FUELLING THE ENERGY TRANSITION

A LOW EMISSIONS ENERGY FUTURE FOR NEW ZEALAND

8 September 2022

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Full Report
8 September 2022

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1 CEO foreword

New Zealand must transition to net zero carbon by 2050 and Energy Resources Aotearoa is committed to supporting this.

We represent energy intensive businesses, including producers, distributors, sellers, and users of energy resources like oil, LPG, natural gas, refined fuels, biomass, and renewable electricity. Our aim is to create a successful and sustainable energy resources sector through and beyond the transition to lower emissions. This report cements our support for New Zealand's net zero 2050 target and the action that the energy sector can take to be part of the solution. It is a positive statement of what we can achieve together, the mistakes we can avoid, and the opportunities we can grasp.

The upstream oil and gas sector has made progress in the energy transition, reducing its Scope 1 greenhouse gas emissions by 34% between 2010 and 2019 and commencing significant investment in renewable energy. This report outlines several actions that the sector and government can take to further drive an orderly transition to net zero carbon. Alongside this report, the major oil and gas producers have committed to an Energy Resources Sector Net Zero Accord to implement those recommendations. We welcome the wider energy resources sector to join us.

The energy resources sector is keen to proactively collaborate with government and stakeholders to deliver optimal outcomes for consumers as part of a well signalled, well managed, and low-cost (i.e., orderly) transition. You will see that we refer to this 'orderly' transition often, and its importance cannot be understated. An orderly transition balances energy affordability, energy security, and environmental sustainability – and New Zealand cannot achieve this without a vibrant gas sector.

We need gas for an orderly and low-cost transition for several reasons. One is that our domestic gas supply is a great source of reliable energy and increases our energy independence. In contrast, jurisdictions like Europe and Japan rely heavily on imported gas, exposing their energy systems and economies to greater geopolitical and economic risk.

Second, gas contributes to a more affordable energy system. It provides the most competitively priced source of energy for many uses today, some of which do not currently have practicable alternatives. It also supports a lower-cost electricity system. In comparison, countries that do not have domestic gas production generally have much higher gas and electricity prices. At a time when consumers are facing increasing cost of living pressures across the board, this could not be more critical to ensuring the wellbeing of communities.

Third, from an environmental perspective, affordable and reliable gas will increase electrification and decarbonisation through lower electricity prices. It also has the lowest emissions intensity of the three fossil fuels (coal, oil, and gas), positioning gas as the transition fuel of choice.

We know that renewable energy will need to be significantly scaled over the coming decades. Natural gas will be critically important to enabling this by assisting the integration of intermittent renewable electricity, supporting affordable and reliable electricity supply that enables electrification, and enabling the blending of green gas. If there are speed bumps through the energy transition, our domestic natural gas supply will support an energy system that is more resilient, positioning gas as the firming fuel of choice.

This report finds that the current policy pathway for New Zealand will not deliver an orderly and low-cost transition; instead, it will deliver a disorderly and expensive transition. The best pathway for New Zealand is one that explores all technological opportunities, directly informed by the Emissions Trading Scheme (ETS) priced at a level to deliver the lowest-cost transition to net zero by 2050. This will require a full range of low carbon technologies and solutions, including energy efficiency; demand response; renewable electricity; green gas; carbon capture, utilisation, and storage (CCUS); and forestry. Our analysis shows an orderly gas transition could save consumers $6.3 billion in electricity costs by 2036 while still enabling a low-emissions transition and preserving high-value regional jobs and economic activity.

But the right policy, regulatory and market settings need to be in place to make this happen. This can be achieved by using the ETS as the predominant solution to reduce emissions in New Zealand, enabling an environment where the most economic technologies and solutions can be deployed. An orderly, well managed and low-cost transition to net zero will not seek to constrain or phase out particular types of energy supply – rather, it will ensure the demand-side has the right price signals, via the ETS, to transition to lower emissions. The supply-side can then provision the right mix of fuels for consumers based on these demand signals. The supply-side can also – and has already begun to – reduce production emissions based on the carbon price signal.

A technology-led pathway also requires policy settings and consenting pathways to remove barriers for low emissions technologies. This includes an improved consenting environment for renewable electricity to speed generation investment, and consenting pathways for offshore wind, CCUS, and green gas. Finally, as our national emissions target is 'net' and not 'gross', we need to ensure that rules for carbon forestry are not overly restrictive, and that there is an enabling regulatory framework for CCUS – without these we will face a more expensive and disorderly transition.

With these changes, we can transition to a low carbon economy at the least cost to New Zealanders. This is important because lower-cost energy improves community welfare. It will support jobs by leveraging all available economic low emissions solutions to reduce carbon and improve economic productivity. The sector can continue to support existing critical industry, like steel and chemical manufacturing, and we can power new low carbon industries like hydrogen and green data centres to create the jobs of the future.

The future of our energy system is incredibly exciting. New technologies offer opportunities for us to reduce emissions at least cost. This report is our sector's commitment to ensuring an orderly and low-cost transition that supports New Zealand's ambition of a net zero carbon economy by 2050. Together, we can unlock a prosperous, low-emissions future.

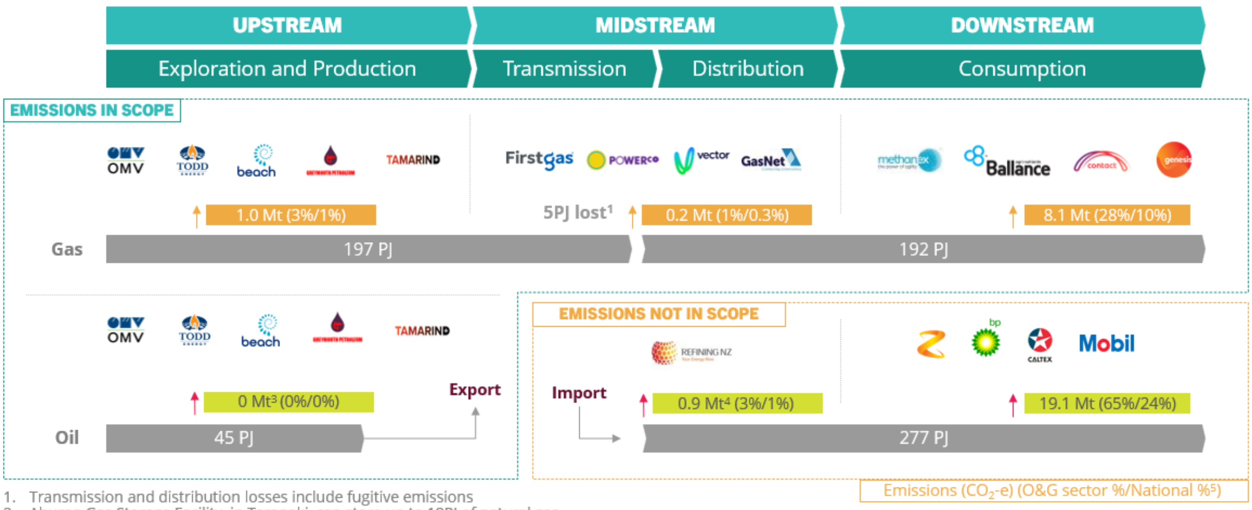
John Carnegie
Chief Executive, Energy Resources Aotearoa

2 Purpose and scope of this report

This report outlines the oil and gas sector's unique opportunity to contribute to emissions reductions in the wider energy sector, support the Government's net-zero ambition, and enable an orderly transition to an affordable, reliable, and low-emissions energy system.

This report focuses on upstream oil and gas production, and midstream and downstream gas consumption. The report provides an end-to-end view of the gas value chain, which is where Energy Resources Aotearoa's members operate, and where action can be taken by our domestic players. Domestic oil consumption, while important, is not considered directly in scope for this report as it is imported from overseas and is not a direct result of upstream oil and gas production in New Zealand.

Exhibit 1: Oil and gas value chain



1. Transmission and distribution losses include fugitive emissions
2. Ahuroa Gas Storage Facility, in Taranaki, can store up to 18PJ of natural gas
3. Domestic emissions only, upstream gas emissions captured in the 1.0 Mt upstream gas emissions
4. These emissions will cease in April 2022 when the Marsden Point Oil Refinery closes
5. Includes biogenic methane in baseline

Source: Climate Change Commission – Inaia Tonu Nei, MBIE Energy in New Zealand 2021

This report outlines the role of the sector, and in particular gas, in delivering a just and orderly energy transition. It also aims to build the case for greater collaboration – both within the industry, and between industry and the government – in the energy transition. Energy Resources Aotearoa looks forward to discussing this report with industry, government, and other key stakeholders, as we provide input into the forthcoming gas transition plan and national energy strategy.

Units of measurement and conventions in this report
Throughout this report, we refer to carbon dioxide equivalents (CO_2-e), the universal term for describing greenhouse gases as a common unit. We also abbreviate megatonne (Mt), kilotonne (kt), petajoule (PJ), gigajoule (GJ), megawatt (MW), and megawatt hours (MWh). *Gas is used to refer to natural gas, unless otherwise specified.*

3 Findings

1. New Zealand must transition to net zero, and the oil and gas sector will play a key role

The oil and gas sector supports the transition to a net zero economy and is committed to playing its part in achieving it. Energy represents 42% of New Zealand's total gross emissions and the sector's net emissions will need to be reduced for New Zealand to meet its 2030 and 2050 commitments. Renewable energy will need to be significantly scaled to achieve this.

Oil and gas provide 41% and 23% of New Zealand's annual energy needs respectively.[1] New Zealand's upstream oil sector produces oil for export and delivers gas to domestic consumers. Gas production is critical for affordable and reliable domestic energy supply (including electricity) today and will be throughout the energy transition. The sector plays an important economic role in New Zealand, contributing ~$2.5 billion each year to the economy and employing around 7,300 people, mostly in Taranaki.

2. The upstream oil and gas sector has already made significant headway in reducing its own emissions

The upstream oil and gas sector is reducing its emissions, building on a 34% reduction in Scope 1 emissions from 2010 to 2019. It is also investing in low carbon technologies like solar and establishing integrated energy companies that are bringing capital and expertise to support the energy transition.

3. Domestic gas provides a critical national advantage to support the energy transition that we should not waste

New Zealand is fortunate to produce gas, all of which is consumed on our shores. Gas provides reliable and affordable energy, represents 11% of national gross emissions across the entire gas value chain, and provides 23% of the energy consumed in New Zealand. It is used as a feedstock for methanol and fertiliser production, as a heat source in industries, as a fuel for electricity, and for heating homes and businesses around the country.

Although gas consumption in New Zealand will reduce by 2050, the Climate Change Commission (CCC) notes that some natural gas will still be required in 2050. Its continued presence will enable the best transition to a net zero carbon economy by:

- providing an immediate transition pathway away from coal, particularly as a solution for producing electricity in dry years;
- improving integration of renewable electricity generation (firming);
- supporting increased electrification of transport and industry by enabling more affordable and reliable electricity;

1 Ministry of Business, Innovation and Employment Energy Balance Tables.

- supporting a viable pathway to lower emissions gas through blending with green gases;
- providing users with relatively low emissions energy where alternatives are currently technologically or economically unfeasible; and
- reducing net emissions when it can be paired with CCUS and forestry.

4. An orderly and well managed gas transition will underpin affordable, reliable energy and will support the transition to net zero

An orderly transition will allow the greatest amount of renewable energy to be reliably introduced without energy supply risks and cost of living increases. This will lead to lower overall energy emissions than a rapid (disorderly) phasing out of gas, as it will increase electrification by maintaining more affordable electricity prices. Modelling shows that achieving an orderly gas transition could save consumers $6.3 billion in electricity costs by 2036 while still enabling these improved environmental outcomes.

Currently ~40% of New Zealand's gas is used by Methanex to produce methanol. This demand volume underpins investment confidence in gas exploration and production. Its continued presence in New Zealand will support an orderly transition.

5. A disorderly gas transition will lead to unintended consequences and represents a high-cost transition to net zero

If the energy transition is not managed well, unintended economic, social, and environmental consequences become more likely. A rapid phasing out of gas will lead to increased energy prices, endanger security of supply, and lead to slower decarbonisation. Under a gas phase-out scenario an additional 4 GW of renewable electricity is required by 2030 and 16 GW by 2050 — for context, the current electricity system has ~9 GW of capacity. We need to scale up renewable energy significantly, but we also need gas in the energy mix as a hedge against energy shortfalls. Recent global events demonstrate the risks and impacts of energy shortages.

A desirable transition to net zero will not constrain or phase out supply of certain forms of energy — rather it will ensure consumers and producers have the right price signals, via the Emissions Trading Scheme (ETS), to transition to lower emissions at the lowest cost to New Zealanders.

6. A technology-led pathway, underpinned by the ETS, is the best way to get to net zero and requires fit for purpose policy and consenting pathways

A transition that considers and deploys a range of low carbon technologies and solutions, including renewable electricity, green gas, CCUS, and forestry, will be most affordable, support existing industry, and foster the development of new industry. Fit-for-purpose, predictable, and enduring policy and consenting pathways will be necessary to remove barriers and deliver this low carbon infrastructure. Examples include streamlined consenting for renewable energy projects, the establishment of a regulatory framework for CCUS, and a balanced forestry policy that allows for sufficient carbon sequestration. If the ETS is then used as the predominant tool for reducing emissions, it will ensure that the best low carbon technologies and solutions can be deployed.

7. **Supporting continued investment confidence for gas production will support the scaling and integration of low carbon technology**

   Achieving future emissions targets could require an average of 3–5 new wind farms (of around 150 MW each) to be built each year until 2050 to support renewable electricity, electrification, and green gases. Gas can support the integration of these technologies, and can fill energy gaps along the way, to ensure a smoother transition. This will require policy settings that support supply-side investment that in turn enables sufficient energy production and flexibility.

8. **To deliver this desirable technology-led pathway there is more work for the energy sector and government to do**

   This report has identified 8 recommendations for the energy sector and government to deliver a transition to net zero:

   1. **Upstream oil and gas sector:** commit significant investment to reduce operational emissions and offset residual emissions;
   2. **Upstream oil and gas sector:** engage closely to understand gas customers' emissions reduction plans while supplying them with affordable and reliable energy through their transition;
   3. **Downstream gas sector:** commit investment to reduce emissions;
   4. **Downstream gas sector:** continue to work with large gas users to provide constructive input to the national energy strategy and gas transition plan;
   5. **Sector and government:** scale clean energy and forestry solutions;
   6. **Sector and government:** support workforces and communities through the transition across New Zealand and in Taranaki;
   7. **Sector and government:** ensure the important role of gas in delivering an affordable, reliable, and low emissions energy system is well understood; and
   8. **Sector and government:** ensure policies, regulation and markets are fit for purpose through the energy transition to improve investment confidence while enabling decarbonisation at the lowest cost to New Zealanders.

We can achieve more together than we can apart – so the leading upstream oil and gas producers have established an Energy Resources Sector Net Zero Accord, with shared commitments on the action areas above, as a platform for collaboration both within the sector and with government. For more information on the Accord, see page 81 and *Appendix 1*.

4 The case for change

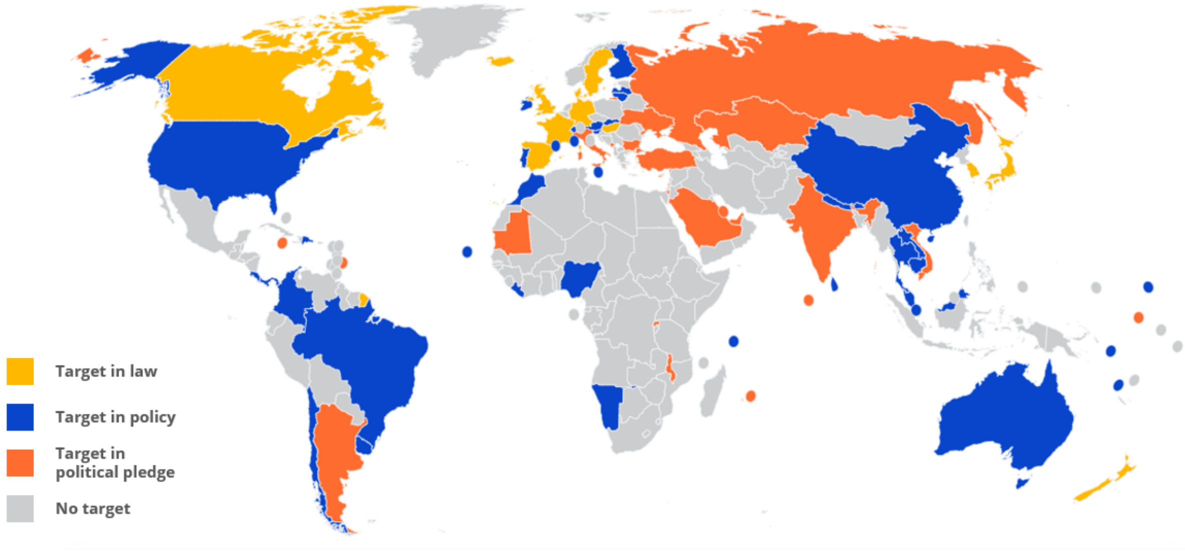
The last 7 years have been the warmest on record, leading to more frequent and intense natural disasters, the melting of ice caps, destruction of coral reefs and rainforests, to name only a few of the consequences.[2] In 2021, global greenhouse gas emissions (including agriculture) reached ~51 billion tonnes of CO_2-e and atmospheric concentration of CO_2-e has now reached 418 parts per million, 50% above levels at the start of the Industrial Revolution.[3]

Emissions have been steadily increasing year-on-year, and it will take a concerted effort to bend the curve and limit warming to 1.5°C. With the world facing the impacts of climate change, action is high on the global agenda. The transition to a net zero economy is gaining momentum, driven by multinational climate agreements, national targets, and meaningful policy. Businesses are also reducing emissions and investing in low carbon technologies. We must adapt to the changing needs of consumers, businesses, and investors.

4.1 Global climate action

In December 2015, 196 countries signed up to the Paris Agreement, a binding international treaty on climate change seeking to limit globally warming to 2°C, preferably 1.5°C, compared with pre-industrial levels in the second half of the century.[4] In the years since, 83 countries representing 74% of global emissions have set net zero carbon targets (Exhibit 2).[5]

Exhibit 2: Extent of net zero commitments by country over time



Source: Net Zero Tracker; Climate Watch

2 The Washington Post, The past seven years have been the hottest in recorded history, January 2022 (https://www.washingtonpost.com/climate-environment/2022/01/13/global-temperature-record-climate-change).

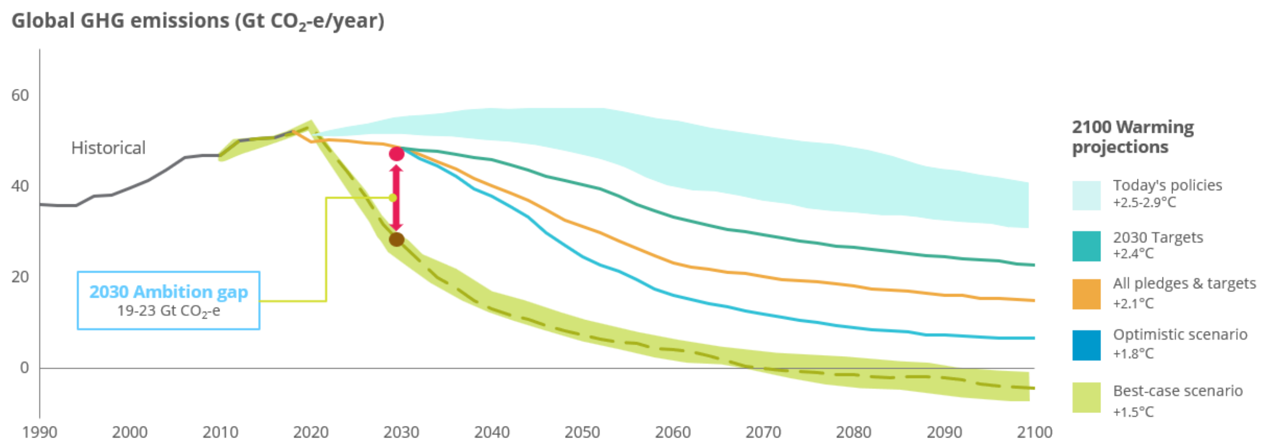
3 Bill Gates, How to Avoid a Climate Disaster, February 2021; NASA, Monthly measurements, February 2022 (https://climate.nasa.gov/vital-signs/carbon-dioxide).

4 UN Climate Change, The Paris Agreement (https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement).

5 Climate Watch, Net-Zero Tracker, (https://www.climatewatchdata.org/net-zero-tracker).

However, the world is not on track to limit warming to 1.5°C, as global emissions continue to rise. Current pledges and targets would limit warming to 2.1°C by 2100; under an optimistic scenario, warming could be limited to 1.8°C by 2100 (Exhibit 3).[6]

Exhibit 3: Analysis of global emissions reduction targets and 2100 warming projections



Source: Climate Action Tracker

4.2 Global emissions versus New Zealand emissions

Reaching the Paris climate pledge of reducing global warming to well below 2°C, preferably to 1.5°C compared to pre-industrial levels, requires each country to play its part.

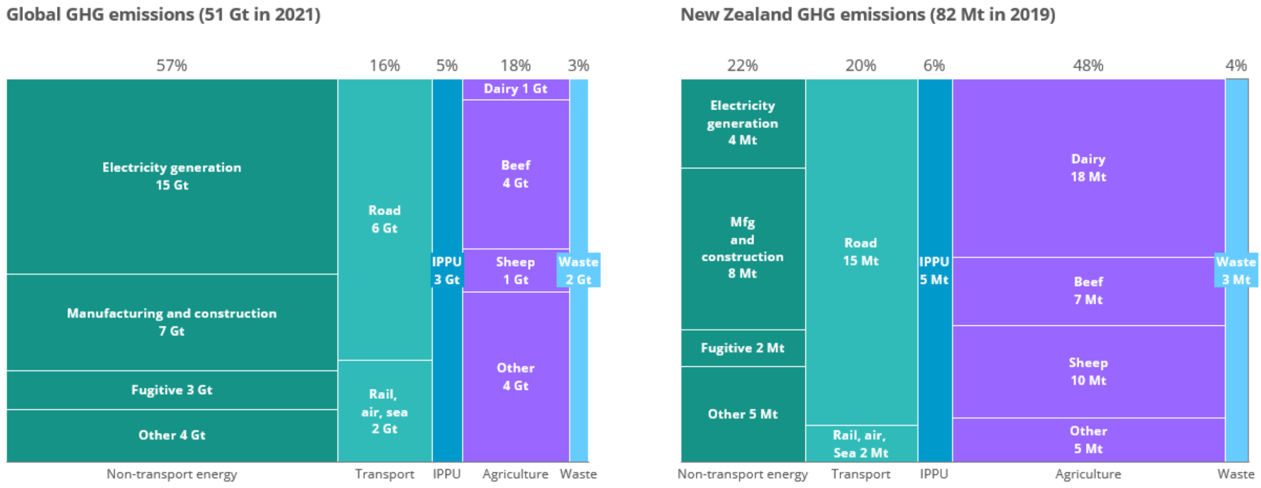
Globally, approximately 51 billion tonnes of CO_2-e are emitted each year – equal to 33 times the weight of every single land-based mammal on the planet. New Zealand's 2019 greenhouse emissions were 82 Mt, 0.2% of the global total, and when compared to the rest of the world, the profile of these emissions is quite different (Exhibit 4).[7] If only CO_2 is considered, New Zealand is responsible for 0.1% of the global total. This becomes 0.2% when other greenhouse gases, such as methane and nitrous oxide which are primarily released through agricultural activities, are accounted for.

In New Zealand, agriculture accounts for 48% of New Zealand's emissions, versus 18% globally. Transport also contributes a larger share of emissions in New Zealand (20% compared with the global average of 16%). New Zealand's proportion of industrial processes and product use (IPPU) and waste emissions are similar to the global average, with the non-transport energy percentage being much lower: 22% versus 57% globally. Progress has been made to reduce emissions here: New Zealand's non-transport energy emissions have reduced by 10% since 2005. This provides a strong base from which to achieve our net zero emissions ambition by 2050, but makes the marginal increments more, not less, difficult to achieve as we have 'banked' many of the gains others are yet to achieve.

6 Climate Action Tracker, Global Temperatures, November 2021 (https://climateactiontracker.org/global/temperatures).

7 Ministry for the Environment, New Zealand's Greenhouse Gas Inventory 1990-2019, October 2021 (https://environment.govt.nz/publications/new-zealands-greenhouse-gas-inventory-1990-2019).

Exhibit 4: Global and New Zealand emissions by sector



Source: Ministry for the Environment; OurWorldInData

4.3 Climate action in New Zealand

New Zealand has adopted ambitious climate targets in recent years (Exhibit 5). After signing the Paris Agreement in late 2015, the New Zealand Government passed the Zero Carbon Act into law in late 2019. This Act sets a net zero carbon target, excluding biogenic methane, to be reached by 2050. Biogenic methane (emissions from livestock) has a separate target of 24-47% below 2017 levels by 2050. Ahead of the COP26 summit in 2021, New Zealand increased its 2030 target to reduce net emissions by 50% below a 2005 gross baseline.[8]

The Government has set emissions budgets to complement these national targets and provide a pathway for emissions reduction through to 2035. The final budgets were released in May 2022 and span across three periods: Budget 1 (2022-25), Budget 2 (2026-2030), Budget 3 (2031-2035).[9]

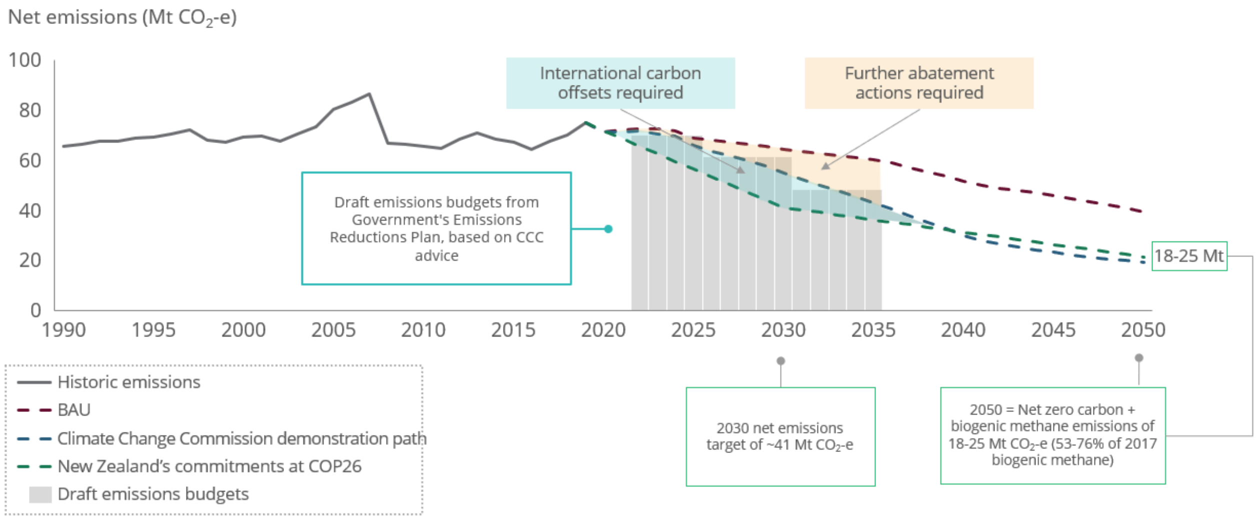
The CCC forecasts that emissions budgets will not be met under a business-as-usual (Current Policy Reference) scenario.[10] Even if New Zealand meets its emissions budgets, the Government will need to purchase international carbon offsets through to 2038 to meet its 2030 emissions reduction and 2050 net zero commitments.

8 Climate Action Tracker, New Zealand (https://climateactiontracker.org/countries/new-zealand).

9 Ministry for the Environment, Emissions budgets and the emissions reduction plan (https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/emissions-budgets-and-the-emissions-reduction-plan).

10 Climate Change Commission, Modelling and data (https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling).

Exhibit 5: New Zealand's historic emissions, carbon budgets, and emissions targets



Note: New Zealand has committed to reducing biogenic methane to 24-47% below 2017 levels (33.5 Mt CO_2-e), 21.6Mt CO_2-e is midpoint of 24-47% reduction

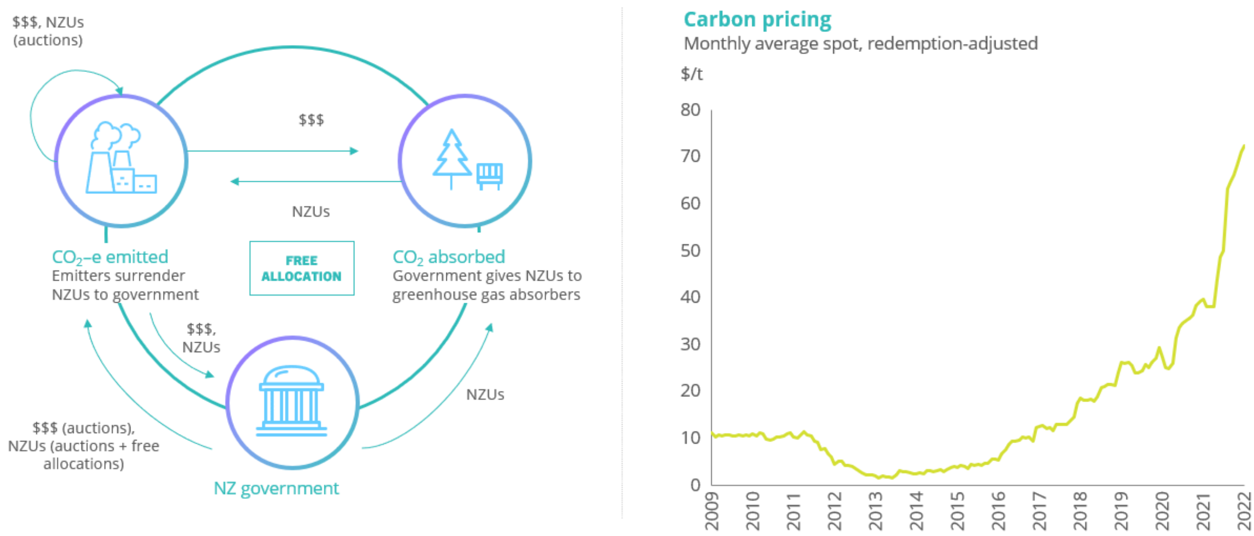
Source: Climate Change Commission, Ministry for the Environment

The *business as usual (BAU)* trajectory in Exhibit 5 represents the CCC's estimate of New Zealand's future emissions, based on February 2021 policies. The red area, *further abatement actions required,* is the additional emissions reductions required to reach proposed emissions budgets, which align closely to the CCC forecast. To meet New Zealand's commitments at COP26, the green area, *international carbon offsets required,* is the emissions reductions New Zealand would need to purchase from other countries to meet its international climate obligations. This analysis does not explicitly account for the role of the carbon price in reducing emissions. However, the CCC did state that under current policy settings, a NZU price of \$50/tCO_2-e would deliver net zero by 2050.

New Zealand has several policies already, or soon to be, in place, aimed at meeting its emissions reduction targets, including the Emissions Trading Scheme (ETS). The ETS puts a price on carbon, providing an economic incentive for business to reduce emissions of greenhouse gases, and applies to all sectors of the New Zealand economy except for agriculture. All sectors of New Zealand's economy, apart from agriculture, pay for their emissions through the ETS.

The ETS is a market-based mechanism which places a cap on the number of tradable emissions permits known as New Zealand Units (NZUs). A single NZU represents one tonne of CO_2-e. The cap declines over time to reduce the number of available NZUs, thereby reducing the emissions of covered sectors. NZUs are generated through forestry-based activities that remove carbon from the atmosphere or are auctioned and freely allocated by the New Zealand Government. The price of NZUs is determined by the market, based primarily on the fundamentals of demand (from emitters) and supply (determined by the emissions cap). The price of NZUs has increased significantly in the last 10 years (See Exhibit 6).

Exhibit 6: The New Zealand Emissions Trading Scheme



Source: Carbon News New Zealand

4.4 The drive to decarbonise

In New Zealand and globally, the drive to decarbonise is not just being led by governments. The public, businesses, and investors recognise the consequences of a changing climate and are driving action (Exhibit 7).

Public concern about climate change is increasing. When surveyed 15 years ago, 74% of New Zealanders believed that climate change was either not a problem or was a problem for the future. This has now reversed – today, 72% of New Zealanders think climate change is either an urgent problem or a problem now.

Businesses are taking accelerated action to reduce emissions. In New Zealand, 105 businesses have signed up to the Climate Leaders Coalition. Of these, 60 have pledged targets aligned to a 1.5°C warming trajectory, and 40 have pledged targets aligned to a well-below 2°C warming trajectory. These businesses employ more than 200,000 people and are responsible for 38% of New Zealand's GDP.[11] Globally, more than 2,000 companies have pledged science-based targets to reduce emissions, up from just 116 in 2015. Together these companies generate US $24 trillion of annual revenue, equivalent to 30% of global GDP. These commitments continue to increase at pace.[12] Moreover, companies with top quartile Environmental, Social and Governance (ESG) credentials recently have recorded a 3% increase in Total Shareholder Return relative to peers, and Western European sustainability leaders in the oil and gas sector have a Weighted Average Cost of Capital (WACC) of 266 basis points lower than the laggards.

