FUEL SECURITY STUDY - INTERIM REPORT REESTABLISHING THE MARSDEN POINT REFINERY

Prepared for Ministry of Business, Innovation and Employment

5 September 2024

Envisory Limited is an energy consultancy specialising in strategic issues affecting the energy sector, including transitioning to low or zero-carbon fuels. With a comprehensive knowledge of local and international energy markets, we provide strategic advice, comprehensive analysis, and services across the entire sector.

Envisory prides itself on being able to analyse and interpret the details, translating the implications into strategic directions for our clients. We provide expertise to a broad range of companies and government departments in New Zealand, Australia, and the Pacific Islands. Envisory has a strong reputation in the sector for producing timely, high-quality, value-adding work.

Castalia is a global strategic advisory firm. We design innovative solutions to the world's most complex infrastructure, resource, and policy problems. We are experts in the finance, economics, and policy of infrastructure, natural resources, and social service provision. Castalia applies economic, financial, and regulatory expertise to the energy, water, transportation, telecommunications, natural resources, and social services sectors. We help governments and companies transform sectors and enterprises, design markets and regulations, and set utility tariffs and services standards, and appraise and finance projects. We deliver concrete measurable results by applying our thinking to make a better world.

Authorship

This document was written by:

Ian Twomey	e-mail: ian@envisory.co.nz
Andreas Heuser	e-mail: andreas.heuser@castalia-advisors.com
Daria Rybalka	e-mail: daria.rybalka@castalia-advisors.com
Steve West	e-mail: steve@envisory.co.nz

Please e-mail for further information.

Disclaimer

Envisory, its contributors and employees shall not be liable for any loss or damage sustained by any person relying on this report, whatever the cause of such loss or damage.

Executive Summary

The Marsden Point oil refinery (MPR) was closed in March 2022 after a 60-year history of processing crude to make products for the New Zealand petroleum fuels market. In the period before closing, it supplied around 70% of New Zealand's petroleum fuels, with the balance imported from international markets.

Context of the decision to close MPR

The MPR competed in a global market where refineries are getting larger and more sophisticated in the range of products produced. Modern Asian refineries are five to ten times larger than MPR, with a greater capacity to upgrade a wide range of lower value crude into higher value products. They often have associated petrochemical facilities meaning their income is not entirely dependent on the volatile margins associated with producing transport fuels.

Refining product margins are volatile and cyclical. Small changes in global capacity utilisation can shift margins between strong and weak. Refineries are vulnerable when margins are weak unless they are integrated into a larger business or have other income streams. Smaller refineries – like MPR - at the end of the supply chain without economies of scale are particularly vulnerable.

Refining margins plunged at the end of 2019 due to excess global refinery capacity. This was compounded by COVID responses reducing demand for refined fuels globally in 2020. The MPR income fell below the contractual Floor level (which triggered set payments from customers), but the company still struggled to cover its operating costs even after simplifying its operation. Fuel companies could import refined product much more cheaply, meaning the high cost of MPR product made them uncompetitive. These conditions were expected to continue, leading to the strategic decision to shut down and convert the site to an import terminal. The International Energy Agency stated in its 2022 World Energy Outlook that under its announced pledges scenario "*more than half of current refining capacity faces the risk of lower utilisation or closure by 2050, and there are few new capacity additions after projects under construction come online*." [1]

MBIE has commissioned Envisory and Castalia to investigate reestablishing MPR

The Ministry of Business, Innovation and Employment (MBIE) has commissioned the Envisory/Castalia team to investigate reestablishing the MPR as a fully functional oil refinery as it was prior to its closure and determine how that could contribute to New Zealand's economy and fuel resilience. This Interim Report addresses reestablishing MPR and will form part of the larger Fuel Security Study due in first quarter 2025.

Reestablishing the MPR would require some major decisions on New Zealand's petroleum fuel supply chain including:

- How to fund and support the significant capital investment required for the rebuild;
- How to structure the MPR operation so it is sustainable over the longer term given the volatility of the refining industry;
- How to integrate it into New Zealand's fuel supply chain; and
- How to make these changes where the benefits of having a refinery in New Zealand may not fall to those making the investment.

[1] World Energy Outlook 2022, International Energy Agency, Revised Edition, November 2022 pg. 362

Reestablishment costs are significant, and shareholders of Channel Infrastructure and its fuel company customers would face significant risks and costs

Reestablishing MPR would be a major undertaking for New Zealand, in terms of time and financial cost. Channel Infrastructure NZ Limited (Channel Infrastructure) has commissioned an expert report from Worley to estimate the reestablishment costs and timeframes (Worley Report). The Worley Report estimates design, engineering and construction would take at least six years.[2]

The financial cost would be substantial. Our review of global benchmarks for refinery construction costs suggests the costs would range from NZ$5.9-16.1 billion (US$3.7-10.1 billion), before considering unique aspects of the MPR site that would likely reduce these costs. This range of estimates is derived from the reported costs of 64 global refinery construction and expansion projects. Channel Infrastructure's Worley Report estimates a capital cost of the recommissioning project is estimated at a P50 to P90 range of NZ$4.9 billion to NZ$7.3 billion with an order of accuracy of -20% / + 50%.

Detailed on-site investigation and analysis is required to make these estimates more accurate. The costs to reestablish MPR may be lower than global benchmarks since existing infrastructure could be repurposed,[3] the site does not require new resource consents, and civil works would not be as extensive compared to a greenfield site. On the other hand, re-establishing MPR may require significant investment to meet current standards.

Much of the former refining equipment and plant was decommissioned upon closure. This involved making all the units safe, including disconnecting power, control systems, water and gas connections. Pipework has typically been cut and capped to prevent the ingress of birds or rodents and avoid leakage of any residual material. All catalysts and internals of processing units and heat exchangers, where there was a risk of contamination of petroleum residues, have been removed and scrapped. Two units have been preserved with nitrogen to avoid exposing the unit internals to the elements, as the company believed this may enhance the prospective sales value of those units.

While much of the former refinery equipment is physically present, the reestablishment cost is substantial as every piece of equipment would need to be reviewed for integrity and repaired or replaced as necessary. Unit internals must be rebuilt, as would all heat exchangers, and most pipe insulation must be replaced. Additional storage (for crude and refined products) would be constructed to replace the MPR tankage that has been converted for use in the import terminal. Channel Infrastructure's current import, storage, and distribution business (which is critical for refined fuel supply) needs the converted storage to ensure secure continuous supply during construction. After construction, much of this storage would be surplus to requirements (in particular, given the overall declining outlook for fuel demand). The operating costs of MPR will increase, affecting global competitiveness, as natural gas, electricity, and non-energy costs are all forecast to rise with inflation and real cost drivers. MPR's international competitiveness is further hindered by higher labour costs in New Zealand.

Significant Government support or other intervention would be necessary to reestablish MPR. Channel Infrastructure shareholders have rejected reestablishment and fuel company customers would require significant commercial inducement to switch back their supply chains to buy refined products from MPR. Recovering these costs from consumers would require a material increase in fuel prices.

---

[2] Marsden Point Refinery Recommissioning Study, Worley, 2024.

[3] Such as jetties, tank bunds, and some administrative buildings.

Channel Infrastructure owns the closed refinery but has changed its business strategy to focus on stable infrastructure income. Channel Infrastructure's shareholders have rejected reestablishing the MPR business, which has more volatile returns and is riskier. In addition, the investment required is many multiples of its current market value, so the company would have no capability to invest. Fuel companies that were previously customers (and shareholders) of the former refinery have stated they have no interest in being investors in, or processors through a reestablished refinery.[4] Fuel companies revealed in consultations that prices for refined products would need to match or better the landed import cost with commercial certainty. Those fuel companies have invested to re-orient their supply chain and storage facilities at other New Zealand ports and transport hubs to handle refined product imports.

Reestablishing MPR would generate some benefits which need to be assessed against other options

Reestablishing MPR, new commercial arrangements with customers and potentially providing fiscal support to ensure its economic viability may enhance New Zealand's fuel security. However, these potential benefits must be evaluated against other options to address any fuel security risks. Our Fuel Security Study (which follows this report) will evaluate other options and potential benefits for New Zealand's fuel security.

Reestablishing MPR would reduce New Zealand's dependency on imported refined fuels. However, New Zealand would shift to dependence on crude imports as MPR would rely on imported crude oil feedstock. Historically, MPR processed only low volumes of indigenous crude because of technical and economic limitations associated with it. Domestically produced crude oil and condensate are unlikely to provide significant feedstock because production has fallen in recent years and is forecast to continue to decline.

Reestablishing MPR could provide more resilience because it can manage product quality issues. However, that benefit is offset by a risk that MPR becomes a single point of failure risk (something highlighted in earlier fuel security studies for MBIE). A major upset to a domestic refinery gives fuel suppliers a lot less time to respond than an upset to any one of the import-supplying refineries.

Stockholding will increase should MPR be reestablished, providing more in-country resilience. Some of that gap is being addressed through the minimum stock obligation being introduced from January 2025, and stockholding levels will be further reviewed in the Fuel Security Study.

Reestablishing MPR would lead to some local employment benefits, with higher-skilled, higher-paying jobs. New Zealand may also benefit from improved resilience to economic shocks as the balance of payments would improve because the cost of imported crude is less than the cost of imported refined products.

Reestablishing MPR would increase New Zealand's greenhouse gas emissions due to refining operations. In 2019, Refining New Zealand reported 4,329 tonnes of SO2 emissions in total and 206kg of CO2 emissions per tonne of product.[5]

---

[4] Channel 2024 ASM voting results, available at: https://api.nzx.com/public/announcement/430295/attachment/417580/430295-417580.pd

[5] Refining New Zealand, Annual Report 2019, available at: https://channelnz.com/wp-content/uploads/2022/03/2019-RNZ-Annual-Report.pdf

Reestablished refinery would need to have a different business model

A reestablished refinery would need a different commercial structure from pre-closure as fuel companies do not want to engage in the previous tolling structure as this did not ensure they had a competitive supply of product. Refinery margins are volatile and are unlikely to cover the operating costs of MPR at lower points of the cycle. This means a reestablished refinery would need income protection when margins fell below certain levels, like the structure used to protect the remaining Australian refineries. In Australia's case, this is funded by the taxpayer, although a levy on fuel sales is another funding option.

There are two main options for the operating structure of a reestablished MPR:

- A Merchant Refinery: The refiner purchases crude to process into a product and sells that product to the domestic fuel marketers at a price which is competitive against the import equivalent. It would need to operate a coastal tanker operation to deliver products to other ports, as its capacity is larger than needed to supply Auckland and Northland. Contracts would need to be for reasonable terms (i.e. years) to ensure MPR could operate close to its optimal capacity. Support would be required to maintain viability at low margins, and the construction debt could not be covered by normal refinery earnings.
- A cost-plus refinery: The refinery would purchase crude to process into a product which all fuel market participants would be forced to buy at a price that made MPR sustainable (not related to the market price at the time), including covering the cost of reestablishing MPR. Under this option, the purchase price for the locally refined products would be higher than the cost of product imports except for brief periods when international refining margins are exceptionally high.[6] This cost would be passed through to consumers in higher costs for all petroleum fuel.

Ownership of either option could be commercial (with appropriate protection), state or a Public-Private Partnership. In all cases, Government intervention would be required, which would be complex and require careful design to avoid commercial risks for the Government. Channel Infrastructure shareholders would presumably have to be compensated for the disruption to the existing import, storage and distribution business, and the increased business risk of a refinery business once the site transitioned back to refining (continuing to operate the import business at the same scale would then be unviable) if it owns a reestablished refinery business. A market intervention of this scale would need to be carefully evaluated against the potential benefits outlined above, and alternative options for fuel security and other policy objectives.

Marsden Point site and alternative investment options

Whether operating as a refinery or an import terminal, Marsden Point plays a critical part in New Zealand's fuel supply chain. It has unique characteristics, including the country's deepest water port capable of accommodating the largest vessels able to be received in New Zealand, a large land area zoned for heavy industry, a high voltage electricity grid entry/exit point, the product pipeline to Auckland, and a natural gas connection.

Channel Infrastructure is pursuing a strategy to identify partners that can help develop Marsden Point into a comprehensive energy precinct. This approach involves integrating various energy infrastructures and technologies to create a robust and resilient energy ecosystem.

---

[6] In a cost-plus model, the cost of product relative to crude would be stable but high due to the cost of reestablishment and high operating cost. It will be higher than the cost differential available from international markets, except at the few times international refining margins go unusually high.

Options for the site currently being proposed include:

- Biofuel,[7] sustainable aviation fuel (SAF) and/or green hydrogen (alternative fuels); and
- LNG import and degasification facility.

The Biofuel refinery, while still under investigation, would use some of the decommissioned equipment from the MPR. It would also use a key site within the old refinery facility. The other project currently under investigation, the Fortescue eSAF[8] manufacturing facility, would also use a significant area of the MPR site. Channel Infrastructure noted should these projects proceed, it would necessitate any reestablishment of a fossil-fuels refinery be sited at an alternative location to the location of the processing equipment of the '2019 refinery'. This is likely to increase the cost estimate in the Worley report as they assumed the decommissioned equipment would be available for reestablishment.

Options that can contribute to New Zealand's fuel security will be explored in more detail in our Fuel Security Study.

[7] In October 2024, Channel announced a conditional proposed biorefinery project at Marsden Point. Biorefinery proposed at Marsden Point Energy Precinct, NZX, available at: https://www.nzx.com/announcements/439197

[8] Synthetic sustainable aviation fuel derived from renewable energy.

Table of Contents

Appendices

Tables

Figures

Glossary

Term	Description
Black products	A term used to cover products that contain the darker components of crude oil which includes fuel oil and bitumen
Brownfields	A construction project on a site where there has already been development and has many of the utility connections available
Cap	Limit on the maximum GRM that the refinery customers had to pay a processing fee on
CCC	Climate Change Commission
Floor	A minimum amount of money that refinery customers had to pay, should the GRM margin calculation not provide the MPR that level of income
Greenfields	A construction project on new land that has not previously been developed
GRM	Gross Refining Margin – a measure of the per barrel upgrade of processing feedstock through MPR
LNG	Liquified natural gas
ML	Million litres
MPR	Marsden Point Refinery
Naphtha	A light faction distilled from crude used to make petrol but needs to be upgraded to increase octane
Residue	Crude after it has been ‘topped’ to remove the lighter components
SAF	Sustainable Aviation Fuel
Topping refinery	A refinery that only distils the 'top' components of crude including naphtha, kerosene and diesel with no ability to upgrade heavier components
White products	A term used to cover the lighter products produced at a refinery including petrol, jet fuel and diesel

1.0 Introduction

A secure and resilient supply of refined engine fuels is critical to New Zealand's economy. The closure of the Marsden Point oil refinery (MPR) in 2022 changed the nature of risks to New Zealand's security of refined fuel supply. As a small, remote market that imports its fuel, New Zealand is particularly vulnerable to supply disruptions. The consequences of a severe and sustained disruption would impact industry and cause significant hardship to New Zealanders.

In 2023, the New Zealand Government committed to commissioning a study into New Zealand's fuel security requirements and investigating the reopening of the MPR.

The Ministry of Business, Innovation and Employment, the Government's lead advisor on national fuel security, commissioned the Envisory/Castalia team to undertake the Fuel Security Study. The first deliverable is to investigate reestablishing the MRP as a fully functional oil refinery as it was prior to its closure and determine how that could contribute to New Zealand's economy and fuel resilience. This Interim Report addresses reestablishing MPR and will form part of the larger Fuel Security Study due in first quarter 2025.

2.0 Background

This section provides the background context of the Marsden Point Refinery, including MPR's history, closure decision and current status. We also review the domestic production of crude oil and condensates along with the outlook for refined fuel demand.

2.1 History of Marsden Point Refinery

This section covers the history of the Marsden Point Refinery's facilities and ownership.

2.1.1 Refinery facilities timeline

MRP was established in the early 1960s. Before that, New Zealand imported all its petroleum fuel. Table 1 shows the key events in MPR's history, particularly the investments made to increase its complexity to meet the requirements for New Zealand's changing fuel demand.

Table 1: Historical timeline of Marsden Point Refinery[9]

Timing	Event
1962	Refinery construction began. Site was selected because it had a deep-water harbour, low earthquake risk, was close to large North Island markets, and available land.
1964	Refinery operations began. MPR was a simple topping refinery that could not upgrade crude oil residue or produce jet fuel.
Mid- 1980's	MPR substantially expanded as part of the 'Think Big' projects of the early 1980s to increase New Zealand's self-sufficiency. This included increasing capacity and adding residue upgrading. A hydrocracking process was chosen because it maximised jet fuel and diesel upgrading. Although this process was more expensive than one that maximised petrol production, petrol was expected to be

[9] Including information from https://channelnz.com/who-we-are/our-history/ and The Point at Issue, Mike Paterson, 1991.

	manufactured at the Synthetic Fuel Plant in Taranaki[10] (now the Motunui methanol plant). The expanded Refinery began operating in 1986. The Refinery to Auckland pipeline (RAP) and the associated Wiri terminal were also built, with Wiri starting operations in 1983.
1988	The industry was deregulated, changing how MPR charged fees, and removing government control.
1998	The Marsden Point Truck loading facility began operations.
2000	A new pumping station was built on the RAP pipeline at Wellsford to increase capacity, followed later by another at Kumeu.
2005	The Future Fuels project was commissioned to produce higher quality products, including removing benzene from petrol and reducing the sulphur content of diesel.
2009	The Point Forward Project was commissioned, which increased MPR's capacity by about 15%.
2015	The Te Mahi Hou project was commissioned, which increased petrol capacity by installing a new Continuous Catalyst Regeneration platformer (CCR), which replaced the older and smaller semi-regeneration platformer.
2021	MPR's process was simplified by shutting down one crude unit, reducing capacity by about 15%, and stopping bitumen production. This was done to reduce the MPR's cash cost while the strategic review was undertaken.
August 2021	Shareholders voted to close MPR and convert it into an import terminal based on the strategic review's recommendation.
March 2022	MPR was shut down and the site was converted into a fuel import terminal.

2.1.2 Refinery ownership

MPR was built in the 1960s after the Government investigated setting up a domestic fuel refinery. Shell led the design and construction, but all fuel companies marketing in New Zealand at the time (including BP, Europa[11], Mobil[12], Shell and Caltex) wanted to ensure access. After lobbying and negotiation, it was agreed that all companies would participate based on their market share. The ownership was split between the fuel companies (60%) and the New Zealand public through listing on the stock exchange (40%), with Europa's share included in the New Zealand public's shareholding[13].

MPR operated as a tolling refinery, receiving a fixed fee of costs plus a margin for processing oil, which belonged to the refinery customers. The processing fee changed over time, but the refinery customers always owned the crude oil and products.

Shell's relationship with MPR, established during the design process, continued throughout much of MPR's life. Shell provided technical services and General Managers, keeping it up to date with international standards and technology. However, in 2009, following an independent tender process,

[10] This plant started up in 1985 and the petrol produced was shipped to Marsden Point for blending into final specification petrol.

[11] A New Zealand based company owned by the Todd family that was later purchased by BP.

[12] Then known as Standard-Vacuum. Mobil Corporation also owned the Atlantic Brand used in New Zealand at that time.

[13] Mobil - 100 years in New Zealand, Tony Nightingale, 1996.

Shell was replaced as the technology provider, ending a relationship of over 40 years. From then on, the General Managers became direct appointees.

In 1988, the petroleum industry was deregulated, requiring changes to MPR's fee structure and addressing debt from the 1980s expansion. The Government took on the debt, funded by a fuel tax, and processing agreements were established between the fuel companies and the refining company. By this time, the oil companies owned about 73%[14] of the refining company, and the public 27%. The processing fee structure was adjusted through to 1995, where a structure with a variable fee based on market margins was agreed (covered in more detail in Section 5.2). This processing fee remained in place, with minor adjustments on components and price formation, until MPR closed.

The processing fee structure required the refinery customers to collectively pay a fixed 'Floor' fee if processing fees were below the 'Floor,' regardless of throughput. This ensured high and consistent utilisation of MPR.

The fuel companies' ownership of MPR stayed around 73% until the last decade, when different companies sold down their shares, did not buy MPR shares when they purchased a marketing company[15], or did not participate in capital raising, diluting their ownership. By August 2021, when the decision was made to close MPR, the fuel companies only owned 42.6% of MPR, which dropped to 35.8% by its closure in March 2022. Z Energy is the only fuel company that owns shares in Channel Infrastructure (12.7%) as of September 2024.

2.2 Closure decision and current status

In 2021, shareholders voted to close MPR, and in 2022, the site was converted to an import, storage and distribution facility, and Refining NZ re-named Channel Infrastructure.

2.2.1 Closure decision

In August 2021, the Refining NZ shareholders voted to close MPR following a strategic review carried out by the Board. The case for change is detailed in Refining NZ documentation that was published for the shareholder vote. In summary, there was a structural oversupply in global refining capacity, which led to an extended period of low margins (see Section 5.1). The impacts of the global Covid response exacerbated this. This made supply through MPR uncompetitive with direct imports, and customers (BP, Mobil and Z) expressed a preference for import supply.

MPR competed in a global market where refineries are getting larger and more sophisticated in the range of products produced. Modern Asian refineries are five to ten times larger than MPR, with a greater capacity to upgrade a wide range of lower value crude into higher value products[16]. They often have associated petrochemical facilities meaning their income is not entirely dependent on the volatile margins associated with producing transport fuels. This resulted in efficiency improvements, and lower costs per unit throughput, offsetting any increase in margin expected to cover rising costs.

---

[14] This was higher than in the 1960s due to BP's purchase of Europa.

[15] When Z brought Chevron's (formerly Caltex) New Zealand business in 2016 they did not buy MPR shares which were sold separately.

[16] Refining NZ had capacity to upgrade medium-heavy crudes but not to the same extent as a modern Asian refinery.

With no reason to expect global refining oversupply to decline, increased competition from international refineries, and considering historically low returns on invested capital from refining, shareholders nearly unanimously approved the closure[17] expecting higher yields and more consistent returns from operating as an import terminal.

In its 2024 Annual Shareholders' Meeting, Channel Infrastructure reported a 28.9% Compound Annual Total Shareholder Return since transitioning to an import terminal. During the previous decade of refinery operations, it had a negative 6.8% return[18].

2.2.2 Conversion to an import terminal

Upon closure, Refining New Zealand was renamed Channel Infrastructure. The conversion to an import terminal had to occur simultaneously with the MPR's closure to replace MPR supply with imports for the Auckland and Northland markets. MPR primarily imported crude and exported products to ship to other locations in New Zealand, and this product flow needed to be reversed so products could be imported while maintaining product segregation. An import terminal required more refined product tankage than was needed by the operating refinery, so tanks were converted from their previous use to be suitable for refined product. Initially, only a minimum viable fuels terminal of 160 (ML) operating capacity was provided, but since the closure, more refinery storage has been converted to refined product storage, providing a 180 ML shared terminal, with another 100 ML of individual customer storage (referred to as "private storage") contracted directly with its customers during 2023.

