Sustainable Development of Natural Gas Market in East Asia Summit Region

edited by

Ichiro Kutani

Yanfei Li

September 2015

ERIA Research Project FY2014 No. 31
Published September 2015

This report was prepared by the Working Group for the 'Sustainable Development of Natural Gas Market in EAS Region' under the Economic Research Institute for ASEAN and East Asia (ERIA) Energy Project. Members of the Working Group, who represent the participating East Asia Summit (EAS) region countries, discussed and agreed to utilise certain data and methodologies proposed by the Institute of Energy Economics, Japan (IEEJ) to analyse market trend. These data and methodologies may differ from those normally and/or officially used in each country, and therefore, the calculated results presented here should not be viewed as official national analyses of the participating countries.

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 role of natural gas in energy supply is increasing in the East Asia Summit (EAS) region where energy demands are steadily growing. The driving factors of this trend include the effective use of domestic resource, diversification of energy source, and reducing environmental load. At the same time, rising import dependency of natural gas supply is seen in many member courtiers, which is casting energy security concern.

As such, there is a need to implement necessary and appropriate policy measures that can respond to this changing natural gas supply–demand structure. What will be required to achieve sustainable development of natural gas market, and thus, contribute to the economic growth of the region and of the countries? It is our hope that this study succeeds in finding and presenting some clues to answer this important and difficult question.

Ichiro Kutani
Leader of the Working Group
June 2015

Acknowledgements

This analysis was undertaken by a working group under the Economic Research Institute for ASEAN and East Asia (ERIA). It was a joint effort amongst an ERIA researcher, the Working Group members of the East Asia Summit (EAS) countries, and the The Institute of Energy Economics, Japan (IEEJ), with the IEEJ acting as the secretariat. We would like to acknowledge the support provided by everyone involved.

We also acknowledge Mr Victorino S. Bala, former secretary-in-charge of the ASEAN Council on Petroleum (ASCOPE), and Mr Paramate Hoisungwan of ASCOPE for providing valuable insights on the issues covered by this study.

Mr Ichiro Kutani
Leader of the Working Group
June 2015

Contents

List of Figures

List of Tables

List of Abbreviations

ASCOPE	ASEAN Council on Petroleum
ASEAN	Association of Southeast Asian Nations
bcm	billion cubic metre
CBM	coalbed methane
CIS	Commonwealth of Independent States
CO_2	carbon dioxide
EAS	East Asia Summit
EIA	Energy Information Administration
ECTF	Energy Cooperation Task Force
ERIA	Economic Research Institute for ASEAN and East Asia
HOA	Heads of Agreement
IEA	International Energy Agency
IEEJ	The Institute of Energy Economics, Japan
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MJ/litre	megajoule per litre
MMBtu	million British thermal unit
MMscfd	million standard cubic feet per day
MMscmd	million standard cubic metre per day
MT	million tonnes
Mtoe	million tonnes of oil equivalent
SPA	Sales and Purchase Agreement
Tcf	trillion cubic feet
Tcm	trillion cubic metre
WG	working group

List of Project Members

Working Group Members

Mr Ichiro Kutani (Leader): Senior Economist, Manager, Global Energy Group 1 , Assistant to Managing Director, Strategy Research Unit, The Institute of Energy Economics, Japan (IEEJ)

Mr Shimpei Yamamoto (Organiser): Managing Director for Research Affairs, Economic Research Institute for ASEAN and East Asia (ERIA)

Mr Shigeru Kimura (Organiser): Special Advisor to Executive Director on Energy Affairs, Economic Research Institute for ASEAN and East Asia (ERIA)

Dr Han Phoumin (Organiser): Energy Economist, Energy Unit, Research Department, Economic Research Institute for ASEAN and East Asia (ERIA)

Dr Anbumozhi Venkatachalam (Organiser): Senior Energy Economist, Energy Unit, Research Department, Economic Research Institute for ASEAN and East Asia (ERIA)

Dr Yanfei Li (Organiser): Energy Economist, Energy Unit, Research Department, Economic Research Institute for ASEAN and East Asia (ERIA)

Dr Wang Yue: Associate Researcher, Strategic Research Center of Oil and Gas Resources, Ministry of Land and Resources (MLR), China

Dr Patuan Alfon Simanjuntak: Head of Exploitation Supervision for Oil and Gas, Directorate of Oil and Gas Upstream Development, Directorate General of Oil and Gas, Ministry of Energy and Mineral Resources (MEMR), Indonesia

Mr Tetsuo Morikawa: Senior Economist and Manager, Gas Group, Coal and Gas Subunit, Fossil Fuels and Electric Power Industry Unit, The Institute of Energy Economics, Japan (IEEJ), Japan

Ms Ayako Sugino: Senior Researcher, Gas Group, Coal and Gas Subunit, Fossil Fuels and Electric Power Industry Unit, The Institute of Energy Economics, Japan (IEEJ), Japan

Mr Naoki Okubo: Senior Researcher, Global Energy Group 1, Strategy Research Unit, The Institute of Energy Economics, Japan (IEEJ), Japan

MS SANAE KURITA: Senior Researcher, Global Energy Group 2, Strategy Research Unit, The Institute of Energy Economics, Japan (IEEJ), Japan

MR MOE THU AUNG: Assistant Executive Engineer, Offshore Department, Myanma Oil and Gas Enterprise (MOGE), Ministry of Energy (MOE), Republic of the Union of Myanmar

MR JESUS T. TAMANG: Director, Energy Policy and Planning Bureau, Department of Energy (DOE), Philippines

DR XUNPENG SHI: Senior Fellow, Energy Studies Institute (ESI), National University of Singapore (NUS), Singapore

Executive Summary

The role of natural gas in energy supply is expected to become more and more important in many East Asia Summit (EAS) countries. To enable the use of natural gas sustainable, i.e., to gain maximum benefit from natural gas use, appropriate actions shall be taken throughout the supply chain.

This study examines the supply–demand outlook of natural gas in the EAS region. The analysis indicates that import dependency of natural gas supply is going to rise in the future as the pace of supply increase cannot catch up with that of demand increase.

Recommendation 1: Towards realising larger investments

It is important to consider here the investment for realising the required future supply of natural gas, including indigenous production and import. According to the International Energy Agency (IEA), the required amount of investment on natural gas-related infrastructure adds up to $2.27 trillion for all of Asia. The following points out four items that may be required to realising large investment, that is, to promote private sector participation:

a) Abolition of investment barriers.
b) Rationalisation of gas prices.
c) Financial support (risk share) by national and governmental organisations.
d) Provision of investment signals.

Recommendation 2: Towards sustainably developing the natural gas market

There are still problems to be solved to achieving sustainable development for the Asian natural gas market. One is improvement of flexibility and another is the rationalisation of pricing in international natural gas trade (e.g. import and export). Improvement of trade flexibility is required because this leads to the expansion of profitable opportunities for the exporting countries, in addition to higher needs for more

flexible balancing tool of gas supply–demand for the importing countries. Rationalisation of pricing is an indispensable element in the functioning and in enhancing market efficiency. The following points out three items that may be required to achieve these goals:

a) Understanding the possible benefits brought about by expanding market flexibility and rationalising the pricing.
b) Formation of an intra-regional agreement on natural gas and liquefied natural gas (LNG) trade.
c) Conduct of market monitoring based on the above agreement.

Conclusion

Natural gas is expected to play a more important role in energy supply in the EAS region. However, to gain maximum benefit from the well-balanced feature of natural gas, its supply stability, economic efficiency, and environmental friendliness, some issues, as pointed out, will need to be resolved. Increasing use of rationally priced natural gas may eventually contribute to the development of both countries—more revenue for exporting countries, while importing countries can enjoy a more balanced energy supply mix.

CHAPTER 1

Introduction

Many East Asia Summit (EAS) countries show growing trend in energy demand. The role of natural gas in energy supply becomes more and more important in several aspects, which include the effective use of domestic resources, diversification of energy supply, and reduction of environmental load. However, since the share of natural gas in 'Total Primary Energy Supply' is relatively low in the region except for a few countries, there is much room for expanding the use of natural gas and, thus, gain maximum benefit from its use.

To make the use of natural gas sustainable, appropriate actions shall be taken throughout the supply chain, such as exploration and production, import if necessary, transmission, distribution, and consumption. For instance, specific actions are needed to (i) maintain investment for developing gas field to enhance natural gas supply, (ii) increase efficiency of natural gas use to avoid wasting resources and unnecessary expenditures, and (iii) develop required infrastructure for natural gas supply. There is also a need to strengthen the capability of adjusting the supply–demand balance in some importing countries, and enhance the transparency of gas market by improving liquidity in natural gas/liquefied natural gas (LNG) market.

In the EAS region, where natural gas demand is expected to increase in the future, it is important to formulate the framework for the sustainable growth of the natural gas market.

1.1. Rationale

The rationale of this study is derived from the 18th Energy Cooperation Task Force (ECTF)[1] meeting, held in Bali, Indonesia on 27 June 2013. In this meeting, Japan proposed new areas of study, namely, Sustainable Development of Natural Gas Market in EAS. The participants of this meeting exchanged views and agreed to commence work on the proposed new study.

As a result, the Economic Research Institute for ASEAN and East Asia (ERIA) has

[1] The ECTF is under the Energy Ministers Meeting of EAS countries.

formulated the Working Group (WG) for the study. Members from EAS countries are represented in the WG with Mr Ichiro Kutani of the Institute of Energy Economics, Japan (IEEJ) as the leader of the group.

1.2. Objective

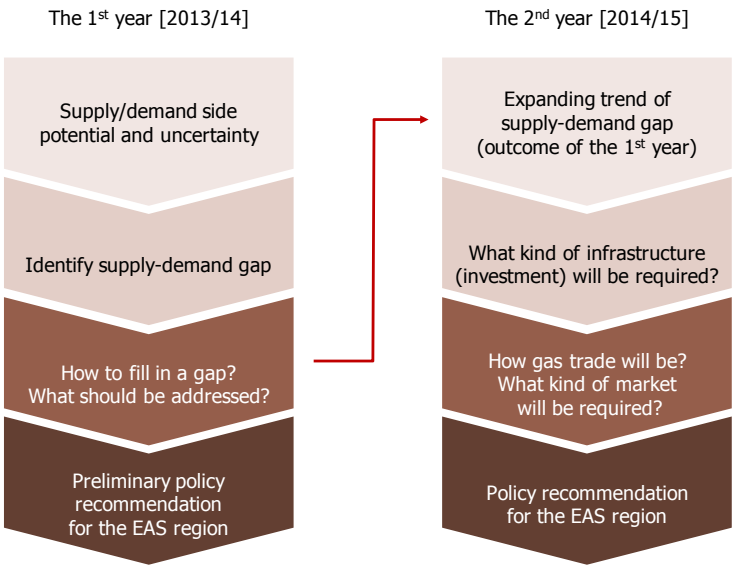
This study aims to generate suggestions for formulating better future market conditions for natural gas in the EAS region. Natural gas market in the EAS region is facing supply increases in both demand and import. In the meantime, outside of the region, the unstable condition in the Middle East region still exists. On the other hand, a high expectation for new supply from North America is also there. Therefore, it is necessary to investigate how the EAS region could address the issues and adapt to these changing circumstances.

