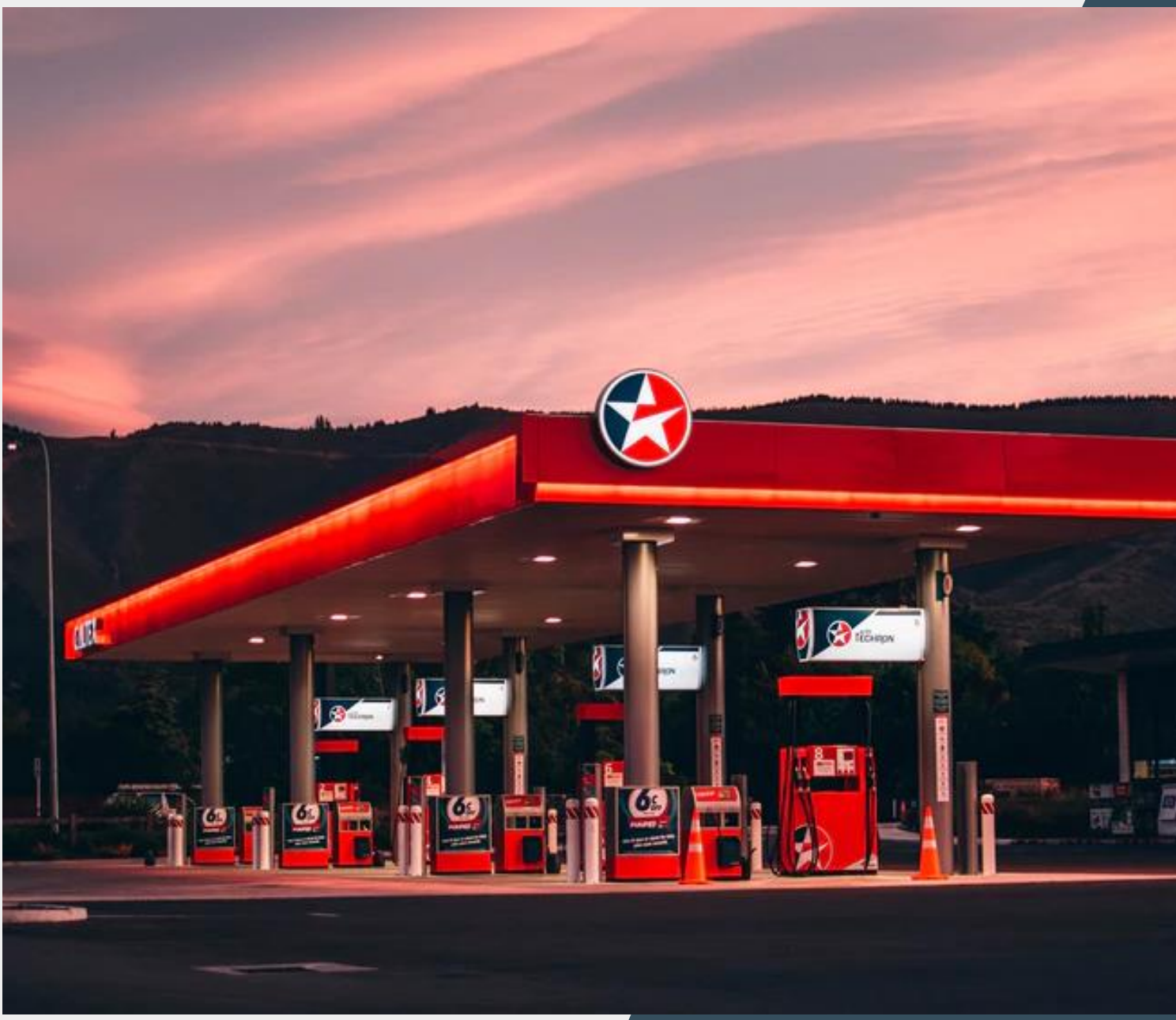
Strictly Confidential

Fuel - Supply Chain Benchmarking Report

Report for the Department of Infrastructure, Transport, Regional Development and Communications

20th August 2021



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Executive Summary and Scope

EXECUTIVE SUMMARY AND SCOPE

Refined fuel is an essential good that is used to power private and commercial transport, heating, manufacturing and in other industrial processes. Fuel itself is an input into virtually all other supply chains, with any change in the cost of fuel having a large effect on the broader economy.

The use of refined fuels is correlated with population, as individuals purchase fuel for their cars and for goods that must be transported to retail stores. The use of diesel is further linked to GDP, with large agricultural and mining sites using diesel to power large machinery.

Fuel is imported, usually via sea and transferred into bulk "terminal" storage tanks. From there, fuel can be moved in bulk to other fuel terminals via coastal shipping, rail or pipelines. Fuel can be picked up from terminals by road tankers and distributed to population centres for retail sale or to commercial sites for industrial use.

