ASEAN ENERGY MARKET INTEGRATION (AEMI):

DRAFT AEMI BRAINSTORMING PAPERS

AEMI BRAINSTORMING SESSION, BANGKOK, OCTOBER 14-16, 2014

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ASEAN ENERGY MARKET INTEGRATION (AEMI)

BRAINSTORMING SESSION

October 14-15-16, 2014, Montien Hotel Bangkok

Forum held under Chatham House Rule

Tuesday, October 14, 2014

18:00-18:30 *Welcome Remarks*
Dean Chayodom Sabhasri, Faculty of Economics, Chulalongkorn University

18:30-21:00 *Welcome Dinner at the Montien Hotel*

Wednesday, October 15, 2014

Visit to Biomass Energy Plant (Saraburi) and Ayutthaya's Historical Park
Whole Day Trip (casual attire)

9:00 **Leave the Montien Hotel for the Biomass Energy Plant (Saraburi)**

10:30-12:30 **Visit of the Biomass Energy Plant**
Guided by Prof. Dr. Tharapong Vitidsant, Vice President, Chulalongkorn University
The plant is a practice research center at Saraburi province. It is dedicated to developing new sustainable energy technology for the utilization of biomass and waste to produce energy.

12:30-13:30 *Lunch at the Krua Baan Suan (Saraburi)*

13:30-14:00 **Trip to the ancient capital city of Ayutthaya**

14:00-18:00 **Visit of the Historical Park**
Guided by Prof. Monthon
The city of Ayutthaya was founded by King Ramathibodi I in 1350 and was the capital of the country until 1767. The Ayutthaya historical park covers the ruins of the old city. In 1991, a part of Ayutthaya Historical Park was declared a UNESCO World Heritage Site.

18:00-20:00 **Dinner Cruise on the Chao Phraya River**
A dinner cruise around Ayutthaya, indulging in a charming and nostalgic atmosphere of the old capital.

20:00-21:00 **Trip back to the Montien Hotel**

Thursday, October 16, 2014

9:00-9:30 **Opening Remarks – The Future of the AEMI Initiative: What's Next**
Nawal Kamel, Chulalongkorn University
Philip Andrews-Speed, National University of Singapore

9:30-9:45 Photo Group Session

9:45-10:15 **Energy pricing and subsidies**
Youngho Chang, Adoracion M. Navarro, Tri Widodo

10:15-10:45: **An Assessment of trade and investment – Barriers in energy services in ASEAN**
Ma. Joy V. Abrenica, Adoracion M. Navarro, Tri Widodo

10:45-11:15 Coffee Break

11:15-11:45 **Evaluation of ASEAN infrastructure connectivity needs**
Youngho Chang, Ir. Tuan Ab. Rashid bin Tuan Abdullah

11:45-12:30 **ASEAN energy technology strategy 2015-2030**
Bundit Fungtammasan, Lim Chee Ming, Aishah Mohd Isa, Maxensius Tri Sambodo, Suneerat Fukuda, Athikom Bangviwat, Christoph Menke, Atit Tippichai, Agya Utama, Jirapa Kamsamron

12:30-14:00 Lunch at the Montien Hotel

14:00-14:30 **Development of ASEAN energy security strategy**
Youngho Chang, Maxensius Tri Sambodo, Philip Andrews-Speed
Developing energy security indicators
Sopitsuda Tongsopit, Weerin Wangjiraniran

14:30-15:00 **Address energy poverty through AEMI**
Maxensius Tri Sambodo, Nguyen Thi mai Anh, Ir. G. Lalchand

15:00-15:30 **Benefits of AEMI: A survey of the literature**
Xunpeng Shi, Tri Widodo, Anindya Bhattacharya

15:30-16:00 Coffee Break

16:00-16:30 **Understand national perspective in joining AEMI**
Ir. Tuan Ab Rashid Bin Tuan Abdullah, Tran Van Binh, Aishah Mohd Isa, Endang Jati Binti Mat Sahid

16:30-17:00 **Develop a geo-political strategy of ASEAN energy security**
Philip Andrews-Speed, Christopher Len, Seksan Anantasirikiat

17:00-17:30 **Conclusions and next Steps**
Nawal Kamel, Chulalongkorn University
Philip Andrews-Speed, National University of Singapore

17:30-17:45 **Closing Remarks**
Dr. M.R. Kalaya Tingsabadh, Vice President, Chulalongkorn University

17:45-18:30 Drinks
18:30-21:00 Farewell Dinner at the Montien Hotel

AEMI BRAINSTORMING SESSION, BANGKOK, OCTOBER 14-16, 2014

AEMI PAPERS

AEMI BRAINSTORMING SESSION: CONCLUSIONS
AEMI PAPERS AND TIMELINE

ENERGY SUBSIDIES – ENERGY PRICING AND SUBSIDIES

Youngho Chang, Adoracion M. Navarro and Tri Widodo

I. Introduction

An invisible hand would allocate resources to those who value the resource highest followed by the next highest one and so on. The market allocation of energy resource would be efficient but cause unwanted outcomes. If the market price is applied to the low income household, then they would end up paying a large share of their income to get the amount of energy resources to sustain decent living or consuming far less amount of energy resources required for decent living. To correct these unwanted outcomes and ensure the low income household to get the required amount of energy for decent living, governments of most ASEAN countries opt to implement various energy pricing schemes and subsidies. The outcomes of such government-administered pricing schemes, however, prove that the schemes distort the allocation of precious resources and most of subsidies did not reach the target groups of subsidies.

Governments provide direct and indirect subsidies to either energy producers or consumers, as well as allow the provision of cross-subsidies from one economic agent to another through energy policies. Direct subsidies involve budget transfers from the government to the producer or consumer and in some literature, these are called explicit subsidies. Examples include pricing of petroleum products, electricity, and related energy consumption goods below cost-recovery level and financing the losses through government budget. Indirect subsidies are those which do not involve government budget transfers but can either result in opportunity losses for the government or create fiscal impacts later on. These are sometimes called implicit subsidies. Examples are free or soft interest rates on loans of public utilities and tax breaks or subsidies for oil and gas exploration. Cross-subsidies involve one group paying more than other groups and examples include price discounts for poor electricity consumers and feed-in tariffs for renewable energy through consumer charges regardless of income class.

This paper aims to examine how ASEAN countries implement energy and fuel subsidies and explore feasible options for energy pricing and taxation, with the view to identifying a cohesive approach across ASEAN for the energy market to function efficiently, while respecting national welfare objectives of protecting the poor and of addressing energy poverty. It also tries to formulates innovative options in the short and medium terms, including the use of different instruments (for example, tax breaks, social security mechanisms, rebates on energy bills or combinations of these instruments) to “decouple” energy pricing from welfare objectives to assist the poor in most vulnerable communities. Along with these, it explores ASEAN-wide equalization mechanisms, inspired from those in action in some federal systems.

This paper is structured as follows. Section 2 examines the typical forms of energy use in developing countries, presents the forms of subsidies and reviews existing energy pricing and subsidies in ASEAN in general and specifically Indonesia, Myanmar, the Philippines, Thailand and Singapore. Possible ways of de-coupling subsidies are explored in section 3 and some options for ASEAN countries are suggested in section4. Section 5 concludes this paper.

II. Review of Existing Energy Pricing and Subsidies in ASEAN

a. An Overview

Energy is a basic commodity and low-income households usually spend sizeable shares of their income on cooking fuels and energy. One of the key justifications for the various fuel subsidies is that they promote social equity by encouraging low-income households to use high-quality fuels. Table 1 shows the patterns of energy consumption by typical households of different income in developing countries. Kerosene is considered a 'key fuel' because low-income households in developing countries use it heavily for cooking. Kerosene subsidies are justified as they could redistribute income from the rich to the poor. Diesel is used heavily for public transport in developing countries and diesel subsidies are expected to make public transportation more affordable for the urban poor. Subsidized modern fuels that can replace traditional biomass are expected to help the world combat indoor air pollution, prevent forest degradation and reduce fuel collection time (Dick, 1980; Pitt, 1985; Kosmo, 1989). Making these fuels more affordable and accessible by energy and fuel subsidies can improve low-income households' living conditions and social welfare and such benefits justify some form of energy subsidy.

Table 1: Typical End Uses by Energy Source in Developing Countries

Uses	Household Income Level		
	Low	Middle	High
Cooking	Wood, residues, kerosene, dung	Wood, charcoal, residues, dung, kerosene, biogas	Charcoal, kerosene, LPG, coal
Lighting	Candles, kerosene, none	Candles, kerosene	Kerosene, electricity
Space heating	Wood, residues, dung, none	Wood, residues, dung	Wood, residues, coal
Space Cooling & Refrigeration	None	Electricity	Electricity, kerosene, LPG
Other appliances e.g. radio, television	None	Grid electricity, batteries	Grid electricity, batteries

Source: UNESCAP (2005).

In reality, however, fuel subsidies often prove to be regressive, benefiting mainly the higher-income households, while the entire population including the low-income households shares the costs. There are three main reasons for this. First, the poorest households may be unable to afford even subsidised energy or may have no physical access to it (UNEP and IEA, 2002). For

example, in Ecuador, subsidised kerosene was diverted to the transport sector and much of it never reached the poor, especially in rural areas (ESMAP 2000). On the other hand, high-income households, which own automobiles that run on subsidised fuels, stand to benefit from the lower fuel prices.

Second, even if the poor are able to benefit from a fuel subsidy, the absolute financial value to them may be very small because low-income households generally have the lowest consumption of fuel and electricity. Higher-income households tend to benefit much more in nominal terms since they consume more of the subsidised fuels. For example in India, LPG subsidies have benefited almost exclusively better-off households, who generally prefer LPG for cooking and water heating (Dick, 1980; Kosmo, 1989; UNEP and IEA, 2001).

Third, subsidised fuel prices can lead to big price differences with neighboring countries, thus encouraging fuel smuggling. When fuels are smuggled out of the country, the government has to pay for the costs of the subsidies while the intended beneficiaries do not enjoy the subsidies. Fuel smuggling is estimated to cost the Indonesian government US$1.6 billion and the Malaysian government US$65 million in 2004 (Tan and Lian, 2005). As such, fuel subsidy programs can paradoxically widen the income gap between the rich and the poor. They are thus an inefficient way to achieve social equity (IEA, 1999; ESMAP, 2000).

b. The Status of Energy Subsidies in ASEAN

To date, there is no comprehensive survey yet of the presence of these subsidies per type of subsidy (i.e., direct, indirect or cross-subsidy) in ASEAN countries. The latest available data are for the amount of subsidies per product category regardless of the type of subsidy. To compare the energy subsidies across countries, we look at available data on subsidies as percentages of GDP and government revenues (Tables 2 and 3 below) from the International Monetary Fund or IMF (2013), which was also cited in Sambodo et al. (2013).

Table 2: Pre-tax Subsidies for Petroleum products, electricity, natural gas, and coal in 2011

Country	Petroleum products		Electricity		Natural gas		Coal	
	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue
Brunei Darussalam	2.34	3.77	0.98	1.57	0	0	0	0
Cambodia	0	0	n.a	n.a	n.a	n.a	n.a	n.a
Indonesia	2.58	14.51	0.66	3.69	0	0	0	0
Lao P.D.R	0	0	n.a	n.a	n.a	n.a	n.a	n.a
Malaysia	1.24	5.67	0.33	1.49	0.31	1.41	0	0
Myanmar	0.54	9.35	n.a	n.a	n.a	n.a	n.a	n.a
Philippines	0	0	0	0	0	0	0	0
Thailand	0.15	0.66	1.64	7.24	0.14	0.61	0.25	1.08
World	0.3	0.91	0.22	0.64	0.16	0.48	0.01	0.03

Source: IMF (2013) Energy Subsidy Reform: Lessons and Implications. (January 2013). International Monetary Fund (IMF): Washington, D.C.

Table 3: Post-tax Subsidies for Petroleum products, electricity, natural gas, and coal in 2011

Country	Petroleum products		Electricity		Natural gas		Coal	
	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue	% of GDP	% of Gov't Revenue
Brunei Darussalam	5.92	9.51	1.37	2.19	1.12	1.81	0	0
Cambodia	0	0	n.a	n.a	n.a	n.a	0	0.01
Indonesia	3.87	21.74	0.72	4.04	0.3	1.67	0.47	2.62
Lao P.D.R	0	0	n.a	n.a	n.a	n.a	n.a	n.a
Malaysia	5.12	23.39	0.56	2.54	0.79	3.36	0.74	3.38
Myanmar	0.97	16.93	n.a	n.a	n.a	n.a	n.a	n.a
Philippines	0.2	1.18	0	0	0.08	0.43	0.46	2.65
Thailand	1.4	6.16	1.76	7.77	0.72	3.19	0.84	3.73
World	1.26	3.77	0.26	0.77	0.43	1.28	0.77	2.31

Source: IMF (2013).

The latest available data on fossil fuel consumption subsidies per capita are also the IMF pre- and post-tax estimates as of 2011. There are available 2012 data from the International Energy Agency (IEA) but these are for four countries only, namely, Indonesia, Malaysia, Thailand and Vietnam. Table 4 below summarizes the fossil fuel consumption subsidies in ASEAN countries.

Table 4: Fossil Fuel Consumption Subsidies, Total, US$ per capita, 2011 and 2012

Country	IMF Pre-tax estimates (2011)	IMF Post-tax estimates (2011)	IEA Estimates (2012)
Brunei Darussalam	1279	3238.2	n.a.
Cambodia	0	0	n.a.
Indonesia	113.8	188.1	109.3
Lao PDR	0	0	n.a.
Malaysia	189.2	726.7	252.4
Myanmar	4.4	8	n.a.
Philippines	0	17.3	n.a.
Singapore	0	605	n.a.
Thailand	117.3	255	136.4
Vietnam	n.a.	n.a.	39.2

Sources: the IMF data - Global Subsidies Initiative Interactive Map (http://www.iisd.org/gsi/interactive-maps) and the IEA data - International Energy Association Database (http://www.iea.org/subsidy/index.html)

When subsidies are distortive or not well-targeted, these could have adverse effects on resource allocation across sectors and economic agents. For example, budget transfers to the energy sector may be competing with the budget needs of important social services such as health and education. Moreover, fossil fuel consumption subsidies may be benefiting the rich more than the poor as the former have larger consumption of fossil fuels through their use of private cars and air conditioning.

Resources being poured into subsidies may also be taking away funds for investment in addressing energy poverty. Energy poverty may be addressed by expanding access to electricity grids, providing electricity to off-grid areas through the use of renewable energy, and enabling modern cooking methods that do not burn wood products. It should be noted that energy poverty in ASEAN is still a crucial concern given that as of 2011, 22 percent of 134 million people in ASEAN still have no access to electricity and 47 percent or 279 million people still rely on the traditional use of biomass for cooking (Table 5 below).

Table 5: Population without Access to Electricity and with Biomass on Cooking

	Population without access to electricity		Population relying on traditional use of biomass for cooking*	
	Million	**Share (%)**	**Million**	**Share (%)**
Brunei Darussalam	0	0%	0	0%
Cambodia	9	66%	13	88%
Indonesia	66	27%	103	42%
Lao PDR	1	22%	4	65%
Malaysia	0	1%	1	3%
Myanmar	25	51%	44	92%
Philippines	28	30%	47	50%
Singapore	0	0%	0	0%
Thailand	1	1%	18	26%
Viet Nam	3	4%	49	56%
ASEAN	133	22%	279	47%

Note: * Preliminary estimates, as noted by IEA (2013).
Source: International Energy Agency (2013). Southeast Asia Energy Outlook: World Energy Outlook Special Report.

Energy subsidies are a potentially explosive political and social issue in Southeast Asia. Many countries in Southeast Asia have fuel subsidies in place. Oil subsidies are commonly perceived to be beneficial to society, serving good economic and social objectives. When global oil prices soared in 2005, however, many such countries experienced unsustainable financial burden on the government budgets and were forced to cut back on subsidies. It is important to examine the economics of these subsidies and assess if they are indeed serving sound objectives.

Subsidies in practice often do not achieve the objectives they are expected to serve. Significant fuel price differential with respect to neighbouring countries can contribute to financial losses through fuel smuggling. To the extent that oil consumption increases under the subsidised prices, oil subsidies can have significant adverse environmental effects. As a result of the distorted fuel pricing structure, Southeast Asian economies are less efficient in their use of oil than developed countries (ADB, 2005).

Subsidy for energy consumption is a common characteristic in both developing and developed countries. Energy subsidy might be defined as any government interventions that lower the cost of energy production, raise the revenue of energy producers or lower the price paid by energy consumers. Energy subsidies would be tolerable if the subsidies can improve social welfare, create jobs creation, encourage the new sources of energy supply and promote economic development to energy security. Large energy subsidies in many countries, however, also have to compete for limited resources that could otherwise be used to deliver other essential

services, widen the scope for rent-seeking and commercial malpractice, discourage both supply- and demand-side efficiency improvement, promote noneconomic consumption of energy, and can make new forms of renewable energy uncompetitive (World Bank, 2010). There are many forms of energy subsidy, but almost all countries in the world are focused in electricity subsidy policy and fuel (i.e., kerosene, diesel and LPG) subsidy policy (IEA, 2010). Table 6 presents countries with low levels of modern energy access and their energy subsidy policies. In the case of the Philippines, 94 percent of total subsidy is allocated to the energy subsidy; while in the case of Indonesia, it is 58 percent.

Table 6: Subsidies on Electricity, LPG, and Kerosene in Countries with Low Levels of Modern Energy Access

Country	Presence of Subsidies			Electricity, LPG & kerosene subsidies as a share of total subsidies (%)
	Electricity	LPG	Kerosene	
South Africa	Yes	Yes	No	16
China	Yes	Yes	No	38
Indonesia	Yes	Yes	Yes	58
Philippines	No	Yes	No	94
Thailand	Yes	Yes	No	47
Vietnam	Yes	No	No	39
Bangladesh	Yes	No	Yes	29
India	Yes	Yes	Yes	50
Sri Lanka	Yes	Yes	No	23
Peru	No	Yes	Yes	30

Notes
1. Countries have been selected from the IEA subsidies dataset on the basis of their low levels of modern energy access (ie. electrification rate lower than 95% or modern fuels access lower than 85%)
2. Kerosene, LPG and electricity have been selected as they support the basic needs of the poor and can be more easily targeted than subsidies on other energy forms.
Sources: IEA
(2010)

c. Country Studies: Indonesia

Indonesia has a long history about energy subsidy - electricity and fuels. The subsidy has played important roles in the societies, not only for consumption but also production and distribution. Many studies show, however, that the subsidy has been misallocated. The Coordinating Ministry for Economic Affairs of Indonesia (2008) noted that subsidy has been the rich's crowd

pleaser, that is, the distribution of fuel subsidy is skewed to wealthy households. The Ministry found that the top 40% of wealthy households enjoyed 70% of the subsidies while the bottom 40% of low income households benefited only 15% of the subsidies. World Bank (2009) found similar result from a survey conducted in 2005, the richest 40% of households enjoyed 60% of the subsidy. Recent result from World Bank (2011) suggests that 50% of wealthy households consumed 84% of subsidized fuel with the top 10% consuming 40% of total subsidy. In contrast, the bottom 10% only consumed less than 1% of total subsidy. Further analysis suggests that two-third of poor households do not consume fuel at all.

For the last decade, Indonesia has had relatively high energy subsidy compared to other countries. According to a price-gap methodology, whereby subsidies are measured as the difference between the regulated retail price and an agreed benchmark price that is an estimate of the "economic price", Indonesia featured among the ten non-OECD countries providing the most generous energy subsidies in the world, in particular for oil (Mourougane, 2010). Because of these subsidies, retail gasoline price per liter and electricity tariff per kWh in Indonesia are relatively lower than other countries. Retail gasoline price per liter in Indonesia is lower than retail gasoline price in the average of Asia countries and OECD countries, and electricity tariff per kWh in Indonesia is also relatively lower than other countries (IEA, 2010). Beaton and Lontoh (2010) state that, in 1965, fuel subsidies represented approximately 20 percent of the country's total spending. In the 2000s, after the New Order regime collapsed, percentage subsidy over country's total spending has been gradually decreased. In 2005, fuel subsidies represented 29 percent of the country's total spending. In 2010, fuel subsidies represented 12 percent of the country's total spending and in 2012 represented "only" 9 percent of the country's total spending. In terms of the amount of total subsidy, in the last ten years, energy subsidy represents more than 80 percent of the Indonesia's total subsidies in which fuels subsidies represent more than 70 percent of the Indonesia's energy subsidies. In last ten years, there have been at least nine changes in terms of fuel price represented by premium price in Indonesia (Table 7). In order to compensate the changes of fuel price, the Indonesia government implemented a cash transfer program for near-poor and poor households verified by the Indonesia Statistic Bureau (BPS).

Table 7: Premium Price in Indonesia, 2003-2013

Effective Date		Premium Price (Rupiah per Liter)
Year	Date	
2013	June 22nd	6,500.00
2009	January 15th	4,500.00
2008	December 15th	5,000.00
	December 1st	5,500.00
	May 24th	6,000.00
2005	October 1st	4,500.00
	March 1st	2,400.00
2003	January 21st	1,800.00

Source: Pertamina (2012)

The Indonesian government sets the electricity rates for all of consumer groups, namely industry, business, residential and public services. The amount of subsidy is determined annually by the government, based on the difference between the average cost of electricity production proposed by *Perusahaan Listrik Negara* (PLN), the state-owned electric company, and the average electricity rates set by the government. The average cost of electricity production is based on an estimate of the composition of the energy inputs for generating electricity and the power plants, transmission, distribution and supply costs, and a margin for PLN (International Institute for Sustainable Development, 2012). In other words, Indonesian government implements electricity subsidies by reduction the cost of electricity load per month and reduction of electricity usage cost (cost per kWh). Table 8 shows the consumer and electricity rate classification.

Table 8: Consumer and Electricity Rates Classification based on Decree of the Minister of Energy and Mineral Resources No. 07 Year 2010 Date of June 30, 2010

No.	Group	Limit Power	cost of electricity load per month (2010)
1	Social Rates	22O VA	-
		450 VA	Rp10,000
		900 VA	Rp15,000
		1300 VA	*
		2200 VA	*
		3500VA–200 kVA	*
		>200kVA	*
2	Households Rates	450 VA	Rp11,000
		900 VA	Rp20,000
		1300 VA	*
		2200 VA	*
		3500 VA – 5500 VA	*
		>6600kVA	*
3	Business Rates	450 VA	Rp23,500
		900 VA	Rp26,500
		1300 VA	*
		2200 VA-5500 VA	*
		6600 VA – 200 kVA	*
		>200 kVA	*
4	Industry Rates	900 VA	Rp26,000
		1300 VA	Rp31,500
		2200 VA	*
		2200 VA – 14kVA	*
		3500 VA – 14kVA	*
		>14 kVA-200 kVA	*

Note: * PLN has its own formula to calculate the rates and it is stated on the rule.

In the last ten years, the average amounts of electricity subsidies in Indonesia account for 28 percent of total subsidies. The electricity industry in Indonesia is heavily operated by fuels (Ministry of Energy and Mineral Resource, 2013). As a result, the changes of world oil price influenced the operating cost of the electricity industry in Indonesia and electricity rates paid by consumers. In the last ten years, electricity rates in Indonesia have changed six times, namely in 2003, 2004, 2009, 2010, and 2013. Table 8 shows consumer and electricity rates classification based on the decree of the minister of energy and mineral resources no. 07 year 2010 date of June 30, 2010. In 2012, electricity subsidies reached Rp64.97 trillion.

In the last ten years, electricity rates in Indonesia have changed six times in 2003, 2004, 2009, 2010, and 2013. In 2013, the Indonesian government through the Decree of the Minister of Energy and Mineral Resources No. 30/2012 has set the electricity rates adjustments. The decree states that the adjustment will be implemented in stages by three months. It means that there are four times of electricity rates adjustments during 2013 and it is started in January 2013. Based on the decree, not of all customers are experiencing an increase in electricity rates. There aren't increases in electricity rates for customer using 450 VA electricity power and 900 VA electricity power. The electricity rates quarterly raise an average of 4.3 percent and a maximum total of 15 percent in one year.

From the descriptions above, there are two main factors why energy sectors, especially fuels, become essential factor in macroeconomic policy and budget policy in Indonesia. First, oil consumption in Indonesia has surpassed Indonesian oil production. Second, the electricity industry in Indonesia is operated heavily by fuels. As a result, the changes in world price of oil affect fuels and electricity price policy in Indonesia.

d. Country Studies: Myanmar

As of 2013, Myanmar, with a population of 59.78 million, has an electrification ratio of only 29 percent, an annual generation capacity of 10,964.9 gigawatt-hours (GWh), and an annual power consumption of 8,450.3 GWh. It exports its surplus generation to neighboring countries. Its 3,734.9 megawatts (MW) installed capacity is dominated by hydropower plants, which account for 74.44 percent of the total installed capacity (Khaing Nyein Aye 2013).

Myanmar is rich in hydrological resources. Its Ministry of Electric Power considers its four major rivers, namely, Ayeyawady (2,063 kilometers (km)), Chindwin (1.151 km), Thanlwin (1,660 km) and Sittaung (310 km), as having huge hydropower potential. Most of the existing hydropower plants are in the northern part of country; however, the areas with large electricity consumers are in the south, in the Yangon region. Thus, the power system needs long transmission lines and managing voltage drops and keeping the system stable are always a huge challenge. The current transmission and distribution facilities are also old and need upgrading. As a result, load shedding is about 20 percent of demand and transmission and distribution losses are about 19.43 percent (Khaing Nyein Aye 2013).

The country's energy sector development is primarily led by the government and the electricity sector is based on a state-owned single buyer model. ADB (2012) explains that seven ministries in Myanmar are responsible for energy matters and the Ministry of Energy is the focal point for policy and coordination. The other ministries are: the Ministry of Electric Power for the electricity generation, transmission and distribution; the Ministry of Mines for coal-related developments; the Ministry of Agriculture and Irrigation for biofuels and micro-hydro; the Ministry of Science and Technology for renewable energy; the Ministry of Environmental Conservation and Forestry for fuelwood, climate change, and environmental safeguards; and the Ministry of Industry for energy efficiency. ADB, however, notes that overall energy planning by the Ministry of Energy is limited.

Under the single buyer model for electricity, the state-owned Myanmar Electric Power Enterprise (MEPE) buys electricity from public and private producers. The MEPE is also responsible for transmission network development, operation and maintenance. It also operates gas-fired power plants. The MEPE sells electricity to two public enterprises the Electricity Supply Enterprise (ESE) and the Yangon Electricity Supply Board (YESB) (Chrisman 2014). The YESB distributes electricity to consumers in Yangon City and the ESE to the rest of the country. The ESE, on the other hand, acts as a distributor to the rest of the country, comprising 13 states and regions, and also undertakes off-grid generation (ADB 2012).

Public information on pricing of various energy products are scarce. In the case of electricity, the OECD (2014) notes that there is no standardized price setting system and the purchase price of electricity is re-negotiated on annual basis. The government, however, is aware of the need to establish such system and has announced plans to come up with one that is consistent with international practices.

Chrisman (2014) reports that the electricity tariffs are one of the lowest tariffs in Asia and heavily subsidized. Some experts estimate that production costs can be as high as 125 MMK/kWh but the tariffs are below this. The government also sells below its purchase price. For example, in October 2012, the government bought electricity at 80 Myanmar kyats (MMK)[1] per kWh but sold it to households at MMK35 to MMK50 per kWh and to industrial consumers at MMK75 per kWh. The huge subsidy required to keep up with this practice is huge and the government puts it at MMK185 billion per year (Chrisman 2014).

It has been reported that providing heavily subsidized electricity has debilitated the Ministry of Electric Power's fiscal situation and rendered it unable to invest in necessary expansion and upgrading of the power system (Chrisman 2014). As a result, blackouts have been occurring, which are especially more constant in Yangon (Myanmar Times 2014).

[1] USD1.00 = MMK974.00 as of September 6, 2014 (http://www.currencyc.com/usd-mmk.html).

The demand for electricity in Myanmar is also increasing rapidly and such rapid increase is expected to continue as electrification and industrial growth are pursued. Peak demand is expected to increase from 1,806 MW in 2012 to 3,078 MW by 2016 (Ministry of Electric Power-Myanmar 2013). Investments in new generation capacity are therefore necessary and such new investments may be discouraged by a pricing regime that heavily utilizes subsidies.

Subsidies for petroleum products are also present. According to the IMF (2013), in 2011, post-tax subsidies for petroleum products represented 9.7 percent of GDP and 16.93 percent of government revenues, pre-tax subsidies for petroleum products amounted to 0.54 percent of GDP and 9.35 percent of government revenues.

Removing subsidies has also been difficult and in the past has caused a political upheaval, such as the incident that sparked the "Saffron Revolution" in 2007. On August 15, 2007, the then ruling military junta that was officially named State Peace and Development Council declared the removal of all fuel subsidies without any warning. Immediately, the prices of diesel and petroleum rose by 66 percent, and the price of natural gas rose by 500 percent. As a result, the prices and commodities spiked, leading to protests which were first led by students and democratic activities and then after a few days were joined by thousands of Buddhist monks in saffron robes. The non-violent protests were cracked down violently by the military junta, which raided monasteries around the country and took many monks captive (Burma Center Prague 2010). This unfortunate experience should be viewed, however, not as an argument against the removal of fossil fuel subsidies but as an argument for a well-planned and phased-in approach to such removal--one that considers the political realities of a country, estimates the possible impacts on inflation, and sets up safety nets for the marginalized sectors of the economy.

e. Country Studies: The Philippines

The Philippines is a country with a population of 92.3 million in 2010[2]. Primary energy supply in the country as of 2011 was 39.4 million tons of oil equivalent (MTOE), about 40 percent of which were imported since the country's energy self-sufficiency was only about 60 percent (DOEa 2013). The Philippines consumed a total of 72,922,011 MWh of electricity in 2012 (DOEb 2013). The generation capacity mix (in terms of installed capacity) as of 2012 was: 18 percent oil, about 21 percent hydro, 11 percent geothermal, 33 percent coal, about 1 percent new and renewable energy, and 17 percent natural gas.

The Philippines' electric power industry currently has four distinct sectors: generation, transmission, distribution, and retail electricity supply. This market structure emerged as a result of reforms that began in 2001 when Republic Act (RA) No. 9136 or the Electric Power Industry

[2] The 2010 census resulted in a count of 92.3 million people but given the birth rate, the Philippines' Commission on Population estimated that as of July 27, 2014, the country's population had hit the 100 million-mark.

Reform Act (EPIRA) was passed. Prior to EPIRA implementation, the generation, transmission and supply activities were vertically integrated and the state-owned National Power Corporation (NPC) acted as the transmission grid operator, dominant generator, and sole supplier of wholesale electricity to distribution utilities (i.e., private distribution utilities, local government-owned distribution utilities, and electric cooperatives). Other generators, called independent power producers (IPPs), used to sell their generated power to NPC. Through the years, the NPC's liquidity problem grew. The NPC's bankruptcy and its impact on the country's deteriorating fiscal position in the late 1990s and early 2000s ushered the industry restructuring through the EPIRA.

With the privatization of NPC generation assets, many players in the generation sector emerged and competition was introduced through the establishment of the wholesale electricity spot market (WESM) in Luzon in 2006 and in Visayas in 2010. At present, generated power is traded through two mechanisms—one, through bilateral contracting between generating firms and distribution utilities and big end-users, and two, through the WESM. Thus, given the competitive environment, the industries for oil, hydro, geothermal, coal, new and renewable energy, and natural gas resources development are also private.

Power grid operation is also currently private. As mandated by the EPIRA, the concession for grid operation was offered to the private sector through a competitive bidding. The distribution sector remains a regulated sector with local monopolies held by the distribution utilities in their respective franchise areas. The EPIRA also laid down the framework for the introduction of retail competition and open access on distribution wires. Under retail competition, consumers with at least one MW of electricity consumption can freely choose their suppliers. The transition to retail competition officially began on June 26, 2013 and 239 consumers in the contestable market are now being supplied by their chosen suppliers.

The Philippines used to stabilize the impacts of world oil prices on domestic prices through an Oil Price Stabilization Fund but the fund was scrapped when the downstream oil industry was deregulated in 1998. Since the deregulation, the government has faced pressures to protect consumers from rising fuel prices and during periods of high oil prices in 2011 and 2012, it implemented a targeted subsidy program for public transport operators. The Public Transport Assistance Program (also called "Pantawid Pasada") distributed free smart cards, which could be used to discount fuel bills at refilling stations, to jeepney[3] and tricyle drivers. This subsidy is no longer available at present.

Electricity pricing at the wholesale level is a result of market forces—bargaining between generating firm and distribution utility for bilateral contracts and competition at the WESM for electricity not covered by bilateral contracts. The transmission operation is a natural monopoly

[3] A public utility vehicle in the Philippines which evolved from post-World War II practice of stripping down surplus military jeeps and altering these by configuring the back seat into two long parallel benches to accommodate many passengers.

business and thus the transmission charge is regulated. The distribution sector remains a regulated sector with local monopolies held by the distribution utilities in their respective franchise areas and thus the distribution charges are also regulated.