1.3. Work Stream and Working Group Activity

The study is designed to be conducted for two years.

During the first year, the study will focus on estimating natural gas outlook in the region to identify possible changes in future market, and on assessing the current policy direction in each country. On the second year, the study intends to discuss market and infrastructure issues that may be required under future market conditions. Finally, the study will draw out policy implications based on these analyses.

Figure 1.1: Study Flow



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

CHAPTER 2

Natural Gas Outlook in the East Asia Summit Region

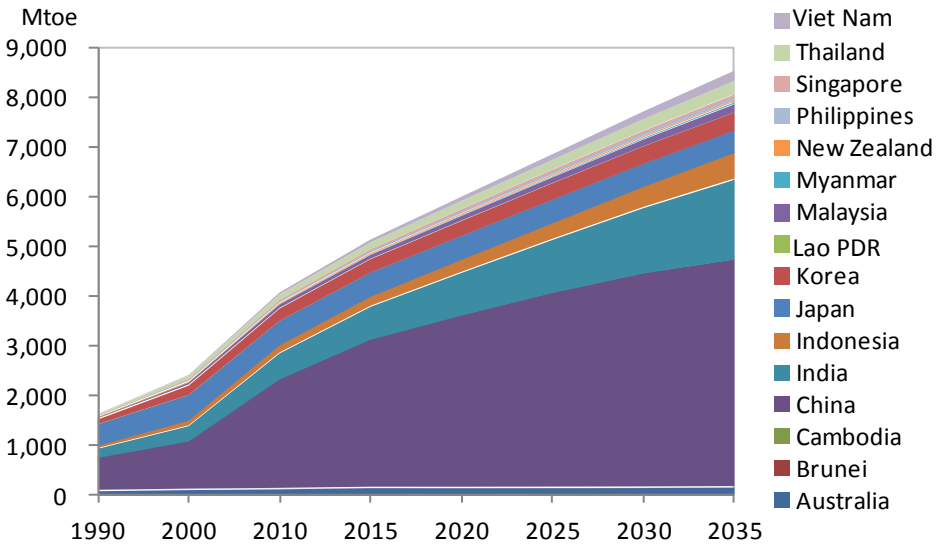
This chapter will look into the perspectives of natural gas demand, supply, and international trades within and outside the EAS region. First, ERIA's energy demand outlook in the EAS region will be presented. Second, the supply perspective in the region based on an IEEJ scenario will be explained. Finally, taking into account the supply/demand perspectives, a possible picture of international trades within the region and with external regions will be presented.

2.1. Demand

With the robust economic growth and population expansion, the EAS region will consume a substantially increased volume of energy in the future. According to the outlook by ERIA,[2] the primary energy demand in the region will increase at 3 percent per annum—from 4,079 million tonnes of oil equivalent (Mtoe) in 2010 to 8,536 Mtoe in 2035. Although ERIA does not conduct worldwide forecast, there is consensus that the Asia-Pacific region, of which EAS countries cover the majority of its energy demand, will drive the world energy demand. China, and to a lesser extent India, will be the driving forces of the demand growth. These two countries alone are expected to consume as much as 73 percent of the total energy supply in the EAS region.

[2] Economic Research Institute for ASEAN and East Asia (ERIA) (2013), 'Analysis on Energy Saving Potential in East Asia'. June. http://www.eria.org/RPR-FY2012-19.pdf

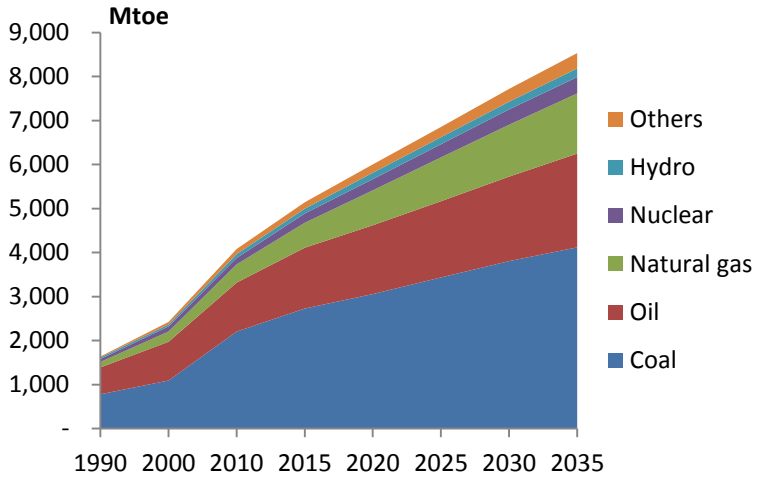
Figure 2.1: Primary Energy Supply Outlook by Country in the EAS Region



Source: Economic Research Institute for ASEAN and East Asia (ERIA).

As far as energy mix is concerned, coal will remain the main fuel for the region, reflecting heavy reliance on coal, especially in China and India. Oil will take the second largest share of the total energy demand in the region, underpinned mainly by rapid motorisation. Natural gas demand will grow fastest amongst the fossil fuels to reach 1,368 Mtoe (1,432 billion cubic metre [bcm]) in 2035, accounting for 16 percent of the total energy in the region.

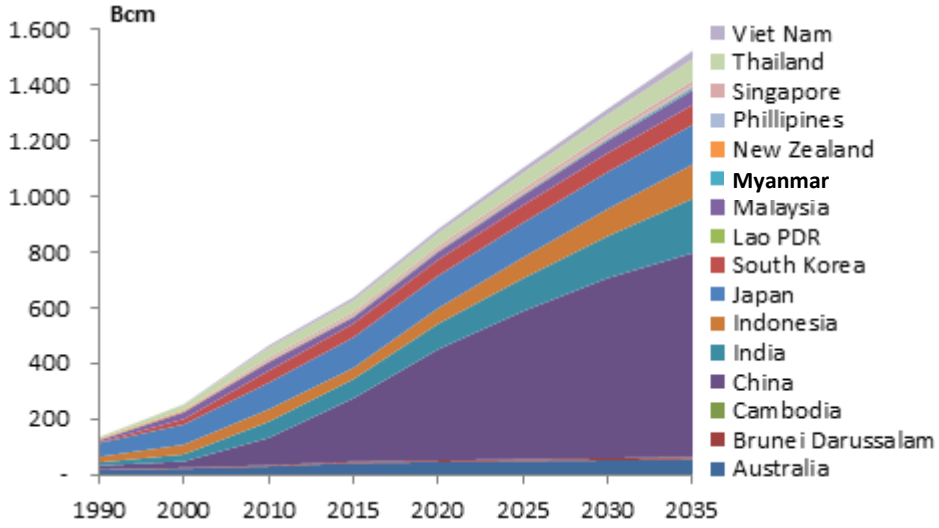
Figure 2.2: Primary Energy Supply Outlook by Fuel in the EAS Region (BAU)



Note: Mtoe = million tonnes of oil equivalent.
Source: Economic Research Institute for ASEAN and East Asia (ERIA).

Like the case of primary energy supply, China and India will drive the natural gas demand in the EAS region. These two countries are expected to account for 48 percent for China and 13 percent for India of the total demand in 2035 in the region, followed by Japan, Indonesia, and South Korea.

Figure 2.3: Natural Gas Demand Outlook by Country in the EAS Region (BAU)

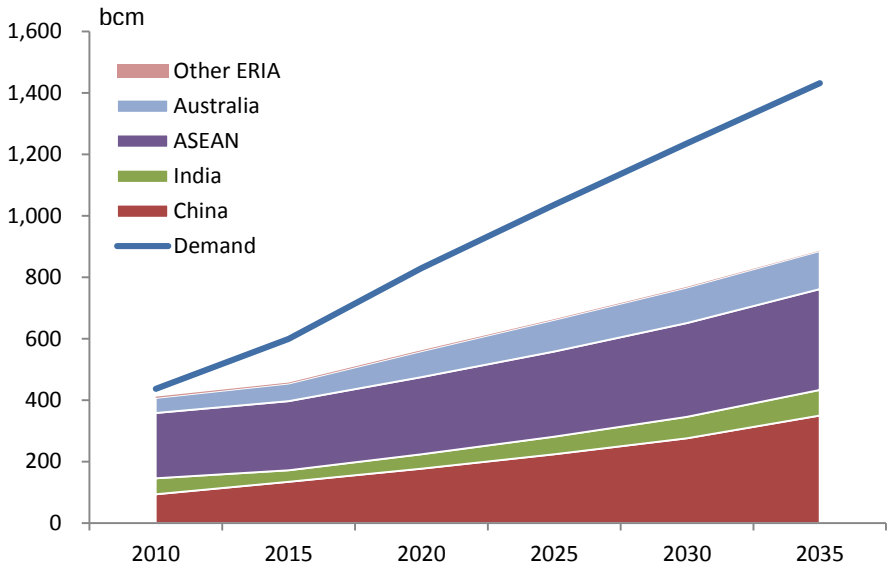


Note : bcm = billion cubic metre. 1Mtoe=1.11Bcm
Source: Economic Research Institute for ASEAN and East Asia (ERIA).

2.2. Supply

The EAS region has a rich resource of natural gas, conventional or unconventional. Production in the region will increase steadily, especially in China and Australia. Other countries, especially Indonesia and Malaysia, are also expected to produce more natural gas during the projected period. Nevertheless, regional production will highly unlikely be able to keep up with the demand growth. As a result, the dependency on non-EAS region will rise from 25 bcm in 2010 to 546 bcm in 2035, making the import dependency rate to reach 38 percent in the same year.