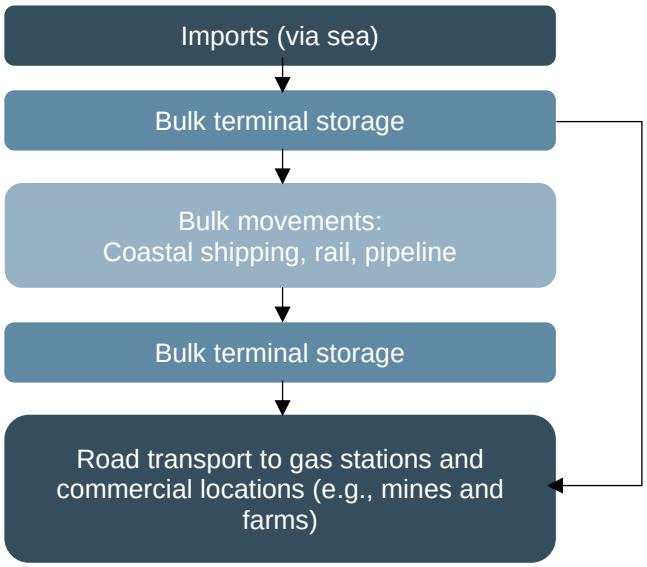


Figure 1: Typical refined petroleum product supply chain

New Zealand and Canada have been selected as comparative countries for Australia's refined fuel supply chain due to their sizeable consumption of refined fuel imports. Both New Zealand and Canada also have some broad geographic and demographic similarities with Australia.

Refined fuel imports make up c.67% of Australia's fuel imports and are sourced predominantly from Singapore, South Korea, China, Japan and Malaysia.

Fuel is generally moved relatively small distances (<250km) to fuel storage terminals located near population centres around the coastline, to minimise the amount of road transport. Australia uses a combination of rail, road, pipelines and waterways to move fuel. Road freight rates for transport of refined fuels are c. AUD $0.13 per tonne-kilometre (tkm).

The refined fuel supply chain in New Zealand is similar to Australia, relying on coastal shipping to move volumes to key ports and road transport to reach inland population centres. While pipelines are used in New Zealand to transport refined fuel imports from the Marsden Point refinery in Northland, most of New Zealand's freight task is handled by coastal shipping and road, with virtually no volume moved by rail. Road freight rates in are AUD $0.16 per tkm.

While Canada is a large producer of crude oil, differences in provincial refining capacity and demand, a highly localised refinery network and Canada's vast geography require Canada to import c.20Mt of refined fuel. This is mostly imported into Quebec, Ontario, the Atlantic provinces and British Columbia due to their coastal location. Refined fuel is moved around Canada using a complex network of road, rail, pipeline and waterway transport. Road freight rates are c. AUD $0.11 per tkm, with rail freight rates at c. AUD $0.04 per tkm.

Scope of this report

This paper covers the import and domestic distribution of crude-oil based fuels refined offshore. It covers movement of fuels from port to retail outlet and commercial premises in Australia, New Zealand and Canada.

KEY FINDINGS & AREAS FOR FURTHER INVESTIGATION

- Overall freight rates for fuel are largely similar among countries studied (Australia, Canada and New Zealand).
- Australia and Canada use a network of rail, pipeline, waterways/coastal shipping and road transport, while New Zealand relies on coastal shipping and road, to move fuel products large distances in a cost-efficient manner.
- Further investigation is required into the overall cost of the supply chain at an aggregate level, as well as into other oil and gas products such as domestically-refined crude oil and LNG.

Australian Supply Chain Overview

AUSTRALIAN SUPPLY CHAIN OVERVIEW

Generic refined fuel supply chain

Fuel, including diesel and petrol is imported by most developed countries to power private and commercial transport, heating, manufacturing and in other industrial processes. Any change in the -cost of fuel therefore has a large effect on the wider economy.

The use of refined fuels is strongly linked to GDP and population, as cars, heating systems and heavy vehicles run on petrol and diesel. The use of diesel is further linked to GDP, with large agricultural and mining sites using diesel products to power machinery.

Fuel usage can be seasonal in some locations, with consumers generally using more petrol in the summer months while on holiday road-trips and more diesel for heating in winter.

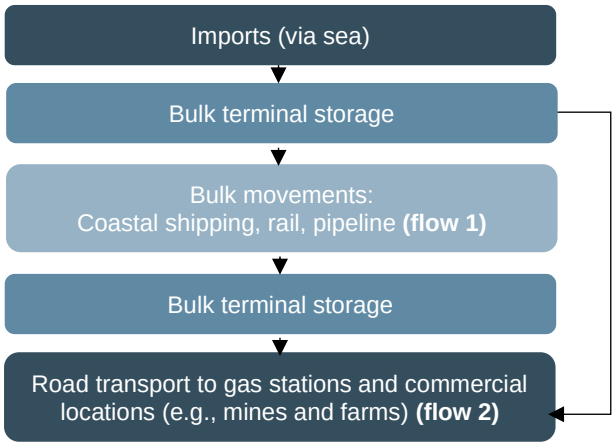


Figure 1: Typical refined petroleum product supply chain (country agnostic)

