Crafting a path for New Zealand's 100% renewable electricity market

Proposal for industry-wide engagement on the future of New Zealand's thermal assets

Executive summary

An opportunity for Aotearoa to take a leadership position

New Zealand can become the world's first large-scale, competitive electricity market to reach 100% renewable electricity. Our advantageous starting point, with a highly decarbonised market powered by our enviable geothermal, hydro and wind resources, gives us a strong competitive advantage over the next two decades.

Electricity generation is today responsible for 5% of New Zealand's carbon emissions, and has the potential to support significant emission reductions across the economy. This report explores how we can make the transition away from our current reliance on electricity generated by fossil fuels, without disrupting a secure and affordable supply of electricity to New Zealanders.

Contact aims to lead the decarbonisation of New Zealand. We are committed to *kaitiakitanga* – to care for New Zealand's *tiaki tiao*[1] and its *tiaki tangata*[2]. This will support our country's progress towards a 100% renewable electricity market and a carbon-neutral economy by 2050. The Climate Change Commission (CCC) has recently outlined a pathway to achieve this national goal, which recognises that electricity will be the main enabler of our economy's decarbonisation. We agree with this, but the questions is: how?

The transition towards a 100% renewable electricity market can unlock significant opportunities for our country, benefiting our environment, our people and our communities, while creating competitive advantages for New Zealand businesses.

New Zealand still relies on fossil-fueled thermal generation during periods of peak demand or when there is insufficient water, wind and sun to meet demand. As new lower-cost renewable projects are built, thermal assets will be used less and less. The CCC predicts that reduced thermal generation, and the corresponding growth in renewable generation, will reduce emissions by ~1.2Mt C02-e per year between 2022 and 2030.

The CCC model also finds that most existing thermal assets will still be required at critical times over the next decade to meet electricity demand as we transition to renewable alternatives. It will be important that the costs to operate and maintain these thermal assets can be recovered, to ensure they continue to be available when needed for security of supply.

We assessed several market options that have been used in other countries and evaluated their ability to mitigate the challenges the transition away from fossil-fueled generation may present.

Our preferred option is the establishment of ThermalCo: an entity that would own and operate all New Zealand's existing thermal assets. It would have the mandate to sell risk management products (for both dry-year and peak demand) to industry participants. Our view is that the ThermalCo proposal could be implemented relatively quickly and would facilitate an orderly phasing out of thermal assets over time. The consolidation of thermal generation assets would ensure the optimisation of the thermal portfolio and help balance the energy trilemma: secure supply, affordability, and environmental factors.

1 environment
2 people

Maintaining the balance to ensure an orderly transition

New Zealand's electricity market is one of only nine countries globally with a 'triple-A' rating in the World Energy Council Energy Trilemma index, demonstrating a world-class balance of decarbonisation (environmental sustainability), security of supply (energy security) and affordability (energy equity). Within these nine countries, New Zealand is one of the best positioned to embark on the transition towards the 100% renewable electricity goal, given its leading renewable electricity penetration and the high quality of renewable resources. During the transition, New Zealand will need to pursue two main objectives:

1. **Maintain its world-class balance across the trilemma, as more renewables economically replace fossil fuelled generation; and**
2. **Ensure an orderly transition of New Zealand's electricity market to 100% renewable generation.**

1. Maintaining the world-class equilibrium across the trilemma

- **Decarbonisation** is well on track, with market analyses[3] demonstrating that the integration of an additional 8.5TWh of renewable generation by the CCC under the Tiwai stays scenario[4] would be economic. The price received by generators is expected to be enough to encourage ongoing investment (i.e. will be above long-run cost). Provided new projects can find cost efficient network access, nodal market incentives will guide them to the locations where they are required. The main risks that could prevent capacity coming online would be regulatory uncertainty or very unpredictable market conditions. International experience shows how regulatory intervention in well-functioning markets can result in suppressed investment signals.

- **Security of supply** will be increasingly challenging as new renewables enter the market and utilisation of thermal plants falls. According to CCC modelling, by 2030 New Zealand will need around 4.5TWh of flexible energy in a dry year (which is currently supplied by fossil fuelled generation). In addition, 1300MW to 1450MW of incremental firm capacity (beyond the 4,600MW provided by renewables and the HDVC) will be required in the North Island to cover winter peak demand and the "safety" margin[5]. CCC modelling suggests ~1150MW of existing gas power plants will provide these firming requirements after the closure of TCC and the Rankines, leaving a 150MW to 300MW firm capacity gap in the North Island. Low utilisation of these flexible thermal plants, which would only operate in peak periods or dry years, could lead to early closure or lack of upstream fuel supply investments, putting security of supply at risk. Additionally, for thermal plants, recovering the fixed costs across fewer and fewer hours of operation may lead to periods of very high price volatility in the wholesale market.

