Gas Transition Plan Issues Paper

AUGUST 2023

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Te Kāwanatanga o Aotearoa
New Zealand Government

MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
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The New Zealand Government is seeking written submissions on the issues raised in this document by 2 November 2023.

Your submission may respond to any or all these issues. Where possible, please include evidence to support your views, for example references to independent research, facts and figures, or relevant examples.

Please include your contact details in the cover letter or e-mail accompanying your submission.

You can make a submission by:

- completing the survey on the MBIE website: https://www.research.net/r/GasTransition
- emailing your submission to gastransition@mbie.govt.nz
- mailing your submission to:

  Energy Resources Markets Branch
  Ministry of Business, Innovation and Employment
  15 Stout Street
  PO Box 1473, Wellington 6140
  Attention: Gas Transition Plan submissions

Please direct any questions that you have in relation to the submissions process to gastransition@mbie.govt.nz

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Ministerial Foreword

We need to do things differently if we are to avoid the impacts of climate change. To play our part in limiting global warming to 1.5°C, the Government has committed to reaching net zero for all greenhouse gas emissions (excluding biogenic methane) by 2050.

Reaching this goal will require a substantial and coordinated effort, and a commitment from across government that we are not shy of making. The Government is focused on the long-term strategic work of system change to a high performing, low emissions future.

The energy system has a critical role to play. In 2021, emissions from energy made up 40 per cent of New Zealand's total gross emissions. Cutting emissions from energy is essential to meeting our international climate commitments and reducing the impacts of climate change.

New Zealand is coming from a strong starting point, with a highly renewable electricity system New Zealanders can be proud of. Compared to many other countries, New Zealand's energy sources are highly reliable, renewable, and affordable. The challenge now is to increase the share of renewable energy, while providing affordability and reliability.

The Government has already made substantial progress in decarbonising the New Zealand energy system, including through our Government Investment in Decarbonising Industry programme, improvements we have underway to speed up consenting for new renewable generation, and the Warmer Kiwi Homes programme to reduce New Zealand's energy use while providing healthier and more efficient homes.

To further this work, I am now releasing a package of consultation papers, each addressing a different challenge in the energy transition.

The gas sector faces opportunities and obstacles in transitioning. These include ensuring that consumers have access to secure and affordable energy, not locking in older and poor performing assets, and supporting the Government's vision for the energy and industry sector. It is almost certain New Zealand will need a level of reliable gas supply for years to come.

This Gas Transition Plan Issues Paper seeks your feedback on the key issues and opportunities facing the gas sector. It sets out what we see as the key issues around investment and certainty for the gas sector. We know that one of the key challenges for the gas sector is ensuring that investment in gas supply continues for an appropriate period of time so that the needs of the gas industry, and the electricity system continue to be met for as long as we need them.

The Issues Paper also considers the role of other opportunities for lowering emissions, like carbon capture utilisation and storage, and renewable gases like biomethane and hydrogen. These present exciting opportunities for New Zealand in reducing emissions associated with gas use.

I welcome your feedback on this document, your insight will inform our pathway to an energy system that is secure, affordable and climate resilient.

Hon Dr Megan Woods

Minister of Energy and Resources

Why are we consulting?

This document seeks your views on the key challenges and opportunities for the fossil gas sector to transition to a low carbon emissions future.

Cabinet has agreed that the Ministry of Business, Innovation, and Employment (MBIE) work in conjunction with the gas industry co-regulator, Gas Industry Company Limited (Gas Industry Co), to develop a Gas Transition Plan (the Plan) for the phase-out of fossil gas over time. The Plan is intended to include a view on where and when renewable gases may be required to offset fossil gas use and associated emissions.

The Government's vision for energy and industry in 2050 is for New Zealand to have a highly renewable, sustainable, and efficient energy system that is accessible and affordable, secure, and reliable, and supports New Zealanders' wellbeing. We will need to do things differently in the energy sector to meet these targets. How we phase-out fossil gas plays a particularly important role in getting this transition right.

Setting New Zealand's gas sector on the right path will be critical for reducing emissions, providing energy security and affordability, and by extension, enhancing New Zealand's prosperity.

We have held discussions with stakeholders in the industry and commissioned a wide range of modelling and research. However, the conversation about the gas transition needs to be wide-ranging and inclusive – we need to have more detailed conversations with our Treaty partners, businesses, and communities to ensure that we take the best approach to managing the gas sector transition.

This Issues Paper seeks feedback on key issues and opportunities that the final GTP will need to address. Your input will be critical for helping inform how the gas sector transitions.

The final Plan will form part of the broader New Zealand Energy Strategy, alongside other dedicated energy transition workstreams. While the Plan's focus will be on the first three emission budgets out to 2035, the choices we make now will influence the direction of the gas sector to 2050. Private sector investment will be needed to make the most of the opportunities presented by the transition. This investment will require confidence in regulatory and policy settings.

Executive Summary

New Zealand’s climate change policy framework has clear legislated targets, and emissions budgets. Mitigating and adapting to climate change will require change across the economy – including the gas sector. We will not achieve our climate goals without managed transition from gas use over the coming years.

Fossil gas[1] currently has a key role in New Zealand’s energy mix. The challenge for the fossil gas sector is not just about reducing emissions, it is about the evolving role of fossil gas in supporting the wider energy transition and the New Zealand economy.

This Issues Paper seeks feedback from the public, organisations, and businesses on a range of key topics to inform the final Gas Transition Plan (**the Plan**). The Plan is intended to cover the first three emissions budgets out to 2035, while signalling the longer-term direction for the sector out to 2050.

Maintaining energy security while demand for gas continues to decline

The transition away from fossil gas needs to be manged carefully because of the unique features of New Zealand’s gas market. We do not import fossil gas and we have limited underground gas storage, which means domestic production of fossil gas must closely match demand. Ensuring supply continues to meet our energy needs as demand declines will require ongoing investment in fossil gas production, distribution, and transmission assets.

Currently, a large proportion of this investment is underpinned by fossil gas supply agreements with a single major petrochemical user, Methanex New Zealand. Methanex alone represents over 40 per cent of New Zealand’s fossil gas consumption. Even with ongoing investment, supply could decrease over time because our major gas producing fields are in the natural production decline phase of their operational lives. This decline may also make our gas supply more vulnerable to unexpected disruptions, such as natural hazards or unexpected technical issues.

Liquified Petroleum Gas (**LPG**) is produced in New Zealand, and imported when required, for example, seasonal peaks. The challenges for our LPG sector are different to that of the fossil gas sector, however these are not the primary focus of this issues paper.

Fossil gas and electricity

The Government has an ambitious target to deliver 100 per cent renewable electricity by 2030 and 50 per cent of total final energy consumption from renewable energy sources by 2035. As New Zealand’s energy system approaches these targets, the role for fossil gas will change and ultimately decrease.

Secure electricity supply is dependent on fossil gas during the transition, but its role will decrease over time:

- Fossil gas generation plays a critical role in ensuring security of electricity supply. A higher renewable energy mix that relies on variable renewables like wind and solar will increase the need for the firming capacity that gas currently provides, especially during winter.
- Meanwhile, electrification will be the major way fossil gas users transition away from gas. Reducing demand for gas will increase demand for renewable electricity, which will require significant investment over the next few decades.

1 Fossil gas is also known as natural gas.

A large part of New Zealand's broader energy transition is about users of fossil fuels moving to renewable electricity. This transition will be best served by clear stable policy settings that give consumers confidence that electricity supply will be secure and prices stable. The Government has implemented several policies to support this transition, including the Government Investment in Decarbonising Industry programme (**GIDI**), improvements the Government has underway to speed up consenting for new renewable generation, and the Warmer Kiwi Homes programme to reduce New Zealand's energy use while providing healthier homes.

Our existing fossil gas power stations are already being run less frequently, primarily due to the impact of the New Zealand Emissions Trading Scheme (NZ ETS) and increasing renewable generation capacity. The role of fossil gas in electricity generation is moving swiftly away from providing baseload generation and existing plants are instead moving to more of a peaking and firming role.[2] This trend is expected to continue, which will result in substantial emissions reductions for the energy sector in the short to medium term.

Forecasts from the industry and government agencies are consistent in their view that the decline in the use of fossil gas for baseload generation will result in New Zealand achieving a very highly renewable electricity market approaching 100 per cent over the next decade, particularly when there is not a dry year, and our hydro lakes are full.

Questions remain over whether a reliable substitute for fossil gas peaking will be economic over the next 10-15 years. The need for flexible fast start peaking capacity will become even more important as the system incorporates more wind and solar variability.

With its fast start capability and stable cost profile fossil gas may still be needed to play a small but important role in security of supply and price stability in the electricity market as it approaches 100 per cent renewable. This price and supply stability will give investors in both renewable generation and consumers the confidence to invest in the transition away from fossil fuels.

Issues for fossil gas users

The demand side of the fossil gas market includes petrochemical, electricity generation, large industrial, commercial, and residential consumers.

The pace of demand change is uncertain. We have a range of policies to support uptake of low-emissions options

Increasing carbon prices, and emerging technology options (such as high-temperature heat pumps) make it increasingly economic for consumers – big and small – to move away from fossil gas. Complementary government policy, like the GIDI Fund and the National Direction for Industrial Process Heat Greenhouse Gases, will further accelerate this decarbonisation transition. Understanding the scale and pace of the change is critical. It is increasingly likely that fossil gas consumers will switch to alternatives at an accelerated rate.

Fossil gas demand from major industrial and process heat users and electricity generation will eventually decline

We expect that fossil gas consumption by the petrochemical sector will eventually decrease, as renewable alternatives to fossil gas become more established. The role played by Methanex and Ballance Agri-nutrients in underwriting investment in fossil gas supply infrastructure will eventually change. They will either exit or switch to low-emissions alternatives.

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2 As outlined in the Government's consultation document on prohibiting the development of new fossil fuel baseload generation. For further information on this proposal please see the discussion document on MBIE's website.

Fossil gas use for baseload generation will also decline steadily as existing baseload gas plants are retired. How long we require gas to support both intra-day and intra-seasonal peaking needs remains uncertain.

Large industrial process heat users include businesses such as Fonterra and Oji Fibre Solutions. These consumers are making active efforts to reduce their use of fossil fuels. The Government, through the GIDI fund, has to date supported around 20 projects that will reduce or eliminate gas use for low and medium-temperature process heat. The Climate Change Commission's 2021 advice projected a steady decline in gas use for process heat between 2022 and 2035.[3] The timing and drivers of the change remain highly uncertain as there is a limit to the rate at which industrial process heat users can upgrade or replace their infrastructure, and change will depend on international prices and trends.

As fossil gas demand continues to reduce from each sector and larger consumers fuel switch or close, the remaining total demand is likely to be highly variable. The petrochemical sector provides considerable stability to current fossil gas demand as does electricity generation. If this demand profile changes, there will be a greater need for gas storage to match supply and demand. It would be beneficial, from an energy security perspective, to ensure these major fossil gas users have the confidence to continue to operate in New Zealand.

Commercial and residential users face risks from a poorly managed transition

Commercial and residential users represent the smallest proportion of the market in terms of fossil gas volume, however, they represent the majority of fossil gas and LPG pipeline connections. There is a risk if consumers rapidly switch away from fossil gas that this consumer segment will be burdened a rapidly increasing share of pipeline costs. Many household consumers also face high switching costs that could be difficult for them to meet, and they may need to be supported.

There are, however, opportunities to use fuels such as biogas in the short term to lower the emissions intensity of gas used in homes. Biogas blending in pipelines could provide a low emissions option for consumers who are willing to pay a small premium and could smooth the rate of change and associated impacts on the electricity network

Issues for the gas supply chain

The supply side of the fossil gas market includes both upstream production, fossil gas storage facilities, and transmission and distribution pipeline networks.

As fossil gas demand falls, we expect the economics of investment in the fossil gas supply chain to change

Ongoing investment is needed to ensure fields are developed and infrastructure maintained. Uncertainty is an inherent part of field development, so we also need to plan for unexpected disruptions to fossil gas supply – such as the Pohokura outages that occurred in 2018. At some point the higher costs of investing in offshore fields will not be economic and the fossil gas market may need to transition to a reliance on onshore fields. Understanding how sustainable onshore production will be is a crucial question. Based on current reserves it would seem likely that onshore fields can support a smaller fossil gas market if major offshore fields were to wind down.

Distribution and transmission networks have significant fixed costs and technical constraints on the level of demand that they can operate at. As demand reduces, there will be a point when these networks are no longer technically or economically sustainable. We expect that economic issues will

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[3] Ināia tonu nei: a low emissions future for Aotearoa (pg 115), Climate Change Commission, 2021.

arise first. Understanding when that is and options for managing the transition for customers is crucial.