Figure 2.4: Natural Gas Supply Outlook in the EAS Region



Note: bcm = billion cubic metre.
Sources: Economic Research Institute for ASEAN and East Asia (ERIA) and The Institute of Energy Economics, Japan (IEEJ)

2.3. International Trades

The EAS region already imports a substantial amount of natural gas from non-EAS region, mainly Middle East, and to a lesser extent, Central Asia and Russia. Import dependency will rise significantly in the future. The above analysis suggests that the EAS region might need to source 546 bcm of natural gas from outside the region in 2035. Considering the demand and supply projections, this section will present the possible scenario in terms of international trades in the EAS region.

2.3.1. Pipeline Gas

Currently, only China imports pipeline gas from non-EAS countries.[3] The country started to import pipeline gas from Turkmenistan in 2010 and from the Republic of the Union of Myanmar in 2013. Additionally, the country reached an agreement to import 38 bcm before 2020 and potentially, another 30 bcm of pipeline gas from Russia. In the long run, the country could import more than 130 bcm–150 bcm of pipeline gas mainly from the former Soviet Union in 2035.

[3] Statistically, Australia imported 7 bcm from Timor-Leste in 2013. The import is all from Timor-Leste–Australia Joint Petroleum Development Area, not the pure jurisdiction of Timor-Leste. Thus, for convenience, this section does not consider this trade as import from a non-EAS country.

Figure 2.5: International Pipeline Concept in Northeast Asia

Source: Northeast Asian Gas & Pipeline Forum.

With its vast demand potential, India is another country that could import significant amounts of pipeline gas from non-EAS region. The country has been in talks with Iran (Peace Pipeline project) and, more recently, with Turkmenistan (Turkmenistan–Afghanistan–Pakistan–India: TAPI project). As far as the Peace Pipeline project is concerned, the Iran–Pakistan section could be built, but it is uncertain whether the pipeline will reach India as originally planned. The TAPI project seems more promising for India although no import contract has been signed yet. The Gas Authority of India estimates that 14 million standard cubic metre per day (MMscmd) (5 bcm per annum) will be consumed in Afghanistan, and 38 MMscmd (13 bcm per annum) in Pakistan, while 38 MMscmd will reach India.

Figure 2.6: Pipeline Routes of IPI and TAPI Projects

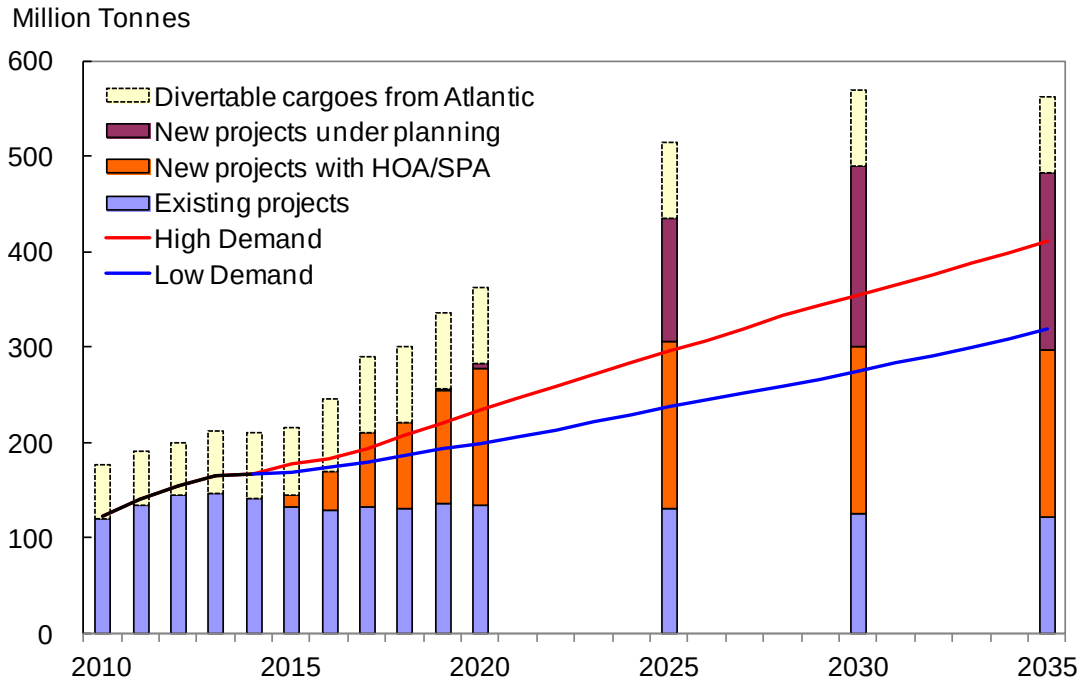
Note: IPI = Iran–Pakistan–India, TAPI = Turkmenistan–Afghanistan–Pakistan–India.
Source: *Wall Street Journal.*

2.3.2. Liquefied Natural Gas

While there is substantial potential for pipeline gas imports, it is expected that the majority of non-EAS supply will be in the form of liquefied natural gas (LNG). According to IEEJ, LNG demand in the EAS region will increase from 122 million tonnes (MT) (166 bcm) in 2010 to 318–411 MT (432–559 bcm) in 2035.

Although the demand will grow rapidly, there is ample supply potential for the EAS region. Australia will add about 60 MT by 2020. The US is expected to produce even more LNG by around 2020, while India, Japan, South Korea, and Indonesia have already committed to lift 33 MT per annum. Canada could emerge as another significant LNG exporter for the EAS region with a potential capacity of around 30 MT per annum by 2025. There are other potential substantial sources, such Russia and East Africa. Nevertheless, it is important to secure adequate and timely investment to realise those potential projects—to achieve security in natural gas supply in the EAS region.

Figure 2.7: Liquefied Natural Gas Outlook in the EAS Region



Note: HOA = Head Of Agreement, SPA = Sales and Purchase Agreement.
Source: The Institute of Energy Economics, Japan (IEEJ).

CHAPTER 3

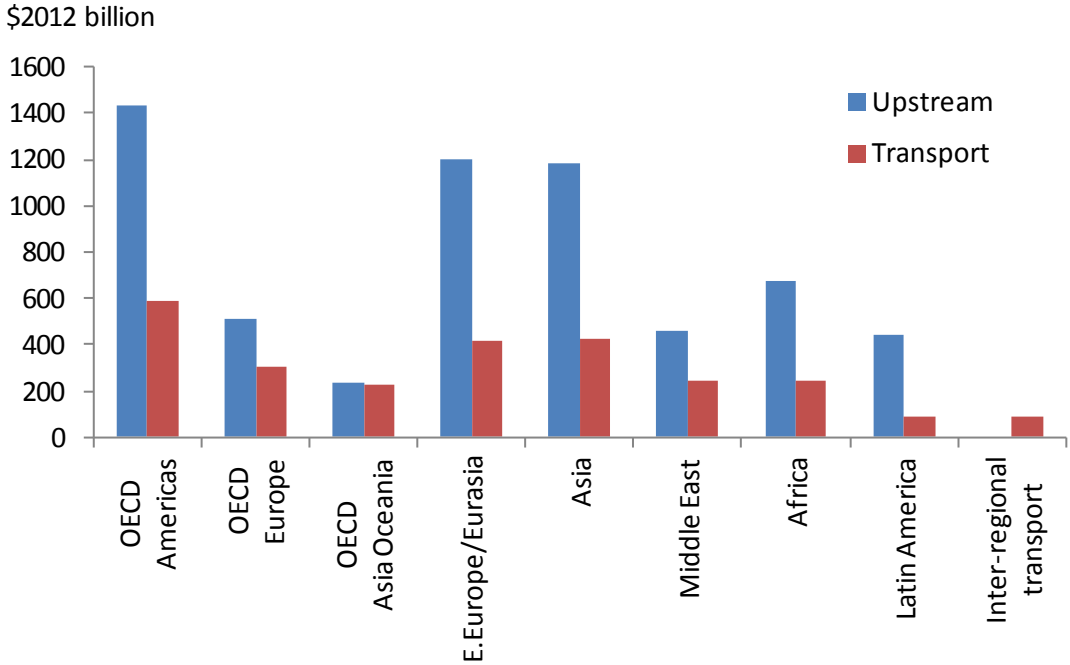
Natural Gas Investment in the East Asia Summit Region

Securing investment is the key to realising the supply potential of natural gas in the EAS countries, as earlier mentioned. Being the demand growth centre, EAS is the main region where huge amounts of investment will be required throughout the supply chain. This chapter, therefore, will examine the investment needs in the region, using the International Energy Agency's (IEA) *World Energy Investment Outlook 2014*, and the country-specific information provided by the working group members.

3.1. Upstream

According to IEA's *World Energy Investment Outlook 2014*, the annual capital expenditure on energy (oil, gas, coal, power, and bio fuel) was $1.23 trillion from 2000 to 2013. With $252 billion, natural gas accounted for 20 percent of the total energy investment for the same period. In this same document, IEA forecasts that the world fossil fuel investments from 2014 to 2035 will be as much as $23 trillion. With $8.77 trillion, natural gas shares 37 percent of the total. Region-wise, the Organisation for Economic Co-operation and Development (OECD) member countries-Americas (Canada, Chile, Mexico, and the US) require the largest amount ($2.02 trillion), followed by East Europe/Eurasia ($1.62 trillion), and by Asia ($1.61 trillion). In most regions, upstream (mainly exploration and production) investment needs to surpass significantly the needs of transport (domestic and cross-border pipelines, distribution systems, liquefaction and regasification plants, and LNG tankers). Assuming that liquefaction plants are usually considered as a part of upstream facilities, upstream gas investment could be much larger than the IEA figures.

