TRANSPOWER

Examining the purpose and future role of our HVDC link

A discussion on the changing role of the HVDC inter-island transmission link in New Zealand, in the context of increasing electrification. As Transpower prepares to upgrade the link and replace the undersea cables over the next decade, we are also considering the overall role and resilience of the link, as our dependence on it to ensure a reliable electricity supply increases.

7 March 2024

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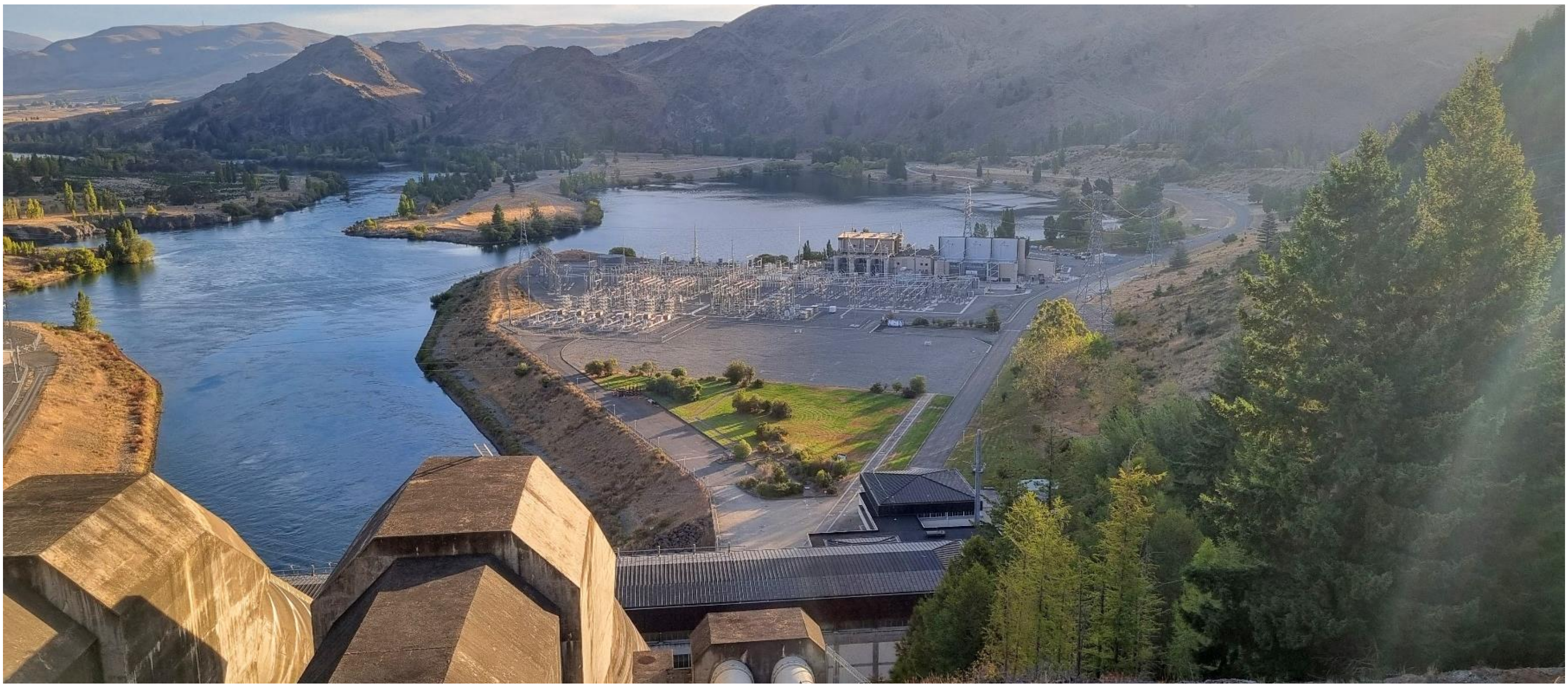


Lake Benmore and the Benmore Hydro-Dam are at the southernmost part of the HVDC link.

1. Overview

High voltage direct current (HVDC) electricity transmission technology is playing a major and increasing role worldwide, in enabling renewable generation and electrification. Almost 60 years ago New Zealand was a pioneer in the adoption of this technology in connecting the separate North and South Island power systems using cables across Cook Strait and transmission line through the South Island to Benmore. Over that time our HVDC link has served us well with several significant upgrades. As we look forward to how Transpower and our national grid will meet the challenges of enabling an energy future where electricity usage increases by at least two thirds between today and 2050, we are asking ourselves what role HVDC technology and specifically our existing HVDC link will need to play.

This document is to inform a discussion with all our stakeholders on our thinking and investigations. It highlights the challenge, the current role and the history as to why the link was developed. It then covers some of the risks to address while ensuring the link is resilient and reliable into the future. Lastly it outlines the current and future investigations to ensure the link plays its role in the wider evolution of New Zealand's power system to enable electrification in an optimal way and at least cost to energy users.