We will likely need to increase the flexibility of the fossil gas system

As we take action to reduce emissions from the fossil gas sector, we also need to ensure security of supply is maintained. It is likely that the needs of fossil gas consumers, particularly the thermal electricity generators, will become increasingly variable, which will mean the gas system will need to become more flexible than it is today. As our fields age, we may also see declining supply-side flexibility. This situation creates a dual risk.

Over time, we may need to invest in more gas storage capacity to respond to increasing variability in demand for fossil gas. Storage will be particularly important if we become reliant on our smaller onshore fields, which have little gas supply flexibility. There are multiple ways we could increase gas storage, including through expansion of the existing Ahuroa Gas Storage Facility, construction of a new storage facility, or storage of gas in alternative mediums (such as methanol). Ensuring that the correct incentives are in place for gas storage is also an important component.

Liquefied Natural Gas (LNG) import facilities have previously been discussed as an opportunity for New Zealand to address system flexibility issues. There are risks of partially connecting our domestic fossil gas market to the international price of gas and thus fluctuations caused by external factors like the ongoing war in Ukraine. LNG facilities would also represent a significant additional investment in the gas system. There are multiple options for where and how LNG import facilities could be constructed, all with considerable costs and benefits and these would need to be considered alongside a range of other options to address a gas supply shortfall.

Based on analysis performed by Enerlytica, the variable cost of LNG to the market could be between $44 - 64 per GJ based on prices after Russia's invasion of Ukraine, or between $11 - $16 on historic pre-Ukraine prices.[4] For comparison, New Zealand's wholesale fossil gas price sits at around $7 - $8 per GJ.[5]

Opportunities

New Zealand needs to actively transition way from fossil gas, but at a pace that ensures risks are managed.

Government is ready to support fossil gas users to transition to low-emissions technologies

On the demand side, customers are increasingly moving away from fossil gas to lower emissions technologies. The Government already plays a key role here through the ETS, the GIDI fund and Energy Efficiency and Conservation Authority (EECA) programmes to encourage the uptake of new technologies. Programmes like Warmer Kiwi Homes can help some low-income households switch to efficient, low-emissions options for space heating and hot water. Work underway as part of the Government's Building for Climate Change Programme will also help to shape how we use energy in our homes and workplaces. However, the Government may need to take further actions to address affordability risks for commercial and residential consumers.

Biogas will help reduce emissions and allow some carbon neutral gas use to continue

There may be an opportunity to reduce reliance on fossil gas through expanding the use of biogas blends in existing fossil gas infrastructure. The timing and scale of this opportunity to offset fossil gas use is uncertain but promising. As discussed above, biogas blending in pipelines could provide a low emissions option for consumers who are willing to pay a premium.

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4 LNG import and options to increase indigenous gas market capacity and flexibility in New Zealand, Enerlytica, 2023.

5 Energy Pricing data, MBIE, 2023.

There is a potential for hydrogen to support the energy transition

Hydrogen is a versatile energy carrier that can be combusted similar to fossil and biogas, producing much lower emissions. It can also be used to produce electricity in a fuel cell where water and heat are the only emissions. Hydrogen is also a feedstock in important chemical precursors.

The Government sees an opportunity for green hydrogen to play a role as part of New Zealand's broader energy transition to a renewable energy system, particularly in hard to abate applications like heavy road transport, replacing emissions intensive hydrogen in chemical production and future opportunities in marine and air transport. The role for hydrogen in New Zealand's broader energy transition, actions the Government is taking and areas signalled for further consideration are set out in more detail in the Interim Hydrogen Roadmap, which has been released alongside this issues paper.

Hydrogen could also be used in the existing gas network blended with fossil gas and biogas, and potentially as a complete replacement in the network in the future. However, these uses are uncertain due to high costs compared to alternatives, the need to adapt existing gas infrastructure and appliances in higher hydrogen concentrations and how a future hydrogen market might develop. However, the Government welcomes private initiatives exploring the use of hydrogen in the gas network, and has co-funded initiatives with industry such as the First Gas Hydrogen Feasibility Study in 2021.

We see a possible role for carbon capture, utilisation and storage, but need to understand the risk

Carbon capture, utilisation and storage (CCUS) could play an important role in decarbonising gas. There is an opportunity for upstream producers to capture their emissions and reinject them into gas reservoirs. Emissions capture technology is technically and economically viable for upstream fossil gas production, so it does not require any government subsidy. It may also be possible to capture combustion emissions from major gas users. Seizing the opportunity carbon capture activities can contribute toward our emissions targets may require legislative and regulatory amendments to incentivise uptake and ensure the long-term integrity of storage facilities.

Next Steps

Your feedback will be important for informing the development of the Plan. We intend to develop a framework for managing the transition of the gas sector, and actions by Government to ensure that the gas sector continues to meet the energy needs of New Zealand, and maximises the opportunities presented to support security of supply and emissions reductions.

The final Gas Transition Plan will:

- help inform decision-making and action by the Government
- help to inform industry on the required investments and work to ensure an equitable transition away from the use of fossil gas
- consider recommendations from the Climate Change Commission, who are expected to provide their advice to Government on the second Emissions Reduction Plan later this year.
- Support the development of the New Zealand Energy Strategy.

Further conversations will be held as this Plan is finalised.

Chapter One: Introduction

This chapter sets out how work on a Gas Transition Plan came about and how it relates to the Government's other priorities in the energy sector.

There are no consultation questions in this section.

Climate change and the future of the energy sector

Climate change is the defining global challenge of our time. The Government has developed a comprehensive framework and set of actions to reduce New Zealand's emissions in line with our targets. The Climate Change Response Act 2002 (**CCRA**) sets a domestic target for Aotearoa to reduce greenhouse gas emissions (except for biogenic methane) to net zero by 2050.

In 2021, following advice from the Climate Change Commission, the Government updated New Zealand's first Nationally Determined Contribution (**NDC1**) to make it compatible with efforts to limit the increase in global average temperatures to 1.5 degrees Celsius above pre-industrial levels under the Paris Agreement.

In May 2022, the Government released its first three emissions budgets (2022 to 2035) and the Emissions Reduction Plan (**ERP**) in response to the Climate Change Commission's advice on planning and budgeting for a low-emissions future.[6] The ERP contains sector targets to help track progress over each budget period. Emissions from gas make up around 21 per cent of the energy and industry sector emissions.

The Government's 2050 vision for energy and industry, including fossil gas, is for New Zealand to have a highly renewable, sustainable, and efficient energy system that is accessible and affordable, secure, and reliable, and which supports New Zealanders' wellbeing.

Realising this vision will offer a range of benefits: it will create opportunities to reduce emissions in other sectors, reduce reliance on global fossil fuel markets, reduce costs through energy efficiency and clean technology, and create high-wage job opportunities.

To realise this vision, the Government has legislated a target of net-zero emissions of long-lived greenhouse gases by 2050[7], an aspirational target of 100 per cent renewable electricity by 2030[8] and a target that 50 per cent of total final energy consumption will come from renewable energy sources by 2035.[9]

The Emissions Reductions Plan also sets out objectives for the transition of the energy and industry sectors over the next 30 years[10]:

- energy remains accessible and affordable to support the wellbeing of all New Zealanders
- energy supply is secure, resilient and reliable throughout the transition and beyond
- energy systems support economic development and productivity growth aligned with the transition.

Transition issues for the gas sector are broader than emissions reduction alone. New Zealand's gas sector plays a critical role in our wider energy system and economy. The transition needs to happen in a way that maintains energy security and affordability.

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6 See footnote 3.

7 Section 5Q of the Climate Change Response Act 2002.

8 Te hau mārohi ki anamata: Towards a productive, sustainable and inclusive economy, New Zealand Government, 2022.

9 See footnote 8.

10 See footnote 8.

The Gas Market Settings Investigation

In December 2020, the Minister of Energy and Resources commissioned Gas Industry Co to investigate whether the current market, commercial and regulatory settings that provide for gas availability and flexibility were fit for purpose in supporting the transition to net-zero.

In its report on this Gas Market Settings Investigation, Gas Industry Co concluded that, in the absence of a transition plan for fossil gas, there was a substantial risk of a disorderly exit of New Zealand's gas sector.[11] Without such a plan, there would not be enough committed investment to ensure that gas reserves and contingent resources could come to market, which would compromise fair and efficient delivery of fossil gas to all consumers. It would also compromise the role that gas needs to play as a transitional fuel while we increase the amount of renewable electricity capacity.

The Gas Transition Plan Terms of Reference

In December 2021, Cabinet agreed that MBIE and the Gas Industry Co would work in conjunction to develop the Plan. In April 2022, Cabinet agreed the Terms of Reference for the Plan and its purpose, which is to[12]:

- establish realistic, but ambitious, transition pathways for the fossil gas sector to decarbonise in line with the 2022 to 2025, 2026 to 2030, and 2031 to 2035 emissions budgets, noting the inherent uncertainties involved.
- provide a framework to inform and engage with industry and other stakeholders about the future challenges and opportunities for the sector, and to identify areas where further measures may be required to achieve an equitable transition.
- establish a strategic view on the potential role for renewable gases, and potential measures for accelerating their uptake.

Cabinet also agreed that the Gas Transition Plan would consider other relevant Government objectives, such as the aspirational target to achieve 100 per cent renewable electricity by 2030.

The desired outcomes laid out in the Terms of Reference include:

- **Emission reductions:** Aotearoa New Zealand prioritises reducing emissions in the most economically efficient way. The pace of emissions reductions will need to support Aotearoa New Zealand's emissions budgets and 2050 emissions targets
- **Sustainability:** Aotearoa New Zealand avoids making decisions that further lock in our reliance on fossil fuels.
- **Energy security:** Security of supply is maintained through the transition, as fossil gas continues to be progressively displaced by renewable, lower emissions, alternatives
- **Energy equity:** Adverse and unexpected effects on fossil gas consumers are prevented or mitigated and consumers retain access to affordable, reliable and abundant energy. This includes minimising the broader effects on prices paid by consumers, as well as pricing of inputs for businesses as we transition
- **Energy conservation and efficiency:** Energy conservation and efficiency play a key role in the overall transition.

As we transition, there will be situations where these outcomes are in tension and trade-offs need to be made.

[11] Gas Market Settings Investigation, Report to the Minister of Energy and Resources, Gas Industry Co., 2021.

[12] Gas Transition Plan Terms of Reference, New Zealand Government, 2022.

New Zealand Energy Strategy

Although this Issues Paper focuses on the gas sector, where appropriate we consider the impacts of changes to the gas sector on the wider energy system. We anticipate undertaking whole-of-energy-system modelling as part of the Energy Strategy, which will provide a complementary view to this work.

Further information on the linkages between our ongoing consultations and the broader Energy Strategy is provided in the supporting note for the consultation release. That document serves to contextualise the papers in the wider energy system, describe how the papers are interlinked, and outline the key questions and issues in each paper and can be read as a standalone paper.

It also links to the Offshore Renewable Energy paper and provides further information about the Energy Strategy including a summary of project timelines and next steps.

International Context

Aotearoa is not alone in facing an energy transition. Many countries have committed to reducing their reliance on fossil fuels following the introduction of The Paris Agreement in 2015. This legally binding international agreement commits parties to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels."

At the same time, fossil gas use grew rapidly this past decade, accounting for almost one-third of total energy demand growth, more than any other fossil fuel. Fossil gas currently accounts for about a quarter of global electricity generation.[13] In some countries, gas has been seen as having a major role in displacing other fossil fuels, such as coal, and reducing associated emissions and air pollution. This is not the case in New Zealand, where abundant renewable energy options enable us to reduce our reliance on fossil fuels.

The Russian Invasion of Ukraine has had an extensive impact on global energy markets. Russia more than halved its pipeline gas supplies to the European Union in the past year. The European gas market responded by rapidly reducing consumption, ramping up alternative supplies, and investing in liquified natural gas (LNG) terminals to facilitate gas trading in a more diversified market. As a result of the supply shock, fossil gas prices in importing countries are likely to remain increasingly volatile and relatively high over the next few years.

The current situation is accelerating pre-existing trends away from fossil gas in Europe. Renewable electricity has become cost-competitive, and there is greater policy support for electrification of heat demand in both buildings and industry. Many regions worldwide are introducing policies to expedite a clean energy transition alongside economic recovery from the COVID pandemic and the Ukraine war, through programs such as the Inflation Reduction Act in the US, the REPowerEU plan in Europe and the GX Green Transformation programme in Japan.

International Energy Agency assessment

As a result of these recent events and trends, gas demand projections published by the International Energy Agency (IEA) are lower than in previous years.[14] In their report, *Outlooks for gas markets and investment*, the IEA has predicted a decline in fossil gas demand in advanced economies under all

13 International Energy Agency, 2023: https://www.iea.org/energy-system/fossil-fuels/natural-gas
14 World Energy Outlook 2022, International Energy Agency, 2022: https://www.iea.org/reports/world-energy-outlook-2022

scenarios and across all industries.[15] This decline is attributed in part to growing investments in clean energy.[16]

The IEA has also noted that there is significant uncertainty about the global long-term trajectory for gas. After reviewing projections across a sample of global gas market assessments, the IEA's consensus view is that fossil gas remains important in the coming decade, but there are large divergences beyond that, which highlight the uncertainties affecting fossil gas and LNG markets.[17]

In the face of so much uncertainty, the IEA drew two important conclusions:

- Despite flat or declining gas demand in the IEA scenarios, additional upstream investment is required to offset declines from existing gas fields so that the remaining demand can be met.
- All IEA scenarios also identify a need to reduce the emissions intensity of gas supply by reducing flaring and methane leaks.

