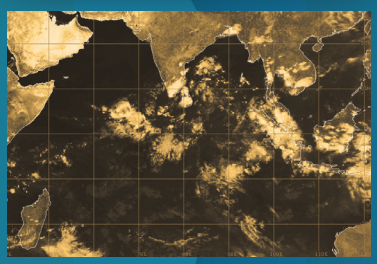

STIMSON

Indian Ocean Rising:

Maritime Security and Policy Challenges

Edited by **David Michel**
and **Russell Sticklor**

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Glossary

AAB . . . . . Abdullah Azzam Brigades
ABOT . . . . . Al Basra Oil Terminal
AMISOM . . . . . African Union Mission in Somalia
APEC . . . . . Asia-Pacific Economic Cooperation
APFIC . . . . . Asia-Pacific Fishery Commission
ASEAN . . . . . Association of Southeast Asian Nations
ATS . . . . . Amphetamine-type stimulants
AQ-AP . . . . . Al-Qaeda in the Arabian Peninsula
AQ-I . . . . . Al-Qaeda in Iraq
ArBL . . . . . Archipelagic base lines
BAB . . . . . Bab al-Mandeb
BIOT . . . . . British Indian Ocean Territory
BMP-4 . . . . . Best Management Practices Version 4
BOBP-IGO . . . . Bay of Bengal Programs Intergovernmental Organization
CBMs . . . . . Confidence-building measures
CENTCOM . . . . United States Central Command
CS . . . . . Continental shelf
CTF-151 . . . . . Combined Task Force 151
EEZ . . . . . Exclusive economic zone
EIA . . . . . Energy Information Administration (US)
E&P . . . . . Exploration and production
ESMR . . . . . Evolving strategic maritime regions
EU NAVFOR . . . European Union Naval Task Force
FAO . . . . . Food and Agriculture Organization
FDI . . . . . Foreign direct investment
FPDA . . . . . Five Power Defense Agreement
FSDS . . . . . Far Sea Defense Strategy
GCC . . . . . Gulf Cooperation Council
HMG . . . . . Heavy machine gun
HRA . . . . . High risk area
ICZM . . . . . Integrated coastal zone management
IMO . . . . . International Maritime Organization
IOC . . . . . International oil company
IOR . . . . . Indian Ocean Region

IRGCN . . . . . Iranian Revolutionary Guard Corps Navy
IRTC . . . . . Internationally Recognized Transit Corridor
ISA . . . . . International Seabed Authority
IUU . . . . . Illegal, unregulated, unreported
IWRM . . . . . Integrated water resources management
LNG . . . . . Liquid natural gas
LOS . . . . . Law of the Sea (also see UNCLOS)
MBD . . . . . Million barrels per day
MCEs . . . . . Maritime centers of excellence
MDA . . . . . Maritime domain awareness
MPA . . . . . Maritime patrol aircraft
MSC-HOA . . . . . Maritime Security Center – Horn of Africa
MSO . . . . . Maritime security operations
NATO . . . . . North Atlantic Treaty Organization
NOC . . . . . National oil company
P&I . . . . . Protection and Indemnity
PAG . . . . . Piracy attack groups
PCASP . . . . . Privately contracted armed security personnel
PLAN . . . . . People's Liberation Army Navy (China)
PMSC . . . . . Private military security company
SALW . . . . . Small arms and light weapons
SIOFA . . . . . South Indian Ocean Fisheries Agreement
SNMG . . . . . Standing Naval Maritime Group
SOH . . . . . Strait of Hormuz
SOLAS . . . . . Convention on Safety of Life at Sea
SPM . . . . . Single point mooring
SSBN . . . . . Ballistic missile submarines
STS . . . . . Ship-to-ship transfer
SUA . . . . . Suppression of Unlawful Acts
SWIOFC . . . . . Southwest Indian Ocean Fisheries Commission
TFG . . . . . Transitional federal government
TS . . . . . Territorial sea
TSA . . . . . Technical sharing agreement
UAV . . . . . Unmanned aerial vehicle
UKMTO . . . . . United Kingdom Maritime Trade Operations
UNCLOS . . . . . United Nations Convention on the Law of the Sea
UNEP . . . . . United Nations Environment Programme
WBIED . . . . . Water-borne implemented explosive device
VBSS . . . . . Vessel boarding, search, and seizure
VLCC . . . . . Very-large crude carrier

Chapter Six

Energy in the Indian Ocean Region: Vital Features and New Frontiers

Rupert Herbert-Burns

Regardless of the specificity of prevailing consumption trends, key importers and exporters of petroleum and natural gas are not only bound together within the global petroleum market; but are also very sensitive to the dynamics and productivity of the major sectors of the industry—*upstream*, *midstream,* and *downstream*. Within the Indian Ocean Region (IOR), the vital components of the three sectors are represented respectively by: the existing primary and evolving secondary locations of oil and gas production; the transportation of crude, refined products, and liquefied gases via sea lines of communication (SLOCs) and pipelines; and the primary refining, storage, and re-distribution nodes that are vital to the region's economic productivity, particularly that of the developing states.

