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**Gas Market Integration:
Global Trends and Implications for the EAS Region[#]**

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Abstract: East Asia is already the main destination of the world's commercial liquefied natural gas (LNG). However, the gas markets in the EAS area are either underdeveloped or fragmented. The objectives of this study are twofold, namely, i) to present a review of the trends in global gas market integration and ii) to draw implications and make recommendations for gas market development in the EAS area. To achieve the goal of an integrated gas market in the EAS region, governments in member economies must work together to implement a plan. Specifically, four recommendations are made to the EAS states: adopt a formal program to promote and nurture the development of gas markets in member states and phased sectoral reforms in relatively mature markets; set targets to gradually harmonise regulatory and technical standards in the gas sector; coordinate better to promote their "gas" causes; and boost cross-border connectivity and trading within the area and eventually achieve regional gas market integration.

Keywords: Gas market integration, Energy market, EAS region.

JEL Classification: Q40, Q48

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1. Introduction

Natural gas as a source of cleaner fuels is important in many economies and will increasingly be so important globally. However, many gas markets in the world are either under-developed or fragmented. As trade in gas led by LNG trade increases, market integration as occurred in other sectors has been promoted in various regions of the world. The objective of this document is to review trends in the world's major gas markets, examine the status of market integration and draw policy implications for gas market integration in the East Asia Summit (EAS) area. The rest of the paper begins with a brief review of global gas markets, in particular gas consumption and trade in the EAS area. This is followed by an examination of gas market integration in the United States (US) and European Union (EU) which are the world's two largest gas consumers. Subsequently gas market development in individual EAS member economies is explored. Finally implications and recommendations for gas market integration in the EAS area are discussed.

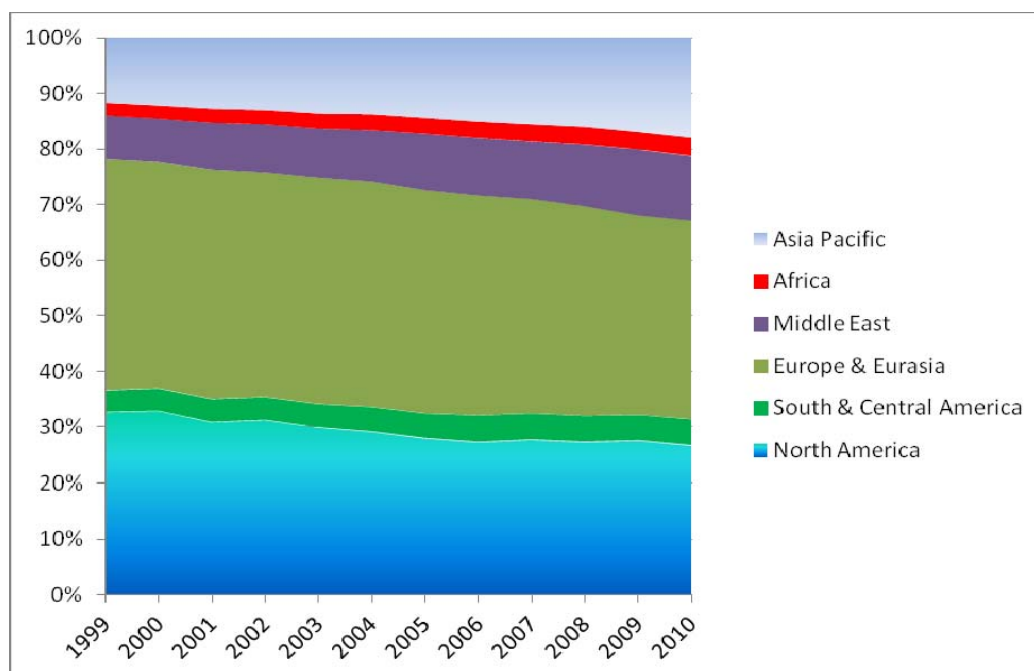
2. Global Gas Markets

The latest statistics show that in 2010 global gas production of 3193 billion cubic metres (bcm) and consumption of 3169 bcm were almost balanced with a small surplus. Europe and North America account for the lion's share of total consumption though the shares of the Asia Pacific and Middle East regions are increasing over time (Figure 1). Among the regions, Europe, North America and the Asia Pacific are the net importing regions. In 2010, about 30.8% (975 bcm) of the total volume of natural gas consumed were traded through either pipelines (21.4%) or LNG trade (9.4%).¹ As gas resource distribution is geographically unbalanced, the top five traders accounted for about a half of the market share. Specifically, the top five exporters (Russia, Norway, Qatar, Canada and Algeria) provided more than a half of the traded gas. The top importers were in

¹ LNG is often measured in terms of millions of tons (MTs). 1 MT of LNG is equivalent to 1.38 bcm of natural gas (EIA, 2003).

turn the US, Japan, Germany, Italy and the UK which also purchased about 50% of the gas traded internationally (Table 1).

Figure 1. World Gas Consumption by Region, 2010



Note: Data are drawn from BP (2011a).