Investors increasingly prefer investments and funds with strong ESG credentials. New Zealand has one of the highest levels of sustainable investing in the world as a percentage

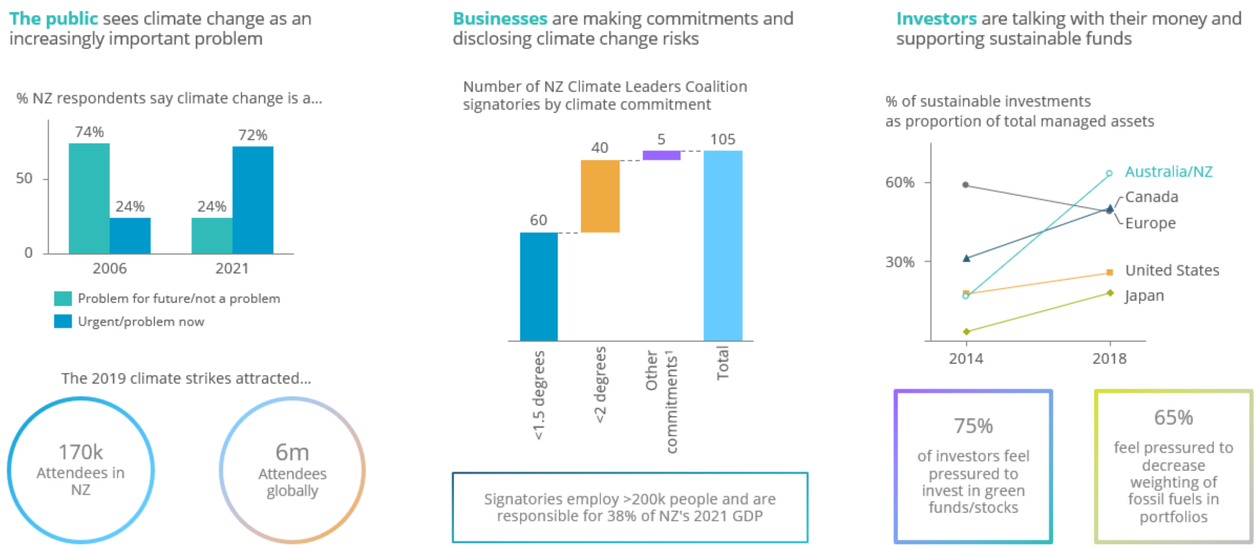
11 Climate Leaders Coalition (https://www.climateleaderscoalition.org.nz).

12 World Economic Forum, Winning the Race to Net Zero: The CEO Guide to Climate Advantage, January 2022 (https://www3.weforum.org/docs/WEF_Winning_the_Race_to_Net_Zero_2022.pdf).

of total managed assets (53%). Globally, ESG assets surpassed NZD $50 trillion in 2020, reaching a third of total global assets under management. ESG assets are on track to exceed NZD $75 trillion by 2025.

Demand from investors is also pressuring investment companies to take climate action. 75% of investors say they feel pressured to invest in green funds and stocks. This also extends to energy, where 65% of investors say they feel pressured to decrease the weighting of fossil fuels in their portfolios.

Exhibit 7: The drive towards a net zero carbon economy is led by the public, businesses, and investors



1. Other commitments include net zero targets

Source: HorizonPoll; Climate Leaders Coalition; Press Search

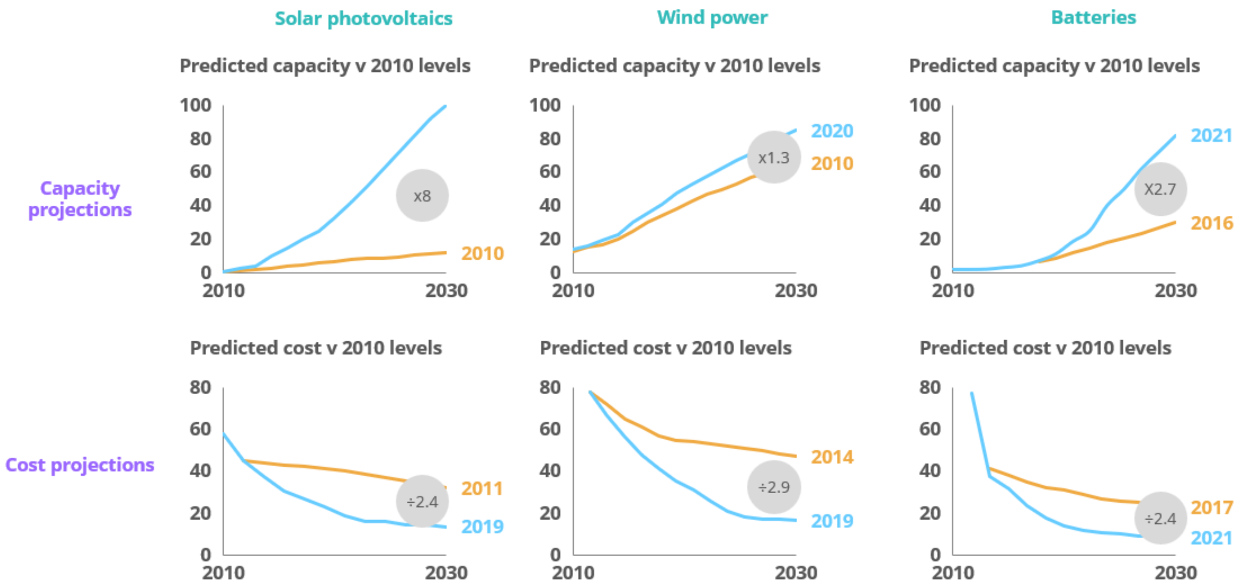
In some instances, it is pressure from the public, businesses and investors that is driving governments to be bolder and more ambitious on climate action. Sometimes, it is government that is leading from the front. Public, business, and investor sentiment provide governments with confidence to enact stronger climate change policy, and this in turn leads to greater action from the public, business, and investors (Exhibit 8).

Exhibit 8: Climate action is reinforced by governments, the public, businesses, and investors

Source: Energy Resources Aotearoa

The drive to reduce net emissions is also being assisted by rapid improvements in the economics and deployment of low carbon technologies. In many instances, these improvements have been occurring at a pace that has surpassed even the most optimistic forecasts (Exhibit 9). While the transition to a low carbon economy will still be costly for many nations, the improving economics of low carbon technologies has assisted global governments' actions and commitments to reduce emissions. This is increasing the momentum behind the energy transition.

Exhibit 9: Low carbon technology improvements outpace expectations

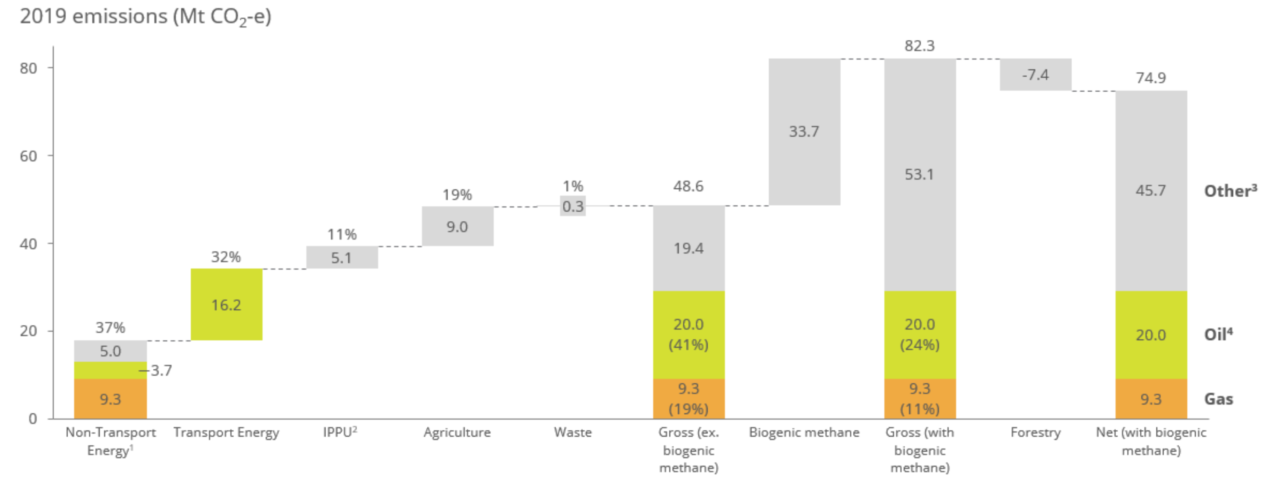


Source: International Energy Agency; Bloomberg New Energy Finance; International Renewable Energy Agency

4.5 Oil and gas emissions in New Zealand today

Oil and gas represent 35% of New Zealand's gross emissions, across upstream, midstream, and downstream; oil contributes 24% and gas contributes 11% (Exhibit 10).

Exhibit 10: New Zealand's greenhouse gas emissions



1. Non-transport energy comprises extraction, refining, chemicals, electricity generation, manufacturing / construction and fugitive emissions
2. Industrial processes and product use
3. Other sources include thermal coal, coking coal
4. Oil includes LPG

Source: Climate Change Commission

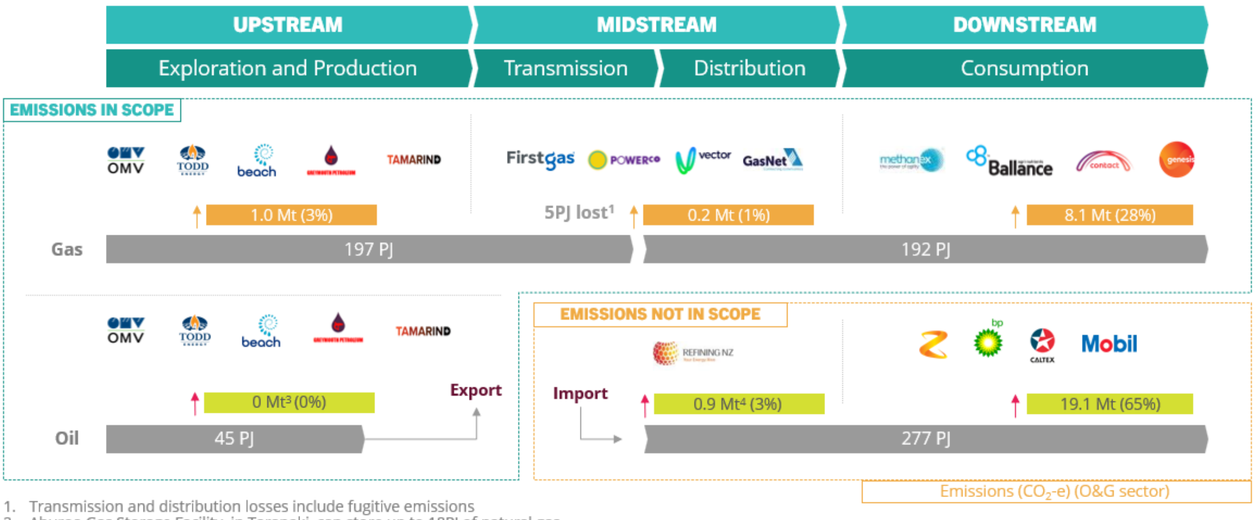
To understand how the oil and gas sector can reduce these emissions, we must consider the source of these emissions. Of the 29.3 Mt of CO_2-e emitted (Exhibit 11):

- 3% is attributed to the upstream exploration, production, and processing of oil and gas. This represents 1.0 Mt, or 1% of national gross emissions (including biogenic methane) — while this may seem small, it is critical upstream providers invest significantly to reduce emissions, every effort counts. Upstream providers can also influence, and create opportunities to collaborate with, downstream providers to reduce emissions;

- 4% is attributed to the midstream transmission and distribution of oil and gas. This emissions baseline uses 2019 data, and most of these emissions are from oil refining, which ceased in April 2022 when the Marsden Point Oil Refinery became an import-only terminal; and

- 93% is attributed to the downstream consumption of oil and gas.

Exhibit 11: The oil and gas value chain



1. Transmission and distribution losses include fugitive emissions
2. Ahuroa Gas Storage Facility, in Taranaki, can store up to 18PJ of natural gas
3. Domestic emissions only, upstream gas emissions captured in the 1.0 Mt upstream gas emissions
4. These emissions will cease in April 2022 when the Marsden Point Oil Refinery closes

Source: Climate Change Commission – Inaia Tonu Nei, MBIE Energy in New Zealand 2021

4.6 The business case for change

Energy Resources Aotearoa's largest upstream members have made public commitments to reduce emissions:

- across its global portfolio OMV aims to reduce net Scope 1 and 2 emissions by 30% below 2019 levels by 2030, and by 60% by 2040. By 2050, OMV will be Net Zero across Scope 1, 2 and 3 emissions, and intends to cease production of oil and gas for energy use by 2050;
- Todd Energy is focused on providing affordable and reliable energy to all New Zealanders through the transition to a low emissions economy and has a target of achieving net zero Scope 1 and 2 emissions by 2045. It has already implemented opportunities to reduce its operational emissions; and
- across its global portfolio Beach Energy aims to reduce Scope 1 and 2 emissions by 25% on 2018 levels by 2025 and has already reduced emissions by 12%. It also seeks to reach net zero emissions by 2050.

Energy Resources Aotearoa supports those leading the charge to reduce net emissions. The business case for change is clear for many reasons, including to:

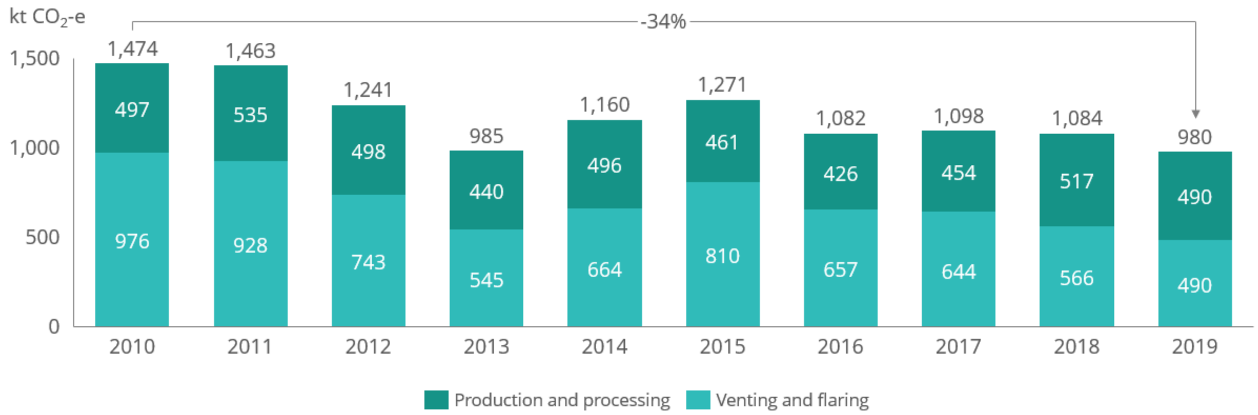
- **deliver good outcomes for consumers:** with momentum behind global and local governments, citizens, businesses, and investors, the transition to a decarbonised future is clear. Many consumers of oil and gas are seeking fuels with lower net emissions. The sector can collaborate with government and other stakeholders to be part of a well-signalled, orderly transition to a low emissions energy system, with affordable and reliable energy supply. Alternatively, we could face an adverse environment that leads to a disorderly transition that compromises affordable and reliable energy supply; and

- **reduce liabilities under the New Zealand ETS:** with an annual cost of $80 million (based on a carbon price of $80/tonne for roughly 1 million tonnes of CO_2-e emissions), the upstream oil and gas sector has a direct financial incentive to reduce emissions. The total gas sector has an annual ETS cost of ~$750 million (for roughly 9.3 million tonnes of CO_2-e emissions). The CCC forecasts indicate the ETS price could increase to $140 per tonne of CO_2-e by 2030.

4.7 Progress to date in reducing emissions

The upstream oil and gas sector has been responding to this business case for change which sets a solid platform from which to ramp up effort. The upstream oil and gas sector has reduced emissions by 34% from 2010 to 2019 (Exhibit 12). This has primarily been driven by investment and measures to halve venting and flaring emissions.

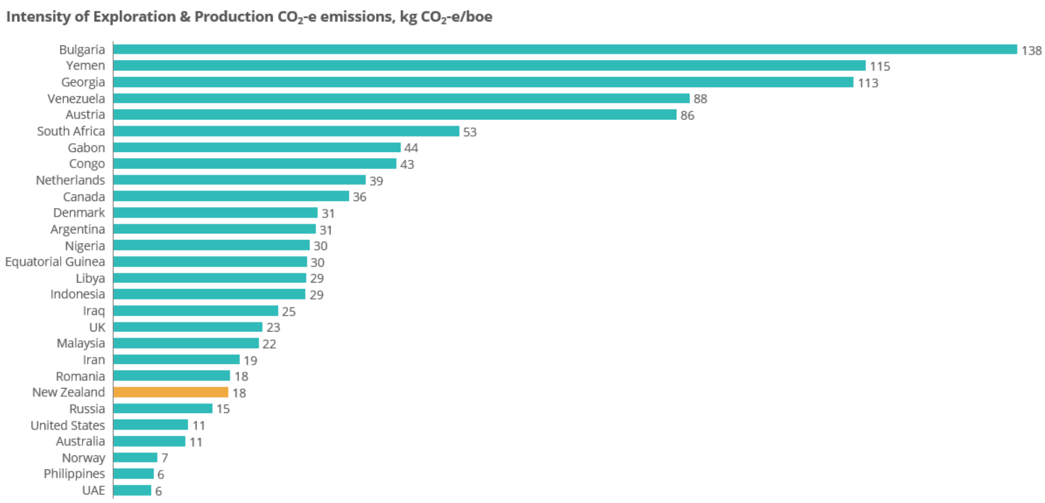
Exhibit 12: Upstream oil and gas emissions



Source: Ministry for the Environment Greenhouse Gas Inventory 2019; Ministry of Business, Innovation and Employment Energy Sector Greenhouse Gas Emissions Data

Venting and flaring emissions from New Zealand producers are lower than most countries, including the Netherlands, Canada, Denmark, and the United Kingdom (Exhibit 13).

Exhibit 13: Flaring and venting emissions intensity by country



Note: Only includes venting and flaring emissions

Source: Rystad

As well as minimising flaring (see below), meaningful action has been taken to reduce emissions through measures such as electrifying compressors, optimising hot oil systems, and scaling up renewable energy sources. The following case studies outline how the upstream oil and gas sector has been taking steps to reduce emissions and develop renewable energy.

Case study: Minimising flaring

Flaring is the controlled burning of hydrocarbon gases inevitably released during venting, start-up/shutdown, pressure relief during plant upsets or emergencies, and emergency de-pressuring. This controlled burning produces mostly water vapour and CO_2. Although oil and gas operators already minimise flaring, the flame must always be kept lit to ensure complete combustion of any released gas, and a constant gas stream (the purge gas) is flowed to prevent air ingress into the flare systems that could cause significant damage.

Beach Energy has implemented a plan to reduce emissions at its Kupe facility by 2,400 tonnes of CO_2-e per year by minimising the use of flared purge gas. This represents a 4% decrease of Kupe's overall Scope 1 emissions (excluding venting, or CO_2 rich gas released from the Thermal Oxidiser). Decreasing this reduces combustion and therefore emissions. Beach Energy has completed a series of studies and will implement operational adjustments, as well as explore investing in more sophisticated pilot and purge gas control systems by 2023.

Case study: Lower emissions condensate stabilisers

At Todd Energy's Kapuni Production Station, condensate was previously stabilised or heated by a direct gas-fired boiler. This stabilisation process ensured that the condensate was on-specification and safe for transport. It was identified that heat could instead be recycled from the high-temperature steam produced by the nearby Kapuni Gas Treatment Plant. This heat source was much more efficient and eliminated the need to combust natural gas directly on to the condensate.

In November 2021, the new steam driven stabiliser was brought online, with the initial expectation that fuel gas emissions would be reduced by 4,500 tonnes of CO_2-e per year. Once online, it was observed that the emission reduction was greater than expected, and had in fact reduced fuel gas emissions by 4,610 tonnes of CO_2-e annually, as well as reducing net energy consumption by 37 TJ/yr.

Case study: Optimising the hot oil system

Beach Energy identified 3 parts of its hot oil heating system which could be optimised to collectively reduce emissions by 8,200 tonnes of CO_2-e or 15% of its Scope 1 emissions at its Kupe facility.

Beach Energy did this by cycling down the furnace when dehydrating gas, saving 3,400 tonnes of CO_2-e yearly and 3,400 kg of fuel daily; utilising dump cooling, saving 4,200 tonnes of CO_2-e yearly, and improving heater control, reducing 600 tonnes of CO_2-e yearly. The three opportunities lead to ~15% emissions reduction.[13]

13 Beach Energy supplied data.

Case study: The move to electric compressors

Over a field's lifetime, well flow rates tend to decrease as they are depleted, making it more difficult to produce energy. A compressor reduces the back pressure on the field, so that gas can be more easily produced, increasing well flow rate and the well's life. Large in-field compressors have typically been powered directly from readily available energy sources such as gas from the field itself, but in recent years many New Zealand oil and gas operators have begun switching from gas-fired compressors to electric-drive compressors.

In 2020, OMV NZ invested in a 10 MW centrifugal compressor for its Pohokura field (Exhibit 14). The $70 million investment takes advantage of New Zealand's 85% renewably sourced electricity. In its first year of operation alone, it avoided emitting 21,500 tonnes of CO_2-e which would have been emitted by a gas turbine compressor.

Exhibit 14: OMV NZ 's electric depletion compressor in Pohokura[14]

OMV also opted to replace a gas-driven recompressor turbine at its Maui Production Station. Instead of upgrading the original equipment's control systems, OMV invested $7 million for an electric compressor. OMV forecasts that the new compressor will reduce its emissions by 3,500 tonnes of CO_2-e annually.[15]

Todd Energy has also invested in electrical compressors for its Mangahewa well sites. Though natural gas-driven compressors were initially considered due to their lower cost, Todd Energy put up an additional $7 million upfront to purchase two compressors and build the necessary supporting electrical infrastructure to reduce emissions. Todd Energy projects that these will reduce net energy demand by 1.5 PJ and save 150,000 tonnes of CO_2-e over their lifetimes.[16]

14 Pictured: electric compressor's discharge cooler.

15 OMV supplied data.

16 Todd Energy supplied data.

Case study: New Zealand's largest grid connected solar farm and other solar opportunities

In mid-2021, Todd Energy's 2.1 MW Kapuni Solar Power Plant was fully commissioned. The site is New Zealand's largest grid connected solar farm. This is the largest solar farm in New Zealand with some 5,800 photovoltaic panels and can generate enough electricity to meet the annual needs of more than 520 New Zealand homes.

The solar plant is adjacent to Todd Energy's Kapuni Gas Treatment plant and was built by the Todd Corporation-owned company Sunergise. It is an exemplar of how oil and gas players can bring significant experience in deploying capital intensive energy projects to renewable energy.

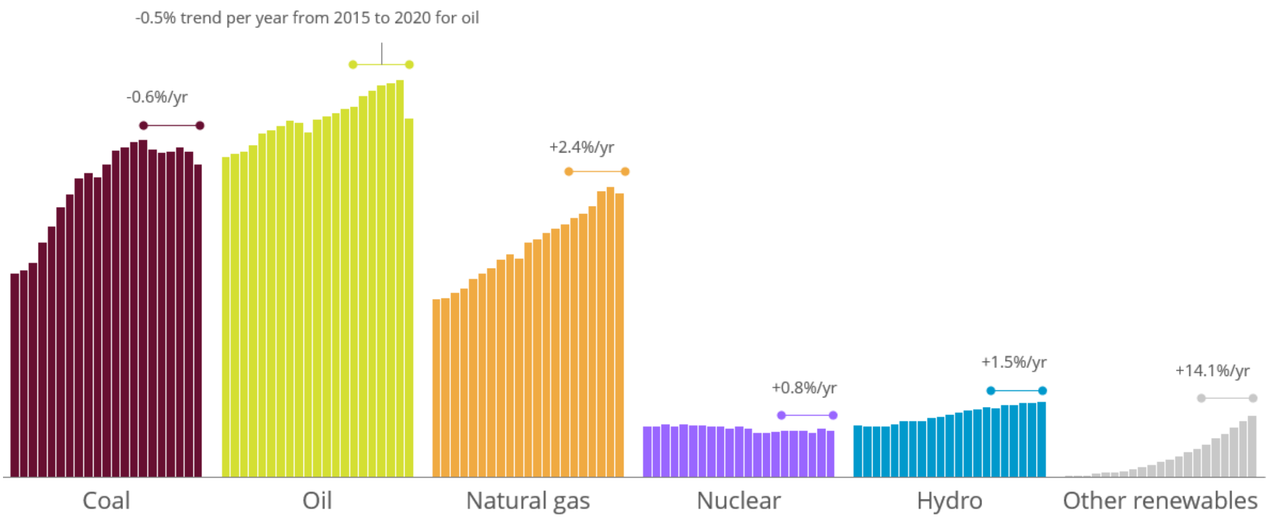
In a similar example, OMV is set to install solar panels at its Paritutu Stores buildings by end of 2022. These will generate carbon-free electricity for site use, subsequently reducing its Scope 2 emissions by 1,000 tonnes of CO_2-e over the lifetime of the project.

4.8 The global energy transition

Today, fossil fuels represent 79% of global energy supply and 72% of energy in New Zealand on a consumption basis.[17] As economies begin to shift their energy systems from fossil fuels with the aim to become low emissions energy-based by 2050, our sources of energy consumption are changing.

Globally, consumption of energy sourced from coal and oil fell between 2015 and 2020, while renewable energy consumption roughly doubled (Exhibit 15). Natural gas consumption is also increasing as many nations use natural gas to replace coal as a lower emissions alternative and support the integration of intermittent renewable electricity like wind and solar.

Exhibit 15: The global energy transition is underway

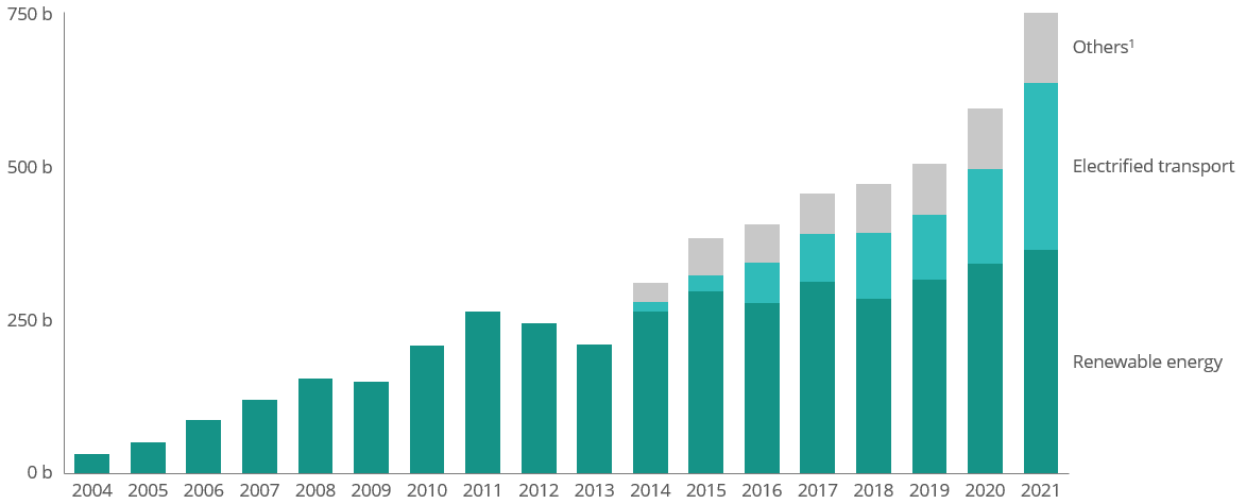


Source: International Energy Agency

17 Ministry of Business, Innovation and Employment, Energy balances (https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-balances/).

This energy transition is backed by growing investment in low emissions technologies. Since 2015, annual investment in energy transition technologies has roughly doubled from US $380–$750 billion per year (Exhibit 16).

Exhibit 16: Global investment in the energy transition by sector

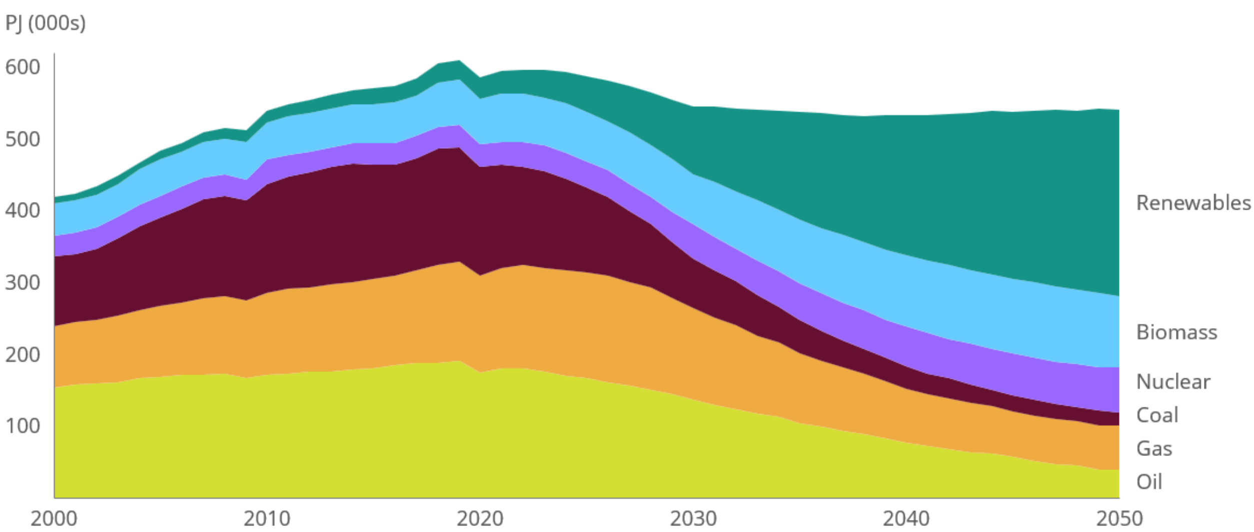


1. Includes nuclear, energy storage, and sustainable materials

Source: Bloomberg NEF; Chart: Badi Wang/Axios

This investment will need to continue and grow. The global energy transition will require a significant transformation of energy systems, increased low emissions technologies, and greater energy efficiency. The International Energy Agency's 1.5°C roadmap for the global energy sector outlines that transitioning from fossil fuel-based economies to renewable-based economies would require investment of USD$4 trillion each year by 2030 (Exhibit 17).[18]

Exhibit 17: Energy supply under the International Energy Agency's 1.5C roadmap



Source: International Energy Agency (IEA)

18 International Energy Agency, Net Zero by 2050, October 2021 (https://www.iea.org/reports/net-zero-by-2050).

While the International Energy Agency (IEA) 1.5°C roadmap is an analysis of what needs to be true to limit warming to 1.5°C, it is not necessarily an analysis that outlines whether this is in fact the most likely future global energy scenario. It is also worth noting that it represents just one pathway to meet 1.5°C. For example, other 1.5°C pathways could have less CCUS (i.e., more renewables and less fossil fuels) or more CCUS (i.e., less renewables and more fossil fuels).

Why the global energy transition is occurring and its implications

Climate change is not the only consideration driving the global energy transition. There are many other considerations that are driving the shift to lower carbon forms of energy.

These includes energy independence and geopolitics, economic and new industry development, and reduced local pollution. For many countries the energy transition is about maximising the benefits while mitigating the costs and risks of the transition. Some examples are outlined below:

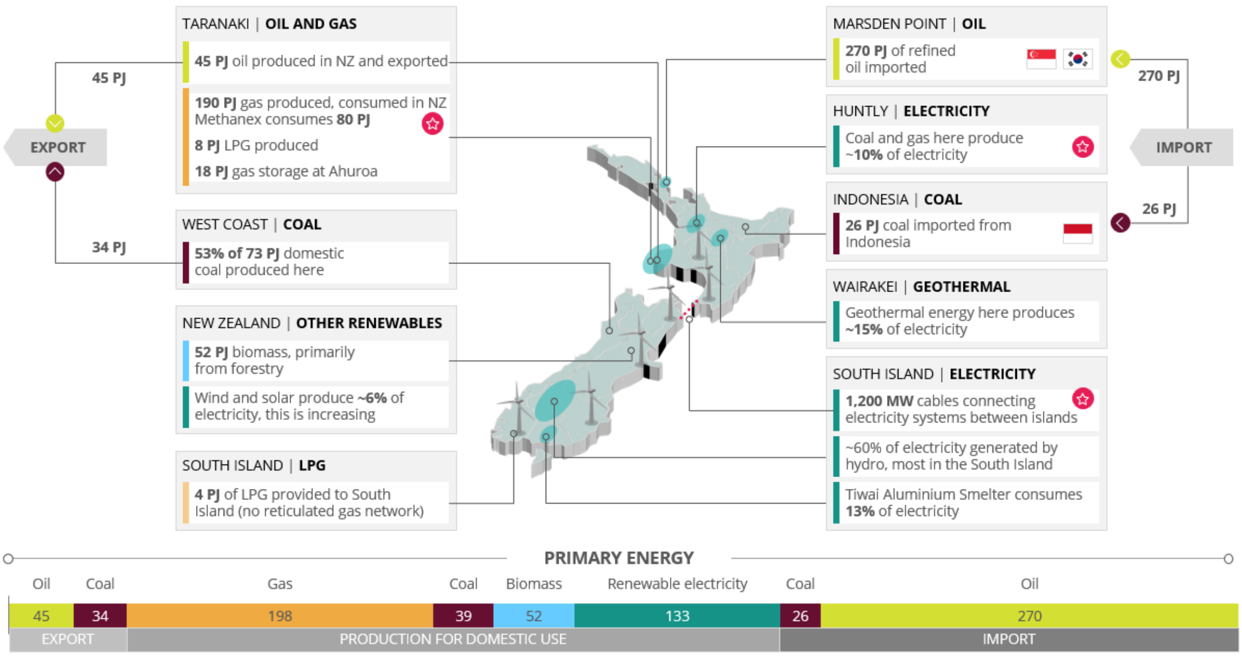
- *energy independence and geopolitics*: Europe is currently seeking to transition away from dependence of imported Russian natural gas and part of that solution involves diversifying to other natural gas sources and transitioning to lower carbon fuels. The United States used the shale revolution as an opportunity to become a net energy exporter, while using shale gas to transition away from coal and support the integration of renewable energy in the domestic economy; and
- *reduced local pollution*: When coal and oil are combusted, they emit pollutants that contribute to smog and local pollution. In China there has been a concerted effort to reduce harmful local pollutants like PM2.5 in the atmosphere. For example, between 2011 and 2021 the PM2.5 level in Beijing has decreased by ~60%.

