

Supply Security

Introduction

Petroleum products are an important part of energy consumption in Australia. Petroleum products are responsible for 52% of final energy consumed in Australia. More importantly, liquid petroleum products fuel very nearly 100% of the transport market. Of these fuels, 95% are produced by Australia's 8 major refineries:

	Capacity (Barrels per day)
Bulwer Island (BP – Brisbane)	83,000
Lytton (Caltex – Brisbane)	105,000
Clyde (Shell – Sydney)	86,000
Kurnell (Caltex – Sydney)	120,000
Altona (Mobil – Melbourne)	135,000
Geelong (Shell – Geelong)	125,000
Port Stanvac (Mobil - Adelaide)	76,000
Kwinana (BP- Kwinana, WA))	138,000
Total	868,000

The total demand for petroleum products in Australia is around 770,000 barrels per day.

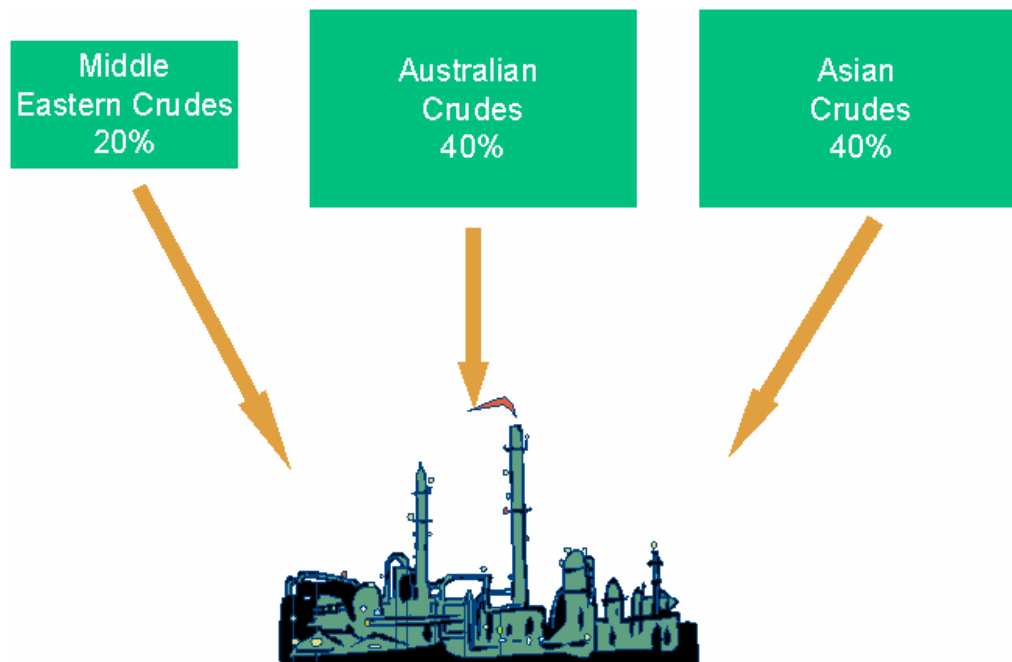
If there is a disruption to petroleum supplies the most important products in the Australian context are:

- Petrol
- Diesel
- Jet fuel
- LPG

These products make up 90% of the consumption of petroleum in the Australian economy. The remaining 10% is made up of heavier products such as fuel oil and various lubricating oils and greases and other specialty products. Under a disruption scenario the lubricating oils and greases are not crucial to the operation of the economy in the short term. Furthermore, stockpiles of these products tend to be much greater than the transport fuels in terms of days consumption cover and often their consumption can be delayed for short periods eg oil change periods can be extended. Although, such action would have a negative impact on the industries which rely on these products eg road making, lubricant sellers, and equipment service industries to name a few. However, a shortage of fuel oil for marine bunkers and other key industrial uses such as power generation may be a significant issue.