- **Energy affordability** for consumers will be the most challenging element of the trilemma to balance during this transition. Today, the fixed costs of the thermal assets required to guarantee security of supply are $100 million to $150 million per annum[6]. Failing to recover these costs could lead to early closures and unstable market conditions, putting affordability at risk. Multiple solutions to replace these thermal assets are currently being assessed by government, consultants, and market participants - from hydrogen flexibility, biomass, and batteries, to pumped-hydro or large-scale demand response. All these solutions still have a high degree of uncertainty in costs for consumers and trade-offs for the electricity market. New Zealand's market structure must ensure a balanced, equitable reward mechanism for the flexible energy and capacity to ensure security of supply at the lowest possible cost. At the same time, New Zealand's electricity market must continue to attract investment in the most efficient technologies so affordability for consumers is maintained.

2. Ensuring an orderly transition

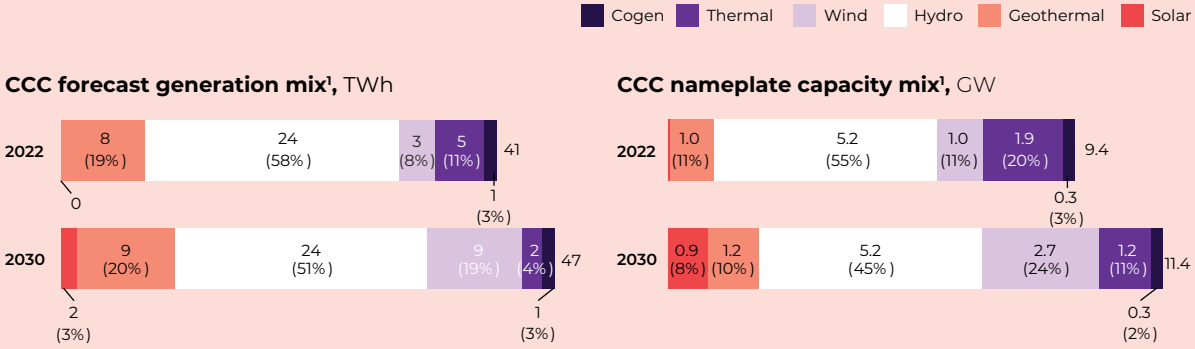
New Zealand's transition to 100% renewable electricity is going to be one of the first in the

3 Jarden September 2021; Concept Consulting; Climate Change Commission; Meridian Energy
4 New Zealand Aluminium smelter have an electricity supply contract to the end of 2024. For simplicity we have assumed that a closure of the smelter would facilitate an equivalent replacement load.
5 Transpower's North Island Capacity Margin test recommends a 630MW to 780MW margin above peak demand
6 New Zealand dollars unless otherwise stated

world. Market signals will need to continue to attract renewables as they have been doing to date, while also incentivising cost-effective solutions to guarantee security of supply. These signals should ensure an orderly transition of assets, providing enough certainty to attract alternatives, and should evolve together with market demands and technology improvements to secure the best outcomes for Aotearoa.

Decisions on decommissioning individual assets need to consider cascading effects for New Zealand. Disorderly exit of thermal assets may put security of supply and jobs at risk – in both the power plants and the upstream fuel supply industry. Equally important, the lack of visibility on the long-term outlook in the sector would delay investments, putting the potential development of new skilled jobs in regional New Zealand at risk.