These observations indicate that the upstream gas industry will play an important role in achieving both energy security and emissions reductions, and that working together with the upstream gas producers will be a key component of a managed transition.

Māori and the gas transition

The Government is committed to developing a transition that is equitable and achievable while supporting Māori interests and honouring the commitments made in Te Tiriti o Waitangi.

Before preparing the final Plan, we have more work to do to listen to iwi, hapū and Māori organisations to understand their interests and perspectives on the transition.

What we understand so far

Considering the policies in this paper, some key related elements of te ao Māori include the interconnectedness of tāngata (people) and te taiao (the natural world/environment), kaitiaki (guardianship) obligations towards te taiao and the inter-generational focus of decisions.

In recent years there has been increased participation of Māori in block offer processes for petroleum exploration permits.

Some iwi, particularly in Taranaki, have expressed strong opposition to continued petroleum extraction because it is a major contributor to climate change.[18] Other iwi emphasise the importance of energy wellbeing for iwi and hapū.[19]

There are outstanding recommendations from Wai 796 "The Petroleum Report" regarding Māori interests in petroleum that have not, to date, been addressed through a review of the Crown Minerals Act 1991.

Iwi and Māori interests in the transition.

We anticipate that Māori interests in the transition may include:

- Some iwi/ hapū have interests in gas as mana whenua of the land from which the gas is extracted, or through which gas is transmitted throughout Te Ika ā Maui. For them there are rangatiratanga and taonga-based interests in the land and the process of extraction and provision.

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15 Outlooks for gas markets and investment, International Energy Agency, 2023: https://www.iea.org/reports/outlooks-for-gas-markets-and-investment
16 World Energy Investment 2023, International Energy Agency, 2023: https://www.iea.org/reports/world-energy-investment-2023
17 See footnote 15.
18 Taranaki iwi strategic plans.
19 Ka Mahana I Taku Kiri: Māori Perspectives on the Measurement of Energy Wellbeing, Haemata Limited, June 2022.

- Some Māori groups and individuals have interests in the extraction industries, including employment, commercial and wider economic interests. There are potential equity and developmental interests in energy and resources. New Zealand's fossil gas resource is in the Taranaki region and the industry is a significant employer in the region, including of Māori.
- Some Māori groups have interests in terms of how any transition away from gas will affect other interests – for example, more use of renewable ways to generate electricity, including offshore renewables. The transition provides some opportunities for iwi and Māori. For example, Māori innovation and investment in renewable energy generation offers an opportunity for iwi to provide for their own wellbeing and energy independence.
- Māori have interests as users of gas which are likely to be similar to the interests of other New Zealanders who use gas. We do not yet know the extent to which Māori might be impacted differently to other New Zealanders by the gas transition. However, we do know that LPG is an important energy source in remote rural communities, where many Māori live. Phasing out LPG could mean that, unless affordable substitutes become available, or targeted support is made available, Māori in these areas might experience a decline in energy security.

The remaining chapters of this document present our early understanding of what the different dimensions of the gas transition might mean for Māori and how positive outcomes can be maximised.

Fossil Gas use in New Zealand

The New Zealand gas sector uses both fossil gas and liquefied petroleum gas (LPG). Energy from fossil gas use is equivalent of about two thirds of the energy consumed by vehicle transport, and about a third more energy than the entire electricity sector (including electricity produced by gas)[20]. In 2021, net fossil gas production in New Zealand was 157.5 petajoules (PJ).

Fossil gas users in New Zealand are diverse, ranging from very large petrochemical plants (Methanex, which makes methanol for export, is by far New Zealand's largest energy consumer) to the residential sector, which features many individual connections (306,000 household connections)[21] but uses a much smaller amount.

Figure one compares domestic gas consumption to gas sector emissions. The figure shows that the volume of energy consumed by each segment does not necessarily correspond to the emissions from each segment. For example, the very large petrochemical sector consumes around 36 per cent of gas in an average year, but comprises less than 20 per cent of emissions from fossil gas. In contrast, gas production consumes slightly less gas than the entire residential sector but emits twice as much CO_2.

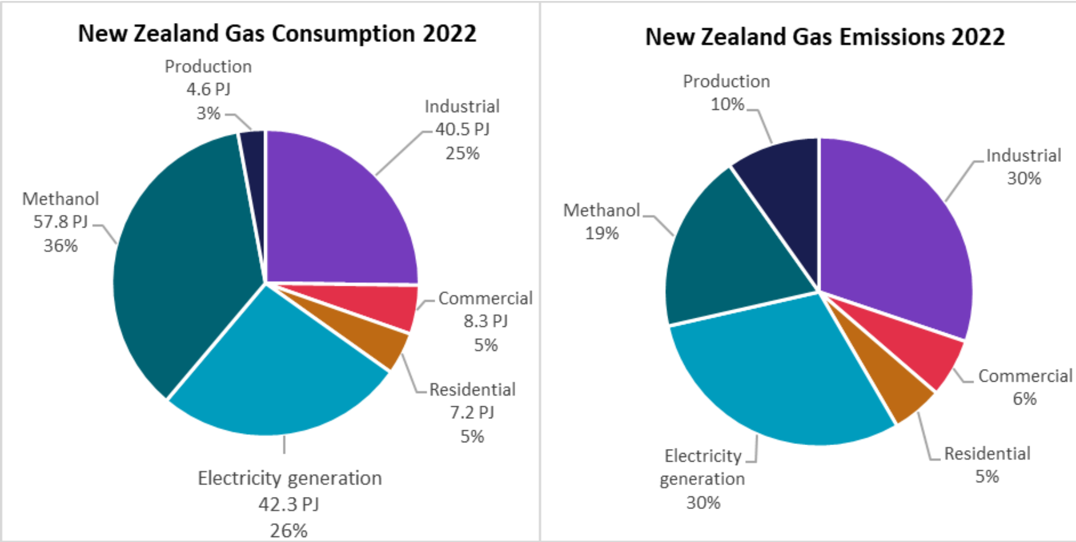
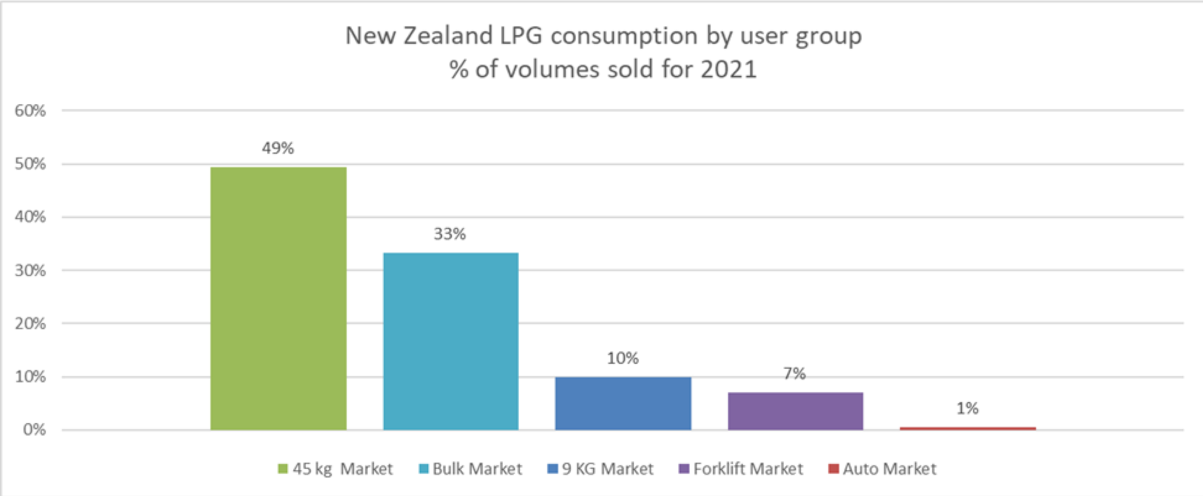


Figure one: Analysis of gas demand and emissions based on Climate Change Commission data, MBIE/Gas Industry Co. analysis, 2023

Figure two sets out LPG consumption by user group. In total, the sector consumed approximately 9.4 petajoules (PJ) of LPG in 2021. The main segments include the 45 kg market, which is used primarily in homes and businesses, the bulk market which supplies reticulated LPG suppliers in the South Island and larger consumers, and the 9 kg market which supplies smaller appliances like barbeques or outdoor heating.

20 Analysis based on MBIE data.
21 Analysis based on Gas Industry Co data.

Figure two: LPG consumption breakdown, Gas Industry Co Analysis



MAGNITUDE OF EMISSIONS REDUCTIONS REQUIRED

While the issue of the gas transition is broader than emissions reductions alone, having an idea of the likely magnitude of the emissions reductions required is important for understanding the scale of change likely required. New Zealand's emissions budgets to 2035 set out a clear expectation of what emissions reductions are required in aggregate for our industries, including the gas sector.

The Climate Change Commission's advice to the Government included a net zero "Demonstration Pathway" which provided modelled estimates of emissions from fossil gas (**Figure three**). This pathway was intended to show one potential way to decrease fossil gas emissions and was not necessarily the Climate Change Commission's recommended direction for how the fossil gas sector should change. We have used the Climate Change Commission's demonstration pathway to estimate the emissions reductions required for the fossil gas sector over time.[22]

It is important not to treat these targets as if they are an emissions 'entitlement' for the sector. We are treating them instead as a guide to the minimum scale of emissions reductions required to reach the legislated emissions targets. For example, in 2035, the fossil gas sector is forecast to contribute ten per cent of the Energy and Industry emissions budget in the first Emissions Budget. In practice, these contributions will be influenced by emissions reductions across Energy and Industry such as decisions around fossil gas use in the electricity system. The Climate Change Commission encourages large reductions in net and gross emissions from the fossil gas sector.

22 The Climate Change Commission's demonstration pathway was used because the Emissions Reduction Plan's Energy and Industry component did not produce gas sector specific targets as part of the emissions budgets.

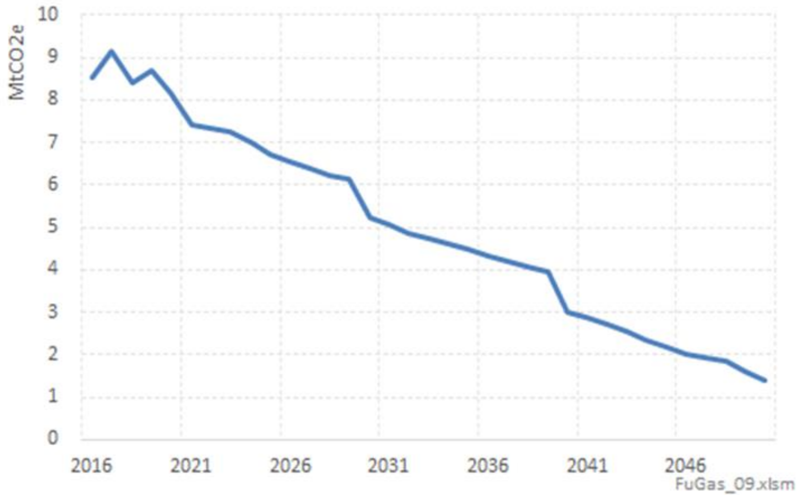


Figure three: Concept Consulting analysis of gas sector emissions in the Climate Change Commission Demonstration Pathway, Climate Change Commission/Concept Consulting, 2022.

Climate Change Commission Demonstration Pathway			
	First Emissions Budget (2022-25)	**Second Emissions Budget (2026-30)**	**Third Emissions Budget (2031-2035)**
Fossil gas emissions (Mt CO_2-e)	28.3	30.5	23.7
Per year target	7.1	6.1	4.7
% of energy and industry emissions budgets met by gas sector	9.7%	10.0%	9.8%

GAS MARKET SEGMENTS

Petrochemicals

Methanex is New Zealand's largest fossil gas consumer, representing over 40 per cent of consumption. Nearly all its production of methanol is exported, although in future it may be used to reduce emissions from hard to abate sectors including shipping, aviation and heavy transport. The other petrochemical manufacturer in New Zealand is Ballance AgriNutrients which produces fertiliser using urea. These manufacturing processes use gas for process heat and as a feedstock.