Supply Chain

Around 95 % of the petroleum products consumed in Australia are produced by the local refineries and these refineries are reliant mainly on imported crude oils with just under 20% sourced from the Middle East, 40% from Asia and 40% from Australia's own production. Consequently, Australian transport fuel consumers are exposed to international disruptions to crude oil because 60% of refinery input is sourced from overseas.



This would appear, at least superficially, to be unusual decision making ie Australian crude oil production in net terms means that Australia is around 85-90% self sufficient and yet Australian refineries purchase 60% of their feedstocks from overseas sources, leaving the producers to export 60% of their production.

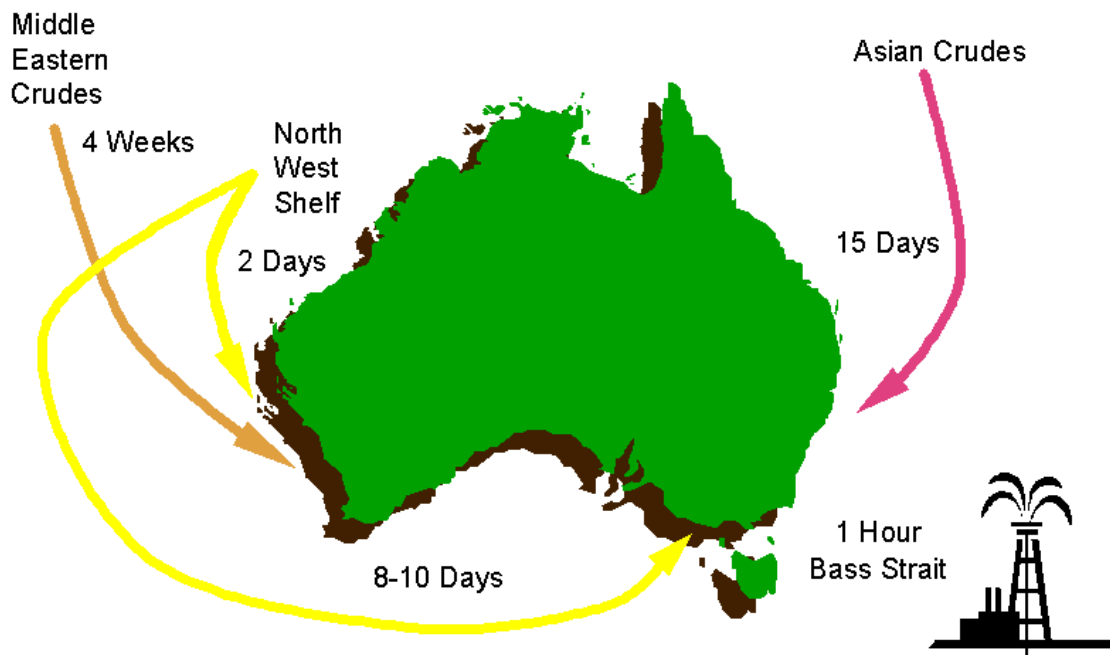
Refinery operations are based on linear programming models which match the Australian product demand with refinery equipment and capabilities leading to decisions on which crude oils to purchase for the least amount of money and still be able to meet product demand.

Australian crudes tend to be lighter and sweeter than most world crude oils which leads to generally higher prices for Australian crudes and refiners can find cheaper alternatives elsewhere. Different crude oils have different inherent yields of products. Australian crudes for instance do not exactly match the products demanded in Australia ie LPG (5%), petrol (41%), jet fuel (10%), diesel (30%), fuel oil (4%) – see Appendix A. In addition, Australian crudes are not suitable for producing the heavier products such as bitumen, lubricating oils and greases. These heavier products account for perhaps 10% of refinery output.