South Island HVDC cable termination station at Ōraumoa / Fighting Bay in the outer Marlborough Sounds.

2. Context

New Zealand has set a target of net-zero carbon emissions by 2050, to limit the impact of climate change. Achieving this includes electrifying activities currently powered by fossil fuels (e.g., transport and industrial process heat). At Transpower we anticipate this electrification will increase annual electrical energy demand by at least two-thirds from now to 2050.[1]

The additional electricity generation to support electrification will need to come from sustainable sources – zero or low carbon renewable resources – most likely solar, wind and geothermal, supported by battery and hydro storage.

For electrification of our economy to succeed, electricity must remain affordable, and importantly be both reliable (from large-scale generation through to transmission and distribution to each household) and resilient (particularly in the face of the increasing frequency and intensity of weather events from global warming).

As owner of the national grid and operator of the real time electricity system, we are responsible for maintaining a resilient transmission network that will meet future electricity demands as well as maintaining real-time security of supply. Given the criticality of the transmission grid to supporting broader electrification, we are scoping what is needed to ensure the grid is fit-for-purpose into the future. Our Net Zero Grid Pathways programme (NZGP) brings this longer-term thinking together.

Work is already underway to enable electrification. Our $400 million package of grid improvements to add more capacity to the existing transmission grid backbone out to 2030, known as NZGP Phase 1 Stage 1, has received strong support from many stakeholders. The Commerce Commission has recently approved this NZGP1.1 major capex proposal (MCP). This is good progress, and we are now looking beyond that timeframe at other longer-term and more significant improvements needed from the mid-2030s.

The potential future role of the HVDC inter-island link (the HVDC link, or link) that connects the North and South islands is part of this planning for a future shaped by electrification.

As the link's custodian, our goal at Transpower in publishing this paper is to encourage discussion as to how the link should be viewed within the New Zealand electricity system as electrification progresses. This will assist us in our long-term planning and ensure the link, and the use of HVDC technology more broadly, plays its key role within the New Zealand electricity system of the future.

[1] 'Whakamana i te Mauri Hiko – Empowering Our Energy Future', Transpower New Zealand Ltd, Page 9, March 2020.

3. Today's role and the history of the HVDC link

3.1 The role of the HVDC link

In global parlance, the link is known as an interconnector. That is, it electrically connects our North Island and South Island power systems together into one. In doing so, it fulfils many key roles in our electricity system:

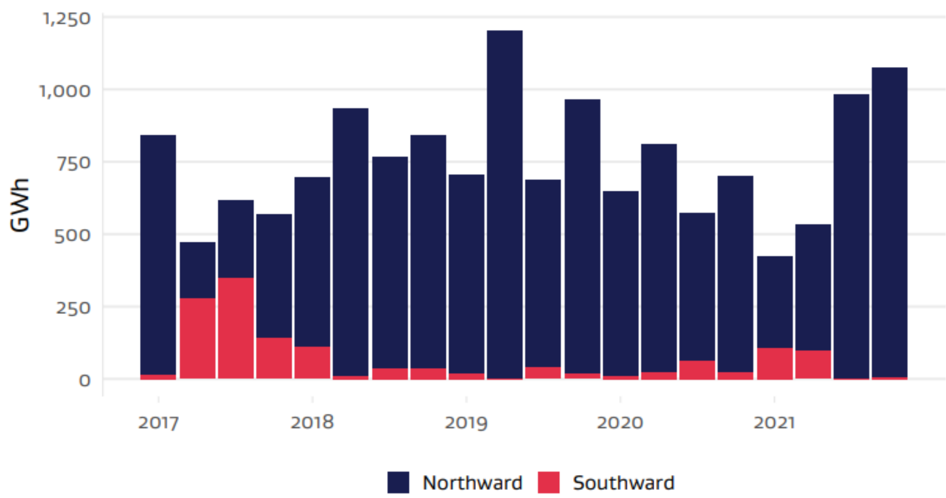
a) **Enables diversity of electricity supply**
The link benefits North Island consumers by enabling access to (lower cost) South Island hydro generation and South Island consumers by enabling access to North Island thermal generation (required in what we call dry years, when the South Island hydroelectric storage lakes are low).

b) **Promotes supply competition**
When the wholesale electricity market was introduced and with the creation of separate generating companies in the mid-1990s, the link enabled greater competition for electricity supply. Connecting the North and South Island power systems increases the overall pool of competing generators in a single national wholesale electricity market. This also widens the geographic area for potential new generation investment. Together this increased competition helps drive more efficient market outcomes and lower generation investment costs.

c) **Helps manage dry hydrological years**
Although originally built to send lower cost electricity from hydro-electric power stations in the South Island to the North, during the first ten years of the link's operation the benefit of sending power south was also identified. Changes were made to the AC (alternating current) to DC convertors, which convert electricity from AC to DC and vice-versa, at Benmore and Haywards in 1976 to enable this southwards transfer capability.