5 Energy in New Zealand

New Zealand's energy system has several unique characteristics to consider for the energy transition. This includes the limitations of hydroelectricity in dry years, large single-site energy users including Methanex in Taranaki (gas for methanol) and Rio Tinto at Tiwai Point (electricity for aluminium), domestic gas production, and a highly renewable electricity system.

Exhibit 18 provides an overview of New Zealand's energy system, including production, export, important, and power stations. Key aspects of energy security are denoted with red stars.

Exhibit 18: The New Zealand energy system



Source: Ministry of Business, Innovation and Employment Energy Balance tables; Climate Change Commission

Critical for energy security

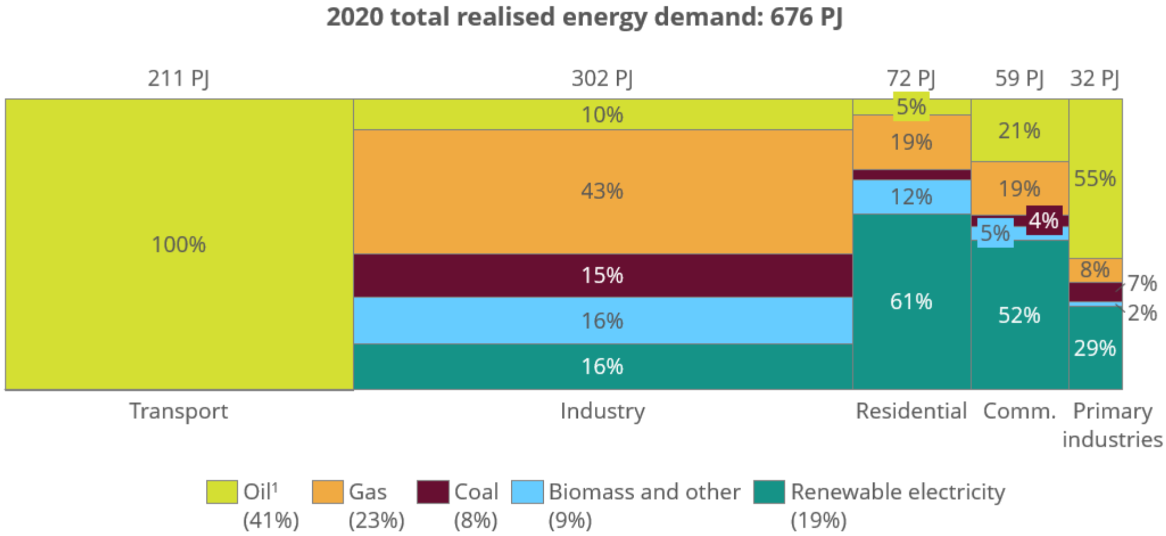
New Zealand is powered by fossil fuels and renewables and has one of the highest rates of renewables in the world.[19] Of energy consumed in New Zealand, 72% is from fossil fuels, 41% of which is from oil, 23% from gas, and 8% from coal; and 28% is from renewable sources, of which 19% is from electricity, and 9% from biomass and other renewable sources, such as geothermal heat (Exhibit 19):

- **transport** is almost 100% powered by oil, although electricity (of which ~85% is produced by renewable sources) is increasing, albeit from a low base;
- **industry** is powered by a range of fuel sources, with gas being the largest. Coal, electricity, and biomass each provide ~15% of energy for industry. Much of this energy is used to produce heat for the production and manufacture of goods;

19 International Energy Agency, New Zealand energy profile (https://www.iea.org/countries/new-zealand).

- **residential and commercial** sectors are predominantly powered by electricity, which provides services such as space and water heating, as well as powering household appliances. Gas and biomass are also contributors and are used primarily for space and water heating, and cooking; and
- **primary industries**, mostly agriculture and forestry, are powered by oil (e.g., for machinery, tractors etc.) and electricity (e.g., for heating and electric machinery).

Exhibit 19: New Zealand's 2020 energy consumption



1. Includes LPG and other liquid fuels

Note: Electricity makes up 23% of demand. The 12% of electricity produced by gas and 4% from coal have been incorporated in gas, coal totals

Source: Climate Change Commission

5.1 Performance of the current energy system and the energy trilemma

To assess New Zealand's energy transition and performance, we utilise the *energy trilemma* (Exhibit 20). For optimal outcomes for people and the planet, an energy transition must balance three critical factors: energy affordability, energy security, and environmental sustainability. If one factor of the trilemma (for example, security) is given a large focus without due consideration to the other two factors (affordability and sustainability) it can result in an unbalanced system that gives rise to unintended consequences.

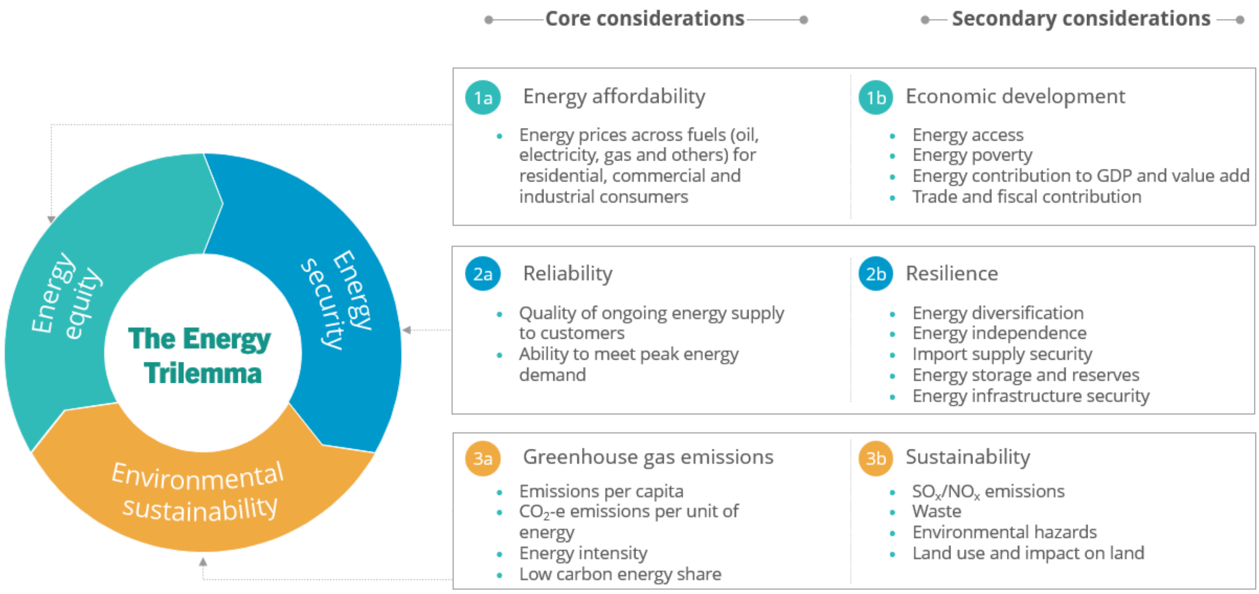
New Zealand's energy system was ranked 9th in the world and 1st in Asia by the World Energy Council's (WEC) trilemma index in 2021. This was based on the country's performance against the three trilemma factors, defined by the WEC as:

- **energy equity:** ability to provide universal access to reliable, affordable energy for domestic and commercial use;
- **energy security:** ability to meet current and future energy demand and the ability to withstand and respond to system shocks; and

- **environmental sustainability:** ability to mitigate and avoid environmental degradation and climate change impacts.

New Zealand achieved an A grade for each of the 3 factors, placing it in the top 25% of countries globally for each factor. New Zealand ranked 28th for energy security, 17th for energy equity and 18th for environmental sustainability. However, since 2000, New Zealand's score across the energy trilemma has been relatively flat — energy security has declined by 5%, energy equity has declined by 3%, and energy sustainability has improved by 6%.

Exhibit 20: The Energy Trilemma



Source: Energy Resources Aotearoa

The most recent World Energy Council trilemma analysis, conducted in 2021, used 2019 data. Since 2019, New Zealand has experienced growing difficulties in its energy system, in part due to an uncertain environment for investment in new energy supply. In 2021, New Zealand experienced issues across the energy trilemma:

- **energy equity**: electricity and gas prices were relatively high in 2021, in part due to an energy shortage. Some energy users needed to reduce consumption as a result;
- **energy security**: an electricity dry year and an electricity blackout demonstrated risks to reliability and security of supply; and
- **energy sustainability**: a significant amount of Indonesian coal was imported to fill the energy supply gap.

Restoring confidence in investment will help address future energy gaps, and investment in gas will be important for improving New Zealand's trilemma performance. From an equity perspective, gas assists with providing affordable energy and electricity. From an energy security perspective, it contributes to New Zealand's high energy independence as it is produced domestically. And from an environmental sustainability perspective, it is a relatively low emitting fossil fuel that also supports the integration of renewable sources into the energy system while avoiding coal.

5.2 Supply and demand of oil and gas

In New Zealand, domestic oil production is not a crucial component of affordable and reliable domestic energy supply but will continue to play an important role for communities and the economy. New Zealand exports all its locally produced oil (45 PJ each year).

Imported oil, however, is an important component of affordable and reliable energy supply in New Zealand, with all oil used in New Zealand imported (roughly 270 PJ each year). While New Zealand has little control over the affordability of imported oil except in relation to government taxes and levies. The fundamentals are driven by a function of global commodity prices and exchange rates and the security of imported oil is less of a significant concern for New Zealand's energy supply. This is due to our relatively small demand for oil compared to other nations, and our diversified source of oil imports.

All gas used in New Zealand is domestically produced and there is no natural gas import capability.[20] While this means New Zealand has the benefit of not being reliant on other producers, the decisions the country makes around gas policy has significant implications for energy affordability, security, and environmental sustainability.

New Zealand produces roughly 190 PJ of gas each year. LPG is used to supply gas to consumers without a reticulated gas connection, such as those in the South Island. This represents an additional ~8 PJ in New Zealand.

Today, almost 90% of New Zealand's gas is produced by just three producers: OMV, Todd Energy and Beach Energy (Exhibit 21). To ensure gas production can continue throughout the transition, ongoing investment in fields owned by these three companies will be required.

Gas represents 23% of energy consumed in New Zealand and is critical to the economy. Gas is used predominantly in industry in New Zealand, across several sectors including as a:

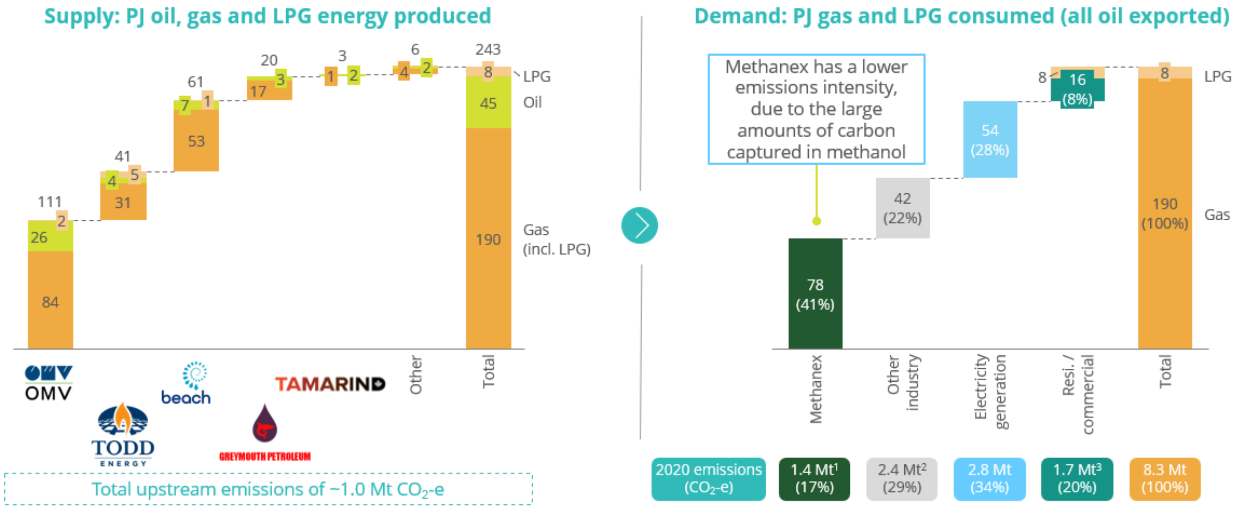
- feedstock to produce methanol and fertilisers;
- industrial heat source in dairy, food processing, timber processing and steel manufacturing;
- fuel source to generate electricity, particularly as a peaking fuel when demand for electricity is high, and as a backup baseload option when lake levels are low; and
- fuel source in over 400,000 households and businesses, primarily for heating rooms and water, and for cooking

The single largest consumer of New Zealand's gas is Methanex, a global methanol-producing company. Methanex's annual consumption of gas is approximately 80 PJ, representing 42% of total annual gas consumption when operating at full capacity. Other industrial uses of gas (such as a feedstock or in manufacturing) represent 22% of annual gas demand. Gas for electricity typically represents 28%, and gas used in commercial and residential properties

20 This excludes a small amount of LPG (0.8 PJ in 2020) which is imported to balance demand not met by local production.

represents 8% of annual demand. In addition, 9 PJ of LPG is used for heating and cooking. Section 5.3 canvasses these uses in greater detail below.

Exhibit 21: Gas supply and consumption emissions in New Zealand



1. Includes IPPU emissions
2. Comprises 0.5 Mt from chemicals other than Methanex, 1.8 Mt from other industry, and 0.1 Mt from refining at Marsden Point
3. Includes LPG emissions

Note: 2019 emissions used as latest actuals used in CCC work

Source: Climate Change Commission, MBIE Oil and Gas datasets

5.3 The role of gas by sector use

5.3.a The role of gas in methanol production

Roughly 42% of New Zealand's gas is used to produce methanol at Methanex's plant in Taranaki. Roughly two-thirds of the gas used at Methanex's facilities is embedded into the methanol finished product, while one-third is combusted to generate heat that helps to synthesise the methanol. As most of the carbon is embedded in the finished product, the domestic emissions impact of gas use in methanol is relatively low at 17 kt of CO_2-e per PJ of gas consumed. Relative emissions intensities are discussed further in Section 7.3.

Virtually all the methanol produced in New Zealand is exported, primarily to Asia. Methanol is used in products like treated wood, paint, glue, silicone, and plastic bottles where it remains embedded and does not generate greenhouse gas emissions. Increasingly, methanol is being used in low emissions manufacturing, of products such as wind farm turbines, solar panels, electric vehicle componentry, and laminated lumber. It is also an alternative fuel for shipping. These are all vital elements of the low emissions economy and there are currently limited alternatives to using methanol in many of these products/end-uses.

Methanex's headquarters are in Vancouver, Canada, and the company brings a high level of external investment into New Zealand. With other production facilities in Canada, the United States, Trinidad, Egypt and Chile, the existing Taranaki facility plays a critical role in supplying methanol to the Asia Pacific region. Methanol produced in New Zealand is less exposed to supply chain and international trade risks than methanol produced elsewhere.

As Methanex consumes 42% of gas in New Zealand it is a vital constituent of the gas sector and underpins affordable, reliable gas supply, and therefore energy supply in New Zealand. If Methanex exited New Zealand, the economics of upstream activity in Taranaki would suffer both immediately and significantly. As an emissions-intensive trade-exposed industry, methanol production in New Zealand is dependent on sound ETS policies to manage the risk of premature closure and carbon leakage.

5.3.b The role of gas in other industry

Beyond the production of methanol, gas is used as feedstock in fertilisers and in process heat for industry. Roughly 10 PJ of gas is used to produce fertiliser in New Zealand each year.

Gas is used to generate heat energy in the meat, dairy, timber processing, pulp and paper and steel manufacturing sectors. For example, gas is often used to dry milk into powder for export. In instances where the heat temperature required is less than 300°C (low or medium temperature process heat) gas is a lower emissions alternative to coal. Biomass and electricity provide opportunities to reduce coal use for heat in industry. In the longer term these technologies and green gases are the most feasible low emissions alternatives for industry. The deployment of these solutions will depend on the economics, reliability of supply, and technical feasibility.

In the case of high temperature heat, such as for steel manufacturing, a near-term low emissions alternative that is both economically and technologically feasible is less likely, although hydrogen could emerge as economically viable in time. Electrification is currently not an option here.

5.3.c The role of gas in electricity generation

With ~80-85% of electricity in New Zealand generated by renewable sources, the New Zealand electricity system is one of the lowest emission systems in the world. This is comprised of roughly 60-65% from hydro, 15% from geothermal, and 5% from wind. 97% of electricity is generated by domestically produced sources like water, geothermal, wind, and gas, while ~3% is from coal imported from Indonesia. Total electricity consumption is 142 PJ per year.[21]

While the electricity system is mostly powered by renewables, gas plays an important role in New Zealand's electricity security. The New Zealand electricity system is heavily reliant on hydrology, with the average lake in New Zealand having around 6–8 weeks of storage. During periods of low rainfall, thermal fuels like coal and gas are required to provide electricity. When the country faces a prolonged period of low rainfall, a dry winter event can occur, causing a greater reliance on coal and gas to meet energy needs. Currently, a lot of this is sourced from Indonesian coal which is highly emissions intensive.

Coal and gas are also required to produce electricity during periods of peak demand, often between 6pm and 8pm in winter. During these peak periods, highly responsive peaking gas power stations quickly balance the system (that is, provide sufficient supply to meet

21 Recall that annual gas production is 190 PJ per year.

demand) and ensure the lights stay on. Gas has a particularly important role in improving integration of renewable electricity by firming up intermittent generation. If gas supply is made flexible and resilient enough to ramp up during periods of low rainfall, New Zealand has an opportunity to transition entirely away from coal in the electricity sector. Gas also plays an important role in providing sufficient reserves to maintain electricity security in the North Island in case of a system-wide issue.

In future, baseload gas use for electricity is likely to reduce, as new intermittent renewable generation enters the electricity mix. However, gas for peaking and for dry year support will still be required and will become even more important in supporting the electricity system as more intermittent renewable electricity generation sources are developed. Underground gas storage can also serve as a cost-effective means to managing dry year electricity generation risks.

5.3.d The role of gas in businesses and households

Gas is used in ~400,000 households and businesses across the country for cooking, as well as space and water heating. Where existing solutions like gas water heaters exist, it is not usually economic to replace these before end-of-life. For new homes, there are other economic options, but consumers should be able to make their own economic choices based on their own preferences, without bans or other mechanisms informing their decisions, especially given that the price of gas already includes the cost of carbon. In the future, hydrogen blending may present an alternative for customers, with FirstGas and some gas distribution companies currently exploring this option. It is important these options are explored because they present opportunities to maximise the economic life of existing infrastructure, rather than prematurely mothballing or decommissioning it.

5.4 The contribution of oil and gas to the economy

5.4.a Economic benefits

Gas, and to a lesser extent, oil not only play an important role in underpinning an orderly energy transition, but they also play an important role in the New Zealand economy. With almost all upstream oil and gas exploration, production and processing occurring in the Taranaki region, it comes as no surprise that this is where the benefits of the oil and gas sector are most prevalent.

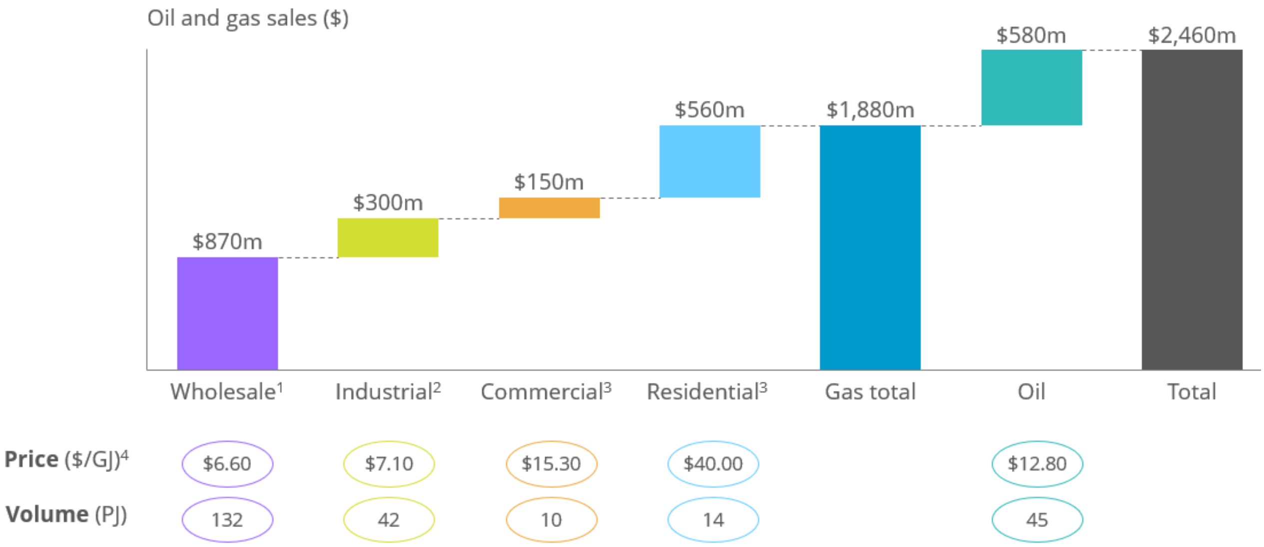
Benefits to the economy come about in three ways:

- **directly:** oil and gas companies have been attracted to the Taranaki area for many years due to its economic prospects. The sector spends money on development programmes, construction, and production equipment, thereby contributing to the local economy directly;
- **indirectly:** international, external investment contributes to New Zealand’s GDP. Local upstream oil and gas companies also buy related goods and services, contributing to the economy indirectly; and

- **induced:** those employed in the sector spend money (e.g., on groceries, education, and healthcare, etc.), which is a further contribution to the economy. This results in greater economic activity and employment for local businesses, which attracts further investment in Taranaki. In this way, the benefits of the oil and sector are self-reinforcing.

Oil and gas contribute about $2.5 billion to the New Zealand economy in sales each year, of which $1,900 million is from gas, and almost $600 million is from exported oil.[22]

Exhibit 22: Financial contribution of oil and gas to the New Zealand economy



1. Includes Methanex and electricity generation (e.g., Genesis Energy)
2. Includes Balance, Oji Fibre, NZ steel
3. Includes LPG
4. Excluding carbon price

Source: Stats NZ, *The Wealth Beneath our Feet* (Adapted), Annual reports

More than $1 billion is spent by the upstream industry on exploration, prospecting, production, and processing permits annually.[23] An estimated further $80 million is spent on meeting ETS obligations by upstream companies. Company tax, other levies and royalties represent an additional contribution to the New Zealand Government and economy.[24]

The oil and gas sector indirectly benefits the economy through the external investments it brings into New Zealand. Over two-thirds of oil and gas is produced by OMV, Beach Energy, and Tamarind New Zealand Onshore (TNO), which are international companies. Their investments enable a contribution of $1.6 billion (pro-rated) to the economy. Their contribution towards exploration, prospecting, production, and processing is estimated at $600–$800 million annually.

22 We have evaluated the oil and gas sector’s contribution to the New Zealand economy using a combination of annual reports, interviews, industry reports, MBIE data, and economic multipliers published by Stats NZ.

23 New Zealand Petroleum and Minerals.

24 Energy resource levies and royalties for petroleum in 2021 were $183,122,607 (https://www.nzpam.govt.nz/nz-industry/nz-minerals/minerals-statistics/industry-statistics).

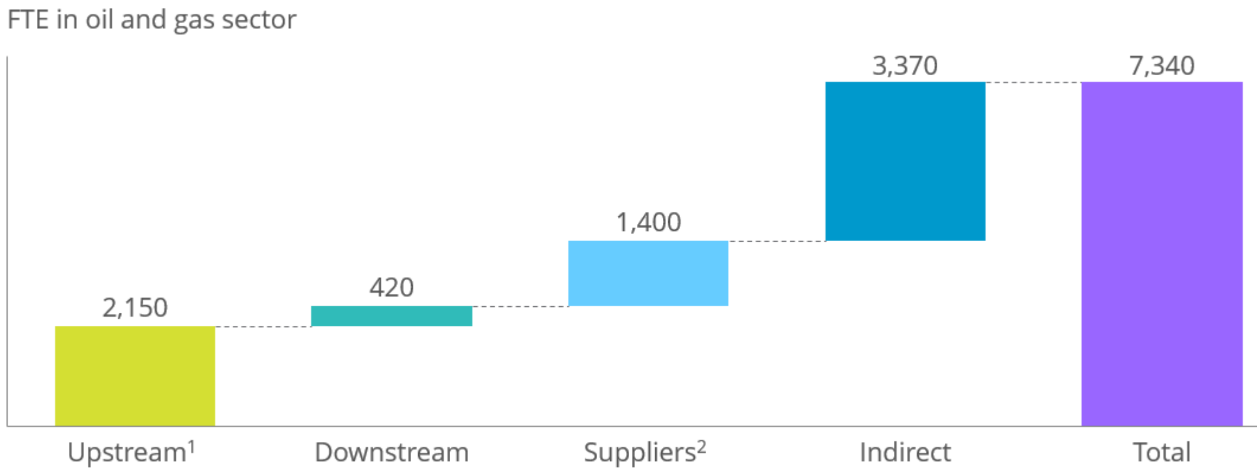
5.4.b Employment and skills benefits

New Zealand's oil and gas sector does not just financially contribute to the economy. It also employs highly skilled people. As the size of the sector has plateaued in recent years, the remaining workforce is even more highly skilled and sought after than before. Such specialists are integral to the energy transition, but also have expertise in adjacent sectors of the economy – for example, in capital project management, large-scale civil engineering, geotechnical and earthquake seismic analysis, offshore wind development, CCUS development, geothermal drilling and complex manufacturing. With a disorderly transition, there is potential to lose this highly skilled workforce to other countries even though their knowledge and experience will be valuable for the energy transition domestically.

As of 2022, about 7,340 people are employed through the oil and gas sector. Of this, 2,150 are employed in upstream activities, such as exploration, drilling, production, processing, engineering, and maintenance, and many people are employed by large downstream customers of gas, including at least 420 in methanol, fertiliser, and fibre-based packaging. According to MBIE's Labour Market Statistics snapshot for March 2022, there were 64,800 people employed in Taranaki meaning that approximately one in ten people in the region are employed through the oil and gas sector.

A further 1,400 people supply the industry, including logistics, specialist services, general suppliers, and professional services personnel. Finally, 3,370 people are employed indirectly, in jobs that would likely not exist if the oil and gas sector ceased to exist (Exhibit 23).

Exhibit 23: Oil and gas sector jobs in New Zealand



1. Includes exploration and production, engineering and maintenance, and drilling
2. Includes logistics, specialist services, general suppliers, and professional services

Source: Stats NZ, *The Wealth Beneath our Feet* (Adapted), Annual reports

5.4.c Contribution to the energy transition

As well as the economic and employment contribution, the oil and gas sector also has a lot to offer during the energy transition, particularly as several companies transition into integrated energy companies. For example, Todd Energy already has the largest grid-scale solar farm in New Zealand (see Section 4.7 above) and OMV has a significant global focus in transitioning its business to become a low carbon fuels and chemicals business.

The sector provides New Zealand with 'adaptive capacity' – that is, the critical mass of knowledge and skills which enable the economy to quickly pivot in response to challenges and opportunities. The sector can support the energy transition by:

- **investing directly in low carbon technologies or supporting their development** (e.g., solar, offshore wind investigations, green gas investigations, CCUS) – the upstream oil and gas sector can continue to invest directly in low carbon solutions and support Ara Ake and Venture Taranaki to scale low carbon solutions;
- **bringing global capital and expertise to the energy transition** – large global energy companies like OMV and Methanex can assist the transition to a lower emissions energy sector as they can bring global expertise and capital to New Zealand;
- **contributing skills and expertise for the energy transition** – the upstream oil and gas sector has unique skills like large offshore capital project capabilities which would be transferrable to offshore wind, CCUS capabilities and geothermal drilling capabilities; and
- **supporting local communities in the regions during the energy transition** – the oil and gas sector is an integral part of the social, cultural, and economic fabric of Taranaki. It has established local and social procurement methods, and health and safety excellence that will be valuable for supporting the existing and new energy industries in the Taranaki.

Case study: Methanex's important role in supporting the local economy

Methanex makes a substantial economic and socio-economic contribution to the Taranaki economy. It contributes some $830 million to GDP, roughly 10% of the entire region's GDP. As Methanex exports nearly all its methanol, it contributes to New Zealand's trade economy. In 2021, its New Zealand business produced 1.3 million tonnes of methanol, valued at $920 million, which is equivalent to ~1.2% of the country's exports. In addition, it employs 200 people directly, and latest estimates are that the company supports 3,000 other jobs indirectly.

5.5 The future of New Zealand's energy system

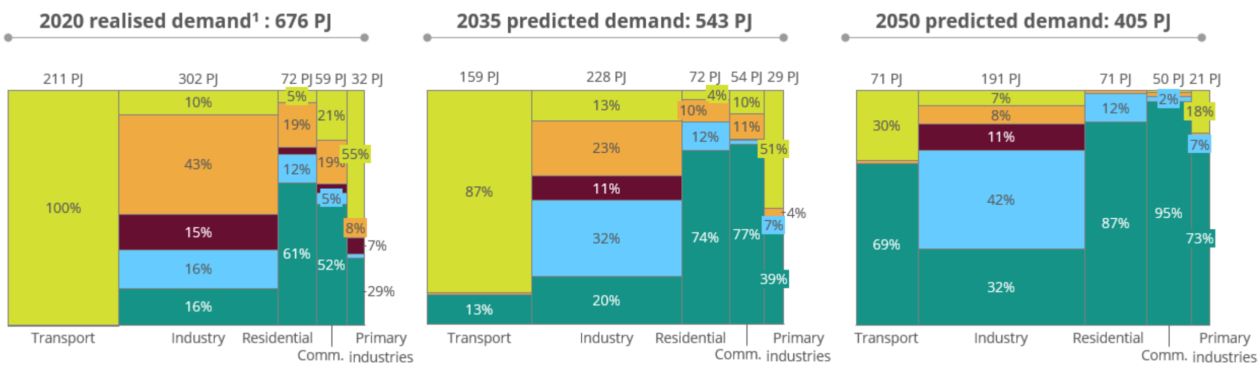
At a very high level, New Zealand's energy transition will likely follow the path of most other developed countries — shifting from a fossil fuel-based energy system to a low-emissions energy system.

The CCC and agencies including the BusinessNZ Energy Council and the Productivity Commission, have identified that electrification will be vital to decarbonising New Zealand's energy system. This will especially be the case for powering transport and industry, making the most of the country's high base of renewable electricity. It is also expected that biomass will provide more low and medium heat in industry (Exhibit 24).

While the energy system makes these shifts, gas will continue to play an important role, supporting the integration of renewable electricity to maintain reliability and affordability of electricity supply. There are also several uses where it will remain more economically and technologically feasible to use gas rather than alternative renewable energy sources — for example as a feedstock and for high temperature heat processes – although this could change over time. New technologies, such as CCUS could also change the outlook for gas, seeing it become a long-term low-emissions energy solution.

In addition, other low emissions technologies such as hydrogen, biogas, biofuels, and geothermal heat are all likely to play a role in a transition to a net zero carbon economy.