The EPIRA introduced a major reform in the distribution sector—the unbundling of the utilities' electricity rates. At present, distribution utilities show in the consumers' bills how their electric bills are divided into these components: generation charge, transmission wheeling rate, system loss, distribution charge, consumer subsidies, universal charges, and government taxes. The EPIRA also introduced the "lifeline rate" scheme or socialized pricing mechanism for consumers. Under this scheme, electricity consumption of 20 kWh or less per month is free of charge, 21-50 kWh per month enjoys a 50 percent discount in rates, 51-70 kWh enjoys 35 percent discount, and 71-100 kWh enjoys a 20 percent discount. Senior citizens are also entitled to a 20 percent discount.

A producer's price guarantee mechanism is set to be implemented in the renewable energy sector. A law enacted in 2008 instituted a feed-in tariff policy and created the National Renewable Energy Board (NREB) to administer this policy. The feed-in tariff (FIT) policy is a scheme wherein renewable energy developers are assured of a fixed FITs or price per kilowatt-hour for the energy that they will be able to produce. The payments for these FITs will then come from a FIT allowance (FIT-All) that will be collected from electricity consumers. The overall design aims to encourage the investment in and use of renewable energy resources. To date, installation targets and FIT rates per type of technology have already been approved by the regulator and renewable energy businesses are starting to invest but the actual implementation of the FIT rates and FIT-All has not yet started.

f. Country Studies: Thailand

Thailand, a country with an estimated 67.37 million people as of 2014, relies heavily on fossil fuels for its primary energy consumption. Fossil fuel consumption accounted for over 80 percent of total energy consumption in 2010. As the economy expands and industrializes, oil consumption for transportation and industrial uses grows. At present, Thailand is the second largest net oil importer in Southeast Asia, next to Singapore. Electricity generation is highly dependent on domestically abundant natural gas, accounting for over 60 percent of the 32.4 GW installed capacity in 2011. Generation in 2011 amounted to over 152 terawatt-hours (TWh) (EIA 2013).

The governance system is characterized by having a separate Ministry of Energy and an independent regulator, the Energy Regulatory Commission (ERC). The Ministry is in charge of overall government energy policy and the Commission regulates pricing, transmission expansion, and the power development fund (WEF 2012). The power development fund is being used to support the expansion of electrification in rural areas, subsidize services for underprivileged energy consumers, compensate power consumers who pay more expensive

rates due to the failure of the system operator, fund the development and rehabilitation of communities surrounding power plants, promote the use of renewable energy and low impact generation technology, and support awareness-building among the public on power-related issues. The fund is sourced from collections from electricity business operators (Ruangrong 2012).

The electric power industry is vertically integrated, with the state-owned Electricity Generating Authority of Thailand (EGAT) acting as a generating company and the sole transmission provider. EGAT awards licenses to generate to companies. It accounts for nearly half of total generation, independent power producers over 35 percent, and small state power producers the rest. EGAT sells wholesale electricity to Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA), Thailand's two distribution authorities (EIA 2013). The MEA is responsible for the distribution of electricity within metropolitan Bangkok and the PEA for the provinces of Thailand (WEF 2012).

The oil and gas industry is dominated by PTT Public Company Limited (PTT), a state-owned and fully integrated oil and gas company which undertakes exploration and production. Together with EGAT, PTT is responsible for the majority of the electricity and oil and gas industry value chains in Thailand (WEF 2012).

The price of petroleum products is being stabilized through the Oil Fund, which was established in 1973. The Oil Fund has been used not only to smoothen the impacts of world market price swings of oil but also to periodically cross-subsidize fuels that are deemed "socially sensitive" such as gasoline, diesel and liquefied petroleum gas (LPG) and, in recent years, bioethanol and biodiesel. The Committee on Energy Policy Administration (CEPA) manages the oil fund and decides on the imposition of levies or grant of subsidies to a fuel. The CEPA takes account of the global oil prices and the level of monetary reserves in the fund when determining levies and subsidies (IISD 2013).

Pricing for electric power is regulated by the ERC and is guided by an automatic adjustment mechanism. The base tariff is adjusted every four months in line with changes in fuel cost, the power purchase cost, and the impact of policy expense. Such policy expense consists of a so-called "adder" for renewable energy development and the power development fund (Ruangrong 2012). The adder is a feed-in premium for renewable energy which guarantees higher tariffs for it, with the intention to make investments profitable.

Consumer energy subsidies in Thailand exist for five energy products: LPG, natural gas for vehicles, diesel, electricity and biofuel blends. Electricity subsidies take the form of half-price up to free electricity to low-consuming households. IISD (2013) estimates that the subsidies as of 2012, which is presented in table 9 as follows:

Table 9: Subsidies for Fuel and Electricity in Thailand in 2012

Energy type	Subsidy type	Borne by	Estimate (THB million)
LPG	Direct subsidy and under-recoveries	Oil fund and oil companies	57,317
NGV	Under-recoveries	PTT	12,820*
	Excise tax exemption	National budget	n/a
	Municipality tax exemption	Municipalities budgets	n/a
	Taxi conversion from LPG to NGV	PTT	n/a
	Low interest loans	PTT	n/a
	NGV credit card	PTT	n/a
	Investment in NGV infrastructure	PTT	n/a
Diesel	Excise tax exemption	National budget	108,231
	Green Fuel for fishing vessels	PTT	n/a
Electricity	Free and half price electricity to poor	Cross-subsidized by other electricity consumers	7,550
	Regulated base tariff and fuel charge	EGAT	9,000
Ethanol blends >20%	Oil fund subsidy	Oil fund	n/a
	Reduced taxes and levies	Oil fund and national government	n/a
Biodiesel	Mandatory consumption	Fuel blenders and consumers	n/a
	Excise tax exemption	National budget	0.87
Total			194,918

* Subsidy estimates relate to 2012 except PTT losses from NGV sales, which relate to 2011.

Source: International Institute for Sustainable Development (IISD). 2013. *A Citizen's Guide to Energy Subsidies in Thailand*.

IISD (2013) notes that the fuel subsidies are "universal" in Thailand since there has been no attempt to target the poor or vulnerable groups be the sole recipients of subsidies. This means that the benefits from subsidies flow disproportionately more to those who consume more energy or the upper income groups. Electricity subsidies, on the other hand, are more targeted than fuel subsidies since the poorest consumers receive the greatest price support. However, the macroeconomic costs of energy subsidies are apparent in the fiscal strain that they impose on the government and the financial strains on state-owned companies. Moreover, such subsidies tend to undermine investments in the energy sector, as is apparent in the natural gas sector wherein below-cost rates discourage private retailers to invest in NGV refueling stations.

g. Country Studies: Singapore

In ASEAN countries, Singapore is a unique country in terms of energy and fuel subsidies. Singapore does not have fuel subsidies but has a rebate scheme for electricity use for low-income households. The rebate scheme is called U-Save scheme, which is a permanent goods and service tax voucher scheme introduced in 2012. The intended target groups are lower- and middle-income households. There are three components – Cash, Medisave and U-Save. It pays differently by types of flats. The rebate is directly credited to the households' utility account. Table 10 shows the details of the U-Save Scheme in Singapore. There was a 'special payment' in July 2014 that is one-time payment to lower- and middle-income households and another one-time 'special payment' is due in January 2015.

Table 10: U-Save Scheme in Singapore:

	April 2014	July 2014			October 2014	January 2015			April 2014
Flat Type	Regular GST Voucher U-Save	Regular GST Voucher U-Save	Special Payment	Total	Regular GST Voucher U-Save	Regular GST Voucher U-Save	Special Payment	Total	Regular GST Voucher U-Save
1-room	$65	$65	$130	$195	$65	$65	$130	$195	$65
2-room	$65	$65	$130	$195	$65	$65	$130	$195	$65
3-room	$60	$60	$90	$150	$60	$60	$90	$150	$60
4-room	$55	$55	$55	$110	$55	$55	$55	$110	$55
5-room	$50	$50	$50	$100	$50	$50	$50	$100	$50
Executive	$45	$45	$45	$90	$45	$45	$45	$90	$45

Source: Energy market Authority, 2014

The U-Save scheme pays for as low as S$180 for the residents at executive flats and as high as S$325 for the residents at 1- or 2-room flat. For example, the average electricity consumption of 1-room households is about 1,520 kWh from July 2103 to June 2014 (SP Services, 2014). Assuming the average electricity tariff during that period S$0.26 per kWh, the electricity expenses are about S$394 and the 1-room households receive S$325 from the U-Save scheme. This covers slightly more than 80% of their electricity expenses. Other than the utility rebate scheme, Singapore does not have any energy and fuel subsidies.

III. Ways of de-coupling subsidies

Energy subsidies take the form of direct cash payments by governments to energy producers or consumers to promote the production or usage of energy. Other measures that do not target the prices of energy directly include legislation or direct interventions in the market in the provision of energy, which will in turn put downward pressure on the market price.

A subsidy is defined as “any measure that keeps prices for consumers below market levels, or for producers above market levels or that reduces costs for consumers and producers” (UNEP, 2008). Energy subsidies are defined as “any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers, or lowers the price paid by energy consumers” (UNEP, 2008). Table 11 presents various subsidy mechanisms that allow a government to correct (or distort) the market in one or combined ways.

Table 11: Various Forms of Energy Subsidies

Government Intervention	Example	How the subsidy usually works		
		Lowers cost of production	Raises price to producer	Lowers price to consumer
Direct financial transfer	Grants to producers	✓		
	Grants to consumers			✓
	Lower-interest or preferential loans	✓		
Preferential tax treatment	Rebates or exemptions on royalties, sales taxes, producer levies and tariffs	✓		
	Tax credit	✓		✓
	Accelerated depreciation allowances on energy-supply equipment	✓		
Trade restrictions	Quotas, technical restrictions and trade embargoes		✓	
Energy-related services provided directly by government at less than full cost	Direct investment in energy infrastructure	✓		
	Public research and development	✓		
	Liability insurance and facility decommissioning costs	✓		
Regulations of the energy sector	Demand guarantees and mandated deployment rates	✓	✓	
	Price controls		✓	✓
	Market-access restrictions		✓	

Source: UNEP, 2008

The amount of oil subsidies can be calculated by estimating differentials in the transmissions of world prices to domestic markets. However, it is not an easy task as governments tend to hide their fiscal expenses on them and different pricing mechanisms are employed by different governments. The degree of transmission can be estimated by calculating the pass-through of oil prices between two periods:

$$\frac{p_{t+1}^{d}-p_{t}^{d}}{p_{t+1}^{w}e_{t+1}-p_{t}^{w}e_{t}} \qquad (1)$$

where p^d and p^w are the domestic fuel price in local currency and world price in US dollars, and *e* is the exchange rate (Jha, Quising and Camingue, 2009). A lower pass-through indicates higher subsidies and vice-versa. Governments that do not pass through world oil prices fully to consumers will incur a fiscal burden.

The amount of consumption subsidies can be calculated by the price-gap approach. The price-gap is any difference between the end-user price and the reference price for a commodity and the difference implies the presence of a subsidy (IEA, 2012). By isolating the subsidies that affect end-user prices, the model allows the studying of factors that affect short-term demand and supply decisions, enabling the broader testing of how subsidies might affect energy markets and society welfare (Koplow, 2009).

During the period of high volatility in the global oil price, most governments in developing countries intervened in the domestic market with price-based policies. In particular, Indonesia, Malaysia and Thailand were identified as the top subsidizers in Asia (UOB, 2008). Indonesia's oil subsidy expenditures in 2008 reached $13 billion by October, Malaysia spent $11.1 billion on fuel price subsidies between 2005 and 2008, and Thailand's oil fund nearly depleted in July 2008, after running a deficit of $2 billion in 2005 (Kojima, 2009).

Fuel subsidies often result in market inefficiency and price distortions, and fail to meet the intended objectives – to alleviate energy poverty and to promote economic development. Economic inefficiencies are caused by various reasons. First, demand-side subsidies given in the form of grants to consumers or by lowering end-user prices will lead to an increase in energy consumption as well as wastage. Policies with poor efficacy will see middle- and high-income users benefit more from the subsidies and increase their energy usage as well. These increases in demand (wastage) will in turn worsen the country's terms of trade. Net energy exporting countries end up exporting less energy overseas in order to meet domestic energy demands, thus lowering their export earnings. Net energy importers need to import more energy and hence suffer more import leakages. Economic growth is thus hampered.

Second, energy subsidies aiming to alleviate energy poverty and to raise living standards among the poor that may not be as effective as intended by the government because only a small proportion of subsidies going to the poor (IEA, 2010). The World Bank estimated that the richest 20% of the population in Venezuela received six times more in fuel subsidy per person than the bottom third of the population in the early 1990s (Baig, Mati, Coady and Ntamatungiro, 2007). The fuel subsidy have distorted the allocation of resources and led to investment or consumption choices that do not reflect the scarcities of resources, thus moving the economy

further away from Pareto-optimality. The less than optimal allocation of resources in turn results in a sub-optimal outcome for consumption and economic growth. The lack of infrastructure in the rural area where most of the lower-income households live and the administrative complexities involved also often result in the ineffectiveness of the subsidy policies in several developing countries (Barnes and Halpern, 2000).

Third, subsidies usually put a significant fiscal burden on governments. The average domestic fuel subsidy burden in major oil-exporting countries in 1999 was about 3.5% of the countries' GDP (Baig, Mati, Coady and Ntamatungiro, 2007). This is a direct fiscal cost on the governments when domestic subsidized oil prices do not adjust to match changing (rising) world prices. In 2005, average fuel prices doubled, and the low level of retail fuel prices in Indonesia meant that government subsidies doubled from 2003 to 2005, with the subsidies estimated to be 3.4% of GDP in 2005 (Baig, Mati, Coady and Ntamatungiro, 2007). To reduce a budget deficit, Malaysia cut fuel subsidies and allowed government-controlled fuel prices to rise between 2004 and 2008. The fuel price hike in February 2006 alone appeared to make the government to save RM4.4 billion (Narayanan, 2007). The saved government revenues could be recycled for better uses.

Fourth, poorly designed and/or enforced subsidy schemes can be abused and further increase the government's fiscal burden but without achieving the desired effect. For instacne, differences in fuel subsidy schemes have led to sharp price differences between neighboring Arab countries between Egypt and the Palestinian territories that resulted in large-scale fuel smuggling across borders (Fattouh and El-Katiri, 2012).

ASEAN countries have provided extensive price subsidies to consumers to raise the welfare of lower-income households and to promote social equity. A unit subsidy is the typical form of energy and fuel subsidies in ASEAN countries. If a lump sum amount that is equivalent to the subsidy amount based on the unit subsidy were paid to the target groups for the subsidies, then their utility would have been greater than that under the unit subsidy (Dahl, 2014). The cash payment is clearly better as it is enhancing the poor's welfare but in reality it does not work that way as stated earlier. The amount of cash paid the poor may not be used for purchasing energy or electricity but some other purposes. This clearly will not achieve the stated goal of giving subsidies – to help the lower- and middle- income households get the sufficient amount of energy to sustain decent life. Although economic theory clearly tells the cash payment scheme will enhance the consumer's welfare under subsidy but in reality the cash payment will not guarantee whether the stated goals for giving subsidies have been achieved as the cash payment scheme will come with many leakages. Without sealing the leakages, the cash payment scheme may perform poorer than the unit subsidy scheme.

The retails prices of various oil products in Indonesia, Malaysia and Thailand that are results of fuel subsidies and those prices in Singapore where no fuel subsidies are prevailing are presented in table 12. It clearly shows that most of the retail prices of various oil products in Singapore are more than twice expensive than those in Indonesia, Malaysia or Thailand. The prices in Singapore are linked to the global price.

Table 12: Retail Prices of Various Oil Products (Unit: US$/liter, US$/kg for LPG)

	Indonesia	Malaysia	Thailand	Singapore
Premium	0.537	0.516	0.687	1.120
Regular	0.594	0.508	0.667	1.050
Diesel	0.578	0.427	0.655	0.645
LPG	0.510	0.486	0.433	1.436
Kerosene	0.219	-	0.670	-

Source: Statistics from ADB (2005); EPPO (2006); NEAC (2006); Pertamina (2006); Singapore Power (2004); Tan and Lian (2005). Calculations author's own.

As Singapore proves in implementing its U-Save scheme, direct payment to the subsidy recipient's energy or electricity account would be the best available option as it can seal such leakages and minimize the possible dead weight loss from implementing energy and fuel subsidies. Even a voucher can be used wrongly if It can be discounted somewhere.

The forms of effective subsidies need to be identified if there is such s form. With this, we can estimate the potential in saving from phasing out ineffective subsidies.

IV. Suggested options

Removing energy and fuel subsidies, apparent and hidden alike, are virtually not possible. This will lead us to find a second best option – any subsidy scheme with the least leakage. One suggested option is what Singapore is implementing – U-Save scheme. Crediting subsidies directly to the customer's account would be the best option. More details need to be developed through various in-depth studies and refined via simulations and field tests.

V. Conclusions

Energy is a necessity and many governments in ASEAN have energy subsidies. Helping the poor is a novel goal but in reality it ends up helping those who do not need such subsidies. With the intrinsic deadweight loss of energy subsidies, missing the target of the energy subsidies have made removing energy subsidies or improving the system of energy subsidy programs a top priority of policy-makers in ASEAN countries. The gap between the domestic energy price and the global one needs to be reduced and eventually eliminated.

In terms of social welfare, however, energy subsidies are an essential channel of securing a certain level of standard of living for the poor or needy people. As many cases in ASEAN countries have shown, a unit subsidy or cash payment will not achieve the intended goal of helping the poor. The U-Save scheme in Singapore that directly deposits the amount of the subsidy into the recipient's account could be an example that can be implemented for energy subsidies at the least cost but maximized benefits for the target group.

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TARIFF BARRIERS – AN ASSESSMENT OF TRADE AND INVESTMENT
BARRIERS IN ENERGY SERVICES IN ASEAN

Joy Abrenica, Adora Navarro and Tri Widodo

I. Motivation

The goal of the ASEAN Plan of Action for Energy Cooperation (APAEC) 2010-2015 is to ensure that the region would have secure and reliable energy supply through regional infrastructure projects such as the ASEAN Power Grid and Trans-ASEAN Gas Pipeline. While APAEC makes no explicit reference to liberalization of trade and investment in energy services, it is sensible to suppose that such measure is in the menu of strategies being considered by the ASEAN leaders to meet the plan's objective.

Bringing energy services into the fold of multilateral disciplines, however, has not had much success, except in a few preferential trading arrangements. Many countries are still protective of their domestic energy suppliers and natural resources, and thus maintain high barriers to foreign trade and investment in energy services.

Yet there are notable changes. A growing number of economies are becoming more disposed towards open and nondiscriminatory market for energy. In these economies, new regulations encouraging competition and private sector ownership are replacing heavy market controls and government ownership – propelled in many cases by the poor performance of state-owned utilities. The fiscal burden of subsidies and investment deficiencies in certain activities because of distorted incentives structure are also providing additional impetus to market reforms.

Many economies are likewise refraining from using price controls and import restrictions, particularly in globally traded fuels such as oil and coal. Where there are active spot and futures trading markets and financial instruments that can help reduce price volatility, it is more logical and practical to provide free rein to market forces in determining energy prices and managing supply. Moreover, even in markets where state utility monopolies are still in control, opportunities for domestic and foreign firms to sell to such monopolies have been introduced as a way of ensuring that capacity additions and innovations are not held up by limitations in public funds.

Despite the changing landscape, significant barriers to energy trade and investment persist. This paper takes stock of these barriers and proposes measures to eliminate them through the multilateral disciplines of ASEAN. The focus is on energy services**,** or activities related to the "exploration, development, extraction, production, generation, transportation, transmission, distribution, marketing, consumption, management, and efficiency of energy, energy products,

and fuels."[4] The policies of the individual ASEAN Member States (AMS) that impede foreign trade and investments in energy services are identified and assessed. The main source of these policies is the individual Member's schedule of commitments in the ASEAN Free Trade Agreement in Services (AFAS). Their energy programs and plans are also reviewed to evaluate their inclination to forego these barriers to attain energy market integration. Other issues that may impact negotiations to reduce or eliminate trade and investment barriers are also discussed such as the application of emergency safeguards and inclusion of regulatory disciplines in the energy services agreement.

The next section defines the scope of energy services. The WTO Secretariat Note on Energy Services serves as the main reference, albeit Indonesia's parallel classification is also discussed. Section III takes an inventory of energy sector commitments in AFAS. Few AMS made specific commitments to energy services, but all underwrite several energy-related sectors. Section IV discusses the nature of trade and investment restrictions maintained by AMS in energy and related sectors. Whether or not the AMS are inclined to lift these barriers may be deduced from their policies, programs and plans that are analyzed in Section V. The shape of an energy services agreement to remove the identified barriers is explored in Section VI. Apart from modalities and timeline of liberalization, the agreement may also contain provisions on emergency safeguards and disciplines on government procurement. It may also include a Reference Paper (akin to the telecommunications reference paper) that would impose obligations on AMS to institute competition safeguards and regulatory reforms. Finally, Section VII summarizes key issues and outlines the tasks ahead towards attaining energy market integration.

II. What are Energy Services?

In spite of the sector's size and importance, energy services have not been well represented in global trade agreements. A possible explanation for this omission is the ambiguity on the scope of energy services. Unlike construction or telecommunications, energy services are not identified as a separate division in the United Nation's provisional central product classification (UNCPC), nor in the WTO services sector classification (W/120). Rather, what are considered energy services appear in the W/120 with other generic services, such as business services, construction, distribution and transportation. In ASEAN, as it is in THE WTO, Members use the W/120 as a guide for scheduling their commitments. Negotiators tend to focus on sectors whose scope is readily identifiable, trade is significant and there is strong business and consumer interest in trade liberalization. That energy services are not easily distinguishable from other

[4] Definition of "energy services" in the "Communication from the United States: Energy Services," S/CSS/W/24, Council for Trade in Services, World Trade Organization, 18 December 2000.

services categories in W/120 make the sector less of a candidate for commitments and negotiations. Unless the definitional issues are settled, no meaningful negotiations on the sector can proceed.

Recently, the Secretariat Note on Energy Services, issued by the Council for Trade in Services of the World Trade Organization (S/C/W/311, 12 January 2010) identified three main energy services activities, namely:

- Services incidental to mining, which includes:
    - services rendered on a fee or contract basis at oil and gas fields, e.g., drilling services, derrick building, repair and dismantling services, oil and gas well casings cementing services (CPC 883), but excluding mineral prospecting services, oil and gas field exploration and geophysical (e.g., seismic) and geological surveying services which are covered by engineering-related scientific and technical consulting services (CPC 8675); and
    - site preparation work for mining, including tunneling, overburden removal and other development and preparation work of mineral properties and sites (CPC 5115), but excluding construction services incidental to oil and gas mining which are classified under CPC 88300[5];
- Services incidental to energy distribution (CPC 887), referring to:
    - transmission and distribution services on a fee or contract basis of electricity, gaseous fuels and steam and hot water to household, industrial, commercial and other users, but excluding transport services via pipeline on a fee or contract of petroleum and natural gas; and
- Transportation of fuels, specifically:
    - transportation via pipeline of crude or refined petroleum and petroleum products and of natural gas (CPC 7131); and
    - transportation of coal slurry (covered under "Transportation of other goods", CPC 7139).

It is important to underscore that the activities enumerated above refer to "services incidental to" production activities such as mining and manufacturing. The main production activity *per se*, whose end-product is a good, is not a service, and therefore outside the scope of AFAS. But if the production is for a fee or on contract basis, *i.e.,* on account of a third party, such activity is nonetheless classified a service. Thus the same activity carried out by a contractor and manufacturer may be treated differently – the former as a service, the latter not. The decisive factor of whether to consider an activity a service or production is the ownership of the raw material that is processed, treated or transformed. The activity undertaken by a manufacturer

[5] The explicit exclusion of services incidental to mining oil and gas is meant to delineate similar activities that are undertaken for coal mining. Thus CPC 883 is understood to cover the former, while CPC 5113, the latter.

that owns the raw materials is a production, whereas that by a contractor on account of another producer is a service.

If the activity is not production for a fee or contract, how does one distinguish mining from services incidental to it? The WTO Members grappled with this difficult question and offered the following specific activities as examples of services incidental to mining: "on land site preparation, on land rig installation, drilling, drilling bits services, casing and tubular services, mud engineering and supply, solids control, fishing and downhole special operations, well site geology and drilling control, core taking, well testing, wireline services, supply and operation of completion fluids (brines), supply and installation of completion devices, cementing (pressure pumping), stimulation services (fracturing, acidising and pressure pumping), work over and well repair services, plugging and abandoning of wells."[6] Similarly, apart from transmission and distribution for a fee or contract, CPC 887 covers incidental activities such as central network control services and power management and monitoring services. It is not clear however if transmission and distribution *per se* are covered by CPC 887, but the general view is they are.

In addition to the above subsectors, the following activities, to the extent they are critical to the energy supply chain, are considered energy-related services:

- construction work for long distance pipelines and power lines;
- wholesale trade services of solid, liquid and gaseous fuels and related products;
- retail sale of fuel oil, bottled gas, coal and wood;
- bulk storage services of liquids or gases;
- engineering design services for oil and gas recovery procedures;
- construction, installation and/or maintenance of drilling equipment, pumping stations, treating and storage facilities and other oil field facilities.
- geological, geophysical and other scientific prospecting services;
- testing and analysis services of the chemical and biological properties of soil and minerals;
- management consulting services; and
- services related to management consulting

The broad list of activities considered as energy services reflects the thinking that all activities in the supply chain should be considered, although only those that are usually outsourced are services. Such comprehensiveness however poses a conceptual problem that many of the activities regarded as energy-related are lumped with other services that are non-energy. For example, construction work for dams, long distance pipelines and power lines is classified under the broad heading of "construction work for civil engineering (CPC 513). Similarly, wholesale trade services of solid, liquid and gaseous fuels are indistinguishable from other wholesaling

[6] WTO Secretariat Note, pp. 11-12.

activities under the subclass CPC 622, broadly labeled as "wholesale trade services". In this sense, therefore, it is impossible to delineate the boundaries of the energy services sector using the CPC. Nonetheless, the UN classification system provides a useful starting list of activities that may be covered by energy services.

Nor has the CPC helped resolve several definitional issues. A lingering debate is whether electricity is a good or service. One view maintains that generated power is a commodity produced through a process of transforming fuels into electrons. A contrary view underscores, however, the services-like characteristics of electricity – non-storable and must be consumed as it is produced. This debate has far-reaching implications since it determines which agreement (hence discipline) applies to the activity. If treated as a good, ATIGA or GATT applies; if services, then it is subject to AFAS or GATS discipline.

Which between ATIGA and AFAS applies to electric power generation matters significantly to the growing community of independent power producers (IPPs). The rules of ATIGA apply to goods manufactured, not to producers, whereas the disciplines of AFAS are enforced on the producers. If electricity were considered a good, then the IPPs cannot demand market access and national treatment that are only granted under AFAS.

There is no final word on the issue but most WTO Members seem to share the view that electricity is a commodity, hence generation of electricity falls outside the GATS discipline, but transmission and distribution of electricity are services. The recent dispute on Canada's feed-in-tariff (FIT) program that was viewed as violation of Canada's obligations under GATT 1994 suggests a leaning towards the commodity interpretation of electricity.[7]

Still, the foregoing conceptual conundrum is not confined to electricity; it applies also to oil refining, gas liquefaction and re-gasification.[8] Again, it matters whether these activities are viewed as production or services in determining the rights and obligations of suppliers.

The issue is confounded further by the liberality afforded to Members in scheduling their commitments in AFAS. In general, AMS follow the CPC, but may choose not to. Indonesia, for

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[7] See WT/DS412/10 and WT/DS426/9.

[8] Although there are contending views on the classification of these activities, three versions of the CPC, including the latest, categorized regasification and liquefaction as services. Concretely, these activities are labeled "liquefaction and re-gasification of natural gas for transportation" under Division 67 of "supporting transportation services".

example, adopted the classification that they proposed to the WTO in 2001, which included activities bordering on production and services. Indonesia's insistence on adopting its proposed classification reflects its view that a broader classification would give more opportunities to developing countries to participate in trade.

Under the Indonesian classification system (which was in hue with the proposal of Venezuela at that time), the sector is divided into five subclasses: upstream activity, downstream activity, energy commercialization, professional services and other energy services. Upstream services consist of activities related to exploration and development of renewable and nonrenewable energy sources. Downstream services pertain to energy transformation, transportation and distribution. Energy commercialization services consist of wholesale and retail supply of energy and commission's agent services. Professional services cover specialized supply services, human resources training and development services. Finally, "other energy services" is a gamut of activities not included in the four other subclasses.

The Indonesian system includes detailed activities that fall under the same CPC classes in the WTO energy services classification. For example, among the upstream activities is the "exploration, drilling and sampling services" which is classified as "services incidental to mining" (CPC 88300). But the Indonesian system is more expansive since it includes activities not covered in the WTO energy services checklist. Specifically, "other energy services" include research and development (R&D) activities in resource exploration, petroleum, material and conservation technologies, as well as environment protection services. Annex I juxtaposes the WTO and Indonesian energy services classification systems.

III. Specific Commitments on Energy Services in AFAS[9]

A. Main Energy Services

If the commitments in AFAS are any indication, the path towards energy market integration seems long and arduous. At this stage, only a handful of AMS are willing to liberalize their main energy services sector as Table 1 suggests. The list includes energy services identified by the WTO from the CPC as well as those that have no specific CPC codes but are distinctly energy-related.

[9] See Annex II for an inventory of sector-specific commitments of the 10 Member States.

Table 1. Commitments Undertaken by AMS on Main Energy Services

	CPC No.	No. of AMS
Services incidental to mining:		
Services rendered on a fee or contract basis at oil and gas fields	883	0
Site preparation work for mining	5115	0
Services incidental to energy distribution	887	3
Services incidental to energy manufacturing (including electricity)	-	1
Services related to energy supply	-	1
Services related to power generation	-	1
Transportation via pipeline of crude or refined petroleum and petroleum products and of natural gas	7131	2
Transportation of other goods (which includes coal slurry)	7139	1

The foregoing attests to the scarcity of commitments in main energy services. None of the AMS made commitment to liberalize services incidental to mining; only four (Cambodia, Indonesia, Myanmar and Philippines) have undertaken commitments in services incidental to energy distribution; only two (Cambodia and Philippines) committed to liberalizing transportation of crude or refined petroleum via pipeline; and only one (Cambodia) scheduled transportation of coal slurry. On the other hand, Myanmar and the Philippines scheduled commitments in sectors not identified in the CPC, specifically services related to energy manufacturing and services related to energy supply and power generation, respectively.

Two of the three AMS that scheduled services incidental to energy distribution have much narrower commitments than the full coverage of CPC 887. Cambodia, in particular, specified that it is committing only to "consultancy services related to the transmission and distribution on a fee or contract basis of electricity, gaseous fuels and steam and hot water to household, industrial, commercial and other users." Similarly, Indonesia stipulated that its commitment covers only "consultancy services related to operation of power plant and network. In contrast, without limiting its commitment, the Philippines clarified its understanding of CPC 887 coverage as "energy distribution networks such as pipelines for transmission, distribution and supply of natural gas, and power transmission and distribution system."

Following two major market reforms in 1998 and 2001 – oil deregulation and electricity market restructuring, respectively –the Philippines emerges to have the deepest commitments in energy services among the AMS. Thus, the Philippines committed to liberalizing the operations of oil terminals, depot and refinery, as well as the exploration and development of oil and gas, geothermal and coal. The Philippine AFAS schedule also indicates that it permits the construction and operation of power plants under a build-operate-transfer (BOT) scheme. But in practice, the Philippine policies are even more liberal than its schedule of commitments bears out. Under the law that restructured the Philippine electricity market, foreign entities are not limited to constructing and operating power plants under a BOT scheme; instead they could do on their own account.[10]

It may seem that Myanmar's commitments are broader and deeper than the Philippines because it committed to energy manufacturing, not just supply and power generation. Yet this is doubtful because of the ambiguity in Myanmar's schedule. Other than stipulating that energy manufacturing includes electricity, Myanmar provided no further information on which activities it meant to cover. Is generation of electricity, or production of any energy, covered by such commitment? The former seems to be suggested by the inclusion of electricity. Since the sector is not found in the CPC, the lack of information on its coverage somewhat undermines the usefulness of the commitment in attracting foreign suppliers and investors. Worse, it renders Myanmar vulnerable to future disputes on potential breaches of its commitment.

B. Energy-Related Services

In contrast to the limited commitments in main energy services, Member States appear more inclined to undertake commitments in services that may be considered energy-related. However, it is difficult to ascribe such liberality to their pursuit for energy market integration since the sectors involved are too broad in scope, so that energy-related activities are just among many that they cover. Thus the commitment on engineering services, for example, may have been propelled by other considerations such as promoting labor mobility, without regard to its possible contribution to energy market integration. Nonetheless, since engineering services are important to the energy supply chain, the commitment is still considered to contribute to the goals of AEMI.

An inventory of AMS commitments in energy-related services sectors is presented in Table 2. Most of these sectors – management consulting for instance – can hardly be identified as energy

[10] In fact, since the Philippine government is no longer allowed to build its own power plants, the BOT scheme referred to in the schedule no longer applies.

services because of their very wide scope. A commitment to such sector is nonetheless counted as commitment on energy-related services unless the scope of commitment is delimited. If the schedule is written plainly for wholesale trade services (CPC 622), for example, it is presumed to apply to wholesale trade services of solid, liquid and gaseous fuel, unless otherwise stipulated. Where the commitment is however identified for a non-energy activity, e.g., wholesale trade services of food, beverages and tobacco, it is considered to apply only to the activity identified and to nothing else, hence it is not counted as an energy services commitment.

