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Fuel Security and Fuel Stockholding Costs and Benefits 2020

Prepared for Ministry of Business, Innovation & Employment

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Executive Summary

The Ministry of Business, Innovation and Employment (MBIE) is the Government's lead adviser on national fuel security and periodically reviews fuel security policy settings. This review updates the previous reviews concentrating on national fuel supply risks and fuel security policies, particularly domestic fuel stockholding policies, under plausible market scenarios including closure of the Marsden Point oil refinery. The fuel importer/wholesalers were consulted as part of this review.

If the refinery closes, New Zealand is likely to see a reduction of stocks held, primarily crude and intermediate product currently held as part of refinery operation. In total stocks could reduce to under 70% of the previous level. New Zealand would be supplied by 100% product imports.

The analysis of the supply chain inventory changes was made more difficult by the poor quality of MBIE's data as a result of incorrect stocks submissions by some industry participants. This has been a recurring problem over may years so H&T recommends MBIE investigates improving the data using the legislative powers it has to ensure this is accurate in future.

Disruption events

The analysis has found there is little change in the disruption impact for most scenarios modelled whichever supply chain New Zealand is dependent on. This is because global disruption events primarily impact price which will flow through to New Zealand prices whether we import crude or product. Both supply chains are heavily dependent on imports (only about 2% of current crude intake is produced domestically).

New Zealand is able to play its part in global oil disruption response by holding ticket stock which can be released to the market should there be a supply disruption. This is held offshore and would be part of a collective response to cover the disruption and keep fuel flowing to markets (in New Zealand's case as part of an International Energy Agency (IEA) response). Companies were supportive of New Zealand continuing its current ticket strategy as it is very cost effective way of complying with its commitments as a member of the IEA, and ensures New Zealand can play its part in a global response. H&T agrees with this view although has proposed an option such that New Zealand holds a certain proportion of product ticket stocks for consideration. H&T agree that ticket stock would not assist in a domestic disruption and saw decisions around stock levels required in New Zealand as a separate decision from compliance stocks for global response.

A hypothetical disruption to North Asian supply was modelled to assess New Zealand's expected increased dependence on this region with 100% product import supply. A disruption to exports from this region could see up to 50% of New Zealand's normal supply disrupted. For an event of this magnitude, the market would quickly respond (prices would rise) which would see product flowing into this region from the United States, India, Middle East and Europe. These flows occur from time to time should there be a financial incentive and the disruption would encourage a greater response. The gap between new supplies arriving (with longer shipping times) and the loss of supply from North Asia was modelled with the expected inventories held under an 100% product import case likely to provide enough buffer in the majority of cases for this transition to happen. By comparison, such an event would be more easily managed under the current supply system as North Asian product imports are a much smaller part of the total mix (10-15%).

There was minimal change in the impact from domestic fuel disruptions (e.g. terminal or pipeline outages) between different supply chains as these events are infrastructure failures rather than supply. In all cases the time to restore normal supply is (until the infrastructure is repaired) related to the time required to put more tank trucks and drivers in place to shift the fuel longer

distances. H&T found there is now greater likelihood of stock outages arising from RAP/Wiri disruption events because of the loss of the Wynyard Wharf facility for back up supply. We have included finding an appropriate way to respond to Auckland related disruption events as a recommendation in this review.

In summary, while a change to 100% product import supply will dramatically reduce the amount of stock held in New Zealand, it will not have a major impact on fuel security as:

- Much of the stock that will no longer be held is currently required to operate the refinery and the related distribution system (coastal shipping) so is not immediately available to respond to disruption events;
- New Zealand's stock held on water volume will still be a similar volume and if this is 100% finished product imports provides a very flexible response measure to disruptions; and
- In most domestic disruption events, the resupply constraint is set by available of tank trucks and drivers and the different supply method has little impact.

Where the loss of refining capacity could impact New Zealand is if there was a failure in normal global trading activity. Such an event is beyond the scope of any scenarios modelled[1]. In this case the loss of crude/ refinery intermediate stock would reduce New Zealand's options as would the loss of the ability to at least refine New Zealand's domestic crude. We acknowledge that in such circumstances other import dependences may be more critical than fuel, and as shown in the COVID-19 response, fuel use can be dramatically reduced if necessary.

Mitigation options

The report considers three mitigation options including:

- Supply diversity;
- Arrangements for prompt supply of regional stocks; and
- Domestic strategic stocks and/or minimum stock obligations.

Supply diversity is a key feature of a resilient supply chain and companies noted this was something they managed as a matter of course (i.e. diverse supply was in their commercial interest). H&T agrees that a diverse supply chain should happen in a well-functioning competitive market and notes that any government imposed diversity requirement could increase supply costs and possibly distort the market. We include a recommendation for monitoring of, and reporting on, supply diversity annually.

In general, defined arrangements for prompt supply would be difficult to establish and likely to be costly for a relatively small timing benefit. Companies have the ability to respond quickly anyway, particularly through their parent companies or trading relationships. The cost of any arrangement is also likely to mean funds could more usefully spent on holding stock in-country.

While stock holding decisions have been left to commercial drivers in the past (and fuel company feedback prefers that continues), any change in supply provides MBIE the opportunity to review if this is the best approach. MBIE should monitor stock levels on an ongoing basis, particularly following any changes in the supply chain. Should there be concern that stock levels are trending down over time, MBIE should consider implementing minimum stock obligations to ensure a stocks are maintained at a reasonable level. This could be done at a level already maintained (the

[1] Companies were unwilling to speculate on the impact of such an event during the consultations.

level assumed in the report) without any major impact to companies as it would not be creating an obligation to hold more stock (just avoiding reductions). H&T believes this could be implemented to avoid impacting companies in different ways depending on their size of operation and would not require major new infrastructure investment in an industry that is facing transition away from fossil fuels.

Should the government decide it requires higher stocks than those that would result from the commercially based obligation described above, it may be that stocks held separately (but in close proximity to) industry stock would be more economic than increasing minimum stock obligations. Such stock could be secured by:

- the government managing additional stocks through a ticket type structure (in line with the current tender opportunity already offered) and funded through the current Petroleum Fuels Levy; or
- an obligation managed through a stock agency that would be allow a collective industry response as allowed in many other countries.

Additional stock should be held where it can most flexibly respond to a range of outcomes (likely to be a large terminal like Refining NZ under 100% import product supply) although Auckland remains the most vulnerable location for infrastructure failure which may give some incentive to hold stock there (as recommended for jet fuel in the Auckland Fuel Supply Disruption Inquiry).

Domestic security recommendations

H&T recommends that MBIE:

1. Work to improve the stock reporting from fuel companies. While the government has the power to enforce stock reporting[2], there are questions as to whether this legislation remains fit for purpose and is achieving its aim. It is not obvious that there is any consequence for providing incorrect information and a maximum $2000 fine may not be appropriate as a deterrent. Whatever powers are used, MBIE needs to ensure there is a structure such that fuel companies are obliged to consistently provide accurate submissions.

2. Should continue to monitor and work with the fuel industry to implement the recommendations from the Auckland Fuel Supply Disruption Inquiry, particularly the provision of appropriate jet storage in the Auckland region, to ensure assumptions made in this assessment are valid once jet fuel consumption returns to previous consumption levels.

3. As also highlighted in the Auckland Fuel Supply Disruption Inquiry, the loss of Wynyard Wharf has impacted disruption response options in Auckland, with this likely to result in greater shortages for a RAP/Wiri disruption. MBIE should continue engaging with industry participants on getting them to establish a replacement emergency response option to restore supply resilience back to at least the level seen when the Wynyard Wharf terminal was operational.

   Should the RNZ proposal for a moveable Skid Facility to increase supply resilience for Auckland (and for other locations as part of an emergency response) not be acceptable, the fuel industry should put forward other proposals to mitigate the loss of Wynyard Wharf.

[2] Through Section 7 of the International Energy Agreement. We note that while the fuel industry is aware of this power, our understanding is that they believe the information is currently provided voluntarily to avoid the mandatory powers being used.

4. MBIE should closely monitor stock levels on an ongoing basis particularly following any change in New Zealand's supply chain such as closure of the refinery. Should there be concern that minimum stock levels are deteriorating over time, MBIE should consider implementing a minimum stock obligation at around the current minimum operating level (for finished stocks) to ensure stocks are maintained at an appropriate level in line with the assumptions made in this report. This should not materially increase fuel industry costs, except for an increase in administration/monitoring, assuming the proposed target is set in line with the capability of the current infrastructure. Care will be required to ensure any stock obligation will avoid penalising individual companies based on their supply method.

5. Investigate the value of holding additional stock within New Zealand above the average level expected to be held on a commercial basis[3], particularly where the government may consider broader concerns than covered by the straight economic cost and risk of any outage.

6. Further consider the options of holding additional stock (if recommended from 5) noting that this report considers using the current ticket tender system, or allowing a collective industry response (e.g. stock agency) will likely provide a more economic outcome than requiring importers to hold a higher level of minimum stock than proposed in recommendation 4.

   As part of this investigation we recommend further consultation with the importers to ensure that if either of these options are implemented that the outcomes will result in the required level of stock and will not create market distortions.

7. Review the New Zealand fuel specifications should the refinery close to ensure the specifications remain aligned with the fuels available in the region, as much as possible without compromising New Zealand's environmental and operability requirements.

8. Implement an annual review of supply resilience (including the minimum stocks held over time) and the diversity of supply, and as part of that consider if importers should be required to provide an annual representation letter setting out their current supply diversity, their actual supply performance over the last 12 months and highlighting any concerns or improvements that can be made for the following year.

9. Engage with the relevant Ministries for industry use of niche fuels to consider undertaking supply security reviews should the refinery cease operation if these are not already being considered.

IEA compliance ticket strategy

H&T recommends that:

10. The ticket strategy should not change from the current approach should refining cease in New Zealand. A minor adjustment to hold a minimum quantity of white product tickets (approximately 100,000 tonnes) as part of the total holdings should be considered.

[3] This is essentially the level calculated in this report and expected to result if a minimum stock obligation is implemented to lock in the current level of minimum finished stocks.

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Glossary

COLL	Coastal Oil Logistics Limited – joint venture company controlling the ships that move products from the refinery to ports around the country and the shared stock scheme Participants in the Joint Venture are BP, Mobil and Z
IEA	International Energy Agency
JUHI	The Joint User Hydrant Installation (JUHI) that is located at Auckland Airport
kbd	Thousand barrels per day
MMB	Million barrels
MMBD	Million barrels per day
RAP	Refinery to Auckland Pipeline (RAP) that takes product from Marsden Point to the Wiri distribution terminal in South Auckland
RNZ	Refining NZ – the company that owns and operates New Zealand's only refinery at Marsden Point near Whangarei
Wiri terminal	Wiri Oil Terminal in South Auckland

1.0 Introduction

The Ministry of Business, Innovation and Employment (MBIE) is the Government's lead adviser on national fuel security and from time to time reviews fuel security policy settings. MBIE has engaged Hale & Twomey (H&T) for advice on national fuel supply risks and fuel security policies, particularly domestic fuel stockholding policies, under plausible market development scenarios that include the closure of the Marsden Point oil refinery.

Refining NZ owns and operates the Marsden Point oil refinery. It is currently reviewing its refining business in the context of challenging global refining market conditions, and is considering options that include reducing its refining capacity and closing the refinery. Closure of the refinery could result in a large reduction in New Zealand's fuel stockholding, other things being equal. The significance of such a change in the supply chain warrants a careful review of relevant supply disruption risks, including the potential disruption related to geopolitical conflict, extreme weather events, and pandemics.

New Zealand is a party to the International Energy Agreement (IEA), under which it agrees to maintain oil stocks equivalent to 90 days of import demand net of oil exports. In recent years commercial stocks made up approximately 60 days of net import demand. The Government procures the balance (recently around 30 days) in the form of options on oil stocks (called "oil stock tickets") held off-shore. MBIE has modelled the impact of closure of the refinery on the future oil stock ticket requirement and has raised questions on whether the current strategy needs any adjustment under those circumstances.

2.0 Project requirement and methodology

2.1 Review requirement

The review is required to produce a report addressing the following questions for the specified fuel demand scenarios and relevant supply disruption scenarios, with and without the refinery:

- How would NZ's fuel supply chain change as a result of closure of the refinery? What impact would refinery closure have on fuel stocks and days of cover, other things being equal?
- What fuel supply disruption scenarios should be considered when assessing fuel supply security if NZ has no domestic refinery? What is the likelihood of each relevant disruption scenario?
- What are the estimated impacts of relevant disruption scenarios on fuel supply under each of the demand scenarios, with and without the refinery?
- What are the expected costs and benefits of disruption mitigation measures, including additional stockholding?
- What measures are recommended to mitigate key supply risks, and why? If additional fuel stockholding is recommended, in what locations should it be held and why?
- What risk mitigation measures, if any, are recommended if the refinery reduces its output (rather than fully shuts down), to supply only Northland and Auckland.
- If NZ continues to hold reserve stock tickets to meet its IEA requirements, what proportion should be held as crude stock if New Zealand has no refinery?
- What other matters should be considered when evaluating fuel supply security in NZ and IEA stockholding requirements?

2.2 Methodology

H&T initially modelled how the supply chain might change should the refinery close and New Zealand shift to 100% product import supply. This model was included in the consultation document shared with the key fuel industry participants along with more detailed questions on disruption scenarios, impacts and mitigation options.

In response to the consultation request made to each of the market participants, meetings were held with:

- BP;
- Gull;
- Mobil;
- Refining NZ; and
- Timaru Oil Services

Z Energy and some of the above companies also provided a written response to H&T on the consultation document.

While some companies already use 100% product import supply, any consideration of mitigation options affects the whole industry, hence the inclusion of all importer/wholesalers in New Zealand. Refining NZ was included in the consultation due to the critical nature of its infrastructure, both in the current supply chain and as in import terminal should refining cease.

Feedback from the fuel industry enabled H&T to adjust the strawman for 100% product import supply before modelling possible disruption impacts. Companies were also able to comment on how supply disruptions might be handled and on possible mitigation options. Feedback has been incorporated into this report but unless companies have given permission, specific comments are not linked to particular companies.

2.3 Report basis

This report assumes a certain base knowledge of New Zealand's fuel supply chain. The place of the Marsden Point refinery in the fuel supply chain has been detailed in earlier reports such as 2005 Oil Security Report[4] and the recent Commerce Commission Market Study into Retail Fuels[5].