Key assumptions and modelling fact base, based on CCC Tiwai stays scenario



1. Tiwai stays scenario, as modelled by Energylink for the CCC. Excludes smaller scale embedded generation.

Annual metrics	2022	2030	Description
Thermal emissions	2.0 Mt CO2e	0.8Mt CO2e	Emissions from thermal generation (excl. cogeneration)
Cost of emissions	$52/TCO2	$138/TCO2	Cost forecast for CO2 emissions
Share of renewables excl. cogen (incl. cogen)	88% (86%)	96% (93%)	Share of energy generation that is from renewables
Renewable gen.	35.5TWh	43.7TWh	Forecast generation from hydro, geothermal, wind and solar
Hydro production	Dry: 21TWh Avg: 24TWh Wet: 27TWh	21TWh 24TWh 26TWh[1]	The amount of hydro generation forecast, by the level of rain in the year
Thermal production	Dry: 7.5TWh Avg: 4.6TWh Wet: 2.3TWh	4.5TWh 1.9TWh 0.3TWh	The forecast requirement for thermal generation (excluding cogen), depending on the level of rain in the year
Winter metrics (1-Apr-30-Sep)	**2022**	**2030**	**Description**
Energy demand	22.6TWh	25.6TWh	The forecast amount of energy required over winter
Energy supply	28.1TWh	29.9TWh	Energy generation potential over winter an average rainfall using Transpower's methodology
Energy margin (optimal range 14-16%)	5.5TWh (25%)	4.3TWh (17%)	The difference between potential generated electricity (in an average rainfall year) vs. energy demand. Optimal range calculated using Transpower's methodology
Fuel demand in dry year	41PJ	27PJ	The quantity of fuel (energy) required over winter to cover the optimal Energy Margin
Fuel availability	41PJ	20PJ	The quantity of gas, diesel and coal available over winter (coal in 2022 only), assuming the provision of gas flexibility from existing assets only.
NI Peak demand	4600MW	5250MW	Peak electricity demand in the North Island
NI Firm Capacity	5850MW	5750MW	The amount of firm capacity in the North Island based on Transpower's methodology
NI Capacity Margin (optimal range 630-780MW)	1250MW	500MW	The margin between the amount of firm capacity and the peak electricity demand in the North Island. Optimal range calculated with Transpower's methodology

1 Higher renewable generation in 2030 results in more spill in wet years

Three potential pathways to support the transition and improve the status-quo

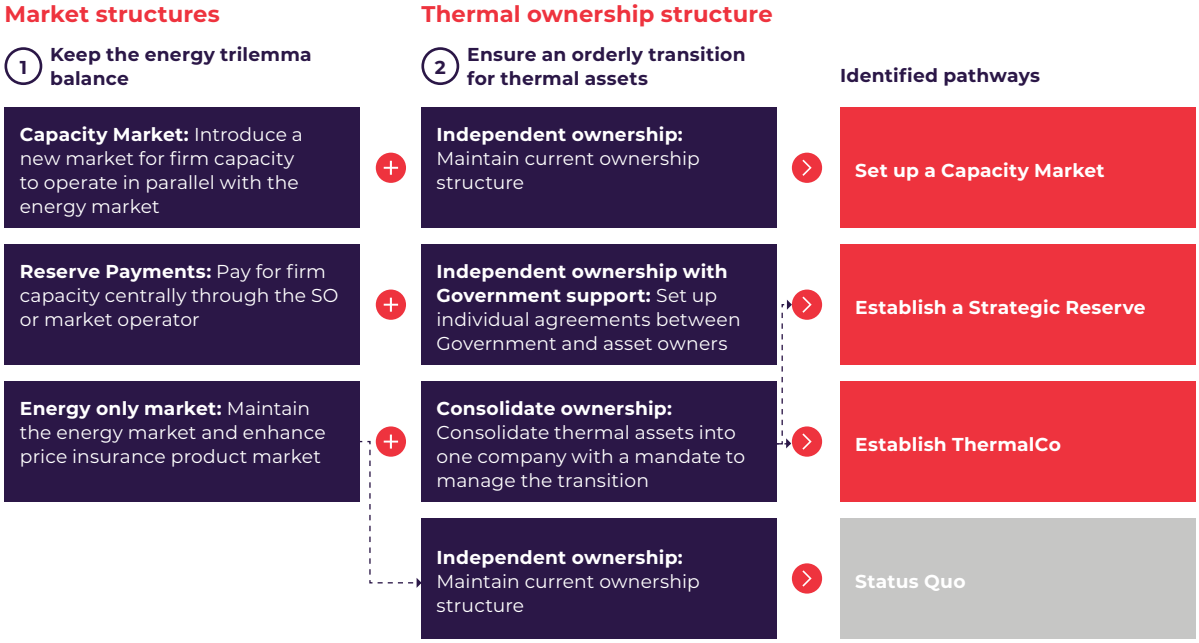
To maintain the energy trilemma balance in New Zealand as the market transitions towards 100% renewable electricity, we believe there are challenges that need consideration over the transition period. We have studied three market structures that aim to mitigate these challenges, drawing from international markets as they transition a high proportion of renewables: Capacity Markets, Reserve Payments in energy-only markets, and Energy-Only markets supported by risk management products.