Another 10-year storage contract for jet fuel was announced with Z Energy on 23 August 2024. This is expected to start in Q1 2027 and run through to 2037. Based on the capital expenditure announced with this contract ($26-$30 million) and its timing, this will involve upgrading the tank and associated facilities (likely a former crude oil tank) to make a tank suitable for jet fuel storage. Channel Infrastructure also expressed interest in offering storage capacity when the government sought options to store additional diesel stocks.

In total, as of August 2024, Channel Infrastructure has 290[19] ML of in-service storage (excluding the jet contract mentioned above) and 400 ML of unutilised storage that could be converted to fuels storage.

2.2.3 Distribution changes

MPR's closure ended the need for the two coastal tankers that transported refined products from Marsden Point to ten coastal port terminals around New Zealand[20]. These ships were leased, so

---

[17] The Shareholder vote was 99% in favour of closing.

[18] https://channelnz.com/wp-content/uploads/2024/05/417548.pdf (pg. 8)

[19] The 290 ML capacity in this announcement is slightly greater than the 180 ML shared terminal plus 100 ML private storage for fuel storage. Channel has announced other private storage contracts which may relate to non-core products (not petrol, jet fuel or diesel). These may make up the balance of the 290 ML currently in service.

Channel Infrastructure Limited HY24 Results, available at: https://channelnz.com/wp-content/uploads/2024/08/NZX-1HY24-Market-Release.pdf

[20] One of the ships had been specifically modified to carry bitumen from MPR to coastal ports as normal fuel product tankers are not capable of carrying bitumen.

were returned to their owners. Coastal Oil Logistics[21], the company which managed the use of the ships and the Joint venture partners' shared inventory system, also wound up soon after MPR closed.

All coastal ports are now serviced directly by import tankers, ending the need for transhipping between New Zealand ports. The impact of this change on the supply chain will be fully explored in the main report of the Fuel Security Study.

2.2.4 Inventory impact

The total petroleum stocks held in New Zealand reduced when MPR closed, as there was no longer any crude oil and partially processed product (known as refinery intermediates) held. Partially offsetting this loss, refined product stocks increased, as more of these stocks are now held at Marsden Point than was typical when operating as a refinery. This is demonstrated by the need to convert crude and intermediate tanks to refined product tanks to provide the contracted storage for terminal users.

Refined product stock levels are now higher than they were immediately after closure because of the conversion of more storage tanks since then. The implementation of the minimum stock obligation from January 1, 2025, may further raise stocks, along with additional storage Channel Infrastructure has recently committed to some of its customers.[22] The Fuel Security and Fuel Stockholding Costs and Benefits 2020 analysed the stock change expected following MPR's closure. While in total the gross stock (crude, intermediates, and refined product combined) was expected to reduce from around 53 days to 36 days, the impact on useable stocks was much lower, as much of the crude and intermediates held at MPR was required for operation.

The impact of the minimum stock obligation in mitigating the reduction in useable stock will be fully analysed in the main Fuel Security Study.

2.2.5 Move to product imports

Even when MPR was operating, all the products produced except fuel oil and CO2 needed significant imports to meet market demand, as shown in Figure 1. Therefore, moving to 100% product import expanded existing product import supply chains rather than creating new ones.

For fuel oil, the market demand was declining due to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI for reduced sulphur fuel, which New Zealand acceded to in 2022. This required fuel oil with a maximum of 0.5% sulphur to be used in New Zealand, whereas MPR's fuel oil had higher sulphur levels. Fuel oil was always exported because production exceeded domestic demand, so exports were expected to increase significantly if MPR stayed open under new specifications.

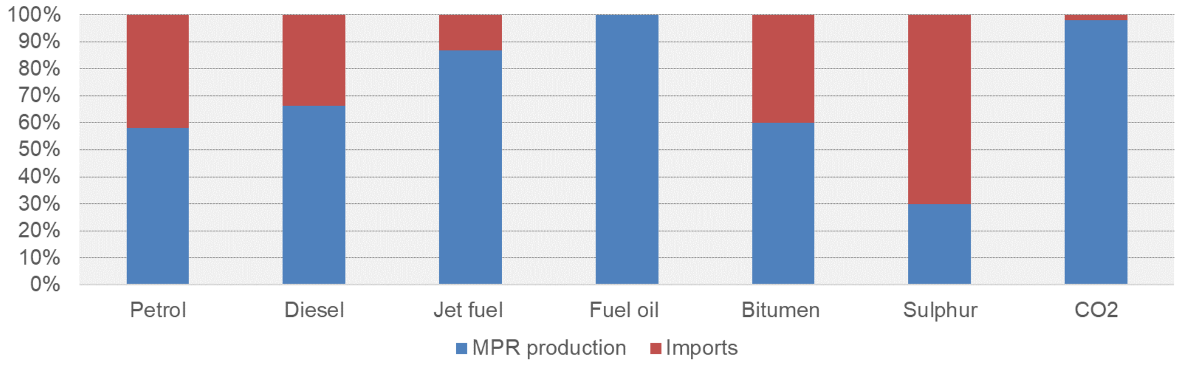
---

[21] Coastal Oil Logistics was a Joint Venture company owned by the BP, Mobil and Z to manage the ships used to transport product to ports and the shared storage system around the country.

[22] The Minimum Stock Obligation, according to the Fuel Industry (Improving Fuel Resilience) Amendment Bill sets the minimum stockholding level of fuels by New Zealand's five fuel importers with bulk storage access to 28 days use for petrol, 24 days use for jet fuel and 21 days use for diesel.

MBIE (2024), Minimum stockholding obligation, available at: https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-generation-and-markets/liquid-fuel-market/fuel-security-in-new-zealand/minimum-stockholding-obligation#:~:text=The%20minimum%20stockholding%20level%20will,21%20days%20use%20of%20diesel.

Figure 1: Market supply - MPR and Import split (2015-2019)[23]



Source: MBIE data, Envisory/Castalia

All the changes to 100% import supply happened relatively smoothly with no interruption to markets, except for CO_2. For CO_2, where the market players were not used to importing, it appears too much reliance was placed on expecting the remaining aged CO_2 plant in Kapuni to increase production, and when that had issues, it was difficult to ramp up imports at short notice due to already stretched (and expensive) supply chains in the period during the COVID recovery.

2.2.6 Quality

All the products formerly produced at MPR (including bitumen, CO_2 and sulphur) have quality requirements. Products must meet the same quality standard whether it is produced locally or imported, which means there are no significant quality changes in the products consumed in New Zealand due to MPR's closure. Within the allowed specifications, there has been some minor variation in quality, as detailed below.

- Petrol is now more typical of international norms, as MPR petrol reflected that produced by a simple topping refinery rather than the more sophisticated upgrading refineries more normal now. This is explored further in Section 4.2.
- The MPR produced very low sulphur jet fuel by international standards. The jet fuel now typically has higher levels of sulphur although still significantly below the international specification.
- All products produced by MPR came from the units warm and dry. By its nature product shipped will come more into contact with moisture. This has required some changes to operating practices at Marsden Point, although it is no different than for all other port terminals. This will be more fully explored in the main Fuel Security Study.
- As noted above the MPR was not capable of making lower sulphur fuel oil so it would have needed to export any high sulphur fuel oil with a loss of margin.

[23] All based on MBIE energy data except for bitumen, sulphur and CO2 which is informed by industry sources. Figure 12 shows the relative splits by product. Sulphur and CO2 production was insignificant relative to the volume of other products, and bitumen was only 2%.

2.3 Domestic crude oil production and supply to MPR

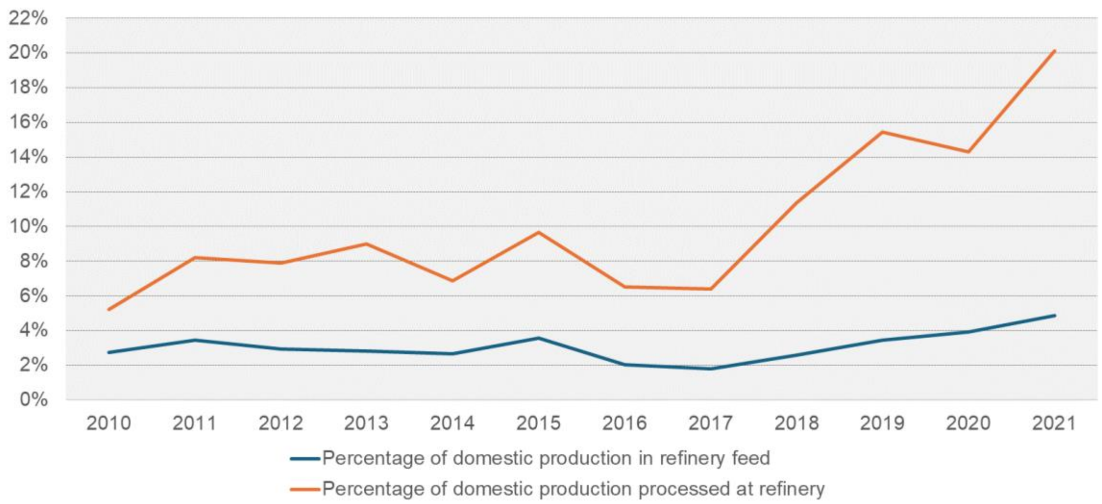
Domestic production of crude oil and condensate has been falling since 2008 and the outlook is that it will continue to decline. The MPR only processed a small proportion of domestic crude.

2.3.1 MPR processing of domestic crude

The MPR primarily processed imported crude oil. Crude oil and condensates made up 96%[24] of its intake, with the other 4% being petrol blendstock and another refinery feedstock. Petrol blendstock was required so MPR could produce premium-grade petrol to the required specification.

There was a small amount of domestic crude and condensate processed at MPR, although this normally only made up 2-4% of the total crude and condensate feed (Figure 2). As a proportion of New Zealand's total crude and condensate production, the amount of domestic feed processed at MPR increased from around 5% in 2010 to between 14% and 20% in the last few years of MPR's operation. This increase was primarily due to falling levels of domestic production rather than more being processed through MPR.

Figure 2: MPR domestic crude & condensate processing



Source: MBIE data, Envisory/Castalia

MPR did not process more domestic crude and condensate due to both its suitability for upgrading and economics. A lot of the domestic supply is condensate associated with gas production. This is a very light feedstock comprising mainly the lighter cuts (naphtha and gases) of normal crude oil. MPR could not run much of this material without overloading the top of its distillation columns, which then reduced capacity, particularly the ability to make feed for the hydrocracker, which was the unit that provided the major product uplift generating value for MPR (the refinery process is covered in Section 3.1).

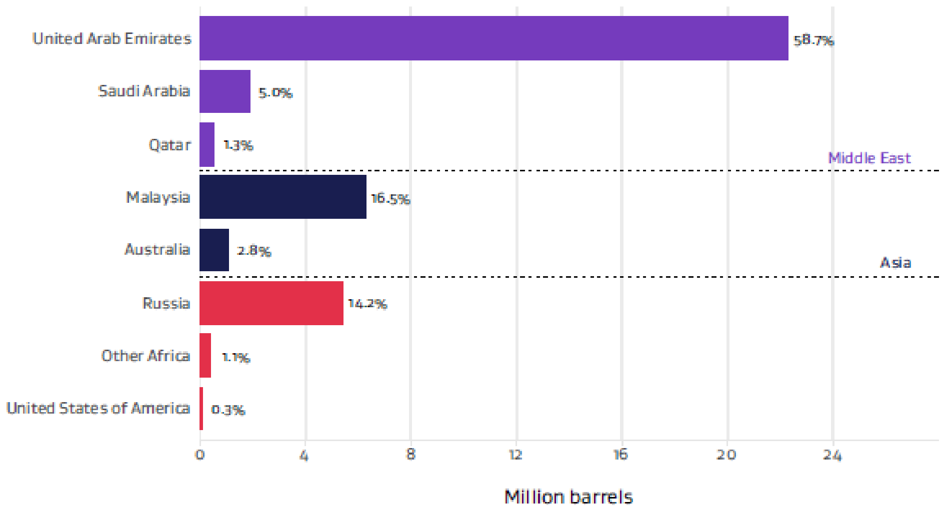
In addition, due to the hydrocracker, the MPR had the ability to upgrade heavier, higher sulphur crudes. These were typically cheaper, generating a higher processing margin. The New Zealand crudes are typically lower sulphur, meaning the sellers of those crudes could get higher prices from refineries that were designed to run a lower sulphur crude slate (such as the Australian refineries).

[24] All figures based on 2010-2021 average data, using Energy Data published by MBIE.

Therefore, the economics dictated that the producers got better value for their production through exporting, while MPR generated more value by importing crude.

The source of imported crude is shown in Figure 3 for 2019, which is relatively typical of the crude mix at MPR. Around 60-70% were medium, higher sulphur crudes from the Middle East with the balance of the crudes coming from the Asia-Pacific region (the Russian crude was from Eastern Siberia so formed part of the Asian market although it is not shown that way on the chart). On occasions there were limited volumes imported from Africa and in the last few years, some cargoes from the United States as it developed into a major crude exporter starting from 2016[25].

Figure 3: Import crude source 2019[26]



Source: MBIE Energy in New Zealand 2020

2.3.2 Domestic crude and condensate outlook

New Zealand has been producing crude oil and condensate since 1965. Over the last 20 years, the most significant production changes came with the development of three offshore fields, two of them liquids only:

- Pohokura gas/condensate field which came online in 2006 (processed onshore);
- the Tui oil field in 2007; and
- the Maari oil field from 2009.

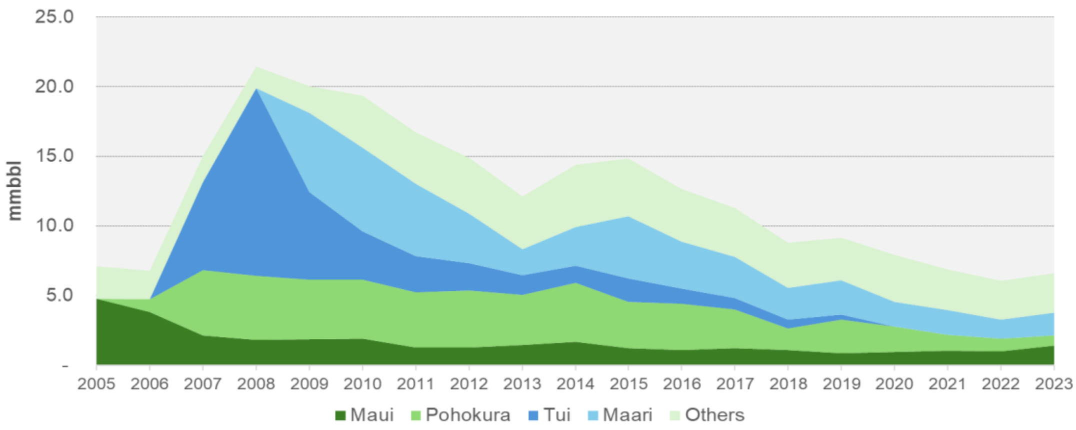
Peak crude and condensate production rates were achieved between 2008 and 2010 (Figure 4). The Tui/Maari peaks characterise new oil field production, which has a high initial volume, but field life is often significantly shorter than those fields producing gas and condensate (e.g. Pohokura and Maui). Investment in more wells where economic (e.g. Maari in 2014/2015), can increase production and extend the field life. It seems unlikely that large new oil fields will be discovered given the 60-year development of the Taranaki basin opportunities, coupled with a relative lack of exploration success in the last decade. The focus is more likely to be extending and enhancing existing gas fields with a small amount of associated liquids.

---

[25] The United States only repealed a 40-year ban on crude exports in December 2015.

[26] Graphic from Energy in New Zealand 2020, MBIE (figure E.9)

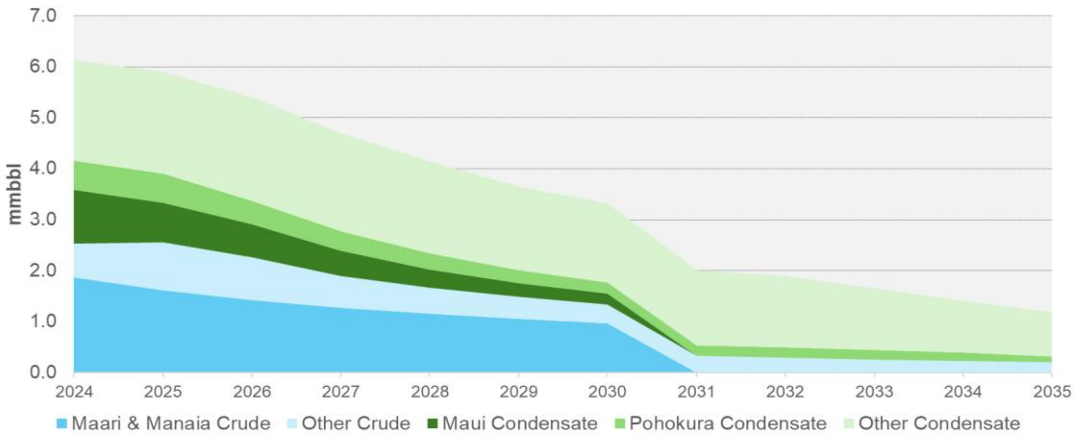
Figure 4: New Zealand's recent crude oil and condensate production history[27]



Source: MBIE data, Envisory/Castalia

Looking forward (Figure 5), there is a significant reduction in both crude and condensate production as fields near the end of life, particularly for the oil fields (e.g. Maari and Tui - Tui last produced in 2019 and have since been decommissioned). The condensate production profiles generally exhibit longer production tails because they are by-products of gas fields.

Figure 5: Future production data by major field[28]



Source: MBIE data, Envisory/Castalia

The Maari crude is most of the current crude oil production, while the condensate production is more widely dispersed across various fields. When the Maari field finishes (currently shown for 2030, but this can change[29]) the level of crude production falls to a very low level. In terms of refinery feedstock, the outlook volumes for domestic crude and condensate production for 2024, if all processed locally, would only provide 15% of the feed needed for the 2019 MPR, and by 2031 would provide less than 5%.

---

[27] Based on MBIE Energy data

[28] This data is from the MBIE published reserves data in 2024. Since this was published there has been a decline in gas production against the expectations which is likely to have also impacted on liquids production shown in these charts.

[29] The current 2030 date is later than provided in earlier Reserve publications, indicating success in extending Maari's life.

2.4 New Zealand demand forecast for refined products

We outline the recent demand for refined petroleum products, principally petrol, diesel and jet fuel. We also set out a 10-year demand forecast for these three products, which will inform the analysis of fuel security options in our next report.

2.4.1 Demand for petrol has declined and is stable or rising for diesel and jet fuel

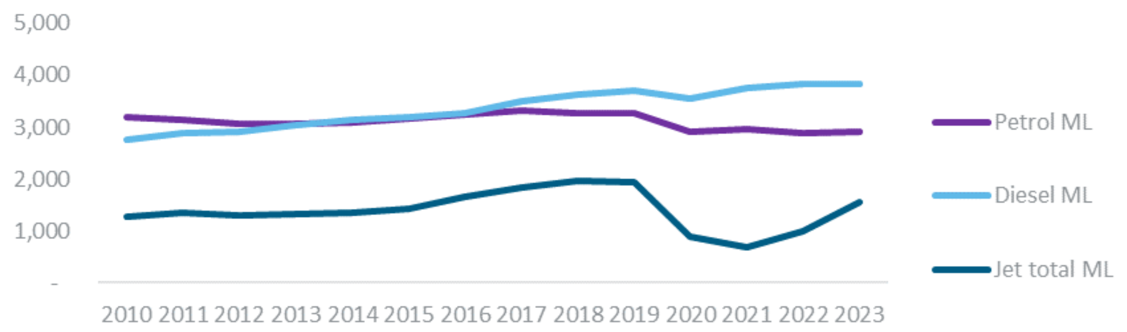
New Zealand's demand for refined petroleum products—specifically petrol, diesel, and jet fuel—has fluctuated in recent years, largely due to COVID-19, economic conditions, and changes in consumption patterns.

Demand for refined products is principally driven by transport in New Zealand. Petrol is the primary fuel for private vehicles, with about 94% of petrol used for light passenger vehicles. Approximately 70% of diesel is consumed by the transport sector. The remaining diesel usage is split among the industrial sector (11%), primarily for manufacturing and construction, agriculture and fishing (10%), the commercial sector (5%), retail (2%), and international shipping (2%). Jet fuel demand is mostly for international aircraft on long-haul flights (80%) with domestic aviation accounting for 20%.[30]

Figure 6 shows the demand trends for refined products from 2010 to 2023. Before 2020, diesel, and jet fuel grew steadily, while petrol demand was relatively flat, peaking in 2017. However, the global pandemic caused significant disruptions, particularly affecting the aviation sector.

In 2020, demand for petrol dropped by 11% due to the impact of COVID-19. It has since recovered but never returned to pre-pandemic levels, reaching 2.9 billion litres in 2023 relative to 3.3 billion litres in 2017. Diesel consumption, on the other hand, has risen steadily, increasing by 10% between 2017 and 2023, with total consumption reaching 3.8 billion litres. Jet fuel demand, although recovering post-pandemic, reached 1.5 billion litres in 2023 but remained below pre-COVID-19 levels of close to 2 billion litres.

Figure 6: Historical consumption of refined products in NZ, ML



Source: Castalia/Envisory analysis

[30] MBIE, 2024, National Fuel Plan, p.16-17

2.4.2 Demand is forecast to decline for petrol, and rise or remain stable for diesel and jet fuel over the next decade

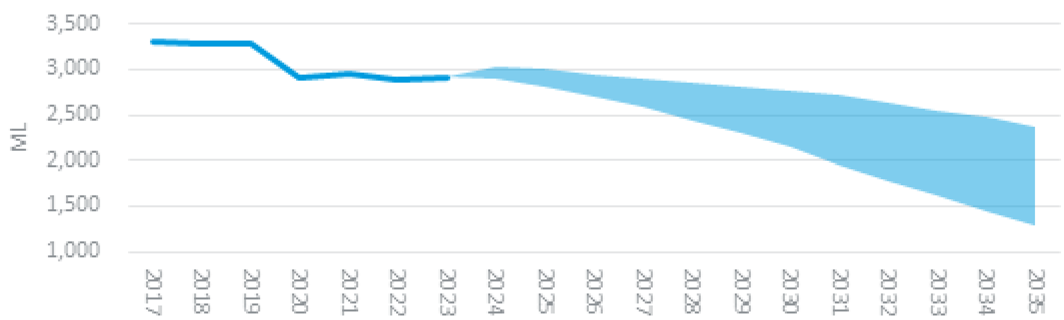
New Zealand's transport sector is expected to undergo significant change in the next decade. Emission reduction targets and technology change will drive this change. Falling capital costs for electric vehicles (EVs), a changing carbon price, and broader efforts are expected to reduce demand for refined products.

We have developed a demand forecast for petrol (both regular and premium), diesel, and jet fuel. This demand forecast takes into account policy, changing capital costs for vehicles and broader economic and consumer trends. Castalia and Envisory have each prepared fuel demand forecasts, which we have compared to the Climate Change Commission's (CCC) forecast contained in draft advice for the fourth emissions budget (EB4) period (2036–2040).

