

Oil Stockpiling and Emergency Response Cooperation of East Asia

edited by

Yoshikazu Kobayashi

Venkatachalam Anbumozhi

September 2015



© Economic Research Institute for ASEAN and East Asia, 2015

ERIA Research Project FY2014 No. 32

Published September 2015

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means electronic or mechanical without prior written notice to and permission from ERIA.

The findings, interpretations, and conclusions expressed herein do not necessarily reflect the views and policies of the Economic Research Institute for ASEAN and East Asia, its Governing Board, Academic Advisory Council, or the Institutions and governments they represent.

Preface

The significance of oil stockpiling to ensure oil-supply security has been increasing in the East Asia Summit region where oil demand and import dependence are steadily growing. While the 'shale revolution' in the United States and the subsequent change in the trade flow of international crude oil have created an opportunity for the East Asia Summit region to diversify its sources of crude-oil imports, the region is likely to continue to depend on the Middle East for most of its oil import requirements. Geopolitical risks in the Middle East have been aggravated by the recent rise of the Islamic State of Iraq and al-Sham (ISIS) in Iraq and Syria and the civil conflict in Yemen. In light of this, East Asia Summit countries have a growing need to strengthen their oil-supply security. In particular, the member states of the Association of Southeast Asian Nations (ASEAN), which have a rapidly increasing domestic demand for oil and limited experience in crafting policies on oil-supply security, urgently need to develop appropriate levels of oil stockpiling.

Based on this understanding, this study reviewed the latest developments in the stockpiling policy of ASEAN countries and explored measures to further promote and improve their stockpiling system. As a representative of the study team, we strongly hope that this report will contribute to the sound development of the oil-stockpiling system of ASEAN countries.

Acknowledgements

This analysis was conducted by the Institute of Energy Economics, Japan (IEEJ) under the Economic Research Institute for ASEAN and East Asia. We would like to acknowledge the support provided by everyone involved. We would especially like to express our gratitude to the ASEAN Centre for Energy for its generous support in collecting information on latest developments in the oil-stockpiling policy of the member states of the Association of Southeast Asian Nations (ASEAN).

Contents

<i>Copyright Page and Disclaimer</i>	ii
<i>Preface</i>	iii
<i>Acknowledgements</i>	iv
<i>Contents</i>	v
<i>List of Tables</i>	vi
<i>List of Figures</i>	viii
Chapter 1 Introduction	1
Chapter 2 Oil Stockpiling Development in Southeast Asia	7
Chapter 3 Challenges for ASEAN Countries' Oil Stockpiling Development	53
Chapter 4 Potential Cooperation beyond ASEAN	75
Chapter 5 Conclusion	107
Appendix Oil Storage Infrastructure in Myanmar	115

List of Tables

Table 2-1-1	Overview of the Oil Stockpiles in Indonesia	9
Table 2-1-2	SWOT Matrix of Indonesia’s Oil-Supply Security	11
Table 2-2-1	Overview of the Oil Stockpiles in Thailand	15
Table 2-2-2	Mandatory Ratio in Private Oil Stockpiling	16
Table 2-2-3	SWOT Matrix of Thailand’s Oil-Supply Security	17
Table 2-3-1	Overview of the Oil Stockpiles in Malaysia	19
Table 2-3-2	SWOT Matrix of Malaysia’s Oil-Supply Security	20
Table 2-4-1	Overview of the Oil Stockpiles in Singapore	22
Table 2-4-2	SWOT Matrix of Singapore’s Oil-Supply Security	24
Table 2-5-1	Overview of the Oil Stockpile in the Philippines	27
Table 2-5-2	SWOT Matrix of the Philippines’s Oil-Supply Security	29
Table 2-6-1	Overview of the Oil Stockpiles in Viet Nam	31
Table 2-6-2	Viet Nam’s Road Map and Scale of Crude Oil and Oil-Product Stockpiling System	33
Table 2-6-3	SWOT Matrix of Viet Nam’s Oil-Supply Security	35
Table 2-7-1	Overview of the Oil Stockpile in Brunei Darussalam	37
Table 2-7-2	SWOT Matrix of Brunei’s Oil-Supply Security	39
Table 2-8-1	Overview of Oil Stockpile in Cambodia	41
Table 2-8-2	SWOT Matrix of Cambodia’s Oil-Supply Security	43
Table 2-9-1	Overview of the Oil Stockpile in Lao PDR	45
Table 2-9-2	SWOT Matrix of Lao PDR’s Oil-Supply Security	47
Table 2-10-1	Overview of Oil-Stockpiling in the of Myanmar	49
Table 2-10-2	Oil Stockpiling Target Road Map	50
Table 2-10-3	SWOT Matrix of Myanmar’s Oil-Supply Security	51
Table 3-0-1	Challenges for Stockpiling Policies in Selected ASEAN countries	53
Table 3-5-1	Types of Stockpiling Systems in Selected IEA Countries	68
Table 4-2-1	Emergency Support Functions	81
Table 4-2-2	US Oil Companies Downstream Assets of in Asia Pacific	88
Table 5-2-1	Indices of Oil-Supply Security and Degrees of Impact on Supply Disruption	111
Table A-1-1	Summary of Operating Refineries in Myanmar	116
Table A-1-2	Main Units of the Thanlyin Refinery	118
Table A-1-3	Storage Tanks Installed around the Thanlyin Refinery	119
Table A-1-4	Main Units of the Thanbayakan Refinery ¹	120
Table A-1-5	Domestic Crude Oil Pipelines in Myanmar	121
Table A-1-6	Myanmar--China Gas and Oil Pipelines ¹	123

Table A-1-7	Fuel Terminals Own by State-Owned Companies in Myanmar	124
Table A-1-8	Fuel Terminal Majority-Owned by the CNPC in Myanmar	125
Table A-1-9	Fuel Terminals Owned by Private Companies in Yangon	126
Table A-1-10	Fuel Terminals Owned by Private Companies in Thilawa	127
Table A-1-11	Sub-Fuel Terminals in Myanmar	130
Table A-2-1	Facilities of International Wharves at the Port of Yangon	133
Table A-2-2	Facilities of International Wharves at Thilawa Port	134

List of Figures

Figure 2-1-1	Primary Energy Demand in Indonesia	7
Figure 2-1-2	Oil Supply-Demand Balance in Indonesia	8
Figure 2-2-1	Primary Energy Demand in Thailand	12
Figure 2-2-2	Oil Supply-Demand Balance in Thailand	12
Figure 2-2-3	Organisational Chart of the Ministry of Thailand's Energy	13
Figure 2-2-4	Organisational Chart of the Energy Policy and Planning Office	14
Figure 2-3-1	Primary Energy Demand in Malaysia	18
Figure 2-3-2	Oil Supply-Demand Balance in Malaysia	18
Figure 2-4-1	Primary Energy Demand in Singapore	21
Figure 2-4-2	Oil Supply-Demand Balance in Singapore	21
Figure 2-5-1	Primary Energy Demand in the Philippines	24
Figure 2-5-2	Oil Supply-Demand Balance in the Philippines	25
Figure 2-5-3	Organisational Chart of the Department of Energy, Philippines	27
Figure 2-6-1	Primary Energy Demand in Viet Nam	30
Figure 2-6-2	Oil Supply-Demand Balance in Viet Nam	30
Figure 2-7-1	Primary Energy Demand in Brunei Darussalam	36
Figure 2-7-2	Oil Supply-Demand Balance in Brunei Darussalam	36
Figure 2-8-1	Primary Energy Demand in Cambodia	40
Figure 2-8-2	Oil Supply-Demand Balance in Cambodia	40
Figure 2-9-1	Primary Energy Demand in Lao PDR	44
Figure 2-9-2	Oil Supply-Demand Balance in Lao PDR	44
Figure 2-10-1	Primary Energy Demand in Myanmar	48
Figure 2-10-2	Oil Supply-Demand Balance in Myanmar	48
Figure 3-3-1	Locations for Planned Refinery Expansion in Indonesia	62
Figure 3-3-2	Locations for Planned Refineries in Viet Nam	63
Figure 3-8-1	CERM Procedures	73
Figure 4-1-1	Share of ASEAN Economies in the World Economy	76
Figure 4-1-2	Outlook of the GDP Growth Rate of Various Regions.	76
Figure 4-1-3	Total Primary Energy Supply in Southeast Asia	77
Figure 4-1-4	Share of ASEAN in the World Oil Market	77
Figure 4-1-5	Gasoline Prices in the US, Europe, and Asia	78
Figure 4-2-1	Scenario-Based Approach	80
Figure 4-2-2	All-Hazards Approach	81
Figure 4-2-3	Incident Command System	82
Figure 4-2-4	Organisation of the US SPR System	84
Figure 4-2-5	US Stockpiling Volume	85
Figure 4-2-6	Oil Net Import in the US	85

Figure 4-2-7	Stockpiling Bases in the US	86
Figure 4-2-8	US Oil Product Exports (2004--2013)	87
Figure 4-3-1	Oil-Stockpiling Volume in Japan	89
Figure 4-3-2	Location of Oil-Stockpiling Bases in Japan	90
Figure 4-3-3	Government Stockpiling and Private Stockpiling	91
Figure 4-3-4	Japan's Oil Product Export by Direction (1994-2013)	93
Figure 4-4-1	South Korea's Oil Stockpiling Facilities	96
Figure 4-4-2	South Korea's Product Export by Direction (2008-2014)	97
Figure 4-4-3	Concept of Dynamic Stockpiling	98
Figure 4-4-4	Concept of Northeast Asia Oil Hub	99
Figure 4-5-1	Oil-Product Imports in Australia and New Zealand	100
Figure 4-5-2	Total On-Land Oil Stock of Asia-Pacific IEA Countries (as of September 2014)	101
Figure 4-5-3	Locations of Australia's Refineries	102
Figure 4-6-1	Oil Product Import / Export of Singapore	103
Figure A-1-1	Location of Refineries in Myanmar	117
Figure A-1-2	Block Flow Diagram of the Thanlyin Refinery	118
Figure A-1-3	Block Flow Diagram of the Thanbayakan Refinery	121
Figure A-1-4	Planned Route of the Myanmar--China Gas and Oil Pipelines	123
Figure A-1-5	Storage Tanks at CNPC's Fuel Terminal in Kyaukphyu	125
Figure A-1-6	Land Plot Allocation for the Development of Ports in the Thilawa Area	126
Figure A-2-1	Location of the Ports in Myanmar	131
Figure A-2-2	Location of Terminals and ICDs at the Yangon Inner Harbour	132
Figure A-2-3	Location of Terminals at the Thilawa Port	134
Figure A-2-4	Perspective View of the Planned Dawei SEZ	136
Figure A-2-5	Small Port at the Dawei SEZ	137
Figure A-2-6	Layout Plan of the Deep-Sea Port at the Dawei SEZ	140
Figure A-2-7	Current Situation at the Deep-Sea Port Basin Area (taken by the authors)	140
Figure A-2-8	Aerial view of the Kyaukphyu Deep-Sea Port	141

Chapter 1

Introduction

1-1. Objectives and Outline

The objective of this study is to review and explore measures to promote the development of oil stockpiling in the member states of the Association of Southeast Asian Nations (ASEAN). According to the 'Southeast Asia Energy Outlook', which was co-authored by the Economic Research Institute of ASEAN and East Asia and the International Energy Agency (IEA), energy demand in the ASEAN has been growing at a rate of 2.5 since 1990 and is expected to continue to grow for the foreseeable future.

In 2002, Takeo Hiranuma, the then Minister of Economy, Trade, and Industry of Japan, proposed a regular meeting of the energy ministers of the ASEAN+3 countries (China, Japan, and the Republic of Korea [henceforth, South Korea]), referring to this growing energy demand in the region. His proposal led to the establishment of the regular ASEAN+3 Energy Ministers Meetings to ensure the energy security of the ASEAN+3 countries as their energy demand continues to grow. In addition, the Oil Stockpiling Working Group was also founded as a subordinate institution to the EMM in 2008 to discuss ways of enhancing energy security. The working group has met annually since then.

Given the global nature of the oil market and oil-supply security, it will greatly contribute to the ASEAN's oil-supply security to include more countries, particularly the United States (US). Therefore, the geographical scope of this study consists of the East Asia Summit Meeting countries; namely, the ASEAN+8 (Japan, China, South Korea, India, Australia, New Zealand, the US, and the Russian Federation [henceforth, Russia]).

1-2. Literature Survey

The importance of energy security has been increasing in Asia. The higher Asia's dependence on energy imports gets, the more vulnerable to energy-supply disruptions the region becomes. Oil-supply security is particularly critical for the region's economic development and social stability. Cutler (2013) observed that Asia's energy security is usually defined in terms of oil-supply security, given the region's growing demand for oil, its flattening oil production, and its dependence on the Middle East.

Oil-supply security can be attained through long-term and short-term policy measures (Asia Pacific Energy Research Centre [APERC], 2002; Shin and Savage, 2011). Long-term measures include diversification of oil import sources, improvements in oil-use efficiency, enhancement of fuel flexibility, investment in alternative energy sources and technologies, removal of market obstacles, and cooperation between oil producers and consumers. Short-term measures are information sharing, mandatory demand restraint on oil use, fuel switching, standby oil production, and drawdowns of emergency oil stockpiles. On the other hand, in the 2014 study of the IEA which reviewed the ability of member countries to cope with short-term oil supply disruptions as a main focus, emergency oil response measures were short-term ones because the IEA's emergency policy focuses on alleviating short-term oil-supply disruptions. Hence, the IEA's emergency oil response measures were grouped into those aimed at increasing oil supply (e.g. oil stock draw and production surge) and measures aimed at reducing oil demand (e.g. demand restraint and fuel switching).

Amongst these various measures, oil drawdown was found to be the most effective in mitigating the negative impacts of oil supply disruptions (APERC, 2002; IEA, 2014). APERC (2002) addressed that oil stock draw had some advantages over other response measures, raising the following four reasons. First, stockholding is more openly available to many oil-consuming countries than fuel switching or standby production. Second, oil stocks are more visible and transparent and would affect market perceptions more effectively compared to demand restraint. Third, oil stocks could be free from adverse economic impacts, which demand restraint could cause through misallocation of resources. Fourth, IEA experience shows that its members' emergency reserve commitments are exclusively met by holding stocks.

In practice, however, holding emergency oil stocks is not yet a common measure in Asia except in IEA member countries which are required to hold oil stocks equivalent to no less than 90 days of net imports. Some studies have conducted cost-and-benefit analyses of holding oil stockpiles to verify the effectiveness of this measure. Leiby and Bowman (2000), for example, targeted all Asia-Pacific Economic Cooperation (APEC) economies except the US and simulated the expected benefits and efficient levels of

APEC strategic oil stocks, with and without additional APEC reserve.¹ The DIS-Risk model was applied to compare oil market outcomes and APEC economic welfare over the period 2000--2030 under the two distinct reserve programs. In their analysis, costs included the capital expenditures to build the reserve, the oil-purchasing costs, and the operation and maintenance costs while benefits were the avoided disruption costs due to the existence of the reserves (i.e. the avoided gross domestic product [GDP] losses to the economy and the avoided net import costs of oil). Their study found that expanding APEC reserves by at least 200 million bbl was justified on the basis of its expected net benefits to APEC economies. Also, their base case presented that the efficient incremental reserve size was about 600 million bbl in the APEC region except the US, yielding an expected net benefit of about US\$2.7 billion. Furthermore, their result held true over a range of conditions and variation in key parameters under sensitivity analysis, indicating expanding reserves would be beneficial.

Another study conducted by Stelter and Nishida (2013) discussed the costs and benefits associated with holding emergency oil stocks. The costs used in their study-- set-up costs for the storage facilities, operating and maintenance costs, refreshment costs, and land costs--varied based on the size and type of storage facilities (e.g. above-ground tanks and underground caverns) as well as the composition of stocks (crude/product).² Economic benefits were mainly calculated from offsetting oil supply losses and thereby reducing potentially significant oil price increases with the use of a large series of simulations over a 30-year time horizon. Stelter and Nishida (2013) did not quantify benefits at the country level because these benefits depended largely on a country's specific economic situation such as the energy intensity of its GDP and the oil intensity in total primary energy supply. Their analysis revealed that holding emergency oil stocks provided significant economic benefits amounting to US\$41 per bbl annually. They also identified that the acquisition costs of oil accounted for the largest share in overall costs related to emergency oil stockpiles.

The measure of holding oil stock may not be easy to implement for some countries in terms of financial and technical issues although the importance of

¹ The United States was excluded because (1) the United States government conducted its own, independent reserve analysis and (2) given the relative size of the economy of the United States, including the United States would reduce the focus on the rest of the APEC.

² The term 'refreshment' means the regular renewal of petroleum product stocks in order to maintain quality specifications.

establishing strategic oil reserves to buffer against sudden disruptions in oil supply has been recognised. However, as the two studies cited earlier showed, putting emergency oil stockpiles in place would bring greater benefits than costs. Holding emergency oil stocks should be regarded as an insurance against the damage caused by any oil-supply disruptions, possibly avoiding or mitigating the effects of such disruptions (APERC, 2002; Stelter and Nishida, 2013). There are different ways of financing the acquisition and maintenance of emergency stocks as demonstrated in the study of Stelter and Nishida (2013). In fact, considerable differences are observed in the way IEA member countries finance their oil stockpiling. IEA (2014) noted that ticketing, a stockholding arrangement under which the seller agrees to hold (or reserve) a certain amount of oil on behalf of the buyer in return for an agreed-upon fee, was a flexible and cost-effective way for companies or agencies to meet obligations.

Holding oil stockpiles provides benefits not only to the stockpiling countries themselves but also to other countries with no stake in the stockpile (Shin and Savage, 2011). In their simulation, Stelter and Nishida (2013) showed that the use of IEA oil stocks was equivalent to approximately US\$3.5 trillion of avoided costs over a 30-year period to IEA and non-IEA net importing countries. Such ripple effects to neighbouring countries or regions could be explained by the international public goods aspect of oil stockpiling. APERC (2002) specified that oil emergency response measures were ‘an international public good in the sense that an oil supply disruption anywhere in the world would affect oil markets everywhere, and actions taken by any oil-consuming as well as [oil]-producing economy to mitigate the adverse effects of the supply disruption, including oil stock draw, would affect all oil markets’ (p. 19).

The characteristics of international public goods necessitate regional cooperation in oil stockpiling. Specifically, collaborative initiatives in oil stockpiling need to be taken into consideration in order to enhance energy security in Asia since many Asian countries share a common interest in mitigating the risks associated with their dependence on the Middle East for oil. Cutler (2013) pointed out that “building a regional oil stockpile seems to be the most feasible next step Asian governments can take to enhance their energy security’ (p.40).

Nevertheless, energy security issues in Asia are complex because the countries in this region are vastly different in terms of size, level of economic development, and scope

of national interest. In particular, when oil is politicised, the oil-importing countries in Asia may become more competitive with one other. This is exacerbated by the fact that no single overarching pan-Asian organisation is actively engaged in energy-security planning where all the key players can negotiate such cooperation (Cutler, 2013). Shin and Savage (2011) suggested establishing an organisation or framework for an Asian version of the IEA, sort of an 'Asian Energy Agency', when each country in the region has built up a certain level of emergency stockpile. This hypothetical AEA could start with Japan, South Korea, China, and Russia, and then extend to other Asian countries. Meanwhile, Cutler (2013) presented the idea that the East Asia Summit was the forum best positioned to further ongoing efforts to protect pan-Asian security after he outlined the history of regional cooperation in Asia on energy security and then compared the emergency planning arrangements for oil disruption drawn up by various multilateral forums.

Surrounded by risks associated with oil-supply disruption, Asian countries need to prepare emergency response systems as they become more dependent on imported oil. Relevant studies have shown that oil stockdraws would be the most effective way to mitigate economic damages caused by oil supply disruption and would benefit not only oil-stockpiling countries but also other countries without oil stockpiles. However, a regional cooperation mechanism for oil stockpiling has not yet been established to cope with emergency situations. This study, therefore, attempts to identify a way to strengthen the formation of a cooperative framework for oil stockpiling in Asia.

References

- Asia Pacific Energy Research Centre (2002), *Energy Security Initiative: Emergency Oil Stocks as an Option to Respond to Oil Supply Disruptions*. Tokyo: Asia Pacific Energy Research Centre.
- Cutler, T. (2014), 'The Architecture of Asian Energy Security', in M.E. Herberg, R. Kamphausen, T. Toichi, and T. Cutler, 'Adapting to a New Energy Era: Maximizing Potential Benefits for the Asia-Pacific'. *NBR Special Report, #46*.
- International Energy Agency. (2014), *Energy Supply Security 2014*. Paris: International Energy Agency.
- Leiby, P.N. and D. Bowman (2000), 'The Value of Expanding Asian Pacific Strategic Oil Stocks', ORNL-1999/39. Oak Ridge, Tennessee: Oak Ridge National Laboratory.
- Shin, E. and T. Savage (2011), 'Joint Stockpiling and Emergency Sharing of Oil: Arrangements for Regional Cooperation in East Asia', *Energy Policy*, 39(5), pp. 2817–2823.

Stelter, J. and Y. Nishida (2013), 'Focus on Energy Security: Costs, Benefits and Financing of Holding Emergency Oil Stocks', International Energy Agency Insights Series 2013, Paris: International Energy Agency.

Chapter 2

Oil-Stockpiling Development in Southeast Asia

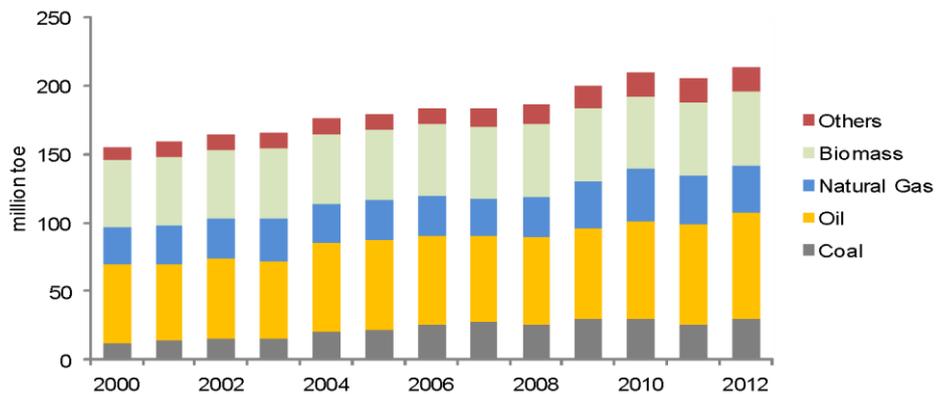
This chapter addresses the current situation and future challenges related to the development of oil stockpiling in ASEAN countries.

2-1. Indonesia

2-1-1. Energy supply and demand

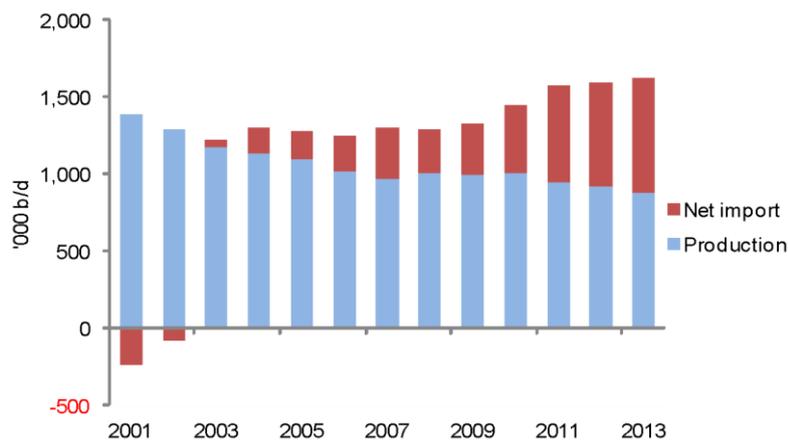
Indonesia's primary energy demand has increased robustly. Demand for oil and natural gas, amongst others, underwent a substantial growth rate. Although Indonesia became a net oil importer in 2003, it has continued exporting oil to other economies, such as Japan while importing inexpensive oil from the Middle East.

Figure 2-1-1. Primary Energy Demand in Indonesia



Source: International Energy Agency, 'Energy Balances of Non-OECD Countries' (Paris, 2014).

Figure 2-1-2. Oil Supply–Demand Balance in Indonesia



Sources: British Petroleum, 'Statistical Review of World Energy' (2014).

2-1-2. Overview of the oil-stockpiling system

(1) Objective

Indonesia is considered to be endowed with natural resources such as oil, natural gas, and coal. This does not mean, however, that these fossil fuels can be exploited indefinitely. In fact, the country became a net oil importer in 2003. As of 2012, imports of petroleum products, which have recently increased, have reached 500,000 barrels per day (b/d) due to the shortage in Indonesia's domestic refinery capacity. Under such circumstances, the purpose of Indonesia's oil stockpiling is to secure the oil supply in areas like Jakarta where oil consumption is substantial.

(2) Institutional Framework

Under the Ministry of Energy and Mineral Resources, the Badan Pengatur Hilir Minyak dan Gas Bumi (Oil and Gas Downstream Regulatory Agency) is responsible for formulating oil-stockpiling policies while the Directorate General of Oil and Gas is in charge of energy policy development and implementation. Badan Pengatur Hilir Minyak dan Gas Bumi was established under the new Oil and Gas Law which took effect in November 2001. It supervises the supply and distribution of petroleum products as well as the transport of natural gas through pipelines. It also monitors the actual supply of petroleum products weekly.

(3) Regulatory Overview

Although the government's responsibility to prepare strategic petroleum reserves (SPR) is prescribed in the 2001 Oil and Gas Law, government oil stocks have not yet been developed. Article 8 of the law stipulates:

(1) The government shall prioritise the exploration of natural gas for domestic needs and be tasked with preparing strategic petroleum reserves to support the supply of fuel oil in the country, which is further stipulated by government regulation.

(2) The government shall guarantee the availability and smooth distribution of fuel oil being a vital commodity and controlling the life of [the] public at large throughout the territory of the Unitary State of the Republic of Indonesia.³

Article 46 identifies 'b. national fuel oil reserves' and 'c. utilisation of fuel oil transport and storage facilities' as tasks of which the regulatory agency is in charge. Since detailed rules were necessary in order to implement the 2001 Oil and Gas Law, Government Regulation No. 36/2004 on Oil and Gas Downstream Business was issued in 2004.⁴ Article 59 under this regulation requires the minister to stipulate the policy on the quantity and type of SPR.

Table 2-1-1. Overview of the Oil Stockpiles in Indonesia

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Private oil stock by authorised companies
Standards of oil stockpiles	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or petroleum products	Share of crude oil	No obligation
	Share of petroleum products	Equivalent to 22 days

Source: The Institute of Energy Economics, Japan.

³ Law No. 22/2001 on Oil and Natural Gas

⁴ Government Regulation No. 36/2004 on Oil and Gas Downstream Business

With regard to private oil stockpiles, oil companies authorised by the Ministry of Energy and Mineral Resources and Pertamina are obliged to maintain operation stocks equivalent to at least 22 days of domestic demand. Pertamina plans to more than double its gasoline and gasoil storage capacity from 2.5 million kilolitres to 6.1 million kilolitres within one to two years, which will expand auto fuel supplies from the current 18 to 20 days to nearly 30 days.

(4) Oil-Stockpiling Entities and Facilities

There is no organisation in charge of SPR in Indonesia. Oil companies such as Pertamina work as an entity for private oil stockpiling.

(5) Mandatory Oil Stockpile

The authorised oil companies have a legal obligation to hold a minimum of 22 days of gasoline, kerosene, and diesel. As of the end of 2013, Pertamina, the NOC, has been maintaining oil stocks of 31 days, larger than the mandatory level.⁵

(6) Emergency Response and its Regulatory Basis

In Indonesia, the Ministry of Energy and Mineral Resources and Pertamina have developed an emergency response system for urgent situations such as earthquakes and accidents at oil facilities. No details, however, have been revealed.

(7) Challenges to Oil-Stockpiling Development⁶

Oil-stockpiling development has made slow but steady progress as 31 days of oil stockpiles have been recently recorded. Nevertheless, it will still be challenging for Indonesia to maintain political willingness and secure funding to develop its oil stockpile. Indonesia could face difficulty in looking for new funding to develop oil stockpiles because the subsidy on petroleum products would be cut if more financial support was provided to oil-stockpiling development. Although the financial burden caused by the subsidy policy has been recognised as a serious problem that needs to be tackled, this issue is too politically sensitive to touch on. Therefore, finding a new financial source for

⁵ From an interview with the experts conducted in February 2014 in Siem Reap, Cambodia.

⁶ Ibid.

oil-stockpiling development would not be an easy task.

2-1-3. SWOT analysis

Table 2-2-2 shows the SWOT (strengths, weaknesses, opportunities, and threats) analysis of Indonesia’s oil-supply security. A major strength of the country is its domestic oil production. Strong political leadership to reduce oil product subsidies is also a strength of its oil-security policy development. A major weakness is its insufficient refining capacity and the lack of a stockpiling system like other countries have. Pertamina’s recent efforts to revamp existing refineries are a great opportunity to enhance the oil-supply infrastructure. The unexpected disruption of product imports is a major threat.

Table 2-1-2. SWOT Matrix of Indonesia’s Oil-Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Domestic hydrocarbon resources • Political leadership of new president • Smaller subsidies 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Insufficient refining capacity • Lack of a stockpiling system • High dependence on oil-product imports
<p>Opportunities</p> <ul style="list-style-type: none"> • Refining joint ventures • Lower prices of crude oil 	<p>Threats</p> <ul style="list-style-type: none"> • Product-import disruption • Large fluctuations in oil prices

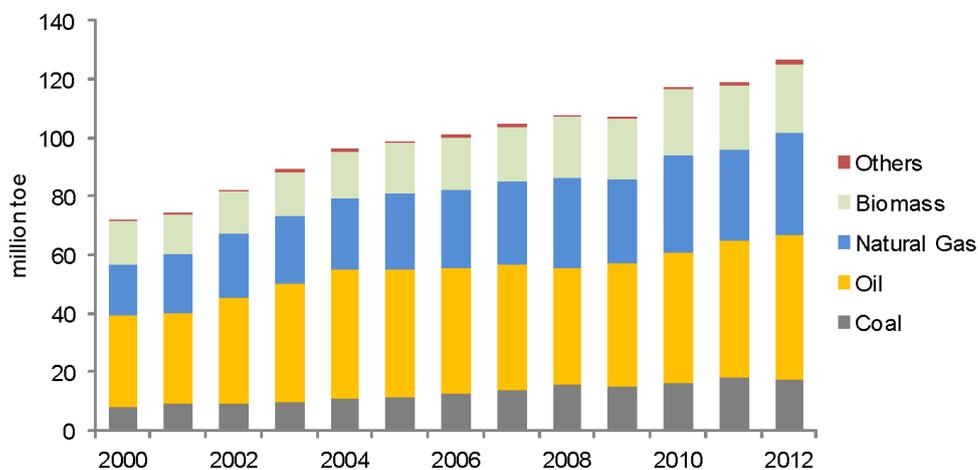
Source: The Institute of Energy Economics, Japan.

2-2. Thailand

2-2-1. Energy supply and demand

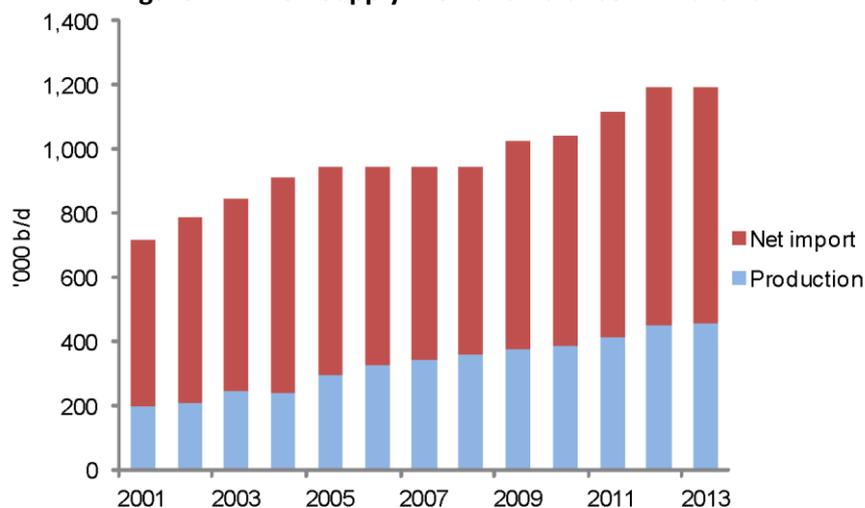
Oil production reached 440,000 b/d and natural gas deposits yielded 41 billion cubic metres in 2012, accounting for 39 percent and 26 percent, respectively, of the primary energy demand. Nevertheless, Thailand is a net importer of oil and natural gas. Imports of oil and natural gas have continuously increased to meet growing domestic demand.

Figure 2-2-1. Primary Energy Demand in Thailand



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

Figure 2-2-2. Oil Supply–Demand Balance in Thailand



Source: British Petroleum, 'Statistical Review of World Energy' (2014).

2-2-2. Overview of the oil-stockpiling system

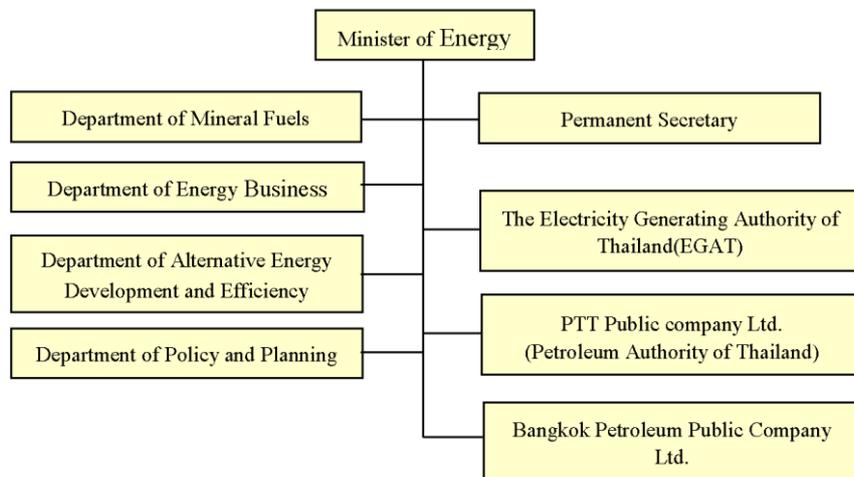
(1) Objective

Thailand is aware that any disruption in oil supply would severely damage the economy due to the country's heavy dependence on imported oil, which constitutes more than half of its oil supply. This perception led to the requirement, established in 1978, that the private sector has to have an oil stockpile.

(2) Institutional framework

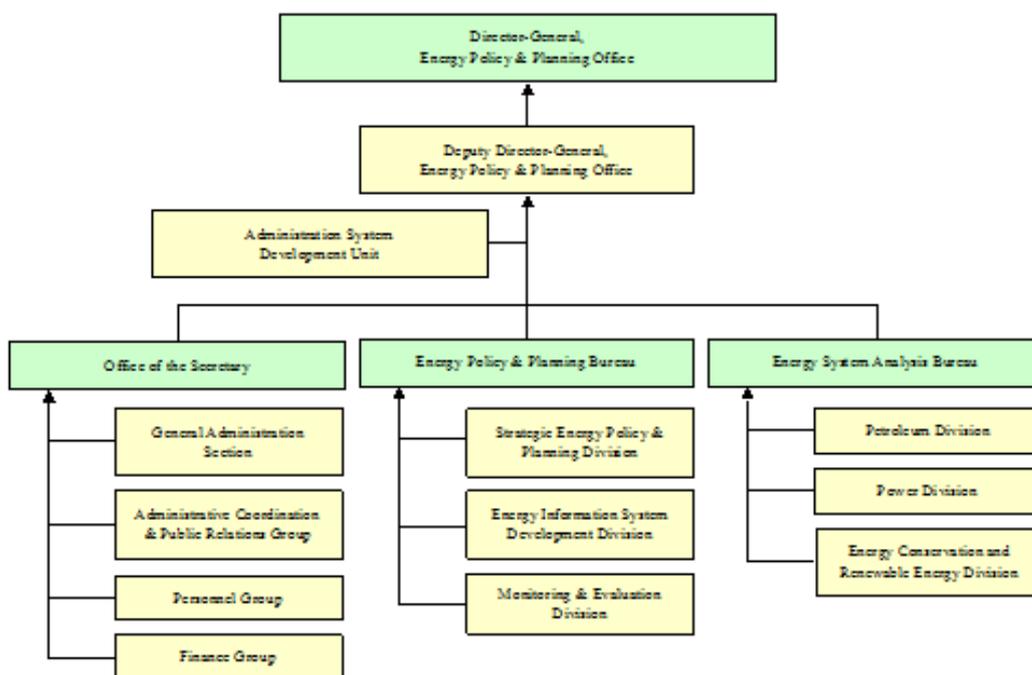
Since its establishment in October 2002, the Ministry of Energy has been in charge of the oil policy, including oil stockpiling. The Energy Policy & Planning Office is responsible for developing an oil-stockpiling policy while the Bureau of Fuel Trade and Stockpile of the Department of Energy Business under the Energy Policy & Planning Office oversees the private oil stockpile.