This is not to say that Australian refineries are unable to process Australian crude oils – they can. It is just that such an approach would lead to a sub-optimal economic outcome in terms of raising the price of the crude oil input but not being able to raise the price of the final product. The outcome is also sub-optimal in that the heavier products could not be produced and the overall refinery output would decrease to around 70% of its current production levels which would not meet market demand.

The length of the crude oil supply lines is on average around 4 weeks for the 20% supplied from the Middle East, around 10 days for the 40% supplied from Asia and anywhere from a few days to a week for the 40% of indigenous crude oil. There is additional lead time required for ordering/purchasing the crude oil and securing the ships to bring it to Australia. This raises the overall supply time to around 3 months.

Length of Crude Supply lines

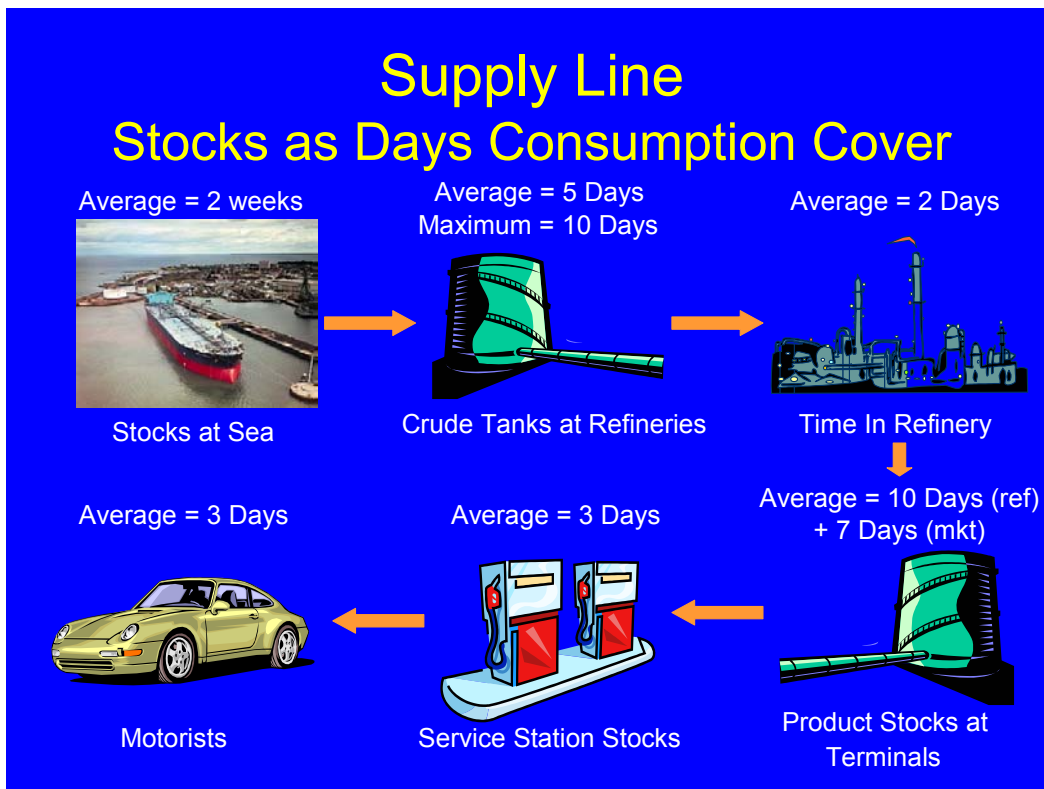


Refining

- Once the crude oil reaches the refineries it is stored in holding tanks and these can hold anywhere from 10-15 days of refinery consumption, where crude supply is by ship, down to perhaps 1 or 2 days for pipeline supply. The refinery will consume crude oil until around 5 days supply is left in the tanks and a tanker will be scheduled to arrive to fill up the tanks to capacity. The minimum planning inventory of around 5 days consumption provides the refinery with security of supply in case the tanker is delayed, which can happen due to weather or other reasons.

