraints are becoming a critical concern in many places due to ongoing growth in electricity demand and the lack of major new Grid investment for 20 years. This Meridian Report looks at the transmission system and how Transpower, Meridian and others work on maintaining security of supply in the current environment of constraints. We greatly appreciate the cooperation of large business customers in initiatives that help manage Grid loads, especially during the winter months.

Transpower has a comprehensive investment programme for upgrading the Grid by 2012 (see article page 5). One project in particular - the planned 400 kV line into Auckland - has generated much debate over possible routes. We note that Transpower is now consulting stakeholders on its preferred alternative route and, of course, relevant decisions will be subject to Electricity Commission approval and resource consents.

As these and other Grid upgrading issues are worked through, it is important for New Zealanders to step back and recognise the fundamental importance of secure electricity supply. The country certainly did 50 and 60 years ago when today's Grid was being built. There are no alternatives to transmission lines if we want energy supplied to our homes and workplaces at reasonable cost, and from generating stations that are either in operation

today, or currently being planned.

At Meridian we recognise the complexity of issues involved in siting and building major energy projects. All technical and economic options must be weighed, and from there, decisions need to be made. There is no way forward in ruling out all options.

When it comes to Grid upgrading projects, New Zealand needs to make progress over the next year or two. We see this as vital to the interests of Meridian customers and, indeed, to the whole country's security of energy supply.

KEITH TURNER  
CHIEF EXECUTIVE

# National Grid – a profile

**The National Grid ("the Grid") links major centres of electricity demand, or load, to generating stations – and these are generally far apart (as the map shows).**

The Grid consists of 11,733 km of high voltage AC (alternating current) and DC (direct current) transmission lines, and 172 substations and switchyards at points of interconnection with generating stations, local distribution networks and some large power customers.

In the North Island, the Grid is mainly a combination of 220 kV and 110 kV lines linking load centres to stations that use a range of technologies: conventional thermal, combined cycle gas turbine, cogeneration, hydro, geothermal and wind. Auckland – obviously New Zealand's largest load centre – is supplied by four 220 kV lines between suburban Otahuhu and Whakamaru, near Taupo, by two 220 kV lines that originate in Taranaki, and by a number of 110 kV lines.

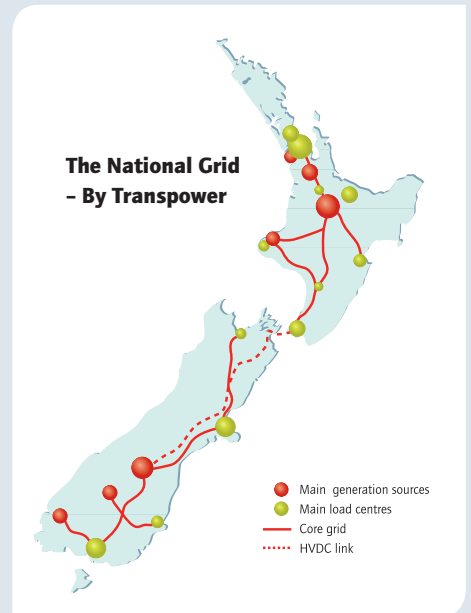
Some of the North Island load centres are also supplied much of the time over the Grid's HVDC link. This runs from a substation at Benmore in the South Island's Waitaki Valley to the Haywards substation, near Wellington, and it includes three submarine cables across

Cook Strait. The HVDC link can carry up to about 1000 MW northwards and often meets the load requirements in the lower North Island. The HVDC can also carry up to about 600 MW south to support the South Island during periods of low hydro inflows.

In the South Island, load centres are linked to hydro stations, principally in the Waitaki and Clutha Valleys and at Lake Manapouri, by 220 kV, 110 kV and 66 kV lines. These include four 220 kV lines between Benmore and the Islington substation, Christchurch.

Wholesale electricity prices vary across the Grid, depending on, among other things, proximity to load centres and generating stations. There are 244 Grid price points around the country, with three of these – Benmore, Haywards and Otahuhu – used as market benchmarks. Prices are generally lower at Benmore than at the North Island benchmarks.