Refined fuel in Australia

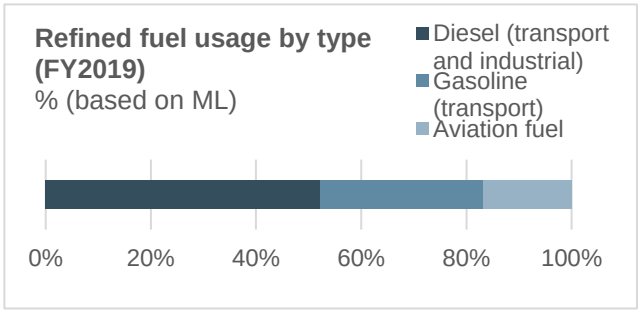


Figure 2: Refined fuel usage by type Australia FY2019 (Source: Department of Industry, Science, Energy and Resources)

From 2019-20, c.67% of Australia's total fuel imports were refined offshore and sourced from Asian countries: Singapore, Korea, China, Japan and Malaysia[1].

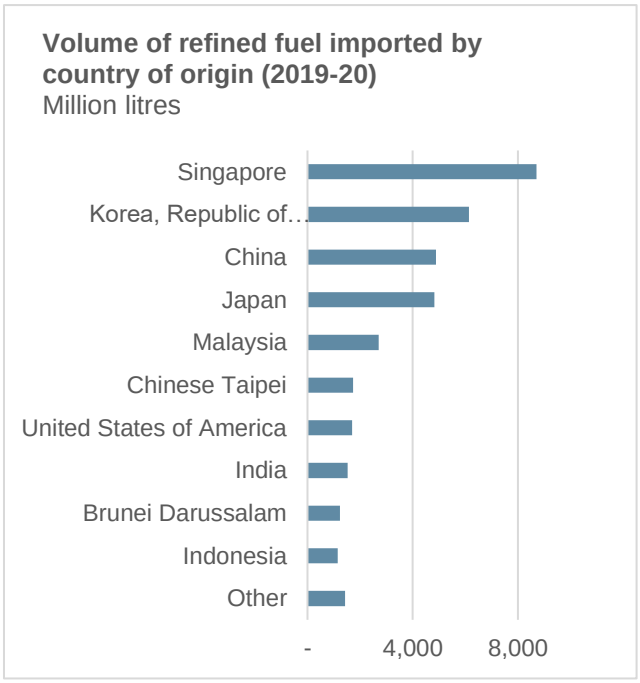


Figure 3: Volume of refined fuel imported by country of origin (Source: Department of Industry, Science, Energy and Resources)

Figure 4: Australia's import terminal and refinery locations (Source: ACIL Tasman)

Australia relies on refined fuel imports having closed the majority of its local refineries and converted them to import terminals. As such, Australia only has three refineries remaining located in Altona (VIC), Lytton (Brisbane) and Geelong (VIC). The owners of the Geelong and Altona refineries have announced plans

[1] Australian Government, Department of Industry, Science, Energy and Resources, Australian Petroleum Statistics, 2019

to convert these to import terminals as early as the end of 2021.

Key supply chain flows

Australia has c.67 import terminals, or bulk fuel storage terminals. Like most of Australia's population, all c.67 bulk terminals are located in coastal areas with exception to BP's terminal in Kalgoorlie WA[2].

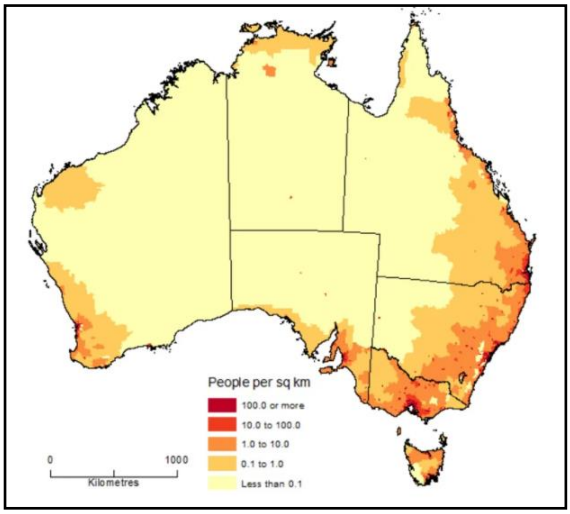


Figure 5: Population density of Australia heat map by SA2 (Source: Australian Bureau of Statistics)

Australia uses road, rail, ship and pipeline to move refined fuel from ports around the country. Traditionally, coastal shipping was used extensively to distribute fuel from domestic refineries to regional centres. However, with the closure of most domestic refineries, coastal shipments have largely been replaced by direct importation of refined fuel from overseas refineries to major fuel demand centres in Australia.

