Sea Power Centre - Australia

SOUNDINGS

August 2015

Issue No 7

Petroleum trade security in the Indo-Pacific region: an assessment of Australia's crude oil and refined product import security and supply resilience

Rupert Herbert-Burns

About the Author

Dr Rupert Herbert-Burns is a leading international maritime security consultant; engaged in operational and security risk management projects for shipping, offshore oil and gas sector clients with operations in Africa, the Middle East, Asia and Europe. In the latter capacity, he has conducted at-sea ship security surveys and risk assessments, oil and gas terminal surveys, land-based drilling project risk assessment, ISPS Code consultation, and the provision of armed at-sea vessel protection services. Herbert-Burns has also operated as an on-scene operations response consultant for the return of hijacked oil tankers in Somalia. From 2006 to 2007, he worked at sea as a security and safety advisor for VLCC operating in the northern Persian Gulf during the war in Iraq.

Previously, as a director at Lloyd's Marine Intelligence Unit in Washington DC and London, Herbert-Burns was engaged in security-risk and shipping data analysis, port and terminal security audits and threat assessment support roles for branches of the US military and government and NATO. Herbert-Burns is a non-resident research fellow at the Stimson Center, and a Senior Advisor for The Chertoff Group; providing petroleum trade, offshore, and oil and gas operations risk consultation services.

Prior to his current professional activities, Herbert-Burns was commissioned as a warfare officer in the Royal Navy; serving worldwide in major surface warships, a conventional submarine, and support vessels. He also had subsequent service as an infantry platoon commander with the Brigade of Gurkhas. Following his re-commissioning in 2007, Herbert-Burns continues to serve as a naval intelligence officer in the Royal Naval Reserve. Herbert-Burns has master's degree in international security studies and a PhD in petroleum geopolitics from the University of St Andrews in Scotland.

About the Paper

This paper was commissioned by the Sea Power Centre - Australia in order to provide the Chief of Navy and the Royal Australian Navy with a more detailed understanding of liquid fuel flows relevant to Australia from a protection of shipping perspective. This specific focus necessarily limited the scope of the work undertaken by Dr Herbert-Burns and quite deliberately there was no analysis of the impact of biofuels and fuel feedstocks on Australia's future energy security. Moreover issues associated with fuel resilience from a defence perspective were not included in the scope of the study as they are being examined elsewhere.

Chapter 1: Introduction

According to some assessments, by 2030 Australia could be left with no domestic refining capacity, less than 20 days' worth of refined petroleum fuel reserves, and the reality that the Australian Defence Force will be entirely reliant on imports for its marine diesel oil, motor diesel, gasoline, jet and helicopter fuel requirements. Opinions vary amongst policymakers as to whether, on the one hand, this is a matter for urgent national energy security concern, or on the other, it is a risk that is mitigated by the dynamics, inclusiveness and free-flowing nature of the international petroleum markets. Nevertheless, what is certain is that for as long as petroleum fuels remain the mainstay of the country's civil transportation system and its military's means of deployment and manoeuvre, Australia will be reliant upon the complete resilience and security of its sources of refined products supply, and the extensive sea lines of communication that connect them with the country's import terminals.

The closure of the Port Stanvac (2003), Clyde (2012), Kurnell (2014) and Bulwer Island (2015) refineries have effectively halved Australia's domestic refinery capacity. When BP announced in April 2014 that is was shutting down Bulwer Island, the president of BP Australasia, Andrew Holmes, stated the refinery was being closed due to the evolution of the huge export-configured refineries in Asia, which could operate at far greater economies of scale. Holmes further stated that this reality had 'transformed the industry' to such an extent that it had 'presented the Bulwer operation with an unsurmountable challenge'. In an interview following the announcement, an energy security expert from Griffith University, Dr Vlado Vivoda, posited that this development effectively shone a spotlight on the fact that Australian 'supplies are essentially subject to the security of supply lines that bring petroleum products from international markets, particularly from Singapore, which we are becoming increasingly reliant on'.[1]

During a senate committee hearing on national fuel supply sustainability in early February 2015, senior officials from the Department of Industry and Science (DIS) were intensively questioned by senators as to the number of days' worth of automotive fuel storage Australia actually had. The hearing revealed that the officials did not know the exact number; after initially stating the country had 52 days of fuel supplies, they later conceded they did not know and that stocks might actually be as little as 34 days. Amidst the backdrop of the reality that Australia now imports 91 per cent of its petrol requirements in the wake of the loss of half of its domestic refining capacity, DIS Associate Secretary, John Ryan, acknowledged that the government had no policy for ensuring the country had a minimum fuel reserve or failsafe minimum level of refining capacity that must be retained.[2] This issue formed the basis for the second of three recommendations from the senate committee report that all fuel supply companies should report their fuel stocks to DIS on a monthly basis.

The above incidents are amongst the most recent manifestations of a deepening concern amongst some policymakers, officials, experts and media that Australia is not as prepared as it should be to meet the fuel demands of key military units, emergency services and vital transportation nodes - the services fundamental to the country's national security and its economic and societal integrity in the event of a serious disruption to the refined petroleum imports upon which the country is now so critically dependent. Aside from the multiplicity of related stories in the media, a number of key studies and reports have been produced in recent years that examine the nature of the issue in various ways, evaluate what is being done to address it, and offer various recommendations or government policy directions. Examples of prominent reports include:

- *National Energy Security Assessment 2011*[3]
- *Liquid fuels vulnerability assessment*[4]
- *Australia's Emergency Liquid Fuel Stockholding Update 2013: Oil Storage Options & Costs*[5]
- *Australia's Liquid Fuel Security Parts 1* and *2*[6]
- *2015 Energy White Paper*[7]

- *Australia's transport energy resilience and sustainability*.[8]

This report is neither a revisionist in-depth examination nor appraisal of the aforementioned papers (though specific observations made in some of them are referenced where appropriate); however, by setting out and answering some very fundamental questions, it is intended to contribute to the discourse on Australia's energy security and offer some recommendations in the context of a risk management approach. One of the underpinning drivers of this approach is to encourage thought and debate not only on the situation today with regards to increasing reliance on imports of refined petroleum, limited stocks and extensive supply lines, but to consider what the future holds - in both positive and negative terms. Though clearly a major feature of Australia's national energy and economic security, in the interests of maintaining focus, this report does not examine the country's production and exporting of liquefied natural gas (LNG) except in reference to the sea lines of communication used by LNG carriers between Australia and its Northeast Asian markets.

This report provides the following examinations and assessments explicit to the country's petroleum energy supply security:

- A status report of Australia's remaining refining capacity.
- An examination of the state of existing oil storage capacity, and that which is currently in development and planned.
- An analysis of the range and nature of Australia's sources of crude oil and refined petroleum products, and an assessment of the supply/logistical risks associated with those sources.
- Based upon the geographical canvas of the overseas sources of Australia's petroleum imports, a chapter is devoted to examine the maritime security and geopolitical risks associated with the routes of these extended supply lines.

Status summary

- Following the earlier shutdown of Port Stanvac, Clyde and Kurnell refineries, the closure of Bulwer Island in 2015 will reduce the country's refining capacity to 447,000 bbl/day; or some 50.57 per cent of its 2000 total capacity. There is now no refining capacity at all in New South Wales or South Australia.
- The *2015 Energy White Paper* states that 'substantial increases in refining capacity in Asia have placed pressure on Australian refineries over recent years and this is expected to continue'.
- Australia now imports 91 per cent of its fuel requirements, which contrasts starkly from 60 per cent in 2000. There is currently no stated policy to prevent this level of dependence from increasing.
- Australia is a net importer of crude oil.
- Australia imports 62 per cent of its refined petroleum requirements from Singapore alone.
- According to the International Energy Agency (IEA) , as of December 2014, Australia had only 52 days of oil stocks. In February 2015, Department of Industry and Science officials admitted that these stocks may actually be as low as 34 days.
- Australia is the only country in the 34 member-state IEA that does not have the stocks to meet the 90-day minimum stored reserves requirement.
- The *2015 Energy White Paper* states that 'Current estimates are that meeting the IEA obligations would require an investment of several billion dollars in stocks and storage infrastructure over a decade. A decision on how to address this compliance issue will be made by the government in 2015'.
- By 2035, Asia will import over 80 per cent of its oil consumption requirements, which is almost equivalent to OPEC's entire current oil production.

When exploring an issue of this importance and profile - the energy security of a state - the starting point is logically to identify and address the problems and concerns; that is expected. However, it is also responsible to remain balanced and nuanced in providing assessment and recommendations. Yes, in several aspects, Australia's situation is far from ideal. Optimally, governments would want to maintain as much domestic refining and storage capacity as possible; but democratic governments functioning in a free market cannot compel non-state oil companies to maintain refineries that are loss-making, nor spend large quantities of taxpayers' money on enormous storage facilities and pipeline networks. Separately, finite military resources and budgets limit the scale, dispersal and duration of naval deployments to protect sea lines of communication. On the other hand, what is seemingly safe or sensible for today in terms of comfortable over-reliance on increasing volumes of imported fuels from a very limited range of sources may not be workable in the future in an era of very tight supplies and escalating prices amidst an unforeseen conflict in a major source or petroleum transit region.

In a plentiful crude oil and refined products market, governments can convince themselves that this apparently guaranteed systemic stability is sufficient to ensure national energy security. This is achievable because we know what we know. But in an uncertain future amidst changing market forces, unpredictable security challenges, and fluxing regional geopolitical norms, you do not know what you do not know. Thus, why take that risk when you do not have to? A national strategic energy security posture is not just for today or the next fiscal year, it should be about projecting 20 to 30 years out.

The petroleum industry is undergoing considerable systemic changes - some offering opportunities to bolster a state's strategic energy security, such as diversification of sources; whilst others present considerable challenges that must be fully understood and adapted to, such as radical changes to the international refining sector and the potential for surging regional demand for refined petroleum imports. Perhaps surprisingly, this report argues that despite the reality of the situation Australia finds itself in and the clear concerns over increasing dependence on imported refined petroleum, it is possible to ensure strategic energy security through the implementation of some prudent infrastructure enhancements, a risk management approach to the sourcing and conveyancing of imported petroleum, and effectively applied military means to ensure the security of petroleum supply lines.

Split into three distinct chapters - oil refining and storage, sources of crude oil and refined petroleum imports, and an analysis of the security of the maritime conveyance of crude and refined petroleum imports in the Indo-Pacific region, this report answers a series of fundamental questions through an examination of quantitative and qualitative empirical evidence. By way of conclusion, it also offers some considered recommendations that could be valuable in a debate about the structural and systemic modifications necessary to boost Australia's petroleum energy security as an insurance policy against uncertainly. The key questions addressed in this report are listed below.

Oil refining and storage

- What is the status of Australia's refining industry and production capacity?
- Is there enough domestic refining capacity in a crisis context?
- What is the status of Australian oil storage capacity?
- Should there be more storage, and is this worth investing in?

Sources of crude oil and refined petroleum imports

- What are the sources of Australia's crude oil imports?
- What are the supply/volume risks associated with the main sources?
- Are sources sufficiently diversified to de-risk a crisis-induced supply squeeze?
- What are the options to ensure diversity and de-risking?
- What are the sources of Australia's refined petroleum imports?
- What are the supply/volume risks associated with the main sources?

- Are sources sufficiently diversified to de-risk a crisis-induced supply squeeze?
- What are the options to ensure diversity and de-risking?

Security threat and risks associated with crude oil and refined products conveyance in the Indo-Pacific region

- What are the sea lines of communication associated with direct and indirect Australian petroleum imports and exports?
- What are the key *maritime security threats* associated with the coastal, littoral and blue water spaces that vital sea lanes pass though, and do these threats present a threat to petroleum streams at a strategic supply level?
- What are the key *geopolitical factors* associated with the maritime spaces that vital sea lanes pass through, and do these factors and forces present a threat to petroleum streams as they relate to Australia's import requirements at a strategic supply level?

Endnotes

[1] 'BP to close Bulwer Island refinery in Brisbane: Hundreds of jobs axed', 2 April 2014, www.abc.net.au/news/2014-04-02/bp-to-close-bulwer-island-refinery-brisbane-jobs-axed/5361296.

[2] Rural and Regional Affairs and Transport References Committee, *Australia's transport energy resilience and sustainability*, Official Committee Hansard, 2 February 2015, Sydney, pp. 90-96, www.aph.gov.au/Parliamentary_Business/Committees/Senate/Rural_and_Regional_Affairs_and_Transport/Transport_energy_resilience/Public_Hearings.

[3] Department of Resources, Energy and Tourism, *National Energy Security Assessment 2011*, Canberra, 2011, www.industry.gov.au/energy/Documents/Energy-Security/nesa/National-Energy-Security-Assessment-2011.pdf.

[4] ACIL Tasman, *Liquid fuels vulnerability assessment: a review of liquid fuels vulnerability*, for Department of Resources, Energy and Tourism, Melbourne, October 2011, www.industry.gov.au/Energy/EnergySecurity/Liquid-fuels-security/Documents/Liquid-Fuels-Vulnerability-Assessment.pdf.

[5] Hale and Twomey, *Australia's Emergency Liquid Fuel Stockholding Update 2013: Oil Storage Options & Costs*, for the Department of Industry, Canberra. 22 October 2013, http://industry.gov.au/Energy/EnergySecurity/Liquid-fuels-security/Documents/HTOilStorageReport2013.pdf.

[6] John Blackburn, *Australia's Liquid Fuel Security: A Report for NRMA Motoring and Services*, 28 February 2013 www.mynrma.com.au/media/Fuel_Security_Report.pdf; and *Australia's Liquid Fuel Security Part 2: A report for NRMA Motoring & Services*, February 2014, www.mynrma.com.au/images/About-PDF/Fuel-Security-Report-Pt2.pdf.

[7] Department of Industry and Science, *2015 Energy White Paper*, Canberra, 2015, http://ewp.industry.gov.au/sites/prod.ewp.industry.gov.au/files/EnergyWhitePaper.pdf.

[8] Senate Standing Committee on Rural and Regional Affairs and Transport, *Australia's transport energy resilience and sustainability*, Parliament of Australia, Canberra 2015, www.aph.gov.au/Parliamentary_Business/Committees/Senate/Rural_and_Regional_Affairs_and_Transport/Transport_energy_resilience/Report.

The study that forms the basis of this Soundings Paper was prepared before the release of the committee report. Interestingly, two of the three committee recommendations provide a post facto rationale for the initial study and this Soundings Paper:

> Recommendation 1: The committee recommends that the Australian government undertake a comprehensive whole-of-government risk assessment of Australia's fuel supply, availability and vulnerability. The assessment should consider the vulnerabilities in Australia's fuel supply to possible disruptions resulting from military actions, acts of terrorism, natural disasters, industrial accidents and financial and other structural dislocation. Any other external or domestic circumstance that could interfere with Australia's fuel supply should also be considered.
>
> Recommendation 3: The committee recommends that the Australian government develop and publish a comprehensive Transport Energy Plan directed to achieving a secure, affordable and sustainable transport energy supply. The plan should be developed following a public consultation process. Where appropriate, the plan should set targets for the secure supply of Australia's transport energy.

Chapter 2: Refineries, import infrastructure, oil storage and stock endurance

In October 2014, the Caltex Australia refinery at Kurnell in Sydney was shut down following a decision to close the facility in July 2012.[1] The refinery had been in operation for almost 60 years. At its peak, it produced 135,000 barrels of light and middle distillate fuels, including large volumes of jet A-1 that supplied Sydney Airport. The closure of this sizable facility, which had amongst the largest throughput of all of the country's refineries, was the third refinery closure since ExxonMobil's 100,000 bbl/day Port Stanvac plant in 2003 and Shell's 100,000 bbl/day Clyde refinery in 2012. Aside from bringing the total loss in the country's refining capacity to 335,000 barrels per day, the closure of Kurnell has resulted in there being no refineries left in New South Wales. In April 2014, BP confirmed that it would shut down its Bulwer Island refinery in Brisbane by the middle of 2015.[2] The Bulwer Island facility can produce 102,000 bbl/day.

This chapter provides a concise inventory of the past and present fundamentals of Australia's refining sector, and explores the steps that are being taken (and could be taken) to address the petroleum fuel availability and held oil stocks in the wake of diminished national refining capacity.

Figure 2.1: Australian refineries past and present (Caltex)[3]

Refining

Viewed at a nationwide level, in 2000 there were eight operational refineries in Australia (see Table 2.1), with an aggregate refining throughput capacity of 884,000 bbl/day. At that time, Australia imported just 5 per cent of its refined fuel requirements - less than 100,000 bbl/day.[4] The closure of Bulwer Island will reduce the country's refining capacity to 447,000 bbl/day; or some 50.57 per cent of its 2000 total capacity. Refined product traders have suggested this could result in Australia's imports of gasoline, diesel and jet fuel (jet A-1) increasing to some 640,000 bbl/day by 2015 (see Figure 2.2).[5] The country's four remaining operational refineries are located in Victoria, Queensland and Western Australia, and there is now no refining capacity at all in New South Wales, South Australia, or the Northern Territory.

Refinery	Owner/operator	Location	Capacity	Status
Kurnell	Caltex	Sydney, NSW	135,000 bbl/day	Closed in 2014
Clyde	Royal Dutch/Shell	Sydney, NSW	100,000 bbl/day	Closed in 2012
Geelong	Vitol	Victoria	130,000 bbl/day	Operational
Altona	ExxonMobil	Victoria	75,000 bbl/day	Operational
Bulwer Island	BP	Queensland	102,000 bbl/day	Closed in 2015
Lytton	Caltex	Queensland	104,000 bbl/day	Operational
Port Stanvac	ExxonMobil	South Australia	100,000 bbl/day	Closed in 2003
Kwinana	BP	Western Australia	138,000 bbl/day	Operational

Table 2.1: Changes in Australia's refining industry[6]

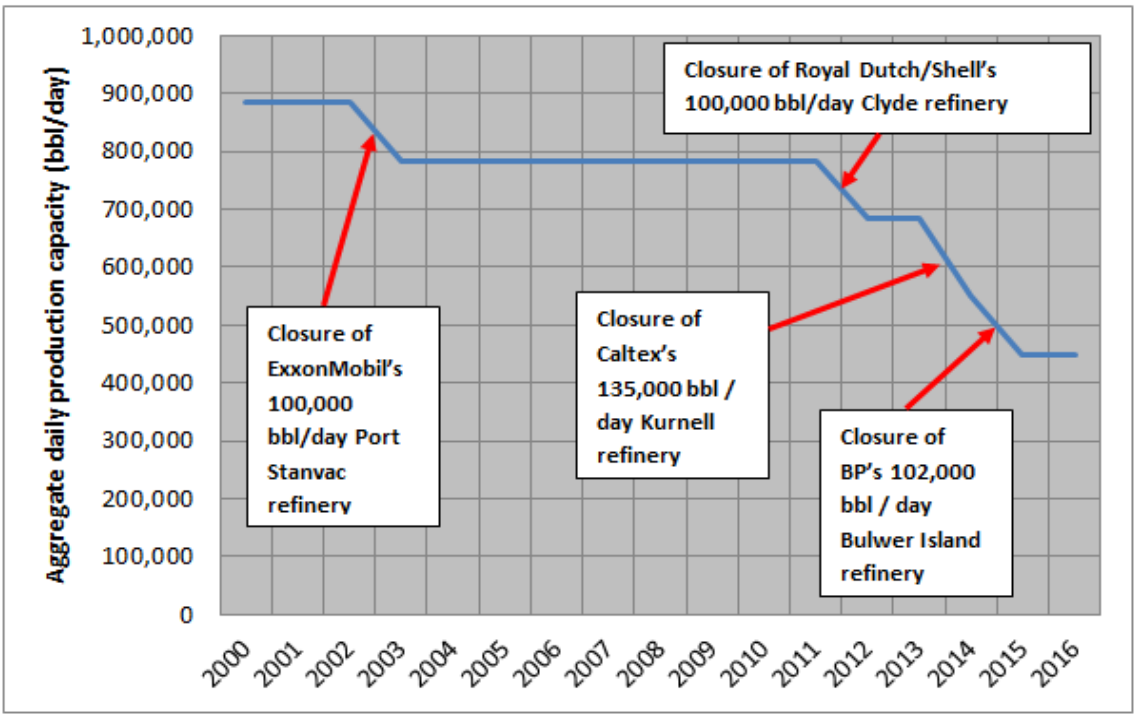


Figure 2.2: Decline in Australia's aggregate refining capacity[7]

Overall, it is the contention of this report that if Australia's domestic refining capacity continues to decline past the point where the country could not refine sufficient volumes of fuels vital to maintain emergency services, support military operations and underpin vital transportation infrastructure, this could represent a strategic energy security concern for the country. However, from a purely commercial perspective, the reasons for the closure of Australia's comparatively small facilities is reflective of a well-established paradigm of the closure or streamlining of downstream refining businesses in the developed economies, due to increasingly weak profit margins. Generally, the factors that have driven the reduction in refining capacities in many OECD countries (that once dominated refined product demand and production) were: industry overcapacity, sluggish demand for transportation fuels in particular, and the upward trending crude oil prices from 2000, which combined have increasingly throttled profit margins.