Following an initial section that summarizes the state of oil and gas reserves in the IOR in order to reaffirm their global strategic value, the purpose of this chapter is to offer a series of examples of key evolving industry activity within the region, highlighting the huge impact of petroleum as a defining politico-economic driver for the wider Indo-Pacific maritime realm. These cases will be drawn from three major industry sectors as indicated above.

In the *upstream* sector, examinations will be made of: the planned expansion of oil production in Iraq and the evolution of Basra as a major regional petroleum exporting node; the addition of significant upward revisions of Iraqi and Iranian 'proven' reserves; exploration and production in the Timor Sea; and Chinese and Indian competition over Myanmar's offshore gas fields.

The *midstream* sector will assess the status and significance of primary export terminals in the Persian Gulf, amidst extant security issues regarding these facilities and petroleum shipping in the region. It will also examine the strategic impact of the planned crude oil pipeline across the United Arab Emirates from Habshan to Fujairah, which offers an export alternative to tanker shipments through the Strait of Hormuz.

In the *downstream* sector, an examination of the current and future regional importance of Singapore as a *petroleum gateway* will be given, amidst the possible implications of the potential development of the Kra Isthmus Canal, which would effectively constitute a 'Malacca bypass' for petroleum trade from the Indian Ocean to the Pacific.

The chapter concludes with an outlook for the petroleum industry activity in the IOR out to 2030.

Figure 6.1: Proven Oil and Natural Gas Reserves in the Indian Ocean Region

Country	Oil [BBL]	Percent of global total	Gas (TCM)	Percent of global total
Saudi Arabia	688.9	19.8	7.46	3.92
Iran	137.6	10.3	29.6	15.57
Iraq	115.0	8.6	3.17	1.67
Kuwait	104.0	7.6	1.79	0.95
UAE	97.8	7.3	6.07	3.19
Qatar	25.4	2.0	25.47	13.39
Sudan	6.8	0.5	0.85	0.04
India	5.8	0.5	1.07	0.57
Oman	5.5	0.4	0.85	0.45
Malaysia	5.5	0.4	2.35	1.24
Egypt	4.3	0.3	1.66	0.87
Australia	4.2	0.3	3.12	1.64
Indonesia	4.05	0.3	3.00	1.58
Yemen	3.00	0.2	0.48	0.25
Timor-Leste	0.55		0.20	0.11
Pakistan	0.44		0.84	0.44
Thailand	0.43		0.342	0.18
Bahrain	0.12		0.09	0.05
Myanmar	0.05		0.28	0.15
Bangladesh	0.02		0.12	0.1
South Africa	0.015		0.002	0
Israel	0.001		0.03	0.02
Jordan	0.001		0.006	0
Tanzania	0		0.0065	0
Somalia	0		0.0056	0

Key states with significant reserves of oil and/or gas are marked in red, while those with important reserves are marked in orange.

Source: BP Statistical Review of World Energy, June 2011

Petroleum Reserves in the IOR

Petroleum exists in abundance in the IOR. Crude oil and natural gas remain unquestionably the most important raw material exports from the region. In short, the global economy would not function without them. Much has been written on the nature and productivity of the largest reserves, and thus supplemental commentary and analysis here is not required; however, Figure 6.1 provides a capture of the state of proven reserves of oil and natural gas in the IOR.

When viewed in an aggregated sense, the total oil and gas reserves held by IOR states as a percentage of the entire world's proven reserves are impressive: IOR states have more than 58 percent of the world's proven reserves and more than 46 percent of gas reserves. When one considers these facts and the inescapable importance of the SLOCs in the Indian Ocean connecting Asia, Europe, and Africa for the conveyance of petroleum, the significance of the IOR to the rest of the world is startling.

Upstream Sector

Expansion of Iraq's Crude Oil Production

In October 2011, the Iraqi oil ministry stated that the country crude oil output would reach 3-million barrels per day by the end of the year. This increase would enable Iraq to boost its exports to some 2.5-million barrels per day by the beginning of 2012, in line with its project to expand the handling capacity of its offshore loading terminals ABOOT and KHAOT. Essentially, this development would mark the first of many milestones in the country's long-term plan to massively increase crude production to 12-million barrels per day by 2017. This overly optimistic target is very unlikely to be attained, however, and more sober predictions suggest total volumes of nearer 8-million barrels might be achievable in the early part of the next decade. Nevertheless, the scale of the project has attracted many of the world's most important international and national oil companies.

The entire future of Iraq's petroleum politics hangs on the successful adoption of the Iraq Hydrocarbon Law, a proposed piece of legislation submitted to the Iraqi Council of Representatives in May 2007. The law confers authority on the government to distribute remaining oil revenues throughout the country on a per-capita basis, and would enable the provinces freedom to award production contracts to foreign companies without central government involvement.[1] Since its introduction, however, the legislation has been mired in disagreement over the ability of the three main segments of Iraq's population—Sunnis, Shiites, and Kurds—to negotiate contracts autonomously and decide upon an equitable distribution of revenue.