Exhibit 24: Change in New Zealand's energy supply by sector under CCC Demonstration Pathway



	2020	2035	2050
Oil²	41%	35%	10%
Gas³	23%	13%	4%
Coal³	8%	4%	5%
Biomass and other	9%	16%	23%
Renewable electricity	19%	32%	58%

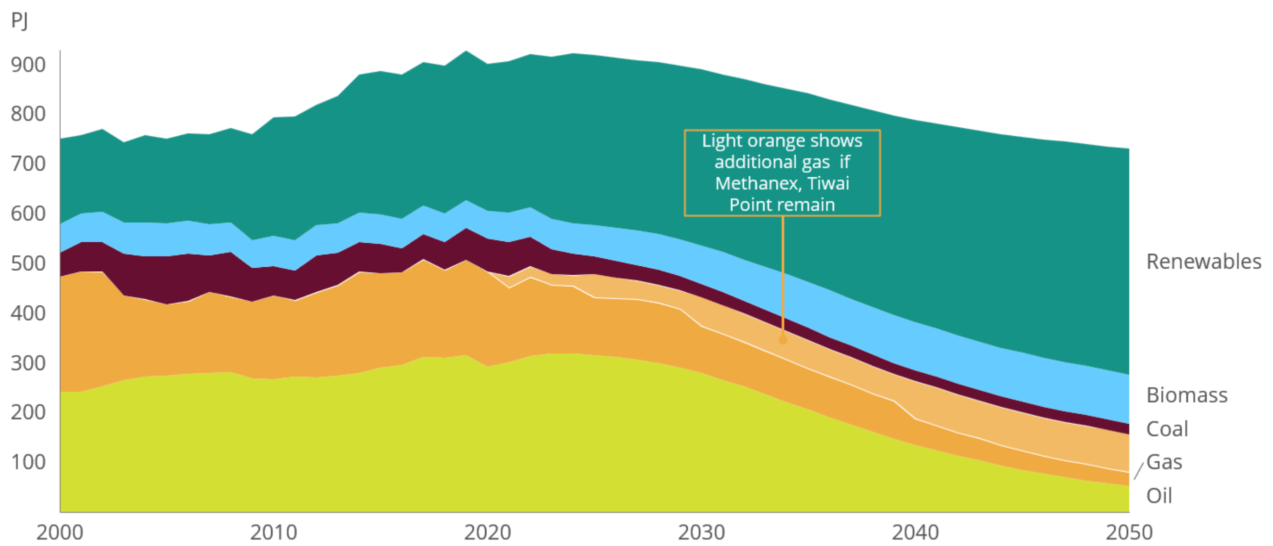
1. Demand in PJ is primary energy demand. Electricity considers generation by fuel, thermal inefficiencies excluded – so the proportion generated by electricity represents a lower bound.
2. Oil includes other liquid fuels
3. Gas and coal numbers include electricity generation, converted from primary energy to the actual PJ electricity consumed, produced by the given fuel

Source: Climate Change Commission

Exhibit 25 below shows New Zealand's changing primary energy mix to 2050, according to the CCC Demonstration Pathway to net zero emissions.[25] Renewables ramp up over time, while coal ramps down from 2025, and oil from 2030. Energy produced by gas decreases over time. We explore this demonstration path and alternatives in Section 6 of this report.

25 Primary energy shown here, which may be larger than consumed energy as discussed elsewhere in this report.

Exhibit 25: New Zealand's changing primary energy system under the CCC Demonstration Pathway



Source: Climate Change Commission Demonstration Path Primary Energy Totals

As all gas consumption is from domestic production it is important for New Zealand's energy affordability and reliability, not to mention its energy independence. Although forecasts identify that gas consumption in New Zealand declines by 2050 to meet economy-wide national climate targets, the CCC has also outlined that some gas will still be required in 2050, for electricity generation, chemicals, and metals manufacturing.

However, Energy Resources Aotearoa believes that the CCC Demonstration Path may lead to a more disorderly transition as industry is phased out and investment confidence further erodes. We believe there are more viable pathways, explored in Section 6 of this report, which could reduce emissions by a similar level, while supporting both affordable, reliable energy and an orderly transition.

6 Gas transition pathways

To inform the development of robust policy settings and to help illuminate the range of choices and trade-offs New Zealand collectively faces, Energy Resources Aotearoa has developed five scenarios for future gas consumption in New Zealand, based on the CCC's demonstration pathways. By modelling scenarios based on the CCC's work, we hope to contribute to the discussion regarding desired transition pathways.

These scenarios are explorative examples only. They are not predictions – none of us can know with certainty how the future will play out. Gas demand is highly unlikely to precisely follow any one of these scenarios. Rather, their purpose is to function as plausible, coherent scenarios that explore and demonstrate how different decisions could drive different outcomes for the wider energy sector.

Importantly, these scenarios demonstrate that there are multiple plausible pathways for gas, and highlight the importance of increasing optionality, instead of basing the future of our energy system on any given assumption-based, normative view of the future. Their objective is to highlight the importance of remaining open to exploring alternative future scenarios, and to build an energy system that is resilient to them should they eventuate.

Our five scenarios are:

- **Scenario 1**: CCC Demonstration Pathway;
- **Scenario 2**: Demonstration Pathway with Tiwai Point (remaining open through to 2050);
- **Scenario 3**: Gas Phase-out;
- **Scenario 4**: Technology-led Pathway; and
- **Scenario 5**: Heavy Industry Continues.

The scenarios focus on gas demand, because all oil consumed in New Zealand is imported (and therefore out of scope). However, the inextricable relationship between upstream gas and oil extraction and processing (that is, most fields in New Zealand produce both gas and oil) means future gas demand is a strong indicator of the amount of oil extracted, and any resulting domestic upstream emissions.

6.1 Assumptions behind each scenario

Each scenario has a different set of assumptions underpinning it (Exhibit 26). There are five types of assumptions, these being:

1. the gas consumption of Methanex (the single largest consumer of gas) over time;
2. whether Tiwai Point closes in 2024 (Scenarios 1 and 3) or remains open with market certainty until 2050 (Scenarios 2, 4 and 5);

3. whether green hydrogen is available. This is the case in Scenario 3 (where it fully displaces gas by 2050) and in Scenario 4 (where a 50% blend with gas is available by 2050);

4. whether CCUS technology will be available (and deployed). This is true only in Scenario 4 (Technology-led path), and is available to most upstream operators, as well as the largest methanol and fertiliser producers (Methanex and Ballance Agri-nutrients); and

5. whether the currently mooted 100% renewable electricity target will be reached. As the Climate Change Commission has modelled, some gas is used to generate electricity through to 2050, which is assumed in Scenarios 1, 2, 4, and 5. Electricity from 100% renewable sources is only modelled in Scenario 3 (Gas Phase-out), to occur from 2030.

Each scenario assumes a carbon price trajectory consistent with that in the CCC's modelling (~$140/t$CO_2$-e in 2030). The carbon price was factored into our electricity analysis.

Exhibit 26: Dimensions of scenarios

Scenario number and name	Base gas demand profile	Methanex assumptions	Tiwai Point aluminium smelter	Green hydrogen blending with gas	Carbon Capture, Utilisation, and Storage	100% renewable electricity
1. CCC Demonstration path	*CCC Demonstration path*	☐ *Ramp down from 2021, trains close 2029 and 2039*[1]	☐ *Closes end of 2024*	× *Not available*	× *Not available*	× *Not achieved*
2. Demo path, with Tiwai Point	*CCC Tiwai stays with certainty*	☐ *Ramp down from 2021, trains close 2029 and 2039*[1]	⇨ *Open through to 2050, with certainty*	× *Not available*	× *Not available*	× *Not achieved*
3. Gas Phase-out	*CCC Demonstration path*	☐ *Ramp down from 2021, trains close 2029*[2]	☐ *Closes end of 2024*	✓ *Widespread, fully displaces gas by 2050 (from 1% in 2030)*	× *Not available*	✓ *Occurs in 2030*
4. Technology-led Pathway	*CCC Tiwai stays with certainty*	⇨ *100% production until 2050*	⇨ *Open through to 2050, with certainty*	✓ *Ramps up from 1% blend in 2030, to 50% in 2050*	✓ *Available for O&G operators, Methanex, Ballance*	× *Not achieved*
5. Heavy Industry Remains	*CCC Tiwai stays with certainty*	⇨ *100% production until at least 2039*	⇨ *Open through to 2050, with certainty*	× *Not available*	× *Not available*	× *Not achieved*

1. Based on Climate Change Commission assumptions
2. Modified, based on Climate Change Commissions assumptions

⇨ Remains open ✓ Available ☐ Ramps own × Not available

6.2 Implications of each scenario on an orderly transition

The five scenarios lead to different outcomes for the energy trilemma and thus for an orderly transition (Exhibit 27).

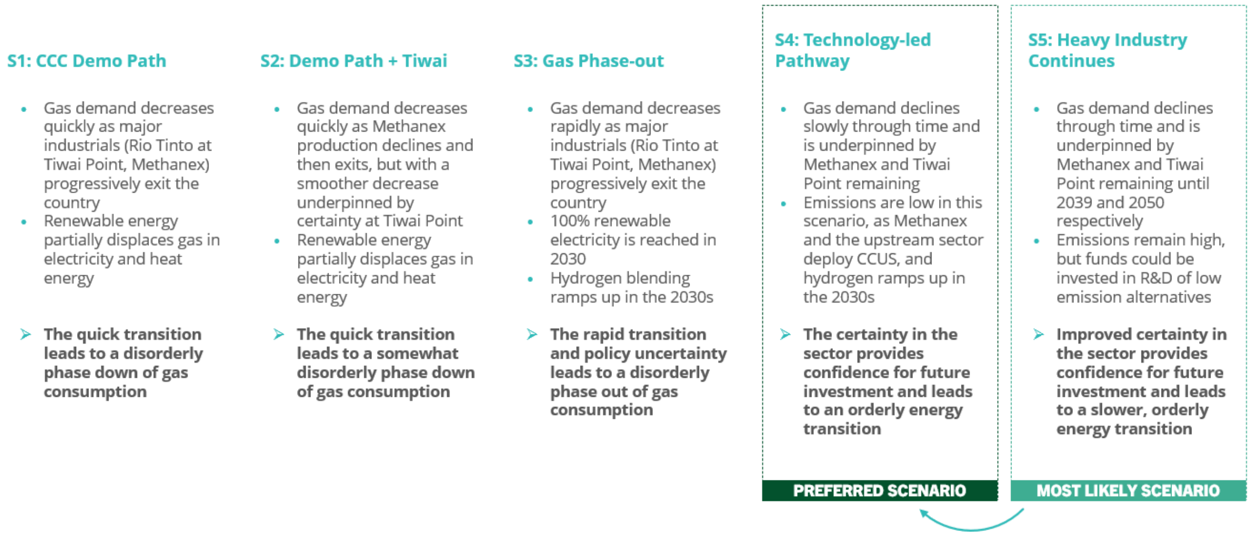
Scenario 1 (CCC Demonstration Pathway) **and Scenario 2** (Demonstration Pathway with Tiwai Point) are similar, with the difference being Scenario 2 (where Tiwai Point remains open through to 2050) sees slightly larger gas demand, with certainty of the aluminium smelter remaining open underpinning demand for electricity and source fuels. This leads to a smoother gas demand profile in the short-term, and a more orderly transition compared to Scenario 1.

Potentially the most disorderly, **Scenario 3** (Gas Phase-out) follows a rapid phase-out of gas from the electricity system and for Methanex by 2030. This could only be achieved with rapidly enforced, ad hoc policy, and would likely lead to volatile pricing and supply security issues, akin to what has been experienced in recent years. In addition, the pumped hydro scheme at Lake Onslow, which would be necessary to achieve the 100% renewable electricity by 2030 goal, is incredibly expensive, and would likely not be fully operational until 2035 in any case (we explore the challenges and uncertainty around Lake Onslow in Section 8 of this report).

Scenario 4 (Technology-led Pathway) represents the optimal scenario for New Zealand, with Methanex underpinning investment confidence in the sector, and new technologies such as CCUS and green hydrogen significantly decreasing emissions.

Scenario 5 (Heavy Industry Continues) is arguably the most likely, given that Rio Tinto at Tiwai Point and Methanex are likely to remain in New Zealand for much longer than was anticipated when the CCC report was written. In this scenario, there is improved investment certainty, which leads to a more orderly energy transition.

Exhibit 27: Our scenarios have varying implications for an orderly transition



All five scenarios show a natural reduction in gas demand over time (Exhibit 28), but it is the rate of change by demand segment which informs how orderly the transition is and whether optimal energy trilemma outcomes are met.

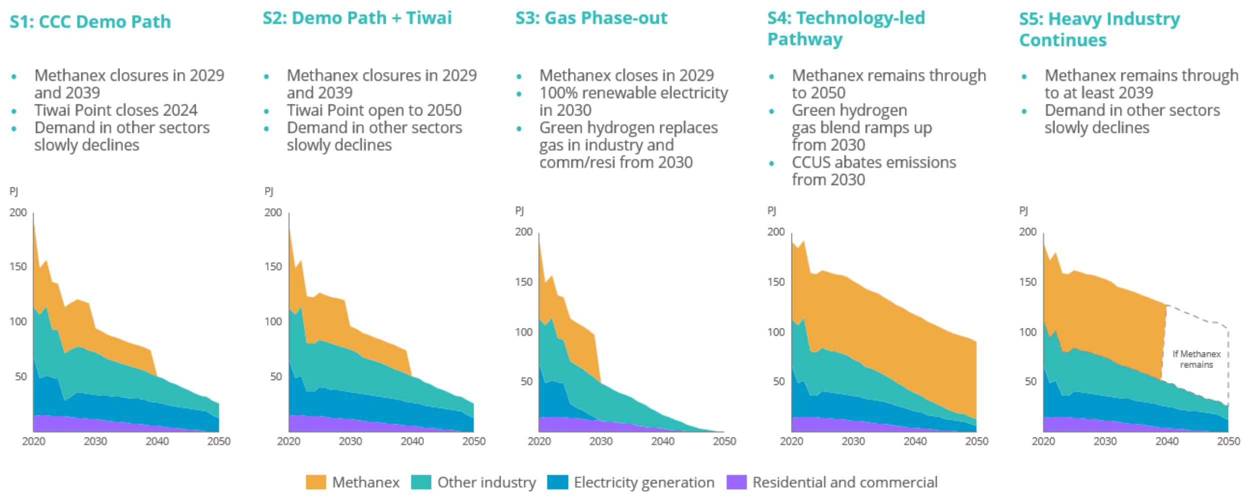
Scenario 1 (CCC Demonstration Pathway) **and Scenario 2** (Demonstration Pathway with Tiwai Point) show near identical reduction in gas demand, except for gas for electricity generation being slightly higher in Scenario 2, particularly between 2025–2030, due to the additional energy that is required to power the aluminium smelter at Tiwai Point.

Scenario 3 (Gas Phase-out) follows a stark phasing out of gas for Methanex and electricity generation by 2030. It sees residential and commercial gas being phased down from 2030, with gas for other industry being the only remaining demand source from 2040 onwards. It remains to be seen if such small demand could be met beyond 2030, or if gas suppliers would cease to be economically viable and act accordingly. If this gas demand (shrinking, but still present) could not be met, it would lead to an even more disorderly transition, and one that compromises affordable and reliable energy supply.

Scenario 4 (Technology-led Pathway) presents the highest demand for gas through to 2050. Methanex remains in the market to underpin supply, while green hydrogen blending ramps up from 2030. This leads to reduced gas demand from other industry, electricity generation, and residential and commercial uses by 2050, but this gradual phasing leads to a smoother, more orderly transition.

Scenario 5 (Heavy Industry Continues) sees high gas demand at Methanex through to at least 2039. Gas may drop off if Methanex exits at this point, which would further contribute to a disorderly transition. On the other hand, if Methanex remains, demand for gas would remain strong, supported by Tiwai Point operating until 2050 and limited alternatives being available.

Exhibit 28: Projected gas demand by scenario



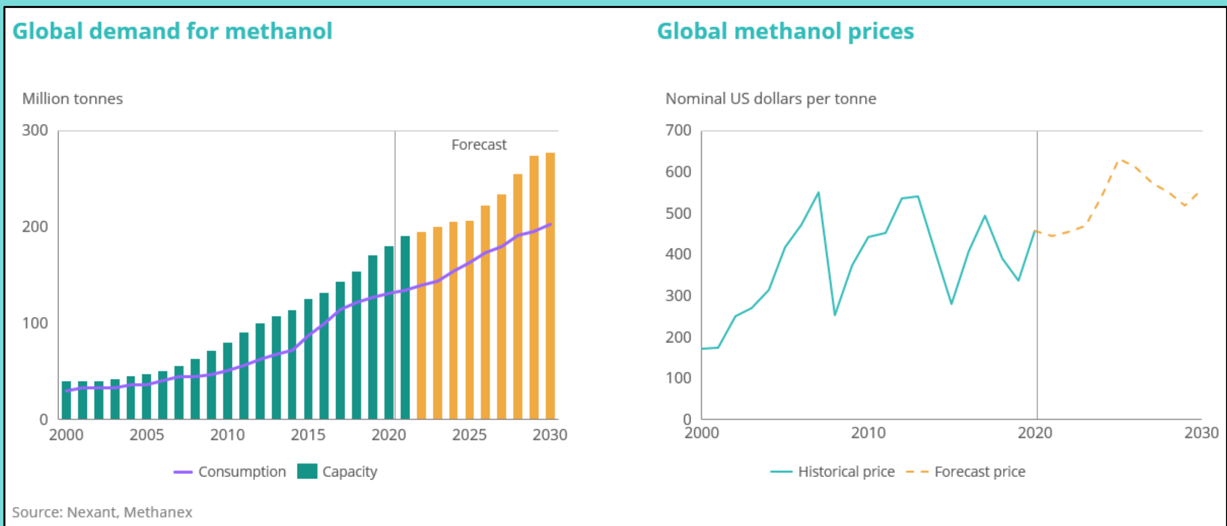
Source: Climate Change Commission - Demonstration Path; and Tiwai Stays with Certainty path

Case study: The future of Methanex[26]

Methanex is the largest global producer of methanol and has six production plants globally. The Taranaki plant is usually its second highest producing plant and in 2020 it produced 25% of Methanex's methanol output.[27] It can flex output to balance the global portfolio. As Methanex comprises 42% of gas demand, its consumption is one of the most critical factors for gas demand modelling. Its consumption is also critical for the energy transition as it underpins confidence for investment in gas supply, which supports affordable and reliable energy supply in New Zealand.

The CCC Demonstration Path forecasts a decline in Methanex's production from 2021 followed by train closures in 2029 and 2039. However, Energy Resources Aotearoa believes that Methanex's Taranaki plant has a brighter future and will be at close to full operation until at least 2039 and likely to 2050. The outlook for methanol demand is strong and is expected to increase year-on-year through to 2030 and beyond. It is being increasingly sought after as a clean burning fuel in Asian cities and in global shipping. Prices are anticipated to remain high, at around US $500-600/tonne (Exhibit 29).

Exhibit 29: Global demand for and price of methanol, 2000-2030



Gas is likely the main source of fuel for Methanex in the long-term, but it is exploring alternatives, including hydrogen and renewable methanol. The company could also deploy CCUS or carbon capture and injection back into the methanol stream in future. Methanex is currently conducting feasibility studies for CCUS in its North American facilities. To do so in the New Zealand context would require further investigation in a New Zealand context to determine both the technological and economic feasibility.

Methanex has a lower emissions-intensity than other uses of gas, so gas emissions can be cut by nearly ~50% by 2035 while demand only declines by ~30% if Methanex production continues. This provides critical support to the gas sector through the transition as well as lower price, more reliable gas supply to New Zealand. With lower price gas, we can maintain affordable electricity which will underpin a rapid transition to electrification of transport and industry and minimise risks of carbon leakage.

26 The commentary and analysis in this case study is based on publicly available information.

27 Methanex, Quarterly Report, December 2021 (https://www.methanex.com/investor-relations/financial-reports).

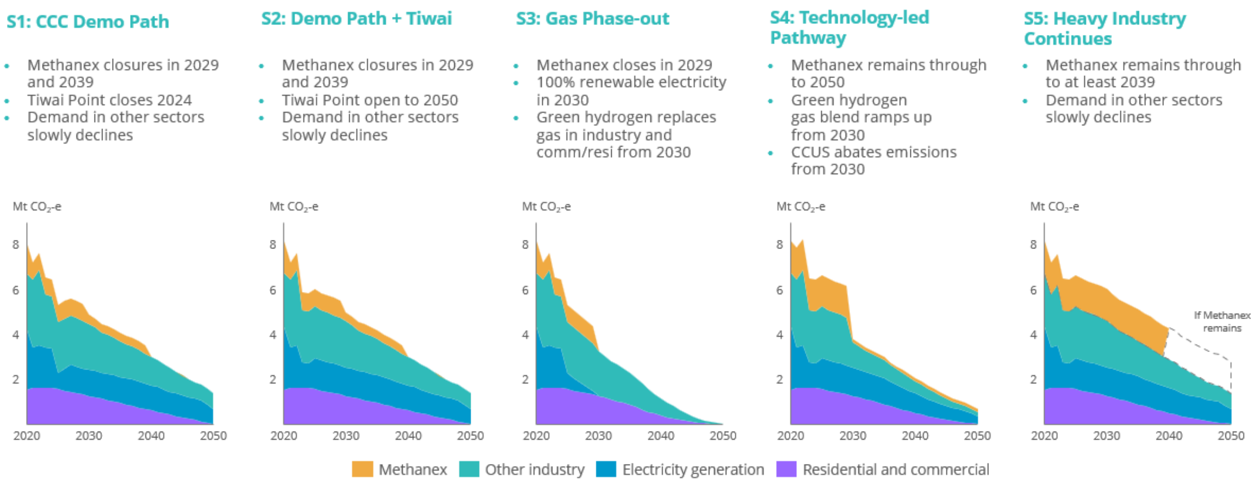
6.3 Emissions reductions over time across the scenarios

All scenarios also show a decrease in gas emissions over time (Exhibit 30). Sharp emissions reductions are driven by either the sudden phasing out of a particular source of demand, or by the introduction of an emissions reduction technology, such as CCUS.

Scenarios 1, 2, 3 and 5 see emissions reduce as gas demand reduces. In Scenarios 1 and 2 (CCC Demonstration Path and Demonstration Path with Tiwai Point), emissions follow a similar trajectory but are somewhat smoother in Scenario 2, due to the certainty of Tiwai Point remaining in the market. Scenario 3 (Gas Phase-out) sees a sharp reduction in emissions in 2030 when Methanex closes, and electricity is generated by renewable sources. Scenario 5 (Heavy Industry Continues) sees emissions follow a similar trajectory to Scenario 4 until 2030. At this point, without CCUS, emissions diverge, until a sudden drop in emissions is realised in 2039 when Methanex closes. If Methanex were to remain until 2050, emissions would steadily decline, albeit at a higher level.

Scenario 4 (Technology-led Pathway) sees CCUS mitigate ~2 Mt CO_2-e emissions from 2030. It has been assumed that 90% of Methanex's emissions can be captured using CCUS, as well as most of Ballance's emissions from fertiliser production. Emissions reduce gradually through to 2050, aided by the incremental blending of green hydrogen up to a 50% level in 2050. The additional upstream oil and gas emissions reduction potential that CCUS could provide has not been captured here but represents an additional benefit of CCUS in this scenario.

Exhibit 30: Projected greenhouse gas emissions by scenario



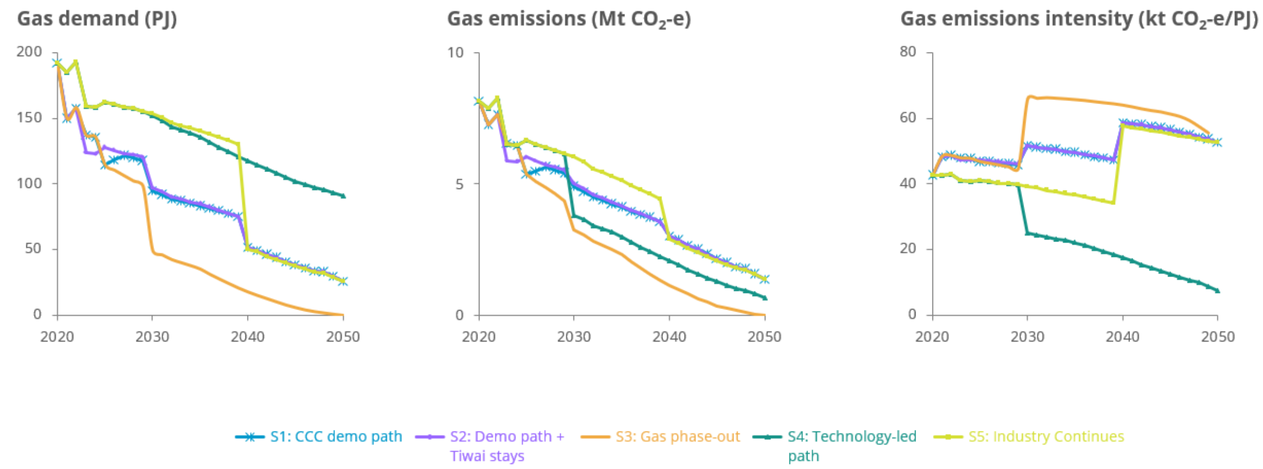
Source: Climate Change Commission - Demonstration Path; and Tiwai Stays with Certainty path

6.4 Emissions intensity over time across the scenarios

The left-hand-side graph in Exhibit 31 below shows the overall demand for gas. In the middle, we see the overall emissions by scenario. The graph on the right-hand-side shows the emissions intensity for gas, that is, the amount of greenhouse gas emitted per PJ of gas consumed (excluding upstream and midstream emissions). This emissions intensity graph reveals three things, being:

- Methanex plays an important role in lowering emissions intensity. For all scenarios, emissions intensity decreases most years as Methanex output remains constant and other demand sources decrease. As Methanex has an emissions intensity of 17 kt of CO_2-e per PJ, compared with ~50 kt of CO_2-e per PJ for other demand sources, a greater proportion of Methanex demand corresponds to a lower emissions intensity. Likewise, we see the emissions intensity rise in Scenarios 1 and 2 when Methanex is modelled to close production trains in 2029 and 2039, and likewise the sharp increase in emissions intensity in Scenario 5 if both remaining Methanex trains were to exit at the same time in 2039;
- CCUS significantly helps lower the emissions intensity of gas. It is the primary reason why the emissions intensity of Methanex is much lower in Scenario 4 than in all other scenarios from 2030 onwards; and
- green gas bends the emissions intensity curve downwards, as seen in Scenarios 3 and 4. We see the emissions intensity decrease further with each passing year, as opposed to the linear decreases seen under Scenarios 1, 2, and 5.

Exhibit 31: Gas demand, emissions, and emissions intensity of our 5 scenarios



Note: Scenario 5 assumes Methanex closure in 2039, ignores world in which Methanex remains until 2050 and beyond

Source: Climate Change Commission - Demonstration Path

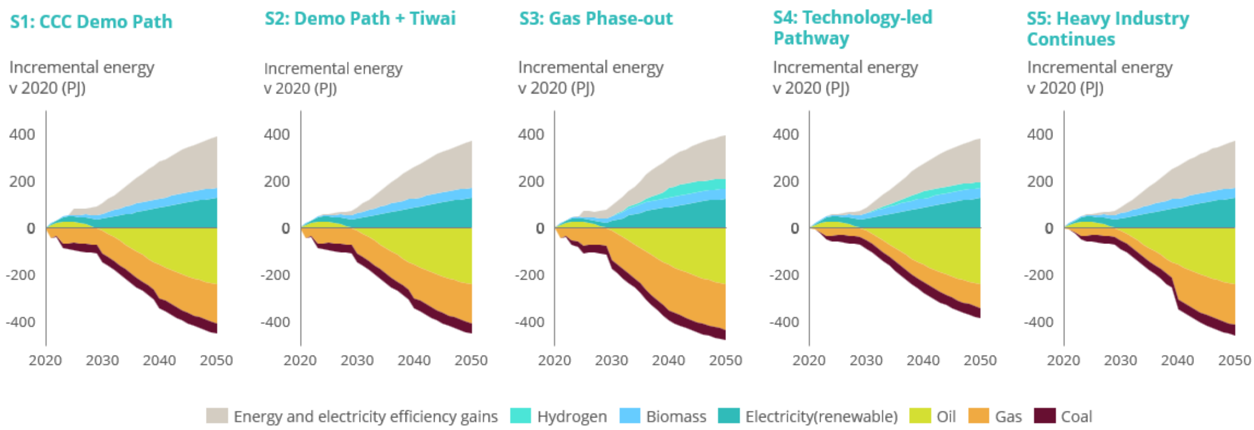
6.5 The energy gaps through the energy transition

As coal, oil and gas use declines over the next 30 years, these fuels will need to be replaced by equivalent fuels or energy savings. Exhibit 32 shows the reduction in certain fuels forecast under each scenario through to 2050 (coal, gas, oil) below the x-axis, as well as the additional fuel (relative to a 2020 baseline) required to meet demand above the x-axis. The grey wedge represents energy and electricity efficiency gains. Because electricity is the most efficient form of energy, it requires fewer PJs of energy than fossil fuels to provide the same level of output. We see that:

- forecast levels of biomass, oil and coal energy remain constant across our five scenarios over time;

- **Scenario 1** (CCC Demonstration Pathway) **and Scenario 2** (Demonstration Pathway with Tiwai Point) are near-identical;
- **Scenario 3** (Gas Phase-out) sees the largest energy gap from today, particularly from 2030. Hydrogen helps make up some of the potential deficit, but much more renewable energy is needed within the next decade to avoid an energy gap if gas is displaced;
- **Scenario 4** (Technology-led Pathway) sees the smallest energy gap from today, with gas underpinning the transition, without having a worse impact on the environment due to the technological advancements of CCUS and green hydrogen. Hydrogen ramps up gradually over time from 2030; and
- **Scenario 5** (Heavy Industry Continues) sees a small energy gap through to 2039 when Methanex exits, acknowledging in this scenario it may stay until 2050. Given that Methanex uses gas as a feedstock, it is assumed that Methanex's closure leads to a shift in the total energy levels which will not need to be compensated for elsewhere. For this reason, the amount of additional renewable electricity required remains relatively small, even from 2040, in Scenario 5.

Exhibit 32: The energy gaps of our five scenarios[28]



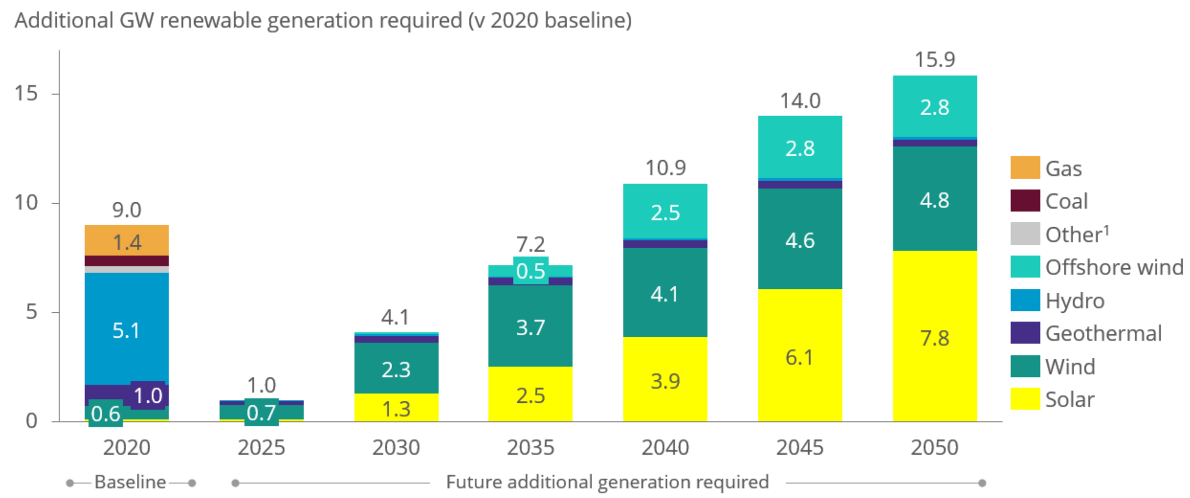
Source: Climate Change Commission—Demonstration Path and Tiwai Stays with Certainty path (adapted)

Given that **Scenario 3** sees the sharpest decrease in gas supply and demand, we investigated what would be needed to deliver this pathway. We found that to phase gas out entirely, we would need to build approximately 530 MW of power plants every year until 2050 — equivalent to 3–5 large-scale wind farms annually. That's about 125 new wind turbines, or over 1.3 million new solar panels, every year, and almost twice the electricity infrastructure we have built over the last 100 years in the next 30.

28 The 'energy gap' graphs outline the additional energy needed by source (above the line) and the energy that will be replaced (below the line). The graphs balance energy above the line and below the line, accounting for the fact that energy reduced from Methanex is not replaced. As the graph balances energy there is technically no 'energy gap' per se – but the graph demonstrates the level of new energy development (generation and efficiency savings) required (above the line) which could result in a gap if there if this is not realised, and sufficient gas is not available to hedge against this shortfall. The graphs therefore give a strong indication of the magnitude of 'what needs to be true' to ensure there is no gap.

To reach this figure, we calculated the additional PJ of electricity and hydrogen that would be required each year through to 2050 to meet increased demand for these fuels and meet the energy gap if a gas phase-out was accelerated. We looked to the CCC's modelling to ascertain a split by source of energy and factored in additional offshore wind to meet increased needs for hydrogen. See Exhibit 33 below.

Exhibit 33: The amount of renewable energy required during a Gas Phase-out pathway



1. Includes co-generation

Source: Climate Change Commission (adapted from Demonstration Path)

Filling this energy gap is likely to be challenging. Therefore, it is important that there is a future for gas in the transition as it will help to manage hurdles in the transition to clean energy. If, for example, renewable energy takes longer to be deployed, having the ongoing 'option value' of a future gas sector present in the country is extremely valuable as a hedge.

6.6 What the scenarios mean: considerations for the energy transition

By exploring the different trade-offs of various possible gas transition pathways, we have revealed some key considerations for achieving an orderly energy transition.

The scenarios reveal the critical role of Methanex. As it consumes over 40% of New Zealand's gas, it underpins investment in the gas sector, and under appropriate conditions has the potential to flex demand in the future to ensure a reliable supply of gas where it is needed. With Methanex also having much lower emissions intensity than other gas users, it highlights the benefits of continued Methanex operation in the Taranaki during the energy transition.