Figure 2-2-3. Organisational Chart of Thailand's Ministry of Energy



Source: Website of Thailand's Ministry of Energy.

Figure 2-2-4. Organisational Chart of the Energy Policy & Planning Office



Source: Website of the Energy Policy & Planning Office.

(3) Regulatory overview

Oil is considered an essential resource for the Thai economy. The Emergency Decree on the Remedy and Prevention of Shortage of Fuel Oils (B.E. 2516) was implemented in 1973 to prepare a system that adjusts according to oil supply and demand and controls the oil price if supply plunges as a result of disruptions. The Fuel Act of 1978 requires all refiners, importers, and retailers in the private sector to have oil stockpiles. Private-sector parties are not allowed to use their oil stocks at their discretion without governmental permission even if their oil stockpile levels exceed the minimum requirement.

When the financial crisis occurred in 1997, the Thai government eased the oil-stockpiling obligations imposed on refiners and retailers. This measure was considered temporary and the mandatory level was supposed to be ratcheted up if the economy revived. Contrary to expectations, however, the oil companies that were obligated to hold oil stockpiles requested the government to further loosen it. Nevertheless, the government decided not to reduce the required oil-stockpile levels given the looming risk of oil disruption after the terrorist attacks in the US on 11 September 2001.

Table 2-2-1. Overview of the Oil Stockpiles in Thailand

Subjects	Oil stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Refiners, importers, and retailers in the private sector
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	Refiners: 6% of yearly sales of crude oil and petroleum products Importers: 6% of import planning
	Share of petroleum products	Refiners: 6% of yearly sales of crude oil and petroleum products Importers and retailers: 12% of import planning

Source: The Institute of Energy Economics, Japan.

The Thai government has considered establishing government oil stockpiles instead of adding to the responsibility borne by the private sector. Exposed to the increasingly intense competition in the Asian economy, the private sector could lose market competitiveness if it was obligated to maintain a higher level of oil stockpiles which would further increase its burden. Meanwhile, at the time of this study, it did not appear that remarkable progress had been made in planning the government oil stockpile because its development entailed a tremendous financial burden for the government, which was especially challenging in a situation where oil prices were high.

(4) Oil-stockpiling entity and facility

In Thailand, private oil stocks are the only required system and there is neither government nor agency oil stockpiling. This required that private oil stocks be jointly maintained in a tank where a company holds oil for sale; that is, mandatory oil stocks are required to be physically separated from other stocks in different tanks.

(5) Mandatory oil stockpile

The government obligates refiners to hold 6 percent of their yearly sale of crude oil and petroleum products, importers and retailers to hold 6 percent of their crude oil, and 12 percent of the petroleum products of an import plan submitted to the Ministry of

Energy. Petroleum products to be stored include gasoline, kerosene/jet oil, diesel oil, and fuel oil.

Table 2-2-2. Mandatory Ratio in Private Oil Stockpiling

	Refiners (%)	Importers and Retailers (%)
Crude oil	6	6
Gasoline	6	12
Kerosene/jet	6	12
Diesel	6	12
Fuel oil	6	12

Source: Presentation from the ASEAN+3 2nd Oil Stockpiling Roadmap (OSRM) Workshop held on 25 February 2014.

(6) Emergency response and its regulatory basis

The Emergency Decree on Remedy and Prevention of Shortage of Fuel Oils (B.E. 2516) implemented in 1973 stipulates that the Ministry of Energy adjust oil supply and demand and control prices if supply plunges due to disruptions.

(7) Challenges to oil-stockpiling development⁷

Thailand has prepared for the steady development of oil stockpiling but recent political turmoil might make it difficult for the country to move the plan forward. Therefore, Thailand will not be needing foreign assistance in achieving an oil- stockpiling development road map. Thailand, however, would like Japan to share its experiences in developing an oil-stockpiling system and hopes that Japan will engage in bilateral cooperation in areas such as capacity building.

One critical issue that Thailand faces is securing a site for the government oil stockpile, which has been difficult due to local opposition. To overcome this hurdle, Thailand has looked into the possibility of a floating oil-storage base as suggested by the Ministry of Land, Infrastructure, Transport and Tourism of Japan.

⁷ From an interview with experts conducted in February 2014 in Siem Reap, Cambodia.

2-2-3. SWOT Analysis

Table 2-2-3 shows a SWOT analysis of Thailand's oil-supply security. Thailand's major strengths are its large refining capacity and the product inventory in its refineries. The country's regular emergency drills also enhance its capability to respond unexpected events. Its notable weakness is the high oil consumption it requires to generate a unit of economic growth. Lower international crude oil prices since the summer of 2014 have provided an opportunity for the country to reduce its oil-import bills but its high import dependence continues to make it vulnerable to unexpected disruption in its oil supply.

Table 2-2-3. SWOT Matrix of Thailand's Oil-Supply Security

Strengths <ul style="list-style-type: none">• Large refining capacity• Emergency-response drill expertise	Weaknesses <ul style="list-style-type: none">• High oil intensity
Opportunities <ul style="list-style-type: none">• Lower oil prices	Threats <ul style="list-style-type: none">• Disruption in oil import• Large fluctuations in oil prices

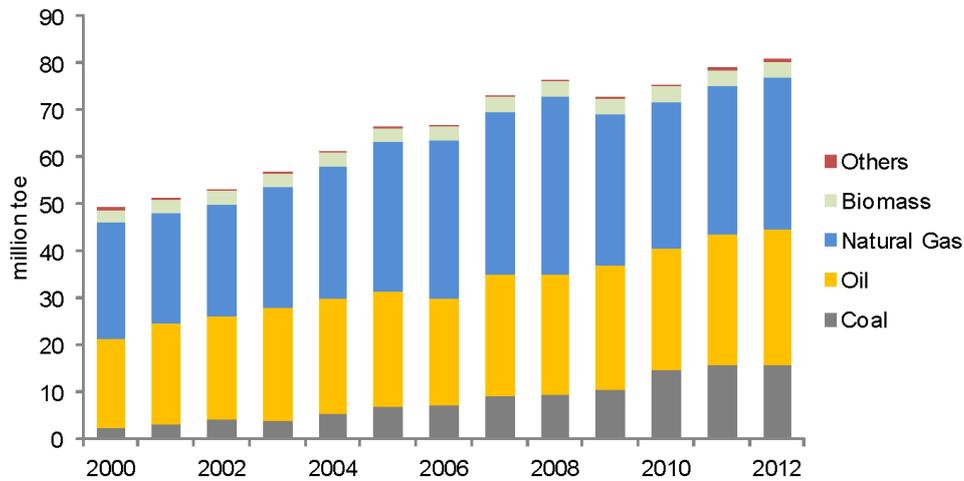
Source: The Institute of Energy Economics, Japan.

2-3. Malaysia

2-3-1. Energy supply and demand

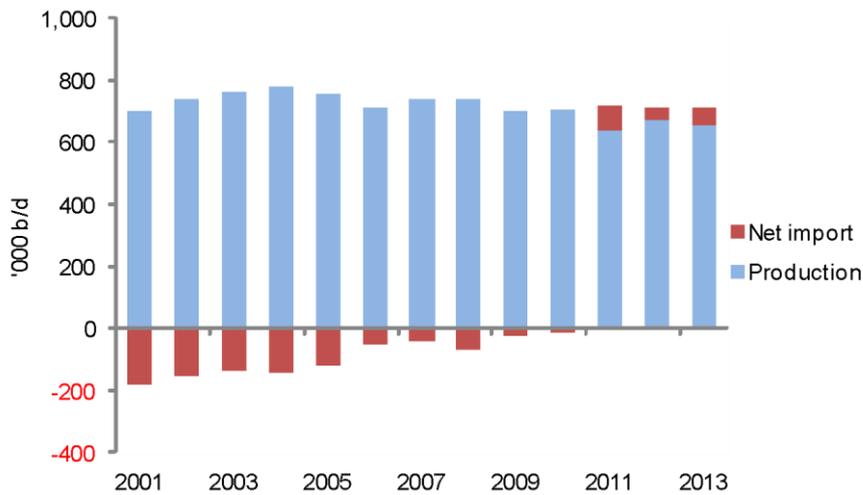
While oil and natural gas are produced domestically and satisfy the bulk of Malaysia's primary energy demands, attention should be paid to the country's increasing coal consumption. Most of the coal used in Malaysia is imported and is mainly consumed for power generation. After reaching 780,000 b/d in 2004, Malaysia's oil production has continuously decreased, making it a net oil importer in 2011.

Figure 2-3-1. Primary Energy Demand in Malaysia



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

Figure 2-3-2. Oil Supply–Demand Balance in Malaysia



Source: British Petroleum, 'Statistical Review of World Energy' (2014).

2-3-2. Overview of the oil-stockpiling system

(1) Objective

No information is available as Malaysia has not implemented an oil-stockpiling policy.

(2) Institutional framework

Energy issues are administratively segmented amongst the four ministries as follows. The Economic Planning Unit of the Prime Minister's Department is in charge of

upstream activities and Petronas. The Ministry of Domestic Trade and Consumer Affairs is responsible for licensing marketing and retail of petroleum products and petrochemical products and for coordinating the policies and regulations related to petroleum products, petrochemical products, and natural gas safety. The Ministry of International Trade and Industry administers licenses for refineries. The Ministry of Energy, Green Technology and Water oversees the power industry as well as the distribution of natural gas because Malaysia relies heavily on natural gas for power generation.

(3) Regulatory overview

Malaysia has no mandatory requirement for government or private oil stockpiling. Oil companies maintain commercial oil storage if they have a corporate strategy to follow. The Malaysian government neither considers it necessary to hold a government oil stockpile nor obligates the private sector to store oil at a certain level because oil-stockpiling development requires a huge initial investment along with maintenance costs.

Table 2-3-1. Overview of Oil Stockpiles in Malaysia

Subjects	Oil stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	No requirement but oil companies hold oil storage
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	No obligation
	Share of petroleum products	

Source: The Institute of Energy Economics, Japan.

(4) Oil-stockpiling entities and facilities

No information is available.

(5) Mandatory oil stockpile

No information is available.

(6) Emergency response and its regulatory basis

No information is available.

(7) Challenges to oil-stockpiling development⁸

At the time of this study, oil dependency was relatively low in the energy mix and Malaysia did not consider it necessary to hold oil stockpiling. Therefore, no particular issues have been raised about oil stockpiling in this economy.

2-3-3.SWOT analysis

Table 2-3-2 shows a SWOT analysis of Malaysia's oil-supply security. Malaysia's self-sufficiency in oil is its major strength while its weakness is its lack of a stockpiling system. The ongoing refining and petrochemical project (the RAPID Project) will strengthen its oil- supply security. The largest threat toward the country at the moment is its declining domestic oil production.

Table 2-3-2. SWOT Matrix of Malaysia's Oil-Supply Security

Strengths <ul style="list-style-type: none">• Domestic hydrocarbon resources• Self-sufficiency in oil supply	Weaknesses <ul style="list-style-type: none">• Lack of stockpiling system
Opportunities <ul style="list-style-type: none">• Expansion of refining capacity	Threats <ul style="list-style-type: none">• Declining oil production

Source: The Institute of Energy Economics, Japan.

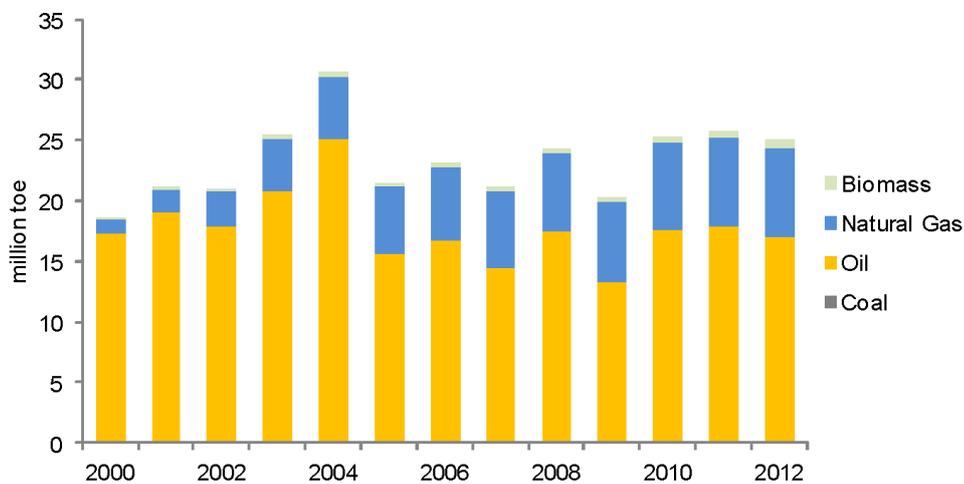
⁸ From an interview with experts conducted in February 2014 in Siem Reap, Cambodia.

2-4. Singapore

2-4-1. Energy supply and demand

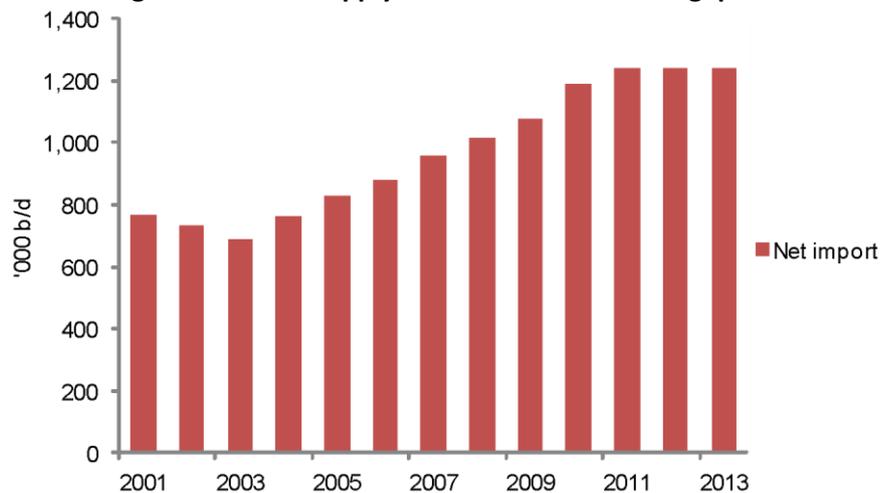
Singapore's primary energy demand is dominated mostly by oil and natural gas, all of which are imported. Singapore is the Asian hub for petroleum product trading. Singapore's total refining capacity is 1.35 million b/d and it has highly developed storage terminals, leading to an oversupply of petroleum products. As for natural gas, Singapore imports natural gas from Indonesia via pipeline. In May 2013, it started obtaining liquefied natural gas (LNG) in order to diversify supply sources.

Figure 2-4-1. Primary Energy Demand in Singapore



Source: International Energy Agency, 'Energy Balance of Non-OECD' (Paris, 2014).

Figure 2-4-2. Oil Supply–Demand Balance in Singapore



Source: British Petroleum, 'Statistical Review of World Energy' (2014).

2-4-2. Overview of the oil-stockpiling system

(1) Objective

Singapore has no specific objective to develop an oil stockpiling system.

(2) Institutional framework

Energy policy and planning is implemented by the Ministry of Trade and Industry. Under the ministry, the Energy Market Authority sets up a regulatory framework for electricity and natural gas and monitors the fuel inventory of oil-fired power plants on a monthly basis.

(3) Regulatory overview

There is no government oil stockpile in Singapore since the obligatory crude-oil stockpile was abolished in 1983 although the Singapore National Oil Company established in 1979 maintained crude-oil stockpiling until then. It is required, however, that power-generating companies hold fuel oil stocks as backup for oil-fired power plants.

Table 2-4-1. Overview of Oil Stockpiles in Singapore

Subjects	Oil stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	90 days of fuel oil stocks are required for oil-fired power plants.
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	No obligation
	Share of petroleum products	

Source: The Institute of Energy Economics, Japan.

(4) Oil-stockpiling entities and facilities

There is no oil-stockpile association.

(5) Mandatory Oil Stockpile

Power-generating companies are obligated to hold 90 days of fuel oil stock as backup for oil-fired power plants.

(6) Emergency Response and its Regulatory Basis

The government monitors real-time security developments through entities such as the Risk Assessment Horizon Scanning programming office. An appropriate interagency government committee will be organised to manage the situation depending on the risk level.

(7) Challenges to Oil-Stockpiling Development⁹

At the time of this study, there were no particular measures where the government took the initiative in developing oil stockpiling.

2-4-3. SWOT analysis

Table 2-4-2 shows a SWOT analysis of Singapore's oil-supply security. Singapore's major strengths are its surplus refining capacity and its ample oil inventory. Its major weakness is its high import dependence, which makes unexpected supply disruption a major threat. A recent expansion of oil-storage capacity in Singapore should raise oil inventory and cushion against supply disruption.

⁹ From an interview with experts conducted in February 2014 in Siem Reap, Cambodia.

Table 2-4-2. SWOT Matrix of Singapore's Oil-Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Open and competitive oil market • Surplus refining capacity • Ample oil inventory 	<p>Weaknesses</p> <ul style="list-style-type: none"> • High dependence on oil imports
<p>Opportunities</p> <ul style="list-style-type: none"> • Expansion of storage capacity 	<p>Threats</p> <ul style="list-style-type: none"> • Oil-supply disruption

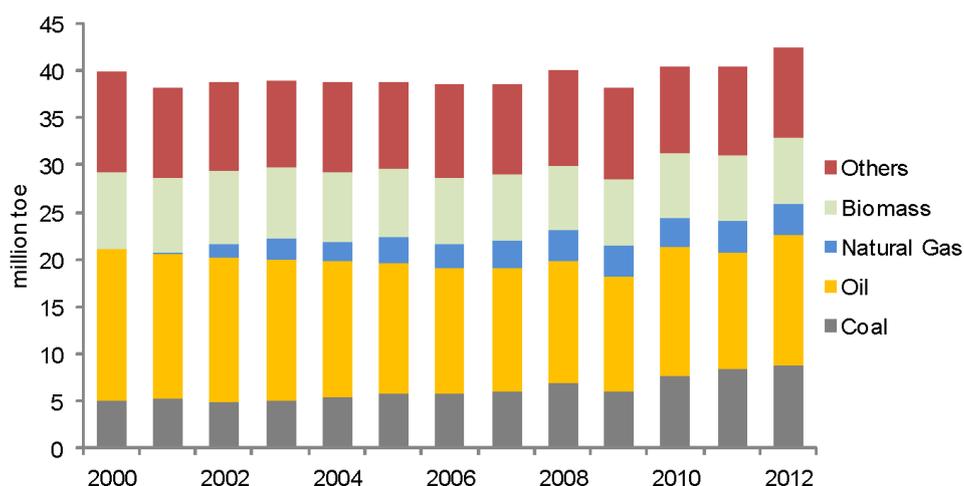
Source: The Institute of Energy Economics, Japan.

2-5. The Philippines

2-5-1. Energy supply and demand

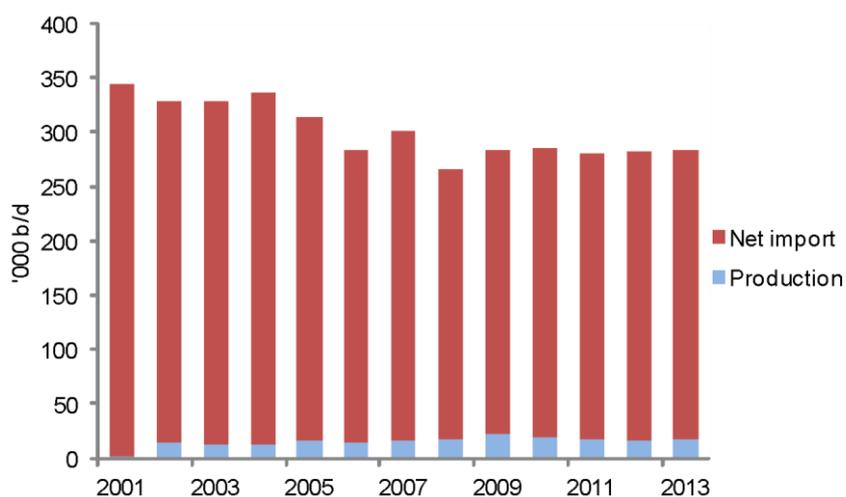
Primary energy demand in the Philippines has not increased as much as in other Asian countries while coal consumption for power generation has increased steadily. The Philippines relies on imported oil to meet almost all of its oil demand although this demand has been stagnant recently.

Figure 2-5-1. Primary Energy Demand in the Philippines



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

Figure 2-5-2. Oil Supply–Demand Balance in the Philippines



Sources: British Petroleum, 'Statistical Review of World Energy' (2014); International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

2-5-2. Overview of the oil-stockpiling system

(1) Objective

The Philippines aims to prepare an oil stockpile to deal with oil-supply disruptions caused by international events such as terrorism and the Iraq War.

(2) Institutional Framework

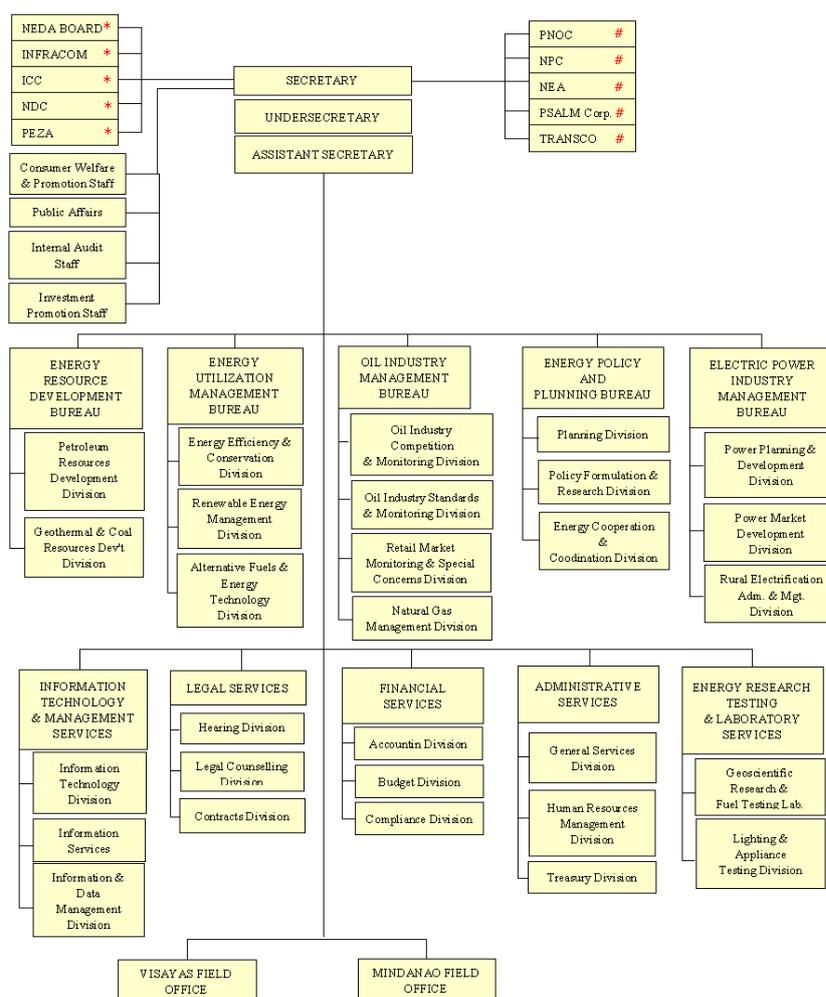
The Oil Industry Administration Bureau under the Department of Energy formulates and implements policies for the downstream oil industry, including oil stockpiling. The Department of Energy is responsible for the energy policy of the state overall. It is mandated to formulate energy policy, to revise or abolish rules and measures, to handle the privatisation of the publicly managed energy business, to develop and implement energy exploration planning, and to promote energy efficiency. The duties of the Department of Energy also include examining the appropriateness of the minimum inventory level based on Presidential Executive Order No. 134 of October 2002 and monitoring the fuel inventory of oil companies.

(3) Regulatory Overview

The Downstream Oil Industry Deregulation Act of 1996 (Republic Act No. 8180) stipulates that refiners and importers must maintain a minimum inventory equivalent to 10 percent of their respective annual sales volume or 40 days of supply, whichever is lower. However, this requirement was criticised because it served as a barrier to new players wishing to enter the oil market. Remedial legislation (RA No. 8479) enacted in February 1998 specified the abolishment of the oil-stockpiling obligation, resulting in all refiners and importers having nothing but the private oil stockpile necessary to run their business.

Presidential Executive Order No. 134 promulgated in October 2002 required refiners and importers to hold a minimum inventory. This was followed by regulations passed in January 2003 that required 40 days' worth of supply for refiners and 30 days for importers. The Department of Energy then eased the minimum inventory requirement in March 2003. The current requirement is 30 days' worth of in-country stocks of crude/petroleum products for refiners, 15 days of in-country stocks of finished products for importers, 7 days for bunkering companies, and 7 days for distributors of liquefied petroleum gas (LPG).

Figure 2-5-3. Organisational Chart of Department of Energy, Philippines



Source: Website of the Philippine Department of Energy.

Table 2-5-1. Overview of Oil Stockpiles in the Philippines

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Minimum inventory of 15 days of supply
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country

Source: The Institute of Energy Economics, Japan.

(4) Oil-Stockpiling Entities and Facilities

Private refiners and other oil companies hold oil stockpiles.

(5) Mandatory Oil Stockpile

The minimum inventory required by the government is 15 days' worth of supply for refiners, seven days for bunkering companies, and seven days for LPG distributors. They are obligated to store crude oil and petroleum products but there are no specific requirements for each product. While the Department of Energy monitors the inventory level that the domestic refiners (Petron and Shell) are required to report every month, quality control and specification changes in the stocks of the petroleum products are left to the discretion of private companies.

(6) Emergency Response and its Regulatory Basis

In accordance with Republic Act No. 7638, the Department of Energy shall control the demand, distribution, and prices of oil only in case of emergencies, such as a presidential decree being proclaimed. The Philippines is a member economy of the ASEAN Petroleum Security Agreement (henceforth, APSA), which was established in 1986 to cope with situations involving oil-supply shortage and oversupply.¹⁰ In the event of an oil-supply shortage, the APSA would be exercised if the oil supply available was less than 80 percent of the domestic requirements of the oil-importing member countries such as the Philippines and Thailand. In that case, the oil-exporting members of the ASEAN--Indonesia, Malaysia, and Brunei Darussalam--would be committed to supply them with oil as priority. The APSA, however, has never been issued before.

2-5-3. SWOT analysis

Table 2-5-2 shows a SWOT of the Philippines's oil-supply security. The major strengths of the country are its open oil market and its market pricing of oil products. This combination will help secure oil supply from abroad through a market mechanism in case of an emergency. The county's high dependence on oil imports is the major weakness in

¹⁰ Association of Southeast Asian Nations. 'ASEAN Petroleum Security Agreement Manila', 24 June 1986. <http://www.asean.org/communities/asean-economic-community/item/asean-petroleum-security-agreement-manila-24-june-1986> (accessed on 10 November 2014).

its oil- supply security. Lower international crude oil prices since the summer of 2014 provide an opportunity for the country to reduce its oil-import bills but its high import dependence continues to make it vulnerable to unexpected disruptions in oil supply.

Table 2-5-2. SWOT Matrix of the Philippines’s Oil-Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Open oil market • No subsidies given to oil products 	<p>Weaknesses</p> <ul style="list-style-type: none"> • High import dependence
<p>Opportunities</p> <ul style="list-style-type: none"> • Lower oil prices 	<p>Threats</p> <ul style="list-style-type: none"> • Disruption in oil imports • Large fluctuations in oil prices

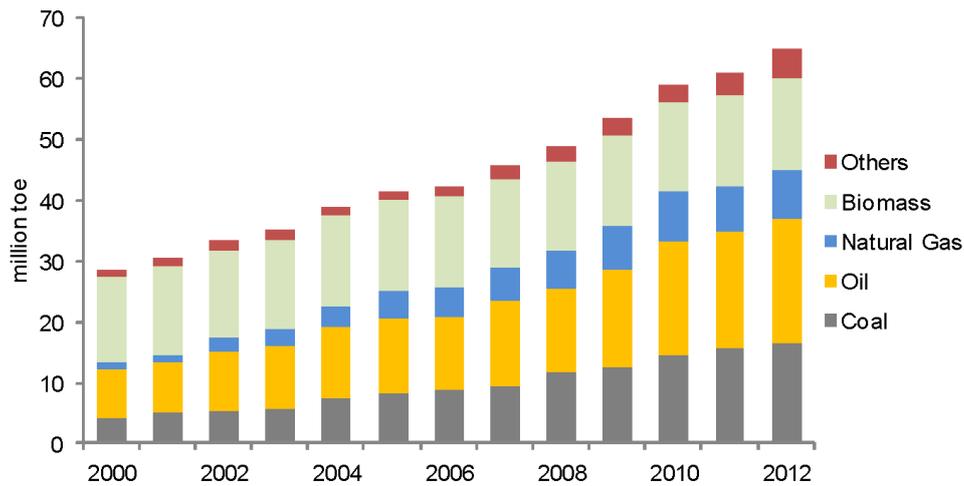
Source: The Institute of Energy Economics, Japan.

2-6. Viet Nam

2-6-1. Energy supply and demand

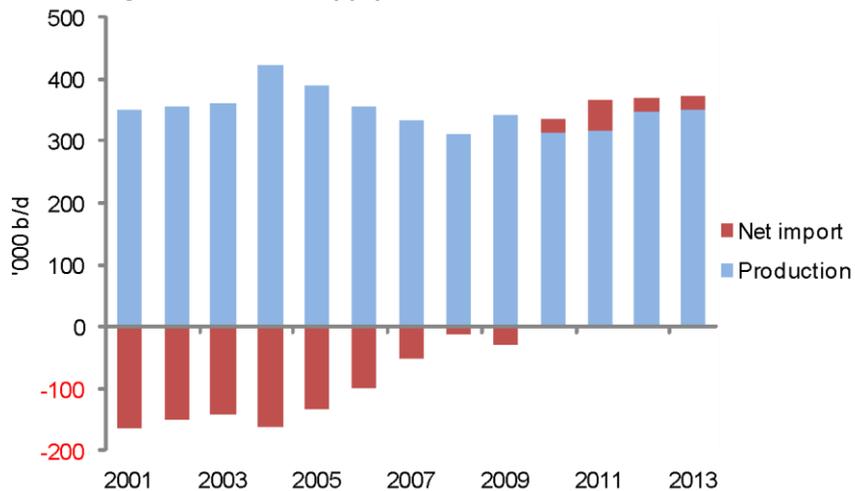
Viet Nam’s primary energy demand for all energy sources demonstrates robust growth. Viet Nam’s oil production is about 300,000 b/d, half of which is exported. Viet Nam imports most of its oil requirements to meet its demand for petroleum products but this demand is expected to decline since the first refinery built in Dung Quat (in the central region of Viet Nam) began operation in 2009. Furthermore, there are plans for some refinery-building projects.

Figure 2-6-1. Primary Energy Demand in Viet Nam



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

Figure 2-6-2. Oil Supply–Demand Balance in Viet Nam



Source: British Petroleum, 'Statistical Review of World Energy' (2014).

2-6-2. Overview of the oil-stockpiling system

(1) Objective

Viet Nam aims to develop its oil-stockpiling system to stabilise its domestic oil-consuming market and the productive capacity of its oil refineries, enhance energy security, and keep up with the development of the domestic oil market as the country anticipates rising demand for domestic oil and dependence on imports of crude oil and petroleum products. Viet Nam also intends to minimise any negative impacts on its economy if the global supply of crude oil suddenly declines. Likewise, it also seeks to

improve economic efficiency to protect against sudden increases in the price of crude oil.

(2) Institutional Framework

The Ministry of Industry and Trade is responsible for the management of government oil stockpiling. Other concerned ministries include the National Stockpiling Department under the Ministry of Finance, which consists of central and regional offices and the National Stockpiling Units.

(3) Regulatory Overview

The Law on the National Reserve (No. 22/2012/QH13) prescribes the formation, management, administration, and use of the national reserves of strategic and essential commodities, including oil. Article 3, titled ‘Objectives of the National Reserve,’ stipulates that ‘the State forms and uses the national reserve to proactively meet unexpected and urgent requirements in the prevention, combat, and remedy of consequences of natural disasters, catastrophes, fires and epidemics and to serve national defence and security.’ The national reserves are to be used to stabilise the economy and to cope with emergency situations.

Table 2-6-1. Overview of the Oil Stockpiles in Viet Nam

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Importers of petroleum products
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	Not mandatory
	Share of petroleum products	100%

Source: The Institute of Energy Economics, Japan.

In July 2009, the prime minister approved the 'Development Planning of Reserve System of Crude Oil and Petroleum Products of Vietnam to the Year 2015, A Vision Toward 2025 (Decision No. 1139/QD-TTg).' According to this decision, there are plans for the commercial petroleum reserve to be equivalent to about 66 days of net import in 2015 and the national reserve of crude oil to reach 2.2 million tons by 2025.

(4) Oil-Stockpiling Entities and Facilities

At the time of this study, only oil companies maintain oil stockpiling in their own facilities. There are plans for government crude oil terminals to be built near or adjacent to domestic petrochemical refineries.

(5) Mandatory Oil Stockpile

Oil companies are obliged to maintain a volume of reserve amounting to at least 30 days' worth of net imports.

Table 2-6-2. Viet Nam's Road Map and Scale of Crude Oil and Oil-Product Stockpiling System

Type of stocks		Unit	2015	2020	2025
Commercial stock		Million tonnes	1.6	2.6	3.6
		Days of consumption	30	30	30
Processing stock	Crude oil	Million tonnes	0.2	1.5	1.5
		Days of consumption	10.2	12.2	9.2
	Products	Million tonnes	0.6	0.7	0.7
		Days of consumption	10.3	8.1	6.2
National stock	Crude oil	Million tons	-	0.7	2.2
		Days of consumption	-	5.8	12.4
	Products	Million tons	0.4	0.4	1.3
		Days of consumption	7.1	5.0	10.4
Total oil stockpiling		Million tons	2.8	5.9	9.3
		Days of consumption	58	61	68
		Days of net import	126	90	90

Source: Viet Nam's Ministry of Industry and Trade.

(6) Emergency Response and its Regulatory Basis

The build-up and release of national reserve commodities is regulated in Section 1 of Chapter IV under the Law on the National Reserves. In principle, build-up and release of national reserve commodities must conform to plan and competence (Article 33). Article 35 specifies that the prime minister will decide on the build-up and release of national reserve commodities in the following circumstances: (i) an occurrence of natural disasters, catastrophes, epidemics or fires, and preventing and overcoming the

consequences of such unexpected situations; (ii) when market prices soar or plunge significantly; or (iii) to meet defence or security requirements. Not only the prime minister but also the ministers for finance, national defence, public security, and agriculture and rural development are authorised to decide on the build-up and release of national reserve commodities under Article 36 with provisions for (i) temporarily delivering national reserve supplies and equipment to accomplish tasks in a timely manner and recovering such commodities for maintenance, rebuild-up, and preservation immediately after the tasks are completed and (ii) building or releasing a free supply of national reserve commodities with a value that is within the budget expenditure.

(7) Challenges to Oil-Stockpiling Development¹¹

In addition to the existing commercial tanks of petroleum products, Viet Nam is in the process of building a terminal for the government stockpile of crude oil near or adjacent to the refineries in four regions where a refinery is already in operation or will be built in the future; namely, Dung Quat, Nghi Son, Long Son, and Van Phong. The Government of Viet Nam is indifferent to having an oil stockpile abroad, such as oil stock tickets or joint oil storage, but it is rather interested in attracting investments and receiving technical assistance from abroad. Viet Nam is focused on the development of oil stock terminals based on the National Stockpile Master Plan. It also appears that Viet Nam would like Japan to share its know-how and information on the maintenance costs for the different types of bases and the management of oil-stockpiling bases.

The government is deliberating on which type of facility would be suitable for the national stockpile of crude oil. Since on-ground tanks have been the most commonly used thus far to store petroleum products in commercial oil stocks, the next task for the government is to decide what type of terminals should be built for Viet Nam. Korea National Oil Corporation (KNOC) is involved in the underground Dung Quat oil-storage project in cooperation with PetroVietnam Oil Stockpile Company Ltd.

¹¹ From an interview with experts conducted in February 2014 in Siem Reap, Cambodia.

2-6-3. SWOT analysis

Table 2-6-3 shows a SWOT analysis of Viet Nam’s oil-supply security. The major strengths of the country are, of course, its hydrocarbon resources. The country’s well-established oil stockpiling roadmap also provides a good guide for its stockpiling policy. Its insufficient refining capacity is notable as a weakness but the country is planning to significantly expand its refining capacity. Viet Nam’s very high oil intensity is another weakness. Lower international crude oil prices since the summer of 2014 provide an opportunity for the country to reduce its oil-import bills but its high import dependence continues to make it vulnerable to any unexpected disruption in the oil supply.