Interim Technical Sharing Agreements (TSAs): Paving the Way to Greater Production Volumes

At the end of 2010, the Iraqi government had awarded 12 oil-service contract TSAs and three gas licenses as part of its extended plan to boost production. Of these, the most significant deal involves a joint BP-CNPC project to boost capacity from the giant Rumaila field to 2.85-million barrels a day from its current level of 1.07-million barrels a day.[2] BP has said

Rumaila may become the world's second- largest producing field by 2015, which will likely transform Basra into one of the most important petroleum production and export nodes in the Persian Gulf. Indeed, once production has been boosted across all of the other major fields in southern Iraq (such as the West Qurna-1), Basra, and the associated production and expanded oil- and gas-exporting infrastructure will likely constitute a major new 'petroleum gateway' in the Middle East.

The other major project being headed by foreign companies is the ExxonMobil/Shell-led partnership to develop the West Qurna-1 oil field, also in the south of the country. ExxonMobil and Shell initially didn't secure the deal earlier in June 2009 because they rejected the maximum production remuneration fee of $1.90 a barrel set by the oil ministry. However, in October 2009, ExxonMobil and Shell, along with Lukoil and CNPC, capitulated and accepted the offer, calculating that to be involved even under these disadvantaged terms was better than having no access at all to this major Iraqi reserve. The consortium has announced that it will raise production to 2.325 million barrels a day in seven years from the current 270,000 barrels per day.

Expansion of Iraqi and Iranian Reserves

In October 2010, Iraq's oil minister, Hussain al-Shahristani, announced that the country's proven "extractable" oil reserves had risen to more than 143-billion barrels,[3] representing a significant rise on Iraq's previously stated reserves of 115-billion barrels, a figure that had been consistent for nine years. Perhaps not surprisingly, in the same month the Iranian oil minister, Masoud Mirkazemi, announced that because of the discovery of a new oil layer containing approximately 34-billion barrels of oil in the Ferdowsi gas field in the Persian Gulf, the country's proven oil reserves had now increased to 150.31-billion barrels.[4]

Iraq's action was intended largely to send a signal to the rest of OPEC that Iraq would need a greatly expanded daily quota, in line with the country's project to greatly expand the country's production through the revitalization of its major oil fields in partnership with outside international oil companies (IOCs) and national oil companies (NOCs) through to 2016. Iraq has been exempt from OPEC's quota protocols since Saddam Hussein's invasion of Kuwait in 1990. However, this situation would inevitably become untenable in the event its output grew discernibly above its current level to the level where output volumes could depress prices. OPEC's secretary general, Mr. Badri, stated that an Iraqi production of 4- to 5-million barrels per day would "trigger that discussion of how to accommodate them in any future quota agreement".[5] This is precisely the kind of statement that the Iraqi government wanted to hear, as it reflected a renewed recognition of Iraq's geopolitical petroleum status as a top world reserve-holder and producer.

Given the international pressure that Iran is under due to sanctions and its stand-off with Western powers over its nuclear program, a reciprocal announcement was almost inevitable.[6] This utilization of the political value of a state's oil reserves is a shining example of how a government can convert the latent geopolitical value of 'new' expanded reserves (that might not be in production) into usable geopolitical influence. The effects of this can be seen at an inter-state level—in Iran's long-term brittle, competitive relationship with

Iraq—and at a multilateral level, where Iran must assert itself sufficiently within OPEC to ensure its continued influence among other major producers.

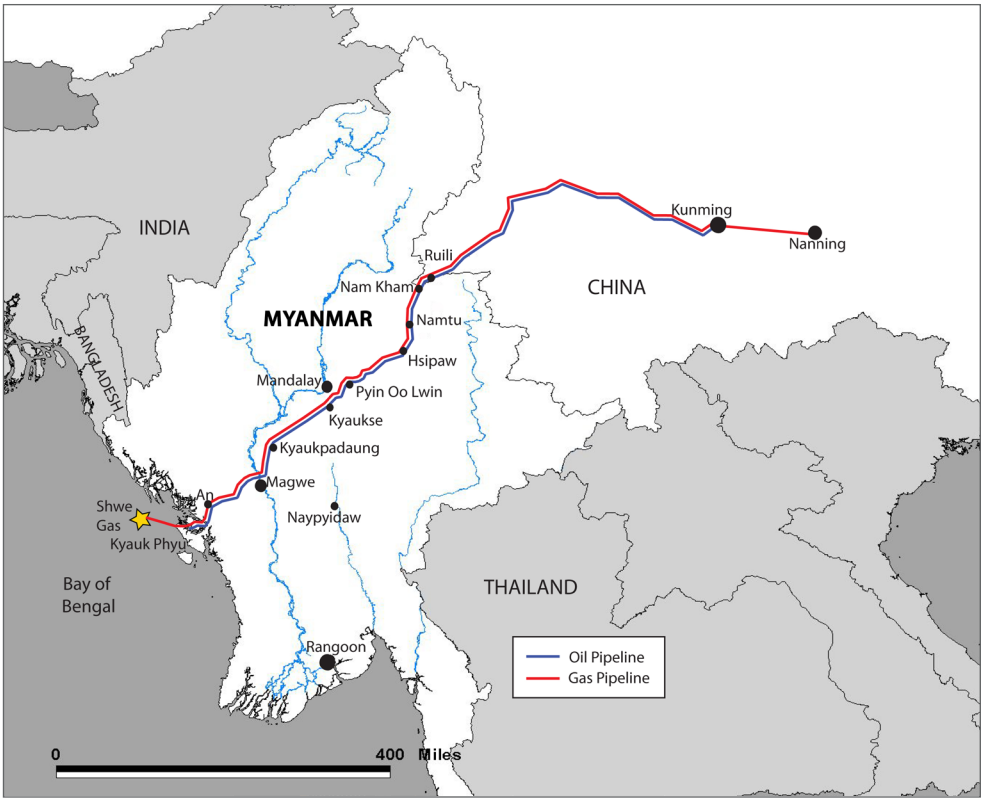
Exploration and Production in the Timor Sea