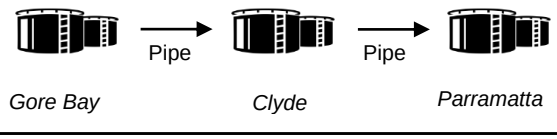
Key flow #1 Bulk fuel movement

Bulk movements to terminals are typically done through coastal shipping, from the port of import to other major seaboard terminals and through pipeline (e.g., from terminal to terminal).

Key flow #2 Movement by road to retailer or commercial site

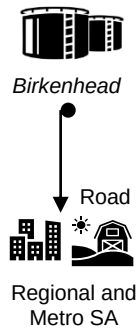
From storage terminals, the majority of fuel is distributed via road tankers to retail and industrial sites.

Example 1: *Gore Bay, NSW, Pipe to pipe*



Example 2: *Brisbane to Cairns, QLD, Coastal shipping*

Example 3: *Birkenhead, SA, ExxonMobil*

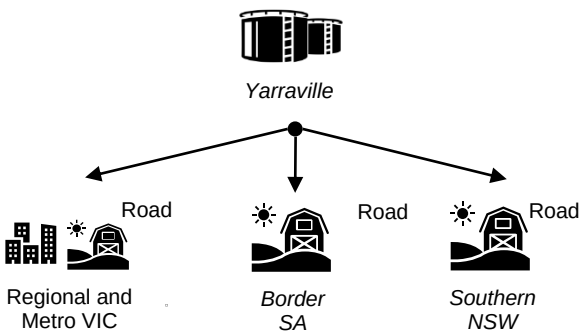


Fuel is transported via road tankers to petrol stations for sale to consumers. As a result of Australia's relatively concentrated population, average distance per trip to transport refined fuel is only 250km and takes an average of 3 hours.

A minority of Australia's population lives inland. Fuel is also transported to these regions by road tankers. For example, there are no oil refineries or ports located in the ACT, so fuel requirements are met by products transported from NSW.

In addition to petrol stations, larger orders of fuels can be delivered directly to agricultural, mining or commercial sites via road tanker. Major airports are usually serviced by pipelines (e.g., Altona to Tullamarine Airport) due to the high volume requirements, but secondary and regional airports use road transport.

Example 4: *Yarraville, VIC, ExxonMobil*



[2] ACIL Tasman, Petroleum import infrastructure in Australia, 2009

Basis for International Comparison

BASIS FOR INTERNATIONAL COMPARISON

New Zealand and Canada have been selected as comparative countries for Australia's refined fuel import supply chains due to their sizeable consumption of refined fuel imports. Both Canada and New Zealand also have similar geographical features to Australia, such as a lower population density in Canada and the geographically isolated nature of New Zealand**.**

New Zealand

New Zealand and Australia's refined fuel supply chains have the following similar features:

- While New Zealand and Australia produce a small amount of crude oil, this is mostly exported. Both countries therefore rely heavily on imports to meet fuel demands.
- Australia's oil refinery industry has been rationalised in recent years, with refineries being turned into import terminals. New Zealand is similarly expected to convert its main refinery at Marsden point into an import terminal in the near term.
- Both countries are heavily reliant on road transport and coastal shipping.
- Both countries are geographically isolated islands in the southern hemisphere.

While New Zealand and Australia's supply chains are similar, there are a number of notable distinctions that need to be considered when interpreting the data in this report:

- New Zealand has a smaller landmass than Australia, meaning that the distance travelled is generally shorter.
- New Zealand currently has a higher reliance on crude oil imports than refined imports, with c.70% of fuels coming from the refinery at Marsden point. However, outside of Auckland, which is primarily supplied via pipeline from the refinery, the supply chain for domestically refined fuel is similar to that of fuel imports. Both supply chains rely on coastal shipping networks to get products to the regions, with secondary distribution by road. Furthermore, New Zealand is expected to shift to a "refined imports only" model in the near term.
- Unlike Australia, New Zealand does not use any rail to transport fuels.

Canada

The refined fuel supply chains in Canada and Australia have the following similar features:

- Both countries have a large landmass, with low population density and significant distances between population centres. This increases the distance travelled within the supply chain and the overall scale of the freight task.
- While Canada is a large producer and net exporter of crude oil and refined products, Canada's vast and diverse geography means that certain provinces of Canada (e.g., Nova Scotia) rely heavily on refined fuel imports.
- Like Australia, a number of Canadian refineries have been converted into import terminals.

While the Canadian and the Australian supply chains are similar, there are notable distinctions to be considered when interpreting the data in this report:

- Canada is the 4th largest producer of oil products in the world. While this report will focus on the provinces that rely heavily on refined fuel imports, the scale of infrastructure used in the production, export and import of larger quantities of crude oil and refined fuel may make aspects of its supply chain more efficient.
- Canada relies on rail for some fuel movements and modal split needs to be considered when interpreting data.

New Zealand Comparison

NEW ZEALAND SUPPLY CHAIN

Fuel in New Zealand

New Zealand is a net importer of fuel and oil, despite having several oil fields that produce just under c.8m barrels of oil annually. New Zealand consumed c.49 million barrels of fuel in 2019.