Our analysis includes two CCC scenarios: the reference scenario and the EB4 demonstration path. The reference scenario represents projected emissions if no additional reduction policies or measures are implemented beyond those in place as of 1 July 2023. In contrast, the EB4 demonstration path outlines a tested set of actions and strategies across sectors to meet the proposed emissions budget. This comparison provides a clearer view of future demand for refined products under varying levels of policy intervention.

The demand for petrol is forecast to decline by 19% to 56% by 2035, with consumption dropping to between 2.4 billion litres and 1.3 billion litres, as shown in Figure 7. The higher end of the forecast reflects the CCC reference scenario, while the lower end is based on the EB4 demonstration path. Forecasts from both Castalia and Envisory fall within this projected range.

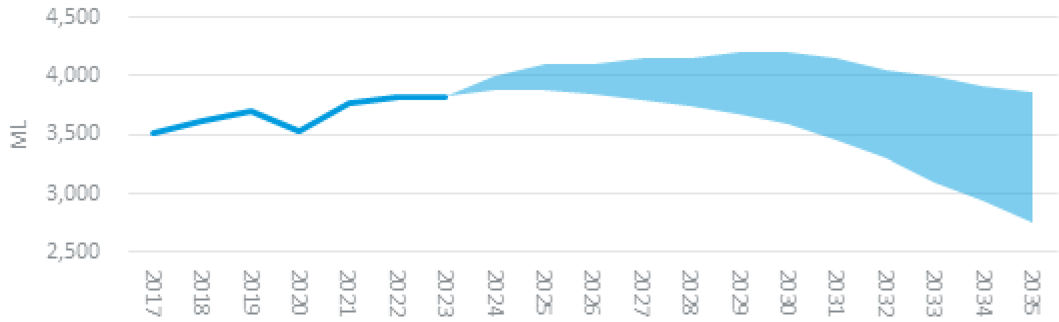
Figure 7: Demand forecast for petrol, ML



Source: Castalia/Envisory analysis

Diesel demand is projected to rise initially before declining. By 2035, in the upper range of the forecast, diesel consumption is expected to return to 2023 levels of 3.8 billion litres. On the lower end, diesel demand could decrease by 23%, falling to 2.9 billion litres, as illustrated in Figure 8. Both Castalia's and Envisory's forecasts align with or fall within the CCC's reference and demonstration paths. Substitute technologies for freight transport such as hydrogen fuel cell (HFC) powered trucks are currently not cost competitive and major step-changes in the cost of green hydrogen production and HFC vehicles are unlikely to emerge during the forecast period. Therefore, unlike for petrol, diesel demand should remain robust.

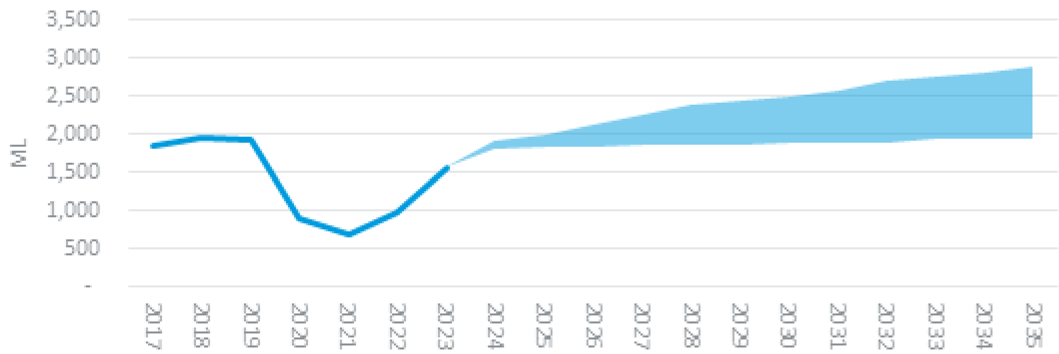
Figure 8: Demand forecast for diesel, ML



Source: Castalia/Envisory analysis

Jet fuel demand is expected to rise significantly. It could increase by 85% in the upper range, reaching 2.9 billion litres. On the lower end, a 25% increase is anticipated, bringing demand to 1.9 billion litres, as illustrated on Figure 9. Both projections are based on Envisory's data. The CCC's forecast suggests a lower range, with a 0.4 billion litre difference between the reference and demonstration paths. Due to high uncertainty in the aviation sector, we believe the potential demand range will likely exceed the CCC's estimates, thus, we have adopted Envisory's forecast range.

Figure 9: Demand forecast for jet fuel, ML



Source: Castalia/Envisory analysis

These demand changes will be driven by a combination of factors, including those CCC identified. They include:[31]

- **Electrification of light vehicles and increasing engine efficiency.** The shift to EVs will play a crucial role, with the CCC predicting 85% of the light vehicle fleet (cars, utes, vans, and motorcycles) expected to be electric by 2040. All new vehicles entering the fleet will be electric, resulting in 80% of total light vehicle travel powered by electricity. This rapid adoption, spurred by government policies like the Clean Car Standard, will sharply reduce petrol demand in the transport sector. Furthermore, new internal combustion engine (ICE) light vehicles are becoming more fuel efficient, with an increasing share of hybrid vehicles entering the fleet.

[31] The Climate Change Commission, 2024, Draft advice on Aotearoa New Zealand's fourth emissions budget

- **Reduced fuel demand in heavy vehicles and mode shifts**. While the switch to electric heavy vehicles (e.g., trucks) will be slower than for light vehicles, progress is expected by the early 2030s due to lower operational costs. By 2040, almost all new trucks will be electric, reducing diesel demand. A shift towards lower-emission transport options, such as rail and coastal shipping, will reduce vehicle kilometres travelled (VKT) by heavy vehicles by 10%, further lowering diesel consumption.
- **Increasing use of public transport, walking, and cycling**. The growth in public transport use, cycling, and walking will reduce the reliance on petrol and diesel-powered vehicles. By 2040, these modes are projected to make up 15% of all passenger kilometres travelled, up from the current 5%. This shift, coupled with the rise of remote work and denser urban development, will lead to an 18% reduction in overall vehicle kilometres compared to reference scenarios.
- **Aviation and low-carbon fuels**. Aviation presents unique challenges for decarbonisation due to its limited electrification potential. There is a possibility that low-carbon liquid fuels, such as Sustainable Aviation Fuel (SAF), and battery-electric aircraft for regional flights will play a role, which may reduce the demand for conventional jet fuel. However, at this stage, it is highly uncertain.

Overall, we expect the electrification of light vehicles and improved fuel efficiency to lead to a significant reduction in petrol demand. This shift will be further accelerated by policy decisions and investments in charging infrastructure to incentivise the switch to electric. However, the demand for diesel and jet fuel is likely to increase. This rise will be driven by factors such as growing GDP, which boosts economic activity, and population growth, which increases transportation needs. Additionally, sectors that rely heavily on diesel and jet fuel, like heavy-duty transport, aviation, and industrial applications, face significant challenges in adopting electrification. There are fewer cost-competitive electric heavy vehicle options and no economically feasible alternative to jet engines for aviation. These sectors may take longer to shift to alternative energy sources, sustaining the demand for these fuels in the near term.

3.0 Marsden Point Refinery operation

This section details the technical operations of the MPR, including an overview of its process flow, capacity, and commercial arrangements. We review MPR as it was in 2019 at its full capacity following the CCR Platformer investment. The changes made to 2020/21 to simplify refinery operations are summarised at the end of the section.

3.1 2019 Refinery process

This section covers MPR's refinery process as it was before it was adjusted in response to COVID-19 impacts and low margins.

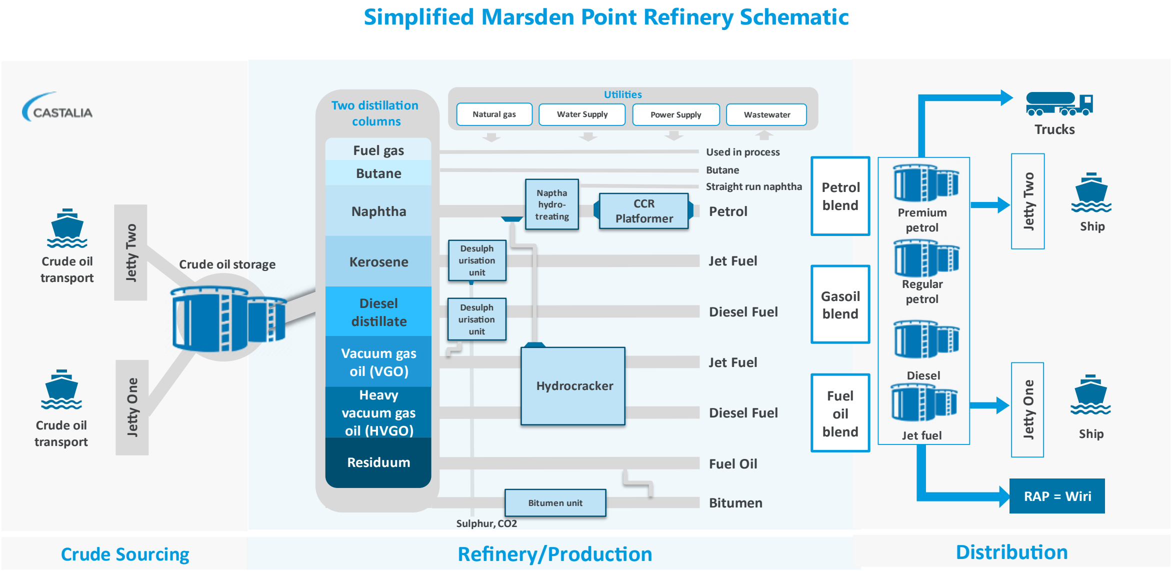
3.1.1 Capacity and Yield

The MPR had a nominal capacity of 135,000 bbls of crude/day (21.5 ML/day or 17,500 tonnes/day). Nominal capacity is a technical measure based on theoretical distillation unit capacity. In practice, due to processing restrictions in various units, the maximum capacity over a period was around 115,000 bbls/day[32].

In addition to the crude and condensate feedstock, MPR used natural gas, blendstock and other feedstocks. Natural gas was used as a fuel for the process, minimising the need to consume some of the crude and condensate processed as fuel. Petrol blendstock was required to blend premium petrol to the required specification. Other feedstocks were more ad-hoc, used when there was an opportunity to upgrade, such as higher sulphur gasoil. In the past, MPR also processed topped residue (crude oil with the lighter fractions removed), although this was not so necessary after the expansion in 2009. Including all the feedstocks, MPR's yield of product was approximately 95%, with 5% of the intake used as fuel during processing.

[32] The highest crude and condensate feed shown in the MBIE Energy data over a year was 112,000 bbls/day in 2019 although total throughput (includes natural gas, blendstock and other feedstocks) averaged around 115,000 bbls/day.

Figure 10: Marsden Point Refinery Schematic[33]



Source: Envisory/Castalia

3.1.2 Major Units

MPR had two distillation towers, one from the original 1960s refinery (expanded in 2009) and one from the 1980s refinery expansion. The second distillation column processed heavier crudes, including those used to produce bitumen[34]. The naphtha from the crude was hydrotreated to remove sulphur and other impurities before being processed through the Continuous Catalytic Regenerating Platformer (CCR). This upgraded the naphtha (increased octane) to make it suitable for blending into petrol.

The kerosene stream went through a hydrodesulphurisation plant to remove sulphur and stabilise the stream to be suitable for use as jet fuel. The straight run gasoil from the distillation columns also went through a hydrodesulphurisation plant to remove sulphur to meet the diesel specification. There were three hydrodesulfurisation units used for jet and diesel desulphurisation in total.

The heavier components of the crude (residue) went to a vacuum distillation column (there were two of these units) to produce feed suitable for the hydrocracker. The hydrocracker cracked the longer carbon chains and saturated them with hydrogen to produce naphtha, jet fuel and diesel. The naphtha was split and some routed to feed the CCR and a portion used for petrol blending. The jet fuel and diesel were blended with the straight-run products.

The heavier components from the vacuum units went to the Butane Deasphalting Unit to produce additional feed for the hydrocracker, or to the bitumen unit when suitable crudes were being run.

[33] The schematic simplifies MPR's processes by removing smaller units and full complexity of the process flows.

[34] Bitumen could only be produced from certain crudes to meet the specification requirements, although in later years the softer (180 Pen) grade of bitumen could be produced more flexibly.

3.1.3 Minor Units

MPR had many smaller units to process feed or gasses, all of which were essential for operation. These include the following units.

- **Depropaniser.** Processed the gas stream splitting it into lighter gases for use as fuel gas and butane to use in petrol blending.
- **Hydrogen Separation Units. (HSU1 & HSU2).** These units used membrane technology to purify hydrogen-rich streams from the CCR Platformer and Hydrocracker to produce hydrogen suitable for use in the hydrocracker and gasoil hydrodesulphurisation unit. The hydrogen-deficient stream from HSU1 was fed to the HMU.
- **Hydrogen Manufacturing Unit (HMU).** This unit took butane and the hydrogen-deficient stream from HSU1 and produced hydrogen suitable for use in the hydrocracker. It also produced a CO2-rich stream to feed the CO2 plant[35].
- **Benzene Removal Unit (BRU).** This unit removed the benzene from the platformate produced by the CCR so it would meet the requirements of the petrol specification.
- **Butane Deasphalting Unit (BDU).** This unit processed residue to increase the feed available for the hydrocracker.
- **Amine Units.** These units removed hydrogen sulphide in the sour gas from the hydrodesulphurisation units and hydrocracker before it was used as fuel gas.
- **Sulphur Recovery Units.** These units converted the hydrogen sulphide removed in the amine units to sulphur that was then pelletised for sale.
- There were also units for treating wastewater.

3.1.4 Processing decisions and domestic crude

The selection of feedstocks was done by the MPR's customers. Each company (there had been four separate companies, but it became three in 2016 when Z purchased Chevron) had a share of MPR they could optimise. In recent years, the MPR had a role in the selection to make sure the feedstock selection decision made sense, although crude and condensate selection still ultimately lay with the MPR's customers.

Customers ran an optimising tool (a Linear Programming model) to assist with the crude selection with the aim to optimise the processing margin based on the cost of various crudes (including delivery cost) and the value of the products generated. The aim was to maximise the use of the upgrading units to keep these at capacity as that is where the most value was generated.

Minor volumes of domestic crude and condensate were processed at MPR (see Section 2.3.1). This was a decision made by the MPR's customers due to local crudes not generating value against other alternatives, given the price necessary to secure that supply. This did not change much from year to year, so the decision was consistent despite quite varied economic conditions over time.

3.1.5 Petrol blending

Unlike jet fuel and diesel, petrol is not a product that can be distilled directly from crude oil. MPR upgraded distilled naphtha through the CCR Platformer to make it suitable for petrol blending. In many refineries, petrol components would also be produced by upgrading units, contributing a significant part of the petrol pool. For example, refineries with catalytic cracking upgraders would

[35] The CO_2 plants were off-site owned by third parties.

also have an alkylation unit (takes the gas stream and combines it with isobutane to form a high octane, low aromatic blend component). The cracked petrol and alkylate produced by these units could make up around half the petrol pool (this setup is typical of the remaining Australian refineries).

MPR did not have these units, so its petrol was more reflective of a simple topping refinery where the only components were those from processing naphtha. Hydrocracked naphtha made up 20-25% of the Platformer feed, so there was an upgraded component. The MPR petrol pool only had the following components:

- Butane (high octane but the blend volume is limited by maximum vapour pressure)
- Light straight run naphtha (low octane component mainly used in regular)
- Light and heavy platformate (high octane although high in aromatics)
- Small portion of Hydrocracker tops stream

The limited components meant that MPR had difficulty blending high octane (95 RON) petrol to specification as the higher octane meant more platformate had to be used which could result in the aromatic level being too high (the specification was 45% maximum, with pool average for all production maximum 42%). As a result, petrol blendstock was imported to assist in blending premium petrol. In recent years this was mainly a refined product, which could be used to offset the MPR components.[36]

3.1.6 Product make

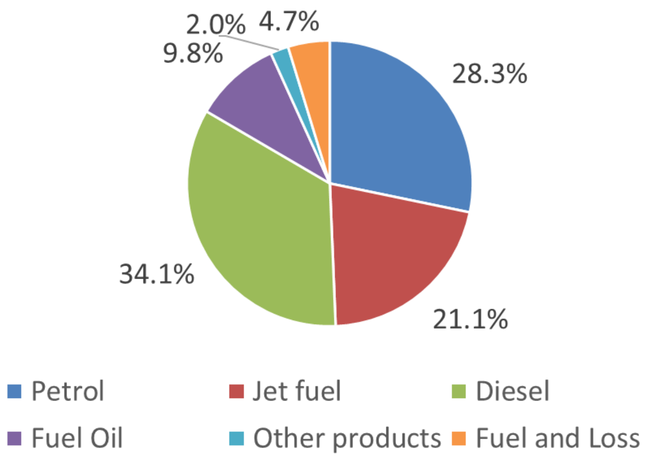
MPR produced two grades of petrol (regular 91 RON and premium 95 RON), jet fuel, diesel, fuel oil, bitumen, sulphur and CO_2. The main white products[37] (the most valuable products; petrol, jet and diesel) were about 83.5% of the intake, with fuel oil most of the balance. The bulk of the other products (2%) was bitumen, with sulphur and CO_2 being very small proportions relatively. Just under 5% of the intake was used in the process as fuel.

Figure 11 shows the products produced as a percentage of intake averaged over the decade to 2019. The proportion of petrol was higher than generated from the processing of crude, due to the use of petrol blendstock, which was close to 2% of the feed. Jet yields were high in recent years, as customers looked to maximise jet fuel make to meet rising demand at Auckland Airport. There were jet fuel imports into Marsden Point included in the 2018/2019 balances reflected in higher yields in those years.

[36] A refinery with a wider mix of components including isomerate, cracked gasoline and alkylate would produce a 95-octane petrol (without any other additives) around a 30% aromatic level on average.

[37] White product is a term used to cover petrol, jet fuel and diesel. It is used as these are the light products produced at a refinery with the heavier black components in crude oil ending up in black products such as fuel oil and bitumen.

Figure 11: MPR product split



Source: MBIE data, Envisory/Castalia

MPR was not able to make 98 RON petrol (that was all imported) and its fuel oil was high sulphur. As shown in Figure 1 most products were also imported to meet market demand. Fuel oil was the main exception as MPR produced more than the New Zealand demand. The excess was exported and between 2010-2019 between 25%-30% of the fuel oil produced was exported. Any exports generated less income as the value was eroded by the need to ship to the export destination, and losing the benefit of selling at import equivalent locally.

3.1.7 Processing changes made at the end of 2020

Refining margins in 2020 were at historic lows, and for MPR the Floor was being paid by customers, as income generated from the GRM was below this level (see Section 3.2). However, the Floor income was not covering the MPR cash costs, so MPR was quickly becoming unviable. Changes were made in the process to reduce costs by 10-15% to maintain viability while decisions were being worked through on the future strategic direction of the company.

This involved reducing the processing capacity to 95,000 bbl/day nominal capacity, which allowed the smaller of the distillation columns to be taken offline. Bitumen was no longer produced which simplified operation (thus reducing cost) and avoided significant spending that was due on those facilities. However, Channel Infrastructure advised us that the move to a simplified refinery was viewed as a temporary measure to allow the refinery to operate on a cash-neutral basis on fee floor revenue levels. Remaining with the simplified refinery was not sustainable in the long-term as in the company's view MPR lacked the scale to provide sufficient returns.

3.1.8 Utilities and infrastructure

MPR required several major utilities and related infrastructure. They were a very large user of water from the regional water supply and required an electricity load of 40-42 MW[38]. MPR used around 3.5 PJ of natural gas although this was treated as feed rather than a utility. This made the site one of the country's larger users of natural gas and electricity. A lot of the water was used to generate steam for process heating, run ejectors, strip steam, prevent coking, and drive turbines as well as a reactant (HMU).

[38] This reduced to around 33MW with the simplifications changes made at the end of 2020.

Much of the MPR site was required for storage tanks rather than processing equipment. Tanks were needed to receive crude (with sufficient storage to keep different types of crude segregated as much as possible). There was storage needed for intermediate products (these were critical so an upset on one plant did not immediately impact other units) as well as refined product. The refined product tanks needed to be sufficient to hold both product for feeding the RAP pipeline and for loading the coastal tankers efficiently.

In total, the MPR site was around 170 hectares, and we estimate storage capacity was around one billion litres.

3.1.9 Staffing and employment

MPR employed around 350 full-time staff and employed 150-200 contractors on an ongoing basis. Many of these positions required highly specialised skills with average salaries well above New Zealand averages.

3.2 Commercial arrangements underpinning refinery operations

MPR (and overall fuels market) was deregulated in 1988, and the previous cost-plus structure of MPR was changed to a commercial structure where the customers had processing agreements with MPR. The key features of the processing agreements included:

- MPR offered its full capacity to its customers split by market share;
- Customers planned, purchased and delivered feedstock for their share of MPR and lifted the products produced;
- For processing, the customers paid MPR a fee based on 70% of the margin generated from the value of the products less the value of the crude (known as the GRM). Refinery margins are detailed further in Section 5.1.
- Should the income generated by the calculation fall below an agreed "Floor" level, the customers had to pay their share of the Floor rather than the fee calculation;
- A "Cap" that meant should the margin rise above US$9/bbl, the customers only had to pay up to that level which meant the MPR fee was capped at a level of 70%*US$9/bbl.

The customers retained part of the margin generated from processing crude in MPR as they carried the cost of the inventories required at MPR (the value of these were many hundreds of millions of dollars) and distributing the product to terminal locations .

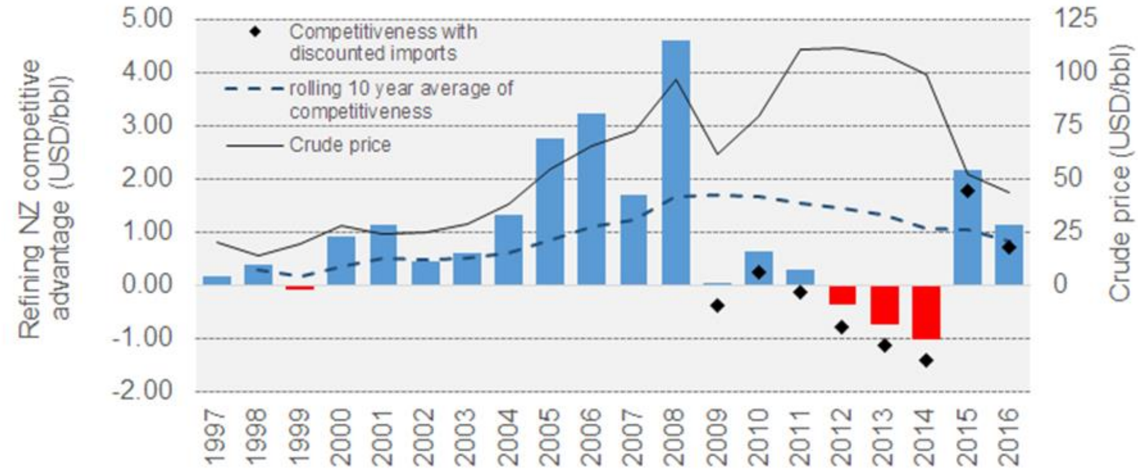
The MPR calculated its GRM in line with the process detailed in Section 5.1. The margin was reported bimonthly, along with a Singapore reference margin and related uplift (the uplift came from the quality of products and the location benefits as crude freight to New Zealand is cheaper than product freight).