The seabed beneath the Timor Sea, which lies adjacent to the Arafura Sea between East Timor and northern Australia, contains substantial petroleum reserves. Between them, Blacktip, Petrel/Tern, Evans Shoal, Bayu-Undan, and the Greater Sunrise fields have an estimated recoverable 17.62-trillion cubic feet (Tcf) of natural gas. The undeveloped Greater Sunrise field alone has estimated recoverable reserves of between 5.12 and 7.7 Tcf of gas, and more than 226-million barrels of condensate.[7] Though there are currently only a few oil fields in production, crude reserves are also estimated to be substantial. The scale of these important deposits has attracted large-scale interest and investment from international oil companies, notably in the production of natural gas and liquid natural gas (LNG).

Currently, oil production is underway at the following fields: Challis/Cassini, Corallina, Elang/Kakatua, Jabiru, and Laminaria. However, oil has been discovered in more than 16 other prospects. The only gas field currently in production is the large Bayu-Undan structure, which has estimated recoverable reserves of some 3.4 Tcf. Gas from this field is transported by pipeline to Darwin, where it is converted into LNG and shipped mostly to Japanese power companies under long-term contract. Darwin LNG currently produces 3.5-million tons per annum, but there are plans to greatly expand Darwin's production trains and exports as more gas fields in the Timor Sea come into production during the current decade.[8] Aside from Bayu-Undan, there are some 30 other gas and condensate plays in this strategically vital part of the eastern Indian Ocean.

Discovered in 1974, the massive Greater Sunrise field, which has yet to be developed, will become the single-most important petroleum project in the Timor Sea once it is in full-scale production. Product from the field could generate more than $40 billion in revenue over its projected 30-year lifespan.[9] However, this project (which will be produced jointly by Woodside, ConocoPhillips, Shell, and Osaka Gas) has been stalled due to complications derived from a dispute between East Timor's government and the consortium leader (Woodside) regarding how the gas and condensate from the Sunrise and Troubadour fields will be processed. The fields lie in the 'Joint Development Petroleum Area' (JPDA), located in a region that straddles Australian and East Timor EEZs, and the consent of both governments concerning the project's operations is essential before production can start. Essentially, the Timorese government wants the gas and condensate flow to be conveyed ashore to East Timor via subsea pipeline, from where it will be processed and re-exported as LNG and other products. Clearly, this would require a massive influx of foreign direct investment (FDI) to the country to build the liquefaction, storage, and loading facility, and it would generate considerable local employment, and be a massive boost to the country's economy. The Woodside-led consortium wants the gas to be processed offshore using a pioneering floating LNG (FLNG) vessel currently under development by Shell. Woodside has rejected the Timorese-favored option, in part because they argue that laying a pipeline would be economically and practically prohibitive due to the 3,300-meter trench that lies in the projected pipeline routing.[10]

Figure 6.2: Proposed Myanmar-China Oil and Gas Pipelines



Source: Shwe Gas Movement, http://www.shwe.org

Though this project remains stalled as of early 2012, the wider importance of this petroleum-rich area of the Indian Ocean—which also constitutes a vital sector for Australasian shipping lanes—has ensured that the region has become of considerable strategic importance to the Australian and US governments. In November 2011, President Obama announced a US-Australia agreement that would see as many as 2,500 US Marines, and other naval and combat units stationed on a rotating basis at Australian bases in Darwin. Aside from the strategic importance of the Timor Sea for the reasons described above, this development was widely viewed as a US move to address growing Chinese military presence and strength in the South China Sea. Nevertheless, as the volume of gas exports to Asia grows, this previously quiet part of the Indian Ocean will become of increasing strategic focus for regional powers as well as for international and national oil companies.

Chinese and Indian NOC Competition for Offshore Gas Fields in Myanmar

For India and China, the prospect of gaining access (exclusive or otherwise) to Myanmar's significant reserves of natural gas is an energy security and geopolitical phenomenon of intriguing complexity. It fuses the reality of fierce competition over potential access to an estimated 21-trillion cubic feet of natural gas with the establishment of a strategic energy supply close to areas where it is needed.[11] All this occurs amidst wider geopolitical and

geo-strategic issues, specifically: Chinese commercial and trade access to the Indian Ocean; the implications of China reducing its reliance on tanker shipping transiting the Malacca Straits; and India's drive to strengthen its strategic influence over an oceanic space that it regards as a vital sphere of influence.[12]

Though other deposits have yet to be uncovered off the coast of Myanmar, and the final volume of its total proven reserves of natural gas have yet to be determined, the site for arguably the most intense contest between India and China for upstream access to foreign reserves to date are the fields of the Shwe project, which are estimated to contain some 9.1-trillion cubic feet of gas deposits.[13]