New Zealand has a major oil refinery, located at Marsden point. There is a fuel pipeline, called the Refinery Auckland Pipeline (RAP), that connects Marsden point to consumers in Auckland. The pipeline currently transports significant volumes of domestically refined products from Marsden Point (c.5.1m tonnes). However, New Zealand is expected to transition to a "refined import only" market in the near term, with Marsden Point converted to an import terminal.

Figure 6: Refined product import by origin (Source: MBIE)

Fuel that is not refined from crude oil at Marsden point is imported as refined fuel. New Zealand imported c.22 million barrels (2.7Mt) of refined fuel in 2019. To deliver refined fuel from Asia and the U.S., tankers arrive in New Zealand ports carrying between 36,000 and 40,000 tonnes per ship.[3]

Key supply chain flows

Key flow #1: Bulk fuel movement

Refined fuel arrives at key New Zealand ports. Tauranga, Wellington and Christchurch receive 75% of all imports, with 25% of imports brought into minor ports.[4] From its port of landing, fuel is coastally shipped to 11 ports.[5]

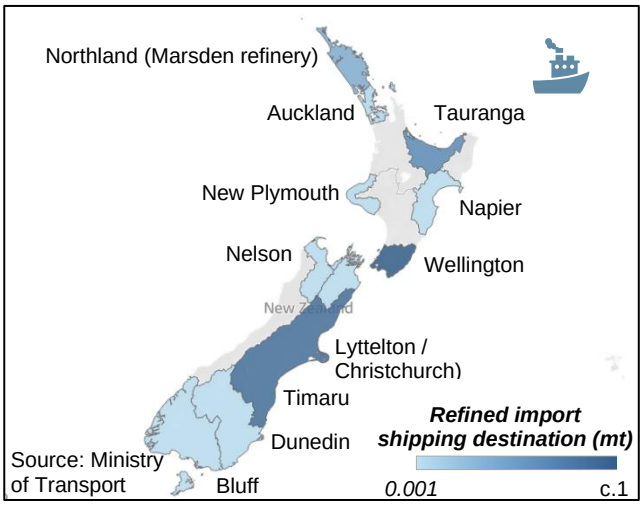


Figure 7: Location of ports that receive refined fuel New Zealand (Source: National Freight Demand Study)

Port / Terminal	***FY18 mt refined imports received***
Northland (Marsden)	0.35
Auckland	0.04
Tauranga	0.61
New Plymouth	0.01
Napier	0.01
Wellington	0.97
Nelson	<0.01
Lyttelton & Timaru	0.83
Dunedin	<0.01
Bluff	<0.01

Table 1: Refined fuel volumes coastally shipped, by port of arrival (Source National Freight Demand Study)

After arriving at the port, fuel is stored in bulk terminals, operated by major fuel providers. Major terminals are generally located near the port. The exception is the Wiri terminal in Auckland, which receives refined crude from the refinery pipeline

[3] Refining NZ, NZCC Market study into the retail fuel sector, September 13, 2019

[4] Commerce Commission New Zealand; Market Study into the retail fuel sector, December 5, 2019

[5] Ministry of Transport, National Freight Demand Study, 2017/18

between Auckland and Marsden Point and transfers jet fuel to Auckland airport by pipeline.

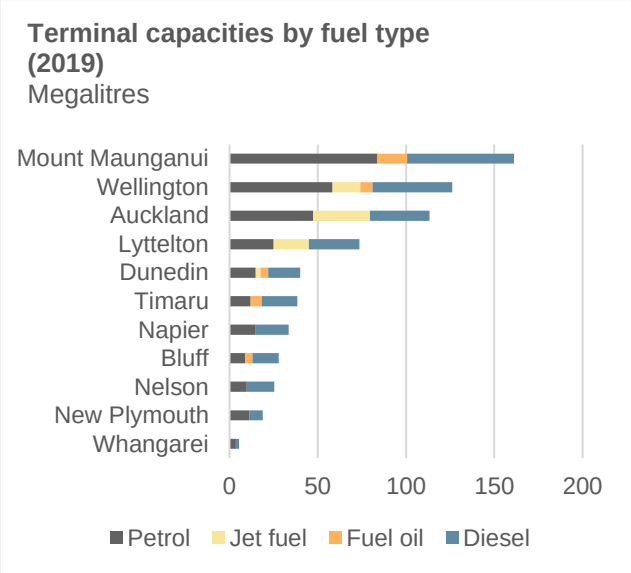


Figure 8: Terminal capacity, by fuel type (Source: MBIE)

Key flow #2 Movement by road to retailer or commercial site

Outside of the few instances of pipeline usage in Auckland, distribution of refined fuels following coastal shipping is almost exclusively by road.

As ports are located in major cities, such as Wellington, Tauranga and Christchurch, petrol and diesel can be picked up by tanker trucks (with a capacity of around 30,000 litres) from the terminal at the port and distributed to retail fuel stations within the city. The trips are typically short (<60kms) and take c.30 mins – 1 hour.