Figure 3.1: Cumulative Fossil Fuel Investment by Region, 2014–2035



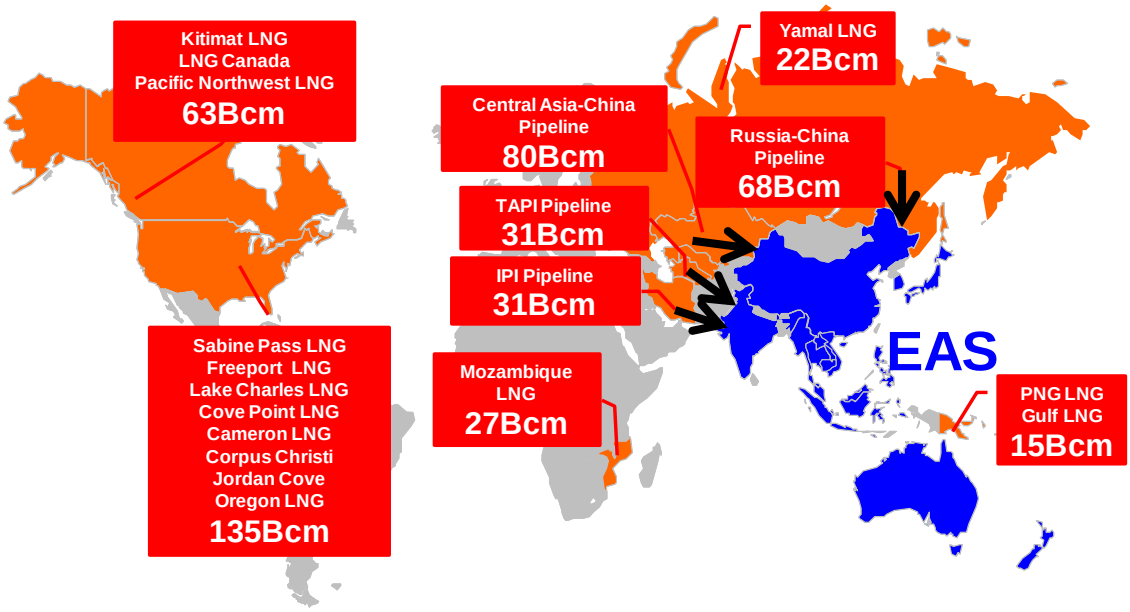
Note:OECD = Organisation for Economic Co-operation and Development.
Source: *World Energy Investment Outlook 2014* of the International Energy Agency (IEA).

The IEA expects that Asia and the OECD-member countries of Asia-Oceania—Australia, Japan, South Korea, and New Zealand—which largely correspond to EAS countries will account for a significant portion of 18 percent of the world's energy investment during 2014–2035. Within the EAS region, $657 billion of investment is needed in China, followed by the Association of Southeast Asian Nations (ASEAN) with $529 billion, and OECD's Asia-Oceania with $463 billion. Generally speaking, the upstream sector in China, ASEAN, and OECD's Asia-Oceania (mostly Australia) is the main area where heavy investment will be made in the coming decades in the EAS region. For instance, China has an ambitious policy to develop domestic shale gas resources to reach an annual production of 230 bcm in 2035. Indonesia has been working to develop its rich gas potential, conventional or unconventional, to satisfy its rapidly increasing domestic demand, as well as for export. LNG projects become more important in the country comprised of a number of islands to transport gas from the East Indonesia to energy hungry west Indonesia. Significant upstream investments are also being made in Malaysia, such as in Kinabalu and Kebabangan, as well as in LNG projects like FLNG Satu and Dua, and MLNG Train 9.

While EAS countries will invest aggressively within the region, it is important to note that investing outside the region is equally important since many upstream projects plan

to supply EAS countries, at least partly.

Figure 3.2: Major Natural Gas Supply Sources for the EAS Region



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

An LNG offers greater mobility than pipeline gas in terms of supply destination. Especially since after the series of Ukrainian gas crises, it has become clearer than before that LNG is more advantageous than pipeline gas in terms of security of supply. In any case, a large number of LNG projects are planned outside the EAS region, especially in North America. Considering that the total capacity of those projects is as large as 224 MT (304 bcm) and that the increasing dependency on non-EAS supplies is expected in the future, the extent of gas supply security in the EAS region will depend on whether these projects will be commercialised in a timely manner to meet increased demand.

Table 3.1: Major Liquefied Natural Gas Projects for the East Asia Summit Region

Region	Country	Project	Capacity (MT/y)	Start up	Investors	Investment Amount ($ billion)
Africa	Mozambique	Mozambique LNG	20.0	2020	Anadrko, Mitsui, ENH, Bharat Petroleum, Videocon, Cove Energy	30?
	Sub-total		20.0			
FSU	Russia	Yamal LNG	16.5	2017	Novatek, Total, CNPC	27
	Sub-total		16.5			
Americas	USA	Sabine Pass	9.0	2016	Cheniere Energy	11
			9.0	2017		
		Freeport	8.8	2018	Freeport LNG, ZHA FLNG, Dow Chemical, Osaka Gas	4
			4.4	2019		
		Cameron	8.0	2018	Sempra, GdF Suez, Mitsubishi, NYK Line, Mits	6
			4.0	2018		
		Cove Point	5.3	2018	Dominion Resources	3-4?
		Lake Charles	15.0	2018	Southern Union, BG	3-4?
		Corpus Christi	15.7	2018	Cheniere Energy	12?
		Jordan Cove	9.2	2020	Fort Chicago, Energy Projects Development	8?
	Canada	Pacific Northwest	12.0	2018	Petronas, SINOPEC, JAPEX, IOC, Dhina Huadian, Petroleum Brunei	9-11?
		LNG Canada	24.0	2023	Shell. Mitsubishi, KOGAS, CNPC	32?
		Kitimat LNG	10.0	2023	Chevron, EOG Resources, Encana	28?
	Sub-total		134.4			
Asia Oceania	Indonesia	Donggi Senoro LNG	2.0	2015	Mitsubishi, KOGAS, Pertamina, Medco	3
		Tangguh (Train 3)	3.8	2019	BP, MI Berau, CNOOC, Nippon Oil Exploration, KG Berau, KG Wiriagar, Indonesia Natural Gas Resources Muturi, Talisman Wiriagar	12?
	Malayisa	Petronas LNG	3.6	2015	Petronas	0.4-0.6
		Petronas FLNG	1.2	2015	Petronas	0.8
		Petronas FLNG	1.5	2018	Petronas	2
	Australia	Australia Pacific LNG	9.0	2015	Origin Energy, ConocoPhillips, Sinopec	20
		Gorgon	15.6	2015	Chevron, Shell, ExxonMobil, Osaka Gas, Tokyo Gas, Chubu Electric	54
		GLNG	7.8	2015	Santos, Petronas, Total, KOGAS	19
		Prelude	3.6	2017	Shell, INPEX	34
		Wheatstone	8.9	2016	Chevron, Apach, Tokyo Electric, KUFPEC, KOGAS, Kyushu Electric	29
		Ichthys	8.4	2016	INPEX, Total, Tokyo Gas, Osaka Gas, Toho Gas	20<
	Sub-total		53.3			
Total			224.2			

Source: Compiled by The Institute for Energy Economics, Japan (IEEJ).

3.2. Downstream

The previous section mentioned that downstream gas investment in the EAS region is likely to be smaller than upstream during 2014–2035. The IEA expects that the gas transport sector in Asia and the OECD's Asia-Oceania might need $658 billion, which is less than half of the upstream investment during the period. This is not to dismiss the importance and difficulty of downstream investment in the EAS region. Many EAS countries are just beginning to gasify and are not necessarily capable of financing large-scale gas infrastructure projects, partly because of the non-profitability of the gas supply business, which often stems from the low-priced gas set for political and social welfare objectives.

Nevertheless, with increasing demand and environmental advantages that natural gas can bring about, significant downstream gas developments are underway in many EAS countries. LNG regasification facility is one of the major areas of such development. While Northeast Asia is expected to be the largest LNG importer in the world, India plans to expand its existing LNG import capacity from 22 MT during 2014–2015 to 30 MT during 2018–2019, and to develop new capacity at Ennore, Gangavaram, and Kakinada by 2020. Southeast Asia is transforming itself into a major LNG-importing region. Singapore and Malaysia started to import LNG in 2013, and both countries plan to build second or third regasification terminals. Indonesia already has three regasification terminals and many other regasification terminal and pipeline projects are planned to fulfil domestic demand. Other countries, such as the Philippines, Viet Nam, and Myanmar, also have plans to build regasification terminals.

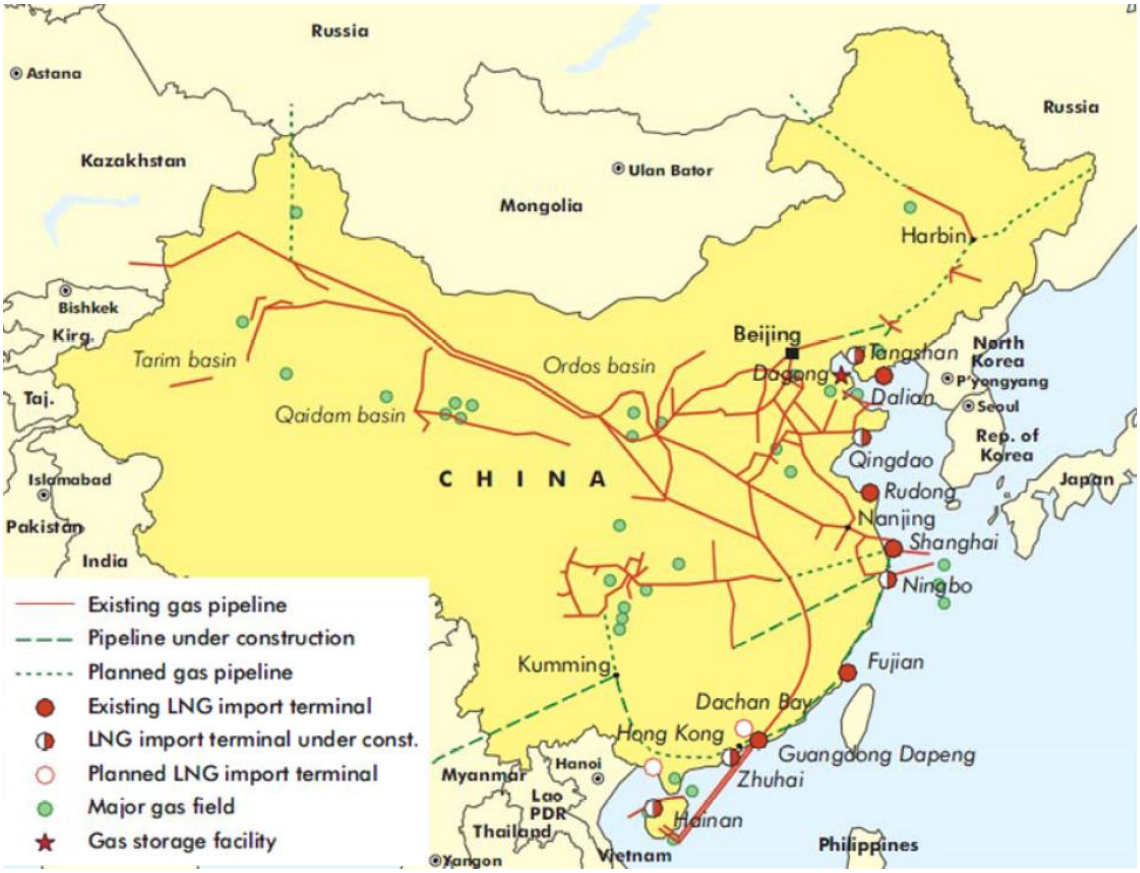
Table 3.2: Major Regasification Projects in the East Asia Summit Region