In the specific context of New Zealand, which has a relatively small share of thermal capacity left in the market, we have explored which ownership structures could better enable an orderly transition: independent ownership, independent ownership with Government support and consolidated ownership.

The combination of the market structures with their most natural ownership structure led us to define three potential alternative pathways to support New Zealand's transition mitigating the status-quo risks outlined above.

- **Set up a Capacity Market:** Create a new market in New Zealand to trade firm capacity to supply winter peak and dry-year demand, and work in parallel to the existing energy market. A market operator – potentially the System Operator – would define the firm capacity requirements in the market (demand) and how each type of power plant contributes to its supply. All existing and new plants wanting to enter the market would bid in reverse auctions to receive a fixed, annual capacity payment ($/ firm MW). The frequency and payment duration of these auctions would be defined by the market operator; typically, this would be yearly auctions with products ranging from 1 to 10 years ahead. The costs of these capacity payments would be passed through to all customers in their bills as a market levy. With a Capacity Market, ownership structure of fossil fuelled assets would be maintained as is, with fossil fuelled plants aiming to recover most of their fixed costs through capacity payments. This is the pathway adopted by United Kingdom, France and several states in the US.
- **Establish a Strategic Reserve**: The establishment of a strategic reserve would entail Government entering into an agreement with one or more of the owners of strategic assets to ensure security of supply in New Zealand. These agreements would consist of reserve payments - long-term contracts between the strategic assets owners and the System Operator. These contracts must ensure assets are available to provide both firm and flexible capacity in exchange for a payment to recover fixed costs and like Capacity Markets, are recovered via a customer levy. The Strategic Reserve agreement would also come with limits in the operation of the plants in the energy market, where they could only bid an agreed price (likely Short Run Marginal Cost) and are dispatched as required by the System Operator. The objective is to provide a stable source of income to strategic assets, to maintain security of supply in the system. Based on international examples, assets under a Strategic Reserve arrangement could maintain their existing ownership, be transferred to the System Operator, or operate under a combined ownership model, as seen in Scandinavia or Germany.
- **Establish a ThermalCo:** The establishment of a ThermalCo is predicated on maintaining the existing energy market, where generators receive a price per MWh of electricity produced, supported by derivative and insurance contracts. ThermalCo would be an entity that consolidates ownership and operation of all existing thermal assets and upstream fuel supply contracts, with the mandate to offer transparent and liquid risk management products (for both dry-year and peak demand) to all purchasers. Consolidation would make the provision of derivatives and insurance products more efficient as new renewables enter the market, diminishing the utilisation of thermal

Exhibit 1: Three pathways for New Zealand's transition to 100% Renewable electricity



plants. ThermalCo could also offer these risk management products through a platform, further increasing the transparency and accessibility in the market. A ThermalCo would support the orderly phasing out of the thermal capacity when more efficient technologies emerge. When demand for risk management products is not enough to recover a plant's fixed costs, this will be a clear decommissioning signal from the market, giving ThermalCo sufficient time to react. The objective of ThermalCo's risk management products would be to provide sufficient upfront revenues to asset owners while keeping the appropriate market signals to promote an orderly execution of the transition.

These pathways and the associated combinations of market structures that led us to them are outlined in Exhibit 1.

While there are multiple implementation choices that combine elements of the different pathways, we have anchored on specific definitions outlined above to help understand the different trade-offs the New Zealand electricity market faces. Against the pillars of the trilemma, all three pathways provide some benefits towards promoting decarbonisation of the electricity market and ensuring security of supply, with differences emerging around affordability. We also saw differences in the contribution towards an orderly transition for the electricity market, as well as variations on implementation feasibility. Exhibit 2 summarises the comparative merits of each pathway.

