



SUPPLY CHAIN PERSPECTIVE

FUEL



QTLC

QUEENSLAND TRANSPORT
AND LOGISTICS COUNCIL

Overview

Australia’s economy is built on key industries that rely heavily on fuel consumption. This report deals with fuel as it is processed from crude oil to refined petroleum and other products. Within this report, the following terminology is used:

- **‘crude oil’** – refers to both locally produced and imported product
- **‘refined petroleum products’** – refers to imported, locally refined and exported products, including diesel, gasoline, jet fuels, LPG etc (these products will be referred to as ‘petroleum products’ throughout this report)
- **‘other refined products’** – refers to solvents, lubricants, bitumen, waxes, etc.

The supply chain maps the extraction or import of crude oil through the refining process to petroleum or other products. The efficiency of fuel supply chains is critically important to ongoing productivity.

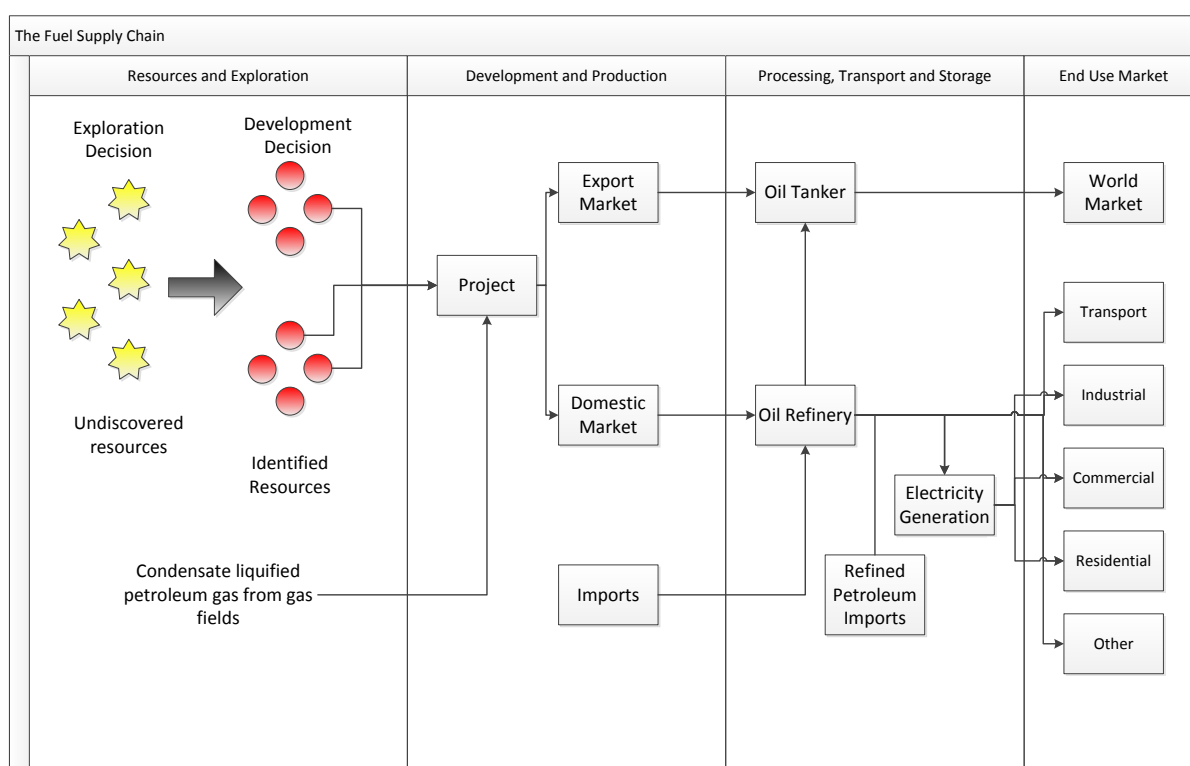
While Australia produces a significant amount of crude oil, the majority is exported to take advantage of high international market prices. As a result, Australia imports large quantities of crude oil for domestic consumption and refinement. Figure 1 depicts the overall petroleum supply chain.

Import supply chains are critical for reliable fuel supply. As such, international shipping (from the source) is a major fuel supply channel.

Australia typically imports around 80% of its crude oil and other refinery feedstock (other products and consumables used in refining)¹. With the closure of domestic refineries at Clyde, Kurnell and Bulwer Island in Brisbane, the percentage of refined imported petroleum products will increase.