Table 2. Commitments Undertaken by AMS on Energy-Related Services

	CPC No.	No. of AMS
Engineering services	8672	10
Integrated engineering services	8673	8
Management consulting services	865	9
Services related to management consulting	866	8
Technical testing and analysis services	8676	8
Related scientific and technical consulting services	8675	4
Maintenance and repair of equipment	8861-8866	3
Construction work for civil engineering	513	9
Renting services related to equipment for construction or demolition of building or civil engineering works with operator	518	8
Commission agents' services	621	6
Wholesale trade services	622	4
Retailing services	632	4
Retail sales of motor fuel	613	2
Maritime transport - freight transportation	7212	10
Rail transport services - freight transportation	7112	4
Internal waterways transport - freight transportation	7222	3
Road transport services - freight transportation	7123	8
Services auxiliary to all modes of transport - storage and warehouse	7422	8
Liquefaction and gasification only for coal	884	1
Business services on subsurface surveying services	86752	2
Surface surveying services	86753	1
Skill training services (not classified under education services and educational institution) related to alternative energy production, on a fee or contract basis	97090	1

There appears to be convergence of commitments in 10 out of 23 of energy-related services. Indeed, all AMS undertook commitments in engineering services and maritime transport for freight transportation. Except for one or two AMS, most committed to the liberalization of integrated engineering services, management consulting services, services related management consulting, technical testing and analysis services, construction work for civil engineering,

renting services related to equipment for construction or demolition of buildings or civil engineering works, road transport for freight transportation and services auxiliary to all modes of transport – storage and warehouse.

All of the foregoing services contribute ultimately and significantly to the production and distribution of energy. The liberalization of maritime transport for freight, as a case in point, is relevant in transporting bulk liquids or gases in special tankers. Likewise, the liberalization of services auxiliary to all modes of transport is seen to facilitate bulk storage and warehousing of liquids and gases. To this end, enforcing the market access and national treatment obligations of those who undertook commitments in these sectors is a significant step towards the attainment of an integrated energy market.

C. Comparison of Commitments in Energy and Non-energy Services

The scheduling of a number of energy and energy-related services in AFAS is indeed a positive sign, even if such commitments were motivated by other goals unrelated to energy market integration. It bears asking however whether the commitments in energy services are more or less liberal than those taken in non-energy sectors.

To facilitate comparison of commitments in the two sectors, reference is made to the horizontal commitments or limitations on market access and national treatment that apply to all sectors included in the schedule unless stipulated otherwise. An exemption from the horizontal commitments makes the commitment to the sector more liberal. On the other hand, the inclusion of additional limitations renders the commitment to the sector more restrictive than those applied to other scheduled sectors. Where the horizontal commitment is “unbound”, a definite limitation makes the commitment more liberal. If the horizontal limitation is defined, an “unbound” entry makes the commitment to the sector more restrictive.

Tables 3 and 4 show on which energy services are commitments more liberal than those taken on non-energy services based on limitations on market access under modes 3 and 4, respectively. Under mode 3, commitments of Brunei and Cambodia are generally less restrictive in energy than in non-energy services. The opposite is true for Malaysia and the Philippines. Overall, the market access commitments in energy services under mode 3 are more restrictive than in non-energy services. Under mode 4, the number of more restrictive commitments in energy is just about the same as those equally restrictive compared to non-energy services.

Table 3. Comparison of Commitments in Energy and Non-energy Services : Limitations on Market Access, Mode 3

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
Engineering services	8672										
Integrated engineering services	8673										
Management consulting services	865										
Services related to management consulting	866										
Technical testing and analysis services	8676										
Services incidental to mining	883										
Services incidental to energy distribution	887										
Related scientific and technical consulting services	8675										
Maintenance and repair of equipment	8861-8866										
Construction work for civil engineering	513										
Renting services related to equipment for construction or demolition of building or civil engineering works with operator	518										

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
Commission agents' services	621										
Wholesale trade services	622										
Wholesale trade services of electricity, town gas, steam and hot water											
Retailing services	632										
Retail sales of motor fuel	613										
Retailing services of electricity, town gas, steam and hot water											
Maritime transport - freight transportation	7212										
Rail transport services - freight transportation	7112										
Internal waterways transport - freight transportation	7222										
Road transport services - freight transportation	7123										
Pipeline transport - transportation of fuel	7131										
Transportation of other goods	7139										
Services auxiliary to all modes of	7422										

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
transport - storage and warehouse											
Liquefaction and gasification only for coal	884										
Business services on subsurface surveying services	86752										
Surface surveying services	86753										
Services related to supply of energy											
Services related to power generation											
Skill training services (not classified under education services and educational institution) related to alternative energy production, on a fee or contract basis	97090										

Color legend: yellow = less restrictive; green = equally restrictive; red = more restrictive.

Table 4. Comparison of Commitments in Energy and Non-energy Services : Limitations on Market Access, Mode 4

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
Engineering services	8672										
Integrated engineering services	8673										
Management consulting services	865										
Services related to management consulting	866										
Technical testing and analysis services	8676										
Services incidental to mining	883										
Services incidental to energy distribution	887										
Related scientific and technical consulting services	8675										
Maintenance and repair of equipment	8861-8866										
Construction work for civil engineering	513										
Renting services related to equipment for construction or demolition of building or civil engineering works with operator	518										

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
Commission agents' services	621										
Wholesale trade services	622										
Wholesale trade services of electricity, town gas, steam and hot water											
Retailing services	632										
Retail sales of motor fuel	613										
Retailing services of electricity, town gas, steam and hot water											
Maritime transport - freight transportation	7212										
Rail transport services - freight transportation	7112										
Internal waterways transport - freight transportation	7222										
Road transport services - freight transportation	7123										
Pipeline transport - transportation of fuel	7131										
Transportation of other goods	7139										
Services auxiliary to all modes of	7422										

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
transport - storage and warehouse											
Liquefaction and gasification only for coal	884										
Business services on subsurface surveying services	86752										
Surface surveying services	86753										
Services related to supply of energy											
Services related to power generation											
Skill training services (not classified under education services and educational institution) related to alternative energy production, on a fee or contract basis	97090										

Color legend: yellow = less restrictive; green = equally restrictive; red = more restrictive.

IV. Barriers to Trade and Investment in Energy Services

As in other services markets, foreign suppliers face various forms of restrictions on trade and investment that essentially fall under two categories: limitations on market access and national treatment, and distortive and discriminatory regulations. Concretely, among these barriers are the following:

- direct restriction on foreign service suppliers to provide services across borders;
- cross-border restrictions on entry of equipment and tools needed for production or maintenance service;
- establishment restrictions, i.e., caps on foreign ownership, requirements to enter into joint venture with local suppliers;
- restrictions on mergers and acquisitions;
- restrictions on deployment of foreign executives, technicians and other specialists;
- restrictions on temporary entry of skilled people and manager, often in terms of unclear or discriminatory rules for multiple-entry visas and for the period that temporary workers may stay in the country;
- cumbersome and opaque licensing procedures applied to energy service providers;
- regulatory uncertainty and lack of transparency in decision making;
- application of mandatory renewable portfolio standards to the extent that they favor local products from specific regions and state, and de facto exclude imports from eligibility; and
- discriminatory access to essential facilities such as transmission and distribution systems.

The individual schedules of commitments in AFAS identify the limitations on market access and national treatment that Member States maintain on the sectors they have committed to liberalize. In energy services, these limitations are mostly found in mode 3 (commercial presence) and 4 (presence of natural persons). Table 5 summarizes these restrictions.

Table 5. Types of Barriers to Trade and Investment in Energy Services

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
Engineering services	8672	1,3,4,5	4, 5	3, 4, 5	3, 4, 5	3, 4, 5, 6	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	4, 5
Integrated engineering services	8673	1,3,4,5	4, 5	3, 4, 5	3, 4, 5	3, 4, 5, 6	3, 4, 5		3, 4, 5		4, 5
Management consulting services	865	3,4,5	4, 5	3, 4, 5	3, 4, 5	3, 4, 5, 6		3, 4, 5	4, 5	4, 5	4, 5
Services related to management consulting	866	3,4,5	4, 5	4, 5		3, 4, 5, 6		3, 4, 5	4, 5	4, 5	4, 5
Technical testing and analysis services	8676	3,4,5	4, 5	3, 4, 5		3, 4, 5, 6		3, 4, 5	4, 5	4, 5	3, 4, 5
Services incidental to mining	883										
Services incidental to energy distribution	887		4, 5	3, 4, 5			3, 4, 5	3, 4, 5			
Related scientific and technical consulting services	8675	3,4,5	4, 5							4, 5	4, 5
Maintenance and repair of equipment	8861-8866	3,4,5		3, 4, 5				3, 4, 5			
Construction work for civil engineering	513	3,4,5	4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5		4, 5	4, 5
Renting services related to	518	3,4,5	4, 5	3, 4,	3, 4, 5		3, 4, 5	3, 4, 5		4, 5	4, 5

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
equipment for construction or demolition of building or civil engineering works with operator				5							
Commission agents' services	621		4, 5				3, 4, 5	3, 4, 5	4, 5	4, 5	3, 4, 5
Wholesale trade services	622					3, 4, 5, 6	3, 4, 5		4, 5		3, 4, 5
Wholesale trade services of electricity, town gas, steam and hot water											
Retailing services	632					3, 4, 5, 6	3, 4, 5				3, 4, 5
Retail sales of motor fuel	613		4, 5					3, 4, 5		4, 5	
Retailing services of electricity, town gas, steam and hot water											
Maritime transport - freight transportation	7212	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5
Rail transport services - freight transportation	7112	3, 4, 5		3, 4, 5				3, 4, 5			3, 4, 5
Internal waterways transport - freight transportation	7222			3, 4, 5	3, 4, 5						3, 4, 5
Road transport services - freight	7123		4, 5	3, 4,	3,	3, 4,		3,	4, 5	3,	3, 4,

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
transportation				5	4, 5	5, 6		4, 5		4, 5	5
Pipeline transport - transportation of fuel	7131		1, 3, 4, 5					3, 4, 5			
Transportation of other goods	7139		1 ,3, 4, 5								
Services auxiliary to all modes of transport - storage and warehouse	7422	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5	3, 4, 5, 6	3, 4, 5	3, 4, 5		4, 5	3, 4, 5
Liquefaction and gasification only for coal	884			3, 4, 5							
Business services on subsurface surveying services	86752			3, 4, 5		3, 4, 5, 6					
Surface surveying services	86753					3, 4, 5, 6					
Services related to supply of energy								3, 4, 5			
Services related to power generation								3, 4, 5			
Skill training services (not classified under education services and educational institution) related to alternative energy	97090					3, 4, 5					

	CPC	BRU	CAM	INA	LAO	MAL	MYA	PHL	SGP	THA	VNM
production, on a fee or contract basis											

Legend: 1 = cross-border restrictions on foreign service suppliers; 2 = cross-border restrictions on entry of equipment and tools needed for production or maintenance services; 3 = establishment restrictions, e.g., caps on foreign ownership, registrations requirements, terms of joint venture agreements with local suppliers; 4 = restrictions on deployment of foreign executives; 5 = restrictions on temporary entry of skilled personnel; 6 = restrictions on mergers and acquisition.

V. Energy Policies in ASEAN Member States

Given the commitments of Member States to liberalize energy services that are critical to the attainment of market integration, a key question is how inclined are the economies in implementing policy reforms, and even market restructuring, to see through the elimination of trade and investment barriers. This section reviews the present energy policies and programs of individual AMS to discern their potential stance to an agreement that would seek to eliminate these barriers.

A. Myanmar

Foreign investment in Myanmar was previously governed under the Foreign Investment Law of 1988. A new Myanmar Foreign Investment Law (MFIL) was enacted on November 2, 2012 which declared open to foreign investment many types of economic activities, but exempted those economic activities which are already reserved for the state by the State-owned Economic Enterprises Law (SEE Law). Myanmar laws and implementing rules are in the local language, but there are available interpretations. PwC Myanmar (2014) explains that the SEE Law specifies 12 economic activities which are closed to private investment and can only be carried out by the government. Among these activities, the ones which directly relate to the energy sector are: exploration, extraction and sale of petroleum and natural gas and production of products of the same (item 3 in the list); and electricity generating services, other than those permitted by law to private and cooperative electricity generating services (item 11 in the list).

PwC Myanmar also notes that the government, on a case-by-case basis, may permit the 12 activities to be carried out by any person or economic organisation, with or without a joint venture with the government and subject to unspecified conditions. The newly transformed Myanmar Investment Commission or MIC (a commission formed in 1994 as a government-appointed body and transformed in 2012 into an independent board) deliberates on the

investment proposals submitted to the government on a case-by-case basis. PwC Myanmar reports that as of January 31, 2013, the MIC notification includes the following:

- 21 types of economic activities which are not allowed to be carried out by foreign investors
- 42 types of economic activities to be allowed only by joint venture with Myanmar citizens
- types of economic activities to be allowed in accordance with the particular conditions specifically prescribed such as:
  (a) types of economic activities to be allowed only with the recommendations of the relevant ministry

  (b) types of economic activities to be allowed only with the approval of others (i.e. meeting some standards and requirements such as meeting Good Animal Husbandry Practice)

  (c) types of economic activities requiring environment impact assessment reports.

The PwC report, however, does not list the specific types of activities.

Lui (2013) explains that pursuant to the MFIL, the government published as implementing rules the Foreign Investment Rules and the Classification of Types of Economic Activities Notification (collectively, the Rules). Under the rules, foreign equity in joint ventures is limited to a maximum of 80 percent for a range of restricted sectors, such as infrastructure development and construction. Foreign investment in such restricted sectors may be subject to specific conditions and approvals, including clearances from the relevant government ministries and regulatory offices. Local equity in an enterprise established under the MFIL can be transferred to foreigners (or other Myanmar citizens) but such transfer is subjet to approval by the MIC, which can withhold the approval on a "broad range of grounds."

Foreigners and foreign companies are also prohibited from owning land, as expressed in the 1987 Transfer of Immovable Property Restriction Law. Transfer to a foreigner or foreign company by way of sale, purchase, gift, acceptance of a gift, mortgage, acceptance of a mortgage, exchange or any other means are expressly prohibited. However, under the new MFIL, investors are eligible to lease land from the government or private citizens or business for a lease term of up to 50 years, with the option for two continuous extensions of 10 years if approved by the MIC. Investors must register their land lease agreement with the Registrar of Deeds. Such registration may be waived by the MIC, but the lease agreement must still be properly stamped as required by the Burma Stamp Act.

The mobility of capital is highly restricted and this is due to lack of regulations, which in turn leads to transactions (such as conversion and cross-border transfer of currencies) that are riddled with permits and not so straightforward processes. Although the financial sector is covered by the 1990 Law on Financial Institutions, it appears that this had not been enough as Myanmar's banking sector is currently severely underdeveloped.

With respect to the employment of foreigners, there is no restriction on the number of expatriate employees to be hired by foreign companies registered under the Myanmar Companies Act (CA). But generally, foreigners cannot be appointed as directors in local companies formed under the CA and owned by Myanmar citizens.

Under the new MFIL, preference shall be given to Myanmar citizens when organizations formed under the permit issued by the MIC hires personnel. Where the foreign investment needs skilled personnel, the foreign investor is required to employ local citizens through the following gradual introduction of local citizens: at least 25% of the workforce shall be local citizens in the first two years, 50% within the second two years and at least 75% within the third two-year period. Lui reports, however, that the Rules are silent on the jobs that will be classified as skilled. For jobs which do not require special skills, the foreign investor shall employ local employees only. MIC permits for forming economic organizations also require the foreign investor to make arrangements for local and foreign training so as to ensure local personnel proficiency in their work and promotion to higher ranks of service.

The insufficiency of specifics in the laws and rules, coupled by the case-by-case basis approach, is a double-edged sword. It may allow the government greater flexibility and room for growth in the learning process toward foreign direct investment liberalization. However, it may also pave the way for undue arbitrariness and spawn corruption. The potential arbitrariness in the way foreign investments may be handled is particularly concerning given that Myanmar's institutions are not yet sufficiently equipped to implement the rule of law. According to one report (Castellani 2013), it still struggles with corruption bred by "tea money", widespread bribery, arms trafficking, tax evasion and money laundering. Moreover, the locals themselves have little confidence in the ability of the judiciary to resolve disputes as the country lacks well-trained lawyers.

Nevertheless, it is still too early to judge how Myanmar will perform with respect to foreign direct investment liberalization, and how this will impact the cross-border exchange of energy-related services and mobility of energy services professionals. What is positively striking in Myanmar's approach is that it implicitly recognizes that not all restrictions are bad and the necessity of some restrictions is actually justified by the level of development of the country. We

refer to the restrictions on hiring foreign skilled workers. One of the urgent and alarming concerns in Myanmar when the military junta gave way to a more democratic government is the small pool of skilled workers. The restrictions on employment of foreign skilled workers and the requirement to hire local citizens for skilled positions will provide employment opportunities that can improve social mobility and alleviate poverty. These will also enable Myanmar to eventually have a larger pool of skilled citizens which can set up their own industries and elevate the capacity of governance institutions.

B. Philippines

The Philippine Constitution and Republic Act (RA) 7042 or the Foreign Investments Act of 1991 provide the legal basis for foreign investments in certain economic activities. As a general rule, RA 7042 permits foreigners to invest as much as 100 percent equity in local enterprises except in areas reserved for Filipinos under the Constitution and existing laws. To clarify this, the government issues and updates every two years what is called a "Negative List" or a list of economic activities where foreign equity is either prohibited or limited. The latest is the 9th Foreign Investment Negative List issued through Executive Order (EO) 98 in 2012. The 9th Negative List contains the following restrictions on economic activities that may be considered relevant to the energy sector:

Restriction	Economic activity
No foreign equity	Practice of professions Engineering Architecture Chemistry Environmental planning Geology Accountancy Law
Up to 40 percent foreign equity	Exploration, development and utilization of natural resources Ownership of private lands Operation and management of public utilities Project proponent and facility operator of build-operate-transfer project requiring a public utilities franchise

The listing of activities described above as having 40 percent equity limitation emanate from the Constitution's expressed restrictions on foreign investments in the country's natural resources, land, and public utilities. Thus, the current thinking is that these activities can only be clarified but cannot be removed through the Negative List amendment every two years, unless the Constitution itself is amended.

The Constitution, however, empowers the Philippine president to enter into financial or technical assistance agreements (FTAA), which are essentially service contracts, with fully-foreign owned corporations for large-scale exploration, development, and utilization of minerals, petroleum, and other mineral oils. Thus, there are no equity restrictions on service contracts for petroleum exploration and extraction. Currently, the government is holding the Fifth Philippine Energy Contracting Round (PECR).

In the FTAA setup, one crucial requirement set by the Constitution is that the participation of foreign contractors must have real contributions to the economic growth and the general welfare of the country. The setup is largely seen in the country as satisfying the nationalist sentiments (since the contractors are viewed as contractors of the state) and at the same time aiding the development of sectors wherein local capital and expertise are lacking. The application of the FTAA setup, however, has been recently tested, particularly for geothermal energy. The Renewable Energy Act of 2008 or RA 9513 does not impose foreign equity restrictions on entities which may be awarded renewable energy service contracts, including those for geothermal energy. But the drafters of the implementing rules and regulations of the law took the position that the 40 percent foreign equity restriction set by the Constitution applies; the rules state that only Filipinos or corporations with at least 60 percent Filipino capitalization may develop renewable energy sources.

Then a 2009 circular by the Department of Energy (DOE Circular No. DC2009-07-0011) exempted large-scale exploration, development or utilization of geothermal energy resources from the nationality restriction. (Note that the Philippines has large untapped geothermal resources and is the second largest producer of geothermal energy worldwide, next to the United States.) This is an arrangement that is patterned after the FTAA setup and recognizes the definition in RA 9513 of geothermal energy as a mineral resource. However, this flexibility in foreign ownership seems to have been set aside as the recently launched Fifth PECR does not include geothermal energy, unlike the predecessor Fourth PECR in 2011 which included it. No official reason has been published but it appears that in this case, the government is weighing the flexibility made possible by executive rules against possible legal challenges that may put foreign investments in peril. Still, the experience shows strong willingness to remove restrictions to foreign investments in the energy sector.

With respect to ownership of land, it is as a general rule restricted to Filipinos only, but there are exceptions. The Constitution makes exceptions in the case of hereditary succession by foreigners and when the acquisition was made by a former natural-born citizen. The Constitution also exempts those corporations at least 60 percent of which are owned by Filipinos. The Supreme Court of the Philippines has also clarified that if land is invalidly transferred to a foreigner who subsequently becomes a Filipino citizen, the flaw in the original transaction is cured and the title of the transferee is rendered valid (Borromeo vs. Descallar, G.R. No. 159310, 24 February 2009). RA 4726 also permits foreign nationals to own real estate property, such as condominium units or shares in condominium corporations, as long as not more than 40 percent of units in a real estate project are acquired by foreigners. Moreover, the 1994 Investors' Lease Act (RA 7652) allows foreign investors to lease land for 50 years with one 25 year renewal.

The Philippines does not restrict repatriation of capital and remittance of income. However, if the initial investment was not registered with the Central Bank, they will not be able to access foreign exchange to fund the remittance or repatriation from a regulated banking entity.

With respect to employment of foreigners, restrictions come in the form of working visa requirements and application for an Alien Employment Permit (AEP). However, the requirements are not too burdensome as foreign workers generally arrive on a tourist visa and then apply later for the AEP and have the tourist visa converted to working visa.

Overall, the Philippines seem to be less restrictive than its ASEAN neighbors when it comes to capital mobility, owing to its well-developed financial institutions and rules, and labor mobility, owing to its flexible tourism and foreign employment rules. However, it is more restrictive when it comes to foreign equity participation, owing to limits set by the highest law of the land, its Constitution. Nevertheless, as the geothermal-related experience shows, the commitment to remove barriers to energy sector investments is there.

C. Thailand

The Constitution of Thailand (amended 17 times since the Siamese Revolution of 1932) assures that "a person shall enjoy the liberties to engage in an enterprise or an occupation and to undertake a fair and free competition." It also provides that "the restriction on such liberties shall not be imposed except by virtue of the law" enacted for specific objectives, including preserving natural resources and protecting the public in regard to public utilities. Thus, relative to the Philippines, Thailand has a more flexible way of eliminating barriers to foreign direct investment through legislation.

Restrictions on foreign direct investments in Thailand are set out in the Foreign Business Act of 1999 and its 2013 amendments. In the energy sector, foreigners are not permitted to participate as majority shareholders (i.e., they can own only up to 49%) in the following economic activities: oil and gas extraction and development; power distribution and transmission; power generation using biomass, coal, hydro, solar and wind. Foreign equity limitation of 49 percent on commercial presence is also applied to a range of professional services, some of which are used in the energy sector such as accounting, legal, architecture, engineering, and construction. For construction services, exceptions are made for those which are rendering basic services to the public in public utilities or transport requiring special tools, machinery, technology or construction expertise having the foreigner's minimum capital of 500 million baht or more, and other categories of construction as prescribed by ministerial regulations.

Foreigners are not permitted to own land in Thailand but they can lease land and own buildings. The 1979 Thailand Condominium Act sets a quota of 49 percent of a building's units for foreign ownership, and therefore a foreigner can own condominiums 100 percent outright as long as this quota has not yet been exceeded.

For projects requiring government procurement, there are legal preferential treatments. (Note that Thailand is not a signatory to the WTO Agreement on Government Procurement.) Thai and US companies are given a 7 percent automatic price advantage. Tenders that are not more than 5 percent higher in cost but have local certification are also given preferential treatment (servicestradeforum.org).

Repatriation of capital, profits, interests and dividends in foreign currency from Thailand is not restricted as long as there are proper documentary evidences.

The repatriation in foreign currency of capital, profits, interests and dividends is not restricted as long as there are proper documentary evidences. However, there are a few restrictions on the transfer of foreign currency into the country. Unlimited amounts of foreign currency may be brought in under the condition that it must be sold or converted into Thai baht or deposited into a foreign currency account located in Thailand within 360 days (Tilleke & Gibbins International Ltd. 2013).

The employment of foreigners is governed by the 1978 Working of Aliens Act. In general, the Department of Employment considers first whether the opening for a foreign worker can be filled by a Thai, whether the foreign worker is qualified, and whether the job is responsive to the needs of Thailand. All companies are also required to observe a Thai to foreign employee ratio of 4:1, except when the Board of Investment waives this restriction. Nikomborirak (2011)

reports that downstream gas transmission and downstream petrochemical businesses are among the Board-promoted businesses for which the bringing in of skilled workers and professionals is allowed. Gas exploration and production businesses, however, are not in the list.

Barriers to foreign direct investment can also take the form of industry structure and there are indications that in the natural gas industry, wherein the state-owned PTT Public Company Limited monopolizes the supply business, there will be liberalization. Reports abound that the regulator has drafted rules allowing third-party access to PTT's gas pipelines, leveling the playing field among domestic and foreign companies by setting just one fee for natural gas transmission, and allowing domestic power plants and other industrial customers the freedom to choose their own gas supplier. It was also reported that global firms Chevron and Shell will participate in gas distribution as soon as the industry is opened (Energy Tribune 2013). The commitment of the Thai government to this reform is strong since it has to find alternatives to Thailand's dwindling gas reserves, which are expected to last for only ten more years. Securing as many natural gas suppliers as possible is a crucial first step.

VI. Towards an Energy Services Agreement

Notwithstanding the limited commitments by Member States to liberalize trade in energy services and the presence of various barriers on energy trade and investments as noted in Section III and IV, the preceding section suggests the common need for secure and reliable supply of energy even among those with indigenous supply. Such imperative could draw these economies together to agree on a plan that will see through the free flow of energy trade and investments in the region.

Such a plan for liberalization of energy services may take the form of an agreement to: (i) develop and implement strategies to remove substantially all impediments to free flow of energy services in the region; (ii) adopt common regulatory principles that would govern domestic energy services; and (iii) conclude mutual recognition agreements (MRAs) specifically for professionals engaged in energy and energy-related services.

The envisaged ASEAN Energy Services Agreement (AEAS) may evolve in the same way as the ASEAN Free Trade Agreement in Services (AFAS). That is, Member States may agree to a progressive liberalization of energy and energy-related sectors, based on clear and agreed upon targets, while respecting national policy objectives and differences in levels of economic development, hence readiness to liberalize markets and institute regulatory reforms.

Critical in rallying support for a separate trade liberalization agreement on energy services is an assurance to Member States that the flexibilities afforded to them in AFAS will be extended as

well in AEAS. Specifically, two principles should be highlighted in such an agreement, namely the ASEAN Minus X formula and allowance for flexibility.

Liberalization through the ASEAN Minus X formula means that Member States that are ready to liberalize can proceed ahead while others may follow at a later time. Under this principle, two or more Member States may proceed with the agreed services sector liberalization without having to extend the concessions to non-participating Member States. The latter may choose to participate when ready. This negotiating formula has helped advance the liberalization agenda while sustaining harmony in the region.

Given the differences in economic development and readiness for market liberalization of Member States, it is also critical to afford them the same flexibilities as in AFAS. Member States which are unable to meet the agreed upon schedule and parameters of liberalization at a particular round of negotiations are given opportunity to catch up in succeeding rounds, or to substitute sub-sectors that have been agreed upon to be liberalized in a round with another sub-sector outside of the agreed list. Thus, while the targets for liberalization are specific and firm, some degree of deviation is allowed to Member States who may not be ready to comply as yet.

In setting the schedule of liberalization, it would do well if Member States follow the same approach they have taken in AFAS. Specifically, liberalization could begin in common services subsectors or those in which four or more Members have made commitments under GATS or previous AFAS packages. Section IV noted that majority of Member States have made commitments in 10 of 23 energy-related services, to wit:

integrated engineering services, management consulting services, services related management consulting, technical testing and analysis services, construction work for civil engineering, renting services related to equipment for construction or demolition of buildings or civil engineering works, road transport for freight transportation and services auxiliary to all modes of transport – storage and warehouse. Members could then agree on the time line to liberalize the other sub-sectors.

Considering the importance of efficient regulation – the absence of which can frustrate all efforts to liberalize – it seems appropriate to consider the inclusion of an energy services reference paper, akin to those included in GATS for telecommunications and accountancy. The provisions in the telecoms reference provide a basis for consideration although they would have to be adopted to the context of energy services. Four core areas are nonetheless important to securing a precompetitive regulatory environment for energy services: third party access to essential facilities, market transparency, competitive safeguards and independent regulation.

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AEMI BENEFITS – BENEFITS OF ASEAN ENERGY MARKET INTEGRATION: A SURVEY OF THE LITERATURE

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Abstract

This study reviews the benefits of energy market integration (EMI) in ASEAN that have been recorded in the literature. Due to the scarcity of ASEAN focused studies, we examined the studies that either indirectly addressing ASEAN or ASEAN member countries. A summary of the general benefits is presented at the second section. Furthermore, it elaborates the benefits from five perspectives: trade liberalization, investment liberalization, regional energy infrastructure development, energy pricing reform, and liberalization of domestic energy markets. The study finds significant benefits for those initiatives, although the benefits may be different among the ASEAN member countries. Based on this survey and estimation, policy implications are offered.

1. Introduction

ASEAN is working towards a single market by 2015, under the guideline of AEC (Bali Concord II, 2003). Considerable progress in the Energy Market Integration (EMI) was made as a result of cooperation achieved through the ASEAN plus Three (APT) process and, later through the East Asian Summit (EAS) process (Shi and Kimura, 2010).

This chapter will examine the potential benefits of EMI in ASEAN at both national and regional levels. The benefits could be economic, social and/or environmental. It will provide quantitative information to the policy makers, who may use this information to judge their policy options.

The benefits are primarily drawn from the literature. Due to the scarcity of ASEAN focused studies, we examined the studies that either indirectly addressing ASEAN or ASEAN member countries. Whenever possible, the review results try to exclude other countries, in particular, China and India, which heavy weight in the ASEAN Plus Three (China, Japan and South Korea) or East Asian Summit. However, such exclusion is not possible in many cases. However, many empirical studies are applicable to ASEAN without geographical prejudice. We also try to interpret the results in the ASEAN context, if the results are not directly relevant to ASEAN.

Following the conceptual framework for analyzing EMI issue in the literature (Shi and Kimura, 2010, 2014), we group the findings into 5 section plus an overall section.

2. Overall benefits of EMI

A few papers (Chang et al., 2013; Widodo and Rafiazka, 2014) simulates the welfare impacts of energy prices decrease due to ASEAN EMI (AEMI). The welfare impacts of AEMI impacts are divided into two (Widodo and Rafiazka, 2014): (i) direct impact (solely due to price equalization in a specific energy price), and (ii) indirect impact (due to price changes of other goods as responses of price equalization in a specific energy price). The direct impact has been estimated

in a previous study (Chang et al., 2013), while indirect impact was estimated as estimated in a recent study (Widodo and Rafiazka, 2014). The study find that indirect impact is in often a few hundreds to a few thousands time of direct impact. Table 1 reports the aggregated results of benefits from a 10% reduction of product price due to AEMI. Benefits are measured as both Compensating Variation (CV) and Equivalent Variation (EV) from different sub-group of products as classified in the Standard International Trade Classification (SITC) classification 3 digit level.

Table 1 Welfare Impact of 10% Decrease in Price of Energy product (million US$)

Product	Measure	Indonesia	Malaysia	Philippines	Thailand	Singapore	Vietnam	Cambodia
Coal, lignite and peat (322)	CV	19,175.8	19,741.0	38,002.4	24,847.9	40,839.5	10,474.0	614.4
	EV	21,307.4	21,948.3	42,229.6	27,621.7	45,377.3	11,638.8	682.7
Briquettes et al (323)	CV	388.7	1,180.5	-55,297.1	-12,235.9	-45,015.7	3,352.3	-56.5
	EV	389.5	1,187.6	-48,268.2	-11,659.6	-40,546.4	3,463.8	-56.0
bituminous minerals (332)	CV	2,970.2	860.1	19,560.8	-6,393.0	199,509.9	31,323.3	-92.2
	EV	3,015.4	863.8	20,438.8	-6,228.0	390,917.4	44,769.8	-91.4
Petroleum products, refine (333)	CV	4,302.7	1,171.9	36,582.6	-6,764.1	-28,056.9	38,401.5	-4,143.3
	EV	4,403.4	1,178.9	40,612.9	-6,583.7	-26,287.1	60,776.6	-2,472.0
Residual petroleum products etc. (334)	CV	4,527.7	1,809.9	26,468.0	94,077.9	-15,206.5	17,881.0	-1,559.2
	EV	4,637.2	1,826.8	28,451.6	151,745.4	-14,660.8	29,707.4	-1,243.8
Gas, natural and manufactured (341)	CV	-726.0	42.3	20,551.2	57,613.0	-11,278.3	-8,373.7	128.3
	EV	-723.3	42.3	21,727.6	75,104.0	-10,975.3	-7,753.7	131.0
Electric current (351)	CV	-592.4	26.7	-273,439.2	-488.0	210,783.9	-6,679.3	117.3
	EV	-590.6	26.7	-158,966.9	-487.1	435,620.8	-6,279.0	119.6
Energy Total	CV	30,046.8	24,832.4	-187,571.4	150,657.7	351,575.9	86,379.1	-4,991.2
	EV	32,439.1	27,074.4	-53,774.5	229,512.7	779,445.8	136,323.7	-2,930.0

Source: (Widodo and Rafiazka, 2014)

The study find that two countries, the Philippines and Cambodia, both of which have high energy price due to relative liberalized market, will suffer from such an energy price decrease. However, the sources of loss are different. In the Philippines, the loss mainly originate from electricity while in Cambodia, the loss is sourced from petroleum group. These loss suggests that those sectors in the two countries have had excess profits currently. One example is that the Philippines' electricity prices (averaged at 24 US cents per kWh) was the fifth highest in the world in 2013 (Tiglao, 2014).