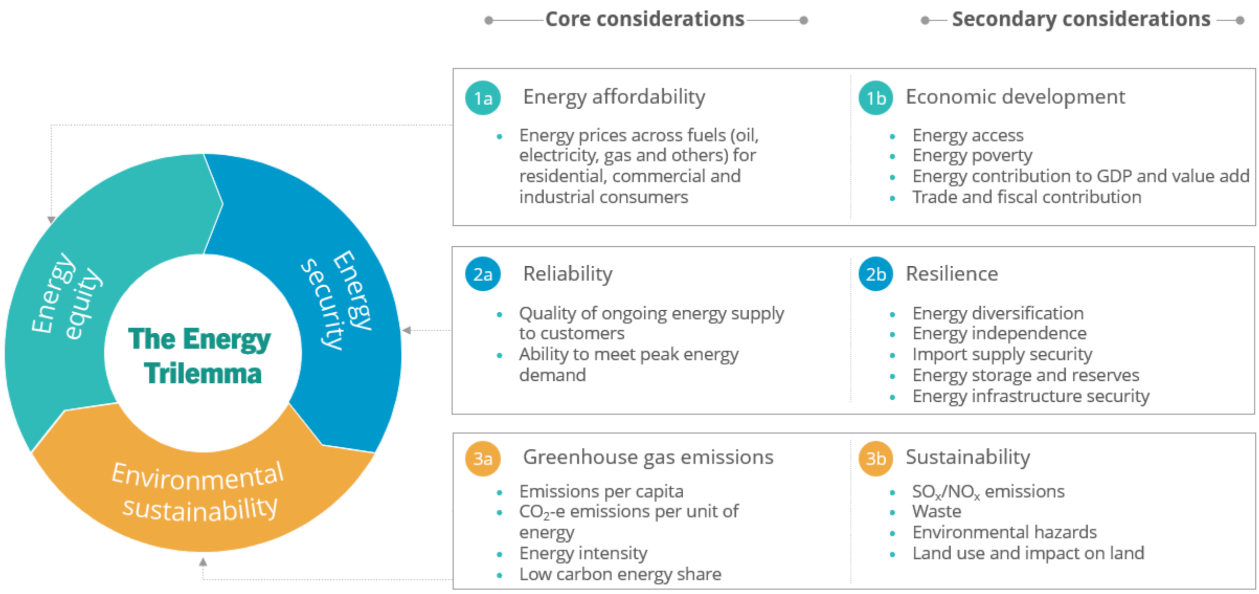
While **Scenario 3 (Gas Phase-out)** sees 100% renewable electricity by 2030, this would require vast amounts of electricity to be consented, built, and completed in a short space of time to avoid a significant energy gap. It would also be economically sub-optimal.

We found **Scenario 4 (Technology-led Path)** is the most optimal gas transition across the various elements of the trilemma. Gas prices will be lower, without any sudden industry exits, and a reliable supply of gas will be assured, with Methanex underpinning confidence in the market and contributing to the Taranaki economy. CCUS and green hydrogen can make a significant difference in lowering emissions, while contributing to an orderly energy transition. It is also the scenario with second lowest gross gas emissions from 2030 onwards. If this scenario's positive impact on electrification were to be overlaid, it is quite plausible that energy prices and reliability would be improved relative to Scenario 3 (Gas Phase-out).

7 Delivering an orderly transition that ensures good outcomes for consumers

One of the most challenging aspects of moving to a net zero carbon economy will be maintaining an affordable and reliable energy supply throughout the transition. Even as renewable energy is increasingly developed, gas will play a central role in providing affordable, secure, and sustainable energy — achieving a balanced energy trilemma (Exhibit 34). Gas is likely to be the most critical of the three fossil fuels (coal, oil, and gas) in the future New Zealand energy system.

Exhibit 34: The Energy Trilemma



Source: Energy Resources Aotearoa

An orderly, well-managed transition is imperative to the broader energy system's shift to low emissions energy. From an affordability and security perspective, this is because all gas used in New Zealand is domestically produced. Changes in domestic supply and demand will have a significant impact on the price of gas and its availability for consumers, as well as a significant impact on electricity prices which flow through the economy. It will also be challenging to replace gas as a feedstock, source of high temperature heat, or for other specialty uses.

From a sustainability perspective, affordable, reliable gas supply will be critical to enabling the electrification of transport and industry. Gas has the lowest emissions intensity of the three fossil fuels (coal, oil, and gas), making it a more economic transition fuel than coal and oil (Exhibit 35). A similar view of the trilemma specific to oil and gas can be found in *Appendix 2.*

Exhibit 35: Gas' role in achieving a balanced trilemma throughout the energy transition

				Equity	Security	Sustainability	
	PJ and emissions today	PJ and emissions (2035 forecast[1])	Supply and demand dynamics	Price dynamics	Reliability dynamics	Emissions dynamics today	Low carbon alternatives
Gas	192 PJ 9.5 Mt CO_2-e	138 PJ 5.1 Mt CO_2-e	All NZ consumed gas is domestically produced	Both domestic gas supply and demand impact pricing $9-12/GJ	High gas supply security due to indigenous production	11% of national emissions 50 kt CO_2-e/PJ	Lowest emissions intensity fossil fuel - less economic to replace than oil / coal
Oil	292 PJ 18.4 Mt CO_2-e	206 PJ 12.8 Mt CO_2-e	All NZ consumed oil is imported	Determined by global markets, NZ has little impact $17-21/GJ	NZ is small and distant market, but with diversified imports	24% of national emissions 63 kt CO_2-e/PJ	Significant opportunity to decarbonise at scale with EVs
Coal[2]	66 PJ 5.8 Mt CO_2-e	25 PJ 2.2 Mt CO_2-e	73% is domestically produced 27% is imported	Determined by global markets, NZ has little impact $14-18/GJ	NZ is small market with most imports from Indonesia, low- security impact	7% of national emissions 88 kt CO_2-e/PJ	Highest emissions intensity - options to replace with biomass and electricity for heat energy
Electricity	142 PJ 4.7 Mt CO_2-e	164 PJ 2.0 Mt CO_2-e	97% is domestically produced (inc. 10% from local gas), 3% from imported coal	Determined by hydro levels, gas prices, carbon price $25-35/GJ	High reliance on hydro, little storage – dry year problem, e.g., 2021 blackout	6% of national emissions 30 kt CO_2-e/PJ	Options to transition coal to gas and to replace baseload gas with renewables + peaking gas
Biomass	56 PJ *Net emissions negligible*	93 PJ *Net emissions negligible*	100% domestically produced	*To be assessed* $10-20/GJ	Few issues with security of supply	*Net emissions negligible*	*Net emissions negligible*

1. CCC demonstration path; gas energy and emissions forecast based on 'Industry Remains' scenario
2. Includes coal used in industry, including steel

Source: Climate Change Commission - Inaia Tonu Nei; MBIE Energy Prices

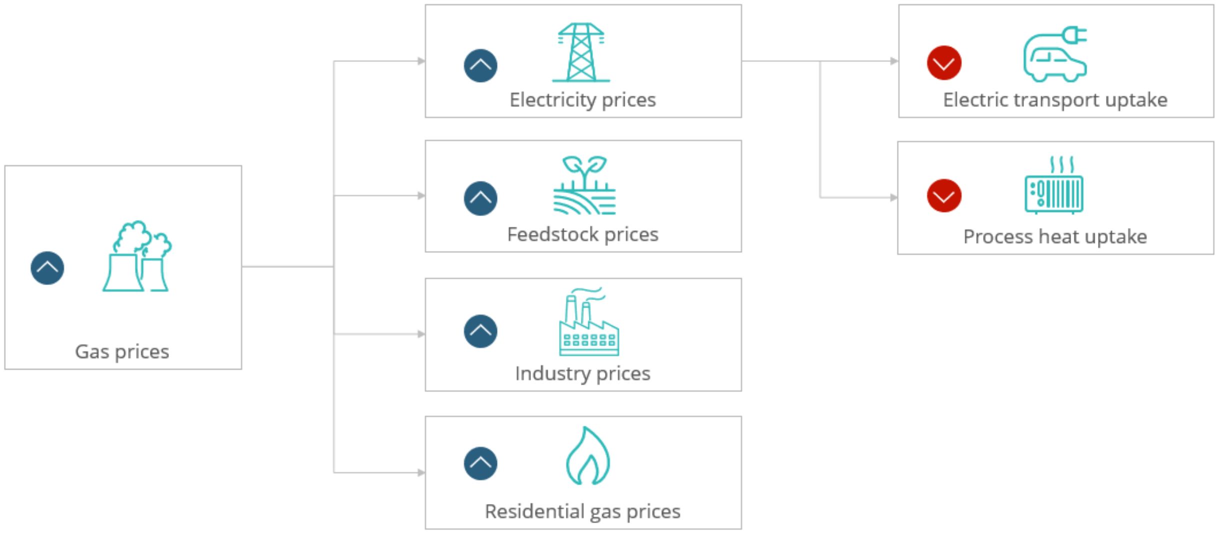
Scenario 4 (Technology-led Pathway) and Scenario 5 (Heavy Industry Continues), outlined in Section 6, enable this orderly gas transition. In contrast, a disorderly or chaotic transition could result in unintended consequences for equity, security, and sustainability. This could possibly occur in Scenario 1 (CCC Demonstration Path) but is particularly likely to occur in a Scenario 3 (Gas Phase-out).

7.1 Energy equity: gas supports affordable energy and electricity, and will continue to do so under an orderly transition

There are several factors that will impact the affordability of gas during New Zealand's net zero carbon transition. Most notable will be the future economics of gas production, investment confidence, and market certainty of large users like Methanex into the future.

The wholesale price of gas directly impacts the prices of other resources, such as electricity, feedstocks, industrial goods, and gas for commercial and residential use. The electricity price can influence the uptake of electrified transport, and the electrification of heat. In this way, the impact of gas prices is felt across the New Zealand economy (Exhibit 36).

Exhibit 36: The impact of gas prices across the New Zealand economy



EnergyLink has conducted analysis to demonstrate the impact of higher gas prices on the energy transition. Detail of the analysis can be found in *Appendix 3*, and below in Exhibit 37. Two simple gas price assumptions have been used:

1. **higher gas price**: a disorderly transition with an average gas price of ~$10/GJ over the next 15 years. This is possible in a transition like Scenario 1 (CCC Demonstration Path), and more likely in Scenario 3 (Gas Phase-out); and

2. **lower gas price**: an orderly transition with an average gas price of ~$8/GJ over the next 15 years. This is more likely in our Scenarios 4 and 5 (Technology-led Pathway and Heavy Industry Continues).

The impact of gas prices flows through to downstream gas consumers directly, affecting the price of gas for methanol and fertiliser production, industry (like food production) and residential and business consumers. It therefore directly impacts on the international competitiveness of our major export industries.

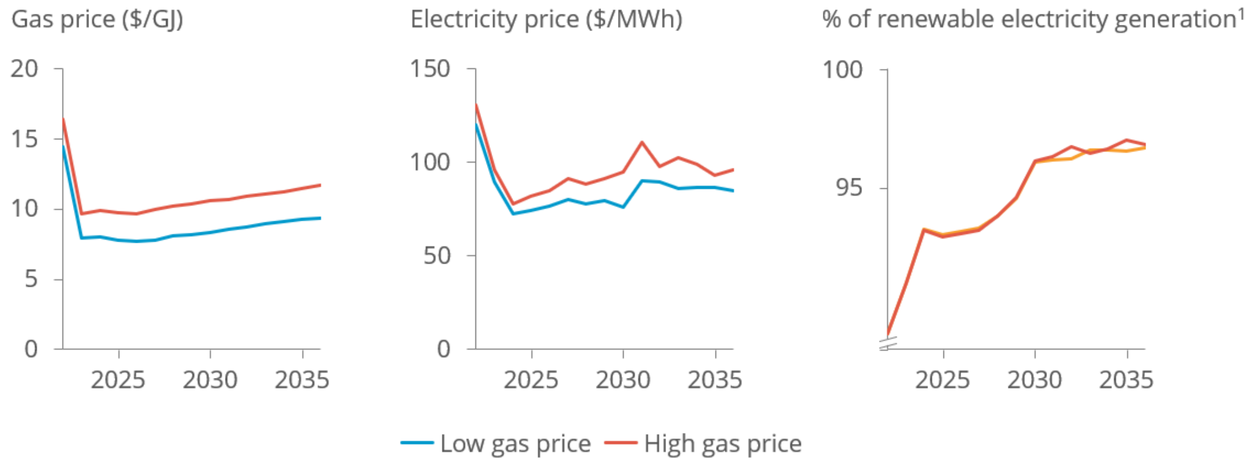
The analysis also found that gas pricing has a direct causal impact on electricity pricing, impacting all electricity consumers in New Zealand. *Appendix 3* on electricity pricing analysis provides more detail on this dynamic.

Table 1: Impact of higher vs lower gas price in 2025

	Lower gas price (orderly gas transition) (~$8/GJ)	Higher gas price (disorderly gas transition) ($10/GJ)
Non-electricity gas use (GJ)	125,000,000	125,000,000
Gas price	~$8/GJ	~$10/GJ
Gas price delta		$2/GJ
Total non-electricity price impact		**$250 million**
Electricity demand (GWh)	41,000,000	41,000,000
Electricity price average (real dollars)	$75/MWh	$82/MWh
Average electricity price delta		~$7/MWh
Total electricity price impact		**$300 million**
Total impact of gas price increase		**$550 million**

For the higher gas price scenario, the electricity price was $7/MWh higher on average. The gap between the gas price and the electricity price remains roughly equal over time, suggesting a clear correlation. Even as gas generation declined and renewables increased over time, the impact of gas prices on electricity prices did not diminish. This is because as weather-dependent generation sources like wind and solar increase, gas is still needed to back them up. When the wind is not blowing, and the sun is not shining, gas is required to provide the flexible energy that the electricity system needs.

Exhibit 37: Affordable gas is critical for affordable electricity



1. Excludes co-generation

Note: All future price forecasts in real terms, assuming 2% annual inflation

Source: EnergyLink

Interestingly, in the model, higher gas prices did not support increased renewable electricity generation and resulted in a deadweight cost to consumers. This was because at a higher percentage of renewable electricity (i.e., 90%+), gas is largely used when solar and wind are not able to generate electricity. As a result, solar and wind cannot fully capture the benefits of the gas price impact on electricity pricing (i.e., it does not improve their economic case).

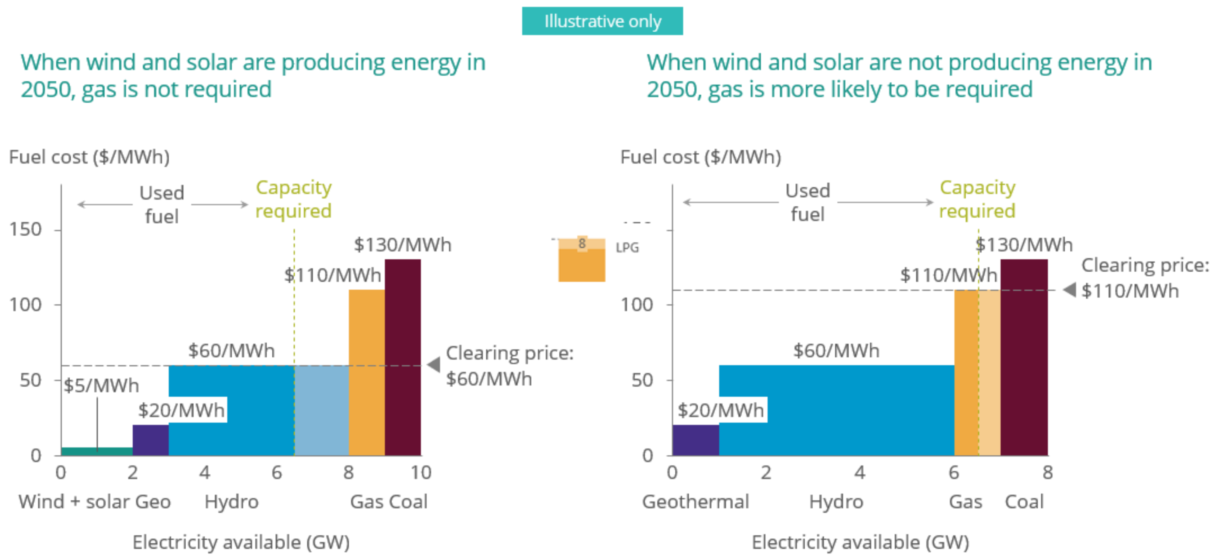
This creates a two-speed market, featuring:

- lower electricity prices when wind and solar are producing electricity (in windy, sunny conditions) and gas is not needed; and
- higher electricity prices in still but overcast conditions, when gas is required to meet demand, but wind and solar are not generating (and wind and solar are therefore unable to capture these higher prices).

This dynamic is captured in Exhibit 38. In New Zealand, and indeed nearly all liberalised electricity markets around the world, the price is set by the marginal bidder.[29] The marginal price setter determines the price for all dispatched power plants in the electricity market. The price that gas generation bids into the market is largely a function of the gas price.

As the graph below shows, there will likely be occasions in the future when there is a substantial amount of renewable capacity available to meet demand, however when wind and solar are not operating, gas will likely be required to meet demand, and as a preferable alternative to coal. When gas is the marginal price setter, and gas is scarce and expensive, all electricity is expensive; conversely, if gas is available and affordable, then all electricity is affordable.

Exhibit 38: A two-speed market develops with high levels of renewable electricity



Under an orderly, well-signalled energy transition, there is investment certainty for gas producers, which translates to lower gas prices. This is advantageous for gas and electricity

29 The uniform clearing price auction is used in nearly all liberalised electricity markets because it is the most effective mechanism for ensuring bidders have incentives to bid their true underlying marginal cost. It also ensures that 'must run' power plants can bid their underlying cost and recover long-run marginal costs which supports reliability. Further reading is available in the paper *Why we need to stick with uniform-price auctions in electricity markets* by Cramton and Stoft (2006).

consumers and is more likely to occur under our Scenarios 4 and 5 (Technology-led Pathway and Heavy Industry Continues).

The difference in energy prices (both gas prices and indirectly electricity prices) between a higher gas price and a lower gas price scenario is marked. The impact of a higher gas price path (relative to a lower gas price path) is a Net Present Value (NPV) of $6.3 billion in energy costs to consumers to 2036. In other words, lower gas prices are worth $6.3 billion to consumers over 15 years, which is $210 per household per year on an NPV basis.

The analysis also found that over this time horizon, the impact was similar regardless of whether Tiwai Point closes or continues to operate at the end of 2024. While total prices are lower through the period 2024-2029, the price gap (between the lower gas price and higher gas price scenarios) persists.

It is also worth noting that the cost of increased gas prices, and therefore energy, impacts economic productivity. Productivity is driven by efficient labour and capital inputs into the economy. Energy is one of these critical economic inputs. When energy costs are higher, economic output is impacted.

Higher energy prices make it more difficult for New Zealand industry to compete globally. Affordable energy prices will shield against potential de-industrialisation, ensuring a just transition as jobs and economic output remain in New Zealand. Affordable energy will also support the development of new industry, including the production of hydrogen and the operation of large-scale data centres.

7.1.a. Affordable gas is the answer to affordable energy

These findings create some inherent issues for the energy transition. One tempting, but incorrect answer would be to phase out gas entirely from the electricity system. This has been identified as a much higher cost solution than keeping gas in the electricity system by the CCC, the Interim Climate Change Committee (ICCC), and almost all other expert modellers who have investigated this issue. Rather than phase out gas in the electricity system, we must create investment conditions that support affordable gas. This will benefit direct users of gas and electricity consumers. In turn, this will promote accelerated electrification, as identified by the CCC and the ICCC.

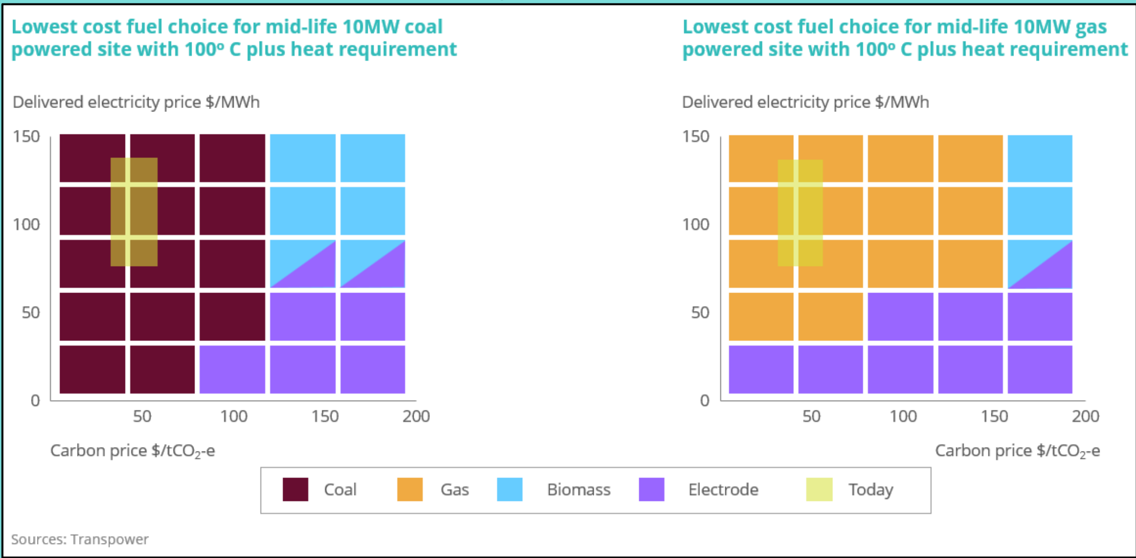
In EnergyLink’s analysis, the percentage of renewable electricity climbed to around 94–97% from 2030, with gas staying in the mix to ensure lower total system costs. These findings are consistent with those of the CCC who have suggested that the government abandon its 100% renewable electricity target in favour of a 95–98% range. Phasing out gas further beyond these levels leads to higher electricity system prices and less electrification. The CCC noted in its Demonstration Path that gas is likely required in the electricity system through to 2050.

This would be more likely to be supported under the Heavy Industry Continues and Technology-led scenarios which would ensure that gas pricing is affordable because of a stable investment environment for gas production that supports an orderly transition.

Case study: The role of gas in affordable medium-high temperature process heat

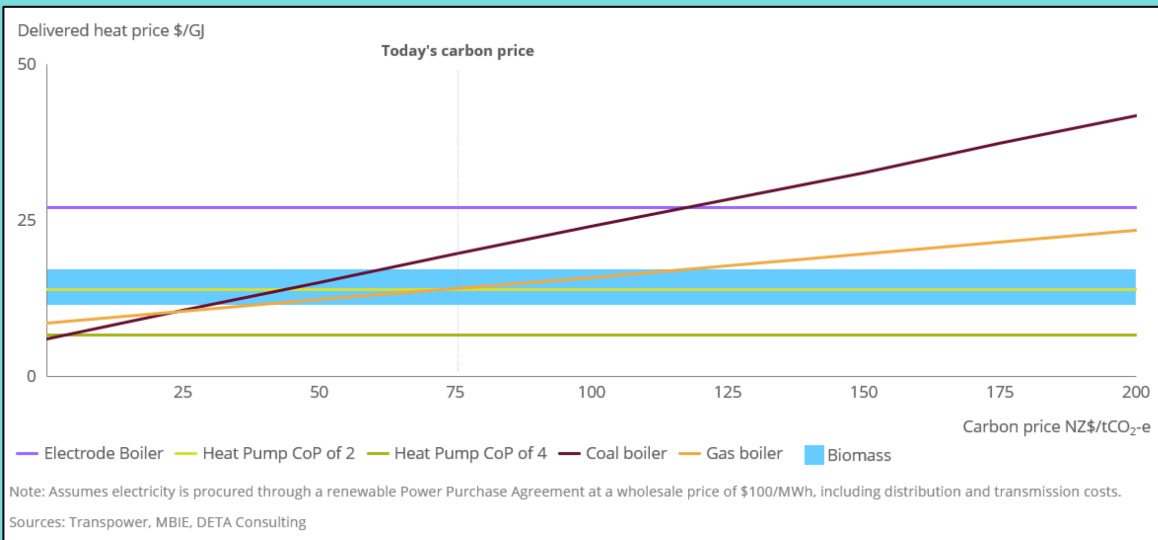
Analysis from Transpower identified that a carbon price of $200 per tonne of CO_2-e is needed to replace a gas boiler for medium temperature heat (100-300°C) early. For coal, the required carbon price is more in the range of $150 per tonne of CO_2-e (Exhibit 39).

Exhibit 39: Most economically rational before-end-of-life fuel choice



This shows that, consistent with the CCC's analysis, coal is the fuel that is most likely to start to be converted to cleaner alternatives in industry (Exhibit 40).

Exhibit 40: Delivered heat price by fuel and technology type under different carbon price scenarios



Where capital costs to convert are very high, hydrogen blending could allow some users to gradually decarbonise while paying incremental operating expenses in the future. Ultimately, in a robust policy environment, the ETS will send the right signals to consumers about which fuels are most economic to convert to lower emissions. This will be supported by a technology-led approach to emissions reductions.

7.1.b. Transitioning to 100% renewable electricity by 2030 would be very expensive and is the wrong choice for affordable energy

The Government is considering developing Lake Onslow pumped hydro energy scheme. Based on international experience, this is likely to cost much more than the estimated ~$4 billion to develop.

Five years ago, the Australian Government announced a similar project — a Snowy 2.0 pumped hydro scheme which was to be built for $2 billion in 4 years. 5 years later, the project is not complete. The latest cost estimates are now between $5-10 billion (2.5 to 5 times the original estimate) with an estimated timeline of 10 years.[30] Snowy 2.0 also has 350 GWh of storage which would be roughly one fourteenth of the size of the Lake Onslow scheme (Table 2).

Table 2: Comparison of Snowy 2.0 and Lake Onslow pumped hydro schemes

	Snowy 2.0 (NSW, Australia)	**Lake Onslow (New Zealand)**	**Comment**
Technology	Pumped hydro energy storage	Pumped hydro energy storage	
Proposed storage	350 GWh	5,000 GWh	Lake Onslow is proposed to be 14 times the size of Snowy 2.0
Initial cost estimates	$2 billion	$4 billion	Gas storage of 5,000 GWh could be built for ~$200 million
Latest cost estimates (NZD)	$5 to $10 billion	*Under investigation*	Lake Onslow cost likely to be much than initial cost estimate – some parties estimate as much as double.
Initial forecast completion date	2020/2021 (4 years construction)	*To be determined, although 2030 is targeted*	
Latest forecast completion date	2026/2027 (10 years construction)	*Under investigation*	Lake Onslow is a complex large-scale engineering project and could take a long time to build

Developing Lake Onslow is an incredibly expensive way to make the last 2–5% of electricity generation renewable. For a likely cost of $4–$10 billion it would reduce CO_2 emissions by just 500 to 1,000 kt of CO_2-e per year. Assuming a lower bound construction cost of $5 billion, this implies a marginal abatement cost of ~$500 per tonne of CO_2-e abated over 15 years from 2035 to 2050.

Even if Lake Onslow proceeds there are several unintended consequences for the energy trilemma that need to be considered. Based on experience from Australia's Snowy 2.0

30 *Five years on, Snowy 2.0 emerges as a $10 billion white elephant*, March 2022 (https://www.smh.com.au/national/five-years-on-snowy-2-0-emerges-as-a-10-billion-white-elephant-20220310-p5a3ge.html).

scheme, Lake Onslow is likely to be completed by 2032, with some gas required to fill the lake through to 2035. This timeline causes uncertainty in the gas market to 2035 which could result in higher gas prices. Our analysis shows that the consumer cost of higher gas prices to 2036 would be ~$6.3 billion on an NPV basis.

This would also crowd out interim investment in electricity peaking generation and dry year solutions which are critical to increasing electrification through to 2035 until Lake Onslow is fully operational. This could compromise energy reliability and security and hamper New Zealand's electrification efforts. It could also worsen North Island's security of supply as the project would shift peaking capacity to the South Island.

In summary, a significant government intervention in energy markets like Lake Onslow, would lead to the same undesirable disorderly transition outlined in the Gas Phase-out scenario.

7.1.c. The best solution is to send the right price signals via the ETS

EnergyLink's analysis demonstrates that a robust carbon price and market forces will likely push renewable electricity generation to 94–97% from 2030. This also leads to the most affordable electricity pricing which enables widespread electrification (and associated emissions reductions). As a result, in Energy Resources Aotearoa's view, there is limited need for direct government intervention in the electricity market. The market is best placed to determine the optimal percentage of renewables provided the ETS has a 'hard cap' in place to guarantee emissions targets are met. This is outlined in Exhibit 41.

Exhibit 41: Logic flow for identifying the best approach for electricity policy

Approach	Gas market outcome	Electricity market outcome	Energy trilemma outcome	National impact
Let market determine optimal percentage of renewables with a robust ETS to ensure emissions reductions	Policy certainty enables investment leading to lower gas prices	Market achieves **94-97%** renewable electricity from 2030 at least cost	Electrification is maximised, overall emissions reductions are better, security of supply is maintained, and prices are more affordable	Improved emissions reductions and economic productivity
Target 100% renewable electricity without Lake Onslow	Policy uncertainty leads to higher gas prices	Market may not achieve **100%** renewable electricity and prices are high	Electrification is impacted, overall emissions reductions are worse, security of supply is worse, and prices are more expensive	Worse emissions reductions and impacted economic productivity
Target 100% renewable electricity with Lake Onslow	Policy uncertainty leads to higher gas prices	Prices remain high until at least **2035** as gas is still required even with Lake Onslow	Electrification is impacted, overall emissions reductions are worse, security of supply is worse, and prices are more expensive	Worse emissions reductions, impacted economic productivity and large cost to taxpayer of building Lake Onslow

Source: Energy Resources Aotearoa

This could be achieved in a technology-led scenario where all available technologies are enabled through effective regulatory frameworks and consenting pathways. The ETS price would encourage the market to deploy the most cost-effective technologies. Non-renewable sources of electricity generation will only find their place in the absence of renewables alternatives that meet the needs of the system and of consumers at any given point in time.

7.2 Energy security: gas supports a secure supply of energy and will continue to do so under an orderly transition

In New Zealand, we are fortunate to have a domestic gas sector, providing energy security and independence. Nations such as Japan and South Korea and countries in Europe rely heavily on imported gas which exposes their energy systems and broader economies to geopolitical and economic risk. In general, energy costs in these countries are much higher as a result — for gas and electricity.

At the same time, because all gas consumed in New Zealand is domestically produced, every decision we make in terms of domestic policy or regulatory changes for gas has real and significant impacts that flow through the energy system and the economy. This also means that if we get it right, we are much better off than other countries who do not have the luxury of this energy security and independence. This contrasts with oil, where decisions made by New Zealand have almost no impact on the global commodity price and therefore the price we receive. We are a global price taker at the whims of global markets, with control only over domestic taxes and levies.

Gas is important for security of supply for direct users of gas. Methanol, fertiliser, steel, pulp and paper, and dairy and meat production rely on gas to do business. If gas is unaffordable, gas users may be forced to reduce or even cease production. It is important that conditions support continued investment in gas so businesses that rely on it can continue to operate.

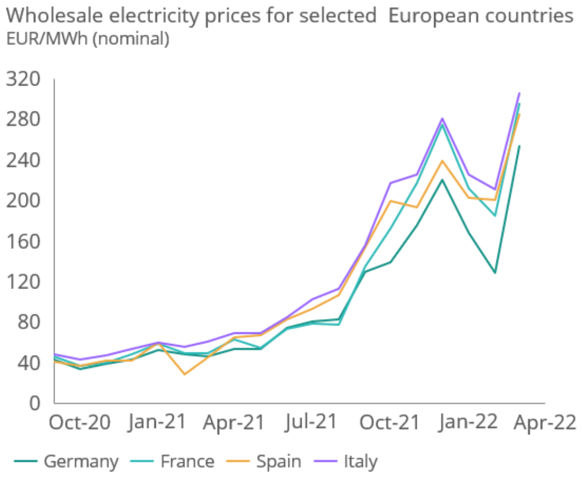
Gas is also critical to providing security of supply in the electricity market. As more intermittent renewable generation plants enter the electricity system, the need for baseload gas is expected to decrease by 2030. However, gas will still be critical for peaking and dry years, to enable affordable and reliable energy supply and the integration of more renewables.

Tight gas supplies in New Zealand and across the world in recent years have demonstrated how gas supply impacts the affordability and reliability of energy supply for customers.

7.2.a. The reality of a disorderly transition was felt in Europe in 2021

Even prior to recent conflict, Europe had been experiencing an energy crisis due to gas shortages. The price of electricity began to rise from the beginning of 2021 due to factors including colder than average weather, lower than average gas stockpiles, and diversions of liquefied natural gas imports from Europe to Asia (Exhibit 42).