Transpower, established as a state-owned enterprise on 1 July 1994, is owner and operator



*The National Grid – by Transpower.*

of the Grid. It is also contracted to the Electricity Commission to be the electricity system operator, providing real-time coordination of electricity transmission in response to supply and demand signals in the market.

## Fieldays

### Mystery Creek

Meridian Energy continues to spread the word on energy efficiency and safety in the dairy industry. Our site at this year's National Agricultural Fieldays at Mystery Creek (15–18 June 2005) has displays and other information on the hazards of stray voltage in the farm dairy, and on new technologies for greater efficiency.

Meridian Energy is using Fieldays as another way to share with farmers knowledge gained on our model dairy farm in North Otago. Electricity usage on these properties has been reduced by up to 27% through use of Varivac software for vacuum pump control, the Mahana Blue system for water heating and other efficiency measures. The farms have also demonstrated the benefits of overcoming stray voltage – milking times are down, animal health and behaviour has improved, and somatic cell counts in the milk are reduced.\*

Health and safety is a key theme at Mystery Creek this year – and Meridian Energy will make a special contribution with practical solutions to promote this along with energy efficiency on dairy farms.

All visitors are welcome at Meridian Energy's site – G16. At 2004 Fieldays, we had more than 2,000 visitors and were proud to win the Silver Aware for Energy Efficiency. And again this year, we will give away a domestic Panasonic heat pump and associated installation (valued at up to \$5,000 including GST) through a draw among all visitors who register at the site.

*Congratulations to Bryan Clearwater of Clearwater Organic Dairy, Geraldine – the winner of a trip to 2005 Fieldays for two. Bryan entered Meridian's prize draw by using our new Farm Dairy Calculator to assess energy efficiency on his farm and provided a copy of the results back to us.*



The Farm Dairy Calculator helps farmers to evaluate their energy usage and costs and compare them to a typical farm dairy. For more information about the Calculator or about on-farm energy in general, call Meridian's Business Services Team on 0800 496 777 or visit the For Your Farm pages on [www.meridianenergy.co.nz](http://www.meridianenergy.co.nz)

\* Savings and results are indicative only and may vary between farms. Meridian Energy gives no warranty or representation of their accuracy.

# Contingency

## Customers benefit from supporting Grid security

**Energy users benefit from a range of initiatives to support security of electricity supply when outages threaten, or occur, on the National Grid ("the Grid").**

Meridian provides financial incentives for customers to shift some of their load into off-peak periods and, at times, it buys supply from customers equipped with diesel generators. In addition, Meridian facilitates a Transpower scheme for instantaneous reduction in loads to some large industrial and commercial sites.

Through these initiatives, Meridian and its customers regularly help reduce demand on capacity-constrained sections of the Grid. And of course, everyone benefits by avoiding unplanned outages due to overloading on transmission lines.

Transpower, as System Operator, operates an Instantaneous Reserves Market where large business customers contract to have supply to their sites reduced for brief periods after any sudden disruption to supply across the Grid. It is a mechanism best suited to sites with large-scale cool storage or heating processes for which supply can be switched off for up to 30 minutes at a time, without causing major problems.

The Instantaneous Reserves Market has so far operated mainly among dairy and forestry processing plants in the North Island. Meridian facilitates the payment of customers for making available "reserves of load" that can be called on immediately and without notice at any time. Instantaneous load shedding is akin to ripple control on domestic water heating which is routinely practiced by lines companies to help manage peak demand during winter.

In the corporate and business markets, some local network companies operate demand management schemes which enable industrial, commercial and institutional customers to help reduce loads at peak times.

In Christchurch, for example, Orion New Zealand Ltd uses ripple control signals to communicate to such customers that they are approaching a "control period". The customers then have the opportunity to reduce electricity usage by turning off boilers and freezers, running their own generators, or taking other steps. Because energy delivery prices are higher during control periods, the customers can achieve significant savings by making even modest efforts to reduce their demand. Orion may operate control periods between 7.30am-8.30pm on working weekdays during the winter, with 15 minutes notice given in advance of each period. They typically last



one-two hours and each winter, there may be around 80 hours of control periods in total.