Table 1. Major Gas Traders, 2010

World top importers		World top exporters	
Countries	Volume (bcm)	Countries	Volume (bcm)
US	105.5	Russia	199.9
Japan	93.5	Norway	100.6
Germany	92.8	Qatar	94.9
Italy	75.3	Canada	92.4
UK	53.6	Algeria	55.8

EAS importers		EAS exporters	
Countries	Volume (bcm)	Countries	Volume (bcm)
South Korea	44.4	Indonesia	41.2
China	16.4	Malaysia	32.0
India	12.2	Australia	25.4
Thailand	8.8	Brunei	8.8
Singapore	8.4	Myanmar	8.8

Note: Data are drawn from BP (2011a).

As both the US and Germany also exported natural gas, Japan was effectively the world's largest net gas importer in 2010.² Apart from Japan, other important gas importers in the EAS area include South Korea, China and India.³ In 2010, the largest gas exporters in the EAS area were Indonesia, Malaysia and Australia (Table 1). In absolute terms, EAS importers and exporters (with the exception of Japan) are not yet compatible with the top players in the world. But this situation may change in the coming decades. China's and India's gas imports will continue to grow and become key buyers in the global markets. Australia has the potential to become one of the world's largest gas exporters.

In the past decade (2001-2010), global demand for natural gas has increased steadily with an average rate of growth of 2.8% per annum (BP, 2011a). The share of natural gas in primary energy consumption was about 24% in 2010.⁴ By 2030 world primary energy consumption is projected to increase by 39% with an annual rate of growth of 1.7% (BP, 2011b). More than half (57%) of the projected growth in energy consumption will originate from power generation. The shares of gas and non-fossil fuels are expected to gain at the expense of coal and oil. Among the fossil fuels, natural gas consumption is projected to grow fastest, with an annual rate of 2.1% (Table 2). This growth rate projection is slightly higher than the average annual rate of 1.8% during 2008-2035 forecasted by IEA (2011). Non-OECD economies would contribute 80% of the increase in gas consumption (BP, 2011b). By 2030 natural gas, oil and coal could converge to market shares of approximately 26% each in primary energy consumption, with the remaining 22% being equally divided among the major non-fossil fuels, namely, nuclear, hydro and renewables (BP, 2011b). Similar projections are also reported by IEA (2011) in which the predicted shares of coal, oil and natural gas in primary energy consumption are 22%, 27% and 25%, respectively. The driving forces for the growth in natural gas consumption are the increased use for electricity generation (with a growth rate of 2.6% per annum) and industrial activities (2.0% per annum) (Table 2). Part of this consumption growth would be met by

² In 2010 gas exports from the US and Germany were 32 bcm and 15 bcm, respectively (BP, 2011a).

³ It is noted that Taiwan's gas imports in 2010 amounted to 14.9 bcm and was hence effectively the fourth largest importers in East Asia (BP, 2011a).

⁴ This figure is estimated using information from BP (2011b).

increased LNG supply, which is projected to expand at the rate of 4.4% per annum during 2010-2030. If this growth target is reached, the LNG share in global gas supply would increase from 9% in 2010 to 15% in 2030 (BP, 2011b).

Table 2. Projected Average Growth Rates (%)

Categories	BP	IEA
	2010-2030	2008-2035
Primary energy consumption	1.7	1.2
Hydro	2.0	2.1
Renewables	8.2	2.6
Nuclear	2.9	1.9
Coal	1.2	0.4
Oil	0.9	0.4
Gas	2.1	1.8
OECD	1.0	0.9
Non-OECD	3.0	2.6
Non-OECD Asia	4.6	4.9
China	7.6	7.7
India	4.7	6.5
Power	2.6	1.9
Industrial use	2.0	
LNG	4.4	
OECD	5.2	
Non-OECD	8.2	

Note: Data are drawn from BP (2011b) and IEA (2011).

The largest increase in gas consumption would be from the EAS region. Demand is expected to grow at the annual rate of 4.6% during 2010-2030 in Asia excluding Japan (BP, 2011b). Growth in gas consumption would be particularly fast in the two emerging giants, namely China (7.6% per annum) and India (4.7% per annum). Natural gas consumption would amount to 9% of China's primary energy consumption in 2030. In 2010, 4% of Chinese energy consumption was natural gas. Growth would also be strong in ASEAN. This is confirmed by IEEJ (2009) which predicts that ASEAN as a group would enjoy a rate of annual growth of 4.5% during 2010-2020 and 5.5% during 2020-2030.

The growth in demand for LNG is projected to be around 8.2% per annum in Asia excluding Japan. More than 74% of the increased LNG demand would be from China

and India (BP, 2011b). Australia is expected to overtake Qatar to become the world's largest LNG exporter around 2020. In the aftermath of the Fukushima nuclear power plant accident in Japan, many countries' policy makers will revisit their nuclear energy programs. This could lead to even more consumption of natural gas in electricity generation in the coming decades.