The Floor structure was designed to cover MPR's operating costs, giving protection in a low-margin environment. This was set in 1995 and inflated—however, since operating costs rose faster than the allowed inflation index as the inflation index did not account for increases in refinery capacity, by 2020 the Fee Floor did not fully cover actual operating costs. Prior to 2020, the Floor had only been paid in 1999 during a period of very low margins, whereas the Cap had been hit in 2007 (relatively minor), 2008 (significant) and 2015 (moderate impact). The Cap level was not inflated.

Various independent processing fee reviews investigated the structure and balance between Refining NZ and its customers, including two carried out by Envisory in 2014 and 2017[39]. In summary, in a low-margin environment, both parties struggled as MPR did not generate a return on investment and the customers were uncompetitive against directly importing product. In a high-margin environment, both parties could generate good returns, particularly fuel companies if margins went above the Cap. The relationship was based on being able to survive through the margin cycles so that on average both parties benefited from refining.

This is best illustrated by the chart (Figure 12) from the 2017 Independent Processing Fee Review report. In the period since the high margins in 2008, refinery supply had been relatively neutral versus imports in the 2009-2011 period, uncompetitive for customers in the period 2012-2014, and highly competitive in 2015-2016.

Figure 12: Refining competitiveness chart[40]



Source: 2017 Independent Processing Fee Review, Envisory

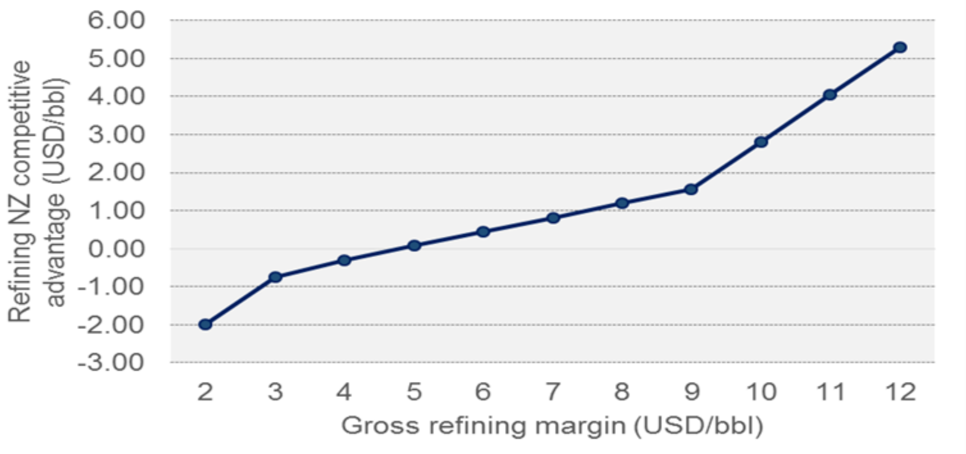
Figure 13 shows MPR's competitiveness versus imports at different margin levels for the 2007-2016 period. Fuel companies required at least a US$5/bbl margin to breakeven, and below this level were better off importing rather than refining. This was especially true when the Floor kicked in at margin levels below US$3.00-3.50/bbl. The breakeven point was rising over time as the cost of tasks such as coastal distribution increased.

Although not shown in this chart, MPR needed margins above around US$7-8/bbl to make a reasonable return on investment, particularly after the CCR investment in 2015. The average margin in the period 2013-2019 was US$6.31/bbl.

[39] Envisory was known as Hale & Twomey Limited at that time.

[40] From the Independent Review of the Refining NZ Processing Agreement, Hale & Twomey, 2017

Figure 13: Refining NZ Competitiveness at varying GRM[41]



Source: 2017 Independent Processing Fee Review, Envisory

These charts show that it is not surprising that closure was considered when margins fell below US$3/bbl for a long period in 2020/2021. Even the margins in late 2019, before COVID-19 impacts, were unsustainable for both Refining NZ and its customers. At that time the excess of global refining capacity was expected to be sustained, with margins predicted to be low until the mid-2020s.

Of course, no one foresaw the Russian invasion of Ukraine in late February 2022 where, after sanctions were put on products from Russia, Europe needed to find another source for millions of barrels of diesel. This put pressure on the global refining system, and while there were no supply disruptions, refining margins went to unprecedented high levels through much of 2022. More recently margins have dropped to relatively low levels again (~US$4/bbl estimated for MPR)[42] - see Figure 25).

[41] From the Independent Review of the Refining NZ Processing Agreement, Hale & Twomey, 2017

[42] This was the calculated margin at the end of August 2024 so not shown in the monthly average chart.

4.0 Estimated costs and feasibility of reestablished refinery

This section outlines Castalia and Envisory's estimates of the anticipated costs and considerations for reestablishing the MPR, covering the facility's current state, required infrastructure updates, capital costs, and ongoing operating and maintenance expenses. Channel Infrastructure commissioned the Worley Report which we have reviewed after preparing the estimates set out below.

4.1 Condition of the closed refinery

The Marsden Point site is currently almost exclusively used as a refined product import terminal by its owner, Channel Infrastructure. The oil refining infrastructure remains in place but is not functional. The assets vary in condition. Some assets have been de-commissioned, some preserved with nitrogen, and some re-purposed for use for the import terminal activity.

Channel Infrastructure's shareholders voted at a special meeting in August 2021 (when the company was known as The New Zealand Refining Company Limited) to cease refining operations and reorient the business to function as a terminal for importing, storing and distributing refined products.[43] Following that decision, the company commenced re-purposing some assets to enable the importation of refined fuels. For other assets it commenced a 10-year process of firstly ensuring site safety, then identifying assets where value could be realised, and decommissioning remaining assets with a view to scrapping these. A further shareholder resolution was put to the annual shareholders' meeting on 30 April 2024 by some shareholders, calling for the company to cease de-commissioning activity and commission a report investigating reestablishing refining.[44] That resolution was rejected by 98.92% of shareholders.[45]

Channel Infrastructure recently appointed specialist technical consultants Worley to investigate the current state of former refinery assets and identify the cost of reestablishing a refinery. This was in response to the Government's Fuel Security Study and the need for an objective and accurate cost estimate for re-establishing refining activities to inform this investigation. The Worley Report provides a more accurate description of the assets' condition and cost to re-instate, re-furbish, replace or remove. We also met with Channel Infrastructure on 4 September 2024 and discussed the status of its former refining assets and conducted a refinery tour to see the site infrastructure first-hand. The below table sets out the key former refinery assets and their status as de-commissioned, mothballed or re-purposed. Those terms mean the following:

- **De-commissioned** means that the asset has been rendered safe, but disconnecting power, water and gas connections is relevant. Where pipework is present, this has typically been cut and capped to prevent ingress of birds or rodents and avoid leakage of any residual material. Some reports suggest that pipework has been filled with concrete. This is not true
- **Preserved** means that the asset has been rendered safe and has been treated with preserving agents such as nitrogen to ensure the asset can be made functional on-site or

[43] Channel Infrastructure Notice of Special Meeting 2021, available at: https://channelnz.com/wp-content/uploads/2022/03/Notice-of-Special-Meeting-5-July-2021.pdf

[44] Channel Infrastructure 2024 ASM presentation, Resolution 5, available at: https://channelnz.com/wp-content/uploads/2024/05/417548.pdf

[45] Channel Infrastructure 2024 ASM voting results, available at: https://api.nzx.com/public/announcement/430295/attachment/417580/430295-417580.pdf

de-constructed and made functional elsewhere (in whole or part). Channel Infrastructure has offered the preserved assets for sale or reestablishment by another party on site. While it has taken steps to ensure the assets can be made functional again, it is selling those assets on an 'as-is where-is' basis with limited warranties about the suitability for re-use. These assets have not been 'mothballed' which would entail additional steps such as turning over motors on a regular basis, applying corrosion inhibitors, plastic wrapping, application of liquid protective waxes or PVC coatings and so on.

- **Repurposed** means that the asset has been either almost immediately directly switched to import terminal operations, or Channel Infrastructure has made additional investment to repurpose the asset for import terminal use.[46] Examples of both types of repurposed assets include:
  - Jetties 1 and 2 required relatively minor investments to enable greater volumes of refined product to be pumped onshore. The piping line-ups also needed to be modified to receive the product into the greater number of refined product tanks and for onward distribution.
- An example of significant capital investment is the conversion of crude storage tanks to refined product tanks. Channel Infrastructure has spent considerable capital expenditure to replace floating roofs with fixed geodesic roofs and strengthened bunds around these tanks to bring them up to current standards, and has installed automated firefighting systems.

Table 2: Categories of refining assets

De-commissioned assets	Preserved assets	Repurposed assets
Crude distillation column (CDU) 1	Catalytic reformer (CCR) platform	Jetty 1
CDU 2	Hydrodesulfurization (HDS) unit	Jetty 2
Hydrocracker unit (HCU)*	Hydrogen manufacturing unit (HMU), in part	Refinery to Auckland Pipeline (RAP)
Some crude storage tanks		Site control centre
		Various tanks

*The HCU has been decommissioned and is under option for a possible purchase.

4.2 Capital cost estimation and benchmarking for a reestablished MPR

We estimate that building a new refinery of MPR's historical nameplate capacity of 135,000 bpd would require a capital investment of between NZ$5.9 billion and NZ$16.1 billion (US$3.7 billion and US$10.1 billion). Our analysis suggests that the capital costs for a new refinery would be between NZ$45,000 and NZ$124,000 (US$$27,000 and US$75,000) per bpd, based on the clear economies

[46] Channel Infrastructure NZ Limited expects that converting to an import-only business (which is ongoing) will cost $200 to $220 million.

of scale in refinery construction, and the rising real costs. This cost estimate should be treated with caution and would need to be adjusted for MPR's unique circumstances for several reasons:

- It is based on a high-level analysis of refineries in different market conditions that do not replicate the unique case of MPR's reestablishment
- MPR's site contains some existing infrastructure, an operating import, storage and distribution terminal, and a mix of decommissioned and preserved assets. Because some assets could be re-used, and site civil works and consents are in place, the capital cost would likely be at the lower end of the global benchmarks
- Additional upgrades and costs are likely for MPR to remain internationally competitive and for MPR to begin operations without affecting Channel Infrastructure's terminal business during MPR's construction period
- Channel Infrastructure's Worley Report estimates the capital costs of reestablishing a refinery. It is prepared by specialist engineers involving asset inspections and in-depth analysis. Worley's estimate is more granular and site-specific than our estimate.

In the following, we set out our approach to estimating the capital cost range (a detailed methodology is contained in Appendix B), and we discuss the additional upgrades and costs to reestablish MPR as a competitive refinery. We also compare our estimate to the Worley Report estimate.

4.2.1 Approach to estimating capital costs

Estimating the cost of reestablishing a decommissioned refinery like MPR is difficult due to the lack of comparable projects and the fact it is not directly comparable to a greenfield or brownfield refinery construction or refinery expansion project. Therefore, the cost estimation cannot be precise.

Estimating the cost of reestablishing MPR is further complicated by the unique site—there is a mix of usable (and repurposed) assets, preserved and decommissioned assets at MPR. There would be additional investment to reestablish MPR to modern standards, for example, strengthening and re-lining the bunds surrounding the crude and refined product tanks.[47] Various assets that have remained can be used for a reestablished refinery. However, the condition of these assets, the adaptation cost, and the proportion of usable assets are not clear. The Worley Report has a more accurate estimate of costs based on expert engineering assessments and on-site inspections.

Adjusting cost estimates from refineries overseas to the New Zealand context is also difficult. There are no local comparisons to benchmark cost estimates because MPR was the only New Zealand refinery. All jurisdictions have locally specific conditions, policies and regulatory settings that impact the cost estimate (for example, subsidies, tax relief, and environmental regulations) that can make direct cost comparison to New Zealand difficult.

We conducted a comprehensive analysis of over 64 international refinery developments.[48] The analysis is based on the data from the last 20 years on the estimated or reported costs of greenfield and brownfield refineries and refinery capacity expansions in various regions. The data includes cost estimates for refineries that were uncompleted, in the process of construction, and that did not begin construction.

[47] Once the major work is done on an existing tank, all tank and related equipment (including bunding) need to be upgraded to meet the latest standards.

[48] Appendix A presents the complete list of refineries considered in Castalia's analysis.

When preparing the analysis, we considered several factors, such as economies of scale, the time of refinery development, and inflation.

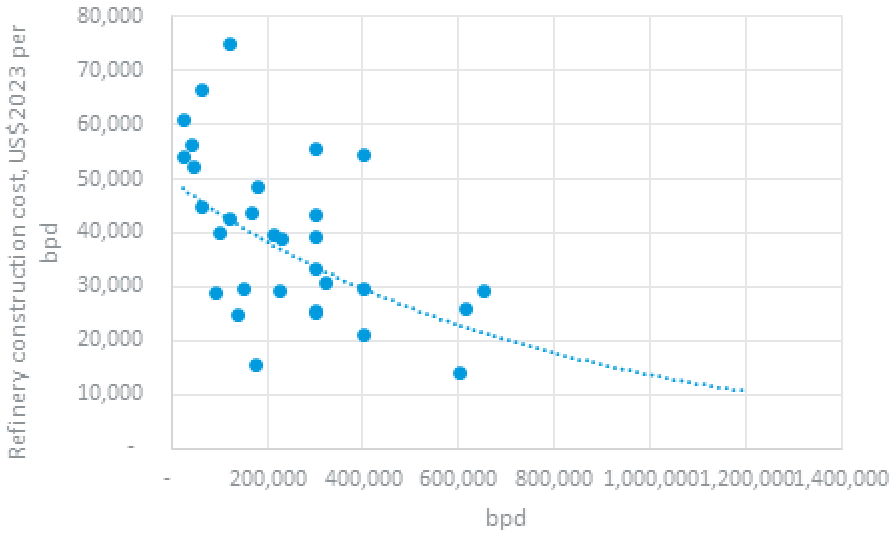
Economies of scale

There are significant economies of scale in refinery construction. As a plant's capacity increases, the cost per barrel per day (bpd) decreases, making larger refineries more cost-efficient on a per-barrel basis. Figure 14 illustrates the relationship between capital cost and daily production capacity.

The capital cost in our analysis is presented on a per-barrel basis of daily capacity, reflecting the total cost of building the refinery divided by the number of barrels it can process per day. This approach enables straightforward cost comparisons across refineries of different capacities and accounts for economies of scale.

Most published refinery capital costs include components such as construction and equipment, procurement, engineering and design expenses, and contingencies and financing charges.

Figure 14: Economies of scale of refinery construction



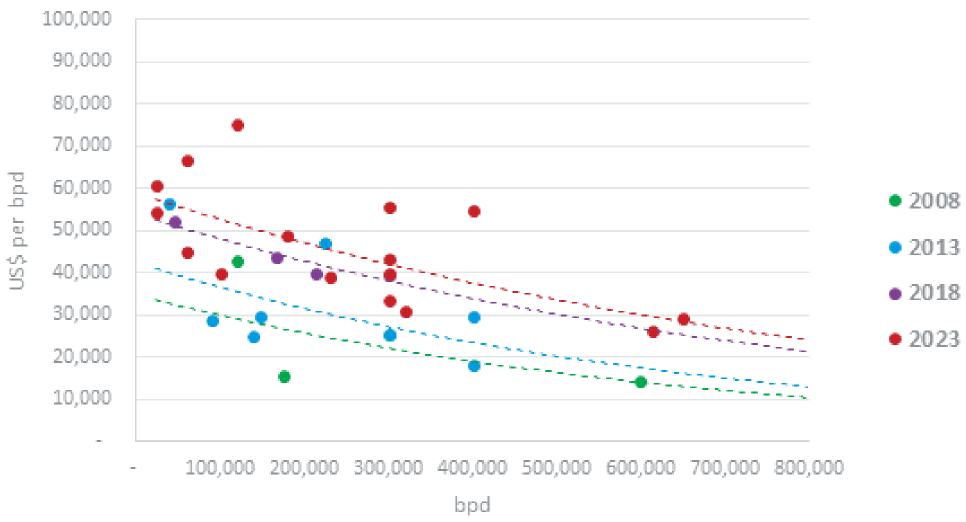
Source: Envisory/Castalia analysis

Time of the development and inflation

To understand how refinery development costs have changed over time, we grouped each development into a five-year period: 2004-2008, 2009-2013, 2014-2018, or 2019-2023. We then adjusted all costs to US$2023 using the Nelson-Farrar cost index for refinery construction to account for nominal inflation. After removing nominal inflation, real cost inflation remains.

Figure 15 illustrates the real cost inflation of refinery developments. For almost all capacity levels, the regressed refinery construction cost per barrel per day rises with recency. That is, more recent projects are significantly more expensive, even when costs are inflated using the Nelson-Farrar cost index. Given the clear real cost inflation, we removed the projects prior to 2019 to estimate the capital cost range for a new refinery.

Figure 15: Refinery construction cost by period



Source: Envisory/Castalia analysis

4.2.2 Other factors impacting the cost of constructing a refinery

Consultation with MPR's former customers revealed that MPR would need significant upgrades to remain internationally competitive over time, which could increase the required investment.

Production upgrades

While this analysis is based on reestablishing MPR as it was in 2019, the following production upgrades would need to be considered to make MPR a modern, internationally competitive refinery. MPR may need to:

- Increase the range of crude types it could process, reducing its dependences on a few particular Middle Eastern crudes;
- Invest in further petrol upgrading units, particularly to meet a lower aromatic petrol requirement, and reduce its dependency on imported petrol blendstock to make on-specification premium petrol;
- Add residue desulphurisation units to produce low-sulphur fuel oil compliant with MARPOL Annex VI regulations and avoid the need to export fuel oil; and
- Have flexibility to transition towards the production of SAF and biofuel[49] to support the energy transition.

Capacity

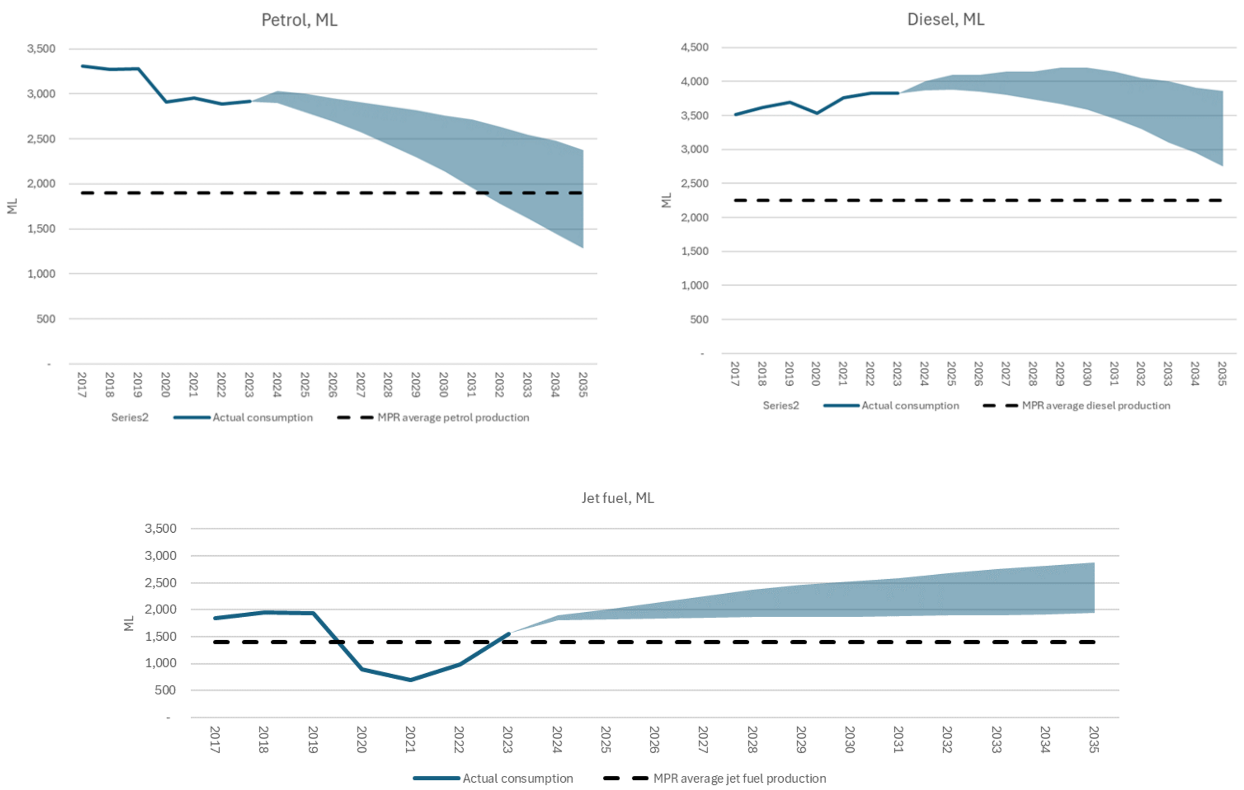
The reestablished capacity should be suitable for New Zealand demand in the short term, but during the 2030s it is likely to find that it produces too much petrol and later in the decade possibly too

[49] In October 2024, Channel announced a conditional proposed biorefinery project at Marsden Point. Biorefinery proposed at Marsden Point Energy Precinct, NZX, available at: https://www.nzx.com/announcements/439197

much diesel. There is limited flexibility to change the product mix, with the MPR already maximising the amount of jet produced.

As demand falls within the local Auckland/Northland area, more production would need to be shipped to other ports, eroding the margin that can be generated. Should the product need to be exported, returns fall substantially as the netback for MPR drops with the extra cost to get the product to where it competes with the import cost at that location. A refinery in New Zealand is unlikely to be viable if reliant on exports. Thus, it is likely some capacity changes would need to be made over time to match demand.

Figure 16: Forecast demand versus refinery capacity by product



Source: Envisory/Castalia analysis

Supply chain improvements

MPR had a project to increase supply flexibility and reduce freight costs by dredging the shipping channel. This would need to be revived and implemented for efficient crude supply. More crude storage would be needed to replace that lost to the fuel terminal and allow larger crude ship deliveries for efficient supply.