Customers have their own contingency plans to achieve specified levels of load shedding in response to signals from Orion, or other local network companies. Such control period-based schemes work separately from Meridian initiatives, although of course they all support Grid security.

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Each of these initiatives may involve customers making use of their own on-site diesel generators or cogeneration plants to substitute supply from the Grid. Some customers have generation capacity surplus to their needs and, therefore, scope to "export" power onto the Grid at locations which enhance security of supply for others. Meridian has mechanisms to facilitate this (see article page 2).

In those regions where Grid security has become a particular issue, Meridian cooperates in contingency planning with Transpower, the lines companies and groups of customers. In Christchurch, Meridian appreciates the cooperation of key customers including Christchurch City Council, Christchurch International Airport, Ravensdown Fertiliser, Bridgestone Tyres and Feltex Carpets.

Grid loads are being closely monitored in the top half of the South Island again this winter, and Transpower will send out warnings should the risk of overloading suddenly escalate. Meridian is ready to use instantaneous reserves, and to call on customers for load reduction or local supply at a few hours' notice. All assistance provided in these critical periods is most appreciated.

Security of supply on transmission lines north of Timaru has been significantly improved through Grid upgrading projects completed over the past year. In winter 2004, there was widespread publicity on the need for contingency planning due to Grid capacity constraints then existing in the upper South Island. This regional situation has been improved since, although some risks are still foreseen, especially during the early evening on cold days.

*We encourage large business and corporate customers to talk with Meridian Energy about their options for participating in electricity demand management. Ask your Meridian Energy Account Manager or call our Business Services Team on 0800 496 888.*

# Outages

System security an increasing issue

**There are thousands of outages on the Grid occurring each year. The large majority are planned for maintenance and upgrading work at key places on the Grid, and electricity users are usually unaware of their impact.**

However the number of such planned outages – and the risk of unplanned outages that could lead to involuntary power cuts – is increasing as load growth on the Grid continues and as ageing Grid assets need replacement.

Most of the Grid was built in the 1950s and 1960s. Growth in the New Zealand economy and population has continued to fuel electricity demand, and in the past five years alone, total load has increased 11%.

Transpower must operate the Grid within both load capacity and voltage stability limits specified for each line. Overloading or excessive fluctuations in voltage can trip a line and ultimately disrupt a whole section of the transmission system.

Transpower works closely with Meridian Energy, other generators and network companies to avoid overloading or instability when outages are planned (see article page 2) and at times of peak demand in areas of particular Grid vulnerability. Once again this winter, the upper South Island and the upper North Island are being watched closely.

Transpower makes regular assessments of “power system capability” in each region of the country. These take into account load growth forecasts,

the configuration of the Grid in each region and the generation supply situation there.

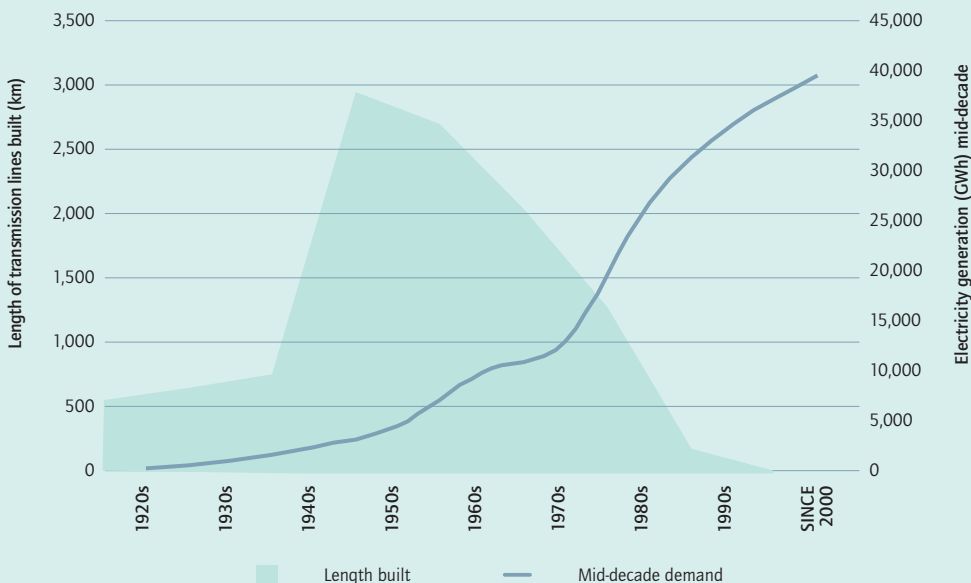
In its latest “System Security Forecast” (December 2004), Transpower concludes: “There are many places in the power system where there is insufficient asset capability (either generation or transmission) to meet forecast demand... enhancement in system capability through investment or the employment of operational measures will be required to avoid the need for demand curtailment in certain parts of the Grid over the next 10 years”.