Country	Name/Location	Capacity (MT/y)	Start up	Investors	Cost estimate ($ billion)
China	Guangdong, Shenzen/Diefu	4	2015	CNOOC, Shenzhen Energy Group	1.3
	Jiangsu, Yancheng	3	2015	CNOOC	1.9
	Guangxi, Beihai	3	2015	Sinopec	2.8
	Jiangsu, Lianyungang	3	2015	Sinopec	N.A.
	Guangdong, Jieyang	2	2015	CNOOC, Guangdong-Yuedong LNG	4.8
	Guangdong, Shantou	1	2016	Sino Gas, Guodian	N.A.
	Jiangsu, Qidong	1	2016	Guanghui Energy, Shell	N.A.
	Zhejiang, Zhoushan	3	2016	ENN Energy	N.A.
	Fujian, Zhangzhou	3	2017	CNOOC	1.1
	Guangdong, Maoming	3	2017	CNOOC	18
India	Ennore	5	2017-18	IOC, TIDCO	0.5
	Gangavaram	5	2018-19	Petronet LNG	9.2
	Kakinada	5	2017-18	APGDG	N.A.
Indonesia	Arun	3	2015	Pertamina	N.A.
	Central Java, Semarang	3	2016	Pertamina	0.4
	Central Java, Cilacap	2	N.A.	Pertamina	0.2
Japan	Hachinohe	1	2015	JX	0.4
	Shinsendai	N.A.	2015	Tohoku Electric	N.A.
	Souma	N.A.	2018	JAPEX	0.5
	Toyama Shinko	N.A.	2018	Hokuriku Electric	0.9
	Hitachi	N.A.	2016	Tokyo Gas	1
South Korea	Boryeong	3	2016	SK, GS Energy	0.7
	Jeju	N.A	2017	KOGAS	0.1
Malaysia	Pengerang ,Johor	4	2018	Petronas, Dialog LNG, Johor government	0.8
Myanmar	N.A.	N.A	N.A.	N.A.	N.A.
New Zealand	New ZeaLand	1	N.A.	Contact Energy, Genesis Energy	0.4
Phillipines	Pagbilao, Quezon	1	2015	Energy World International	0.2
	Limay, Bataan	N.A.	2017	GN Power	N.A.
	Tbangao, Batangas	4	2017	Shell	1.6
	San Gabriel, Btangas	1	2019	First Gen	N.A.
Singapore	(Second terminal)	N.A.	N.A.	N.A.	N.A.
Viet Nam	Thi Vai	1	2017	PetroVietnam Gas	N.A.
	Son My ,Binh Thuan	2	2020	PetroVietnam Gas, Shell	N.A.

Note:N.A. = not applicable.
Source: Compiled by The Institute for Energy Economics, Japan (IEEJ).

Domestic pipeline is another major area of investment in downstream gas. With the huge demand growth expected in the future, China is the country that has undertaken and will implement the largest scale of pipeline investment in EAS countries. With two West–East lines as backbone, a number of pipelines—such as the Shaan-Jing line and Sichuan–Eastern line—have been built. With increasing imports from Central Asia, the Third West–East lines will be completed in 2015 and the fourth line is under planning.

Figure 3.3: Natural Gas Pipeline Network in China



Source: International Energy Agency (IEA).

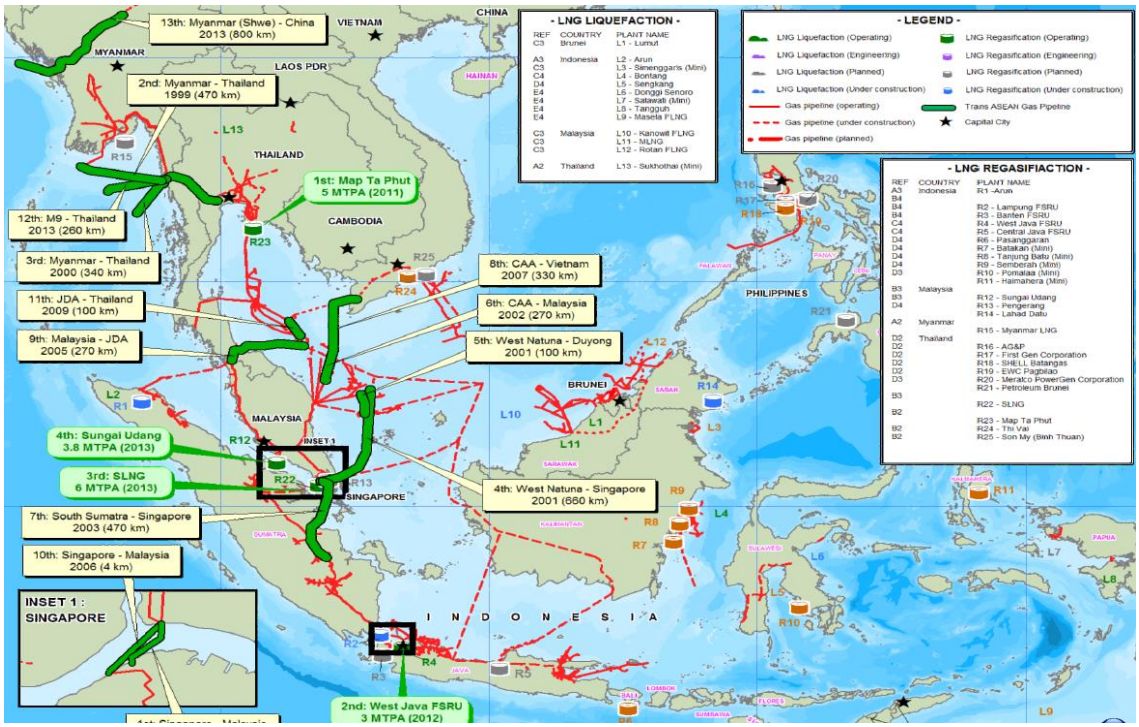
Other countries have also expanded their pipeline networks significantly. In India, the main lines so far include the HBJ (Hazira Bijaipur Jagdispur) gas pipeline, which connects Hazira and Jagdishpur and the East–West line that brings gas from the Krishna Godavari basin to Gujarat. India plans to invest $7.3 billion on gas transmission network by 2017.

Figure 3.4: Natural Gas Pipeline Network in India

Source: International Energy Agency (IEA).

The ASEAN countries have been working on the Trans-ASEAN Gas Pipeline to realise the interconnecting arrangements of natural gas in the region. According to the ASEAN Council on Petroleum (ASCOPE), 12 bilateral connections have been established with a total length of 3,279 kilometres (km). ASCOPE estimates that $7 billion will be needed to complete the TAGP (Trans ASEAN Gas Pipeline) projects with a total length of 4,500 km.

Figure 3.5: Trans-ASEAN Gas Pipeline



Source: ASEAN Council on Petroleum (ASCOPE).

CHAPTER 4

Flexibility in the International Gas Trade

International gas trade is usually characterised by large volume, long-term, and rigid contractual terms. These characteristics have been justified by high investment risks associated with upstream natural gas developments, particularly in the case of LNG. However, it is also true that importers have started to demand more flexibility in gas trade, especially in recent years. This chapter identifies the origin and rationale of trade inflexibility, at least in the past, and then argues for the possibility and advantages of flexibility for both importers/consumers and exporters/producers.

4.1. The Source of Inflexibility

It is perhaps worth examining where the inflexibility of international gas trade stems from before discussing the flexibility. It is possible or it can be argued that the source of inflexibility resulted from the following three elements.

Firstly, and the most important is the characteristics of natural gas as a commodity. Natural gas mainly consists of methane, although various other components like ethane, propane, butane, carbon dioxide, nitrogen, and others are included. Natural gas has low volumetric energy density. While crude oil has a heating value of 37 megajoule (MJ)/litre, natural gas has only 0.04 MJ/litre, and 22 MJ/litre even when liquefied. Therefore, natural gas is inferior to oil when it comes to transportation and storage efficiency. Although LNG enables the long-distance marine transport of natural gas, LNG tanks, which are installed at liquefaction and regasification facilities, as well as LNG tankers, are 4–9 times more costly than oil tankers. This is mainly because of expensive aluminium alloy and nickel stainless that are used in LNG tanks to keep them at extremely low temperature.

Secondly, the high cost of natural gas transport and storage results in the capital-intensive nature of natural gas developments. In the previous chapter, it was mentioned that an LNG project would often cost billions of dollars. This capital-intensive characteristic leads to considerable investment risk.

Thirdly, while the two characteristics of natural gas—its being a commodity and being capital intensive when it comes to natural gas development—require very rigid sales

arrangements, these same features also inhibit the liquidity of international gas trade. Certainly, these features also apply in the EAS region. For instance, until recently, there was very little spot LNG trade in Asia. The rigidness of LNG trade will be explored further in the next section.

4.2. Inflexibility of International Gas Trade

4.2.1. Quasi-vertical Integration

Vertical integration is a concept that is contrary to a market that features an arm's length transaction by a number of players. While pure vertical integration would involve only a single player, international gas trade features a small number of players with tight trading arrangements underpinned by a long-term contract—quasi-vertical integration, in other words. This is in turn the reflection or legacy of the lack of market function in international gas trade. Without any trade flow, or market—as was the case in the EAS region until mid-1960s—quasi integration was probably the only way to control the investment risk and realise trade flow itself. In such arrangements, natural gas flows only in a particular value chain, which results in higher market concentration, higher barrier for entry, and information asymmetry between those involved inside the value chain and those not involved.

Quasi-vertical integration has been traditionally adopted for gas exports for Europe and Asia, and the extent and forms of which is diversified mainly because of market liberalisation in importing countries, infrastructure developments, and emergence of market liquidity in international gas trade.