The gas consumed for process heat generates emissions which are counted in New Zealand's emissions totals. The gas used as feedstock does not count towards New Zealand's total domestic emissions because either the product will be consumed overseas, or it will not be combusted (for example in plastics manufacturing). Petrochemical gas use is important for overall gas supply. Gas demand from Methanex tends to underwrite the development of gas fields. Field operators generally invest to meet Methanex supply contracts, and little if any private sector investment is likely to occur in the absence of demand from a gas user of that scale.

Electricity

Fossil gas is used to generate electricity to meet both baseload demand and demand peaks. Gas-fired peaking electricity is generally required when generation from renewables is constrained and cannot meet demand. Fossil gas required for gas-fired peaking generation is supplied by a range of services including the gas spot market, contracted gas, gas storage (at the Ahuroa Gas Storage Facility) and, rarely, from gas demand response when gas is in short supply.

Industrial

Industrial consumers typically use gas for process heat or to cogenerate electricity. Opportunities to transition away from fossil gas depend on the cost and in some cases, the properties of gas (for example, some industrial processes cannot sustain the micro-outages associated with electricity). Transition can involve switching to electricity or low-carbon gases, or process efficiencies. Currently, these options tend to be more expensive than fossil gas.

Some industrial gas consumers cannot currently absorb carbon prices or switch fuels without reducing their competitiveness and may consider closing or exiting New Zealand.

Commercial

Commercial consumers span a wide range of activity, from cooking in cafes and heating in hotels, to greenhouse processes that re-use carbon dioxide. Commercial uses also include the use of gas in facilities that require very high heat, and LPG supply to remote areas where electricity cannot easily be supplied at required energy loads.

Opportunities for commercial consumers to switch fuel are specific to individual circumstances. For example, low-to-medium heating of warehouses can be economically replaced by electric heat pumps. For other uses, there are limited or no technically or economically viable decarbonising options at the moment. Opportunities for decarbonising can depend on relative costs, capital, space, availability of electricity connections, and the properties of alternative energy sources.

Residential

The majority of Liquified Petroleum Gas (LPG) use comes from residential consumers supplied through 45 kilogram bottles or through bulk supply through reticulated LPG networks in the South Island. Nine kilo LPG bottles are also widely used for barbeques, remote energy supply (including boats) and outdoor heating.

Switching options for households include heat pumps, electric water heating, and electric or induction stovetops. In recent years, the cost of these alternatives has greatly reduced. Switching involves not just an ongoing operational cost, but also capital investment in appliances, and can involve substantial renovation costs where re-modelling is required. The Government does not propose phasing out existing residential gas connections.

Transmission and distribution infrastructure

Transmission pipelines move bulk gas supplies around the country while distribution lines carry gas to the end consumer. Some gas pipelines function as storage where the network operator varies the pipeline demand in response to changes in demand. Pipeline pressures can be altered in response to changes in demand, which can considerably reduce operational costs, so operational costs borne by each user do not necessarily increase steeply as they are shared across diminishing numbers of customers, until few customers remain.

Commerce Commission regulates gas transmission and distribution pipelines under the Commerce Act 1986.

Production

New Zealand has six main producing gas fields. All of these fields are in Taranaki and all are in decline. Fields need ongoing investment to continue production. Investment occurs to meet contracted demand and in the absence of a secure contract with a gas buyer, producers will not develop fields.

Gas fields are unlikely to be developed solely for uses other than petrochemical manufacture because it is unlikely that any other gas buyer has the scale to contract volumes sufficient to underwrite investment in field development. Onshore and offshore fields have different investment profiles. As offshore drilling is more expensive, fewer production wells are generally drilled. Onshore fields generally require more drilling than offshore to maintain production rates.

Generally, with sufficient ongoing investment, New Zealand’s gas fields tend to produce steadily at maximum output and even when short-term prices rise, gas fields do not change output.

Chapter Two: Transitioning our gas sector

We seek your views on the uncertainties and challenges in the gas sector. Ensuring that we have a robust understanding of the issues facing the gas sector (and our broader energy system) will enable the development of a gas transition plan that helps address the challenges as we progress towards our targets.

KEY POINTS:

- The issues for the gas sector are broader than reducing emissions, with outcomes for the wider energy system and our economy requiring careful consideration.
- Gas will play a role in supporting our strategic industries and in supporting electricity security of supply for some time until renewable or low emissions technologies can replace gas, or adequately reduce emissions associated with its use.
- Underinvestment in the maintaining gas infrastructure could undermine security of supply for both the gas industry and the wider energy system.
- The transition will require significant investment in new technologies to support gas users to transition, emissions reductions in the gas sector, and in maintaining gas supply to enable us to meet our energy needs.
- Without greater certainty, capital investment in the gas sector will get harder to attract because of:
  - Increasing risk profiles and uncertainties about returns on investment.
  - Decreasing ability to use traditional risk management approaches (such as joint ventures) to help mitigate risks for gas sector participants.

*There are **10** consultation questions in this section.*

THE TRANSITION CHALLENGE

Currently fossil gas and LPG support New Zealand's energy needs in several critical ways, which are difficult to replace with current technology. Fossil gas use provides:

- security of supply in the electricity system, through firming/peaking and dry year cover
- a feedstock in the substantial, exporting petrochemical sector
- process heat for our key manufacturing industries, particularly high temperature process heat
- energy for consumer needs in homes and businesses through space and water heating, and cooking.

The New Zealand gas sector has several distinct features:

- we do not import gas other than small amounts of LPG, which means domestic fossil gas production must closely match demand
- we have limited gas storage
- fossil gas demand is dominated by a small number of large consumers
- most gas consumers are supplied by reticulated gas networks, which rely on sufficient demand to be sustainable economically and to operate at minimum pressures

- gas consumers often have significant capital tied up in gas appliances and equipment which makes the costs and timing of transitioning challenging
- there is a tight inter-twining of the gas and electricity markets which presents both risks and opportunities.

This section looks at the transition issues from a production, distribution, end consumer and electricity sector perspective and seeks views on key questions for each of these parts of the overall gas market.

BALANCING SUPPLY AND DEMAND

New Zealand relies on ongoing domestic fossil gas production to meet demand. With limited gas storage, we need ongoing investment in production, such as new wells, to maintain a reliable gas supply. One of the core challenges we face during the transition is how to ensure this investment continues, even as demand declines.

Generally, investors have been willing to undertake ongoing investments in long-lived gas supply infrastructure by signing Gas Supply Agreements with major gas users. These agreements give certainty to about the level of demand that can be expected, and therefore the return on investment in gas production.

Investment in long-lived gas production infrastructure can be commercially challenging in a market in which demand is declining and the rate of this decline is unpredictable. Uncertainty about the transition pathway (particularly around levels of demand) can also reduce the confidence that investors have in earning a return from their investments.

Even in a favourable investment environment, gas production volumes are difficult to predict. The best estimate of the volume of gas that can be produced from a gas field is generally reported as 2P reserves (or P50 reserves). 2P reserves are a point in time estimate of volumes that have been discovered by drilling a well and testing and have a 50 per cent chance of being technically and economically producible from known accumulations under given economic conditions.

Much of New Zealand's gas supply comes from fields which were discovered several decades ago. Over the past decade, these fields have been in a phase of stable production, keeping New Zealand's 2P reserves relatively consistent at around 2,000 PJ. However, this picture is beginning to change, with a 17 per cent decline in 2P reserves reported in 2023. Deliverability (i.e. how much gas that can be produced per day) has decreased as the gas fields are entering their natural production decline phase.

Risks of underinvestment in fossil gas supply during the transition

While we understand that there are sufficient producible resources to meet New Zealand's expected gas demand to the late 2030s[23], this production can only occur if the sector continues to invest in field development far enough in advance. The required investment is estimated to be about $200 million per annum across all gas fields, according to the advisory firm Enerlytica.

Currently, a large proportion of this investment is underpinned by fossil gas supply agreements with a few major gas users, specifically Methanex with their Taranaki Methanol plant, Ballance Agri-Nutrients with their Kapuni Urea Ammonia plant, and gas fired baseload electricity generators (e.g. the Contact owned Taranaki Combined Cycle plant, and the Genesis owned Huntly Power plant). These large customers can make long term commitments on volume and price, which helps to de-risk investments, particularly for larger offshore fields. This situation may change as we transition. We expect that fossil gas consumption by the petrochemical sector will eventually decrease, as

23 Gas supply and demand projections, Concept Consulting, 2022.

renewable alternatives to fossil gas become more established (such as biomethane or green hydrogen).

The ability of the sector to invest, and the risk of underinvestment, was a key issue that Gas Industry Co identified in its Gas Market Settings Investigation which highlighted three factors that make it more difficult to secure necessary capital investment[24]:

- Demand for fossil gas and in turn investment into fossil gas development and production to meet that demand, is affected by concerns that:
  - businesses and industries will become uneconomic and shut down or switch to low-emissions fuels, thus reducing demand for developed gas producing assets,
  - major gas users are unclear about the likely timing of when their gas use will reduce, and complete decarbonisation will happen, thus reducing confidence to enter long term contracts for gas supply,
  - gas supply may not be available to meet the demand, thus reducing confidence to invest in a plant that would contract for long term supply.
- Fewer opportunities will exist to manage risk as the size of the fossil gas industry reduces. For example, there will be less opportunity to diversify investment, and fewer parties willing and available to share the risk. Diversification and risk-sharing are the most common strategy for managing investment in gas production.
- Investors in gas production and demand understand and expect that policy and regulatory levers will be pulled during the transition period. These will change the economics of their investments, but investors unsure about the extent and timing of that change. For example, resource management reforms will have an impact on the ability of gas consumers to obtain consents for new plant over time.

What a smaller gas market could look like

As the demand for gas changes and fields enter their end of life the country will need to navigate how to ensure that sufficient gas is available.

New Zealand has a mix of offshore and onshore fields. The economics of these fields differ with offshore fields being larger but with generally higher costs. As discussed above, the economics of New Zealand's offshore fields have been underpinned by long-term supply contracts with major users. In a smaller gas market, it is likely that offshore field development will become economically unsustainable. New Zealand may need to rely more heavily on its onshore fields.

In addition to providing economic incentives for offshore field development, the petrochemical sector provides considerable stability to current fossil gas demand, as does electricity generation. As fossil gas demand from each sector continues to decline, and larger consumers fuel switch or close, the remaining total demand is likely to be highly variable. As our fields age, we will also see declining supply-side flexibility.

This situation creates a dual risk and makes us more vulnerable to unexpected disruptions, such as natural hazards or unexpected technical issues. This increasingly variable and unpredictable market creates a greater need for gas storage to match supply and demand.

Opportunities to improve the flexibility of our gas supply, particularly for thermal electricity generation, are discussed further in Chapter 3.

[24] Gas Market Settings Investigation, Gas Industry Co 2021.

GAS NETWORKS

Gas networks face a similar investment challenge given the uncertainty of future demand on their networks.

Increasing carbon prices, and emerging technology options (such as high-temperature heat pumps) make it increasingly economic for consumers – big and small – to move away from fossil gas. Complementary government policy, like the GIDI Fund and the National Direction for Industrial Process Heat Greenhouse Gases, will further accelerate this decarbonisation transition.

Gas networks face risks regarding sections of the network becoming uneconomic to run as users disconnect. As demand declines, the fixed costs of maintaining the pipeline network will be shared between fewer consumers, creating the risk of gas becoming increasingly expensive for consumers and driving accelerating network disconnection. If the number of users drops below a critical level, it could create issues in maintaining minimum pressures and increasingly prohibitive costs for the remaining gas network users. We expect that economic issues will arise first. Understanding when that is and options for managing the transition for customers is crucial.

Commercial and residential users represent the smallest proportion of the market in terms of fossil gas volume, however, they represent the majority of fossil gas and LPG pipeline connections. Many residential consumers also face high switching costs that could be difficult for them to meet, or they are unable to switch if they are renting. There is a risk if consumers rapidly switch away from fossil gas that this consumer segment, particularly low-income users and renters, will be burdened with a rapidly increasing share of pipeline costs. These vulnerable users may need to be supported.

Consultation Questions

- How can New Zealand transition to a smaller gas market over time?
- What is needed to ensure fossil gas availability over the transition period?
- What factors do you see driving decisions to invest or wind down fossil gas production?
- Does the Government have a role in enabling continued investment in the gas sector to meet energy security needs?
  - If yes, what do you see this role being?
- Does the Government have a role in supporting vulnerable residential consumers as network fossil gas use declines?
  - If yes, what do you see this role being?

FOSSIL GAS AND ELECTRICITY

Electrification is New Zealand’s major opportunity to reduce emissions from the energy and industry sector and in land transport. Gas is likely to support energy security in the electricity system for some time, even as demand for gas for electricity generation is likely to become lower and more variable over time.

The cost of solar, wind, geothermal and batteries have continued to fall, making renewable electricity options the most cost-effective investments to meet the large increase in electricity demand forecast over the next few decades. This trend is reflected in the rapid acceleration of renewable electricity projects coming to market, under construction, and in the planning stage. According to the Climate Change Commission, with the level of announced investment in renewable generation, New Zealand is likely to reach around 96 per cent renewable generation by 2030, positioning the country to push further towards a fully renewable electricity system. The Government has an aspirational target to reach 100 per cent renewable electricity by 2030.