Costs associated with reestablishing alongside the existing import terminal

The new refinery must co-exist with the existing Channel Infrastructure import terminal, storage, and distribution business during the construction phase. This requires additional storage capacity to be built, which will raise MPR's total storage capacity above efficient levels. Channel Infrastructure's import terminal has structured its assets to run its import, storage and distribution business efficiently, with terminal capacity based on New Zealand fuel demand. This capacity cannot be adapted for MPR because it is required to store imported refined products for off-takers to ensure New Zealand's fuel supply is maintained. Additional tankage needs to be built for MPR to store crude oil and intermediate products. Therefore, the MPR site will be left with excess refined product storage—the existing storage used for Channel Infrastructure's imported refined products and the additional storage to be used for MPR.

Impact on New Zealand emissions

Re-establishing MPR would lead to an increase in New Zealand's domestic emissions by 0.75 to 1.2 million tonnes of CO2 equivalent (Mt CO2-e) annually. The economic cost of these additional emissions can be calculated by multiplying the total increase in emissions by the cost of carbon. The present value (PV) of this cost would reflect the long-term financial impact of the increased emissions over time.[50]

4.2.3 Comparing Castalia/Envisory estimate to Worley Report estimate

The Worley Report, released to us on 23 September 2024, takes a different approach to estimating capital costs to reestablish MPR. It is prepared by specialist engineers and uses the AACE International (AACEi) Class 5 Capital Cost Estimate approach. This is a preliminary cost estimation typically used when very little project information is available and serves as a rough order of magnitude. We understand that Worley carried out some on-site inspection, but this was not detailed or invasive. Worley estimates the reestablishment costs at a P50 to P90 range of NZ$4.9 billion to NZ$7.3 billion with an order of accuracy of -20% / + 50%. In practical terms, this means that:

- NZ$4.9 billion is a moderate estimate with a 50% chance of being over or under.
- NZ$7.3 billion is a cautious estimate with a high likelihood the cost will not exceed it.
- Due to uncertainties, the actual cost could range:
- As low as NZ$3.92 billion (if the project were to proceed better than expected).
- As high as NZ$10.95 billion (if there are significant overruns or unforeseen issues).

In contrast, Castalia/Envisory's estimate is based on global comparators. Our estimate is NZ$5.9 to NZ$16.2 billion **before** taking into account the substantial existing infrastructure in place and existing site resource and land use consents. That may reduce the costs by half, meaning the Castalia/Envisory estimate is in a similar range to the Worley estimate.

4.3 Operating and maintenance costs estimates

MPR would also face operating and maintenance expenses. We estimate these operating and maintenance costs on a per-barrel basis will increase, driven by inflation and the increased cost of electricity, reaching NZ$7.13 (US$4.42) per barrel in 2028[51] and escalating to NZ$9.57 (US$5.93) per barrel by 2040. In annual terms, the OPEX required to operate a reestablished MPR escalates from NZ$299 million (US$186 million) in 2028 to NZ$402 million (US$249 million) in 2040.[52,53]

---

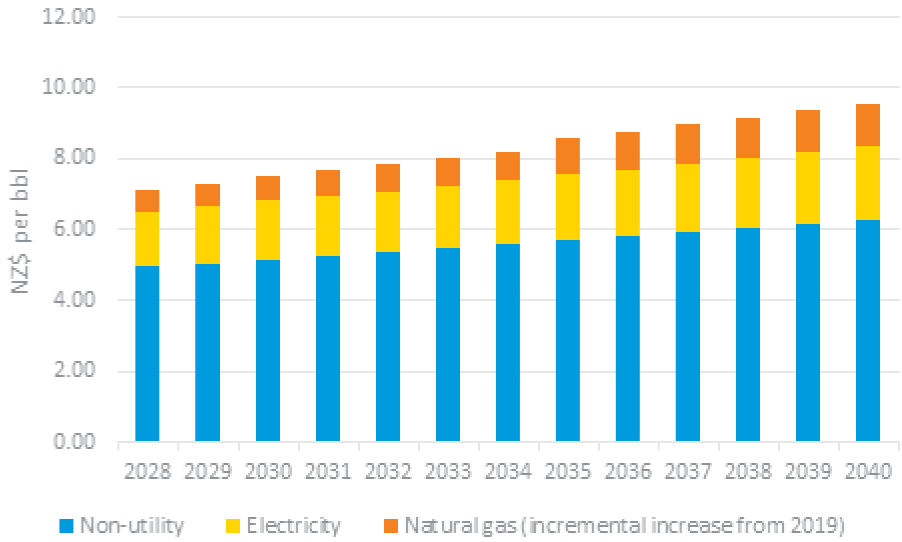
[50] MBIE, Cabinet paper, Fuel supply resilience without a domestic oil refinery, 2021. Available at: https://www.mbie.govt.nz/dmsdocument/17733-fuel-supply-resilience-without-a-domestic-oil-refinery-proactiverelease-pdf

[51] Assuming MPR will be operational after 2027.

[52] Assuming that refinery throughput is fixed at 115,000 bpd.

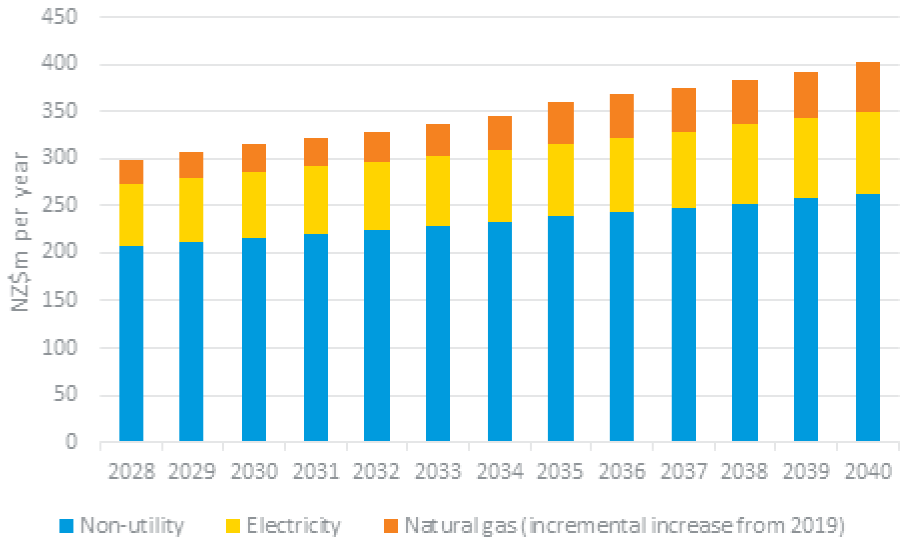
[53] Assuming an exchange rate of NZ$1:US$0.62.

Figure 17: Forecast refining OPEX per barrel



Source: Envisory/Castalia analysis
Note: Nominal prices.

Figure 18: Forecast annual refining OPEX



Source: Envisory/Castalia analysis
Note: Nominal prices.

These estimates are approximate and rely on several broad assumptions—notably, the cost of electricity incurred by MPR before its closure and future inflation rates. Additionally, they are primarily based on Refining NZ's historical refinery operation costs, implying a similar cost structure in the future. As noted above, MPR's former customers believe that a reestablished refinery would need additional capital expenditure to modernise the facility, which could add to the operating costs. Appendix C provides a detailed methodology for estimating and forecasting the operating costs for a reestablished MPR.

In order to estimate future operating costs at MPR, we analysed:

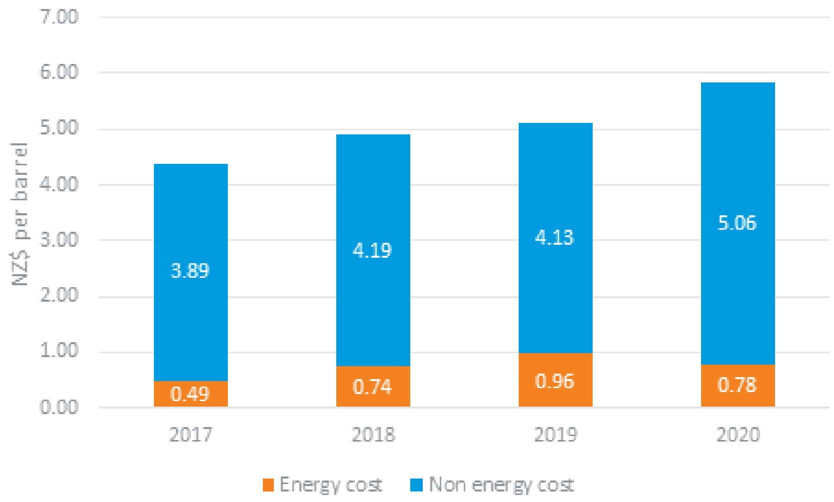
- Historical MPR operating costs
- The primary drivers of operating costs:
  - **Energy costs,** particularly electricity
  - **Non-energy refining costs,** including labour, chemical additives and catalysts necessary for refining operations.

4.3.1 Historical MPR refining operating costs

In recent years, MPR's refinery operating costs increased markedly from NZ$4.38 per barrel in 2017 to NZ$5.84 per barrel by 2020[54], as illustrated in Figure 19.

Operating costs also exclude the cost of importing crude oil into MPR and the cost of natural gas. These are included in the GRM, discussed later in the report.

Figure 19: Historical total refining opex per barrel processed at MPR



Source: Refining NZ, Castalia/Envisory analysis
Note: Nominal prices.

4.3.2 Estimated energy costs

Electricity accounts for between 11% and 19% of the total refining OPEX per barrel processed. While natural gas is not part of the operating cost, rising natural gas prices will increase the revenue needed to cover overall expenses. To quantify this impact, we analysed the increase in natural gas prices and their incremental effect on total costs.

We expect that MPR's operating costs will continue to rise, driven by inflationary pressures and the increasing electricity and natural gas costs.

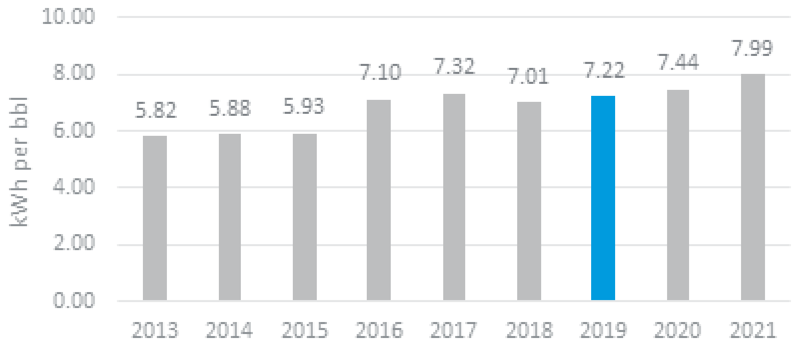
[54] 2020 costs per barrel were impacted by the reduced throughputs in 2020 due to COVID responses reducing demand for products.

As energy costs are a significant part of refinery operations, any fluctuations in the price of electricity and gas will have a direct impact on the refining costs, making it an important factor in considering the feasibility of reestablishing MPR.

Electricity usage and cost forecast

Historically, Refinery NZ's electricity usage for refining fluctuated between 5.8 and 8 kWh per bbl, as demonstrated in Figure 2.4.[55] Given a nominal electricity cost of 13.36 cents per kWh[56] and refinery electricity usage of 7.22 kWh per barrel, refinery electricity cost was approximately NZ$0.96 per barrel processed in 2019.

Figure 20: Refinery electricity usage per barrel processed



Source: Refining NZ, Envisory/Castalia analysis
Note: Nominal prices.

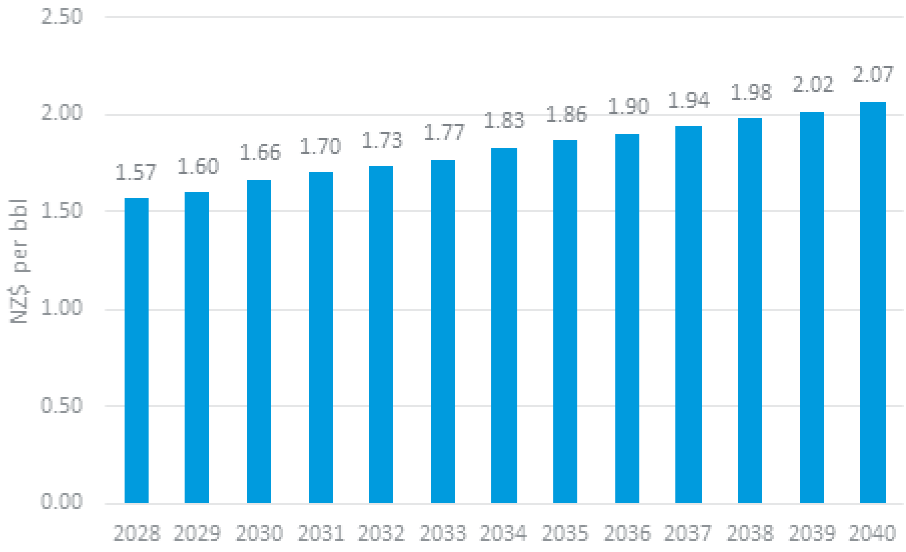
Electricity prices are expected to rise over time. MBIE's Wholesale Electricity Price Indicator (under its mixed renewables scenario) suggest that electricity prices will increase by about 14% from 2024 to 2050.

Using a real cost progression based on the MBIE's forecast adjusted for inflation, the electricity cost per barrel is projected to increase from NZ$1.57 in 2028 to NZ$2.07 per bbl by 2040, Figure 21.

[55] To estimate electricity usage, we first calculated Refining NZ's total electricity consumption for 2023, assuming this reflects usage for all non-refining operations. We then subtracted this figure from historical electricity consumption during the years when MPR was operational. The remaining figure represents electricity used solely for refining activities. Refinery electricity usage per barrel processed was then calculated by dividing this refining electricity consumption by the annual refinery throughput (see Appendix C for details). To estimate the electricity cost per barrel, we took the nominal cost before MPR's closure and adjusted it for inflation. This was done using two inflationary factors: real cost inflation and nominal cost inflation. For real cost inflation, we used MBIE's Energy Outlook's Wholesale Electricity Price Indicator (mixed renewables scenario), which projects the real levelized cost of electricity (LCOE) based on expected investments in electricity generation. We then added a 2% annual inflation factor to convert this into a nominal cost per barrel processed

[56] MBIE Nominal annual average energy prices, Basic metal and chemicals (2020)

Figure 21: Forecast refinery electricity cost per barrel

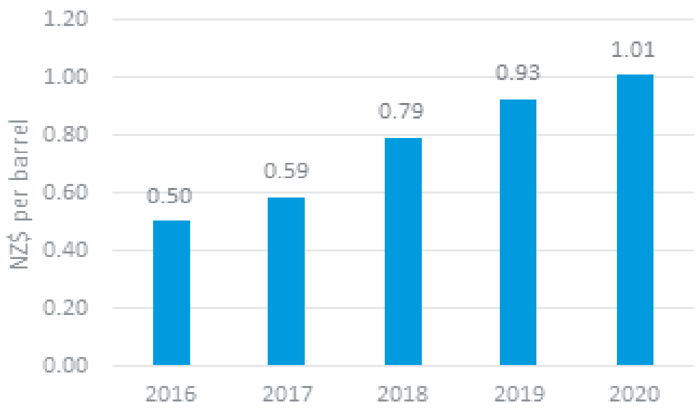


Source: Envisory/Castalia analysis
Note: Nominal prices.

Natural gas usage and costs

Refining NZ reported natural gas costs as a separate line item in their financial statements. Using the reported cost, we established that natural gas costs per barrel rose significantly between 2016 and 2020, increasing from NZ$0.50 in 2016 to NZ$1.01 per barrel in 2020, as shown below.[57]

Figure 22: Natural gas cost per barrel

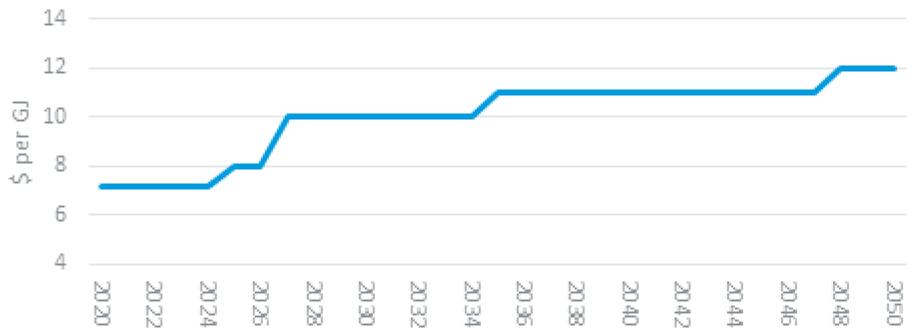


Source: Refining NZ, Channel Infrastructure, Envisory/Castalia analysis
Note: Nominal prices.

[57] Natural gas costs were calculated on a per-barrel processed basis by dividing the total natural gas expenditure by the annual refinery throughput. The nominal cost of natural gas per barrel before the closure of MPR was then estimated and adjusted for both real and nominal inflationary factors. This provided a forecasted cost trajectory, allowing for future projections of natural gas expenses per barrel. Further details on these calculations and adjustments are available in Appendix C.

Similarly to electricity, natural gas prices are expected to increase. Based on the MBIE's Energy Outlook's Electricity Insight, which presents real gas price projections, the price is expected to increase by about 68% from 2024 to 2050, as shown below.

Figure 23: Real gas price forecast

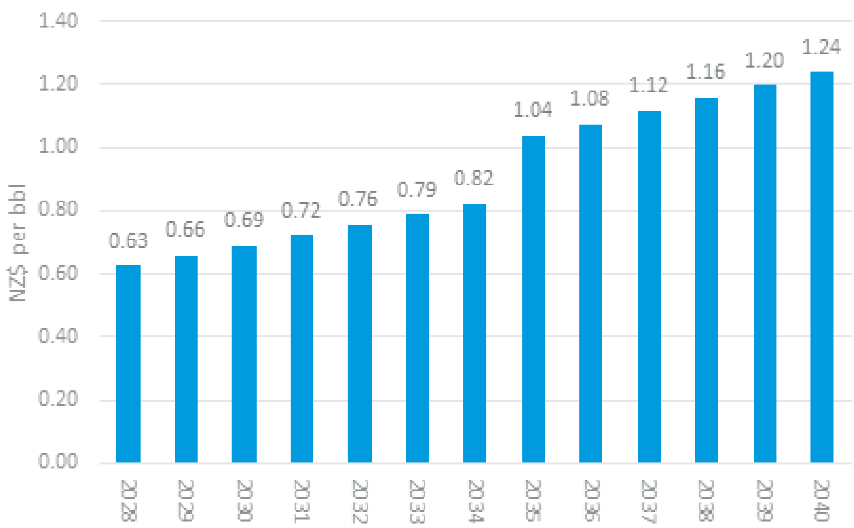


Source: MBIE Energy Outlook Electricity Insight, mixed renewables scenario
Note: Real prices

Historically, natural gas costs have been considered part of the feedstock cost and included in MPR margin calculation. New Zealand's natural gas prices are forecast to rise, so a reestablished refinery would have to generate higher revenues to recover these higher gas costs. To illustrate this, we present the incremental impact of rising natural gas prices compared to historical levels, highlighting how these increases affect overall refinery costs.

As a result, combined with a nominal inflation rate, we expect that the incremental natural gas cost per barrel (relative to 2019 levels) will increase from NZ$0.63 per bbl in 2020 to NZ$1.24 per bbl by 2040, as shown in Figure 24.

Figure 24: Forecast additional refinery natural gas cost per barrel



Source: Envisory/Castalia analysis
Note: Nominal prices, relative to 2019 levels.

4.3.3 Estimated non-energy refining costs

Refining costs, excluding electricity, were estimated by subtracting electricity cost per barrel from refinery OPEX per barrel in 2019. These costs were escalated at an inflation rate of 2% to obtain a nominal cost estimate.

4.4 Technical and operational capacity

Reestablishing a refinery would require hiring skilled expert staff, and specialist contractors. While a significant number of MPR staff have transitioned to work on important functions and tasks under Channel Infrastructure's import terminal business, most former refinery employees have either retired or found work in other industries. This means that a reestablished refinery would need to hire new skilled expert staff for any transitional period and ongoing future operations.

Oil refining requires specialist skills. The oil refining industry labour market is global, so salaries at a reestablished refinery would have to match global benchmarks (accounting for differences in the cost of living, and relative benefits of living within commuting distance of MPR). A reestablished refinery would have to conduct a local and global recruitment process and set employment conditions and wages in line with the global market. Contractors and other specialist service providers would also have to scale up, with skilled labour recruited both locally and globally.

Australia had seven oil refineries in the 2000s, but five have closed since then, with three closing in the past four years.[58] MPR closed in 2022. Therefore, some workers and contractors with sufficient skills may be able to be recruited from the region to rejoin the refining industry.

4.5 Regulatory and compliance issues

A reestablished refinery would require resource consent for refining and related activities and would need to comply with safe work rules (WorkSafe), hazardous substances and other regulations. We understand that the Marsden Point site has already consented to oil refining activities and would not need to re-apply. Building and engineering work would need to meet relevant structural safety requirements. Presumably, if the Government were to prioritise reestablishing a refinery, it would streamline any consenting and permitting matters.

---

[58] Parliament of Australia, 2020, Oil refineries and fuel security

5.0 Estimated income of reestablished refinery

5.1 Refining margin trend

Refineries generate their income by producing a product slate that is of higher value than the cost of crude oil and shipping it to the site. This income needs to cover all operating costs and provide a return on capital (the stock required to run a refinery is part of the working capital).

*Income = Products produced * value of products – feedstock used * (cost of crude + freight, natural gas and other feedstocks)*

The value of the products produced is the regional market price (in this region, the Singapore market price), including any adjustments for product quality, plus the freight to get to the country[59]. The MPR could generate a higher margin compared to a nominal Singapore margin as the cost of product freight to New Zealand is more expensive than crude freight and there is a benefit from better product quality than the industry standard. This offset some of the disadvantages of a smaller scale. Refining NZ reported this as the uplift over the Singapore complex margin[60]. A refinery aims to supply its home market, as was the case for MPR – a small refinery is unlikely to be economic if it needs to export.

Refineries use some of the feedstock as fuel to run the process. Therefore, the product yield is less than the crude input, although, in volume terms (litres), this can be partially offset by volume swell through some units (the hydrocracker is an example). The MPR achieved a product yield of approximately 95% of the input. The value uplift from product value needs to cover that yield loss as well as the operating costs.

Figure 25 shows a modelled refinery margin trend based on the value of the product produced at MPR, the typical refinery yields and the estimated cost of crude.[61] This is a representative margin for illustrative purposes rather than reflecting the actual MPR margin.

The margin generated is typically between US$5/bbl and US$10/bbl (we discount the unusual 2022/2023 peak which was caused by disruption to the market following sanctions being placed on Russian crude and product exports by many countries following the Russian invasion of Ukraine). For MPR a margin in the high part of that range reflected a good margin where costs were covered, and a reasonable return on capital was generated. At the bottom of that range, while costs might be covered, the returns on capital employed were nil or very low.