Other cities not on the coast receive their fuel deliveries via road from ports. To illustrate, Wellington is used as a distribution hub for Levin and Palmerston North. After being picked up by a tanker in Wellington, a fuel truck travels to Levin (a 2-3 hour return travel, c.200km). Once the truck nears Levin, it may discharge the refined fuel at a truck stop or at a retail site within the city. It then returns to Wellington to refill and travels to Palmerston North and back (a 5–6-hour journey, c.300-400km). Any excess fuel is left at truck-stops along the journey.

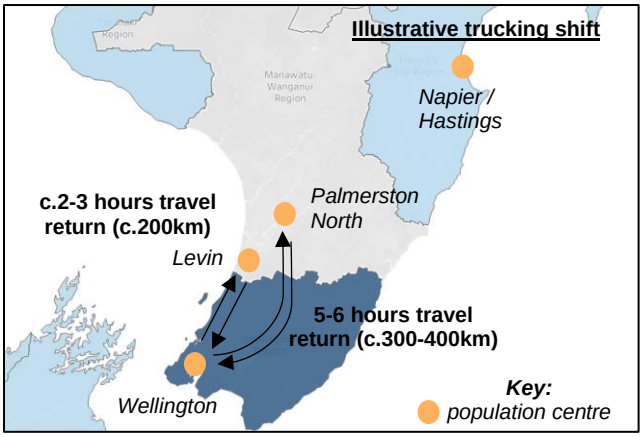


Figure 9: Illustrative fuel delivery (c.10-hour shift) (Source: Industry Participants)

Larger orders of fuels can be delivered directly to agriculture or commercial sites. While the average journey depends on the exact site, generally fuel will be moved from a major storage terminal to on-site storage tanks by road.

Fuel freight data in New Zealand

The total freight task for road is estimated to be c.280m TKM, with coastal shipping making up an estimated c.83% of total tkm (excluding pipeline). According to industry participants, road freight costs are c. AUD $0.16 per tkm, representing a 20% premium over Australia.[6]

Landing point	***Final destination***	***Estimated max trip distance (one way)***
Wellington	Wellington region	100km
	Manawatu (Palmerston)	200km
Canterbury	Canterbury region	200km
	West coast	300km
Bay of Plenty	Bay of Plenty region	100km
	Auckland, Waikato, Gisborne	200km
Northland	Coastally shipped elsewhere	N/A

Table 2: Key road routes for fuel, following coastal shipping (Source: Industry participants, Google maps)

[6] *National Logistics Manager at a large New Zealand fuel distributor*

Canada Comparison

CANADIAN SUPPLY CHAIN

Fuel in Canada

Canada is the 4th largest crude oil producer in the world. Canadian refineries produce c.98% of total Canadian fuel demand. However, differences in provincial refining capacity and demand, a highly localised refinery network and Canada's geography, require Canada to import a significant amount of refined fuel. Approximately 20% of Canada's refined fuel consumption (c.20Mt per year) is imported to meet local demand.[7]

Broadly, Quebec, Ontario, the Atlantic provinces, and British Columbia are key refined fuel import regions, due to their coastal locations, while crude oil is predominantly produced and refined domestically in western Canada.

Quebec has the 2nd largest demand for refined fuel products in Canada (after Ontario), due to high energy demand from industrial activities (c.39% of total demand) and transportation (c.30% of total demand). Quebec does not produce any crude oil, but refined imports from the U.S. and Europe fill the gap left by oil refined within the province

The Atlantic provinces are not serviced by pipelines, relying heavily on road transport and coastal shipping to move fuel. Nova Scotia relies on refined fuel imports from the East Coast of the U.S. and Europe, as it no longer has any oil refineries.

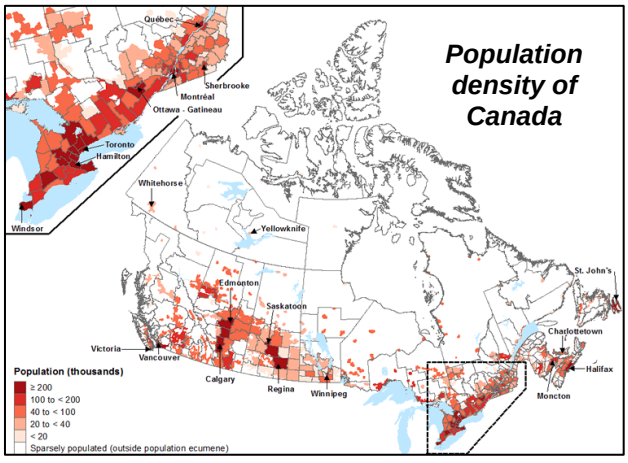


Figure 10: Heatmap of Canada's population density (Source: Canadian Government)