The trend of reducing refining capacity in parts of the OECD has occurred amidst a surge in building refining capacity in many parts of Asia, notably in China, India and Saudi Arabia. From the perspective of refinery operators in Australia, the development of very large-capacity refining

complexes in Asia with far lower operating costs, notably those in India and Saudi Arabia, has forced the reality that the process of refining crude oil at Australia's far smaller facilities is uneconomical due to higher operating costs and a strong currency. This reality was echoed by BP in 2014 as the reason for the planned closure of their Bulwer Island facility, which could no longer compete with capacity coming on stream in China and the Middle East.[8] For Australia, despite the levels of aggregate refining capacity that the government might want in an ideal situation, not only for energy security resilience but also to maintain employment levels in the sector, the reality of overwhelming competition from massive export-configured refineries in Asia forcing closures at home is a commercially-driven reality the state has to readjust to.

Status of Australia's Remaining Refineries

Geelong

In February 2014, Royal Dutch/Shell sold its Geelong refinery and some 870 petrol stations for $2.9 billion to Swiss-based Vitol, the world's largest oil trading firm. To the surprise of some in the industry, Vitol did not break up the business and re-role it into a product import terminal and storage facility, but maintained full refining operations. The sale of Geelong by Shell was part of a wider shrinkage of its downstream business that had resulted in sales of refineries in the Czech Republic, France, Germany, Norway and the United Kingdom.[9] Geelong is now the largest refinery in the eastern half of Australia, and its longer term viability would seem to be relatively secure for several reasons: like Altona, it has access to local, cheaper crude oil feedstock from the offshore fields in the Bass Strait; it has benefited from extra investment in some key processing infrastructure; it now has greatly reduced in-country competition following the closures of the Kurnell and Clyde refineries in the Sydney area; it produces some 50 per cent of Victoria's road fuel requirement; and, due to the specialisation of key refining modules, is one of only a few refineries in the entire Southern Hemisphere that can produce aviation gasoline (Avgas) used in piston-engine aircraft.[10]

Altona

ExxonMobil's Altona facility, located just 13km to the west of Melbourne, is the smallest of Australia's remaining refineries and one of the oldest. Paradoxically, amidst a downstream sector suffering from shrinking profit margins and seemingly overwhelming competition from the mega refineries in Asia, Altona appears to be surviving and maintaining commercial viability. This is due to a new advanced fluidised catalytic cracker and the fact that the plant has been sourcing cheaper high-quality crudes that give far better product yields. Furthermore, it sources 50 per cent of its feedstock from local fields in the Bass Strait, which greatly reduces costs, particularly for transportation. Ultimately, the closure of four of its previously rival refineries has also greatly eased the competitive landscape for Altona.[11]

Lytton

In September 2014, Caltex confirmed that because of the restructuring of the company's business in Australia, and in order to ensure the continued operation of its Lytton refinery, there would be redundancies at the facility during a phased process into late 2015.[12] In October 2014, the refinery's manager Vusan Subanake, was quoted as saying that 'the business as we look at it today is not enough to make us competitive. So then we talk about structure and the number of people, then we have to make changes'.[13] There are no reports of any intentions by Caltex to close the Brisbane-based refinery; nevertheless, the company's reported broader international strategic plans are to withdraw altogether from the refining business sector.

Kwinana

In mid-January 2015, BP announced that it was cutting about 20 per cent of its workforce at its Kwinana refinery. The facility, located outside of Perth in Western Australia, is the only refinery on the west coast of Australia. BP has stated that the redundancies were a result of pressure on

operating costs caused by reduced revenue from lower prices of its products, and were necessary in order to continue the operation of the facility.[14] This kind of action is in and of itself not overly remarkable for a modern industrial unit. However, in the context of the increasing market pressures being felt by Australia's refining sector from overseas - the same reasons for the recent closures of Clyde, Kurnell, and soon, BP's own Bulwer Island, this action by BP raises questions of Kwinana's long-term prospects and continued viability. The refinery does of course have the key advantage of being the only facility in the region, which strengthens its viability in the eyes of its operators. In 2014, Kwinana closed down for a substantial maintenance period, but is now operational. For the time being, there are no plans to shut down the facility; however, the recent maintenance carried out would certainly make the refinery more attractive for the purposes of a sale.

Overall, what will shortly be Australia's four remaining refineries - Geelong, Altona, Lytton and Kwinana - appear to have the technical properties and comparative commercial advantages to ensure their continued operational viability in the medium term. Nevertheless, with ongoing redundancies at some of the facilities amidst the wider context of structural changes in the nature of the refined fuels and products supply chain driven by strengthening competitive pressures from refineries in Asia, the long-term survivability of these small-scale Australian refineries cannot be guaranteed by the companies that own and operate them.

As posited earlier in this chapter, the halving of the country's refining capacity by mid-2015 could not likely been have prevented due to the logic of commercial pressures that determine the viability of private, non-government held businesses. Now Australia's economy must continue to function in an environment where it needs to import and store a substantial and growing volume of its annual transportation fuel and industrial petrochemical requirements. This notwithstanding, there is a very good argument for retaining a fundamental level of domestic refining capacity as a strategic contingency against the possibility of future disruptions in supplies of refined petroleum. Thus, consideration should be given to ensuring sufficient government support to prevent the closing down of all of the country's remaining domestic refining capacity. Ideally, the maintenance of the remaining four facilities (after the closing of Bulwer Island in 2015) should be encouraged as this provides for better supply resilience on both the eastern and western halves of the country. In additional to maintaining a sustainable minimum volume refining capacity, the feasibility for also ensuring that enough of this remaining capacity is able to refine Australia's own crude oil into essential levels of petrol, diesel, jet and the vital fuel types required by the Australian Defence Force should be explored.

Oil Import Terminals and Storage Facilities

Regardless of the argument in favour of helping to underpin Australia's fuel supply security by retaining the remaining domestic refining capacity as described above, it is possible that commercial pressures may yet weigh heavily against this and force other closures. In such a scenario, the only viable option to fortify the country's fuel supply resilience and security is to ensure the capacity to store ample stocks on Australian soil. Whilst Australia has geographically well-dispersed import terminals and storage capacity, it is insufficient in absolute terms to provide a minimum of the 90-day stocks mandated by the International Energy Agency (IEA). This requirement notwithstanding, the fact that Australia's regions of greatest fuel demand are located at extensive distances from sources of supply means that having more than just the minimum stocks on Australian soil is fundamental strategic logic. Before examining those projects underway to boost capacity and proposed ideas to provide even greater capacity, it is necessary to have an appreciation of existing capacity in this regard. There are three main types of import/storage facilities:

1. at operational refineries
2. at those refineries that have decommissioned their refining capability but retained operational import terminals and tank storage farms

3. at dedicated stand-alone import terminals with storage tanks for various refined fuels and other distillates.

Operational and decommissioned refineries

There are tanker loading and discharge facilities and oil storage facilities at Kurnell, Clyde (Gore Bay), Geelong (Geelong Port), Altona (Gellibrand Dock), Lytton (Fisherman Island crude oil berth), Bulwer Island (Luggage Point crude oil berth) and Kwinana (Kwinana BP jetty). The storage capacity at these refineries is listed in Table 2.2.

Facility	Area	Crude oil	Gasoline	Diesel	Jet	Other	Total
Kurnell/Clyde	Sydney	502	214	140	81	37	**472**
Geelong/Altona	Melbourne	388	79	82	48	117	**327**
Lytton/Bulwer	Brisbane	531	194	161	73	1	**519**
Kwinana	Perth	347	263	99	66	13	**440**
Total		**1,769**	**719**	**515**	**356**	**169**	**1,758**

Table 2.2: Storage capacity in megalitres at refineries (both formerly and currently operational)[15]

Dedicated import terminals

There are 64 petroleum import terminals in Australia (see Figure 2.3). The numbers of terminals in each of the states and the corresponding volume capacities are shown in Table 2.3.

Figure 2.3: Australia's refinery and petroleum import terminals[16]

State/Territory	No of terminals	Gasoline	Diesel	Jet	Other	Total
New South Wales	11	295	214	159	86	**754**
Northern Territory	4	33	73	36	138	**281**
Queensland	17	204	481	78	65	**827**
South Australia	6	99	78	20	1	**198**
Tasmania	5	94	65	4	3	**165**
Victoria	4	207	128	54	29	**418**
Western Australia	17	121	355	19	29	**524**
Total	**64**	**1052**	**1394**	**369**	**351**	**3166**

Table 2.3: Terminal numbers by location and capacities (megalitres)[17]

The majority (44) of the import terminals are owned by the refiner owner/operators - BP, Caltex, ExxonMobil and Vitol, either under sole ownership or as a joint venture. Fifteen are independently owned by firms such as: Coogee Chemicals and Terminals Pty Ltd, GEMCO, Gull Petroleum, Marstel, Neumann Petroleum, Rio Tinto and United Petroleum.

Essentially, the combination of all of the storage capacity at all of the various facility types listed above represents what has been the *status quo* oil storage level in Australia for crude oil, refined fuels and other products (such as bitumen and petrochemicals). Though insufficient to meet the 90-day IEA requirement, this infrastructure was arguably sufficient prior to 2003 when Australia had all eight operational refineries, and thus more refined oil stock and national re-supply resilience.

What is the state of investment projects in Australian terminals and storage?

The structural and systemic changes in Australia's refining, oil production, import and export industry and national petroleum requirements has not gone unnoticed by investors and companies with interests in the development of petroleum storage. There are several encouraging examples of investment and construction initiatives taking place in Australia that will boost the country's oil storage capacity as it settles into an era when the necessity to rely upon increased imports and storage of refined fuels has now become the status quo. The five projects highlighted below will provide an additional 317 megalitres of refined product storage.

In July 2014, Mitsubishi announced it was developing an 81 megalitre diesel import terminal at Port Bonython in South Australia in response to the reality of limited existing storage capacity in the face of projected increasing regional demand for diesel. In January 2013, Petro Diamond Australia, Mitsubishi's wholly-owned subsidiary acquired Port Bonython Fuels (PBF), invited Coogee Chemicals to become an operating partner in the new PBF terminal. The terminal project has been developed in close collaboration with the South Australian government in recognition of both future demand growth and as part of the government's broader intention to try and bolster the fuel energy supply security in the region. The terminal is scheduled to become operational in the second quarter of 2016.[18]

In May 2014, Australia's largest independent fuel supplier, Puma Energy, completed construction of a new products terminal in Mackay, Queensland, which will expand import and storage capacity primarily for diesel in the state. The facility is comprised of a six storage tank farm with a combined storage capacity of 56 megalitres. The tanks are supplied from the terminal via a dedicated 1.6km pipeline. The facility has targeted the expanding fuel requirements of the Queensland mining industry, and as with other new storage developments has been precipitated by the decline of domestic refining capacity, specifically the imminent closure of BP's Bulwer Island refinery and the concomitant need to increase imports of diesel.[19]

Also in May 2014, following a nine-month construction project, a new 85 megalitre fuel storage terminal began operations in Pelican Point, South Australia. Pelican Point has the highest storage capacity for petrol and diesel in South Australia. The facility also has a new deep water bulk liquids berth, which will enable larger product tankers to discharge with a faster turn-around time. Crucially, Pelican Point was designed to enable two potential future expansion phases to store a total of up to 135 megalitres in the event of notable fuel demand growth.[20]

Earlier in February 2014, GrainCorp announced it would build three new fuel and chemical storage facilities at terminals in New South Wales, Queensland and Western Australia with a combined capacity of 65 megalitres. The New South Wales tanks will be built close to GrainCorp's grain port terminal at Port Kembla, and will provide supplies to the local chemical industry. The new facilities in Queensland and Western Australia will be built in Pinkenba and Fremantle respectively to provide feedstock and fuels for the petroleum, chemical and mining industries. As with the Pelican Point development, the GrainCorp terminals have been designed to enable future expansion in line with potential demand growth.[21]

In a project that was initiated in October 2012, BP has expanded its Largs North terminal in Adelaide, South Australia. The terminal now has an additional storage tank that can store up to 30 megalitres of diesel. The facility will import fuel from the company's Kwinana refinery in Western Australia; however, importantly, Largs North will also be able to import increased volumes of fuels from overseas refiners.[22]

Is all of this sufficient in light of extant low stock levels and in light of daily demand volumes?

In 2015, Australia's daily oil consumption will be approximately 1.144 million bbl/day (equates to 181.88 megalitres). For Australia to have sufficient storage for 90 days would require stocks of some 16,369.2 megalitres held at refineries, at import terminal tanks farms, other storage tanks inland, and in tankers berthed or at anchor in ports. The most recently available IEA figures indicate Australia has 52 days of oil stockpiled (and as previously highlighted some officials have stated this could be as low as 34 days), which amounts to 9458 and 6184 megalitres respectively. If we take the IEA estimated stocks of 52 days, this leaves Australia with a shortfall in recommended oil stocks of 42 per cent.

The five examples above, whilst perhaps the largest projects undertaken since 2012, are not the only initiatives to increase distillate and chemical storages in the areas of greatest existential need and demand growth, and others will certainly follow. If all of the currently committed projects and investments go ahead as planned, total storage capacity in Australia would increase by approximately 13 per cent. This is certainly a positive development in expanding Australia's total oil storage capacity and other developments will likely add to this incrementally. This does not address, however, the capacity expansion that would be needed by Australia during a protracted supply disruption in the event of a major crisis in the Middle East or Southeast Asia, however seemingly unlikely these scenarios might seem.

Oil Stocks

The capacity for an advanced industrial state to ensure sufficient supplies of refined petroleum distillates and petrochemicals to fuel and grow its economy is a key feature of its economic security, and by extension, helps underpin its strategic national security. In the modern petroleum era, following the oil shocks of the 1970s, this has been achieved by IEA member-states with a combination of domestic refineries processing domestic and/or imported crude oil feedstock and sizable volumes of stored oil on their own territory. Thus, fundamentally, regardless of the means of oil acquisition and processing, member-states are supposed to ensure that they have a minimum stock of 90-days of net oil imports.[23]

As of December 2014, Australia had only 52 days of stocks; it has long remained the only country in the 34 member-state IEA that does not have the stocks to meet the 90-day requirement. In 2015, public officials have also disclosed in hearings that stocks may actually be as low as 34 days. This

latter revelation raises a serious concern that obtaining accurate national oil stockpile data at any given time is clearly problematic.

There are arguments as to why Australia's situation in this regard is somewhat unique; specifically, due to the very long distances between Australia and its fuel sources and thus the larger volumes of booked 'oil on the water' in transit to its import terminals. Nevertheless, the combination of this fact and the decline in domestic refining capacity has raised serious questions as to the adequacy of the country's energy security resilience in the event of external supply disruptions of various kinds.

Only a step change in expansion projects at existing terminals and refineries or the building of a dedicated strategic or emergency petroleum reserve to add to existing stocks would address the national requirements during a long period of import disruptions because of a major external crisis. Added to this, projected oil demand growth for OECD Asia and Non-OECD Asia out to 2040, lends further clarity on the levels of future demand sought by Australia's Asian neighbours. This demand would quickly absorb available cargoes of both crude and refined fuels that Australia would also be competing for in the event of supply disruption. In this kind of situation, no matter how seemingly unlikely, states must rely heavily on robust reserves held in their own territory. A project to define and address this requirement should be at the heart of any forthcoming government fuel supply security strategy. Such a program will be expensive; however, in the circumstances in which Australia finds itself with regards to increasing dependence on refined petroleum imports and long sea lines of communication, this is an insurance policy that must surely be worth the cost amidst future oil market, security and geopolitical uncertainties.