¹ APH Economics Committee Report – Oil Refining Industry

Figure 1: Australia’s fuel supply chain

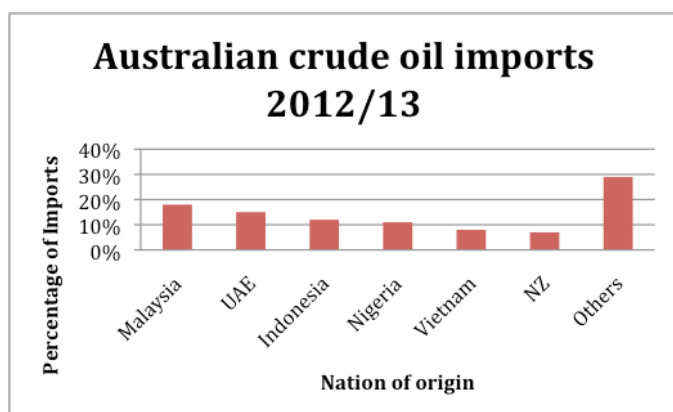


Source: Bureau of Resources and Geoscience Australia

Points of origin

Crude oil is imported to Australia from a number of locations, including from Asia (55%), the Middle East (21%) and Africa (21%)². The points of origin for imported crude oil are shown in Figure 2.

Figure 2: Australian crude oil imports 2012/13

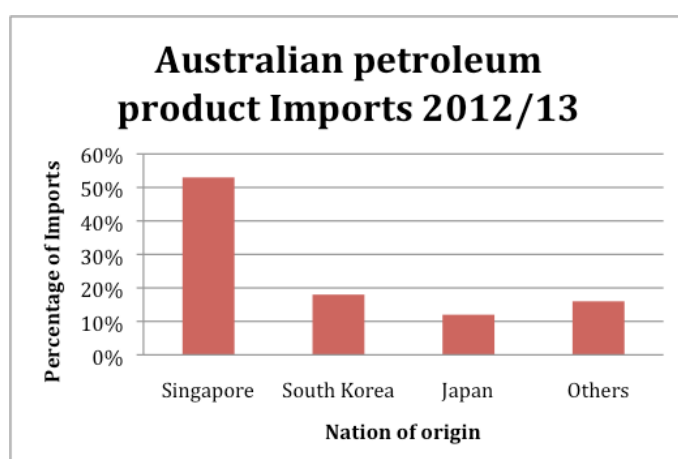


Source: *Downstream Petroleum Report 2013*, Australian Institute of Petroleum

The 'Others' category in Figure 2 includes nations such as Gabon, Libya, Congo and Papua New Guinea.

Imported petroleum products are primarily sourced from refiners and regional traders in Singapore. The points of origin for imported petroleum products are shown in Figure 3.

Figure 3: Australian petroleum product imports 2012/13



Source: *Downstream Petroleum Report 2013*, Australian Institute of Petroleum

² Downstream Petroleum Report 2013: Australian Institute of Petroleum

The 'Others' category in Figure 3 includes nations such as Chinese Taipei, Malaysia and Thailand.

In order to meet the demands of the growing Asian market, significant refinery capacity has been built in the Middle East and Asia in recent years, with surplus refining capacity resulting in depressed margins. This is challenging the commercial viability of petroleum product refining in Australia. Australian refineries are adapting by introducing cost control and efficiency measures. Independent fuel distributors in Australia have increased the level of petroleum products imported from Asian sources, and this trend is predicted to continue into the future.

This changing supply base has a direct impact on the supply chain by way of the International Energy Association's (IEA) requirement for Australia to always hold 90 days' supply of oil (based on the prior year's average net oil imports). Australia currently does not meet this obligation³. The Australian Institute of Petroleum is of the view that risk is mitigated by the unique logistics and geographic challenges that make Australia's fuel supply chain reliable⁴.

Supply lines from Asia, which provides the bulk of imported crude oil and petroleum to Australia, typically involve 12 to 14 days sailing to Queensland, and six to eight days to the Northern Territory and Western Australia. Other states generally require two to four days longer sailing than the Queensland locations. As such, a larger proportion of imported petroleum is supplied to Northern Territory and Western Australia³.

However, this will change with the closures of the domestic refineries. Due to the conversion of refineries in Sydney into imported refined petroleum distribution hubs, Australia's reliance on imported petroleum products will increase.

³ House of Representatives Standing Committee on Economics, Chapter 4
⁴ Downstream Petroleum Report 2013, Australian Institute of Petroleum

Figures 5 and 6 depict ports with fuel terminal operators in Queensland (see page 6).