The New Zealand electricity system has always needed to deal with the variability of renewable electricity – particularly dry year risk with hydro-generation. We are addressing the long-term dry year risk through the NZ Battery Project. However, with increasing wind and solar generation, new challenges are emerging on how to manage shorter term variability from calm and cloudy periods.

A consistent conclusion from many commentators, including the Climate Change Commission, is that this challenge will not be met by any one answer but will require multiple solutions on both the demand and supply side. On the supply side there are emerging technologies that could play the key role of dry year and shorter-term needs to meet peak demand and firm the day-to-day supply, but their readiness for market is a key uncertainty.

We need to ensure that the energy system can continue to meet the needs of New Zealanders through the transition. As noted by the Climate Change Commission, "*the speed with which Aotearoa reduces fossil gas use for generating electricity needs to be carefully managed to ensure electricity remains reliable and affordable.*"[25]

The role of fossil gas in electricity generation is already moving away from baseload generation and existing plants are now moving to more of a peaking and firming role. Existing gas peaking generators and plants are aging and will likely be insufficient by around 2032 according to the Electricity Authority[26]. The economics of investing in gas peakers are also challenging compared with additional investment in renewables like geothermal, solar or wind. Replacement or new gas peaking generators will have an important role in supporting the system while more variable renewable generation is built. Some new peakers have already been consented, but no business currently intends to build them as the costs and perceived investment risks are too high.

There may be a role for government in encouraging investment in gas-fired electricity generation, but there is also a risk in encouraging investment for longer than is optimal. There may be lock-in of emissions from gas fired peaking for longer than is needed to maintain energy security. This could lead to New Zealand failing to meet our emissions targets, and potentially stranded asset risks in the future if low-emissions alternatives come into the market faster than is currently anticipated. We also need to support the development of renewables, encourage electrification, and allow as much time as possible for new technologies to mature.

Given electrification is at the heart of New Zealand's decarbonisation strategy, we are seeking your feedback on the nature of this key relationship between fossil gas and electricity.

Consultation Questions

- What role do you see for gas in the electricity generation market going forward?
- What would need to be in place to allow gas to play this role in the electricity market?
- Do you think gas can play a role in providing security of supply and/or price stability in the electricity market? Why / Why not?
- Do you see alternative technology options offering credible options to replace gas in electricity generation over time? Why / Why not?
- If you believe additional investment in fossil gas infrastructure is needed, how do you think this should be funded?

25 See footnote 13.
26 Ensuring an Orderly Thermal Transition, Electricity Authority, 2023: https://www.ea.govt.nz/documents/3148/Ensuring_an_Orderly_Thermal_Transition_6_June_20231397102.1_1.pdf

Chapter Three: Key issues and opportunities

This chapter discusses strategies to support the reduction of emissions from the gas sector while maintaining security of supply and energy equity.

This chapter presents an initial view on opportunities to increase the use of renewable gases and low carbon technology in New Zealand. It also looks at potential ways to increase flexibility of gas supply.

These opportunities will need private sector investment and possibly regulatory changes to support their deployment. This issues paper is intended to inform a position on the strategic role these could play, rather than seek specific feedback on regulatory options or propose specific investments. The final Gas Transition Plan will help provide the further certainty around the gas sector's long-term role in the New Zealand energy sector that is needed to enable private sector investment.

Your feedback will help us to narrow down this long-list to identify the key priorities that could be pursued as part of the Plan.

The key opportunities we seek feedback on are:

- Greater use of renewable gases and emission reduction technologies:
  - Biogas/biomethane
  - Hydrogen
  - Emissions sequestration (or CCUS)
- Ways of increasing capacity and flexibility of gas supply:
  - Enhanced Gas storage
  - Liquefied Natural Gas (LNG) import

This section has been informed by a range of more detailed technical reports which have been published alongside this document on the MBIE website.

*Chapter Three includes **13** consultation questions.*

Renewable gases and emissions reduction technologies

The development of a market for renewable gases could provide a low-emissions alternative to fossil gas, such as hydrogen and biogas/biomethane. Emissions sequestration could also provide an opportunity to reduce emissions in the gas sector while utilising existing gas infrastructure, which could help support energy security and affordability in the energy sector out to 2035.

BIOGAS AND BIOMETHANE

Key Points

- Some biogas can be upgraded to biomethane, and injected into the fossil gas network at relatively low cost.
- Larger volumes of biomethane can be expensive. There could be sufficient feedstock to make very large quantities of biogas technically feasible, but not at prices that are economic for electricity generators that use gas or large industry with mature technology.
- Smaller quantities of biogas can be produced at much more economic cost and play an important role in decarbonising key areas of the fossil gas sector.
- Waste management and renewable gas trading will be important if biogas is to play a role in the transition.

Biogas is produced from bacterial digestion (anaerobic digestion) of raw materials such as manure, municipal waste, plant material, sewage, green waste, wastewater, and food waste. It is a renewable energy source and contains a mixture of gases, primarily methane, carbon dioxide and hydrogen sulphide.

For biogas to be used in the fossil gas network, the impurities need to be removed so that it can meet the requirements of piped gas. Once the biogas has been through this process to upgrade it to biomethane, it is identical to fossil gas in use. Anaerobic digestion and upgrading of biogas to biomethane are well understood technologies and are commonly used today in commercial systems here and overseas.[27]

The lifecycle emissions of biogas generated from organic wastes and residues is on average 17 kilograms of carbon dioxide (equivalent) per gigajoule of energy ($kgCO_2e/GJ$), which represents a 70 per cent emissions reduction when compared to an equivalent amount of fossil gas (57 $kgCO_2e/GJ$). In addition to those emissions reductions, large net reductions in emissions intensity result when biogas is derived from a material going to landfill (or other destinations where the material would decay and generate large quantities of biogenic methane).[28]

Anaerobic digestion also produces digestate, which can be used as an organic fertiliser. At sufficient scale, this could be used to help offset the use of synthetic fertilisers in some applications.

Current biogas production in New Zealand

Current estimated biogas production in New Zealand is about 4.9 petajoules per year (PJ/year), which is around five per cent of the size of the fossil gas market, equivalent to around half of gas used by residential and commercial users. Currently landfill gas capture is the largest source of biogas in New Zealand (around three PJ/year). Other production sites include wastewater treatment plants and industrial facilities such as milk and meat processors. Biogas production from source separated organic municipal wastes, while mature overseas, is not yet common in New Zealand. The

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27 Gas Transition Plan - Biogas Research Report, WoodBeca, 2022.

28 See footnote 27.

first purpose-built organic waste digestion facility (Ecogas) has recently opened and is moving into production in Reporoa, in the central North Island.

Biogas potential in New Zealand

There is potential for New Zealand to convert more of our waste feedstocks to biogas. There is also potential to make use of existing fossil gas assets through upgrading biogas to biomethane and blending it into gas pipelines. Many of the existing biogas developments in New Zealand have been driven by desire to deal with a waste product onsite, rather than realising the potential that product can have in the wider energy sector. By upgrading biogas to biomethane and injecting it into pipelines, it could be delivered to gas users who are willing to pay a premium price.

Figure five shows the estimated feasible biogas production in New Zealand at different price levels. Biogas from landfills, wastewater treatment plants, and food waste digesters can be accessed, upgraded, and injected into the fossil gas network at relatively low cost per unit of biomethane but at a higher price than current fossil gas. For example, up to two PJ of biogas from these sources is likely to be available for around $15/PJ or less, compared to the current residential fossil gas price of $8/PJ. This volume of biogas could replace around 20 per cent of residential and commercial fossil gas consumption. As the cost of gas comprises less than 20 per cent of these consumers' gas bills, the higher price of biogas wouldn't directly correlate with a corresponding increase in retail gas prices. The total accessible and economic size of biogas potential before 2035 is estimated to be about seven PJ/yr. This volume is about the same size of the current residential and small commercial fossil gas market.[29]

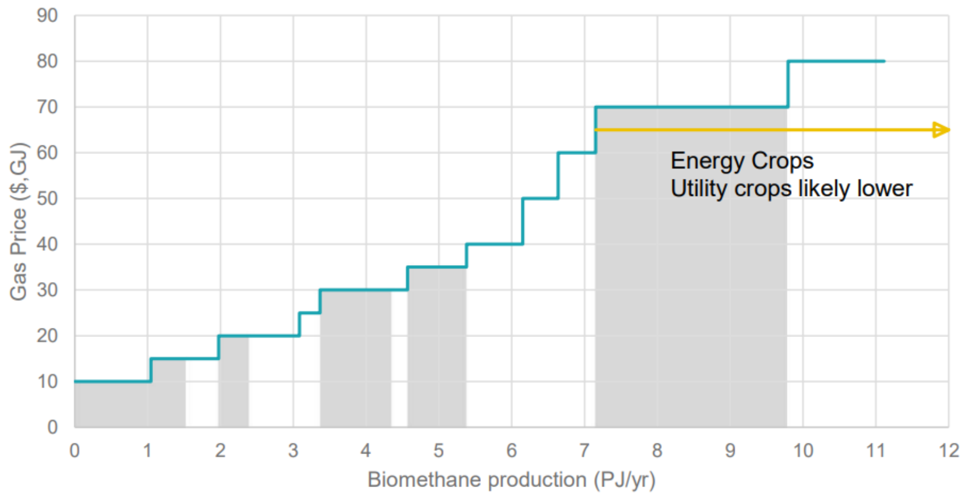

Figure five: *Estimated feasible biomethane production costs compared to fossil gas, Concept Consulting Analysis, 2023*

A significant volume of additional biogas potential exists in New Zealand in the form of agricultural and forestry waste. However, much of this feedstock is currently economically challenging to access. It is also likely that there would be a level of competition with biomass and biofuel production for these resources, particularly forestry residues. Biogas production potential from these sources is likely to evolve as a biogas market is established and new technologies are introduced.

More biogas could be produced from purpose-grown energy crops. However, growing crops at the scale required could create competitive pressure for land used for growing food. The total land required to replace New Zealand's fossil gas demand, at approximately 150 PJ, would be 1.7 million hectares. This is equivalent to around 20 per cent of New Zealand's productive grassland. Under all

[29] See footnote 27.

future projections of demand, the gas market is expected to reduce in size, which would reduce the amount of land required for energy crops, should this path be pursued. The land use impact could be minimised by growing energy crops on marginal land which is not productive enough for growing food, or by developing aquatic crops such as seaweed and algae.

While biogas from waste products makes use of methane that would otherwise contribute to GHG emissions, generating biogas from purpose-grown crops may create new fugitive emissions due to methane leaking from the anaerobic digestor facilities as it is produced, increasing the emissions associated with the use of these fuels.

Potential role of biogas and biomethane in the transition

We consider it highly unlikely that a complete transition to biogas for the gas sector could be achieved in the short to medium term. However, smaller quantities of biogas can be produced at a much more economic cost and play an important role in decarbonising key areas of the fossil gas sector. Biogas blending into distribution networks for use by residential and commercial consumers could be feasible in the short-term because of the small relative cost of gas as a component of final energy bills.

For biogas to play a role in the transition, it will be important to improve the way we manage and process our organic wastes. In New Zealand, 90 per cent of municipal solid waste ends up in landfill with some form of gas capture, where it is left to decompose to biogas in sealed landfill cells. Generally, the quality of the gas generated in landfills is much lower than the quality of gas produced in a purpose-built anaerobic digestion plant. Treating source-separated organic wastes at purpose built anaerobic digestion facilities could allow us to extract more energy from our existing waste feedstocks and to create high-quality biogas which can be upgraded to biomethane and injected into gas networks.

The Ministry for the Environment has released a proposed national waste strategy targeting 30 per cent reduction in methane emissions from waste by 2030 and a low-carbon circular economy by 2050. We expect this strategy to play a key role in diverting organic wastes from landfills in favour of anaerobic digestion processing.

Consumers, particularly businesses, purchasing gas from the distribution network may be willing to pay a small premium for biogas because of the associated sustainability benefits. However, biogas production is in various locations around the country, often in different locations to gas demand. Once it is blended into the gas pipeline, biomethane is physically indistinguishable from fossil gas – there is no way to deliver 100 per cent biomethane to a particular consumer through the network. To encourage development of a biogas market, it will be important to have a system through which consumers can choose to “virtually” purchase gas from biogas producers at a premium price, so that even though they are physically consuming a mixture of biomethane and fossil gas, they are in effect only paying for biomethane. This concept of renewable gas trading is discussed further in the following section.