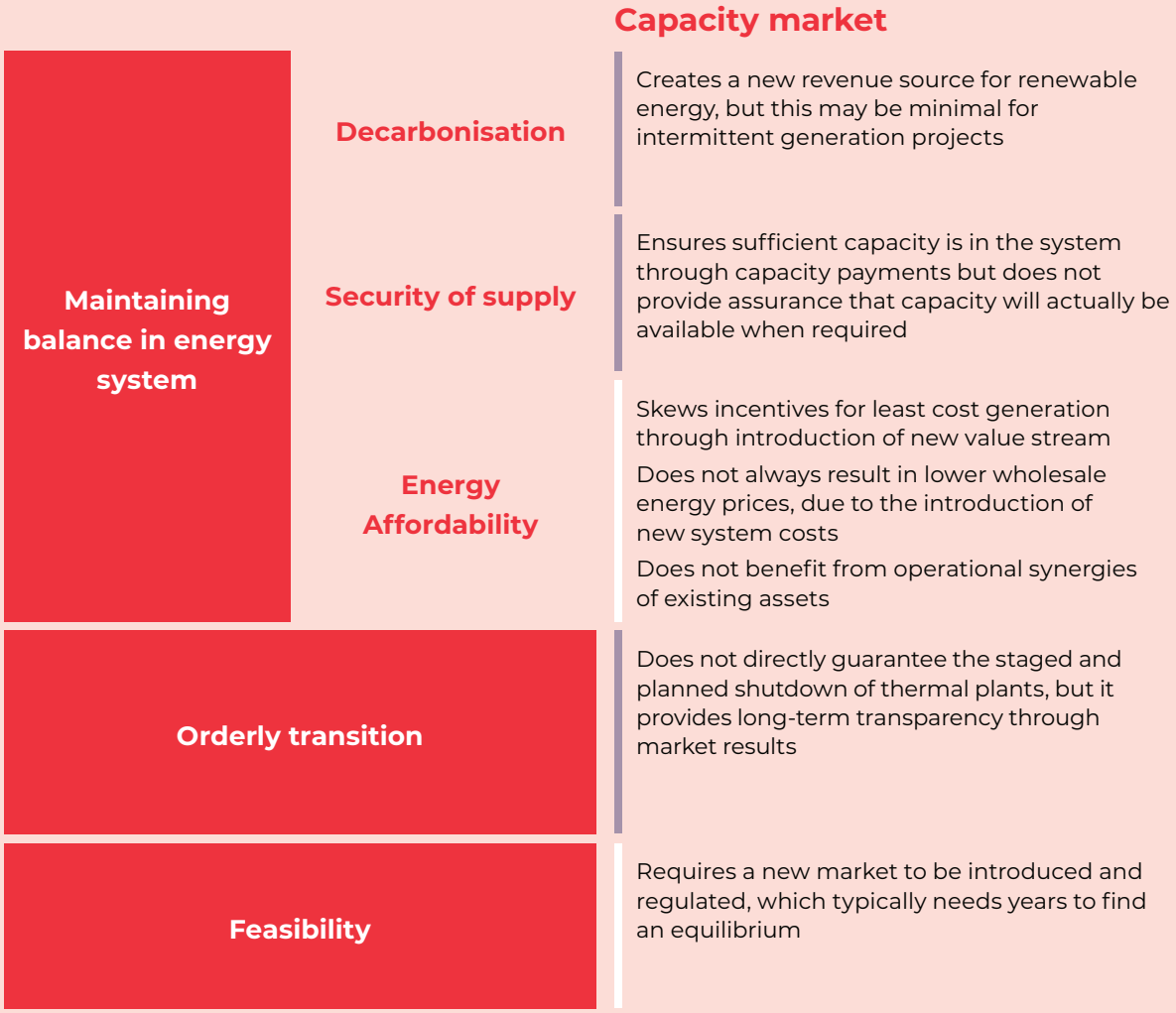
- On **affordability**, Strategic Reserve would enable an equitable share of fixed system costs while Capacity Markets would remunerate all capacity available in the market. However, incentives for the System Operator are too biased to maintain high capacity margins in both Strategic Reserve and Capacity Markets, likely leading to overcapacity scenarios as seen in Germany and the United Kingdom. This could result in an expensive alternative to support the flexibility required to cover dry-year swing and winter peak demand in New Zealand. Energy affordability during the transition period could be best maintained through ThermalCo as its risk management products will be closely and dynamically linked to market needs. ThermalCo will also enable an equitable split of the fixed system costs across market participants and facilitate operational synergies across thermal generators (e.g. up to 4.5% fuel savings through co-optimised dispatch).[7]
- With regards to **supporting an orderly transition** for New Zealand's electricity and

7 Based on analysis of FY21 dispatch information, assuming most efficient thermal plants are available to run in each interval

its people, the shared ownership structures that could be provided by ThermalCo and Strategic Reserve pathways will deliver greater transparency and clear accountability as there will be a single entity managing the transition. Both could also decrease the operational risk of maintaining low utilised assets and provide more demand certainty to the upstream gas industry. In contrast, while Capacity Markets will guarantee recovery of most fixed costs for the thermal assets, the risk will solely reside with individual players, whose individual decisions can be rapidly affected by changes in capacity auction rules or capacity demand thresholds determined by the System Operator.