Following conclusively successful appraisal drilling in the Shwe structure in 2004 and 2005, India's ONGC Videsh and GAIL acquired 20-percent and 10-percent interests in the A-1 and A-3 blocks in the Shwe field, respectively. The other consortium partners were Korea's Daewoo, the project leader with a 60-percent stake, and KOGAS, with a 10-percent share. India had hoped that it could turn this exploration and production (E&P) success story into an important strategic gas supply stream for the country by transporting its share of the gas via a 960-mile pipeline from Myanmar to India. However, in mid-2006, as plans for the $3-billion pipeline were being considered by the Indian NOCs in concert with the Junta, PetroChina managed to sign a memorandum of agreement with Myanmar's government for exclusive rights to 6.5-trillion cubic feet over 30 years.[14] Indian diplomats only found out about the deal after it had been negotiated. In an ironic twist, this essentially means that if the Chinese managed to secure exclusive purchase rights, the Indians (along with their Korean partners) would end up having to produce gas to sell to their rival. On the one hand, that could be viewed as a reasonable business deal. On the other hand, however, this was a major setback, as India had viewed its acquisition as a source to fortify its own energy security. This subsequently prompted an Indian presidential visit to Burma in March 2006, which included the signing of additional gas sales to India.

In September 2007, the then–Indian Minister of Petroleum and Natural Gas, Murli Deora, reinjected fresh impulsion into India's quest to secure additional upstream access to Myanmar's offshore gas by witnessing ONGC Videsh's signing of a $150-million, seven-year deal for three deep-water blocks off the Arakan coast. This success came soon after the realization that the planned scheme to develop the Iran-Pakistan-India gas pipeline (IPI) had stalled once again, thereby prompting the government to urgently seek additional sources elsewhere. Unfortunately, given the obstacles to building the proposed Myanmar-Bangladesh-India gas pipeline, any equity gas India's NOCs may have in Myanmar still remained effectively 'stranded' in terms of their utility for India itself. Put another way, though India is seemingly making up for earlier losses to China, if the Chinese manage to secure exclusive rights to buy the gas from the Shwe field (which is then transmitted to China via their own proposed 560-mile gas line to the Chinese-Myanmar border), then this remains a net strategic loss for India.

Underlying India's economic and energy interests in Myanmar is a desire to counter China's growing influence in the country, and, if possible, regain some measure of influence over the volumes and destinations of these important gas reserves. Arguably, the Shwe project can be seen as a microcosm of the contest for resources and political influence in the region

between Asia's two rising powers. However, at this juncture, China is winning in the contest for access to Myanmar's gas. It is aptly demonstrating the significant geopolitical advantage it possesses in having an unobstructed common-land border with Myanmar, as well as exercising its clearly stronger diplomatic influence over Myanmar's government juxtaposed to that of India's.

Midstream

Major Persian Gulf Export Terminals and Crude Trade to Asia

This section examines the crude oil trading dynamics and imperatives from the Persian Gulf and Arabian Peninsula with the primary markets in Asia. The production and exporting of crude oil from this maritime space constitutes arguably the most intensively scrutinized and important feature of systemic petroleum conveyance at a global level. In this sense, the trade of these resources is a major factor in determining important features of the petroleum geopolitical ontology of the Indo-Pacific maritime realm. From the point of view of the economic security of the producer countries in this space and the energy security of the major consuming powers in Asia (in particular China, Japan, and India), there is no more important single factor than the unimpeded export of crude oil from Iran, Iraq, Kuwait, Saudi Arabia, and the United Arab Emirates (UAE).

Saudi Aramco's terminals handle more than 3,000 tanker loadings per year. Aramco terminals are located at Ras Tanura and Ju'aymah on the Arabian Gulf coast, and at Jiddah, Rabigh, Jaizan, Yanbu, and Duba on the Red Sea coast. However, it is the significant dominance of Ras Tanura and Ju'aymah in terms of loading and export capacity that sets them apart. The two terminals alone account for more than 32 percent of total crude exports by sea from the region, and almost 90 percent of Saudi Arabia's annual exports of crude oil. This pivotal concentration of export capacity renders these Saudi terminals arguably the two single-most important crude oil export facilities in the world. Between 1999 and 2009, average global consumption of oil stood at approximately 81 million barrels of oil per day, representing an average annual consumption of some 29.57 billion barrels.[15] Of this, Ras Tanura and Ju'aymah alone account for 1.3-billion barrels, or 4.4 percent.[16]

If Saudi Arabia is the cornerstone of oil supplies to the global market due to the scale of its daily output, then Ras Tanura and Ju'aymah, the two largest crude terminals in the world, are the linchpins of the kingdom's export infrastructure. As much as 80 percent of the approximately 10-million barrels of oil (average: 1999-2009) produced by Saudi Aramco every day is piped from fields such as Ghawar to the processing facility at Abqaiq, which feeds processed crude to the massive tank farms and refinery at Ras Tanura.[17] The Ju'aymah terminal is also fed from Abqaiq. There are six Single Point Moorings (SPMs) at Al Ju'aymah, which combined have a nominal loading capacity of up to 6-million barrels per day.[18] VLCCs and ULCCs bound for the major refineries in China, Japan, South Korea, India, Singapore, Europe, and the United States load approximately 1.3-billion barrels of oil each year at Ras Tanura and Ju'aymah.[19]