Table 2-6-3. SWOT Matrix of Viet Nam’s Oil Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Domestic hydrocarbon resources • Well-established oil-stockpiling road map 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Insufficient refining capacity and tank storage • Lack of stockpiling base • High oil intensity
<p>Opportunities</p> <ul style="list-style-type: none"> • Refining construction projects • Lower oil prices 	<p>Threats</p> <ul style="list-style-type: none"> • Disruption in oil import • Large fluctuations in oil prices

Source: The Institute of Energy Economics, Japan.

2-7. Brunei Darussalam

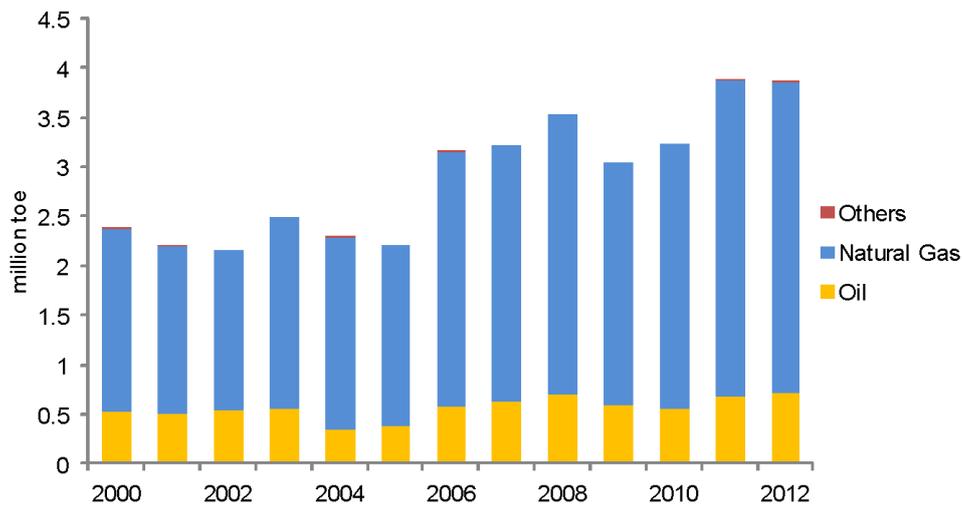
2-7-1. Energy supply and demand

The primary energy demand of Brunei Darussalam is dominated by natural gas and oil due to the fact that the economy is endowed with hydrocarbon resources. Natural gas accounts for 99 percent of the electricity generation mix in Brunei.

Brunei is a net exporter of oil and natural gas and the fourth-largest exporter of LNG in the Asia–Pacific region. Although the economy exports approximately 90 percent of its crude oil, petroleum products have to be imported due to the limited capacity of the country’s sole refinery, Seria, which currently stands at 8,600 b/d. Excess demand for

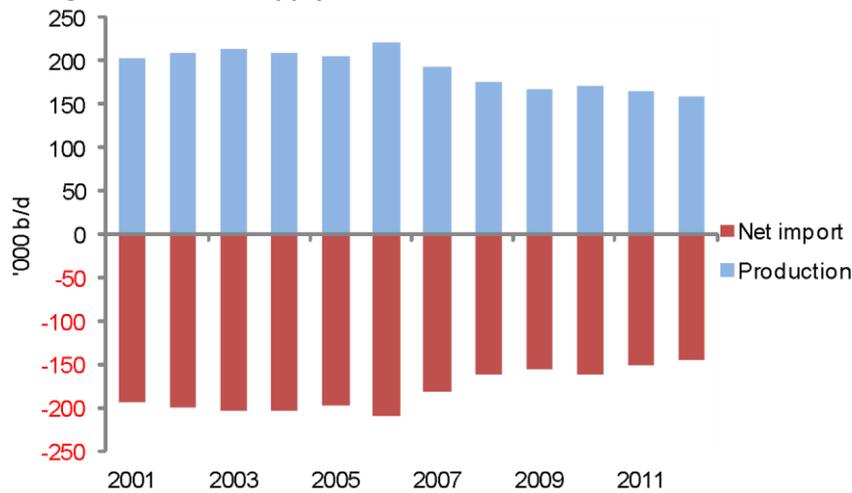
petroleum products is likely to continue in the medium term.¹² In the future, however, this situation may change as the Chinese petrochemical firm Zhejiang Hengyi Group Co., Ltd is undertaking a project to construct a refinery and aromatics cracker plant with a capacity of 160,000 b/d on Pulau Muara Besar Island. This plant is expected to start operation in late 2017.

Figure 2-7-1. Primary Energy Demand in Brunei Darussalam



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

Figure 2-7-2. Oil Supply–Demand Balance in Brunei Darussalam



Sources: British Petroleum, 'Statistical Review of World Energy' (2014) and International Energy Agency, 'Energy Balance of Non-OECD Countries' (Paris, 2014).

¹² 'Country Report Brunei Darussalam: Petroleum Products Stockpiling' was presented at the 2nd Workshop of the ASEAN+3 Oil Stockpiling Road Map in Siem Reap, Cambodia, on 25 February 2014.

2-7-2. Overview of the Oil-Stockpiling System

(1) Objective

Brunei has no specific objective to develop an oil-stockpiling system since it is a net oil exporter.

(2) Institutional Framework

The energy department under the Prime Minister's Office is responsible for formulating energy policies and presiding over energy matters.

(3) Regulatory Overview

Brunei's Energy Contingency Plan for Refined Petroleum Product Imports sets the obligatory level of stockholding at 31 days for the industry.¹³ The emergency stock is called the Countrywide Stock.

Table 2-7-1. Overview of the Oil Stockpiles in Brunei Darussalam

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Oil companies are requested to maintain a stockholding level of 31 days.
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or petroleum products	Share of crude oil	No obligation
	Share of petroleum products	

Source: The Institute of Energy Economics, Japan.

¹³ International Energy Agency (2014), 'Energy Supply Security 2014', Paris: IEA.

(4) Oil-Stockpiling Entities and Facilities

There is no oil-stockpile association.

(5) Mandatory Oil Stockpile

Oil companies are directed to hold petroleum products for domestic requirement on an operational basis.¹⁴

(6) Emergency Response and its Regulatory Basis

In the event of emergency, the government has a preferential right to purchase crude oil and petroleum products produced domestically.

(7) Challenges to Oil-Stockpiling Development

It is necessary for Brunei to develop legislation that obligates oil companies to stockpile for a certain period of time. The economy currently has the directive to make requests to the industry about oil stockpiling but the legal terms need to be upgraded to make it more persuasive.

2-7-3. SWOT analysis

Table 2-7-2 shows a SWOT analysis of Brunei's oil-supply security. A major strength is, of course, its domestic hydrocarbon resources and the country's self-sufficiency in its oil supply. A weakness is the lack of refining capacity and of a stockpiling system. The recent expansion of refining and tank capacity is undoubtedly an opportunity for Brunei while the unexpected disruption of product imports will remain a major threat.

¹⁴ 'APEC EWG 40 Brunei Darussalam - Short-Term Energy Security Initiative Measures' is available at http://apecenergy.tier.org.tw/database/db/ewg40/02/PU_short_term_initve.pdf (accessed on 1 December 2014).

Table 2-7-2. SWOT Matrix of Brunei Darussalam’s Oil-Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Domestic oil and gas production • Smaller population and demand • Self-sufficiency in its oil supply 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Lack of refinery • Lack of product stockpiling system
<p>Opportunities</p> <ul style="list-style-type: none"> • Expansion of refining capacity and tank-storage capacity in neighbouring ASEAN countries 	<p>Threats</p> <ul style="list-style-type: none"> • Disruption in product imports • Large fluctuations oil prices

Source: The Institute of Energy Economics, Japan.

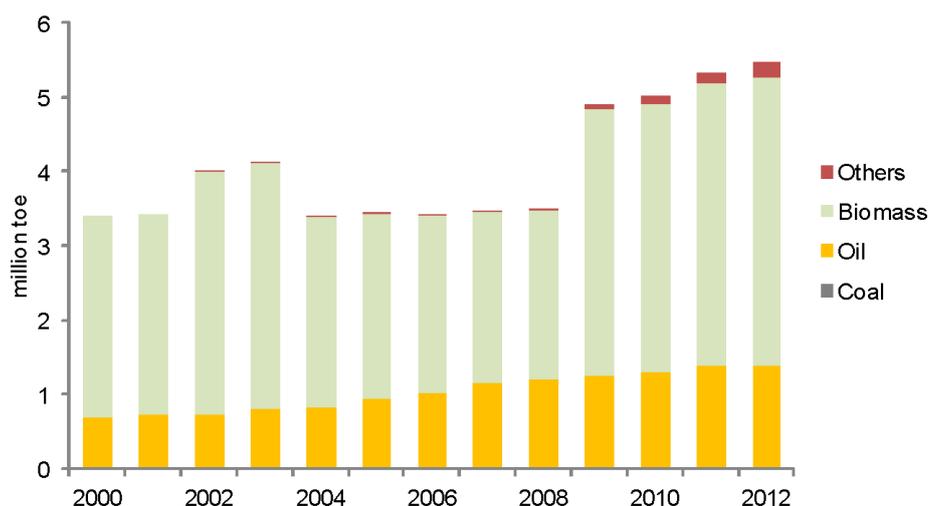
2-8. Cambodia

2-8-1. Energy supply and demand

In Cambodia, biomass accounts for approximately 71 percent of the primary energy demand followed by oil; that is, petroleum products. The primary energy demand for petroleum products almost doubled from 694 kilotonnes of oil equivalent (ktoe) in 2000 to 1,374 ktoe in 2012. ‘Other’ indicates hydro and electricity imports from Thailand and Viet Nam.

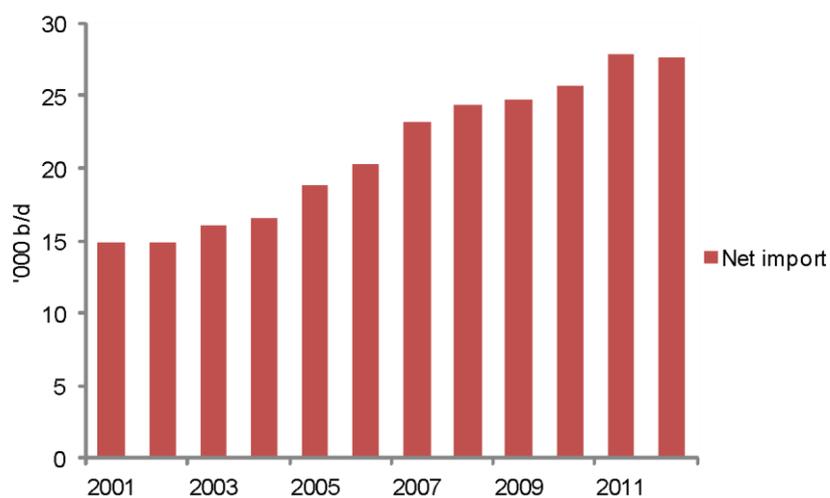
As shown in Figure 2-8-1, Cambodia is totally dependent on imports of petroleum products, which comes primarily from Singapore, Thailand, and Viet Nam. The major imported petroleum products are diesel and gasoline. Petroleum products are important in power generation in Cambodia, accounting for 60 percent of the energy-generation mix in 2012.

Figure 2-8-1. Primary Energy Demand in Cambodia



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (2014).

Figure 2-8-2. Oil Supply–Demand Balance in Cambodia



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries' (2014).

2-8-2. Overview of the oil-stockpiling system

(1) Objective

Considering the fact that Cambodia relies on imports to meet all of its oil-product demand as well as for electricity, the country has only recently recognised the importance of energy security.

(2) Institutional Framework

The Ministry of Mines and Energy is responsible for developing, implementing, and managing government policy and strategy with regard to three sectors: mineral resources, energy, and petroleum. The General Department of Petroleum is responsible for managing the development of the Cambodian petroleum industry, both upstream and downstream.

(3) Regulatory Overview

Cambodia has no regulatory framework that requires oil stockpiling.

Table 2-8-1. Overview of Oil Stockpiles in Cambodia

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	Oil companies are requested to have a stockholding level equivalent to at least 30 days of domestic oil consumption.
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	
	Share of petroleum products	100%

Source: The Institute of Energy Economics, Japan.

(4) Oil-Stockpiling Entities and Facilities

No information is available.

(5) Mandatory Oil Stockpile

In Cambodia, the oil industry is obligated to hold oil stockpiles equivalent to at least 30 days of domestic oil consumption.

(6) Emergency Response and its Regulatory Basis

No information is available.

(7) Challenges to Oil-Stockpiling Development

The legal environment in Cambodia is not yet well developed. It is necessary to establish a comprehensive legal framework to regulate oil-industry activities in Cambodia. The Petroleum Regulations of 1991 have been used so far to attract investments in oil exploration and development. In addition, a draft of a petroleum law expected to provide clear investment conditions in accordance with international standards is expected to be finalised by the end of 2015. Still, Cambodia will need a rationale to help develop the oil- stockpiling system.

2-8-3. SWOT analysis

Table 2-8-2 shows a SWOT analysis of Cambodia's oil-supply security. A major strength of the country is its open market policy in the oil market. It is expected that its market mechanism and the presence of various players, including foreign oil companies, will function well in the event of an emergency. Its largest weaknesses are its lack of domestic production and its high dependence on oil product imports. This makes an unexpected disruption of product imports the major threat to oil-supply security. Recent investments from China in the refining sector as well as the international cooperation with the Japan Oil, Gas and Metals National Corporation are great opportunities for the country to enhance its oil-supply security.

Table 2-8-2. SWOT Matrix of Cambodia's Oil-Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Open and competitive market • No subsidies 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Lack of refining capacity • Lack of stockpiling system • No domestic oil production and high dependence on imports
<p>Opportunities</p> <ul style="list-style-type: none"> • Foreign investments in refinery • Planning and technical cooperation with the Japan Oil, Gas and Metals National Corporation 	<p>Threats</p> <ul style="list-style-type: none"> • Disruption of product imports • Large fluctuations in oil prices

Source: The Institute of Energy Economics, Japan.

2-9. Lao People's Democratic Republic

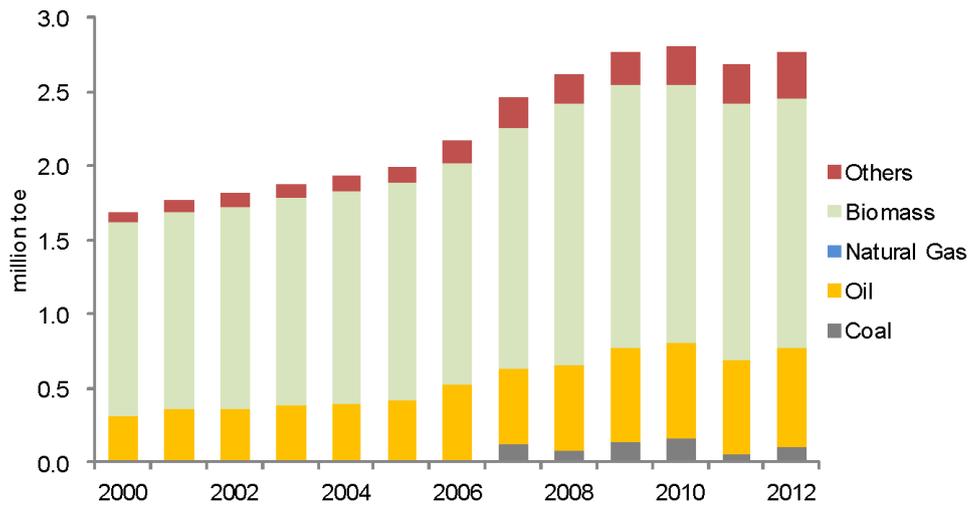
2-9-1. Energy supply and demand

In the Lao PDR, biomass (e.g. firewood, charcoal) has been dominant in the primary energy mix. 'Other' includes hydro and electricity exports to neighbouring countries.

Lao PDR is not engaged in the exploration or production of hydrocarbons and has no refinery. Therefore, it imports all its petroleum products from Thailand and Viet Nam. As of September 2014, diesel accounted for 60 percent of the imported products followed by gasoline at 33 percent.¹⁵

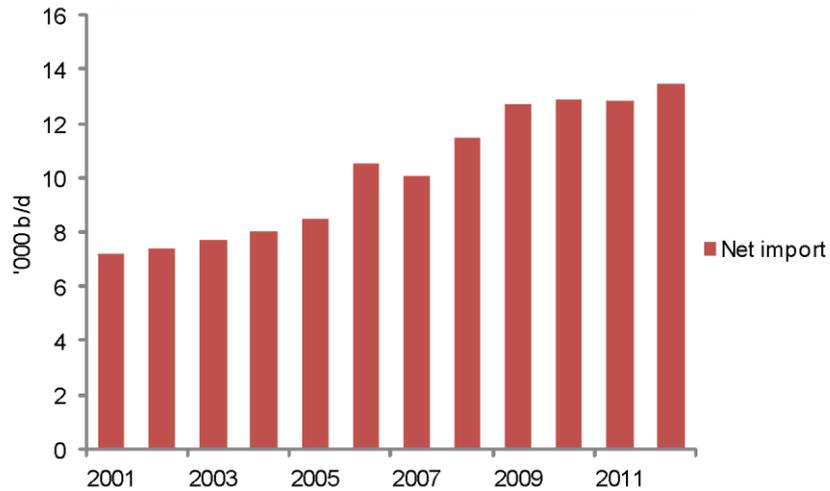
¹⁵ 'The Latest Development on Oil and Gas in Lao People's Democratic Republic' was presented at the 4th ASEAN+3 Oil Market and Natural Gas Forum, 5 February 2015, Bangkok, Thailand.

Figure 2-9-1. Primary Energy Demand in Lao PDR



Source: Lao Ministry of Mines and Energy.

Figure 2-9-2. Oil Supply–Demand Balance in Lao PDR



Source: Lao Ministry of Mines and Energy.

2-9-2. Overview of the oil-stockpiling system

(1) Objective

Lao PDR has no specific objective to develop an oil-stockpiling system.

(2) Institutional Framework

The Ministry of Energy and Mines under the Prime Minister's Office is the central agency in charge of the energy sector.

(3) Regulatory Overview

Clause 5 under Prime Minister's Decree No. 76/PM dated 12 June 2014 specifies that by the year 2020, government petroleum reserves must be available in the quantity of 60 million litres, which is equivalent to 30 days of consumption.¹⁶

Table 2-9-1. Overview of the Oil Stockpile in Lao PDR

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	No requirement
	Agency	
	Private	The oil industry is requested to maintain at least 15 days' worth of oil imports.
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or Petroleum products	Share of crude oil	
	Share of petroleum products	100%

Source: The Institute of Energy Economics, Japan.

(4) Oil-Stockpiling Entities and Facilities

No information is available.

(5) Mandatory Oil Stockpile

The oil industry is obligated to hold at least 15 days' worth of oil imports. As the aforementioned regulation states, the government aims to establish public petroleum reserves of 60 million litres, which is equivalent to 30 days of consumption.

(6) Emergency Response and its Regulatory Basis

No information is available.

¹⁶ Ibid.

(7) Challenges to Oil-Stockpiling Development

While Lao PDR seems to have an interest in establishing government oil stockpiling, there may be some work to do for that purpose. For instance, it is necessary to clarify which entity would be responsible for the oil-stockpiling development project as doing so would help coordinate the related parties and move things forward. Also, more detailed regulations or procedures may be needed to define how an oil stockpile would be developed and used. Last but not least, it is critical to secure the financial resources to build an oil-stockpiling base. These costs vary depending on what kind of oil-stockpiling base the country desires. Being a landlocked country, Lao PDR faces the possibility of oil-supply disruptions if a transport route is blocked. Therefore, it would be beneficial for it to expand its oil-stockpiling capacity to prepare for an emergency event.

2-9-3. SWOT analysis

Table 2-9-2 shows a SWOT analysis of Lao PDR's oil-supply security. A major strength of the country is that its oil intensity is the lowest amongst ASEAN economies, making its economy more resilient to oil-supply disruption. Its weaknesses are almost the same as other ASEAN countries. Its geological condition of having no naval transportation routes may limit options to secure the oil supply in the event of an emergency. Because neighbouring countries such as Viet Nam and Cambodia are currently working to expand their oil-supply infrastructure, such capacity expansion will indirectly benefit Lao PDR's oil-supply security, too. A major threat toward the country is the unexpected disruption of product imports.

Table 2-9-2. SWOT Matrix of Lao PDR's Oil Supply Security

<p>Strengths</p> <ul style="list-style-type: none"> • Smaller market size • Low oil intensity 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Lack of refining capacity • Lack of stockpiling system • Lack of naval transportation means • High dependence on oil-product imports
<p>Opportunities</p> <ul style="list-style-type: none"> • Expansion of refining capacity and tank storage in neighbouring countries 	<p>Threats</p> <ul style="list-style-type: none"> • Disruption in product imports • Large fluctuations in oil prices

Source: The Institute of Energy Economics, Japan.

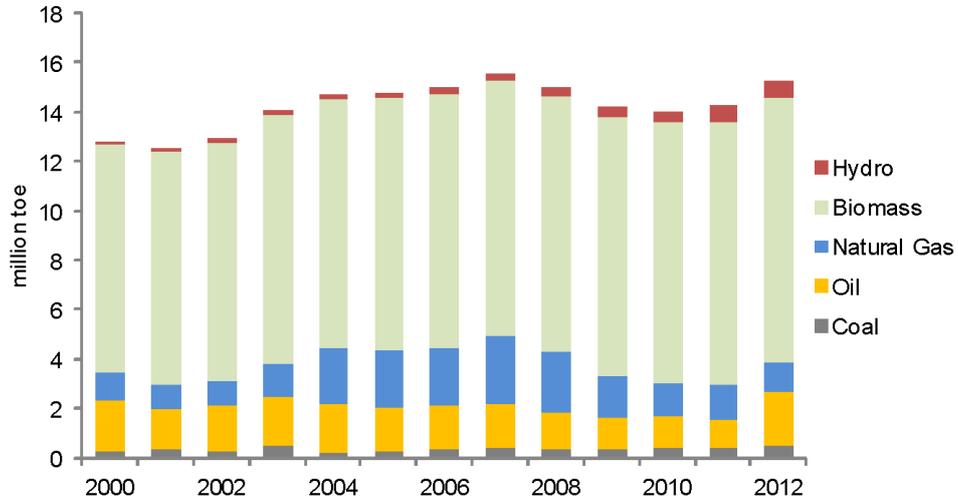
2-10. Myanmar

2-10-1. Energy supply and demand

Myanmar is heavily dependent on biomass such as fuel wood, which accounted for 70 percent of the primary energy demand in 2012. Hydro is the major source for power generation and accounted for 72 percent of electricity output in 2012.

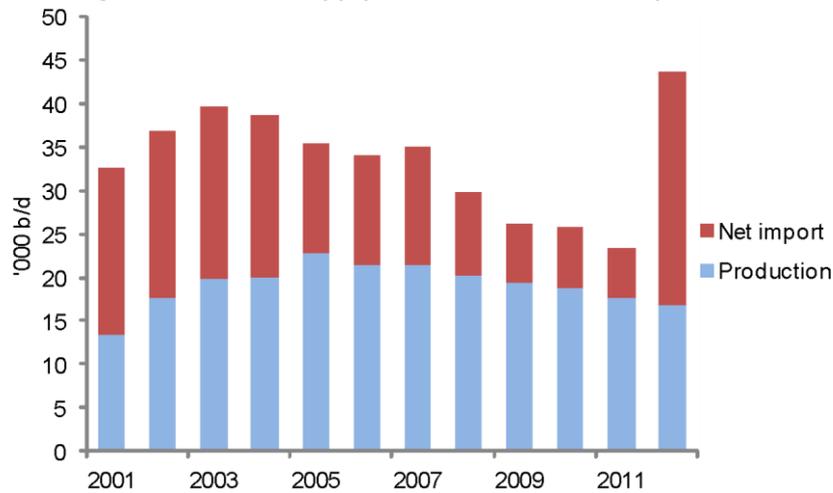
Petroleum products are imported to make up for declining oil production as well as limited refinery capacities due to aging. Myanmar has attempted to replace petroleum products with natural gas to suppress oil demand in the industry and transport sectors. In 2012, however, oil demand increased significantly, driven by robust economic growth.

Figure 2-10-1. Primary Energy Demand in Myanmar



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries', (Paris, 2014).

Figure 2-10-2. Oil Supply-Demand Balance in Myanmar



Source: International Energy Agency, 'Energy Balance of Non-OECD Countries', (Paris, 2014).

2-10-2. Overview of the oil-stockpiling system¹⁷

(1) Objective

Myanmar's oil-stockpiling development plan will be implemented and progressed to achieve the target of the ASEAN. The plan may need to be revised in accordance with the country's economic development and financial situations.

¹⁷ Interview with the Energy Planning Department of the Ministry of Energy conducted at Nay Pyi Taw, Myanmar, on 9 December 2014.

(2) Institutional Framework

The National Energy Management Committee (NEMC) formed in January 2013 to coordinate amongst the ministries related to energy is supposed to take over the role of the energy planning department within the Ministry of Energy..

(3) Regulatory Overview

Necessary laws, rules, regulations, and procedures regarding oil stockpiling are expected to be approved in 2015. In addition, the NEMC is working on a draft of a National Energy Security Strategy that will cover oil stockpiling. Specifically, the strategy is anticipated to include plans for when emergency stocks are added and for any changes to the stockholding regime.

Table 2-10-1. Overview of the Oil Stockpiles in Myanmar

Subjects	Oil-stockpiling systems	Measures
Oil stockpiling body	Government	The MOE/NEMC is required to hold 2.7 million bbl of crude oil.
	Agency	No requirement
	Private	Commercial stocks
Oil stockpile standards	International Energy Agency (IEA) rules	Non-IEA member country
Crude oil and/or petroleum products	Share of crude oil	The government will hold mainly crude oil whereas the private sector will stock petroleum products.
	Share of petroleum products	

Source: The Institute of Energy Economics, Japan.

(4) Oil-Stockpiling Entities and Facilities

The Ministry of Energy (or the NEMC in the future) is responsible for oil stockpiling and is required to hold 2.7 million bbl of crude oil. The government holds oil stocks in a storage tank which the state-owned oil company uses as inventory but there is no public stock purely for emergency purposes. Other oil stocks are mostly commercial stocks needed for regular operation.

There is a plan to establish a joint venture between the country's refinery sector and foreign investors. It is believed that if this joint venture is created and successfully

managed, it would enhance the storage capacity of crude oil and petroleum products.

(5) Mandatory Oil Stockpile

An oil-stockpiling development road map is laid out in the draft of the Energy Security Plan. According to the plan, the oil-stockpiling capacity target is to achieve 30 days reserve by 2020, 45 days by 2030, and 90 days by 2050. It is still not clear whether this oil-stockpiling target road map would be carried out by the government alone or with the cooperation of private companies. Although private companies have storage-capacity expansion targets for 2025, it does not necessarily mean that they are mandated by the government. It could mean that the private sector would need the increased storage for commercial purposes.

Table 2-10-2. Oil-Stockpiling Target Road Map

Type of stock		Stock quantity	Target				
			2013	2014	2015	2020	2025
Commercial stock		Million bbl	0.14	0.24	0.28	0.41	0.61
		Days of consumption	3	4	6	8	12
Government oil stockpiling system	Crude oil	Million bbl	0.75	0.80	0.80	0.75	0.65
		Days of consumption	10	12	12	10	9
	Products	Million bbl	0.52	1.37	1.40	1.50	1.68
		Days of consumption	11	23	28	30	33
Total oil stockpiling		Million bbl	1.41	2.41	2.48	2.66	2.94
		Days of consumption	24	39	46	48	54
		Days of net import	11	21	26	28	32

Source: Interview with the Energy Planning Department of the Ministry of Energy conducted at Nay Pyi Taw, Myanmar, on 9 December 2014.

(6) Emergency Response and its Regulatory Basis

In terms of measures to deal with oil-supply disruptions, the Myanmar government considers 14 days of emergency oil stockpiling to be necessary. If the oil stock is not enough, Myanmar would rely on imported petroleum products.

(7) Challenges to Oil-Stockpiling Development

Myanmar needs a data management system for oil-stockpiling development. Data management is essential to make the system work properly. If a data management system is efficiently applied, the performance of the oil-stockpiling system would improve.

2-10-3. SWOT analysis

Table 2-10-3 shows a SWOT analysis of Myanmar's oil-supply security. A major strength of the country is its low dependence on oil in its energy mix, which is the lowest amongst the ASEAN countries. Its weaknesses are its insufficient refining capacity and its lack of a stockpiling system like many other ASEAN countries. Ongoing projects to introduce foreign investments into the refining and marketing sectors will enhance oil-supply security. A major threat for the country is any unexpected disruption of oil-product imports.

Table 2-10-3. SWOT Matrix of Myanmar's Oil Supply Security

Strengths <ul style="list-style-type: none">• Lower oil dependence	Weaknesses <ul style="list-style-type: none">• Insufficient refining capacity• Lack of stockpiling system
Opportunities <ul style="list-style-type: none">• Ongoing project to form joint ventures in the refining and marketing sectors	Threats <ul style="list-style-type: none">• Disruption in product imports• Large fluctuations in oil prices

Source: The Institute of Energy Economics, Japan.

Chapter 3

Challenges for ASEAN Countries' Oil-Stockpiling Development

Based on the previous chapter's reviews of each ASEAN country's oil supply-demand balance and stockpiling policies, this chapter aims to identify what kind of challenges ASEAN countries will face in their future stockpiling development efforts. There are several challenges common to all ASEAN countries while some countries have their own set of challenges. The major challenges are shown in Table 3-0-1.

Table 3-0-1. Challenges for Stockpiling Policies in Selected ASEAN Countries

	Common challenges				Country-specific challenges		
	Accurate and timely statistics	Regional cooperation (APSA)	Securing finance	Expanding stockpiling capability and volume	Detailed oil stockpiling development planning	Emergency exercises	Interim measures
Cambodia	✓	✓	✓	✓	✓	✓	✓
Indonesia	✓	✓	✓	✓		✓	
Lao PDR	✓	✓	✓	✓	✓	✓	✓
Myanmar	✓	✓	✓	✓		✓	✓
Philippines	✓	✓	✓	✓	✓	✓	✓
Thailand	✓	✓	✓	✓	✓		
Viet Nam	✓	✓	✓	✓		✓	✓
Net exporters							
Brunei				N/A			
Malaysia				N/A			
Large storage capacity and inventory							
Singapore				N/A			

Source: Based on the reviews in Chapter 1 and interviews with each country's government officials conducted by the ASEAN Centre for Energy (ACE) and the Institute of Energy Economics, Japan (IEEJ) in December 2014.

Because Malaysia and Brunei are net oil exporters as of 2012, and Singapore has plenty of storage capacity and physical inventory of oil products in its territory, these three countries are excluded from the table.

The following four items are considered as common challenges for the seven ASEAN countries, excluding Malaysia, Brunei, and Singapore:

- Developing accurate and timely statistics to understand the current oil market balance and to analyse future demand size to identify the appropriate level of stockpiling inventory;
- Promoting regional cooperation, particularly the operationalisation of the APSA;
- Securing financing from the government budget and from domestic and foreign private sources; and
- Expanding existing oil-storage capacity to build up stockpiling.

Country-specific challenges that may not be applicable to all seven countries include the following:

- Detailed planning of oil stockpiling development, including establishing an overseeing organisation and setting a specific inventory target with a clear deadline;
- Emergency exercises to identify potential problems in emergency response; and
- Interim measures to bridge gaps until the domestic oil-stockpiling development is completed.

3-1. Developing Accurate and Timely Statistical Data Collection

The first common challenge for ASEAN countries is to develop an accurate and timely statistical data-collection system. In most ASEAN countries, statistical data on energy supply and demand has not been well developed because until recently, oil demand was low and oil-supply security was not a major policy issue. As oil demand is growing rapidly, however, it has become an urgent need to establish a system that can collect accurate oil-consumption data in a timely manner. Understanding the correct volume and location of oil inventory is always critical in emergency response. Also, recording and collecting historical oil-consumption data is a very important premise in providing a long-term outlook for oil demand and import dependence.

Since oil is consumed in various sectors and in various economic activities in the ASEAN, collecting data on oil consumption requires cooperation from various sectors of the government and private organisations. The government should start building an extensive network amongst various sectors and entities from which it can receive regular statistical data reporting.

It is also important to manage the data after it is collected. Once the data is collected, it should be edited and maintained so as to be easily referenced and utilised. In this regard, a permanent organisation to maintain the data should be set up and a sufficient number of full-time analysts and staff may need to be hired to analyse the data.

Accurate and timely data is critically important in emergency response. In case of oil-supply disruption, the government or the oil company has to decide where or to which locations to provide the limited oil supply. If accurate statistics are not available, the oil might be supplied to the wrong place. If statistics are not available in a timely

manner, the decision will take longer or will be made without reliable reference.

Accurate statistics are important even after the stockpiling development plan is provided because they serve as a fundamental reference for revising the outlook on oil supply and demand. It is needless to say that an accurate outlook is a fundamental reference for setting an appropriate stockpiling development target. In Viet Nam, for instance, although the country should already have a well-developed oil stockpiling road map, its plan always has to be re-examined and modified in accordance with changes in the international oil market and the domestic oil supply-demand situation. Correct and timely oil-consumption data is very important in this review process.

3-2. Promoting Regional Cooperation in ASEAN

There is always a limit to a country's capability to respond to an unexpected and sudden emergency, and regional cooperation can fill this gap. One of the most effective templates to promote regional cooperation in ASEAN is undoubtedly to utilise the APSA. The agreement was originally established in 1986 and then revised in 2013 to include a coordinated petroleum supply arrangement. The details of APSA are summarised at the end of this chapter.

3-2-1. Issues toward activating and operationalising APSA

While the revised APSA has been enacted and the detailed procedures for Coordinated Emergency Response Measures (henceforth, CERM) have been provided, CERM has never yet been activated and it is likely that it will not be conducted smoothly. This is because there are several issues to be addressed in the current APSA and CERM procedures.

(1) Insufficient storage capacity and physical inventory within member countries

In most ASEAN countries, the growth of domestic oil demand has been rapid in the last decade, and the development of the oil-supply infrastructure (including oil-stockpiling facilities) has not yet caught up with the speed of demand growth. In this sense, the ASEAN is vulnerable to an unexpected disruption in the oil supply. APSA assumes supply coordination in which a country with a surplus oil inventory would provide its oil to another country with a supply shortage due to an emergency. Most

ASEAN countries, however, have increasing import dependence and seldom have such a surplus. This problem would become more acute if an emergency caused disruption on a regional basis (such as a disruption of the oil supply in the Middle East from which many ASEAN countries import). Because ASEAN countries have not built up sufficient storage capacity and inventory, it might still be difficult to achieve meaningful coordination of the oil supply.

(2) Less binding agreement provisions

Another issue is that the provision of APSA is not binding enough to achieve meaningful cooperation. A typical provision in this regard is the provision that member countries take cooperative actions 'on [a] commercial and voluntary basis.' This is a big difference from the IEA agreement that obligates member countries to hold a minimum-level stockpiling system.

Even though the ASEAN region has a sufficient capacity of oil-stockpiling bases and volume of oil stock, the existing provision has less binding power to enforce member countries to cooperate by sharing their oil with other countries.

(3) Lack of a permanent secretariat office

APSA does not have a permanent secretariat office and this lack of critical organisation would limit the function and effectiveness of its provisions. As seen in the last part of this chapter, in APSA's CERM, ASCOPE is designated to play the role of coordinator in an emergency. ASCOPE, however, is a small organisation that also does not have a permanent office. Its office is regularly relocated to the country where its secretary general resides. Until October 2014, the secretariat office of ASCOPE was located in the Philippines. It was relocated to Bangkok in May 2015 upon the inauguration of current Secretary General Nopporn Chuchinda from Thailand. The secretariat office of ASCOPE, therefore, tends to have limited permanent staff and does not have enough manpower to function as a coordinator in an emergency.

In activating CERM, ASCOPE is supposed to analyse and evaluate the needs and timing of oil sharing but in reality, it is not easy to make appropriate decisions without setting up a permanent secretariat office and employing a sufficient number of permanent staff specialising in oil market analysis. While budgetary constraints obviously

exist in ASCOPE, a clear coordinator would be necessary in order to achieve effective international oil sharing similar to the IEA's CERM system.

Another problem caused by not having a permanent secretariat office is that there is no organisation overseeing the operationalisation of APSA from a long-term perspective. It will take a long time to make APSA a more workable framework. It is necessary to have an organisation or staff members permanently engaged in such an effort. The APSA secretariat should be the organisation that undertakes this task. Setting up a permanent secretariat is also important for the purpose of operationalisation.