Dimensions⁴

Liquid fuel and petroleum products underpin the economic performance of transport, mining and agriculture industries Australia-wide. In 2012/13, Australia consumed 55.1 billion litres of petroleum product, of which 36.9 billion litres (around 67%) was refined locally and the balance imported.

Refined import flows to Australian states typically represent:

- 50% of consumed fuel in New South Wales
- 100% of consumed fuel in north-west Western Australia
- 100% of consumed fuel in Northern Territory
- approximately 50% of consumed fuel in Queensland, for locations from Gladstone, north.

The reliable supply of these products to industry sectors has been a hallmark of the Australian refining industry. However, due to the rapid expansion of refinery capacity in the Middle East and Asia as mentioned above, the degree to which the Australian market is serviced by imported petroleum products will increase.

Figure 4 shows how the petroleum supply chain in Australia is structured, from crude oil through to retailers, including volumes in million litres.

Figure 4 shows:

- Australia imports 32,900 ML of crude oil, which is more than double the amount it exports (15,000 ML); Australia also imports 2,600 ML of gasoline
- 15,000 ML of gasoline is sold by retailers, while 4,200 ML is sold to distributors and industrial end users. This is an indicator of the overall demand for fuel between these two end uses.

(Note that diesel flows are not included in Figure 4.)

For 2012/13, approximately 60% of the petroleum products required by major industries and for the fuel distribution network (around 6,300 service stations), was supplied from Australian domestic refineries⁵.

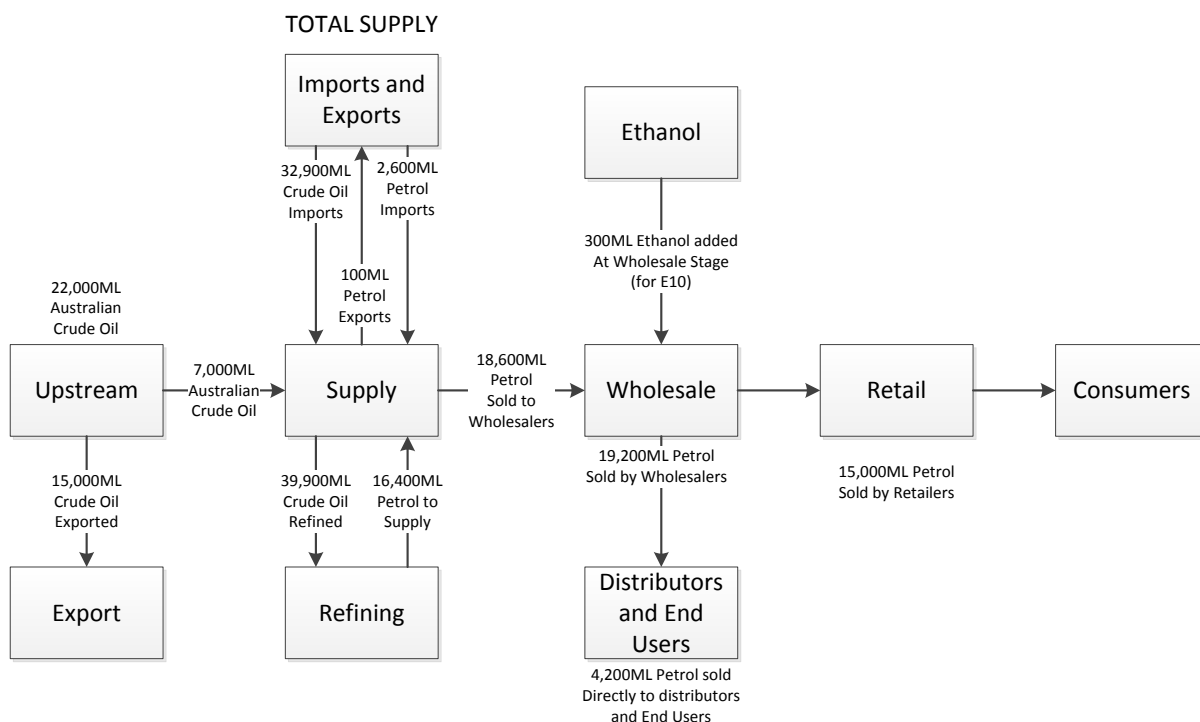
Australia's domestic refined product comprises:

- gasoline: 43%
- diesel: 35%
- jet fuel: 15%
- fuel oil: 2%
- LPG: 3%
- other 2%.