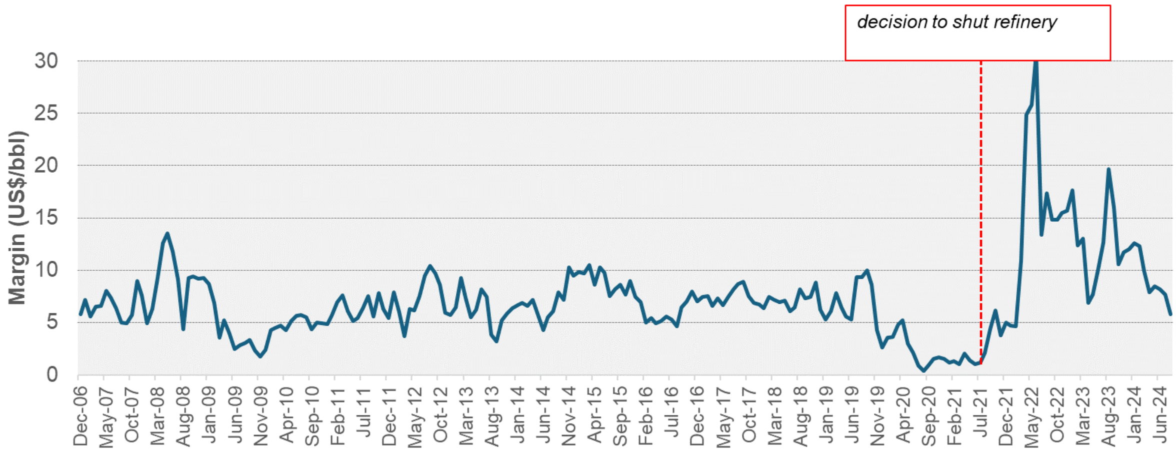
During periods where the margin dropped below US$5/bbl, MPR struggled to cover costs, and for its customers, the Floor payments kicked in. This occurred in an extended period in 2019/2021 leading up to the closure decision.

[59] The 2019 Commerce Commission Market Study into retail fuel has a full description on how fuel prices are set in the New Zealand market. A similar methodology was used in the margin calculation for MPR.

[60] A complex refining margin is where there is upgrading of the crude residue stream. A simple refining margin is where there is no residue upgrading. As they had residue upgrading, MPR refinery was compared to a complex margin.

[61] This margin has been developed by Envisory and does not reflect any performance impacts, yield variation from year to year, or changing crude slate.

Figure 25: Envisory calculated refining margin trend since 2006



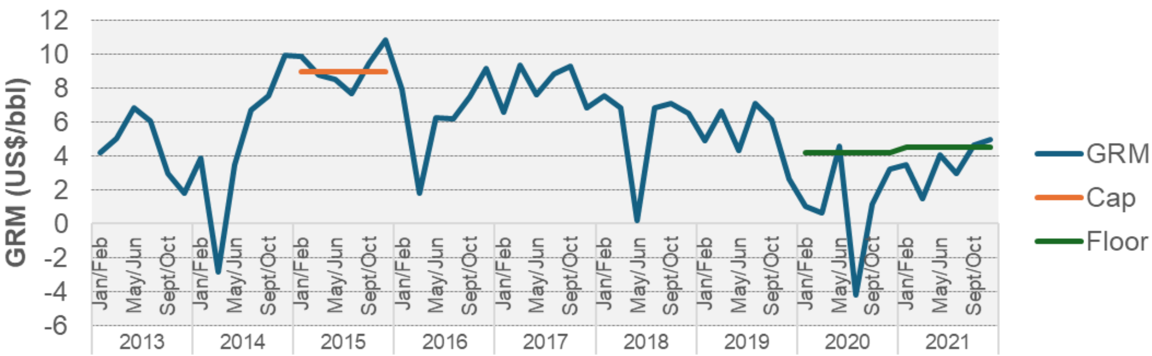
Source: Envisory/Castalia

5.2 Refining margin for MPR

5.2.1 Historic margin

The actual GRM achieved by Refining NZ since 2013 is shown in Figure 26. Every couple of years there is a sharp drop in margin not seen in the representative trend in Figure 25. This relates to major maintenance activities at MPR involving shutdowns of units, impacting efficiency and the margin that could be generated. The chart shows the Cap, which was reached in 2015, and the effective margin level of the Floor payments in 2020/21, based on the level of throughput at that time[62]. The gap between the Floor level and the actual margin indicates how much extra the customers had to pay over that period.

Figure 26: Actual MRP GRM 2013-2021



Source: Envisory/Castalia

[62] The Floor was a level of income, rather than throughput or margin related. Because the throughput was much lower than previously in 2020/2021, the Floor level is higher in GRM terms than it would be in a full capacity refinery.

5.2.2 Income expectations for reestablished MPR

The income expectations for a reestablished refinery depend on the commercial structure of MPR. However, the same physical refinery should generate a similar total margin (GRM) from processing crude and condensates as before in the same market conditions so that is the starting point. For the future income calculation, we assume MPR would likely be a standalone 'merchant' refinery, available to sell to any marketer in New Zealand as long as it provides a cost-competitive and reliable supply compared to direct import.[63] We also assume that the refinery is fully utilised, so throughput matches pre-closure levels of 115,000 bbl per day.

This would be a change to the previous tolling structure, although the MPR would now capture the full margin compared to only 70% previously. Offsetting the additional income, MPR would have additional costs, including the cost of holding inventories necessary for operation , trading risk, and costs for distributing the product to terminals. There are also likely to be some changes in the margin generated. These adjustments are shown in Figure 27 and include the following impacts.

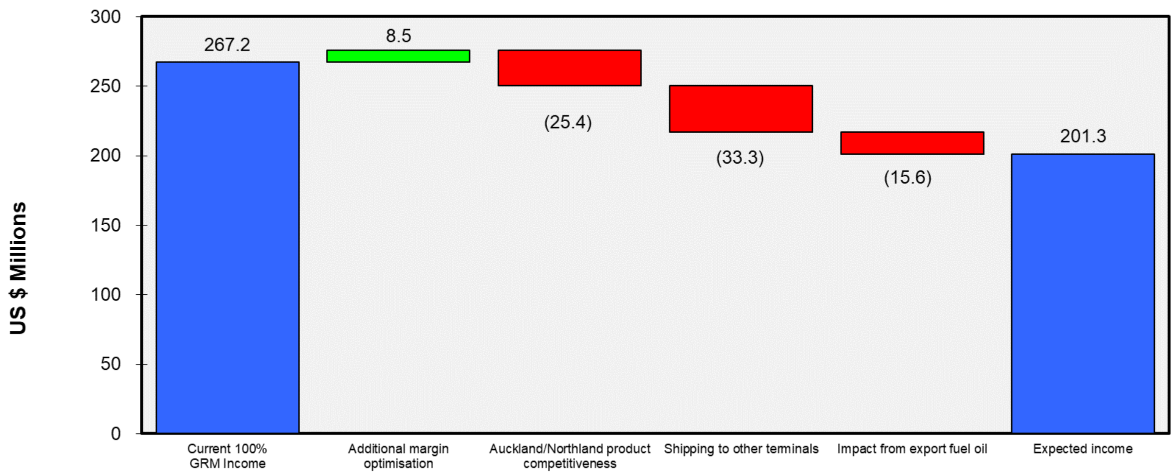
- The Refinery company would generate income by capturing the full margin from processing crude into products.
- Against the previous margin level, it is reasonable to assume the income could be optimised (enhanced margin) by optimising MPR as a single operation, rather than having multiple customers optimising their shares.
- Fuel companies are now importing more efficiently into Marsden Point (particularly with larger ships) compared to the price formula in the GRM, so the refining company would need to adjust prices on that portion of the market to be competitive.
- Between 30-35%[64] of the refined products need to be shipped to other ports. With a merchant refining model, the refining company may have to provide this service. Either way, the cost needs to be covered which means the revenue is reduced for that portion of the production to remain competitive with direct imports.
- Due to the fuel oil being high sulphur, it would need to be exported. This could be minimised by optimising crude selection, although either way, it will reduce revenue against a previously expected level. Using lighter or lower sulphur crudes that are more expensive will decrease margins.

---

[63] We did not model a tolling refinery scenario because all MPR former customers revealed that they do not want to engage in the tolling business model in consultations.

[64] This is a little lower than previously as we assume no fuel oil would now be shipped.

Figure 27: Expected income based on a full GRM revenue expectation



Source: Envisory/Castalia

Margin variation

Figure 27 assumes a GRM margin of US$6.31/bbl, the average margin between 2013 and 2019, and MPR running at its realistic capacity. Margins are expected to continue to cycle so at times income will be higher, although it will also be much lower. Table 3 illustrates how much the income may vary during a margin cycle, with MPR hardly generating any income at low margin levels, but good levels of income should margins be high.

Table 3: Merchant refinery income at different margin levels

OLD GRM level	Income	Income 0.5 US/NZ	Income 0.6 US/NZ	Income 0.7 US/NZ
USD/bbl	USD millions	NZD millions	NZD millions	NZD millions
2.00	18.8	37.6	31.3	26.8
3.00	61.1	122.2	101.9	87.3
4.00	103.5	206.9	172.4	147.8
5.00	145.8	291.6	243.0	208.3
6.00	188.1	376.3	313.6	268.8
6.31	**201.3**	**402.5**	**335.5**	**287.5**
7.00	230.5	461.0	384.1	329.3
8.00	272.8	545.6	454.7	389.7
9.00	315.2	630.3	525.3	450.2
10.00	357.5	715.0	595.8	510.7
11.00	399.8	799.7	666.4	571.2

Source: Envisory/Castalia

Table 3 highlights the impact of the exchange rate level. The Refinery is exposed to the US/NZ exchange rate, with most (but not all) expenses in New Zealand dollars and income in US dollars.

When the New Zealand dollar is strong, income falls, and higher margins are needed to cover operating costs. When the New Zealand dollar is weaker, the converse is true.

The income profile for the refining company is different than under the previous tolling structure. At margins below US$5/bbl, the company would now make less money, especially at lower margin levels where there would be no Floor protection. Above US$5/bbl income will be higher, noting that it now needs to generate revenue to provide a return on the inventories it would own. As a stand-alone company, MPR would require income protection at lower margins to be sustainable over the margin cycle.

Forward margin expectation

While there are forward curves for both crude and product from which a margin could be derived, these are relatively short-term in the context of a reestablished refinery that may not be producing until 2028. Based on general rising prices, one might expect refining margins to rise over time to compensate refinery owners. This does not happen, with efficiency improvements from larger more sophisticated refineries opening or expanding and older less efficient refineries closing resulting in an industry that cycles around similar margin levels. Therefore, we cannot assume margins will be higher in the future than they have in the past, despite an assumption of increasing costs locally.

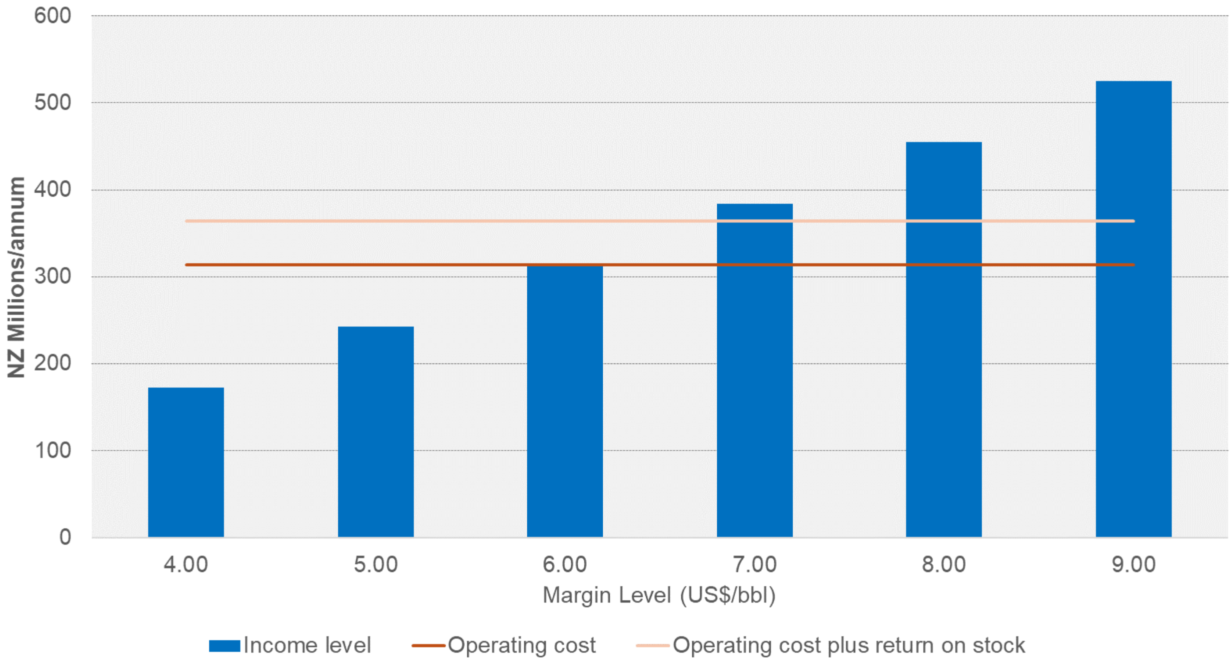
MPR could invest more in upgrading equipment to enhance margin and may need investment to produce the products the fuel industry wants to purchase in future as outlined in Section 4.2. However, any additional investment would need to be justified by the margin enhancement generated. For the base analysis, it is more realistic to assume a capability of generating margins at previous levels.

5.2.3 Income versus expense

The income generated by MPR needs to cover all operating expenses, and the cost of holding stocks and provide a return on capital invested. Using the forecast operating expenses for the first five years of expected operation (2028-2032)[65], we can show this against different margin levels (typical levels seen between 2013 and 2019) - see Figure 28.

[65] Expenses would continue to increase.

Figure 28: Income variation vs operating expense forecast



Source: Envisory/Castalia

The average margin over the 2013-2019 period was US$6.31. The Refinery will only be a little above cash neutral with this income given the operating cost estimates. This means for much of the margin cycle (margins below ~ US$6/bbl) MPR would need external (non-commercial) support to survive. Margins higher than average are needed to also provide a return on the stocks held. There would be virtually no return on capital invested until margins were above US$7/bbl.

These figures are higher than when MPR was previously operating due to inflation and the much higher cost forecasts for natural gas and electricity as covered in Section 4.4.

6.0 Commercial arrangements required to reestablish refinery

It is unlikely that any commercial party would reestablish MPR and a refining business without significant Government support. Channel Infrastructure's balance sheet is not large enough for multi-billion-dollar investments, and its shareholders have twice voted overwhelmingly against reestablishing and re-entering the refining business. Former MPR customers have confirmed that they would not re-enter the same contractual relationship with a reestablished refinery as they had previously. Fuel companies would need to be satisfied that the price they pay for fuel refined in New Zealand is the same as the landed cost of fuel refined overseas.

Channel Infrastructure is highly unlikely to re-enter the refining business

Channel Infrastructure shareholders voted to close MPR and convert to an import, storage and distribution terminal due to very poor commercial returns, improved outlook of an import terminal business and its customers' preference for the change. They prefer the lower risk, and steady returns from a tolling import, storage and distribution business.

Channel does not want to reestablish petroleum refining or enter any other business with volatile earnings. It is comfortable supporting other businesses with the infrastructure at its site as a landlord, for example, it is discussing the production of synthetic Sustainable Aviation Fuel at the site with Fortescue Future Industries.

Fuel companies are unlikely to reestablish commercial arrangements that were in place with MPR

None of the former customers of MPR want to be involved in a domestic petroleum refining business, either as shareholders or as tolling refinery customers. They prefer their current 100% import supply chain arrangements.

Under the tolling refinery, product from the refinery was more expensive than direct imports when margins were low, and this made the fuel companies using the refinery uncompetitive against those fuel marketers only importing. Periods of low margins were becoming more frequent while the related costs such as coastal distribution were increasing. The outlook for refining margins is that competition is likely to keep them relatively low over time, which is why companies expect importing to be a more competitive supply in the future.

Fuel companies would likely only purchase products from a reestablished MPR if it was priced competitively and could be delivered to their terminals in a similar way as imports are now. Having both refinery supply and import supply would complicate fuel companies current import schedules, and any variation in refinery production could result in additional costs.

Capital costs are high and significant commercial uncertainty would deter commercial investment

NZ$5.9 billion to NZ$16.1 billion (US$3.7 to 10.1 billion) would be required to build a new refinery, with the final cost likely to be at the lower end of the estimate range due to the above-mentioned existing infrastructure and unique circumstances. There is significant uncertainty in the operating costs and the feasibility of globally competitive fuel production. This substantial investment and significant commercial uncertainty limit the options for how MPR could be reestablished as a viable business. Certainly, as well as conflicting with its business model, this level of investment is well beyond the capacity of Channel Infrastructure, whose current market capitalisation is around NZ$600 million.

Possible models for Government-supported refining business

In this context, reestablishing a refinery will be commercially complex, and is only likely to happen with Government support as it would not be viable for a commercial investor. Possible models are shown in the following table. For all options, Channel Infrastructure shareholders would have to be fully compensated for the disruption to the existing import, storage and distribution business, and the increased business risk of a refinery business once the site transitioned back to refining (continuing to operate the import business at the same scale would then be unviable). Shareholders would also require compensation for the value of land used by a reestablished refinery. The exact structure of such a transaction is beyond this scope of this assignment, and would require very careful consideration to manage legal and reputational risk to the Crown and keep existing owners and contractual rights holders whole.

Table 4: Possible operating models for a reestablished refinery

Model	Description	Comment
Merchant refinery	MPR would be a separate commercial company that purchases and processes crude and other feedstocks and sells the refined products into the domestic market at a competitive price versus direct imports. It will need to operate a coastal tanker operation to be able to deliver products to other ports. Contracts would need to be for reasonable terms (i.e. years) to ensure MPR could operate close to its optimal capacity.	This is the preferred model of the fuel companies who said they would purchase a product if price competitive. The high capital cost makes it unviable for any commercial operator so the government would need to support the costs (or support the debt required) to reestablish MPR. Options to pay for that could include using a fuel levy (similar to the 1980's). The volatility of refining margins requires a support system at lower margins, like the Australian scheme, to keep the refining company viable. This could be funded by general taxation (as in Australia) or by a fuel levy. Negotiations for fuel sales could be difficult as the buyers who are in the product market all the time may be better informed than the refining company.
Cost Plus refinery	If New Zealand saw value in long-term refining capacity it could legislate for a cost-plus refinery and make all market participants lift a portion of their product, in relation to their market share, from MPR at price related to the costs involved not international prices. Assuming the inclusion of a return on the capital needed to reestablish MPR (including the cost of the land acquired/leased from the existing owners), the cost	This model would require significant intervention into the downstream fuels market to make all participants purchase fuel from MPR. All fuel marketers would have to purchase a similar share in relation to their market size to avoid distorting the fuel market, and no company would be allowed to operate as a 100% importer.

	of purchasing refined products is likely to be much higher than direct imports at most times during the margin cycle. This cost will be passed through to the market as higher fuel costs for all consumers.	The higher cost of domestically refined products would be passed through to all segments of the petroleum market. The higher cost of jet fuel may see more fuel tankers to New Zealand on planes[66], resulting in higher overall emissions.

While these two structures, or slight variations of them, are the main options for reestablishing MPR, there are several possibilities for ownership in addition to the commercial, or semi-commercial options assumed above. These include:

- State ownership of MPR;
- State ownership of MPR but operation is leased or contracted to a professional refinery operator; or
- A Public-Private Partnership (PPP).

Any option would require significant Government intervention in the fuel market. In addition to the cash costs of reestablishing a refinery, such interventions may also affect New Zealand's attractiveness as an investment destination if commercial parties are not made whole. Market interventions of this scale also carry significant risks that the Government invests poorly. All these risks would have to be carefully managed.

To justify an investment and market intervention of this scale, the reestablished refinery would have to provide significant benefits to New Zealand in excess of the costs. The potential benefits (also described in detail in Section 7.0 below) include:

- Fuel security benefits (which will be more fully studied in our next phase, and compared against other options for improving fuel security);
- Local employment benefits; and
- Resilience to external shocks due to improved balance of payments.

[66] If fuel at the departure location is substantially cheaper than the destination, and the aircraft has the capacity, then the airline will load more fuel so only limited fuel has to be purchased at the expensive location for the return flight. While cheaper for the airline, ultimately more fuel will be used doing this tankering. An example of this operation is flights into Queenstown. Most flights land with plenty of jet fuel remaining so they only need limited volumes at Queenstown due to its expense (both domestic and international flights).

7.0 Estimated benefits of a reestablished refinery

Reestablishing the MPR presents both potential benefits and risks. While it could provide potential fuel security benefits, it also introduces increased risks related to crude oil supply and refinery operations. MPR could provide higher incomes for employees compared to the Northland region's average earnings, potentially improving New Zealand's balance of payments. These benefits are only compared to a counterfactual of the **current** use of the MPR site. The potential fuel security benefits will be compared to other fuel security options available to New Zealand in our next report. Furthermore, there are other options for the site discussed in section 8 below which may also generate local employment and balance of payment benefits. The potential economic benefits were calculated where possible using a 30-year period and the public sector discount rate of 5% (as per the then current Treasury guidance on social cost-benefit analysis). These are as follows:

Table 5: Combined economic benefits of reestablishing MPR

Benefit type	Present value (NZ$)	Comment
Fuel security	Uncertain, to be analysed in depth in the next stage of the project.	Potentially offset by a single point of failure risk of local refinery and other factors.
Local employment	596 million	Potentially higher, as some employees could relocate from other regions or abroad, boosting the local population and increasing localised economic activity
Resilience to external shocks (balance of payments improvement)	494 million	Sensitive to the volumes of fuel demanded in New Zealand and the potential benefit will reduce as fuel demand falls in future.

7.1 Potential fuel security benefits of reestablished refinery

Regardless of whether New Zealand has a domestic refinery or imports 100% refined products, it will be dependent on global shipping and supply chains. Reestablishing the MPR could reduce New Zealand's dependence on imported refined fuels and enhance fuel security. However, it also re-introduces risks to fuel security related to crude oil supply and refinery operations.

Overall, while the reestablishment of MPR offers fuel security benefits (and risks), such as reducing dependence on international refined product markets and enhancing stock flexibility, it must be considered alongside other fuel security enhancement options (and their respective risks). The upcoming Fuel Security Study will provide a more comprehensive assessment, weighing the benefits of local refining against alternative strategies like increasing fuel reserves, diversifying supply chains, and investing in renewable energy sources.

Fuel security benefits and risks with imported refined products

The primary fuel security benefit of reestablishing MPR is reduced reliance on imported refined products. New Zealand imports 100% of its refined fuel, leaving it vulnerable to disruptions in the refined product supply chain. A few notable jet shortage examples occurred since 2022, partially linked to MPR's closure. Since 2022, New Zealand experienced multiple jet fuel quality failures, including problems with water content, conductivity, and freezing points. This highlights the risks of full dependence on foreign refineries.[67] [68]

New Zealand will be dependent on international crude markets whether it has a local refinery or imports refined product. This will be a direct dependency for domestic refining, or an indirect dependency for imported products as supplying refineries are dependent on crude oil supply chains being secure and reliable.