These facilities are thus *de facto* the most vital single terminals for the crude oil supply-security for many leading Asian and Western states. Indeed, were the terminals to be put out of commission, the impact upon the global oil market would be severe in the extreme, given that the pipeline capacity within Saudi Arabia is currently insufficient to divert the terminals' output to the kingdom's primary Red Sea terminal at Yanbu. Currently, the 1,200-kilometer 'Petroline' that links oil sourced from the Ghawar, Abqaiq, and Hawtah fields only has a capacity of 5-million barrels per day (MBD).[20] Furthermore, the terminal at Yanbu does not have sufficient loading capacity nor can it accommodate the necessary VLCC turnaround, even if the pipeline capacity was sufficient to redirect the required 179-million barrels per year.

The security considerations regarding Ras Tanura and Ju'aymah are clear on two fundamental and interrelated levels. The significance of the terminals' annual export capacity—as proportions of both Saudi and regional export totals, and also as a percentage of annual global oil consumption—is inescapable. This strategic-level appreciation has clear implications for the crude oil supply security (and thus the national energy security) of a number of dependent states around the world, including major Western powers, the Asian 'Tiger' economies, and Asia's rising powers. As a result, the strategic-level appreciation is intrinsically linked to the operational-level security of the terminals themselves.

In particular, Ras Tanura is a highly attractive terrorist target, due to its conspicuous, isolated, and vulnerable Sea Island terminal structures, its proximity to the shoreside tank farms on the Ras Tanura peninsula, and its larger output.[21] It is estimated that 10 percent of global oil supplies are loaded onto VLCCs at the terminal every day. Furthermore, it has been estimated that a major strike against Abqiaq and Ras Tanura could remove as much as 50 percent of Saudi Arabia's export capacity.[22] This somewhat alarmist estimation by some commentators is difficult to corroborate. Nevertheless, given the enormous output and handling capacity of these facilities, the point is made. Given the history of conflict in the Persian Gulf region and its status as a shatterbelt, in the event of an inter-state war involving Saudi Arabia, the terminals would also be clearly important strategic targets, in the way that Iraq and Iran's major terminals were targeted during the Iran-Iraq War to disrupt oil exports.

Providing comprehensive security for the facilities—both in terms of continuous threat intelligence, and sufficient practical security in the form of protective naval patrols and defences—is therefore of paramount importance not only to the kingdom itself, but also to key dependent consuming states and the stability of the global oil market. It is in part for this reason that Western-led naval coalitions, such as Combined Task Force 152, maintain a continuous presence in the Persian Gulf. Notwithstanding the considerable strategic reserves of oil in the US, Europe, and parts of Asia, the tight supply-demand balance of the contemporary petroleum age means that any prolonged interruption of supply from either or both of these terminals (particularly Ras Tanura) would have considerable repercussions for the oil market and potentially for macroeconomic stability.

Iranian, Kuwaiti, Omani, and UAE Terminals

Kharg Island in Iran, Jebel Dhanna Terminal in the UAE, and Kuwait's Mina al Ahmadi constitute the second tier output terminals in the region, with a combined export output representing 28.11 percent of the region's total.[23] Though Saudi Arabia's maritime export capacity tends to overshadow that of other producers in the region, it can quickly be seen that even if the total maritime export capacity of Iran, the UAE, and Kuwait individually were to be compromised, the effect on dependent countries and the market-volume/price dynamic would be considerable.

Oman's Mina al Fahal terminal is an important facility for geographical reasons. Though Oman's crude output will decline faster in real terms than the other main producers, it is currently the only high-capacity crude terminal in the Arabian Sea located outside of the Straits of Hormuz. (The UAE currently is developing a 1.8 MBD, 360-kilometer oil export pipeline from Habshan to Fujairah, which is expected to be completed in 2012 [see "The Habshan-Fujairah Oil Pipeline" section].)[24]

Lastly, the Al Basra Oil Terminal (ABOT) in Iraq—the country's main maritime export facility, which became the most closely protected terminal in the world following the unsuccessful terrorist strike against both Iraqi terminals by an Al-Qaeda in Iraq (AQ-I) cell in April 2004—will become the focus of expanded regional export capacity in the coming years, as Iraq begins the gradual process of expanding its daily crude production.[25] It is intended that export capacity from the Iraqi terminals will be significantly boosted in order to accommodate increased production capacity from Iraq's major southern oil fields, specifically the north and south Rumaila, west Qurna, and Zubair fields between 2010 and 2016. These terminals will render Basra a major regional petroleum gateway once production has expanded significantly.

The Habshan-Fujairah Oil Pipeline

Due to be completed in August 2012, the Habshan–Fujairah oil pipeline's purpose is ostensibly to provide an additional means of exporting crude oil from the Persian Gulf, by bypassing the Strait of Hormuz. UAE officials have suggested that the line is being built to ensure security of exports from the UAE, in case hostilities with Iran compromise freedom of navigation through the strait.