Out to 2035, biogas will likely be slightly more expensive than fossil gas. We expect pipeline fossil gas demand to eventually decline due to electrification, and increasing carbon prices, regardless of whether it is blended with biomethane. If demand declines, the fixed costs of maintaining the pipeline network will be shared between fewer consumers, creating the risk of gas becoming increasingly expensive for consumers and driving accelerating network disconnection. Biomethane blending could provide a low emissions option for consumers who are willing to pay a premium to continue using pipeline gas and could smooth the rate of change and associated impacts on electricity networks. However, we don’t expect it to win out over commercial and residential electrification in the long term. We may need to develop complementary support programs for low-income users and renters who are unable to respond to rising gas prices by buying electric appliances.

While we currently have an abundance of waste resources that could be converted into biogas, it may not be appropriate or desirable to use them all for biogas in pipelines. The Government's Waste Strategy should encourage waste minimisation to some extent, which may reduce the amount of biogas feedstock available from landfills. The use of biogas for preparing kai could also be a concern for Māori if that biogas is produced from waste feedstocks (for example, manure), even if that biogas is processed. We need to engage with Māori to understand any concerns in detail and whether the source of the biogas should determine the potential uses for it. Given these complexities, it is best to assume that the estimated total accessible and economic biogas potential of seven PJ/yr by 2035 represents a maximum.

Biogas blending in distribution pipelines could be viewed as an interim measure which would provide more choices for consumers and could facilitate the development of a biogas market in the short term out to 2035. Larger users such as Fonterra and Methanex have also shown interest in biogas as a substitute for fossil gas, but they are more exposed to the gas cost and more time is required for the market to reach sufficient scale for their needs. In the longer term, once markets and supply chains have developed at scale and pipeline gas demand begins to decline, we envision that biogas supply established for pipelines could be used to supply larger industries.

Consultation Questions

- On a scale of one to five, how important do you think biogas is for reducing emissions from fossil gas?
  - Why did you give it this rating?
- Do you see biogas being used as a substitute for fossil gas?
  - If so, how?

HYDROGEN

Key Points:

- Hydrogen is a versatile energy carrier that can be combusted like fossil- and bio-gas, producing fewer emissions. It can also be used to produce electricity in a fuel cell where water and heat are the only emissions. Hydrogen is also a feedstock in important chemical precursors.
- The Government sees an opportunity for green hydrogen to play a role as part of New Zealand's broader energy transition to a renewable energy system, particularly in hard to abate applications like heavy road transport, replacing emissions intensive hydrogen in chemical production and future opportunities in marine and air transport.
- Blended hydrogen may be viable in the gas network, but it is likely to be much more expensive than other emissions reduction options at least until the mid-2030s. The existing gas pipeline system could carry up to 20 per cent hydrogen blended with fossil gas (methane) and biogas in the North Island's reticulated gas system.
- There is a strong potential for green hydrogen to replace emissions-intensive hydrogen currently derived from fossil gas in methanol production, and ammonia production for fertiliser and other products and processes.
- Initial Government views on the role for hydrogen within New Zealand's broader energy transition, actions the Government is taking to support this and areas we plan to consider further alongside the New Zealand Energy Strategy are set out in greater detail in the Interim Hydrogen Roadmap.

Hydrogen is an energy dense element, with a range of possible applications

Hydrogen is the smallest, lightest, and most abundant element in the universe, making up more than 90 per cent of all matter. In its normal gaseous state, it is odourless, tasteless, colourless, and non-toxic.

It is a versatile carrier of energy due to its high energy density and wide range of uses, including as a feedstock in industrial chemical processes, as a combustible gas that can be used in same ways as fossil gas, and as a way to generate electricity through a fuel cell. When used in a fuel cell, hydrogen recombines with oxygen in the air to produce water and is considered to produce zero greenhouse emissions at the point of use.

Worldwide hydrogen demand was around 90Mt in 2020.[30] Most hydrogen is currently used in industrial processes like oil refining, fertiliser production and other chemical production. Almost all of this hydrogen is produced from emissions -intensive sources, such as steam methane reformation using fossil gas and coal gasification. However, there is rapidly growing interest around the world in the use of hydrogen produced through renewable methods to replace existing emissions-intensive hydrogen, and in new uses such as in transport using fuel cells and fuel blending, energy storage and electricity generation.

Hydrogen can be produced in renewable ways to help decarbonise critical hard to abate activities

Hydrogen produced using renewable methods is often referred to as 'green' hydrogen, and the most common and viable method is through electrolysis of water using renewable electricity to separate hydrogen and oxygen molecules from water. Green hydrogen is New Zealand's primary interest, given our considerable potential for additional renewable electricity generation and relative abundance of water compared to other countries. Several companies are already producing green hydrogen in New Zealand.

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30 Global Hydrogen Review, International Energy Agency, 2021.

Hydrogen produced from fossil gas that deploys measures to capture some or all of the associated emissions has also attracted interest and is commonly referred to as 'blue' hydrogen. While blue hydrogen production is currently more competitive with fossil gas than green hydrogen, the emissions capture technology used in its production could also be used to decarbonise fossil gas use directly. Because of this, and our relative abundance of renewable energy generation and additional generation potential, we consider that New Zealand is more likely to use fossil gas directly than blue hydrogen for key use cases such as industry and electricity generation, rather than the more inefficient pathway of converting the fossil gas to hydrogen for the same uses.

There are challenges to the deployment of hydrogen. As a small and light molecule, it requires different storage solutions to fossil and biogas, including compression at greater pressures or liquefaction to improve its volumetric energy density. Green hydrogen using electrolysis requires large amounts of electricity to produce, and additional energy throughout the supply chain to its end use. This means that using electricity directly is likely to be preferable wherever possible, and the most attractive uses for hydrogen appear to be in critical activities that may be infeasible or impractical to electrify, such as industrial chemical processes and some heavy transport applications.

There are also economic challenges to address, including the higher costs of hydrogen compared to fossil fuels and biogas, and the need for a trading market for hydrogen to develop to support uptake. Building early-stage demand for green hydrogen is key to supporting uptake and helping to reduce costs.

The Government is supporting hydrogen uptake, and has released an Interim Hydrogen Roadmap to guide direction. There are a number of potential roles for hydrogen in the gas system

There is already a range of public, private and mixed-funded projects underway to develop a hydrogen ecosystem in New Zealand. The Government has invested around $88 million in hydrogen projects covering research and development, funding and financing for key early-stage capital projects and a number of demonstration projects through the Low Emissions Transport Fund to test hydrogen fuel cell and dual fuel hydrogen-diesel trucks and hydrogen fuel cell buses. Further initiatives were announced as part of Budget 2023, including a $100 million green hydrogen consumption rebate to help bridge the price gap between hydrogen and fossil fuels to enable switching and provide long-term certainty to help a market emerge, and a $30 million clean heavy vehicle grant scheme where hydrogen fuel cell vehicles will be eligible to help address high up front capital costs for zero emissions heavy vehicles.

Initial Government views on the role for hydrogen within New Zealand's broader energy transition, actions the Government is taking to support this and areas we plan to consider further alongside the New Zealand Energy Strategy are set out in greater detail in the Interim Hydrogen Roadmap. We are seeking public feedback on the Interim Hydrogen Roadmap at the same time as this Paper.

The potential use cases for hydrogen as they relate to New Zealand's existing gas system include:

- Blending hydrogen in the existing gas network alongside fossil gas and biogas.
- Repurposing existing gas infrastructure, skills, and supply chains to carry 100 per cent hydrogen, as a replacement for existing gas uses like industrial feedstock, industrial process heat, residential and commercial heat and electricity peaking generation, as well as distribution to support new use cases like vehicle refuelling.
- Deploying green hydrogen as a replacement feedstock for emissions-intensive hydrogen for important chemicals like ammonia and methanol.

These possibilities are discussed further in the sections below.

Blended hydrogen in the gas network is possible, but is expected to remain costly through the 2030s

Hydrogen can be blended with fossil gas and biogas, as it produces a similar high-temperature flame but without carbon emissions. However, hydrogen's volumetric energy density is approximately one third that of fossil gas at the pressures used in the reticulated system. This means that around three times the volume of hydrogen gas is needed to deliver the equivalent energy of fossil gas.

In its current state, the existing gas pipeline system could carry up to 20 per cent hydrogen blended with fossil gas throughout the North Island without modification. To transport a greater proportion of hydrogen, capital investment would be required to upgrade the gas pipeline system. Transmission and distribution networks would need to be updated to account for the change in fuel consumption and deal with practical issues like embrittlement and potential cracking of steel pipes when exposed to high pressure hydrogen.

Around one third of the First Gas network is comprised of steel pipes and fittings. The cost of these modifications across all distribution networks in New Zealand have been estimated to be in the order of $270 million over the next 30 years[31]. This figure excludes the steel transmission system. However, in most fossil gas applications, complete substitution would also require replacing or modifying existing equipment or appliances as well as supply chain infrastructure.

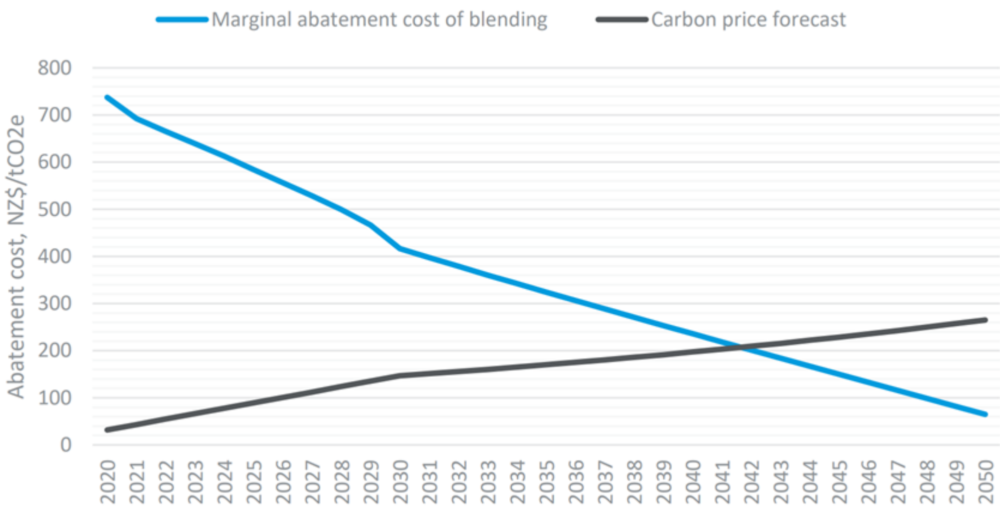
Although hydrogen is unlikely to be a complete gas transition solution appears uncertain, it may have a role to play as part of the transition. Blended hydrogen may be viable to decarbonise fossil gas in blend of up to 20 per cent, but this would come at a greater cost that just using gas. Initial analysis indicates blended hydrogen would be less cost effective at reducing emissions compared to other options.[32]

Figure four below shows the estimated marginal abatement cost of blended green hydrogen against the carbon price forecast. Incurring the cost of carbon from fossil gas use is likely to be cheaper in most applications than using blended hydrogen to offset emissions until the 2040s. The marginal abatement cost measures the cost of reducing one more unit of pollution i.e. the marginal tonne of CO_2 emitted. In this context, it is used to inform whether hydrogen blending is more cost effective compared to purchasing NZ ETS units. This landscape may change, depending on the extent to which technology costs decrease over time.

While hydrogen blending does not appear economic currently, gas sector participants may wish to pursue hydrogen blending deployment opportunities, which the Government is generally supportive of. The First Gas Hydrogen Pipeline Blending Feasibility study was co-funded by the Government in 2021, and there is work underway to update standards for the reticulated gas network to accommodate hydrogen blends, as well as biogas.

31 First Gas Group Hydrogen Feasibility Study, 2021.

32 See footnote 31.



Note: Carbon price forecasts are CCC headwinds scenario carbon prices. The marginal abatement cost of blending is the price difference between blended hydrogen and natural gas over the carbon dioxide content of natural gas displaced by green hydrogen.

Figure four: *Cost effectiveness of blended hydrogen in reducing emissions, New Zealand Hydrogen Scenarios and the Future of Gas, Castalia, 2022.*

The fossil gas network could be repurposed for green hydrogen in the future, but this depends heavily on the shape of a future hydrogen market

A future hydrogen market in New Zealand could see significant demand for green hydrogen. Depending on the shape of a future hydrogen market in New Zealand, the gas network could be completely repurposed over time to carry 100 per cent green hydrogen for distribution to end uses. However, this is uncertain as unlike the current fossil gas system, production of green hydrogen may be more decentralised as the required inputs, electricity and water, are far less geographically concentrated than fossil gas deposits. Conversely, large scale centralised production could emerge to serve large industrial users, production for export or co-locate close to large-scale renewable electricity generation like offshore wind generation. These factors could strengthen the need for bulk transmission of hydrogen.