Sheng and Shi (Sheng and Shi, 2011, 2013) construct two indexes, the energy trade index and the energy market competition index, to measure EMI at the country level by applying the PCA approach and use these measurements to examine the impact of EMI on growth convergence by estimating both the σ-convergence and β-convergence. Data used in this study come from four major sources including the World Development Indicator (WDI) Database, the cross-country historical adoption of technology (CHAT) dataset, the UN Comtrade Database and Subramanian and Wei (2007) and covers 49 countries in 1960, 118 countries in 2008. Both Pooled ordinary least square (OLS) and country-fixed effects (FE) econometrics techniques were

applied. They find that an integrated energy market may significantly help poor countries to catch up with rich countries in economic growth, thus reduce income disparity across countries, and accelerate the step of the catch-up. When EMI has been implemented and the investment and technology progress are well controlled, the poor countries can save at least 10 years when catching up with rich countries that have double income per capita.

Moreover, a comparison among three regions, i.e., EU, NAFTA and EAS, shows that energy market in the EAS region has integrated more quickly than that in the EU or the NAFTA regions in recent years and EAS countries are more likely to achieve economic convergence than the rest of the world. Yet, the impact of the EMI process on economic convergence in the EAS region is relatively smaller than that in EU. The study also finds that investment and capacity building may help to facilitate the catch-up and promote economic convergence across countries. Since ASEAN is at the core of the EAS regional integration and EMI, the impact of AEMI should not be less than that of EAS EMI found in these studies.

With a similar measurement of EMI, Sheng and Shi (Sheng and Shi, 2012a, b; Sheng et al., 2013) show that rapid economic growth due to industrialization and urbanization tends to increase the energy consumption per capita, which in turn may generate a surge in the overall demand for energy. They used the General Method of Moment (GMM) regression technique to estimate a cross-country energy demand function with a data set covering 71 countries over the period of 1965-2010. The econometric results show that an increase in economic growth may increase 0.6 per cent of energy consumption per capita. Moreover, economic growth also leads to lower price and income elasticity (in absolute terms). However, energy market integration can help to reduce the energy demand pressure and to smooth the demand shock through decreasing the income elasticity and increasing the price elasticity in particular in the long run. This finding is important for ASEAN, the energy demand of which, according to IEA's recent projection, will increase by over 80% between 2011 and 2035 under the IEA's "new policies scenario," a rise equivalent to current demand in Japan (IEA, 2013). Without AEMI, energy demand, at least in some country, may experience some shocks and thus create stress to energy security.

The benefits of EMI on energy markets prices was examined in the case of China, have implications on ASEAN as well. Using the panel data of 27 provinces between 1978 and 2008, Sheng at. al (Sheng et al., 2014) employed an instrumental regression technique to examine the relationship between economic growth, energy demand/production and the related policies in China. The empirical results show that forming a cross-province EMI will in general reduce the response of equilibrium user costs of energy products to their local demand and production. The findings implies that AMEI can also help to reduce price variability in ASEAN where energy demand will grow dramatically.

Since many ASEAN countries are agricultural exporters, they may be vulnerable to an increase in energy price particularly to crude oil price hike because energy costs may play an important part in the food industry. Hamid, Zakariah, and Zarina (Hamid et al., 2011) apply the input-output (I-O) table methodology, to selected East Asian countries to evaluate whether there exist any potential benefits of the food industry from EMI. They find that resilient economies, especially

developed EA countries, have consistent performance in terms of value added creation and imported inputs during the period of energy price surge. In addition, the price spread model implies that a doubling of crude oil price will cause CPI for food to rise by approximately 22%.

The case study of Malaysia and Singapore demonstrated that although Malaysia is an oil-exporting country and Singapore mostly imports its energy need, similarly both were vulnerable to the increase in crude oil price (Table 2). This suggest that ASEAN will benefit from AMEI if AMEI can help mitigate price hike.

Table 2 Total effects of increase in oil price for Malaysia and Singapore, 2005

Malaysia				Singapore			
Total effects	**VA'* (I-A)**	**M'* (I-A)**	**M/VA**	**Total effects**	**VA'* (I-A)-1**	**M'* (I-A)-1**	**M/VA**
Food Crops	0.829	0.162	0.195	Food preparations	0.402	0.595	1.478
Vegetables	0.715	0.274	0.383	Bread, biscuits & confectionery	0.559	0.439	0.784
Fruits	0.828	0.161	0.195	Sugar, chocolate & related products	0.300	0.699	2.332
Poultry Farming	0.754	0.232	0.307	Oils & fats	0.240	0.759	3.155
Other Livestock	0.804	0.186	0.231	Dairy products	0.447	0.552	1.234
Fishing	0.747	0.224	0.300	Coffee & tea	0.408	0.590	1.444
Meat and Meat Production	0.721	0.257	0.356	Other food products	0.423	0.575	1.359
Preservation of Seafood	0.674	0.292	0.434	Soft drinks	0.484	0.513	1.061
Preservation of Fruits and	0.652	0.324	0.497	Alcoholic drinks & tobacco products	0.568	0.426	0.751
Dairy Production	0.518	0.455	0.878	Food & beverage services	0.718	0.279	0.388
Oils and Fats	0.730	0.236	0.323				
Grain Mills	0.530	0.442	0.834				
Bakery Products	0.606	0.358	0.591				
Confectionery	0.453	0.528	1.165				
Other Food Processing	0.566	0.394	0.695				
Wine and Spirit	0.495	0.340	0.688				
Soft Drink	0.496	0.468	0.944				

Note; Highlighted cells have value more than 1.

Source: (Hamid et al., 2011)

3. Trade liberalization

The impact on trade liberalization in ASEAN (Lee and Plummer, 2010; Park, 2000) and East Asia (Lee et al., 2009) is sometime addressed in the literature but little attention has been focused on the case of energy. Bhattacharya and Kojim (2010) is the only relevant study on regional wide energy trade liberalization in ASEAN and East Asia. In their study, they simulated the impact by removing tariff and export subsidy/tax using the REPA model, which is a multi-regional computable general equilibrium (CGE) model developed for conducting integrated policy impact

assessment encompassing environmental, economic and poverty impacts in East Asia (Kojima, 2008).

The results show that although the distribution of economic benefits is not balanced, the magnitude of impact in most countries is close to zero. Cambodia and Vietnam will benefit the most from trade liberalization. Other ASEAN countries like Indonesia, Malaysia and Singapore will lose in that context. However, such loss is comparatively very small. The reasons for the negative impacts are complicated in the CGE model, which models the impact through complex inter-sectoral and international linkages. For example, the real GDP loss of Singapore is mainly due to a reduction in trade balance, as trade liberalization will undermine the comparative advantage of the current free trade policy of Singapore. With the increase of GDP, CO2 emission will also increase. Due to border tax reduction to zero, more or less all the countries experience reduced levels of domestic energy prices except Indonesia and Malaysia (Table 3).

Table 3 Impact of energy trade liberalization on GDP, CO_2 emissions and consumer prices of energy commodities

Region	Real GDP	CO_2 emissions	Coal price	crude oil price	Gas price	petroleum products price	Electricity price	gas distribution price
Cambodia	0.128	1.25	1.79	1.7	-0.23	-4.28	-0.26	0.02
Indonesia	-0.065	-0.37	3.37	1.15	0.17	0.18	0.28	0.02
Lao PDR	-0.130	0.96	-2.96	-0.03	-0.07	-1.89	-0.25	0.02
Myanmar	-0.044	-0.37	2.62	-0.03	1.42	-0.84	0.43	0.24
Malaysia	-0.078	-0.47	2.54	-0.21	0.49	0.57	0.34	-0.01
Philippines	0.011	0.38	-2.36	0.56	-0.04	-0.34	-0.22	0.02
Singapore	-0.070	0.12	1.85	1.19	-0.14	0.11	0.02	-0.05
Thailand	0.011	-0.13	0.95	0.28	-0.09	0.22	0.01	-0.02
Vietnam	0.263	3.21	5.16	-0.59	-6.14	-8.44	0	0.34
Brunei Darussalam	-0.147	-0.02	1.19	1.79	-0.22	0.41	0.07	0.16

Source: Bhattacharya and Kojima (2010).

At sub-regional level, there are more studies. Watcharejyothin and Shrestha (2009b) evaluates effects of energy resource development within the Greater Mekong Sub-region (GMS) during 2000–2035 with a MARKAL-based integrated energy system model of the five GMS countries. The study found that an unrestricted energy resource development and trade within the GMS region would reduce the total-regional energy systems cost by 18% and would abate the total CO_2 emission by 5% as compared to the base case.

4. Investment liberalization

Kojima and Bhattacharya (2011) developed a dedicated multi-regional CGE model for conducting a quantitative assessment of electricity sector investment scenario in which the investment demands in the EAS member countries projected by the International Energy Agency are met. The assessment results show that for meeting energy sector investment demands, FDI will play an important role not only to benefit investing and hosting countries but also to increase the regional GDP as the whole. The most interesting finding shows that introduction of FDI increases not only the national GDP of the investing countries but also the regional GDP as the whole EAS region by 0.04%. However, the study also shows that many ASEAN countries will loss due to investment liberalization. The unfordable results, however, are explained as the limitation of CGE technique by the Authors. Therefore, better methods for estimating investment liberalization are needed.

5. Regional Infrastructure development

There are quite a few studies on the impact of ASEAN regional infrastructure development. Bhattacharya and Kojima (2008) has shown in a study on impact of cross border energy infrastructure development project in ASEAN region that increasing physical linkages between two countries will bring more economic benefits and will reduce more CO2 emissions than business as usual situation. Due to cooperative infrastructure development activities, economic burden on individual country get reduced significantly and increases the efficiency of resource use to produce energy in the system.

In the case of power grid connection, Chang and Li (2012) build a dynamic linear programming model and simulate optimal development paths of power generation capacities in ASEAN countries. They consider three scenarios (no trade, 20% trade and 50% trade in electricity) of developing optimal power generation capacity and their impacts on market integration in ASEAN. Their findings show that a more open power trade regime encourages the development of renewable sources of power generation, and accrues more savings in the total cost of meeting the growing future power demand from 2010 to 2030. Specifically under the scenarios of partial trade (20% and 50% capacity) the present value of cost savings would be USD 20.9 billion (3.0%) and USD 29.0 billion (3.9%), respectively. Thus even with partial integration (cross-border power trading) substantial cost reduction could be realized.

At bilateral case, Watcharejyothin and Shrestha (2009a) analyzed the effects of hydropower resource development in Laos and power trade between Laos and Thailand using a MARKAL-based model for an integrated energy system between the two countries. They find that 80% exploitation of hydropower resource in Laos would induce power trade between the countries. In such case, although the energy system cost save is marginally, the trade would mitigate the

CO2 emission by 2% when compared with the base case. Thailand will benefits from the trade in terms of lower energy system cost, better environmental quality and, greater energy diversification, while Laos earns significant export revenue.

In the case of ASEAN natural gas pipeline connection, Chang and Li (Chang and Li, 2011) use a competitive equilibrium model to analyze the implications of an integrated and competitive natural gas market in the region. They find that by adopting an integrated and competitive natural gas market in the region, overall welfare of countries involved in natural gas trade in the region improves by 5.5%. In general, their study shows that the supply of natural gas from the region, which has cheaper transportation costs, increases its portion in the total supply of natural gas. By introducing new natural gas infrastructure in the region, Chang and Li observe that welfare of countries involved in natural gas trade in the region further increases by 0.3%.

6. Energy Subsidy removal

Energy subsidies in ASEAN are frequently studied. Oktaviani, *et al*. (2005) analyze the impact of fuel subsidy reduction on macroeconomic variables, agricultural sector, and income distribution using a recursive CGE model and finds an increased fuel price at consumer level reduces the Indonesian real GDP. Their results show that the *reduction in fuel price subsidy tends to increase prices of industrial outputs* highly dependent on fuel, such as the transportation and fishery sectors. They found that wage of skilled labor, land rent, and capital rent declined steadily in response to changes in fuel price. They also found households would incur income losses following the reduction in fuel subsidy, decreasing the overall welfare of households. They suggest to compensate the poor either through direct transfer, or through the development of infrastructure.

Widodo and his three colleagues (Widodo et al., 2012) consider several scenarios of the removal of fuel subsidies in Indonesia and found that the removal of fuel subsidies without redistributing the money back to the economic system would reduce production output, GDP, and labor income. At the sector level, it is found that the removal of fuel subsidy would have the greatest impact on energy intensive sector, with the Chemical and cement industry, the Electricity, gas, and drinking water, and Food, beverage, and tobacco industry, to be the most affected sectors. Their simulation results also show that the impact on labor income is higher than that on capital returns and the lowest income group will be affected most. In contrast, high-income earners as well as workers in agriculture sector would be the least affected by the removal of the fuel subsidy. If this amount of subsidy is reallocated to four targeted sectors- i.e. 1) Agriculture; 2) Trade; 3) Food, Beverage, and 4) Tobacco Industry; and Education and Health, the gains would be smaller than the negative effect of fuel subsidy removal. This suggests that the sectoral compensation approach cannot compensate the overall loss of the economy. This discouraging findings, however, could be due to the limitation of the methodology (*Social Accounting Matrix*, SAM). For example, their multiplier exercise is based on a fixed economic structure and does not

take into account of the dynamics over time and cannot capture productivity gains; and it does not allow for substitution effect either as prices are fixed.

In the case of Malaysia, Hamid and Rashid (2012) investigate the effects of subsidy removal using the Malaysian input-output table supplemented by a static CGE model and find significant economic benefits. The I-O table analysis illustrates that the removal of subsidy of one ringgit will increase the output by six cents and GDP by eight cents at the final demand. Their findings imply that phasing out oil subsidy would initially increase the general prices that will especially affect the heavily oil-dependent sectors such as the petroleum refinery, wholesale and retail trade, and motor vehicles. The authors also argue that there are significant variations across industries since different proportions of energy inputs are employed in the production process. In general, the less energy intensive industries and domestic resources-based industries are less affected by the removal of subsidies. The most effect is on workers' income that experiences an increase of 34 cents due to the removal of subsidies. The authors further argue that delaying the removal of subsidies will primarily increase costs for the government and leave little room for policy space in case market prices are higher than expected.

In the Vietnamese case, Khanh (2012) explores the impacts of an increase in the electricity tariff from 6.0 US cents/kWh (domestic price) to 9.5 US cents/kWh (international rate) (a rise of 58.3% in the electricity tariff) in Vietnam (Khanh, 2012). He shows that prices in the five most affected sectors would in turn increase by 11.15% (water), 7.36% (gas), 4.82% (paper & paper products), 4.73% (chemicals and chemical products) and 4.30% (sports and entertainment). The price increase in all other sectors would be less than 4%. These increases in prices would lead to an increase in the CPI (Consumer Price Index) of 4.2%. Lower income earners suffer more from an electricity tariff increase because their payment for electricity represents a bigger share in their annual expenditure than the rich's. Nguyen argues that though the impacts of subsidy removal on the economy are not very large, a one-shot increase in electricity tariffs would be socially unacceptable. He thus proposes a gradual approach towards subsidy removal and separate implementation in each sector. Nguyen further argues that an improvement in efficiency in the power sector would help reduce the repercussions of subsidy removal.

Subsidy removal, which is naturally a transfer payment, will not generate value-added, but rather than tends to reduce GDP through reducing consumers' disposable income, which will discourage aggregate consumption, and increasing costs of production, which will likely decrease aggregate investment (I) (Hamid and Rashid, 2012). The benefits of subsidy removal will be increased if the efficiency gains can be captured. With the subsidy removal, energy price will direct energy to be used in the most efficient sectors and thus increase the allocation efficiency of the economy and increase the productivity of the energy. Such benefits are likely to be significant but cannot be fully captured by the current models.

By capturing some of those efficiency and productivity gains using a multi-regional Computer General Equilibrium (CGE) approach, Kojima and Bhattacharya (Kojima and Bhattacharya, 2011) find that even if a partial removal of energy subsidies can ripe the benefits of market efficiency improvement. It is estimated that around 500 Million USD of subsidy reduction per annum in

the EAS region can improve the regional economic condition in terms of real GDP by around 0.05% and its welfare by around 0.14% compared to the base line scenario of 2020. Energy subsidy reduction also helps to push down the demand for subsidized commodities in the market and also subsequently cuts the sales of subsidized energy commodities in the domestic market. Such energy will generate economic and security benefits.

7. Domestic liberalization

Bhattacharya and Kojima (2010) is also the only study that tries to quantify the impact of liberalization of domestic energy markets in ASEAN. To estimate the impact of domestic market liberalization using the REPA model, the simulation assumes that due to such liberalization there is an overall improvement in the total factor productivity of the energy distribution services (assumed 20% in the estimation), that is electricity transmission and gas distribution, due to increased competitiveness through open access to transmission systems. The simulation shows double benefits of market liberalization: i.e. overall economic development and reduction of CO2 emissions (Table 4). These significant benefits, however, have an unbalanced distribution. The estimation results show that no single policy can create the miracle of an integrated market where all the member countries are winners. Some members may lose from certain initiatives. Such loss often is caused in sectors other than the energy sector, which indicates that trade-offs may occur between the energy sector and other sectors.

Table 4 Impact on GDP and CO_2 emissions due to market liberalization, % change to baseline 2020

	Real GDP	CO2 emissions
China	1.551	-0.84
Japan	0.737	-2.23
Korea	0.834	-1.53
Cambodia	0.725	1.78
Indonesia	0.852	1.87
Lao PDR	0.943	8.47
Myanmar	1.926	10.54
Malaysia	1.278	2.48
Philippines	0.934	-2.11
Singapore	0.760	-2.85
Thailand	1.464	1.05
Vietnam	2.479	4.52
Brunei Darussalam	1.139	1.70
India	1.825	-2.49
Australia	0.620	-1.29
New Zealand	0.829	2.59
Brazil	-0.010	0.27
EU	0.003	0.55
USA	0.003	0.43
Russia	-0.079	0.38
MENA and Venezuela	-0.029	0.11
Rest of the World	-0.004	0.49
World Total	0.259	0.01
EAS Total	1.090	-0.80

Source: Bhattacharya and Kojima (2010).

8. Policy implications and conclusion.

Although much of the current findings in the literature are applicable to ASEAN, some studies that are dedicated to ASEAN are highly recommended. The review of studies on AEMI finds that while trade liberalization and fossil fuel subsidy removal have been well studied, there are many room left for future studies. Even in the case of fossil fuel subsidies, the current macro models, such as GTAP, has limit capability due to highly aggregation of data in the model. Yet, the impact of subsidy removal is more or less understandable and thus future studies are not that urgent. More studies to deepen understanding on the other three aspects of AMEI are needed.

However, there are not many models that can easily be modified to the regional context. More fundamental works are needed to create ASEAN's own energy market integration assessment models. For example, from the bottom up approach, an ASEAN TIMES model would be very

useful to study the economic impact and investment requirement for AEMI. From the top down approach, some global model with energy and environmental sectors, such as GTEM, are highly valuable. To construct that bottom up models, however, we need data of energy technologies, their penetration levels, and associated costs in all ASEAN member countries. While for building up of top down model, macro data which are required are more convenient to be compiled.

Based on the review, the following policy implications can be drawn. Trade and investment liberalization and development of infrastructure will generate net benefits for ASEAN. However, the distribution of the benefits, could be different across the member countries. In the case of trade liberalization, the countries that have freer trade regime will lose more since their comparative advantages will be undermined. Furthermore, the economic benefits of EMI often come with increasing CO2 emissions, which thus needs to be addressed through technical innovation and policy intervention.

Domestic liberalization may achieve both economic growth and CO2 emission reduction. But process of domestic liberalization is often challenge because there are subject to behind the board barriers, removal of which requires changes in national institutional frameworks and thus are sensitive (SHI, 2014).

Phasing out subsidies is politically and economically challenging and needs to be carefully planned in consideration of each individual country's circumstances. Despite the process requiring an extended time-frame, immediate actions in terms of planning could facilitate the process and reduce difficulty. The fiscal revenue saving of the government from subsidy removal can be either used to develop much needed infrastructure for economic benefits, or to assist the poorest for social benefits.

Different impacts among different policies demand a comprehensive development AEMI policy portfolio. In that case, some of the negative impact can be offered within a country boundary and thus will reduce resistance for such an integration. The regional integration shall also pay particular attention to the less developed countries, who may not be able to reap their potential benefits due to a lack of national and regional competitiveness resulted from institutional weakness and capacity limit.

Although the models have various limitations, the estimated results can be explained more optimistically. The estimated economic impacts are indicative in nature and could be less than real benefits, mainly because many economic benefits, and most environmental and social benefits, cannot be modeled. However, this study shows the direction of economic and environmental impacts of EMI in the region, which can be the building block for future policies in this context.

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ENERGY INFRASTRUCTURE – EVALUATION OF ASEAN INFRASTRUCTURE CONNECTIVITY NEEDS

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I. Introduction

An economy needs to extract available energy resources, process them and deliver the refined products to the end user for consumption. The endowments of energy resources in ASEAN countries are not even. Countries like Myanmar and Indonesia have huge endowments of various energy resources while countries like Singapore and Thailand do not have much or no endowment of energy resources. The energy-abundant country faces two major obstacles in developing the potential energy resources. First, it lacks in funds to develop the potential energy resources. Second, it does not have sufficient demand to ensure the full utilization of the potential energy resources. These obstacles led to a serious imbalance between the demand for energy and the supply of energy among ASEAN countries.

If there is transportation or transmission network between energy-abundant and energy-deficient countries, then the available energy resources can find the source of secured demand and the funds for full development of the available energy resources. This would bring a win-win situation for both countries – the former can increase its GDP and promote economic growth while the latter can accelerate its economic growth by ensuring the supply of energy. ASEAN have initiated to connect member countries by power grid and gas pipelines such as APG and TAGP and completed their master plans. However, the full connectivity seems to be still a long way to go.

This study aims to evaluate the needs of ASEAN infrastructure connectivity such as power grids, gas pipelines, LNG terminals and answer to the following research and policy questions.

- It evaluates ASEAN infrastructure connectivity needs to balance the long term energy demand and supply for the economic centres in every corner of ASEAN for the well-being and comfortable social wellbeing.
- The evaluation is to be based on the mapping of demand-supply need for various economic sectors within each of the long term national development.
- This can be a pre-study in sending the right signal to investors in each economic centres, in particular, to study the progressive infrastructure development to enable the energy flow from those resource rich area and deficient areas.

This paper is structured as follows. Section 2 reviews gaps in the infrastructure, either in term of physical connectivity, standard for interoperability, cross-border energy trading framework or barrier. It also documents the infrastructure need for energy market connectivity to support efficient use of energy resource appropriately and convert resources throughout the ASEAN grid without increasing the risk of the energy security to the participating nations. Section 3 briefly outlines the policy on common standards

for smart metering usage and smart grids development to ensure interoperability across the network and empower end-user to get their energy need from options from any energy supplier within the ASEAN energy market – be it gas, electricity or other form of energy carrier. Section 4 presents a few policy recommendations and section 5 concludes this paper.

II. Assessment of the investment needs for physical connectivity

a. Long-term evolution of the regional power and natural gas market in ASEAN

In the Asia/World Energy Outlook 2013, IEEJ forecasts the final electricity consumption will be 2,220 TWh in 2040 from 614 TWh in 2011 (IEEJ, 2013).[11] This is more than a three-fold increase for the period of a little less than 30 years. Table 1 presents how fast the power demand in ASEAN countries will grow from 2010 to 2030 (IEEJ et al, 2011).[12]

Table 1: the Growth Rate of Power Demand in ASEAN Countries (Unit: %)

	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Growth Rate	1.2	9.9	3.9	7.7	4.5	9.0	4.5	4.2	4.9	6.7

Sources: The Third ASEAN Energy Outlook, 2011

Together with IEEJ, ERIA explores effective investment options for power grid connection in East Asia. Table 2 presents the expected growth of electricity demand from 2010 to 2035 in ASEAN countries and two neighboring regions (Yunnan Province, China and Northeast India). This echoes the earlier forecast of strong growth in electricity demand in ASEAN.

[11] The forecast is based on the reference scenario in which the business as usual is assumed.

[12] If legitimate forecasts on the growth of power demand are available, a kind of sensitivity analysis such as lower growth or higher growth cases could be done. As the focus of this research, however, is to examine the impact of regional power trade policy regime and corresponding power development planning, it does not consider alternative growth rates of power demand.

Table 2: The Expected Growth Rate of Electricity Demand

	TWh						AAGR		
	2010	2015	2020	2025	2030	2035	2010-2020	2020-2035	2010-2035
BRN	3.87	4.47	5.22	5.96	6.77	7.67	3.0%	2.6%	2.8%
IDN	169.79	252.38	341.64	448.07	576.05	733.09	7.2%	5.2%	6.0%
KHM	0.99	6.15	12.33	17.67	19.58	22.15	28.6%	4.0%	13.2%
LAO	8.45	22.54	51.35	65.44	67.13	68.82	19.8%	2.0%	8.8%
MYA	7.54	11.42	16.44	23.15	32.24	44.59	8.1%	6.9%	7.4%
MYS	124.10	161.20	205.10	254.00	309.10	371.80	5.2%	4.0%	4.5%
NEI	11.44	15.68	22.18	29.52	38.34	49.28	6.8%	5.5%	6.0%
PHL	67.74	84.63	106.79	130.51	156.00	185.93	4.7%	3.8%	4.1%
SGP	45.38	51.19	55.60	59.40	61.85	65.76	2.1%	1.1%	1.5%
THA	147.01	180.37	210.86	257.53	309.56	355.03	3.7%	3.5%	3.6%
VNM	92.17	148.35	219.59	295.41	398.83	538.70	9.1%	6.2%	7.3%
YNN	136.50	188.88	223.71	260.19	296.66	324.67	5.1%	2.5%	3.5%

Source: ERIA (2014)

Albeit the strong demand growth, the existing capacity of power generation is far smaller than what is needed. Table 3 shows the existing electricity generation capacity in MW as of 2012 in ASEAN region.

Table 3: The Existing Capacity of Power Generation

(MW)

	Coal	Gas	Oil	Nuclear	Hydro
BRN	0	885	32	0	0
IDN	15,603	9,680	7,705	0	4,343
KHM	10	0	286	0	207
LAO	0	0	8	0	2,125
MYA	0	347	29	0	1,678
MYS	5,685	7,875	3,136	0	2,897
NEI	60	824	143	0	1,200
PHL	4,598	2,656	4,653	0	3,441
SGP	0	4,077	2,850	0	0
THA	4,568	19,366	1,133	0	3,517
VNM	3,964	4,884	1,328	0	10,051
YNN	13,047	0	0	0	22,495

Source: ERIA (2014)

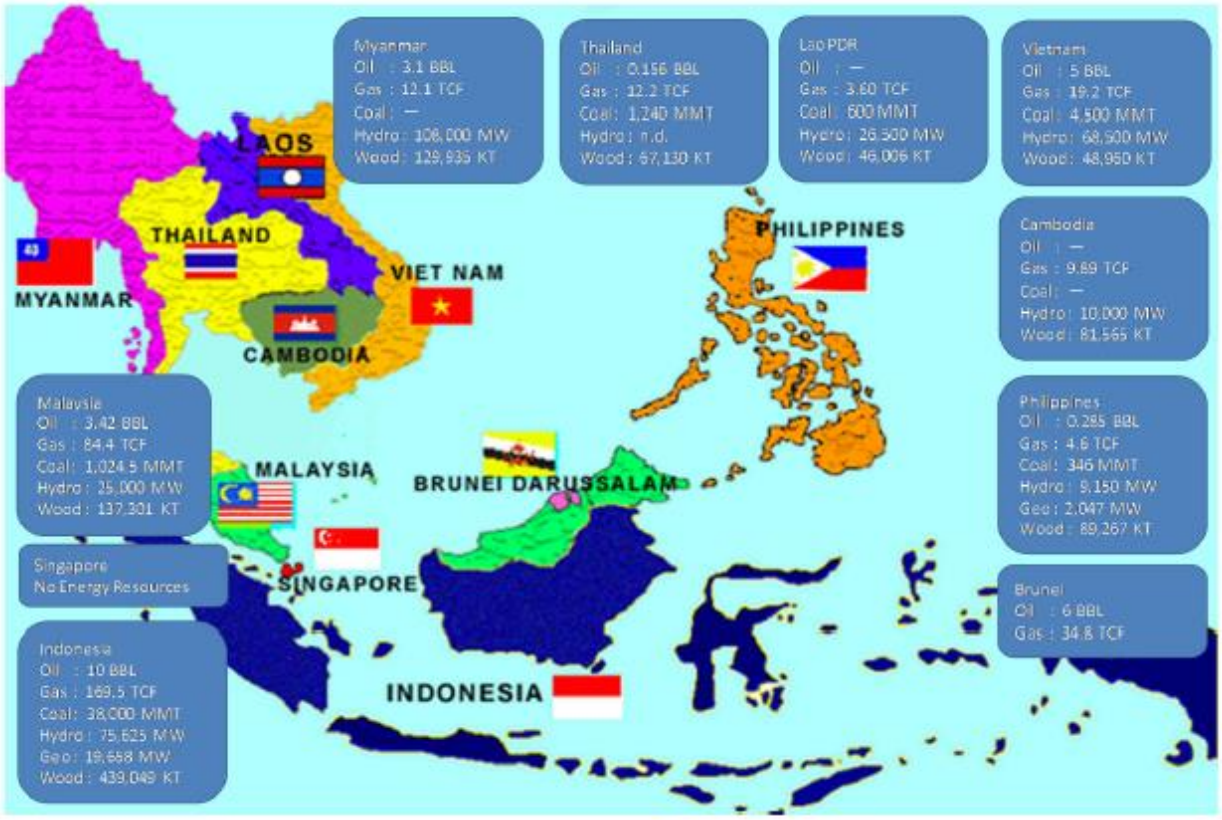
A simple calculation of the projected power generation out of the existing capacity shows that there is a huge deficiency in the capacity.[13] For example, assuming 80%

[13] This evaluation does not take account the planned capacity additions.

availability (but this is pretty optimistic), Brunei may face a shortage in electricity supply sometime between 2020 and 2025 and Indonesia sometime between 2015 and 2020. The current level of existing installed capacity implies that there must be huge increases and investments in electricity generation capacity.

There are huge potentials in hydropower generation in ASEAN, however. Figure 1 shows the potentials of various energy resources and figure 2 presents the potential of hydropower generation in ASEAN countries.[14]

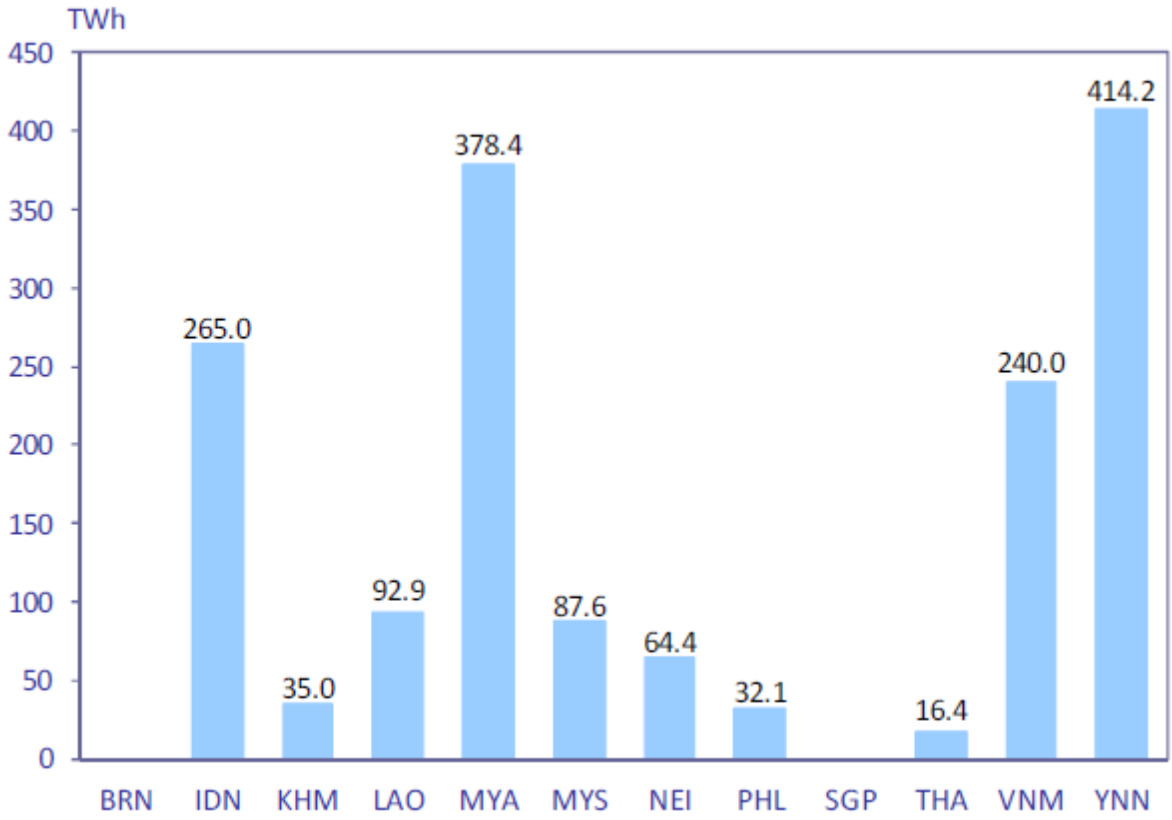
Figure 1: Potential of Various Energy Resources in ASEAN Countries



Source: ERIA (2014)

[14] The resolution of original source is very vague.