Endnotes

[1] 'Caltex shuts Kurnell Refinery', *The Australian*, 14 October 2014, www.theaustralian.com.au/business/latest/caltex-shuts-kurnell-refinery/story-e6frg90f-1227089677181.
[2] 'BP to close Brisbane refinery, sheds 355 jobs', *The Australian*, 2 April 2014, www.theaustralian.com.au/business/bp-to-close-brisbane-refinery-sheds-355-jobs/story-e6frg8zx-1226872201114.
[3] Caltex, 'Does Australian oil refining really matter?', *The Star*, Issue 40, Dec-Jan 08, http://microsites.caltex.com.au/thestar/issues/40-Dec-Jan-08/b_Does_Australian_oil_refining_really_matter~.asp
[4] 'Australian oil imports set to soar', *Financial Times*, 15 November 2012.
[5] 'Australian oil imports set to soar'.
[6] Compiled from data from BP, Caltex, ExxonMobil & Royal Dutch/Shell.
[7] Compiled from data from BP, Caltex, ExxonMobil & Royal Dutch/Shell.
[8] Trefis Team, 'BP's Closure Of Australian Refinery To Improve Its Downstream Profitability', *Forbes*, 10 April 2014, www.forbes.com/sites/greatspeculations/2014/04/10/bps-closure-of-australian-refinery-to-improve-its-downstream-profitability/.
[9] John Dagg, 'Shell strikes $2.9 billion deal to sell Geelong refinery and 870 petrol stations', *Herald Sun*, 21 February 2014, www.heraldsun.com.au/business/shell-strikes-29-billion-deal-to-sell-geelong-refinery-and-870-petrol-stations/story-fni0dcne-1226833566220.
[10] 'Geelong Refinery', www.vivaenergy.com.au/operations/geelong.
[11] Peter Ker, 'ExxonMobil Altona oil refinery finds a formula for survival', *Sydney Morning Herald*, 3 May 2014, www.smh.com.au/business/exxonmobils-altona-oil-refinery-finds-a-formula-for-survival-20140502-37nd8.html.
[12] Anthony Marx, 'Caltex to cut Brisbane oil refinery jobs at Lytton', *Courier Mail*, 12 August 2014, www.couriermail.com.au/business/caltex-to-cut-brisbane-oil-refinery-jobs-at-lytton/story-fnihsps3-1227021000976.
[13] Brayden Heslehurst, Caltex Lytton Refinery confirms more than 100 jobs will be axed by the end of 2015, Quest Newspapers, 10 October 2014, www.couriermail.com.au/questnews/east/caltex-lytton-refinery-confirms-more-than-100-jobs-will-be-axed-by-the-end-of-2015/story-fni9r0lo-1227086161012.
[14] Cole Latimer, 'BP to cut jobs at Kwinana refinery', *Australian Mining*, 13 February 2015, www.miningaustralia.com.au/news/bp-to-cut-jobs-at-kwinana-refinery.
[15] ACIL Tasman, *Liquid fuels vulnerability assessment: a review of liquid fuels vulnerability*, for Department of Resources, Energy and Tourism, Melbourne, October 2011, www.industry.gov.au/Energy/EnergySecurity/Liquid-fuels-security/Documents/Liquid-Fuels-Vulnerability-Assessment.pdf.
[16] ACIL Tasman, *Liquid fuels vulnerability assessment: a review of liquid fuels vulnerability*.
[17] ACIL Tasman, *Liquid fuels vulnerability assessment: a review of liquid fuels vulnerability*.
[18] 'Mitsubishi to expand operations with South Australia diesel terminal', *Tank Storage Magazine*, 23 July 2014, www.tankstoragemag.com/industry_news.php?item_id=8072.

[19] 'Puma Energy opens new fuel terminal in Queensland, Australia', *Tank Storage Magazine*, 27 May 2014, www.tankstoragemag.com/industry_news.php?item_id=7828.
[20] 'Biggest fuel storage terminal opens in S Australia', *Tank Storage Magazine*, 2 May 2014, www.tankstoragemag.com/industry_news.php?item_id=7727.
[21] 'GrainCorp unveils plans for new Australia storage units', *Tank Storage Magazine*, 24 February 2014, www.tankstoragemag.com/industry_news.php?item_id=7443.
[22] 'BP begins Adelaide fuel terminal expansion', *Tank Storage Magazine*, 22 October 2012, www.tankstoragemag.com/industry_news.php?item_id=5525.
[23] The IEA minimum stockholding obligation is based on net imports of all oil, including both primary products (such as crude oil, natural gas liquids) and refined products. It does not cover naphtha and volumes of oil used for international marine bunkers. The 90-day commitment of each IEA member country is based on average daily net imports of the previous calendar year. This commitment can be met through both stocks held exclusively for emergency purposes and stocks held for commercial or operational use, including stocks held at refineries, at port facilities, and in tankers in ports. See IEA, 'Explanation of the Closing Oil Stock Levels in Days of Net Imports Table', www.iea.org/netimports/explanations/netimportstable/.

Chapter 3: Sources of Australia's crude oil and refined petroleum imports

In examining a country's situation with regards to petroleum energy utilisation, reliance and adaptation in a strategic sense, everything starts with sources of supply, and more specifically the security of that source. It is true that in the contemporary market for petroleum energy liquids, organisations, traders and state entities acquire these supplies from the international market, which has considerable diversity of supply. However, once the trading data for hydrocarbons is assessed in its most fundamental form, this market is of course ultimately fed by sources inside nation-states that have hugely varied levels of reserves, production capacities, reserves-to-production ratios, unique and sometimes dysfunctional domestic political ontologies, complex geopolitical settings, and are located at widely varying distances from the end-user. For this reason, it is important for consumers to have an appreciation of the scale of the resource in terms of reserves and reserve to production ratios, and the logistics, politics and geopolitics and logistical realities that govern the security and reliability risk of that supply.

This chapter examines historical, contemporary and possible options for future sources of Australia's crude oil and refined products, discusses the ontology of the country's most important sources, and assesses the possible risks associated with these sources. In the context of assessing the security of Australia's typical (or traditional) current sources of crude oil and refined petroleum, the chapter examines the data for crude oil and refined petroleum, quantifies the associated risks, and explores options to broaden the diversification of sources as part of a petroleum energy risk management strategy.

Australian Oil Production and Export

Before proceeding to examine the nature of the county's oil imports, it is important to note that Australia too is also an oil producer, but that production volumes and reserve locations do not enable the country to be self-sufficient, even during peak production at the end of the 20th century. The majority of oil is extracted from fields off the coasts of Western Australia, Victoria, and the Northern Territory. Current production of all petroleum liquids is approximately 447,000 bbl/day, which is a decline of 46 per cent from its peak of at 828,000 bbl/day in 2000.

The country exports approximately 220,000 bbl/day of its crude and lease condensate, some 49.2 per cent of its total production. This large proportion of its production is exported northwards to Singapore, Republic of Korea, China, Japan, Thailand, and Malaysia because the majority of production is from offshore fields in the northwest of the country, which are distant from Australia's remaining refineries in the southwest and south southeast. Furthermore, most of Australia's crude is light-sweet, which is very desirable for refining and thus commands a higher value per barrel, further enhancing the logic of its export value. Finally, the country imports roughly 253,000 bbl/day of crude oil, making it a net crude importer.

Crude Oil Import Source Analysis

In the eight years from 2007 to 2014, Australia has sourced an average of 72.5 per cent (almost three quarters) of its crude oil from just six countries.[1] In descending order of supply volume, these are: Malaysia, Vietnam, the United Arab Emirates, Indonesia, New Zealand and Nigeria (see Figure 3.1). The next 25 per cent of Australia's crude was sourced variously from: Algeria, Azerbaijan, Brunei, China, Gabon, Libya, Papua New Guinea, The Philippines, the Republic of Congo, Russia, Saudi Arabia, Singapore and Thailand.[2]

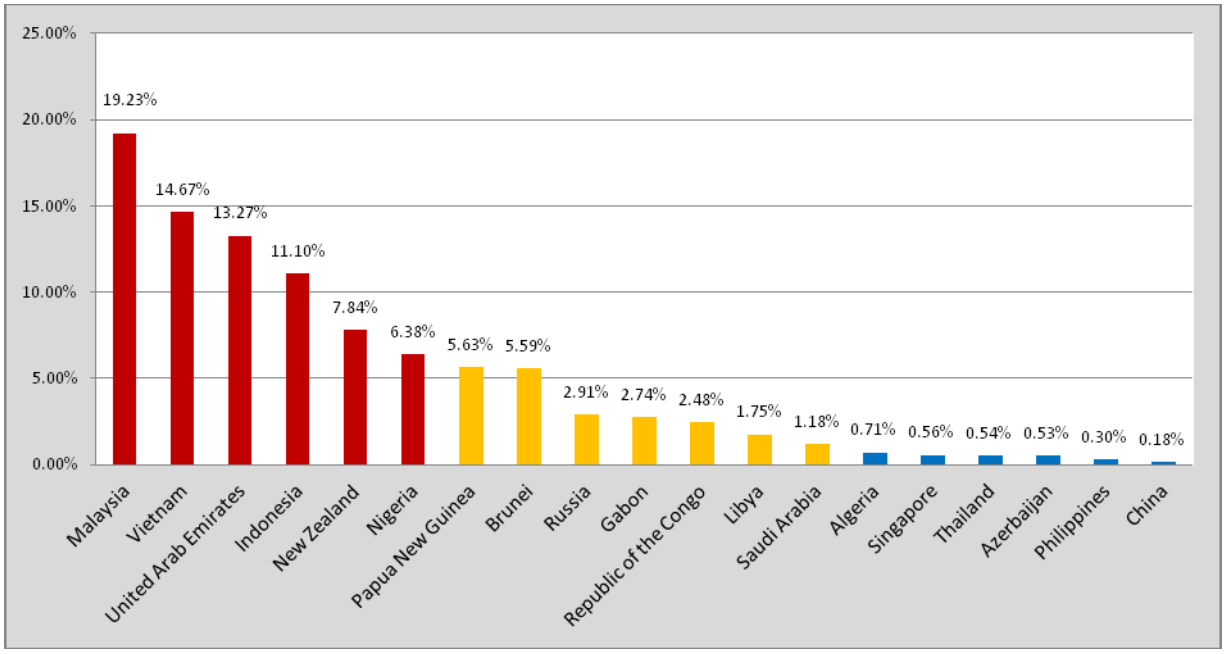


Figure 3.1: Source countries for Australian crude oil imports[3]

In totality, this group of source countries make up on average some 97.58 per cent of the crude oil imported into Australia. The remaining 2.42 per cent is made of low volume and irregular shipments of crude from countries such as: Angola, Cote d'Ivoire, India, Iran, Iraq, Kazakhstan, Norway, Qatar and the United Kingdom.

Figure 3.1 illustrates the relative importance and diversity of these sources. The three colour bands reveal relative volume contribution categories: *high*, *medium* and *low*. Interestingly, of the six states in the high-volume red grouping, only two are considered large volume producers in a global context - the UAE and Nigeria. It is also clear that some of the largest contributing countries are also geographically more proximate to Australia, resulting in shortened distances of sea lines of communication and commensurately reduced vessel steaming times and lifting costs - namely, Malaysia, Indonesia, New Zealand and Vietnam. It is important to note also that all of these countries typically produce light-sweet crude oil, which is the most sought after grade of crude by refiners as it gives higher yields of gasoline, kerosene and low-sulphur diesel middle distillates. However, none of these countries are what are generally thought of as major producers on a global scale.

Direct crude oil import source analysis

Using Table 3.1, a closer examination of the current primary sources of Australia's crude oil imports (which as noted earlier, make up 72.5 per cent of total imports) reveals some interesting and important features. Aside from the UAE and Nigeria, all of the major sources (including the largest two, Malaysia and Vietnam) have proven reserve bases that are well below the global average; in particular New Zealand, with proved reserves of just 0.004 per cent of the global total. Indeed, of Australia's primary current sources, only the UAE has a substantial crude reserve base and commensurate production capacity. Though the UAE is the most distant of the primary sources, it is the most robust in every way, including an impressive reserves to production ratio (R/P ratio) of over 73 years.

	Reserve base (% of total global proved reserves)	Production (thousand barrels/day)	Reserves to production (R/P) ratio (years)
Malaysia	0.200	657	15.3
Vietnam	0.300	350	34.5
United Arab Emirates	5.800	3646	73.5
Indonesia	0.200	882	11.6
New Zealand	0.004	35.3	5.2
Nigeria	2.200	2322	43.8
Global average	**2.2**	**1607**	**26.4**

Table 3.1: Crude oil statistics for the top sources of imported crude oil[4]

Despite the advantages of reduced export terminal to import terminal distances of Malaysia, Vietnam, Indonesia and New Zealand over sources from the Persian Gulf and the Gulf of Guinea, it is the weak R/P ratios of Malaysia, Indonesia and in particular, New Zealand, which shed some light on the longer term strategic supply risk implications of these countries.

Despite its own crude oil production, Australia was reliant upon imports of crude oil even when all of its eight refineries were at nominal full operational capacity in 2002 (see chapter four on refining). Today, despite the closure of almost 50 per cent of its refining capacity, Australia imports marginally more crude oil than it once did as a result of its own declining crude oil production. Furthermore, the commensurate increasing reliance upon imports of refined products (in particular automotive fuels) means that by extension, Australia must take growing interest in the reliability of crude sources from the foreign refining centres that she is now heavily reliant upon for imports; specifically Singapore, Republic of Korea and Japan. This 'once removed' crude oil source dependence will be considered in more detail in the section addressing refined product import reliance.

To provide some comparative context, the graph below provides an illustrative perspective on the changing nature of Australia's crude oil imports and domestic oil production capacity juxtaposed against steadily rising import volumes of refined products.

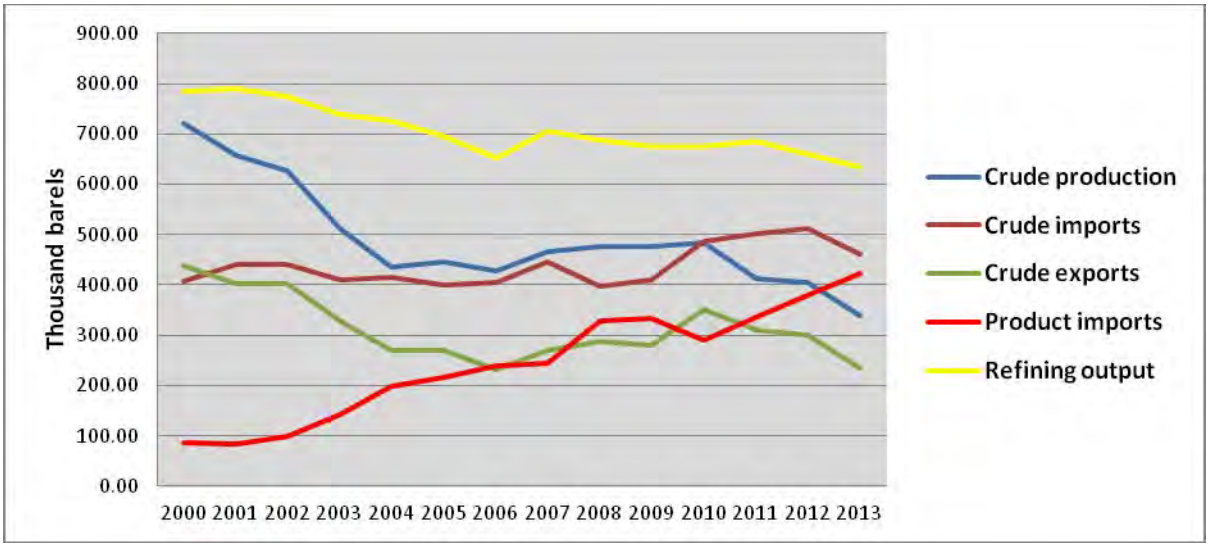


Figure 3.2: Australia's crude oil imports, exports and refining volumes since 2002[5]

Figure 3.2 reveals the generally declining volume of domestic crude oil production, which has been partially compensated by constant and then rising levels of crude oil imports; although imports have

been declining more recently since 2012. Unsurprisingly, Australia's exports of its own crude oil have been declining since 2010; due to shrinking domestic production as indicated previously. The most notable change shown by the graph is clearly the steady rise in the volume of refined product imports indicated by the red line. The source reliability of *direct* crude oil imports will of course continue to be of considerable importance to Australia over the coming decades. However, as highlighted earlier, it is the deepening reliance upon growing imported volumes of refined petroleum that will become of increasing strategic relevance in terms of national energy security, and the commensurate requirement to assess the supply risks associated with the sources of those growing imports.

The nature of the sources and associated risks must be analysed in two main ways: first, the refined product sources themselves; and second, the crude oil feedstock sources for those refining countries (principally Singapore, Republic of Korea and Japan) must be assessed for their reliability and the range of associated risks. Clearly, if the refineries that Australia now relies so heavily upon were to suffer disruptions to their supplies of crude oil feedstock and restrict their ability to refine and export sufficient volumes of middle and light distillate fuels in particular, that would likely have considerable implications for Australia, as pressure increased on finite reserves stored in-country.

Crude oil source risk assessment (direct import)

When assessing the comparative (or relative) risks associated with Australia's direct imports of crude oil, a holistic approach using a quantitative methodology is revealing. In order to achieve this, a wide range of metrics were selected, split into two broad categories: supply risks; and, political/security risks. All of these drivers were inserted into a spreadsheet to calculate risks for each category and as aggregate values based upon recognised oil industry, shipping and political empirical data sets. This methodology will be similarly utilised to establish the risks for sources of imported refined petroleum as well as the sources of crude oil imported by those refining countries that Australia currently relies upon, and those that it could utilise in the future in the process of supply diversification.

The risk scoring for all categories except internal political risk is formatted as follows:

High	**Small volume/value**	**4**
Elevated	**Med-high volume/value**	**3**
Moderate	**Med-low volume/value**	**2**
Low	**High volume/value**	**1**

Supply risk encompasses all of the physical, practical, technical and logistical metrics involved in actually producing and then exporting oil by sea. This is determined by the quantification and relative scoring of the size of a state's oil reserve base; its reserves to production ratio (R/P ratio) - the total number of years it can produce oil at current rates of extraction; total production capacity; its aggregate nominal export volume; and the supply route distance between source and market terminal (the greater the distance and the more protracted the streaming time, the greater the chances of interference from weather, natural phenomena, human error, and mechanical/technical problems). Data for these risk drivers were sourced from: *BP Statistical Review of World Energy 2014,* the US Energy Information Administration, the International Energy Agency, and maritime distance tables.

Political risks are those that can have a discernible impact upon whether a source country's internal socio-political and economic ontology and forces have the potential to have an inimical impact upon its oil industry to effectively produce, sell and export petroleum due to factors such as: corruption, sovereign non-payment; supply chain disruption; legal and regulatory dysfunctionality; political violence (terrorism) and/or recurring industrial action; banking sector vulnerability; business risk; and, lack of government support or stimulus for industrial output. This category is also supported by a geopolitical risk score, which is the risk borne by a tanker steaming along a sea

lane that passes through a region or sea area that is threatened by various factors and forces such as: contested territory, maritime border disputes, elevated or conflictual tensions between opposing states, the effects of power projection by a regional hegemon and/or the interference of external powers (which might include the deployment of military forces). The third main component of this category is security risk, which considers extant and potential threats to the maritime domain from: piracy, vessel hijacking and armed robbery at sea; terrorism; and, the effects of insurgency or civil war spilling into a state's littoral space. Information for these risk drivers was sourced from: the International Maritime Bureau, ReCAAP, and the Lloyds Market Association War Risks Committee.

It should be stressed that whilst risk assessments for any phenomena can be a valuable guide as to relative pros and cons and potential disruptions and dangers, such assessments are of course not absolute. Clearly, sourcing petroleum, like other resources, is also very much a choice based upon commercial drivers such as price, access, quality and typology. Nevertheless, the risk assessments provided below offer useful cautionary perspective in terms of broader energy and national security contexts. The tables that follow summarise the various potential risk levels for each of the various existing and alternative crude oil sources for direct import to Australia. The compound values are sums of the individual risk factors and the mean score gives an indication of the overall risk category of that source. The levels indicated for mean political/security risk score are revealed in more detail and explained in the following chapter.