The important point here is that there is little or no surplus tankage for crude oil at refineries. Crude tanks operate between full and relatively low inventory on a regular basis, in line with the supply shipping pattern.

The crude oil will usually take 1-2 days to be processed through the refinery until it becomes a final product and is stored at the refinery terminal. Refinery terminals typically hold the equivalent of 10 days worth of consumption. Marketing terminals typically hold an additional 7 days of products supply. There are generally no spare product tanks at refineries or marketing terminals.



As indicated earlier, refineries are operated on an economic basis, and if there are cheaper alternatives to processing crude through local refineries to produce finished product these will be taken advantage of. It is, for instance, cheaper at times to source product from Singapore and if this course of action is taken, either by independent suppliers or local refiners, refinery operations are scaled back to compensate. The important point here is that all suppliers are continuously looking for the lowest cost supply of petroleum products into Australia.

Distribution

The structure of distribution has been changing over the past few years in the search for greater efficiencies. There is an increasing trend for fuel distributors to supply their

customers directly from large terminals or other seaboard facilities, rather than handling product through depots as in the past. Fuel distribution is handled partly by company owned fleets but mainly by contractors. Intermediate steps have been taken out wherever possible. Depots now tend to be restricted to distributor depots in country areas where delivery of supplies to farmers for instance can be intermittent and are generally smaller loads, and therefore require some stocks to be held. Sea transport is used in WA and Qld to transport product to rural terminals there and to NT. On the eastern seaboard 80% of product is delivered directly from major refinery or import terminals to service stations or other end consumers. This trend is common to a range of industries, another example being direct deliveries of newspapers from the publisher rather than from the newsagent.

The effect of this trend is that the product supply lines post the refinery terminal have shortened considerably. In addition, tankage at depots has been de-commissioned leaving less storage capacity. Moreover, this structural change has not been completed with the downstream petroleum industry continuing to look for opportunities to reduce inventory as a cost saving measure. However, the search for inventory reductions is always taken in conjunction with assessments of the risk of disruption to supply.

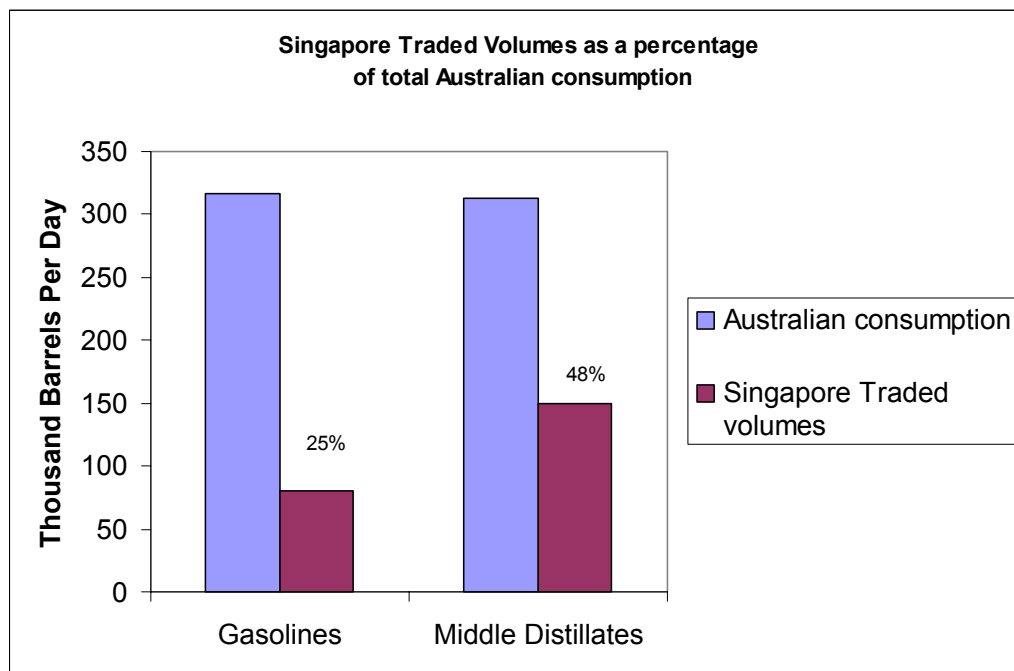
It is always possible for there to be an interruption to supply, either through disruptions to petroleum product supply or to crude oil supply. In general, Governments are faced with the following choices to match supply and demand if the situation is beyond the ability of industry to control:

- Constrain demand
 - Rationing measures such as odds and evens, maximum dollar or volume amounts allowed per customer.
 - Prioritising customers ie emergency services to have unlimited access to supplies and everyone else is rationed
 - Controlling public order and access to supplies.
- Improve supply
 - Drop fuel standards to allow greater choice of crude oils and greater yield of product eg sulfur in diesel.
 - Require indigenous supplies of crude oil to be made available to Australian refiners
- Mandate strategic stockpiles of crude oil.

The industry would argue that the most appropriate and efficient supply and demand matching mechanisms for Government to use would be to constrain demand and, other than relaxing fuel standards, Governments should steer clear of supply side controls. The industry has the expertise to manage supply shortfalls and Government intervention would most likely lead to inefficiencies. This observation also applies to strategic stockpiles. Meaningful stockpiles of crude oil or product need to be large and would therefore be very expensive to set up and to operate. Purchase costs alone for crude oil equivalent to one third of Australia's requirements for one month would currently be around \$A500 million. Furthermore, industry is regularly assessing risks of disruptions to supply and weighing these against the cost of higher or lower inventory and has the

expertise to do this effectively. In the current climate the industry also has contingency plans in place to cope with potential disruptions to international crude oil supplies with company teams set up to monitor crude oil supplies and likely threats.

Moreover, just to the north of Australia is Singapore, a huge petroleum trading centre for Asia, providing Australia with access to significant supplies of product. Traded volumes of gasoline in Singapore are equivalent to 25% of Australia's entire petrol market while diesel trades in Singapore are equivalent to nearly half of the diesel market in Australia – see below.



The large volume of traded products coupled with the significant volumes of products held in storage by independents make Singapore a useful source of product in the event of a disruption. Product storage capacity at the refineries is of the order of 20 million barrels while independent storage is also quite large at 10-15 million barrels. If its cost is not to be prohibitive, any strategic stockpile Australia might contemplate would be much smaller than what is already available in this market. For example, the product cost alone for a strategic stockpile of 10 million barrels would be at least \$A500 million.

Where industry would appreciate assistance is when there is a prolonged and significant disruption to supply and Government could prioritise supplies in terms of need – industry does not have the power or right to differentiate between customers.

Domestic Disruption Scenarios

Disruptions to petroleum **product** supply (rather than crude oil disruptions) would only be of major consequence if they were to occur within Australia because 95% of

petroleum products consumed within Australia are provided by the local refining industry. The types of disruption likely within Australia are:

1. technical difficulties or accidents in refineries in which case it is likely to be affecting at most one or perhaps two refineries; or
2. industrial unrest with supplies from refinery terminals blocked; or
3. unusual demand from a large consumer such as the Defence Department impacting on supplies to the rest of the economy.

In scenario 1 refinery management would arrange alternative product supplies either from other Australian refineries or from Singapore refineries. In fact this is a relatively common occurrence with supplies in certain parts of Australia quite often only 70-80% of normal. However, consumers are generally not disadvantaged or even aware of any problem because the industry is adept at managing such supply disruptions within Australia.