A benefit from domestic refining is the higher levels of petroleum held within the country. While a reasonable level of crude and refinery intermediate stock is required to operate MPR (and therefore of no use in a disruption), levels were typically higher than the minimum operational level providing a number of days' supply in the country should there be external disruption.

This loss has been partially offset by higher levels of refined stock now held in the country than was the case when MPR was operating. This may be further enhanced with the implementation of the minimum stock obligation from January 1, 2025. These impacts will be fully analysed in the main Fuel Security Study due in Q1 2025.

Should New Zealand want to hold higher levels of stock than it did when MPR was operating for fuel security reasons, then not having a refinery has reduced the option of holding that stock as crude oil. Crude oil is cheaper to store in bulk and can be stored indefinitely without degrading. Refined products require more expensive tanks and regular turnover to maintain quality, leading to additional logistical challenges and costs.

Domestic refining of foreign crude oil also presents fuel security risks

While reestablishing MPR offers several advantages, it also introduces certain risks related to crude oil supply and MPR's potential to become a single point of failure in the supply chain. Importing crude oil for domestic refining involves a longer and more complex supply chain than importing refined products. Refining crude oil locally adds several steps to the process: sourcing the crude oil, shipping it to New Zealand, refining it at the facility, and then distributing the final products domestically. Each of these steps increases the likelihood of disruptions at multiple points.

In contrast, importing refined products eliminates the local refining stage, simplifying the supply chain and reducing complexity. International refiners face similar disruption risks, but the current model of importing refined products from various sources spreads these risks across multiple suppliers. This shift happened with the closure of MPR, re-organisation of that business as Channel Infrastructure, and reorganisation of the supply chain at other fuel terminals. This allowed New Zealand to streamline its fuel logistics by relying on already-processed fuels from international suppliers. Former refinery customers have already reorganised their fuel supply chains and invested in increased tankage and storage.[69]

[67] One mile at a time, 2022, New Zealand has a jet fuel shortage

[68] NZ Herald, Grant Bradley, 2023, Airlines hit by bad aviation fuel in Wellington again

[69] Confirmed in meetings and written feedback from former refinery customers

Another risk is that MPR could become a single point of failure for New Zealand's fuel supply. Operational issues, such as maintenance shutdowns or technical malfunctions, could halt fuel production even if crude oil reserves are available. This could lead to significant supply disruptions if alternative supply chains are not adequately prepared to handle such a scenario.

Refining domestic crude would require significant investment and supply chain re-orientation

Although New Zealand produces some crude oil domestically, only 2-4% was refined locally due to technical and economic limitations. The outlook for declining domestic production means that there will not be local crude oil available even if there is an incentive to increase throughputs. Therefore, the possible resilience benefits from running a higher proportion of local crudes will not be an option for a reestablished MPR. Therefore, even with a reestablished MPR, New Zealand will remain vulnerable to disruptions in international crude oil supply.

7.2 Other potential benefits

Reestablishing MPR can also offer other potential benefits, including employment benefits and an improved balance of payments for New Zealand.

7.2.1 Employment benefits

Reestablishing MPR would create higher-paying jobs at MPR itself and across the supply chain, including in logistics, infrastructure, maintenance, and other services. The reopening of MPR could offer employment opportunities for skilled workers, which would have a significant positive impact on the regional economy of Northland, where MPR was located.

The oil refining industry typically pays higher salaries than other sectors. Our research shows that in the past, refinery workers at MPR earned well above the local average wage due to the technical nature of the job and the skillsets required. Additionally, average wages in Northland are below the national average, which means that new jobs at MPR could help lift overall income levels in the region.

For example, in 2020, refinery staff earned around NZ$157,000 before tax, and contractors earned about NZ$79,000, both well above Northland's, with average salaries between NZ$51,363 and NZ$61,430 for more technically skilled utility industries.

If the MPR is reestablished, many workers will be employed, far exceeding the current workforce at the import terminal. The Refinery previously employed about 350 full-time workers and 150-200 contractors on an ongoing basis. In contrast, the current import terminal employs only 90 full-time staff and 40 contractors.

Reestablishing MPR will also create new construction jobs during the reconstruction phase, in addition to restoring the historic employment levels.

Assuming MPR operates for 30 years with a four year construction phase, the net present value (NPV) of employment benefits is expected to be about NZ$0.6 billion (US$0.4 billion). However, the localised output gains could be higher, as some employees relocate from other regions or abroad, boosting the local population and increasing localised economic activity. Additionally, during regular maintenance turnarounds, the number of contractors increases by 500 to 1,000, further contributing to regional economic activity.

Appendix E outlines the details of the calculation method used.

7.2.2 Balance of payments improvement

Reestablishing the MPR would reduce New Zealand's need to import refined products and provide a marginal improvement in New Zealand's balance of payments. Refined fuels generally cost more per unit of energy due to the additional processing and shipping costs compared to crude oil. Reducing these import costs would enhance New Zealand's current account. The economic benefit of improving the balance of payments lies in strengthening New Zealand's ability to withstand economic shocks.

Abrupt adjustments in the current account balance from external shocks can negatively impact gross domestic product (GDP). We use a methodology developed by Edwards (2006)[70] to estimate the impact of an abrupt current account adjustment on GDP and the impact of the improvement in the current account due to the reestablishment of MPR on the probability of shock. The Edwards methodology assumes that the probability of shock increases as the current account deficit widens. We describe our approach in more detail in Appendix D.

We estimate the benefit of an improved current account balance as the difference, in the present value terms, of the expected cost of an external shock for the factual and counterfactual. Here, the expected cost of an external shock in a single year is the product of two values:

- The cost of an external shock in that year
- The probability of an external shock in that year.

The benefit of reestablishing MPR from improving the current account balance between 2028 and 2058 is NZ$494 million in present value terms. However, this is sensitive to the volumes of fuel demanded in New Zealand and the potential benefit will reduce as fuel demand falls.

7.3 Increase in emissions disbenefits

Reestablishing MPR would increase New Zealand's greenhouse gas emissions due to refining operations. In 2019, Refining New Zealand reported 4,329 tonnes of SO2 emissions in total and 206kg of CO2 emissions per tonne of product.[71] Refining NZ had been protected from the cost of these emissions to ensure it was not disadvantaged against international competitors who do not incur an emissions charge. If there was an emissions charge on the reestablished refinery it would further erode its internation competitiveness.

---

[70] Edwards, 2006, External imbalances in New Zealand. http://www.rbnz.govt.nz/research/workshops/12jun06/tspl-edwards.pdf (accessed 8 September 2011)

[71] Refining New Zealand, Annual Report 2019, available at: https://channelnz.com/wp-content/uploads/2022/03/2019-RNZ-Annual-Report.pdf

8.0 Other energy security enhancing options at Marsden Point

Several other strategies for the Marsden Point site could enhance New Zealand's energy security and utilise the site's full potential. The main Fuel Security Study will explore these options in greater detail.

The Marsden Point site is unique in New Zealand. It has the following special characteristics:

- Large land area that is zoned for heavy industrial use, with significant surplus land;
- High voltage electricity grid entry and exit point directly adjacent (Marsden A 250MW power station was commissioned in 1967 and mothballed in the 1990s and the Marsden B 250MW power station was built in the 1970s but never commissioned);
- Gas transmission pipeline originally used to transmit large volumes of natural gas from Taranaki (via gas demand centres in Auckland, Huntly and Te Rapa) for use in oil refining; and
- Deep water port facilities that can accommodate the largest vessels able to be received in New Zealand.

Channel Infrastructure is pursuing a strategy to identify partners that can help develop Marsden Point into a comprehensive energy precinct. This approach involves integrating various energy infrastructures and technologies to create a robust and resilient energy ecosystem.

Four publicly discussed options for the site are:

- Biorefinery at Marsden Point utilising some of the decommissioned equipment, likely focusing on sustainable aviation production;
- Manufacture of sustainable aviation fuel and/or green hydrogen (alternative fuels) from renewable fuel;
- Additional diesel storage to meet the 28 day minimum stockholding requirement; and
- LNG import and degasification facility.

Alternative fuel production at Marsden Point

Biofuel import. Channel Infrastructure is collaborating with its customers to support the import and supply of biofuels in New Zealand. As biofuels become more prevalent in the fuel supply chain, Marsden Point's tank storage capacity and proximity to Auckland provide logistical advantages. The pipeline to Auckland, which delivers fuel using almost no emissions,[72] positions Marsden Point to play a role in reducing carbon emissions in New Zealand's fuel distribution network. [73]

Biofuel Manufacture: Channel Infrastructure recently announced that a conditional agreement with Seadra Energy (a consortium of Qantas, Renova Inc,, Kent Plc and ANZ) to retain hydrocracking

[72] As of January 1, 2024, the electricity purchased at Marsden Point is certified as renewable.

[73] Channel Infrastructure NZ Limited website, Future Growth

assets at Marsden Point, sell additional decommissioned refinery assets and develop a biorefinery at Marsden Point.[74]

Green hydrogen. The production of green hydrogen is under assessment at Marsden Point. Channel Infrastructure, in partnership with Fortescue Future Industries (FFI) are conducting feasibility studies on the production, storage, distribution, and export of industrial-scale green hydrogen. With less than half of the site's land required for current terminal operations, there is capacity for repurposing parts of Marsden Point for hydrogen-related activities. The project is in the second stage of evaluation, and ongoing work focuses on developing a viable commercial model for green hydrogen production. The facility is expected to produce green hydrogen using renewable energy from partnerships with local providers.

Channel Infrastructure and FFI are also considering using the green hydrogen facility to produce synthetic Sustainable Aviation Fuel (eSAF). The facility would be capable of producing 60 ML of synthetic eSAF annually, which would meet over 3% of New Zealand's pre-COVID jet fuel needs. If successful, it would be one of the first large-scale eSAF projects globally.[75]

Diesel Storage

Channel Infrastructure had offered to hold stock when the Government was seeking options for holding an additional seven days of diesel storage. The method of holding this stock is now being reassessed, although Channel Infrastructure remain interested in offering this service.

LNG import and degasification facility

A further option is establishing a liquefied natural gas (LNG) import terminal at Marsden Point. This terminal would import LNG by sea, store it, and then regasify it for use in power generation, industrial processes, or other applications. An LNG terminal would diversify New Zealand's energy supply and enhance energy security. The Government recently prioritised LNG importation as a key option to improve the resilience of New Zealand's power supply, mitigate risks from low hydro lake levels in winter, and firm the increasing share of variable renewable generation.

The gas could be used in electricity generation at Marsden Point (for example at the site of either the former Marsden A or B power stations) and/or transmitted to other sites via the gas transmission network previously used to transmit large volumes of gas to Marsden Point for use in oil refining.

[74] In October 2024, Channel announced a conditional proposed biorefinery project at Marsden Point. Biorefinery proposed at Marsden Point Energy Precinct, NZX, available at: https://www.nzx.com/announcements/439197

[75] Fortescue, 2023, Production of Sustainable Aviation Fuel at Marsden Point progresses to the next phase

Appendix A : Refinery data

We collected and analysed data on 64 refineries and benchmarks. We then followed these steps:

- Removed data that couldn't be converted into comparable costs, usually due to the absence of concrete capacity figures. This left 55 data points.
- Removed 10 outliers and 12 benchmarks, reducing the dataset to 33 data points.
- Removed data outside the 2018–2023 period, leaving a final set of 16 data points.

Table 6: Refinery data

Refinery/region	Barrels per day	US$2023 per bpd	Period ending	Source
EU				
Elefsina Refinery expansion (2012)	39000	56388	2013	https://www.edisongroup.com/research/a-refined-mediterranean-player/20238/
Cartega Refinery expansion (2008)	120000	42808	2008	https://www.hydrocarbons-technology.com/projects/cartagena-refinery/
Gdansk Refinery expansion (2011)	90000	28853	2013	http://abarrelfull.wikidot.com/gdansk-refinery-project
MENA				
Al Zour Refinery (2023)	615000	26016	2023	https://kipic.com.kw/al-zour-refinery/
Expansion of the Middle East Oil Refinery (MIDOR) in Alexandria (2023)	60000	45000	2023	https://www.ogj.com/refining-processing/refining/capacities/article/55093600/egypts-midor-completes-expansion-modernization-of-alexandria-refinery
Jazan Refinery (2021)	400000	54755	2023	https://www.reuters.com/world/middle-east/saudi-aramco-ramp-up-jizan-fuel-output-sources-say-2023-03-27/#:~:text=Located%20in%20Saudi%20Arabia's%20southwest,close%20to%20the%20matter%20said.
SOCAR Star Oil Refinery (2014)	214000	39895	2018	https://www.socar.az/en/page/star-oil-refinery2
Yanbu Refinery (2010)	400000	21079	2008	https://www.hydrocarbons-technology.com/projects/aramco-yanbu/#:~:text=%E2%80%9CSaudi%20Aramco's%20Yanbu%20refinery%20is%20estimated%20to%20cost%20%2412bn.%E2%80%9D

Duqm Oil Refinery (2023)	230000	39130	2023	https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/020724-omans-duqm-refinery-finds-plenty-of-buyers-before-official-start
Kuwait National Petroleum Co (2005)	600000	14141	2008	https://www.reuters.com/article/markets/oil/chronology-new-oil-refineries-announced-in-2005-2006-idUSB371353/
NA				
Consumers Co-op Refinery Expansion (2018)	45000	52320	2018	https://tarjomefa.com/wp-content/uploads/2018/05/TarjomeFa-F694-English.pdf
SinoCan Global Refinery (2018)	167000	43791	2018	https://www.reuters.com/article/business/china-s-sinopec-plans-to-build-canadian-oil-refinery-idUSKCN1LU2CU/
Second Irving Oil 300,000 bpd refinery in Saint John, NB (2008)	300000	25309	2008	https://tarjomefa.com/wp-content/uploads/2018/05/TarjomeFa-F694-English.pdf
SA				
Bina Refinery (2010)	138904	25069	2013	https://www.bharatpetroleum.in/Our-Businesses/Refineries/Bina-Refinery.aspx
Barmer refinery (2023)	180000	48625	2023	https://economictimes.indiatimes.com/industry/energy/oil-gas/hpcl-to-commission-barmer-refinery-by-january-2025-co-exec-s-bharathan/articleshow/107550499.cms?from=mdr
Punjab Guru Gobind Singh Refinery (2012)	225000	29351	2013	https://www.hmel.in/gurugobindsinghrefinery
SEA				
Balikpapan refinery (Expansion) (2023)	100000	40000	2023	https://www.hydrocarbons-technology.com/projects/balikpapan-refinery-expansion/
Binh Son Refining and Petrochemical Dung Quat Expansion (2023)	23000	54330	2023	https://vietnamnews.vn/economy/1653228/dung-quat-refinery-s-expansion-project-to-cost-nearly-1-5-billion.html
Hengyi Pulau Muara Besar (Proposed) Phase II (2023)	120000	75000	2023	https://thescoop.co/2023/03/08/us9-billion-for-expansion-of-pulau-muara-besar-complex/#:~:text=In%20Phase%20I%2C%20Hengyi%20Industries,day%20to%20280%2C000%20barrels%2Fday.

Palu refinery (2017)	300000	39533	2018	https://sulteng.antaranews.com/berita/35065/pgrc-to-build-oil-refinery-in-palu
Panjin proposed refinery (2023)	300000	33333	2023	https://energy.economictimes.indiatimes.com/news/oil-and-gas/saudi-aramco-plans-10-billion-china-oil-refinery-complex-for-2026/99025730
Shenghong Petrochemical Complex (2022)	320000	31055	2023	https://www.hydrocarbonprocessing.com/news/2022/05/chinas-private-refiner-shenghong-starts-trial-operation
Pengerang Integrated Petrochemical Complex (2021)	300000	55624	2023	https://www.hydrocarbons-technology.com/projects/petronas-rapid-project-malaysia/
Proposed Long Son Refinery (2023)	300000	43333	2023	https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/oil/010623-vietnam-hopes-to-become-self-reliant-on-oil-products-with-2027-mega-refinery-target
Tuban Refinery (2005)	175000	15515	2008	https://www.reuters.com/article/markets/oil/chronology-new-oil-refineries-announced-in-2005-2006-idUSB371353/
Proposed Kuwait Petroleum Corp Java Island Refinery (2013)	300000	25504	2013	https://en.antaranews.com/news/91764/kuwait-cancels-plan-to-build-refinery-in-indonesia
Dung Quat Refinery (2009)	148000	29761	2013	https://www.reuters.com/article/markets/oil/vietnam-set-to-open-3-bln-oil-refinery-idUSSP397495/
Dung Quat Refinery Expansion (2023)	23000	60870	2023	https://vietnamnews.vn/economy/1653228/dung-quat-refinery-s-expansion-project-to-cost-nearly-1-5-billion.html
SSA				
Dangote Petroleum Refinery (2023)	650000	29231	2023	https://www.reuters.com/business/energy/nigerias-dangote-says-refinery-will-hit-550000-bpd-output-this-year-2024-07-20/#:~:text=The%20Dangote%20refinery%2C%20built%20at,after%20several%20years%20of%20delays.
Mthombo Oil Refinery (2012)	400000	29718	2013	https://www.hydrocarbons-technology.com/projects/mthomboilrefinery/
Uganda Refinery Project (2023)	60000	66667	2023	https://www.offshore-technology.com/news/uganda-talks-partners-refinery/

Ghana's new petroleum hub (2023)	300000	40000	2023	https://www.reuters.com/world/africa/ghana-begins-construction-12-bln-petroleum-hub-2024-08-20/

Appendix B : Methodology for Estimating Capex

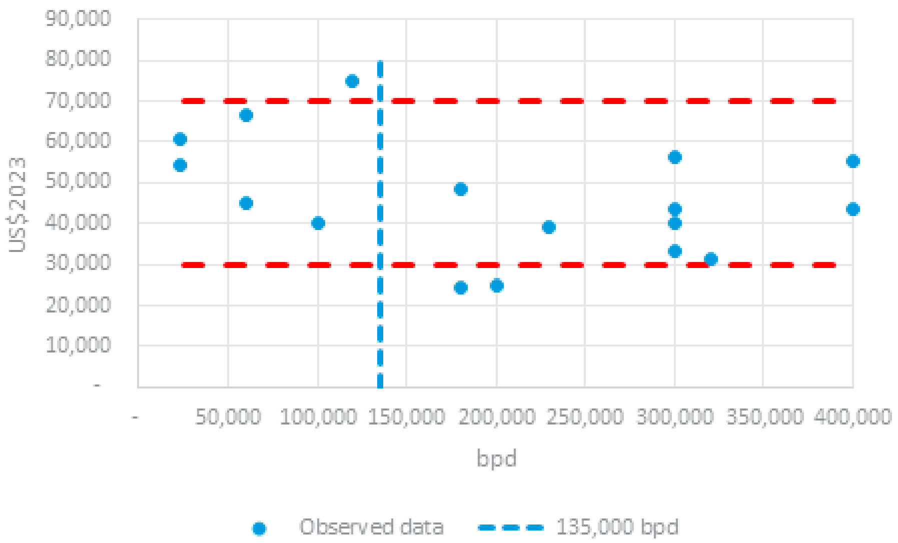
Cost estimation methodology

Taking into account both the economies of scale and the real inflation impact on a refinery's cost, we used the following approach to estimate the total cost of reestablishing MPR to its nameplate capacity of 135,000 bpd.

Our cost estimation is based on analysing cost per capacity—that is US$2023 per bpd. This allows for a uniform comparison between refinery developments of different scales. It also means that we can account for economies of scale by establishing the relationship between cost per capacity and capacity.

First, we estimated the range of refinery construction costs by analysing the scatter plot of refinery development cost per bpd and bpd. This scatter plot only considers refinery developments between 2019-2023 due to the effect of real cost inflation. Using data on earlier refinery developments will underestimate current costs since refineries from previous periods do not factor in the real cost increase in refinery construction. Based on Figure 29, a refinery with a nameplate capacity of 135,000 bpd should cost between US$30,000 and US$70,000 per bpd.

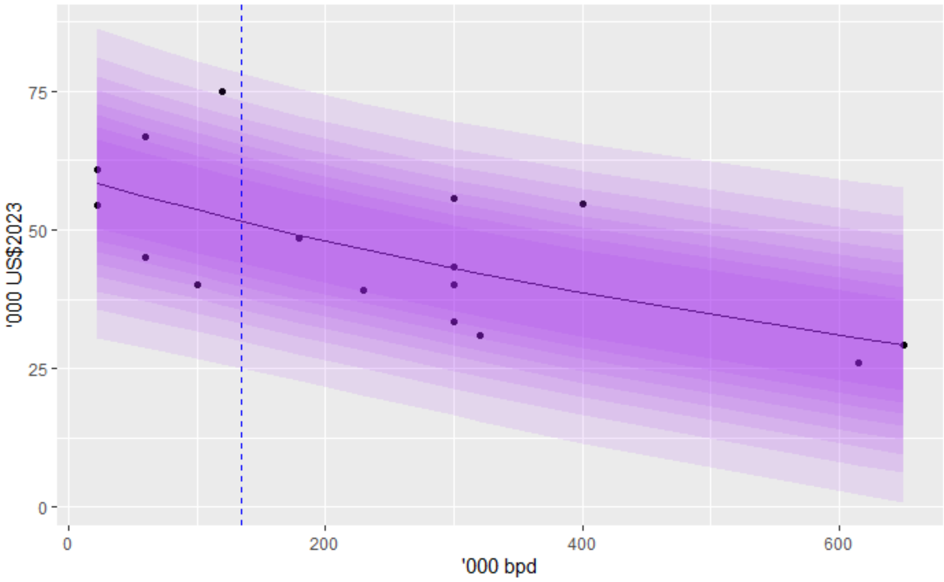
Figure 29: Refinery cost scatter plot



Source: Castalia analysis

Next, to estimate the cost of refinery development while accounting for economies of scale, we applied regression analysis using data from refineries built or proposed between 2019 and 2023. We fitted an exponential decay curve to the data and built prediction curves of various levels to illustrate the variation in total construction costs. Based on the fitted regression curves, 135,000 bpd refinery development should cost between US$27,000 and US$75,000 per bpd.

Figure 30: Regression curves of refinery cost



Source: Castalia analysis

Therefore, based on our high-level analysis, reestablishing MPR at a nameplate capacity of 135,000 bpd would cost between US$27,000 and US$75,000 per bpd. This amounts to a total cost ranging from US$3.7 billion to US$10.1 billion. As explained earlier, this cost estimate should be treated with caution, as it is based on a high-level analysis of refineries in different market conditions that do not replicate the unique case of MPR's reestablishment. These factors include the existing site condition and country or region.

Appendix C : Methodology for Estimating Opex

Taking into account real inflation of energy prices and nominal inflation on refinery OPEX, we used the following approach to estimate the OPEX of a reestablished MPR to an expected throughput of 115,000 bpd.

Refining NZ's segment reporting served as the basis for OPEX estimation. Historical refinery OPEX is estimated by subtracting refinery EBITDA from refinery revenue. These annual costs were divided by annual refinery throughputs to estimate refinery OPEX per crude barrel processed.