	Reserve base score	R/P ratio score	Production capacity score	Export volume score	Voyage distance risk score	Compound supply risk score	Mean supply risk score	Mean pol/sec risk score
Brunei	4	3	4	4	1	16	**Elevated**	**Elevated**
Gabon	4	3	4	4	3	18	**High**	**Moderate**
Indonesia	4	4	4	4	1	17	**Elevated**	**Elevated**
Libya	3	1	4	2	3	13	**Elevated**	**High**
Malaysia	4	4	4	4	1	17	**Elevated**	**Elevated**
New Zealand	4	4	4	4	1	17	**Elevated**	**Low**
Nigeria	3	3	3	2	3	14	**Elevated**	**Elevated**
Papua New Guinea	4	4	4	4	1	17	**Elevated**	**Moderate**
Republic of the Congo	4	4	4	4	3	19	**High**	**Elevated**
Russia	2	3	1	1	4	11	**Moderate**	**Elevated**
Saudi Arabia	1	2	1	1	2	7	**Low**	**Elevated**
United Arab Emirates	2	2	2	2	2	10	**Moderate**	**Moderate**
Vietnam	4	3	4	4	1	16	**Elevated**	**Elevated**

Table 3.2: Risk scoring for higher volume existing sources imported by Australia

Table 3.2 reveals the following notable findings in terms of both supply and political/security risk. Sources that give rise to potential caution for their overall long-term strategic reliability as key sources of crude oil are: Brunei, Gabon, Indonesia, Libya, Malaysia, Nigeria, Republic of Congo

and Vietnam, which currently constitute 62 per cent of Australia's existing regular main sources. The remaining sources - New Zealand, Papua New Guinea, Russia, Saudi Arabia and the UAE - present reduced potential risk; however, of these, only the UAE is without fundamental concern in terms of long-term strategic supply reliability.

	Reserve base score	R/P ratio score	Production capacity score	Export capacity score	Distance risk score	Compound supply risk score	Mean supply risk score	Mean pol/sec risk score
Angola	4	4	3	2	3	16	**Elevated**	**Moderate**
Brazil	3	4	3	3	3	16	**Elevated**	**Moderate**
Canada	1	2	2	2	3	10	**Moderate**	**Low**
Iran	2	2	2	2	2	10	**Moderate**	**High**
Iraq	2	1	2	2	2	9	**Moderate**	**High**
Kazakhstan	3	3	3	3	4	16	**Elevated**	**Elevated**
Kuwait	2	2	2	3	2	11	**Moderate**	**Moderate**
Mexico	4	4	2	3	4	17	**Elevated**	**Low**
Norway	4	4	3	3	4	18	**High**	**Moderate**
Qatar	3	3	3	3	2	14	**Elevated**	**Moderate**
US	3	4	1	3	4	15	**Elevated**	**Low**
Venezuela	1	1	2	2	4	10	**Moderate**	**Elevated**

Table 3.3: Risk scoring for potential alternative sources for import to Australia

Table 3.3 reveals the following notable findings in terms of both supply and political/security risk. Notwithstanding their obvious importance and nominal utility as global market suppliers, potential new large-volume source options that give rise to potential caution for their reliability are: Iran, Iraq, Kazakhstan and Norway. Angola, Brazil, Canada, Kuwait, Mexico, Qatar, the United States and Venezuela present reduced potential risk; however, currently, the US does not yet export substantial volumes of crude due to the politically imposed ban, and Venezuela's oil is a heavy-sour grade, which is problematic to process for most refineries.

Refined Product Source Analysis

During the period from 2007 to 2014, Australia imported a wide range of refined products, including: aviation gasoline (Avgas); bitumen; diesel; fuel oil; gasoline; heating oil; jet; kerosene; lubricating oils, greases & base stocks; and, petrochemicals. It has sourced these products variously, and in widely different volumes, from over 40 different countries in Asia, Africa, Australia, Europe and the Americas. However, viewed holistically over a longer time span, the data reveal the three dominant sources of supply (shown in Figure 3.3), and as is now well-known, the clear primacy of Singapore in this regard. Indeed, Australia's heavy dependence on Singapore as the single largest source for refined fuel imports necessitates a separate discussion of the potential risks associated with this in the event of a supply disruption, and highlights the options to de-risk this by further diversification of sources, particularly for fuels.

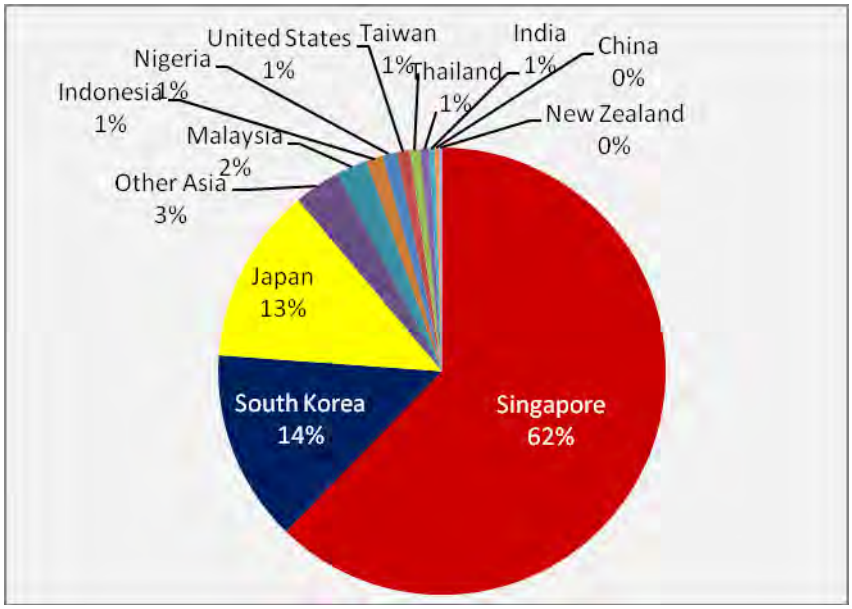


Figure 3.3: Country sources of Australian imports or refined petroleum[6]

As illustrated in Figure 3.3, aside from the clear dominance of Singapore, which supplies almost 2.3 times the volume of refined products as the next two largest suppliers combined, Republic of Korea and Japan have also long been important sources of refined fuels and petrochemicals for Australia.

Japan

Japan is Australia's third largest source of refined petroleum products; with a total of 25 operational refineries, it is the world's fourth largest refiner and the second largest in Asia after China. Japan has an aggregate refining capacity of 4.25 million barrels per day, which constitutes some 6.4 per cent of the world's total capacity.[7] In 2013, Japan imported 4,395,000 barrels of crude, and is the world's third largest importer of crude oil after the United States and China. It typically sources its crude from the major OPEC producers in the Persian Gulf; in order of importance: Saudi Arabia, the UAE, Qatar and Kuwait.

The country has long been a major exporter of refined products to the region; however, even despite the halving of crude oil prices since June 2014, the industry is experiencing considerable difficulties as margins have fallen by over 40 per cent since 2011. The problem has been exacerbated by exports of middle distillates from more profitable refiners in the United States and Saudi Arabia coming into the Asian market - two very important future source options for Australia. This has prompted once fiercely competitive refining companies in Japan to merge and consolidate, and the Japanese government has warned it is not realistic for Japan with its less competitive refineries to make up for a decline in domestic demand and compete with US and Middle Eastern refiners by expanding its exports of oil products in the years ahead.[8] This could result in Australia seeking other sources of import volumes and product types previously provided by Japan as noted previously. Japan exports the following refined distillates and products to Australia: diesel; fuel oil; gasoline; jet A-1; lubricating oils, greases and base stocks; and petrochemicals.

Republic of Korea

The Republic of Korea, by a small margin over Japan, is Australia's second largest source of refined petroleum. With a refining capacity of 2.88 million barrels per day (about 3.1 per cent of total global capacity), it is the sixth largest refiner in the world and the third largest in Asia after Japan and China.[9] Unsurprisingly, it is also one of the largest importers of crude oil. In 2013, Republic of Korea imported on average some 2,264,000 barrels per day; making it the fifth largest importer in the world (with an average of approximately 80 per cent coming from the Persian Gulf).

Like Japan, the industry's reliance on (or over-exposure to) crude supplies from the Middle East is clear; however, commentators have suggested that with crude prices at record lows and because OPEC producers are offering such favourable contract terms to its primary Asian customers in order to ensure continued market share, it is unlikely that Republic of Korea will contemplate diversifying it source base in the near term.[10] This feature of the dynamics of crude oil market flows from west to east in the Indo-Pacific region is crucial to understanding the wider geospatial implications and potential petroleum supply risks for Australia, and will be examined further following an introduction to Singapore, which will complete the initial examination of this refining triumvirate. Republic of Korea exports the following refined distillates and products to Australia: bitumen; diesel; fuel oil; gasoline; jet A-1; lubricating oils, greases and base stocks; and naphtha.

Singapore

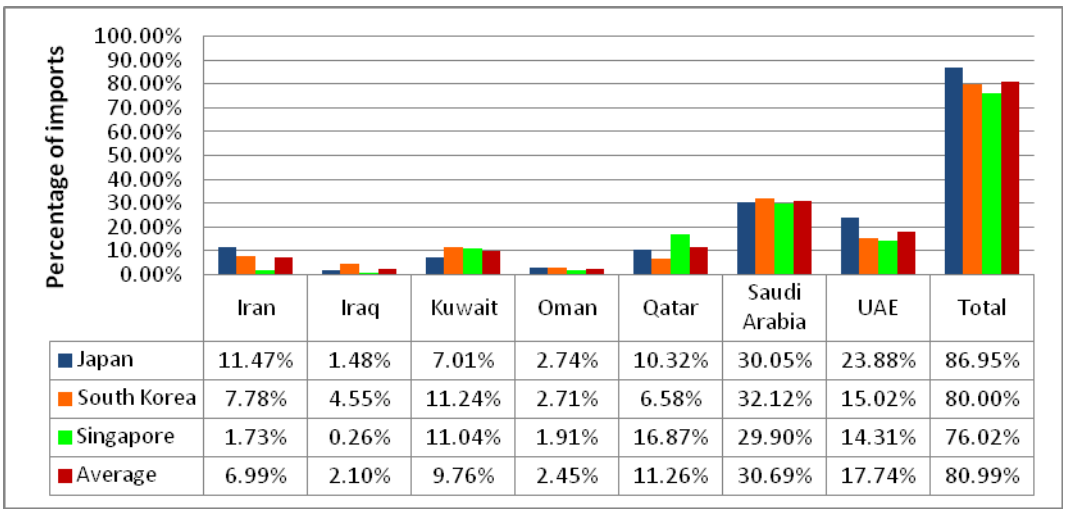
Singapore is the smallest of the three refiners in absolute terms, despite being by far the largest single source for Australia. However, its comparative geographical proximity to Australia juxtaposed against Japan and Republic of Korea, its growing storage capacity and easy access to plentiful product tanker charters, has resulted in Singapore becoming the single-most important strategic pillar in Australia's petroleum energy security. The country has a total refining throughput capacity of 1.395 million barrels of oil per day, from three refining sites; of which some 14 to 15 per cent is exported to Australia annually. Though Singapore is certainly not the largest refining country in terms of total oil refining output, it is, however, the third largest refining and trading hub in the world after Houston and Rotterdam, and the largest in Asia. Various expansion programs at its three refining sites will enable Singapore to not only maintain its share of refining capacity in the Indo-Pacific but also to extend its oil trading activities through the expansion of export-configured refining throughput. Singapore exports the following refined distillates and products to Australia: bitumen; diesel; fuel oil; gasoline; jet A-1; and lubricating oils, greases and base stocks; with a considerable emphasis on volumes of diesel, gasoline and jet A-1.

Similarly to Japan and Republic of Korea, Singapore imports the majority of its crude oil feedstock from the Persian Gulf and Arabian Peninsula. In recent years, its refiners have imported over 80 per cent of their crude import requirements from the region; principally from Saudi Arabia, Qatar, the UAE and Kuwait.[11] Arguably more than any other major export-orientated refining centre in the Indo-Pacific region, in the event of a crude supply disruption from the Middle East, Singapore would face the dilemma of having to judiciously allocate what volumes of refined products need to be maintained for vital domestic consumption and those volumes available for export and re-export (in the case of crude).

In a modelled scenario wherein Singapore's imports of petroleum amounted to 3 million bbl/ day (approximately 1.1 million barrels of which would pass through the Strait of Hormuz), resulting exports and re-exports of crude and refined products to the region would total approximately 1.9 million bbl/day.[12] Were this feedstock from the Persian Gulf to be disrupted, the knock-on effects for countries dependent upon Singapore for imports of light and middle distillates would be considerable, not least for Australia. This example provides an ideal segue to a more focused examination of the nature of the dependence of Japan, Republic of Korea and Singapore's refineries upon uninterrupted crude streams from the Middle East. Clearly, Australia, by association, is similarly dependent upon a stable crude flow from Saudi Arabia, the UAE, Qatar and Kuwait.

Dependence of Japan, South Korea and Singapore on the Middle East for crude imports

The geopolitics and geography of the global petroleum market is changing. In broad terms, the emphasis of oil movements has shifted from one of east to west (the Middle East to Europe and the United States) to one where the predominant volumes are from west to east (from the Persian Gulf and Arabian Peninsula eastwards to Asia). Whilst this drive has been led largely by steadily growing demand from China and to a lesser extent from India, Figure 3.4 and Table 3.3 clearly show the continued reliance upon imports from the key OPEC producers.



	Iran	Iraq	Kuwait	Oman	Qatar	Saudi Arabia	UAE	Total
Japan	11.47%	1.48%	7.01%	2.74%	10.32%	30.05%	23.88%	86.95%
South Korea	7.78%	4.55%	11.24%	2.71%	6.58%	32.12%	15.02%	80.00%
Singapore	1.73%	0.26%	11.04%	1.91%	16.87%	29.90%	14.31%	76.02%
Average	6.99%	2.10%	9.76%	2.45%	11.26%	30.69%	17.74%	80.99%

Figure 3.4: Crude imports by Japan, Republic of Korea and Singapore from the Middle East[13]

Using a sample of data over ten years, Figure 3.4 reveals that Saudi Arabia still dominates as the crude oil exporter for all three of Australia's most important refining countries, with an average share of 30.69 per cent - almost twice the volume of the next largest exporter, the UAE. Qatar and Kuwait are the next largest exporters, with Iran supplying an average of a surprisingly large 7 per cent. Iraqi exports have been comparatively small juxtaposed against its regional OPEC co-members, as production and export volumes remained modest after the long Iraq War of 2003 to 2011, and projects to raise production from the major fields in the south have taken time to mature into greater export volumes via Iraq's offshore terminals in the northern Persian Gulf. Though the dominance of the traditional exporters is unsurprising, it is worth noting that once the global supply/demand dynamic settles and basket pricing finds its readjusted norm, the volumes supplied eastwards from Iraq and Iran will start to gain market share. Iraqi production and export capacity is expanding steadily, and the likely lifting of international sanctions ranged against Iran will release stored crude into the Asian market by 2016.

The significance of crude oil supply risks for Singapore, Republic of Korea and Japan

An important question to pose is why is a good understanding of the origin and associated volumes of crude exports to these vital refining countries so important, particularly in a period of surplus of supply and low basket prices? Additionally, why is it also important to consider the implications of potential supply volume disruptions?

Things do not remain the same in the oil market for long. What is true today will not necessarily be so in the weeks and months to follow. On 19 June 2014, Brent crude was priced at $115.71 per barrel.[14] At the time, few traders would have predicted the enormity of the price collapse that was about to take place over the remainder of 2014. The steadily growing stocks of unsold oil and slackening demand in Asia, principally the tapering of Chinese demand, put mounting downward pressure on spot prices so quickly and to such an extent that many commentators began to suggest that the world was entering a new era of permanently depressed prices, and that the age of $100 plus oil was over. Perhaps, this kind of prophesising can be forgiven in the context of the startling pace of the price collapse; however, the market has been here before. The Asian economic crisis caused prices to fall to almost $10 per barrel by the beginning of 1999, yet by the end of the following year prices had more than tripled. In 2006, prices had risen sevenfold over the low of 1999, and by 2008, Brent stood at over $90 per barrel. At the depths of the global economic crisis in 2009, prices had fallen to $40 per barrel, yet by 2011 prices soared to over $120 as suppliers struggled to keep up with demand from key Asian industrial economies gathering in economic strength once again.

What is the message from this going forward, and what is the significance for Australia and its sources of crude oil and refined petroleum? The key risk driver is the preponderant reliance of

Singapore, Republic of Korea and Japan upon the main Gulf suppliers for their feedstock. Prices will eventually rise again as demand picks up, and when they do, consumers will need once again to compete for available cargoes. In a tight market, Australia, Japan, Republic of Korea and Singapore will need to compete with demand from India and China. This scenario is of course manageable as it has been in the past. However, the problem arises in the event of a significant disruption in supplies from the Middle East. Clearly, Australian policy and recommendations cannot affect the crude oil feedstock sourcing decisions and risk mitigation strategies of external refining operators. Nevertheless, Australia can enable its own risk mitigation strategy for its imports of refined petroleum through continuous assessment of the macro risk picture of existing sources and prospective alternative sources.

Source risk assessment for Australia's overseas suppliers of refined petroleum

Using the same methodological approaches as for assessing crude oil source risk, it is possible to get a comparative picture of the relative risks associated with one source juxtaposed against another, which is illustrated in Table 3.4. The data provides for both the three existing primary sources - Singapore, Republic of Korea and Japan, and also offers risk views for alternative source options, drawn from a list of the remainder of the world's largest producers and exporters of refined petroleum.

	Oil reserve base score	Refining capacity score	Export volume score	Distance risk score	Compound supply risk score	Mean supply risk score	Mean pol/sec risk score
China	4	1	4	1	10	**Elevated**	**Elevated**
India	3	3	3	2	11	**Elevated**	**Moderate**
Japan	4	3	4	1	12	**Elevated**	**Moderate**
Russia	2	2	1	4	9	**Moderate**	**Elevated**
Saudi Arabia	1	2	3	3	9	**Moderate**	**Elevated**
Singapore	4	4	2	1	11	**Elevated**	**Moderate**
South Korea	4	3	3	2	12	**Elevated**	**Moderate**
United States	3	1	1	4	9	**Moderate**	**Low**

Table 3.4: Risk scoring for existing and sources of refined petroleum imported by Australia

The table reveals that Australia's main source - Singapore - has a supply risk of **elevated**. This is due to several factors: clearly, it is totally reliant upon imports for its own crude oil feedstock as analysed earlier in this chapter; despite high export volumes, it has a comparatively low total refining capacity, which means that it has limited expansion capacity in the event of surges in regional demand for its products (in particular fuels); however, it is closer to Australian refineries and thus carries lower sailing distance/time risk. Singapore has a political and security risk level of **moderate**, which is driven largely by the piracy and vessel hijacking threat (see Chapter Four). Republic of Korea and Japan profiles are broadly similar. They carry lower production capacity risk than Singapore, but interestingly higher export capacity risk (both countries consume much of their own refining capacity domestically). The longer shipping distances linking their refineries with Australia's import terminals gives rise to higher distance (or logistics) risk than Singapore. Though both countries have low political risk, their maritime security and geopolitical risk ratings are elevated due to tensions in the South China Sea, giving a mean political/security risk of **moderate**.