- On **implementation feasibility**, Capacity Market will require new regulation, and international experience suggests a time frame in excess of 5 years to establish a new equilibrium between capacity and energy markets. Strategic Reserve will need to legislate a change in mandate for the System Operator and will require the development of new skills, bringing additional complexity that will take time to embed. By operating within existing market rules, ThermalCo presents the least disruptive and fastest implementation pathway, assuming industry consensus and the approval from the Commerce Commission.

Exhibit 2: Comparison of pathways for New Zealand's transition



Positive contribution Moderate contribution Minor contribution

Strategic Reserve	ThermalCo
Maintains energy market price signals to attract new renewable projects, with moderate risk of muting scarcity price signals which attract investments in clean flexibility	Maintains energy market price signals to attract new renewable projects in the locations where they are most needed through nodal pricing
SO ensures security of supply by directly contracting (reserve payments) with strategic assets	Market participants pay for risk management products to ensure their energy needs are covered, incentivising enough capacity is online in the system
Risk of reserve payments to be extended beyond the actual need of the assets, leading to uneconomical support of stranded assets May disincentivise the attraction of flexible technologies	Market dynamics put downward or upward pressure on risk management product pricing to ensure capacity mix adapts to system needs Limits impact of volatility to only unhedged market participants Benefit from operational synergies (e.g. 4.5% fuel savings through dispatch co-optimisation)
Ensures there are no shock thermal exits but SO decisions can change wholesale market price outcomes and investment decisions	Allows one entity to plan and stage shutdown of thermal plants, benefiting from synergies and learnings Gives one point of communication for government and communities
No market change required, but it requires change of mandate to SO to be able to source and dispatch capacity, as well as building capabilities	Market and regulation already exists and requires no changes Requires wide-industry agreement and Commerce Commission approval