Queensland consumes around 25% of all petroleum products in Australia and is the leading consumer of diesel by state or territory, with 30.5% of total national consumption.

⁵ Downstream Petroleum Report 2013, Australian Institute of Petroleum

Figure 4: Australian petroleum flows, 2010/11 – megalitres (ML)



Source: Energy White Paper 2012, Department of Resources, Energy and Tourism

Table 1 shows the total usage of petroleum products for the year 2012/13. Queensland consumes more diesel than any other fuel type, mainly due to mining and road transport operations, which consume 52% and 34% respectively. Motor vehicles are a significant consumer of automotive gasoline.

Table 1: Queensland product use 2012/13 - kilolitres (kL)

Product	kL
Heating	23,965
Diesel	6,891,307
LPG	577,094
Fuel oil	185,072
ULP	4,042,818
Lubes	101,157
Bitumen	300,451
Aviation	1,618,934
Other	13,284
Total	13,754,082

Source: April 2014 BREE Australian Petroleum Statistics, Table 3C

Other major industry consumers of petroleum products are forestry and fishing. The demand for petroleum products among Queensland's major industries is shown in Table 2 on an energy consumption basis.

➤ People working in fuel

More than 100,000 people are employed by the energy sector in Australia, with 6,000 involved in petroleum refining⁶.

Queensland currently has approximately 20% of Australia's refining capacity. In addition to refining, people working in this sector are employed in:

- shipping, port, terminal and depot operations
- transport and distribution
- retail and wholesale.

➤ Fuel businesses

The Queensland fuel supply chain involves logistics service facilities and providers, as well as organisations including:

- major and independent retailers
- marine, rail and road transport companies
- all ports
- major private users from mining, transport and agriculture industries
- fuel companies, including Viva Energy, Caltex, BP, Puma and Mobil.

740 businesses work in the Queensland fuel sector⁷:

- 420 operate with a turnover greater than \$2m
- 580 employ 19 employees or less
- 151 employ 20 to 199 employees
- 12 employ over 200.

⁶ Energy White Paper 2012, Department of Resources, Energy and Tourism
⁷ ABS 816501 Number of Australian Businesses 30 June 2012

Table 2: Energy consumption by industry and fuel type 2013 – Petajoules (PJ)

	Ag, forestry & fishing	Mining	Construction	Road transport	Air transport	Sub-total
Auto gasoline	1.7	0	0	135.8	0	137.5
Aviation turbine fuel	0	0	0	0	52.7	52.7
Automotive diesel oil	19.6	63.7	6.5	97.2	0	187.0
Natural gas	0.1	16.9	0.5	0.5	0	18.0
Petroleum products	0	1.1	0	0	0	1.1
Sub-totals	21.4	81.7	7.0	233.5	52.7	396.3
ALL	5.4%	20.6%	1.8%	58.9%	13.3%	
Automotive diesel oil	10.5%	34.1%	3.5%	52.0%	0.0%	

Source: 2013 Australian Energy Statistics Data, Table F

Points of value add, transformation and consumption

Fuel is distributed throughout Queensland as follows:

- Ports are the initial storage points for imported refined products. Fuel is stored at importing companies' tank farms, known as terminals, which are shown in Figure 5.
- Refineries store the imported crude products awaiting refining.
- Domestic refined products are then distributed to depots, or direct to customers.
- Depots providing intermediate storage are dispersed throughout Queensland (see Figure 6).
- Service stations will, in most instances, receive direct delivery of product from these storage locations via terminals or depots. Major retailers and independents control the majority of the retail fuel outlets⁸.
- Major users of fuels, such as mining operators, industrial plants, agricultural operations and transport operators, may have their own on-site storage facilities.

Figure 5: Fuel terminals and ports in Queensland



⁸ Downstream Petroleum Report 2013, Australian Institute of Petroleum

Figure 6: Fuel depots and ports in Queensland



Freight movements

Fuel is available for consumption in Queensland through two supply chains, supported by a number of distribution networks. These chains are:

- imported refined product
- domestic refined product, derived from imported crude.

Table 3 shows the detail of fuel import volumes received at Queensland's ports for imported refined and imported crude product.