De-risking through greater diversification

As highlighted previously in this report, international oil company decision making is shaped by commercial factors; however, governments have a responsibility to remain concerned with the wider strategic picture. Singapore, supported by Republic of Korea and Japan, are excellent and logical sources of refined petroleum for Australia in every regard and will likely continue to be so. Nevertheless, the heavy reliance upon refining centres that do not have their own crude oil feedstocks, are located at extensive distances from their undiversified source of crude oil (in particular Republic of Korea and Japan), and are located in a brittle *geopolitical shatterbelt* (see Chapter Four), conflates to elevate the risk of these sources.[15]

Table 3.4 reveals other large capacity producers as options to diversify the make-up of Australia's refined petroleum sources. The three countries that stand out are the United States, Saudi Arabia and India. The United States is the world's largest refiner, has prolific crude reserves, and is low risk. Saudi Arabia is in the midst of a very large refining capacity expansion program that is specifically geared for the export market in the Indo-Pacific region, and has the world's largest proven crude reserves. Like the United States, this means Saudi Arabia will never be reliant upon external sources for feedstock. However, these positives must be tempered with its elevated political and security risk rating. India is fast becoming one of the world's more important refiner/exporters (its largest refinery, Jamnagar, is the largest single-site refinery in the world, which was specifically designed as an export-orientated facility), and is close to Australia within the Indo-Pacific region relative to other sources. Its currently elevated source risk will diminish in the coming years as its refining capacity and export capacity climbs; making one of the most strategically significant refiner-exporters in the Indo-Pacific region by 2020.

Endnotes

[1] Sourced from a combination of statistical data from The Observatory of Economic Complexity and the Australian Bureau of Resources and Energy Economics.
[2] Sourced from a combination of statistical data from The Observatory of Economic Complexity and the Australian Bureau of Resources and Energy Economics
[3] Sourced from a combination of statistical data from The Observatory of Economic Complexity and the Australian Bureau of Resources and Energy Economics.
[4] Sourced from a combination of statistical data from the EIA and *BP Statistical Review of World Energy 2014*.
[5] US Energy Information Administration (EIA)
[6] Sourced from a combination of statistical data from The Observatory of Economic Complexity and the Australian Bureau of Resources and Energy Economics.
[7] 'The 10 biggest oil refining countries', *Hydrocarbons-technology.com*, 2 December 2013, www.hydrocarbons-technology.com/features/featurethe-10-biggest-oil-refining-countries/.
[8] Tsuyoshi Inalima, 'Japan refinery rivals turn to allies amid fuel import threat, 9 February 2015, www.bloomberg.com/news/articles/2015-02-10/japan-refinery-rivals-turn-to-allies-amid-fuel-import-threat.
[9] 'The 10 biggest oil refining countries'.
[10] Claira Lloyd, 'South Korean oil, gas and petrochemicals', 17 February 2015, www.energyglobal.com/downstream/refining/17022015/Oil-gas-petchem-South-Korea/.
[11] The Observatory of Economic Complexity, 'Import origins of of crude petroleum to Singapore (2010)', http://atlas.media.mit.edu/en/explore/tree_map/hs/import/sgp/show/2709/2010/.
[12] John V Mitchell, *Asia's Oil Supply Risks and Pragmatic Remedies*, Chatham House, The Royal Institute of International Affairs, London, 7 May 2014, p. 18, www.chathamhouse.org/sites/files/chathamhouse/field/field_document/20140506Asia%27sOilSupplyMitchell.pdf.
[13] Sourced from The Observatory of Economic Complexity.
[14] Isaac Ansdorf, 'Why oil prices went down so fast', *Bloomberg*, 29 October 2014, www.bloomberg.com/news/articles/2014-10-29/why-oil-prices-went-down-so-far-so-fast.
[15] Shatterbelts are 'a large, strategically located region that is occupied by a number of conflicting states and is caught between the conflicting interests of adjoining Great Powers'; see Geoffrey Kemp and Robert E Harkavy, *Strategic Geography and the Changing Middle East*, Carnegie Endowment for International Peace/Brookings Institution Press, Washington, DC, 1997, p. 5.

Chapter 4: Crude and refined petroleum trade security in the Indo-Pacific

The purpose of this chapter is to examine in some detail the threats to the security of petroleum exports along the sea lines of communication that are of direct relevance to Australia; either as imports of crude oil from the Persian Gulf and west Africa, or as imports of refined petroleum cargoes from the major Asian refiners of Singapore, Republic of Korea and Japan. The region and sea areas examined are also of direct relevance to the sea lanes used by liquefied natural gas (LNG) carriers lifting gas from north-western Australia to Northeast Asia.

The first main section examines the key maritime security threats of piracy, hijacking and armed robbery at sea, and the far less prevalent but more sensational and potentially far more destructive threat of maritime terrorism. The second key section examines the geopolitical tensions in the South China Sea and the Persian Gulf for their potential to cause disruption to petroleum flows through, and originating from, those spaces. The chapter concludes with a summary risk assessment of the facets examined in the aforementioned sections.

Maritime Security Threats

History shows that the impact of major warfare upon petroleum shipping and their crews is well known, and the vulnerability of tankers and their crews to attack, sinking or constructive total loss was highlighted during the Iran-Iraq War (1980-88). However, petroleum shipping - crude oil tankers, product tankers, chemical tankers and gas carriers (notably LNG and LPG carriers) - is also at risk from other quarters at sea other than major conflict. Whilst the threats would probably not result in a large-scale or long-term disruption of imports to, and exports from Australia, and her suppliers of refined products, it is the 'strategic premium' of oil petroleum shipping that ensures this trade will be a favoured target in the future by non-state belligerents, notably terrorists and criminals.

One of the better guides to establishing a baseline picture of the parts of the maritime world exposed to security risk is the Lloyd's Market Association *Joint War Committee Hull War, Piracy, Terrorism, and Related Perils Listed Areas* (JWLA). The most recent version of JWLA (021) was published in 12 June 2013 and revised two years later, thus this report makes some additions and refinements where necessary to provide more up to date context. The inclusions within JWLA 021 pertinent to the sourcing and/or supply of crude oil and refined products to Australia and relevant to Australia's petroleum exports (crude, products and LNG) are outlined in Table 4.1. Regions, sea areas and countries of particular relevance as key sources of petroleum or areas vital to oil and gas conveyance are marked with an asterisk.[1]

Region/Sea Area/Countries	**Extant/potential causes of insecurity**
Africa • Benin • Egypt* (including Suez Canal) [added by author] • Eritrea (but only South of 15°N) • Gulf of Guinea (but only the waters of the Togolese, Beninese and Nigerian Exclusive Economic Zones north of Latitude 3° N)* • Libya* • Nigeria* • Somalia* • Togo	• piracy and armed robbery at sea • vessel hijacking • insurgency • terrorism

Indian Ocean [Arabian Sea, Gulf of Aden, Gulf of Oman, Southern Red Sea]*
• The waters enclosed by the following boundaries:
  o To the north-west, by the Red Sea (south of Latitude 15° N)
  o To the west of the Gulf of Oman (Longitude 58° E)
  o To the east (Longitude 78° E)
  o To the south (Latitude 12° S)
Note: This space excludes the coastal waters of adjoining territories up to 12 nautical miles offshore unless otherwise specified
	• piracy and armed robbery at sea
	• vessel hijacking
	• terrorism
	• insurgency

South Asia • Pakistan	• maritime terrorism

South China Sea [Indonesia/Malaysia/Philippines]
• Borneo, but only the north east coast between the ports of Kudat and Tarakan inclusive
• The port of Jakarta
• Sulu Archipelago (including Jolo)*, comprising:
  o On the western side, a straight line between Tanjung Bidadari (5°49′·6N, 118°21′·0E) to position 3°32′·0N, 118°57′·0E
  o On the south eastern side, a straight line from there to position 5°50′·0N, 122°31′·0E, and thence northwards to position 7°06′·6N, 122°31′·0E
  o On the northern side, a straight line from there to Batorampon Point Light (7°06′·6N, 121°53′·8E)
  o On the north western side, a straight line from there back to Tanjung Bidadari
	• piracy and armed robbery at sea
	• vessel hijacking and cargo theft
	• kidnapping of crews
	• terrorist support activity (logistical support operations)

Middle East • Bahrain (excluding transit) • Iran* • Iraq (including all Iraqi offshore oil terminals)* • Israel • Lebanon • Saudi Arabia (excluding transit)* • Syria • Yemen* • Persian Gulf shipping lanes and the Strait of Hormuz* [added by author]	• terrorism • insurgency • piracy and armed robbery at sea

Table 4.1: Areas of maritime security threat in the Indo-Pacific and Atlantic Ocean petroleum source areas[2]

The extent of the oceanic, littoral and coastal maritime space encompassed in Table 4.1 is clearly very large, and taken at face value as a listing derived from various threats to security, it could be viewed with a good deal of concern in the context of risks to oil and gas sourcing and supply. However, this is a listing that is also compiled in the context of possible security risks to marine insurance underwriters and brokers that must consider all potential aspects of risk to the vessels and offshore units they underwrite; risks that are often latent, dormant or moderate. Put another way, Table 4.1 should be viewed as a cautionary guide to possible threats, and certainly not seen in an alarmist way as a seemingly endemic list of extant and persistent dangers to tankers and other shipping. Nevertheless, it is important to examine the security threat categories and their effect on certain maritime spaces, and most importantly to convey a sense of perspective - a 'reality check' - on the threat level, likelihood and its implications for the oil and gas sector as it might affect Australia.

Terrorism

The threat of terrorist acts in the maritime domain, also referred to as maritime terrorism, has a reasonably long history, has manifested itself in numerous ways - such as hijackings, waterborne improvised explosive devices (IED), amphibious style assaults, and the use of placed IED. A long assessment of the history of maritime terrorism is not warranted here; however, a concise assessment of terrorist operations conducted against the maritime petroleum sector is germane. Three incidents are useful for their extrapolative value in determining the possible form and effectiveness of attacks against the sector in the future. These are the waterborne IED attacks against MV *Limburg* in October 2002, against the Al Basra Oil Terminal (ABOT) and the Khor al-Amaya Oil Terminal (KAAOT) off Iraq in April 2004, and against MV *M.Star* in July 2010.

The Al Qaeda conducted attack against *Limburg*, whilst she was in roads at the Ash Shihr oil terminal in Yemen (which uses single point moorings), ruptured both the wing ballast tank and a wing cargo tank and caused the spilled crude to catch fire. The attack, though visually spectacular, did not result in the destruction or sinking of the ship, nor a sustained panic in the oil market resulting in oil flow disruption or prolonged price increase. The vessel was subsequently repaired, sold, and is now back in service as MV *Maritime Jewel*.

The attack underscores the utility of waterborne IED, and would certainly be the most effective means of terrorist attack against a tanker in the future. However, in order to completely destroy a tanker and its cargo, a device with a far larger explosive core charge would be required. Ideally, more than one device would also be required; attacking two different parts of the vessel simultaneously.

The attacks against ABOT and KAAOT in April 2004 were carried out by the al-Zarqawi-led group Jamaat al-Tawhid (which became al-Qaeda in Iraq (AQ-I) in October 2004; elements of which later morphed into what is known today as ISIL, ISIS or simply, IS). This incident involved the use of a dhow and two high-speed boats as waterborne IED. The speed boats were used against the larger ABOT facility and the dhow against KAAOT.

Both attacks ultimately failed in their objective to detonate the devices against the terminals or tankers moored at them; however, the most important feature of this incident to take away is the 'what if' factor. Had the devices that made it alongside the MV *Takasuza* (which was loading at ABOT) detonated as intended, there is every chance that the resulting conflagration could have destroyed both the ship and the terminal unless it could have been towed away from its birth. Such an outcome would have been by far the most effective terrorist attack against the maritime petroleum sector ever undertaken. It would have terminated Iraq's ability to export meaningful volumes of crude via the Persian Gulf for an extensive period.

Another contemporary maritime terrorist threat comes from the Abdullah Azzam Brigades (AAB), which has demonstrated the capability to attack petroleum shipping in the Persian Gulf using a waterborne IED. On 28 July 2010, an AAB maritime cell attacked the laden Japanese-owned MV

M.Star at night as she was transiting the Strait of Hormuz. The device was detonated close to the starboard side beneath the superstructure. Fortuitously, the blast was not sufficient to cause crippling damage and the tanker proceeded to a port in the UAE. The fortunate outcome notwithstanding, the incident itself is of considerable significance as an act of maritime terrorism: the attack was executed by an Islamist terrorist group not previously judged to have a maritime operations capability; the assault was conducted against a moving target at night (previously Islamist terrorists have only managed to attack merchant vessels at anchor or berthed at a terminal during daylight); and, it was executed in the world's most critical oil trading chokepoint, in one of the most militarised maritime spaces in the world. It is far from certain whether terrorists could mount another attack of this kind. However, it must be assumed by security forces and the oil industry that it can, and that such an attack could be conducted without warning and may in the next instance be far more destructive, not only for the vessel but also for the area in which the attack occurs.

Current threat summary

- Terrorist groups with maritime capability: Al Qaeda in the Arabian Peninsula; AAB; Ansar Bayt al Maqdis; Lashkar-e-Tayyiba.
- Possible targeting areas: Persian Gulf/Strait of Hormuz/Gulf of Oman; northern Arabian Sea; Suez Canal/Eastern Mediterranean/Gulf of Suez; and, Gulf of Aden/Bab al Mandeb.
- Oil industry maritime targets attacked in the past: tankers; coastal oil terminals; offshore terminals; and, platforms & floating production, storage & offloading units [Nigerian militants/extremists].
- Means of attack: stand-off weaponry; armed assault and various IED.

As highlighted earlier in this section, a well-organised and properly executed attack using multiple high explosive yield waterborne IED against a tanker/terminal target could cause considerable disruption to the oil trading system and wider market. However, though there are groups that, in theory, have the capability to carry out an attack of this kind, its complexity renders it less likely than other low-impact attacks, such as the use of standoff weaponry against moored vessels. Fundamentally, the threat posed by maritime capable groups exists and thus it is vital to remain vigilant. However, it is low, and the impact of a more likely low-consequence attack would not pose a major strategic-level threat to the petroleum flows in the Indo-Pacific region upon which Australia relies.

Piracy, Vessel Hijacking, and Armed Robbery at Sea

When assessing risks to the flow of oil and gas within the Indo-Pacific region (including the sources from west Africa) it is responsible to include the threat posed by piracy, hijacking and armed robbery at sea. However, it is important to remember that even when the threat in the northern Indian Ocean peaked in 2011, it did not become a threat to supplies of oil and gas at a strategic level. Piracy and vessel hijacking currently presents a threat to tankers, other merchant vessels, and their crews in certain maritime regions pertinent to this report, and this threat is likely to persist in the short-to-medium term. Indeed, it is certainly possible that tankers lifting refined products to Australian terminals from refineries in Japan, Republic of Korea and Singapore could fall victim to attack in the future.

The graphs that follow highlight the following: the general decline in the threat in a macro sense; where the areas of greatest threat exists; and, identifies trends with regards to vessel type and types of attack, most notably armed attacks and hijackings. The views compiled are done so with specific reference to areas of petroleum sourcing and routes or conveyance. The data are sourced from the International Maritime Bureau (IMB) and ReCAAP.

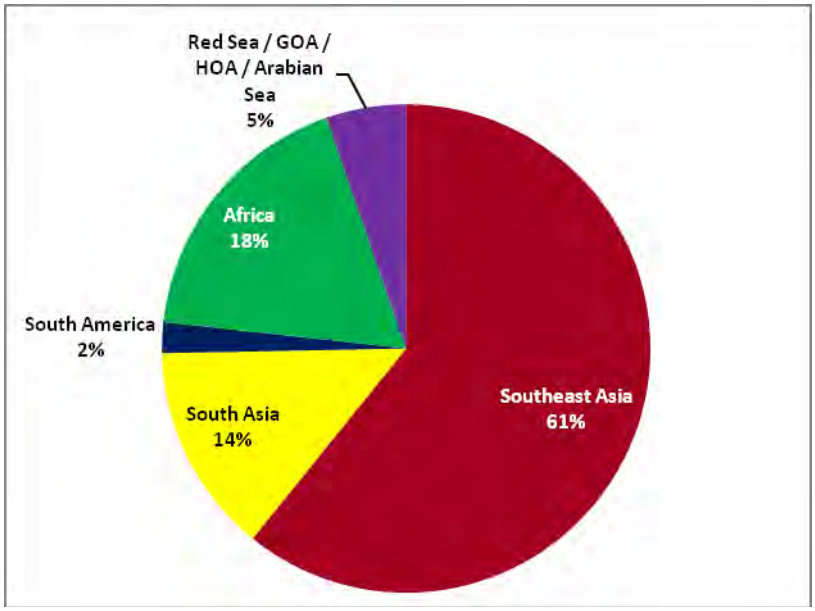
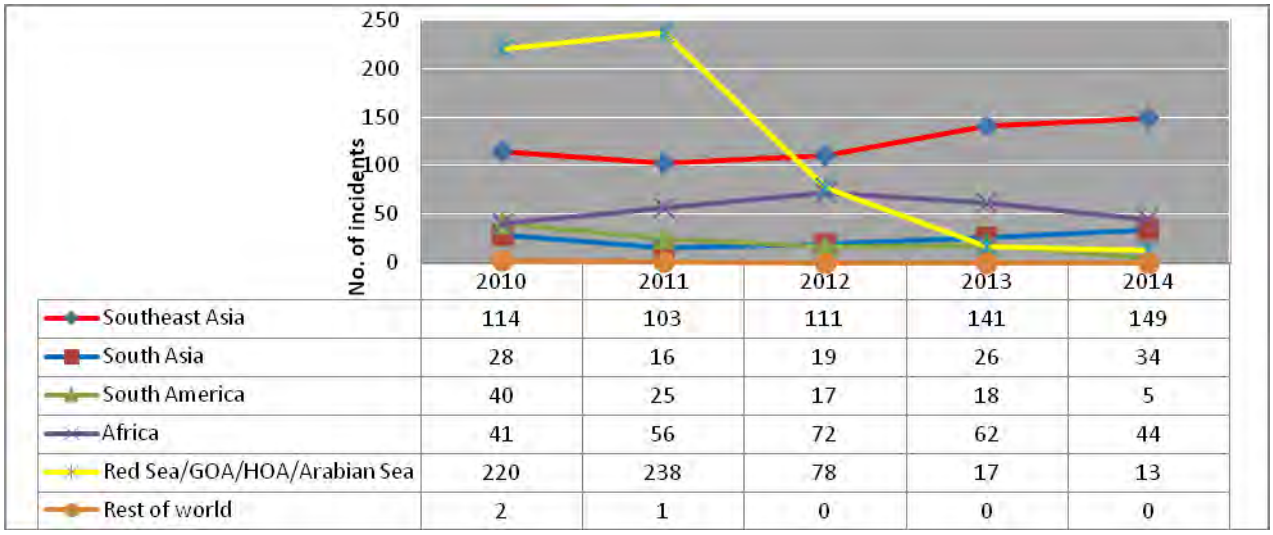


Figure 4.1: Actual and attempted piracy incidents 2014[3]

Figure 4.2 reveals two important trend changes. Most notably is the sharp decline in the number of incidents attributable to Somali pirates in the Indian Ocean, which falls from a peak of 238 in 2011 to just 13 in 2014; an 18 fold decrease. Separately, the figures reveal the steady increase in the number of incidents in Southeast Asia (which also incorporates the whole South China Sea) from 103 in 2011 to 149 in 2014; an increase of almost 31 per cent. Viewed in comparative terms, the threat to petroleum shipments originating in the Persian Gulf and Europe bound for Australian terminals has decreased commensurately with the greatly diminished threat from Somali piracy. However, the threat to tankers and other shipping from attacks in Southeast Asia that may be bound for Australia or having originated at an Australian terminal has increased since 2011, and that trend has continued into 2015.