MBIE has previously reviewed fuel security and stockholding options; relevant documents can be found at this MBIE website link. In particular, the report Petroleum Supply Security 2017 Update (2017 Report) assesses the impacts of various supply disruption scenarios, and the report *Economics of Fuel Supply Disruptions and Mitigations* evaluates the economic consequences. While this report builds on these earlier reports, due to the focus on possible changes should refining cease in New Zealand, it is not a straight update of the earlier reports.

2.4 Fuel security

Fuel security covers the resilience of the fuel supply chain. The 2019 RAP Inquiry[6] has a useful discussion on resilience which encompasses a much wider view of a resilient system than purely

[4] *Oil Security*, Covec and Hale & Twomey, February 2005, Section 1.3, pg. 10

[5] Retail fuel market study - Final Report - 5 December 2019, Commerce Commission. Section 2.111 (pg. 79) through 2.152 (pg. 85)

[6] Government Inquiry into The Auckland Fuel Supply Disruption, August 2019

analysis of disruption events. For this review, with the focus on the possible change to 100% product import along with the costs and benefits of additional stockholding, the report assesses disruption events related to that change and the value for additional stock.

Most of the questions in the review requirement relate to fuel security in New Zealand, even if the disruption event may be external. New Zealand is a member of the IEA and purchases ticket stock to ensure compliance with the requirement to maintain stock levels above 90 days of New Zealand's net fuel imports. It is recognised by government and industry that the ticket stock does not provide domestic fuel security as it is likely to take longer to purchase and deliver stock from exercising tickets than the industry could achieve from normal market sources. Therefore, the ticket strategy is seen as a compliance strategy that means New Zealand can play a role in a global fuel disruption rather than as something that provides domestic fuel security.

We note that this analysis, in line with previous fuel security reports, concentrates on the main white product (petrol, jet fuel and diesel) supply. The refinery closure may also impact specialty product supply including fuel oil, bitumen, carbon dioxide and sulphur. These are not explicitly covered in this report, although we do note some points in the recommendation section where issues with these product's supply have been raised during the consultation.

3.0 Supply chain change with 100% product import

3.1 Current supply chain and demand

Refining NZ (RNZ) currently supplies between 65-70% of New Zealand's main product demand (Table 1). The decline in share from 2015 reflects continued demand growth (particularly jet and diesel growth) rather than a change in refinery output.

Table 1: Refinery output as a percentage of total NZ demand

Product	2015	2016	2017	2018[7]	2019
Petrol	62%	64%	59%	61%	62%
Jet Fuel	95%	88%	84%	86%	87%
Diesel	75%	65%	67%	56%	62%
Total	74%	69%	68%	64%	67%

The balance of the market demand is supplied by direct product imports, primarily to the three largest demand ports (Tauranga, Wellington, Lyttelton) but also at times to some of the other seven ports around the country.

The refinery's output directly services the Northland and Auckland markets via a pipeline to a truck loading facility at Marsden Point (Northland) and the refinery to Auckland pipeline (RAP) to the Wiri terminal in Auckland. These locations take around 57%[8] of the refinery's output including most of the jet fuel, as 75-80% of New Zealand's jet fuel demand is normally required for Auckland Airport which is fed directly by a pipeline from Wiri terminal.

[7] 2018 refinery output was lower due to a full refinery shutdown in that year.

[8] https://www.refiningnz.com/about/our-company/. The percentage would be higher if expressed as only petrol, jet , diesel as most black product is shipped from the refinery on the coastal tankers.

Most of the rest of the refinery's output (~40%) is shipped by coastal tanker to the 10 ports around the country. This task is run by Coastal Oil Logistics Limited (COLL), a joint venture owned by RNZ's customers (BP, Mobil and Z). For this task, they operate two Medium Range (MR) sized tankers (capable of carrying around 40,000 tonnes or 50 million litres each)[9].

Most crude processed through the refinery is imported, with Middle East (mainly United Arab Emirates) the main supplying region. Some domestic crude and condensate are processed (~2%) and these are transported to the refinery on the coastal tankers used for product distribution.

While there has been substantial short term demand destruction due to the COVID-19 pandemic in 2020, diesel and petrol demand returned close to normal levels once the country returned to Level 1. Jet fuel demand is still substantially lower (about 35-40% of previous levels) due to border controls restricting international movements. While it is now expected to take many years for international travel to return to previous levels[10], this report assumes 2018/2019 demand as base level as oil security needs to be considered over the longer term.

The report does take into account that over the longer term, demand for petroleum fuels is expected to decline as transport transitions away from fossil fuels to renewable fuel sources in line with the government's objective for New Zealand to reduce net carbon emissions to zero by 2050. Any decisions around mitigation measures need to take this trend into account.

3.2 Expected change under 100% product import

The expectation is that the refinery will be converted to an import terminal should refining cease, as it will continue to provide the most efficient supply route into Northland and Auckland given the ability to leverage existing infrastructure. Assumptions include:

- The Marsden Point import terminal would be able to receive imports directly from Asian refineries (and further afield if the economics were favourable);
- As an import terminal it would handle at least two grades of petrol, jet fuel and diesel;
- The RAP (and Wiri terminal) would still be used for supplying Auckland although there may be some change in volume due to changes in distribution envelopes from different terminals;
- All other ports would be fully serviced by direct imports;
- We have not assumed any increase in storage at other ports although their operation might change given import supply; and
- There would be no need for a regular shipping task from Marsden Point to other ports, so the two coastal tankers currently used by COLL would not be required.

Given these changes, a terminal at Marsden Point would service about 40% of New Zealand's demand, ~30% for petrol and diesel and ~80% for jet fuel. Terminal throughput would be around 55% of current refinery output.

[9] http://www.coll.co.nz/about.html

[10] The International Air Transport Association does not expected aviation demand to recover to 2019 levels until 2024 (https://www.iata.org/en/pressroom/speeches/2020-07-28-01/)

While there would be no coastal tankers, on average there would be one 40,000 tonne product tanker[11] arriving every two days to meet New Zealand's fuel demand.

3.3 Impacts of change on inventories

A change to 100% product import supply is expected to have a major impact on New Zealand's in-country inventories (Table 2), mainly in the loss of crude oil and intermediate products currently held at Refining NZ as part of the refining process (includes stock on crude ships that have arrived in New Zealand but are yet to discharge).

Based on H&T modelling, we expect finished product inventories to increase from current levels due to slightly higher inventories at Refining NZ (some movement from intermediate to finished stock) and from more stock on product ships due to the increase in import tankers (this is expected to more than offset the drop in stock from having no local coastal tankers).

In total, our expectation is white product inventory (petrol, jet fuel and diesel) will average around 24 days gross[12], which is just above 20 days net supply[13] giving a couple of days higher for finished stock than current levels.

Table 2: Modelled inventory change[14]

Modelled Average Inventory Change	Current		100% product import	
	Gross kT	days cover	Gross kT	days cover
Crude upstream	95	5	95	5
Crude refinery	220	11	-	-
Refinery intermediates	171	8	-	-
Finished product	585	29	635	31
- white product only	419	22	469	24
- petrol	173	26	183	28
- jet	72	17	102	24
- diesel	174	20	184	21
Total	**1,070**	**53**	**730**	**36**

In total, New Zealand's in-country average stock holding would reduce around 340kt from the current 1,071kt which is more than a 30% decline. Days cover would reduce from 53 days to ~36 days. This analysis does not cover stock on the water in line with IEA rules for counting stock. Crude voyages to New Zealand are on average slightly longer than product (20 days versus 17 based on a 2012 analysis) and the expectation is for only a small change to the amount of stock on the water (more product imports replacing 90-95% of current crude imports). As a result the amount of stock on the water will only fall marginally to around 17 days (from 19 days).

[11] Note that if the tankers used are larger the number will reduce although it is currently expected that tankers of this size will meet the majority of the demand.

[12] This is about 6 days less that initially shared with the fuel industry due to issues we found with MBIE"s reported stock data. These issues are now being reviewed.

[13] Net inventory is gross inventory less tank heels, which is the bottom portion of the stock in tank not available in normal operation.

[14] White product inventory is the sum of petrol, jet and diesel. Other products included in total product inventory include LPG, avgas, lubricants, fuel oil, bitumen, petroleum coke and other speciality products.

Should no other changes be made, and the government covers the reduction in stock by buying more tickets to remain in compliance with its IEA requirements, this would require an approximate 60% increase on current ticket purchases (pre-COVID impacts). This is expected to be an additional cost of NZ$5-13 million per year.

3.4 Comments on the change in supply chain impact on fuel security

Industry feedback on the H&T modelling was that it seemed a reasonable estimate although could not comment on individual product inventories in some cases, as that was still under negotiation.

Comments on the changed supply chain with 100% product import included:

- The loss of crude/intermediate stock did not necessary reflect a change in fuel security, as much of the stock that would be lost is necessary for operation of the refinery and therefore not a loss of available stock;
- For many disruption events (particularly refinery related) the crude and intermediate stock was not useful for managing supply to customers;
- Fuel security/strategic stocks are a separate issue to refinery closure – should not be linked as the import risk is not changing with additional product imports largely replacing crude imports;
- Not having a single source of supply (RNZ) for 60-70% of New Zealand's product actually reduced the disruption risk from previous levels (related to removal of disruption scenarios 2 and 3 that were assessed in 2017 Report);
- The lead time on product is less than crude, meaning adjustments can be made more promptly (this relates primarily to trading time before loading rather than the voyage time itself, although product shipping time is on average about 3 days less than crude);
- There may be some loss of flexibility for niche products like deep south diesel with its specific cold property requirements for the winter season;
- There would be less variation in product levels due to more frequent smaller product import cargoes (compared to larger crude imports) and removing the variation (often between product types) caused by refinery processing changes;
- Around 20 net days average product stock in country seemed reasonable when taking account of the amount of import cargoes, their frequency and ability to move between locations;
- Minimum stock levels are complex and will vary depending on a number of factors – it will never be a single number that suits all products/locations;
- With refinery finished product tankage now only supporting Auckland/Northland demand rather than coastal distribution as well, the days cover level increases;
- Noted decisions on minimum jet inventory needed to account for single supply to Auckland Airport consistent with the recommendations of the RAP Inquiry; and
- New Zealand would still have a similar amount of stock on the water (not counted in the inventory numbers in Table 2) on route to the country, but now it would all be finished product stock rather than 60-70% crude oil. This would increase the ability to flexibly respond to disruption events.

3.5 H&T comment on feedback/stock reporting

H&T did not make any significant adjustments to the stock modelling following the feedback although agreed with industry that stock variation would be much lower with 100% product import supply. Therefore, the modelling assumes around 20 days net stock availability with the

variation likely to be within +/- 5 days demand (effectively +/- 100,000 tonnes around a midpoint, considerably lower than the current variation which is around double that level).

H&T also agreed that while the stockholding would be lower, more of it is useful as less stock would be required to 'run the system'[15]. H&T felt that net stocks could be taken under 10 days without any significant impacts and even lower in an emergency (5 days) although that is likely to result in localised disruption. This implies average buffer stocks of 10-15 days.

This modelling work was made more difficult by the poor (incorrect) quality of stocks information some companies were reporting in their monthly submissions to MBIE. This has been a problem over many years and it would appear that not all companies are taking an appropriate 'duty of care' to ensure these submissions are correct. It is difficult for MBIE to carry out its role of monitoring the fuel industry given the poor information supplied, yet alone the impact of incorrect submissions for New Zealand's reporting to external agencies including the IEA.

MBIE needs to work with industry on improving the quality of this data including using its legislative powers as needed[16]. It may be that these powers need to be modified (for instance there does not appear to be any penalty for incorrect submissions and the penalties are low) to ensure the fuel industry takes appropriate care to ensure these submissions are accurate.

3.6 Jet fuel future demand and additional capacity

Industry participants noted the outcome of the Auckland Fuel Supply Disruption Inquiry and the recommendation to hold jet stock near the Airport (includes Wiri) covering 80% of demand (based on a formula relating to peak days demand), for at least 10 days. As noted, jet demand has been significantly impacted by COVID-19 border restrictions, so this measure is currently easily met within the current storage (some companies have publicly stated that work on additional capacity is on hold).

While the future growth of jet fuel demand is uncertain, with the International Air Transport Association not expecting airline demand to return to pre-pandemic levels until 2024[17], H&T has assumed in its modelling that the recommended RAP Inquiry levels for minimum stockholding will be met even if/when jet demands returns to previous levels. MBIE should continue to monitor the implementation of the recommendations from the Auckland Fuel Supply Disruption Inquiry to ensure these assumptions are valid as jet fuel consumption returns to historical levels.

3.7 Partial refinery processing

One of MBIE's questions asks what risk mitigation measures, if any, are recommended if the refinery reduces its output (rather than fully shuts down), to supply only the Northland and Auckland markets. The currently stated plans of Refining NZ are to reduce capacity for 2021 from currently ~115 kbd to around 90 kbd[18]. We note that 90kbd is still well above the throughput needed to only supply the Northland and Auckland markets, so when asking companies to

[15] This is because no stock is needed at Refining NZ to support coastal shipping or the stock on the ships themselves in a 100% product import model.

[16] Through Section 7 of the International Energy Agreement.

[17] https://www.stuff.co.nz/travel/travel-troubles/300068547/air-travel-not-expected-to-recover-until-2024

[18] kbd is thousands of barrels a day

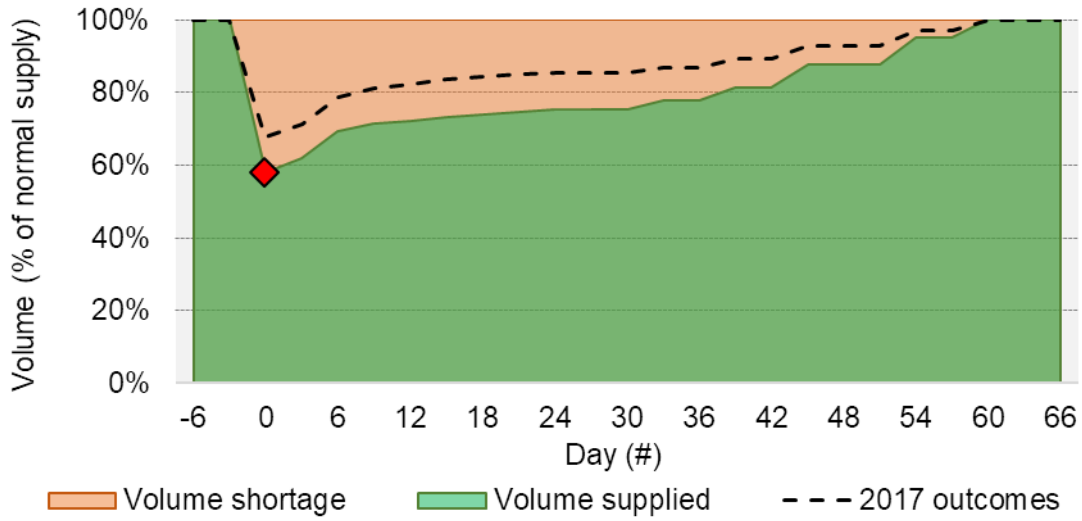
consider this question, we asked in the context of both the 2021 plans and, should it be feasible, with a further reduction in throughput.