(4) Lack of regular exercise mechanism

APSA does not have a mechanism to conduct regular exercises amongst member countries. Conducting exercises is very important in order to be well prepared for an unexpected supply problem. A number of unexpected events occur every time an emergency happens. To ensure whether the existing CERM procedures work smoothly, emergency exercises need to be conducted regularly. There are extensive issues to be confirmed in such exercises, such as whether communication amongst coordinating agencies of each country is conducted properly, whether the eligible government personnel makes timely and proper decisions, how to secure logistics to the affected areas, how to prioritise the direction of supply, etc. Such regular exercises would be initiated by ASCOPE as a coordinator. ASCOPE's organisation and capability also need to be expanded from this perspective.

(5) Overly strict activation threshold

The threshold for APSA to activate CERM is 10 percent disruption for 30 days, but these conditions may be too strict. In reality, there is a very low possibility of such a large oil-supply disruption. Even the IEA, which used to have a similar threshold, has been relaxing the conditions to release its stockpiling. When the IEA was founded, the threshold to release stockpiling was a 7 percent supply reduction. Though such a large-scale disruption has never occurred in reality, even a disruption smaller than 7 percent can cause a significant economic impact similar to what happened in the second oil crisis in 1979. The IEA, therefore, introduced a more flexible Coordinated Emergency Response

Measure¹⁸ wherein if the IEA governors found that a supply disruption would have a significant economic impact on the world economy, IEA can release stockpiling, allowing IEA member countries to release their stockpiling volume. Reflecting this trend of relaxing the threshold, APSA may consider revising it to be more realistic.

3-2-2. Potential solutions to achieve a more effective APSA

Providing solutions to the previously discussed issues will be a big challenge because of the lack of experience with multilateral cooperation in oil-supply security amongst ASEAN countries, insufficient financial and human resources, and the difficulty of securing unanimous consent amongst ASEAN countries in order to improve the existing practice. The following, however, are considered as potential solutions to address the above-mentioned issues.

(1) Permanent and effective secretariat

The most meaningful and feasible solution to operationalise APSA is to set up an active secretariat for APSA. As mentioned earlier, such a secretariat would be a driving force to consistently improve APSA from a long-term perspective. The new APSA secretariat has to be permanent because of the long-term nature of the APSA operationalisation process. The secretariat, therefore, will have a secretary general with a reasonable length of tenure and staff with professional expertise in the oil market or in emergency response.

In this regard, the ASEAN Centre for Energy may have such capacities because the centre has already worked as the secretariat for the ASEAN+3 Oil Stockpiling Roadmap (OSRM) activities and has insight into the oil-supply security efforts of each ASEAN country. Further strengthening ACE's capabilities, therefore, may be the most realistic option to create a capable secretariat for APSA.

(2) Collaboration with other frameworks and organisations

Another solution measure is to strengthen collaboration with international organisations and utilise their resources. Some international organisations are interested in the ASEAN's activities and have actually worked closely with ASEAN countries in oil-

¹⁸ This is a different system from APSA's CERM.

supply security. The ASEAN+3 framework, for instance, has supported oil-stockpiling developments in ASEAN countries by assisting in drafting a road map and monitoring its implementation. APERC conducted Oil and Gas Security Exercises in Bangkok and Jakarta in 2013. APERC is developing an exercise training manual, which is expected to be published in 2015. The organisation plans to continue to assist with such exercises in other ASEAN countries. The IEA has increasingly been interested in Asia's energy issues as part of its outreach activities. The organisation is willing to provide and share its expertise with ASEAN countries by conducting training courses, and it actually regularly sends its experts to various oil-supply security workshops held in the ASEAN. The Economic Research Institute of ASEAN and East Asia, of course, has also worked in this field by providing consultancy on APSA operationalisation.

All of these initiatives and actions aim to make the ASEAN's oil supply security more resilient. The ASEAN can utilise these opportunities to strengthen its oil-supply security. It is also necessary to share information amongst international organisations in order to avoid duplication amongst these oil-supply security initiatives. It is critically important to have coordination by the Japanese government, particularly the Ministry of Economy, Trade, and Industry, which provides financial and professional resources to many of these initiatives.

(3) Joint oil stockpiling

Developing a joint stockpiling system amongst the ASEAN countries is an effective measure as a regional stockpiling cooperation. This is because oil-supply disruptions from outside the ASEAN tend to cause a regional effect on many ASEAN countries (i.e. oil-supply disruption tends to be regional), and ASEAN countries should have a reasonable reason to make joint arrangements to minimise impact. It would take a very long time for each country to develop oil-stockpiling bases and, in some ASEAN countries, the oil-consumption market may still be too small to set up a separate oil-stockpiling base. Developing joint oil-stockpiling bases, therefore, would be a beneficial solution for many ASEAN countries.

Singapore is the natural location for such a joint stockpiling base because of its ample existing storage capacity and export infrastructure. Singapore is the centre of oil market intelligence and the most ideal place to collect oil market data and information of

high quality and accuracy. However, since some ASEAN countries are relatively far from Singapore, another oil-stockpiling base may be built in Thailand or the Philippines where multiple refineries exist and storage capacity for stockpiling can be expanded with relative ease.

The type of organisation for the joint stockpiling initiative could be the type where each ASEAN country holds their own equity and can claim their share of stockpiling in an emergency. The organisation will be assigned by ASEAN countries to oversee the operations and maintenance of the joint stockpiling bases.

(4) Amendments to APSA

A more drastic solution to operationalise APSA would be to amend some of the provisions of APSA itself. Some of its provisions are not sufficiently clear or binding to make it a workable framework. CERM procedures are provided in APSA's annex but the organisations mentioned in the procedures were not clearly designated. For instance, APSA does not clearly identify a coordinated agency that communicates with the APSA secretariat and coordinates within each country's government. This creates another problem: the lack of an established communication network amongst ASEAN countries to activate APSA CERM.

As has been previously mentioned, APSA prescribes that cooperation by each country will be conducted 'on a commercial and voluntary basis,' which lacks the compulsory power to force each country to collaborate in the event of an emergency. This loose provision limits the incentive of ASEAN countries to participate proactively in APSA activities.

Amending the existing APSA is not an easy task. Some countries require a ratification process to do so. The amendment process takes a long time as well as patient efforts by the government officials of each ASEAN country. Yet in the long term, if APSA aims to be an effective multilateral framework like the IEA, amendment efforts cannot be avoided. Discussions toward the amendment process need to be initiated immediately.

3-3. Securing Finance

The third common challenge is financing. Stockpiling development requires a very large amount of capital while its economic benefit is difficult to identify. Securing financing for stockpiling development is, therefore, always a difficult task. In the case of oil-stockpiling development in IEA countries, the countries share a threat of serious oil-supply disruption. After experiencing the first oil crisis in 1973, it was relatively easy to mobilise domestic resources to develop a stockpiling system. In the case of ASEAN countries, however, it is difficult to create such a strong incentive.

Because stockpiling development is a policy of energy security, it would be ideal for each country's government to secure funds for its development. In order to secure a budget, it will be necessary to provide concrete reasoning for why the country has to work on stockpiling development. Any visual or quantitative material should be developed to raise the priority of stockpiling development in the budget allocation of each country.

If government sources cannot be obtained, then private funding will be sought. The government may regulate the oil industry to hold a certain level of inventory by requiring investment in a stockpiling facility and building up an inventory. However, the government might still be requested to provide an economic incentive to the industry in order to achieve such developments.

If sufficient capital cannot be obtained from domestic sources, foreign sources will become a realistic option. Introducing foreign investment may be achieved through several means.

The most straightforward means is to have foreign equity investments in an oil-stockpiling organisation. This is to invite foreign investment to a newly founded organisation dedicated to maintaining and operating stockpiling.

Another means of encouraging foreign investment is to invite foreign companies to invest in oil-supply-chain infrastructure projects on the condition that they will have extra storage for oil stockpiling. Because the ASEAN is one of the prospective future oil markets, it is a very attractive place for foreign oil companies. Including the interest of foreign companies in stockpiling development is an option to consider. In the case of Indonesia, for instance, the NOC, Pertamina, is currently discussing expansion projects for

its five refineries by forming a joint venture with foreign companies such as the Saudi Arabian Oil Company (Saudi Aramco), China Petroleum & Chemical Corporation (Sinopec), and JX Nippon Oil & Energy (JX). The Indonesian government may urge the joint venture to build additional storage capacity for stockpiling. Under ordinary market conditions, the joint venture can utilise the storage for commercial purposes as long as it maintains a certain level of inventory but in an emergency, it will be utilised as stockpiling.

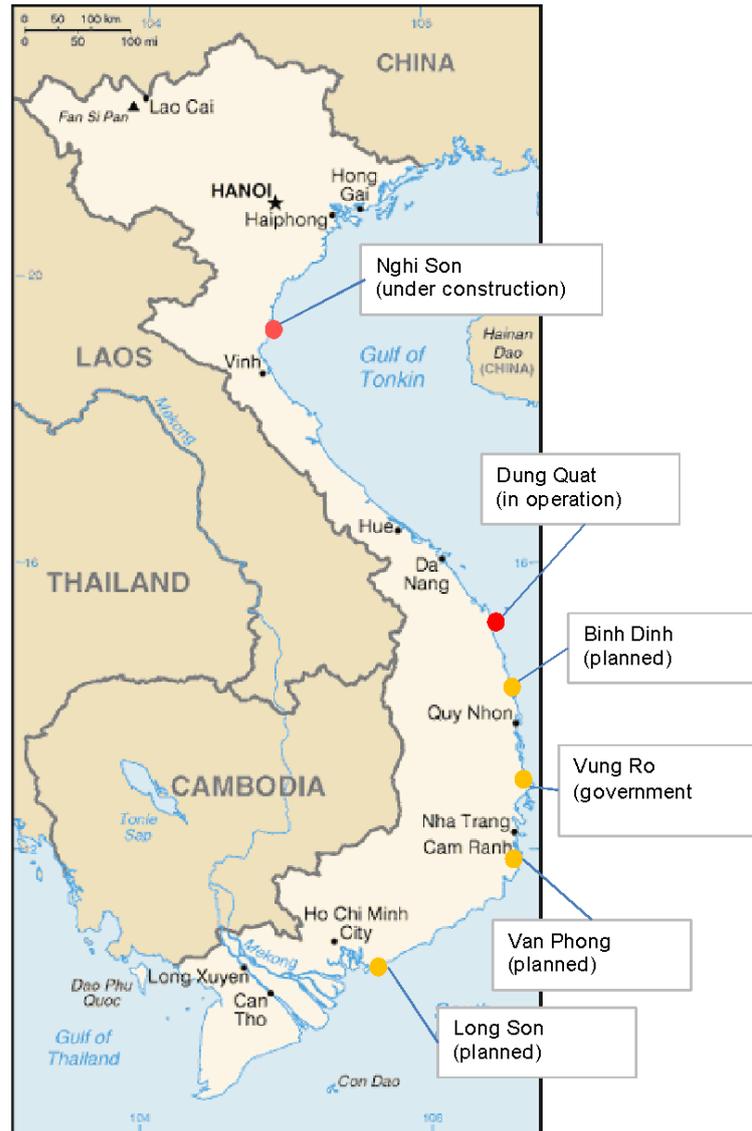
Figure 3-3-1. Locations for Planned Refinery Expansion in Indonesia



Source: The Institute of Energy Economics, Japan (IEEJ).

Of course, the foreign oil companies that are supposed to form a joint venture may be less willing to invest in such additional facilities because such assets will cause operating expenses while not generating profits per se. Indonesia will need to provide economic incentives to foreign investors to utilise their investments in developing oil stockpiling developments. Such incentive arrangements may include preferential treatment (e.g. taxation benefits). Because Saudi Aramco and Sinopec are also national oil companies, specific cooperative agreements on a government-to-government basis may bring additional incentive for investing in stockpiling facilities.

Figure 3-3-2. Locations for Planned Refineries in Viet Nam



Source: The Institute of Energy Economics, Japan (IEEJ).

In the case of Viet Nam, the country has several refinery construction projects (Figure 3-3-2). Most of the planned refinery construction projects are led by Vietnamese national oil companies, such as PetroVietnam and Petrolimex, together with foreign partners. If the government could provide sufficient incentive to those foreign investors to consider building extra storage capacities for stockpiling, it would ease the budgetary constraints of Vietnamese national oil companies while enabling access to these foreign companies' expertise on the operation and maintenance of oil-storage facilities.

Although the Vietnamese government currently aims to build stockpiling capacity without the involvement of foreign governments or companies, utilising foreign capital and expertise will help and facilitate the realisation of the country's oil-stockpiling road

map.

In the case of Myanmar, many foreign companies are also interested in investing in Myanmar's downstream sector. The Myanmar government is also willing to accept foreign investments in the refining and marketing sectors of the country. In fact, the Myanmar Petroleum Enterprise (MPE), the state-owned refining company, plans to introduce foreign investments in renovating its Thanlyin refinery near Yangon. Myanmar Petroleum Product Enterprise (MPPE), the state-owned marketing company, plans to partially privatise its gasoline and diesel sales business with foreign capital. This opening of its downstream sector can be utilised as leverage for foreign investment into oil stockpiling.

Cambodia is also planning to build a new refinery with foreign capital. It is reported that a new refinery is being built in Prea Sihanouk by Chinese investors and is expected to be completed in 2020. With the completion of this new refinery with a capacity of 84,000 bbl/day, Cambodia will be self-sufficient in oil-product supply (it is still in a net import balance on a total oil supply basis). Promoting refinery construction is a prioritised policy issue for the country.

Finally, as another potential scheme to introduce foreign investments, inviting investments from oil-producing countries may be a mutually beneficial option for the ASEAN countries and the oil-producing countries. As import demand for crude oil is rising in ASEAN countries and competition amongst oil-producing countries has become more intense, securing a physical foothold to market their crude oil will stoke the interest of oil-producing countries. Of course, holding inventory does incur cost but having such inventory near the market will enable the producer to sell its crude oil flexibly depending on market conditions. In fact, Japan already introduced such an oil producers' joint stockpiling system in 2009 in Kiire (Kagoshima) with the Abu Dhabi National Oil Company and again in 2010 in Okinawa with Saudi Aramco. Under this framework, oil producers can utilise tanks in Japan for commercial operations while the inventory in those tanks would be supplied to Japan with priority in case of an emergency.

3-4. Expanding Stockpiling Capability and Inventory

The fourth common issue is to expand the physical storage capacity in each ASEAN country. In this case, refinery construction is the most effective means of increasing the domestic storage capacity and inventory of oil. Because refineries have storage tanks for their commercial operations, having a stockpiling base next to those commercial storage facilities offers the benefit of saving on administrative expenses for operation and maintenance as these tasks are performed jointly with the commercial storage operations. In fact, having storage tanks for stockpiling within or near a refinery is the most effective and efficient means of expanding stockpiling capacity. Geographical proximity between refineries and storage facilities minimises the time lag between the release of crude oil stockpiling and the actual supply of oil products to consumers. It also lowers the risk of disruption to the means by which crude oil is transported to the refinery. Building a stockpiling base near the refinery, therefore, is considered the most cost-effective means of strengthening oil-stockpiling capacities.

3-5. Planning Oil-Stockpiling Development

3-5-1. Importance of a stockpiling plan

One country-specific challenge is developing a comprehensive plan for oil-stockpiling development or at least setting a specific target for stockpiling build-up.

Providing a road map includes a number of processes. It will be necessary to develop the best possible oil supply-demand outlook at an earlier stage of planning because setting a specific numerical target for oil stockpiling should be based on a reliable outlook. In fact, the oil-stockpiling target is usually set as specific days of net oil import but in a country whose import continues to grow such as Indonesia, the days-of-import target is not indicative of the absolute amount of imports. Thus, it is hard to identify the size of stockpiling facilities. Providing a reliable oil supply-demand is crucially important in planning oil-stockpiling development.

In the case of Myanmar where oil demand has been rapidly increasing and policy planning has been catching up with market development, a total oil policy system is currently being developed. Because the country is self-sufficient in the supply of natural

gas, oil is the primary concern for energy security, and stockpiling development has a high importance in its energy policy agenda. Another important factor for total oil-policy system development is the collection of reliable and solid information required to develop stockpiling planning, such as oil demand and import outlook, a refinement expansion plan, and supply from international oil pipelines. Those two policy planning activities should be conducted simultaneously.

Cambodia's oil demand was low before the 2010s so it did not have a systematic oil-policy framework from upstream to downstream. Neither did it have an oil-supply security policy. Given its growing oil consumption, Cambodia needs to have specific policy goals and to identify tasks needed to achieve the goals. In this regard, the Cambodian government has made a memorandum of understanding with the Japan Oil, Gas, and Metals National Corporation to draft an oil-stockpiling road map. The road map will be a fundamental policy document that will guide the government in the pursuit of its stockpiling efforts.

3-5-2. Crude oil or oil product

Another issue in the development of an oil-stockpiling plan is determining the kind of oil to be stored. Oil can be stockpiled in the form of crude oil or refined oil product. In developing an oil-stockpiling plan, the specific type of oil needs to be determined in consideration of the merits and demerits of both types of stockpiling.

Storing crude oil is the easiest way to build stockpiling because there would be no need to store separate tanks for each grade (as different grades of crude oil can be stored together). In oil-product stockpiling, each oil product storage facility needs to be separated, sometimes in different types of tanks. Stockpiling crude oil will also, to some extent, enable flexibility in the process of refining specific products (as during the refining process, refineries can change the yield of the oil product to a certain extent). If there is a severe shortage of diesel oil, for instance, refiners can produce more diesel oil than gasoline and kerosene from a single bbl of crude oil. Quality degradation (e.g. change in colour) occurs in oil-product stockpiling, and it is necessary to periodically shuffle inventory. In the case of crude-oil stockpiling, however, such quality degradation is very limited; crude oil can be stored over decades without causing additional expenses for

inventory shuffling.

On the other hand, the benefit of oil-product stockpiling is operational promptness. Because, with limited exceptions,¹⁹ there are no consumers of crude oil, releasing stockpiled oil products can save time in the process of refining crude oil into oil products. This is particularly the case in an emergency involving a disruption in the local supply (e.g. a typhoon, an earthquake, or other similar events) which can affect both the local supply and the distribution network. In such cases, there is very limited time to secure the lost oil supply, and it would be very effective and helpful to release the oil product stockpile. Likewise, storing crude oil makes sense if the country has sufficient refining capacity. Otherwise, the stockpiled oil will necessarily be oil products.

The location of the oil-stockpiling base may also vary depending on the kind of stockpiled oil. If crude oil is stockpiled, the location of the base will be close to the refinery. If refined products are stockpiled, the base will be close to a large city where demand is high. The kind of oil to be stored should be considered well in developing a stockpiling plan.

3-5-3. Identifying the responsible party

It is also necessary to identify the party that will be responsible for developing and storing the oil stockpile. Amongst the IEA countries, some countries (e.g. US) hold only government stockpiling (SPR) while some European countries hold stockpiling through an association formed by oil companies. Some IEA countries (e.g. Japan, South Korea) have both government and private stockpiling systems (Table 3-5-1). In the case of ASEAN countries, since the NOC of each country often has a dominant position in the refining and marketing sectors, how to involve these NOCs will be an important policy issue.

¹⁹ Notable exceptions are direct burning of crude oil in the power sector in Japan or in Gulf countries. According to Joint Oil Data Initiative, Japan consumed 22,000 bbl/d and Saudi Arabia consumed 48,000 bbl/d for power generation in 2013.

Table 3-5-1. Types of Stockpiling Systems in Selected IEA Countries

Country	Stockpiling operator	Stockpiling days	Stockpiling release procedure
United States	Government	94 (crude oil and product)	Released by competitive bidding. Price is determined by bidding.
Germany	Association* funded by private industry	117 (crude oil and product)	Association members have a right to receive stockpiling oil based on their share in the Association's operation.
France	Government Private industry	102 (crude oil and product)	Private industry stockpiling is released in the early stages of an emergency.
Netherlands	Association* Private industry	143 (crude oil and product)	Stockpiling volume above IEA obligation is released by bidding.
United Kingdom	Private industry	49 (crude oil and product)	No government stock. No public stockpiling agency.
Italy	Private industry	99 (crude oil and product)	Private industry releases stockpiling on a voluntary basis based on the government's recommendation.
Japan	Government Private industry	136	The government relaxes the obligated days of private stockpiling. Government stock is released by government order.
Republic of Korea	Government Private industry	78	The government relaxes the obligated days of private stockpiling. Government stock is released by government order.

*The Association is a public organisation designated to hold, operate, and maintain oil stockpiling. Stockpiling days shows the figure as of 30 September 2014 based on the International Energy Agency's *Oil Market Report* (March 2015).

Source: IEEJ based on the Ministry of Economy, Trade, and Industry's study on the oil-stockpiling system in 2008.

In the case of Viet Nam, the question of who builds up the stockpiling base has become an issue. The country's first oil-stockpiling base will be built near the Dung Quat refinery. A consortium of South Korean companies has been awarded the bid to construct the 600,000-kilolitre (kl) stockpiling base by 2018. The groundwork for it, however, has not started yet because it is thought that for security reasons, the Prime Minister's Office of Viet Nam prefers greater involvement of Vietnamese companies in the oil-stockpiling development. If the Vietnamese government pursues such localisation of stockpiling development activities, more importance will be placed on the capacity building of Vietnamese engineering companies, construction companies, and oil companies. Because it might take longer to complete the stockpiling base using local players and expertise alone, it is necessary that Viet Nam further hone its expertise on building and operating a stockpiling base. Training of human resources will be of high importance in this area.

3-6. Conducting Emergency Exercises

Regardless of the stage of development in oil stockpiling, it is very important to conduct emergency exercises as these can identify a number of problems, issues, and weaknesses in a country's oil-supply system.

Conducting regular exercises also contributes to better emergency response measures by creating an opportunity for the people in charge of emergency response to meet and get to know one another. In an emergency, the speed and accuracy with which relevant organisations share relevant information is a key factor in achieving an effective emergency response. APERC conducted several exercises in Thailand and Indonesia in 2013. Utilising the expertise of the centre may be worth considering for all ASEAN countries.

Thailand has made notable efforts in this regard. Every year, it conducts emergency exercises assuming a specific crisis scenario. Exercises using role playing are conducted by a wide range of participants from the government. Such efforts serve to strengthen the country's emergency response capacity.

3-7. Arranging Interim Measures

Countries that require a long period to develop a stockpiling system may consider a shorter-term arrangement that transitions to a more solid one, such as an oil-stockpiling base. In countries like Myanmar, Lao PDR, or Cambodia, the growth in oil demand is rapid but demand is still very low. A large oil-stockpiling facility may be built in the long run but it may be too early to build such a large-scale infrastructure at this stage. Those countries, therefore, will be interested in developing a short-term oil-supply security arrangement by utilising another country's supply infrastructure.

One option is to have a deal to swap crude oil and oil products with a neighbouring country. In such an arrangement, when a refinery of Country A is affected and cannot refine crude oil, Country A can swap its crude oil with Country B for Country B's oil product. Country B, the provider of the oil product, will be a country with ample refining capacity, such as Thailand.

Another such measure is the so-called ticketing system. If Country A cannot build up its stockpiling in the short term, it can purchase the right to use a certain volume of the oil inventory held by Country B by paying a ticket fee to Country B. This ticket stockpiling system is explained in greater detail in Chapter 3.

Still another short-term arrangement is a bilateral emergency oil-supply security agreement. An ASEAN country with a product shortage may make an agreement with another country with ample stockpiling, such as Japan, to enable it to secure its oil supply in an emergency. Such stockpiling volume may be government oil stockpiling but if a private company finds it economically attractive to release its stockpiling to a specific country, that company may be willing to provide its product stock to be released. The government of the provider's country may also readily relax the existing stockpiling regulations by request of the affected country so that the private company of the provider's country can readily export its product. It will further enhance the effectiveness of this arrangement if the two governments and oil companies in both countries can conduct an emergency exercise jointly under this arrangement.

Of course these short-term measures have to be temporary until stockpiling facilities are completed. Constructing a physical location to store a large amount of stockpiling volume should be the final goal of oil-stockpiling development.

Annex ASEAN Petroleum Security Agreement (APSA)

What is APSA?

APSA, which stands for ASEAN Petroleum Security Agreement, is an international agreement amongst all ASEAN member countries enacted on 1 March 2009. APSA originates from the Agreement on ASEAN Energy Cooperation enacted amongst ASEAN member countries in June 1986. The agreement prescribed that ASEAN countries strengthen energy cooperation to enhance their solidarity. The original APSA was established with the agreement to facilitate the emergency response system for crude oil and oil products when the oil supply is too large or too small. In 1999, the ASEAN Ministers on Energy Meeting agreed that the original APSA would be modified to include both short-term and mid- to long-term emergency response measures as well as to provide detailed procedures to share crude oil and product supply amongst member countries in an emergency. The revised APSA was not enacted for a decade because Indonesia did not sign the agreement until 2009, at which point it was officially enacted.

Objectives and Provisions of APSA

The objectives of APSA are to provide both short-term and long-term emergency response measures, enhance the oil-supply security of ASEAN member countries, and minimise vulnerability in an emergency.

As short-term measures, APSA prescribes that member countries should reduce their oil demand during ordinary conditions, avoid rapid demand growth, and collect appropriate information and data before asking for regional oil sharing. In addition to these efforts during ordinary conditions, member countries will also undertake CERM if an emergency occurs. Unlike IEA's CERM, however, this coordination would be conducted on a commercial and voluntary basis by each member country.

As long-term measures, APSA mentions future developments of the ASEAN power grid and the Trans-ASEAN natural gas pipeline as a regional energy infrastructure. APSA also prescribes that member countries pursue regional energy policy plans based on the ASEAN's recommendations and that they cooperate in areas such as coal, new oil

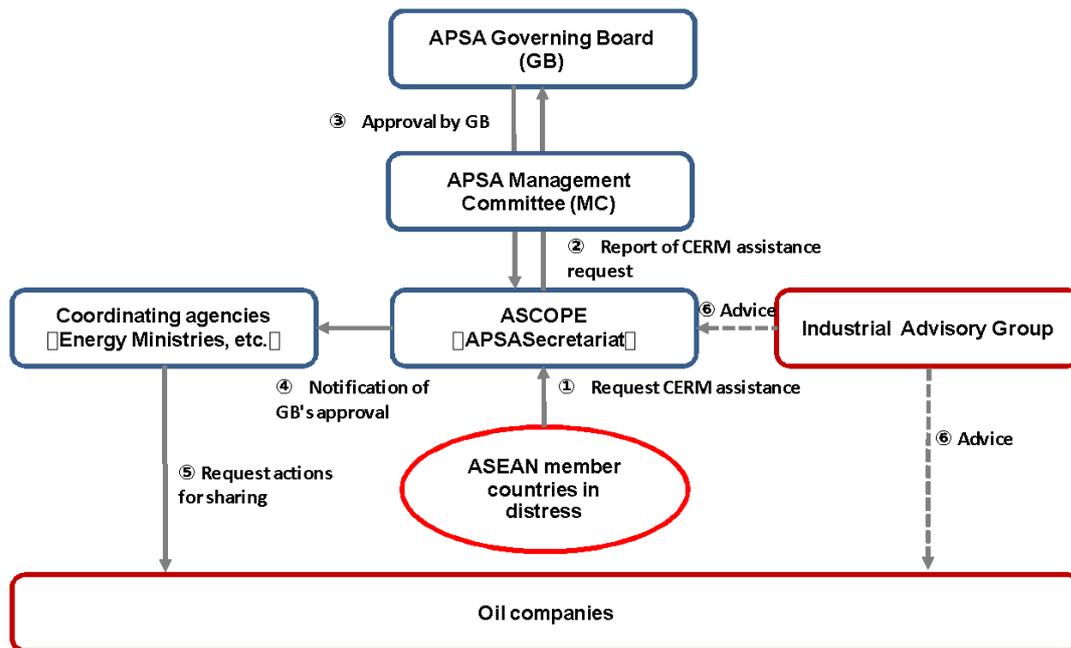
development, diversification of energy sources, introduction of renewable energy, energy efficiency, improvement of energy efficiency, and so on. What is notable in APSA's long-term measures is that it considers the liberalisation of the oil and natural gas markets and commercial and voluntary stockpiling as important measures to ensure regional energy security.

CERM Procedures

APSA provides procedures for CERM or a coordinated oil-sharing system amongst member countries, and this forms the core of APSA.

CERM is initiated by a country in distress. CERM's activation threshold is 10 percent supply disruption from normal domestic consumption continuing for 30 days. If such a disruption happens, the country in distress would try to manage its disruption through its best possible efforts, such as utilising other energy sources or reducing oil consumption. If such measures are insufficient, the country could request CERM assistance. The request would be made to the ASEAN Council on Petroleum (henceforth, ASCOPE) as the secretariat of APSA. ASCOPE would then evaluate the necessity of reporting the request to the APSA governing board. ASCOPE would prepare to report whether or not CERM should be activated by evaluating information obtained from various sources, including the departments of the member country's government or oil companies.

Figure 3-8-1. Coordinated Emergency Response Measures (CERM) Procedures



Sources: ASEAN Petroleum Security Agreement (APSA); Institute of Energy Economics, Japan (IEEJ).

ASCOPE would convene the APSA Management Committee (MC) to review the report prepared by ASCOPE. If the MC finds that the request should be sent to the APSA Governing Board (which is composed of minister-level representatives) for their approval, the request would be examined by the GB. If the GB approves the request, ASCOPE would notify the coordinating agencies of member countries. The coordinating agency is usually the ministry that oversees energy policy. The coordinating agencies would then evaluate how they can cooperate with the request for assistance and would then ask oil companies for specific actions for assistance. As already mentioned, these cooperative actions would be taken on a commercial and voluntary basis.

After the coordinated actions are taken, ASCOPE would continue to watch market developments. If ASCOPE finds that there is no longer a serious supply disruption, ASCOPE would prepare a report to deactivate CERM. The MC would evaluate that report and if the MC finds that it should be discussed at the GB level, it would send the report to the GB. If the GB approves the deactivation, CERM would actually be deactivated.

Chapter 4

Potential Cooperation beyond ASEAN

This chapter explores potential items for cooperation between ASEAN and non-ASEAN countries, especially IEA member countries in the Asia–Pacific region such as the US, Japan, and South Korea.

Given the globalised nature of the international economy and oil markets, cooperative activities bring large benefits to all countries in the region. Since successful cooperation meets one country's specific needs using another's resources, it is very important that countries understand one another's background, expertise, and resources in order to form meaningful cooperation in stockpiling. Based on this perspective, this chapter first briefly confirms why such cooperation is important. The chapter then explores what kind of cooperation can be considered relevant and effective between ASEAN and non-ASEAN countries and organisations, specifically the US, Japan, South Korea, Australia, and New Zealand, and the IEA.

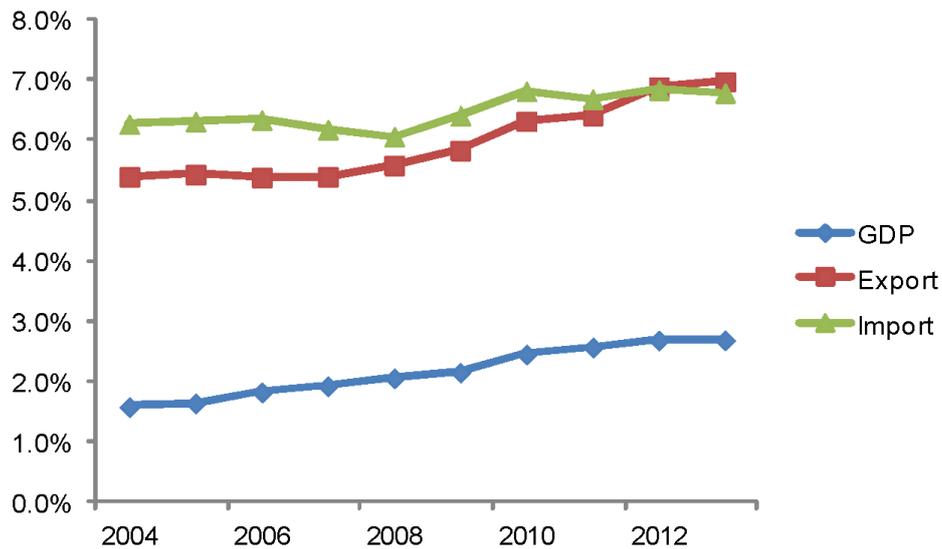
4-1. Why Cooperate?

4-1-1. Growing weight of the ASEAN in the world economy

Non-ASEAN countries have multiple reasons to build cooperative relationships with the ASEAN in terms of oil-supply security. First, as the weight of ASEAN economies in the world economy grows, a stable oil supply to the region's economies becomes more relevant and important to the economic growth of non-ASEAN economies. As shown in Figure 4-1-1, while the share of the ASEAN's economic activities in the world economy is still low at 2.7 percent as of 2013, it has been increasing steadily in the last decade. Its growing significance to the world economy is also evident in world trade. The ASEAN's share in the volume of world trade has expanded steadily over the last decade (Figure 4-1-2). Given its potential for further growth in the future, the ASEAN's importance to world trade is highly likely to continue to grow.

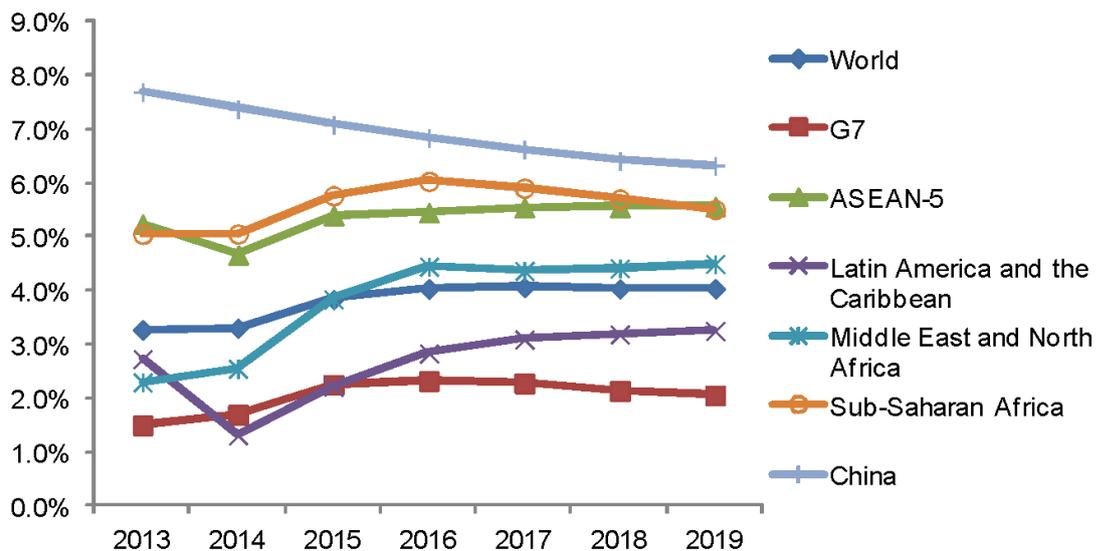
Because oil is the largest source of the region’s energy mix (Figure 4-1-3), securing a stable oil supply is a cornerstone of the region’s sound and stable economic growth in the future. Non-ASEAN countries cannot neglect the ASEAN’s significance for their own economy and thus have high stakes in there being a stable oil supply for the ASEAN.

Figure 4-1-1. Share of ASEAN Economies in the World Economy



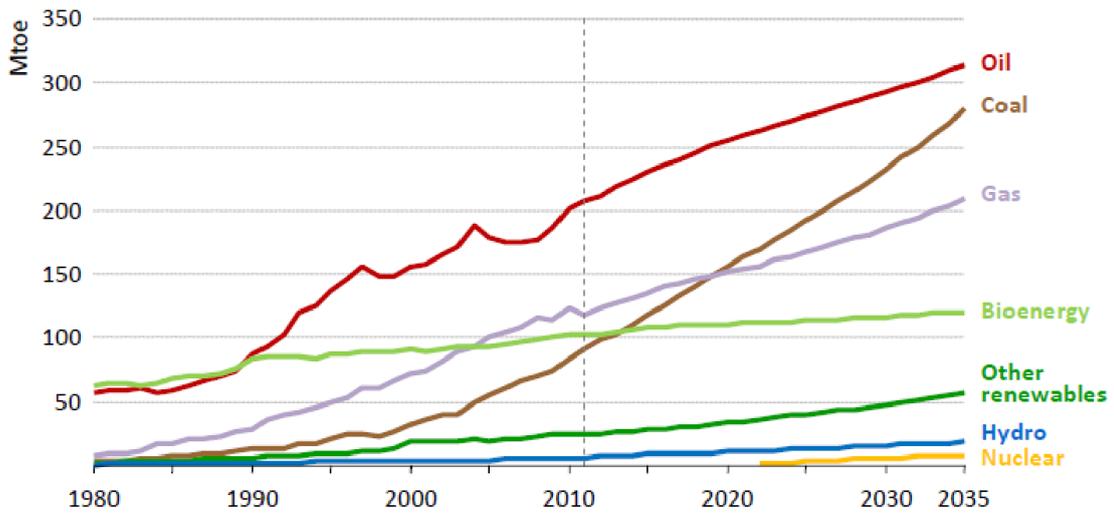
Note: The share of ASEAN’s Gross Domestic Product (GDP) includes the share of ASEAN 5 countries (Philippines, Indonesia, Malaysia, Thailand, and Singapore).
Sources: International Monetary Fund (IMF), ‘*International Financial Statistics*’ (for GDP) (2015); IMF, ‘*Direction of Trade Statistics*’ (for export and import) (2014).