As a result, the link can transmit power in both directions – south to north and north to south. Today north to south transfer happens regularly across a typical week, due to the natural variations in output from the increasing amount of North Island wind generation being "firmed" or balanced by changes to the amount of South Island hydro generation sent north. North to south transfer occurs most frequently at night when North Island wind generation is strong. Critically the link allows thermal generation in the North Island to supply South Island demand in a 'dry hydrological year' – when South Island hydro lake levels are low – to avoid rolling blackouts. This was the case in 1992 and 2001 and again in 2008. Figure 1 shows energy transfer between the islands, both in the north and south direction more recently between 2017 and 2021. As shown, 2017-18 was a dry year where southward power transfer accounted for more than half the electricity transferred over the link.

Figure 1 – Recent Inter-Island Energy Transfer



d) Provision of a national reserves market

There have been two major upgrades to the HVDC link over its almost 60-year life. As part of the first major upgrade completed in in 1991, controls were added to allow South Island generation to instantly provide extra power into the North Island following the tripping of a North Island generator (and vice-versa). As part of the next upgrade completed in 2013 this inter island reserve sharing functionality was enhanced to always be available using "round power". Now the link no longer shuts down when there is less than 30 MW scheduled transfer in either direction. Changes to the electricity market to create a national reserves market in 2016 enabled the benefits to be passed to consumers, as generators in each Island no longer pay for dedicated reserves sourced exclusively from within that Island.

e) Frequency management

Another cost in operating the grid is the payment to generators of keeping the grid frequency at 50 Hz in each island. During the second major upgrade, controls were also added to tie the North and South Island grids in such a way that the frequency keeping role provided by generators can be shared between the islands, reducing the overall costs of frequency keeping to consumers also.

The HVDC link is also becoming more critical in supplying the North Island at winter peak

We are relying more on the link to meet North Island demand as our generation mix changes. The 2 August 2023 winter peak demonstrated how important the link is to supplying the North Island electricity needs at peak times. That evening's peak of 7122 MW was at a time when all available North Island thermal generation was operating, with some 500 MW of generation unavailable due to equipment failures. HVDC transfer into the North Island at peak was over 800 MW. At that point, as system operator we calculated there was just 300 MW of residual capacity left in the entire power system. Had the full link capacity not been available the North Island electricity needs would not have been fully supplied.

The role of interconnectors is changing internationally as well

Similar interconnectors have been installed in other power systems; they are widely used in Europe and North America to connect different countries and join previously separate power systems.

Interconnectors are typically not designed with the same focus on reliability or resilience as the rest of the transmission network.[2] The investment in major interconnectors is almost always to access lower cost sources of electricity and other electricity markets. This was the rationale for the link from Tasmania to mainland Australia as well as the many recent links built across mainland Europe and the North Sea. They diversify supply and, by increasing competition, provide access to renewable generation, lower electricity costs and prices. Usually, if they are not available, the power system can still meet electricity demand albeit by running older or more costly existing generation.

A natural consequence of interconnecting power systems is a greater reliance on the interconnectors from the consequential shutdown and closure of higher cost or end of life thermal generating plants. This can result in energy security concerns if the interconnector was to be unavailable due to an equipment failure or major storm event, particularly if one country or region has become very reliant on another country's or region's electricity.

Our link is becoming more critical in New Zealand, given the surplus hydro generation in the South Island and growing intermittent wind generation in the North Island that needs to be "firmed" when it drops away, by either South Island hydro-power via the link, or slow starting North Island thermal generators.

3.2 Why was the link established, how has it been upgraded?

The original rationale for our HVDC link

In the 1950s, North Island electricity demand was rapidly increasing, and forecasts indicated that growing demand could not be supplied by further North Island hydro power development, which had expanded rapidly along the Waikato River, securing the most significant resource available, or by coal-fired generation, due to limitations on the understood coal reserves at that time. The alternative was to connect the North and South Island grids and supply North Island demand by utilising the abundant hydro power resources that had been identified in the South Island.[3]

The original link was commissioned in 1965 by the New Zealand Electricity Department. When built, the link was regarded as a feat of engineering. It was an ambitious project to transmit bulk power over a long distance using a then relatively new technology, and with the additional challenge of crossing the Cook Strait with its deep water, strong currents, and often stormy weather. Following the success of this project many HVDC links have been built worldwide. HVDC links are now the

[2] While the equipment itself may be as reliable and may be maintained to a high level of availability, such as in New Zealand, interconnectors do not usually incorporate the same level of equipment redundancy.

[3] 'White Diamonds North', Chapter 3, Transpower, 1990.

preferred option in most cases for bulk onshore as well as offshore electricity transfer, with many more planned for the future.

The original link could transmit 600 MW[4] from Benmore in the South Island to Haywards in the North Island, over 570 km of overhead line and three submarine cables across 40 km of Cook Strait (see Figure 2).

Figure 2 – Overview of the New Zealand Transmission Network

[4] 600 MW is the power required for approximately 300,000 electric kettles.