3. Market Integration Initiatives

For decades, gas markets or pipeline gas markets mainly exist locally or regionally. Trade in gas has been limited due to geographic distance. As the oil price increases and the world's environmental condition deteriorates, natural gas as a cleaner energy becomes more affordable and increasingly a tradable good. Market integration, both sub-regionally and globally, then emerges as a goal to be pursued in many parts of the world. The economic rationale for market integration is well documented in the literature (Williamson, 1996 and Majone, 1996). Specifically, there are several factors which are driving gas market integration in the world. The first factor is the increasing demand for gas consumption due to rising world energy prices and hence increasing affordability to consumers. As a result, numerous local or national gas markets have emerged in the world. In the midst of global economic integration, policy makers in the world economies are keen to promote the link and integration between various gas markets as it has occurred in other economic areas such as the manufacturing sectors and telecommunications. Second, the expansion of LNG trade has made it possible for the emergence of a global gas market where gas can be sold at spot prices or with long term contracts. In 2010, LNG accounted for 30.5% of total gas traded (BP, 2011a). Third, market integration is promoted as a measure to provide the security of gas supply and hence the stability of gas prices.

Various initiatives towards gas market integration have been proposed or implemented so far. In particular the two major gas-consuming regions, namely, the United States (US) and European Union (EU), are leading the world in the promotion of market liberalization and integration. In the United States, gas market regulation began

in 1938 when the Natural Gas Act was enacted to guide interstate gas transmission and sales. However, it was in 1978 when the Natural Gas Policy Act was promulgated that gas market liberalization began. The implementation of the Natural Gas Policy Act helped create a single national natural gas market, equalize supply with demand and let market forces establish the wellhead price of natural gas. In 1985, the Federal Energy Regulatory Commission (FERC) issued Order No. 436 which changed how interstate pipelines were regulated and provided pipeline customers more flexibility in purchasing natural gas and making transportation arrangements. The era of open access began (and hence Order No. 436 is also called the Open Access Order). Later, under FERC Order No. 636 (1992), interstate pipeline services were further restructured. Under FERC Order No. 436, pipeline unbundling was voluntary. Order No. 636 made unbundling mandatory. That is, interstate pipelines are required to 'unbundle' their services; essentially separating the sales of natural gas from its transportation.

Due to production deregulation and open access to the interstate gas pipelines, active spot markets for wholesale natural gas throughout the pipeline network emerged rapidly. Through these markets, a large number of gas consumers buy gas directly from a large number of gas sellers on a short-term basis. The spot market share over total gas consumption in the US increased dramatically from 5% in 1983 to 70% in 1987 (Sutherland, 1993). Cuddington and Wang (2006) provide empirical evidence of market integration in the East and Central regions during the 1990s. These authors also argue that limited physical connectivity between the West and other regions made it impossible to create a single national market at that time. To deepen the reforms, the open access order was strengthened by the circulation of two more documents, Order No. 637 and Order No. 639 in 2000. After almost three decades of deregulation, gas market in the US is now the world's largest and most integrated single market. This is confirmed by empirical findings (Siliverstovs *et al.*, 2005 and Mohammadi, 2011).

The history of gas market liberalization and integration within the European Union (EU) is much shorter than that in the US. As part of the EU economic integration drives, gas market liberalization and integration programs were initiated in the late 1990s. The implementation process began with the introduction of the European Gas Directive in 1998, which was further strengthened by the release of the EU Acceleration Directive in 2003 (EC, 1998 and 2003). These initiatives have brought fundamental

changes in the natural gas sector across many European countries. As such, the natural gas industries have transformed from vertically integrated monopolies to more competitive structures (Haase, 2008; Harmsen and Jepma, 2011). However, among EU members, the progress of liberalization is very different. For example, gas market liberalization in the UK started much earlier than in other EU members, and has become the best practice model in the EU. In 1986 the British government privatized the then publicly-owned, vertically integrated gas transporter and supplier in the UK, namely British Gas. At the same time the gas sector was deregulated to allow for competition in the wholesale and contract markets for large consumers while retailing and pipelines were still monopolized. Competition was eventually introduced into the retailing sector (residential and small consumers). Further deregulation led to the break-up of British Gas into several separated entities in the 1990s. Though limited, the initial reform was very successful. According to Juris (1998), during 1986-1995 residential and industrial gas prices fell by 24% and 47% in real terms, respectively, and gas consumption increased by 38% in the UK. Through several reviews and subsequent regulatory interventions and adjustments, deregulation in the UK gas sector has created one of the most liberalized markets in the world. There is now genuine competition at all levels of the gas supply chain in the UK although many more amendments to the Gas Code can be anticipated in the future (Heather, 2010). Natural gas has recently overtaken oil to become the largest source of primary energy in the UK with a share of 39.16% in 2009 in comparison with those of oil (37.41%) and coal (14.93%) according to Heather (2010).