The mechanisms which the industry uses to adjust supply include:

- purchase product from the other refinery in that state. The timing is of the order of a day or so;
- purchase and ship product from a refinery in another state. The timing is of the order of a few days to a week;
- purchase and ship product from Singapore. The shortest time frame is about 3 weeks while more generally the ordering time is about 5 weeks;
- purchase and ship product from other overseas sources (could be diversion of another cargo already on the water or supply from another Asian refinery perhaps in South Korea or Thailand for instance). The ordering time is likely to be several weeks to a month.
- Companies may also allocate scarce supplies of product between customers to manage demand in the event of a significant supply shortfall.

It is important to note that alternative supply options are likely to be at a higher cost but normal competitive forces will constrain any impact on market prices. In an extreme situation industry or Government may wish to allow increased prices to reduce demand so as to assist in managing the supply shortfall.

The commercial background to the above responses by industry is that normally refineries order crude oil about 3 months ahead of when it is required. If additional supplies are required within that time frame then a premium will apply, if it can be found. An example of this was the Longford explosion which cut off supplies of Bass Strait crude oil to the Altona refinery in Melbourne for several months. Mobil had to purchase alternative crude oil at short notice and had to pay a considerable premium, but there were no product supply shortages. The key conclusion here was that the industry was faced with a local crude oil supply shortfall and coped within the normal market mechanism but was forced to pay higher prices for its feedstock. Thus, within the range of mechanisms which industry uses to manage a supply shortage there are usually pricing

and competitive implications, hence Government intervention should be restricted to extreme circumstances.

Scenario 2 may be an issue for State or Territory Government intervention.

Industrial unrest can be a difficult issue to handle. Industrial relations conditions can deteriorate quickly which sometimes does not allow for any stocking up by the industry before hand. If blockades of terminals are put in place then it means that petrol supplies available to consumers are probably only of the order of a few days to a week. In these circumstances, if the industry is unable to finalise the industrial relation issue, then some form of demand constraint such as odds and evens restrictions will be needed. However, in the end, the blockade will need to be lifted for meaningful supplies to be available and there may be a role for a state government to invoke emergency powers.

Scenario 3 Unusual demand by a large consumer over a very short time frame could create priority difficulties for a refiner/marketer. An example is the loss of gas supplies due to the Longford incident, leading to an increased demand for diesel for power generation and other industrial/commercial use.

If the time frame is longer, say several weeks to a month, then the company could arrange alternative product supplies from either another Australian refinery or from Singapore. If the supply request was too large or involved a very short time frame (less than 3-4 weeks), then it is likely that the domestic industry could not supply. Government involvement would not normally be expected unless there were unusual circumstances such as some form of defence action in the local region which for some reason necessitated supply from within Australia. In this case, the Government would have to dictate priorities to the suppliers under emergency legislation.

Government Intervention

In scenario 1 there is no need for Government intervention as the industry is experienced at evening out such supply disruptions and any intervention by Government would only make the process less efficient. Continued close liaison with Government is needed when supply impact is significant or prolonged.

In scenario 2, it is quite likely that Government intervention will be needed, but only to influence the industrial unrest outcome or to introduce rationing.

In scenario 3, there may be a need for Government intervention particularly if there was a defence issue or an extreme supply shortage of a particular grade for some reason. The industry would determine whether it was capable of meeting the requirements from either local refining or imports or a combination of both.

Crude Oil Supply disruptions outside of Australia are likely to be of the following types:

1. A relatively small supply shortfall driven perhaps by Iraqi production ceasing ie 2.5mbd or 3% of world output.
2. A bigger shortfall driven perhaps by Saudi production ceasing ie 9mbd or 12% of world output.
3. Supply suddenly ceasing from an Asian country with replacement crudes being further away and therefore leading to a supply shortfall until replacement crudes arrive.