Exhibit 42: Energy shortages in EU led to issues in 2021, even before Ukraine conflict



Drivers of crisis:

- Constrained Russian gas imports
- Phase-out of baseload nuclear and coal plants in Germany
- Colder than average weather
- Lower than average gas stockpiles
- Diverted imports of LNG from Europe to Asia
- Lower than average North Sea wind speeds
- Gas-to-coal switching → higher carbon prices

Impacts of crisis:

Customers pay more with long-term impacts to be felt:

- Higher energy costs, particularly seen in counties such as Spain and Italy where gas is a larger portion of the electricity generation mix
- Bankruptcies leading to reduced market competition
- Long-term transformation projects put on hold

Govt energy spending increases, tax take decreases:

- France provided 5.8 million low-income households with further €100/year worth of energy vouchers
- Italy cut VAT on energy prices to 5%

Source: Bloomberg; EnergyScan; Press search

The energy shortage led to a sixfold increase in electricity prices from €40/MWh in January 2021 to ~€250/MWh in December 2021. This demonstrates what can happen if there is an energy shortage and not enough affordable gas to support the energy transition. Consequently, Europe has had to burn more coal and industrial output has been curtailed, impacting both economic and sustainability outcomes. Further analysis on the role of gas in the United Kingdom's electricity system can be found in *Appendix 4.*

This is not to suggest that Europe's energy transition is failing. The continent has been very successful at scaling new renewable energy sources and reducing emissions over a long time. However, this does provide a clear caution of what could occur in a Gas Phase-out scenario. The key lesson is that alongside the scaling of renewable energy in New Zealand, a reliable supply of gas will support an orderly transition — as outlined in Scenario 4 (Technology-led Pathway) and Scenario 5 (Heavy Industry Continues).

7.2.b. Transition speed bumps in New Zealand

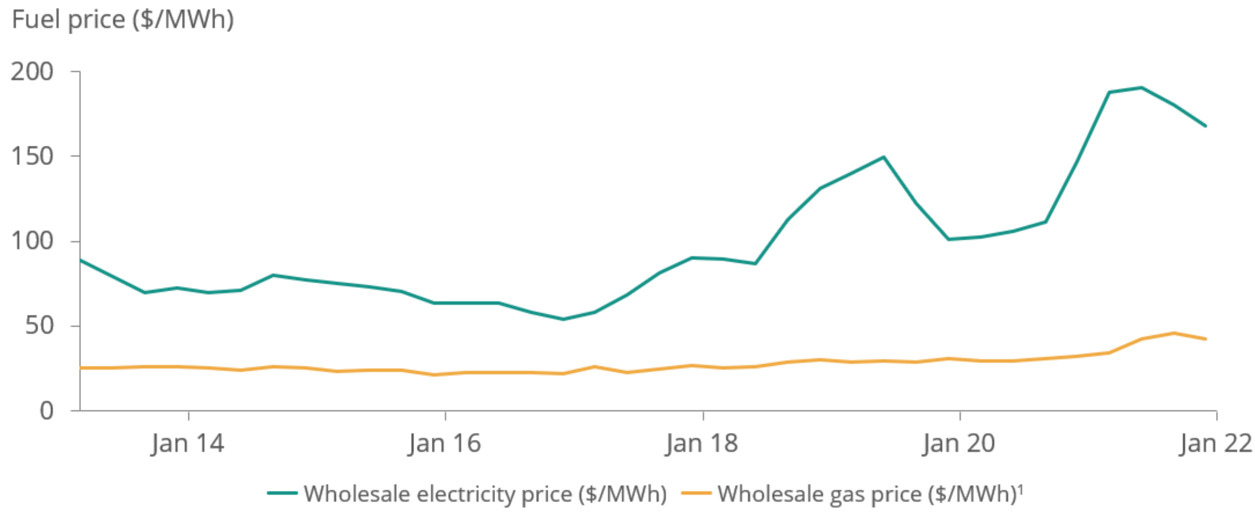
While New Zealand has not experienced energy shortages like Europe, there have been some recent speed bumps in the energy transition. Since June 2020, energy prices have been higher than average (Exhibit 43), coal consumption has increased, and we have experienced dry years and a blackout (9 August 2021). Consumers like Methanex and Tiwai Point have had to curtail energy use to support system security. This represents poor energy trilemma outcomes for New Zealand.

The drivers of these pricing and security issues include:

- dry years in 2020 and 2021;
- increasing carbon price;
- unfavourable investment conditions for energy supply; and
- issues with Pohokura gas field production in 2018 and 2020.

These recent speed bumps demonstrate the unintended consequences of declining gas production, and why an orderly transition, aligned to our Scenario 4 (Technology-led Pathway) or Scenario 5 (Heavy Industry Continues) is favourable to a more disorderly Scenario 3 (Gas Phase-out).

Exhibit 43: Electricity prices and gas prices have been higher in recent years

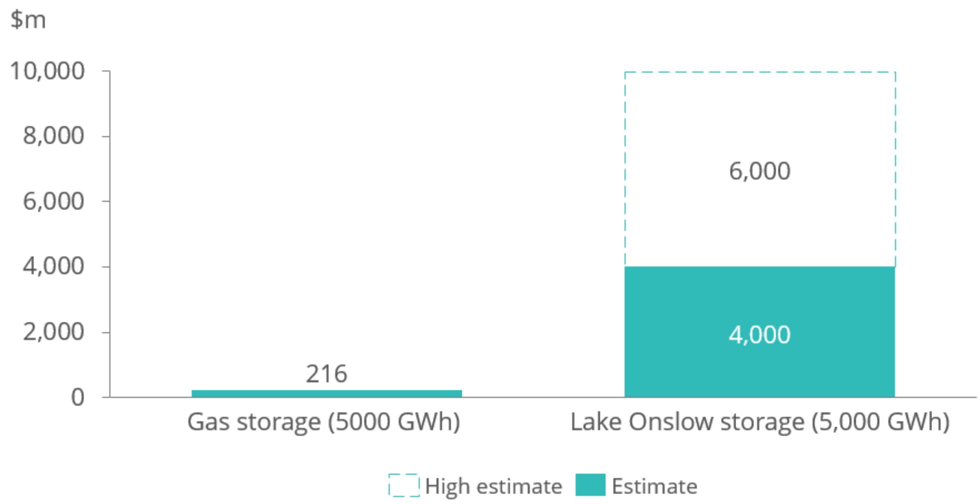


1. Includes variable carbon price

Source: Electricity Market Information, Ministry of Business, Innovation and Employment

There is an opportunity for gas to be the predominant fuel in dry years. This will require more gas system flexibility which could be provided by more gas storage and/or more demand-side flexibility in the gas market. If storage is the solution, it would require roughly 18 PJ of additional gas storage, equivalent to 5,000 GWh or the proposed storage size of Lake Onslow. The Ahuroa Gas Storage Facility that exists today has 18 PJ of storage and was built for a cost of $177 million in 2011 ($216 million in present-day dollars) — a much lower cost than the $4 billion estimate for Lake Onslow (Exhibit 44).

Exhibit 44: Storage required to transition away from coal in electricity: Comparison of cost of 5,000 GWh of gas storage and 5,000 GWh of pumped hydro storage

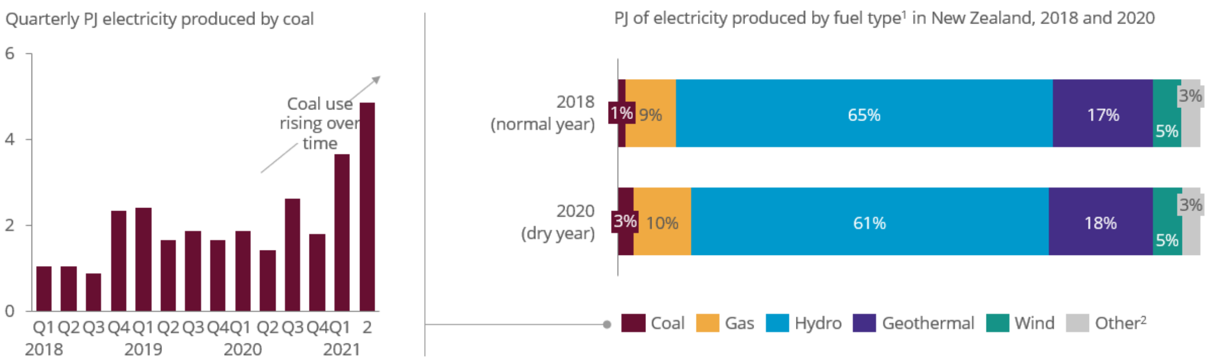


Source: Ministry of Business, Innovation and Employment, Stats NZ, Press search

Case study: The role of gas in transitioning to an electricity system free of coal

Gas will not only continue to play an important role in meeting peak demand, but it could also play a greater role when rainfall is lower than expected. In these dry years, gas can make up for reduced hydro generation. It is expected that as New Zealand's carbon price increases, coal could exit the electricity system and gas will replace it as an interim lower carbon alternative. Currently New Zealand relies on coal to supplement energy in dry years. In 2020, for example, coal generation increased to meet a reduction in hydroelectricity as outlined in Exhibit 45.

Exhibit 45: In the 2020 dry year, coal generated electricity consumption increased



Imported coal from Indonesia, which is emissions-intensive and expensive, is currently used to meet peak demand and as cover in dry years (e.g., 2020). As New Zealand transitions away from coal (as the government has committed to), gas remains an important reserve fuel for electricity generation, particularly in dry hydrological conditions

1. Some fuels, such as coal, gas and geothermal have conversion inefficiencies, which means that their primary energy totals are in fact much higher
2. Includes solar and biogas

Source: Ministry of Business, Innovation and Employment, 2018 and 2020 Gross Energy Balance Tables; Transpower Whakamama i te Mauri Hiko report

7.3 Environmental sustainability: gas will support the transition to a net zero carbon economy under an orderly transition

As the least emissions-intensive fossil fuel, gas will continue to play an important role in the economy during the transition to a net zero carbon economy by:

- improving integration of renewable electricity generation;
- supporting increased electrification of transport and industry by enabling more affordable and reliable electricity;
- providing a viable transition pathway away from coal, particularly as a solution for producing electricity in dry years;
- supporting a viable pathway to lower emissions gas through blending with green gases;
- providing users with relatively low emissions energy where alternatives are currently technologically or economically unfeasible; and
- reducing net emissions for users when it can be paired with CCUS.

In a less orderly, more expensive transition, which will occur in a Gas Phase-out scenario, higher gas prices would hinder decarbonisation because they lead to higher electricity prices overall and slow the electrification of transport and process heat. Analysis from electricity market modellers EnergyLink also found that higher gas prices do not have a material impact on the forecast percentage of renewable electricity in the electricity system.

The ICCC outlined how phasing out gas in the electricity system would lead to more expensive energy and less decarbonisation. We explore this in the case study below.

Case study: Balancing the energy trilemma

The ICCC found that delivering an electricity system with 93% renewables would result in an average wholesale electricity price of $80/MWh in 2030, while 100% renewables would result in an average wholesale electricity price of ~$115/MWh (Exhibit 46). A system with 93% renewables would deliver more emissions reductions because cheaper electricity could be used to electrify transport and industry sectors. The CCC has subsequently agreed that a 100% renewable electricity target is not the optimal way to reduce emissions in New Zealand. Pursuit of 100% renewable electricity would undermine not only affordability, but to sustainability too (Exhibit 47).

Exhibit 46: Cost of chasing 100% renewable electricity

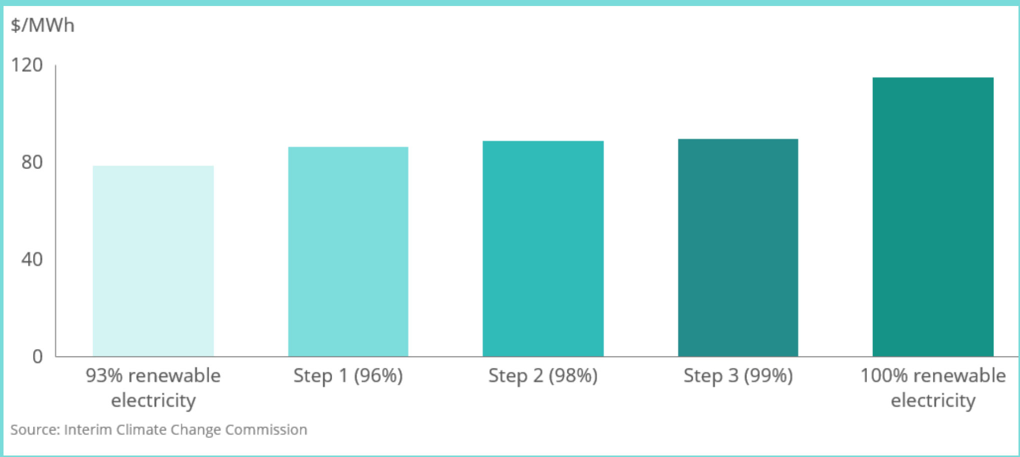
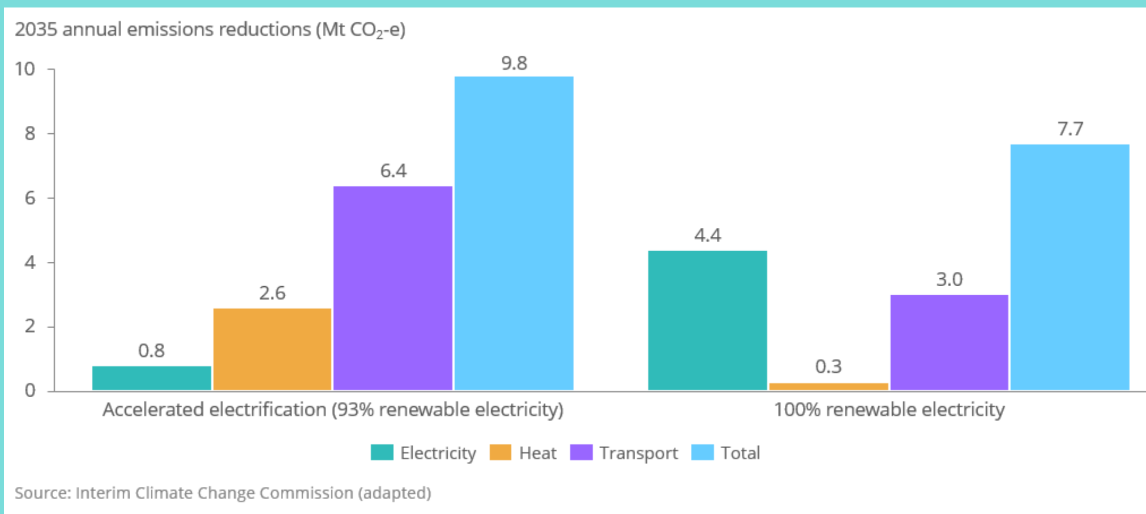


Exhibit 47: Economy-wide sustainability is improved when 100% renewable electricity is not pursued

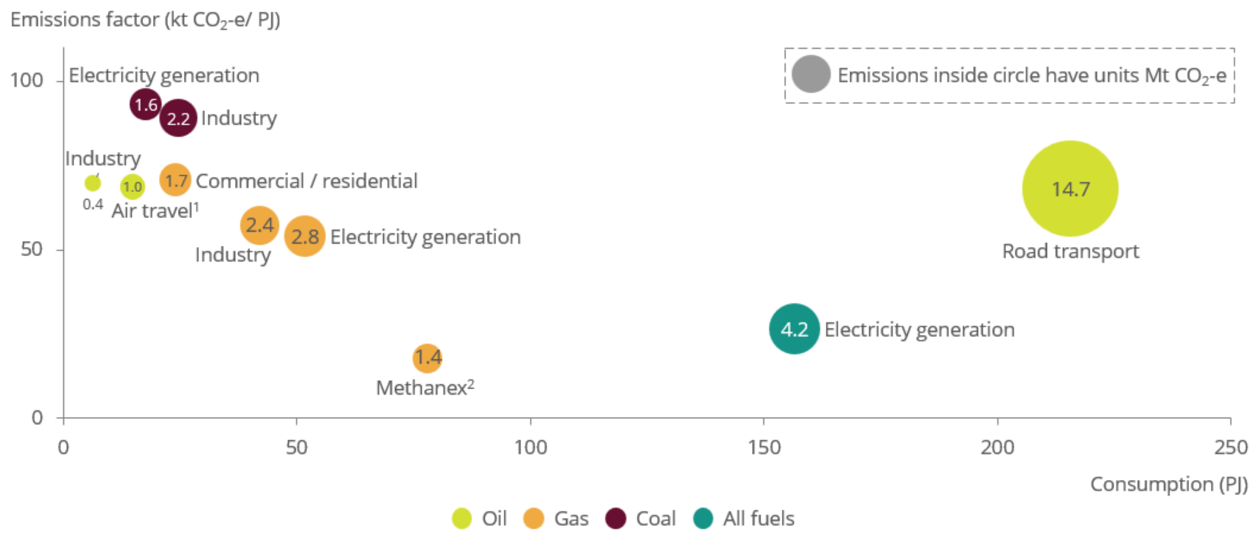


In the ICCC's accelerated electrification scenario, gas is the predominant thermal fuel remaining in the electricity mix. It enables an affordable electricity supply which benefits electrification, and in this scenario total emissions reductions are larger than in the 100% renewable electricity scenario. The analysis demonstrates the critical role that gas plays in reducing emissions across the energy sector.

Another important consideration for the role of gas in reducing emissions is the relative impact of various fossil fuels on the environment, measured by their emissions intensities –

that is, the tonnes of CO_2-e released per PJ of fuel consumed. In Exhibit 48, as we move down the graph from coal to oil to gas, the emissions intensity drops. Indeed, the average emissions intensity for coal is 88 kt of CO_2-e/PJ, compared with 63 kt of CO_2-e/PJ for oil and 50 kt of CO_2-e/PJ for gas.

Exhibit 48: Emissions intensity of fossil fuels[31]



1. Domestic emissions and energy consumption only (international excluded)
2. 2019 data, so includes Waitara Valley

Note: Fugitive emissions have been excluded

Source: Climate Change Commission - Inaia Tonu Nei

For gas specifically, it is important to note that the emissions intensity of Methanex is 17 kt of CO_2-e per PJ, a third of the emissions intensity for other gas uses. This is lower than the emissions intensity of electricity today, even at 85% renewable electricity. This is because two-thirds of the carbon is captured in the methanol production process. Therefore, the gas used to produce methanol is the cleanest form of gas in New Zealand, and indeed methanol made in New Zealand has between a fifth to a quarter of the emissions of methanol produced in countries such as China, where coal is used. If Methanex can remain operating, it will underpin an affordable supply of gas, as well as provide economic output for New Zealand — while maintaining low emissions intensity.

On average, electricity generation has an emissions intensity of 27 kt of CO_2-e per PJ. This is the average across the high emissions intensity of coal generation, the moderate intensity of gas, the 30 kt of CO_2-e per PJ intensity of geothermal-generated electricity, and the negligible intensity of renewables. Hence from a sustainability perspective, renewables are a preferable alternative to fossil fuels, noting that not all processes (such as high-temperature heat processes) are currently able to be electrified with established or even emerging technologies.

31 This graph shows the total energy consumption by sector on the x-axis, and emissions intensity per unit of energy on the y-axis. Fuel type is denoted by colour. The size of the circle denotes total emissions. Those circles further up the graph – such as coal for electricity generation and industry – are more emissions-intensive, while those further down – such as Methanex, and all-fuels electricity generation – are less emissions-intensive. It also shows that road transport uses far more total energy than industry and electricity generation and is responsible for much more total emissions.

On an absolute basis, oil used in transport is the most significant contributor to energy sector emissions and has a higher emissions intensity than gas. On an intensity basis, coal has the highest emissions factor. Subsequently, it is likely that gas will play the most important role of the three fossil fuels through the energy transition.

The relative emissions reductions across these three fuels do not need to be set in stone years in advance. The ETS will send a clear price signal to energy consumers that will allow the most economically viable emissions reductions to occur across the economy.

8 Future opportunities to reduce emissions

The extensive analysis in this report has provided a strong case for the importance of an orderly transition. Before outlining the recommendations to achieve this orderly transition (Section 9), we believe it is important to outline opportunities for the upstream oil and gas sector to further reduce its emissions and assist the economy in the transition to net zero carbon.

8.1 Overarching view of the opportunities

Upstream producers' activities lead to 1% of national emissions. While the size of these emissions is not as large as downstream consumption, it is Energy Resources Aotearoa's view that all sectors need to reduce emissions to meet national targets. To that end, Energy Resources Aotearoa is the convening partner of an Energy Resources Sector Net Zero Accord, signed in the first instance by the leading upstream oil and gas producers (see *Appendix 1*). This will require significant further investment to reduce net upstream emissions.

Downstream gas consumption represents 10% of national emissions. To reduce these net emissions through time, Energy Resources Aotearoa believes it will be critical for the upstream oil and gas sector to work with customers to understand users' decarbonisation plans. This will require producers to align investment in upstream production volumes to be consistent downstream customers' decarbonisation plans. Extensive collaboration between upstream producers and downstream users to develop viable gas transition pathways will be key to success.

The upstream oil and gas sector also has an opportunity to further expand into low carbon sectors. The 'energy gap' analysis in Section 6.5 outlines that a significant increase in renewable energy is required by 2050 to meet national emissions targets. There are opportunities for sector participants to continue investing in, or supporting, the development of energy efficiency, demand response, renewable generation, green gas, CCUS, and biofuels.

One of the most critical roles the sector can play is to continue to provide affordable, reliable gas supply through the transition to support the integration of renewable electricity, electrification, and green gas. We outline how the sector can achieve this in our recommendations (Section 9).

Beyond these four key actions that individual upstream oil and gas companies can take – reducing upstream emissions, working with customers to align investment to their decarbonisation plans, investing in low carbon technologies, and supplying affordable, reliable gas – we believe there are several areas where the upstream oil and gas sector can collaborate to play its part in achieving reduced emissions, including:

- **a joint commitment:** establishing a joint commitment among upstream oil and gas producers to continue reducing their Scope 1 and 2 emissions as part of the effort to reach New Zealand's target of national net zero carbon by 2050;

- **sharing best practice:** sharing best practice for emissions reductions projects and forestry investment among upstream oil and gas producers and throughout the energy value chain;
- **supporting customers:** working with large gas users to understand viable transition pathways and ensure their aggregate gas demand continues to be met;
- **supporting the gas transition:** working with large gas users to provide constructive input into the national energy strategy and the Gas Industry Company's (GIC's) gas transition plan;
- **enabling coal-to-gas switching:** collaborating with customers and large users on demand-side flexibility and storage options to enable gas to replace coal as the predominant solution for electricity dry years;
- **developing CCUS:** contributing financially to a feasibility study for CCUS in New Zealand to identify its economic and technical viability as well as the regulatory framework required to enable it; and
- **supporting low carbon technology:** supporting Ara Ake and Venture Taranaki, through providing time and expertise, to develop and scale low carbon solutions.

8.2 Emissions reductions in practice: A case study

Tamarind New Zealand Onshore Ltd (TNO) is a privately-owned upstream oil and gas company with two sites, Cheal, and Sidewinder, in the Taranaki. Further detail on TNO can be found in *Appendix 5.* In 2020, TNO embarked on an ambitious plan to identify whether it could achieve net zero emissions by 2030.

This example serves as a case study for what could be possible for an upstream oil and gas operator and builds on the significant progress already made by major participants in the sector (see Section 4.7 above).

Tamarind New Zealand Onshore's Net Zero Roadmap

The business rationale for TNO developing a net zero roadmap was very clear:

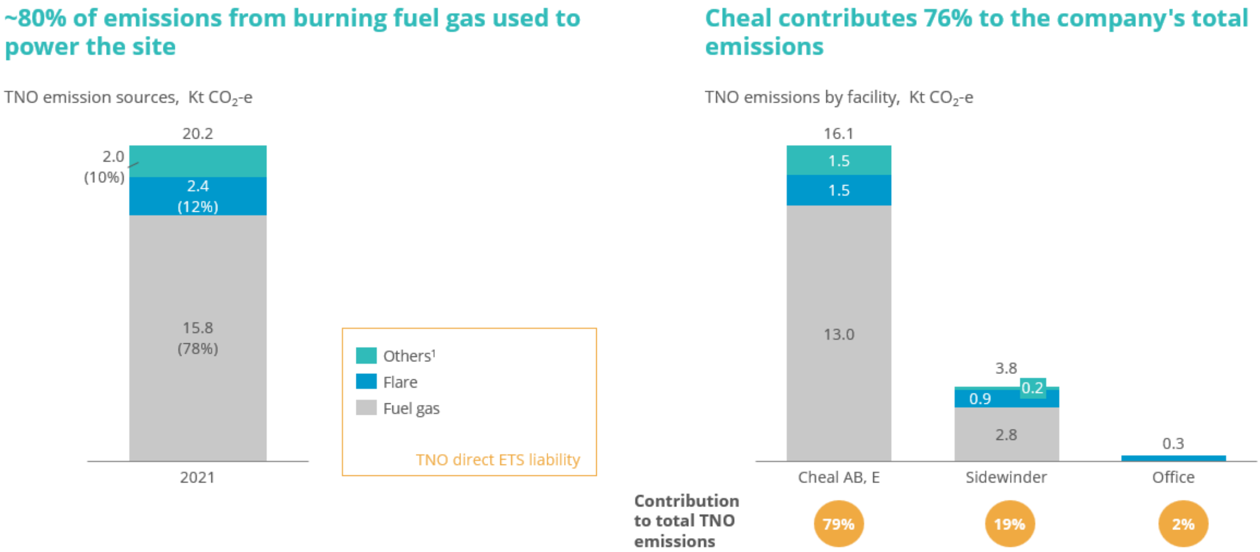
- **reduce liabilities under the NZ ETS:** TNO's emissions liability under the ETS is approximately 20,000 tonnes of CO_2-e per year;
- **improve access to financing:** if unmanaged, the ETS presents a financing risk to TNO which would result in a higher WACC. The net zero roadmap presents an opportunity to provide additional certainty to financiers around TNO's future emissions profile and liabilities;
- **demonstrate ESG commitment:** TNO is a privately held company, but it is still increasingly keen to demonstrate strong ESG credentials. The net zero roadmap for the New Zealand business will inform the broader decarbonisation of its Asia Pacific business;

- **do the right thing:** as an important part of New Zealand's oil and gas landscape, TNO aims to reach net zero and play its part in reducing the sector's emissions; and

- **create sustainable future business models:** the financial case for TNO in a scenario where nothing is done to address emissions would lead to operations ceasing by 2031. If the company pursues net zero emissions, it may be possible for it to continue and contribute to the energy transition and the economy. This also gives TNO opportunities to diversify into emerging technologies such as solar.

The first step for TNO was to thoroughly understand its emissions profile. Based on its 2021 emissions, TNO recognised that ~80% of its emissions were directly from burning gas to power field and plant operations, primarily at its main site, Cheal (Exhibit 49).

Exhibit 49: TNO 2021 Scope 1 and 2 emissions

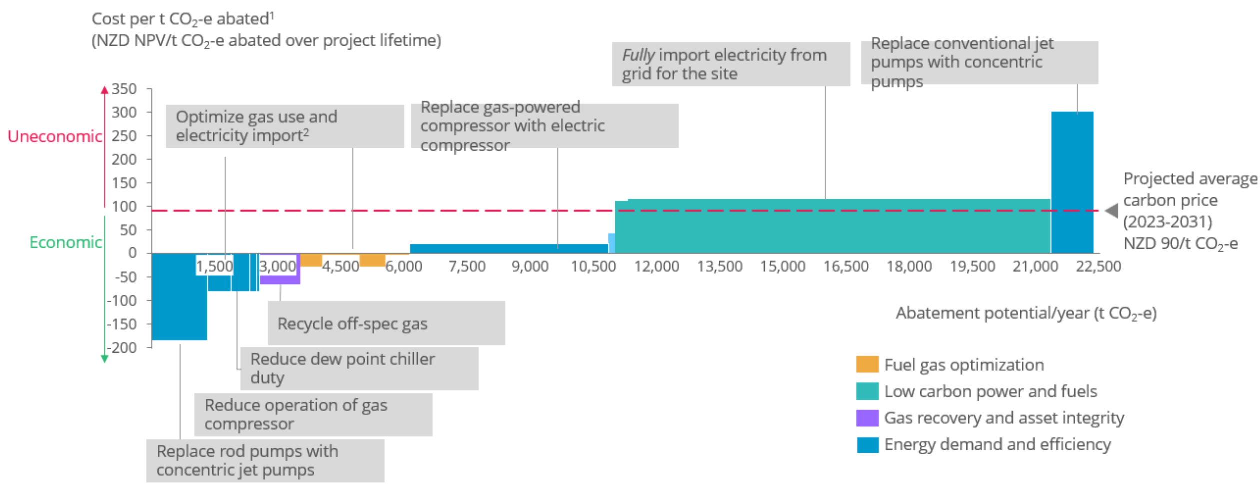


1. Includes Scope 1 emissions from exploration and construction, travel, diesel equipment, and Scope 2 emissions from electricity.

Source: TNO emissions data

TNO then identified potential projects to reduce emissions through benchmarking and workshops. The projects were prioritised according to economic viability and potential reduction impact. The Marginal Abatement Cost (MAC) Curve (Exhibit 50) highlights the cost per tonne of CO_2-e abated for each project (excluding savings in ETS costs) and the potential tonnes abated annually. Any project below the average projected carbon price is economic because it would cost less to implement the project than to pay the ETS cost of emissions, while any project above the carbon price is uneconomic.

Exhibit 50: Assessment of each emissions-reduction project



1. Excludes ETS cost savings. Includes an additional NZD 34, to normalize for discounting of carbon price over 2023-31.
2. This illustrates the overall impact of gas optimization as it interacts with other emissions reduction opportunities.

Note: MAC curve excludes five initiatives that collectively have <100 t CO_2-e abatement potential/year, each with <50 t CO_2-e abatement potential/year. Also excludes exhaust capture opportunity due to low regulatory readiness in the relevant time period.

Source: TNO GHG reduction opportunity list

TNO's MAC curve includes the following projects:

- implement energy efficiency improvements which will collectively reduce emissions by 7,300 tonnes of CO_2-e each year. These include replacing rod pumps with less power-intensive concentric jet pumps, replacing gas engine-driven compressor with an electric compressor that runs at lower capacity, and decreasing the operating time of the compressor to reduce energy demand;
- optimise between burning fuel to power site operations and using electricity from the grid to reduce emissions by 2,500 tonnes of CO_2-e annually. Although complete reliance on electricity from the grid is cost-prohibitive — it is possible to optimise costs while reducing emissions by dynamically switching between burning fuel and using the grid depending on the prevailing gas and electricity prices. TNO will also explore using 100% certified renewable energy; and
- improve asset integrity and enhance gas recovery to potentially reduce emissions by 170 tonnes of CO_2-e each year. One example of this is recycling unused low-pressure gas to reduce flaring.

Note the marginal abatement cost rises as companies move from projects on the left to the right of the MAC curve. Many oil and gas companies in New Zealand have already implemented, or are currently implementing, actions to reduce their emissions — examples are included in Section 4.7 of this report. Their challenge is now to find more abatement opportunities.

In TNO's case, ten net present value-positive projects have potential annual emission savings of 10,000 tonnes of CO_2-e, representing ~50% of its 2021 emissions. At a positive net present value (NPV) of $10.2 million this equates to cost savings of $113 per tonne of CO_2-e abated (Exhibit 51).

Exhibit 51: NPV-positive projects will equate to cost savings

	Project	Average annual emissions savings (t CO_2-e/year)	NPV[1] (NZD)	MAC[2] (NZD/t CO_2-e)
MAC < $90[3]	Inject water from Sidewinder to Cheal instead of trucking	<5	150,000	(4,000)
	Improve management of waste disposal	<5	80,000	(3,400)
	Replace rod pumps with concentric jet pumps	1,300	2,700,000	(180)
	Operate compressor intermittently instead of 24/7	550	900,000	(80)
	Reduce dew point chiller duty	450	700,000	(80)
	Route oil tank vent to heaters	150	250,000	(80)
	Improve shell and tube/ plate heat exchanger performance	80	130,000	(80)
	Install recycle line for off-spec gas	970	1,400,000	(70)
	Optimize gas use and electricity import	2,600	2,000,000	(30)
	Replace gas-powered compressor with electric compressor	4,700	3,200,000	20
	Recycle the unused LP gas back to the system	170	75,000	40
MAC >= $90	Shift to 100% certified renewable energy for office	300	(200,000)	110
	Fully import electricity from grid for site	10,000	(2,000,000)	120
	Convert conventional jet pumps to concentric jet pumps	1,000	(2,000,000)	300
	Use electric vehicles	50	(400,000)	1,000
	Reduce unrequired cooling by moving cooler	10	(120,000)	1,300
	Leak detection and repair program	30	(330,000)	1,500

Annual emission savings: 10,000 t CO_2-e at positive NPV of $10.2 M, savings of $113 / t CO_2-e

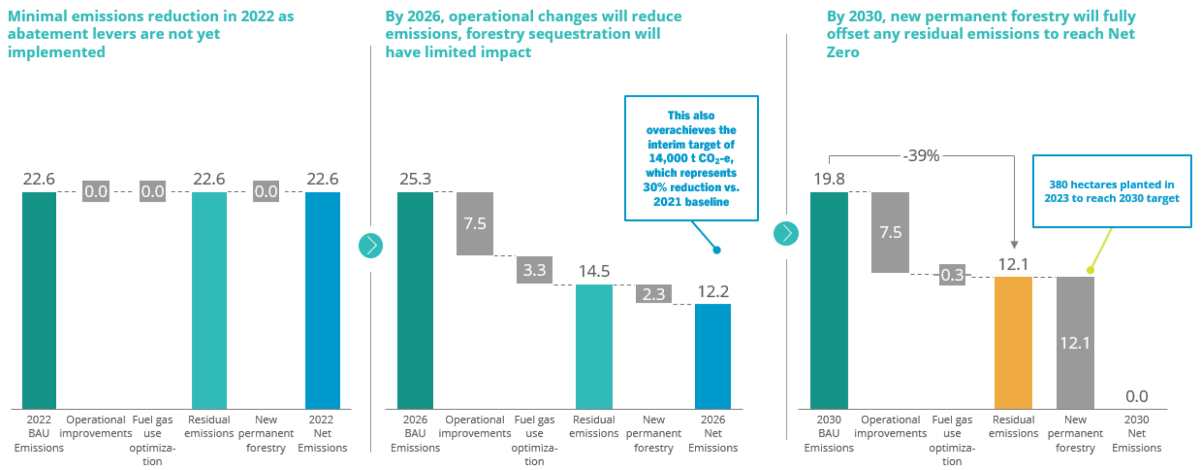
Note: Calculations exclude this opportunity, as it is not applicable once electric compressor is implemented

1. Includes savings from ETS.
2. Excludes savings from ETS. Includes an additional NZD 34, to normalize for discounting of carbon price over 2023-31.
3. Projected average carbon price for period 2023-2031.