Upgrading the link

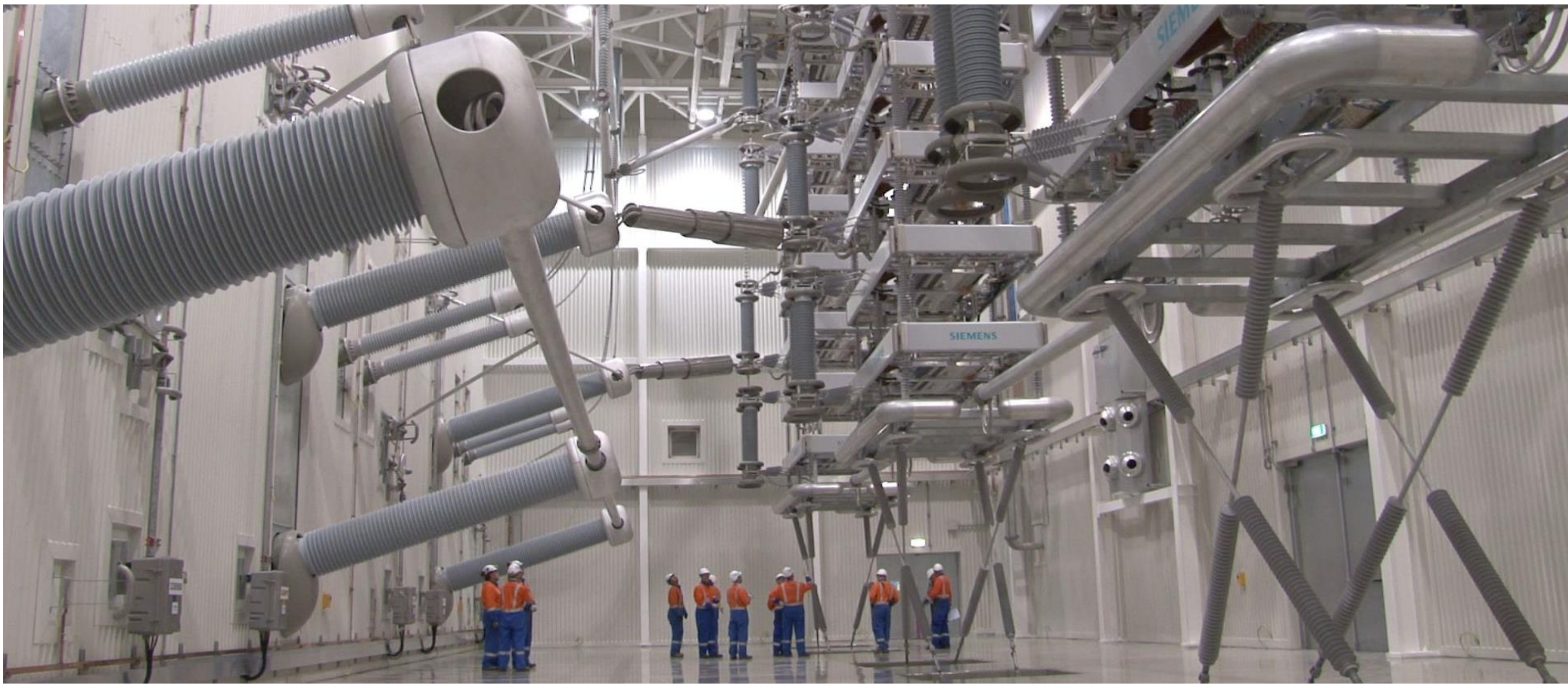
In 1991 we carried out the first major upgrade to the link, doubling the northward transmission capacity to 1,240 MW and adding three new submarine cables. The original submarine cables were failing, and all were retired by 1996, reducing the capacity to 1,040 MW. In 2013 we completed a second major upgrade, providing the present northward capacity of 1,200 MW. The ultimate design capacity of the convertor stations at Haywards and Benmore is 1,400 MW northward.[5]

We retain the specialised skills to maintain and operate the link

Like all large power system infrastructure, a continual maintenance program is required to keep the link operating. The equipment at Benmore and Haywards is the most complex and unique part of the New Zealand transmission grid.

After almost 60 years of service and multiple upgrades and replacements, the only original part of link still in use is most of the overhead transmission towers and wires.[6] Even the towers and wires have been upgraded and strengthened as part of the two major upgrades to the link completed in 1991 and 2013.

Maintaining the HVDC convertor and control system technology requires specialised engineering skills that are not widely available in New Zealand, or even internationally. As custodians of the link, we have an in-house team with multi-generational institutional knowledge and experience. We meet our targets for link availability, which varies between 96-99% in any year depending upon maintenance requirements. This deep knowledge and experience positions us well for supporting and maintaining other complex grid equipment that utilises power-electronics such as STATCOMs and grid scale batteries. This also includes the technologies associated with the connection and operation of offshore wind generation.