If the transmission network were to be repurposed for pure hydrogen in the future, it is likely that both the supply and demand for hydrogen would also need to be in large volumes and in places that can already access existing transmission infrastructure. If this was not the case, further investment would be needed to extend the network. If the end-uses for hydrogen were either not large or geographically concentrated enough, it is less likely it will be economic to maintain existing transmission assets for this purpose.[33] Additionally, development of a hydrogen market in the short to medium term is likely to involve on-site production, which may lessen the need for large transmission volumes.

Given these uncertainties, we do not currently consider hydrogen should be the focus for complete replacement of fossil gas as a transition strategy before 2035.

While the industry is growing, the role of green hydrogen remains uncertain. Other opportunities for green hydrogen include use as a substitute for fossil gas-derived hydrogen for chemical production

A significant potential application for green hydrogen is substituting or replacing the hydrogen produced from fossil gas for methanol and ammonia production. This could be an application that is more economic than other uses that relate to the fossil gas network, such as hydrogen blending.

[33] See footnote 31.

Methanol production also makes use of fossil gas to produce hydrogen and provide a source of carbon. Opportunities exist for green methanol production from green hydrogen and a source of carbon. Alongside its industrial uses, methanol is attracting interest as a low-carbon marine fuel for heavy shipping, and as a hydrogen derivative that is more easily transportable that compressed of liquid hydrogen.

Hydrogen is already an input into the production of synthetic nitrogen-based fertilisers. It is a key ingredient in the production of ammonia, which is then combined with a carbon source to produce urea. Currently, fossil gas is used in this process to produce hydrogen and provide a source of carbon.

The source of carbon in these processes could come from captured carbon or biomass, as discussed in the following section on CCUS.

Consultation questions:

- On a scale of one to five, how important do you think hydrogen is for reducing emissions from fossil gas use? Why do you think this?
- Do you see hydrogen being used as a substitute for fossil gas? If so, how and when?
- What else can be done to accelerate the replacement of fossil gas with low-emissions alternative gases?

RENEWABLE GAS TRADING

Key Points:

- Renewable gas certification provides a way for gas suppliers and gas consumers to buy and sell the renewable attributes of gases. Such schemes are designed to grow the use of renewable gases and transition away from fossil gas, by allowing consumers to choose to pay for renewable options.
- A privately run renewable gas certification system was launched in New Zealand in 2022.
- Stakeholders have shown an appetite for more Gas Industry Co/MBIE involvement in ensuring such systems facilitate emissions reductions and adhere to international standards.

We have heard from stakeholders that a certification scheme for renewable gases like biomethane and green hydrogen could improve their viability and facilitate investment in the sector.

Several countries have already developed renewable energy certification schemes. These schemes generally allow consumers to purchase certificates that represent a unit of energy produced by renewable sources, and the specific attributes of that unit, such as emissions intensity. Through the purchase of a certificate, a consumer 'reserves' that unit of generation, and its attributes, as their own. The funds generated through this purchase are passed on to renewable energy producers, creating a financial incentive for expanded renewable energy production.

These certificates can be useful in electricity and gas markets with a mix of renewable and non-renewable energy, where the end user cannot otherwise distinguish their energy source. They are a way for consumers to reliably claim the sustainability of the energy they use. In some countries, such schemes underpin legislated mandates for consumers to use a minimum amount of renewably sourced energy. Other schemes are voluntary and rely on consumer willingness to pay for certificates to demonstrate their use of renewable energy.

Renewable certificate schemes for electricity are already in place in many countries including New Zealand. The most established schemes for gas are in Europe, where they generally operate within the EU Renewable Energy Directive framework. Another key example is the Australian Government's Greenpower scheme, which administers a renewable energy accreditation program. It is now investigating opportunities to support emerging renewable gases, such as biomethane and green hydrogen.

In 2022, Certified Energy, a private company which runs a certification scheme for electricity in New Zealand, launched a voluntary certification scheme for renewable gases. They have published a method document which outlines the framework for this certificate scheme.[34] The Gas Industry Co is currently considering work to develop a regulatory framework and monitoring regime for renewable gas certification providers. This would be part of a broader renewable gas workstream that Gas Industry Co is undertaking, informed by the development of the Gas Transition Plan.

It is important that a renewable gas trading scheme the direct effect of adding new renewable gas production to the market. Monitoring and verification of emissions reductions and other attributes are critical to ensure genuine emissions reductions from certificate schemes. As several renewable gas trading schemes are already established internationally, it will also be important to ensure a New

[34] Method for assessment and certification of renewable gas production, Certified Energy, 2022: https://www.certifiedenergy.co.nz/renewable-gas

Zealand scheme builds on these examples and that it is compatible to support future uses, such as trading renewable gases or derivatives internationally as markets develop.

Stakeholders have argued that greater Government or Gas Industry Co support could help ensure that the scheme incentivises the development of new renewable gas supply, facilitates emissions reductions, and adheres to commonly accepted international standards. Such involvement could also boost market confidence in the scheme.

Consultation Questions

- On a scale of one to five how important is a renewable gas trading to supporting the uptake of renewable gases?
    - Why have you given it this rating?
- What role do you see for the government in supporting such a scheme?

CARBON CAPTURE, UTILISATION AND STORAGE

Carbon Capture, Utilisation and Storage (CCUS] could be used to meet our emissions budgets during the transition period where fossil gas remains in the energy system. Capture and sequestration may also provide a long-term solution to removing emissions from otherwise hard to abate uses of fossil gas.

CCUS involves the capture of CO_2 from large point sources, such as power generation or industrial facilities that use either fossil fuels or biomass as fuel, or from upstream fossil gas extraction and production facilities. Direct air capture (DAC) refers to capturing CO_2 directly from the atmosphere.

If captured CO_2 is not used on-site, it is compressed and transported for use in a range of applications or injected into deep geological formations for permanent storage (including depleted oil and gas reservoirs or saline aquifers).

The International Energy Agency's (IEA) Special Report on CCUS in 2020 states[35], *"Alongside electrification, hydrogen and sustainable bioenergy, CCUS will need to play a major role. It is the only group of technologies that contributes both to reducing emissions in key sectors directly and to removing CO_2 to balance emissions that cannot be avoided."*

The IEA identifies several ways that CCUS can contribute to the transition:

- **Emissions from existing energy infrastructure:** CCUS can be retrofitted to existing power and industrial plants that could otherwise emit CO_2.
- **A solution for emissions from cement, iron and steel and chemicals manufacturing:** CCUS is virtually the only technology solution for deep emissions reductions from cement production. It is also the most cost-effective approach in many regions for iron, steel, and chemical manufacturing.
- **A cost-effective pathway for low-carbon hydrogen production:** CCUS can support a rapid scaling up of low-carbon hydrogen production.
- **Removing carbon from the atmosphere:** For emissions that cannot be avoided or reduced directly, CCUS provides an option to remove carbon from the atmosphere.

DAC differs to normal CCUS. DAC is the process of capturing CO_2 directly from the air and permanently storing it thereby removing it from the atmosphere, compared to CCUS where CO_2 is removed from a concentrated emissions stream.

CO_2 is more easily captured if it is emitted from a large point source such as an industrial facility. The current cost of capturing CO_2 with DAC is far above alternative emissions reductions technologies. With considerable investment taking place in innovation, future prices are likely to fall, and the future cost of DAC will likely fall below the expected future carbon price sometime in the 2030s.

The potential of CCUS in New Zealand

In New Zealand, there is the potential for CO_2 to be stored in depleted petroleum, geothermal or saline reservoirs deep underground as well as in high-magnesium content rock. In the past, CO_2 has been successfully re-injected into reservoirs at the Kapuni field to allow more fossil gas to be extracted. This is called enhanced oil recovery and is common practice overseas. New Zealand companies are investigating the carbon sequestration potential of New Zealand's high-magnesium, ultramafic rocks (dunite and serpentine). Carbon sequestration using these high-magnesium rocks is being looked at from two possibilities:

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35 Special Report on Carbon Capture Utilisation and Storage: CCUS in clean energy transitions, International Energy Agency, 2020, P 13.

- direct injection of CO_2 into the rocks at depth, triggering mineralisation reactions to convert CO_2 into stable carbonate minerals, effectively trapping it forever, and
- mining of those rocks followed by crushing and mixing with CO_2 (offsite) to form stable carbonate minerals. This has the added possibility for use as a CO_2 neutral cement, or in plasterboards and construction materials.

CO_2 can be further processed and re-sold for other industrial processes, including food production. About four to six per cent of the CO_2 received in the raw gas processed at Kapuni is sold as liquid food grade CO_2. Currently, remaining CO_2 is vented to the atmosphere.

Although not directly related to fossil gas, some geothermal electricity generators in New Zealand are already capturing significant quantities of CO_2 and hydrogen sulphide. These gases are dissolved and reinjected into the geothermal reservoir.

A preliminary study into the viability of CCUS in New Zealand has found that it is both technically and economically feasible and could be operational from the mid-2020s.[36] CCUS at extraction and production of fossil gas has been identified as a viable priority option, with existing knowledge and understanding of the operations in these areas.[37]

This study estimated the cost of capturing carbon at an onshore site in Taranaki is less than $30/tonne.[38] It is also technically and economically possible to develop an 'industrial hub' around a sequestration facility, in which carbon intensive industrial sites capture production emissions. Costs of CCUS rise in proportion to the distance that CO_2 is transported. The study concludes that large volumes of CO_2 could be captured in New Zealand, comprising a significant share of required emissions reductions and significantly reducing emissions compared to continued use of gas without emissions capture. The technology is viable in both onshore and offshore settings.

Māori and CCUS

It is unlikely that there is a single Māori view about CCUS. There are several aspects of CCUS which may be significant in te ao Māori.

There may be concerns from a kaitiaki perspective for example, about the concept of moving resources from one rohe to another, the reinjection of CO_2 into Papatūānuku or that the process serves to prolong the extraction of fossil fuels.

On the other hand, some Māori may support the use of CCUS to return CO_2 from where it has come from and restore the balance between Ranginui and Papatūānuku and if CCUS were an effective way to keep energy affordable and available throughout the transition. These will be some of the issues we will seek to better understand through conversations with Māori stakeholders.

CCUS and the Emissions Trading Scheme

Currently the NZ ETS provides for carbon sequestration only if the relevant gas emissions never pass a meter. Once gas passes a meter, any removal of carbon is not recognized in the NZ ETS as the only removal activity allowed is forestry. A gas producer re-injecting CO_2 'behind the meter' (before the emissions are counted) could benefit by reducing their emissions before NZ ETS obligations are imposed. Other than that, the NZ ETS does not provide an incentive to capture emissions through CCUS.

As part of the second Emissions Reduction Plan, the Government is developing a Carbon Removals Strategy to enable complementary measures that support a wider range of removal activities to be recognised in the NZ ETS. The strategy will be developed to coordinate and prioritise effort and

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36 Review of CCUS/CCS Potential in New Zealand, WoodBeca, 2023
37 See footnote 36.
38 See footnote 36.

investment across government, the private sector, and communities and address key questions such as how new removal activities can be recognised and rewarded over time. In consultation with other agencies, the strategy will consider the feedback received as part of the NZ ETS review consultation.

New Zealand's regulatory consenting environment for CCUS

A 2023 report by Professor Barry Barton from the University of Waikato looked at the regulatory environment for CCUS in New Zealand. It found that there are no barriers to a company applying for environmental resource consents to undertake CCUS (except for injecting third-party CO_2 in the coastal marine area)[39]. However, as a technology which is largely untested in New Zealand it would likely be a lengthy consenting pathway in those cases where a consent is required (particularly the storage of CO_2).

CCUS onshore or in the Coastal Marine Area (up to 12 miles from the coast) would require resource consents under the Resource Management Act 1991 (RMA). Beyond the Coastal Marine Area is the Exclusive Economic Zone (EEZ) (up to 200 nautical miles from the coast); CCUS in the EEZ would require marine consents under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2011 (the EEZ Act) from the Environmental Protection Authority. Third party CO_2 injection in the coastal marine area is a prohibited activity and cannot be granted a discharge permit.

Professor Barton found a broadly neutral policy setting exists for matters that the RMA and EEZ Act require or suggest being considered. [40] However, there are some aspects of the existing regulatory framework under the RMA and EEZ Act that are not well-suited to CCUS, particularly for the post-injection phase of a project.

We have heard from stakeholders that uncertainty over the ultimate abandonment obligations is an impediment to investment in sequestration.

Utilisation of CO_2

While concentrations of CO_2 in the atmosphere have negative climate impacts, as a containerised product or dry ice it has many uses in the economy from beer and soft drinks, safe food and medical transportation, to chemicals and aviation fuels. The domestic market for CO_2 is limited in size but it supports production at several relatively large businesses.

Since the closure of the Marsden Point oil refinery in April 2021, around half of CO_2 used by businesses is sourced from the Kapuni fossil gas plant. The rest is imported. During the summer of 2022/23, there was a shortage of CO_2 which pushed prices up and forced manufacturers to find alternatives. CCUS technology could provide an opportunity to build more resilience into CO_2 supply in New Zealand through increasing the number of businesses that can capture CO_2 and either use or supply it.