3.8 Loss of Wynyard Wharf and alternative options

The modelling done for the 2017 Report included supply of diesel from Wynyard Wharf terminal, with this found to provide significant benefit for reducing the level of trucking resource required due to its proximity to the Auckland market. Since then, the product storage at Wynyard Wharf has been decommissioned (diesel and fuel oil) with the site developed for America's Cup activity. While the diesel throughput was not normally high, it provided a very important option in disruption to either the RAP or Wiri Terminal. This was proven in the 2017 RAP disruption, where not only was diesel throughput increased massively to support supply into Auckland, some chemical tanks were converted at short notice to handle jet (although little was delivered to the Airport via this route as the tanks were only commissioned shortly before the RAP was repaired).

The loss of this supply route means in a RAP/Wiri disruption all diesel would now need to be delivered from the TLF or Mt Maunganui terminals. As these are a long way from Auckland, the same truck/driver resources (availability of both set the limits of what can be delivered in the short term) will now deliver a lot less diesel and also petrol, as companies will look to minimise the impact across all road transport fuels.

Figure 1: Petrol and diesel impact of long-term disruption to RAP or Wiri



As shown in Figure 1: , the assessed shortfall for a long term disruption event to the RAP or Wiri terminal would now likely result in 42% shortfall initially until mitigation options are implemented, compared to around 32% when assessed in 2017 when Wynyard terminal was available to assist with supplying the market.

We note the Government Inquiry into The Auckland Fuel Supply Disruption mentioned that in the context of the then upcoming Wynyard Wharf closure and diesel supply resilience, *"We have recommended that the fuel companies monitor the situation closely and make timely decisions on investment in new infrastructure, to ensure sufficient resilience in the infrastructure supplying Auckland with diesel."*[19]

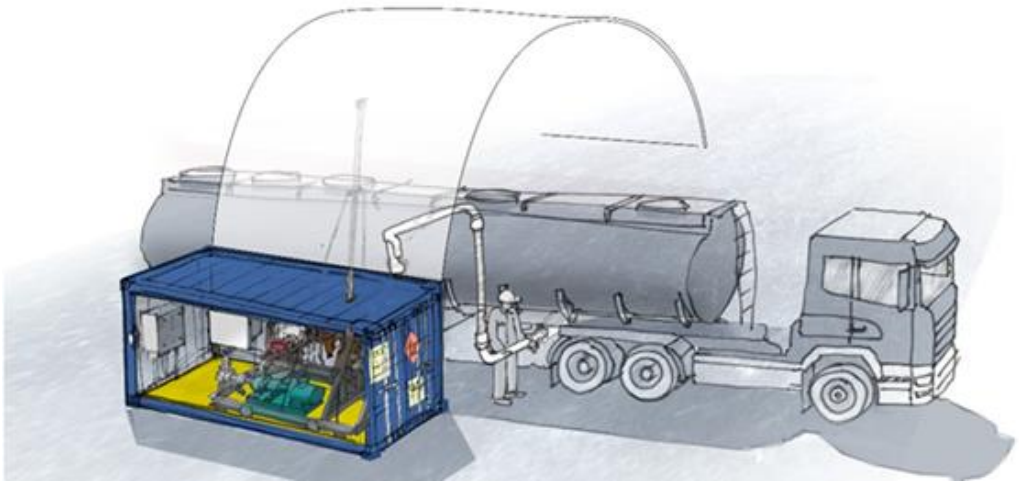
[19] Government Inquiry into The Auckland Fuel Supply Disruption, August 2019, Pg. x

3.8.1 Temporary supply

RNZ has shared a copy of their report provided to the Government Inquiry into the Auckland Fuel Supply Disruption on the potential for temporary mobile fuel truck loading facilities on one of the Auckland wharves for supplying jet fuel (or petrol and diesel) during an emergency response. These could also be quickly and easily be deployed elsewhere in New Zealand in the event of an earthquake or other civil defence emergency.

RNZ has completed an initial design for the skid mounted container discharge facilities (Figure 2) for use in a temporary situation along with a ship (the ship provides product and storage). RNZ advised these types of facilities are readily available and are commonly used around the world and that deployment could occur quickly (perhaps within a day). However, additional road tanker offloading facilities would be required at the Wiri terminal and/or the Auckland JUHI. The details of this design have been provided to each of the RNZ Users.

Figure 2: Skid Facility concept



RNZ's modelling suggests four Skid Facilities would be needed to fully supply Auckland Airport with around 4.3 million litres of jet fuel daily and that would require 21 certified jet trucks along with 42 qualified drivers. If there was a fleet of ten trucks and 21 certified drivers this would likely provide half the replacement capacity[20]. High level cost estimates provided to RNZ suggests the emergency facility (with four Skid Facilities) could be built for approximately $5m to $7m.

General feedback given to H&T during the consultations was that there are some key issues requiring further consideration, including:

- Confirmation of the quantity of jet fuel that could be delivered to the Airport from the Skid Facilities along with the investment required at Wiri/JUHI to facilitate that;
- Whether timely access to a suitable wharf can be guaranteed by Ports of Auckland during an emergency response; and
- That the Skid Facility will be operationally feasible (i.e. would coastal and/or import ships be capable of and prepared to pump fuel to these units).

[20] Our understanding is limited availability of jet capable trucks and conversion from other uses is not a straight forward process. It would likely take time to provide the necessary trucks and drivers.

In conclusion, the proposed Skid Facilities offer an alternative supply option for replacing Wynyard Wharf, but there are several outstanding questions. If these cannot be resolved, the RNZ Users should be required to seek alternative options to achieve a similar supply outcome as it is clear these would prove useful in both a civil defence emergency and for a major infrastructure disruption particularly now that Wynyard Wharf is no longer available.

4.0 Fuel disruption scenarios

This section summarises the disruption scenarios analysed, along with fuel companies feedback, while Section 5 covers the supply impacts. The 2017 Report covered the following disruption scenarios.

a. International disruption (major international event that disrupts 10% of crude oil supply for around six months)
b. Major (long term) disruption to the refinery at Marsden Point
c. Short term (three week) disruption to the refinery at Marsden Point
d. Major (long term) disruption to RAP/Wiri terminal
e. Short term (9 day) disruption to RAP/Wiri terminal
f. Major disruption at Wellington
g. Major disruption at Lyttelton (Christchurch)
h. Multiple port disruption

We have been asked to reassess scenarios a, d and e in light of the possible supply chain change. In addition, we have been asked to consider a product focused international disruption (e.g. a conflict in North Asia or the South China Sea), a pandemic (similar to 2020) and a more domestic focused product disruption (e.g. product cargo(s) quality unsuitable for discharge).

4.1 International Disruption – Crude

This scenario is unchanged from the analysis used in the 2017 (and earlier reports). In summary the disruption would be:

- Disruption of 10% (net of spare capacity) to the international crude oil market;
- Probability of 2.5% of this disruption in any one year (1 in 40 years); and
- 6 month duration.

Should New Zealand no longer have a refinery it is still exposed to crude supply disruptions as the product supplying refineries are still dependent on a reliable flow of imported crude. Many of these refineries are more dependent on Middle Eastern feedstock than Refining NZ. Therefore, it is still valid to analyse this case.

While the probability and duration have not been updated[21], we note that the last four years has seen some major disruption events in the Middle East, including a 2019 drone attack on the key

[21] Both the 2012 and 2017 fuel security reports looked back to a 2005 report from Oak Ridge National Laboratory. Similar analysis was carried out by some of the same people along with the US Department of Energy (paper published in 2018). This gave similar results to the 2005 study so we have not changed the basis of our assumptions. The report is available from this link

Saudi Arabia processing facility at Abqaiq. This cut Saudi Arabia's oil production by about half which is about 5% of global oil production. What is notable is Saudi Arabia managed to bridge the supply short from storage and restore operations within three weeks. The impact to international markets was a short lived price spike with no physical disruption of supply to consumers.

The response to this event gives assurance on the robustness of the international oil supply chain, although the scenario we analyse is a larger, longer term event which would require more international response, including use of strategic stocks. This is covered in Section 5.1.

4.2 International Disruption – Product

This is a new scenario to assess a product focused disruption rather than crude. We do not need to be specific about the particular scenario, other than it would be an event that impacted New Zealand's normal product supply chains.

Examples of the types of event would include:

- Hostilities or the threat of hostilities in North Asia that resulted in the cessation of product exports from South Korea and neighbouring countries;
- Hostilities or the threat of hostilities in the South China Sea that resulted in the interruption of crude supplies to North Asia and product supply from China/Taiwan (and possibly North Asia); or
- Interruption to Singapore exports from a pandemic or something similar in the region.

Unlike crude oil disruptions, there is no material available on the probability of an Asian product disruption. A 2017 Wood Mackenzie study noted that *"Global oil markets would be severely affected in the event of a regional conflict that affects South Korea, Japan and China, where about 65 percent of Asia's refining capacity is located"*[22].

While the likelihood of lesser disruption could be higher, for the purposes of this analysis we assume a major disruption (halting all product exports) for at least a month. The likelihood would be lower for such a major event so for the purposes of modelling (in the absence of any other information) we use the same 2.5% probability as for the crude oil disruption.

4.3 Long term disruption to RAP/Wiri

This scenario focuses on a long term disruption to the Wiri terminal so there is a major distribution issue in serving the Auckland market. The scenario is as previously modelled with the focus on any differences with 100% product import supply.

We do not explicitly model a scenario with a long term outage on the import terminal at Marsden Point as that will have a similar (although slightly larger) impact as the scenario already modelled. A Marsden Point terminal is likely to be more robust than most other port terminals due to its spread of storage over a larger land area and twin jetties, although remains vulnerable to tsunamis like most New Zealand port terminals. Its spread of storage facilities means a single fire/explosion event is less likely to disrupt the whole facility for an extended period as is the case for a more compact terminal like Wiri.

[22] https://www.cnbc.com/2017/08/31/a-north-korea-crisis-would-threaten-more-than-a-third-of-the-oil-moving-on-the-oceans.html

4.4 Short term disruption to RAP/Wiri

This is as modelled in the 2017 report and expected to be very similar to the actual RAP disruption in 2017. We modelled a nine-day outage but for this update, are now increasing this to 12 days based on the 10 day actual disruption. The 12 days includes the time to deal with the pipeline contents and a period of slower operation on start-up after disruption.

4.5 Pandemic

This effectively uses the 2020 pandemic response with a focus on how the response might change under 100% product import supply. There is no explicit modelling rather a commentary on whether the response would be different, more difficult or easier under 100% product import rather than the current supply system. New Zealand's pandemic response has provided insight into how demand (particularly petrol) can be significantly reduced through collective action such as encouraging or requiring people to work from home.

4.6 Product Quality

This scenario assesses the impacts of off-specification product cargoes, particularly the impact should there no longer be refinery processing in New Zealand.

4.7 Feedback on scenarios

- General comments were that the adjusted scenario cases gave a good range of cases to assess fuel security over.
- H&T had incorrectly noted the short-term RAP outage as being three weeks in the discussion document. In the 2017 Report the scenario was 9 days and this has been adjusted to 12 days, based on a 10 day outage and a couple of days to reflect the start-up process (and that Wiri stocks would never be taken to zero over the outage period in case the outage was extended).
- There would be a greater degree of flexibility with the number of product MRs under 100% product import and noted this would remove refinery disruption (but not RAP) as a single point failure risk.
- NZ specification product availability: There was variable responses on this with some feedback noting global specifications are becoming more aligned (making it easier to get NZ quality product from any region) and other feedback noting it would help (both for routine supply and emergency) if New Zealand specifications were more aligned to international norms. Specific mention was made on the differences with Australia specifications (for petrol), although it was noted that these will be more aligned from 2027 once Australia tightens its sulphur specification.
- All companies highlighted the value of stock on the water in responding to any scenario given the ability to move this stock to other locations at short notice. This also applies to the ability to move product that might have been coming to Australia in an emergency and the large terminal stock only 5 days sailing away (East Coast Australia) was also noted as a response option.
- The ability to possibly waive/relax some product specifications in an emergency response is seen as a key tool to assist in a supply disruption.
- For the North Asian disruption scenario, in many ways product supply is more diverse than crude as most major locations can make New Zealand specification product, unlike crude that is normally limited to only those that can be efficiently processed at RNZ.

- There was agreement that New Zealand is likely to become more dependent on North Asia with 100% product import supply.
- Pandemic response is probably easier under 100% product import as there are simplified supply options and it should be easier to manage variable demand impacts on each product.
- Off-specification cargo risk is mitigated as most imports to New Zealand are multi-grade so it is likely only one grade is off-specification rather than whole cargoes.
- Inability to reprocess off-specification cargoes (no refinery case) will have an impact if the product is well off-specification where it cannot be fixed by terminal blending.
- Companies thought the risk assessments in the previous report followed a reasonable approach but were unwilling to speculate on increased risks in the global environment.
- Several companies noted New Zealand needed to be 'in-step' with the global transition to a low carbon future to avoid risk of dislocation from global supply chains.
- Noted that the main constraint on the scenarios that cause local disruption is the availability of trucks/drivers rather than stocks.

We do not comment on this feedback here, rather pick up the points made in the analysis of the disruption scenarios in the next section.

5.0 Scenario disruption details

This section considers the likely impact on fuel supply for each of the disruption scenarios. For the onshore disruption scenarios, the key constraint remains prompt access to trucks and drivers with little direct difference in outcomes for either the refinery or 100% product import supply routes, although the ability to manage operations for those disruption events may vary. We expect the probability and cost impacts will remain similar to the 2017 assessment. A summary of the operational differences is provided at the end of each of the local disruption scenarios.