Pole 3 Valve Hall at Haywards Substation, commissioned in 2013.

[5] This would require an additional 4th cable and additional support equipment.

[6] Haywards synchronous condensers C7, 8, 9, and 10 are still used to provide reactive support to the grid, but are not directly a part of the link.

Past investments in our link that improve reliability and resilience

The link and subsequent upgrades, including our $600 million Pole 3 project completed in 2013, were justified on the benefit of accessing lower cost generation or economic grounds, as typical for interconnectors. Our link has a number of features that aid its reliability and resilience to minimise the chance that a major environmental hazard may take it out of service, at a time it is critical to supplying the North or South Islands. These are:

1. Programmes completed in 1991 and 2013 improved the capability of the overhead line section through the South Island to withstand extreme major wind events.
2. A cable protection zone in Cook Strait to reduce the risk of damage to one or all three cables from shipping and marine fishing hazards.
3. The HVDC convertors for Pole 2 and Pole 3 are designed to withstand a 1:1000 and 1:2500-year return earthquake event.
4. Having three undersea cables rather than two, increases transfer capability between the North and South Island, but also allows one cable to fail with only a modest reduction in maximum transfer.

3.3 Trends in the use of HVDC links and the future role of our link

Trends in the adoption of HVDC technology for long distance high-capacity electricity transmission

Internationally, HVDC links are playing an increasingly significant role in electricity transmission. They not only link existing power systems as across the North Sea in Europe, but also connect significant new remote renewable generation, including from offshore wind.

HVDC links are usually technically superior to HVAC systems (the rest of New Zealand's grid is high voltage AC) over long distances and can be economically superior as the electricity lost in transmission is much lower. Combined, the technological and economic benefits of HVDC results in it being the preferable technology for overhead point-to-point transmission projects when distances start to exceed 300 km and when cable-based interconnection is required. For the grid integration of remote offshore wind farms HVDC is the preferred technology beyond 50 km.

We are keeping a watchful eye on developments with our many peer transmission grid owners in their application of HVDC technology. Our interest is its role here in Aotearoa New Zealand as we consider how we will meet our future major grid backbone electricity transmission needs.

The changing role of the HVDC link in the New Zealand electricity system

Although our link was originally built to access lower cost South Island hydroelectricity, its role is changing, and it will likely play a crucial part in delivering on our electrification ambitions.

As our power system changes and becomes more dynamic we can no longer assume the broader system can continue to fully supply electricity if the link is unavailable or its operation interrupted. The link's availability is now more important in maintaining the reliability and security of the broader system. The HVDC link already provides much more than just access to lower cost electricity – and it has the potential to provide even greater reliability and resilience for the broader power system.

The counterfactual here would be that we plan the power system so that the North and South Island could function reliably if the link were not operational. The question to be asked is, does the cost of enhancing reliability exceed the benefits to consumers in being able to access electricity generated by lower cost renewables, and the benefits of greater market competition?

Alternatively, if a large-scale hydro-electric generation development in the South Island had proceeded, with one of its roles to firm North Island wind and solar when the wind is not blowing or sun not shining, this might have justified a complete new second link.

We are starting to develop these different use cases to discuss them with stakeholders and inform our investment planning.

Findings from our investment planning so far in NZGP 1.1

We can get insights into the longer-term role of our HVDC link from the longer-term modelling we did in 2022 under our NZGP programme. This was to support our investment case for the Net Zero Grid Pathways Phase 1 Stage 1 application (NZGP 1.1 MCP) to the Commerce Commission. Here we made a case for added capability to the existing link both with a STATCOM in Stage 1 (which the Commerce Commission has approved) and increasing link capacity by adding a fourth undersea cable in Stage 2 (a proposal yet to be submitted).

Our NZGP modelling considered several electricity demand growth scenarios and link upgrade options. Our modelling assumes new generation will be built and operated to minimise whole of system electricity costs. It also shows that in all scenarios it is economic to install a fourth undersea cable to increase maximum northwards capacity by 200 MW or 15%.

This is because much of the new generation built to supply increased electricity demand is intermittent renewable generation in the North Island. As a result, a significant proportion of the transfers across the link will be South Island hydro electricity used to firm North Island intermittent generation. Firming generation is required when either the wind is not blowing, or the sun is not shining. Hydro power is ideal to firm wind and solar generation but there is not enough in the North Island to firm North Island intermittent generation. South Island hydro is required, and this is transmitted over the link.[7]