However, gas market deregulation was initiated much later in continental Europe than in the UK. Only in the last decade has market liberalization and regional integration been accelerated in some economies.⁵ The reform progress in others is slow, but is catching up quickly, for example in Germany, Luxemburg and Sweden. Haase (2008) introduced a scoring method to rank the EU states in terms of gas industry regulatory function and competencies. The former covers issues such as market opening, network access conditions and unbundling. The latter refers to competencies, capacities and degree of autonomy of the regulators. The combined score gives a

⁵ These members include Denmark, Spain, the Netherlands, Italy, Belgium, Austria, Ireland and France (Haase, 2008).

measure of regulatory comprehensiveness in an economy. According to Haase (2008), the UK was ranked number one in 2005 followed in turn by Denmark, Spain, the Netherlands and Italy with France, Sweden, Germany and Luxembourg in turn at the bottom of the ranking list. Since 2005, many countries have moved forward in gas market liberalization. For example, the German Energy Law (*Energiewirtschaftsgesetz*) was introduced in 2005 with the aim to speed up gas market reforms in Germany (Growitsch *et al.*, 2009).

The experience of the world's two largest gas consumers, US and EU, shows that gas market integration undergoes a common trajectory, which consists of several steps including the creation of intra-country regional markets, formation of an integrated national market, deregulation and international integration. The implementation of this last step involves the standardization of the gas sector, harmonization of members' regulatory systems and removal of cross-border trade barriers. EAS members can learn from the experience and lessons in the US and EU and develop a plan for gas market integration in coming decades.

4. Gas Markets in the EAS Region

According to the stage of market and regulatory development, we can broadly divide the natural gas markets in the EAS area into three groups: the mature markets, the developing markets and the fledgling markets (Table 3). Relatively more advanced gas markets or the "mature markets" exist in some EAS countries, namely, Australia, Japan, New Zealand and Singapore. A gas market is yet to be created (and hence the term "fledgling markets") in other countries including Brunei, Cambodia, Laos, Myanmar, the Philippines and Vietnam. Those which stand between the "mature" and "fledgling" market categories are classified as the "developing markets" and include China, India, Indonesia, Malaysia, South Korea and Thailand.

4.1. Mature Markets

The “mature markets” refer to economies with relatively well-developed gas infrastructure, a large share of natural gas over total energy consumption and a liberalised or partially deregulated domestic gas sector. Among the sixteen EAS members, Australia, Japan, New Zealand and Singapore fall in this category. These economies set the best practice standards within the EAS area and are also in the process of catching up with international best practice.

Table 3. Gas Consumption in EAS Economies

Market classification	Country	Consumption (billion cubic meters)	Shares of gas over primary energy consumption (%)
Mature markets	Australia	28.73	21
	Japan	94.10	17
	New Zealand	3.82	19
	Singapore	6.85	25
Developing markets	China	84.39	4
	India	40.07	6
	Indonesia	42.99	25
	Malaysia	44.25	51
	South Korea	35.32	14
	Thailand	36.89	29
Fledgling markets	Brunei	3.41	79
	Cambodia	0.00	0
	Laos	0.00	0
	Myanmar	2.03	13
	Philippines	3.54	8
	Vietnam	7.11	18

Notes: Unless stated otherwise, the statistics are based on 2008 data reported in APEC (2011). The shares are gas consumption over primary energy consumption. Indian data are drawn from Corbeau (2010). Data for Myanmar are 2005 figures reported in IEEJ (2009).

In Australia, natural gas accounts for about 21% of primary energy consumption currently (Table 3). This figure is projected to increase to 33% by 2030 (Syed *et al.*, 2010). About 50% of Australian natural gas is exported in the form of LNG. Due to geographic constraints, the gas market in Australia now comprises of three separate regional markets, namely Western Australia, South-eastern Australia and the Northern Territories. Gas market reform for third party access is still ongoing, though substantial progress has been made since the enactment of the National Third Party Access Code

for Natural Gas Pipeline Systems in 1997. The reform involved the breakup of government-owned vertically integrated gas utilities into separate transmission and distribution businesses. Some of them have since been privatized. This process of reform has been strengthened by the decree of the National Gas Law (NGL) in 2008 and its Amendment in 2009. The gas law and its amendment aim to ensure the functioning of a single gas market regulator and to send the right signals for efficient infrastructure investment in the country.

In Japan, natural gas amounts to 17% of primary energy consumption in 2008 (Table 3). Gas supply is almost sourced entirely through imported LNG from Indonesia, Australia, Qatar, UAE, Russia, Malaysia, Brunei and Oman (Takahashi, 2004). For this reason, Japan accounted for 31% of the world's traded LNG in 2010 (BP, 2011a). Traditionally Japanese imported LNG has been over-priced to ensure stable supply (APEC, 2011). To reduce costs and hence prices, regulatory reforms were initiated in 1995 through the enactment of the Gas Utility Industry Law and its Amendments in 1999, 2004 and 2007. The reform measures provide guidance for price-setting, new entries and open access. Now Japanese gas and electric utilities are under tremendous pressure to reduce costs and lower prices even though the reform has not covered all sections of the gas market.

New Zealand has so far been self-sufficient in natural gas supplies. Natural gas has a share of 19% in the country's primary energy consumption (Table 3). Gas sector reform began with the enactment of the Gas Act in 1992, which was subsequently amended in 1993, 1997 and 2000 (Coull and Bamford, 2010). Currently the gas sector is "co-regulated" by the government and the Gas Industry Company (GIC), an industry body established under the Gas Act 1992 (APEC, 2011). The government has never rejected a GIC recommendation on the basis of policy grounds (IEA, 2010b). It is argued that the "co-regulated" system can combine the benefits of industry self-governance with government oversight to ensure delivery of public policy objectives.