	2010	2011	2012	2013	2014
Southeast Asia	114	103	111	141	149
South Asia	28	16	19	26	34
South America	40	25	17	18	5
Africa	41	56	72	62	44
Red Sea/GOA/HOA/Arabian Sea	220	238	78	17	13
Rest of world	2	1	0	0	0

Figure 4.2: Piracy and armed robbery at sea incidents 2010 to 2014[4]

The data that follows shows the breakdown in location of the various attacks in Southeast Asian waters, their level of severity and typology, and the trends in the types of vessel that are being targeted.

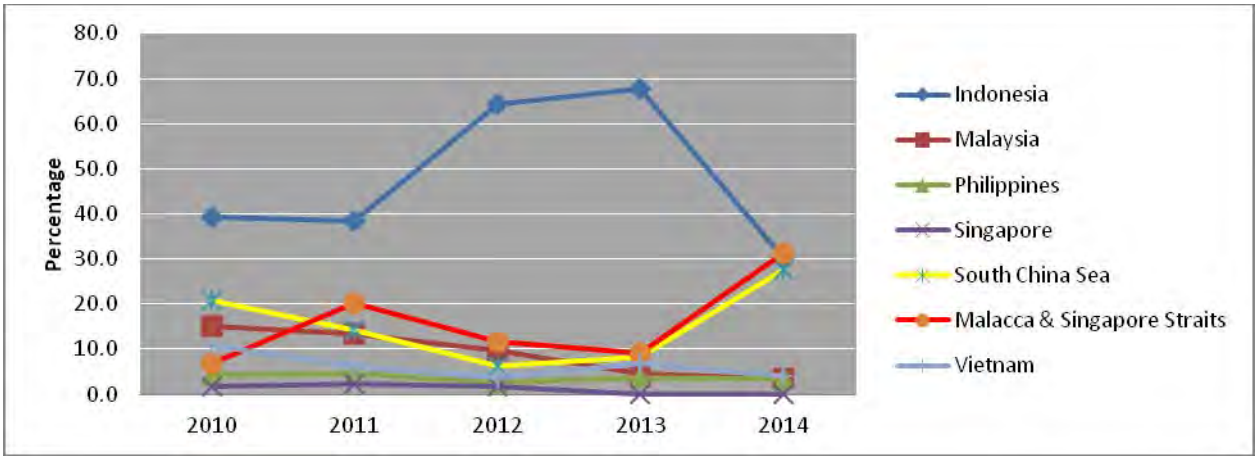


Figure 4.3: Piracy and armed robbery as sea incidents in Southeast Asia 2010 to 2014[5]

The graph in Figure 4.3 shows the encouraging trend of the gradual decline in incidents in the territorial waters of the following countries: Malaysia, The Philippines, Singapore and Vietnam. Whilst there was a considerable rise in the percentage of incidents reported in Indonesian waters from 2012 to 2013, 2014 saw incidents fall to below its previous low in 2011. However, the graph also shows a notable rise in incidents in 2014 in the Malacca and Singapore straits and the South China Sea. This is due largely to the surge in attacks against product tankers whilst underway in international waters. Figure 4.4 reveals some interesting trends with regards to the increasing rise in attacks against product/chemical tankers that stands out against amidst the context of the overall diminishing of total attacks worldwide and in the Indian Ocean specifically. This has been due to the growing seriousness of the threat to hijacking of product tankers in west Africa and Southeast Asia. Indeed, viewed in totality, there has been a clear rise in attacks involving petroleum sector vessels since 2010.

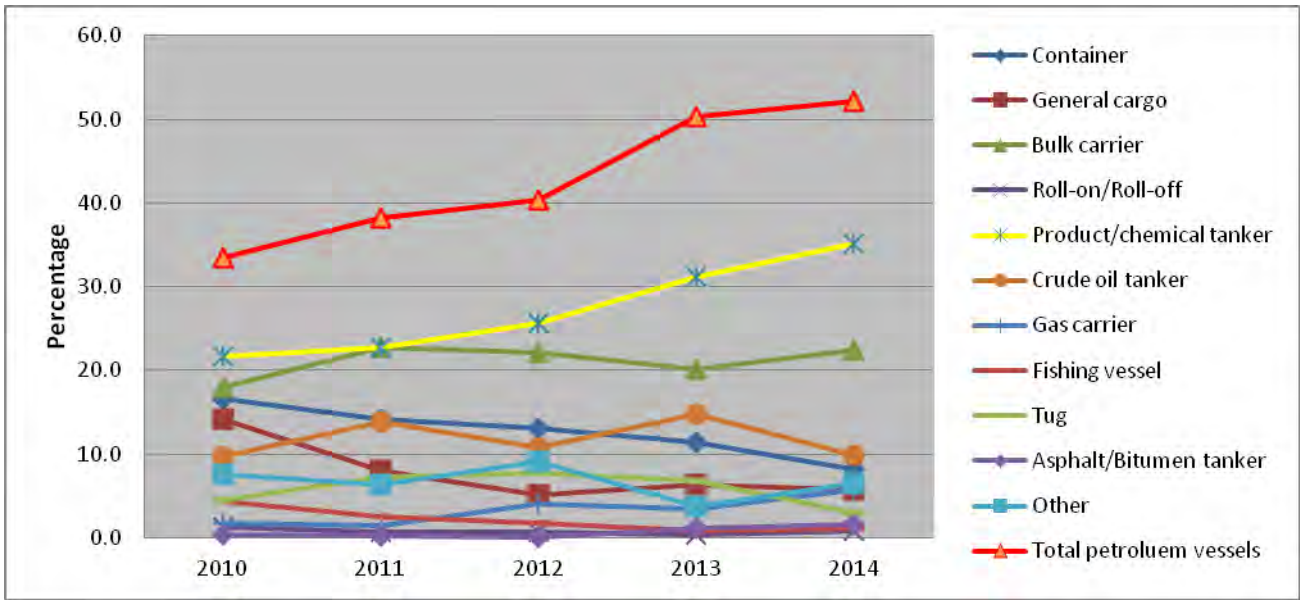


Figure 4.4: Incidents by vessel type 2010 to 2014[6]

Targeting of laden product tankers underway in the southern South China Sea

Of direct relevance to the purpose and focus of this report, it is the deliberate targeting of product tankers by armed, experienced and determined pirates in Southeast Asian waters that is becoming of increasing concern. ReCAAP has three levels of incident seriousness: CAT 1, CAT 2, CAT 3, and a fourth - petty theft. The seriousness of the incidents is based upon levels of violence, and economic loss, where CAT 1 is the most serious. During 2014, of the 168 piracy and armed robbery incidents

reported to ReCAAP, 13 were classified as CAT 1; all of these incidents involved attacks against product and chemical tankers.

Unsurprisingly, there is a clear navigational logic to the location and concentration of attacks against laden product and chemical tankers that have sailed from Singapore. Once these vessels have exited the traffic separation scheme in the Phillips Channel, tankers proceed north, northeast and east (to terminals in Thailand, Cambodia, Vietnam, The Philippines, Brunei and Indonesia (Borneo Island)), and southeast to Java, East Timor, Papua New Guinea and Australia. The locations of the Anambas and Riau Island groups to the northwest, the Subi-besar Serasan island group to the east and Bintan to the southeast of Singapore, shape the orientation of the shipping lanes that radiate out to the various destinations. Crucially, however, these geographical features ensure concentrations of shipping, which render vessels far more vulnerable to detection and tracking attack by skilled pirates. Figure 4.8 illustrates the approximate orientation of shipping lanes and their relative positioning to the various island groups. The sea areas marked in red indicate aggregations of CAT 3 pirate incidents in the last 3 years, which coincide with greater concentrations of vessel traffic.

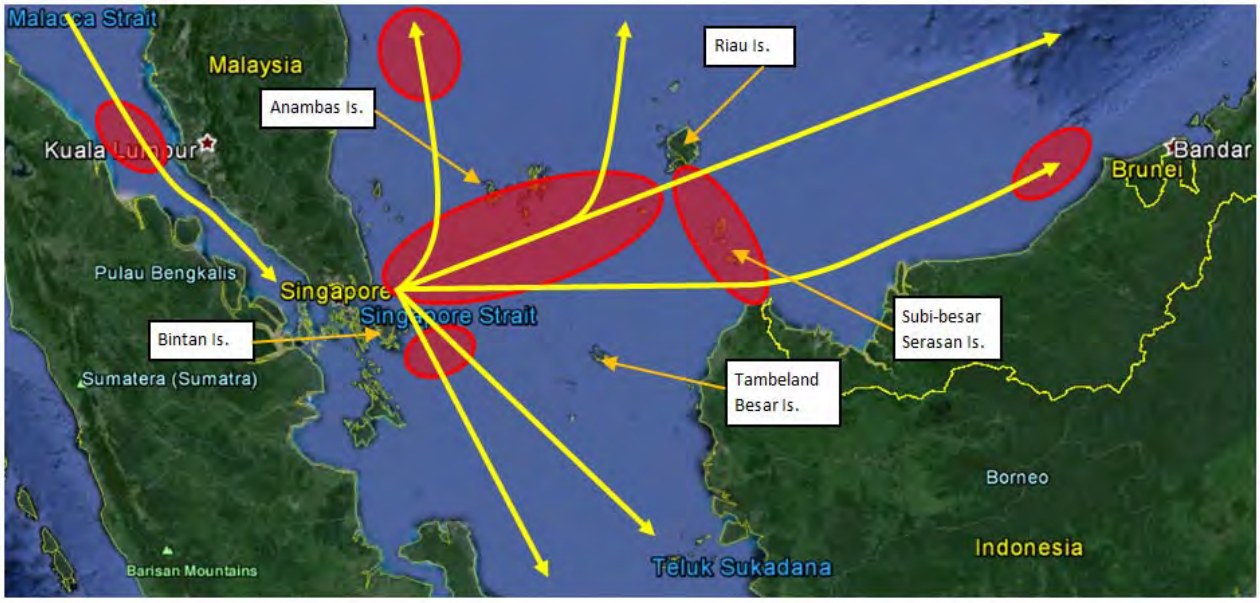


Figure 4.5: Approximate shipping lanes and CAT 3 pirate incident concentrations (Herbert-Burns)

The incident scenarios are generally similar:

1. Pirates pre-position themselves in areas of vessel traffic concentration in sea lanes and select vulnerable/unprepared target tanker
2. The attacking boats approach the vessel, force it to slow or stop in the water, and board
3. If the crew has not withdrawn to a citadel, they are taken hostage and the vessel taken under command. Violence does take place if pirates meet with resistance, and in some cases crew fatalities have resulted due to injuries sustained
4. Pirates then transfer the refined cargo at sea (gasoline, diesel, jet or bitumen etc) to another tanker in a ship-to-ship evolution
5. Prior to releasing the crew and target vessel, pirates destroy communications and navigational equipment on the bridge
6. Pirates withdraw with stolen cargo, which is then sold on the black market through organised criminal channels

As mentioned earlier, the piracy threat to tankers in west Africa and in particular in Southeast Asian waters does not currently constitute a strategic risk to the flow of petroleum from source countries and refining centres to markets. Nevertheless, the risk to tankers in the South China Sea in particular is increasing, whole cargoes are being stolen at sea by increasingly capable, organised

and very well connected criminals, and some seafarers are losing their lives in the process. If unchecked, this hijacking threat to tankers will likely increase, and could eventually result in some disruption to refined products supply to Australia and other countries in the region.

Regional Geopolitical Pressures as Causes of Potential Disruption to Petroleum Streams

There are numerous territorial and boundary disputes between two or multiple countries in the Indo-Pacific region; some are near to sources of petroleum whilst others lie astride sea lines of communication. The number and variances of these disputes are too numerous to examine systematically and inclusively in this report, and the majority of cases would be most unlikely to cause major and protracted disruption to the supply and sourcing of petroleum as it affects Australia's energy and economic security. Nevertheless, there are two main regions beset by geopolitical tensions that need to be highlighted for their potential to cause disruption to the flow of oil and gas by sea in the event of raised tensions or open hostility - these are the South China Sea and the Persian Gulf. Both of these topics have been written about extensively (and some might say exhaustively) by academics, military officers, policymakers and journalists; particularly the Persian Gulf. For that reason, I will address the issues specifically as they do (and might in the future) impact directly upon the flow of petroleum by sea in such a way that could be inimical to Australia's petroleum energy security.

From a methodological perspective, the analysis will focus on the pairing of geopolitical flashpoint issues and the navigational viability (or functionality) of the sea lines of communication that route via them. It is important to note that despite much of the rather alarmist commentary about the possibility (or even likelihood) for open conflict between states in these regions and the impact upon trade and security, disputes in these areas are complex and nuanced, and that whilst armed clashes might occur, this does not necessarily translate into an inevitable strategic-level disruption of maritime trade. In fact it would be unlikely to do so - except, arguably, in the case of a full-scale multi-state regional war.

The South China Sea

The territorial and boundary disputes in the South China Sea and the concomitant displays of state power-projection, defensive actions and localised clashes between claimants are prototypical of geopolitics in its formal (or academic) sense. In its broadest context, the contest stems from China's exclusive claim to an extensive swathe of the South China Sea encompassed by what is often referred to as the 'nine-dashed line', which is shown in Figure 4.6.[7] The use of this term refers to the regular utilisation of the professed line that encompasses approximately 90 per cent of the South China Sea (some 3.15 million km^2) claimed by China on its own maps since the initial claim by the Nationalist government in 1947.

A Chinese diplomatic communiqué in March 2008 posited that:

> The dotted line of the South China Sea indicates the sovereignty of China over the islands in the South China Sea since ancient times and demonstrates the long-standing claims and jurisdiction practice over the waters of the South China Sea.[8]

Ironically, however, in an ensuing diplomatic cable later that year (published by WikiLeaks), a senior Chinese government maritime lawyer, Yin Wenqiang, declared he was 'unaware' of the historical basis for the nine-dash line positioning. Regardless of the oblique and apparently confused historical basis, the overt Chinese posture on the matter is very unambiguous. China claims virtually all of the South China Sea and the islands and resources within it. This claim is disputed by all other states in the region, which have various competing claims of their own.

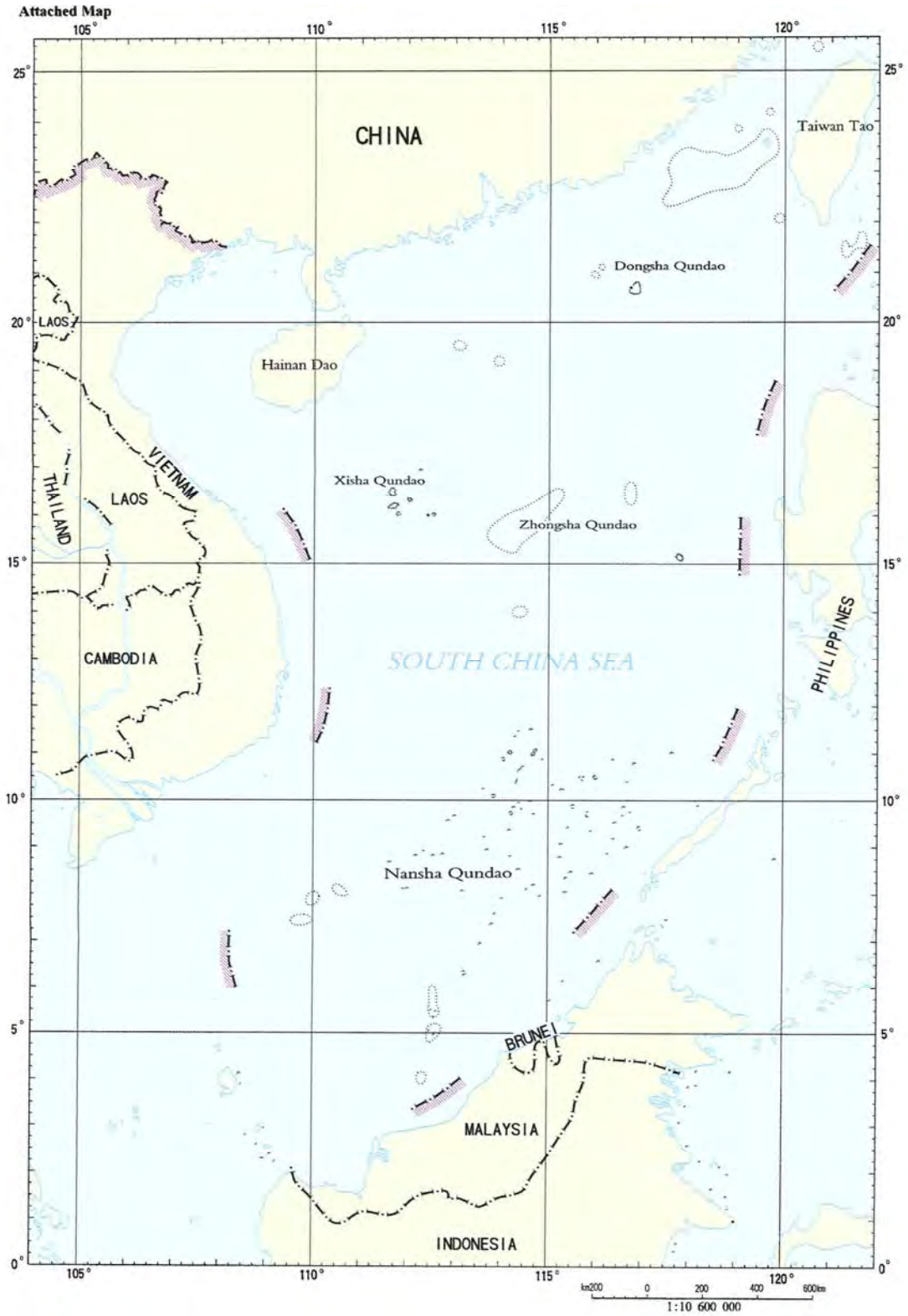


Figure 4.6: Chinese territorial claim in the South China Sea (SinoMaps Press)

The most important disputed island territories contained within the nine-dash line are: the Scarborough Shoal, and the Paracel and Spratly Islands, which are the two most important disputed island groups.[9] As a result of the fact that the nine-dash line also encompasses parts of the exclusive economic zones of Brunei, Indonesia, Malaysia, The Philippines, Singapore, Taiwan and Vietnam, it is also clear that there would be numerous shipping lanes, or sea lines of communication, that transit these contested sea areas. However, the most important cases involve disputed island groupings that sit on top of possible sizable undiscovered oil and gas deposits.