System capability is obviously constrained further during outages of any kind and a significant such event occurred over the past summer on the HVDC. One of the three cables across Cook Strait failed on 5 October 2004, leading Transpower into a major (and innovative) repair project.

During the outage, the transfer capability of the HVDC was reduced from 1040 MW to 86 MW. The failure was traced to electrical breakdown internal to the cable, with the cause unknown. Full transmission capacity could not be restored until the cable was put back into service on 28 March 2005.

More information is available on [www.transpower.co.nz](http://www.transpower.co.nz)

## Transmission Build Since 1920



# Case Study

One planned outage

In April 2004 Transpower advised Meridian Energy of plans to take down one 220 kV circuit between Twizel and Islington, Christchurch, for up to 12 days in November 2004. The outage was necessary for a circuit breaker to be replaced.

In the follow-up communication, Meridian informed Transpower of serious possible security of supply issues and suggested that the outage be moved to December when demand in Christchurch would normally be lower. As November approached, Transpower confirmed that the work could be condensed into two weekend periods, and rescheduled for mid December.

Meridian Energy and Orion worked with Transpower to prepare a demand management strategy that included possible control of residential water heating loads. In addition, Meridian advised industrial and institutional customers to be ready to shift some of their load to supply from their diesel generators.

Prior to the outage happening, Meridian prepared to manage generation in the Waitaki hydro chain so that supply into Christchurch could be maximised over the circuits that remained in operation. Meridian also informed large customers about the increased risk to security of supply and the prospect of a spike in the wholesale spot electricity price. This information was delivered through Meridian's weekly Market Report email, and some customers were called directly.

During the outages, Meridian generation controllers significantly reduced levels in Lake Benmore and increased the variability of flows into the lower Waitaki River. The first weekend (11–12 December 2005) was mild in Christchurch and electricity demand was accommodated by supply over operating circuits.

But the following weekend was unusually cold with snow in the Southern Alps. Demand in the upper South Island swung up 9% compared with the previous weekend.

Because of Transpower moving the outage, blackouts were averted in Christchurch that weekend through the demand management actions taken by Meridian, Orion and large customers. For all those who participated, your efforts are greatly appreciated by all. However the spot price for the city and for Marlborough/Nelson and the West Coast peaked at \$3 per kW/h.

# Upgrading

## Transpower plans major upgrading

**Transpower's planning for a new 400 kV transmission line into Auckland is part of a comprehensive programme to upgrade the National Grid ("the Grid") and meet forecast growth in loads.**

If it proceeds, the new line from Whakamaru to Otahuhu will be the largest addition to the Grid for 20 years. Two other major new lines are also being planned, in the South Island and on the HVDC, along with 30 regional projects.

Transpower estimates that upgrading the Grid for security of power supply will require a total of \$1.5 billion in new investment between now and 2012.

Transpower has three key drivers for this programme – forecast growth in loads, the ageing of existing Grid assets and the need to connect a range of new generation, including wind farms. Its forecasting indicates that New Zealand will see electricity demand double over the next 35 years, with much of the growth concentrated in the Auckland region. Planning for the Whakamaru-Otahuhu line reflects an expectation that peak demand in Auckland could increase by as much as 12%

in the next five years. Transpower has warned that without substantial additional capacity in this part of the Grid by 2010, the power system in the Upper North Island will be at risk.