Currently 95% of products consumed in Australia are sourced from Australian refineries. However, if this level of production is not possible due to constrained availability of crude oil there are supply alternatives:

- in the case of petrol, diesel and jet fuel, the most likely alternative source would be the refineries in Singapore. Although as fuel specifications tighten over the next few years it is possible that alternative sources of supply, particularly petrol, would come from Middle Eastern refineries as they have been configured with European and US markets in mind – where tighter fuel standards exist. Singapore refineries have been configured with diesel markets in mind and overall less tightly specified markets.
- If crude supplies from Asia are constrained for some reason then product supply from Singapore might be available but if not then other possibilities are further away - perhaps leading to a lengthening of supply lines and a shortage in Australia in the short term.
- in the case of LPG, even though Australia exports significant volumes of LPG (equivalent to around 75% of local consumption), imports would more likely be sourced from Saudi Arabia rather than Australian fields because the Australian export and import facility infrastructure does not match up in such a way as to facilitate shipping LPG from say the North West Shelf to the Eastern Seaboard.

Government Intervention

In circumstances where crude oil availability world wide is constrained then the refining industry is best placed to search and procure alternative supplies at the best available price. If crude oil availability was constrained to the extent that the refining industry was not able to produce enough product for the Australian market and there were no alternative supplies of product available from outside of Australia, there would be a need for Government intervention to introduce demand constraint measures.

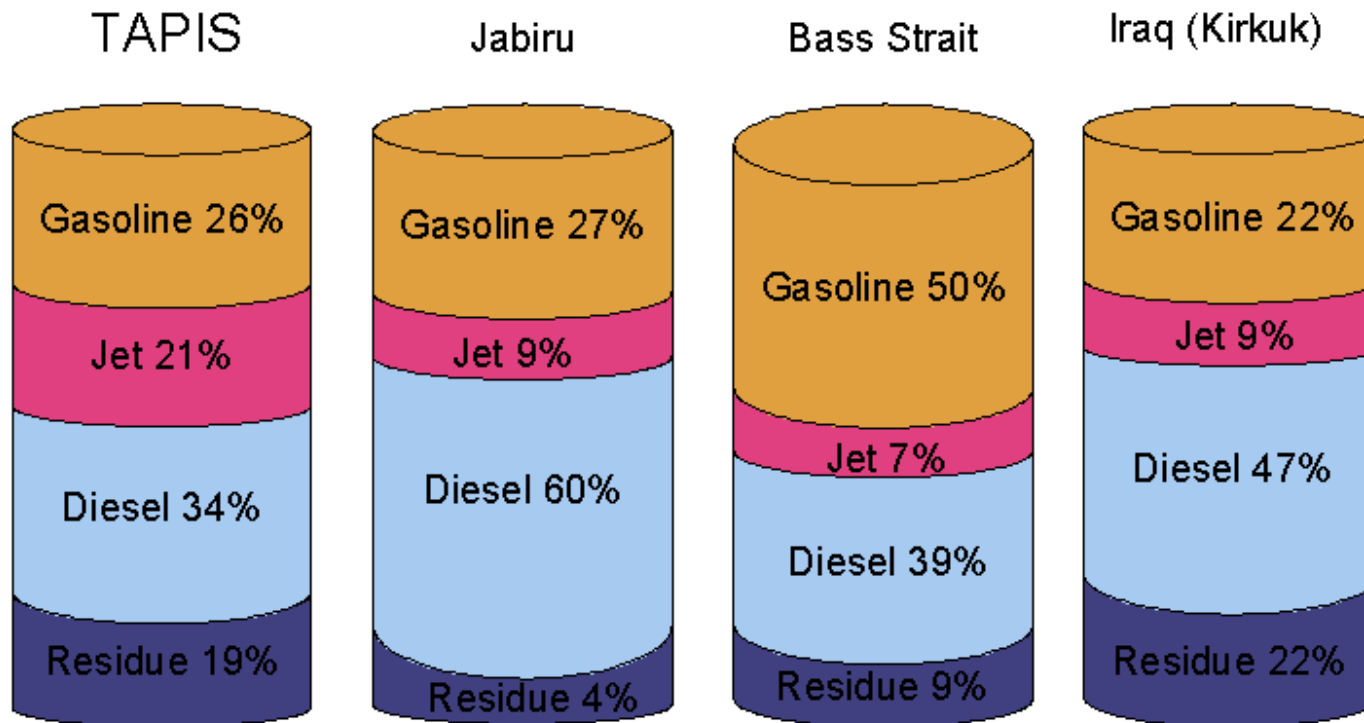
If crude availability in Asia were suddenly constrained then Australia could possibly be exposed to a shortage because alternative supplies were further away, possibly necessitating Government intervention to constrain demand.