Figure 2: Projected Hydropower Generation in ASEAN Countries.



Source: ERIA (2014)

The strong growth in electricity demand, the lack of installed power generation capacity to meet the surging electricity demand and huge potentials in hydropower in the region make integrating power grids and natural gas transportation a feasible solution.

Table 4 shows the natural gas reserves and the level of consumption for selected countries in ASEAN. The reserve-production (R/P) ratio is about 37. Figure 3 presents there are a large and strong upward trend in natural gas consumption in Indonesia, Malaysia and Thailand. For countries like the Philippines, Singapore and Vietnam, the level of natural gas is relatively lower than Indonesia, Malaysia and Thailand but there is also a strong upward trend in natural gas consumption.

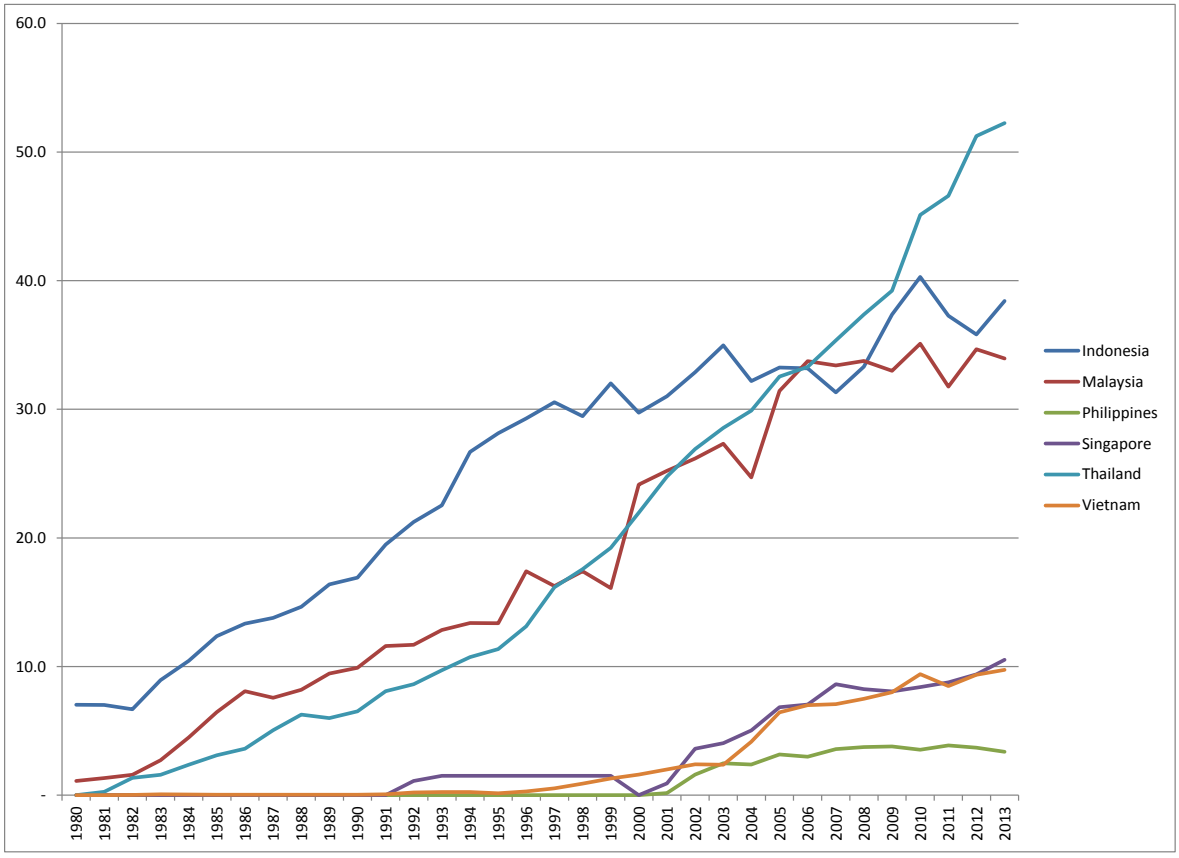
Table 4: Natural Gas Reserves and Consumption in 2013 (unit: billion cubic meters)

Country	Reserves (Billion cubic meters)	Consumption (Billion cubic meters)
Brunei	288.0	-*
Indonesia	2,926.5	38.4
Malaysia	1,091.4	34.0
Myanmar	283.2	-*
Philippines	-*	3.4
Singapore	0	10.5
Thailand	284.9	52.2
Vietnam	617.1	9.8
Total	5,491.1	148.3

Note: * denotes data is not available

Source: BP Statistical Review of World Energy 2014

Figure 3: Natural Gas Consumption in Selected Countries in ASEAN: 1980 – 2013



Source: Calculated from BP Statistical Review of World Energy 2014

The descriptive statistics of electricity and natural gas consumption shows that there is a strong demand growth in ASEAN. This also hints that there will be markets for power and natural gas if the power grids and gas transportation networks across the region are connected and relevant financial and regulatory infrastructure are provided. The following sections review the investment needs for physical infrastructure and explore what financial and regulatory infrastructure and how they can be provided to support ASEAN energy market integration.

b. Reviewing and updating of the APG and TAGP investment

ASEAN has envisioned connecting its power grids and natural gas pipelines to meet surging electricity demand growth by developing a huge potential in hydropower. The channels of realizing this vision are APG and TAGP. Table 5 shows the cross-border power transmission lines in ASEAN countries. The existing capacity is too small to cover the volume of power trade in the future among ASEAN countries. To cater the volume of

power exchange in the future, ASEAN plans to interconnect various power grids across ASEAN countries.[15]

Table 5: Existing Cross-border Power Transmission Lines

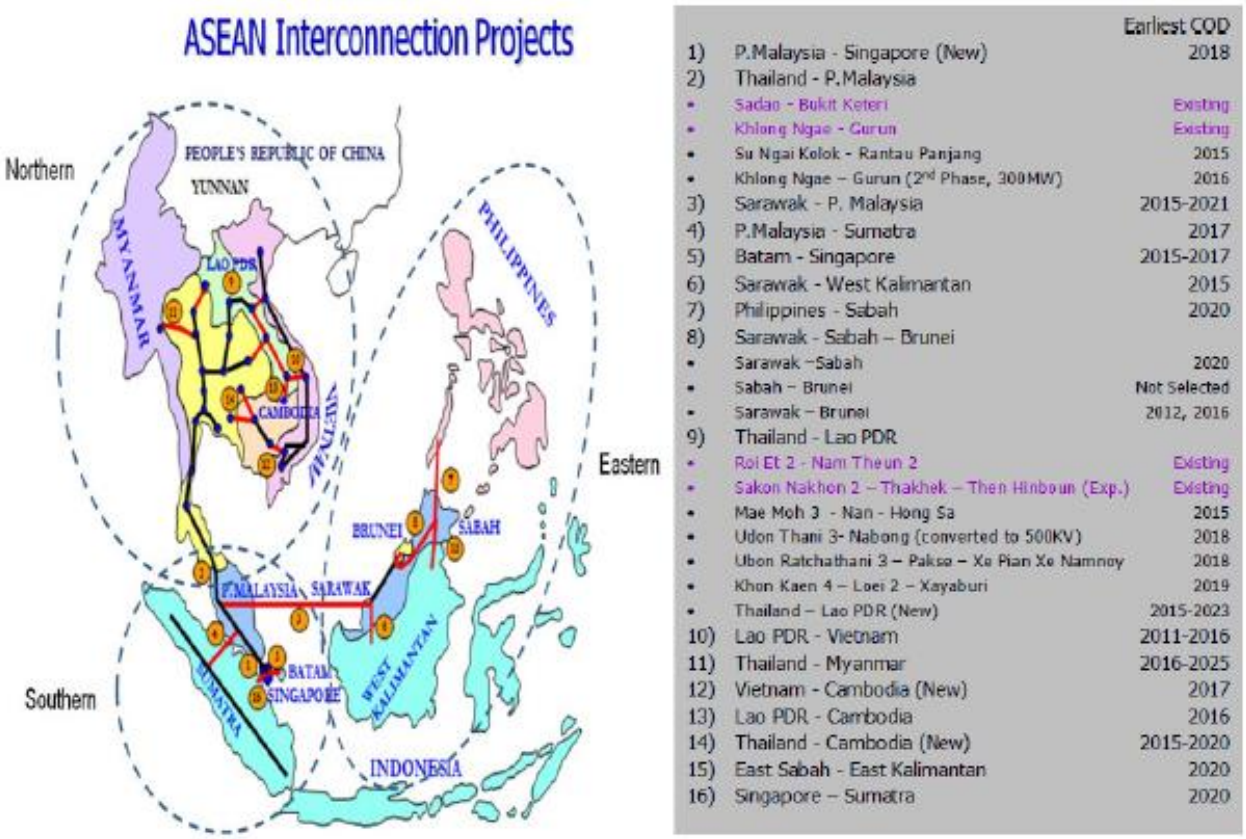
Country A	Country B	Project Name	Capacity (MW)
Malaysia	Singapore	Plentong-Woodlands	450
Thailand	Malaysia	Sadao-Chuping	80
Thailand	Malaysia	Khlong Ngae - Gurun	300
Laos	Thailand	Theun Hinboun- Thakhek - Nakhon Phanom	220
Laos	Thailand	Houay Ho -Ubon Ratchathani 2	150
Laos	Thailand	Nam Theun 2 -Roi Et 2	1000
Laos	Thailand	Nam Ngum 2- Na Bong -Udon Thani 3	615
Laos	Thailand	Theun Hinboun (Expansion) - Thakhek -Nakhon Phanom 2	220
Laos	Vietnam	Xehaman 3 - Thanhmy	248
Vietnam	Cambodia	Chau Doc - Takeo - Phnom Penh	200
Vietnam	Cambodia	Tai Ninh - Kampong Cham	200
Thailand	Cambodia	Aranyaprathet - Banteay Meanchey – Siem Reap - Battambang	120
China	Vietnam	Xinqiao - Lai Cai	250-300
China	Vietnam	Maguan - Ha Giang	200
Myanmar	China	Shweli 1 - Dehong	600

Source: Chimklai (2013); Zhai Yongping (2010); ADB (2013); APERC (2004); Bunthoeun (2012)

Figure 4 shows ASEAN interconnection projects and their details. There are three focus areas – Northern, Southern and Eastern. The Northern area mainly covers the Greater Mekong Sub-region, the Southern areas covers Malaysia, Singapore and Indonesia, and the Eastern area covers the Philippines, Brunei, East Malaysia and West Kalimantan. Table 6 presents the status of ASEAN interconnection projects as of August 2013. The existing interconnected capacity is 3,489 MW and on-going and future capacities are 7,162 MW and 22,474 MW, respectively. The total capacity will be 33, 125 MW. It is almost 10 folds increase.

[15] The chronological sequence of how the decision of interconnecting the grids has been made and vis-à-vis actions is not reflected in table 5.

Figure 4: ASEAN Interconnection Projects



		Earliest COD
1)	P.Malaysia - Singapore (New)	2018
2)	Thailand - P.Malaysia	
•	Sadao - Bukit Keteri	Existing
•	Khlong Ngae - Gurun	Existing
•	Su Ngai Kolok - Rantau Panjang	2015
•	Khlong Ngae – Gurun (2nd Phase, 300MW)	2016
3)	Sarawak - P. Malaysia	2015-2021
4)	P.Malaysia - Sumatra	2017
5)	Batam - Singapore	2015-2017
6)	Sarawak - West Kalimantan	2015
7)	Philippines - Sabah	2020
8)	Sarawak - Sabah – Brunei	
•	Sarawak –Sabah	2020
•	Sabah – Brunei	Not Selected
•	Sarawak – Brunei	2012, 2016
9)	Thailand - Lao PDR	
•	Roi Et 2 - Nam Theun 2	Existing
•	Sakon Nakhon 2 – Thakhek – Then Hinboun (Exp.)	Existing
•	Mae Moh 3 - Nan - Hong Sa	2015
•	Udon Thani 3- Nabong (converted to 500KV)	2018
•	Ubon Ratchathani 3 – Paksa – Xe Pian Xe Namnoy	2018
•	Khon Kaen 4 – Loei 2 – Xayaburi	2019
•	Thailand – Lao PDR (New)	2015-2023
10)	Lao PDR - Vietnam	2011-2016
11)	Thailand - Myanmar	2016-2025
12)	Vietnam - Cambodia (New)	2017
13)	Lao PDR - Cambodia	2016
14)	Thailand - Cambodia (New)	2015-2020
15)	East Sabah - East Kalimantan	2020
16)	Singapore – Sumatra	2020

Source: ERIA (2014)

Table 6: the Status of ASEAN Interconnection Projects (as of August 2013)

STATUS OF ASEAN INTERCONNECTION PROJECT AUGUST 2013 DATA				(MW)
SYSTEM REGION	EXISTING	ON-GOING	FUTURE	TOTAL
NORTHERN REGION	2,659	6,062	16,374	25,095
9. Thailand - Lao PDR	2,111	3,352	2,465	7,928
10. Lao PDR-Vietnam	248	2,410		2,658
11.Thailand- Myanmar			11,709	11,709
12.Vietnam-Cambodia	200			200
13.Lao PDR - Cambodia		300		300
14.Thailand - Cambodia	100		2,200	2,300
SOUTHERN SYSTEM	450	600	1,800	2,850
1. P. Malaysia - Singapore	450		600	1,050
4. P Malaysia - Sumatra		600		600
5. Batam - Singapore			600	600
16. Singapore - Sumatra			600	600
EASTERN SYSTEM		400	800	1,200
6. Sarawak - W. Kalimantan		200		200
7. Phillines - Sabah			500	500
8. Sarawak - Sabah - Brunei		200	100	300
15. E.Sabah - E. Kalimantan			200	200
NORTHERN - SOUTHERN SYSTEM	380	100	300	780
2. Thailand - P.Malaysia	380	100	300	780
SOUTHERN - EASTERN SYSTEM			3,200	3,200
3. Sarawak - P. Malaysia			3,200	3,200
GRAND TOTAL	3,489	7,162	22,474	33,125

Source: ERIA (2014)

Table 7 presents the details of on-going and planned cross-border transmission line projects, which is also called APG+. The physical connectivity is well planned but how to implement the planned interconnection needs more attention and collective efforts among member countries. Apart from a smooth implementation of physical interconnection, what has not been discussed is how to finance the physical infrastructure connectivity.

Table 7: Ongoing and Planned Cross-border Power Transmission Line Projects (APG+)

Country A	Country B	Project Name	Capacity (MW)
Thailand	P. Malaysia	Su - ngai Kolok - Rantau Panjang	100
Thailand	P. Malaysia	Khlong Ngae - Gurun (Addition)	300
Malaysia	Sumatra (Indonesia)	Melaka - Pekan Baru (AIM II Priority Project)	600
Sarawak (Malaysia)	W. Kalimantan (Indonesia)	Mambong - Kalimanyan	230
Sabah (Malaysia)	E. Kalimantan (Indonesia)	Newly Proposed	200
Sarawak-Sabah (Malaysia)	Brunei	Sarawak - Brunei	200
Laos	Thailand	Hong Sa - Nan 2 - Mae Moh 3	1473
Laos	Thailand	Nam Ngiep 1 - Na Bong - Udon Thani 3 -	269
Laos	Thailand	Xe Pien Xe Namnoi - Pakse -Ubon Ratchathani 3	390
Laos	Thailand	Xayaburi- Loei 2 - Khon Kaen 4	1220
Laos	Thailand	Nam Theun 1- Na Bong -Udon Thani 3	510
Laos	Thailand	Nam Kong 1 & Don Sahong - Pakse - Ubon Ratchathani 3	315
Laos	Thailand	Xekong 4-5- Pakse -Ubon Ratchathani 3	630
Laos	Thailand	Nam Ou - Tha Wang Pha -Nan 2	1040
Laos	Vietnam	Ban Hat San - Pleiku	1000
Laos	Vietnam	Nam Mo - Ban Ve - (Vinh)	100
Laos	Vietnam	Sekamas 3 - Vuong - Da Nang	250
Laos	Vietnam	Xehaman 1 - Thanhmy	488
Laos	Vietnam	Luang Prabang - Nho Quan	1410
Laos	Vietnam	Ban Sok - Steung Treng (Cambodia) - Tay Ninh	Unknown
Laos	Vietnam	Ban Sok - Pleiku	1151
Laos	Cambodia	Ban Hat - Stung Treng	300
P.Malaysia	Singapore		600
Batam (Indonesia)	Singapore	Batam - Singapore	600
Sumatra (Indonesia)	Singapore	Sumatra - Singapore	600
Philippines	Sabah (Malaysia)		500
Sarawak - Sabah (Malaysia)	Brunei	Sarawak - Sabah - Brunei	100
Thailand	Laos	Nong Khai - Khoksa - at; Nakhon Phanom - Thakhek; Thoeng - Bo Keo;	600
Thailand	Cambodia	Prachin Buri 2-Battambang	300

Thailand	Cambodia	Trat 2 - Stung Meteuk (Mnum)	100
Thailand	Cambodia	Pluak Daeng - Chantaburi 2 -Koh Kong	1800
Myanmar	Thailand	Mai Khot - Mae Chan - Chiang Rai	369
Myanmar	Thailand	Hutgyi - Phitsanulok 3	1190
Myanmar	Thailand	Ta Sang - Mae Moh 3	7000
Myanmar	Thailand	Mong Ton - Sai Noi 2	3150
China	Vietnam	Malutang - Soc Son	460
China	Thailand	Jinghong - Laos - Bangkok	1500
Myanmar	India	Tamanthi - ?	960
Cambodia	Vietnam	Sambor CPEC - Tan Dinh	465

Source: Chimklai (2013); Zhai Yongping (2010); ADB (2013); APERC (2004); Bunthoeun (2012)

III. Assessment of investment needs for renewable energy, smart grids and smart meters

a. Investment Needs for Renewable Energy

Provided that the physical and the financial interconnectivity is fully placed in ASEAN, Chang and Li (2013a) analyzed how cross-border power trading encourages renewable energy development in ASEAN and estimated possible economic and environmental benefits accrued from the power trading in ASEAN.[16] When cross-border power trade is allowed up to 20% of each country's peak demand, hydro capacity appears to increase by about 60%, wind energy by about 35% and geothermal energy by more than 20% compared to no-trade case. When cross-border trade is allowed up to 50% of each country's peak demand, the rate of renewable energy utilized appears to be close to 100% increases compared to the 20% case.

Market instruments for promoting renewable energy utilization such as Feed-in-Tariffs (FIT) and Renewable Portfolio Standards (RPS) are expected to harness more energy from renewable sources.[17] Taking account of the cost of carbon emissions, Chang and Li (2013b) also examined how the introduction of renewable energy-related polices such as FIT and RPS into the cross-border power trading in ASEAN facilitates renewable energy development and power trade. FIT appears to be better performing than RPS and implementing RPS of 30% by 2030 appears to a reasonable option as it achieves the moderate performance in reducing carbon emissions and developing renewable energy at a negligible increase in total cost of electricity generation.

[16] Large hydro power plants are included.

[17] FIT schemes are expected to be phased out soon due to mainly the achievement of grid-parity in the near future. They are considered in the study for comparing the results with those of RPS and a sensitivity analysis.

Noticing the cost of realizing physical interconnectivity could offset the reduction in the cost of electricity generation, Li and Chang (2014) explored how the practical consideration of the cost of interconnecting cross-border power grid will influence the accrued economic benefits of cross-border power trade. Table 8 shows that the existing planning of power transmission infrastructure in the region, so-called APG+, appears to stand as commercially and financially viable.[18]

Table 8: Expected Cost Savings from Power Transmission Infrastructure

Scenarios	Cost Savings (%)	Net Savings ($billion)
20% Trade Allowed	0.15	2.2
50% Trade Allowed	0.67	8.0
80% Trade Allowed	1.0	12.1

Source: Li and Chang (2014)

The simulation model assesses only theoretical financial viability and the projects are assumed to be delivered on time. There is no consideration on any barriers in cross-border regulation, legislation or standards harmonization. To realize the theoretical financial viability, policies should be designed and implemented to relieve non-financial barriers so as to keep investment risks low and enable the financial viability.

b. Net metering

It can be foreseen that the energy resources, in particular those converted into electricity will require an electrical network infrastructure complete with appropriate metering. Net metering is the one potentially universal metering system that accounts for in and out flow (i.e., import and export) of the energy from one source point to load point. The estimated excess kW from source points to the grid in order to meet the daily demand for the respective load point can be identified and the tariff rate structure for commercial offers could be viable through net metering.[19] Studies show, however, that the rate required for sound investment can be high. A study shows that factors including

[18] This assertion is based on the author's simulation study. The asserted viability must be scrutinized and tested further as ASEAN seems to lack in capital, ability or willingness to pay for such interconnection on behalf of consumers.

[19] Whether excess kW exists in utility networks, especially in the ASEAN region, is debatable as such excess capacity comes from very high PV or wind generation in countries with exorbitant levels of such intermittent generation capacities.

the net metering legislation, the size of the connected energy sources, capital equipment, direct and indirect manufacturing, and operation and maintenance costs can be the major contributor in determining the profitability based on net metering (Payne, Duke and Williams, 2014).

The net metering allows people to trade photovoltaic solar energy but the rate can be expensive. A study in Tunisia shows that net metering for PV Program is practically a good investment but the rates used in the trading are high and not attractive for investment unless the government can introduce a special tariff rate (Bouazzi and Karti, 2003).[20] Another study on USA homeowner using PV system in net metering shows that issues such as solar irradiant level, tax incentive and proper installation can be the key driver to get the money among different sponsor of the demonstration project. The study shows there were significant roles from the installation cost of the PV system with the tax incentive within the use of the net metering system in order to get the monetary benefit of using the PV system with the net metering system with different tax incentive scenario (Sedghisigarchi, 2009).

In order to allow the flow of energy resources across the different ASEAN nations, a policy framework is needed mainly to ensure long term investment is secured and sustainable. In particular to incentivize the infrastructure connectivity, investment over a period of time before the economic return ensues over the life time of network. The policy shall cover areas like regulatory framework to address mechanism for clearing house and rate structure; awareness program to address capacity development and awareness on the ASEAN level opportunity for import/export of electricity via the interconnected grid.; national/ASEAN agenda to support R&D in particular to optimize national resources in order to increase national economic value and contribution to domestic/national production) Thus increase the wellbeing of each nation state in ASEAN.

IV. Policy recommendations

This paper presents three recommendations. First, it suggests establishing an Independent System Operator (ISO) for physical infrastructure connectivity. The ISO will coordinate all grids and distributed generations and dispatch the least cost generation capacity and followed by next expensive generation capacity. Second, it suggest

[20] The requirement of high rate for attracting investment needs a reality check and is debatable as governments cannot guarantee high FIT rates for PV or other renewable energy generation capacity.

benchmarking the Nord Pool for implementing financial infrastructure connectivity. Third, it needs to establish a clearing house for power and natural gas.

In the case of the USA, legislations and policies were implemented at different levels both at the federal and the states in particular to pursue the high usage of energy metering system and various incentives, which benefits USA citizens economically, strengthen the national security and improve health (Singarao and Singh, 2009). A project in Europe tested a project to promote PV through net metering optimization mainly for use of retail customer connections (Christoforidis, Chrysochos and Hatzipanayi, 2013). Whether net metering could help accelerate the interconnectivity in the ASEAN region needs to be examined.

V. Conclusions

Facing a rapid growth in energy demand following a fast growth in its economy, ASEAN needs to increase its power generation capacity. ASEAN does not have much reserve of fossil fuels but has huge potentials in renewable energy, especially hydropower, wind and geothermal energy. However, the supply sources are scattered and the demand sources are far from the supply sources, so linking the supply sources to the demand sources is the key to facilitate the development of renewable energy in the region. Such interconnectivity needs have been well taken care of by ASEAN countries.

ASEAN has well-developed plans for interconnecting power grids (e.g., APG and APG+) and gas pipelines (e.g., TAGP). The interconnected power grids and pipelines encourage the trading of power generated from renewable sources and natural gases in the region, and the interconnected gas pipelines not only facilitate to develop indigenous natural gas but help transport imported natural gas throughout the region. To fully utilize the renewable energy potential, especially from hydropower, geothermal, solar or wind energy, appropriate metering is critical for the successful development of renewable energy.

Apart from connecting the physical infrastructure, the financial infrastructure for power trade also needs to be developed to complete the interconnectivity. For the physical and the financial infrastructure, an independent system operator along with a clearing house for all transactions can be established. The European experiences and Nord Pool could be a good benchmark for this purpose.

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ENERGY TECHNOLOGY - ASEAN Energy Technology Strategy 2015-2030

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Abstract

Over the next two decades, ASEAN's energy demand is predicted to grow by over 80% and electricity demand more than double due to population growth and rapid economic expansion. However there is a wide disparity among the ten member states on energy access and quality of energy services. And while the region's reserve of fossil fuels is fast depleting, its energy consumption continues to be dominated by these carbon-intensive fuels. Thus providing affordable, lower carbon and modern energy services while ensuring equitable access will be a formidable challenge in the next decades for each member state and the region as a whole. One of the key issues in meeting this challenge is ASEAN's capability to adapt and apply best available energy technologies and to innovate energy technology solutions appropriate to the local context. It is revealed in this review paper that, in general, there existed a significant gap between the technologies in stock in ASEAN and the best available technologies (BAT's) globally, be they conventional power generation technologies, renewable energy technologies, or end-use technologies in the industry, transport, commercial and residential sectors. There is also huge knowledge and capacity divide between current, predominant practices and the best practices in energy efficiency within each country and in the design and implementation of supportive policy measures for the development and deployment of cleaner technologies among member states. Taken together, there is significant scope for efficiency upgrading of existing power generation facilities and for efficiency gain through the installation of more efficient, state-of-the-art fossil-based facilities. There are abundant renewable energy sources, particularly bio-based resources for heat, electricity, and transport fuel production, hydro, geothermal and solar energy. Potential exists for the applications of carbon capture and storage (CCS) technology for enhanced oil recovery (EOL) and for power generation and industry sectors, though its feasibility has yet to be determined. Also, opportunities abound for energy saving and, hence CO_2 emission reduction, in all end-use and final service sectors.

However developing countries in ASEAN generally have difficulties to follow, adopt, and implement policies and strategies for the development and deployment of appropriate energy technology options to ensure energy security and access on the one hand, and to limit GHG emissions on the other. This is due to a number of economic and non-economic barriers, ranging from the lack of technical information and capability, financial schemes and investment resources, human capital capacity, to cultural, institutional, and legal barriers and the absence of forward-looking science, technology and innovation policy. For example, even though nearly all member states have implemented pertinent policies and programs with varying degree of success, 15-non

economic barriers, at the ASEAN level, in promoting renewable energy have been identified. Most of the top 5 barriers are related to government failures in providing infrastructure, leadership, reliable information, and incentives.

To move the energy technology agenda in ASEAN forward, it is proposed, first and foremost, that governments set clear and achievable long-term goals/targets, with appropriate implementation strategies. Agencies responsible for establishing strategies and implementing programs (e.g. tendering and evaluation) must be in place, along with program monitoring and evaluation mechanisms. Energy technology development and innovation policies should be sector and end-use specific and their definition and formulation based on clear and achievable objectives and on in-depth consultation with relevant stakeholders: concerned industrial sector representatives, research institution, universities and technology consultants and/or providers. A well-defined technology development plan for 3-5 years could then be developed together with the respective ministries, such as the ministries of economics, industry, finance and energy.

As regards to R&D, research programs should be well defined with a perspective for eventual commercialization, and therefore should cover research, development, demonstration and deployment (RDD&D) aspects. R&D grants should also be awarded on a transparent, competitive basis to collaborative project proposals involving academic institutions and industry partners.

In addition governments should provide easy finance access for innovation and investment in innovative projects through various schemes. Presently, a number of international financing mechanisms/schemes could be accessed by ASEAN countries, particularly in the context of climate or green financing, such as the Private Financing Network (PFAN) implemented by USAID, ADB's Clean Energy Financing Partnership Facility (CEFPF), and the Clean Technology Fund (CTF) – a multi-donor fund channeled through several development banks, etc. While these funds are useful and should continue to be accessed, it is felt that an ASEAN focused trust fund that would support ASEAN specific clean energy technology development and deployment agenda is desirable. It is against this background that the ASEAN Clean Energy Technology Trust Fund (CETTF) is proposed. Its objective is to serve as a key instrument to remove finanacial and other related barriers to the development and deployment of clean energy technologies at the ASEAN level. It is designed to provide financial support on projects, to divert private investors' risks by leveraging with its own funds, and to offer technical assistance to investors, through project loans, grants, and technical knowledge provision and exchange. A preliminary proposal on the fund structure, possible sources of fund, governance and procedures, and examples on the types of projects to be funded are outlined. However, a more detailed definition of the Fund based on broader

stakeholder consultation needs to be conducted and in-depth investigation should be carried out to test and validate its feasibility and practicality.

1. Introduction

ASEAN, a vibrant region with a population close to 600 million, is experiencing very rapid economic growth while gearing up for regional economic integration in the name of ASEAN Economic Community (AEC) by 2015. With the region's population predicted to expand by almost one-quarter and the GDP to nearly triple within the next two decades, its energy demand will grow by over 80% and the demand for electricity will more than double. However despite this projected phenomenal growth, the reality at present is that over 20% of the population still have no access to electricity and nearly half of the population rely on the use of traditional biomass. At the same time the region's fossil fuel reserve is fast depleting, turning some of the net energy exporting member states into net importers. The fact that ASEAN's energy consumption is still, and likely to continue to be over the next several decades, dominated by fossil fuels is also a source of concern in the face of increasing threat of climate change, and Southeast Asia being one of the most vulnerable regions on earth. Thus the provision of secure and affordable energy while ensuring equitable access and environmental sustainability will be a formidable task for each member state and the region as a whole.

Because of the relatively long lifetime nature of most energy technologies, one of the critical challenges in meeting the above demands is the choice of technology, since the technology stock in place and in planning now will dictate how efficient and environmentally benign energy will be generated, transmitted or transported, and used over the next decades. This would then have significant ramifications on the security and sustainability of energy supply and use in the region. Other technology-related, critical issues include: the ability to apply and adapt the best available technologies to suit the local physical, social and environmental conditions, the capacity to innovate to lower the cost of energy technologies, and the ability to improve the efficiency of existing or installed facilities.

This paper therefore aims to identify barriers to and opportunities for the deployment of more energy-efficient and less carbon-intensive energy technologies in the electricity supply, transportation, industry and building sectors in ASEAN. It also attempts to analyze and suggest strategies and policy instruments, particularly financing mechanisms that are needed at the ASEAN level to support the realization of those opportunities.

The paper begins with a macroscopic view of global energy flows, energy resources of ASEAN nations and their future demand. A perspective on new energy technologies

that will likely shape the global energy landscape in meeting the dual demands of energy security and sustainability is given in section 3. Sections 4 and 5 reviews and takes stock of the predominant type and status of energy technologies currently in use in the major economic sectors in ASEAN, followed by a review of the main types of cleaner energy technologies that should be promoted, over the 2015-2030 period. Section 6 identifies the challenges and barriers to the development and deployment of these technologies, including: technical, financial, investment, cultural, institutional, legal and human capital capacity aspects. Finally section 8 provides recommendations on strategies and mechanisms to remove major barriers to and support for, at the ASEAN level, the development and deployment of more energy-efficient and less carbon-intensive energy technologies.