We forecasted refinery OPEX in two general components: energy and non-energy, which comprises all other OPEX components such as labour and catalysers.

Electricity usage and cost forecast

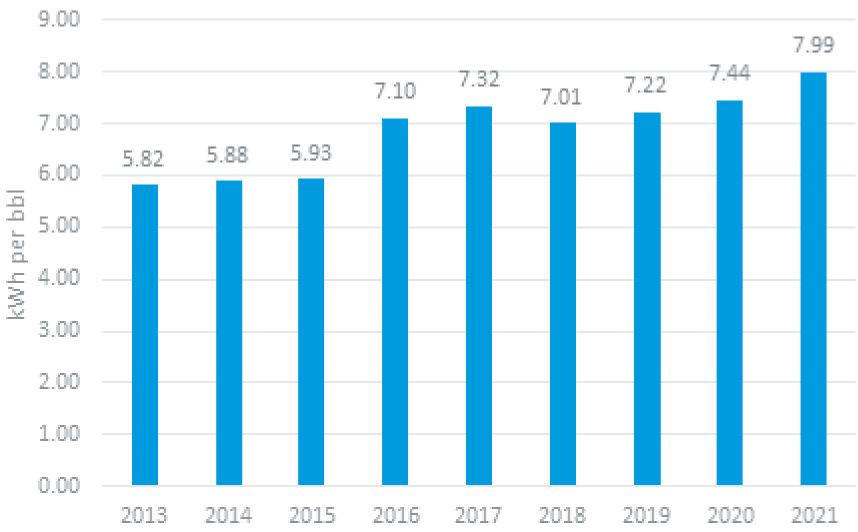
Electricity costs are estimated per barrel processed by estimating the nominal cost of electricity per barrel before the closure of MPR and escalating it according to real and nominal inflationary factors.

Estimating pre-closure electricity costs

We estimated MPR's electricity costs pre-closure because Refining NZ and Channel did not report electricity costs as an individual line item in their annual reports. MPR's electricity costs pre-closure is driven by two factors: the cost of electricity per kWh and electricity usage per barrel. Since Refining NZ and Channel do not report electricity costs as a line item, it is not possible to calculate the per kWh cost of electricity from their financial statements. Therefore, we assumed a nominal electricity cost of 13.36 cents per kWh for the basic metals and chemical industry.[76]

To estimate refinery electricity usage per barrel processed, we used Refining NZ and Channel's reported annual electricity usage to estimate electricity usage attributed to MPR, by subtracting 2023 electricity usage from pre-closure electricity usage. Refinery electricity usage for refining was divided by annual refinery throughput to estimate refinery electricity usage per barrel processed.

Figure 31: Pre-closure refinery electricity usage per barrel processed



Source: Refining NZ, Castalia analysis

[76] MBIE Nominal annual average energy prices, Basic metal and chemicals (2019).

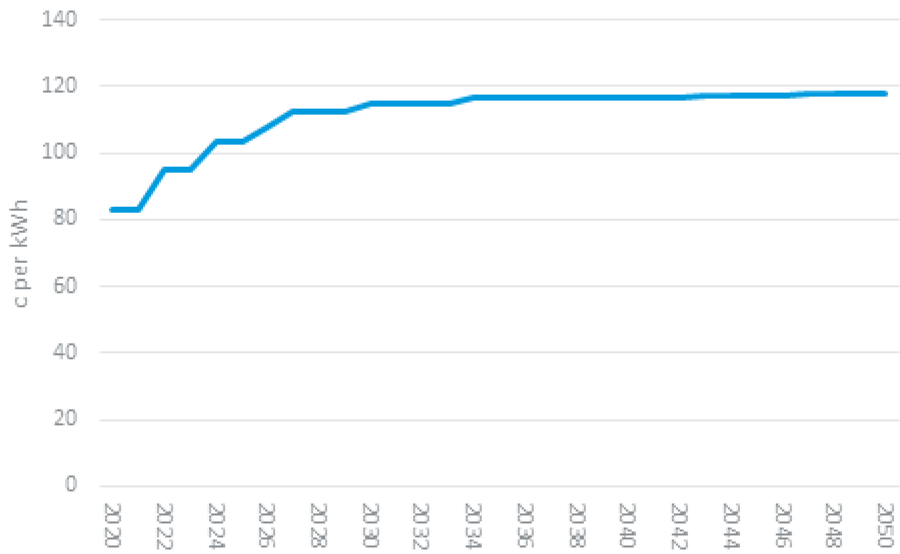
Note: Nominal prices.

We estimated the refinery electricity cost per barrel to be NZ$0.96 per barrel processed in 2019 by combining the assumed nominal electricity cost of 13.36 cents per kWh77 and an electricity usage per barrel of 7.22 kWh per barrel.[78]

Projecting future electricity costs

We forecasted refinery electricity costs based on two factors: real cost inflation and nominal cost inflation. Real cost inflation is estimated by using MBIE's Energy Outlook's Wholesale electricity price indicator (mixed renewables scenario) as an index. MBIE's Energy Outlook's Wholesale electricity price indicator (mixed renewables scenario) projects electricity generation asset investment to calculate a real LCOE of total electricity generation in New Zealand. Figure 32 presents the electricity wholesale price indicator.

Figure 32: Electricity wholesale price indicator



Source: MBIE Energy Outlook Electricity Insight, mixed renewables scenario

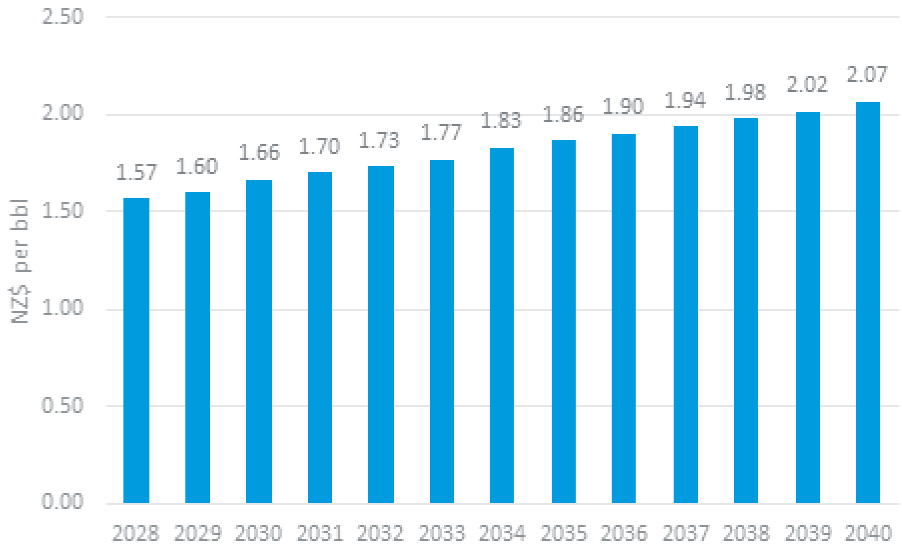
Note: Real prices.

Real electricity cost inflation was combined with a 2% annual inflator to obtain a nominal refinery electricity cost per barrel processed. Figure 33 presents Castalia's projected electricity cost per barrel processed.

[77] MBIE Nominal annual average energy prices, basic metal and chemicals (2019).

[78] We chose 2019 as the reference year for cost projections because it was the most recent year when MPR operated without being impacted by the COVID-19 pandemic.

Figure 33: Projected electricity cost per barrel



Source: Castalia analysis

Note: Nominal prices.

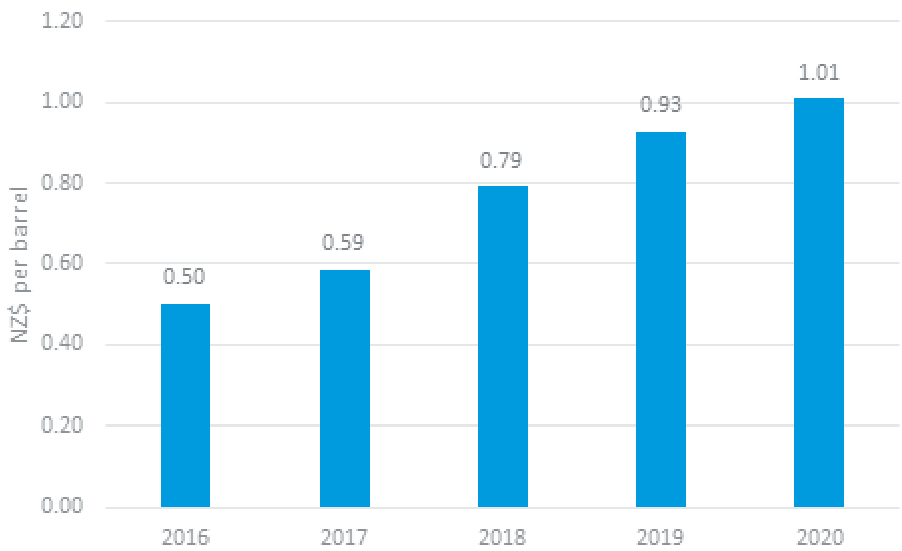
Natural gas usage and cost forecast

Natural gas costs are estimated per barrel processed by escalating natural gas costs per barrel before the closure of MPR and escalating this cost according to real and nominal inflationary factors. We present natural gas costs as an increment on 2019 cost levels.

Estimating pre-closure natural gas costs

Pre-MPR closure natural gas costs were reported in Refining NZ's annual reports as an individual line item since natural gas costs were recovered from off-takers. Therefore, the pre-closure natural gas cost per barrel was estimated by dividing this annual natural gas cost by refinery throughput. Figure 34 presents the estimated pre-closure refinery electricity usage per barrel processed.

Figure 34: Pre-closure refinery natural gas cost per barrel processed



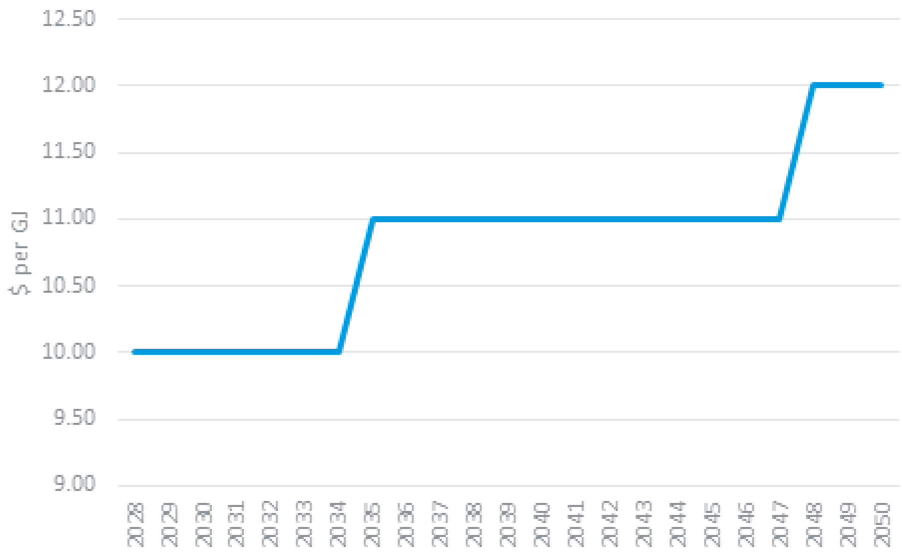
Source: Refining NZ

Note: Nominal prices

Projecting future electricity costs

We forecasted refinery natural gas costs based on two factors: real cost inflation and nominal cost inflation. Real cost inflation is estimated by using MBIE's Energy Outlook's gas price forecast (mixed renewables scenario) as an index. MBIE's Energy Outlook forecasts gas prices based on simulating gas field exploration, development, and operation costs that calculate a break-even price, all in real terms.[79] Figure 35 presents MBIE's gas price forecast.

Figure 35: Natural gas price forecast



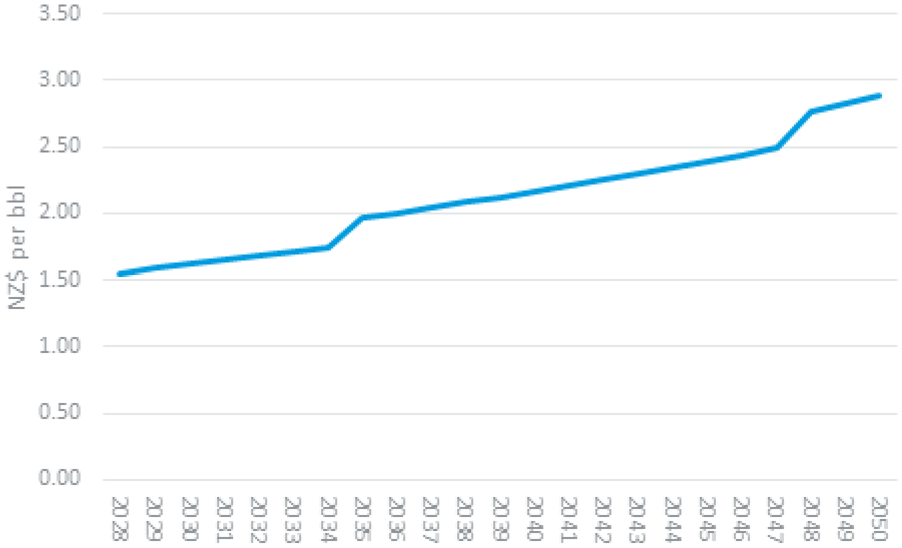
Source: MBIE Energy Outlook Electricity Insight, mixed renewables scenario

Note: Real prices.

Real gas price inflation was combined with a 2% annual inflator to obtain a nominal refinery natural gas cost per barrel processed. Figure 36 presents Castalia's projected natural gas cost per barrel processed.

[79] Energy Modelling Technical Guide, MBIE (2016)

Figure 36: Forecast refinery natural gas cost per barrel



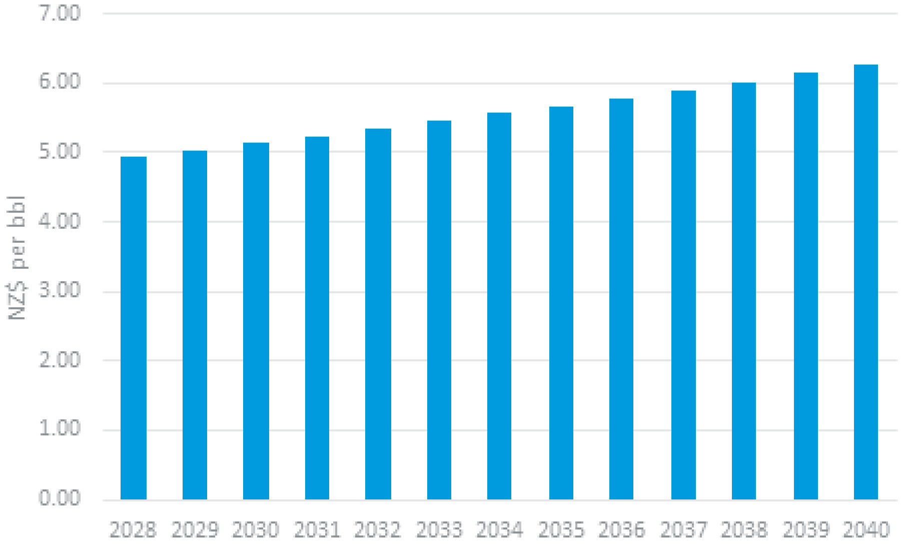
Source: Castalia analysis

Note: Nominal prices.

Non-energy refining costs

Non-energy refining costs (that is, total refining OPEX excluding electricity) of NZ$4.13 per bbl in 2019 are calculated by subtracting electricity per barrel from refinery OPEX in 2019 (NZ$0.96 per bbl and NZ$5.10 per bbl respectively). These costs were escalated at an inflation rate of 2% to obtain a nominal cost estimate for future non-energy refining costs.

Figure 37: Projected non-energy refining costs per barrel processed



Source: Castalia analysis

Note: Nominal prices.

Appendix D : Methodology for calculating current account impact

We calculated the current account impact in two steps. The first is to calculate the real impact of reestablishing MPR on the current account through reduced imports of refined products and increasing imports of crude oil for processing. The second is to estimate the social benefit that this current account shock provides.

Estimating the real effect that reestablishing MPR has on the current account

Reestablishing MPR will significantly change New Zealand's import profile and, therefore, current account.[80] If MPR is reestablished, import levels will decrease by the value of refined products produced by MPR and increase by the value of crude oil processed by MPR. We use the typical historical gross refining margin as a proxy for the difference between the value of refined products and crude oil per barrel processed. The overall impact of reestablishing the MPR on total imports is estimated by multiplying the historical GRM by the MPR's typical throughput.

Table 7: Assumptions to calculate the effect on the current account

Item	Unit	Value
Gross refining margin	US$ per bbl	6.31
Exchange rate	NZ$ per US$	1.67
Throughput	bpd	115,000
Refinery usage	Days per year	365

Calculating the social benefit of an improved current account balance

The domestic refining of crude oil offsets the foreign exchange that would have otherwise been spent on the imported refined product. On the other hand, importing crude oil for MPR's feedstock forces New Zealand to purchase foreign currency. We estimate the benefit of an improved current account balance as the difference, in the present value terms, of the expected cost of an external shock for the factual and counterfactual. Here, the expected cost of an external shock in a single year is the product of two values:

- The cost of an external shock in a year
- The probability of an external shock in that year.

The difference in expected cost between the factual and counterfactual scenarios is the project's benefit for that year, which comes from reducing its vulnerability to external shocks. We use the social discount rate to estimate the present value of these benefits over the project's life.

[80] The overall impact of reestablishing the MPR on total imports is estimated by multiplying the historical GRM by MPR's typical throughput of 115,000 barrels per day (bpd). The overall impact of reestablishing the MPR on total imports is estimated by multiplying the historical GRM by MPR's typical throughput of 115,000 barrels per day (bpd).

We note that New Zealand currently has a high current account deficit representing 6.8% of GDP.[81] We assume in our analysis that New Zealand will return to having a modest current account deficit by the time MPR is reestablished, at -2.8% of GDP.

Figure 38: New Zealand's current account deficit to GDP ratio

Source: BPM6 Quarterly, Key International Ratios. Statistics New Zealand

To complete our valuation, we make the following assumptions:

External shocks. We assume that if a shock occurs, it will be at least at the 3% level. We also assume that multiple shocks could occur over the project life, and this is captured in the probabilities.

Shock occurs over 2 years. When there is an external shock there is a loss in GDP of 5.8% over 2 years. After 2 years the economy returns to its long-run growth rate of 2.5%. This means that 5.8 % of GDP is lost forever and the cost of the external shock from that year onwards is equal to the lost GDP in perpetuity. The cost of an external shock in GDP is estimated based on Edwards (2005).

Probability of external shock follows Edwards' paper. The probability of an external shock in any given year is estimated from the current account deficit and the Probit function set out in Edwards (2006).

We summarise these assumptions in Table 8.

Table 8: Balance of payments assumptions

Parameter	Description	Units	Value
Current account Reversal	Typical magnitude of current account reversal that is associated with an external shock	% GDP	3

[81] With respect to historical values. New Zealand's current account deficit rose above 4% for only one quarter from 2010 to 2019.

Cost of External Shock	Expected loss in GDP growth. Edwards (2006)	% GDP	-5.83
Imported Capital	Materials, equipment and any other capital expenditure that is imported	%	50
Imported OPEX	Materials, equipment and any other operating materials that are imported	%	20
Real GDP growth	Long-term real GDP growth	%	2.5
Average CA deficit	Typical current account deficit for Australia	% GDP	-2.8
Probability of reversal	Probability of a 3% or more current account reversal in a given year.	% p.a.	2.9

Appendix E : Approach to Estimating Economic Employment Benefits

To estimate potential employment benefits from reestablishing MPR, we applied the following approach.

First, we collected data on average salaries in New Zealand and the Northland region. This information was sourced from the New Zealand Institute of Economic Research, New Zealand career websites, and Stats NZ Tatauranga Aotearoa.

We then estimated the expected salaries for refinery workers in 2024 using historical data as a reference. Based on past wage levels and anticipated increases, we projected the average salary at the reestablished refinery. For instance, historical figures showed refinery workers earned approximately NZ$157,000 before tax. Adjusted for inflation, this suggests that by 2024, refinery workers would earn an average of NZ$190,739.[82]

Table 9: Average salaries in New Zealand and the Northland region relative to MPR average salaries

	Average in NZ and the Northland region	Refinery	Increase in salaries in the region
Fulltime employees	NZ$76,394.19	NZ$190,739	NZ$114,345.06
Contractors	NZ$76,394.19	NZ$92,883	NZ$16,489.29

Source: Castalia/Envisory analysis

We calculated the difference between projected refinery salaries and the average regional salaries for 350 full-time employees and approximately 175 contractors. This difference represents the additional income refinery workers would earn compared to regional averages.

In addition to refinery employees, we considered the wages for about 200 construction workers expected to be employed during MPR's three-year reconstruction phase. Their salaries, estimated at NZ$75,456, are based on industry standards and regional norms for construction roles.83

During the construction period, the total annual income increase in the region would be around NZ$15 million, rising to over NZ$42 million during MPR's operational phase. Assuming a 30-year economic life for MPR and applying a 5% social discount rate,84 the employment impact of establishing MPR would total around NZ$0.6 billion.

It is important to note that the benefits are likely higher, as some employees would need to relocate from other regions or abroad, boosting the local population and bringing additional spending to the

[82] Economic assessment of reconsenting discharges and structures at the Marsden Point Refinery, NZIER (2020).

[83] Earnings from main wage and salary job by industry (ANZSIC), sex, age groups, and ethnic groups, Stats NZ Tatauranga Aotearoa (Aotea Data Explorer, retrieved September 2024)

[84] Discount rates to be used in economic analyses, The Treasury (https://www.treasury.govt.nz/information-and-services/state-sector-leadership/guidance/reporting-financial/discount-rates, retrieved September 2024).

area. Additionally, during regular maintenance turnarounds, the number of contractors increases by 500 to 1,000, further contributing to regional income.

Appendix F : Refining NZ reporting extracts

Table 10: Segment reporting

Item	2021	2020	2019	2018
	NZ$000	NZ$000	NZ$000	NZ$000
Refining revenue	187,104	200,423	297,836	304,509
Finance income				102
Finance cost				-13,892
Depreciation and disposal costs				-89,648
Income tax				-1,079
Net profit after income tax				882
EBITDA	33,839	25,912	80,175	105,399
Oil refining costs	153,265	174,511	217,661	199,110

Source: Refining NZ annual reports

Table 11: Energy usage and throughput

Item	Unit	2017	2018	2019	2020	2021	2023
Electricity usage	PJ	1.22	1.14	1.23	0.92	0.96	0.12
Natural gas recovery	NZ$000	21,403	24,442	31,987	39,579	30,156	0
Refinery Throughput	'000 barrels	41,724	40,440	42,687	29,876	29,214	0

Source: Refining NZ annual reports