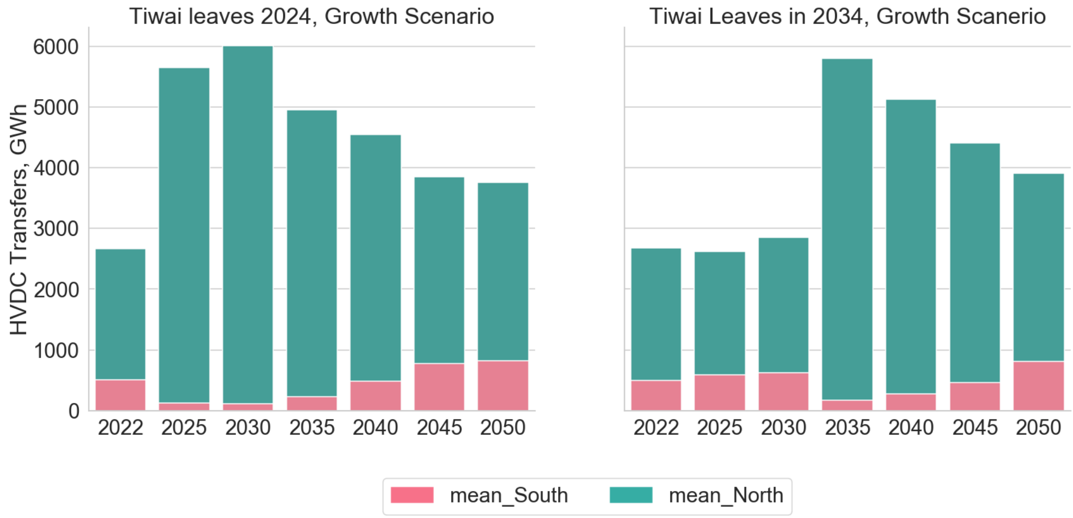
The scenario we considered is a reasonable variation of one Electricity Demand and Generation Scenario (EDGS). Under this scenario, it is economic to install a fourth Cook Strait cable and increase link capacity to 1,400 MW northwards and 950 MW southwards. In our NZGP1.1 modelling this scenario:

- assumed a North Island dry year solution is developed,
- assumed New Zealand's Aluminium Smelter (NZAS) at Tiwai Point closes at the end 2024,
- included a sensitivity where NZAS closes at the end of 2034.

[7] Our analysis assumes a North Island dry year solution is developed and Tiwai Point closes at the end 2024 or at the end of 2034.

Figure 3 shows average link transfers from our modelling for Tiwai closing in either 2024 or 2034. In both cases north transfers increase sharply in a scenario where NZAS closes, remain above existing levels to 2050, and then slowly decline as new North Island generation and South Island demand growth both act to reduce the bulk supply of energy over the link. In both of our 'Tiwai leaves' states, link transfers remain above existing levels through to 2050.

Figure 3 – Forecast Link Transfers



3.4 Improving and maintaining the reliability and resilience of the link

If we are to improve the reliability and resilience of the link (which would support broader electrification), there are some significant investment choices to be considered.

Submarine cable failure

Submarine cables crossing Cook Strait are vulnerable to extreme events such as severe storms or damage by a dragging anchor (like the 2016 Storm Angus event in the English Channel where a ship's anchor damaged four of eight cables on the Cross-Channel HVDC Link). To protect the cables, a cable protection zone was established along the route crossing Cook Strait in which anchoring and fishing is prohibited. The protection zone is patrolled by a dedicated vessel, and we spend over $2 million a year on ensuring our submarine cables are not at risk from these activities. The Cook Strait is a very active marine environment with strong tidal currents moving gravels across the cables and with sections of the cables suspended across undersea outcrops. We conduct an annual health assessment of each cable including electrical tests, a deep water remote operated vehicle (ROV) survey, and shallow water inspection by divers. When our surveys identify any damage to the outside of the cables from the effects of the undersea environment, we use a range of measures to protect the cable from further damage.

Figure 4 – An HVDC cable on the sea floor of Cook Strait

Annual health assessments of each cable include underwater surveys to identify and address any damage.

The original cables were replaced in 1991 with some cable failures prior to replacement. The current three cables have had only one failure in 2004, however they are ageing. The lifetime of the original cables was about 25 years, and the existing cables, installed in 1991, were anticipated to have a useful life of 40 years. Our ongoing health assessment of the existing cables suggests that is correct and there will be an increased probability of needing replacement in the early 2030s.

Figure 5 – Laying a replacement section of the Cook Strait submarine cables in 2005

Transpower predicts it will be economic to replace the existing ageing cables in the early 2030s. A cable fault could take 6-18 months to repair, and a new cable might require 7-10 years to procure and install.

Cable failures always result in long duration outages. A typical repair can take 6-18 months even with our access to a standby cable repair ship in the South Pacific/South-east Asia.[8] If the cable cannot be repaired the lead time for a replacement cable is currently about 7-10 years.[9]

We are currently preparing an investment case as part of the NZGP programme along with early procurement work to enable replacement of the cables by 2032.

Risks from natural events – storms and earthquakes

Like the wider power system, the link will face growing risk from extreme wind and flooding events due to climate change.

In retrospect, the original overhead line design for the connection from Benmore and Ōraumoa/Fighting Bay plus Oteranga Bay and Haywards in the North Island, was designed using what we consider today to be lightweight towers.