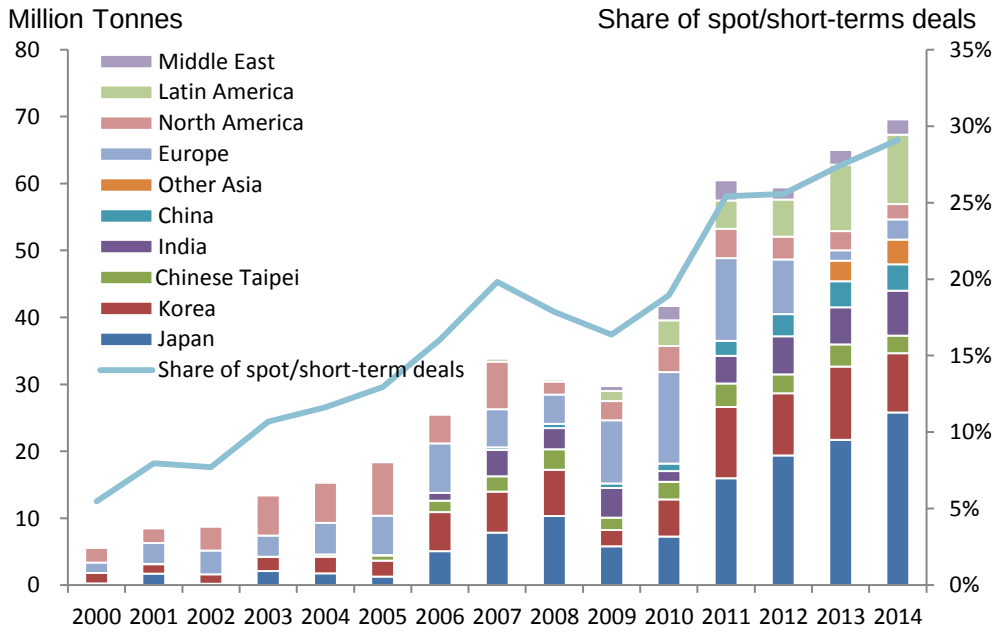
In Europe, for instance, energy market liberalisation, particularly the unbundling of vertically integrated electricity and gas utilities, changed the gas import arrangements. Separation of transport and commercial activities—or vertical disintegration—is one of the requirements to create a wholesale gas market (or a gas hub) that features arm's length transactions. Indeed, since the break-up of the former vertical integration entities, gas hubs started to emerge in the region. These hubs primarily form a domestic gas prices, but import gas prices are increasingly linked to those hub prices. Meanwhile in Asia, Japan and Singapore are the only gas-importing countries that have liberalised their domestic energy markets to date. Nevertheless, the liberalisation has already affected Japanese gas

importers in terms of reluctance of signing long-term contracts for fear of experiencing demand loss in their own market.

As far as infrastructure is concerned, adequate infrastructure capacity has been developed for the existing value chain, such as traditional LNG projects in Southeast Asia for the demand in Northeast Asia. However, this is not the case with other importing countries in the EAS region, such as China, India, and Southeast Asian countries. A number of EAS countries need to invest on greenfield projects in terms of exploration, production, liquefaction, pipeline, storage, regasification, and distribution. Thus, there is no generalisation in terms of market development in the EAS region, and traditional vertical integration business model could still be valid.

Despite the characteristics of natural gas as a commodity and the capital intensiveness of a gas development project, there emerges liquidity in international gas trade in the EAS region. In the years before 2000, most LNG cargoes were traded under long-term contracts. However, the share of spot and short-term deals has expanded significantly from 5 percent in 2000 to 29 percent in 2014. The share of pure spot trade on cargo-by-cargo basis could be around 8 percent of the total LNG trade in 2014. Several LNG traders without any liquefaction or regasification assets that specialised on spot/short-term deals entered the market. Therefore, it can be said that liquidity in LNG trade has increased steadily in recent years, and vertical control over the value chain has been weakened accordingly although long-term contract is still a valid instrument for large-scale, greenfield, new projects.

Figure 4.1: Spot/Short-Term Deals in Liquefied Natural Gas Trade



Note: Short-term is defined as a contract that has a duration of four years or less.
Source: GIIGNL (International Group of Liquefied Natural Gas Importers).

4.2.2. Contractual Terms

Traditional natural gas supply contracts for Western Europe and Asia feature certain terms to reduce upstream investment risks and secure operation in a quasi- vertically integrated manner.

First, products are typically sold under long-term contracts that often span more than 20 years. This is still largely the same with new projects, either LNG or pipeline gas. Nevertheless, there have been significant changes in terms of contractual parties. Traditionally, sellers are (inter)national oil companies, and buyers are power and/or gas utilities. However, since 2000s, it is often the case that international oil companies take the LNG and market it to the highest-valued destination at any given time. A series of Qatar's mega train projects (Qatargas 2, 3, 4, RasGas 3) are the typical examples. International oil companies like ExxonMobil, Shell, Total, and ConocoPhillips are responsible for marketing the products. Another new contractual arrangement is found in LNG projects in the United States (US). Unlike traditional projects where sellers own and operate liquefaction plants, most operators of liquefaction plants there will not own the commodity but only sell their liquefaction and loading services to sellers or buyers.

Second, term contracts of international gas supply usually include the so called 'take-or-pay' clause where a buyer is required to pay for the cargoes even if it cannot take

them for whatever reasons, although 5–10 percent upward or downward quantity allowance is typically embedded in the contract.

In most international gas contracts for Asia, products are only shipped to specific geographical point(s) or country under the 'destination clause'. This clause was originally intended to enhance the security of supply for buyers and of demand for sellers. With the destination clause, even in the case of a free on board (FOB) contract, a buyer is not allowed to resell a cargo to another buyer without a seller's consent.

4.2.3. Price Formation

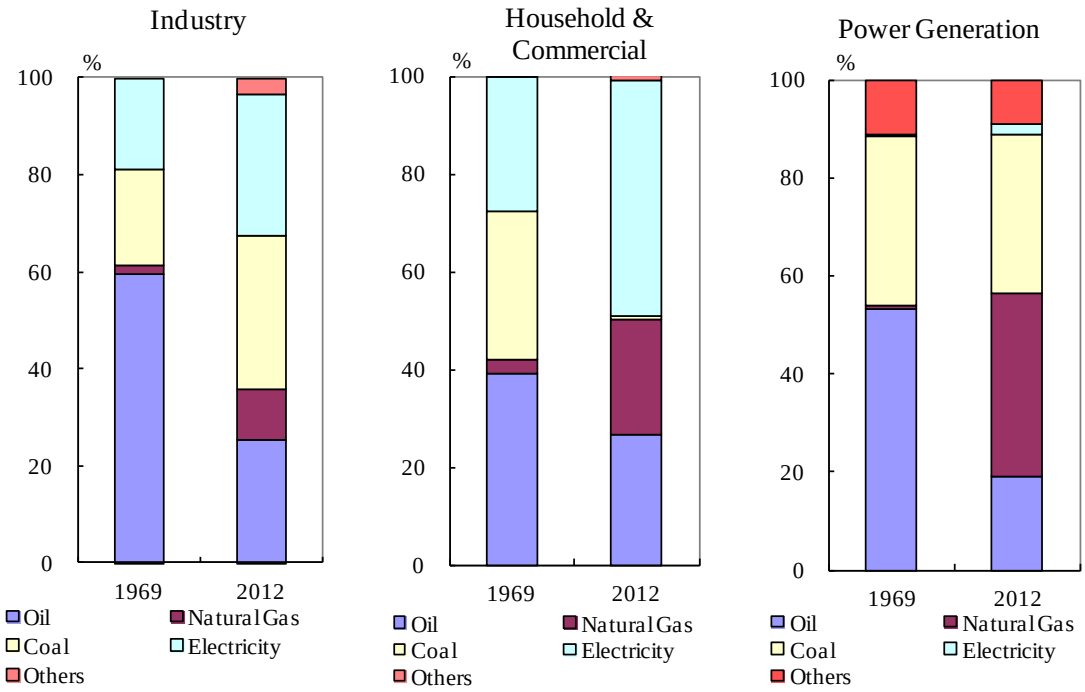
Perhaps the most controversial element in traditional gas supply contract for Asia is how price is determined. It is well known that natural gas has traditionally been priced in relation to crude oil price—typically Japan's average crude import price or Japan's customs-cleared crude (JCC) in the EAS region. Oil indexation is not only an issue for price formation but also for flexibility because, due to the structure of price formula, oil indexation prices cannot always follow flexibly market fundamentals.

Oil indexation originates from Europe where the majority of imported gas was priced by formula so that natural gas can compete with alternative fuel (mainly fuel oil and gas oil) in the market of importing countries. Although gas-on-gas pricing has been increasing rapidly in Europe, oil indexation is the dominant price formation in international gas trade in the EAS region.

In recent years, many importers and observers started to question the rationality of oil indexation as a price formation process in gas supply contracts for Europe and Asia. For instance, Stern (2007) argues that oil indexation in Europe is not reasonable because natural gas has already replaced oil products to a significant extent and, thus, there is no competition between natural gas and oil.[1] The same can be said in Asia. Data in Figure 4-2 represent the energy mix changes in major LNG-importing countries in Asia, comparing the year when those countries first imported LNG in 2012.