In Singapore, the 2001 Gas Act sets the legal basis for the separation of the contestable component of the gas industry (that is, gas retail and gas import) from the monopolistic component (that is, gas transportation). Since 2008, the Gas Network Code (GNC) has specified the GNC's rules which govern the activities of gas transportation, providing open and non-discriminatory access to Singapore's onshore

gas pipeline network (APEC, 2011). In 2008, over 80% of Singapore's electricity was generated using natural gas, which was imported from Malaysia and Indonesia through four cross-border pipelines (Wong and Reinbott 2010). Currently, four companies hold gas import licences. There are also two domestic gas pipelines which are not interconnected yet. Singapore is also expected to receive LNG in 2013. For this purpose, new imports of pipeline gas are subjected to the approval by the Energy Market Authority of Singapore, a regulatory body responsible for the gas industry.

4.2. Developing Markets

In 2010 China's domestic production of natural gas amounted to 94.5 BCMs and imports of LNG exceeded 9 MTs.⁶ For the first time, China also imported natural gas of 4.4 BCMs from central Asia via the cross-border gas pipelines. Thus the rate of China's dependency on gas imports was about 15% in 2010. China's reform in the late 1990s has sought to separate business from regulatory roles in state-owned enterprises (SOEs). While the major oil and gas companies are partially privatized, the state is still the majority share-holder of those companies.⁷ On 30 August 2007, China released its National Gas Utilization Policy, which was intended to ease natural gas supply and demand, and optimise the structure of natural gas utilisation. China is still in the process of constructing a national gas grid. Over the next 10 years (2010-2020), more than 25 000 kilometres of pipeline are expected to be commissioned to form a gas trunk line network 'running through east-west and north-south and connecting overseas' (APEC, 2011). In the currently fragmented markets, gas has been under-priced and hence is heavily subsidized by governments. Reform in the gas sector has been discussed and experimented with at a very slow pace. The latest speculation is that China may raise domestic gas prices in August 2011 (Liang, 2011). Interconnectivity and unbundling are still at the stage of being debated. For example, it is reported that China Gas Association proposed a so-called "X+1+X" model which implies competitive suppliers and distributors with a monopolized grid system. The

⁶ The information is drawn from China Petroleum Enterprise Association (2011).

⁷ China's whole and retail gas market is dominated by three SOEs, namely, China's National Petroleum Corporation (CNPC), China's National Petroleum and Chemical Corporation (SINOPEC) and China's National Overseas and Offshore Corporation (CNOOC).

implementation of the reforms likely still has a long way to go, as a national pipeline network is expected to be completed in 2020.

India's natural gas market is still at the early stage of development. Both the regulatory framework and gas distribution infrastructure are underdeveloped. SOEs such as Oil and Natural Gas Corporations (ONGC), Oil India Ltd (OIL) and Gas Authority of India Ltd (GAIL) dominate the sector in particular the upstream businesses. Gas pricing follows a two track-system, namely the administrative price mechanism (APM) and market mechanism (non-APM). Gas produced by the SOEs is charged at the APM price while private companies and joint ventures receive the non-APM price (Corbeau, 2010). The non-APM price can be two or three times as high as the APM price. Until 2006, gas produced by ONGC and OIL and distributed by GAIL has been sold at the APM prices. In 2007, APM gas has a domestic gas market share of 75% (Jain and Sen 2011). The heavy subsidies in the form of price gaps are absorbed by the SOEs and federal government. In 2006 the Petroleum and Natural Gas Regulatory Board (PNGRB) was created and subsequently the PNGRB Act was promulgated. In 2008, with the construction of the 1400 km "East-West" pipeline, the private company Reliance Gas Transportation Infrastructure Limited (RGTIL) entered the pipeline business. Thus the Indian gas sector has moved from pure state ownership to a mixed structure of state and private ownership. In the 2010/2011 financial year, a major pricing reform is to increase APM gas prices to the market level (set by the private company, Reliance Industries Limited). The government subsidizes the end-users directly. These initiatives lay the foundation for further reforms and hence the introduction of competition into the gas market.

Indonesia is a major gas exporter in the EAS region, with 55% of gas produced being exported in 2008. Of the exported gas, Japan has a share of 70%. Gas accounts for 25% of primary energy consumption in the country. The enactment of the Oil and Gas Law (Law No. 21/2001) requires that the state-owned oil company, Pertamina, relinquishes its governmental roles to the new regulatory bodies BP MIGAS and BPH MIGAS, and the termination of Pertamina's monopoly in upstream oil and gas activities

(APEC, 2011).⁸ Currently, the transport of natural gas in Indonesia is separated from supply, which lays the foundation for further reform of the gas sector.