Figure 4-1-2. Outlook of GDP Growth Rate of Various Regions



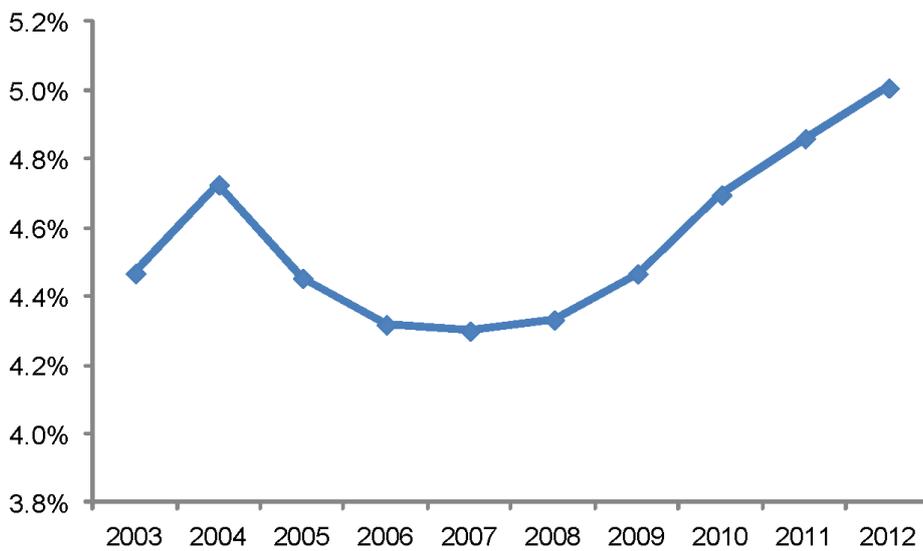
Source: International Monetary Fund (IMF), ‘*International Financial Statistics*’ (2015).

Figure 4-1-3. Total Primary Energy Supply in Southeast Asia



Source: International Energy Agency (IEA), 'Southeast Asia Energy Outlook' (Paris, 2013).

Figure 4-1-4. Share of the ASEAN in the World Oil Market



Note: ASEAN figures do not include figures from the Lao People's Democratic Republic due to data constraints.

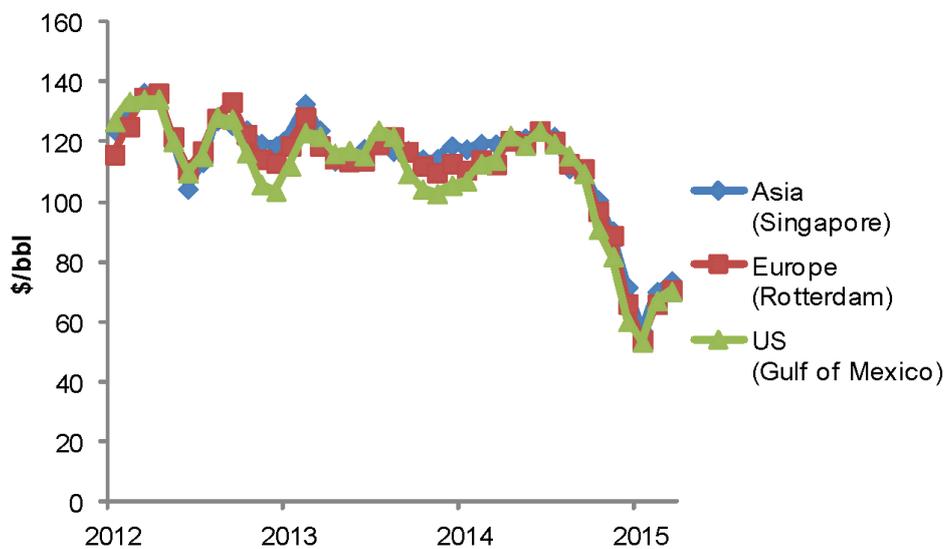
Source: International Energy Agency (IEA), 'Energy Balances of Non-OECD Countries (Paris, 2014).

4-1-2. Globally integrated international oil market

Because the international oil market is integrated, any supply disruption affects the global oil market as a whole. Figure 4-1-5 suggests that gasoline prices in different regions have very close correlations. This is because of the arbitrage process where a high price in one market attracts additional supplies from another market, and eventually the high price converges with those of other markets. It also means that any supply

disruption in one market can cause a price rise effect in other markets. As the share of the ASEAN in the world oil market has been consistently increasing, it is becoming more relevant for non-ASEAN countries to ensure a stable oil supply in the ASEAN. In this sense, all ASEAN and non-ASEAN countries are in the same boat. Non-ASEAN countries should have a strong interest in the oil-supply security of the ASEAN in order to ensure the security of their own supplies.

Figure 4-1-5. Gasoline Prices in the United States, Europe, and Asia



Source: International Energy Agency, 'Oil Market Report' (various editions).

4-1-3. Investments in the ASEAN's oil market

Third, the ASEAN's oil market is a place where a number of US, Japanese, and Chinese oil companies have already invested or are planning to make investments. US and Chinese companies have refining capacities in ASEAN countries, and one Japanese company is constructing a refinery in Viet Nam. Developing a sound oil market and ensuring that the ASEAN oil market is functioning properly will certainly meet the long-term objectives of those oil companies because such market development will facilitate the generation of an appropriate return on their investments.

4-2. Cooperation with the United States

The US has well-developed systems for oil stockpiling and emergency response. Its systems have been tested and improved through a number of experiences in supply disruption caused by natural disasters (particularly hurricanes) and by terrorism. The country can provide its valuable expertise to ASEAN countries in areas such as the principle concept of an emergency response system, the organisational design of emergency response, and smooth and timely procedures to release its SPR in case of emergency.

4-2-1. Concept of energy response measures: all-hazards approach

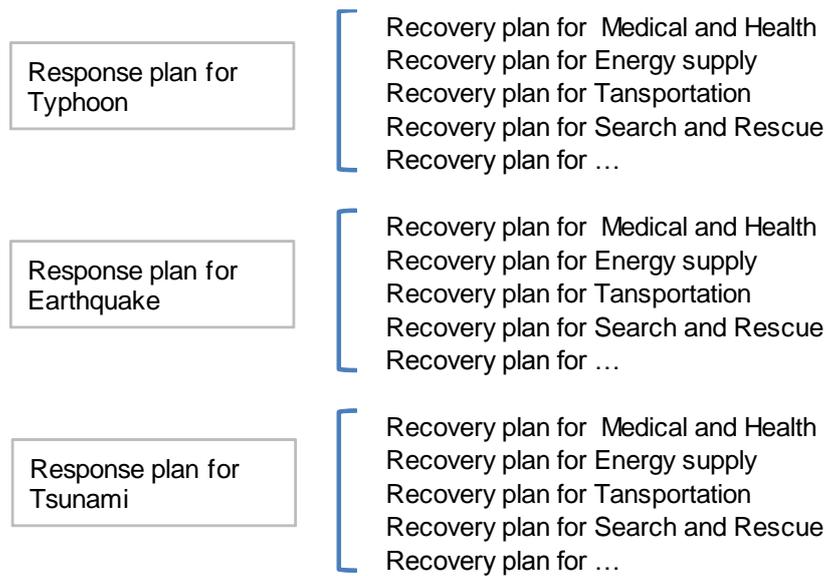
First of all, the US has a very advanced emergency response system, which can be introduced to ASEAN member countries as a reference for their own emergency response systems.

One of the most outstanding aspects of the US emergency response system is its key concept: all-hazards planning. This concept is the idea that an emergency response plan should be based on the affected functions rather than on the type of emergency. Emergency response plans tend to be developed assuming the occurrence of a specific event such as a typhoon, an earthquake, or a tsunami. An all-hazards approach does not take this event-based view. This is because the activities of emergency response plans based on specific events are more complicated on the whole. Until the 1970s, the US response system was also built on an event-based system. In 1979, however, a new emergency response organisation named the Federal Emergency Management Authority was established, and a new all-hazards approach was introduced. This approach has been used as a guiding principle for the US emergency response system since then (Figure 4-2-1 and Figure 4-2-2).

In the all-hazards approach, an emergency response plan is developed based on the affected functions instead of a specific type of event. Such functions are called Emergency Support Functions, and 15 such functions have been identified (Table 4-2-1). A specific government department or agency is designated as the leading organisation for each function. In case of emergency, each leading organisation has the responsibility to

restore its respective function, regardless of the type of emergency. The leading organisation acts as the response coordinator in an emergency. For ESF Energy, for example, the leading organisation is the Department of Energy, which is responsible for restoring the energy supply regardless of what causes the supply disruption. Table 4-2-1 lists the leading organisations of the 15 ESFs.

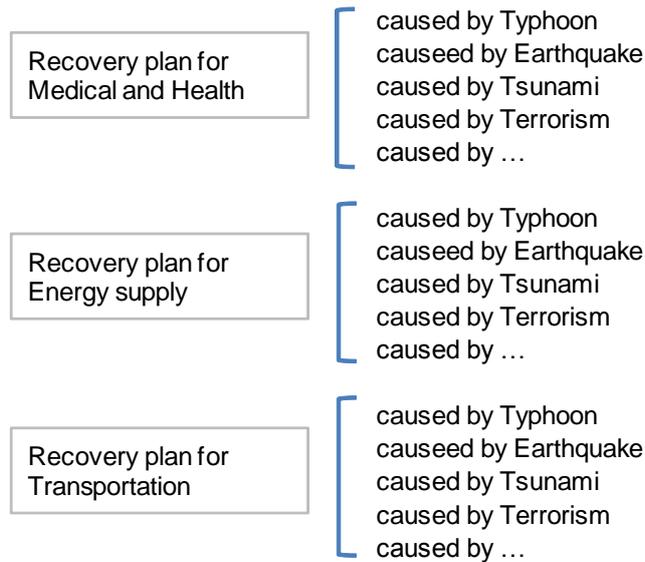
Figure 4-2-1. Scenario-Based Approach



Recovery plans and recovery actions tend to be very complicated
 Actual response may not well function when two emergencies simultaneously occur (e.g. earthquake and tsunami)

Source: International Institute of Global Resilience.

Figure 4-2-2. All-Hazards Approach



Recovery plans and actual recovery actions can be simplified on the functions to be restored.

Source: International Institute of Global Resilience.

Table 4-2-1. Emergency Support Functions

ESF 1: Transportation (Dept. of Transportation)	ESF9: Search and Rescue (Federal Emergency Management Agency / Dept. of Homeland Security)
ESF 2: Communications (National Communication Systems / Dept. of Homeland Security)	ESF 10: Hazardous Materials (US Coast Guard, Dept. of Interior)
ESF 3: Public Works (US Army Corps of Engineers / Dept. of Defense)	ESF 11: Food (Dept. of Agriculture)
ESF 4: Fire Fighting (Forest Service / Dept. of Agriculture)	ESF 12: Energy (Dept. of Energy)
ESF 5: Emergency (Federal Emergency Management Agency / Dept. of Homeland Security)	ESF 13: Public Safety and Security (Dept. of Justice)
ESF 6: Mass Care (Mass Feeding and Shelter) (Federal Emergency Management Agency / Dept. of Homeland Security)	ESF 14: Long-term Community Recovery (Federal Emergency Management Agency / Dept. of Homeland Security)
ESF 7: Logistics (Federal Emergency Management Agency / Dept. of Homeland Security)	ESF 15: Public and External Affairs (Federal Emergency Management Agency / Dept. of Homeland Security)
ESF 8: Health and Medical (Dept. of Health and Human Services)	

Note: The organisations listed in parenthesis are the leading agencies for each ESF.

Source: Federal Emergency Management Agency website.

This concept was generated and refined through the various experiences of emergency response activities in the US. In an emergency, a number of unexpected events occur and in such cases, it is always challenging to know who made what decisions based on what kind of information. The concepts above will help develop an effective emergency mechanism by clarifying that the core of emergency response is restoring affected functions and specifying who is responsible for the mission. In designing an emergency response system in the ASEAN, this all-hazards approach would work as a very useful principle.

4-2-2. Organisational design: Incident Command System

Another outstanding and useful element of the US emergency response system for the ASEAN to learn from is the organisational design of its emergency response: Incident Command System. The ICS is an organisational template that all emergency response organisations in the US are encouraged to adopt (Figure 4-2-3). In this template, the incident commander is the chief of the response organisation who oversees four functional groups: operations, planning, logistics, and finance and administration. The incident commander also has supporting staff responsible for safety, information and communication, and liaison with other organisations. By following the same organisational template and developing an identical organisation within each emergency response organisation, it is possible to facilitate communication and coordination amongst them and achieve a smooth and well-functioning response.

Figure 4-2-3. Incident Command System



Source: Federal Emergency Management Agency website.

ICS has the following two characteristics.

- It is a standardised organisation. Each organisation has a common organisational design that facilitates efficient coordination, avoiding redundant roles and communication.
- It is highly adaptable. The ICS organisation can expand or shrink in answer to the development of emergency response. The number of staff can increase or decrease depending on the status of the emergency.

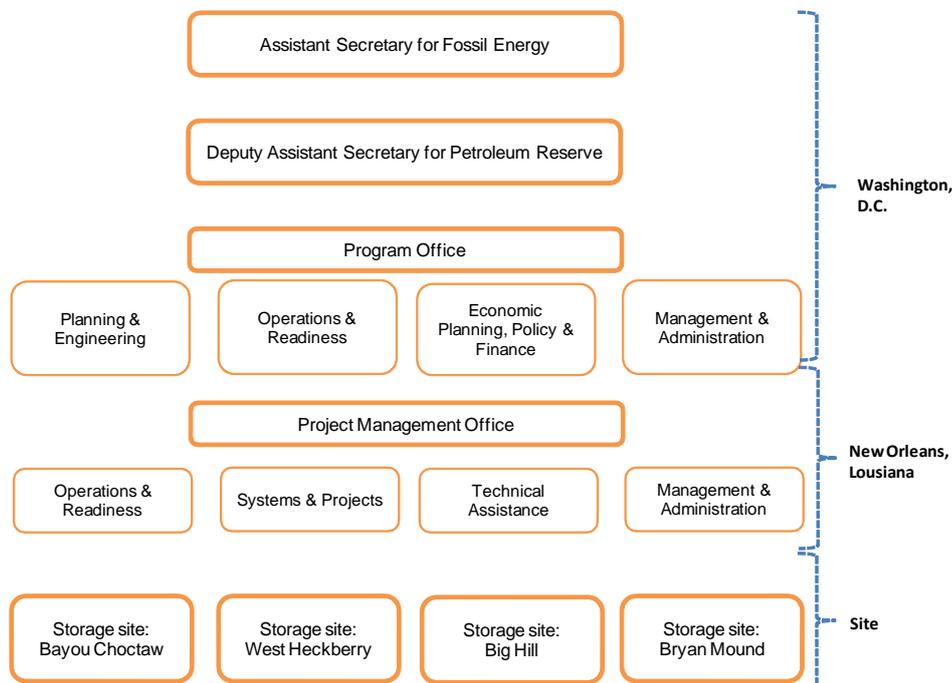
The US has deep expertise in designing emergency response mechanisms utilising the ICS. In particular, the Federal Emergency Management Authority under the Department of Homeland Security manages and operates emergency response systems based on ICS and was able to achieve very effective response actions in their response to Hurricane Sandy in 2012. The ICS can provide useful guidance to ASEAN countries that have not yet developed such emergency response activities but plan to do so in the future.

4-2-3. Stockpiling system in the United States

The US has one of the best-functioning oil-stockpiling systems in the world. The legislative framework of the US oil-stockpiling system is provided by Energy Policy and Conservation Act, which was originally provided in 1975, and modified most recently in 2012. The Department of Energy's assistant secretary for fossil energy is responsible for meeting the objectives of the SPR. Practical matters are handled by the Department of Energy's deputy assistant secretary for petroleum reserves. Stockpiling policy implementation is undertaken by the Program Office in Washington, DC and day-to-day operations are overseen by the Project Management Office in New Orleans, Louisiana. The United States has four major SPR bases in Louisiana and Texas where major refineries exist nearby. All stockpiling operation activities are undertaken by these local stockpiling bases. According to the annual SPR report issued by the Department of Energy, 111 federal government staff and 834 contractors were engaged in SPR operations as of the end of 2012.

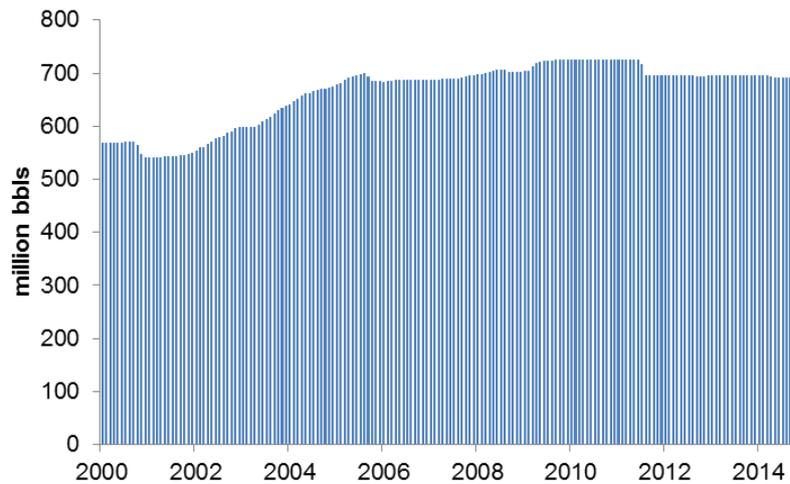
Being the largest oil-consuming country in the world, the US holds about 700 million bbl of oil stockpiling, by far the largest stockpiling volume in the world. The volume was raised to its current level in 2005 under the Bush administration. This decision to raise the volume of oil stockpiling was made when the international oil market balance was tight and the US oil import volume was rising due to declining domestic production (Figure 4-2-5). The experience of simultaneous terrorism attacks in 2001 strengthened awareness of national security in the US, and rising oil imports made the then administration find the necessity to increase the SPR stockpiling. Since then, however, the oil supply situation surrounding the US market in 2015 has been significantly different. Thanks to the shale revolution that makes it possible to extract oil and gas resources from shale reservoirs, US oil production has greatly increased and as a result, the country's oil imports have been rapidly decreasing (Figure 4-2-6). In this sense, the incentive to hold the existing high levels of stockpiling volume is receding for the United States.

Figure 4-2-4. Organisation of the United States SPR System



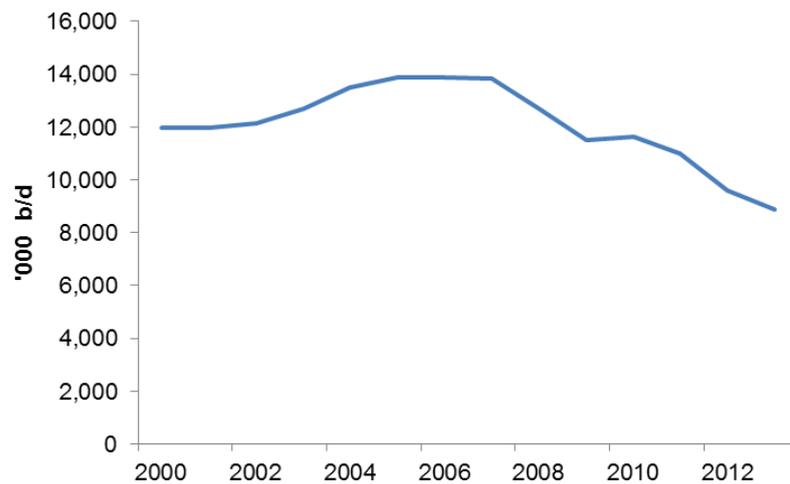
Source: US Department of Energy website.

Figure 4-2-5. United States Stockpiling Volume



Source: US Energy Information Administration website.

Figure 4-2-6. Oil Net Import in the United States

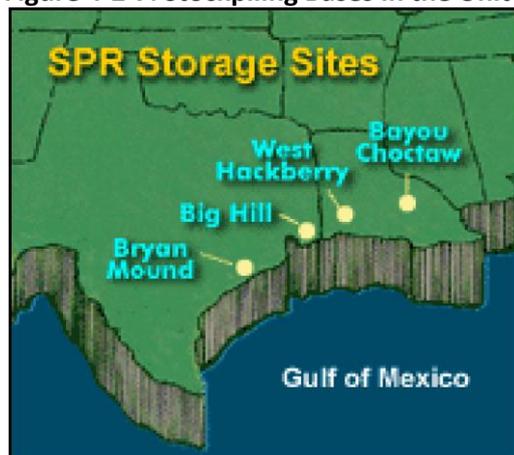


Source: British Petroleum, 'Statistical Review of World Energy' (2014).

All of the stockpiling volume in the United States is owned and operated by the US government; there is no private stockpiling system in the country. All the oil stocks US oil companies have are commercial stocks. Until the US Department of Energy began to stockpile low- sulphur heating oil in 2000,²⁰ all stockpiling was held in the form of crude oil. As of the end of 2013, more than 99 percent of the total oil stockpiling is crude oil.

²⁰ Stockpiling of low-sulphur heating oil is located in states in the Northeastern region (e.g. New Jersey, Rhode Island, and Connecticut) and its total stockpiling volume is two million barrels.

Figure 4-2-7. Stockpiling Bases in the United States



Source: US Department of Energy website.

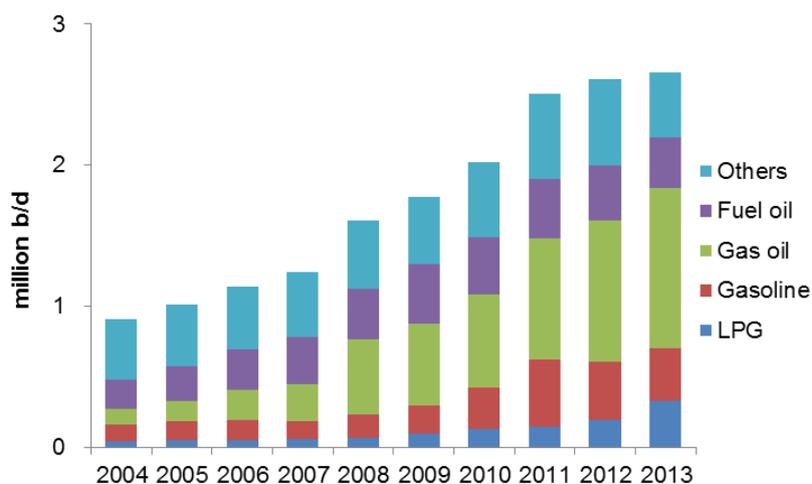
The US has four major crude oil stockpiling bases in the states of Texas and Louisiana (Figure 4-2-7). All of the stockpiling bases are linked to major refineries along the coast of the Gulf of Mexico by a domestic pipeline network, and the operation of releasing the stockpiled oil to the refineries is quite easily accomplished.

4-2-4. Limited possibility of physical product supply to Asia

Although the US has ample stockpiling and the largest refining capacity in the world, it is unlikely to be a major direct and physical supplier of oil to ASEAN countries in an emergency. Thanks to the shale revolution and growth in the production of domestic crude oil, crude oil prices in the US market have been traded at a discounted level compared to the international market.²¹ Natural gas prices in the US are much lower than those at the international level, and refineries in the US enjoy the benefits of cheap feedstock and refinery fuel and have significantly increased their operational utilisation and product exports as well. The US has ample *physical* capacity to supply oil products to ASEAN countries if the region has a product shortage problem.

²¹ In 2014, West Texas Intermediate (WTI), the US benchmark crude oil price, was \$6/bbl cheaper than Brent, the European benchmark crude oil price.

Figure 4-2-8. United States Oil Product Exports (2004–2013)



Source: US Energy Information Administration website.

It is, however, a significant distance from the US to the ASEAN region. Even after the Panama Canal expansion is completed, it will take more than 20 days to navigate to the Asian market region from the Gulf of Mexico, the refining hub of the US. This may be too slow to meet the urgent need of Asian countries in an emergency.

Even if this distance is permissible, government-to-government coordination to arrange the export of oil products on a cooperative basis might be difficult. This is because all refiners in the US are private players and they will not export their product by US government mandate. They will only do so if the commercial conditions of such trade are met.

Furthermore, as mentioned earlier, all of the oil stockpiling held by the US government is crude oil but export of crude oil is prohibited in the US, with very limited exceptions. Asian countries will need the final product in case of emergency because many ASEAN countries have a refining capacity shortage. Therefore, there is limited chance of the US becoming a direct and physical oil supplier to ASEAN countries.

4-2-5. Oil product supply by US oil companies in Asia

Several US oil companies are operating globally and they could be an important source of oil products in the ASEAN in case of emergency. As shown in Table 4-2-2, US oil companies hold a refining capacity of 1.6 million b/d in the Asia–Pacific region and will be an important source of product supply.

Table 4-2-2. US Oil Companies Downstream Assets in Asia Pacific
(as of 31 December 2014)

Company	Country	Refining capacity (total capacity, '000 b/d)
ExxonMobil	Singapore	592
	Thailand	167
	Other Asian countries	256
Chevron	Republic of Korea	393
	Singapore	145
	New Zealand	14
	Australia	54
Total		1,621

Source: Websites of the above-mentioned companies.

Despite the recent trend of US oil companies reducing their refining assets around the world²², US companies still have large refining capacities and will be an important supply source in an emergency. US oil companies have a long history in the downstream oil business in particular and have experienced a number of emergencies in the past. All US oil companies have developed business continuity plans which prescribe actions to be taken in an emergency and have established procedures to respond to such an emergency. These companies are likely to be reliable suppliers to consumers.

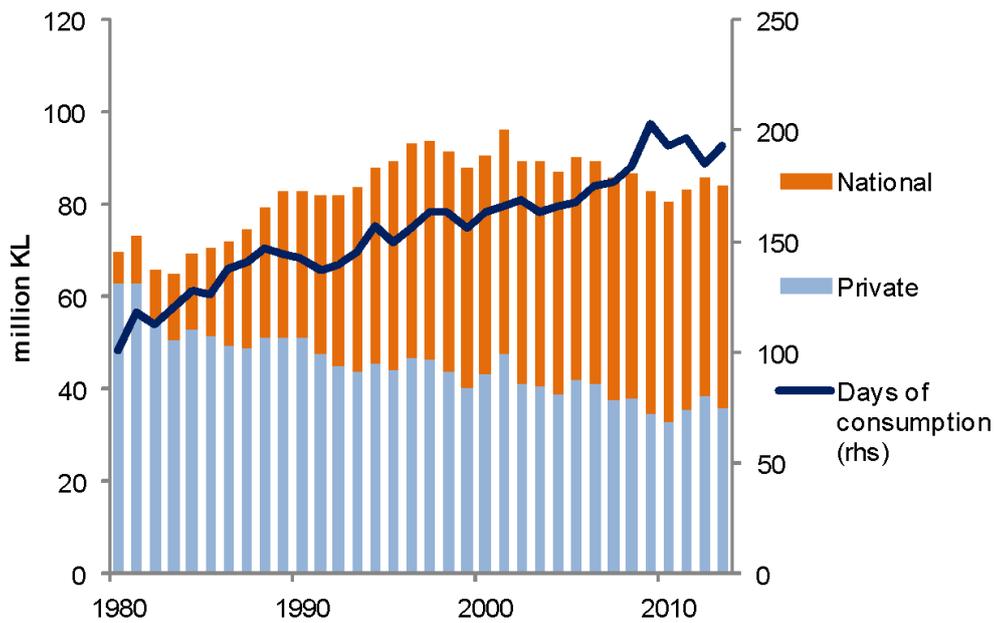
4-3. Cooperation with Japan

4-3-1. Japan's oil-stockpiling systems

The development of the Japanese oil-stockpiling system dates back to 1963 when the Energy Committee under the Industrial Structure Council of the Japanese government proposed to develop oil stockpiling equivalent to 60 days in accordance with a recommendation by the Organisation of Economic Co-operation and Development. After Japan achieved the 60-day target in 1974, another target of 90 days was set because the first oil crisis had occurred in 1973 and 60-day stockpiling was no longer considered sufficient to meet such a large-scale oil supply disruption. Oil stockpiling was continued and the 90-day target was achieved in April 1981.

²² Chevron closed its refinery in 2003 and turned it into an import terminal. ExxonMobil also sold its Malaysian refinery to San Miguel Corporation in 2011.

Figure 4-3-1. Oil Stockpiling Volume in Japan



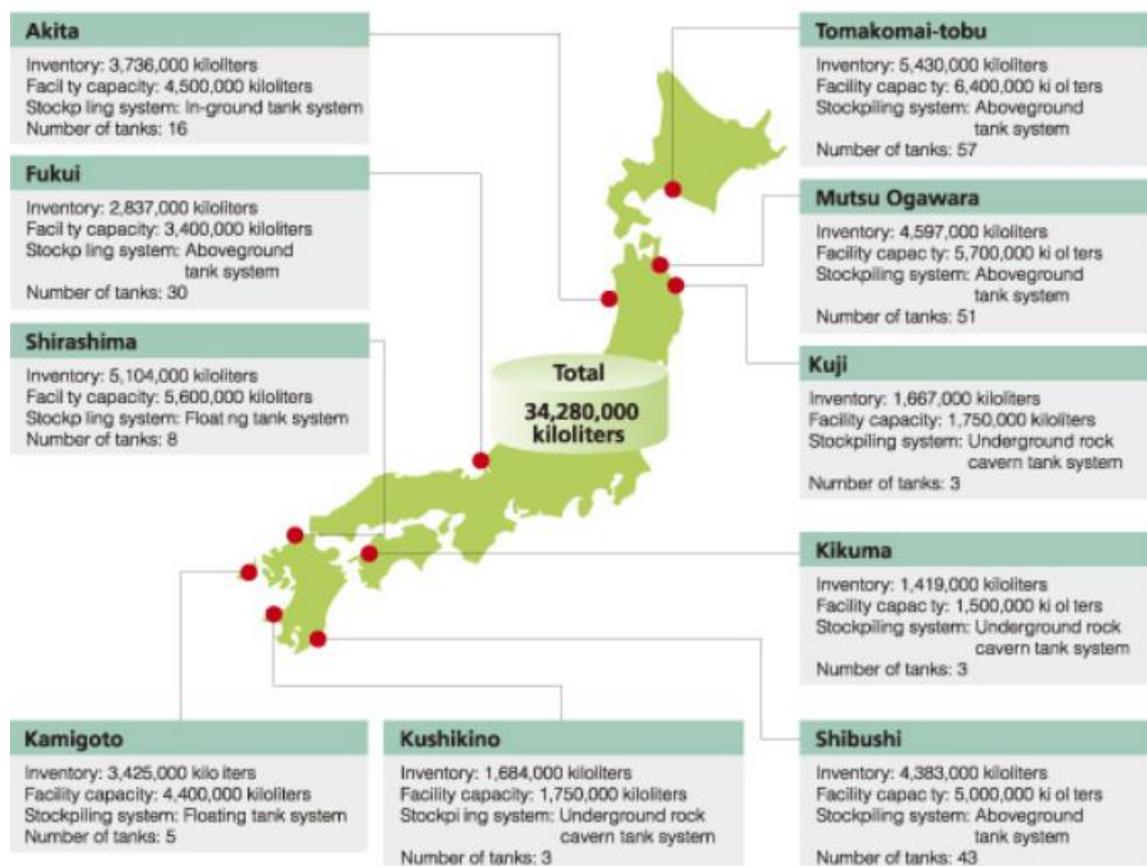
Source: Petroleum Association of Japan, 'Sekiyu Shiryō Geppō' (2015).

While most of the initial oil stockpiling in Japan was built up by private oil companies with the government's financial support, the Japanese government also started to build oil stockpiling by itself (Figure 4-3-1). Japan National Oil Corporation (currently reorganised as the Japan Oil, Gas, and Metals National Corporation) began to raise government stockpiling in 1978. The target of the government stockpiling was 50 million KL (310 million bbl), and this was achieved in 1998. The government stockpiling was held in 10 oil-stockpiling bases in Japan (Figure 4-3-2) as well as in leased crude oil tanks in private companies' refineries in Japan.

As for the private stockpiling system, the Oil Stockpiling Act prescribes that oil refiners have to hold a minimum of 70 days of their sales volume and oil importers have to hold a minimum of 40 days. These refiners and importers are required to regularly report their crude oil and product inventory to show that they are maintaining the minimum inventory requirement for stockpiling purposes.

Figure 4-3-2. Location of Oil-Stockpiling Bases in Japan

(As of December 2006)



Source: Japan Oil, Gas and Metals National Corporation (JOGMEC) website.

Japan has released private oil stockpiling five times but never government stockpiling (Figure 4-3-3). This is because private stockpiling is part of the commercial inventory of refiners or importers and is more easily released by utilising the regular commercial supply infrastructure. Particularly in the case of crude oil, private stockpiling is held within refinery premises and can thus be transported and processed at a refinery much more easily than the government-stockpiled crude oil, which is stored at a more remote location.

Figure 4-3-3. Government Stockpiling and Private Stockpiling

■ Current Status of Oil Stockpiling in Japan (as of Dec 2013)

	Private Stockpiling	Government Stockpiling
Stockpile Days	82 days	108 days
Stockpiling Volume	36.4 million kl	47.8 million kl
Obligation Days	70 days of domestic demand	50 million kl (attained in Feb 1998)
Holding Method	Through production and distribution processes	In sealed designated storage tanks (Oil products are held through production and distribution processes.)
Holding Location	Private sector tanks in refineries and oil terminals	Crude oil: ① Tanks of national stockpiling bases ② Tanks borrowed from private sector Oil products: Private sector tanks in refineries and oil terminals
Composition	Crude oil : 50% Oil products: 50%	Crude oil : 97.3% Oil products: 2.7%
Administrative Body	Oil refiners and importers (It is however possible for the joint stockpiling companies to act for such management.)	① 10 national stockpiling bases (2/3 of government reserve) ② Private oil companies (1/3 of government reserve): (Management on consignment)
Effect of Stockpile Release	① Prompt supply to distribution markets as a large part of stockpiles are held at refineries and oil terminals ② Flexible release of stockpiles depending on crude procurement status and seasonal demand fluctuation	① strong psychological effect on the market when the government announces its decision to release its stockpiling to increase oil supply in the market ② Reduced mobility of released stockpiling, compared with the private sector release, as reserves are stored at remote national stockpiling bases
Cases of Stockpile Release	① 2nd Oil Crisis (Mar 1979-Aug 1980) ② Gulf Crisis in response to CERM (Jan-Mar 1991) ③ Hurricane Katrina aftermath (Sep-Dec 2005) ④ The Great East Japan Earthquake (Mar-May 2011) ⑤ Libyan situation (Jun-Dec 2011)	None
Financial Measures	Subsidy for oil purchasing costs and tank construction costs	Government's budget (Petroleum and Coal Tax)
Cost Recovery	Part of product cost (passing the cost on to consumers is expected)	Part of product cost (passing the cost on to consumers is expected)

Source: Petroleum Association Japan website.

In the late 2000s, the Japanese government introduced the third category of oil stockpiling besides government stockpiling and private stockpiling; namely, joint stockpiling with oil producers. This is a framework where the Japanese government or oil companies lease their crude oil tanks to an oil exporter, such as a Middle Eastern crude oil producer, for commercial and trading purposes. Under ordinary circumstances, the oil exporter can utilise the tanks for commercial activities. Because the tanks are located in the Asian market region, the exporter can readily and easily respond to Asian importers' demand for crude oil. The exporter may even export to refiners on the West Coast of the United States if market conditions are met. In an emergency, on the other hand, Japan has priority claim to the tankers of the stored crude oil as if it were part of emergency oil stockpiling. The Japanese government entered into such an agreement with Abu Dhabi National Oil Company in 2009 and again with Saudi Aramco in 2010.