5.1 International Disruption – Crude

The international crude disruption scenario is little changed from the scenario covered in the 2017 Report. It is only briefly summarised here before an analysis of whether the consequences on New Zealand will be different with a move to 100% product import supply.

In summary the event assumes:

- Disruption of 10% (net of spare capacity) to the international crude oil market
- Probability of 2.5% of this disruption in any one year (1 in 40 years)
- 6 month duration

The expectation is that the actual shortage will be mitigated by countries releasing their strategic reserves (both IEA countries and other countries with reserves such as India and China). There would be an immediate impact on prices (increase) which will help stimulate supply (i.e. rising prices will encourage additional supply as well as use of any spare capacity) and reduce demand. However, the release of strategic stocks will mitigate the initial price rise.

As calculated in the 2017 Report, the initial shock of 10% disruption would be expected to see a price increase of around 74% but once emergency stocks begin to be released this would fall to an increase of 37%. This has the following impact on international and local prices.

Table 3: Impact of International disruption[23]

		Initial response (10%)	Likely settled response (5%)
Increase in base price		74%	37%
Crude oil price (assuming base price US$50/bbl)	US/bbl	$87	$68.5
NZ petrol price increase	Cpl (%)	+47 (22%)	+24 (11%)
NZ diesel price increase	Cpl (%)	+47 (35%)	+24 (18%)
NZ jet fuel price increase[24]	Cpl (%)	+41 (75%)	+21 (37%)

The New Zealand price increases shown in Table 3 assumes refining margins and freight also increase due to the disruption. The local diesel and jet fuel increases are proportionally larger due to a lower taxes in the total cost. The exchange rate assumption used is USD/NZD 0.66.

Stocks held in New Zealand would not have any impact on the price changes above, but New Zealand's international ticket holdings mean that it could participate in the stocks release, assisting the impact on prices. Earlier analysis (The 2012 NZIER Report) concluded that while an international event was likely to have larger potential impact than domestic scenarios due to the price impact, it did not justify stockholding locally as this would not prevent the price rise.

The following table summarises any positive or negative impacts on the response to a global crude disruption from a change to 100% product import supply.

Table 4: Differences in scenario with 100% product import supply

Positive	Negative
■ New Zealand would not be directly impacted as doesn't import crude ■ New Zealand's major product exporters are either IEA or IEA Association members	■ New Zealand's supplying refineries would be affected ■ Countries with refineries may be reluctant to allow product exports if uncertain about their own crude supply ■ No longer have the fall back of ability to at least generate some product from New Zealand crude

In summary, while the scenario would play out is a similar way (price rises), New Zealand will now be dependent on its product suppliers continuing to export in such an event, rather than primarily efforts to maintain crude supply to the refinery. While this changes the risk profile, it is difficult to assess the overall impact, except to say crude producers are typically quite dependent on getting crude flowing again to keep their finances on track. By comparison, product exporting countries' economies are not so dependent on the fuels income, so are likely to ensure domestic supply security is sound before allowing exports.

[23] We left this table using a base price of US$50/bbl as in the 2017 report. While the current price has been closer to US$40/bbl recently, US$50/bbl is a better reflection of most companies long term price outlook.

[24] No GST impact included as jet fuel is not retail

Having noted that, New Zealand's major product suppliers (and other countries likely to provide supply in an emergency like the United States) are IEA or IEA Association members so, in theory, are part of an arrangement where countries are supposed to work together to share impacts in such a scenario.

5.2 International disruption - Product

For this hypothetical scenario we assess disruption to North Asia product supply such that for a period product exports cease from South Korea, Japan, China and Chinese Taipei. As noted in Section 4.2, North Asia contains about 65% of Asian refining capacity and while much of this is domestic focused, some of these countries are major products exporters (particularly South Korea).

Currently New Zealand imports approximately 35% of its product from this region and this is expected to increase in a 100% product import scenario (to ~ 50% based on H&T modelling).

The immediate reaction to a North Asia disruption will be an increase in product prices in Asia reflecting the loss of supply. This will not necessarily translate to a crude price increase as crude consumption may reduce, although this could be offset by locations with excess refining capacity increasing throughput. The Asian product price increase is likely to have the impact of:

- Increasing refinery throughput where possible at non-impacted regional refineries (e.g. Singapore in this example);
- Reducing demand due to the price increase as it flows through to market; and
- Attracting product from other regions, particularly the United States, India, Middle East and Europe.

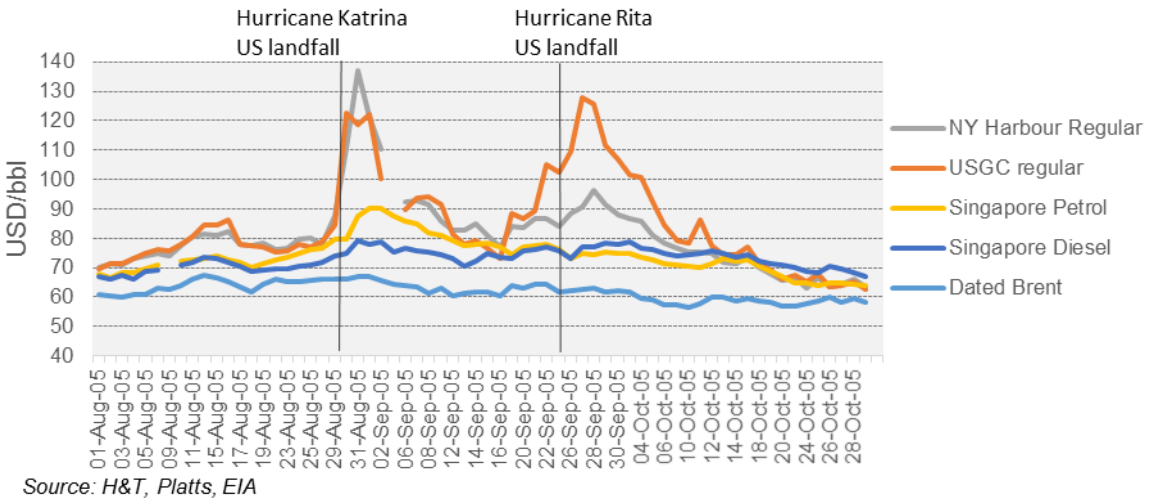
The most significant of these is the change in product flows. Product normally flows between regions as traders look for opportunities to trade the price difference between regions where it can more than cover the shipping cost. Within Asia we normally see a flow of petrol into the region and a flow out to other regions of jet and diesel. A disruption will change these flows as the price increase will see an incentive for all products to flow into the region.

The best example of such a market response was from the disruption to the United States (US) product markets in 2005 when Hurricane Katrina impacted about two million barrels of US Gulf Coast refining capacity.

Figure 3 shows the price changes following the hurricane's landing. There was an immediate sharp rise in US product prices (although as expected very little impact on crude prices). European and Singapore markets then rose as traders looked to secure product to move to the United States. This was a normal market response to the arbitrage opportunity that had opened, with the substantial price difference encouraging as much flow of product as there were ships available to transport it[25]. Within a day, the other main product markets were responding and in Singapore over the next three days, the petrol price rose by USD10/bbl (petrol was the main product import required for the US).

[25] The bulk of product imports came from Europe and the IEA response which included a preference for releasing product stocks (in Europe) would have assisted in the flow of product from Europe to the US.

Figure 3: Price changes during Hurricane Katrina (2005)



Source: H&T, Platts, EIA

This market response quickly mitigated the US price rise which then dropped to a level where the arbitrage was still open (as the refining capacity was lost for some time) but only at a level to keep the import flow maintained. The premium in other regions also declined as markets responded to the extra incentive to produce petrol.

This disruption event provides a good example of the global interconnectedness of petroleum markets and a suitable case study for considering supply responses to a similar disruption in the Asia-Pacific region.

As product flows from other regions to replace the lost production is likely to be the major supply response, our analysis looks at the timing for those replacement supplies, and how New Zealand might manage in the interim. It is reasonable to assume that:

- New Zealand will have reasonable product supply in country of around 20 days (net) with stocks expected to only vary +/- 5 days;
- As noted in Section 3.5, less stock is needed to 'run the system' with 100% product import so stocks can be taken lower; we assume absolute minimum stock will be 5 days (net), giving a drawable stock range of 10 to 20 days;
- There is likely to be another 17 days of stock on the water that will not be impacted by the disruption;
- New Zealand's 50% of imports met from other sources (outside North Asia) will continue to be supplied (as these are already contracted).

The issue is the cargoes that were expected to be loaded in North Asia over the next month to meet around 50% of New Zealand's demand will now not be loaded and therefore, can the country manage for the period of time that will be required to secure product from locations that in most cases require longer shipping journeys.

Table 5 provides a summary of the likely product impact for a North Asia disruption scenario for each of the likely alternative supply route options. In the case of supply from the US or Europe we assume the initial supply route will not be able to access the shorter shipping route through the Panama Canal due to the likely inability to obtain access at short notice, although for later cargoes this would become the preferred route from those locations.

Table 5: Summary of the disruption impact

Location	First discharge	Supply gap	Stock impact	Onshore stock draw	Likely shortfall
Singapore	25 days	8 days	4 days	10-20 days	nil
Other SE Asia	25 days	8 days	4 days		nil
India	31 days	14 days	7 days		nil
Middle East	40 days	23 days	12 days		max 2 days
USA	43 days	25 days	13 days		max 3 days
Europe	43 days	25 days	13 days		max 3 days

The key assumptions in this analysis are:

- First discharge is the time to organise, ship and arrive at first port in New Zealand in an emergency scenario from each location. The assumptions (for Asia) are in line with industry feedback for securing prompt cargoes in a supply emergency,
- The supply gap is the difference between that time and the timing of the cargoes now no longer been delivered from north Asia (17 days).
- The stock impact recognises stocks are needed to cover the 50% loss of imports for the time gap.
- Onshore stock draw and likely shortfall then calculate whether onshore stocks will be sufficient to provide the cover needed.
- The initial lead time to secure a cargo (included in time to first discharge) for loading in an emergency response situation would be seven days for most locations, although for the US and Europe this may be quicker at around four days given the significant stocks held in these locations[26]; this is much faster than would normally occur.

As shown in Table 5, for most of the alternative supply routes we expect the gap in supply arising from the switch to the new location can be covered by drawing down onshore stocks. Even for supply from the Middle East, USA, Europe (which may be more likely supply options due to the call on supply across the region for more product from the remaining regional refineries) the gap in supply is only likely to be material if onshore stocks were near the bottom of cycle. With the stocks available onshore, together with 17 days supply on the water, industry would have significant time to plan for any shortage, and we would expect only localised disruption as companies look to spread the reduced supply across New Zealand in the worst case.

The other key point to note is that during this period New Zealand's supply resilience will be reduced and if there a surge in demand (i.e. panic buying) this could see an increase in localised service station stockouts. However, this will be mitigated by any likely shortage being well after the news of the initial disruption so any surge may work its way through the system while supply is still normal.

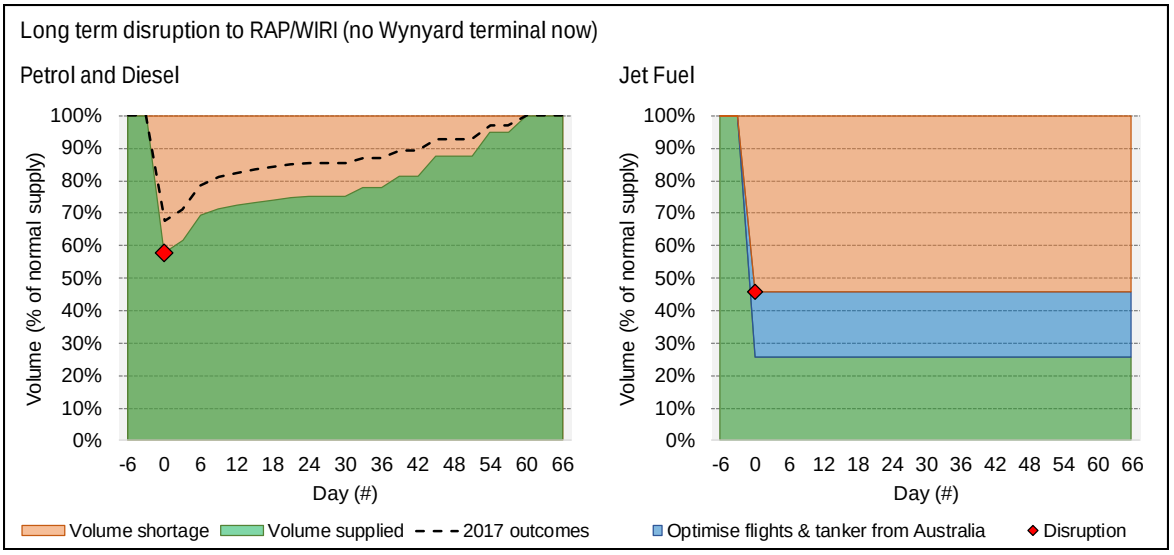
In conclusion, expected inventories should be sufficient to manage a major North Asia supply disruption, however, that is contingent on companies holding stocks at around 20 days net.

[26] This was demonstrated with the speed of product supply coming out of Europe after Hurricane Katrina

5.3 Long term disruption to RAP/Wiri

This scenario assumes long-term disruption to the Wiri terminal impacting supply into the Auckland market. The scenario outcomes are the same for both the refinery and 100% product import supply routes as the key constraint is availability of trucks and drivers to ramp up supply from the TLF and Mount Maunganui Terminals. The biggest impact for this scenario compared to 2017 is the loss of Wynyard Wharf terminal as a closer supply option (albeit only for diesel) with less volume now supplied due to the same initial trucking assets having to travel further distance.

Figure 4: Impact on supply from long term disruption to the RAP/Wiri terminal



5.3.1 Petrol and diesel impact

For petrol and diesel ultimately 100% of the supply can be met from the neighbouring terminals once sufficient trucks and drivers are in place, but this will take time. Initially trucks in the upper North Island will be used to resupply Auckland with spare trucks and drivers (10 units[27]) expected to arrive soon after. While maximising utilisation of the trucking fleet and using other measures like shifting demand from the region and improving distributor fleet utilisation will then help, the final solution will be the arrival of offshore trucks and drivers from weeks four to eight[28]. In total 30 offshore trucks would now be required (versus 14 in 2017) due to the loss of Wynyard Wharf.