Scarborough Shoal

Located some 160km from The Philippines and 800km from China, they both claim the Scarborough Shoal (referred to as Huangyan Island by the Chinese). The matter worsened in April 2012 when Chinese forces took control over the Shoal following a three-month standoff with a Philippine coastguard vessel. In February 2015, The Philippines accused the Chinese coastguard of ramming Philippine fishing boats, and in April of the same year, a Chinese coastguard vessel used a water cannon on Philippine fishermen.[10] Whilst it is disputed as to whether the shoal area has substantive hydrocarbon deposits, it is a rich fishing ground and is located in between two major south-west/north-east sea lanes linking Singapore with mainland China, Republic of Korea, Japan, Taiwan and The Philippines. Put another way, the Chinese now have a military presence on the Shoal that straddles arguably the most strategically important sea lanes in East Asia. However, it worth noting that this is a just a modest presence and not a full-capable military base from which the Chinese navy and air force could launch large-scale joint operations.

Paracel Islands

The Paracel Islands are claimed by both China and Vietnam, and the dispute has become more inflammatory in recent years as oil drilling operations in contested waters have sparked far more serious confrontations between the two countries. China occupied the islands following a brief war with Vietnam in 1974. There are currently no proved and probable reserves in the Paracels, and available geologic data indicates there is not much in the way of potential in terms of conventional hydrocarbons. Nevertheless, as can be seen in the map at Figure 4.11, the island grouping is strategically located adjacent to a primary sea lane that links Singapore with Hong Kong. In July 2012, Vietnam passed a law demarcating maritime borders that included the Paracel and Spratly islands. In response, China announced the establishment of the prefecture-level city of Sansha to administer both island groups, which resulted in diplomatic protest from The Philippines and Vietnam.[11]

As with the Scarborough Shoal and the Spratly Islands, disputing countries tend now to utilise paramilitary maritime units such as coastguard and fishery protection vessels to demonstrate their resolve in claims over territory. However, the establishment of a Chinese garrison at Sansha on Woody Island is a sign that the utilisation of military units is also becoming a preferred means of Chinese power projection into the South China Sea.[12] In May 2014, a Chinese coastguard vessel rammed and sank a Vietnamese fishing boat during a tense stand-off at sea between the two nations over the positioning of the Chinese National Offshore Oil Company operated oil rig in the waters off the Paracel Islands.[13]

Spratly Islands

The Spratly Island group, which is spread across some 425,000km^2, is located to the east of the main south-west/north-east sea lane in the South China Sea (near to where it forks into northerly and north-easterly tracks). Aside from China, the Spratly Islands are also claimed in part by Brunei, Malaysia, The Philippines, Taiwan and Vietnam. All of these states have built airstrips on islands in sections they claim except Vietnam. Estimates indicate that up to $5 trillion worth of trade and 50 per cent of the world's very large crude carriers (lifting 25 per cent of all the crude oil traded by sea per year) pass through the sea lanes located to the northwest of the Spratlys each year.[14] The principal reason for provoking such rigorous effort by each of the state's claims over the islands stems from the possibility that substantial deposits of oil and gas lie in the geology beneath the islands and reefs. Estimates put forward by the Chinese National Offshore Oil Company indicate reserves in the South China Sea total some 125 billion barrels of oil and 500 trillion cubic feet of gas, of which large unspecified volumes could lie under the Spratly Islands.[15] More specifically, the US Geological Service estimates the Spratly Islands could contain between 0.8 and 5.4 billion barrels of oil and between 7.6 and 55.1 trillion cubic feet of natural gas in undiscovered reserves, which viewed on a global scale is not a particularly remarkable volume.

In March 1988, Chinese forces seized six islands in a section of the Spratlys claimed by Vietnam, which resulted in a naval engagement during which three Vietnamese vessels were sunk and 72 sailors killed.[16] This marked the first serious use of military power by China in its determination to claim the islands. Since this incident, there have been numerous serious skirmishes. More recently, in May 2011, Chinese patrol boats attacked two Vietnamese seismic survey vessels ships near the Spratly Islands, resulting in major damage to their streamer array.[17] One of the most recent examples of Chinese determination to press its claim on the islands by boosting its military and infrastructure presence occurred in April 2015 when satellite imagery revealed China was constructing at 10,000 ft (3048m) long military airstrip on Fiery Cross Reef, which is one of the closest substantial islands to the main south-west/north-east sea lanes.[18]

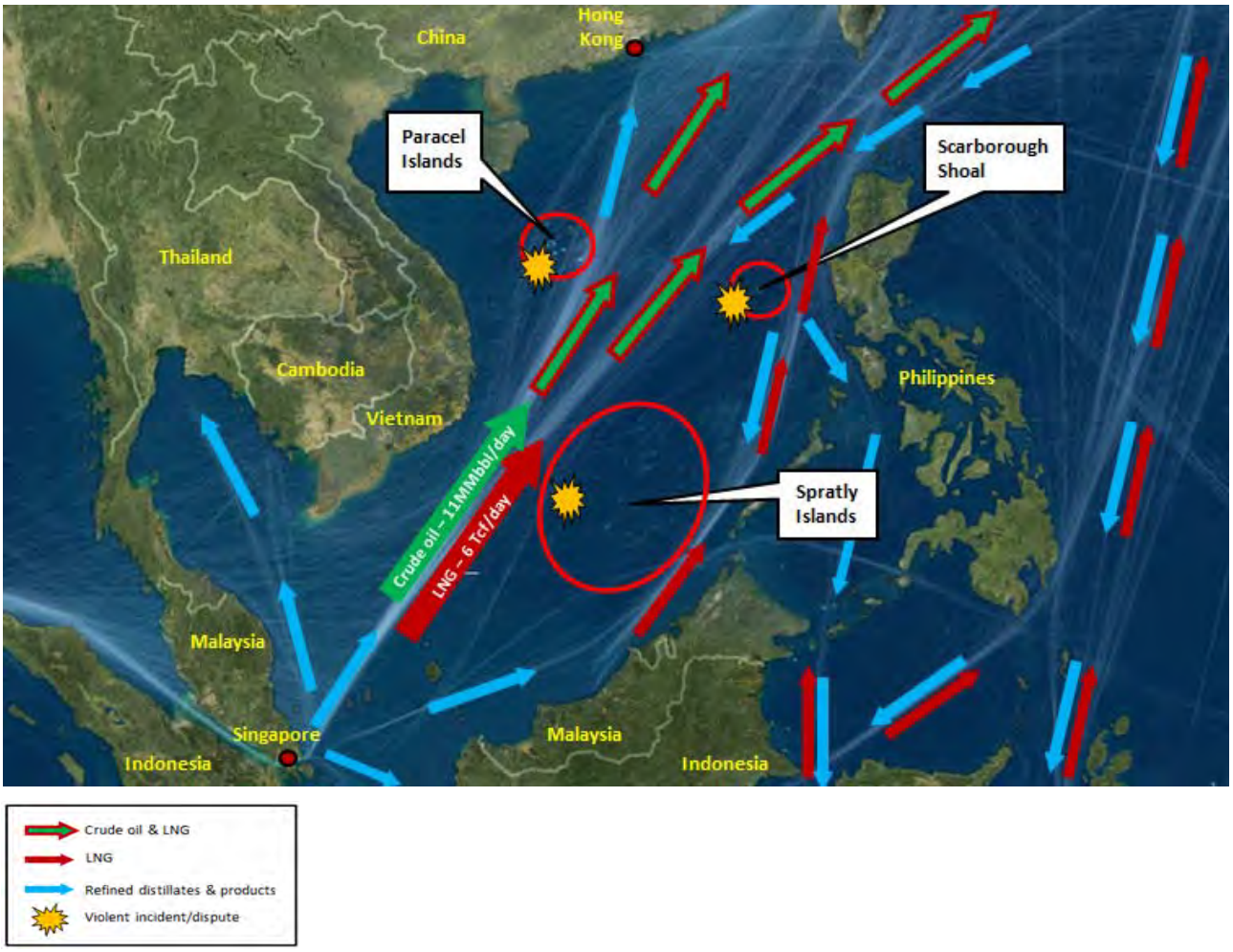


Figure 4.7: crude, LNG and refined product streams in the South China Sea (Herbert-Burns)

Assessing the likelihood for major conflict in the South China Sea

So what does all this really mean? Could this classic geopolitical issue evolve from being a flashpoint into a major regional conflict that could seriously disrupt direct and indirect supplies of petroleum and other maritime trade that Australia relies upon? There is no concise answer to this given the inherent challenges in accurately predicting how states will behave at the fine edge of a deepening crisis involving military operations. It would be irresponsible to say that there is no possibility of a major conflict in and over the South China Sea; however, it is plausible to judge the risks of one. One logical approach to this is to examine an escalation of the disputes between China and the other claimants in a cost/benefit context to measure the relative likelihood of armed conflict versus the maintenance of the status quo (even if a rather more febrile version of it).

The pessimistic view

Since the clashes between Chinese and Vietnamese vessels off the Paracel Islands in May 2014, there have been numerous media and journal articles speculating how existential tensions are now a clear indicator that a major crisis involving armed conflict is growing in likelihood, and for some commentators, all but inevitable. The common denominator in this view is that the fundamental problem is China, which now has developed naval power projection capability, is increasing its military/surveillance capacity on the disputed islands it has taken *de facto* control over, and is increasingly prepared to use force when pushed. Furthermore, some commentators question whether China has developed a sufficiently nuanced and flexible realpolitik capacity to enable the de-escalation tensions and posture in the way that the United States and the former Soviet Union managed in the Cold War. The most acute confrontations are between Vietnam and China and between The Philippines and China. It is the China-Philippines dispute that is judged to be the most likely to precipitate a military confrontation, though the time-scale is difficult to judge. One of the key features of this dispute is the Philippine view that the United States would have to come to their assistance militarily in the event of Chinese aggression due to the tenets of the *Mutual Defense Treaty between the United States and the Republic of The Philippines 1951*, which could broaden the conflict by drawing in the US into a naval engagement with China.[19]

However, it is far from clear whether the United States would rush to get involved in a dispute that it has officially not taken sides in. As a partial reflection of this, regional states are expanding and/or modernising their own naval and air forces in order to boost their military capabilities in the event they could not count on US kinetic support. Many countries, including Vietnam, Indonesia, Singapore, Malaysia and The Philippines are variously procuring frigates, patrol vessels, submarines and fighter aircraft. Collective spending by the aforementioned states is estimated to reach $40 billion by 2016, and the International Institute for Strategic Studies has stated that Asia's military spending is set to overtake Europe's.[20] Whilst some have likened this to a regional arms race, evidence indicates this is more a rational process of military modernisation as well as expansion during a time of economic prosperity in the region. Nevertheless, the message is clear, the bulk of the ASEAN member states have taken Chinese military expansion and territorial assertiveness seriously. Regardless of the military expansion programs undertaken by Vietnam and The Philippines, they are clearly no match for Chinese power. Nevertheless, on the verge of a war, the ability to inflict not insignificant damage upon Chinese naval units, could give China pause for thought and buy time before an anticipated US intervention.[21]

In this view, therefore, the conflation of existential disputes over territory, China's bellicosity and preparedness to use force, the positioning of military assets on key islands in the South China Sea, and the expansion in the numbers and capability of naval and air forces of states such as The Philippines and Vietnam has produced a combustible mix that presages an almost inevitable wider conflict. An interesting litmus test for this paradigm will be to see how China reacts to the initiation of a Philippines-contracted gas drilling operation by UK-based Forum Energy off the Reed Bank later in 2015; one of 15 exploration projects near Palawan Island planned by The Philippines government, which has declared Reed Bank a 'red line' in its stand-off with China.[22]

The realist view

As shown above, there is certainly a state of existential dispute between many of the riparian states in the South China Sea over the Paracel, Spratly and other island groups. Indeed, variously, the disputes between the states in the region have been ongoing since the early 1970s, and disagreements between China and former European powers over some of the islands date back to the 19th century. However, without wanting to diminish the seriousness of the limited mini-conflicts and skirmishes over the years in terms of loss of life and material, the disputes have not provoked a major war. There is an excellent reason for this: China does not seek a war with its Asian neighbours over the South China Sea, and the other riparian states certainly do not. Why? - because it is bad for business and trade. In a globalised world with deeply interdependent economies and

trade reciprocity, the need for unfettered navigation through major sea lanes is axiomatic. That is not to say the situation is straightforward or, by association, comfortably predictable.

Arguably the most responsible and balanced view of the situation is a classically realist view. China is a major world power, the regional hegemon, and a clear economic superpower. Its economy is the oxygen and engine of this power, and as such the government treats the security of the sea lines of communication and sea areas that enable imports of vital raw materials, exports of its manufactured goods and sources of energy with extreme gravitas. For this reason, it should be expected that it will engage robustly and sometimes quite aggressively to protect its interests and demonstrate its status to its neighbours. This is not something to be necessarily feared; but it is something that needs to be adapted to and monitored closely.

In his book, *Asia's Cauldron: The South China Sea and the End of a Stable Pacific*, Robert Kaplan argues that though China's government is authoritarian and sometimes brutal towards its own people, this does not necessarily extrapolate into it wanting to take control over all its surrounding maritime spaces militarily.

Indeed, he goes on to say that 'Though China seeks dominance, do not assume it will be unreasonable… There is nothing unusually aggressive about anything China is doing.'[23] Whilst I disagree with the 'about anything', his point has merit. The balance to this, regardless of any public statements, is that despite its increasing muscularity, China is the revisionist power and the United States remains for the time being the status quo power, and China knows this. Beijing is pragmatic and a realist, and is thus unlikely to risk its dependence on trade to fuel its economy and evolutionary power in a war that draws in the United States.

Contemporary Chinese regional diplomacy is sometimes seemingly bellicose and indicative of a zero-sum game, but in reality its posture is more nuanced and intelligent than that. It likes to probe for weakness and accommodation by its neighbours, but habitually tends not to force a situation that creates no room for elasticity, as evidenced by its withdrawal of the CNOOC oil rig from the Paracels in July 2014. Perhaps, thus, Kaplan has a point when he suggests that 'the struggle over the South China Sea is going to be detached and unemotional…The fact is East Asia is all about trade and business.'[24] In summary, the argument that there is unlikely to be a major conflict over the contested territory in the South China Sea is as follows:

- China likes to keep others off balance by provoking them, and then claiming that violent outcomes were caused by the irresponsible behaviour of others (such as Vietnam and The Philippines). China likes to probe, to make itself felt; but not to go too far.
- Fundamentally, China needs the sea lines of communication at least as much as all the other states in the region for unfettered trade, and for this regional peace and security at sea is the prerequisite.
- War is bad for trade and economic prosperity, which is fundamentally an interdependent phenomenon. By extension, it does not want to provoke more US involvement and force deployments to the area than it has already.
- Despite its claims, China too is not really certain as to the true extent of the reserves in disputed territory as it also has not conducted extensive surveying - because it cannot do so without provoking likely clashes. In other words, despite its shows of strength and determination, China also weighs up whether the Spratlys are really worth fighting over at the risk of disrupting far more important streams of oil and gas from the Middle East and LNG and other critical raw materials from Australia.

This paper argues in favour of the realist view, and judges that large scale war that would be inimical to flows of petroleum to and from Australia is unlikely. However, for the realist paradigm to work, it requires all other states, perhaps led by Australia, to remain extremely vigilant of Chinese posture, and to ensure that Beijing feels and sees the determination and tools of this vigilance. Regional states must show resolve through the maintenance of robust naval and air forces and regular patrols in areas of strategic importance, such as sea lines of communication. Where

necessary, coalitions are useful, but these must be formed and deployed judiciously to show determination but not provocation to others.

The Arabian Gulf

At the beginning of May 2015, Reuters reported that US Navy warships had begun escorting British and US-flagged merchant vessels through the Strait of Hormuz.[25] This initiative came in response to the detention of a container vessel, the MV *Maersk Tigris*, by Iranian Revolutionary Guard Navy (IRGCN) patrol boats on 27 April 2015 (the vessel was eventually released on 7 May 2015). Following a distress call sent out by the master of *Maersk Tigris* in which he said warning shots from the IRGCN vessels had been fired across his bow, USS *Farragut* was deployed to the location of the incident. Four days previously, IRGCN patrol craft had surrounded and then followed a US-flagged vessel, the *Maersk Kensington*, through the strait.[26] Though Iran has said that all of these actions were not politically motivated, the IRGCN has direct responsibility for projecting Iranian maritime capability in the Strait of Hormuz and the shipping lanes on either side of it, and the IRGC is nothing if not a quintessentially politically-directed branch of the Iranian armed forces.

These incidents occurred against the backdrop of multiple complex regional geopolitically-charged phenomena:

- the Saudi-led military operation to dilute the combat effectiveness and control of the Shia Houthi insurgents in Yemen, which is now firmly in the grip of a civil war
- persistent restive tensions between Shia and the Sunni leadership in Bahrain
- the assertion of authority of new leadership in Saudi Arabia; an ongoing insurgency in Iraq pitting the Sunni terrorist group ISIL against the Shia-dominated government
- the struggle to complete a deal between the P5+1 powers and the Iranian government that would end economic sanctions against Iran in exchange for monitored Iranian guarantees not to develop their nuclear technology beyond civil power generation capability.

As discussed in chapter three, oil originating in the Persian Gulf is crucial not only for direct imports of crude to Australian refineries, it is the dominant source for crude feedstock for the refineries in Singapore, Republic of Korea and Japan upon which Australia is now so dependent. Furthermore, potentially important future sources of large volumes of refined petroleum - India and Saudi Arabia - are by definition and trade, bound to the region. The security of petroleum flows from this space are directly threatened or secured by the fluxing and frequently brittle regional geopolitics as alluded to above. If the security in the Persian Gulf and Arabian Peninsula were to deteriorate to the point that shipping to and from the Gulf and within the Gulf of Oman became seriously disrupted, this would clearly have very serious implications for the crude and refined oil supplies for Australia. Whilst not wanting to diminish the potential strategic seriousness of such an eventuality, it is important to bear in mind that all of the wars, existential tensions, outside great power involvement, and ongoing territorial disputes since the 1970s have not resulted in a reduction of crude oil supplies to the extent that it has a major or protracted inimical effect on the global market. That being said, a brief capture of the drivers of ongoing geopolitical instability is important so as to gauge potential flashpoints and effects. This is set out in the box that follows.

Prime assumptions about systemic regional insecurity and geopolitics

- The three largest and most populous states - Iran, Saudi Arabia and Iraq - have long had aspirations to dominate the geopolitical and security fabric of the region.
- Iraq remains in the grip of a civil war that is characterised by the power struggle between Sunni, Shia and Kurdish sects, and the destructive effects of a highly organised terrorist organisation (ISIL) with geopolitical power aspirations.
- The five smallest states - Bahrain, Kuwait, Oman, Qatar and the UAE are not individually militarily strong enough to defend themselves without external allied assistance.
- Since the advent of oil-derived wealth, there has been a long-term process of major arms acquisitions by all of the states in the region, which fuels tensions.
- Given the existential strategic importance of the Gulf's petroleum reserves to the reset of the world and in particular the major powers, the prospect of meaningful demilitarisation of the region is very unlikely in the medium to long term.
- The ever deepening schism between the Sunni and Shia denominations in Islam are having an increasingly inimical impact upon existing tensions in Iraq, Yemen, Bahrain and Saudi Arabia.
- Long-standing unresolved territorial disputes, particularly between Iraq and Iran and between the UAE and Iran serve to amplify regional insecurity, and remain potential geopolitical flashpoints.