4-3-2. Administration experience to introduce stockpiling system

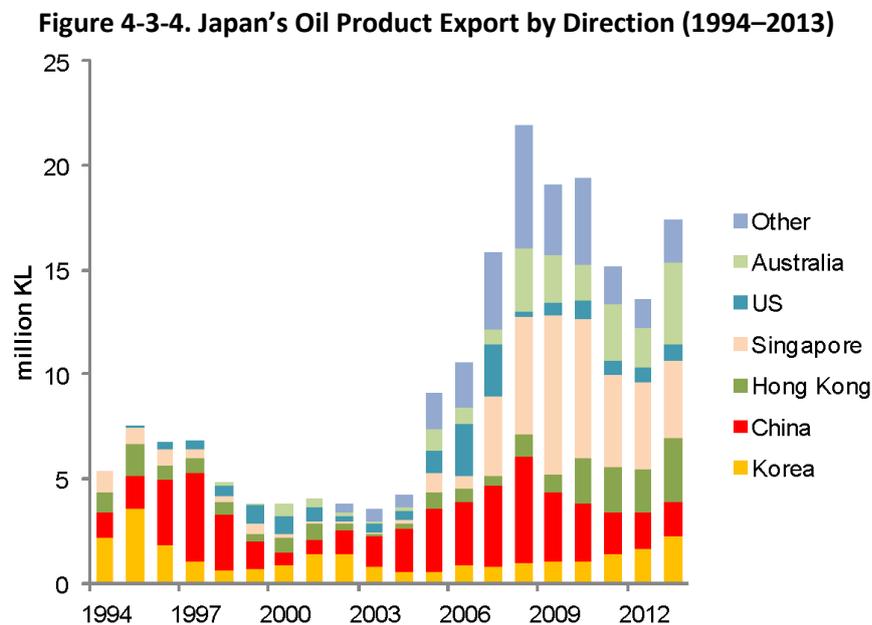
As an IEA member country, Japan is Asia's pioneer in developing oil stockpiling systems and has deep expertise and experience in developing and managing such systems. In developing a stockpiling system, a government needs to deal with numerous issues in initiating its efforts. It needs to determine who will undertake the stockpiling operation. Will it be the government or an oil company? If it is the government, a budget needs to be secured. If it is the private sector, the government may have to provide some financial assistance. The government also sets the target for the stockpiling volume.

The government also needs to tackle many other issues. For instance, it has to provide a legal framework and set up a regular monitoring system to ensure that sufficient stockpiling volume is maintained within the country. In monitoring the volume, the government needs to develop an accurate statistical system for oil supply and demand as well as a regular reporting system. The government may need to establish a dedicated organisation to oversee oil stockpiling issues. In setting a specific target for oil stockpiling, it is necessary to examine the future demand outlook not only for oil but also for other energy sources such as natural gas or electricity. The target can be set as an import volume or a total demand volume. The government may decide which base is more relevant for the stockpiling target they set. Japan has developed its own stockpiling system by dealing with all of these issues and can therefore share its experience and administrative know-how with ASEAN countries.

4-3-3. Japan's product supply capacity to the ASEAN

Japan has an ample product supply capacity with its large refining capacity and stockpiling volume. In fact, Japan has maintained a high level of product exports in recent years despite its rationing of the refining capacity. This is because its domestic demand is rapidly declining and, therefore, its surplus refining capacity forces it to export its refined products abroad. While Japanese refineries are, in general, originally designed to refine products mainly for the domestic market, they have invested in export facilities such as berths and loading pumping capacity because the demand decline since the mid-2000s has been so large and rapid. Its export volume has significantly increased since the mid-

2000s as shown in Figure 4-3-4. Most Japanese oil product exports are directed mainly to the Asia-Pacific market, and this consistent export supply can be utilised as an emergency supply source if any oil-product supply disruption occurs in ASEAN countries.



Source: Ministry of Economy, Trade and Industry, 'Yearbook of Mineral Resources and Petroleum Products Statistics' (2014).

Since the demand for Japan's domestic oil products is expected to decrease, its oil refiners will continue to have a surplus refining capacity and, consequently, the capability to provide a short-term measure for ASEAN countries.

4-3-4. Expertise on the various types of stockpiling bases and their construction and maintenance

Another kind of expertise that Japan can share with ASEAN countries is about constructing and operating various kinds of oil-stockpiling bases. In addition to the ordinary above-ground stockpiling bases, Japan also has floating tank stockpiling bases, underground stockpiling bases, and semi-underground (or in-ground) stockpiling bases.

Selecting a specific type of stockpiling base is a very important process in developing oil stockpiling. A number of factors and conditions need to be considered, such as economics, storage capacity, securing a site for the stockpiling base and consent

from the local community, and the geological structure of the construction site. Different types of stockpiling bases have different maintenance costs, and these costs may change as the stockpiling base continues to operate. Japan has a long history spanning more than 40 years of operating these stockpiling bases. It has accumulated expertise on selecting a specific type of stockpiling base and on construction and maintenance cost structure. This expertise will be a useful resource for ASEAN countries that plan to construct their own stockpiling bases.

4-3-5. Paper-based stockpiling

Utilising its ample stockpiling volume, Japan can provide an opportunity for paper-based stockpiling. It has stockpiling equivalent to almost 200 days and as its domestic demand decreases, its stockpiling days tend to rise. Japan, therefore, has sufficient volume of stockpiling and can lend it to another country on a paper basis.

In fact, Japanese oil companies have been lending a certain volume of stockpiling to New Zealand since 2009. In this case, based on an intergovernmental agreement between Japan and New Zealand, the New Zealand government bid for the rights to purchase oil stockpiling in an emergency, and a Japanese oil company was awarded the bid to sell those rights to the New Zealand government. In this transaction, the New Zealand government pays a fee to Japanese oil companies in return for the right to secure oil products in an emergency. Until ASEAN countries develop their own stockpiling bases, Japan can provide them a similar arrangement as an interim oil stockpiling measure.

4-3-6. Training program and facilities

In relation to sharing its expertise with ASEAN countries, it should be noted that Japan has well-developed training program and facilities. Japan Cooperation Center, Petroleum has organised approximately 30 courses, inviting industry professionals from overseas, and has an established scheme to conduct professional education in the oil industry. Japan Oil, Gas and Metals National Corporation also regularly receives a number of international visitors and gives lectures about its operation of government stockpiling facilities. Japan already has the infrastructure as well as established procedures and the

experience to share its expertise with foreign professionals. It can utilise this in international cooperation with ASEAN countries that are considering developing their own oil-stockpiling system.

4-3-7. Emergency response measures

Japan has also recently accumulated expertise in emergency response measures, particularly against natural disasters. The Great East Japan Earthquake in 2011 revealed a number of issues in Japan's oil-supply system, such as the lack of a coordinating organisation that collects accurate information and allocates the limited supply of oil products to prioritised places such as hospitals or emergency assistance vehicles. Based on this experience, the Japanese government has modified the Oil Stockpiling Act to facilitate inter-company cooperation in case of an emergency and has built up the stockpiling of government oil products. The government also requires oil companies to provide a business continuity plan and to review it in order to develop a more effective plan. In 2014, the government conducted an emergency drill involving oil companies and the Japan Self-Defense Forces. Insights and skills gained from this drill are expected to play crucial role during rescue operations and in the transport of necessities such as food, medical supplies, and fuel.

On the infrastructure side, the government secures the budget necessary to enhance the physical resilience of refinery sites. Because natural disasters such as typhoons, earthquakes, and tsunamis are a common threat to all ASEAN countries, how to prepare well for these threats is a major issue in oil-supply security. Japan has accumulated extensive insight in this area and can assist ASEAN countries significantly with its experience and learning process.

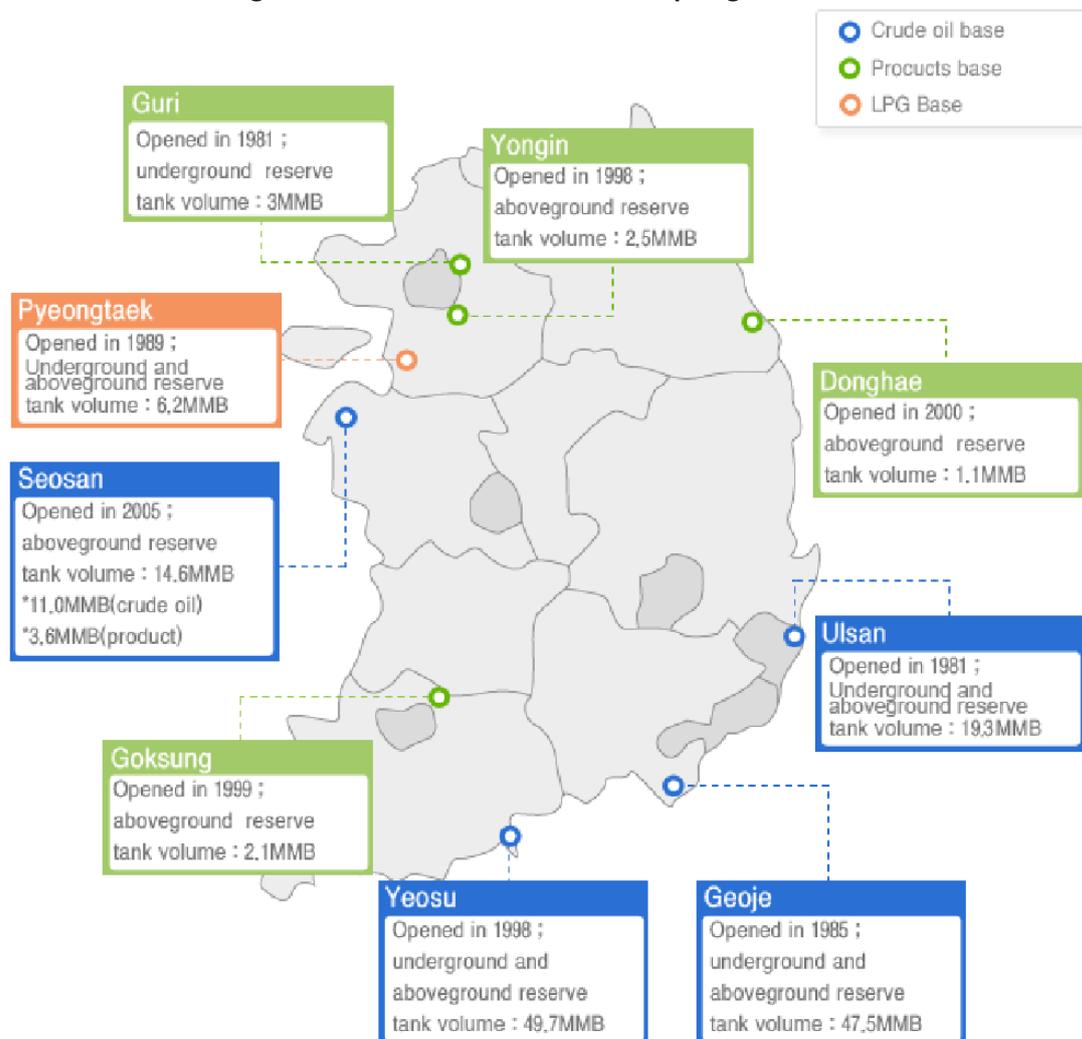
4-4. Cooperation with South Korea

Another IEA member country that has developed a sophisticated oil stockpiling system is South Korea.

4-4-1. South Korea's oil-stockpiling systems

Like Japan, South Korea has introduced both government and private oil-stockpiling systems. The government oil-stockpiling system is operated by the state-owned Korea National Oil Corporation (KNOC). KNOC has nine oil-stockpiling bases in South Korea holding 91.7 million bbl of stockpiling. Given the country's relationship with its northern neighbour, North Korea, five of these are underground storage bases for security purposes. KNOC's oil-stockpiling bases are all linked via pipeline with refineries and major cities such as Seoul and, in case of emergency, stockpiled oil can be released promptly without arranging for a tanker (Figure 4-4-1).

Figure 4-4-1. South Korea's Oil Stockpiling Facilities



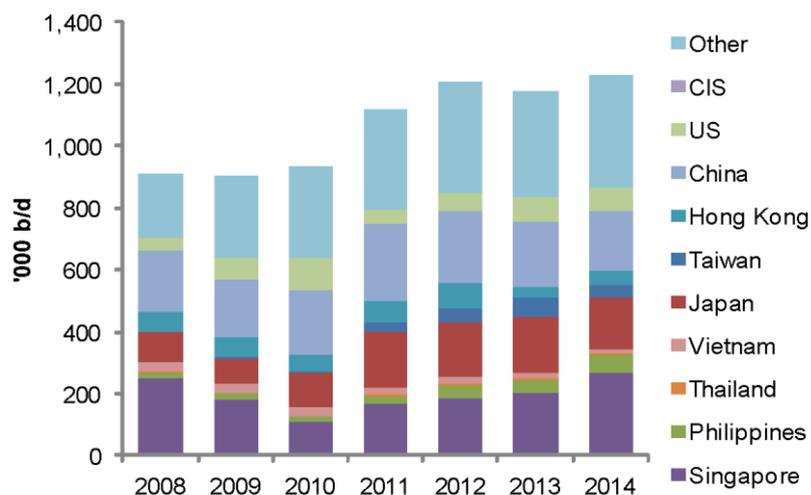
Source: Korea National Oil Corporation (KNOC) website.

In South Korea, private stockpiling is undertaken by private oil companies. South Korean oil companies are required to hold the equivalent of at least 40 days of crude oil and oil-product inventory. This stockpiled oil is held in their refineries or terminals.

4-4-2. Product supply capacity

South Korea is one of the largest oil-product exporters in the world. It has a refining capacity of more than 3 million b/d while its domestic oil product demand (excluding naphtha for petrochemical feedstock) is 1.1 million b/d. As shown in Figure 4-4-2, ASEAN countries including Singapore, the Philippines, Viet Nam, and Thailand are a major direction of export for South Korea.

Figure 4-4-2. South Korea’s Product Export by Direction (2008–2014)



Source: Korea National Oil Corporation (KNOC), ‘Korea Monthly Oil Statistics’ (2010–2014).

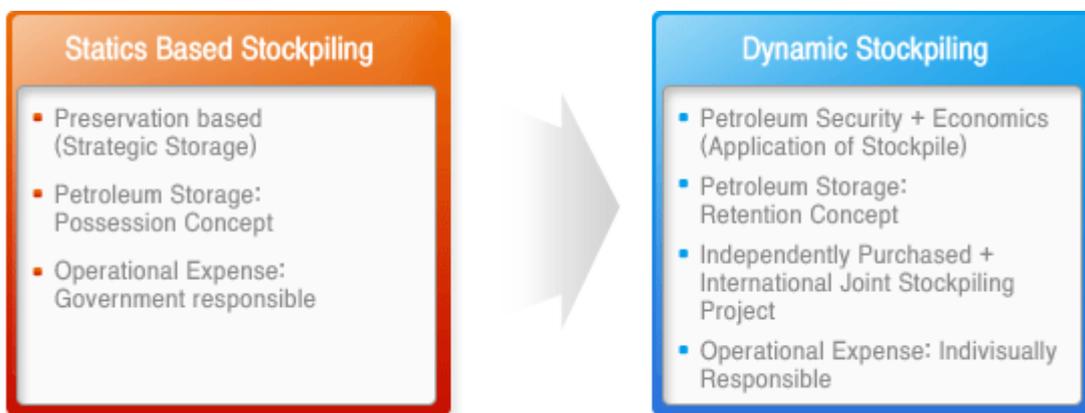
4-4-3. ‘Dynamic stockpiling’

One of the unique aspects of South Korea’s oil stockpiling system is its method of stockpiling operation. KNOC launched an international joint stockpiling arrangement in 1999. This agreement allows it to lease its stockpiling storage capacity to a third-party player for its commercial activities on the condition that the stored inventory will be used as stockpiling volume. Because the storage inventory is moving as a commercial product,

it remains fresh and quality degradation can be avoided while the total level of inventory is maintained. This is why it is called dynamic stockpiling. The concept of this type of stockpiling is shown in Figure 4-4-3. The essence of dynamic stockpiling is that while the total volume remains the same, the volume is not just being stored; it is always flowing. Since the inventory is always flowing, it is more easily released in an emergency.

KNOC can collect fees by leasing its storage capacity to third parties and it can utilise the revenue to develop and operate its oil-stockpiling bases. According to the KNOC’s annual report, it collected US\$131 million through stockpiling operations in 2013.²³ This amount may be far short of the total expenses in all its stockpiling activities but it certainly helps the state budget.

Figure 4-4-3. Concept of Dynamic Stockpiling



Source: Korea National Oil Corporation (KNOC) website.

Dynamic stockpiling has several implications for cooperation for ASEAN oil security. If storage capacity and economic conditions allow, ASEAN countries can store their stockpiling product in KNOC’s storage bases. One of the most important goals for the development of oil stockpiling for ASEAN countries is, of course, to build their own stockpiling bases in their countries but it takes a long time to construct such bases. Until they can complete the construction of their own bases, ASEAN member countries can utilise South Korean storage capacity as an interim stockpiling base. ASEAN countries may bring their own product to storage for stockpiling or they may purchase the right to claim part of the existing stockpiled volume by paying a ‘ticket’ fee (ticket stockpiling).

South Korea’s dynamic stockpiling also provides an important business model for once the oil-stockpiling base is completed. If the government has developed a stockpiling

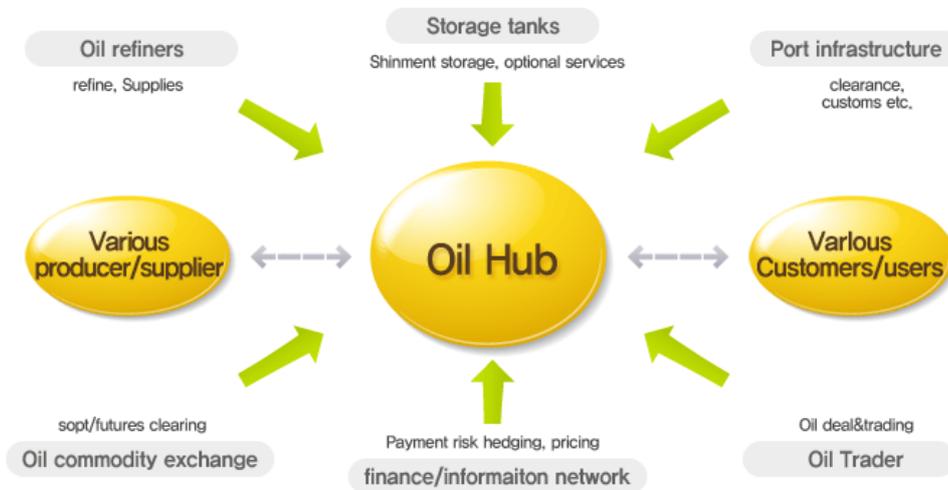
²³ Korea National Oil Corporation (KNOC) Annual Report 2013.

base and can lease out part of its capacity, it can collect fees to ease its financial burden through such leasing activities. Securing financial resources is always one of the biggest obstacles to developing oil-stockpiling bases and this leasing ‘business’ can ease the burden to some extent.

4-4-4. Utilisation of the Northeast Asia oil hub

The South Korean government began its Northeast Asian Oil Hub project in 2008. Being a hub in various aspects (from shipping to air transpiration to the financial sector) is a national goal for South Korea. Becoming an oil-trading hub with storage capacity and active trading activities is an envisioned goal. The joint venture, which is led by the KNOC, finished constructing a storage facility in Yeosu in April 2013. The total capacity of the newly built facility is 8.2 million bbl. The KNOC also plans to construct another storage base in Ulsan with a capacity of 28.4 million bbl.

Figure 4-4-4. Concept of the Northeast Asia Oil Hub

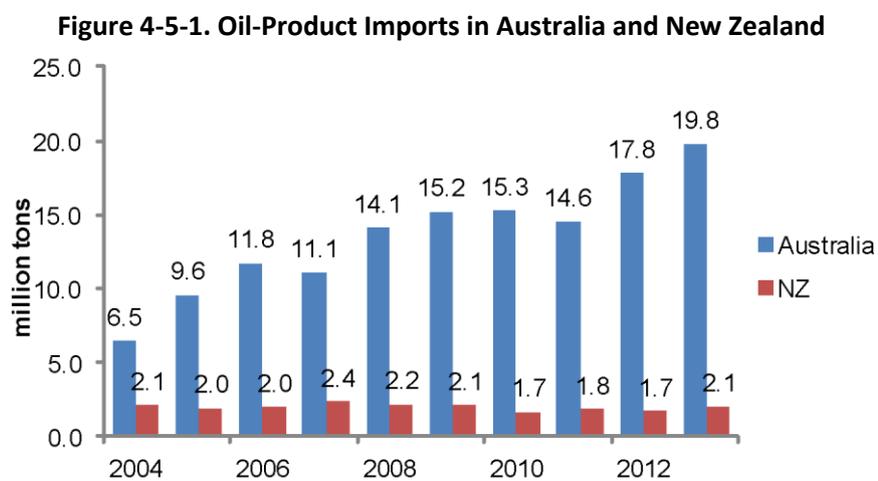


Source: Korea National Oil Corporation (KNOC) website.

ASEAN countries can also utilise this oil hub as another means of holding their stockpiling volume. ASEAN countries can borrow the storage capacity and store their stockpiling products or crude oil. If possible, they can also borrow stored volume on a paper basis (ticket stockpiling).

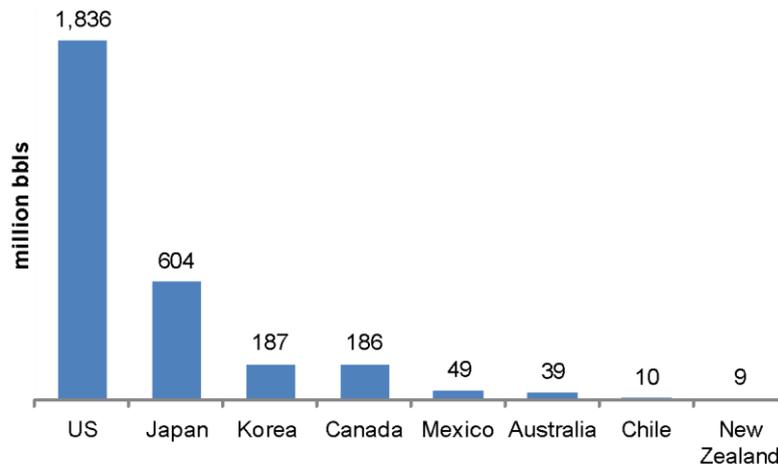
4-5. Cooperation with Australia and New Zealand

Australia and New Zealand are other IEA member countries that may be able to provide effective cooperation. These two countries are net oil-product importers. Since the 2000s, several of their refineries have shut down and their oil-product imports have been increasing (Figure 4-5-1). Their stockpiling volume is also limited compared to other Asia–Pacific IEA countries because their domestic demand is also small (Figure 4-5-2).



Source: International Energy Agency, 'Energy Balances of OECD Countries' (2014).

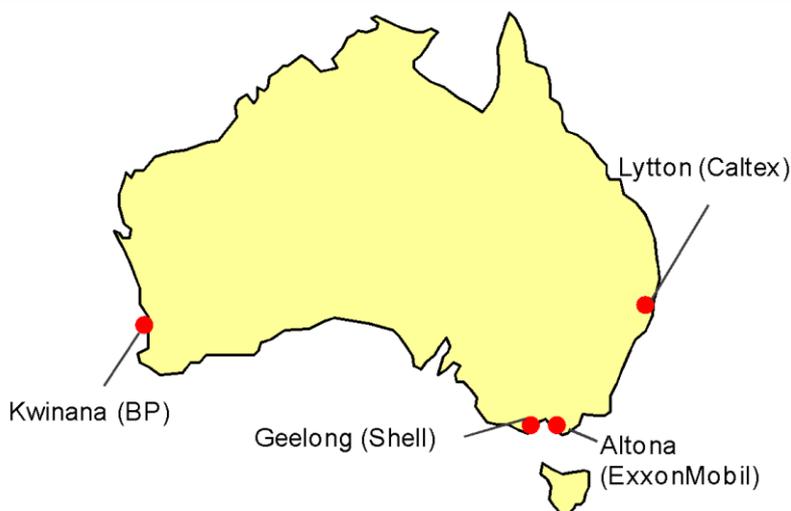
**Figure 4-5-2. Total On-land Oil Stock of Asia–Pacific IEA Countries
(as of September 2014)**



Source: International Energy Agency, *'Monthly Oil Market Report'* (March 2015).

Australia and New Zealand may, however, provide product supply to ASEAN countries, especially to Indonesia, which is located in the southern part of the ASEAN region. Because these two countries are always importing oil products, if they decide to release their domestic oil stockpiling, those imports originally directed to them can be redirected to ASEAN countries with an urgent need to secure product supply. Some refineries in Australia, such as those in Western Australia or Queensland, may become product suppliers to the ASEAN. The oil market in Asia is essentially integrated and any release of surplus oil supply contributes to easing the market's supply and demand balance.

Figure 4-5-3. Locations of Australia's Refineries



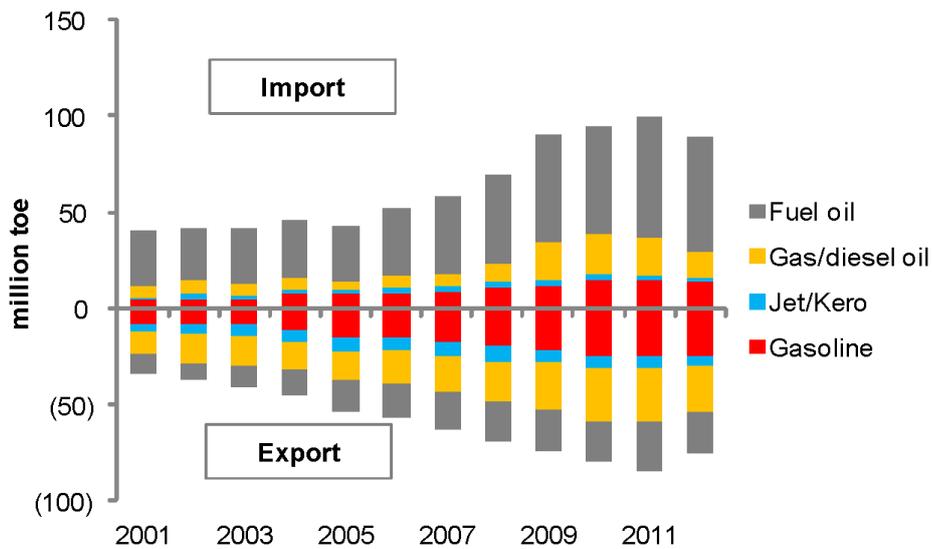
Source: Institute of Energy Economics, Japan (IEEJ).

4-6. Potential Role of Singapore

Although Singapore is itself an ASEAN member country, it has a unique position in the Asian oil market and can play an important role in ASEAN oil-supply security. Located at the heart of Southeast Asia and having surplus refining capacities and large storage capacities, Singapore has been a key supplier of primary oil products such as gasoline, diesel, or jet fuel to other ASEAN countries. Singapore hosts the offices of various oil companies and traders and provides a place for them to trade their crude oil and oil products. The country is indeed the hub of the Asian oil-product trade and its traded volume has been increasing since 2000 (Figure 4-6-1). Tank capacity in particular has significantly expanded since the 2000s and such storage-capacity expansion provides opportunities for innovative trading activities.

The existence of such a refining capacity and product inventory will undoubtedly play a very important role in supplying oil products to ASEAN countries, especially in an emergency.

Figure 4-6-1. Oil Product Imports / Exports of Singapore (2001–2011)



Source: International Energy Agency (IEA), 'Energy Balances of non-OECD Countries' (2014).

Singapore can help ensure oil-supply security by making oil-trade activities more transparent. Collecting and publishing statistical data on oil import, export, and inventory within Singapore in a timely manner can provide appropriate market information to the oil market and thus minimise the risk of market participants making ill-informed decisions in a panic. Because all oil companies in Singapore are private companies, it may be difficult to obtain such statistical information. Developing this, however, will be of increasing importance since the weight of the Asian oil market in the international oil market is growing. It is expected that Singapore will work to obtain and publish such market data.

Hosting the regional headquarters of almost all the major oil companies and traders, Singapore is also the centre of market intelligence for Asian oil markets. The existence of a strong financial industry in the country also strengthens its position and its value as the informational hub of the oil industry and market. This means that Singapore is one of the candidates to host the permanent secretariat of the APSA which will coordinate oil-supply transactions amongst the member countries as discussed in the previous chapter. One of the expected roles of the secretariat is to collect proper market information in a timely manner, and Singapore would have the easiest access to such information.

4-7. Collaboration with the International Energy Agency (IEA)

Another important source of oil stockpiling and emergency response expertise is the IEA. Because its original mission was to form a collaborative body of oil importers against the Organization of the Petroleum Exporting Countries (OPEC), the cartel of oil producers, the IEA has accumulated vast experience in oil stockpiling development and other oil-security policies for more than 40 years. In fact, no organisation other than the IEA has better understanding or know-how in oil stockpiling development. The IEA has increasingly become interested in expanding its activities to non-IEA countries and is ready to provide support for the efforts of the ASEAN countries in this area.

The first such area would be to draft a development plan for oil-stockpiling development. The method of initiating oil stockpiling varies for different IEA member countries. In the US, all oil stockpiling build-up was undertaken by the government while in Japan, the initial stockpiling was started by private companies because it was much faster to build up stockpiling with the existing infrastructure. The burden of oil stockpiling was gradually shifted to the government as the government stockpiling facilities were constructed. The IEA has a number of cases of initiating oil stockpiling in its member countries. Each ASEAN country can consult the IEA about what is the most effective way to start stockpiling. When utilising private-industry capital to build up oil stockpiling, another important issue where the IEA has expertise is how to encourage those companies to participate in stockpiling efforts or, in other words, how to reconcile commercial interests with stockpiling needs.

The IEA can also provide a useful reference in the areas of quantifying oil-stockpiling benefits and conducting emergency exercises. As mentioned above, the IEA has already established its own methodology to calculate the hypothetical economics of oil stockpiling²⁴, and this methodology can be utilised in quantifying stockpiling benefits. The IEA can assist the ASEAN in visualising the benefits of stockpiling development. It also has unrivalled expertise and experience in emergency exercises. It has conducted annual international exercises with member countries and has a long history of pursuing such exercises. It can facilitate exercises from substance to logistics, developing a hypothetical

²⁴ International Energy Agency, *Focus on Energy Security—Costs, Benefits and Financing of Holding Emergency Oil Stocks* (Paris: International Energy Agency, 2013).

supply-disruption scenario to review the exercise afterwards. Some previous materials from IEA exercises can be utilised in exercises conducted by ASEAN countries. In fact, an emergency exercise managed by APERC in 2013 was observed by IEA representatives who provided their expert comments.

Chapter 5

Conclusion

Previous chapters discussed the oil supply-and-demand balances of ASEAN countries, the developments and challenges of oil stockpiling in the ASEAN, and potential items for cooperation toward oil-stockpiling development within and beyond the ASEAN member countries. Based on these observations and discussions, this chapter summarises the findings and explores several policy proposals.

5-1.The Wide Variety and Diversity of ASEAN Countries

First of all, as Chapter 1 reveals, ASEAN countries have extensive variety and diversity in terms of their stages of economic development, oil-market conditions, import dependence, primary energy mix, oil-security policy principles, and oil- stockpiling development. Like the European Union (EU), the ASEAN is a regional framework composed of countries in the same geographical region but unlike the EU, this geographical proximity does not guarantee the closeness of their political, economic, and social features. Some countries have a higher per capita income and thus a different energy consumption structure from other countries with lower per capita income. Some countries are endowed with significant natural resources and, therefore, import dependence is not a big issue while for other countries, securing a stable and reliable oil supply is an acute policy issue. In some countries, the NOC is a dominant player in the domestic oil market but in others, private players are the primary suppliers of oil products to their markets. This extensive variety and diversity of background amongst the member countries cannot be overemphasised in considering any policy initiative or cooperation in ASEAN countries.

This variety and diversity also means that no single ‘cookie cutter’ approach toward oil-stockpiling developments will work effectively in ASEAN countries. In the 1970s, facing a serious threat of oil-supply disruption, countries in the Organisation for Economic Co-operation and Development formed an international organisation called the

IEA. This organisation required its member countries to build up a certain level of oil stockpiling as well as to release this stockpiled inventory in coordination with other members in case of actual supply disruption. This kind of obligatory approach toward member countries was feasible mainly because the countries were in similar stages of economic development and had the capability and resources to achieve the required stockpiling volume and participate in the coordination framework. Most European countries are more or less net oil importers and had similar oil-supply security concerns; another reason was that the 1973 oil crisis was a very shocking event and so member countries found a strong incentive to realise these oil-supply security arrangements. In ASEAN countries, however, such conditions do not apply, and any type of obligatory framework as in the IAE would not be workable there.

What would be appropriate for ASEAN countries is a framework that is more flexible but inclusive of all member countries. The APSA, established in March 2009, could serve as a starting point for such a framework. As discussed in Chapter 2, the agreement is rather too flexible to be effective in an emergency. How to modify and operationalise the agreement will be the primary focus of the regional oil-security arrangements for ASEAN for the moment.

It is also necessary to keep in mind the ASEAN's various and diverse features in order to form a cooperative arrangement between ASEAN countries and non-ASEAN countries such as the US, Japan, or South Korea. Because the progress and challenges in oil-stockpiling development vary greatly between different ASEAN countries, any cooperative actions in the ASEAN have to be designed to fit the specific needs of each ASEAN country. Cooperative actions with Indonesia, for instance, should have different items than those with Myanmar because the former has much higher demand and a wider geographical reach than the latter. Likewise, cooperative actions for Viet Nam should be different from those for Cambodia because the former has already provided a concrete oil-stockpiling development road map while the latter has just begun to work on one. The best practice for a certain ASEAN country may not be so for another. The menu of cooperative actions should, therefore, be tailored to meet the unique requirements and challenges of each ASEAN country.

5-2. How to 'Visualise' the Benefits of Oil Stockpiling

As dependence on imported oil supply increases in almost all ASEAN countries, any serious policy planner and government official in the relevant sector will recognise the importance of promptly building up oil stockpiling. In fact, government officials of the ASEAN+3 countries regularly gather once a year for the ASEAN+3 Oil Stockpiling Roadmap Forum where they review and discuss the latest status of each country's oil- stockpiling development and share their experiences and challenges in development. Information on the necessity and benefits of oil-stockpiling development under the current oil market environment has been uniformly shared amongst the officials of the member countries via the relevant ministries of each country.

However, this recognition is not necessarily shared amongst the entirety of government organisations in each country. Because of rapid economic growth, there is an extensive need to develop different types of infrastructure, including water supply facilities, roads, railroads, bridges, and grid networks. There is also a need to boost the capacity for electricity generation. Government budgets are always constrained to meet this demand. If the necessity of oil-stockpiling development is not sufficiently recognised throughout the entire government, especially by the ministry of finance or the relevant ministry that oversees the allocation of government budgets, there will be insufficient budget allocated to the development of oil stockpiling. This, in turn, will lead to delays in development. This phenomenon has, in fact, been observed in many ASEAN countries. Recognition of the benefits of oil stockpiling is shared amongst a relatively small circle in each country's government organisation.

This is because the benefits of oil stockpiling are difficult to understand. Unlike highway roads or airports or even refineries, oil stockpiling itself does not generate cash benefits. Building a new highway, for example, will increase the transportation of goods and persons, and it is easy to quantify its economic effects. Oil stockpiling, however, only holds inventory and, conversely, generates operation and maintenance costs rather than cash profit. Oil stockpiling is held for an emergency and is not used for commercial profit. Building up oil stockpiling is, therefore, rather closely related to national defence activities, and it may not be appropriate to judge its utility solely from an economic standpoint.

Quantification or visualisation of the benefits of oil stockpiling is needed in order to address this issue. As mentioned earlier, expenditures to develop oil stockpiling are similar to defence expenditures so discussion in the context of a cost-benefit analysis may not be appropriate. Yet such quantification of oil stockpiling benefits is a common interest amongst all relevant government officials of ASEAN countries. Quantified—or at least visualised—material explaining why oil stockpiling has to be developed would help more government officials and decision makers better understand the issue. If these officials recognise the importance of oil stockpiling and endorse the idea, it will be possible to mobilise more resources, from human to capital, and contribute to developing the oil stockpiling system.

Quantification of oil stockpiling is a difficult task. The simplest method would be to assume a crisis case and calculate the economic loss avoided by stockpiling. In fact, the IEA has conducted this analysis, which was published in 2013.²⁵ The analysis assumed an Organisation for Economic Co-operation and Development country and its cost calculation was done in accordance with this assumption. Conducting a similar analysis assuming the development of a new oil-stockpiling base may be helpful in addressing the need for quantification. Needless to say, different ASEAN countries have different backgrounds, as already mentioned. Some countries may prefer to build an underground stockpiling facility while others would be more willing to choose a floating stockpiling base. Even if the same type of facility is chosen, the expenditures will be different. While any cost-benefit analysis will be a hypothetical one, such a case study will facilitate the development of stockpiling facilities.

²⁵ International Energy Agency, *Focus on Energy Security* (Paris: International Energy Agency, 2013)

Table 5-2-1. Indices of Oil Supply Security and Degrees of Impact on Supply Disruption

	Oil dependence	Net import	HHI	Oil intensity	Stockpiling days
Brunei	22%	0%	No data	70.2	31 days
Cambodia	25%	100%	No data	137.6	No data
Indonesia	45%	42%	0.256	180.5	22 days
Lao PDR	24%	100%	No data	43.7	15 days
Malaysia	35%	0%	No data	145.1	No data
Myanmar	14%	60%	No data	95.0	23 days
Philippines	32%	94%	0.632	94.4	30 days
Singapore	60%	100%	0.479	93.3	90 days (power generation)
Thailand	41%	59%	0.290	219.0	43 days
Viet Nam	35%	12%	No data	233.6	62 days

Impact of oil supply disruption

Large	65%+	80%+	0.80+	200+	Below 30 days
Moderately large	50-65%	60%-80%	0.60-0.80	150-200	30-50 days
Medium	35-50%	40%-60%	0.40-0.60	100-150	50-70 days
Moderately low	20-35%	0%-40%	0.20-0.40	50-100	70-90 days
Low	below 20%	0%	0-0.20	0-50	More than 90 days

Sources: International Energy Agency (IEA), 'Energy Balances of non-OECD Countries' (2014), 'APEC Energy Statistics'.