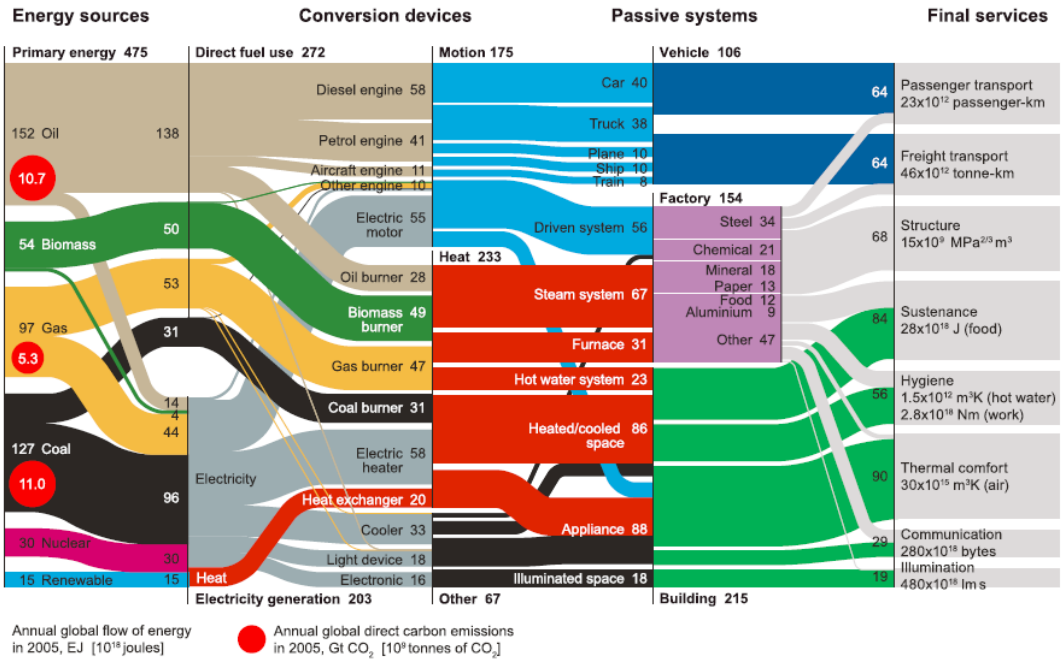
2. Global Energy Flows and Energy Supply and Demand in ASEAN

2.1 Global energy flows

Figure 2-1 shows the map of global energy flow through society, from primary energy sources, through different conversion devices to various end-uses or services, as at 2005 (Cullen and Allwood, 2010). Even though the data may be somewhat dated, it serves to demonstrate the nature of the flows, the critical role of energy technology in various stages, and the order of magnitude of the share of each component. For example, the global primary energy mix, shown on the left column, is as follows: 32% oil, 27% coal, 20% gas, 12% biomass, 6% nuclear and 3% renewables (hydro included). It is clear that fossil fuels still dominate, while low-carbon sources (nuclear, biomass, and renewables) make up only 20% of energy supply. Thus de-carbonizing the energy supply remains a formidable challenge when compared with gains from energy efficiency.

The majority, about 70%, of electricity is generated by burning coal and natural gas.

Figure 2-1 From fuel to service:tracing the global flow of energy through society (Cullen and Allwood, 2010)



On final services side, 45% of total energy is used in buildings, 32% in factories, and the remaining in transportation, which is primarily powered by oil.

Thus efforts should be focused on improving energy efficiency throughout the conversion chain to end-uses. For example, combustion processes should be improved (as over 90% of energy sources are fuels which are combusted), and technical options for converting the chemical energy of fuels directly to electricity, heat, or motion, be explored.

The challenge for *passive systems* is to design technologies that make better use of energy, by preserving and recovering the heat in buildings, the materials in products, and the momentum in vehicles. Improvements can also be made by reducing the demand for final services, through behavioral and lifestyle changes. Furthermore, thermal comfort also ranks high on the list and can be targeted by reversing the practice of using high quality fossil fuels to supply low temperature heat. Significant savings are available from the wider use of heat pump technology and improving the insulation of buildings (Cullen and Allwood, 2010).

2.2 Energy profile of ASEAN nations

Despite having more than 28,000 billion barrels of oil reserves, the member countries of ASEAN (Association of South East Asian Nations, perhaps except Brunei Darussalam) are

predicted to become a net importer of oil in the next 5-10 years. Apart from oil reserves, the region has some other natural resources potential such as natural gas and coal, but these resources are fastly depleting due to the rapid global economy growth particularly in developing world. Anticipating to downward movement of these fossil energy resources, most countries have begun developing renewable energy and even consider developing nuclear power plants to reduce their dependence on fossil energy and in some respects to help mitigate the impact of climate change.

The reserves on natural gas, for instance in Indonesia and Malaysia alone, are proven to be more than 5.5 TCM (Terra Cubic Meter) or almost 37% of the reserve available (over 15 TCM) in the whole Asian region. The total reserves of more than 4,300 MMT (Million Metric tonnes) coal in Indonesia (bituminous and lignite), Vietnam and Thailand (lignite) represent the biggest fossil fuel reserves in the region (ACE, 2005; IEA and ERIA, 2013). However, these reserves are relatively low compared to the worldwide reserves.

At of the end of 2011, Indonesia had 13.5 billion tonnes of hard coal reserves and 9.0 billion tonnes of brown coal reserves, ranking tenth- and sixth-largest globally, and by far the largest in Southeast Asia (BGR, 2012). Its reserves have risen significantly since end of 2010 – hard coal by 45% and brown coal by 15% (IEA and ERIA, 2013). Moreover, the country's coal production reached 296 Mtce in 2011, increasing by 15% per year on average since 2000, the largest in the region, followed by Vietnam (IEA and ERIA, 2013). The region's total final coal consumption increased from 248.7 Mtoe in 1997 to 1,620 Mtoe in 2006, to meet the electricity need which gradually increased from 369 TWh in 2000 to 3,600 TWh in 2010 (ACE 2005 and IEA 2008).

The oil price boom in 2007-2008 was the crucial moment for policy makers in ASEAN member countries to consider reducing its dependence on fossil fuels by shifting to other renewable energy resources. According to the prediction by Asian Center of Energy (ACE) (ACE, 2005), the share of generation mix in the region will move towards non-oil fuels. But by 2020, almost 45% of the fuel mix for power generation in ASEAN will still be coal, followed by 40% natural gas and only less than 2.0% oil. The rest of the electricity will be generated either by renewable energy or nuclear power.

Table 2-1 shows the comparison for ASEAN member countries to the world in terms of population, GDP, and energy consumption growth over the past 20 years. It shows that ASEAN's GDP growth has been far ahead of the global average. In contrast to GDP growth, energy consumption per capita growth in most ASEAN member states has been lower than the global average, except for Malaysia and Thailand, where the growth being much higher than the global average.

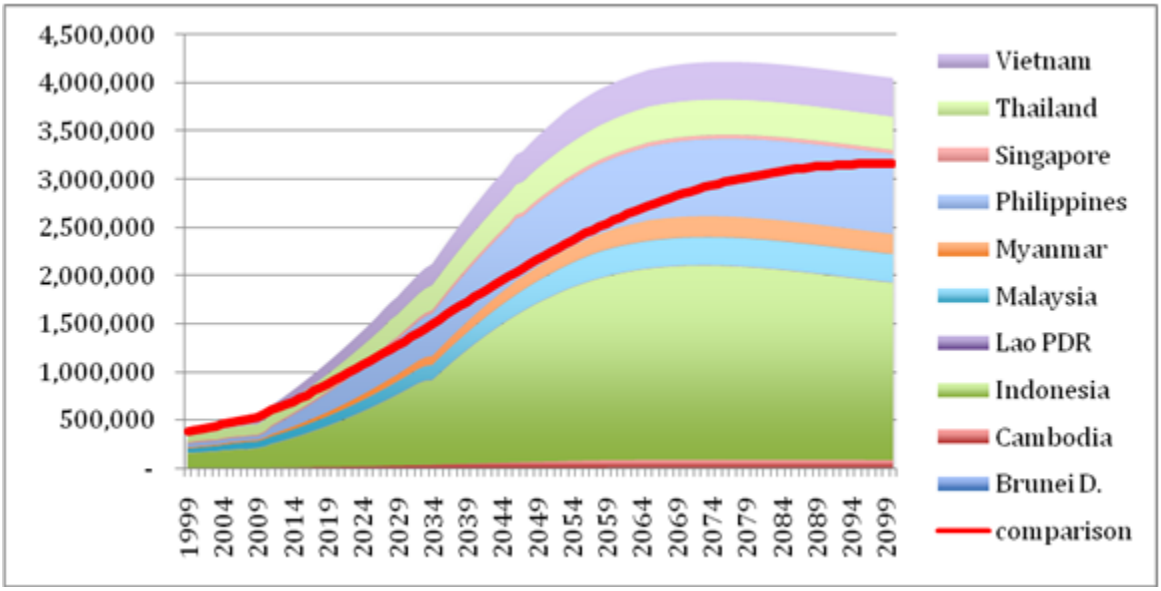
Table 2-1 Demographic and economic growth in relation to energy consumption per capita in ASEAN (GCOE, 2013; AEC, 2005)

Country	GDP [billion US$]			Population [thousand]			Energy consumption [KTOe/capita]			Total area
	1990	2010	Growth (20y)	1990	2010	Growth (20y)	1990	2010	Growth (20y)	Thousand sq km]
Brunei Darussalam	3.5	14	300%	252	399	58%	6.99	7.50	7%	5,765
Cambodia	2.2	11.24	411%	9,532	14,138	48%	n/a	0.32	n/a	181,035
Indonesia	114.4	706.6	518%	184,346	239,871	30%	0.55	0.73	33%	1,904,569
Lao PDR	0.865	7.29	743%	4,192	6,201	48%	n/a	n/a	n/a	236,800
Malaysia	44	237.8	440%	18,209	28,401	56%	1.21	2.02	67%	329,847
Myanmar	2	19	850%	39,268	47,963	22%	0.27	0.28	2%	676,578
Philippines	44.3	119.6	170%	61,629	93,261	51%	0.47	0.52	12%	300,000
Singapore	36.1	208.7	478%	3,017	5,086	69%	3.80	4.91	29%	683
Thailand	85.3	318.5	273%	57,072	69,122	21%	0.73	1.15	56%	513,115
Vietnam	6.5	106.4	1537%	743	1,124	51%	0.36	0.47	29%	331,689
World	21,900	63,120	188%	5,306,425	6,895,889	30%	2.27	3.12	37%	n/a

2.3 Future energy supply and demand in ASEAN

The true challenge in the region is not coming from its limited fossil fuel supply, the vast growing energy demand shows staggering fact to be faced for all nations in the region. The energy consumption prediction should show less disparities in order to optimize the regional energy policies. Study done in Kyoto University Energy Science as shown in Figure 2-1 by considering not only demographic and economic pictures as its variables but also considering the geographical and landscape challenge into the model, shows an approximate more than 5-15% higher energy consumption from year 2020 up to 2100 compare to the common forecast on energy consumption. With the assumption on the population and economic growth mentioned in table 2.1.

Table 2-2 Predicted energy demand between BAU and model in MTOe (red; BAU) (in MTOe) (GCOE, 2013)



When considering the potential future scenarios for energy in ASEAN, it is important to consider that all of these developing nations will at some stage attain 100% electrification rate and close to 100% share of modern fuels in residential energy mix. The crucial elements will be at what level of final energy consumption, what efficiency rate and from what mix of primary energy sources that energy will be provided (Keiichi et al., 2013). To transition from a fossil based energy system to a more sustainable system, strong policy to improve energy efficiency should be a high priority, as there is significant room for improvement in the current system.

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3. Global Energy Technology Perspective

3.1 Power Generation: Centralized and Decentralized

The past five years have seen major changes in power infrastructure development trends around the world. Emerging technologies like solar and wind have experienced dramatic price decreases – up to 80% decrease over a decade for wind power generation and up to 50% decrease over the past five years for solar power generation[21]. This trend of decreasing prices combined with technologies that are more robust, efficient and are increasingly able to generate power even in suboptimal conditions such as low wind speeds and low solar irradiation has moved renewable energy technologies from niche to mainstream[22] (IRENA, 2014). According to the IRENA report, *Rethinking Energy*, global renewable power capacity has reached 1,700 GW in 2013, constituting about 30% of all installed power capacity and renewables have accounted for more than half of net capacity additions in the global power sector since 2011.

Unlike large-scale power infrastructure like coal and hydropower technologies, emerging renewable energy resources are generally site-specific and mostly small-scale thus making this energy resource economically suitable for off-grid systems, micro-grid systems or for deployment at the distribution level. In rural or off-grid areas, this is served by renewables like biomass, biogas and wind power, while for urban areas decentralized power largely comes from solar power and combined heat and power systems (CHP) for providing electricity for example district cooling. In addition, solar power will be increasingly contributed to decentralized power in urban areas through rooftop and building integrated. As these power sources are located close to the point of consumption, electricity transmission losses are greatly reduced and energy security and flexibility is improved with a more diversified energy mix. The increase integration of variable renewable energy into the grid requires the transformation of the whole energy system (IEA, 2014b). The transformation of renewable energy requires many aspects e.g. smart grid, DSM, energy storage. The technology for the transformation of energy system already mainly exists but the economic aspects have yet to be how to optimize and to make use of various technologies. It requires energy regulatory in the country that affect to grid.

[21] GE Workout Presentation in KL

On the other hand, power grids are traditionally designed to allow only a unidirectional flow of electricity from source to load, which means that adding a power source at the load point can cause disruptions to the overall system, especially if the power source is intermittent. This challenge has generally been mitigated with improvements in smart grid, power grid and energy storage technologies.

In recent year, several events like the Fukushima Nuclear Accident in 2011, the shale gas revolution in United States and China's PM2.5 air pollution crisis has sparked public concerns on how energy is being extracted and generated and how it will impact public health and the environment. The ensuing pressure has encouraged more development and deployment of more sustainable energy technologies that include cleaner coal technologies, high efficiency thermal power technologies and research into carbon capture,utilization and storage (CCUS) technologies.

Coal thermal plants employing ultra-supercritical coal technology are now able to reach up to 46% thermal efficiency, with advanced technologies like integrated gasification combined cycle (IGCC) and pressurized fluidized bed combustion (PFBC) enabling even higher efficiencies, expected to be up to 50% in the future (WNA, 2014). Gas power plants are less controversial than nuclear, produce less emissions than coal combustions, has shorter start and shutdown times than both, and with the shale gas revolution and improving LNG technologies, is becoming more easily available and to transport. Furthermore, with its dispatchable and flexible operations, gas power plants can complement the variable nature of renewables, thereby enhancing the transition to a cleaner and more secure energy future.

For nuclear, the IEA Energy Technology Perspectives reports that global nuclear capacity is stagnating at this time. This is due to safety regulations and public opinion of this resource becoming stricter after the Fukushima Nuclear Accident in 2011, making it extremely difficult for new nuclear capacities to come online. In Japan, as of July 2014, all nuclear facilities are still offline and under inspection. On the other hand, the heightened scrutiny of nuclear power facilities have brought about more stringent safety and security protocols, which would ultimately ensure that the development of global nuclear power programs will take place in a safe, efficient, responsible and sustainable manner (IAEA, 2014).

In summary, it is clear that the power generation industry is in a state of transition, shifting from fossil fuels to renewables, moving towards higher efficiencies across the

board and becoming more decentralized with the support of improved power grid and energy storage technologies. It is vital that this transition is managed holistically and effectively to ensure a sustainable future for all.

3.2 Industry

3.2.1 Technology penetration

According to the Energy Technology Perspective 2014 (IEA, 2014) the global industrial energy use reached 143 EJ in 2011, up 36% since 2000. The increase is largely fuelled by rising materials demand in non-OECD countries, which now use 66% of industrial energy, up from 50% in 2000. Growth in industrial energy use must be cut to 1.7% per year in the period from 2011-25 compared with 3.3% per year in 2000-11 to meet the 2DS (or the 2-degree Celsius scenario to mitigate climate change) targets set by the IEA for 2050 (IEA, 2014a).

Similarly, trends in industrial CO_2 emissions must be reversed: from 2007 to 2011, emissions grew by 17% by 2025, they must be reduced by 17% to meet 2DS targets (IEA, 2014a).

Improvements in energy efficiency have offset the upward effect of structural changes in the industrial sector, such that overall industrial energy intensity is decreasing; in 2011 most regions were below a level of ten gigajoules (GJ) per thousand USD purchasing power parity (PPP) of industrial value added. China (2.4%) and India (1.9%) have had the highest annual reductions since 2000. Thanks to high shares of new capacity. China is now among the world's most energy-efficient primary aluminum producers (IEA, 2014a).

Substantial potential to further improve energy efficiency exists. By applying current best available technologies (BATs), the technical potential to reduce energy use in the cement sector is 18%, 26% in pulp and paper, and 11 % in aluminum (IEA, 2014a).

These potentials are unlikely to be fully tapped by 2025 due to slow turnover of capacity stock, high costs and fluctuation in raw material availability. Meeting 2DS targets will also require resolving challenges related to increased use of alternative fuels and clinker substitutes, and greater penetration of waste heat recovery (WHR) in the cement sector, among others (IEA, 2014).

3.2.2 Market creation

Energy management systems (EnMS) can be effective tools to enable energy efficiency improvements, but in most countries they are still voluntary. ln 2013, China mandated provincial-level implementation of energy management program in companies covered

by the Top-10 000 Program, an energy conservation policy for large energy users. In the United States, pilot companies in the Superior Energy Performance program on average improved their energy performance by 10% in 18 months. The Australian Energy Efficiency Opportunities program, which is mandatory for large energy users, was estimated to have enabled 40% energy savings in participating firms (IEA, 2014). A growing number of industrial sites have certified EnMS (ISO 50001) in place: 6 750 in 70 countries in March 2014, up by more than 300% over the previous year (Peglau, 2014).

3.3.3 Technology developments

Innovative energy-saving technology developments have been relatively slow in energy-intensive industries over the last decade and need to accelerate: in the 2DS for instance, deployment of CCS starts before 2025. To stimulate investment in CCS, industry is investigating opportunities for CO_2 use in EOR and developing processes that use CO_2 as a feedstock (e.g. in polymer production). In pulp and paper, the Confederation of European Paper Industries (CEPI) announced in 2013 promising lab-scale results of deep eutectic solvents (DES) allowing the production of pulp at low temperatures and atmospheric pressure, Applying DES-based pulp making throughout the sector could reduce CO_2 emissions by 20% from current levels by 2050 (CEPI, 2013).

3.3 Buildings

The global trend for energy performance of building is to achieve near zero net energy (NZEB). This means the import and export ratio of energy tends toward 1:1. This vision in achieving NZE for building is considered highly challenging and the measure used for determining this energy balance is still being debated (Crawley, 2009; Deng, 2014). Despite the ambiguity, different economic zones, like the European Union (EU), has introduced the EU energy performance of buildings directive which sets targets achieving near NZEB buildings (EU, 2014).

Energy technology for NZEB comes in the forms of building designs, equipment, and control. In building designs, the form factor, tightness, envelope materials, and orientation, all combine to determine the heat transfer between the outside and inside of the building (Sadineni, 2011; Sozer, 2012; Pacheco, 2012). The technologies targeted on the envelope materials, involves new designs and new materials, for example composite cavity walls infused with phase change materials (PCM). The use of coatings will be dominant as this approach is effective for existing building. Coating technology has the function of reducing thermal conduction and solar heat gain, these parameters are measured in terms of U-value, and g-value, respectively. Building integrated energy harvesting claddings are increasingly being used as building envelopes.

To achieve NZEB, the energy use intensity has to be improved, and renewable energy harvesting capabilities has to be installed (Li, 2013; Oliveiri, 2014; Andersonn, 2013; IPCC, 2014). The control system, or more commonly refer to as the energy management system (EMS), plays an important role in binding the equipment and the renewable energy sources.

The matrix of benefits versus risk, prepared by Anderson&Roberts (2013), showed the high impact and low risk technologies are centred on climate control. The use of combined cooling, heating and power (CCHP), and a combination of renewable energy sources will dominate, as standalone systems, or as a collective community level system.

3.4 Transport

To respond to the global challenge of climate change, energy technologies in the transport sector are always deemed an important component of greenhouse gas emissions reduction options. These technologies are widely examined by an analytical approach called ASIF (Facanha et al., 2012, Bongardt et al., 2013, Sims et al., 2014)

- ***Avoiding or shortening journeys (A)*** by, for example, densifying urban landscapes, sourcing localized products, internet banking, internet shopping, and utilising information and communication technologies (ICTs), such as tele-conference, navigator system. Smart land-use planning in a compact city could save energy in a sustainable manner for long-term periods.
- ***Mode shift (S)*** to lower-carbon transport systems – encouraged by increasing investment in public transport, walking and cycling infrastructure, improving railways, water transport, logistic systems to become more attractive for users. Mass rapid transit system (MRT) which is well-connected with feeder systems (e.g., light rail transit, bus) is crucial to shift private car users to public transport for a large city. Bus rapid transit system (BRT) a bus service with dedicated lanes that can be a backbone system for a small to medium-sized city, instead of MRT, which can be developed with lower investment and shorter period of construction. However, preserved spaces on roads for the BRT system is needed to avoid future objection from private car users.
- ***Lowering energy intensity (I)*** by enhancing vehicle and engine performance, using lightweight materials, increasing freight load factors and passenger occupancy rates, deploying new technologies such as electric-drive vehicles; hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV), and battery electric vehicles (BEV). HEV has been fully commercialised in many countries. BEV is promising technology to reduce oil-based fuels and pipe-line emissions,

but cost-effective electricity supply infrastructure and storage for vehicles are still the main challenges for the widespread use. Combining batteries and internal combustion engines (ICE), i.e. PHEV would be a solution during the transition period (IEA, 2014a). Technologies for on-road vehicles such as idling stop system, fuel-efficient tyres can improve energy efficiency in the range of 3-10% (Sims et al., 2013 and Kojima, 2012)

- ***Fuel choice (F)*** by shifting to efficient and low-carbon content fuels, including electricity and hydrogen.

3.5 Carbon dioxide capture and storage (CCS)

Carbon-dioxide capture and storage (CCS) technologies could reduce carbon dioxide equivalent (CO_{2eq}) life-cycle emissions of fossil power plants, and their deployment in both power and industry is critical to address climate change. Indeed at the global level, atmospheric greenhouse gas mitigation scenarios reaching 450 ppm CO_{2eq} by 2100 (to prevent exceeding the two-degree Celsius rise in global temperature) are characterized by tripling to nearly quadrupling of the share of zero and low carbon energy supply from renewables, nuclear energy, and fossil energy with CCS (IPCC, 2014). Although all of the components of integrated CCS systems exist and are in use today by various industry sectors and significant progress is being made in demonstrating elements of capture, transport and storage, CCS has not yet been applied at scale to a large, commercial fossil-fired power plants. As of end-2013, eight large-scale CCS projects – all using anthropogenic CO2 for enhanced oil recovery (EOR) - are in operation. However two of the first projects built in the electricity sector are among nine large-scale projects that are under construction (IEA, 2014a). Applying CCS in an electricity generation facility incurs substantial efficiency penalty and addition capital investment. Up scaled commercial operation of CCS in this sector is therefore unlikely without stringent limits on GHG emissions or regulatory mandates requiring the installation of CCS. In addition, there are other significant barriers, including concerns about the operational safety and long-term integrity of CO_2 storage as well as transport risks. There is, however, a growing body of literature on how to ensure the integrity of CO_2 wells, on the potential consequences of a pressure build-up within a geologic formation caused by CO_2 storage (such as induced seismicity), and on the potential human health and environmental impacts (IPCC, 2014 and IEA, 2014a)

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4. Current Stock of Energy Technology in Use in ASEAN

4.1 Power production and distribution

Since 2002, the number of people in the ASEAN region without access to electricity has decreased by around 60 million, despite the growth in population. While this is a positive achievement, yet, access to modern energy services is still limited for several ASEAN member states, with the exception of Brunei Darussalam, Malaysia, Thailand and Singapore. In 2011, as many as 134 million people in Southeast Asia, or 22% of the region's population, still do not have access to electricity and around 280 million people rely on the traditional use of biomass for cooking, almost half of the region's population (see Table 4-1). These numbers actually exceeds the global average in the same year whereby the share of world population without access to electricity is 19% while the share of world population that still relies on biomass for cooking is 39% (IEA, 2011).

Table 4-1 Access to modern energy services in ASEAN (IEA, 2013)

	Population without access to electricity		Population relying on traditional use of biomass for cooking*	
	Million	Share (%)	Million	Share (%)
Brunei Darussalam	0	0%	0	0%
Cambodia	9	66%	13	88%
Indonesia	66	27%	103	42%
Lao PDR	1	22%	4	65%
Malaysia	0	1%	1	3%
Myanmar	25	51%	44	92%
Philippines	28	30%	47	50%
Singapore	0	0%	0	0%
Thailand	1	1%	18	26%
Vietnam	3	4%	49	56%
Total ASEAN	**134**	**22%**	**279**	**47%**

* Preliminary estimates based on IEA and World Health Organization (WHO) databases. Final estimates for 2011 will be published online at *www.worldenergyoutlook.org*.

At the same time, ASEAN is a fast growing region and IEA predicts that the regional GDP will nearly triple between 2011 and 2035, while population will expand by almost one-quarter (IEA, 2013). Both these factors will drive energy demand to increase by over 80% over the same time horizon. For the power sector, electricity demand will more than

double from about 600 TWh in 2011 to about 1500 TWh in 2035 (IEA, 2013). The technology stock in place and in planning now will dictate how electricity will be generated and transmitted over the next 20 to 50 years, which would then have significant ramifications on the energy security and energy sustainability in the region. Ideally, the current and new stock chosen will be of the latest and most efficient technology available but as will be seen in the following discussions, this may not always be the case.

4.1.1 Conventional power production technology

Traditionally, electricity is produced and managed centrally by utilities and the technology utilized depends on the resources availability in the country, which could either mean exploiting already existing resources or imports. This is obviously reflected in ASEAN, for instance, Brunei Darussalam as a major gas producer relies almost exclusively on gas power technologies for its electricity supply whereas Singapore with limited resources on its own imports fuel from neighboring countries and abroad. The power capacity developed would then depend on the expected demand requirements of the country.

As of 2011, ASEAN electricity is largely fueled by fossil fuels, namely coal, gas and oil. Gas currently dominates the mix, but cheaper coal will likely overtake gas in the future given the large number of units being added around the region within the next decade. One example is Indonesia with plans to add over 10 GW of coal power capacity under the 10,000 MW Accelerated Power Program Phases I and II.

According to IEA, the existing stock for coal power in ASEAN has an average efficiency of about 34% (IEA, 2013), which is quite low considering that current ultra-supercritical coal technologies are able to reach up to 46% efficiency. This is due to the proliferation of subcritical coal power plants already existing in the ASEAN power systems, and which will remain in operation for at least another 20-30 years. The choice of how efficient the technology to be added depends largely on the cost and highly efficient cleaner coal technologies (CCT) can be prohibitively expensive, and some are still in demonstration process. Cleaner coal technologies describe technologies and industry practices that enhance coal derived generation efficiency including coal gasification, carbon capture and storage, and conversion of coal to chemical fuels.

The resulting trade-off from choosing less efficient technologies will be higher fuel costs and increased emissions; especially over the long term as coal power plants have a technical lifetime of over 30 years. However, given the rapidly growing electricity demand in the region, particularly to cater for the population newly gaining access to electricity and the urbanizing population, power planners are under pressure to provide

capacity as quickly, securely and as economically as possible; so this may also be a factor to mature coal technologies being chosen rather than new, more efficient cleaner coal technologies.

To accelerate the deployment of cleaner coal technologies in ASEAN, its member countries have listed 4 strategies under the Coal and Clean Coal Technology Program Area of the ASEAN Plan of Economic Cooperation 2010-2015 which are:

- Strengthen Institutional and Policy Framework and build an ASEAN Coal Image
- Promote coal and Clean Coal Technologies (CCT)
- Promote Intra-ASEAN Coal Trade & Investment
- Enhance environmental planning and assessment of coal projects

For gas power technologies, there are still a number of open-cycle turbines in operation around the region, but with increasing realization of the benefits of the more efficient combined-cycle gas turbines, there has been a definite shift towards this technology over the past decade which will likely continue in the future. Other factors like dwindling gas reserves and increasing gas prices may also play a role in this development, for instance, gas producer Malaysia and Thailand have begun to import LNG in 2013. Thus, it makes economic sense for these countries to begin repowering or replacing open-cycle turbines with combined-cycle gas turbines and thus improve fuel utilization. Instead of using inefficient open-cycle gas turbines for meeting peak load, the economy could consider employing demand side management or RE to shave or shift demand peaks, or dispatching the hydropower stations available under its portfolio to meet peak demand.

Besides fossil fuel technologies, hydro also plays a small but significant role in ASEAN electricity mix, up to 10% of the electricity generation in 2011 was hydropower. ASEAN has significant potential in this area, and there are already several large-scale hydropower projects in operation and under construction especially in the Greater Mekong sub-region. The ASEAN Power Grid (APG) project is a big factor driving this development as in enables countries with limited energy resources to purchase electricity from countries with abundance of hydro resource, but lower demand. However in some countries, particularly Thailand, plans to build large storage dams for hydropower have met with strong public resistance. Here improving the efficiency of existing hydropower plants and building more eco-friendly alternatives like run-of-river type power plants should be investigated. Such strategies have been widely adopted in the US and Europe.

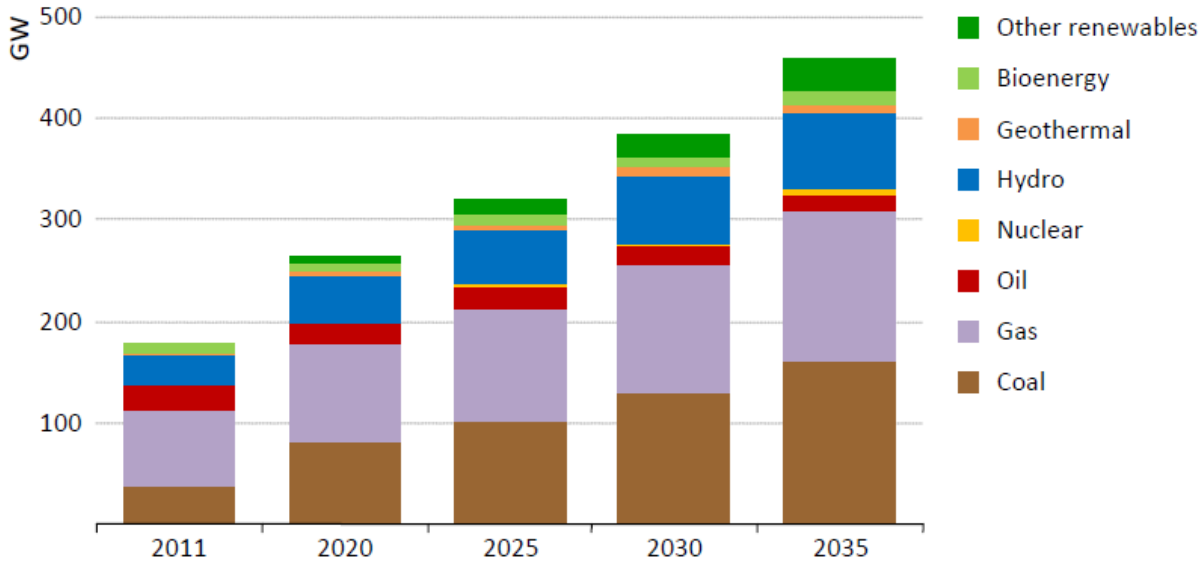
A third type of existing power technology is nuclear, for now, ASEAN does not have any nuclear power capacity. Prior to the Fukushima Nuclear Accident 2011, several ASEAN member states were in the early stages of feasibility studies towards adding nuclear power capacity to their electricity mix, this includes Indonesia, Malaysia, Thailand and

Vietnam, with concrete dates of commissioning for the early 2020s. After May 2011, these plans have been reconsidered; with only Vietnam forging ahead with the first 2GW plant in Phuoc Dinh expected to begin construction in 2017 or 2018 (WNA, 2014)

4.1.2 Renewable energy technology

ASEAN has a fast growing energy demand driven by its economic and demographic growth. ASEAN's primary energy requirement (Reference Scenario) is projected to triple between 2005 and 2030 by an average annual growth rate of 4%. While being highly dependent on oil and gas imports, the issue on climate change mitigation will pose constraints on the use of coal, which is the dominant energy source of the region. Therefore, meeting the region's energy needs is a challenge and diversification of energy resources as well as seeking for any available and possible energy resources should be pursued. In 2011, the contribution of renewable energy share in ASEAN power generation was 29.3%. Biomass is the second largest source of renewable energies after hydropower and accounts for 3.6% of total power generated, as shown in Figure 4-1.

Figure 4-1 ASEAN electricity generation capacity (IEA, 2013)



4.1.2.1 Biomass and Bioenergy

Biomass is an important energy source since it is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural area. The utilization of biomass as an essential energy resource is increased continuously. In ASEAN, energy from biomass such as wood and agricultural residues represents about 12.41% of total renewable energy consumption in 2011. Wood and agricultural wastes are widely used as fuels in the domestic sector and small-scale industries for cooking

and heating, while modern biomass systems including combined heat and power generation and large-scale power plants are also adopted in many countries such as Indonesia, Malaysia, the Philippines and Thailand. Sugar/starch rich and oil rich plants have also been used as raw materials for bioethanol production mainly in Thailand and biodiesel mainly in Malaysia, Indonesia and Thailand. Nevertheless, energy production from biomass still has a significant potential since a large portion of biomass is still under-utilized. Moreover, increasing potential of energy crops and development of plant yield improvement technology will extend the bioenergy potential even more. Therefore, biomass is considered as a major issue in both national and regional future strategic energy planning as an alternative primary energy source for the energy demand.

Among biomass technologies for heat and power generation, combustion is most commonly used in all ASEAN countries, except Brunei and Singapore which do not have or have a limited biomass resource. Biomass combustion applications include tradition uses for cooking and heating, heat and steam generation or combined heat and power generation (CHP) in industry and large-scale power plants. In some countries like Malaysia, Thailand and Vietnam, biomass combustion for electricity, heat and CHP is considered as fully commercial with local capability for manufacture. However, very high efficiency boilers and related components are still imported from China, Japan and Europe. Large-scale biomass power plant projects are also implemented in Laos and Philippines solely by foreign companies. Types of technology are mainly grate fired and some are fluidised bed.