However, if such a circumstance arose, it is possible for Australian refineries to process indigenous crude oil and condensate. The impacts would include:

- total petroleum product production would decrease by 30% ie to just over 600,000 bpd or 170,000 bpd less than demand;
- petrol production would probably be equal to local demand;
- middle distillate (diesel and jet fuel) production may be less than demand;
- there would be virtually no production of bitumen, lubricating oils and greases;
- there would probably need to be a relaxation of certain fuel standards such as sulphur in diesel (a portion of the Australian refining industry has already moved away from using certain Australian crudes in order to meet the 500 ppm sulphur diesel specification).
- There would be contractual issues associated with taking supply away from the normal customers for Australian exports.

Indicative product yields from selected crude oils.

Crude Oil Percentages



Refinery Flexibility

The refinery objective is to meet the demand for products efficiently in a manner which is sustainable and profitable and has several mechanisms to do this:

1. Choose appropriate crude oils which inherently produce the right proportion of products ie generally Middle Eastern crudes will produce more diesel and fuel oil while Asian crudes will produce more petrol.
 - a. The time frame for this mechanism is 3 months.
2. Switch refinery feedstocks to a greater proportion of Australian crude oils.
3. Different catalysts can be used in the catalytic cracker or hydro-cracker to produce more or less diesel or petrol
 - a. Catalysts are expensive and this mechanism would only used if management was satisfied that the change required was long-lived ie year or more.
 - b. The time frame for implementation is 3 months.
4. Change the settings on the catalytic cracker or hydrocracker
 - a. The time frame for this mechanism is hours to days.
5. Alter the cut points for different products ie 'steal' denser components from jet fuel for diesel.
 - a. This would mean less jet fuel
 - b. The time frame for this mechanism is hours to days.
6. Purchase product from another Australian refiner
 - a. The time frame for this mechanism is anywhere from hours to days or even a week or so.
7. Purchase product from another refinery outside of Australia, say Singapore
 - a. The time frame for this mechanism is a minimum of 3 weeks and more likely 5 weeks.

How would these mechanisms be used?

If there is a disruption to supplies of product from within Australia then the most useful mechanism would be 6 with some use of 5 if there was a shortage of a particular product but not of another (robbing Peter to pay Paul).

If there is a disruption to crude oil supplies leading to still adequate supplies of crude oil but perhaps a shortage in the types used as feedstocks for Australian refineries then mechanism 3, 4 and 5 may be useful to correct a product imbalance in the refinery. However, these mechanism would only be used if the imbalance was going to be long term, otherwise local purchase or imports of product would most likely be the least cost solution.

If there is a general, world wide shortage of crude oils and prices rise then the refiners will have to pay higher prices and must be able to pass on those higher prices to consumers. If they are prepared to meet the higher prices asked, then presumably there would not be a shortage for Australia – just higher priced products.

If not even a preparedness to pay higher prices leads to enough crudes for our refineries then perhaps there is a role for Government to examine the possibility of using Australian crudes. However, this would not satisfy total demand in Australia. Governments would still need to implement demand constraint measures, and due to the likely competition between refiners for the most appropriate Australian crudes, there would probably need to be some sort of crude oil allocation system to ensure inequities did not arise within the industry and in the supply of products to different states and territories.

Supply Balancing Mechanisms

Australian Refineries supply 95% of Product Demand in Australia