In Malaysia, natural gas accounts for about 51% of Malaysia's primary energy consumption. The country is the world second largest LNG exporter. The gas sector is in general highly regulated and dominated by the state-owned company, Petronas and gas prices are set by the government. Companies need a Petronas licence to operate in the upstream industry. In terms of deregulation, Malaysia is lagging behind its neighbouring countries Singapore and Indonesia.

South Korean natural gas amounted to 14% of primary energy consumption in 2008. Although reform was envisaged in the 1999 Basic Plan for Restructuring the Gas Industry and the 2001 Implementation Plan, little progress has been made so far. In the aftermath of the Asian financial crisis, Kogas was partially privatized (43%) in 1999. Kogas still monopolizes Korea's natural gas industry including the gas import, storage, transportation and wholesale businesses.

In Thailand, the Petroleum Authority of Thailand (PTT) is the single buyer, transporter and reseller of natural gas, which amounts to 29% primary energy consumption in the country in 2008 (Table 3). One-third of natural gas consumption relies on imports, mainly through pipeline gas from Myanmar (with LNG imports expected in 2011). As for the reform of the gas sector, though a Power Development Plan was launched in 2010, unbundling the PTT is still a long way off.

4.3. Fledgling Markets

Six EAS members fall into the "fledgling markets" category. These members are the relatively less developed ASEAN members. In Laos, biomass is still the main source of energy with other fuels having a small market share and being imported mainly from Thailand. Thus gas market and infrastructure is yet to be developed. The government is still struggling to increase the level of electrification of households, which is currently at about 70%. Cambodia also relies on biomass as the main source of energy. The first significant oil and gas discovery in Cambodia was announced by

⁸ BP MIGAS (Badan Pelaksanaan Minyak dan Gas) is responsible for granting licences and managing contracts. BPH MIGAS (Badan Pengatur Minyak dan Gas) has regulatory responsibilities for trading, distribution and retailing.

Chevron in 2005 (World Bank, 2007). However commercial production has not started yet. In Myanmar, although biomass accounts for over 60% of total energy consumption, a small gas market exists and provides about 13% of the country's total fuel demand (Table 3). The country also started exporting pipeline gas to Thailand in 1998. It is now the fifth largest gas exporter in the EAS region. Gas exploration and production is open to foreign companies. The state-owned company, Myanmar Oil and Gas Enterprise (MOGE), however dominates the domestic gas sector.

Brunei Darussalam (Brunei for short) is a net energy exporter. More than 90% of Brunei's LNG was exported to Japan in 2009. Domestically natural gas accounts for about 80% of primary energy consumption. However, the gas market in Brunei is mainly vertically integrated. That is, the government or its agencies are responsible for supply, transmission and distribution. Deregulation has so far not been on the agenda of government policies.

In the Philippines, 40% of the country's energy is imported. Gas has a share of 8% of primary energy consumption in 2008 (Table 3). In general, gas market and infrastructure development in the Philippines is still at the early stage. Currently gas production is enough to meet the country's domestic requirements. In the future the Philippines is expected to import pipeline gas via the proposed Trans-ASEAN Gas Pipeline (TAGT) network.

Gas accounts for 18% of primary energy consumption in Viet Nam (Table 3). The gas industry is dominated by the state-owned company, Viet Nam Oil and Gas Group (PVN), through its arm, The Gas Corporation, which was incorporated in August 2006. The government has an unbundling plan for electricity (2005-2022). But the gas sector is yet on the government's agenda for liberalization.

4.4. Gas Trade between EAS Members

Within the EAS area, members have been actively engaged in natural gas trade either via pipelines or in the form of LNG (Table 4). While some members (Indonesia, Malaysia, Australia, Brunei and Myanmar) are net gas exporters, others (Japan, South Korea, China, India, Thailand and Singapore) are net importers. As shown in Table 4, EAS exporters, mainly export within the region (89% of total exports) while major EAS importers, such as Japan, South Korea and China, also buy from non-EAS countries

(45% of total imports). Thus EAS as a group is a net importer. In 2010, net imports of natural gas by EAS members amounted to over 72 BCMs (Table 4). In terms of pipeline gas trade, EAS only accounts for about 4% of the world total while LNG imports by EAS members amount to 55% of the world total in 2010 (BP, 2011a). Thus in terms of gas market integration in the region, LNG market will unavoidably play an important role.

Table 4. Intra-EAS Gas Trade Movement, 2010

Major Importers	Major Exporters						EAS Imports	World Imports	EAS Shares Over world
	Australia	Brunei	China	Indonesia	Malaysia	Myanmar			
Australia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0%
China	5.2	0.0	0.0	2.5	1.7	0.0	9.3	16.4	57%
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2	0%
Japan	17.7	7.8	0.0	17.0	18.6	0.0	61.0	93.5	65%
Malaysia	0.0	0.0	0.0	2.9	0.0	0.0	2.9	2.9	100%
Singapore	0.0	0.0	0.0	7.0	1.5	0.0	8.4	8.4	100%
South Korea	1.3	1.1	0.0	7.4	6.4	0.0	16.2	44.4	36%
Thailand	0.0	0.0	0.0	0.0	0.0	8.8	8.8	8.8	100%
EAS Exports	24.2	8.8	0.0	36.8	28.1	8.8	106.7	192.4	55%
World Exports	25.4	8.8	3.8	41.2	32.0	8.8	120.1	975.2	12%
EAS/World	95%	100%	0%	89%	88%	100%	89%	20%	

Note: Raw data were drawn from BP (2011a). Unless stated otherwise, the unit is billion cubic meters.