Table 3: Imported crude oil and petroleum product volumes

Port	Volume (ML)
Weipa	79
Cairns	650
Townsville	1,110
Mackay	1,500
Port Alma	60
Gladstone	1,400
Brisbane	7,900 crude
	1,944 refined
Totals	7,900 crude
	6,743 refined

Source: Industry interviews

It is estimated there are a minimum of 275,000 loaded single trip petroleum movements in Queensland each year (550,000 return). This figure is based on the total annual consumption of petroleum product in Queensland for 2012/13 (13,754,083 kL), and assuming a typical unit of movement occurs in a B-Double rated at 50,000L capacity. This is provided as a minimum, as there may at times be multiple trips required, and not all vehicles will carry the assumed volume.

Petroleum product is transported in purpose-built trailers and/or tanker equipment that must comply with the Australian Dangerous Goods code and Australian Standard AS 2809⁹. Each unit is equipped with filling and discharge equipment, and a high level of safety equipment and protocols must be observed when operating. These units must be intrinsically safe electrically.

When multiple trips are required, the vehicle configuration differs from B-Double capacity. It is smaller for route distribution, and larger for servicing remote regions¹⁰.

In remote areas of Queensland, configurations capable of transporting larger quantities of fuel per movement are favoured, depending on access restrictions specific to the local area. In addition to B-Doubles, the following combinations are used to distribute fuel, based on the nodal infrastructure and access:

- rigid body tankers
- rigid and dog trailers
- road trains and quad equivalent

Figure 7: Typical fuel transport vehicle



Fuel transported by rail in Queensland is limited to movements on the Townsville to Cloncurry and Mt Isa section¹¹. Annual diesel volumes of 165 million litres move up to six days a week on a combination of dedicated and mixed-use trains. All gasoline and aviation fuels are transported by road.

⁹ <http://www.tieman.com.au/products/road-tankers/fuel-road-tankers>

¹⁰ http://tieman.com.au/assets/document/Tanker_Topics_Vol_18.pdf

¹¹ Industry sources

The aging rolling stock has capacity of between 45,000 litres and 56,000 litres per wagon, and moves in 12 to 14 rail cars. This aging rolling stock is nearing the end of its economic life. Options are being examined for lower cost rolling stock solutions involving ISO fuel container and container wagons versus a road solution. Subject to long-term requirements and these investigations, there may be a modal shift to road, with movements by Type 2 road trains or equivalent. A number of factors will impact this modal shift decision:

- Standard rolling stock replacement is a large and long-term investment, yet fuel supply contracts are typically five years' in duration.
- New generation lower-cost and more flexible rail solutions, such as ISO fuel containers and wagons, would require broad user acceptance.
- A current major customer can access their own global fuel supply network and may choose to move to a closed loop logistics system in the future, resulting in 65% of current fuel movements potentially moving away from rail.
- The Port of Townsville has Type 2 road train access to the entry gate, which would allow for easy access to fuel import terminals and quick turnaround cycles to Mt Isa and Cloncurry.

Main routes

Due to the nature of fuel movements and the points of consumption, fuel travels on all major highways, motorways, developmental roads, and state and local council roads. This is shown in Figures 5 and 6.

Key nodal infrastructure

Key nodal infrastructure includes¹²:

- ports, including harbours, berths and fuel unloading, storage and loading facilities
- refineries for domestic production of refined products
- terminals (at port and refinery), for both road and rail distribution
- regional depots, for intermediate storage
- service stations and retail outlets
- private fuel farms, for major industrial and agricultural producers.

¹² Downstream Petroleum Report 2013, Australian Institute of Petroleum

Change in the supply chain

Future change in fuel supply chains will be driven by three major factors.

The first is the pending reduction in fuel refining capacity in Brisbane. As a result, 5.8 million litres a year will be replaced by imported refined product supply chains. This will have no major impact on outbound logistic channels, as the refined product will still emanate from the same precincts.

Overall, the reduction in domestic refining capacity will lead to increased imports of refined product. The refinery in Sydney will be transitioned to a refined product import terminal.

The second driver will be the Queensland Government's preference to encourage, where feasible, fuel transport back onto rail. This has the potential to impact ports and major fuel terminals that have rail access, including potential investment in new rail-based fuel loading facilities and infrastructure.

It is likely that rail operators will explore next generation fuel rail haulage technology and equipment. The depots and distribution hubs at points of consumption will need to be redefined, and suitably configured to accommodate rail transport.

Lastly, should the International Energy Association's requirement for stock holding levels be met, the current capacity in import storage infrastructure will need to be increased to support increased stock holdings. Currently, forecast stock holdings – expressed as days of consumption cover – are between 44 and 51 days, well below the required 90 days of cover.