The petrol and diesel disruption will be at its worst in the first couple of weeks (Figure 4:) and then gradually ease. Over the whole period (60 days) the short is 22% of demand in the upper North Island (126 million litres), although for the first two weeks the short is 40% (52 million litres). With the increased trucking activity, the loading gantries at the TLF and Mount Maunganui terminals would be under significant pressure.

Previous analysis has not assumed demand restraint as significant mitigation option, but as seen for the pandemic response, if New Zealanders were able to achieve savings similar to those when at alert level 2, this would save around 750kl of petrol daily. If this was sustained for the first four weeks of the disruption that would reduce the shortfall by around 23 million litres.

[27] Consultations with companies in 2011 identified the equivalent to 10 spare trucks available for use in an emergency and communications with companies for this report confirmed these assumptions are still valid.

[28] Timeframe for importing trucks and getting offshore drivers was verified during the 2011 consultations.

5.3.2 Jet fuel impact

The jet shortage would be similar to 2017 with Wiri terminal the only real means of getting jet fuel to Auckland Airport (under normal supply this would be ~80% of national demand). The impact will become apparent quickly as the Airport JUHI currently only has a couple of days stock. Should the additional stock being held as a result of the Auckland Fuel Disruption Inquiry still be available (i.e. not impacted by Wiri incident), then there may be some more stock available initially, although due to the long term nature of the scenario will not mitigate the major shortages.

The options for mitigating the loss of supply remain the same with around 34% of the demand able to be covered by airlines either optimising flights or refuelling at Wellington and Christchurch. A further 9% will likely be covered by tanking fuel on the Australian flights. This would leave a further 57% (around 2.5ml/day) of demand that would not be met so would require actions such as diverting flights via Australia or Fiji for refuelling with major adjustments to the Auckland flight schedule expected over the period.

5.3.3 Operational impacts for 100% product import supply

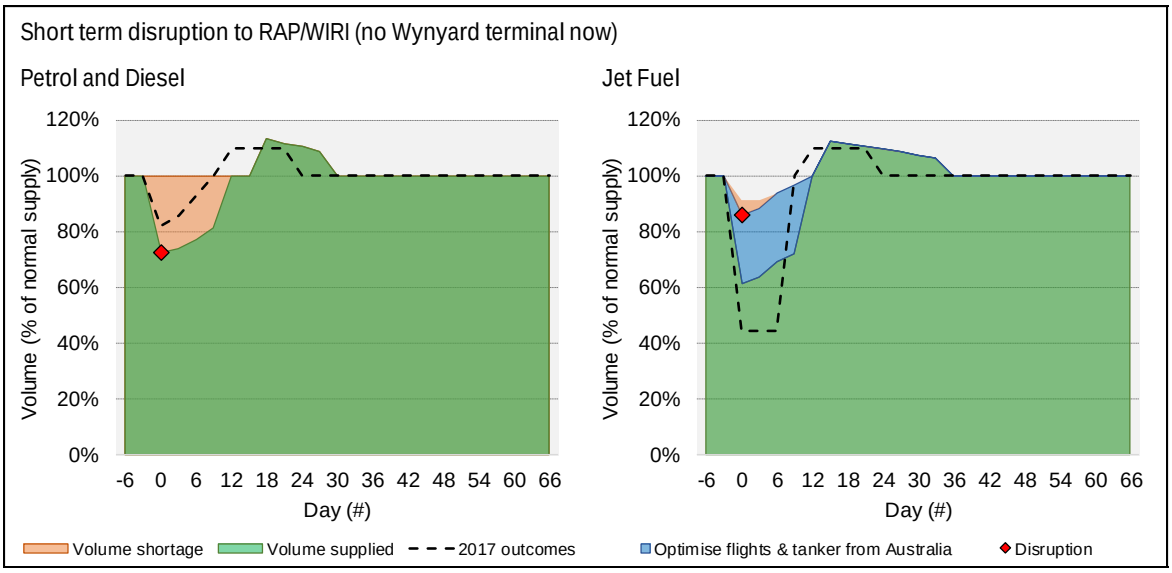
While the magnitude of the supply disruption impact is expected to be similar for both the refinery and 100% product import supply routes, the operational management of these impacts will differ for each of these supply routes, such as:

- For refinery supply, loss of RAP/WIRI would quickly see jet fuel stocks build at RNZ, with options to redeploy this stock at other New Zealand ports limited by the amount of demand the airlines can shift to other airports. This could see refinery production slowed or even stopped until regular jet fuel exports can be arranged.
- With 100% product import it will be easier to relocate imports to other ports and in the case of jet fuel, this could even be delivered to other international ports like Sydney or Nadi to assist with meeting increased jet fuel demand at those locations as airlines start diverting flights via these locations to refuel.
- While the proposed Skid Facility (if built) would provide an alternative supply route for Auckland, this would require vessels to remain at the berth to provide floating storage with capacity to pump product to the skids. In the short term it may not be practicable to find import vessels for this, which could mean these may only be useful as a medium-term solution or more promptly if there remains a coastal tanker fleet.

5.4 Short term disruption to RAP/Wiri

The scenario assumes an incident or natural disaster causes damage to RAP with it taking 12 days to repair the pipeline, clear the contaminated product from the pipeline and restore operations. In this case we assume four days drawable stock at the Wiri Terminal for petrol and diesel and for jet fuel that there would be eight days stock (including stock at the JUHI) from the recommendations from the RAP Inquiry having been implemented ahead of demand increasing to pre -COVID levels.

Figure 5: Impact on supply from short term disruption to the RAP/Wiri terminal



5.4.1 Petrol and diesel impact

Trucking is the primary response option with spare trucks and drivers expected to be relocated to the region within a week, increasing the volume of petrol and diesel able to be supplied from the TLF and Mount Maunganui Terminals. While some of the fleet that normally uses Wiri will remain there to access the remaining stock, the rest will be redeployed to the neighbouring terminals.

Despite the remaining Wiri stock smoothing the disruption, around 32% of normal petrol and diesel demand (27 million litres) will not be able to be supplied over the 12-day period, which is significantly larger than the 13% shortfall in the 2017 report. If demand restraint (like COVID alert level 2) was achieved after day two, this would reduce the short fall by ~7.5 million litres, reducing the shortfall to around 23%. In the 2017 RAP outage companies reported only a few service station stockouts, with much of the shortfall covered by drawing down service station stocks. However, with the shortfall now much larger due to the loss of the Wynyard Wharf terminal, we expect there would be more service station stockouts.

5.4.2 Jet fuel impact

In this update, the modelling assumes 2019 demand (i.e. post COVID situation) and that there will be at least eight days of drawable stock at the Wiri Terminal and JUHI (i.e. reflecting new tanks), although this could be as high as 12 days stock if Wiri has just been replenished. Figure 5: shows how the worst case (8 days stock) situation might impact. Most of the demand is now expected to be covered by drawing down Wiri stocks (67%), optimising flights and shifting domestic demand to Wellington to Christchurch airports (18%) and some tankering from places like Australia (8%). In the worst case (stocks at bottom of cycle) only 7% of demand would remain uncovered.

While our modelling still shows a shortfall, the additional stock has allowed some of the more extreme mitigation measures used in the 2017 disruption (such as airlines diverting international flights via Christchurch to refuel) to be dropped to reduce the impact on passengers and cost.

5.4.3 Operational impacts

Like the long term Wiri/RAP outage, the magnitude of the supply disruption impact will be similar for both the refinery and 100% product import supply, with similar operational impacts for each of the supply routes.

The key differences for this short-term outage are:

- While jet fuel stocks would build at RNZ under the refinery chain, this is less likely to result in refinery production being slowed or even stopped, due to the much shorter outage period with that allowing temporary options such as returning jet to the crude tanks for reprocessing later. A jet export may be required in future to bring stocks back down to normal levels.
- For the 100% product import supply option, while discharging jet fuel at other locations would be easier, given the short term nature of the outage it seems more likely that ships will be held out once the import terminal tanks are full, until there is ullage to discharge the jet, particularly if the Skid Facility (or something similar) is not an option.

5.5 Pandemic

The scenario to consider the impacts from a pandemic has not modelled the response (as New Zealand and the fuel industry have experienced these impacts this year) but rather assesses whether a change to 100% product import supply would change how that response would happen.

The impact of the 2020 Covid-19 pandemic was a dramatic fall in demand for all products, but with different impacts on each:

- For petrol, the impact was dramatic during the Level 4 lockdown with demand around 20% of normal levels, although this recovered almost immediately with each relaxation of levels (~50% for Level 3, above 80% for Level 2 and close to normal for Level 1).
- Jet fuel started falling with increased border restrictions prior to lockdown and then fell substantially in the Level 4 lockdown to 25-30% of normal levels. This level of demand was sustained primarily by freight and repatriation flights (both to and from New Zealand). While domestic demand recovered with the level relaxations, international border restrictions means total demand (international and domestic) remains at about 35% of normal, and that is unlikely to increase much until there is quarantine free travel to at least some countries.
- Diesel dropped substantially in Level 4 (to around 50%) but was not so impacted at other levels as commercial activity was more normal. At times in Level 2/Level 1 use was higher than normal levels which is likely to reflect some catch up from the shutdown period and an increase of online shopping.

The variation in impact on each product made it more difficult for the industry to manage, as refineries normally produce products in line with market requirements with imports managed around that production capacity to infill the gaps.

In general companies felt the response would probably be easier under 100% product import supply as:

- There are less issues to deal with (fewer supply options to consider);

- There will not be issues with the refinery producing excess of a now unwanted product (jet) while still trying to meet the requirement for other products; and
- It is a shorter time frame to adjust product supply (e.g. product mix) than to try and adjust the crude slate.

In practice, in both cases the sudden demand shock is managed by paying demurrage on ships (payment for the ship to sit idle while waiting for ullage to discharge its cargo) but the product ships provide more flexibility to manage the different demand impacts than for the current crude/product mix. It may not change the overall cost impact a lot (not taking into account refinery margin impacts), although H&T agree that it should be easier to manage.

Companies also considered that the sharp rise of demand following a pandemic would be managed without a refinery, as the system (storage) is likely to be at capacity along with possible stocks held on ships at anchor after the demand destruction. Even if the supply chain is slowed down to reflect the lower demand, the high stocks would give them time to adjust their import schedule along with the shipping time (likely to be a 20-25 day adjustment) to meet increasing demand. Having noted that, some early warning of possible level changes is likely to ease the adjustment for fuel suppliers, particularly if the pandemic had required a long period of restrictions giving companies time to have started reducing stocks closer to normal levels.

It could be that a future pandemic (or something similar) could have a more extreme impact than Covid-19, to the point where, for a period New Zealand's borders were closed to imports/exports as well as people. In this case the loss of a refining capacity would have an impact on fuel availabilities. This point is picked up in Section 6.5.3.

5.6 Product Quality

MBIE asked H&T to consider a scenario involving product quality issues with imports. Companies have strict quality processes in place to ensure delivered quality is suitable but from time to time there are quality issues either due to the product initially supplied, from an event on the ship (such as contamination), or a terminal issue (e.g. errors on discharge). Typically, companies look to sort these issues at a terminal level where the off-specification product is isolated and blended into on-specification product at a rate that keeps the resultant product on-specification.

Occasionally, the problems can be too severe to manage by terminal blending and currently that product is taken to the refinery for re-blending or re-processing. With no refinery in New Zealand there will be no local option to correct off-specification product if it can't be managed in a terminal, instead it would need to be exported.

Companies agreed that might be the case but noted that a number of factors mitigated the impact that might arise from an off-specification cargo including:

- Many imports are mixed product cargoes and it is usually only one of the products that is off-specification;
- The larger terminal at Marsden Point may provide more flexibility for correcting off-specification product through blending than existing terminals;
- They all have independent supply chains so a product quality issue is likely to only impact one company (compared to now where a refinery quality issue could impact nearly 70% of the market); and
- The frequency of import cargoes provides some flexibility to cover the 'hole' cause by a product quality issue.

H&T agrees these factors may mitigate the problem but there are already single grade imports, and these may increase in frequency with the move to 100% product import. We therefore look at the impact of a whole cargo being off-specification for a worst case scenario, even though for a single grade import, it may only be some compartments on the ship that are off-specification. From a national demand level, a whole cargo (MR tanker) of each of the main product grades is only around 6 days supply for petrol, 9.5 for jet and 4.5 for diesel.

If the country is holding around 20 days net demand of each product than it should be able to manage a temporary (until replacement cargoes arrive) loss of product on each of these grades, although in the case of a whole jet cargo, we expect it would put the system under some stress. However, import cargoes are currently (and expected to continue to be) individually owned by a company. For any one company (and it is only the companies with larger market shares who are likely to consider single grade imports), the impact could be more severe and they may need to make arrangements with other companies to help cover their requirements (i.e. pay for cover).

The solution may require other import ships to make additional port calls to cover locations not supplied with the off-specification product and normal terminal buffer stock should normally be sufficient to manage this. In the instance where a terminal is only supplied by the company with the off-specification product and that is the only terminal in that location (this is relatively unusual in New Zealand), there may be additional trucking required unless arrangements are made for deliveries from other companies.

H&T sees this as an important risk that fuel companies should be left to manage as this is one of the factors that feeds into their inventory decisions and why they will be driven to maintain certain levels of stock. A company does not want to stock out its customers or be exposed to buying cover from a competitor to manage a product quality issue at what would likely be a high cost.

The Government already has a policy (as part of the New Zealand ticket stock storage tender) that any domestic emergency stockholdings will not be made available to help one company with a supply issue. This is a sound policy as it means companies need to make normal commercial decisions to set stockholdings as they will not be able to rely on any domestically held stock to assist if they get their product supply wrong (from product quality or any other issue).

Therefore, while the risk from off-specification product does increase with no refinery reprocessing option, this risk should remain with companies to manage as part of their normal commercial stock decisions. Even if there is a decision to hold emergency stocks in New Zealand, H&T believe the restriction on those stocks not being made available to help an individual company's supply issue should remain to ensure companies make the right commercial stockholding decisions.

6.0 Contingencies/mitigations

Within New Zealand, the fuel industry has been responsible for managing domestic supply security to date. MBIE has asked H&T to consider possible mitigations to supply disruptions including their cost and benefit. Mitigations that have been mentioned include:

- Some means of ensuring supply diversity;
- An arrangement giving prompt access to back-up stocks if required;
- Means of ensuring a certain level of stocks in country through options such as:
  a. Dedicated in country additional stock (whether government or industry owned); and

b. Minimum stock obligations (generally related to a minimum days net stockholding for each industry participant).