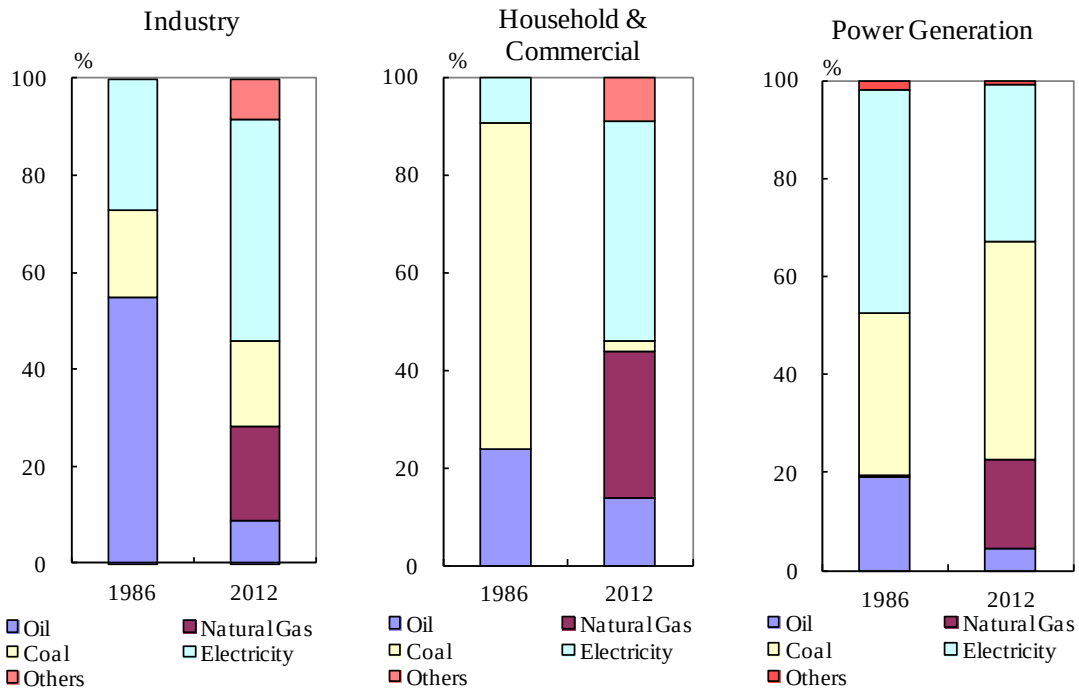
[1] Jonathan Stern (2007), 'Is There A Rationale for the Continuing Link to Oil Product Prices in Continental European Long-Term Gas Contracts?' Oxford Institute for Energy Studies. http://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG19-IsThereARationaleFortheContinuingLinkToOilProductPricesinContinentalEuropeanLongTermGasContracts-JonathanStern-2007.pdf

Figure 4.2: Energy Mix by Demand Sector in Japan (%)



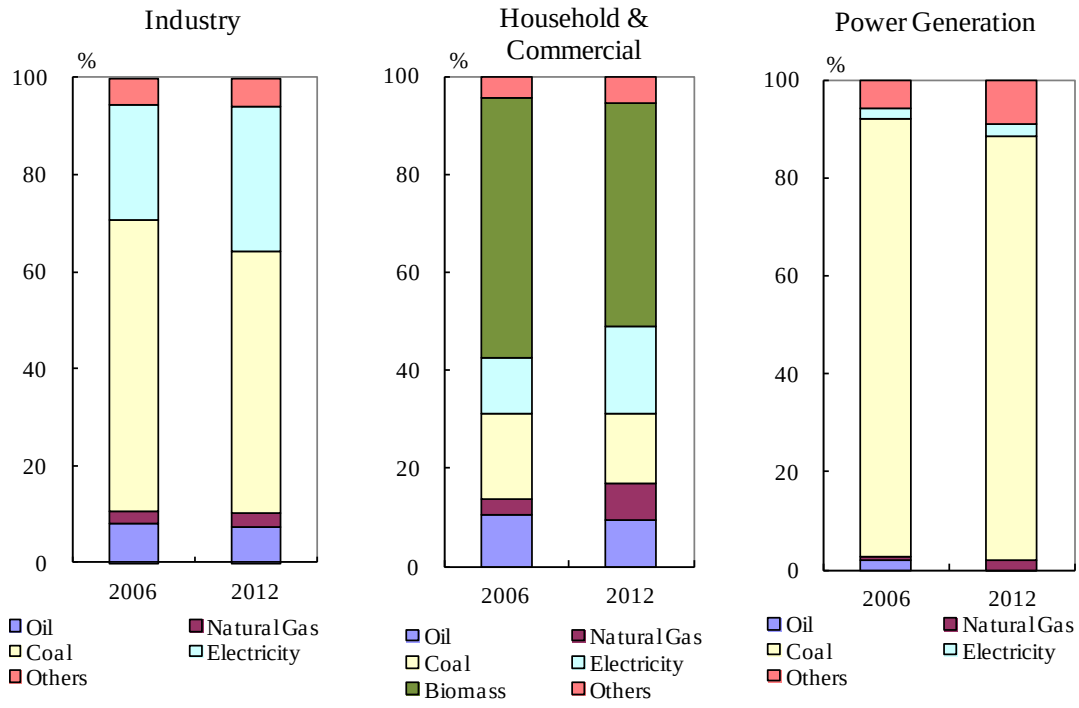
Source: International Energy Agency (IEA).

Figure 4.3: Energy Mix by Demand Sector in South Korea (%)



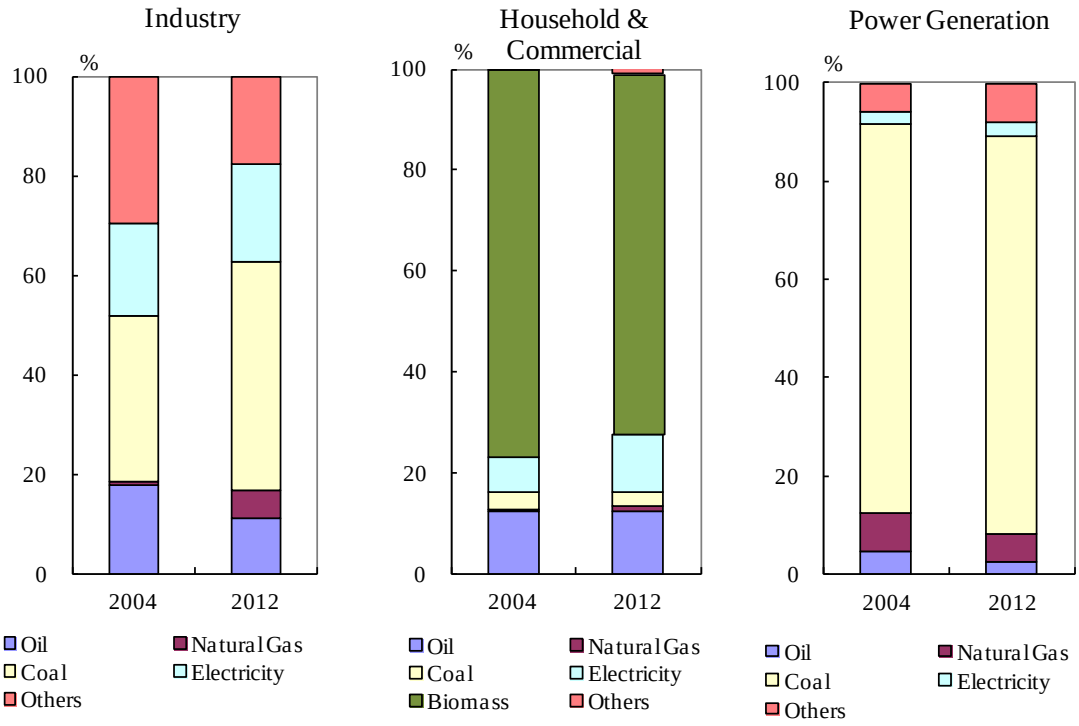
Source: International Energy Agency (IEA).

Figure 4.4: Energy Mix by Demand Sector in China (%)



Source: International Energy Agency (IEA).

Figure 4.5: Energy Mix by Demand Sector in India (%)



Source: International Energy Agency (IEA).

Among traditional LNG importers like Japan and South Korea, the share of oil has decreased over the years, and is assumed that natural gas has replaced oil to a certain extent. For China and India, the dominant fuel is coal for power generation and industry sectors, and biomass for household and commercial sectors. Therefore, competition between oil and natural gas has either significantly ended, especially for power generation in Japan and South Korea, or such competition did not exist much in China and India. In other words, one can argue that oil indexation, much like natural gas pricing for Asian importers, is irrational.

4.3. Flexibility of International Gas Trade in the EAS Region

4.3.1. Division of Roles: Flexibility and Inflexibility

The previous section explained where the inflexibility came from and what actual inflexibility is in terms of contractual terms, including price formation. With more players entering the international gas trade—especially LNG, in and for the EAS region—it is increasingly obvious that demand/supply adjustment and price formation are inevitably left to market mechanisms because no single player, or even limited number of players, can operate each supply chain in a vertically integrated manner.

Nevertheless, this is not to deny the role of traditional, inflexible vertically integrated operation, especially pipeline gas projects for the developing countries in Asia, considering the inadequacy of infrastructure and the need and scale of investment required throughout the value chain for the EAS region. A large-scale, remote, and greenfield project, such as the Russia–China pipeline, naturally necessitates investment and operation in an inflexible vertically integrated manner simply because there is no market at all.

Hence, it is important to differentiate when and where flexibility should be pursued, then let the market forces play a greater role when and where appropriate—like the LNG trade in the EAS region. Indeed, with over 40 years of history, the LNG market has expanded in terms of quantity, geographical area, and the number of players. Increasing flexibility in the market will not only contribute to efficiency but also to security of supply and demand as long as the right price is signalled. When a market is tight and if the price duly reflects the tightness, the market adjusts itself by a demand decrease and/or supply increase, at least theoretically. When a market is weak and if the price is rightly signalled, the increase

in reserve is supposed to happen. It is arguable that this simple but powerful market force should play a greater role in the LNG trade for the EAS region.

4.3.2. Destination Clause

The destination clause is the most important contractual inflexibility in the international gas trade when considering the EAS region. It does not allow free gas flow, inhibits market liquidity from increasing, and prevents a more rational LNG pricing in the region.

It is well known that the destination clause was illegal in the European Union (EU). The legal point is that a destination clause violates Articles 101 and 102 in the Treaty on the Functioning of the European Union, in terms of free flow of natural gas. Although the negotiation between the EU and exporting companies like the Gazprom of Russia and Sonatrach of Algeria lasted for years, it is understood that the destination clause in most gas supply contracts was removed for Western Europe. Together with domestic gas market liberalisation in the EU countries, it can be said that removing the destination clause contributed to a more liquid gas market in Europe.

The same procedure cannot be applied to the Asian countries mainly because of the absence of super national organisation like the EU. Nevertheless, whilst LNG buyers pursue flexibility to accommodate their demand fluctuations, sellers also need flexibility to optimise their supply portfolio. As a result, so-called portfolio contracts that offer flexible supply sources and weaker destination restriction are increasingly common in recent years. Additionally, it is possible for importing countries to jointly negotiate the rationality of the destination clause so that the LNG market can be more transparent and liquid, and that both exporters and importers can benefit from such transparency and liquidity.