These two overhead line sections of the link have twice had significant strengthening carried out to better withstand extreme wind events. We are also assessing options for further strengthening. This includes relocating or protecting towers located on and next to the braided rivers in the South Island.

The link also faces risks from earthquakes and associated tsunamis. The Haywards converter station is located close to a major fault line, and the two submarine cable stations are close to the shore. As already referenced, the most recent upgrades ensure the new converters at Haywards and Benmore have a very high level of seismic resilience. We are progressively improving the seismic resilience of

Figure 6 – HVDC converter valves at Haywards

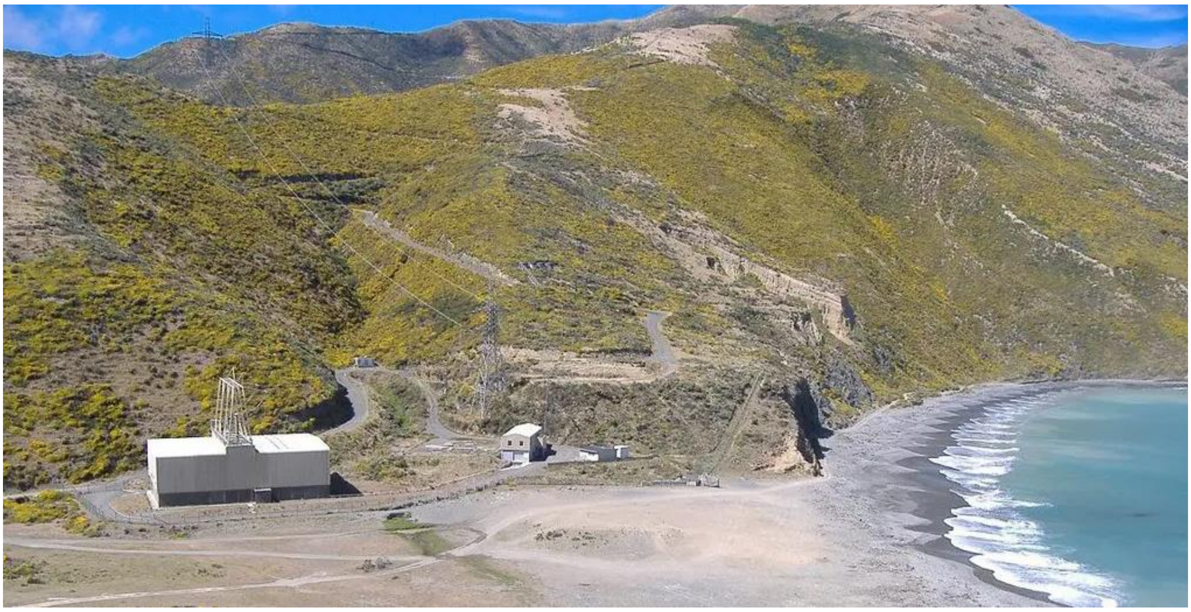
The Pole 2 Valve Hall. The HVDC converter valves are suspended from the ceiling, allowing movement during a severe earthquake, reducing the risk of damage.

[8] 'HVDC & Reactive Information requested during/following 2nd round interview'.

[9] 'HVDC Submarine Cable Replacement and Enhancement Investigation (NZGP) – HVDC Submarine Cables Q&A', Transpower, 6 April 2023.

older parts of the link. This includes assessing the tsunami and seismic risks at the cable termination stations and how they are best mitigated.

Figure 7 – North Island HVDC Cable Termination Station at Oteranga Bay near Wellington



The cable stations on the shore of the Cook Strait at Ōraumoa/Fighting Bay and Oteranga Bay are subject to severe weather conditions and vulnerable to severe earthquakes and tsunamis.

Figure 8 – Erosion by the Clarence River, one of several river crossings of major braided rivers

This HVDC tower beside the Clarence River in the South Island is increasingly threatened by erosion. We will be relocating this and other towers near major river crossings to make the HVDC line more resilient to flooding.

Figure 9 – Repair of a damaged HVDC tower in January 2004

Following the failure of several transmission towers in Molesworth Station, temporary Lindsey Towers were used as a measure to restore the link to operation within five days, while the destroyed towers were replaced.

Loss of ancillary equipment at Haywards

The type of technology used in our HVDC link requires an electrically "strong" power system at the convertor stations. At Benmore this "system strength" is provided by the adjacent Benmore hydroelectric power station and other nearby generators in the Waitaki Valley. At Haywards, at the end of the HVDC link, this strength and the ability to support and control voltage has to be provided by ancillary equipment at Haywards, including multiple synchronous condensers, a STATCOM and the reactors, filters and capacitors needed for link operation itself.