Apart from combustion, biomass gasification has also been adopted for heat and power production but for smaller scales with many for rural energy purposes. Many countries in ASEAN have developed gasification technology in different stages. The technologies are found to come from imports as well as self development. The major barriers for biomass gasification for power generation are similar in all countries, including the problem of high tar content in product gas, the lack of technical skills and the need of local development to reduce the cost of technology.

Anaerobic digestion of organic wastewater to produce biogas for heat and power production has also been in practice in household and industrial sector. Among ASEAN countries, Thailand and Malaysia are considered as the technology leader for both development and implementation of biogas production.

4.1.2.2 Geothermal

Unlike other renewable resources, geothermal is a mature technology that is dependable as a base-load. However, development is tied to locational potential. Out of

the ten ASEAN economies, the Philippines and Indonesia have the biggest geothermal resource potential. The Philippines currently ranks second in the world after the US for the highest geothermal capacity. Indonesia is building up several geothermal capacities, about 49% of the 10,047 MW of new capacity to be built under the 10,000 MW Accelerated Power Program Phase II will be geothermal-based. Malaysia will also be exploring its geothermal resource for the first time next year.

4.1.2.3 Solar and Wind

Several ASEAN countries are offering attractive incentives like feed-in tariffs and tax exemptions to encourage solar and wind development, particularly for solar PV since ASEAN countries are located near the equator with reliable solar irradiance throughout the year. As a result, a large number of solar PV systems are now already in operation in different forms, including solar rooftop installations (solar PV are placed on the roof, this is very popular for residential buildings and factories), building-integrated systems installations (solar PV modules are integrated into the building, acting as walls or roofs) and solar farms installations (ground installed modules). Thailand and Malaysia are also exploring the potential for concentrated solar technology, although this is still in experimental stage since the technology is more suited for desert climate, where direct radiation is more intense.

4.1.3 Carbon Capture, Utilization and Storage

Carbon Capture and Storage (CCS) is a technology that can capture up to 90% of the carbon dioxide (CO_2) emissions produced from the use of fossil fuels in electricity generation and industrial processes (CCSA, 2014), and their deployment in both power and industry is critical to address climate change. Indeed at the global level, atmospheric greenhouse gas mitigation scenarios reaching 450 ppm CO2eq by 2100 (to prevent exceeding the two-degree Celsius rise in global temperature) are characterized by tripling to nearly quadrupling of the share of zero and low carbon energy supply from renewables, nuclear energy, and fossil energy with CCS (IPCC, 2014). The CCS chain typically consists of three components:

1. Capturing the carbon dioxide
2. Transporting the carbon dioxide
3. Securely storing the carbon dioxide emissions either underground in depleted oil and gas fields or deep saline aquifer formations.

Although all of the components of integrated CCS systems exist and are in use today by various industry sectors and significant progress is being made in demonstrating elements of capture, transport and storage, CCS has not yet been applied at scale to a large, commercial fossil-fired power plants.

According to the Global Status of CCS Report released in February 2014, there are 21 'active' large-scale CCS projects (those in operation or under construction) globally with twelve already in operation. Seven of the projects in operation are in the US, 2 in the EU, one in Canada and one each in South America and Africa (GCCSI, 2014). Two of the projects nearing completion in North America will be the first developed for the power sector.

So far, there have been no definite plans yet towards installing CCS facilities in any of the ASEAN member states, but the technology has generated a lot of interest and feasibility studies. An ADB report released last year identified possible key sites for CCS development in four out of the ten ASEAN countries: Indonesia, the Philippines, Thailand and Vietnam.

4.2 Current stock of Energy Technology in Use in ASEAN

The concept of green building is well understood in ASEAN, and this is reflected by the various localized forms of sustainable building assessment standards found in ASEAN. The technology used to achieve energy savings and sustainability are off the shelves products widely available and the global market.

4.2.1 Commercial

In the commercial sector, the energy saving of buildings are benchmarked using local measures like Green Mark, Lotus, TREES, or using standards from outside the ASEAN region such as CASBEE or LEED. As space cooling takes up 60% of the energy use of buildings, the technology for control and CCHP are main focus. Several organizations provide the guidelines and standards for the 6 member countries (TGBI, 2014; VGBC, 2014; BCA, 2014a; PHIBC, 2014; MGBI, 2014; GBCIN, 2014). Currently, only 6 out of 10 ASEAN member countries have working energy performance measurement standards. There is no indication of a regional ASEAN standard, like the EU energy performance of building directive.

Buildings achieving green or sustainable status based on local or regional measures like Green Mark, Lotus, TREES, or those based on standards outside ASEAN like, CASBEE and LEED are all commercial or public buildings. As space cooling takes up 60% of the energy use of buildings, the technology for control and CCHP are the main focus.

4.2.2 Residential

The focus on energy saving on residential buildings are mainly for high rise tower blocks rather than small, below 500 sq.m. floor area, standalone buildings (BCA, 2014b). The use of building integrated solar photovoltaic and solar thermal are popular for the

residential sector (Sharpe, 2014).

4.3 Industry

Industry is presently the largest end-use sector in ASEAN, with energy demand accounting for 30% of total final consumption in 2011. Industry has seen rapid growth in energy consumption in line with a move towards more energy-intensive manufacturing activities at the expense of agriculture. In the New Policies Scenario* of the IEA Special Report on Southeast Asia Energy Outlook, final energy consumption in this sector is projected to grow at an average annual rate of 2.7% through 2035, driven by a continued structural shift from labor-intensive activities to more energy- intensive ones (IEA, 2013).

In ASEAN'S major economies (primarily Indonesia, Thailand, Vietnam, Malaysia and the Philippines), a growing manufacturing sector is increasing demand for cement, steel, brick/ceramic, glass, pulp and paper, plastics, chemicals, food processing, and textiles. The manufacture of these products involves energy-intensive processes and, taken together, they make up a very high proportion of total energy demand in the industry sector. In Thailand, for example, the non-metallic materials (cement, ceramics and glass), food & beverage, chemicals, paper & pulp and basic metals sectors combined make up about 85% total industry energy demand (EPPO, 2011). In comparison to world best practices (WBP), the average specific energy consumptions (SEC) or energy demand per ton of products of these industries are generally quite high, even in the case of modern cement and chemical plants. Table 4-2 compares the average Thai SEC of some industries with WBP, and with Thai best practice (TBP). It is shown that while some production processes are already quite efficient with SEC/WBP of around one, other processes still consume up to 2-3 times the amount of energy needed for WBP. Note that in the chemical/petrochemical industries, the product range and specifications vary widely, it is difficult to compare the SEC with WBP. The best that could be done is to compare the average SEC with the local best, in this case, the TBP, which shows a wide gap. Therefore there is much room for energy efficiency improvement in the industry sector in Thailand and in ASEAN as a whole both in existing processes and in new plants to be installed (Roland, 2011).

Table 4-2 Average Specific Energy Consumption in major energy consuming industries in Thailand (JGSEE, 2011)

Production process or product type	Comparison to WBP (times)	Production process or product type	Comparison to TBP
Cement (raw materials preparation)	3.1	Chemicals	
Cement (kiln)	1.3	(primary products)	1.0 – 2.2
		(downstream products)	> 4
Ceramics (floor tiles)	1.1	Petrochemicals	
Ceramics (sanitary products)	2.3	(midstream products)	1.1
		(downstream products)	3 - 15
Flat glass	2.3		
Scrap metal arc furnace (different products)	1.2 – 1.4		
Billet heating (different forms of metal)	1.2 – 2.2		
Food (sugar)	1.3		
Food (Canned vegetables/fruits)	1.9 – 2.1		
Food (Frozen seafood)	1.1		
Feed meals	1.1 – 1.3		

Note: WBP = World Best Practices, TBP = Thai Best Practices

**The New Policies Scenario is the central scenario of the IEA report, which incorporates policies and measures that had been adopted as of mid-2013 that affect energy markets, as well as other relevant commitments that have been announced.*

4.4 Transport

4.4.1 Alternative fuels

Alternative fuels that are currently used for transportation in ASEAN are biodiesel and ethanol. Major biofuel-producing countries include Indonesia, Malaysia, Philippines and Thailand. Indonesia and Malaysia are two largest palm oil producers – jointly producing 85% of world's production, while Thailand is leading in ethanol production in the region. Main drivers for the development of biofuels in the region are energy security and socio-economic concerns; reducing oil import dependence at the same time to boost up income generation for farmers, while, climate change is a minor driver. Current blending

ratios of biodiesel for Malaysia, Indonesia and Thailand are 5% and 2% for Philippines. Palm oil is major feedstock to produce biodiesel, while Philippines use coconut oil. Cassava main is feedstock to produce ethanol in Thailand, while Philippine use sugarcane (Kumar, 2013). Thailand has a mandate for E10, while, E20 and E85 are already available at 2,888 stations nationwide, as of July 2014. Furthermore, Thailand has concrete targets to utilize biofuels; ethanol for 9.0 million litres per day and biodiesel for 7.2 million litres per day, by 2021. This target is equal to 15% of the aggregate total of gasoline (includes ethanol) and diesel (include biodiesel). Thailand also has tax reductions for flexible-fuel vehicles (FFV), which are designed to run on a blend of 20-85% ethanol.

4.4.2 Energy efficient vehicles

Energy efficiency policies in the transport sector have shown signs of improvement, though no country in the region has introduced fuel economy standards (IEA, 2013). Thailand is developing mandatory standards and has introduced a tax reduction for the purchase of cars with average fuel consumption of no lower than 20 km/litre and meeting at least Euro 4 emissions standards for passenger vehicles which is so called Eco-cars. Governments in ASEAN are promoting green and environmental friendly technology. Indonesia is considering fuel-economy standard, while Singapore has already the mandatory fuel economy labeling and rebates for cars with low carbon emissions and penalty for cars with high emissions. Since 2009, green car demand has been growing at an average of 130% p.a. in ASEAN; 6% penetration in Malaysia and 17% in Thailand (Frost & Sullivan, 2014). Hybrid cars are being promoted with tax incentives in Thailand, Malaysia and Philippines.

4.4.3 Mass transit systems

Bus services are basic public transport system to move mass of people in ASEAN cities. Mass rapid transit (MRT) systems have been developed for several decades to alleviate traffic congestion in mega cities. However, progress is slow and largely limited by financial and governance factors, except Singapore which is leading in MRT systems in the region. Bangkok and Kuala Lumpur are expanding MRT lines to provide more coverage networks. ASEAN has increasingly focused on developing sustainable transport systems, and emphasized the development of cost-effective mass-transit systems, i.e., Bus rapid transit (BRT) systems. Indonesia is leading in BRT systems in the region, introduced the first BRT system in 2004 in Jakarta and led the launch of similar systems in other cities, such as Yogyakarta, Batam, and Bandung (Global Mass Transit, 2011)

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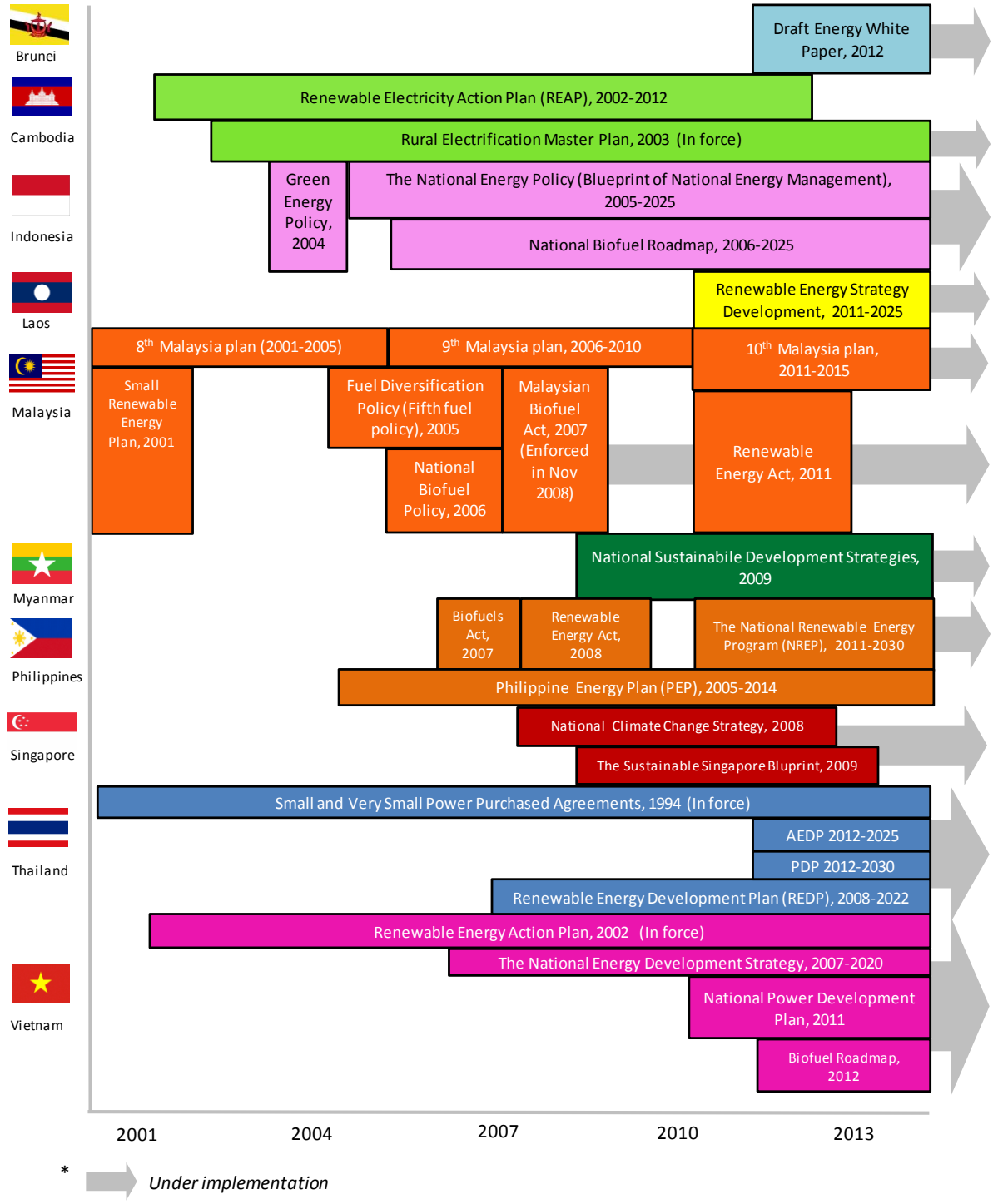
5. Energy Technologies with Potential for Applications in ASEAN by 2030

5.1 Power production and distribution – centralized and decentralized

Electricity generation capacity in Southeast Asia is expected to grow steadily, from 176 gigawatts (GW) in 2011 to almost 460 GW in 2035 (IEA, 2013). Coal will become more dominant fuel source for power plants, with 40% of new capacity additions. Gas (26%) and hydro (15%) also add significant capacity. Oil-fired capacity falls, largely because of deteriorating economics as a result of high fuel costs, though some is maintained to serve the region's isolated areas.

Since Southeast Asia also has diverse and abundant biomass feedstocks, ranging from agriculture and forestry residues to forestry products, most ASEAN countries have set policies and targets for renewable-based capacity and/or generation (JGSEE, 2013). Indonesia, Malaysia, the Philippines and Thailand also have financial support measures such as feed-in tariffs and tax exemptions to accelerate renewable energy deployment.

Figure 5-1 Renewable energy policies in ASEAN countries (JGSEE, 2013)



It should be noted that from the Figure 5-1, RE Act has replaced Small Renewable Energy Plan and Fifth fuel policy). The biofuel policy and the national biomass strategy are more current & relevant initiatives have been updated.

Table 5-1 Renewable energy targets in ASEAN countries (JGSEE, 2013)

Country	Biomass for heat & power targets	Biofuel mandates/targets
Brunei	No biomass target	No biofuel target
Cambodia	To achieve 100% level in village electrification from renewable energy by 2020	No biofuel target
Indonesia	8149 MW Biomass and 107.012 million m^3 biogas by 2025	3450 million liters ethanol and 9520 million liters biodiesel by 2025
Laos	58 MW Biomass, 51 MW Biogas and 36 MW Waste by 2025	150 million liters ethanol and 300 million liters biodiesel by 2025
Malaysia	1340 MW Biomass, 410 MW Biogas and 390 MW MSW by 2020	B5/Biofuel to replace 5% of diesel in road transport
Myanmar	To achieve a collective target of 15-18% of renewable energy in the total power installed by 2020	Biofuel to replace 8% of conventional oil in road transport by 2020 based on 2005 level
Philippines	276.7 MW Biomass by 2030	B20 and E20/E80 in 2030
Singapore	No biomass target	No biofuel target
Thailand	4800 MW Biomass, 3600 MW Biogas and 400 MW MSW by 2021	Ethanol 9 million liters/day, B10 7.2 million liters/day and BHD 3 million liters/day in 2021
Vietnam	400 MW Biomass by 2030	550 million liters of biofuel production by 2020

5.2 Industry

Energy technology development and its deployment in the industrial sector is nowadays a very complex field, where basic research institutions, applied research institutions and industry have to work closely together on an international level and beyond country borders. In addition successful commercialization of technologies requires that the share of private sector involvement in the development of technologies increase along the commercialization of the technologies.

For the ASEAN region technologies applied in their major industrial sectors should be considered first to be tackled in a joint ASEAN approach. Therefore applied research institutions active in the research areas of the resources unique to ASEAN are very important, e.g. energy technologies using biomass resources prevailing in ASEAN, like rice husk, rice straw, sugar cane, EFB, etc. just to name a few.

To bundle the energy technology development around these relevant resources and to identify which research institutions in ASEAN and which companies in ASEAN are important players in this field and are keen and capable to start and pursue applied research to improve existing or develop new energy technologies for these applications is an important first step to focus research activities for this sector.

For the industrial sector two different kind of energy technologies are of major importance; firstly the cross-cutting energy efficiency technologies for end-uses, like motors, fans, pumps, compressors, boilers, furnaces, heat exchangers just to name a few. (These cross-cutting technologies use more than 70% of all industrial energy use.) And secondly the process specific technologies for major industrial sectors like iron and steal or chemicals.

Cross-cutting technologies are normally manufactured by international companies and shipped all over the world. To determine which technologies shall get a special support within the ASEAN region for further development it is important to establish first which cross-cutting technologies are manufactured by regional companies in ASEAN in what amount and value and which of these companies have the potential for further own technology development in close cooperation with applied research institutions, such as boilers for biomass combustion or fans for industrial processes.

For process-specific technologies it is suggested to concentrate on some of the major industrial sectors in ASEAN, like chemicals, cement and iron and steel. In addition the agro-industry process sector shall get a special recognition, as it is of global importance. International companies, like Holcim® in the cement sector are installing world wide international standards for their production facilities irrespective of the country of production. Here the first and highest importance must be on accelerating the stock turn-over process through stricter environmental standards and application of better energy efficiency standards, like the BAT (Best available technology) concept of the EU, meaning the best energy efficiency improvement can be achieved by a new process plant in ASEAN, which fulfills international BAT standards.

In other sectors, like food processing, ASEAN companies are world leaders and their demand for further process technology development must be assessed to determine in which sector which technologies are required to be further developed. Here a sector-specific technology needs assessment is required.

5.3 Transport

The transportation sector is expected by IEEJ, ACE and ESSPA (IEEJ, 2011) that it will have the highest growth in energy demand of 5.6% per annum, while an average annual rate of energy demand in ASEAN is 4.4% up to 2030, in Business-as-usual (BAU) scenario. In Alternative policy scenario (APS), it also has the highest potential to be reduced by about 22% of BAU's energy demand. It is in line with the Efficient ASEAN scenario done by IEA and ERIA (IEA and ERIA, 2013) that transport energy demand can be reduced by 16% beyond that of the New Policies Scenario in 2035. This implies room for energy efficiency technology applications in ASEAN. It would be progressive improvements in energy efficiency in road transport, for example via

mandatory fuel-economy standards, fuel-economy labelling, tax breaks and incentives. Importantly, ASEAN countries are trying to remove inefficient subsidies to fossil fuels that would help investment of mass transit development and encourage travellers to use more public transport. Biofuels as alternative fuels for transportation will play an important role of energy supply in the ASEAN countries. However, current use of biofuels rely on first generation biofuels; therefore, development of second generation biofuels is essential to address energy concern and ensure that there is no competition between energy and food productions.

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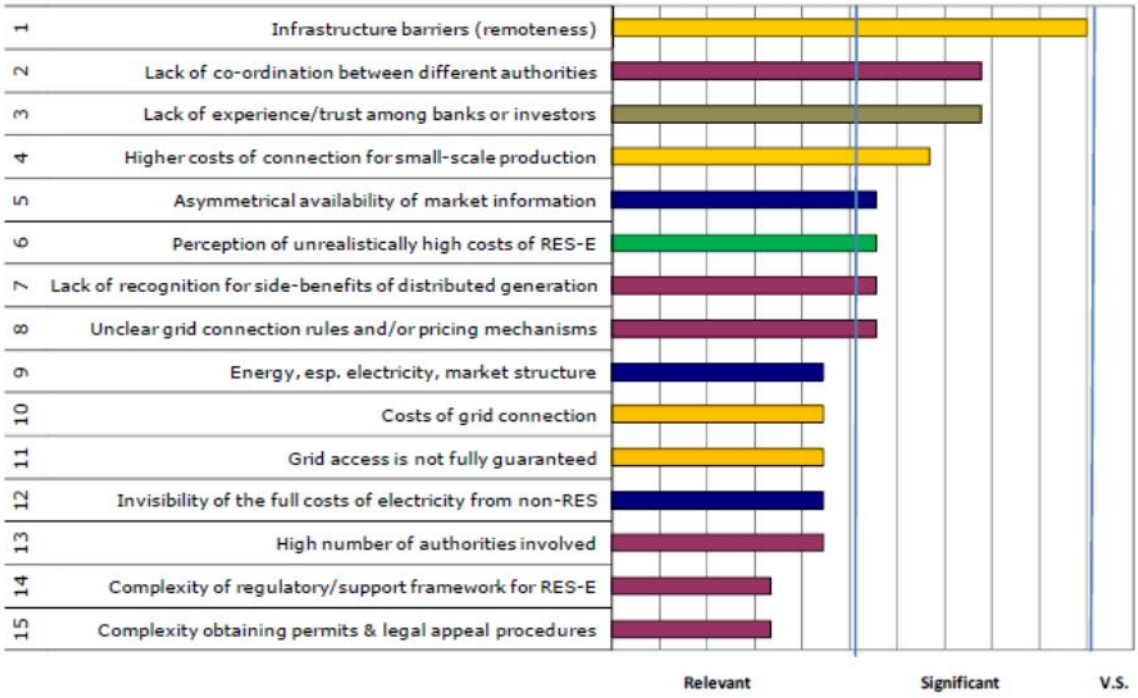
6. Barriers and Challenges

Innovation in energy technology is widely regarded as a basis for sustainable energy, which rests on two pillars: (i) energy from renewable sources, and (ii) energy efficiency (John and Rubbelke, 2011). Lee (2010) said that renewable energy needs to provide value added in terms of cost reduction (as compared to unsustainable path) and less greenhouse gas emissions. Energy technology is key to deep-cuts in anthropogenic greenhouse gas reductions required for climate change mitigation and energy efficiency also provide more space for easing the risk on energy shocks such as price vulnerability and supply shortage. Similarly Edenhofer et al (2011), outlined eight climate policies base on technology and innovation: (i) energy efficiency improvement; (ii) fuel switching to lower carbon fuels, (iii) bioenergy, (iv) other renewable energies; (v) carbon capture from fossil fuels and storage; (vi) nuclear (albeit with substantial risks and side-effects), (vii) reduction of non-CO2 greenhouse gases (multi-gas strategy), and (viii) land use related mitigation options. However, most developing countries such as Indonesia have difficulties to follow, adopt, and implement policies and strategies for the deployment of desired energy technologies to ensure energy security and access on the one hand, and to meet GHG reduction obligations on the other. This is mainly due to lack of promotional incentives system, human skills, technical information and technology support services, finance, and the government's science and technology policy (Thee, 1998).

For examples at the ASEAN level, 15-non economic barriers in promoting renewable energy have been identified (IEA, 2010). As seen from Figure 6-1, most of the top 5 barriers are related to government failures in providing infrastructure, leadership, reliable information, and incentives. This indicates that to be successful in promoting renewable energy government needs to de-bottleneck all the constraints. Then it is also essential to promote effective and coherent renewable energy policies with a long-term strategic perspective.

Figure 6-1 Ranking of non-economic barriers in selected ASEAN Countries (IEA, 2010)



Legend:

- Technical/infrastructure barriers
- Administrative and regulatory barriers
- Market barriers
- Financing barriers
- Socio-cultural barriers

"Relevant", "Significant" and "V.S." refer to a barrier that is deemed "relevant", "significant" or "very significant" respectively based on the survey results.

6.1 Technical aspects

Through the value chain approach, Roland Berger Strategy Consultants (2011) identified five stages across four actors (see Figure 6-2). As seen from the figure, all the actors have their own barriers in promoting energy efficiency. This indicates that promoting energy efficiency needs an integrated approach both on organizational and institutional dimensions. Organizational dimension means that suppliers, producers, and governments need to share a common vision on the importance of energy efficiency. The institutional dimensions need to ensure that all parties (producers and consumers) obtain win-win solutions after implementing regulations. Because most of advanced technology is imported and it is usually produced following the global production networks, performance standards and product labeling, and certification of suppliers/ESCOs need to be prepared both globally and regionally. However, according to CSIS (2012), energy efficiency standards are mainly voluntary and where mandatory, are poorly enforced. Thus it is necessary to

introduce new energy standards and strengthen existing standards for buildings, appliances and automobiles (CSIS, 2012).

Figure 6-2 Key barriers along the energy efficiency value chain as identified by companies needs (Roland, 2011)

VALUE CHAIN	1. Identification of demand	2. Manufacture and sale of products	3. Evaluation and Investment	4. Delivery and Installation	5. Long-term Operations and Maintenance
	• Overall, lack of an effective overarching and comprehensive EE policy framework • Insufficient role as facilitator to integrate different stakeholders in the marketplace				
Governments	• Insufficient provision of information channels to match users and suppliers		• Insufficient financial support and assistance	• Insufficient technical training provided	• Lack of standards on energy auditing methods • Room for improvement in awareness-raising efforts
Suppliers/ ESCOs	• Difficulty in identifying demand • Lack of commitment to pro-vide sufficient resources to gauge savings potential	• Difficulty in convincing clients of benefits of EE equipment		• Lack of technical know-how to carry out product installation	• Lack of integration into users' business lifecycle
Users	• EE often not regarded as a business priority	• Lack of confidence that equipment can achieve projected savings • Difficulty in identifying customized products to suit specific needs	• "Quick-win" investments favoured over EE projects with longer payback periods		• Lack of awareness on energy efficiency • Lack of consistent investment plans in EE products and technologies
Financial Institutions			• Lack of familiarity with EE financing • Lack of confidence in return on EE projects		

Note: ESCOs is energy service companies

6.2 Financial and investment barriers

As mentioned in the previous section, energy efficiency is one of the pillars of sustainable energy and ASEAN has a commitment to reduce regional energy intensity at least 8% by 2015 (based on 2005 level). A study by Roland Berger Strategy Consultants (2011), showed that by 2020, the estimated energy saving potential in the five Southeast Asian countries (Indonesia, Malaysia, Singapore, Thailand, and Viet Nam) is about USD 15 billion to USD 43 billion. The huge gap between the lower bound and upper bound of energy efficiency is due to different assumptions on energy subsidies and prices. However, ASEAN countries need to work hard to remove barriers to the deployment of energy efficiency technologies and measures. The governments should make more efforts to formulate energy efficiency target.

The benefits of energy efficiency are huge. While some technologies or measures can have short payback periods or low cost, others may involve substantial up front costs and long pay back periods. This will become a disincentive to the early state of investment. Further, the financial institutions may not find it attractive to finance

energy efficiency projects due to lack of experience and technical expertise (Roland Berger Strategy Consultants 2011). This situation is problematic to small & medium enterprises, in particular, where there is a higher perceived risk than for large companies. Here again appropriate, measured government intervention is crucial.

In the case of renewable energy technologies, similar financial barriers exist and are well known. Although the cost of some renewable energy technologies has declined rapidly in recent years, some are still at much higher cost than conventional technologies IRENA (2012).

6.3 Cultural, institutional, and legal barriers

Often there are cultural barriers arising from conflicting objectives in promoting new technology, such as with the environment, employment, and other sectors. For example, there is always a conflict between geothermal power plants and forest conservation. Some new technologies that are imported may not create jobs in the domestic market, especially from manufacturing activities. There could even be significant competition between locally developed and imported technologies. Further, in some cases, promoting new technology may not benefit the poor. For example in the case of the Ulumbu geothermal power plant, which was commissioned in November 2011, the villagers that provide water to run the plant were only supplied with electricity by March 2014, after a prolonged struggle.

Basically communities are quite open to adopt new technologies because it is believed that new technologies will improve their quality of life. However, in many cases, new technologies arrive at the village without proper socio-economic-environmental assessment. The lack of information on the nature of the technologies, their likely impacts to the community and the proper handling of the waste after the life time of the equipment concerned is also seen as an important barrier.

6.4 Human capital capacity

Lack of human capital is widely recognized as one of the key barriers to development, acquisition, deployment, and diffusion of sustainable energy technologies. There is increasing concern in the energy supply and final services sectors in many countries that the current educational system is not producing sufficient qualified workers to fill current and future jobs, which increasingly require science, technology, engineering, and mathematics (STEM) skills. This is true not only in the booming oil and gas and traditional power industries, but also in the rapidly expanding renewable energy supply sector. Developing the skills to install, operate, and maintain renewable energy equipment is exceedingly important for successful project implementation (NAS, 2013; IPCC, 2014).

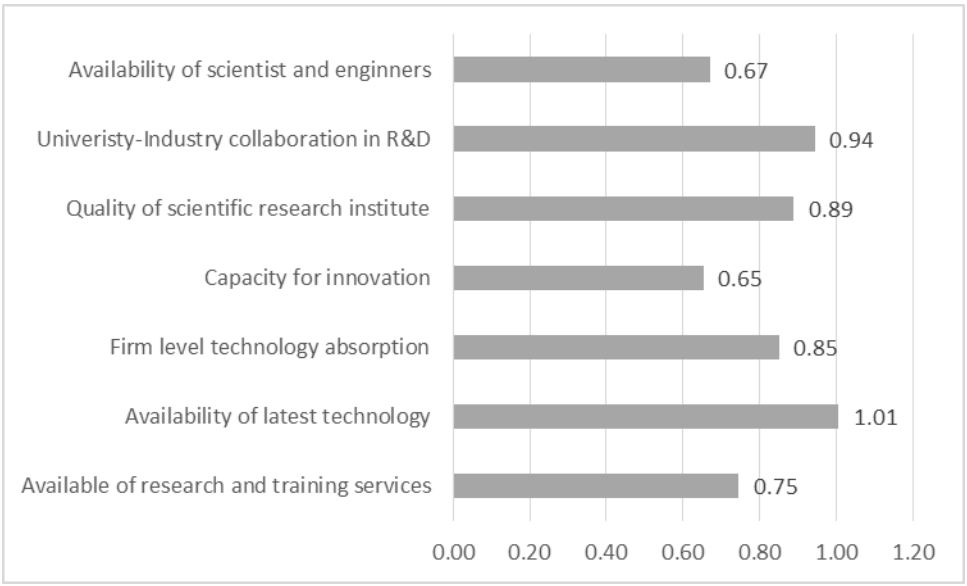
Transfer of technology is also an important issue for energy sustainability. For

example, Ulumbu geothermal power plant in East Nusa Tenggara Indonesia, was designed and constructed by engineers from outside Indonesia. Due to lack of capacity building during construct and start up of the power plant, the local engineers had to learn how to operate the power plant from “learning by doing”, causing unnecessary delays in repair and maintenance. I obtained this information after discussion with engineers in Ulumbu Power Plant

In ASEAN, as seen from Figure 6-3, there is huge gap across member states in terms of access to the best available technologies and the capacity to innovate. In any case, there is a general lack of skilled workforce, technicians, scientists and engineers and R&D personnel, and a lack of linkage and interaction among academic and research institutions on the one hand, and industry and government on the other.

Apart from technical skills, institutional and human capacity for policymaking and planning, assessing and choosing technology and policy options, for sustainable energy development are also crucial (IPCC, 2014).

Figure 6-3 Standard deviation of global competitiveness score among the 10 ASEAN countries, for some selected indicators (WEC, 2014)



Note: Calculate from the global competitiveness report 2013-2014, standard deviation is calculated from value

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7. Recommendations on Strategies and Mechanisms

7.1 Effective policies around the world and their relevance to ASEAN

Policies to accelerate the utilization of renewable energy and improve energy efficiency in different end-use sectors have to be specified to the purpose. Therefore energy policies must be sector and energy end-use specific. In this part we will concentrate on policies to accelerate energy technology development for the application in the different end-user sectors.