Tanker and oil flow insecurity in war

Despite the sobering list of regional problems and realities listed, in order to gain some moderating perspective on the effects of the most serious manifestation of regional geopolitical tension - a major inter-state war - upon the flow of petroleum from the Persian Gulf, the Iran-Iraq War (1980-88) is instructive. Crucially, notwithstanding the bitterness of the conflict and the widespread destruction on land, in the air and at sea, the impact upon the volume of oil exported from the Persian Gulf and the price of crude oil was surprisingly moderate, which is the key point to take away.

There is insufficient scope in this report to provide a detailed assessment of the effect of Iraqi and Iranian attacks upon tankers and the compound impact upon the supply of crude from the Persian Gulf to the world market, nor is it warranted. However, a few key outcomes are worthy of note for their value as indicators for the capacity of possible future wars in the Indo-Pacific region to disrupt the conveyance of oil and gas by sea.

- Large tankers are highly vulnerable to attacks from the air; however, they are not easy to sink and completely destroy.
- Escorting of tankers in convoy by warships can provide effective protection in increasing the chances of survivability; however, groups of tankers in confined waters with limited freedom to manoeuvre are easier to target from the air and harass from the surface.
- The targeting of tankers whilst loading at a terminal is far more effective in terms of compound destructive effect.
- The sinking or constructive total loss of 55 tankers (including a substantial number of very large crude carriers) during the course of the war amidst over 540 separate attacks on vessels had little impact upon the supply of oil to the global market or spot prices during the crude oil glut of the 1980s. However, had the supply demand balance been tight as it was in the early part of the 21st century, a similar campaign against tankers and loading terminals fought in a future period of limited volumes of crude or refined products would likely have considerably greater impact upon available export supplies, and particularly upon pricing.
- In a conflict space where both or all protagonists rely equally upon the free navigation of the same shipping lanes and chokepoints, the vulnerability of these features to compromise or attack by one actor is greatly diminished.

- Destroying or disrupting the production and means of export of crude oil from the Persian Gulf was the primary focus and means of imposing operational and strategic effect by the protagonists. Consequently (though the broader effects were not really felt by those outside the region for much of the war), given the strategic and geopolitical nature of the commodity in question, it was inevitable that outside powers would eventually become politically and militarily involved in the event the war's effect on the security of tankers was unacceptably prolonged. Though the relative strategic importance of the Persian Gulf will moderate in the future as oil supplies from the United States, Africa and Eurasia increase, a future general war in Southwest Asia would very likely precipitate external military involvement to ensure supply and protect against price increases.

Outlook

By way of considering divergent possible outcomes and their effects upon the security of the region and by extension the security of petroleum exports from the major producers to Asia and Australia, it is perhaps instructive to game three possible futures - the pessimistic, the optimistic and the realist status quo.

Pessimistic

- Deepening schism between Shia and Sunni denominations leads to a growing rift between Iran and Saudi Arabia, and exacerbates internal tensions in Iraq, Saudi Arabia, Bahrain and Yemen
- Iran and the P5+1 powers are unable to agree on a final solution to end sanctions against Iran, and tensions deepen into 2016 and beyond with the potential for maritime/naval clashes
- Geopolitical tensions between Iran and the UAE over Tunb Islands and Abu Musa boil over and lead to military clashes between Iran and elements of the Gulf Cooperation Council (GCC); this threatens the security of the shipping lanes in the south-eastern reaches of the Gulf and the intervention of outside powers to restore maritime security
- Iraqi government forces are unable to suppress ISIL, which leads to extended civil conflict and the potential for the increasing destabilising effect of IRGC interference inside Iraq

Optimistic

- Following the lifting of sanctions, Iran comes into the fold and becomes a progressive and positive contributor to ensure regional stability that also helps dilute the cleavage between Shias and Sunnis in the region
- ISIL is neutralised in Iraq and Syria, an accord is cemented between the Iraqi government and the Kurdish and Sunni sects, which allows the ending of the civil war and a return to peace
- Outstanding territorial disputes in the Gulf are gradually resolved with the assistance of international arbitration
- The security of maritime trade and other commerce is ensured through intra-regional confidence building measures and improved diplomatic relations between Iran and the GCC states

Realist status quo

This is the scenario assessed as more probable for the medium to long-term outlook.

- A deal is solidified between Iran and P5+1 powers resulting in a lifting of sanctions and the revitalisation of the Iranian economy and its petroleum exports; however, tensions remain due to the effects of internal power struggles
- Saudi Arabia becomes more proactive as a shaper of regional security and Arab power assertion
- Iraq stabilises but after extended struggle with ISIL and brittle accord with the Kurds; Iraqi oil production and export capacity flourishes
- Shia-Sunni tensions flux commensurately with the behaviour of leadership in Iran, Saudi Arabia and Iraq; leading to periodic domestic sectarian violence
- Security and prosperity of oil industry, shipping and commerce is ensured by the balance of power between Iran and Saudi Arabia and the presence of external power military units

Sea Lines of Communication Routeing Security Risk

At the end of each of the sections in this chapter pertaining to the primary maritime security threats and the sections examining the two notable regions that give rise to geopolitical risk for their potential to disrupt petroleum flows along vital sea lines of communication, qualitative summations and conclusions have been given. Whilst transforming qualitative security risk assessments into quantitative risk metrics is not straightforward and the process is vulnerable to subjectivity (as with the risk processes undertaken in the previous chapter), there is some value to scoring these phenomena to gain comparative context. The methodological approach used in the table below is similar to the approach employed in Chapter Three.

Sea Lines of Communication	Maritime security risk	Mean political risk of source	Regional geopolitical risk	Pol/sec risk score	Final SLOC security risk category
Persian Gulf to Singapore [Crude]	3	3	3	9	**Elevated**
Persian Gulf/Arabian Sea (India) to West Australia/South Australia [Crude/Products]	3	3	3	9	**Elevated**
Gulf of Guinea to West Australia/South Australia [Crude]	3	5	1	9	**Elevated**
Singapore to NE Asia [Crude & refined products]	3	2	3	8	**Elevated**
Singapore to West Australia/South Australia [Refined products]	3	2	2	7	**Moderate**
Singapore to East Australia [Refined products]	3	2	2	7	**Moderate**
West Australia – NE Asia [LNG]	3	1	3	7	**Moderate**
NE Asia to East Australia/South Australia [Refined products]	2	1	1	4	**Low**

Table 4.2: sea lines of communication routeing security risk

Using the risk drivers of piracy attacks and hijacking against merchant shipping in the Gulf of Guinea, northern Indian Ocean and Southeast Asia, maritime terrorism, political risk, and the existential or intrinsic geopolitical risk in the South China Sea and the Persian Gulf, Table 4.2 reveals which of the most important sea lines of communication for Australian imports of petroleum carry the most security risk.

What is immediately apparent is than none of them are high risk. This is due to the fact that whilst there are certainly concerns with regards to maritime security threats, they do not constitute a strategic level threat to petroleum or other shipping. Separately, though the Persian Gulf and South China Sea regions represent the regions of greatest geopolitical concern in the Indo-Pacific, it is the judgment of this report that their existential levels of geopolitical risk do not currently present a strategic-level disruptive threat to the imports and exports of petroleum within the Indo-Pacific. For this level of threat to become manifest, the regional geopolitical tensions would need to transition to interstate war where merchant shipping and in particular, very large crude carriers, product tankers and gas carriers were deemed a strategic target by the protagonists.

The results derived in Table 4.2 should be used in conjunction with the risk assessment outcomes provided in the preceding chapter to gain a compound perspective on petroleum source and supply route risks as it pertains to Australia's imports of crude oil and refined petroleum products from and within the Indo-Pacific.

Endnotes

[1] I have also included Egypt and the Persian Gulf shipping lanes and the Strait of Hormuz as areas that are also of interest.
[2] Lloyd's Market Association, *Joint War Committee Hull War, Piracy, Terrorism, and Related Perils Listed Areas*, 12 June 2013, www.lmalloyds.com/LMA/Underwriting/Marine/Joint_War_Committee/Web/market_places/marine/JWC/Joint_War.aspx.
[3] International Maritime Bureau, *Piracy and Armed Robbery Against Ships, Report for the Period 1 January - 31 December 2014*.
[4] International Maritime Bureau, *Piracy and Armed Robbery Against Ships, Report for the Period 1 January - 31 December 2014*.
[5] ReCAAP ISC, *Annual Report 1st January - 31st December 2014, Piracy and Armed Robbery Against Ships in Asia*.
[6] International Maritime Bureau, *Piracy and Armed Robbery Against Ships, Report for the Period 1 January - 31 December 2014*.
[7] David Lague, 'Analysis: China's nine-dash line in the South China Sea', *Reuters*, 25 May 2012, www.reuters.com/article/2012/05/25/us-china-sea-boundary-idUSBRE84O07520120525.
[8] Lague, 'Analysis: China's nine-dash line in the South China Sea'.
[9] Lague, 'Analysis: China's nine-dash line in the South China Sea'.
[10] Manuel Mogato, 'Philippines says Chinese ship rammed fishing boats in Scarborough Shoal'; *Reuters*, 4 February 2015, www.reuters.com/article/2015/02/04/us-philippines-china-idUSKBN0L81IM20150204.
[11] Austin Ramzy, 'China's Newest City Raises Threat of Conflict in South China Sea', *Time*, 24 July 2012, http://world.time.com/2012/07/24/chinas-newest-city-raises-threat-of-conflict-in-the-south-china-sea/.
[12] Ramzy, 'China's Newest City Raises Threat of Conflict in South China Sea'.
[13] 'Vietnam boat sinks after collision with Chinese vessel', *BBC News*, 27 May 2014, www.bbc.co.uk/news/world-asia-27583564.
[14] Lague, 'Analysis: China's nine-dash line in the South China Sea'.
[15] Colin Chilcoat, 'China strengthening claim to South China Sea oil and gas', *OilPrice.com*, 25 November 2014, http://oilprice.com/Energy/Energy-General/China-Strengthening-Claim-To-South-China-Sea-Oil-And-Gas.html.
[16] Michael T Klare, *Resource Wars: The New Landscape of Global Conflict*, Owl Books, 2001, pp. 122-123.
[17] Ben Bland and Katherin Hille, Vietnam and China Oil Clashes Intensify, *Financial Times*, 29 May 2011, www.ft.com/cms/s/0/4d3badc0-8867-11e0-a1c3-00144feabdc0.html#axzz3Y3NZHa8a.
[18] 'Vietnam boat sinks after collision with Chinese vessel'.
[19] Bonnie S Glaser, *Armed Clash in the South China Sea: Contingency Planning Memorandum No. 14*, Center for Strategic and International Studies, Washington DC, April 2012, www.cfr.org/world/armed-clash-south-china-sea/p27883.
[20] 'Shopping spree: Countries are buying lots of weapons, but does it count as an arms race?', *The Economist*, 24 March 2012, www.economist.com/node/21551056.
[21] 'Shopping spree: Countries are buying lots of weapons, but does it count as an arms race?'.
[22] Glaser, *Armed Clash in the South China Sea: Contingency Planning Memorandum No. 14*.
[23] Robert D Kaplan, *Asia's Cauldron: The South China Sea and the End of a Stable Pacific*, Random House, 2014.
[24] Kaplan, *Asia's Cauldron: The South China Sea and the End of a Stable Pacific*.
[25] David Alexander and Phil Stewrat, 'US warships accompany British commercial vessels in Strait - Pentagon', *Reuters*, 4 May 2015, http://uk.reuters.com/article/2015/05/04/uk-iran-usa-ship-britain-idUKKBN0NP1HK20150504.
[26] Noah Browning and David Alexander, 'Iranian Revolutionary Guards seize cargo ship in Gulf', *Reuters*, 28 April 2015, http://uk.reuters.com/article/2015/04/28/uk-iran-usa-ship-idUKKBN0NJ1QZ20150428.

Chapter 5: Key Findings and Recommendations

By way of conclusion, the following is a consolidation and summary of the key findings within the three core chapters of this report - refining sector status, import infrastructure and oil storage and stock endurance; sources of Australia's crude oil and refined petroleum imports; and, crude and refined petroleum trade security in the Indo-Pacific region.

Key Findings

Refining, storage and oil stocks

- In 2000, there were eight refineries in Australia with an aggregate refining throughput capacity of 884,000 bbl/day. At that time, Australia imported just 5 per cent of its refined fuel requirements. The closure of Bulwer Island in 2015 reduced the country's refining capacity to 447,000 bbl/day; or some 50.57 per cent of its total capacity in 2000.
- If Australia's refining capacity continues to decline past the point where the country could no longer refine sufficient volumes of fuels to maintain emergency services, support military operations and underpin vital transportation infrastructure, this would represent a strategic energy security concern for the country.
- In 2015, Australia's daily oil consumption will be approximately 1.144 million bbl/day, which equates to some 181.88 megalitres. For the country to have sufficient storage for the IEA mandated 90-days would require stocks of some 16,369.2 megalitres. The most recently available IEA figures indicate Australia has 52 days of stockpiled oils (and some officials have stated this could actually be as low as 34 days), which amounts to 9458 and 6184 megalitres respectively. If we take the IEA estimated stocks of 52 days, this leaves Australia with a shortfall in recommended oil stocks of some 42 per cent.

Crude oil and refined petroleum imports

- From 2007 to 2014, Australia sourced an average of 72.5 per cent (almost three quarters) of its crude oil from just six countries. In descending order of supply volume, these are: Malaysia, Vietnam, the United Arab Emirates, Indonesia, New Zealand and Nigeria. The next 25 per cent of Australia's crude was sourced variously from: Algeria, Azerbaijan, Brunei, China, Gabon, Libya, Papua New Guinea, The Philippines, the Republic of Congo, Russia, Saudi Arabia, Singapore and Thailand.
- Singapore remains the most important single source of refined fuel imports - supplying some 62 per cent of all of Australia's requirements. Republic of Korea and Japan are the next two largest sources. In total, the three countries supply 89 per cent of Australia's refined petroleum imports.
- Singapore, Republic of Korea and Japan are heavily dependent on the main producers in the Persian Gulf for their crude oil imports. They are dependent upon Saudi Arabia, Qatar, Kuwait, Iran, Iraq, Oman and the UAE for almost 81 per cent of their crude oil. Thus, indirectly, Australia is similarly dependent on these sources.

Petroleum trade security in the Indo-Pacific region

Terrorist threat summary:

- Terrorist groups with maritime attack operations capability: Al Qaeda in the Arabian Peninsula; Abdullah Azzam Brigades; Ansar Bayt al Maqdis; and, Lashkar-e-Tayyiba.
- Possible targeting areas: Persian Gulf/Strait of Hormuz/Gulf of Oman; northern Arabian Sea; Suez Canal/Eastern Mediterranean/Gulf of Suez; and, the Gulf of Aden/Bab el Mandeb.
- Oil industry (maritime area) targets attacked in the past: tankers; coastal oil terminals; offshore export terminals; and, oil platforms & floating production, storage & offloading units [Nigerian militants/extremists].
- Means of attack: stand-off weaponry (RPG and mortar); armed assault and various IED.

Fundamentally, though the threat posed by maritime capable terrorist groups certainly exists, thus necessitating continuous threat vigilance, it is low and the impact of a more likely low-consequence attack would not pose a major strategic-level threat to the petroleum flows in the Indo-Pacific region.

Piracy, hijacking and armed robbery at sea

Viewed in comparative terms, the risk to petroleum shipments originating in the Persian Gulf, Africa and Europe bound for Australian terminals has decreased commensurately with the diminished threat from Somali piracy in the northern Indian Ocean. However, the hijack threat to tankers in Southeast Asia that may be bound for Australia, or have originated at an Australian terminal, has increased since 2011, and that trend has continued into 2015.

Security risk assessment

Using the risk drivers of piracy in the Gulf of Guinea, northern Indian Ocean and Southeast Asia, maritime terrorism, oil source-country political risk, and the existential (or intrinsic) geopolitical risk in the South China Sea and the Persian Gulf, quantitative risk calculations indicate that collectively these factors do not currently constitute a strategic-level threat to petroleum industry shipping and sea lines of communication upon which Australian energy security depends.

Recommendations

The following is a list of recommendations intended only as initiators for debate and considered action that might be included in the wider and ongoing process of assessing and ensuring Australia's petroleum energy security into the future.

- Consider whether there is sufficient political support to ensure Australia does not lose all of its domestic refining capacity. Encourage the configuration of enough of the remaining capacity to be able to refine Australia's own crude into essential levels of petrol, diesel, jet and vital fuels required by the military.
- Examine the viability of a public-private initiative to expand the aggregate national land-based oil storage to enable Australia to maintain at least 90-days of oil stocks as mandated by the International Energy Agency. Monitor these stock requirements juxtaposed against future national oil demand increases.
- In order to de-risk the possibility of a future supply disruption, encourage importers of crude oil to explore options for greater diversification of sources, whilst encouraging more balanced volumes of lifted imports from the current source range.
- As part of a risk reduction strategy, encourage importers of refined petroleum fuels and products, in particular petrol, diesel and jet, to ensure greater diversification of sources. As part of a future diversification process, examine options to import greater volumes of refined petroleum from the United States, Saudi Arabia and India.
- Maintain, and if necessary, boost intelligence gathering capacity regarding maritime security threats in the Indo-Pacific, with emphasis on organised criminal networks in Asia that are driving laden product tanker hijackings and illicit ship-to-ship operations in the South China Sea, and the maritime terrorist capability of Lashkar-e-Tayyiba.
- Enhance maritime domain awareness within the Indo-Pacific to monitor the positions and tracks of vital petroleum shipping (very large crude carriers, product tankers, LNG and LPG carriers) to and from Australia.
- Study the naval force and logistics support requirements for simultaneous contributions to coalition maritime security operations in the Arabian Sea and the South China Sea.
- Monitor and assess the geopolitical ontologies in the South China Sea and the Persian Gulf/Arabian Peninsula/Gulf of Oman for their respective impacts upon the security of maritime trade in those spaces.

Disclaimer

Soundings papers are presented by the Sea Power Centre - Australia for the purposes of disseminating information for the benefit of the public. The content and views expressed in Soundings papers are the author's own, and are not in any way endorsed by or reflect the views of the Department of Defence.

About the Sea Power Centre - Australia

The Sea Power Centre - Australia was established to undertake activities to promote the study, discussion and awareness of naval strategy, doctrine, history and maritime issues within the Royal Australian Navy, the Department of Defence and the wider community. Its mission is:

- to promote understanding of sea power and its application to the security of Australia's national interests
- to manage the development of RAN doctrine and facilitate its incorporation into ADF doctrine
- to contribute to regional engagement
- to contribute to the development of maritime strategic concepts, and strategic and operational level doctrine, and facilitate informed force structure decisions
- to preserve, develop and promote Australian naval history.

Comments on this Soundings paper may be directed to:

Director
Sea Power Centre - Australia
Department of Defence
PO Box 7942
Canberra BC ACT 2610
AUSTRALIA

Email: seapower.centre@defence.gov.au
Website: www.navy.gov.au/spc

SOUNDINGS