This section covers the benefit of mitigation options, more detail on compulsory security fuel stocks options, the cost of mitigation options before covering industry feedback.

6.1 Benefit of mitigation options

6.1.1 Supply diversity

The benefit of supply diversity is that with a range of source locations, there is more flexibility to adjust supply reducing dependence on a single source/location. A resilient system is likely to have a diverse supply chain.

Currently New Zealand's product supplies primarily come from the two main export hubs in the Asia-Pacific Region, Singapore and South Korea. In 2019, these countries made up over 80% of product imports although it should be noted both countries have a number of export refineries, so this still reflects a diversity of refinery sources. Smaller volume suppling countries include United States of America, Australia and Japan and in previous years there have been reasonable volumes from China and Chinese Taipei.

The benefit from having good supply diversity is seen in the North Asian disruption scenario discussed in Section 5.2.

Feedback from the consultations was that simply looking at supply locations for product imported to New Zealand may not provide an accurate reflection of each company's supply chain diversity, rather this will reflect their most economic supply routes at that time. Companies suggested their supply options are normally wider than the locations where supply is normally sourced from. While there were no clear suggestions for how MBIE could assess supply chain diversity, one idea was for each importer to periodically provide details of their supply chain arrangements and options.

6.1.2 Back-up stocks

Back-up stocks refer to stocks suppliers have in their systems generally to support their normal commercial activity rather than dedicated strategic stocks which are covered below. These might be stocks held at trading centres to support trading activity and/or supply to a number of countries in the region.

Typically, only the larger trading companies are likely to hold these stocks although arguably companies with large refining and/or terminal complexes also hold what could be regarded as back up stocks (normal operating buffer stocks).

A firm arrangement giving prompt access to stock would be something new to the market and is likely to come with a cost (it could look like a ticket option). However, as this stock is normal stock in the system, companies are likely to try and use it in supply disruption if needed anyway, so a firm arrangement may not be required.

The benefit of such a firm arrangement would be timing as the product should be available a little quicker than securing prompt supply. However, as the stock is likely to be held in or near a trading centre (e.g. Singapore) the time difference compared with normal prompt trading activity is likely to be marginal, as a ship would still need to be secured. We estimate at best this is only likely to shorten the resupply time by around 3 to 4 days.

6.1.3 Strategic stocks/minimum stock obligations

Strategic stocks may be held separately or together (co-mingled) with normal commercial stocks but would be a deliberate strategy to hold higher stocks than otherwise would be held under normal commercial activity. The stock level below the specified minimum could only be used by the company when authorised by the government.

The benefits are that the stock can normally be fairly quickly made market ready, particularly for stock held in country. The other advantage of stock held in country is it may be useful in a domestic disruption which is less likely for stock held offshore. The different options for strategic stocks are covered in the next section.

6.2 Compulsory security fuel stocks options

Strategic stockholding regimes vary between countries. Approaches reflect different national attributes and national policy choices. These include:

- Oil market structure (net importer/exporter, upstream producer, in-country refining sector, presence of majors/independents/national oil companies);
- Geography (sea ports/land locked, proximity to production hubs, distribution channels); and
- National emergency response policy settings (energy self-sufficiency, demand response tolerance, fuel quality and switching flexibility, international obligations and affiliations).

The more complex stock threshold schemes tend to be supported by a multilateral organisation like the IEA, although many countries outside the IEA also hold security stock. For member countries of the IEA, the minimum stock volume is a measure of net imports (90 days import self-sufficiency), while the EU allows for a measure of consumption cover (61 days use), whichever is higher. Rules of international organisations may also govern the type of stocks held (crude/products) and in what locations (in-country, internationally under bilateral agreement).

There are many different approaches to how security stocks are held in IEA and non-IEA countries (Appendix 1 provides a summary of these). Most include some obligation on industry participants (refiners, importers, wholesalers) to hold reserves relative to their domestic sales/consumption and/or imports. The main stock holding structures are:

- Government owned and financed stocks held only for emergency purposes (e.g. NZ, Australia, USA)
- Stockholding Agency. Can be Government or industry-sponsored and funded but uses stocks only for government authorised emergency (e.g. Germany, Belgium)
- Industry Obligation. Stakeholders must maintain minimum stocks subject to government direction in an emergency. Stock volume is related to domestic market share (e.g. UK, Norway, Thailand)
- Combination Government and Obligated industry (e.g. Japan, South Korea)
- Combination Agency and Obligated industry (e.g. France, the Netherlands)
- National Oil Company used as holder of public emergency stocks (e.g. Indonesia)

The complexity of the design and government regulation correlates to volume held and the cost of measures.

Table 6: Typical IEA member stockholding model options

	Ticket Stocks	Tickets and physical stocks	Physical Stocks
Government owned or agency	New Zealand, Australia	Ireland, Germany	USA
Combined government owned and industry obligation		France, Netherlands	Japan, South Korea
Industry obligation	Luxembourg	United Kingdom	Austria

Increasingly complex regulation required.

Change in cost not certain but may be higher.

Increasing cost and complexity; capable of managing more volume

Source: Hale & Twomey

This report does not analyse which structure would be most suitable for New Zealand should fuel security stocks be held in New Zealand but notes initial Industry feedback preferred (should the decision be made to hold security stocks) either the government take responsibility (as now), or a common industry stock agency be allowed. We note the IEA considers that best practice is to set up a Stockholding Agency and recommends that stocks held include a share of refined products.

6.3 Cost of mitigation options

6.3.1 Diversity of supply cost

All companies noted that to force an outcome on supply for diversity reasons different to what is driven by best economic outcome would increase costs. While no companies would put a figure on it, to give an order of magnitude the table below shows the impact should a portion of the supply cost increase by US$1/bbl[29].

Table 7: Indicative cost impact from imposed supply diversity

	Lower cost estimate	Higher cost estimate
Portion of market impacted	25%	75%
Cost NZ$/kl	2.4	7.3
Cost NZ$ millions/year	21	64

The cost could increase by between 0.2 and 0.7 cents per litre across the total New Zealand demand. In total costs could increase by NZ$ 21-64 million each year. These estimates are only to provide an indication and, while directionally in line with the feedback from the consultation, have not been reviewed by industry.

[29] We use US$1/bbl as reflective of a significant increase in import cost (companies would change suppliers for a much lower margin gain) without the cost of forcing supply from a completely different region.

6.3.2 Back-up supply cost

We have not costed this option, as based on the consultation feedback it didn't seem to be a realistic option in terms of making a payment to try and speed up a process that the companies will be responding as quickly as possible anyway. In effect, a payment is likely to turn it into a storage option which is covered below. Paying a cost similar to a storage option for back-up supply is likely to be substantially more cost than the value obtained from a few days saved in resupply time.

6.3.3 Storage options cost

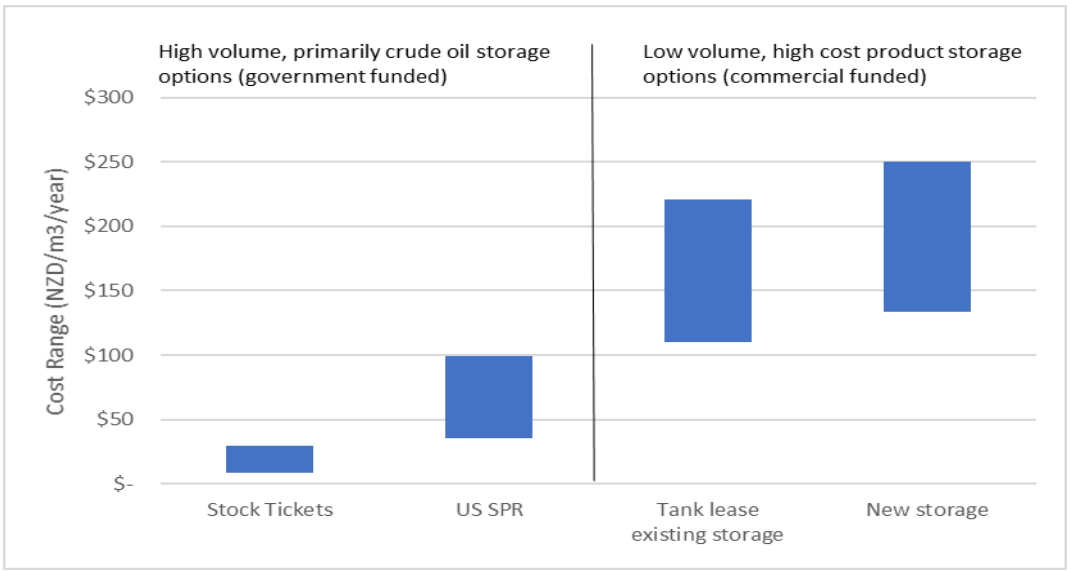
The cost of storage depends of a number of factors with the main drivers being the price of the fuel stored, the cost of the capital required for the storage (taking into account where that needs to be built) and the volume of stock held. Figure 6 shows the range of costs for various storage options where those on the left reflect high volume, primarily crude storage options that the government might do, and those on the right, reflecting in-country product storage options in a commercial market.

The chart highlights the value provided using ticket stocks to ensure compliance, with the cost between 8 and 15 times cheaper than holding stock in new storage. The benefit from having higher cost stock in-country to assist for domestic disruption needs to provide a benefit greater than the cost difference with tickets to provide economic value.

The large range in the cost of storage options also highlights the impact of the return required on the capital invested on the overall cost. Structuring storage options where they can be financed at lower rates of return than normal commercial expectations can have a significant positive impact on the overall cost to industry/consumers.

The cost of repurposing tankage for use as strategic storage is expected to be cheaper than building new storage (would not be worth the conversion otherwise). We would expect any company doing conversions to base the revenue stream on likely tank lease income. Therefore, the cost range shown for 'tank lease existing storage' in Figure 6 should cover the expected costs should tanks be refurbished. Both the tank lease and new storage cost ranges include the same cost for stockholding so the difference between the two options is in the storage cost.

Figure 6: Range of cost of storage options



Assumptions

- Offshore stock ticket costs are based on New Zealand's experience to date – the cost may increase should the strategy change.
- Crude oil held in the US SPR reflects a government based cost of capital (range of 3-7% used).
- Tank lease cost based on commercial product storage which is higher than the cost of crude oil strategic storage.
- Commercially funded options use a range of 6-12% return with the lower end reflecting a structure which turns the requirement into more of an infrastructure play than normal commercial funding.
- New storage reflects the likely cost of building new tanks close to or within existing terminals and the associated related costs (maintenance, land, etc.).

Minimum stock holding obligations

Introducing minimum stock obligations could ensure companies keep stocks above a level the government deems appropriate. For example, should the government set a minimum days stock level of four days above the minimum the companies might otherwise operate to, assuming the maximum inventory does not change (no new tanks), the average inventory held might increase by two days.

The cost of such a strategy will include:

- The cost to companies from holding higher inventory than they otherwise would;
- Additional port drops on import ships as there is likely to be reduced useable ullage and/or dead-freight[30] on imports due to not being able to load ships to capacity; and
- Possible need to invest in more storage to avoid increased supply cost.

H&T analysis shows that the increased supply cost should all import ships require an extra port call would be about NZ$3/kl. This would be $27 million per year over the whole market. It is likely a dead-freight solution would be similar or slightly higher cost.

While there is no certainty that all import cargoes would need extra port calls/demurrage, certainly some of the importing companies could be impacted with this level of costs. H&T agrees with feedback given in the consultations that the impact of this may not be even over the market due to the supply dynamic and terminal options for each of the market participants.

If the aim is only a marginal increase in stocks then this may be a high cost option compared to the dedicated storage options costed above.

6.4 Industry feedback on mitigation options

6.4.1 Supply diversity

- All companies felt supply diversity should be left to industry as any imposed requirement would increase the cost of supply and may cause market distortion. Companies noted it is their interest (economic drivers) to not become dependent on a single or limited supply

[30] Dead-freight is the term used for unused capacity of a tanker (e.g. if a ship can hold 50 million litres but only ships 40 million litres it results in 10 million litres dead-freight). Dead-freight increases the cost per unit for the volume shipped.

routes and retain diversity and optionality in supply (many companies term much of their supply but keep a portion as spot to ensure they are continuously in the market).

- The specification comment noted under Section 4.7 (better alignment of specifications) could also assist in New Zealand's product supply diversity.
- Companies may raise concerns themselves if they felt diversity of supply was reducing.
- A more open (to third parties) wholesale terminal system should improve supply diversity as it may encourage more market participants.

6.4.2 Back up stocks

- Ships perform this role more effective than stocks held in source countries.
- Many companies have stock in their offshore system – does not need to be explicitly identified.
- Stock going to Australia can perform this role (more quickly) through trading activity.
- Alternative stocks in the case of disruption could take 3-4 weeks to arrive, but also noted having stock on the water (either destined for NZ or elsewhere) would provide a practical solution to help mitigate disruption initially.

6.4.3 Strategic stocks/minimum stock obligations

- All feedback given was that industry should mange stockholding decisions on a commercial basis rather than this being set by the government as they do not want an imposed system that could undermine investment decisions.
- If the government decided additional stocks were necessary, this should be held within/close to existing inventory to manage quality and turnover and government should fund this.
- Also, any level needs to be sensible/achievable, not at an unrealistic level as has happened in some countries.
- The benefit of holding stock above commercial levels was questioned as to whether it would provide a net benefit for New Zealand consumers.
- A minimum stock requirement above current levels will initially lead to more suboptimal import/delivery parcels (either ships carrying less to New Zealand or more discharge ports for each import) and then (if economic against that cost) more tank investment.
- Companies with fewer or single terminals may be more penalised by a minimum stock obligation as they will have less ability to manage the requirement across multiple sites.
- Companies would expect to be remunerated if they were required to hold higher stock levels than required by their normal commercial operations.
- Additional stockholdings should focus on the products that provide most economic benefit (i.e. cause largest economic impact if not available). This is likely to be diesel.
- Any imposed stock requirement would need very careful consideration and consultation to avoid unintended consequences (such as market distortion). Companies would expect a detailed consultation process including input from other countries' strategies.
- Suggestion that a joint company (possibly government/industry owned) would be better for holding additional stocks collectively above what companies would do commercially.
- Saw a NZ domestic ticketing system as a possible option for the government to increase stock levels without interfering in normal commercial inventory decisions.
- Mandating locations for stocks would likely make stock obligations more difficult and expensive. Flexibility to move product to where it was required should be a key requirement.
- Government should be aware of future trends when making any decisions in this area as do not want to add cost when the future might be different.