The 360-kilometer long, 48-inch pipeline starts at the 'Habshan' onshore oil field in Abu Dhabi, and will have an initial capacity of 1.5 MBD of crude, rising eventually to 1.8 MBD. The pipeline is being built by China Petroleum Engineering & Construction Company at a cost of $3.29 billion. Aside from its strategic value, it is thought the pipeline will eventually totally transform Fujairah into an 'Energy Special Zone' with extensive crude oil refining facilities, storage tank farms, and petrochemical plants.

The pipeline will eventually supply a planned 300,000-barrels-per-day oil refinery, as well as the Zone's crude oil export terminal. Some UAE officials also have suggested the desire to convert Fujairah into a 'small Rotterdam' of the region. According to the US Energy Information Administration (EIA), approximately 17 MBD of crude oil is transported through the Strait of Hormuz each day (roughly 20 percent of the daily crude oil produced

worldwide). It is estimated that the Habshan-Fujairah line has the capacity to carry almost 10 percent of what passes through Hormuz in any given year. Clearly, this volume does not fundamentally diminish the oil export significance of the Strait of Hormuz, and indeed a mass of other vital trade and warships must also pass through the chokepoint. Nevertheless, its significance as an 'insurance policy' is clear. Moreover, as the project evolves, it is conceivable that an additional line could be built (and storage capacity increased) as the region assesses the significance of this 'Hormuz bypass' to the Gulf's economic and geopolitical security.

Downstream Sector

Singapore as a 'Strategic Petroleum Gateway'

Singapore is arguably the best example in the world of the confluence of petroleum processing, mass oil storage (including distillates and petrochemicals), tanker loading capacity, distribution coverage, and ideal geographical location. Simply put, it is the most vital petroleum hub in southeast Asia, rendering it an ideal example of what I refer to as a 'strategic petroleum gateway.' That said, Singapore faces increasing competition from new, large facilities in the Indo-Pacific Maritime Realm, such as Jamnagar on India's northwestern coast.

A strategic petroleum gateway derives its status from six key factors:

- Strategic location at an oceanic trading crossroads (e.g. the Malacca Straits);
- The scale of its VLCC and product tanker discharging and loading terminals;
- Massive refining throughput;
- Very large oil storage capacity (crude, distillates, and petrochemicals);
- The existence of a international financial and petroleum trading market; and,
- A region-wide tanker distribution network for distillates and petrochemicals.

In 2004, the Singaporean government made clear its plans to maintain and boost its status with storage expansions, and announced studies into how to transform the country into an LNG hub to complement its oil processing, trading, and distribution capacity. Currently, with more than 70 production and storage companies, Jurong Island is now recognized as one of the world's major oil and petrochemical nodes, and the site of one of the world's top three refining centers, after Rotterdam and Houston. Singapore is also the third largest oil-trading center in the world, after New York and London.[26]

Singapore's Geo-strategic Location

Today, Singapore remains the world's most important single waypoint in the maritime conveyance of crude oil. In 2002, the continuous stream of VLCCs transiting via Singapore from the Indian Ocean to the South China Sea en route to China, Japan, and South Korea

equated to more than 11-million barrels of oil passing through the straits each day (some 32 percent of total global oil trade). By EIA estimates, this volume could reach as high as 24-million barrels of oil per day (37 percent of the global oil trade) by 2030.[27] Currently, VLCCs transport up to 80 percent of China's annual crude imports via the Malacca Straits and Singapore.[28]

Oil Imports, Refining, Storage Capacity, and Distribution

In 2009, Singapore imported 2,598,000 barrels of crude oil and products per day and exported 1,552,000 barrels per day, most of which were refined products, indicating the remainder was crude feedstock for the refineries.[29] Singapore has a total crude oil refining throughput capacity of approximately 1.3 MBD. The country's three refineries are: ExxonMobil's Jurong/Pulau Ayer Chawan facility (605,000 MBD); Royal Dutch Shell's Pulau Bukom complex (458,000 MBD); and, the Singapore Petroleum Company's (SPC) Pulau Merlimau refinery (273,600 MBD).[30]

Viewed cartographically, the pattern of product and chemical tanker trade conveying the fuels and petrochemical products listed above appears as a series of spokes, radiating outward from Singapore along SLOCs through much of the Indo-Pacific Maritime Realm to many of the major petroleum-capable ports and terminals in the aforementioned maritime space. Currently, tankers link the refineries and terminals in Singapore with product and distillate-configured oil discharging terminals in Australia, Bangladesh, Brunei, China, East Africa, Hong Kong, India, Indonesia, Japan, Malaysia, Pakistan, Philippines, South Africa, Sri Lanka, Taiwan, Thailand, and Vietnam.[31] Many of these countries, including Australia, are heavily dependent upon Singapore as a source of all grades of distillates and petrochemicals. However, the geopolitical reach of Singapore's role in the petroleum industry extends even further than the tanker network's already considerable coverage, due to Singapore's status as a hub of for the electronic trading of crude oil and refined products between traders all over Asia. This extraterritorial 'virtual trading' enables Singapore also to influence those petroleum markets that it is not physically connected to by SLOCs and tankers.