In terms of cross-border connectivity, several sub-markets have been operating with many new pipeline connections being constructed or considered. One of the most important projects is the Trans-ASEAN Gas Pipeline (TAGP) project which was endorsed in the ASEAN Plan of Action on Energy Cooperation (APAEC) 1999-2004 and is expected to link the existing and proposed new gas pipeline networks in ASEAN states by 2020. TAGP is important not only for the connectivity between ASEAN members but also due to its role in integrating gas markets in continental Asia. Currently selected ASEAN states are interconnected through gas pipelines over 2600 km in length (Table 5). To complete the interconnection of ASEAN networks, new pipelines of several thousands of kilometres will have to be constructed (ASEAN, 2010). An additional possible connection is the Philippines-Brunei-Malaysia link.

Table 5. Cross-border Gas Pipelines in East Asia

Pipeline names	Length (km)	Completion Year
Malaysia-Singapore via Johore Straits	5	1991
Yadana, Myanmar-Ratchaburi, Thailand	470	1999
Yetagun, Myanmar-Ratchaburi, Thailand	340	2000
West Natuna, Indonesia-Singapore	660	2001
West Natuna, Indonesia-Duyong, Malaysia	100	2001
South Sumatra, Indonesia-Singapore	470	2003
Malaysia-Thailand JDA	270	2005
Malaysia-Singapore	4	2006
Malaysia-Vietnam via PM3-Ca Mau pipeline	325	2007
China-Myanmar	870	2013

Source: Author's own compilation using information from ASEAN (2010).

5. Policy Implications

The review in the preceding section demonstrates the existence of highly heterogeneous gas markets and regulatory regimes in the EAS region. In some member economies, a gas market is yet to be developed. Overall natural gas as a source of primary energy consumption still plays a relatively small role in the EAS area, particularly in large EAS members such as China and India (Table 3). There is no doubt that gas consumption will increase in many EAS member states in the near future. A critical question is whether supply can meet demand in the long run and hence, whether it is wise to invest in infrastructure. While the EAS group is a net importer of natural gas, the global gas resource base is vast. According to the International Energy Agency (IEA, 2011), recoverable conventional gas resource is equivalent to more than 120 years of current consumption level in the world while total gas resources could sustain today's production for over 250 years. Among EAS members, China and India have the potential to become important suppliers of unconventional gas in the future. Given the abundance of global gas supply, gas markets in the EAS area are expected to

expand in the coming decades. Thus, development in natural gas infrastructure and regulations in the EAS region have long-term implications.

As the gas market expands, regional market integration will become important. To achieve the goal of an integrated gas market in the EAS region, governments in member economies must work together to implement a plan which will lead to the harmonisation of regulatory standards and hence integration of gas markets while different national characteristics are also taken into account. These characteristics include national gas market size, existing networks, import infrastructure and market structure. Specifically, the work plan should aim to achieve several objectives, namely, to 1) promote the development of gas markets in individual EAS member economies, 2) harmonize regulatory standards in natural gas sectors within the region, 3) strengthen the coordination between multiple institutions and eventually, 4) achieve the goal of cross-border integration within the EAS area. Each of the four objectives is in turn detailed as follows though this is not necessarily the order of implementation of these tasks in practice.

5.1. Development of Gas Markets in EAS Member Economies

As shown in the preceding section, natural gas markets across individual EAS member economies are very diverse in terms of their level of development. To achieve the goal of gas market integration within the EAS region, gas market development in member economies should be promoted first. While recognizing differences in the stage of economic development, members should be encouraged to develop internal gas markets following the best practice within the region and hence the process of catch-up can be shortened significantly. Issues involved include:

- The optimum gas market structure with regard to individual members' economic and environmental conditions;
- Specific policies in infrastructure development such as the construction of pipelines;
- Country-specific pricing policies;
- Internal market integration;
- Introduction of competition through deregulation; and
- Timetable for gas sector reforms.

5.2. Harmonization of Regulatory Standards

To prepare for regional market integration, the gas regulatory and technical standards within the EAS area should be harmonized through multilateral agreements. The harmonized standards will define best practice in the gas sector within the EAS area. Emerging and new markets can adopt those standards at an earlier stage so that the process of catch-up with best practice later can be significantly shortened. Specifically, the gas industry regulatory and technical standards cover

- Metering and quality standards;
- Legal and tax issues;
- Trading systems;
- Standard contract forms;
- Pricing mechanism; and
- Other general regulatory issues.