ThermalCo: A market-based pathway for Aotearoa

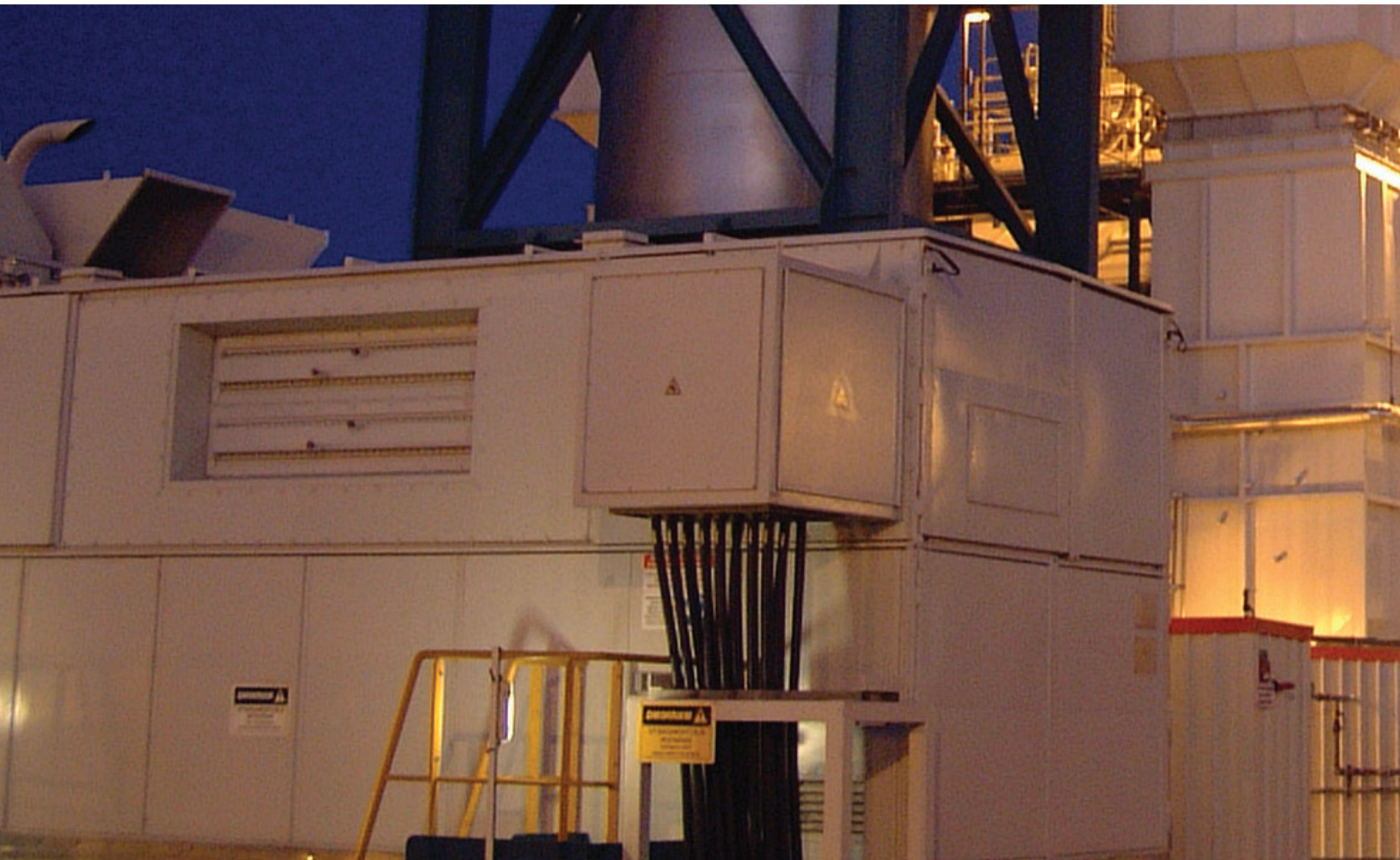
After exploring three potential pathway's to keep the energy trilemma in balance during the transition to 100% renewables, we propose the establishment of ThermalCo. ThermalCo will be an entity that owns and operates all existing thermal assets and upstream fuel supply contracts, with the mandate to:

- **offer transparent, liquid and accessible risk management products (for both dry-year and winter peak) to all market participants, while**
- **ensuring an orderly phase out of the thermal capacity as more reliable low emission technologies become economic.**

ThermalCo's ownership structure could comprise a broad range of industry participants, from existing thermal asset owners, to infrastructure funds or large-scale electricity purchasers, as can be seen in global examples such as Scandinavia or Germany. Critically, the successful implementation of ThermalCo will require industry-wide alignment and commitment to ensure liquidity of risk management products.

The benefits of ThermalCo are sound and will help Aotearoa capitalise on its renewable electricity opportunity during the last step of the journey while ensuring an orderly transition.

Ngā tapuae ō inanahi rā, hei huarahi mō āpōpō
The steps of our forbears, form the pathways for tomorrow.



The establishment of ThermalCo will maintain the energy trilemma balance as:

- The offer of risk management products to cover all thermal capacity in an open platform will be a further evolution of the hedging market helping to support **transparency and liquidity** for all market participants to cover dry-year and winter peak risk
- Consolidated ownership of thermal **assets increases the availability of capacity** that could be offered to derivative markets, as outage risks are spread across a larger portfolio
- Security of supply risks, **priced through hedging contracts, will provide the price signal to incentivise the market-led investments of the lowest cost, reliable technologies** that address these risks. Long-term hedge premiums will support dry-year coverage, while short-term strike prices will provide price signals for new flexible capacity
- **Fixed cost recovery through premium** on risk management contracts will **reduce volatility in the spot market** as only variable costs will need to be recovered. Most market participants will likely prefer to cover their risks rather than be exposed to price spikes, providing a more **equitable distribution of fixed costs**.

The establishment of a ThermalCo will ensure an orderly transition of New Zealand's electricity market as:

- Consolidated ownership will provide greater **certainty in the mid- and long-term demand for thermal assets**, allowing for more effective and coordinated planning of the transition of these assets when new technologies can displace them
- **It maintains a stable regulatory framework** that works well today.

We invite support from stakeholders that want to collaborate and contribute to building a market-led solution for a 100% renewable electricity market in New Zealand that not only achieves environmental targets, but also meets the challenges of security of supply and affordability while ensuring an orderly transition for all.

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