- If there are short term fuel security concerns with the change in supply chain, the government should consider shorter term, flexible options like floating storage rather than forcing long term costs on the industry.
- If the coastal tankers are no longer required government should consider how the current (cabotage) Section 198 exemption rules in the Maritime Transport Act can be updated to accommodate the use of import product vessels with shifting products around the coast when needed to manage supply disruption.
  The act currently prohibits the use of foreign vessels to carry coastal cargo from one NZ port to another unless this is incidental to the carriage of its international cargo (e.g. the vessel was already scheduled to call at these ports). On a case by case basis the Minister can provide an exemption, but in doing so must be satisfied that no coastal vessel is available to carry the coastal cargo. This option would also be available in an emergency.

6.5 Mitigation options summary

6.5.1 Supply diversity

H&T agree that supply diversity is critical for fuel security but concur with industry feedback that a forced supply diversity outcome is likely to increase costs well beyond any benefit provided. Supply diversity should happen naturally if the market has a good range of participants, as each participant may have links to facilities in different countries (as now). Each participant also has an incentive to ensure their own supply is diverse to maintain competitive supply costs and provide a mix of options for maintaining supply to their customers.

There was some feedback that could help ensure supply security and this included:

- Ensuring New Zealand's fuel specifications were as close as possible to international standards to give the widest range of source countries (within environmental and operability constraints); and
- Having open access terminals (where appropriate) so it makes it easier for more participants in the market as that is likely to improve diversity of supply.

Rather than a forced supply diversity, H&T propose that the government has a formal process for monitoring supply diversity (at least annually, perhaps as part of publishing Energy in New Zealand) and if desired this could include a requirement for each importer/wholesaler to provide a letter setting out their current supply diversity, their actual supply performance over the last 12 months and highlighting any concerns or improvements for the next year.

6.5.2 Back up stocks

As noted above this is not seen as a realistic option with the cost more likely to be similar to strategic stocks for little improvement in resupply time. This is not worth further investigation.

6.5.3 Strategic stocks/minimum stock obligations

Modelling impacts of disruption scenarios has provided a very similar outcome to both the current supply route and 100% product import. This reflects that some of the scenarios consider infrastructure failure where the limit is set by truck/driver availability and others do not necessarily result in a physical shortage, rather a price spike from international market response. This will be similar whatever the supply chain New Zealand uses.

The modelling of a product specific disruption scenario shows that if inventories are in line with H&T's expectations, then such events should be managed with minimum local impacts other than

price. However, it is reasonable that the government should at least monitor stock levels and ensure (if supply moves to 100% product imports) minimum stock levels are maintained above an appropriate minimum level such as 15 days net (18 days gross) stock cover to ensure these findings remain valid.

Should stocks fall below the expected level, MBIE should consider implementing a minimum product stock obligation at around the current minimum operating level. This would ensure that product stocks are not taken lower than current levels, and would give a basis to assess future adjustments from. We consider the concerns over unequal impacts of different suppliers (single port suppliers versus multi-port) can be managed, with one option being to use a 15-day rolling average for the minimum stock level. For example, if the minimum stock level is set at 18 days gross[31] (~15 days net) then an individual importer could draw stocks down to around 7 days net prior to cargo delivery (note cargoes can be counted once they are in New Zealand coastal waters) which is in line with indicated current minimums.

As the proposed minimum level is set around current minimums there should be no significant cost to the suppliers. There will be some additional administrative cost in monitoring and reporting, although companies monitor their stock levels daily so this should be minimal. Most of the administrative cost would be incurred anyway in improving the reporting systems as recommended in Section 3.5. The benefit will be more assurance that appropriate levels are being maintained and increasing the focus of both government and fuel industry on holding appropriate levels of stock for each product.

Despite the robustness of international supply chains, many countries do impose stockholding requirements well above the level assumed here. The government could also choose to do this but the reason for doing so will likely to need to be justified on risk aversion basis, as previous economic analysis has not provided a convincing cost/benefit analysis for holding more stock[32].

H&T considers there are two options that should additional stocks be justified above the level set by implementing a minimum stock obligation at current levels, may provide a more economic outcome than raising a minimum stock obligation on industry. These are:

- Allowing companies (possibly in partnership with government) to form a company (e.g. stock agency) that can take the obligation from companies and look to secure additional reserves in the most cost effective way[33]; or
- Using the current NZ domestic ticket tender to use the commercial market to provide the most economic storage solution with this option having the benefit of already having a funding mechanism (PEFML) which is a small levy on the motorist.

Industry feedback was more in favour of the ticketing option although it was noted that the local ticketing rules need to be strict to avoid any market distortion (the rules are strict but many companies had not reviewed these recently). Should these options be considered, a more detailed investigation and consultation would be required. The advantage of the existing ticket tender option is that market cost could be established through a competitive tender process.

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[31] We expect it would be easier to monitor and manage gross inventories but that would be a subject for more detailed consultation if implemented.

[32]The report Economics of Fuel Supply Disruptions and Mitigations (Market Economics, 2019) has a discussion on this subject on pages 10 and 11 of its Executive Summary.

[33] Stock agencies are common in other IEA countries (refer Section 6.2) and recommended by the IEA as best practice in these circumstances. Generally, these have been set up/managed without competition concerns.

All the above discussion assumes there will be continued smooth operation of global markets. Companies were unwilling to speculate on whether geopolitical risks are increasing although some noted New Zealand would not want to become too dependent on any countries that might stop exporting for political reasons.

It is only this area (global market failure) where it can be considered there is a real loss in supply security by not having a refinery. If New Zealand becomes isolated, without a refinery, there will be less total stock available and New Zealand will lose the ability to ensure at least minimal supply (~20%) from processing its own crude (and in such a market failure crude supply might be easier to secure than product). However, as seen during the pandemic, there are other critical items (e.g. medicines) that will become more of an issue than fuel, particularly as use of fuel for critical services is not a high proportion of total demand.

Any solution also needs to consider the likely transition away from fossil fuels over time. Options that result in new tanks being required may not make sense, particularly with more economic options (tank conversion) likely to be available at Marsden Point should it become a fuels terminal.

7.0 International obligations and stock tickets

With respect to New Zealand's current ticket strategy MBIE asked the question "*If NZ continues to hold reserve stock tickets to meet its IEA requirements, what proportion should be held as crude stock if New Zealand has no refinery?*"

7.1 Ticket stock strategic aims

It is important that this question (and response) follows any discussion on domestic security. It has always been acknowledged that while New Zealand's stock ticket strategy is a cost effective means of compliance with its IEA requirement to hold stock to cover at least 90 days of net import demand, it does not add to domestic security. That is, holding stock tickets offshore is a compliance strategy that ensures New Zealand can play its part in any global disruption scenario where release of the stocks will add to the stock available in the global system and therefore help mitigate any supply disruption.

While New Zealand retains the right to purchase the stock held and bring it to New Zealand in an emergency, this is seen as a more unlikely scenario only to be pursued if New Zealand's fuel companies were having difficulty obtaining physical supply. It is assumed, even in an emergency, that New Zealand's fuel companies will typically be able to secure additional supplies in an emergency more rapidly than the exercise of stock tickets.

Understanding the strategy of why ticket stocks are held and how they are expected to be used is critical to answer the question of what proportion of stock should be held as certain product types. If the prime intention is to support supply into the New Zealand market in an emergency, then the ability to use that product is critical. In that case if New Zealand no longer has a refinery then holding crude stock tickets does not make sense. However, if the prime aim is for New Zealand to play its part in any global response and release stocks wherever they are most needed to support the system, then the ability to use directly in New Zealand is not critical and the current strategy of having the most cost effective mix of tickets type should continue.

7.2 Current ticket stock holdings

New Zealand ticket holdings in recent years have been a mix of crude and product tickets with crude tickets always making up the majority (Table 8). Many of the larger sellers (e.g. BP, ExxonMobil, Litasco) primarily sell crude oil tickets, as that is the excess stock type against the host country's domestic requirements.

Table 8: Ticket holdings crude and product trend

kt	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Crude	160	221	335	436	463	375
Product	114	95	125	145	241	293
Total	**274**	**316**	**460**	**581**	**703**	**667**
%crude	58%	70%	73%	75%	66%	56%

While the product ticket proportion has increased in the last couple of years, that primarily relates to the strategy of allowing more black oil tickets (e.g. fuel oil and petroleum coke - see Table 9). Black tickets have been purchased once New Zealand's total ticket stock holding increased above 300,000 tonnes (currently 640,000 tonnes) as this level is assessed as significantly higher than any expected response New Zealand would be requested to make in a supply emergency.

Crude tickets have made up the majority of New Zealand's holding as they have been the most cost effective and provide the large volumes required. If New Zealand was to place a limit of crude tickets (or not allow them):

- The average cost of ticket holding would go up as we would be limiting supply to probably less than half the ticket market;
- It is questionable if the volume of product tickets will be available to fully cover New Zealand's requirements, based on the response to NZ's tenders to date (at least half the last six tenders would not have had sufficient product offers even if accepting much higher priced options); and
- If the product tickets were available, it is likely that would include a large proportion of black oil products to both provide the volume and to keep the cost down.

Swapping crude tickets for black oil tickets is of arguable value, and given New Zealand's black/other oil demand is only around 12% of total demand, any proposal to limit crude tickets due to New Zealand no longer having a refinery would also need to consider limits on black oil tickets. This would severely limit the ticket availability.

Table 9: Product tickets - split black/white[34]

kt	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
White product	114	95	125	79	108	103
Black product	-	-	-	66	133	190

[34] 2020/21 volume includes a large contract in black product, where the supplier has the option of what product to declare. To date black product has been held.

7.3 Industry feedback

The majority of companies agreed that New Zealand's ticket strategy should remain the same should the refinery close. Their view is that it is a compliance strategy best managed by the government. They agreed it would not provide benefit in a domestic disruption so the strategy should be to meet the requirement in the most cost effective fashion such that New Zealand can play a role in any global disruption response (which would likely be releasing stocks held offshore making them available to the market).

One company thought ticket stock should be held as New Zealand quality product as close to New Zealand as possible if this could be done cost effectively. However, that is unlikely to be practical or cost effective in the current ticket market as there is a lack of approved countries to hold stock in this region (they need to be IEA members and sign an arrangement with New Zealand to allow tickets to be held), the structure of tickets has a delay in supply, and it is likely to be very difficult to get offers for NZ specific grades (although in many cases quality differences are minimal or better than NZ quality).

7.4 Options

Based on the discussion and feedback we have analysed four different options for assessment:

1. Continue current strategy of selecting most cost effective tickets and take into account mix of crude and product tickets (and amount of black oil tickets) in portfolio decision.

2. No longer hold crude oil tickets following closure of refinery. Bring in some limit on black oil holdings.

3. Limit crude oil tickets to some percentage of holding (50%) with product tickets needing to be held as the rest.

4. Continue current strategy with a modification to ensure that at least 100,000 tonnes or 25% (whichever is lower) has to be held as white product (petrol, jet, diesel or LPG).

7.5 Analysis and Recommendation

Table 10: Ticket holding options assessment

	Cost	Feasibility	Direct usefulness for NZ
1. Current strategy	Good	Good	Limited.
2. No crude	High	Difficult	Improved, if limits placed on black product holdings, but still likely to be held mainly outside NZ's traditional supply locations due to limited host countries in this region.
3. Crude limit	Moderate	Moderate	Some improvement as noted above.
4. Ensure some white product	Good (only minor increment)	Good	Ensures at least some holdings meets product requirement although location (long way from NZ) remains an issue.

H&T and the fuel industry agree that the prime intention of New Zealand's ticket holding strategy is to play it its part in an IEA led global response. This would likely mean releasing ticket stock in the location it is held to the support the global market rather than shipping to New Zealand.

Therefore, the closure of New Zealand's refinery should have no impact on the product mix selected and it is valid to maintain the current ticket strategy (Option 1 in the table).

H&T recommend (and partially in line with the company suggesting product stock be held close to New Zealand) that a minor adjustment could be considered where a minimum holding of white product tickets are held (Option 4 in the table).

The addition of a requirement to hold some white product tickets would ensure at least some of the product could be directly useable in New Zealand in the unlikely event that the market does need physical product supply, although because of the nature of the ticket market this stock is still likely to be held outside New Zealand's normal supply envelope. The amount suggested (minimum of 100,000 tonnes) is about 5.5 days of net import cover, approximately 15% of recent ticket holdings. As shown in Table 9, New Zealand has been holding white product tickets of around that level so this additional measure would ensure that continues.

8.0 Other issues raised

During the consultations, some respondents asked how supply of smaller, niche products like fuel oil and bitumen would be managed if the refinery was to close and how that might impact on supply resilience for those products in New Zealand.

This report, like the earlier reports, has focussed on the key transport fuels (petrol, jet fuel and diesel) as these are critical for New Zealand's economic and social wellbeing. However, other products may also be critical with fuel oil used to supply some marine vessels including the Cook Strait ferries and bitumen used for roading. While the marine vessels will be able to use diesel as a fuel substitute, there is no alternative for bitumen.

With the prospective change to supply (and bitumen production is ceasing at the refinery in 2021 anyway), consideration should be given to the supply resilience of these fuels. It is likely other Ministries would be more suited to lead these investigations. We note in the case of bitumen this is already been considered by the Transport Agency[35].

9.0 Recommendations

The key recommendations from this review on national fuel supply risks under plausible market development scenarios that include closure of the Marsden Point oil refinery are provided below. These recommendations have been split into those that relate to domestic security and those on the government's ticketing strategy for maintaining its IEA compliance.

9.1 Domestic security

The key finding from our analysis is that infrastructure constraints, rather than supply chain route is likely to be the larger contributor to supply chain resilience. A switch to 100% product import supply in itself is unlikely to result in a materially different supply security situation for New Zealand. However, the import option would see a significant reduction to stock levels, albeit the majority of the reduction will be from operational stocks rather than stocks that provide fuel security. This change in supply should at least prompt MBIE to assess whether current reporting,

[35] https://www.stuff.co.nz/business/123215155/roading-industry-confident-it-can-rely-on-imported-bitumen

monitoring and stock obligations are sufficient and H&T has made a number of recommendations in that light.

H&T recommends that MBIE:

1. Work to improve the stock reporting from fuel companies. While the government has the power to enforce stock reporting[36], there are questions as to whether this is legislation is still fit for purpose and achieving its aim. It is not obvious that there is any consequence for providing incorrect information and whether a maximum $2000 fine is appropriate as a deterrent. Whatever powers are used, MBIE needs to ensure there is a structure such that fuel companies are obliged to consistently provide accurate submissions.