Visualisation of oil stockpiling benefits may be easier. Table 5-2-1 is one such attempt. It summarises five benchmarks related to the oil-supply security of ASEAN countries. A high percentage of oil in total primary energy supply and a high percentage of import dependence suggest high vulnerability against oil-supply disruption. A high percentage on the Herfindahl-Hirschman Index (HHI) means that a country's import sources are more concentrated and, therefore, the country's supply security is high risk. A high oil intensity suggests that a country needs more oil to generate a unit of economic growth and that an oil-supply disruption will have greater economic impact on the country. The number of stockpiling days shows the degree to which a country can absorb the shock of an oil-supply disruption. Higher levels of risk are indicated with darker shades of green. The darker greens signify that the country is considered to have a higher risk in oil-supply security. Indonesia and the Philippines are regarded as high-risk countries.

Although the table only shows the degree of risk and does not specify the benefits of oil stockpiling, it certainly shows the degree of the potential cost of supply disruption relative to other countries. It also shows in which areas, from oil dependence in primary energy mix to oil intensity, countries are vulnerable against oil-supply disruption. This guide will be a reference in deciding specific policy actions.

5-3.Prepare for short-term measures

One of the extreme goals of an oil-stockpiling development policy, at least in terms of infrastructure, is to construct an oil-stockpiling base and build up oil inventory for that base. This arrangement, however, requires a large amount of money. It also takes a long time to acquire the land, construct the tank storage and oil-shipment facilities, train operation staff, and maintain the facility once it is built. It is difficult for most ASEAN countries to achieve this goal within a short period of time (e.g. within five years). These ASEAN countries' oil-import dependence is increasing and thus the security risk concomitant to an oil-supply disruption is also growing. It is, therefore, necessary to consider a means of enhancing oil-supply security in a shorter period of time.

As discussed elsewhere in this report, one such measure is a leased stockpiling system (ticket stockpiling). Countries with plenty of oil inventory but are facing declining domestic demand (e.g. Japan or South Korea) may be willing to issue a ticket to an ASEAN country in return for segregating a specific volume of their stockpiling as the ticket holder's inventory. This ticket system can be a bridging facility until said ASEAN country builds its own stockpiling facilities.

Another such short-term measure is a bilateral oil-stockpiling arrangement. The partner country in this case may again be Japan or South Korea but as the US has an expanding capacity for exports of oil products, it might also be capable of providing such services to ASEAN countries. Since the oil industries of Japan and South Korea have a high interest in increasing their oil-product exports to ASEAN countries, such a bilateral arrangement could be achieved relatively easily if ASEAN countries could allow the oil industries in Japan and South Korea access to their domestic market. In addition, the governments of Japan and South Korea are either expanding their oil-product inventory or are already maintaining a large amount of oil products and, therefore, a government-to-government level of agreement can be realised for this stockpiling arrangement.

These two measures can be regarded as a market-based arrangement as the arrangement is done mostly on a commercial basis and the primary players are private oil companies on the supplier side. While this market-based approach is not sufficient to achieve oil-supply security, it is still an effective means, at least in the shorter term.

Conducting emergency drills is also an important measure. If an emergency scenario is assumed as mentioned earlier, an exercise should be conducted. This exercise

can be implemented even if oil-stockpiling facilities have not yet been built. It provides an opportunity to review how to collect accurate information, who decides supply priority if the domestic oil supply is far short of the domestic demand, and who makes key decisions about oil supply. Thailand, for example, has been conducting such exercises every year and has accumulated expertise in emergency crisis management. APERC has already arranged such exercises in several ASEAN countries that are also APEC members. Utilising such services will be a good way to kick off exercises.

5-4. How to Reconcile Commercial Interests with Stockpiling Development

The next challenge is to determine who will be the primary player for stockpiling; in other words, who will bear the cost of developing stockpiling. If we look at the example of Organisation for Economic Co-operation countries, it was found that European countries tend to choose an association (or agency) type of stockpiling in which the owners are private oil companies. In the US, as observed in Chapter 3, all stockpiling volume is held and operated by the US government (the Department of Energy, specifically). Japan and South Korea, on the other hand, have combined government and private stockpiling systems. In ASEAN countries, it will be necessary to determine who will lead oil-stockpiling development and how.

In most ASEAN countries, the dominant entity in the oil market is an NOC and it is natural to involve the NOC in oil-stockpiling development. The biggest question will be to what extent private capital or foreign capital is employed. Because oil stockpiling is a core activity in energy security, some countries may prefer to restrict investment from these nongovernment sources. On the other hand, foreign companies have much better expertise in oil stockpiling management than local NOCs. They can be an important financial source if the government's budget is not large enough. Determining to what extent to include nongovernmental players is a key issue to consider.

Even if a government decides to utilise private or foreign sources, the next issue will be whether those sources have interest in investing in stockpiling facilities. The government, therefore, needs to make sure that the investment scheme is an attractive one for the investors through methods such as opening the domestic market to those investors.

APPENDIX

Oil Storage Infrastructure in Myanmar

This appendix provides more detailed information on the oil-storage infrastructure of Myanmar. In preparing an effective oil-stockpiling development plan, understanding domestic oil infrastructure such as tank storage locations and their capacities is very important. Collecting accurate statistics is also based on correct information of oil storage infrastructure. Myanmar is one of the few ASEAN countries that is currently working to develop a comprehensive oil-supply security plan, and precise information of the country's oil-storage infrastructure would assist such development efforts. The country is also in the process of developing a system for collecting and managing energy-related statistics. Infrastructure information would also be a useful reference in the development of this system. Based on this consideration, this appendix aims to provide the latest oil-storage infrastructure information as of March 2015.

A-1. Oil-Storage Facilities in Myanmar

A-1-1. Oil-stockpile situation in Myanmar

As elaborated in 2-10, Myanmar does not have any oil-stockpile strategy yet, and its oil is stored in storage facilities as feedstock for refineries and petrochemical complexes. The Myanmar government established the NEMC, a new organisation responsible for formulating energy policy and plans, in 2013. According to the interview conducted with officers in the Ministry of Energy in 2014, the NEMC specified in the draft of the Energy Security Plan that 30 days of net imports will be held in 2020, 45 days of net imports will be held in 2045, and 90 days reserve will be held in 2050. Currently, the Ministry of Energy is responsible for oil stocks. However, the NEMC will assume this responsibility in the near future. Oil-storage facilities will be reported in the following subsections because there are no stockpile plans and facilities in Myanmar as explained earlier.

A-1-2. Oil refineries

Myanmar has three refineries in operation—Thanlyin, Chauk, and Thanbayakan (Mann)—with a refining capacity of 51,000 b/d in total (Asia Development Bank, 2012). Table A-1-1 summarises information on the three refineries and Figure 2.1 shows their locations. As shown in Table A-1-1, the refineries are old and the operating percentages are low, ranging from 33 percent to 57 percent. The refineries use a blend of domestic crude oil from onshore fields (heavy sweet crude oil) and condensates from the Yetagun offshore gas field. Detailed information will be described in the following sections.

Furthermore, Myanmar plans to build several new refineries to meet domestic demand as well as to export larger volumes of diesel. Future plans on refineries will be described in a later section.

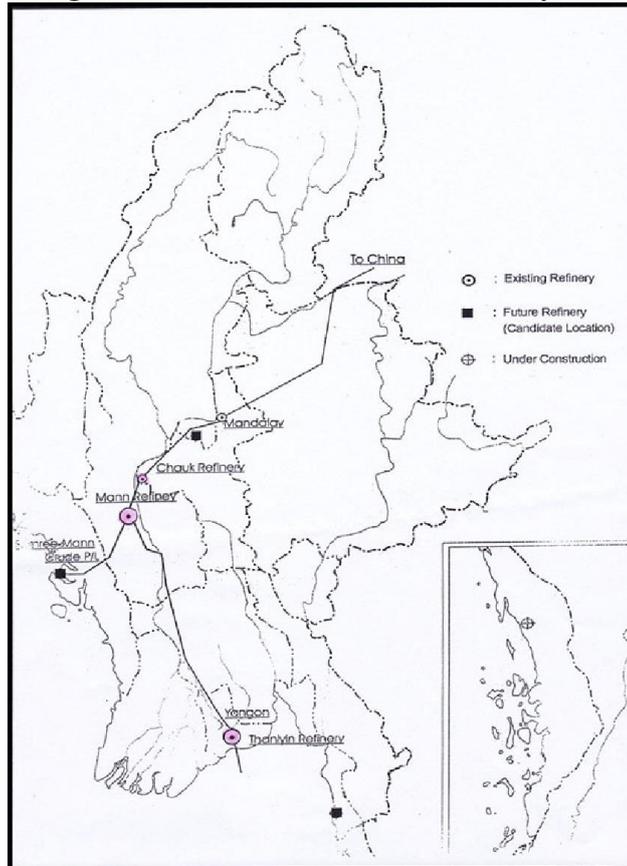
Table A-1-1. Summary of Operating Refineries in Myanmar

No.	Name	Location	Design Capacity [kb/day]	Actual Capacity [kb/day]	Percent of Design Capacity [%]	Start Year	Operator	Ownership [%]
1	Thanlyin Refinery	Thanlyin, Yangon	20	11	57	1963	MPE	100
2	Chauk Refinery	Chauk, Magway	6.0	2.0	33	1954	MPE	100
3	Thanbayakan Refinery	Minhla, Magway	25	8.6	34	1982	MPE	100

MPE: Myanmar Petrochemical Enterprise

Source: Asia Development Bank (2012) and Myanmar Immortal Trading (n.d).

Figure A-1-1. Location of Refineries in Myanmar



Source: Project Monitor News Bureau (n.d.)

(1) Thanlyin Refinery

The Thanlyin Refinery is located on the bank of the Bago River, 14 km from Yangon, Thanlyin Township. It is the largest and also one of the oldest refineries in Myanmar (Myanmar Petrochemical Enterprise, 2012 and The World Bank, 2012). Though the design capacity of the refinery is 20,000 BPSD, the actual production is approximately half of the design capacity as shown in Table A.1.

Table A-1-2 summarises the main units of the Thanlyin Refinery and Figure A-1-2 shows a block flow diagram of the refinery (ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1992). Crude oil was used as a feedstock when the refinery started its operation. The feedstock, however, was changed to the condensate from Yetagun in 2002. Therefore, the Delayed Coker Plant was shut down in 2002 while the Bitumen Plant was shut down in 2007. The Crude Oil Distillation Unit B and Unit C were renovated in 1997 (Unit B) and 2007 (Unit B and Unit C) to enhance the performance of the refinery.

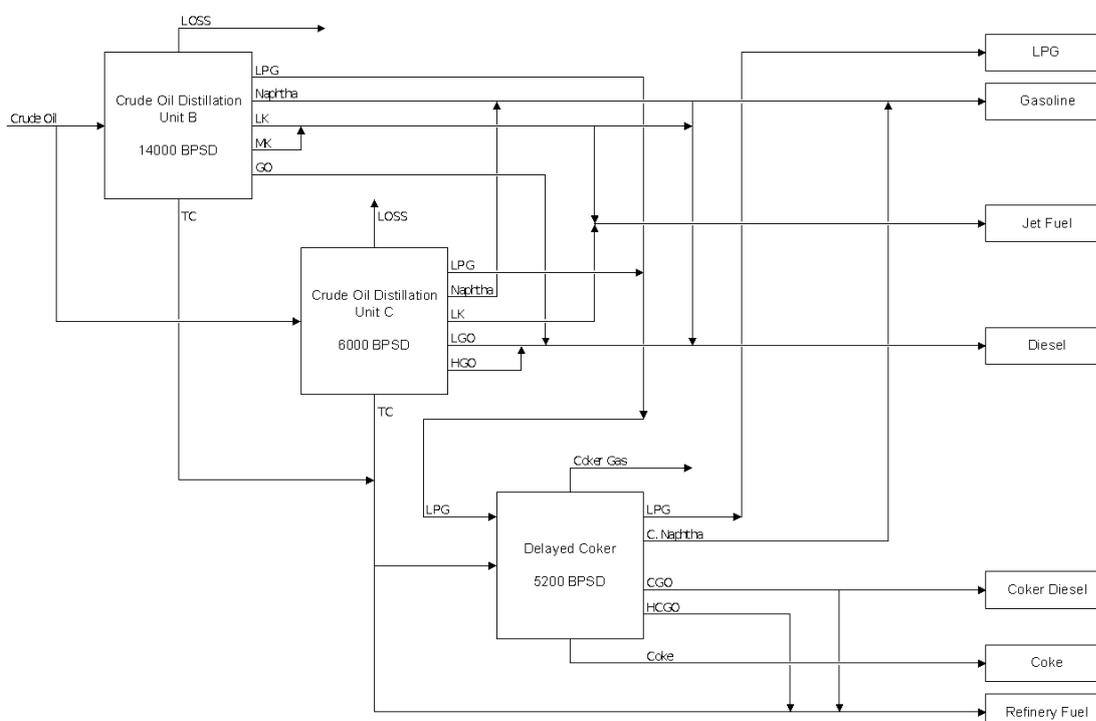
Table A-1-2. Main Units of the Thanlyin Refinery

Name	Design Capacity	Contractor	Year
Crude Oil Distillation Unit B	14,000 BPSD	Foster Wheeler	1962
Crude Oil Distillation Unit C	6,000 BPSD	Mitsubishi Heavy Industries	1980
Delayed Coker Plant	5,200 BPSD	Mitsubishi Heavy Industries	1982
Special Boiling Point Solvent Plant	1,400 BPSD	APV Mitchell Ltd.	1973
Bitumen Plant	400 t/day	Nichimen Company	1999
Candle Factory	1.5 t/day	N/A	1963
6 MW Electricity Generation Plant	6 MW	Mitsubishi Heavy Industries	1980
4.5 MW Electricity Generation Plant	4.5 MW	Angelique International Co. Ltd.	2007

Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1992.

The Thanlyin Refinery has tank farms and offsite facilities including 54 storage tanks and five berth marine terminals. Table A-1-3 summarises the information about the storage tanks installed around the Thanlyin Refinery. Thanlyin Refinery has intermediate tanks associated with the main units such as the Crude Oil Distillation Unit, the Delayed Coker Plant, and the Special Boiling Point Solvent Plant in addition to storage tanks for crude oil and products.

Figure A-1-2. Block Flow Diagram of the Thanlyin Refinery



Source: Asian Development Bank (2012a).

Table A-1-3. Storage Tanks Installed around the Thanlyin Refinery

Description	Quantity of Tanks	Capacity
Crude Oil/Condensate	12	29.6 ×10 ⁶ gal
Motor Gasoline	14	21.8 ×10 ⁶ gal
Aviation Turbine Fuel	3	4.45 ×10 ⁶ gal
Diesel Oil	11	17.1 ×10 ⁶ gal
Topped Crude	3	1.33 ×10 ⁶ gal
Fumace Oil	3	2.43 ×10 ⁶ gal
LPG	8	5.55 ×10 ³ t

Source: The World Bank, 1992.

(2) Chauk Refinery

Chauk Refinery is located in Magway division. It is the smallest refinery of the three refineries in Myanmar operated by MPE and its design capacity is 6,000 BPSD (Myanmar Immortal Trading Co., Ltd., n.d.). Several small jetties are built on the Irrawaddy River, and two small storage tank farms are located near the jetties and the refinery.

The Chauk Refinery refines crude oil produced from the Chauk-Lonywa oilfield found in 1902. It includes a topping and vacuum unit with 6,000 BPSD as design capacity and a wax plant producing 1,500 tons per month (Aung Kyaw Htoo, 2014; Myanmar Immortal Trading Co., Ltd., n.d. and The World Bank, 1985). From 1979 to 1980, vacuum residue was reclaimed from open pit storage where it has accumulated since start-up and sold as heavy petroleum oil. Paraffin wax is produced using a chill process. However, the sharp decline in production in the period 1982–1983 points to difficulties in repairing the wax plant (Daw Hla Kyi, 2006). The actual refining capacity of the refinery is approximately 38 percent because it is difficult to transport crude oil to the refinery and products from the refinery due to the limitations imposed by its location.

(3) Thanbayakan Refinery (Mann Refinery)

The Thanbayakan Refinery, located in Magway division 500 km from Yangon, is the newest refinery. Oilfields here are scattered within a 10 km to 20 km radius from the refinery and the oil produced from these fields constitutes the major feedstock of the refinery. Although the design capacity of the refinery is 25,000 BPSD, the actual

production is less than half of the design capacity as shown in Table A-1-1.

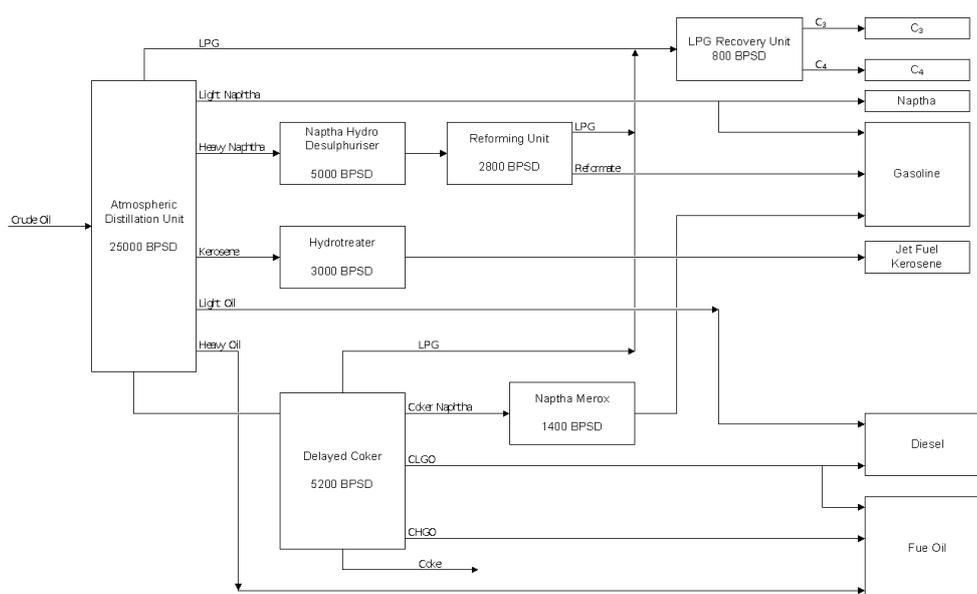
Table A-1-4 summarises the main units of the Thanbayakan Refinery and Figure A-1-3 shows a block flow diagram of it (ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015). The refinery has a 25,000 BPSD Crude Oil Distillation Unit; a 2,800 BPSD Semi-regenerative Catalytic Reformer; a 5,200 BPSD Delayed Coker; a Kerosene Hydrodesulphurisation unit (3,800 BPSD); an LPG Recovery (Merox treating) unit; and a Naphtha Merox treating unit. The LPG Separation Plant at Thanbayakan has a design treating capacity of 24 million cubic feet per day (MMCFD) of wet natural gas and a design production capacity of 60 t/d of propane and 55 t/d of butane. Crude oil is transported from local oilfields through pipelines that are 10 inches in diameter (Mann, Htauk Shabin, and Kanni) and by barge (Ye-Nan-Chaung, Kyauk-Kwet, Nyaung-Don, Kwai Ma, and Nga-Bat-Chaung). Yetagun condensate from the Yetagun offshore oilfield is also processed in response to demand.

Table A-1-4. Main Units of the Thanbayakan Refinery

Name	Design Capacity	Contractor	Year
Crude Oil Distillation Unit	25,000 BPSD	Mitsubishi Heavy Industries	1982
Naphtha Hydro Desulphuriser	5,000 BPSD	Mitsubishi Heavy Industries	1982
Reforming Unit	2,800 BPSD	Mitsubishi Heavy Industries	1982
Hydrotreater	3,000 BPSD	Mitsubishi Heavy Industries	1982
Delayed Coker	5,200 BPSD	Mitsubishi Heavy Industries	1982
LPG Recovery Unit	800 BPSD	N/A	1982
Naphtha Merox	1400 BPSD	N/A	1982
Fouling Water Stripper	15.2 t/h	N/A	1982

Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015.

Figure A-1-3. Block Flow Diagram of the Thanbayakan Refinery



Source: ADB, 2012a; Myanmar Immortal Trading Co., Ltd., n.d. and OG Analysis, 2015.

A-1-3. Pipelines

(1) Domestic Pipelines

There are three crude oil pipelines in Myanmar as of 2014 (Japan Petroleum Energy Center, 2011). Table A-1-5 gives details of these three domestic crude oil pipelines. All pipelines are owned and operated by Myanma Oil and Gas Enterprise. It would be easy to assume that there are oil-storage tanks at the origin and the destination in each pipeline. We, however, could not obtain any detailed information on these storage tanks.

Table A-1-5. Domestic Crude Oil Pipelines in Myanmar

Name of Pipeline	From	To	Start Year	Length [km]	Diameter [inch]	Company
Mann-Thinlyin Pipeline	Mann field	Thinlyin	1979	449.8	10	MOGE
Letpando-A yadaw Pipeline	Letpando	Ayadaw	1998	75.7	8 , 6	MOGE
Thargyitaung-Kamma Pipeline 1	Thargyitaung	Kamma	2001	9.9	10	MOGE

Source: Japan Petroleum Energy Center, 2011.

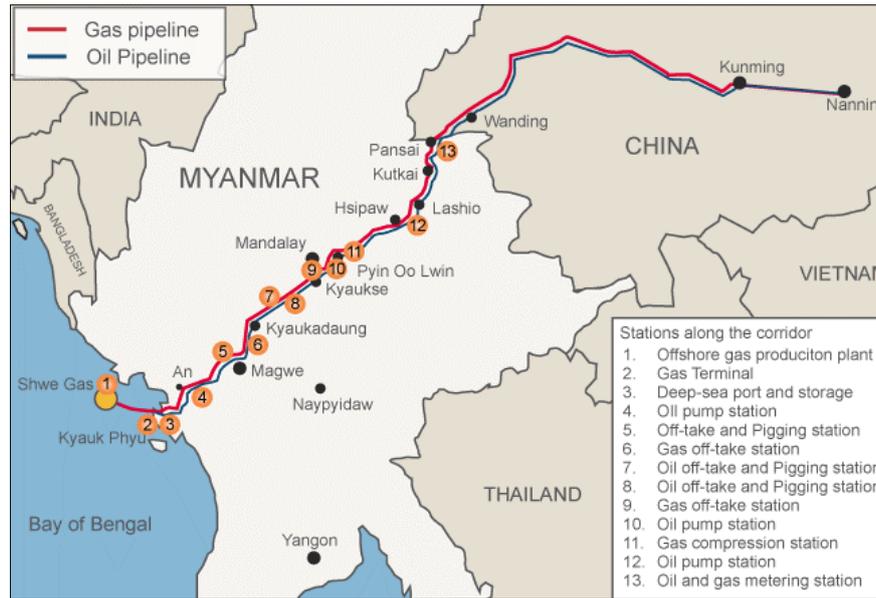
(2) International Pipelines

China National Petroleum Corporation (CNPC) built and will operate the Myanmar–China oil pipeline which bypasses the sea route via the Malacca Strait. This pipeline and a companion natural-gas pipeline transport hydrocarbons from the Bay of Bengal across Myanmar to southwestern China (Hilton, 2013).

Figure A-1-4 shows the planned route of the Myanmar–China gas and oil pipelines (Wikipedia, n.d.) and Table A-1-6 gives details of these pipelines. The gas and oil pipelines run in parallel and start near Kyaukphyu, run through Mandalay, Lashio, and Muse in Myanmar before entering China at the border city of Ruili in Yunnan province. The gas pipeline, the maximum capacity of which is 12 billion cubic metres/year, will carry natural gas from Myanmar's offshore A-1 and A-3 blocks. This pipeline runs further from Kunming to Guizhou and Guangxi in China and is 2,806 km long in total. The oil pipeline, the maximum capacity of which is 0.24 million bbl/year, will transport crude oil carried by tankers from the Middle East. Therefore, a large oil-import port and storage tanks will also be built as an input point of this oil pipeline. The port can receive vessels up to 300,000 deadweight tonnage (DWT) and has storage capacity of 1.2 million cubic metres. This pipeline, which eventually terminates in Kunming, capital of Yunnan Province, has a total length of 771 km (The Associated Press, 2013). The total estimated project costs are US\$1.04 billion for the gas pipeline and US\$1.5 billion for the oil pipeline (Hilton 2013).

Construction of the Myanmar–China oil pipeline and gas pipeline started in June 2010. In June 2013, the CNPC announced that the Myanmar section of the gas pipeline was complete and ready for testing while the oil pipeline was 94 percent complete^[28]. In January 2015, Myanmar officially opened a deep-sea port off its western coast and started trial operation (China Harbour Engineering Company).

Figure A-1-4. Planned Route of the Myanmar–China Gas and Oil Pipelines



Source: Wikipedia, n.d.

Table A-1-6. Myanmar–China Gas and Oil Pipelines

Name of Pipeline	From	To	Start Year	Length [km]	Diameter [inch]	Owners	Operator	CAPEX [billion USD]
Myanmar-China gas pipeline	Kyaukphyu	Guizhou and Guangxi	2013	792	40	CNPC (50.9%) MOGE(49.1%)	CNPC	1.04
Myanmar-China oil pipeline	Kyaukphyu	Kunming	2015	2806	32	CNPC (50.9%) MOGE(49.1%)	CNPC	1.50

Source: Japan Petroleum Energy Center (2011), Hilton (2013), The Associated Press (2013) and China Harbour Engineering Company.

To be exact, the port and storage tanks are located on the Madae Island. As reported by the Associated Press, China Harbour Engineering Company, and Tank Storage Magazine, there are 12 storage tanks at the port and the capacity of each tank is 100,000 cubic metres.

Myanmar is supposed to receive US\$13 million per year and a toll fee of the pipeline (US\$1/tonne) from the CNPC (Aung Kyaw Htoo, 2014). In addition, the construction of a new refinery is planned in the greater Mandalay area with feedstock to come from a branch line from this pipeline. Future refinery plans are described in detail in a later section.

A-1-4. Storage tank terminals

(1) Fuel Terminals

Figure 2.11 shows the location of storage terminals and ports in Myanmar. There is little information on the storage terminals in Myanmar. Therefore, the fuel storage network in Myanmar is expected to be inadequate.

i) Terminals Owned by State-Owned Companies

As shown in Table A-1-7, a total of seven fuel terminals are owned by state-owned companies such as the MPPE and MPE (Japan Petroleum Energy Center, 2011).

Table A-1-7. Fuel Terminals Owned by State-Owned Companies in Myanmar

Name	Type	Location	Division	Capacity [m ³]	Company
Taungdwingyi Terminal	Fuel Terminal Grade (A)	Taungdwingyi	Magwe	---	MPPE
Chauk Terminal	Fuel Terminal Grade (A)	Chauk	Magwe	---	MPPE
Mandalay Terminal	Fuel Terminal Grade (B)	Mandalay	Mandalay	---	MPPE
Popaywa Terminal	Fuel Terminal Grade (C)	Popaywa	Mandalay	---	MPPE
Bassein Storage Terminal	---	Bassein	Ayeyarwady	946	MPPE
Moulmein Storage terminal	---	Moulmein	Mon State	2,271	MPPE
Thanlyin refinery Storage Terminal	---	Thanlyin	Yangon	875,538	MPE

Source: Japan Petroleum Energy Center, 2011.

ii) Terminals Majority-Owned by Chinese State-Owned Company

NPC, a Chinese state-owned oil and gas company, has a large fuel terminal in Kyaukphyu. This terminal has 10 storage tanks with a capacity of 100,000 cubic metres/tank (in total 1.2×10^6 cubic metres). The engineering, procurement, and construction (EPC) contractor for this oil terminal and channel-dredging project was China Harbour Engineering Company Ltd and the storage tanks were built by China Huanqui

Contracting & Engineering (China Harbour Engineering Company, n.d.; Oil & Gas Technology, 2013 and Tank Storage Magazine, 2013). Table A-1-8 summarises information on the fuel terminal in Kyaukphyu.

Table A-1-8. Fuel Terminal Majority-Owned by the CNPC in Myanmar

Terminal	Location	Start Year	Operator	Owner	Tank Capacity [m ³ /tank]	Number of Tanks [tank]	Total Capacity [m ³]	Stored Products
CNPC Kyaukphyu Terminal	Kyaukphyu	2015	CNPC	CNPC (50.9%) MOGE (49.1%)	100,000	12	1,200,000	Crude Oil

Source: Japan Petroleum Energy Center (2011); China Harbour Engineering Company (n.d.) and Tank Storage Magazine (2013).

Figure A-1-5. Storage Tanks at the CNPC’s Fuel Terminal in Kyaukphyu



Source: Tank Storage Magazine (2014).

iii) Terminals Owned by Private Companies in Yangon

As summarised in Table A-1-9, there is one fuel terminal project under construction which will be owned and operated by Guangdong Zhenrong Energy Co., Ltd at Yangon port. In addition to the Guangdong Zhenrong Terminal, a plan for another fuel terminal called the Vitol Yangon Storage Terminal has been announced and has received approval from the Myanmar Port Authority. However, little information is available on the current situation regarding the Vitol Yangon Storage Terminal.

Table A-1-9. Fuel Terminals Owned by Private Companies in Yangon

Terminal	Location	(Planned) Start Year	Operator	Owner	Tank Capacity [m ³ /tank]	Number of Tanks [tank]	Total Capacity [m ³]	Stored Products	Status
Yangon Oil Terminal	Yangon	2018	Guangdong Zhenrong	Guangdong Zhenrong (100%)	---	---	100,000	Refined Products	under construction
Vitol Yangon Storage Terminal	Yangon	---	Vitol Tank Terminals International BV	Vitol Tank Terminals International BV	---	---	---	---	approved

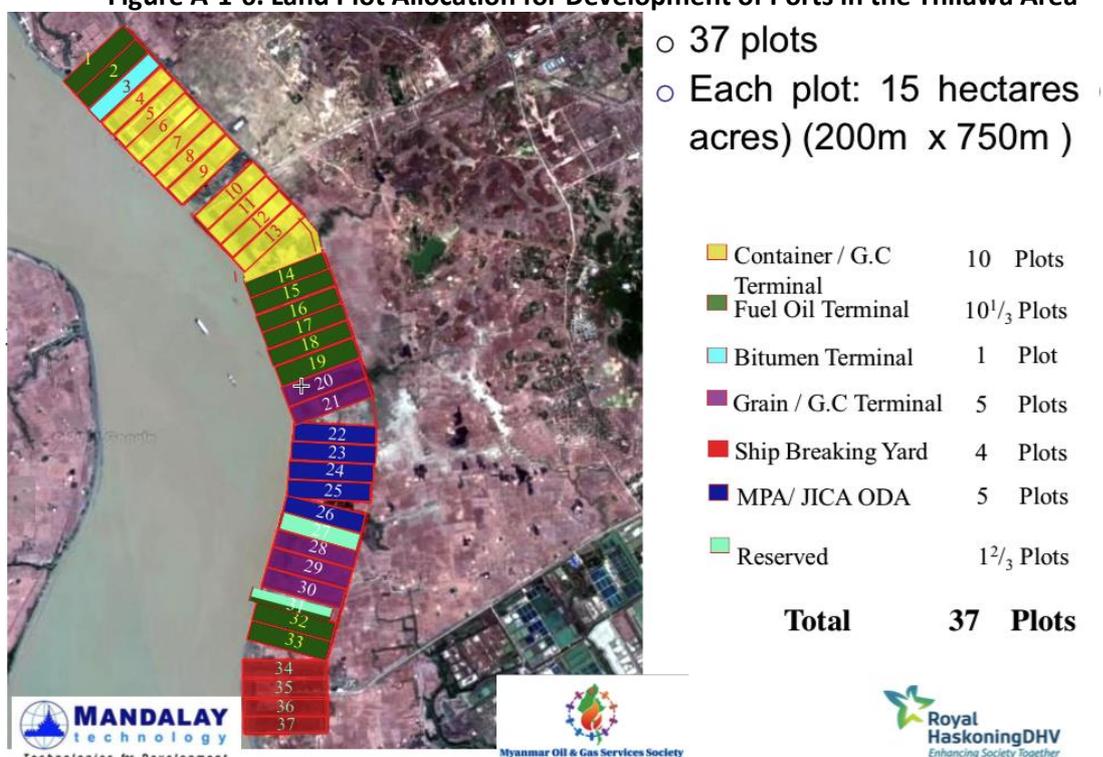
Source: Aung Kyaw Htoo (2014), Japan Petroleum Energy Center (2011) and Zaw Naing (2014).

iv) Terminals Owned by Private Companies in Thilawa

The construction of fuel terminals has been planned to in concert with the expansion of Thilawa port. As shown in Figure A-1-6, there are 37 allocated plots and the area of each plot is approximately 24 acres (200 metres by 750 metres). As of 2014, approximately 10 plots were planned to be used for fuel oil terminals. The construction of some of these terminals had been finished and they were in operation.

Table A-1-10 summarises information on fuel terminals. Detailed information on the fuel terminals in operation will be described in this section and information on the planned terminals will be described in a later section.

Figure A-1-6. Land Plot Allocation for Development of Ports in the Thilawa Area



Source: APEX Gas & Oil Public Company Limited.

Table A-1-10 Fuel Terminals Owned by Private Companies in Thilawa

Terminal	(Planned) Start Year	Operator	Owner	Tank Capacity [m ³ /tank]	Number of Tanks [tank]	Total Capacity [m ³]	Stored Products	Status	Plot No.
Great Petroleum Terminal	2013	APEX Gas & Oil Public Company Limited	APEX Gas & Oil Public Company Limited (100%)	5,000 15,000	2 1	25,000	Gasoil and Gasoline	in operation	1, 2(B)
Myat Myittar Mon Petroleum Terminal	---	Myat Myittar Mon	Myat Myittar Mon	380 2,000	2 2	4,760	Gasoil and Gasoline	in operation	1, 2(A)
Asia World Petroleum Terminal	---	Asia World	Asia World	7,600 15,200	4 2	60,800	---	in operation	17, 18 (A)
Great Petroleum Terminal Expansion	2015	APEX Gas & Oil Public Company Limited	APEX Gas & Oil Public Company Limited (100%)	---	---	50,000	Gasoline	under construction	1, 2(B)
Puma energy Thilawa storage terminal	2015	Puma Energy	Puma Energy (80%) Asian Sun Group Company Limited (20%)	---	---	88,000	bitumen and petroleum products	under construction	3
Thuriya Energy Thilawa SEZ Storage Terminal	2016	Thuriya Energy Depot Management Ltd	Dagon Group of Companies (100%)	---	---	74,560	Diesel and Octane	under construction	17, 18
Denko oil storage terminal	---	Denko Trading Company	Denko Trading Company	---	---	---	---	approved	17, 18 (B)
Padauk Shwe War Port and Petroleum Storage Terminal	---	Padauk Shwe War Port and Petroleum	Padauk Shwe War Port and Petroleum	3,800 5,700	2 1	13,300	---	approved	33
International Group of Entrepreneur Storage Terminal	---	International Group of Entrepreneur	International Group of Entrepreneur	380 380 7,600	2 2 2	9,120	---	approved	31, 32 (B)
Green Asia Services Storage Terminal	---	Green Asia Services	Green Asia Services	---	---	---	---	approved	---
Max Myanmar and Elite Petrochemical Storage Terminal	---	Max Myanmar and Elite Petrochemical	Max Myanmar and Elite Petrochemical	20,000 8,700 15,200 7,600	4 4 2 3	168,000	---	approved	15, 16 (A, B) 15, 16 (A, B) 15, 16 (C) 15, 16 (C)
Kaung Myanmar Aung Shipping Storage Terminal	---	Kaung Myanmar Aung Shipping	Kaung Myanmar Aung Shipping	5,700 160	2 1	---	---	approved	31, 32 (C)
Shwe Taung Energy Services Storage Terminal	---	Shwe Taung Energy Services	Shwe Taung Energy Services	4200 8400	2 1	16,800	---	approved	1, 2(C)

Source: Japan Petroleum Energy Center (2011), U Aung Khine Htun (2012), APEX Gas & Oil Public Company Limited and opencorporates APEX Gas & Oil Public Co., ltd (Public).

Great Petroleum Terminal : (Japan Petroleum Energy Center (2011), opencorporates APEX Gas & Oil Public Co., ltd (Public) and opencorporates Myat Myittar Mon Co., Ltd.)