Captured CO_2 could also be used in e-chemical production; green hydrogen combined with captured CO_2 could have potential as a petrochemical replacement in urea and methanol production if New Zealand's green hydrogen production capacity increases.

WoodBeca noted that an industrial hub around a reservoir in Taranaki could help to decarbonise a range of very large emitting heavy industries, which could both use carbon in production processes and avoid releases of CO_2 into the atmosphere.[41]

Fitting carbon capture technology to existing electricity generation plant is unlikely to be economic, but construction of new electricity peaking generation could require emissions sequestration. Using

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39 Carbon Capture and Storage: Taking Action under the Present Law, University of Waikato, 2022

40 See footnote 39.

41 See footnote 36.

emissions sequestration with peaking generation could potentially help to move closer to 100% renewable energy sooner at lower cost than alternatives.

Consultation Questions

- On a scale of one to five how important do you think CCUS is for reducing emissions from fossil gas use?
    - Why did you give it this rating?
- What are the most significant barriers to the use of CCUS in New Zealand?
- Do you see any risks in the use of CCUS?
- In what ways do you think CCUS can be used to reduce emissions from the use of fossil gas?

Options to increase capacity and flexibility of gas supply

As well as ways to reduce emissions from the fossil gas sector, we also need to ensure secure delivery of energy is maintained. Our fossil gas system will evolve through the transition.

It is likely that the needs of thermal electricity generation and other fossil gas consumers will become increasingly variable will mean the gas system will need to become more flexible than it is today.

We have identified two key options that could be pursued to increase the flexibility:

- Enhancing the capacity of gas storage
- Importation of Liquified Natural Gas (LNG).

These options would require new investment, and further investigation, for them to be deployed.

ENHANCED GAS STORAGE

Increased storage capacity for domestically produced fossil gas could help to balance supply and demand, particularly as gas demand for electricity becomes more variable.

Storage options in New Zealand

New Zealand currently has one underground fossil gas storage facility, Ahuroa Gas Storage, operated by FlexGas. Gas storage is used to support gas consumers when additional gas supply is required.

There are two main options for increasing the gas storage capacity:

- Expansion: increase the storage capacity or how much gas can be withdrawn from Ahuroa underground storage facility per day.
- Conversion: the development of new underground storage to increase flexibility. The cost of adding underground storage capacity would need to be met by a company prepared to pay to have flexible gas available. The gas industry has identified some candidate sites that would require further investigation. Work to date has shown that the conversion of the Tariki gas reservoir is likely to be the most attractive option given its ability to introduce significant further storage capacity into the market.

A challenge for any gas storage investment case is the term which a buyer of storage capacity would commit to. For underground storage options, it is expected that an investor would require a commitment term of at least 15 years.[42]

Gas availability for storage

Any domestic storage option relies on the availability of fossil gas to charge and draw down from storage as it is needed. Adding storage capacity for domestically produced gas does not on its own increase our gas production.

If fossil gas supply was able to be stored, instead of consumed as it is produced, then underground storage options could present a cost-effective solution to increase the flexibility of the gas system. However, this would require gas supply to be redirected to gas storage. This may not be possible at times of high gas demand or if our gas fields are not fully able to meet gas demand.

A specific use case for enhanced gas storage may be electricity. The existing Ahuroa Facility is currently contracted to two thermal electricity generators (Contact and Nova). As we increase our renewable electricity generation capacity, there will still be a small, but declining, need for dispatchable thermal electricity demand to meet system peaks or periods of cloudy still weather.

[42] LNG import and options to increase indigenous gas market capacity and flexibility in New Zealand, Enerlytica, 2023.

Given the existing limited flexibility in gas supply, gas storage could play a role in meeting a need for gas to support these peaks.

However, for longer time periods (such as dry-year cover in the electricity system) demand response from other gas consumers is likely more economic than storing gas at significantly increased volume. This is because demand response relies on gas that is being produced, rather than having to pay to store gas that may or may not be needed. Gas storage could be made commercially viable through payments by those requiring stored gas. However, the incentivisation of demand response may be more cost effective.

Access to local underground storage represents an additional supply chain cost. This would need to be considered against other options for enabling system flexibility, such as large-scale demand response or from the importation of LNG.

Other options for gas storage

Other options such as greater use of methanol (which is derived from fossil gas) to meet energy needs could also be considered. Given limited existing use of methanol as a fuel in New Zealand, this would require additional investment from plant owners to convert systems to run on methanol (for example, electricity generators). This is likely to be situation and context specific.

Consultation Questions

- What role do you see for gas storage as we transition to a low-emissions economy?
- On a scale of one to five, how important do you think increasing gas storage capacity is for supporting the transition?
    - Why did you give it this rating?
- What should the role for government be in the gas storage market?

LIQUEFIED NATURAL GAS (LNG)

LNG importation is considered by some as an option to support New Zealand's gas market. It would require investment in new gas importation infrastructure and could be significantly more expensive than existing domestic gas. The main benefit is that it would enable New Zealand to access the international gas market but would also expose us to the volatility of LNG commodity prices.

Given the significant costs we do not consider LNG importation as a viable option for New Zealand. We invite you to provide any comments on this position.

What is LNG?

LNG is fossil gas that has undergone a refrigeration process that condenses it to a liquid state. LNG is 1/600th the volume of its gaseous state and, as a liquid, is not combustible, making it ideal for bulk transportation. At its destination, LNG is heated to restore it to its gaseous state then injected into the local gas transmission or distribution networks or combusted on-site. Due to its energy density, LNG can also be stored to help balance variability in gas demand.

Global demand for LNG has increased because it is energy dense and can be transported. It is often used as a substitute for coal although imported LNG is considerably more expensive than imported coal or indigenous fossil gas. Major LNG producer/exporters include Australia, Qatar, and the United States.

Compared to indigenous fossil gas, imported LNG is more expensive than long-term domestic fossil gas prices. Recently, this has been compounded by disruptions to international trade patterns brought about by COVID-19 and the war in Ukraine, which has led to a large increase in LNG demand and prices. This does highlight the exposure of LNG prices to international market forces.

LNG and New Zealand

New Zealand does not currently have a domestic source of LNG nor the port infrastructure to enable importation or export. Imported LNG would require upfront investment in this type of infrastructure. Based on analysis performed by Enerlytica, the variable cost of LNG to the market could be between $44 - 64 per GJ based on prices after Russia's invasion of Ukraine, or between $11 - $16 on historic pre-Ukraine prices.[43] For comparison, New Zealand's wholesale fossil gas price sits at around $7 - $8/GJ.[44]

There are several locations where LNG importation infrastructure could be developed in New Zealand. These options have different costs, ability to supply the market, and therefore implications for the broader energy system.[45]

A report that Enerlytica produced on LNG importation options identified four concepts that could be pursued with various costs and benefits for the gas system:

- Marsden Point ($250m – $338m)
- Port Taranaki ($140m to $210m)
- South Taranaki Bight ($328m to $511m)
- Maui-A ($426m to $624m)

All use Floating Storage and Regasification Units, or a combined system of a Floating Storage Unit and a Floating Gas Units, over land-based importation infrastructure. As can be seen by Enerlytica's

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43 See footnote 42.
44 Energy Pricing data, MBIE, 2023.
45 See footnote 42.

the high-level cost estimates above, the cost of these facilities can range widely. Further work would be required to estimate the likely costs more accurately.[46]

Enerlytica considered there floating LNG costs would be very substantial on a per-unit throughput basis because of the relatively low utilisation of the facility on average (based on a concept of LNG being used to support thermal electricity generation). This cost could well be the most significant part of the gas fuel cost rather than the supply cost into a New Zealand port.

However, LNG supply would be flexible and could be imported relatively easily on demand, for example when domestically produced gas availability is constrained or in response to an increase in demand for electricity generation. This could be required for different reasons, such as an unexpected and sharp decline in gas production from a gas field failure or insufficient investment to maintain gas production at sufficient rates. In this way it could help address security of supply issues, while providing greater certainty around pricing to the energy market.

LNG as a backstop option

LNG is more expensive, would require new infrastructure (with a wide range of potential costs, depending on the option). It would also mean that we would not be obtaining the same royalty/tax, employment, and broader economic outcomes that we receive from our domestic gas industry. At the same time, we may become more exposed to gas supply risks as we transition, and our fields continue to age.

The risk that LNG importation would lock in further fossil gas use in New Zealand would also need to be carefully considered if it were to be pursued.

Should sufficient gas supply be available, gas consumers are likely to be better off with domestic gas due to the much lower price. For this reason, we do not consider LNG importation as a viable option for New Zealand.

If in future, domestic gas prices were to rise significantly, LNG could be an option as it would provide an effective maximum price in the market. Given the higher gas prices that LNG would represent, in this scenario only consumers with more willingness-to-pay for gas would be able to meet the higher price. This is most likely to be thermal electricity generators and commercial/residential consumers.

Consultation Questions

- Our position is that LNG importation is not a viable option for New Zealand. Do you agree or disagree with this position?
    - If so, why?
- What risks do you anticipate if New Zealand gas markets were tethered to the international price of gas?

[46] See footnote 42.

Conclusion

We need gas to play a declining role in supporting our industry, businesses and people, while supporting security of the supply in the electricity system.

This needs to happen while achieving our emissions reduction goals.

There are many ways the fossil gas sector could achieve our emissions reduction goals and maintain its critical role until it is no longer needed. All require investment from the sector, both in maintaining gas supply and in projects that deliver tangible emissions reduction benefits. This paper has set out the key issues and opportunities for investment in helping deliver this transition.

We know that investment in the sector is getting more difficult. If investment does not continue, we risk the gas major gas users triggering a disorderly exit from New Zealand. This would have a wide range of deep impacts on New Zealand's economy.

The Gas Transition Plan will help establish what an optimal transition pathway would be and provide greater certainty to investors. We recognise that there is a role for Government to ensure that investment is enabled, and that the sector meets emissions reductions objectives in an economically efficient way.

Your feedback will be important for informing the Government on how this could be achieved, and what needs to be prioritised as we move through this transition.

Glossary of Key Terms

Base-load – Power plants that do not change their power output quickly, such as large coal, gas or geothermal facilities

Biogas - a renewable energy source containing a mixture of gases, primarily methane, carbon dioxide and hydrogen sulphide. It can be produced from raw materials such as manure, municipal waste, plant material, sewage, green waste, waste water and food waste.

Biogenic methane – methane that is produced by living organisms (i.e., in New Zealand, a source of biogenic methane is livestock)

Biomass – renewable organic material that is used for the production of bioenergy (i.e. biogas)

Carbon Capture Utilisation and Storage (CCUS) – a suite of technologies that aim to remove, and store, carbon from the atmosphere

Direct Air Capture (DAC) - a method of carbon capture utilisation and storage, when carbon is captured directly from the atmosphere

Feedstock – any renewable, biological material that can be used or converted into a product, such as fossil gas into urea

Firming – generation that is reliably available when called on or dispatched i.e. is able to provide "firm" or steady generation output.

Fossil gas – a fossil fuel mainly consisting of methane found in either natural gas fields or oil well fields, alternatively called natural gas

Gas Industry Co – The Gas Industry Company, the co-regulator of the gas sector alongside MBIE

Gigajoule (GJ) – a unit of measurement of gas in energy terms

Green Hydrogen – hydrogen produced using renewable resources (the most common method is electrolysis of water using renewable electricity to separate hydrogen and oxygen molecules from water)

Hydrogen – the most abundant chemical element with an atomic number of one

International Energy Agency (IEA) - an autonomous intergovernmental organization established in 1974 to provide policy analysis, recommendations, and data on the international energy sector

Kaitiaki - minder, guardian, custodian

Liquefied natural gas (LNG) – fossil gas that has been cooled down to liquid form for ease and safety of non-pressurized storage or transport

Petajoules (PJ) - a unit of measurement for gas in energy terms, one petajoule is equal to one million gigajoules

Papatūānuku - the land, the earth mother figure in Māori mythology

Peaking – Generation that usually operates only for minutes or hours each day, during the shortest demand peaks

Te taiao - the natural world, environment

Terajoule – a unit of measurement of gas in energy terms, equal to a thousand gigajoules

List of Acronyms

CCUS – Carbon Capture Utilisation and Storage

CO_2 – Carbon Dioxide

DAC – Direct Air Capture

DPP - Default price-quality path

EEZ – Exclusive Economic Zone

ERP – Emissions Reduction Plan

GJ - Gigajoule

LNG – Liquid Natural Gas

LPG – Liquefied petroleum gas

MBIE – Ministry of Business, Innovation, and Employment

$MTCO_2e$ – Metric tonnes of carbon dioxide equivalent

NZ ETS – New Zealand Emissions Trading Scheme

NZU - one NZ emissions unit

PJ – Petajoule

RMA – Resource Management Act

TJ - Terajoule

Te Kāwanatanga o Aotearoa
New Zealand Government

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