2. Should continue to monitor and work with the fuel industry to implement the recommendations from the Auckland Fuel Supply Disruption Inquiry, particularly the provision of appropriate jet storage in the Auckland region, to ensure assumptions made in this assessment are valid once jet fuel consumption returns to previous consumption levels.

3. As also highlighted in the Auckland Fuel Supply Disruption Inquiry, the loss of Wynyard Wharf has impacted disruption response options in Auckland, with this likely to result in greater shortages for a RAP/Wiri disruption. MBIE should continue engaging with industry participants on getting them to establish a replacement emergency response option to restore supply resilience back to at least the level seen when the Wynyard Wharf terminal was operational.

   Should the RNZ proposal for a moveable Skid Facility to increase supply resilience for Auckland (and for other locations as part of an emergency response) not be acceptable, the fuel industry should put forward other proposals to mitigate the loss of Wynyard Wharf.

4. MBIE should closely monitor stock levels on an ongoing basis particularly following any change in New Zealand's supply chain such as closure of the refinery. Should there be concern minimum stock levels are deteriorating over time, MBIE should consider implementing a minimum stock obligation at around the current minimum operating level (for finished stocks) to ensure stocks are maintained at an appropriate level in line with the assumptions made in this report. This should not materially increase fuel industry costs (except for an increase in administration/monitoring) assuming the proposed target is set in line with the capability of the current infrastructure. Care will be required to ensure any stock obligation avoids penalising individual companies based on their supply method.

5. Investigate the value of holding additional stock within New Zealand above the average level expected to be held on a commercial basis[37], particularly where the government may consider broader concerns than covered by the straight economic cost and risk of any outage.

6. Further consider the options of holding additional stock (if recommended from 5) noting that this report considers using the current ticket tender system, or allowing a collective industry response (e.g. stock agency) will likely provide a more economic outcome than requiring importers to hold a higher level of minimum stock than considered in recommendation 4.

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[36] Through Section 7 of the International Energy Agreement. We note that while the fuel industry is aware of this power, our understanding is that they believe the information is currently provided voluntarily to avoid the mandatory powers being used.

[37] This is essentially the level calculated in this report and expected to result if a minimum stock obligation was implemented to lock in the current level of minimum finished stocks.

As part of this investigation we recommend further consultation with the fuel industry to ensure that if either of these options are implemented that the outcomes will result in the required level of stock and will not create market distortions.

7. Review the New Zealand fuel specifications should the refinery close to ensure the specifications remain aligned with the fuels available in the region, as much as possible without compromising New Zealand's environmental and operability requirements.

8. MBIE implement an annual review of supply resilience (including the minimum stocks held over time) and diversity, and as part of that consider if importers should provide an annual representation letter setting out their current supply diversity, their actual supply performance over the last 12 months and highlighting any concerns or improvements that can be made for the next year.

9. MBIE engages with the relevant Ministries for industry use of niche fuels to consider undertaking supply security reviews should the refinery cease operation if these are not already being considered.

9.2 IEA compliance ticket strategy

H&T recommends that:

10. The ticket strategy should not change from the current approach should refining cease in New Zealand. A minor adjustment to hold a minimum quantity of white product tickets (approximately 100,000 tonnes) as part of the total holdings should be considered.

Appendix 1: International stock holding policies

Table 11: IEA member countries stock holding policies

IEA Member Country	Approach to obligated security stocks (Government, Agency, Obligated Industry)[38]
Canada *net exporter*	No obligation on industry or government
Mexico *net exporter*	Obligated Industry The IEA lists Mexico in this category but provides no additional information.
Austria	Obligated Industry and Agency (ELG) All industry obligations are assumed by privately owned agency ELG. Quantity held is 25 percent of their prior year's imports of petroleum, biofuels and feedstocks used directly to produce biofuels in country, equal to about 89 days consumption cover. No bilaterals.
Belgium	Agency (APETRA) APETRA is solely responsible for meeting Belgium's stock holding obligations with costs met by obligated oil companies. Quantity held is 90 days of their prior year's daily average net oil imports, or 61 days of prior year daily average inland use.
Czech Republic	Government (ASMR) Government owned ASMR solely holds emergency stocks. Quantity held is 90 days of the reference year's daily net oil imports, held in country (no bilaterals).
Denmark *net exporter*	Obligated Industry and Agency (FDO) Obligated industry are importers or producers of petroleum in Denmark. Minimum quantity held is 24 days of oil consumption while FDO holds 67 days.
Estonia	Agency (OSPA) Government-owned OSPA is financed by the government and obligated companies. Quality held is 90 days of their prior year's daily net oil imports, or 61 days of prior year daily average inland consumption of energy products.
Finland	Obligated Industry and Agency (NESA) Obligated companies are importers of petroleum. Minimum quality held is two months of average net imports in the previous year while NESA covers domestic demand for an average of five months.
France	Obligated Industry and Agency (SAGESS) Obligated companies are warehouses and oil product related operations that attract domestic value added tax or deliver a petroleum product to aircrafts in France. Quantity held is one quarter of the prior year's net petroleum imports. Part of this is stockholding is delegated to the CPSSP company and is managed by SAGESS.

[38] The IEA distinguishes three types of obligated stockholding ownership arrangements being Government, Agency or Obligated Industry. Countries may use one category or a combination of stock categories. https://www.iea.org/areas-of-work/ensuring-energy-security/oil-security

IEA Member Country	Approach to obligated security stocks (Government, Agency, Obligated Industry)[38]
Germany	Agency (EVB) All obligated companies are members of the public corporation EBV which is solely responsible for managing Germany's reserves. Quality held is 90 days of daily net imports averaged across the previous three calendar years.
Greece	Obligated Industry Obligated companies hold stocks equal to at the least to 90 days of the prior year's average daily net imports.
Hungary	Agency (HUSA) Obligated companies distribute or import petroleum products and are members of and fund HUSA. Quality is 90 days of the prior year's average daily net imports.
Ireland	Agency (NORA) Obligated companies fund NORA via an industry levy. Companies already holding 55 days of their prior year's imports may apply for an exemption. Quantity held mirrors international obligations.
Italy	Obligated Industry and Agency (OCSIT) Quantity held is greater of the 90 day of the prior year's average daily net imports, or 61 days of domestic consumption in the previous year.
Korea	Government and Obligated Industry Obligated industry obligated to maintain stocks. KNOC government company has management and oversight. No bilateral stocks. (Refineries, specified distributors, and importers, are obliged to hold from 40 days to 60 days of their daily import, sale, or refined production, based on the previous 12 months)
Japan	Government and Obligated Industry Government stocks held by JOGMEC. Oil stockpiling targets are fixed on a five-year basis and industry obligated private emergency stocks should equate to 70-90 days of Japanese oil consumption in the previous year (currently set at 70 days). No bilateral stocks.
Luxembourg	Obligated Industry Obligated companies hold stocks at least to 93 days of the prior year's net average daily import. If the 61 days of average daily domestic consumption of the country exceed 93 days of average daily domestic imports, then the minister fixes an additional storage obligation for each importer.
Netherlands	Obligated Industry and Agency (COVA) Obligated companies hold 20 percent and COVA the remaining 80 percent. Quantity held is 90 days of their prior year's daily average net oil imports, or 61 days of prior year daily average inland use. No bilaterals.
Norway *net exporter*	Obligated Industry Importers or producers of petroleum products or biofuels obligated to hold stocks to cover at least 20 days of consumption. No bilaterals.
Poland	Government (MRA) and Obligated Industry Obligated companies hold 53 days of the prior year's average daily production or net imports. The balance is held by government agency MRA which is financed mainly by obligated oil producers and traders. No bilaterals.

IEA Member Country	Approach to obligated security stocks (Government, Agency, Obligated Industry)[38]
Portugal	Obligated Industry and Agency (ENMC) Obliged companies stock the equivalent of 60 days of the prior year's average daily net imports. The remaining 30 days is held by ENMC.
Slovak Republic	Agency (EOSA) Quantity is the higher of 90 days of the prior year's average daily net imports or the 61-day average daily inland consumption, with 50 percent held as oil.
Spain	Obligated Industry and Agency (CORES) Quantity is 92 days of sales or consumption in the previous year. Within this minimum, industry holds 50 days with the remaining 42 days held by CORES.
Sweden	Obligated Industry Obligated companies and agency hold the higher amount of either 90 days of the prior year's average daily net imports or to 61 days of average daily consumption. No bilaterals.
Switzerland	Obligated Industry Obligated industry hold the compulsory stocks commingled with commercial stocks. The target volumes are not written into law. Currently, they are 4.5 months for petrol, diesel, and fuel oil and 3 months for kerosene. No bilaterals.
Turkey	Obligated Industry Target cover of 90 days of prior year's average daily net imports. Within this, oil refineries and distributers must hold emergency stocks corresponding to at least 20 days of supplied product in the previous year. No bilateral stocks.
UK	Obligated Industry Under EU legislation (which are fully enforceable at the time of writing), the UK is required to hold 67.5 days' domestic net consumption (61 days plus 10 per cent). The UK government directs substantial suppliers to hold stocks to meet its international stocking obligation, of which 22 days must be finished products.
USA	Government The Strategic Petroleum Reserve (SPR) is government owned and the operation, development, and maintenance of the SPR is supervised by the US Secretary of Energy for the storage of up to 1 billion barrels of petroleum (actual maximum capacity of the SPR currently stands at 714 million barrels). SPR stockholding is currently equal to 1,357 days of the prior year's average daily net imports. Northeast Gasoline Supply Reserve (NGSR), which consists of 1 million barrels of gasoline in the Northeast United States are counted as part of the SPR. DOE also holds 1 million barrels of petroleum distillate in the NEHHOR, which operates under separate statutory authority and which are not counted as part of the SPR.

Table 12: IEA association countries stock holding policies

IEA Association Country	Security stocks approach
Brazil	No public information found. Assume no target or obligation

IEA Association Country	Security stocks approach
China	Industry and government Government is building and filling SPR since 2001 and expects storage capacity to reach 500 mb by 2020 (274mb June 2017 confirmed by China NBS). Also "encourages" (IEA wording) domestic oil companies to increase their commercial reserves to enhance resilience. In 2015, the NDRC started to oblige refineries to hold at least 15 days of crude oil reserves based on daily processing capacity.
India	Government India does not place a minimum stockholding obligation on its industry. India set up the Indian Strategic Petroleum Reserves (SPR), a wholly owned subsidiary of the Oil Industry Development Board under the Ministry of Petroleum and Natural Gas in 2004. The entire SPR volumes are expected to be in the form of crude oil. The construction of three sites was completed by 2018 and the caverns are now filling. India is exploring creation of an additional 6.5 Mt of storage capacity (around 50 mb) in rock caverns and associated facilities.
Indonesia	Industry (NOC) Indonesia relies upon operational stocks held by the national oil company, Pertamina, amounting to 21-24 days of consumption in 2019. (source IEA)
Morocco	Obligated Industry Stockholding obligations placed on oil distributers and importers; since 2014 they have to be equivalent to two months (60 days) of oil product sales. The government also imposed stockholding obligations on refiners, equivalent to one month (30 days) of their crude oil needs. Since the closure in 2015 of its only operating oil refinery, Samir, Morocco has had to import all its refined product requirements. The refinery's closure also resulted in the loss of the use of over 60% of the country's storage capacity; however, the oil storage infrastructure is still intact. The government has decided to take steps to ensure that it has sufficient oil stocks for security of supply purposes by reviewing compliance with the current stockholding regime, with a view to either confirming and enforcing existing stockholding obligations, which are currently not being met, or by putting in place a new emergency stockholding structure.
Singapore	Industry (oil-fired power generation only) There is no government oil stockpile in Singapore since the obligatory crude-oil stockpile was abolished in 1983 although the Singapore National Oil Company (established in 1979) maintained crude-oil stockpiling until then. It is required, however, that power-generating companies hold fuel oil stocks equal to 90 days of use as backup for oil-fired power plants.
South Africa	Government (SFF) The oil stocks are held and managed by the Strategic Fuel Fund Association (SFF), a non-profit state-owned entity. The SFF is wholly owned by another SOE, the Central Energy Fund (CEF). Both report to the Minister of Energy, the shareholder on behalf of the government. The SFF manages the reserves and rents out storage space in its tanks, which covers the costs of managing the reserves. In a major scandal, the SFF fraudulently sold 10 million barrels of reserves for $280 million in 2015 and applied to invalidate the sale in 2018.

IEA Association Country	Security stocks approach
Thailand	Obligated Industry The Fuel Trade Act (2000) places mandatory stockholding obligations on all Thai refiners, retailers and importers in the private sector that have operations greater than 100 Kt per year. These operators have to stockpile 6% of their yearly sales of crude oil and 10% of oil products, which should be at least equivalent to 25 days of consumption (reduced from 43 days in May 2015).

Table 13: Other APEC and ASEAN countries

Other APEC & ASEAN	Security Stock Approach
Chile	Obligated Industry Chile imposes a mandatory minimum stockholding requirement on producers and importers (if the imports are for their own consumption) of petroleum-derived liquid fuels. They must hold inventory levels that equal 25 days of average sales (or average imports) of the previous six months
Peru	Obligated Industry Obligatory 15-day inventory (TBC)
Chinese Taipei	Obligated Industry and Government Refiners and importers must hold 60 days of sales volumes as stockholdings. The government uses the petroleum fund to finance the storage of oil and also stockpiles 30 days of oil consumption.
Malaysia	No Obligation No mandatory requirement for government or private oil stocks.
The Philippines	Obligated Industry Since 2003 the requirement for industry is to hold 30 days of in-country stocks of crude/petroleum products for refiners, 15 days of in-country stocks of finished products for importers, 7 days for bunkering companies, and 7 days for distributors of LPG.
Vietnam	Obligated Industry Oil companies are obliged to hold stocks equal to 30 days of net imports.
Brunei Darussalam *Net exporter*	Industry Oil companies are requested to maintain a stockholding of 31 days
Cambodia	Obligated Industry Oil companies obligated to hold stocks equal to 30 days of domestic use.
Laos	Obligated Industry Oil companies obligated to hold at least 15 days of oil imports.
Russia *Net exporter*	Government As of 2011, Russia is accumulating strategic reserves of refined oil products to be held by Rosneftegaz, a state-owned company. The reserves will be held at commercial refineries, Transneft facilities and state reserve facilities.