Terminals and Storage

Aside from its considerable refining capacity, Singapore's virtually unparalleled status as the most important petroleum hub in Asia is derived from its deep-water loading and discharging terminals for VLCCs and product tankers, and also from its vast oil storage capacity. The three major oil refineries hold 88 million barrels of combined storage capacity (88 percent of the country's total), while Singapore's independent storage operators possess a further 24.4-million barrels of capacity.[32]

Several projects are underway to expand Singapore's storage capacity, and ensure its continued dominance in this regard. The most significant is the construction of the new joint Hin Leong/PetroChina Universal Terminal on Jurong Island. In November 2007, the 2.3-million cubic-meter capacity Universal Terminal, now acknowledged as the largest commercial oil storage terminal in Asia, received its first test cargoes of fuel oil and distillates.

Conclusions and Future Realities for Singapore and the Region

Notwithstanding the country's long-held and continued primacy as a strategic petroleum processing node and conveyance gateway, there are some actual and putative developments evolving in the Indian Ocean and western Pacific realm that will likely alter the pattern of crude and product trade as it concerns Singapore. Aside from the growth in capacity and versatility of the Reliance refinery complex at Jamnagar (India), competition for markets and trade is maturing in Malaysia (with its Melaka refinery), and Thailand has also demonstrated intentions to expand its influence and capability as a refining and distribution hub with the recent completion of its Sri Racha oil center. The latter facility is still disadvantaged geographically compared to Singapore and, for the time being, is disadvantaged in terms of its throughput capacity as well. However, Sri Racha, Jamnagar, and the new and expanded facilities in Saudi Arabia could benefit tremendously if a planned $20-billion Kra Isthmus Canal is built.[33]

Though it is far from certain that the Kra Isthmus Canal will ever be constructed—particularly given its likely staggering cost—it is an intriguing possibility that would transform the petroleum trading and geopolitical map of Asia. In effect, the canal constitutes a 'Malacca bypass', which would shorten the passage from the eastern Indian Ocean to the western Pacific Ocean by some 700 nautical miles.[34] In tanker shipping terms, this would mean that VLCCs and product tankers could steam from the Persian Gulf and from the refinery at Jamnagar directly to the massive markets in China, Japan, and South Korea without transiting via the Malacca Straits and Singapore. This has several economic, logistical, and security implications. A shortened passage would significantly reduce time, charter fees, and bunker costs. Also, such a bypass could effectively neutralize security concerns in the Straits, such as a surge in piracy attacks, a high-consequence terrorist incident, or blockade in the event of a major war.

Clearly, the possible future development of the canal would have considerable economic implications for Singapore, including: lost transhipment dues; decreased bunker sales (Singapore is still the world's largest single vessel refuelling point); lost refining business; reduced oil storage volumes; and, an inimical impact upon locally based product tanker charters. However, as of early 2012, the Thai government has several reasons to delay moving forward with the project, such as its enormous price tag, significant engineering challenges, the need for diplomatic and commercial convergence with Malaysia, and uncertainty regarding the canal's security implications given radical Muslim militant activity or a wider insurgency in Thailand's southern reaches. Singapore, for its part, will be relying on these geopolitical, financial, and security obstacles to delay or totally stymie development, thereby creating a window for it to consolidate its petroleum gateway status and capacity.

Indian Ocean Petroleum Outlook to 2030

The petroleum industry activity in the Indian Ocean for the next two decades will be dominated by two key features: increasing Asian- and developing-country reliance on OPEC production from the Persian Gulf exporters; and, the evolving importance of upstream activity in frontier regions in the IOR, particularly for natural gas and condensate. However, in the midstream and downstream sectors, there will be modifications in volume and patterns of conveyance, and in refining capacity nodes.

Precise levels of crude production output, fluctuation, and growth from Saudi Arabia, the UAE, Iran, Iraq, and Kuwait are complex, if not impossible to predict out to 2030. However, what is certain is that the Asian developing nations and powers will be increasingly reliant on this source as a share of their petroleum energy requirements. This will be reflected in the growth of their NOC involvement in the region, a likely increase in their geostrategic interest in the Gulf, and heightened military commitments in the area—particularly in the form of Chinese and Indian naval task groups, and joint military exercises with (and support for) major Gulf producing states. There will be considerable growth in Iraqi crude output, and a strong likelihood of increasing gas pipeline exports to Europe and the country's first LNG terminal at Basra. An eventual change in the Iranian government to one far more inclined to constructive regional and international cooperation will likely result in a surge in FDI from both Western IOCs and Asian NOCs, enabling Iran to greatly boost its crude production from its massive but dilapidated fields, and pursue the long-awaited development of its LNG production potential from its giant South Pars field. Meanwhile, an increase in infrastructure development at Ras Laffan in Qatar would also likely boost that country's LNG export capacity, largely due to demand from Chinese electrical power companies.

Upstream developments in the frontier regions will be characterized by the growth of projects and investment in the following areas: the Timor Sea; all along the east African littoral (including Seychelles); LNG exports from Mozambique to Asian markets; India's offshore territory in the Bay of Bengal (most notably in the Krishna-Godavari Basin); and growth in Myanmar's offshore gas production. Meanwhile, evolution in the midstream and downstream sectors will be dominated by increased Indian crude and natural consumption and its widening refining output; challenges to Singapore's preeminence as a refining and distribution hub; an increase in Hormuz bypass export capacity across the UAE and Saudi Arabia; and the conveyance of oil from Sudan (and possibly Uganda) to the Indian Ocean via pipelines to the Kenyan coast.

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