Key supply chain flows

Flow #1: Bulk fuel movement

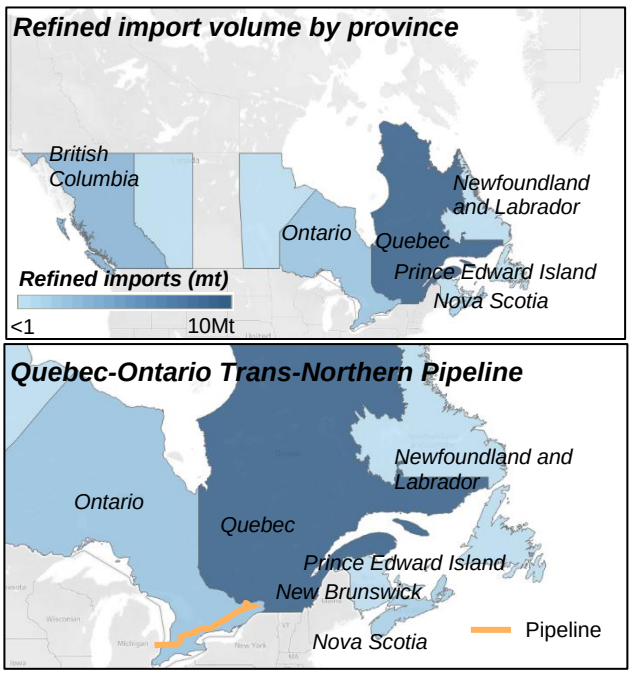
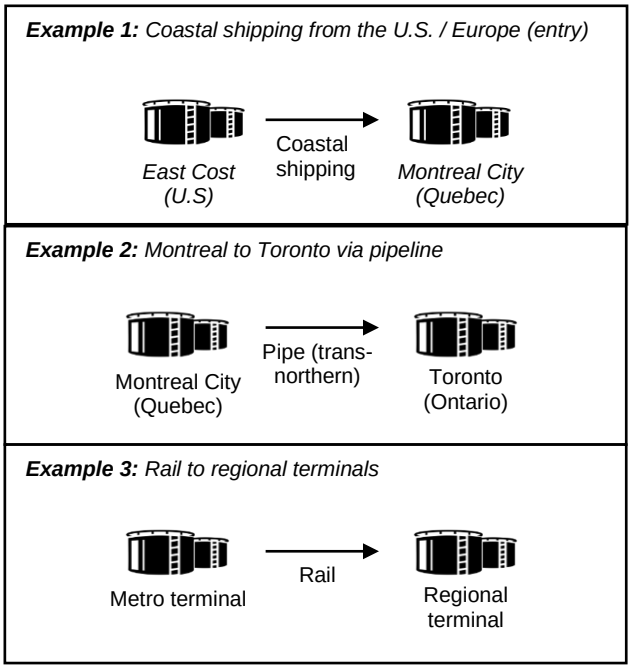


Figure 11: Heatmap of refined import volume, by province (including pipeline location) (Source: Canadian Government)

Bulk refined fuel is moved around Canada using a complicated network of rail, pipelines and waterway transport.



[7] Government of Canada (webpage), Petroleum products facts, 2020

Imports of refined petroleum products typically come initially from Europe and the U.S. (via coastal shipping). They arrive at ports in Quebec, Ontario, the Atlantic provinces, and British Columbia. The products are discharged from the ship to fuel terminals.

While these are often located near cities and towns (also key gasoline demand centres), they also include old, decommissioned refineries. All terminals can connect to trucks, though some are equipped to connect to railcars, ships or pipelines. In 2017, there were 21 registered terminals in Ontario, 11 in Quebec and 16 in Atlantic Canada.

From its port of landing, refined fuel can be moved in three key ways. Firstly, it can be shipped between terminals by barge along Canada's coasts. Secondly, fuel can travel to nearby population centres by pipeline. Montreal (in Quebec) receives petroleum products via sea from North-eastern U.S. and Europe. The Trans Northern Pipeline then transports fuel c.850km away to terminals in Toronto. Thirdly, fuel can also be transported via rail to its destination.

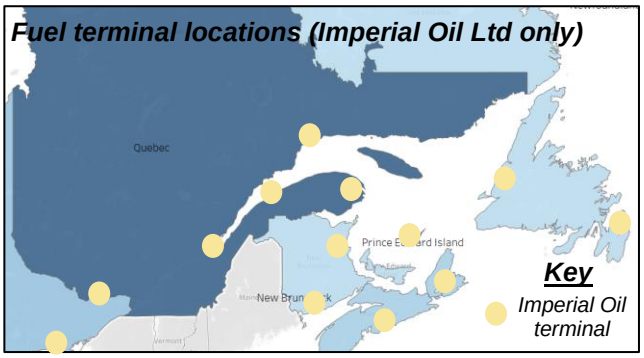


Figure 12: Indicative fuel terminal locations (Source: Imperial Oil)

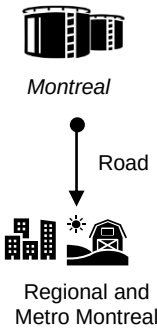
Key flow #2 Movement by road to retailer or commercial site

From the storage point, highway truck tankers transport gasoline from the terminals to underground storage tanks at retail petrol stations for distribution to customers.[8] The journey is usually no more than 50-100km.