5.3. Coordination between Multiple Institutions

Within the EAS area, multiple institutions exist and share the same objective of promoting gas or energy market integration. Examples include the APEC Energy Working Group formed in 1990, ASEAN Plan of Action for Energy Cooperation established in 1997, EAS's Energy Cooperation Task Force (ECTF) initiated in 2007 and ASEAN plus three (APT) Natural Gas Forum, started in July 2010. The ASEAN Plan of Action for Energy Cooperation, overseen by the ASEAN Centre for Energy (ACE), has made some progress in constructing the ASEAN Power Grid (APG) and Trans-ASEAN Gas Pipeline (TAGP) (Table 5). In 2010, the Ministers of APT countries commended a regional dialogue on natural gas, namely APT Natural Gas Forum, acknowledging the Forum's contribution in facilitating a robust information exchange and closer cooperation in the areas of gas trade, market development, research and development, and technical cooperation across the region. The Ministers supported the initiatives proposed by the APT Natural Gas Forum 2010 (i) to develop a compendium of natural gas policies, development, projects and plans of the APT countries, and (ii) to initiate preparatory activities for conducting a study on natural gas market in the APT region. They further noted that APT countries will continue to chart the appropriate direction for the natural gas industry in the region.

The Energy Cooperation Task Force (ECTF) was set up by the EAS group in 2007. Energy market integration (EMI) in the EAS area is one of the three program streams undertaken by ECTF (Shi and Kimura, 2010). A series of workshops have been conducted under this scheme (Bannister *et al.*, 2008, ERIA 2010 and 2011). There are considerable overlaps in the missions of these institutions. Coordination between these institutions could lead to more efficient use of public resources and a unified voice for the promotion of gas market integration in the region.

5.4. Cross-border Integration within the EAS Area

The eventual goal of the coordinated efforts in the EAS gas sectors is to achieve market integration. This can be realized through several steps. The first step will be the interconnection of gas pipelines in subregions within the EAS area. These sub-regional markets include ASEAN, China-Myanmar, India-Myanmar and The Greater Mekong Sub-region (GMS involving two Chinese provinces, Thailand, Viet Nam, the Laos, Cambodia and Myanmar). In addition, there are also current or potential connections with non-EAS pipeline networks such as the China-Turkmenistan, China-Russia and India-Iran pipelines. These connections will essentially become part of an integrated EAS market. The next step is to integrate sub-regional markets. Interconnection may be possible for land-bound economies such as ASEAN, China, India and Korea.

In addition, the LNG market is an integral part of the gas market in the EAS area and can play a key role in the integration of gas markets. In 2010, LNG imports by and exports from EAS members accounted for about 60% and 32% of the world's total trade, respectively (BP, 2011a).⁹ With more LNG terminals being constructed in China, India and Thailand, demand for LNG in the EAS area is set to increase significantly. This trend will not only supplement cross-border trade in pipeline gas, but also has implications for gas pricing in the region. Traditionally the price of natural gas is tied with the price of oil. This is still the case in Asia, however, the gas pricing mechanism has changed in other parts of the world. In the US, due to gas to gas competition, the gas price is determined by the domestic gas market price, and imported gas is also linked to the domestic gas price (Fukushima, 2009). A similar market-oriented pricing

⁹ The import share of 60% in 2010 includes LNG imports of 14.9 bcm by Taiwan, officially a non-EAS member.

mechanism is also emerging in Europe. With expanded capacities in terms of both pipelines and LNG terminals, a gas to gas competing market may appear in the EAS area.

6. Conclusions and Recommendations

This study briefly reviewed the status and trend of global gas market integration. Global awareness of climate change, rising affordability and improved technology have made natural gas, both conventional and unconventional, the preferred fossil fuel in the coming decades. While the US and EU are leading the world in gas consumption, trade and market liberalization, the rest of the world, in particular the EAS area, is catching up rapidly. Among the sixteen EAS members, there is considerable heterogeneity in terms of gas usage, trade participation and sectoral reforms. With abundant supplies both in the region and globally, natural gas consumption is to grow rapidly in the EAS area. Thus gas market integration becomes attractive and indispensable in the coming decades. To make this possible, it is recommended that the EAS states should adopt a formal program to promote and eventually achieve gas market integration within the region. Specifically, four recommendations are made:

- *Recommendation One:* Through multilateral agreements, EAS states should adopt a formal program to promote and nurture the development of gas markets in member states and phased sectoral reforms in relatively mature markets. ERIA's EMI workshop series is the first step to achieve this goal.
- *Recommendation Two:* Through multilateral agreements, EAS states should set targets to gradually harmonise regulatory and technical standards in the gas sector. A set of mutually agreed and harmonised standards, or the EAS Best Practice (EBP) standards, can be implemented initially in the relatively more developed markets and then extended to other markets over time.
- *Recommendation Three:* Several institutions in the EAS areas should coordinate better to promote their "gas" causes. For example, the "gas" sections of these

institutions could be merged to form an EAS Gas Agency (EGA) so that a unified voice could be heard in the EAS region.

- *Recommendation Four:* EAS states should develop a formal program to boost cross-border connectivity and trading within the area and eventually achieve regional gas market integration. This goal could be achieved through the evolution of the current schemes such as TAGP and GMS or new initiatives such as the establishment of regional gas storage or gas exchanges.

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