4.3.3. Price Formation

Although oil indexation is problematic in terms of rationality, it should be noted that there are a lot of oil indexation contracts that often span over 20 years. New remote greenfield projects, such as the TAPI pipeline, are likely to adopt traditional oil-indexation pricing, and there is nothing wrong with that. Many buyers are surely inclined towards oil indexation with the recent low oil prices. Hence, it is not realistic to consider that oil indexation will disappear any time soon.

Nevertheless, the dominance of oil indexation does not mean that rational pricing should not be pursued. On the contrary, many Asian LNG buyers are seeking alternative pricing in recent years. Table 4-1 represents pricing options and their advantages and disadvantages. These pricings can largely be categorised into gas-on-gas competition and indexation. The former includes domestic and foreign hubs, or wholesale prices, and spot LNG that is international price. The latter includes oil indexation, as well as indexation with electricity and coal, especially natural gas, which is considered for power generation.

Table 4.1: Pricing Options of Internationally Traded Natural Gas for the EAS Region

	Gas on gas competition pricing			Indexation	
	Domestic Hubs in Asia	Henry Hub, NBP	Spot LNG	Oil	Other fuels (Electricity, Coal)
Advantages	• Possible to reflect regional market balance	• Already available • Lower prices (for now)	• Already available	• Possibly the quickest solution	• Rational for power generation
Disadvantages	• Not yet available • Higher volatility	• Higher volatility • Asia market balance not reflected	• Higher volatility • Limited liquidity (so far)	•Gas market balance not reflected	• Lack of power market liquidity

Hybrids

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

With all the advantages and disadvantages, it is clear that the price of internationally traded natural gas for the EAS region should reflect market fundamentals in an accurate and timely manner. In this sense, domestic hubs in Asia and (Asia) spot LNG pricings are the most rationale. However, domestic hubs require substantial domestic gas market liberalisation, especially unbundling of transmission lines and strict Third Party Access regime, which many developed importing countries in the EAS region are not ready. Rather, spot LNG pricing seems to satisfy both in terms of rationality and feasibility, especially since spot trade has expanded substantially. This comes back to the issue on the destination clause. It is important to at least relax, and if possible abolish the destination clause, also for the sake of rational LNG pricing in the EAS region.

CHAPTER 5

Policy Recommendations

This study reconfirmed the supply–demand outlook of natural gas with the EAS region as a starting point because this will be the base for discussing the necessity of investments and the whole market concept later.

According to the analyses, China and India have been leading the increase in natural gas demand and their ratios in regional natural gas demand are expected to be 48 percent and 13 percent, respectively, as of 2015. On the supply side, in response to these increases, the production volume is expected to steadily increase in China, Australia, Indonesia, Malaysia, and others, but seemingly cannot catch up with the increasing rate of demand. As a result, it is very likely that dependence on import will increase across the regions, resulting in a higher import volume from outside the regions through pipelines, and in the form of liquid natural gas (LNG).

5.1. Recommendation 1: Towards realising higher investments

What matters here is investment for realising the required future supply. The targets include not only the development of natural gas resources, but also the development of transport facilities. According to the International Energy Agency (IEA), the required investment for natural gas-related infrastructure adds up to $2.08 trillion for all of Asia. Of that amount, the upstream investment is $1.42 trillion and the downstream is $658 billion. What will be required for realising these enormous investments? The following points out four items:

(i) Abolition of investment barriers
(ii) Rationalisation of gas prices
(iii) Financial support by the national government and other organisations
(iv) Provision of investment signals

A) *Abolition of investment barriers*

It is ideal that the required investments are made by private corporations, based on the economic rationality of a project. From this viewpoint, what is required first is to prepare an environment allowing investments by the private sector.

Private corporations also include foreign capital. This does not deny the idea of regulating the participation of foreign capital to protect and support domestic industries, or for national security. If those investments are essential to the development and supply of natural gas, which cannot be fully provided by their own domestic corporations, it becomes practical to consider the utilisation of foreign capital.

B) *Rationalisation of the gas price*

In promoting investments from the private sector, the rationalisation of the gas price becomes important. In other words, the gas price has to be adjusted to the level that reflects the supply cost and allows adequate profit. If the gas price is lower than the supply cost, the business becomes economically inefficient and private corporations would not invest. Or, even if investments were made, the business piles up deficit every year, failing to be sustainable.

The energy price level may reflect not only the cost, but also the viewpoints of social security and industrial competitiveness. In such cases, it would be difficult to immediately raise the gas price to the level of the supply cost plus adequate profit. This is, however, an essential element in securing investments and must be reviewed in a step-by-step manner.

C) *Financial support by the national government and other organisations*

There could be several motivations for financial support from the public sector. First, even if an investment plan does not have economic rationality by itself, it can sometimes generate positive externality in the form of social and economic returns, such as activation of peripheral industries and creation of employment. Second, there may cases where it would be difficult to recoup investments within a given period, but sufficient profits may be possible by allowing for a longer period of operation or ownership. Third, in case the investment plan itself is very attractive, but risks may exceed the allowable limits of private corporations, the national government and other organisations can partly share the risks in such investments. For example, share holdings or partial financing by the government

and national-level organisations for the investment plan could be considered. Many countries already have such systems and are expected to continue supporting/sharing in the investment risks of the private sector.

D) *Provision of investment signals*

To attract investment from private corporations, it is important to provide investment signals. There are two types of investment signals—'price' and 'prospect and planning'.

The price functions as an investment signal. In case the natural gas price rises sharply at a certain place due to a tight supply–demand balance, this price rise indicates that there is high demand for natural gas at that place, or there is a need to enhance the natural gas supply infrastructure. Investments are then made if no corporations are taking this as a profitable opportunity. As an investment signal, the 'price' features immediacy—reflecting current market condition. Looking at this alone, the price may seem inadequate as a signal for natural gas-related investments, which generally require a long investment-recouping period. But that is not true. For instance, the crude oil price maintained a historically high value for over three years since 2011. In such a case, the price fully functions as an investment signal. Also, if a futures market is developed, this can be used as a reference for foreseeing a future supply–demand balance. To make these price signals work, the role of governments are described later.

Since natural gas-related investments take a long time before investments are recouped, prospect and planning based on estimation are also significant investment signals. If the government has prepared a future supply–demand prospect, the investment needs can be presented widely or disseminated by the government to the public. To attract investments from the private sector, the government would need to provide a mixture of these long-term prospects and planning, with short-term price investment signals.

5.2. Recommendation 2: Towards sustainably developing the natural gas market

Problems are still waiting to be resolved for the sustainable development of the Asian natural gas market. That is, flexibility and rationalisation of pricing in international natural gas trade (import and export) still require improvements. Trade flexibility is required because it leads to the expansion of profitable opportunities for exporting countries, in

addition to the need for a more flexible balancing tool of gas supply–demand on the part of the importing countries. Therefore, the rationalisation of pricing is an indispensable element in the functioning and in enhancing the efficiency of the market.

What will be required for realising these two elements—more flexible balancing tool and more rational pricing? The following points out three items:

(i) Full understanding of the possible benefits brought about by the expansion of flexibility and rationalisation of pricing.
(ii) Formation of intra-regional agreements on natural gas and LNG trade.
(iii) Market monitoring based on the above agreements.

These three policy proposals may give a roundabout impression as a means to achieve the purpose of improving flexibility and rationalising the pricing. This is because the trade (import and export) entities of natural gas and LNG are corporations, not countries, and also because it is generally difficult and undesirable for the government to directly get involved in various trade requirements, including flexibility and formation of pricing, since they are based on mutual agreement between relevant business corporations. Accordingly, possible policies have no choice but to be indirect.

A) *Full understanding of the possible benefits brought about by the expansion of flexibility and rationalisation of pricing*

To promote flexibility and price-related change, it is necessary to begin with a full understanding of the resultant profits by the exporting and importing countries. Exporting countries are requested to deepen their understanding of the environmental impacts of the transactions on the importing countries, and vice versa—to know where the mutual needs are and what benefits will be mutually shared.

In this sense, continuing efforts are necessary, which include the exchange of opinions to discuss flexibility and pricing with relevant domestic corporations, bilateral consultations with a trade partner country, or multilateral consultations. Self-righteous claims may sound good to domestic corporations and to the people, but this would be inadvisable and ineffective in promoting a reform where the understanding and involvement of other countries are indispensable. The issue of flexibility and pricing of

natural gas and LNG trade would, in this context, require actions based on mutual understanding.

B) *Formation of intra-regional agreement on natural gas and LNG trade*

Once changes in the market environment were fully understood and shared among relevant governments, the next possible step is to form an agreement amongst the governments on intraregional natural gas and LNG import and export trade. The agreement shall include matters associated with flexibility and pricing.

There are several possible forms of agreement. The most stringent form would be to stipulate common trade rules. On the other hand, a possible loose form is to sign a statement describing the principles associated with trade.

In any form, if the governments in the region succeed in concluding a document that describes the intentions of an Asian gas/LNG market design, it is expected that the intention will be gradually reflected in the import and export contracts in the future. By documenting the common recognition and understanding among the governments, it is possible to obtain grounds for the government to influence the market to a certain extent.

C) *Market monitoring based on agreement*

Finally, the government is expected to monitor whether the market and business corporations function and behave based on the agreements stipulated in item B). The degree of governmental interference with the market as a result of monitoring differs, depending on the form of agreement. If the agreement can be organised in the form of common rules, the government can issue an order accompanied by a penalty. In case of an agreement that describes principles on the contrary, the government is only allowed to give unbinding advice or recommendation.

5.3. Conclusion

Natural gas is expected to play a more important role in energy supply in the EAS region from now on. However, to gain maximum benefit from natural gas use, with its well-balanced feature of supply stability, economic efficiency, and environmental friendliness, some issues will need to be resolved. Specific issues include investments to secure the natural gas supply, flexibility, and pricing mechanisms in international trade. Unless these

issues are resolved, it may not be possible to fully utilise the advantages of natural gas. This will be a loss to the EAS region, which includes natural gas-producing countries such as Australia, Brunei Darussalam, China, Indonesia, Malaysia, Myanmar, Thailand, and Viet Nam. Hence, to fully benefit from the merits of natural gas, it is imperative that related infrastructure and the market be improved for their effective use. An increasing use of rationally priced natural gas may eventually contribute to the development of exporting countries, where they can gain more export revenue; and of importing countries, where they can enjoy a more balanced energy supply mix.