Transpower would like to have the 400 kV line commissioned by the winter of 2010 (at an estimated capital cost of \$500 million). As you may be aware, Transpower is now consulting with stakeholders on a preferred route for the line and firm proposals will soon be put to the Electricity Commission for review. The latter's decision could be at least a year away and Transpower has indicated it will, in the meantime, proceed with project planning and resource consent processes.

It has also indicated that planning is underway for a major new transmission line between the Waitaki Valley and Christchurch by 2012, and for a capacity upgrade on the HVDC by 2010.

In various regions, Transpower has a further \$158 million upgrading programme with some of this work already being carried out.

The Grid owner intends to fund all new investment through extended use of debt on its existing balance sheet. Line charges paid by generators, distribution companies and some larger electricity users will be adjusted so that Transpower can achieve its required rate of return on new investment. The pricing formula applied in this context will be subject to Electricity Commission approval.

The new investment will not stop in 2012. Transpower says several hundred million dollars will be required in further Grid upgrading projects over the decade that follows.

More information is available on [www.gridupgrade.co.nz](http://www.gridupgrade.co.nz)

## Lines

### Local networks investment

Network upgrading is also a key issue in the electricity distribution sector. Local network companies have identified a substantial requirement for new investment for increased distribution capacity and for replacement of ageing lines.

Recent analysis undertaken for the Government's Infrastructure Stocktake project\* put an estimate of \$1.7-\$2.5 billion on the total investment required on local networks between now and 2010. This was based on an assumed 1.6% annual increase in peak electricity demand and on efficient use of network assets.

The analysis showed that most of New Zealand's 28 local distribution companies have network assets with, on average, 50-60% of their economic life remaining. Of these companies, 18 have been experiencing annual growth in new connections of 2% or higher (much higher in some cases).

There is concern among the local network companies that the new price regulation regime for this sector will inhibit the level of new investment required to accommodate growth in electricity load and to maintain current network performance standards.

\*Report by PriceWaterhouseCoopers

## Supply

### Customers become power suppliers

**Meridian Energy customers can also become energy suppliers – and that is important for security of supply to everyone.**

When security issues arise on the National Grid ("the Grid"), or on local networks, Meridian can call on a number of large customers to supplement supply at certain points from their own diesel generators. The customers have industrial, institutional or commercial sites equipped with generators for stand-by power supply.

From time to time, Meridian will buy generation that is surplus to the site's requirements and available to be fed back onto the Grid or local network, and so help to lessen the impact of transmission or distribution constraints. This form of supply can make a significant contribution to security of supply.

These customer-suppliers have signed Provision for Generation contracts with Meridian Energy. The contracts create a basis for Meridian to buy electricity supply from the customer over a specified period at a pre-determined price which is based on the operating and capital costs of each particular on-site generation plant.

The contracted customer commits to make its plant available to supply on one hour's notice. Meridian Energy will issue a generation notice specifying the level of supply required for a particular period or periods, and the customer is committed to using their best endeavours to ensure its generation is in line with these requirements.

Supply under these arrangements can be profitable for the customer, especially if their local network company is also providing incentives for their generation to help manage peak demand. This is most likely to be the case in the early evening on cold days during winter, especially in the upper South Island.

*Meridian Energy initiates each period of customer generation in response to signals from Transpower about an actual or impending situation at a particular place on the Grid, and after identifying the customers best able to contribute supply.*



# Market

## Price increases reflect demand and inflows

Electricity spot prices increased in May after holding steady for much of the previous two months. The increase reflected higher national demand in May and below-average hydro conditions.

Daily average prices for the first two weeks of May were 6.88c per KWh at Benmore, 7.33c per KWh at Haywards and 7.13c per KWh at Otahuhu. These prices were significant increases from the previous two months, and from averages for the month of May 2004 which were 4.26c per KWh (Benmore), 4.42c per KWh (Haywards) and 4.55c per KWh (Otahuhu).