Source: TNO GHG reduction opportunity list

TNO will seek to implement these projects over 2023 and 2024, but they alone will not be enough to reach net zero emissions. As such, TNO would need to plant ~400 hectares of new forestry to offset residual emissions[32]. Forestry will play a large role in TNO's journey to net zero. Because new trees do not sequester as much carbon as more mature trees, these new forests will not reach the point of consistently offsetting residual emissions for 5 years. TNO could reach net zero by 2030 if forestry investments are successful (Exhibit 52).

Exhibit 52: TNO could reach net zero emissions by 2030 through emission reduction projects and new forestry



Source: TNO GHG reduction opportunity list

32 Based on analysis using Ministry for Primary Industries look up tables. New forestry is required to offset emissions as it is an activity that is additional to business as usual and each NZU generates represents a true removal of CO_2-e from the atmosphere. NZUs purchased directly from the market may not be true removals as they may have been freely allocated or generated via auction and therefore cannot be claimed as offsets.

TNO will also investigate the feasibility of CCUS. Many oil and gas companies increasingly consider CCUS once lower cost emissions reductions opportunities have been exhausted. In TNO's case, some form of CCUS would potentially reduce emissions by 55% of its 2021 emissions. However, CCUS requires further analysis and will likely take 3-5 years to set up from the time of permit. More importantly, it requires the regulatory framework to enable it, which does not exist today. This is discussed further in Section 9, Recommendation 5.

9 Recommendations for delivering an orderly transition

As discussed in the previous three sections, the scenarios most likely to deliver an orderly transition are the Technology-led Pathway (Scenario 4) and Heavy Industry Continues (Scenario 5). The most important question then, is what needs to be true to make sure that this happens.

Energy Resources Aotearoa acknowledges that more needs to be done, and the oil and gas sector needs to be a part of that effort. We want to play our part in an orderly and efficient transition that delivers New Zealand's emissions reduction goals, while ensuring availability of affordable and reliable energy.

The eight recommendations laid out below have been incorporated into an Energy Resources Sector Net Zero Accord (see *Appendix 1*). The upstream oil and gas signatories will work with Energy Resources Aotearoa, and with participants in the wider energy resources value chain (e.g., customers) to operationalise these recommendations.

9.1 Eight recommendations to enable an affordable, reliable, low emissions energy transition

Energy Resources Aotearoa has identified 8 recommendations across 4 areas that will support an affordable, reliable, low emissions energy transition (Exhibit 53).

Exhibit 53: Eight recommendations for the energy transition

		Recommendation
Future operations	1	**Upstream oil and gas sector:** commit significant investment to reduce operational emissions and offset residual emissions
	2	**Upstream oil and gas sector:** engage closely to understand gas customers' emissions reduction plans while supplying them with affordable and reliable energy through their transition
Future sector	3	**Downstream gas sector:** gas consumers commit investment to reduce emissions
	4	**Downstream gas sector:** continue to work with large gas users to provide constructive input to the national energy strategy and gas transition plan
Future collaboration	5	**Sector and government:** scale clean energy and forestry solutions
	6	**Sector and government:** support workforces and communities through the transition across New Zealand and in the Taranaki
Future policy, regulation, and markets	7	**Sector and government:** ensure the important role of gas in delivering an affordable, reliable and low emissions energy system is well understood
	8	**Sector and government:** ensure policies, regulation and markets are fit for purpose through the energy transition to improve investment confidence while enabling decarbonisation

The recommendations are split across 4 areas:

- **future operations:** what the upstream oil and gas sector can do;
- **future sector:** what the broader gas industry, including gas users, can do;
- **future collaboration:** how the sector and government can work together to deliver outcomes; and

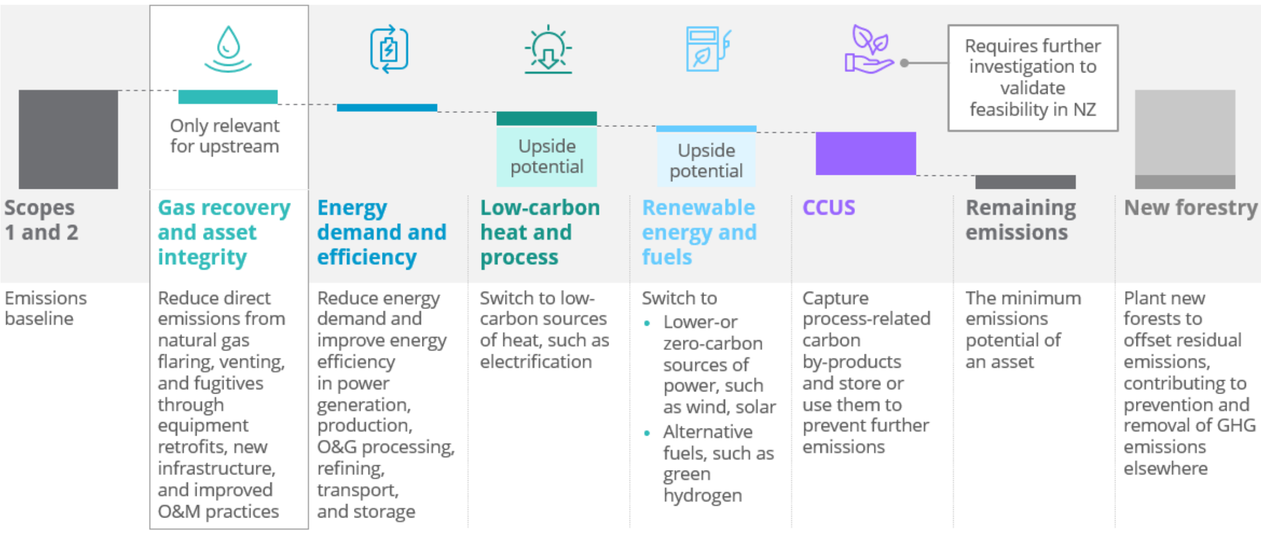
- **future policy, regulation, and markets:** how the sector and government can ensure the right policy, regulation and markets are in place for the energy transition.

9.2 Future operations

Recommendation 1: Upstream oil and gas sector: commit significant investment to reduce operational emissions and offset residual emissions.

The upstream oil and gas sector's emissions reductions to date are just the start of a long journey. The case studies outlined in the section 4.7 identified some of the initiatives that the sector has already invested in. Further investment is required across the several levers available to these producers to reduce emissions (Exhibit 54).

Exhibit 54: Levers to reduce upstream oil and gas emissions



Source: Eikon; IEA; UN Emissions Gap Report 2020

Note: CCUS = Carbon Capture, Utilisation, and Storage; O&G = oil and gas; O&M = operations and maintenance; GHG = greenhouse gas emissions

More detail is provided on these levers below.

Gas recovery and asset integrity: measures to reduce direct emissions from venting, flaring, and distributing gas tend to be relatively lower cost and technically mature. They can be achieved by retrofitting equipment, building new infrastructure, and improving operation and maintenance practices. For example, baseload flaring can be significantly reduced by enabling gas export to the network, while flaring from operational changes can be reduced by aligning planned outages and optimising plant start-ups and shutdowns. Maximising equipment reliability and maximising process stability — thus minimising emergency trips — also reduces emissions.

Energy demand and efficiency: measures to reduce energy demand and improve energy efficiency for gas production, processing, transport, and storage are typically the most feasible and lowest cost to implement. They include changing plant operating strategy, upgrading equipment, or increasing equipment efficiency, optimising processes, right-sizing operations, and increasing heat recovery.

Low carbon power: switching to low carbon fuels or power sources can have a high impact on emissions. An example is electrification of heat and processes to reduce the use of gas fuel, which also frees up gas that can be on-sold to customers.

Renewable energy and fuel procurement: using renewable electricity or other renewable fuels (e.g., hydrogen) can reduce some emissions that remain after steps have been taken to reduce energy demand, increase efficiency, and switch power sources for conversion processes.

Even when a producer has taken all these steps to reduce gross emissions, there will likely be residual emissions. The two remaining options to help producers achieve net zero emissions are:

- **CCUS to capture and store process-related carbon by-products:** there is further work required to validate the feasibility of CCUS in New Zealand, as well as a regulatory framework to establish provisions and accountability for the process[33]. CCUS is not just a potential option for upstream producers; many energy producers and users in New Zealand could benefit significantly from CCUS. In 2020, the CCC outlined that CCUS could be required to capture emissions from geothermal power plants. Energy Resources Aotearoa estimates that up to 3 million tonnes of CO_2-e per annum could be abated in New Zealand by CCUS at reasonable economic cost if the right regulatory framework is in place; and

- **new forestry to offset emissions:** for emissions to be credibly offset, forestry activities to reduce emissions must be from new forestry and additional to business-as-usual activities.

More detail is provided on the policy settings required for forestry and CCUS in recommendation 5.

*Recommendation 2: **Upstream oil and gas sector: engage with downstream customers to understand their emissions reduction plans while supplying them with affordable and reliable energy through their transition.***

To reduce gas customers' emissions through time, while continuing to ensure enough affordable, reliable gas supply, it will be very important for the sector to understand customers' decarbonisation plans so that gas production can be matched to meet these requirements. Extensive collaboration between upstream producers and downstream customers to develop viable gas transition pathways will be key to success.

Although forecasts identify that gas consumption in New Zealand is likely to decline by 2050 to meet national climate targets, the CCC has outlined gas will still be required in 2050. It will play an important role in the economy during the transition to a net zero carbon economy by:

- improving integration of renewable electricity generation;

33 This call has been echoed by the Productivity Commission in its 2018 report Low Emissions Economy, and by Ara Ake in its 2022 report Carbon Dioxide Removal and Usage in Aotearoa New Zealand.

- supporting increased electrification of transport and industry by enabling more affordable and reliable electricity;
- providing a viable transition pathway away from coal, particularly as a solution for producing electricity in dry years;
- supporting a viable pathway to lower emissions gas through blending with green gases;
- providing users with relatively low emissions energy where alternatives are currently technologically or economically unfeasible; and
- reducing net emissions for users when it can be paired with CCUS.

This is illustrated in the most likely transition pathway — Scenario 5, Heavy Industry Continues — where gas demand is still 153 PJ in 2030 and 130 PJ in 2039. In this scenario, while demand drops by 20% by 2030 and 33% by 2039, gas emissions decline further by 26% by 2030 and 46% by 2039. This is due to the ongoing presence of Methanex, the lowest emissions intensity gas user, which ensures the emissions intensity of the sector declines gradually over time.

9.3 Future sector

Recommendation 3:* *Downstream gas sector: commit investment to reduce emissions

Downstream gas consumption represents 10% of national emissions. Gas consumption emissions have been relatively flat since 2010.

There are several levers available to gas consumers to reduce emissions, including reducing energy demand and increasing energy efficiency, switching from coal to gas, converting to low carbon heat processes, and using green gas, and introducing CCUS.

Energy demand and efficiency: reducing energy demand and improving energy efficiency for gas consumption is typically the most feasible and lowest cost to implement.

Switching from coal to gas: substantial emissions reductions have already been achieved in New Zealand by switching from coal to gas and further opportunities exist, particularly in the electricity sector.

Case study: Genesis Energy's transition away from coal

Genesis Energy has an ambitious plan to reduce absolute Scope 1 and 2 greenhouse gas emissions by 36% by 2025 from a 2020 base year. Its targets align to limiting climate change to below 1.5°C of warming by 2025. Genesis Energy is the only electricity generator and retailer to have 1.5°C aligned target outside of Europe.

In the decade to 2018 Genesis Energy cut its coal use by 80% and halved its overall carbon emissions, although coal use has increased over the last 3 years.

Genesis Energy's 953 MW Huntly Power Station currently plays a critical role in ensuring security of supply for electricity during peak periods and dry years. In 2018 Genesis Energy committed to not use any coal to generate electricity in normal market conditions by 2025, with the intention to phase out coal use completely by 2030.

Converting to low carbon heat processes: electrification and biomass can replace gas in providing low and medium temperature heat where it is economically viable. This is most likely to occur in instances where the capital costs of converting to these fuels are lower.

Using green gas: natural gas blended with green gas like hydrogen or biogas can be used as a feedstock or for heating. Where the capital costs of converting to electricity or biomass are high, hydrogen blending could provide an opportunity for gas users to reduce emissions gradually while incurring incremental operating costs. It is important to note that hydrogen and biogas are nascent fuel sources in New Zealand and work is still being done to investigate their applicability. Midstream gas pipeline companies are investigating how to repurpose existing infrastructure to support this blending.

Case study: Balance-Hiringa hydrogen project

In 2021, Ballance Agri-Nutrients, in conjunction with Hiringa, committed to develop a 25 MW wind farm in the Taranaki. It will power 75% of Ballance's electricity needs at its Kapuni Plant and it will also produce green hydrogen which will be used as a feedstock to produce fertiliser.

Case study: First Gas biogas plant

First Gas, New Zealand gas transmission company, is collaborating with Ecogas to develop New Zealand's first large-scale biogas project. The project intends to take organic waste, like food scraps, to produce biomethane through an anaerobic digester. The plant is expected to reduce emissions by 11,000 tonnes of CO_2-e per year.

Producing or procuring renewable electricity: renewable electricity can be used to reduce some emissions that remain after a business has taken steps to reduce energy demand, improve efficiency, and converted heating processes. This can be achieved via directly building renewable generation or signing Power Purchase Agreements (PPAs) with renewable electricity developers.

Case study: Genesis Energy's Future-Gen strategy

As part of its ambitious plan to reduce absolute Scope 1 and 2 greenhouse gas emissions 36% by 2025, Genesis Energy is signing PPAs with renewable electricity producers.

It is targeting 1,350 GWh of new renewable generation by 2024 and 2,650 GWh by 2030. Genesis Energy has stated this would enable them to reduce baseload gas generation while assisting with switching from coal to gas for peaking generation. To date Genesis Energy has signed PPAs with ~270 MW of renewable generation.

Once downstream customers have taken these steps to reduce gross emissions there may still be residual emissions. Like upstream producers, two options remain: CCUS to reduce gross emissions and new forestry to reduce net emissions.

While CCUS will be an important tool for decarbonising upstream producers, the largest potential for CCUS in terms of total CO_2 is likely to be with downstream users.

Recommendation 4:* *Downstream gas sector: continue to work with large gas users to provide constructive input to the national energy strategy and gas transition plan

Like Recommendation 2, which outlined why it is important for upstream producers to support customers through their transition, groups like the Major Gas Users Group (MGUG) and Energy Resources Aotearoa can also engage industry to facilitate analysis of aggregate pathways for gas demand and supply.

The Gas Industry Company and Ministry of Business, Innovation and Employment are working on a broader gas sector transition plan. MGUG and Energy Resources Aotearoa can lead the sector's input to ensure the plan considers the full breadth of possible pathways – including the insights drawn from this report. Energy Resources Aotearoa will continue to engage collaboratively on this project to ensure the best outcome for the industry and New Zealand.

9.4 Future collaboration

Recommendation 5:* *Sector and Government: scale clean energy and forestry

As outlined in Section 6.5, a significant increase in low emissions energy will be required to achieve New Zealand national climate change targets, meaning low emissions energy solutions will need to be scaled. After efforts to reduce gross emissions, forestry will need to be planted to achieve net zero emissions or international offsets will need to be used.

We believe an effective way to scale clean energy technology, and forestry is to have a technology-led approach, with the ETS as the predominant lever to reduce emissions. To achieve this, it is essential that policy and regulatory frameworks are fit-for-purpose, and at a minimum do not inhibit, the deployment of least cost technology through time to achieve emissions reductions. If the most desirable scenario for the energy transition, identified as

Scenario 4 in this report — the Technology-led pathway — is to be achieved, it will require all clean energy technology to compete on a level playing field.

Fit-for-purpose policy and consenting pathways for renewable generation, hydrogen, CCUS, and offshore wind energy will support this and will remove barriers to delivery of these technologies. We have identified some potential improvements below to ensure a more effective technology-led transition.

Renewable electricity generation

As an example, 3–5 new wind farms (of 150 MW each) will need to be built every year to 2050 to address the energy gap – this is scale not seen before in New Zealand. Transpower predicts that in the next 30 years, as much new generation will need to be built as in the last 100 years, accompanied by new transmission lines and distribution lines.[34] These projects can typically have long lead times. To achieve this scale, Resources Management Act reform is required to make it easier for renewable generation to gain consent, as well as streamlining of electricity network approval processes to expedite the development of infrastructure.

Hydrogen development

Blue and green hydrogen could play a role in our future gas supply. From an energy transition perspective, it will enable gas users to decarbonise using existing infrastructure and receive a similar energy service that they are used to, with incremental operating costs rather than large capital expenditure. It could also assist with decarbonisation of the natural gas stream through a gradual phase in the mix from some point in the 2030s.

If hydrogen is gradually phased into the gas mix through to 2050, it could provide users with the option to continue using gas (both natural and green) through the 2030s and 2040s without having to shift completely.

Work is underway by First Gas and distributors to understand what is required to repurpose existing infrastructure to enable blending of green hydrogen. First Gas intends to integrate green hydrogen into gas pipelines from 2030. Fit-for-purpose policy needs to be in place to ensure that infrastructure can be effectively repurposed to supply hydrogen.

One option to produce green hydrogen in New Zealand would be from offshore wind, particularly in the Taranaki region. Venture Taranaki has analysed this possibility and has identified at least 2.5 GW of offshore wind potential in Taranaki, noting that the development costs and timeframes may be significant. An enabling consenting framework is required for offshore wind, which would allow it to be developed if economically viable.

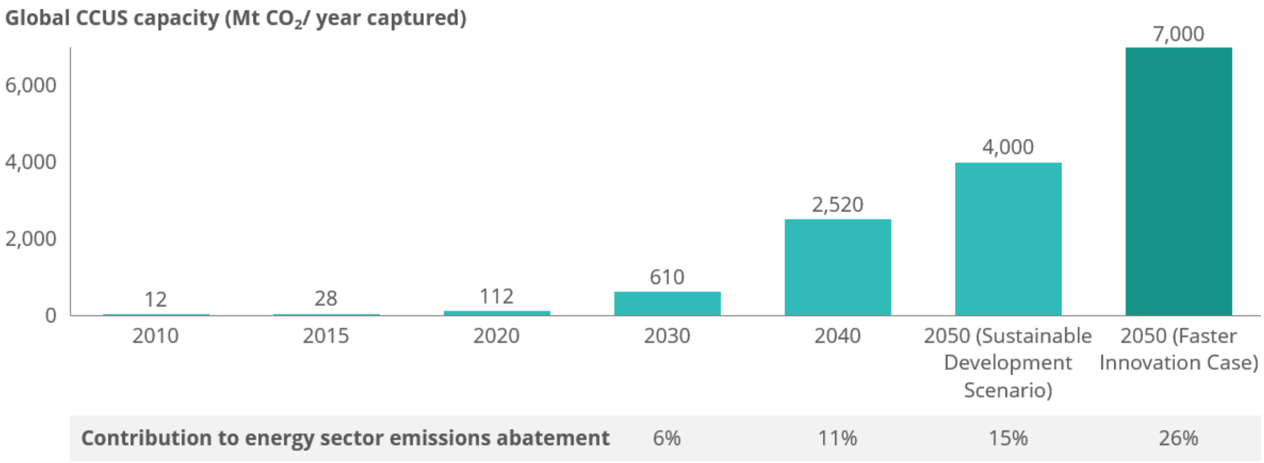
Carbon capture, utilisation, and storage

Almost all global analyses that consider net zero carbon scenarios include CCUS. There is no feasible way to get to net zero globally, according to these models, without CCUS. The International Energy Agency (IEA) projects that up to 26% of the energy sector's emissions

34 Transpower, Whakamana i te Mauri Hiko (https://www.transpower.co.nz/resources/whakamana-i-te-mauri-hiko-empowering-our-energy-future).

abatement efforts will stem from CCUS to achieve the 1.5°C global warming target (Exhibit 55).

Exhibit 55: IEA forecast of CCUS capacity and contribution to the energy sector's emissions abatement



Source: Global CCUS Institute Report (2020); IEA CCUS in Clean Energy Transition (2020) Sustainable Development Scenario

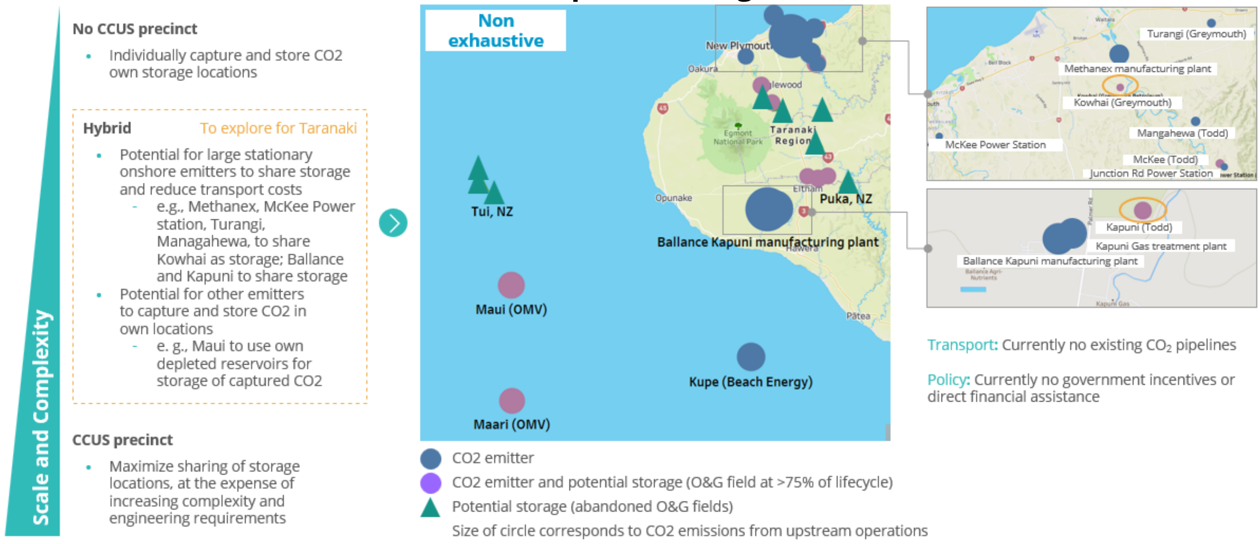
Every major emitting country is investigating or already using CCUS to address emissions. Currently there are 27 fully operational commercial CCUS facilities globally, with a capture capacity of 36.6 million tonnes of CO_2-e per annum. Of these, 12 are in the USA, and the rest are in Canada, China, UAE, Australia, Hungary, Ireland, Brazil, Qatar, Norway, and Saudi Arabia. 106 more CCUS facilities (excluding suspended projects) are in the development pipeline.[35]

In the Taranaki region, approximately 15 emitters and potential storage locations sit within a 70 km radius. A number of these emitters already process their emissions to isolate CO_2, which lowers the cost of capture. In addition, the proximity of emitters to potential storage locations would minimise the capital costs to build pipelines. Indeed, some mature producing fields could also function as storage locations as these are likely to have depleted reservoirs.[36] It would be conceivable to establish a CCUS precinct where emitters send captured CO_2 to a central storage location such as a depleted hydrocarbon reservoir or a saline aquifer. This would enable shared infrastructure costs, reducing the marginal abatement cost of CCUS for users (Exhibit 56).

35 Global CCUS Institute, Global Status of CCUS 2021.

36 A 2009 study estimated Taranaki reservoirs could have estimated carbon storage capacity of up to 572 Mt (nine years of New Zealand's net CO_2 emissions). More information can be found at https://www.researchgate.net/publication/268422317_Opportunities_for_underground_geological_storage_of_CO2_in_New_Zealand_-Report_CCS_-085_-Onshore_Taranaki_Basin_overview.

Exhibit 56: How a CCUS precinct might look in Taranaki



Source: Rystad data on production per field

For CCUS to be deployed there needs to be a regulatory framework to enable, or at a minimum, not inhibit development. While no law specifically prohibits CCUS in New Zealand, there are currently very limited regulations and guidelines to enable CCUS (Exhibit 57). Conversely, regulatory frameworks are already established in the United States, Europe, the United Kingdom, and Australia. The Productivity Commission (2018) and Ara Ake (2022) have echoed our calls for a fit-for-purpose, enabling legislative regime for CCUS in New Zealand.

Energy Resources Aotearoa does not want, nor believe there is a need for grants or subsidies for CCUS. We believe the ETS should be the predominant lever to reduce emissions in New Zealand and that policy and regulatory framework should enable technology led choices (by having viable regulatory frameworks for these technologies).

Exhibit 57: Enablers for CCUS in New Zealand

Note: Opportunity to include CCUS as technology eligible for Government Investment to Decarbonise Industry (GIDI) funding

	Capture	Transport	Storage
Financial	Place a value on CO_2 emissions, through pull factors e.g., tax credits and grants, or push factors e.g., carbon tax, ETS price		
	Capital support for transport and storage investment, guaranteed offtake to kickstart market		
	Lower cost of financing for CCUS infrastructure		
Infrastructure		Develop cluster-scale transport & storage networks with open access for emitters	
			Ensure easy access to pore space (reservoirs)
Policy/ Regulatory	Create clear and concrete commitment/targets (and required legislation) across value chain		
	Create consistent carbon capture requirement for specific sectors		Create clear regulation on value of carbon captured and stored
	Ensure there are clear provisions for siting, design, capture, pipeline operations, storage, closure, monitoring etc.		
	Create clear standards for low carbon products		
			Implement regulation around operating saline aquifers
			Create provisions for long-term liability of stored CO_2
	Create provisions for cross-border liability of CO_2		
	Ensure robust approval and permitting process for projects		
Others	Build public awareness on CCUS		
	Train local workforce and hire foreign talent		
	Promote CCUS potential and engage potential international partners e.g., IOCs		

For instance, there must be an environmental consenting pathway for CCUS — either under the Resource Management Act (RMA) or through a new Act for CCUS. Under current laws, the positive effect of CCUS on climate change is not recognised when granting a resource consent. The RMA is also not equipped to deal with the long-term liability required for CCUS operations. Thus, a regulatory framework for CCUS must be created to establish provisions and accountability for the entire end-to-end process from capture to transport, storage, and monitoring.

Energy Resources Aotearoa does not yet know whether CCUS is technically and economically feasible in New Zealand. However, we know that the potential size of the prize (up to ~3 million tonnes of CO_2-e per annum) is significant enough to warrant investigation at a sector-wide level to understand the opportunity, and development of an appropriate regulatory regime to unlock it should it prove economically feasible.

A reasonable next step will be for the sector to co-fund a detailed technical and economic study to understand the future potential of CCUS in New Zealand.

Case study – Methanex's methanol manufacturing emissions could be reduced by up to 90 percent through CCUS

Methanex has invested time and resources into better understanding the potential that carbon CCUS holds for reducing its Scope 1 emissions from methanol manufacturing. The CO_2 produced by fuel combustion and industrial processes can be purified and compressed and transported via a pipeline to either be reused as a feedstock or stored underground in deep geological formations. Other than in the context of producing renewable methanol at scale, CCUS holds the greatest potential to materially reduce emissions from methanol production.

In 2022, Methanex has committed to conducting technical and economic feasibility studies at Geismar and Medicine Hat facilities in North America. As part of this work, Methanex's CO_2 Emissions Management Leadership Team are evaluating the following:

- geological suitability of storage locations near Geismar and Medicine Hat sites;
- potential to use pipelines near existing facilities to capture and transport CO_2;
- likelihood of competing carbon capture technologies; and
- capital and operating costs of CCUS.

In North America, Methanex is continuing to work collaboratively with local government and neighbouring industries to assess CCUS. This initiative will help to inform the suitability and viability of CCUS for other manufacturing locations such as New Zealand should the circumstances warrant it.

Forestry

Many energy users and producers will be able to reduce emissions through time, but for some it may be either technologically or economically impractical to reduce gross emissions to zero. Some companies may also want to reduce net emissions during their transitions to lower emissions or net zero carbon.

To credibly offset their emissions, companies may plant forestry. Forestry must be new to demonstrate that planting is additional to business-as-usual activities, and it is best if this forestry is planted on land that is not in highly productive farming.

The Government recently proposed to change legislation to ensure that only native forestry can be planted as permanent forest under the ETS. This would mean that exotic forests, such as Pinus Radiata, which sequester carbon much faster than native forests would not be eligible for permanent forestry, on the basis that widespread exotic forestry is undesirable, or that too much of our emissions reduction would be met with removals rather than reductions. This would make it significantly more expensive to offset emissions using forestry and would mean that significantly more land would need to be converted to forestry to achieve net emissions reductions. As a result, it will make decarbonising New Zealand's economy and meeting national climate change targets much more difficult and expensive.

Energy Resources Aotearoa sees a significant opportunity for gas producers and users to plant forestry, after all viable efforts are taken to reduce gross emissions, to achieve low or net zero emissions.

At time of writing a decision on the proposal has been deferred. It is our view that this policy proposal is not sensible, on balance, because it will significantly increase the cost of decarbonising the economy and businesses, and we suggest it should be permanently taken off the table.

New business models to scale clean energy

Scaling clean energy solutions presents an opportunity for many businesses in the energy sector to diversify their business models. Several global oil and gas majors like BP and Shell are identifying ways to shift to cleaner energy over time. In New Zealand, there are already examples of this:

- Todd Energy purchased a majority stake in solar energy company Sunergise in 2019. Its 2.1 MW Kapuni Solar Farm is currently the largest in New Zealand, although it has recently announced plans to construct a 400 MW solar farm near Taupō; and
- OMV has a new global strategy to shift toward sustainable fuels, chemicals, and materials, with a strong focus on circular-economy solutions to become net-zero for Scopes 1, 2 and 3 emissions by no later than 2050.

Case study: Nova Energy's proposed 400MW solar farm

Nova Energy, part of Todd Corporation, has recently applied for resource consent for a 400 MW solar farm near Taupo. This would be 190 times larger than the current largest solar farm – the 2.1 MW Kapuni solar farm also owned by Todd Corporation. When completed it will involve more than 750,000 solar panels and could power 100,000 homes – more than one in every 20 homes in New Zealand. The plan is to build the project in three phases – 150 MW, 150 MW, 100 MW – over 6 to 7 years.

***Recommendation 6:* support workforces and communities through the transition across New Zealand and in the Taranaki**

A just transition relies on ensuring energy affordability for households, industries, workforces, and communities. The workforces and communities where energy is produced and consumed benefit from a nation-wide just transition (that is, all New Zealanders). The current disorderly and high-cost transition will lead to energy poverty and prevent new industry from being developed. This would likely hamper our productivity as a nation.

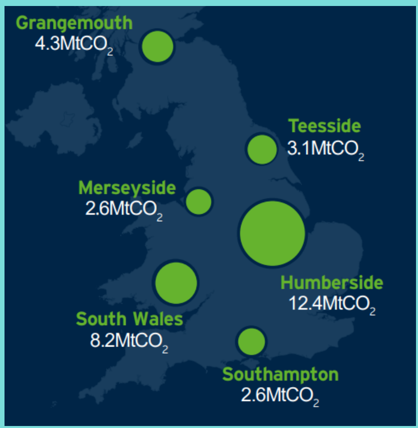
A just transition in the Taranaki is more targeted and refers to the workforces and communities involved in, or impacted by, the upstream oil and gas sector. As discussed in Section 5.4, the oil and gas sector employs about 7,300 people, many who are highly skilled and has some unique capabilities that would be highly valuable to our energy transition. For example, some companies have offshore capabilities and experience with large scale capital investment projects which could transfer to offshore wind, and some have capabilities that would be highly valued for deploying CCUS for both upstream and downstream businesses.

One targeted way that these skills could be harnessed is through supporting the energy innovation cluster in the Taranaki. Some groundwork has been laid through the efforts of Ara Ake and Venture Taranaki, and the presence of these organisations highlights the potential for the Taranaki to become a net zero precinct with many large industries, including oil and gas, and chemicals production.

Case study: Net Zero Industrial Clusters in the UK

The UK Government aims to establish the world's first net-zero carbon industrial cluster by 2040, and at least one low-carbon cluster by 2030. It is seeking to understand how CCUS, hydrogen, and renewable electricity can enable these large industrial precincts to transition to lower emissions. Below is a map of the precincts identified as being potentially suitable.

Exhibit 58: Industrial clusters in the United Kingdom



By 2030, the Department for Business, Energy, and Industrial Strategy (BEIS) is seeking to have one low carbon cluster where the low-carbon infrastructure needed to support industrial decarbonisation will be operational, attracting new investment and innovation. In this cluster it also aims to have many industrial facilities already operating at reduced emissions, by the greatest possible extent.