Fuel can be trucked to nearby towns and cities, moving distances of 200-300km by road (taking 3-4 hours).

Fuel can also be moved to commercial sites within the relevant province, such as agricultural facilities, mines and other industrial facilities. Depending on the location, a combination of pipelines, road, rail and waterways can be used to move fuel to the site from existing terminals.

Example 2: *Montreal refined fuel movements*



Fuel freight data in Canada

Large trucks can be used to transport fuel between terminals in Canada, holding 40-50,000 litres in two cars (40,000 litres on average). Smaller trucks, usually holding c.20-25,000 litres are used to move fuel from fuel terminals to retailers.

Rail can carry 100,000 litres per carriage, with trains able to carry up to 90 carriages each.

The modal split for transporting refined fuel imports is c.60% road, c.30% pipeline and c.10% rail (the latter two focused mainly in Ontario and Quebec). Rural areas are often only accessible by road, limiting modal choice in some circumstances. Indicative costs for fuel transport are:

- **Rail:** AUD $0.04 per tkm[9]
- **Road:** AUD $0.11 per tkm[10]

[8] Government of Canada (webpage), Petroleum products distribution networks, 2020

[9] *Statistics Canada fuel data*

[10] *Statistics Canada fuel data*

DATA COMPARISON

DATA COMPARISON (ROAD AND RAIL ONLY)

Estimates	**Australia** *CSIRO*	**N.Z.** *Source/method in italics*	**Canada** *Source/method in italics*
Annual tonnes (c. millions)	65	c.3[11]	c.20[12]
Annual net tkm (c. millions)	15,000 (road and rail only)	c.276 (road only), c.1,350 (coastal shipping only)[13]	11,520 (road and rail only)[14]
Annual trailers / shipments (c.000)	2,639	132[15]	614[16]
Cost of movement ($AUD per tkm)	$0.13 (road)	$0.16 (road)[17]	$0.04 (Rail)[18] $0.11 (Road)[19]
Total transport costs (c. AUD$m)	1,940	*Unavailable*	660[20]
Average trip distance (km)[21]	251	c.200 for road journeys between population centres without a nearby waterway c.<100 for road journeys from storage terminals to local petrol stations and commercial premises	c.300 for road journeys between population centres without a pipeline or waterway nearby c.<100 for road journeys from storage terminals to local petrol stations and commercial premises
Average trip duration (c. hours)[22]	2.9	2-3 hours for road journeys between population centres <1 hour for rod journeys from storage terminals to local petrol stations and commercial premises	3-4 hours for road journeys between population centres <1 hour for rod journeys from storage terminals to local petrol stations and commercial premises

[11] Data from Ministry of Business, Innovation and Employment New Zealand
[12] Statistics Canada
[13] Estimated by multiplying annual refined fuel imports by an average journey distance of c.100km. Coastal shipping c.83% of all freight task based on NZ National Freight Demand Study 2012
[14] Statistics Canada. Freight Analysis Framework, data for fuel oils and crude petroleum (Statistics Canada, fuel data), apportioned by total refined tonnes as a % of all fuel oils and crude petroleum tonnage
[15] Total tonnage divided by 18k litre truck (21 tonne capacity)
[16] Statistics Canada
[17] Expert interview - 20% premium on Australia's cost due to higher road user charges, smaller trucks
[18] Statistics Canada
[19] Statistics Canada
[20] Statistics Canada, apportioned by total refined tonnes as a % of all fuel oils and crude petroleum tonnage
[21] Aggregate of industry participant views
[22] Aggregate of industry participant views

FREIGHT DATA COMPARISON SUMMARY

Fuel is a significant input into every other supply chain, due to its significance to the transport sector, therefore the efficiency of the fuel supply chain, particularly surrounding the import of refined products, is extremely important. Australia's refined fuel import volumes are relatively high (c.65Mt) compared to Canada (c.20Mt) and New Zealand (c.3Mt), due to recent rationalisation of local refineries.

The average trip duration in all three countries is similar, depending on the journey, at around 200-300km (2-4 hours) for regional trips (outside of a city where fuel is directly imported into). Australia and Canada in particular, utilise multi-modal systems to move fuel in the most efficient manner, using road, rail, waterways and pipelines in some cases to optimise freight flows. The cost of moving refined fuel in bulk by road is similar in both Canada, Australia and New Zealand (c. AUD $0.11, c. AUD $0.13 and AUD $0.16 per tkm respectively). While cost of individual freight tasks in New Zealand is known, total fuel cost is not, though substantial work has commissioned done by the Ministry of Transport in terms of estimating the freight task and flows.

There is an opportunity to undertake further study around the costs of moving non-refined fuel products, such as domestically produced and/or domestically refined crude oil and how these compare to the movement of fuel products refined offshore.

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