During March and April, demand was consistently lower than those months of 2004. However colder weather in May brought demand growth and the daily average for the first two weeks of the month was up 1.2% from the corresponding period last year.

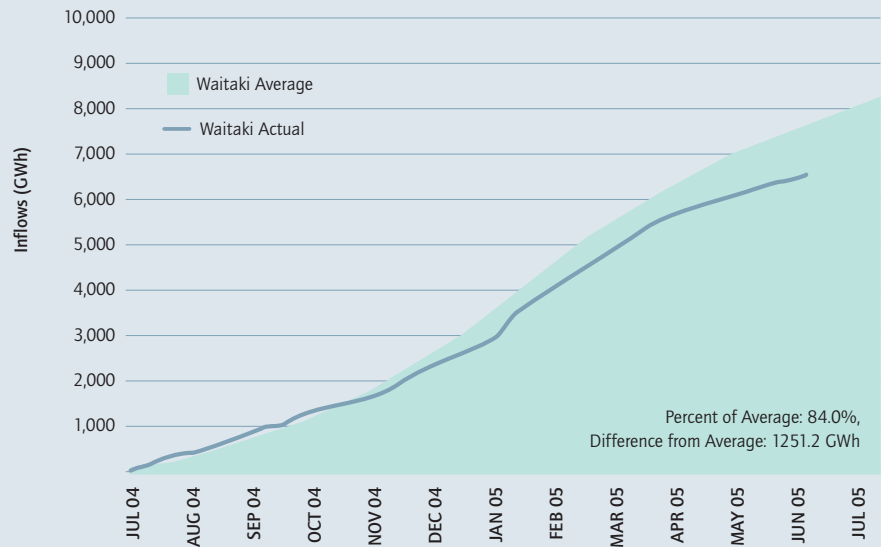
The national hydro storage position was strong through February and March before a significant decline in April. During the latter, hydro inflows were only 64% of average, with the daily inflow level above average on three days only. The low rainfall patterns reflect those of 2003 when low hydro levels resulted in a winter energy crisis. Conservative management of the hydro lakes has resulted in storage levels of slightly close to average as we move into winter this year.

Through April, national hydro storage went from being 112% of average to 96%. The position improved slightly in the first two weeks of May, with inflows rising to be around 90% of average for that period and national storage sitting at 99% by mid month.

Transmission constraints on the HVDC inter-island link impacted on the market during the early months of 2005. Full restoration of the link

in late March brought the end of noticeable price separation between the North and South Islands. North Island supply was also reduced by a 10-day unplanned outage at the Otahuhu B thermal station in late March–early April. There were no further outages or significant disruptions to transmission through the remainder of April, or into May.

## Waitaki Cumulative Inflows Financial year



## Business Online

### New service for energy analysis

**Many of Meridian Energy's large business customers are closely analysing their energy usage and costs, using a new web-based service provided by Meridian Energy.**

Business Online enables customers to track their usage in half hourly intervals, and to see the financial implications of changing usage and improved energy efficiency.

Meridian Energy is the first electricity retailer to provide such a service to managers of large businesses in New Zealand. Business Online provides access to monthly information on energy usage and costs, as well as the tools to graph usage and demand profiles, load duration

curves, contract prices and volumes, and time-of-use billing data.

Business Online is available to customers at any time on a secure, password-protected website, and at no charge from Meridian. The service offers a valuable means for managers to better understand their energy expenditure and to make better-informed decisions on energy usage. The tools are designed for use by non-technical business managers and staff.

Meridian plans to introduce other valuable online information services for customers in the future.

Business Online is available to all business

customers who have time-of-use, or half-hourly meters. Password and log-in details are available from Meridian's Business Services Team. If you're interested in using Business Online please call the Business Services Team on 0800 496 888, 7.30am – 7.30pm, Monday to Friday, excluding public holidays.



We value your feedback. To get in touch please either call your account manager, or email us at [meridianreport@meridianenergy.co.nz](mailto:meridianreport@meridianenergy.co.nz)

[www.meridianenergy.co.nz](http://www.meridianenergy.co.nz)

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