The Taranaki region's annual emissions of ~3 Mt CO_2-e are a similar size to several of the precincts identified by BEIS in the UK. There is an opportunity to better understand the viability of the Taranaki region as a low carbon cluster, to enable existing industry to thrive in a low emissions economy, while also attracting new low carbon industries. This could involve CCUS precincts, as outlined in Recommendation 5 of this report.

The cluster model could lead to lower cost infrastructure if investment can be shared. A net zero industrial cluster, or a similar concept, would enable workers to remain in existing industries as they decarbonise, and transition to new industries as they emerge.

9.5 Future policy, regulation, and markets

Recommendation 7:* *Sector and government: ensure the important role of gas in delivering an affordable, reliable, and low emissions energy system is well understood

The analysis in this report has laid out that a well-signalled, orderly transition is more favourable than a chaotic, disorderly transition. When the oil and gas sector has confidence to invest in production, it ensures an orderly transition; energy prices remain affordable, energy supply remains reliable, and emissions can be most effectively reduced across the energy sector.

Higher gas prices hinder decarbonisation because they:

- lead to higher electricity prices which slow the electrification of transport and process heat; and
- do not have a material impact on the forecast percentage of renewable electricity in the electricity mix

Recent experience demonstrates that countries who rely on gas imports tend to face increased energy prices, are more exposed to external shocks, and tend to have less resilient energy systems. New Zealand is incredibly fortunate that it can meet all its domestic gas needs locally.

It is crucial that key energy sector stakeholders and policy makers are aware of the importance of gas throughout the energy transition to achieve the best energy trilemma outcomes, and ultimately the best outcomes for consumers, economic productivity, and New Zealand.

Recommendation 8:* *Sector and government: ensure policies, regulation and markets are fit for purpose through the energy transition to improve investment confidence while enabling decarbonisation.

The right policy, regulatory and market settings are integral to delivering an orderly transition, with affordable, reliable gas supply that enables decarbonisation.

The most important policy changes to deliver the technology-led transition, are to ensure the ETS does the 'heavy lifting' in reducing emissions and that low carbon solutions have regulatory frameworks and consenting pathways to remove barriers to their development. In recommendation 5 we have outlined how this could occur.

Beyond this there are opportunities to improve settings that relate specifically to the gas market. The most important opportunities are outlined in Table 3.

Table 3: Proposed solutions to current issues facing the gas sector

Opportunity area	Issue	Complication	Possible solution
Improve investment confidence	Complex and changing climate and energy policy	Layering of additional policies creates uncertainty and can lead to unintended consequences	Focus on the ETS as the primary mechanism to reduce emissions; remove unnecessary bans or additional policies
	Outlook for Methanex	Methanex supports gas sector investment confidence – but it also needs confidence in gas market conditions	Shift focus from a 'phase out' of gas to an environment that sends the right price signals (i.e., the ETS) for reducing emissions and provides confidence for supply-side investment. Continue to explore practical ways to avoid carbon leakage.
	Speed of low-carbon technology development	A significant level of new renewable energy is needed, and possible speed bumps could be encountered through the transition	Ensure the investment environment for gas ensures production can flex up when needed to address possible energy shortages
Enhance energy system flexibility and resilience	Options to manage tight market situations	In instances when gas supply drops (e.g., due to an unexpected decline in production) or gas demand increases (e.g., due to a dry year in the electricity system) energy affordability and reliability are impacted	Additional flexibility could improve affordability/reliability. This can be achieved by: • an investment environment conducive to investment • additional gas storage (noting that longer term demand certainty is needed) • formalised demand-side response contracts
	Security of supply of electricity in dry years	New Zealand is reliant on imported Indonesian coal to produce electricity in dry years	Storage and/or demand-side flexibility of up to 20 PJ could enable gas to replace coal as the predominant dry year solution
	Maintaining an orderly transition	As the size of the industry changes over time, greater risk concentration could occur	Investigate whether sufficient notice can be provided to the market ahead of asset decommissioning

9.6 An Energy Resources Sector Net Zero Accord

The recommendations above highlight how much there is much to be done throughout the whole energy resources value chain. The complex and interconnected nature of the decarbonisation challenge calls for collaboration. To that end, Energy Resources Aotearoa has convened a historic Energy Resources Sector Net Zero Accord.

The establishment of this voluntary sector accord will unlock and enable greater ambition among signatories to build upon their emissions reductions to date. It creates a platform for collaboration, with signatories to the Accord affirming their commitment to playing their part in driving progress toward New Zealand's collective emissions goals.

The Accord lays out:

- a shared commitment to playing our part in the low-emission transition;
- a series of actions to drive progress toward these commitments; and
- areas where the industry itself can lead the way, and where we can achieve more through constructive engagement and collaboration with government.

A working group will be established by the signatories and a dedicated work programme will be developed in the coming months to give effect to the recommendations laid out in this report.

While initial signatories are New Zealand's upstream oil and gas producers, this is a vehicle to encourage all energy market participants to enhance collaboration and shared effort in identifying and seizing emissions reduction opportunities as they become economically viable over time. Signatories will work with all energy sector participants to understand the potential of such collaboration and to explore the benefits in joining the Accord.

10 Conclusion

The New Zealand economy must transition to net zero by 2050. There are many possible pathways to achieve this goal. While renewables will play an important role in meeting New Zealand's future energy needs, gas will be critical throughout the transition. New Zealand must take full advantage of its domestically produced gas to allow an orderly, well managed and low-cost transition to net zero by 2050.

The upstream gas sector is already contributing towards our economy's net zero ambition having reduced Scope 1 emissions by 34% between 2010 and 2019, with much more work underway.

The upstream gas sector is now looking to work together, and with customers, to understand their needs and ensure there is sufficient gas available for their transition. To do this, the upstream gas sector needs pragmatic, predictable, enduring regulatory settings to justify investment and make the most of the gas needed to support the broader transition. Specifically, the ETS should be used to drive down emissions at the lowest possible cost without 'picking winners' – that is, reducing emissions without stifling investment with over-reaching policy and increasing the risk of unintended consequences.

Shifting the focus from a 'phase out' of gas to a technology-led approach to reducing emissions will also be critical. Fit for purpose policy and consenting pathways are needed to ensure that barriers to the deployment of low carbon technologies are removed.

By working together, government and the energy resources sector can deliver an orderly energy transition—allowing the sector to play its part in addressing climate change in New Zealand.

11 Acknowledgements

Fuelling the Energy Transition: A Low Emissions Future for New Zealand is the result of months of work by not just Energy Resources Aotearoa, but many stakeholders.

Energy Resources Aotearoa wishes to thank all contributors for their time, resources, and expertise. Contributors represented a diverse range of perspectives including energy producers, energy consumers, environmental experts, economists, government and policy advisors, energy consultants, and global experts.

These contributors include OMV; Todd Energy; Beach Energy; TNO; Genesis Energy, Methanex; Oji Fibre Solutions; Powerco; First Gas; the Ministry for Business, Innovation and Employment, the Ministry for the Environment; Taranaki Regional Council; Ara Ake; Venture Taranaki; The New Zealand Initiative; the Major Gas Users Group; New Zealand Oil & Gas; Elemental Group; Arete Advisors; Hale & Twomey; Gas Industry Co; and Enerlytica. Additional analysis was provided by EnergyLink, and various other sources have been cited in the body of the report.

While Energy Resources Aotearoa engaged with external parties to develop *Fuelling the Energy Transition: A Low Emissions Future for New Zealand*, the analysis and conclusions drawn are our own.

12 Appendices

12.1 Appendix 1: Energy Resources Sector Net Zero Accord

The Paris Agreement sets a global commitment to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels, and to achieve a net zero world in the second half of this century. Goal 7 of the Sustainable Development Goals similarly demands significant progress in delivering an affordable and clean energy system. This includes facilitating access to clean energy technology such as energy efficiency and cleaner fossil-fuel technology (Target 7.a).

New Zealand's Nationally Determined Contribution under the Paris Agreement commits to a headline target of a 50 per cent reduction of net emissions below gross 2005 levels by 2030. The Climate Change Response Act further commits to reaching national net zero emissions by 2050.

These anchor points guide the actions required of the energy resources sector.

New Zealand's energy resources sector needs to be a leader in reducing emissions and driving New Zealand toward its national net zero target by 2050. To achieve this, we have established a national **Energy Resources Sector Net Zero Accord**. The Accord will pave the way for the industry to continue reducing its Scope 1 & 2 emissions and support an affordable, reliable, and low-emissions energy system.

Our collective commitments are:

1. **Upstream decarbonisation:** continue to reduce our Scope 1 & 2 emissions as part of the transition toward a national net zero emissions economy by 2050
2. **Customer decarbonisation:** understand and support our domestic customers' emissions reduction plans, while continuing to meet their energy needs
3. **Scaling low-emissions energy:** support the development and deployment of technologies that will reduce the emissions intensity of the energy system over time
4. **Supplying affordable, reliable, and low-emissions energy:** deliver affordable and reliable energy with reduced emissions, provided the right policy, regulatory and market settings are in place

Our collective actions to achieve these commitments are:

1. **Upstream decarbonisation:**
    - invest significantly in low-emissions upstream technologies including energy efficiency; low-emission fuels; and flaring and venting reduction
    - invest in permanent and/or production forestry to offset residual emissions
    - fund a detailed technical and economic study into the viability of carbon capture, use and storage (CCUS) in New Zealand to determine if it is a feasible domestic solution
2. **Customer decarbonisation:**
    - work closely with our customers to understand their decarbonisation pathways/plans and match our gas production to meet these requirements
    - support customers to switch from coal to gas where opportunities exist
    - explore opportunities for customers and other New Zealand businesses to use CCUS

3. **Scaling low emissions energy:**

- invest directly in low-emissions energy solutions like solar, wind, and CCUS
- support Ara Ake and Venture Taranaki to scale low-emissions energy by providing access to domestic and international expertise
- commit capability to assist the scaling up of clean energy technologies where we have unique expertise (e.g., offshore capabilities for offshore wind)

4. **Supplying affordable, reliable, and low-emissions energy:**

We need the right policy, regulatory and market settings in place to deliver this Accord and to support New Zealand's progress toward national net zero by 2050. We will work with government and the broader sector to:

- promote policy and regulatory settings that improve investment confidence while enabling decarbonisation
- contribute to enhancing flexibility and resilience of the energy sector through engagement on the national energy strategy
- support a transition away from coal as the predominant solution for electricity dry years

Further details of the Accord and the settings that will be needed to support the energy transition can be found in Energy Resources Aotearoa's 2022 *Fueling the Energy Transition* report.

The Accord creates a platform for collaboration both within the energy resources sector, and between the sector and government, as we explore and shape the future of energy through the transition.

We welcome interested participants in the energy resources sector to join us in our shared commitment as signatories to the Accord. To join the Accord, contact Energy Resources Aotearoa (our convening partner).

Mark Macfarlane Chief Executive **Todd Energy**	Henrik Mosser General Manager **OMV New Zealand**	Mat Quinn Country Manager **Beach Energy**	Drew Cadenhead Country Manager **Tamarind New Zealand Onshore Ltd**

Energy Resources Aotearoa is the convening partner for the Energy Resources Sector Net Zero Accord. Prospective signatories can reach us here: www.energyresources.org.nz/contact-us/

12.2 Appendix 2: Trilemma analysis by fuel use

There are instances today where there are limited technologically or economically viable alternatives to gas today (Exhibit 59). For these uses, gas will continue to play a critical role.

Exhibit 59: Limited alternatives for some uses of oil and gas

			Equity	Security	Sustainability	
	PJ and emissions today	Supply and demand dynamics	Price dynamics	Reliability dynamics	Emissions dynamics today	Low carbon alternatives
Oil in transport	306 PJ **16.2 Mt CO_2-e**	All NZ consumed oil is imported. From April 2022, Marsden Point Oil Refinery will become import only, and cease to receive crude oil	Determined by global commodity markets, NZ demand has little impact	NZ is a small and distant market, but with diversified imports.	23% of national emissions 63 kt CO2-e/PJ	Significant opportunity to decarbonise at scale with EVs
Gas - Methanex	78 PJ **1.4 Mt CO_2-e**	Most of Methanex's gas comes from Pohokura (nearby); demand uncertain as certain trains could be mothballed, depending on ETS, global methanol prices	Methanex commands prices close to wholesale prices due to proximity/volume	Reasonable security of supply, but demand expected to flex	17% of gas emissions 17 kt CO2-e/PJ	Few alternatives available; biogas requires substantial volume, requires significant increase in electricity
Gas – other industry	42 PJ **2.4 Mt CO_2-e**	Ballance (fertiliser producer) is also based in Taranaki; other industry consumers are spread around the country	Users pay industrial or commercial rate based on size, location	Variable security of supply, depending on company size, location and flex	29% of gas emissions 57 kt CO2-e/PJ	Biomass/electricity/H2 for low/ medium temp. heat; more difficult for high temperature
Gas – electricity generation	54 PJ **2.8 Mt CO_2-e**	Most gas for electricity is consumed at Huntly, ~200km from Taranaki	Typically, price closer to wholesale, due to economies of scale and existing infrastructure	Reasonable security of supply, but limited storage options available in the long-term	34% of gas emissions 52 kt CO2-e/PJ	Good options to transition coal to gas and to replace baseload gas with renewables + peaking gas
Gas – residential/ commercial	24 PJ **1.7 Mt CO_2-e**	Gas transmission and distribution networks available across the North Island. South Island has no reticulated gas network, and instead relies on LPG	Residential users pay premium (localised connections), commercial users get better rate	Reasonable security of supply, with nuances for LPG	20% of gas emissions 71 kt CO2-e/PJ	Green hydrogen being investigated

1. CCC demonstration path, gas energy and emissions forecast based on 'Industry Continues' scenario

Source: Climate Change Commission - Inaia Tonu Nei

One possible alternative fuel in the future is hydrogen blending. Hydrogen would enable gas users to receive a similar energy service to natural gas, using existing infrastructure. If green hydrogen is gradually phased into the energy mix from the 2030s, it could also support the decarbonisation of natural gas, allowing users to use both natural gas and green hydrogen with incremental operating costs rather than large capital expenditure to completely switch fuels.

12.3 Appendix 3: Impact of gas on electricity prices

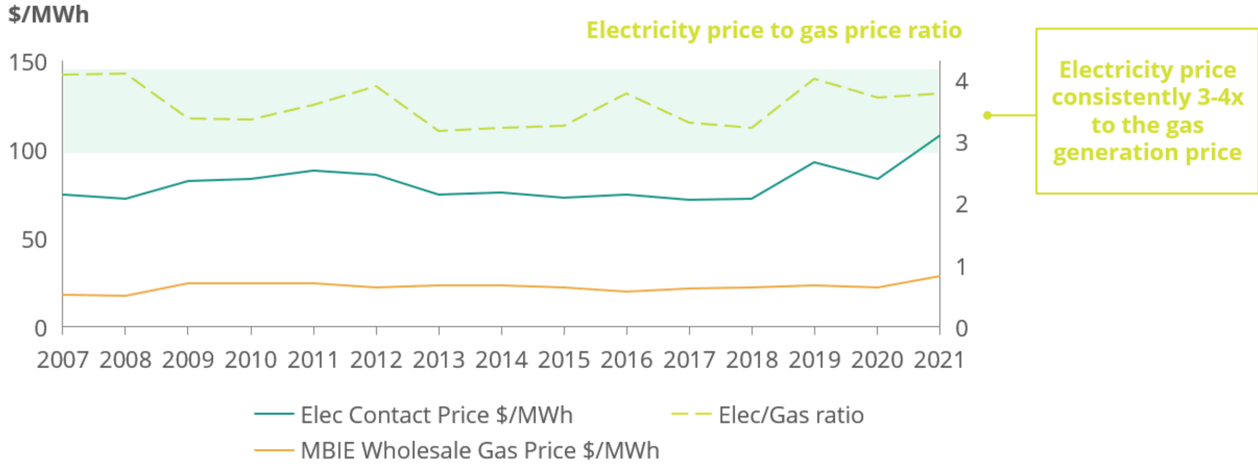
EnergyLink analysis outlined that over the last 20 years, the wholesale gas price has been highly correlated with contract electricity prices and has had a statistically significant impact on electricity prices. The correlation coefficient between wholesale gas prices and electricity contract prices was 0.97 for 2010 to 2021 (with 1.0 being a perfect correlation), which is a stronger correlation than for the carbon price and electricity demand.

Table 4: Correlation coefficient between different variables and contract electricity price

Correlation Coefficient	MBIE Demand TWh	Carbon Cost $/tonne	MBIE Wholesale Gas Price $/MWh	MBIE Industrial Gas Price $/MWh	Elec Spot Price $/MWh
1999 - 2021	0.86	0.59	0.86	0.82	0.59
2010 - 2021	0.91	0.53	0.97	0.94	0.80

A simple correlation analysis identifies that the contract electricity price to wholesale gas price ratio has been between 3 and 4 since 2007 (Exhibit 60).

Exhibit 60: Illustration of correlation between gas prices and electricity prices



Source: Ministry of Business, Innovation and Employment

The multiple regression analysis for 1999 to 2021 on an annual basis identified that gas prices have a statistically significant impact on the electricity price. This was determined by the formula *Elec Contract Price = 19.02 + 1.79 * Wholesale Gas Price $/MWh + 0.91 * Industrial Gas Price $/MWh* with both the wholesale and industrial gas prices being statistically significant at a 99% confidence interval.

This was then analysed on a monthly basis and since 2010 when the carbon price was first applicable to electricity. This also identified that gas prices have a statistically significant impact on the electricity price. This was determined by the formula *Elec Contract Price = 28.5 + 2.22*MBIE Wholesale Gas Price + 0.31*Carbon Cost*. In this analysis both the wholesale gas price and the carbon price were statistically significant at a 99% confidence interval. As carbon cost adds to the gas price directly as a $/GJ figure, this did not change the conclusion that gas prices are strong drivers of electricity contract prices.

Next, future electricity prices were assessed by conducting detailed electricity market modelling with the same input assumptions. For one case, a lower gas price path was used (assumed under an orderly transition scenario) and in the other case, a higher gas price was used (assumed under a disorderly gas transition). The average difference between the low and the high gas price was ~$2/GJ with an average price of ~$8/GJ in the low case and ~$10/GJ in the high case.

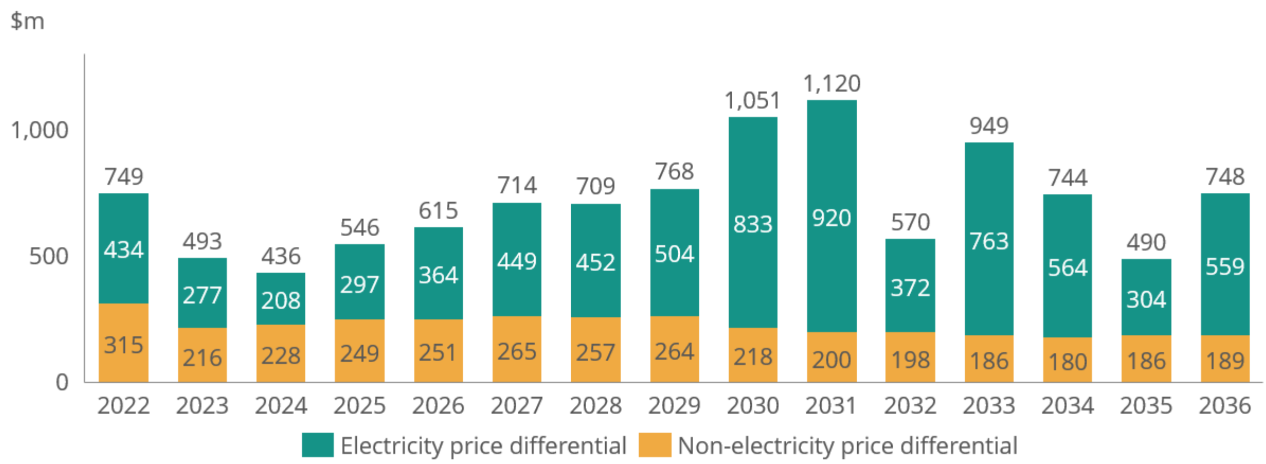
The analysis found that for the higher gas price scenario, the electricity price was $13/MWh higher on average. This suggested that each increase of $1/GJ in gas price increased the wholesale electricity price by $6.50/MWh on average. The gap between the gas price and the electricity price remains roughly equal over time, which suggests a clear correlation. Even as gas generation declined and renewables increased over time, the impact of gas prices on electricity prices did not diminish.

Gas generation is sometimes the marginal price setter for all dispatched power plants in the New Zealand electricity market. The price that gas generation bids into the market is largely a function of the gas price. When gas is the marginal price setter and gas is expensive, all electricity is expensive; if gas is affordable, then all electricity is affordable

As a result, even if gas is only 10% of the electricity generation mix, a 25% rise in gas can lead to a 25% rise in electricity prices for all electricity – not just for the 10% produced using gas. This is significant, because it impacts not just the 400,000 users of gas in New Zealand, but also the millions of Kiwis who rely on electricity every day.[37]

Exhibit 61 shows that the electricity price varies over time, and is subject to multiple factors, including new generation build and demand. Nonetheless, the difference in prices between a higher gas price and a lower gas price scenario is marked and includes both the direct impact of higher gas prices on gas consumers and the indirect impact of higher gas prices on electricity consumers.

Exhibit 61: Dollar impact of higher gas prices and impact to consumers



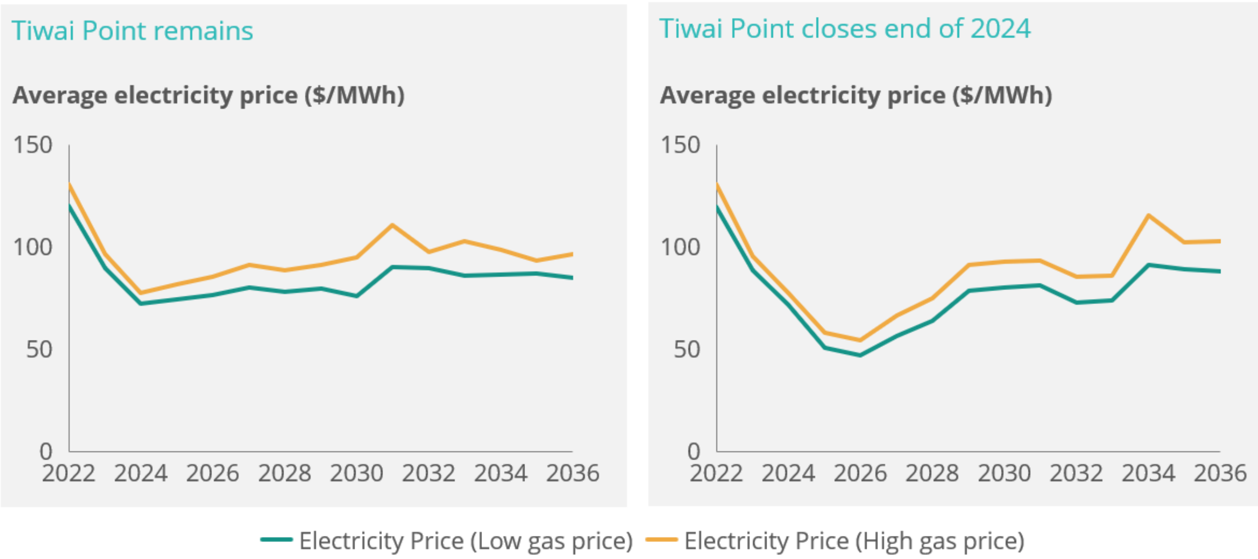
Note: All future price forecasts in real terms, assuming 2% annual inflation

Source: EnergyLink model

37 Gas NZ.

Regardless of whether Rio Tinto continues to operate or close Tiwai Point operations at the end of 2024, analysis found that the cost impacts are similar (Exhibit 62). While total prices are lower through the period 2024-2029, the price gap (between the lower gas price and higher gas price scenarios) persists.

Exhibit 62: Costs impacts are similar regardless of Tiwai Point decision



Note: All future price forecasts in real terms, assuming 2% annual inflation

Source: EnergyLink model

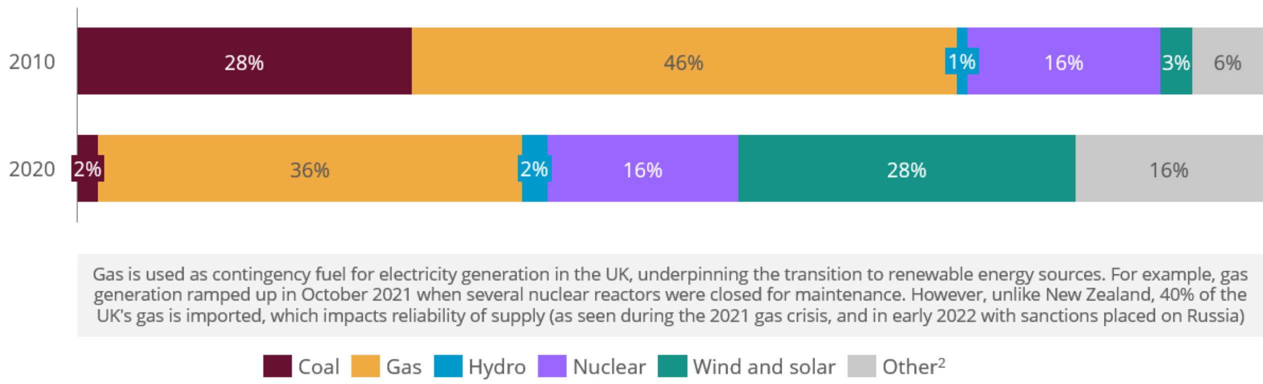
12.4 Appendix 4: The role of gas in the United Kingdom's transition away from coal

In the United Kingdom, coal use has decreased sharply over the last 10 years, while the decline in gas has been much smaller. With half the emissions intensity of coal, gas can cover peaking generation to meet the UK's demand for electricity. Gas can also cover baseload generation in case of decreased supply, such as in October 2021 when multiple nuclear power plants were down for maintenance.

Unlike the UK, New Zealand's gas is entirely domestically produced and therefore less exposed to international trade and supply chain issues, which further makes gas a prime candidate in the short to medium-term for ensuring security of supply of electricity, throughout the gas transition (Exhibit 63).

Exhibit 63: Gas supports the UK's transition to renewable electricity

PJ of electricity produced by fuel type[1] in the United Kingdom, 2010 and 2020



1. Some fuels, such as coal, gas and geothermal have conversion inefficiencies, which means that their primary energy totals are in fact much higher
2. Includes oil and biogas

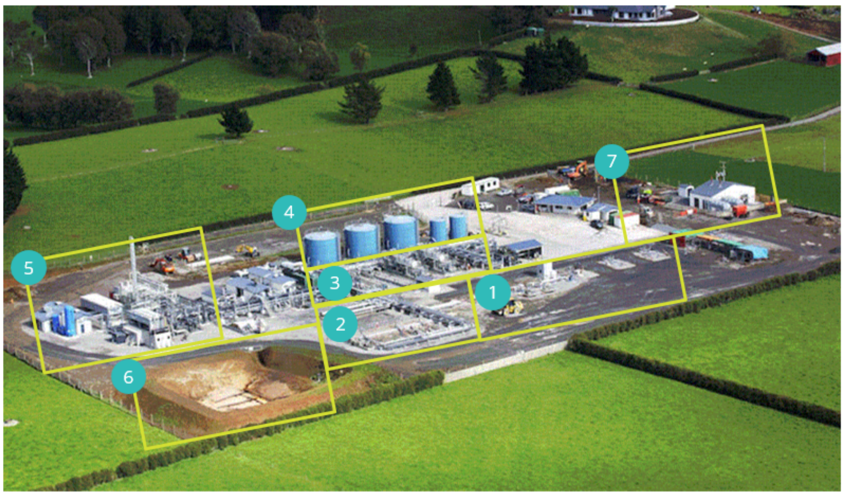
Source: UK Energy in Brief 2021

12.5 Appendix 5: Overview of Tamarind New Zealand's upstream oil and gas operations

Tamarind is a privately-owned upstream oil and gas company with operations in New Zealand, Australia, and the Philippines. Tamarind New Zealand Onshore Ltd (TNO), its New Zealand-based business, is in the Taranaki region, where it operates the Cheal and Sidewinder sites. Combined, they produce ~440,000 barrels of oil and gas (~3 PJs) yearly, representing 1% of New Zealand's domestic supply. The company generates NZ $45 million in revenue and employs ~25 FTE. Its business provides work to ~450 contractors and employees who have highly specialised skillsets in upstream operations.

TNO's sites span 200,000 square metres. All extracted oil from Cheal's 16 wells is processed in the central Cheal facilities, while oil from Sidewinder's 6 production wells is processed in Sidewinders' own dedicated facilities. Cheal serves as the focus for discussion in our case studies, as it represents 90-95% of TNO's production. An overview of the site is provided below (Exhibit 64).

Exhibit 64: TNO's Cheal site



1. Wells with wellheads and associated equipment regulate flow rate
2. Pipelines transport the extracted liquids from the wells to the processing facilities, and power fluid and gas from the processing facilities to other fields
3. Crude oil treatment plant separates oil, gas, and water
4. Storage tanks keep the treated oil and produced water
5. Gas treatment plant further separates water from the gas and compresses the gas for fuel use or export
6. Flare pit burns off excess gas which cannot be used or recovered
7. Power generation unit uses the compressed gas to generate electricity

Source: TNO asset team

Exhibit 65 outlines the key processes in Cheal's upstream operations. Wells contain equipment that pump out oil from the ground. The extracted solution is a mixture of oil, gas, water, and other impurities. It is transported through pipelines and processed as the components need to be separated from each other before the oil can be sold.

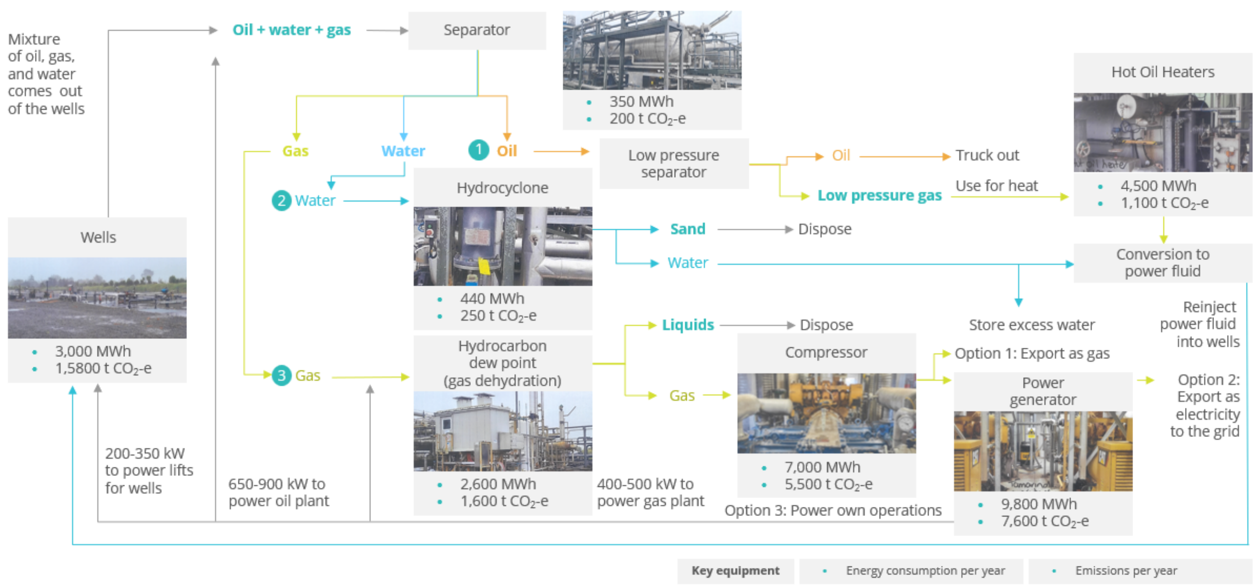
The mixture is first flowed into a primary separator, which allows the gas to settle on top of oil, and oil to settle on top of the water. The oil is then put through the low-pressure separator wherein the atmospheric pressure is drastically lowered so that the gas can be extracted from the oil stream. This gas is referred to as LP (low pressure) gas, which is used to generate heat. The oil is stored and trucked out to be sold.

In parallel, the separated water from the primary separator is put through a hydrocyclone which spins out sand from the water. The sand is disposed, while the water is heated through the hot oil heater with the aid of LP gas from the low-pressure separation process. The heated water is used as power fluid and reinjected back into the wells to enable consistent flow in oil production. Excess water is stored in tanks and intermittently used to flood the reservoir, as increasing reservoir pressure enhances the flow of oil upwards.

The third process happening simultaneously is gas processing. The separated gas from the primary separator is chilled through the hydrocarbon dew point. In this step, any other liquids mixed in the gas are condensed and can be extracted out. This is necessary to prevent corrosion of the pipes which the gas travels through. The dehydrated gas is then compressed.

After compression, TNO maintains the flexibility to choose whether to export gas or to use it for electricity. TNO can sell excess gas via its export pipeline. Alternatively, it can pipe the gas to its generators. The generator units have a combined capacity of 2.4 MW, which can be used to power Cheal plant operations, with the option to export electricity to sell to the grid. TNO aims to maximise revenue and optimize costs by dynamically switching between these options depending on the prevailing gas and electricity prices.

Exhibit 65: Diagram of TNO's upstream processes



Source: TNO asset team

Energy Resources Aotearoa