- Plot No.: No. 1 and 2 (B) (see Figure A-1-13 for an aerial view of the area)
 - ✓ Sharing Plots No.1 and No. 2 with Myat Myittar Mon Company Limited and Shwe Taung Company Limited
- Operator: APEX Gas & Oil Public Company Limited
- Ownership: APEX Gas & Oil Public Company Limited (100%)
- Tank capacity and number of tanks:
 - ✓ 1 million gallon/tank × 2 tanks (approximately 5,000 m³/tank × 2 tanks)
 - ✓ 3 million gallon/tank × 1 tank (approximately 15,000 m³/tank × 1 tank)
 - ✓ Expanding to 10 storage tanks with a total capacity of 75,000 m³ for Gasoline

APEX Gas & Oil Public Company Limited was incorporated on 16 January 2013 with registration No. 4334 and established the Great Petroleum Terminal. The Great Petroleum Terminal is the first standard private petroleum terminal in Myanmar certified in accordance with ISO 9001-2008.

The terminal operates a full range of storage tank services, gasoil (diesel), gasoline (mogas 92/95, etc.) and terminal-related logistics services for both local and import/export use. Moreover, gasoil and gasoline are provided to their 19 filling stations and more than 30 of their partners' filling stations.

As shown in Figure A-1-13, there are 11 tanks built in plots No. 1 and No. 2. It is difficult to identify which tanks belong to Great Petroleum Terminal. However, three tanks located at plot No. 2 are assumed to be those used for Great Petroleum Terminal according to the information on sizes and the total number of tanks.

Myat Myittar Mon Terminal (Japan Petroleum Energy Center (2011), opencorporates Asia World Co., Ltd.)

- Plot No.: No. 1 and 2 (A) (see Figure A-1-13 for an aerial view of the area)
 - ✓ Sharing Plots No.1 and No. 2 with APEX Gas & Oil Public Company Limited and Shwe Taung Company Limited
- Operator: Myat Myittar Mon Company Limited
- Ownership: Myat Myittar Mon Company Limited
- Tank capacity and number of tanks
 - ✓ 0.5 million gallon/tank × 2 tanks (approximately 2,000 m³/tank × 2 tanks)
 - ✓ 0.1 million gallon/tank × 2 tank (approximately 380 m³/tank × 1 tank)

Myat Myittar Mon Company Limited was incorporated on 3 April 2000 with registration No. 14 and established the Myat Myittar Mon Petroleum Terminal in Thilawa. The terminal is in operation using the four tanks listed above and Myat Myittar Mon is building additional four storage tanks in the terminal.

It is difficult to identify which tanks shown in Figure A-1-13 belong to the Myat Myittar Mon Petroleum Terminal. However, four small tanks located at Plot No. 1 are assumed to be those used for the Myat Myittar Mon Petroleum Terminal considering the tank capacity and the number of tanks.

Asia World Petroleum Terminal: (Japan Petroleum Energy Center (2011), opencorporates Asia World Co., Ltd., Asia World Co., Ltd. Opencorporates Green Asia Services Co., Ltd, Kudo (2005))

- Plot No.: No. 17 and 18 (A) (see Figure A-1-14 for an aerial view of the area)
 - ✓ Sharing Plots No.17 and No. 18 with Denko Petrochemical Company Limited and Thyuriya Energy Depot Management Company Limited

- Operator: Asia World Company Limited
 - ✓ Green Asia Services Company Limited, which is a group company of Asia World may be an operator of this terminal.
- Ownership: Asia World Company Limited
 - ✓ Green Asia Services Company Limited, which is a group company of Asia World may be a one of the owners of this terminal.
- Tank capacity and number of tanks
 - ✓ 2 million gallon/tank × 4 tanks (approximately 7,600 m³/tank × 4 tanks)
 - ✓ 4 million gallon/tank × 2 tanks (approximately 15,200 m³/tank × 2 tanks)

Asia World Company Limited was incorporated on 5 June 1992 with registration No. 120 and established the Asia World Company Petroleum Terminal in Thilawa. The terminal is in operation using the six tanks listed above.

It is difficult to identify with certainty which tanks shown in Figure A-1-14 belong to the Asia World Company Petroleum Terminal. However, four smaller tanks and two larger tanks located at plot No. 18 are assumed to be those used for the Asia World Company Petroleum Terminal considering the tank capacity and the number of tanks.

(2) Sub-Fuel Terminals

As described in section 2.4.1(a), MPPE and MPE own and operate seven storage terminals through their subsidiaries. MPPE also established 25 sub-fuel terminals, 10 aviation distribution facilities to supply aviation fuels, and 271 fuel filling stations and one LPG filling station (Japan Petroleum Energy Center (2011), AsiaTradeHub.com, Myanmar Port Authority)

Table A-1-11 summarises information on the sub-fuel terminals in Myanmar owned and operated by the MPPE.

Table A-1-11. Sub-Fuel Terminals in Myanmar

Name	Type	Location	Division	Company
Myeik Terminal	Depot Grade (A)	Myeik	Tanintharyi	MPPE
Dawei Terminal	Depot Grade (A)	Dawei	Tanintharyi	MPPE
Mawlamyine	Depot Grade (A)	Mawlamyine	Mon	MPPE
Pyinywa/Labuta	Depot Grade (A)	Pyinywa/Labuta	Ayeyarwady	MPPE
Sittwe Terminal	Depot Grade (A)	Sittwe	Rakhine	MPPE
Pyay Terminal	Depot Grade (A)	Pyay	Bagyo	MPPE
Hsihseng Terminal	Depot Grade (A)	Hsihseng	Shan	MPPE
Myaung Terminal	Depot Grade (A)	Myaung	Sagaing	MPPE
Kawthoung Terminal	Depot Grade (B)	Kawthoung	Tanintharyi	MPPE
Thaton Terminal	Depot Grade (B)	Thaton	Mon	MPPE
Hinthada Terminal	Depot Grade (B)	Hinthada	Ayeyarwady	MPPE
Kyaiklat Terminal	Depot Grade (B)	Kyaiklat	Ayeyarwady	MPPE
Thandwe Terminal	Depot Grade (B)	Thandwe	Rakhine	MPPE
Sinbaungwe Terminal	Depot Grade (B)	Sinbaungwe	Magwe	MPPE
Pyinmana Terminal	Depot Grade (B)	Pyinmana	Mandalay	MPPE
Thazi Terminal	Depot Grade (B)	Thazi	Mandalay	MPPE
Pakokku Terminal	Depot Grade (B)	Pakokku	Magwe	MPPE
Kengtung Terminal	Depot Grade (B)	Kengtung	Shan	MPPE
Konkyan/Launkai	Depot Grade (B)	Konkyan/Launkai	Shan	MPPE
Kutkai Terminal	Depot Grade (B)	Kutkai	Shan	MPPE
Larshio Terminal	Depot Grade (B)	Larshio	Shan	MPPE
Myitkyina Terminal	Depot Grade (B)	Myitkyina	Kachin	MPPE
Bhamo Terminal	Depot Grade (B)	Bhamo	Kachin	MPPE
Mawlaik Terminal	Depot Grade (B)	Mawlaik	Sagaing	MPPE
Monywa Terminal	Depot Grade (B)	Monywa	Sagaing	MPPE

Source: Japan Petroleum Energy Center (2011).

A-2. Existing Infrastructure Related to Oil Storage in Myanmar

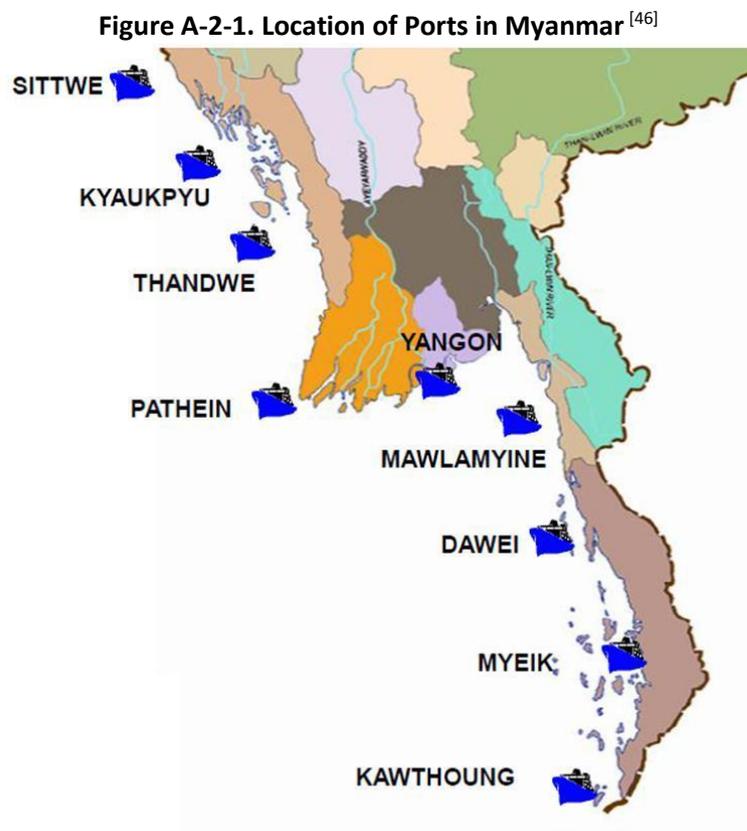
A-2-1. Pipelines

Refer to section A-1-3 for information on existing domestic and international pipelines in Myanmar.

A-2-2. Ports

Figure A-2-1 shows the location of the main ports in Myanmar. Yangon Port is an international port and Sittwe, Patheingyi, Mawlamyine, and Myeik Ports are international exporting ports. Kyaukpadaung, Thandwe, Dawei Ports are mainly for domestic coastal traffic. Kawthoung Port, a domestic coastal port has been used for domestic coastal

traffic as well as an exporting port mainly for exports destined for Thailand. Myanmar Port Authority is responsible for these coastal ports (Japan International Freight Forwarders Association, 2012 and Captain Aung Khin Myint, 2014).



Source: Asian Development Bank (2012b).

The ports in Yangon (including Thilawa), Kyauphyu, and Dawei are expected to be important for transporting crude petroleum and petroleum products because deep-sea berths are being, or will be, built at these ports.

(1) Port of Yangon

The Port of Yangon is the premier port in Myanmar and handles about 90 percent of the country's exports and imports, which amounted to 12 million tons of import and export freight in 2011. The Port of Yangon is the only port in Myanmar that handles both export and import shipments. This port is located along the Yangon River, which is 30 km inland from the sea and close to Yangon City (Japan International Freight Forwarders

Association, 2012; Captain Aung Khin Myint, 2014; Aung Min Han, 2013).

Access to the Port of Yangon is limited to vessels of around 12,000 DWT to 15,000 DWT because of the shallow draft leading to the port (Figure A-2-2) (APEX Gas & Oil Public Company Limited; Japan International Freight Forwarders Association, 2012; Captain Aung Khin Myint, 2014; Aung Min Han, 2013 and Ports.com). Additional government-owned terminals for petroleum products and other commodities are in the same port area (Japan International Freight Forwarders Association, 2012).

Table A-2-1 summarises the facilities of international wharves at the Port of Yangon. Other basic information on the port is summarised as follows (APEX Gas & Oil Public Company Limited; ADB, 2012b; Aung Min Han, 2013; Ports.com and Aung Min & Kudo, 2012).

- Tidal Range: 5.85 m (at spring tide) – 2.55 m (at neap tide)
- Current Velocity: 4–6 kt
- Waves:
 - ✓ Do not do not hinder marine operations
 - ✓ Seldom rough with less than 2 m wave-height
- Vessel Size: LOA 167 m, Draft 9 m, 15,000 DWT
- Depth:
 - ✓ Anchorage depth: 6.4 m–7.6 m
 - ✓ Cargo pier depth: 6.4 m–7.6 m
 - ✓ Oil terminal depth: 7.1 m–9.1 m
- Dry dock: Small
- Harbour size: Small
- Railway size: Medium
- Harbour type: River Natural
- Max size: Up to 500 feet in length
- Repairs: Limited

Crude oil and diesel fuel are currently imported in large crude carriers in volumes of 6,000,000 bbl. These carriers are moored at the mouth of the Yangon River. Due to the low draft and sandbars along the river, the crude has to be transported to the refinery using shuttle tankers with a capacity of 6,000 bbl. As a result, it takes nearly 14 days to clear a tanker. To overcome this problem Myanmar's Ministry of Energy is currently seeking to utilise a Single Buoy Mooring (SBM) at the mouth of the river and then to lay a pipeline from the SBM to the Thanlyin Refinery.

Figure A-2-2. Location of Terminals and Inland Container Depots at Yangon Inner Harbour



Source: APEX Gas & Oil Public Company Limited.

Table A-2-1. Facilities of International Wharves at the Port of Yangon

No.	Name	Type of Terminal	Quay Length [m]		Apron Width [m]	Vessel DWT [DWT]	Back Up Area [acre]
			each	sub total			
1	SPW (1)	GC	137		12.2	15,000	
2	SPW (2)	GC	137		12.2	15,000	
3	SPW (3)	GC	137		12.2	15,000	
4	SPW (4)	GC	137	1040	12.2	15,000	38
5	SPW (5)	GC	168		15.2	15,000	
6	SPW (6)	GC	162		15.2	15,000	
7	SPW (7)	GC	162		15.2	15,000	
8	BSW (1)	GC/ Container	137		15.2	15,000	
9	BSW (2)	GC/ Container	137	457	15.2	15,000	24
10	BSW (3)	GC/ Container	183		30.0	15,000	
11	AWPT (1)	GC/ Container	198		30.5	15,000	
12	AWPT (2)	GC/ Container	156	614	19.5	15,000	30
13	AWPT (3)	GC/ Container	260		30.5	15,000	
14	MIP (1)	GC/ Container	155		18.0	12,000	
15	MIP (2)	GC/ Container	155	310	18.0	12,000	17
16	HOB	Edible Oil	120		15.0	5,000	
17	HPT (2)	Edible Oil	213	546	30.0	15,000	---
18	HPT (3)	Edible Oil	213		30.0	15,000	

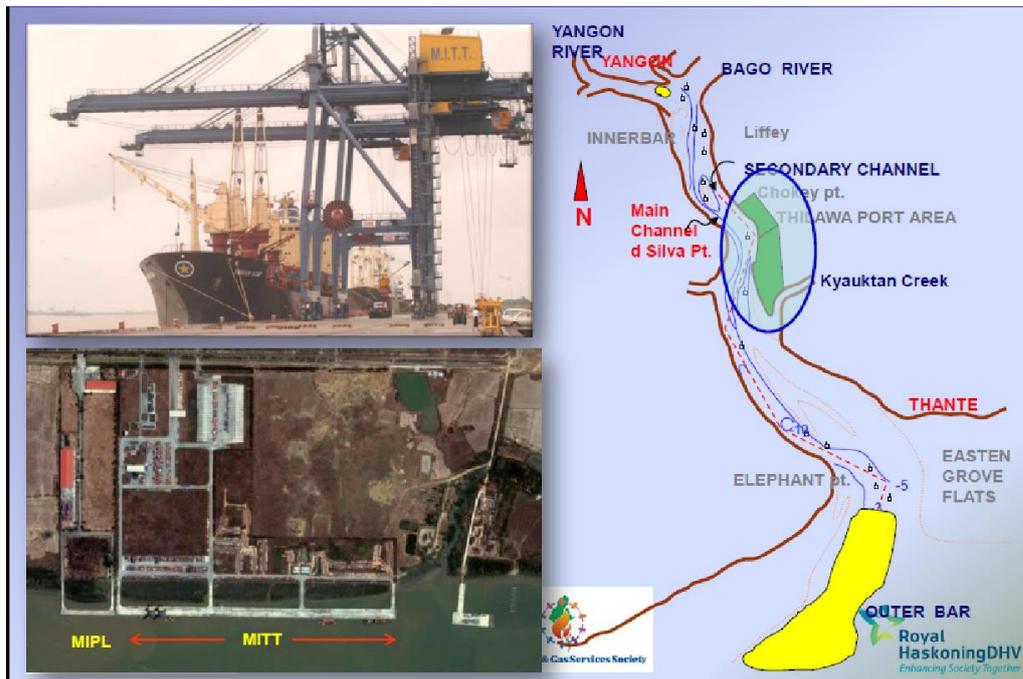
Source: Aung Min Han (2013).

(2) Thilawa Port

Yangon port now includes the new port area at Thilawa called Myanmar International Terminals Thilawa (MITT), about 20 km downstream of Yangon. This is a private sector investment developed and operated by Hutchison Port Holdings (HPH) of

Hong Kong, China. The new port has rail access, provides some 1,000 m of wharf, and handles container and general cargo. It offers a deeper draft than Yangon—10 m compared with Yangon’s 7 m. As a consequence, it can handle larger vessels, including cruise ships (Japan International Freight Forwarders Association, 2012 and Captain Aung Khin Myint, 2014). Figure A-2-3 shows the location of terminals at Thilawa Port and Table 3.1 summarises the facilities of the international wharves at Thilawa Port.

Figure A-2-3. Location of Terminals at Thilawa Port



Source: APEX Gas & Oil Public Company Limited.

Table A-2-2. Facilities of International Wharves at Thilawa Port

No.	Name	Type of Terminal	Quay Length [m]		Apron Width [m]	Vessel DWT [DWT]	Back Up Area [acre]
			each	sub total			
1	MITT (1)	GC	200		30.0	20,000	
2	MITT (2)	GC	200		30.0	20,000	
3	MITT (3)	GC	200	1,000	30.0	20,000	185
4	MITT (4)	GC	200		30.0	20,000	
5	MITT (5)	GC	200		30.0	20,000	
6	MIPL	GC / Liquid Bulk	200	200	17.0	20,000	37

Source: Aung Min Han (2013).

Thilawa Port is currently under development for expansion as described in section A-1-4. As shown in Figure A-1-12, there are 37 plots available; however, they are very small and currently being bought in groups by construction companies and investors. The plot land owners are not all looking to give up the plots they own at the port entirely but are looking for financial partners to construct facilities on them so that they may benefit in the future when the port is completed and established in the market, according to the report by Clairia Lloyd (Italian-Thai Development Public Company Limited, 2014).

(3) Dawei Small Port and Deep-Sea Port

The Dawei deep-sea port development was planned as a part of the Dawei Special Economic Zone (SEZ) Development Project. Figure A-2-4 shows a Perspective View of the Planned Dawei SEZ. Dawei SEZ Development consists of the following development (in full phase) (Italian-Thai Development Public Company Limited, 2013).

- Deep-sea port
- Industrial-estate heavy industries such as steel mill, oil refinery, petrochemical complex, fertiliser plant, ship building and maintenance services facilities, power plants, and other utilities service businesses
- Cross-border road and rail link with connecting oil and gas pipelines and transmission lines from the Dawei SEZ to the Myanmar–Thailand border
- Township for residential and commercial development

In order to start the Dawei SEZ Project, an initial-phase development will first be implemented. The expected concession agreements signing date was in February 2015. The initial-phase project, along with the associated infrastructure will be divided into four phases of industrial-estate development totalling an industrial estate area of 28 square km or 21 square km of saleable industrial estate land. The development period for the initial-phase project will total eight years with the commercial operation date expected in mid-2016 with a land lease period of 50 + 25 years (Italian-Thai Development Public Company Limited, 2013).

Figure A-2-4. Perspective View of the Planned Dawei Special Economic Zone



Source: Kruewan (2014).

i) Small Port

Small-port development as part of the initial phase was partially completed as of December 2014. The authors participated in an infrastructure mission hosted by the Japan External Trade Organization (JETRO) in 2014 and had an opportunity to visit the Dawei SEZ project site. Only the 1st Jetty Berth, however, had been completed when the authors visited the Dawei SEZ. This port will be the logistics base for the light- and medium-industry estate, which will be developed adjacent to the port.

Figure A-2-5 shows the planned perspective and isometric view of the small port at Dawei SEZ and the actual berth of the small port. Basic information on the small port based on the information provided by the Italian–Thai Development Public Company Limited (ITD), the Thai developer on this project, is as follows:

- Jetty Berth
 - ✓ 1st Berth (Completed) : 100 m length jetty berth
 - Overall length is 150 m
 - 13,000 DWT multipurpose vessel (approximately 400 twenty-foot equivalent unit [TEU]) with an estimated capacity of 330,000 tonnes per annum (TPA)
 - ✓ 2nd Berth (future expansion): 150 m length jetty berth

- Overall length is 180 m
- 25,000 DWT multipurpose vessel (approximately 400 TEU) with estimate
- Depth
 - ✓ Approach Channel: 8 m
 - ✓ Anchorage Area: 7 m
- Other planned facilities:
 - ✓ There are also plans to provide cargo operation and ship operation facilities in the future according to demand.
 - ✓ An LNG terminal will be developed within two years. LNG is to be used as fuel for the power plant which supplies electricity to the Dawei SEZ.
 - Shell is involved in the development of the LNG terminal.
 - Most of the participants in the JETRO Infrastructure Mission expressed doubts regarding the feasibility of building the LNG terminal within two years.

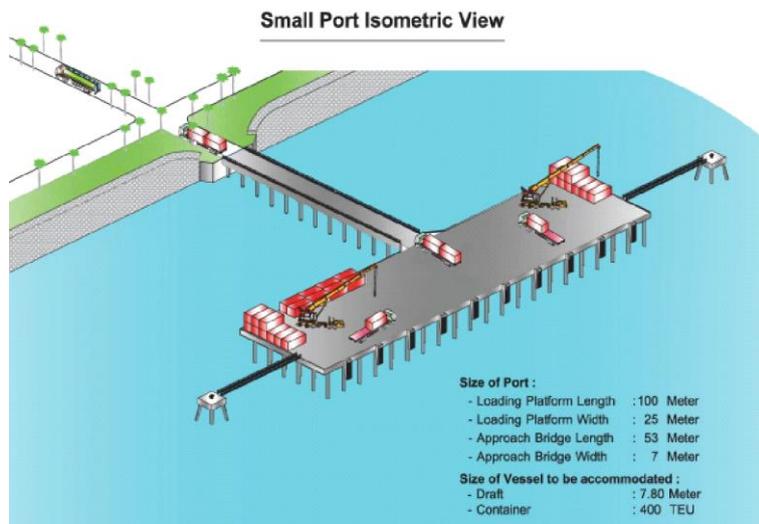
Source: Italian-Thai Development Public Company Limited, 2013; Kurewan, 2014 and Kimura & Umezaki, 2010).

Figure A-2-5. Small Port at the Dawei Special Economic Zone

(a) Perspective View of the Planned Small Port



(b) Isometric View of the Planned Small Port



(c) Photograph Taken at the Berth of the Small Port



Source: Authors.

ii) Deep-Sea Port

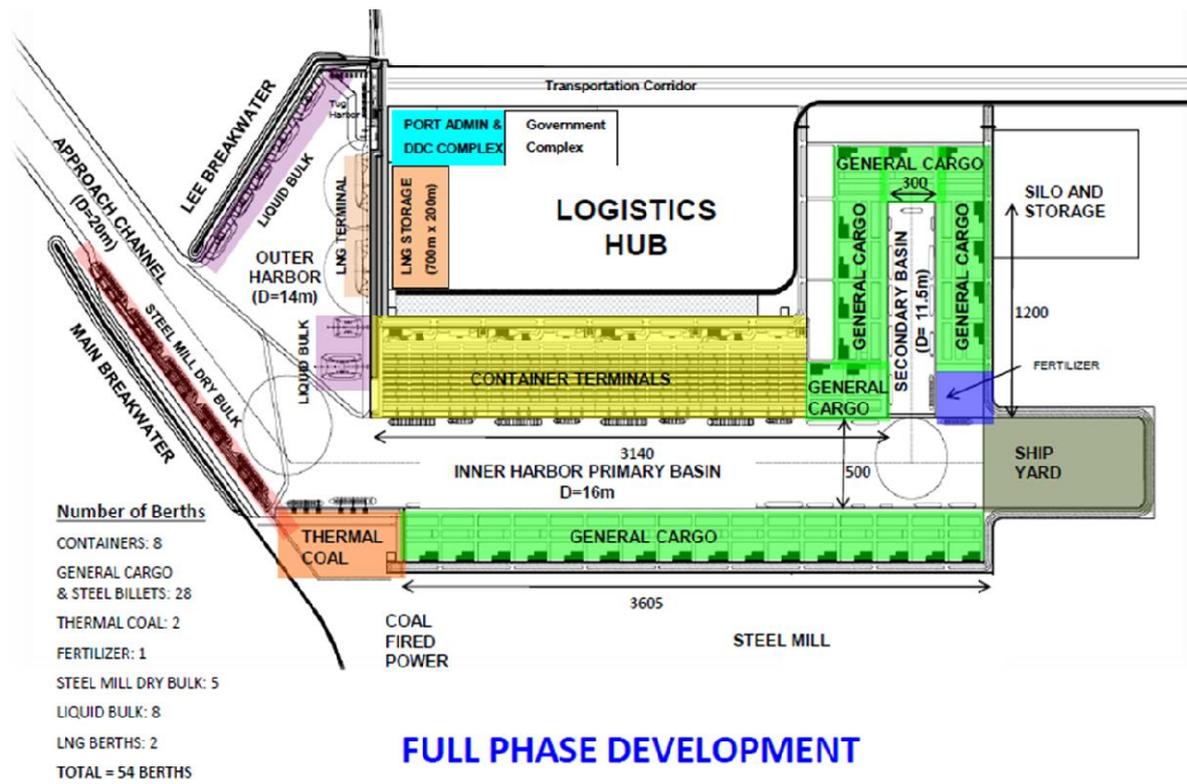
Figure A-2-6 shows the current plan for a deep-sea port at the Dawei SEZ. Originally, two deep-sea ports were to be developed. However, only one deep-sea port will now be developed according to the current development plan. The outer harbour is designed with container terminals and berths for liquid and dry bulk cargo while the inner harbour will contain general cargo-handling facilities. As shown in Figure A-2-7, the current status of the deep-sea port development project is still in the land-preparation stage and it seems that it will require much time to complete development and start commercial operation.

Italian–Thai Development Public Company Limited provided the following basic

information on the deep-sea port (Llyod, 2014; Italian-Thai Development Public Company Limited, 2013; Kurewan, 2014 and Kimura & Umezaki, 2010).

- Total area: 1,000 ha
- Estimated capacity at full phase: 287×10^6 t and 5×10^6 TEU
 - ✓ General cargo: 50×10^6 t (approximately)
 - ✓ Chemical and petrochemical: 35×10^6 t
 - ✓ Crude oil: 36×10^6 t
- Estimated Project Cost: US\$2.4 million for full phase
- Vessel size: up to 300,000 DWT
- Number of berths: 54
 - ✓ Containers: 8
 - ✓ General cargo and steel billets: 28
 - ✓ Thermal Coal: 2
 - ✓ Fertiliser: 1
 - ✓ Steel mill dry bulk: 5
 - ✓ Liquid bulk: 8
 - ✓ LNG: 2
- Quay Length: 8.7 km
- Depth
 - ✓ Approach channel: 20 m
 - ✓ Inner harbour primary basin: 16 m
- Breakwaters (3.7 km) and revetment
- Tug harbour and vessel traffic management and navigation aids

Figure A-2-6. Layout Plan of the Deep-Sea Port at the Dawei Special Economic Zone ^[55]



Source: Kruewan (2014).

Figure A-2-7. Current Situation at Deep-Sea Port Basin Area



Source: Authors.

(4) Kyaukphyu Deep-Sea Port

Myanma Oil and Gas Enterprise and CNPC have been jointly operating the tanker port on Made Island for the Myanmar–China crude oil pipeline. The tanker port is 480 m long and can accommodate 300,000 DWT vessels. This would also provide easier access to the markets of Africa, the Middle East, and Europe for Chinese manufacturers through Myanmar. Construction on the workboat wharf and other necessary structures started in November 2009 (Myanmar News Agency, 2015). Myanmar has officially opened a deep-sea port off its western coast and started trial operation in January 2015 (China Harbour Engineering Company). Basic information on the deep-sea port is as follows: ^{[48]–[50]}:

- Vessel size: up to 300,000 DWT
- Number of berths: 5
- Quay Length: 480 m (tanker ports)
- Depth: 25 m
- Loading: 4 sets of DN400 hydraulically actuated marine arms,
✓ maximum unloading rate: 12,000 m³/h

Source: Captain Aung Khin Myint, 2014; Aung Min Han, 2013 and Ports.com.

Figure A-2-8. Aerial view of Kyaukphyu Deep-Sea Port



Source: Myanmar News Agency (2015).

References

- APEX Gas & Oil Public Company Limited, Available at: <http://www.apexgasnoil.com>
- Asia World Company Limited (2014), 'Code of Ethics', 15 December.
- Asian Development Bank (2012a), *Myanmar Energy Sector Initial Assessment*, Manila: ADB.
- Asian Development Bank (2012b), *Myanmar Transport Sector Initial Assessment*, Manila: ADB.
- AsiaTradeHub.com, Burma's Energy Infrastructure, Available at: <http://www.asiatraderhub.com/burma/energy.asp>
- Aung Kyaw Htoo (2014), 'Myanmar Petroleum Sector Future Pathways and Prospect', Material presented at the Myanmar Oil and Gas Summit 2014, 23–24 June, Yangon, Myanmar.
- Aung Min and T. Kudo (2012), 'Newly Emerging Industrial Development Nodes in Myanmar: Ports, Roads, Industrial Zones along Economic Corridors', *BRC Research Report*, No. 8, Chiba: IDE-JETRO.
- Aung Min Han (2013), 'Logistics Infrastructure and Supply Chain System in Myanmar' (presentation material).
- Aung Shin (2015), 'Energy Planning Department Gone with Reorganisation', *The Myanmar Times*, 7 April, <http://www.mmtimes.com/index.php/business/13949-energy-planning-department-gone-with-reorganisation.html>
- Captain Aung Khin Myint (2014), 'New Opportunities for Myanmar's Ports and Container Shipping Industries', Material presented at the TOC Container Supply Chain Asia 2014, 8–9 April, Marina Bay Sands, Singapore.
- Central Intelligence Agency (2014), *The World Factbook 2014*. Langley, Virginia: CIA.
- China Harbour Engineering Company, 'Workboat Wharf and Auxiliary Facilities of China-Myanmar Crude Oil Pipeline Project', Available at: <http://www.chec.bj.cn/zq/tabid/896/InfoID/6263/Default.aspx>
- Daw Hla Kyi (2006), 'Progress Report on Oil Refineries Earlier Audited in Myanmar', Material presented at the Seminar on the Promotion of Energy Efficiency and Conservation (PROMEEC) for Major Industries in Southeast Asia', Myanmar Petrochemical Enterprise.
- Dawei Development Company Limited, General Geographic and Demographic Overview. Available at: <http://www.daweiindustrialestate.com/Burmesedays> (amendments by Globe-trotter and Joelf), Map of Myanmar with regions colour coded
- Dawei Development Company Limited, Myanmar Government Structure, <http://www.daweiindustrialestate.com/>
- Hilton, I. (2013), *China in Myanmar: Implications for the Future*, NOREF Report, p. 10.
- International Energy Agency (2014), *Energy Supply Security 2014: The Emergency Response of IEA Countries*, Paris: IEA.
- International Money Fund (2015), 'The World Economic Outlook Database', Available at: <http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/index.aspx>, April 2015 edition.
- Italian-Thai Development Public Company Limited (2013), 'Dawei Development Company Limited, Dawei Deep Seaport & Industrial Estate Development Project'

- (presentation material).
- Italian-Thai Development Public Company Limited (2014), 'Presentation for JETRO Myanmar Infrastructure Mission' (presentation material).
- Japan International Freight Forwarders Association (2012), *ASEAN Logistics Survey Report Volume 5 Myanmar*'.
- Japan Petroleum Energy Center (2011), 'Oil Refinery Industry in Myanmar' (in Japanese), *JPEC Report*, p. 10.
- Japan Petroleum Energy Center (2011), *Oil and Gas Industry in Myanmar Expanded by Strong Partnership with China* (in Japanese), JPEC Report, p. 6
- Japan Petroleum Energy Center (2014), 'Oil and Gas Industry in Myanmar Under the Current Economic Liberalization' (in Japanese), *JPEC Report*, p.22.
- Kimura, F. and S. Umezaki (2010), *ASEAN-India Connectivity: The Comprehensive Asia Development Plan, Phase II*, ERIA Research Project Report 2010-7, Jakarta: ERIA.
- Kruewan, M. (2014), 'Thailand Development Policy for Neighboring Countries: Dawei Development Project Case Study'.
- Kudo, T. (2005), 'Stunted and Distorted Industrialization in Myanmar', *Discussion Paper*, No. 38, Chiba: Institute of Developing Economies (IDE).
- Lloyd, C. (2014), 'Focusing on Myanmar', *Hydrocarbon Engineering Magazine*, Available at: <http://www.energyglobal.com/downstream/gas-processing/08102014/Myanmar-focus-TSA/>
- Myanmar Immortal Trading Co., Ltd. (n.d.), *Looking for Local Partner*. Myanmar Immortal Trading website. Available at: <http://www.ksstmyanmar.com/lookingfor-local-partner.htm>
- Myanmar News Agency (2015), 'Ma-de Oil Port to Create Job Opportunities for Locals and Contribute to Development of Education and Health Sectors', 18 January.
- Myanmar News Agency, Ma-de oil port to create job opportunities for locals and contribute to development of education and health sectors, 18 January 2015, 2015.
- Myanmar Oil and Gas Enterprise (2012), Myanmar Country Report on Status of Decommissioning (presentation material).
- Myanmar Petrochemical Enterprise (2012), 'Implementation of Joint Venture Project for No.1 Refinery (Thanlyin)' (presentation material).
- Myanmar Port Authority, Available at: http://www.mpa.gov.mm/index.php?option=com_content&view=article&id=17&Itemid=13&lang=en
- Nicolas, F. (2009), *ASEAN Energy Cooperation: An Increasingly Daunting Challenge*. Paris: Institut Français des Relations Internationales.
- OG Analysis (2015), *Myanmar Oil and Gas Strategic Analysis and Outlook to 2025*, Rockville, MD: OG Analysis.
- Oil & Gas Technology (2013), 'China: CNPC Tanks for Burma Terminal Near Completion', *Downstream News*, 3 June. <http://www.oilandgastechology.net/downstream-news/china-cnpc-tanks-burma-terminal-near-completion>
- opencorporates, Apex Gas and Oil Public Co., Ltd (Public), Available at: <https://opencorporates.com/companies/mm/4334-2012-2013>

- opencorporates, Asia World Co., Ltd, Available at:
<https://opencorporates.com/companies/mm/120-1992-1993>
- opencorporates, Green Asia Services Co., Ltd, Available at:
<https://opencorporates.com/companies/mm/4013-2011-2012>
- opencorporates, Myat Myittar Mon Co., Ltd, Available at:
<https://opencorporates.com/companies/mm/14-2000-2001>
- Ports.com, 'Port of Rangoon, Myanmar', <http://ports.com/myanmar/port-of-rangoon/>
- Project Monitor News Bureau (n.d.), 'Soft Loan for Myanmar Refinery Likely', Available at:
<http://old.projectsmonitor.com/detailnews.asp?newsid=7629>
- Smith, C. E. (2013), 'Worldwide Pipeline Construction: Crude, Products Plans Push 2013 Construction Sharply Higher', *Oil & Gas Journal*, 111(2).
- Tank Storage Magazine (2013), 'Tank Terminals Update – Asia', 5(5), pp. 11–12.
- Tank Storage Magazine* (2014), 'Tank Terminals Update – Asia', pp. 9–10.
- The Associated Press (2013), 'Myanmar Opens Deep Sea Port for Chinese Oil Pipeline', *The New York Times*, January 30, Available at:
<http://www.nytimes.com/aponline/2015/01/30/world/asia/ap-as-myanmar-china-pipeline.html>
- The World Bank (1985), 'Myanmar: Issues and Options in the Energy Sector', Report No. 5416-BA, Washington, DC: The World Bank.
- The World Bank (1992), 'Myanmar: Energy Sector Investment and Policy Review', Report No. 10394-BA, Washington, DC: The World Bank.
- U Aung Khine Htun (2012), 'Business Insight to Myanmar Energy Trade', Material presented at the Myanmar Energy Trade Show, 26–27 September, Myanmar Convention Centre, Yangon.
- United Nations Conference on Trade and Development, 'UNCTADstat', Available at:
<http://unctad.org/en/Pages/Statistics.aspx>
- US Department of State (2011), *Burma Background Note* (08/03/11), Available at:
<http://www.state.gov/outofdate/bgn/burma/189439.htm>
- US Energy Information Administration (2014), 'Country Analysis Note: Burma', Available at: <http://www.eia.gov/countries/country-data.cfm?fips=bm#pet>, revised 12 June 2014.
- Website of China Harbour Engineering Company,
<http://www.chec.bj.cn/tabid/654/Default.aspx>
- Wikipedia, 'Sino-Myanmar Pipelines', Available at: http://en.wikipedia.org/wiki/Sino-Burma_pipelines
- World Bank, *World Development Indicators 2014*, <http://data.worldbank.org/products/wdi>
- World Culture Encyclopedia, Culture of Burma. <http://www.everyculture.com/Bo-Co/Burma.html>
- Zaw Naing (2014), 'Ports Development in Myanmar', Material presented at the Oil & Gas Myanmar 2014, October 15–17, Myanmar Convention Centre, Yangon.