Outages of this ancillary equipment, particularly the synchronous condensers which have high maintenance needs, are the main contributing factor to limiting the overall maximum HVDC transfer capability. During the period 2017-2021 the average maximum HVDC north transfer capability was 1,070 MW, 130MW less than that with all ancillary equipment available.[10]

We will be undertaking life extension refurbishments on the condensers between 2025 and 2030, which will limit maximum link capacity during that time. In our NZGP1.1 MCP we applied for funding to install a further ancillary device to support full link capability at Haywards.[11] This is intended to provide more resilience to outages and increase the average transfer capacity closer to 1,200 MW North.[12]

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[10] Net Zero Grid Pathways 1 Investigation.

[11] Net Zero Grid Pathways 1.1 MCP.

[12] 'Net Zero Grid Pathways 1 Major Capex Project (Staged) Investigation - Attachment B: Power System Analysis report', Transpower, 2 December 2022.

Figure 10 – Synchronous condenser at Haywards

Synchronous condensers at Haywards contribute to system strength and can help to support and control voltage.

3.5 Ensuring the link is fit for its future enabling role

We manage most of the issues we currently face in operating the link, in our role as a prudent transmission owner and operator. For long-term planning, with the link having an ongoing role as an integral part of our transmission network, we need to evaluate some risks in more detail. This includes the costs and benefits of alternatives. For example, the trade-off between further investment in the reliability and resilience of link compared to ensuring both the North and South Island are self-sufficient in terms of generation.

Fit-for-purpose electricity system

We are investigating the role of the link into the future as part of our Net Zero Grid Pathways programme. This is to ensure the link and our wider electricity transmission network plays its part to enable an optimal, least-cost energy transition. There are several options for its potential future role and alternatives to those options. They include:

- An ongoing role in accessing lower cost renewable electricity (an economic interconnector)
- A greater role to enable South Island hydro to firm North Island intermittent generation, requiring greater reliability and resilience including the possibility of a second link[13]
- A future generation mix where both the North and South Island are self-sufficient if the link is not there.
- Added services from the link for instance to enable "black start" in either island.

To illustrate the last point, this could be where the link could be used to provide added resilience to electricity supplies. An example is to "black start" and supply the lower North Island and Wellington

[13] This may cost in the order of $3-5 billion, for which we do not see a justification at present.

from the South Island in the event of the total loss of Bunnythorpe substation (a critical gateway connecting the lower North Island grid to the rest of the North Island).

Investigations already underway

As part of our investigations to secure regulatory approval to replace the submarine cables we are also making a case for the addition of a fourth submarine cable. A fourth cable would increase northward capacity from the present 1,200 MW to 1,400 MW, up to the combined maximum capacity of the Pole 2 and 3 convertors at Haywards and Benmore. This would both increase the maximum capacity for South Island hydro to firm North Island intermittent generation, and further improve the link's resilience with added redundancy for our submarine cables.

Without pre-judging the outcome of the investigation, the long 7–10-year lead time for installing a fourth cable and the associated establishment costs makes it likely, that if justified, it would be installed at the same time as the other three replacement cables in the early 2030s. This investigation is being undertaken as the second stage of NZGP1 i.e., NZGP1.2.

Future investigations

We need to consider how the wider power system will evolve, as increasing power transmission on the link also raises other questions for the evolution of our power system. We may need to upgrade the North Island AC grid to carry the additional power injected into Wellington to the rest of the North Island. We could consider adding a second inter-island link at some stage into the future if the ultimate design capacity of the existing link regularly constrains power transmission between the islands, or we cannot economically otherwise improve resilience of the existing link. This would be an expensive investment, for which we do not see a justification at present. Our wider planning of the future grid across New Zealand from the mid-2030s to 2050 is part of our NZGP2 programme.

Aerial view of Haywards Substation.

4. Further engagement

As custodians of today's HVDC inter-island link, we at Transpower are publishing this paper to inform all stakeholders of our challenge in ensuring the link is fit-for-purpose given Aotearoa New Zealand's goal of net zero carbon by 2050. The link has served New Zealand well in the past and will play a key future role to help balance the energy trilemma – affordable electricity, a secure power supply, and sustainability through electrification, as we move towards our goal.

Our analysis shows the link will continue to fulfil its original primary purpose in providing the North Island with low-cost hydro energy from the South Island. It will also be an important element in improving resilience of the power system overall and supporting our electrification efforts.

We are currently considering investment that will maintain the link's present 'business as usual' role, and to improve reliability and resilience. Beyond that, we want to discuss with stakeholders their preferences for how the future role of the link should be considered in our long-term planning. It is already becoming critical to supplying the North Island at peak (by offering the benefit of accessing flexible South Island hydro generation to firm future North Island intermittent generation).

We look forward to further engagement and welcome your thoughts and comments as we begin our investigation into the longer-term role. We'll also be formally consulting on our funding applications for replacement of the Cook Strait Cables and adding a fourth cable towards the end of 2024.

We will be contacting interested stakeholders for informal discussions on the longer-term role over the coming months to start this conversation. We would like to hear from you and if you are keen to be involved please get in touch with us at nzgp@transpower.co.nz.

The overland section of the HVDC line in the South Island from Ōraumoa/Fighting Bay to Benmore.

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