To establish an energy technology development policy, a general energy policy is required. Because it is only when there is a clear general energy policy in place that achievable, long-term energy technology development and innovation can happen. A case in point is Germany, where the development of wind and PV technologies only took place once the government set a long-term feed in tariff policy (FiT) (launched in 1990), which was basically an industrial sector development policy. The FiT mechanism accelerated the uptake and helped to grow related manufacturing facilities and their R&D.

Viewed in this perspective, the authors offer some general recommendations as follows:

1. For any successful energy policy at the beginning the government has to set clear and achievable long-term goals/targets, that shall be achieved in 5, 10, 15 and 20 years. This policy should not be altered and if the targets are not achieved. It needed to be monitored every 2-3 years in order to determine if it is achieved according to its plan. The implementation strategies have to be directed to achieve these clear goals.
2. The government has to appoint responsible agencies/ministries/departments, that are responsible for the establishment of the different implementation strategies, their implementation (tendering of programs, evaluation of the programs) and finally of the monitoring and review for acceleration, if the goals were achieved as set.
3. In this context a specific energy technology development and innovation policy can be formulated. The definition and formulation of these policies around the world are based on firstly setting clear achievable objectives that are measured and reviewed after some time. The policies formulated are based on in-depth discussions with all relevant stakeholders: concerned industrial sector representatives, applied research institutions, basic research institutions,

universities and technology consultants/providers. Together with the respective ministries, such as the ministries of economics, industry, finance and energy, develop a well-defined technology development plan for 3-5 years.

4. Then the implementation of research programs and tendering of the R&D as joint projects for academic institutions in cooperation with industry is done. Once the result of the tendered research projects are presented in public workshops, the review of achieving the objectives is done and, if necessary, next round of research is tendered.
5. Governments do not formulate energy technology development targets, but facilitate their realization by enabling joint research projects from applied research institutions and industry. In addition governments provide easy finance access for innovation through various schemes, like the PFAN approach currently implemented by USAID in ASEAN.

Further energy technology development and innovation requires a comprehensive and coordinated approach with a clear focus on selected technologies in selected sectors, which shall be pushed forward at the ASEAN level.

Such an energy technology development policy (within an STI policy) is centered around the following process:

[1] Firstly, for the energy technologies in this segment, the respective research institutions and existing private or public companies, that are capable of applied research in ASEAN have to be identified, grouped and their capabilities and interest has to be established.

[2] Policies to promote energy technology development shall include the establishment of regular energy research programs that are tendered openly and transparently as research projects. Universities, applied research institutions and private sector shall be encouraged to form consortia by different players for the bidding for these tenders from the government. (Governmental research institutions can as well participate, but should not be the sole receiver of the research grants. The reason for this is, that in most OECD countries it has been found, that government research institutions are not effective in applied research if they are guaranteed receiver of research funds by government. The introduction of competition and open and transparent tendering of research projects has improved the effectiveness of applied research results.

[3] When all research projects of a specific energy research program are completed, normally after 3 years, open workshops where the results of all research projects are presented to all stakeholders shall be done.

[4] Once all results of research projects are published and disseminated to all stakeholders a new round of discussion shall be set, where based on the

results of the first round of research projects the next objective for the next research program is defined and discussed with all stakeholders and government.

[5] By tendering research projects it shall be guaranteed, that along the development of technologies an increasing participation of the private sector will result. With universities alone, without the private sector, which takes an increasing share in these research projects, hardly any new energy technology, or incremental improvement in technology can be developed and brought into the market.

With such a research tendering process the participation of the relevant institutions can be accelerated and most likely more relevant energy technologies can be developed in ASEAN region in the future. The handling of the energy research program shall not be done by the ministry itself, but an autonomous agency, that is held responsible for an effective and transparent handling and implementation of energy technology research programs.

7.2 Policies for acceleration of power production and distribution – centralized and decentralized

Effective policies for this segment shall consist of:

[1] Long term policy with targets for the different technologies, like x% wind, y% PV, z% co-gen, etc. which takes care of conventional power technologies , co-generation and on-grid renewables systems, like wind, PV and biomass.

[2] Responsibility assignment to an agency/ministry for their implementation and monitoring

[3] Promotion scheme, like a decreasing feed-in tariff for an off-take of technologies

[4] Removal of any subsidies for conventional energies to remove the disadvantage of renewable energy technologies and efficient conventional systems, like Co-gen systems

[5] City planning concept, that includes explicitly a plan for “district cooling”, like the city energy plans for some major European and international cities.

[6] Supporting of demonstrations projects to disseminate knowledge and create confidence in this newer technologies of tri-generation, district cooling, etc.

[7] For off-grid and micro-grid systems first subsidies for diesel must be removed so that transparent power supply system must be installed. Policies shall support demonstration projects and monitor them over long time to show, that hybrid system consisting of diesel and a combination of PV/Wind/biomass/hydropower can be competitive and are more cost effective.

[8] For the respective energy technology development in this segment the respective research institutions and existing private or public companies, that are capable of applied research have to be identified.

7.3 Policies for Industry Sector

Effective policies to promote energy technology development and innovation in the industrial sector are centered around the following policies:

[1] Application of a BAT concept for major industrial sectors, like the EU has established now for several sectors

[2] Innovation policy for the development of specific promising technologies, like fuel cells, low temperature combustion burners, etc.

[3] Specific cross-cutting technologies deployment programs, like the compressor program in Germany or high efficient motors exchange program, etc.

[4] Sector specific technology and process optimization programs for selected industrial sectors, like the waste heat recovery program for the iron & steal sector.

7.4 Policies for Building Sector

Effective policies to promote energy technology development and innovation in the Building sector are centered around the following policies:

[1] Setting of mandatory energy building standards would be the most effective policy. These standards need to be developed, adopted and then tested. Then they should be applied and their use must be monitored and observed by e.g. the Ministry of housing or others. They must be enabled to evaluate building drawings and proposed energy demand of future building, done by energy simulation modelling. Investment decision for buildings shall be based on life cycle costing.

[2] These agencies/ministries should be allowed to deny and Energy impact assessment certificate, if certain energy standards is not achieved, like the EIA concept.

[3] Energy labeling of building is as well a suitable tool to encourage the development of respective energy technologies.

7.5 Policies for Transport Sector

Effective policies to promote energy technology development and innovation in the Transport sector are centered around the following policies:

[1] Setting MEPS for vehicles is a first and effective step.

[2] In addition setting requirements fro regular technical inspection, like every two years of all rolling stock would improve the energy efficiency of the existing vehicles.

[3] Technology development in this segment is mainly done be the few international car manufacturing companies world wide. Here ASEAN could improve the situation by setting stringed environmental standards for vehicles and introduce MIPS. A special focus shall be given to the introduction of bio fuels in the vehicle fleet.
[4] For city transport non-vehicle transportation shall be encouraged, from public trains to bicycles)
[5] Here technology development requirements have to be established which are relevant to ASEAN

7.6 Feasibility of an ASEAN Clean Energy Technology Trust Fund

Because of the huge investment required – in the tune of billions of dollars – for providing access to and transitioning to secure and low-carbon energy systems and services, a number of international entities have introduced initiatives to improve access to and create incentives for financing and investments. Examples include the Private Financing Network (PFAN) implemented by USAID, ADB's Clean Energy Financing Partnership Facility (CEFPF), and the Clean Technology Fund (CTF), etc. CTF in particular is presently the largest multilateral mitigation fund, with a large capitalisation in grants and concessional loans. Its objective has been to achieve "transformational change" in developing countries towards low carbon development strategies through public and private sector investments. Administered by the World Bank and implemented through the World Bank Group and regional development Banks that include the ADB, the Fund aims to achieve this transformational change through financing the deployment of low carbon technologies at scale. The experience of the CTF offers important insights into what it takes to use diverse financial instruments at scale to support developing countries to respond to climate change. In addition to seeking to foster innovative approaches to delivering finance for climate change, it has made investments that seek to reduce the costs of promising new technologies (Smita Nakhooda and Amal-Lee Amin, 2013).

While these funds are useful and should continue to be accessed by ASEAN countries, it is felt that an ASEAN focused trust fund that would support ASEAN specific clean energy technology development and deployment agenda is desirable. Here we propose our first thougths on the setting up of an ASEAN Clean Energy Technology Trust Fund (CETTF).

7.6.1 Objectives

As key instrument to remove finanacial and other related barriers to the development and deployment of clean energy technologies at the ASEAN level, the objectives of CETTF are to encourage investments in clean energy technologies, to improve energy security in ASEAN countries, and to slow down the rate of carbon

emission. The ASEAN Clean Energy Technology Trust Fund is designed to provide financial support on projects, to divert private investors' risks by leveraging with its own funds, and to offer technical assistance to investors. The promotion of clean technology will be implemented through the key mechanisms as;

1. project loans,
2. grants through clean energy technology trust fund,
3. technical knowledge provision and exchange.

7.6.2 Structure

The organizational establishment of ASEAN Clean Technology Trust Fund comprises two main functions, which are an advisory committee and a project management office.

[1] Advisory Committee : Representatives from members of ASEAN will form an advisory committee whose main responsibilities include;
   a. clearly define the roles and responsibilities of the trust fund,
   b. provide guidance on policy and strategy,
   c. recommend for new funding sources,
   d. ensure effective, efficient and transparent implementation of program.

[2] Project Management Office : Project Management Office (PMO) is led by the Director of the PMO, who is appointed by the advisory committee. Roles and Responsibilities of the project management office will be:
   a. management and coordination of the fund,
   b. establish strategy, policies, guidelines and standards for the fund management,
   c. ensure effectiveness of the implementation according to strategy, plans, policies, guidelines and standards of the trust fund,
   d. accounting, management and reporting of routine activities of the trust fund,
   e. maintain and share carbon data to national data center.

7.6.3 Sources of Fund

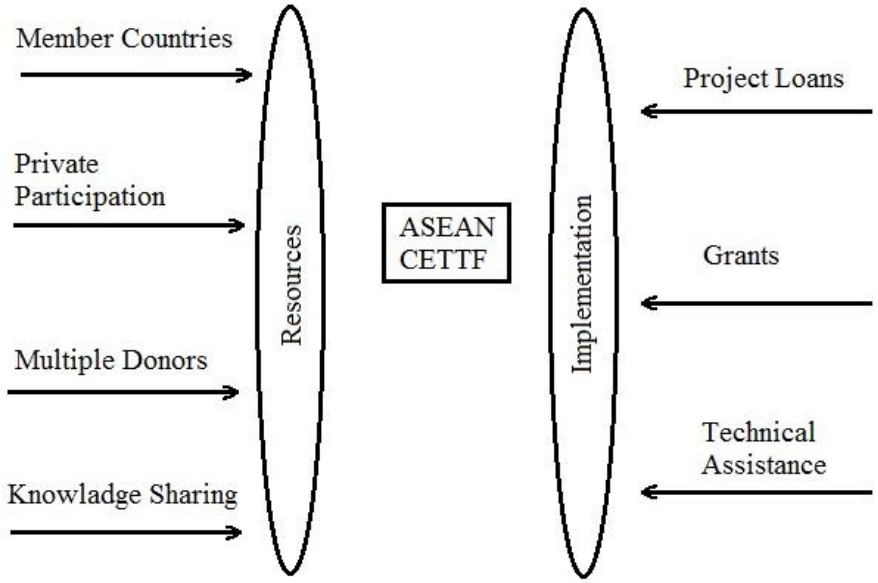
[1] The source of ASEAN Clean Energy Technology Trust Fund can start with seed funds from member countries. Although equal seed funds from member countries can be the basis of equal responsibility, ownership, and vote, unequal seed funds are acceptable for the fact of different economic situations of the members.

[2] Contributions to ASEAN Clean Energy Technology Trust Fund from individual sources, including private companies and foundations are welcome. Public sector can be the key player for public-private partnership programs that enhance the implementation of clean energy technology.

[3] Concessional loans that are provided on terms substantially more generous than market loans. They are available through interest rates below the market rate or by grace periods, or a combination of these. Concessional loans typically have long grace periods.

[4] In addition to monetary supports, knowledge sharing can be considered as a resource provision to ASEAN Clean Energy Technology Trust Fund.

Figure 7-1 ASEAN Clean Energy Technology Trust Fund Overview

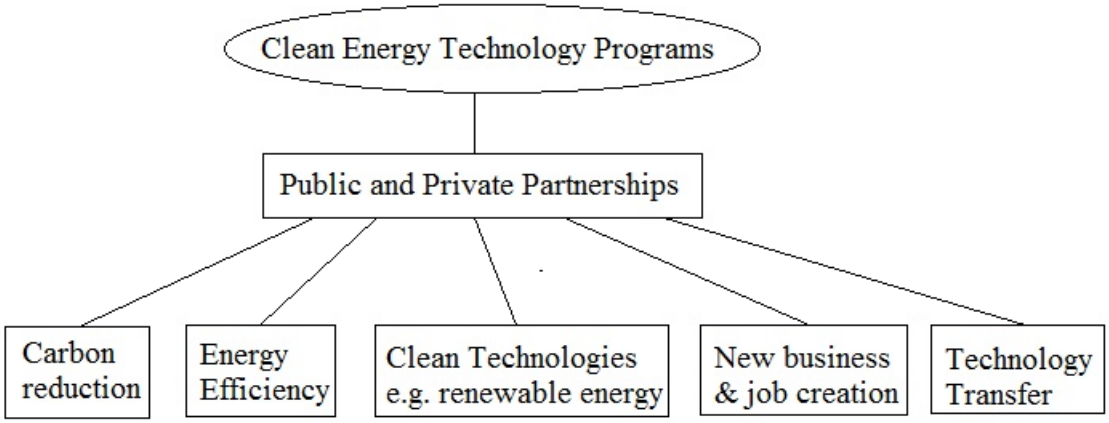


7.6.4 Procedure and Governance

ASEAN Clean Energy Technology Trust Fund aims to support projects which benefit the public and the economy, such as:

1. carbon reduction activities that improve the environment,
2. energy efficiency improvement and energy conservation projects,
3. job creation in both urban and rural areas,
4. activities that provide opportunities for new businesses,
5. emerging clean technologies relating to carbon reduction,
6. public and private investments that intend to maintain competitiveness of traditional industries with clean technologies.

Figure 7-2 Clean Energy Technology Programs & Partnerships



A. Investment Projects

ASEAN Clean Energy Trust Fund will invest in innovative and pioneering clean energy and low carbon projects. The trust fund can work out with private companies and governmental offices to identify and evaluate potential projects. The investment can help in the development of new technologies by reducing the cost, facilitating their deployment and lowering barriers. Possible qualified projects which will be financed, are as follows:

1. power station retrofits to improve generation efficiency,
2. upgrading of transmission and distribution systems to reduce system losses,
3. retrofit street lighting by energy efficiency technology,
4. urban mass transit that will result in reduced fossil fuel consumption,
5. agricultural waste and biomass energy projects,
6. manufacturing of lower cost solar cells,
7. development of wind generation for both private and public sectors,
8. refurbishment and management of high-quality, low carbon office space,
9. commercialization of organic photovoltaics (OPV) technology,
10. development of biofuel to commercialization,
11. design and manufacture of hydrogen energy systems for energy storage and clean fuel production,
12. reduction of cooling requirements for electronic data center and telecommunications equipment,
13. design and manufacture of energy-efficient power conversion products.

B. Technical Assistance

ASEAN Clean Energy Trust Fund will also be used for technical assistance, which helps in development of policies, regulations, standards, capacity building, and clean energy projects for financing, to support business decisions and engineering services as follows:

1. verification of clean energy to sustainable growth of economic sectors,
2. preparation of projects for investment,
3. cost sharing in clean energy investment programs between donors and private sectors,
4. transfer of technology, knowledge and experience; and
5. capacity building for potential stakeholders of clean energy investments and programs.

The concept of CETTF outlined above represent preliminary thoughts by the authors. A more detailed definition of the Fund based on broader stakeholder consultation needs to be conducted and in-depth investigation should be carried out to test and validate its feasibility and practicality, particularly with respect to the vast resources that are required, as well as technical assistance, which may be outside the ASEAN's own capacity, at least at the presesent stage of development.

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ENERGY SECURITY – DEVELOPMENT OF ASEAN ENERGY SECURITY STRATEGY

Youngho Chang, Maxensius Tri Sambodo and Philip Andrews-Speed

I. Introduction

Energy security has diverse dimensions and perspectives and there is no an umbrella definition. This paper aims to define energy security that fits well with ASEAN context and explore the following research and policy questions.

In the literature of energy security, energy security is defined as "an adequate and reliable supply of energy resources at a reasonable price". Adequacy refers to how much energy resources are available regardless of domestic and import for a country or a region and whether the available energy resources are sufficient enough for an economy to function properly. Reliability refers to whether and how the available resources are delivered to the end users and is associated with transportation of energy resources or transmission and distribution of electricity generated. A reasonable price refers to whether the price of energy resource is affordable so that the end user can have guaranteed access to the energy resource. There are a few studies that have developed quantitative indicators and applied them to measure the status of energy security for a country or a group of countries (for example, Sovacool and Mukherjee, 2011; Kruyt et al, 2009; von Hippel et al, 2009).

This paper is structured as follows. Section 2 reviews how energy security has been defined for the ASEAN context and what efforts in ASEAN context have been put to ensure and improve energy security in ASEAN. Section 3 scans the framework of energy security and policy implementation in a regional context such as OECD, EU, East Asia and North America. Following this review, section 4 defines energy security for ASEAN. With the definition of energy security for the ASEAN context, it assesses how the existing efforts of energy security policies and strategies for energy security in ASEAN have contributed to energy security in ASEAN. Following the assessment of existing efforts for ensuring and improving energy security, section 5 suggests new strategies for ensuring and improving energy security for ASEAN and proposes how to implement such strategies in ASEAN. Section 6 concludes this paper.

II. Energy Security and Strategy in ASEAN – Concepts, Policies and Implementation

a. Concepts and Indicators

As for energy security, ASEAN has mainly dealt with the availability of energy resources in ASEAN and how to improve the amount available in the region. The Asia Pacific Energy Research Centre (APERC) constructed the energy security framework using energy resource availability, accessibility barriers, environmental acceptability and investment cost affordability for the Asia-Pacific countries (APERC, 2007). For the specific indicators, they adopted the diversification energy supply sources, net energy import dependence, non-carbon based fuel portfolios and net oil import dependence and Middle East oil import dependence. Its main focus was oil supply security and suggested the diversification of energy resources and resource development and transport and resource trading. Advancing energy technologies such as nuclear energy, clean coal technology and renewable energy was also suggested.

Table 1 presents oil supply risk indicator and oil supply offset indicator. The former measures the key factors that could help decrease an economy's oil supply security. It is the weighted average of oil consumption, economic risk of imports, political risk of imports, oil demand elasticity and refining capacity. The latter measures the key factors that could help offset an economy's risk in acquiring enough resources. It is the weighted average of domestic resource capacity, non-energy intensive industry structure, strategic petroleum reserve (SPR) and non-carbon fuel switching. The higher the score is the better energy security is.

Table 1: Oil Supply Risk Indicator and Oil Supply Offset Indicator

Oil Supply Risk Indicator

Rank		Oil Consumption (MEX=10)	Economic Risk of Imports	Political Risk of Imports (INA=10)	Oil Demand Elasticity (RUS=10)	Refining Capacity (Deficit)	Score
1	USA	34.9	17.6	8.6	6.2	1.5	**3.5**
2	ROK	22.8	5.6	12.1	21.7	0.0	**3.0**
3	JPN	21.6	9.6	11.3	9.1	6.9	**2.6**
4	PRC	2.6	27.4	3.9	11.2	18.4	**2.5**
5	INA	3.2	2.7	10.0	17.7	54.7	**2.5**
6	CDA	33.3	0.0	8.7	5.9	0.0	**2.5**
7	THA	7.8	4.8	13.8	22.6	0.0	**2.1**
8	AUS	19.8	0.2	11.6	6.5	3.8	**1.8**
9	MEX	10.0	0.0	1.3	10.9	10.3	**1.4**
10	RUS	9.8	0.0	0.6	10.0	0.0	**1.1**

Oil Supply Offset Indicator

Rank		Domestic Resource Capacity	Non-Energy Intensive Industry Structure	SPR	Non-carbon Fuel Switching	Score
1	RUS	97.5	60.0	0.0	8.3	**14.5**
2	MEX	86.2	70.0	0.0	6.2	**14.0**
3	AUS	77.7	71.0	15.3	1.3	**13.9**
4	USA	66.3	77.0	23.7	10.6	**13.9**
5	CDA	68.6	66.2	17.8	19.7	**13.2**
6	PRC	89.9	41.0	0.0	2.7	**12.1**
7	INA	76.5	41.0	4.5	3.8	**11.0**
8	JPN	17.0	68.0	30.4	16.0	**8.7**
9	THA	43.0	46.0	4.4	0.5	**8.0**
10	ROK	2.8	56.0	22.4	16.2	**6.0**

Source: APERC (2007)

Applying the diversification of energy resources to energy security, Chang (2009) established the indicators of energy security based on the availability of energy resources. Four specific indicators for energy security are the total number of energy resources utilized, the share of the most utilized energy resource, the share of fossil fuels used and the share of the top five most utilized. These indicators are simple but very powerful to interpret the status of energy security in terms of the diversification of energy resources vis-à-vis the availability of fossil fuels and renewable energy resources in a country.

Table 2 presents the status of energy security based on the four indicators. The lower the value is the higher diversified and status of energy security. This indicator strongly suggests that ASEAN countries need to diversify the sources of energy resources in other words to decrease the dependence on fossil fuels and to increase the share of renewable energy resources. This is to be elaborated more in section 5.

Table 2: The Status of Energy Security in ASEAN Countries

Country	Number of resources (inverse of the number of energy resources [1/n])	Most utilised resource (share of the most utilised resource [%])	Share of fossil fuels used (%)	Share of top five most utilised resources (%)
Brunei	0.5 (2)	Natural gas (73)	100.0	100.0
Cambodia	1.0 (1)	Oil (100)	100.0	100.0
Indonesia	0.11 (9)	Oil (47)	97.7	99.6
Laos	0.33 (3)	Oil (100)	100.0	100.0
Malaysia	0.13 (8)	Natural gas (51)	97.5	100.0
Myanmar	0.5 (2)	Natural gas (56)	100.0	100.0
Philippines	0.13 (8)	Oil (58)	92.5	100.0
Singapore	0.33 (3)	Oil (88)	100.0	100.0
Thailand	0.13 (8)	Oil (52)	96.6	98.1
Vietnam	0.17 (6)	Oil (37)	100.0	100.0

Abbreviations ASEAN = Association of Southeast Asian Nations; *n* = number of resources

Source: Chang (2009)

Energy security index (ESI) for East Asian countries has been developed by the Economic Research Institute for ASEAN and Easy Asia (ERIA) and Institute of Energy Economics, Japan (IEEJ). It is based on the availability and reliability of energy resources, namely the development of domestic resources, the acquisition of overseas resources, the reliability of domestic supply chain, demand management, preparedness for supply disruptions and environmental sustainability (ERIA, 2011). The constructed ESI has been analyzed with respect to which policies have influenced the changes in the ESI (ERIA, 2013).

Table 3 presents an example of major energy security indices in Indonesia from 1970s to 2000-09 that are compared with the OECD average. The higher the indices are the higher the energy security status is.

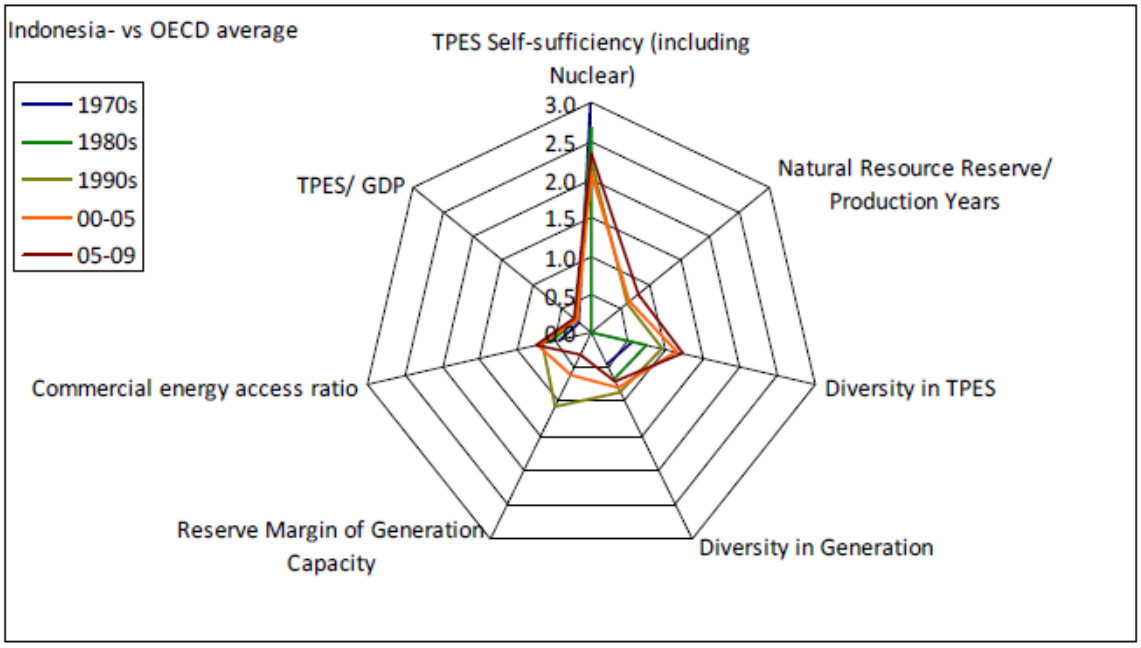
Table 3: Major Energy Security Indices in Indonesia in Comparison with the OECD Average

	1970s	1980s	1990s	00-05	00-09
TPES Self-sufficiency (including Nuclear)	3.2	2.7	2.2	2.1	2.3
Natural Resources Reserve/ Production Years		-	0.6	0.6	0.8
Diversity in TPES	0.6	0.7	0.9	1.1	1.2
Diversity in Generation	0.4	0.7	0.9	0.8	0.7
Reserve Margin of Generation Capacity			1.1	0.6	0.3
Commercial energy access ratio	0.4	0.6	0.7	0.7	0.7
TPES/GDP	0.2	0.3	0.3	0.2	0.3

Source: ERIA (2011)

Figure 1 shows the major energy security indices in a diagram. It clearly indicates a high level in self-sufficiency in Indonesia.

Figure 1: Major Energy Security Indices in Indonesia in Comparison with the OECD Average



Source: ERIA (2011)

b. Policies (e.g., APSA, APG, TAGP, etc.)

To increase the availability of energy resources in the region, a few policies have been suggested and implemented. One notable policy is the ASEAN Petroleum Security Agreement (APSA). The main goal of the APSA is to mitigate the possible negative impact of a sudden disruption of oil supply by increasing oil stockpiling in the region. It was signed in 1986 but it did not explicitly require oil stockpiling for oil supply disruptions or other emergencies in ASEAN. In 2009 it was signed for voluntary stockpiling among ASEAN countries. [23] This is clearly an improvement compared to the 1986 agreement. Unlike IEA countries, however, the APSA does not require compulsory stockpiling[24] and its effectiveness in improving energy security by mitigating the impact of oil supply disruption is expected to be minimal if not nil.

[23] APSA has been fully ratified by ten member countries and Coordinated Emergency Response Mechanism (CERM) has been added to annex.

[24] Stockpiling is not a "necessity" for oil producing countries but it can function as an inventory or a buffer of absorbing excess supply.

Noticing huge potentials in hydropower in the region, ASEAN adopted the vision of connecting the power grid in ASEAN. The Twenty-first ASEAN ministers on Energy Meeting held in Langkawi, Malaysia on 03 July 2003 approved the regional master plan on the ASEAN Power Grid (APG).[25] At the Twenties ASEAN Ministers on Energy Meeting held in Bali, Indonesia on July 2002 the ASEAN Energy Ministers signed a Memorandum of Understanding on the Trans-ASEAN Gas Pipeline (TAGP). APG and TAGP are mainly geared towards increasing the availability of energy resources within the region by promoting renewable energy development and utilizing natural gas that are relatively more abundant than oil.

c. Implementations (e.g., efforts by ASCOPE, HAPUA, etc.)

To implement the APSA, the APG and the TAGP, ASEAN established the ASEAN Council on Petroleum (ASCOPE) and the Head of ASEAN Power Utilities/Authorities (HAPUA).[26] The ASCOPE is tasked to lead greater cooperation to establish interconnection for electricity and natural gas to enhance energy security in the region. The HAPUA is assigned to task the APG.

III. Energy Security and Strategy in Other Regions – Indicators, Policies and Implementation

a. Organisation of Economic Cooperation and Development (OECD)

The OECD's principle energy security institution is the International Energy Agency (IEA). This was created in November 1974 is response to the oil supply crisis of 1973. As of September 2014, the IEA had 29 member countries plus the European Union. Most, but not all, of these countries are and have long been net importers of oil. Chile is a candidate member, whilst Iceland, Mexico, Israel and Slovenia are OECD members but not in the IEA. Formally, the IEA is an autonomous body within the framework of the OCED. The governing board comprises individuals from all member countries and has the power to make recommendations and decisions which are binding on its members.[27]

Membership of the IEA is restricted to members of the OECD. In addition IEA members must demonstrate that they have:

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[25] The current form of APG has been initiated by "bilateral needs" but it has been geared to integrate the power grid throughout the entire ASEAN. ASEAN Power Grid Consultative Committee (APGCC) has been formed to assist the implementation of APG Memorandum of Understanding (MOU).

[26] HAPUA and APGCC have prepared an APG Roadmap towards ASEAN Electricity Market Integration by 2025.

[27] OECD, *Decision of the Council Establishing an International Energy Agency of the Organisation* (adopted by the Council at its 373rd Meeting on 15th November, 1974), available at <http://www.iea.org/media/aboutus/history/decesionofthecouncil.pdf> (visited on 3 September 2014).

- "as a net oil importer, reserves of crude oil and/or product equivalent to 90 days of the prior year's average net oil imports to which the government (even if it does not own those stocks directly) has immediate access should the Co-ordinated Emergency Response Measures (CERM) – which provide a rapid and flexible system of response to actual or imminent oil supply disruptions – be activated;
- a demand restraint programme for reducing national oil consumption by up to 10%;
- legislation and organisation necessary to operate, on a national basis, the CERM; and
- legislation and measures in place to ensure that all oil companies operating under its jurisdiction report information as is necessary."[28]

These requirements reflect that fact that the original aim of the IEA was to address crisis in the international oil markets: crises of supply and/or crises of price. The most fundamental requirement is that all IEA members hold stocks of oil equivalent to 90 days of net imports. As at May 2014, the aggregate stocks of all IEA members amount to 222 days. In the case of those states which are net oil importers (i.e. excluding Canada, Norway and Denmark), total stocks amount to 171 days.[29]

The CERM is the central instrument of the IEA's strategy. These emergency response measures include:

- the coordinated drawdown of emergency stocks;
- the coordinated restraint of oil demand, principally in the transport sector;
- coordinated allocation of oil among IEA countries in the event of a severe supply disruption.[30]

The CERM has only been activated three times (Fattouh and van der Linde, 2012):

- at the outbreak of the "First Gulf War" in January 1991;
- after Hurricane Katrina had damage oil production infrastructure in the US Gulf of Mexico in 2005;
- in response to the drop in Libyan oil production in 2011.

Preparations for a coordinated stock drawdown were also made in late 1999 in anticipation of the Y2K information technology scare and in 2003 when a number of sources of supply interruption were emerging. In support of the CERM, the IEA runs emergency response simulation exercises and reaches out to non-member, net oil importing states such as India and China.

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[28] International Energy Agency, *Member Countries,* available at <http://www.iea.org/countries/membercountries/> (visited on 3 September 2014).

[29] IEA, *Closing oil stock levels in days of net imports,* May 2014, available at <http://www.iea.org/netimports/> (visited on 3 September 2014).

[30] IEA, *IEA Response System for Oil Supply Emergencies*, 2012, available at <http://www.iea.org/publications/freepublications/publication/EPPD_Brochure_English_2012_02.pdf > (visited on 3 September 2014).

In addition to creating and sustaining the CERM, the IEA also operates a permanent information system on the international oil market, as well as providing data on gas and coal markets. In the context of the framework for this paper, the IEA was established to address availability and affordability.

In addition to its core tasks relating to oil supply, the IEA carries out a number of other functions[31]:

- promoting rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- trying to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- promoting international collaboration on energy technology;
- assisting in the integration of environmental and energy policies.

The IEA fulfils these tasks through a range of activities including carrying out and publishing research, developing bilateral policy dialogue and research programmes with selected non-member countries, providing training courses and holding events to disseminate information.

It has been argued that the IEA faces two key challenges today (Kolgan, 2009). The first is that its ability to respond effectively to an international oil supply crisis has diminished substantially over the last 20 years as its share of global oil trade has declined. The organisation has recognised this problem which is why it is seeking to build effective emergency response coordination mechanisms with China and India. Ideally, these two countries would join the IEA, but the bylaws of the IEA require new member to first join the OECD. Further, it is not evident that China and India would want to become members of the IEA in its present form. The second challenge for the IEA relates to the issue of scope. Recent years have seen the agency add an ever increasing number of analytical and coordinating tasks to its portfolio of activities. This risks undermining the core mission of the IEA which should be emergency response.

b. The European Union (EU)

In 2012 the EU relied on imports for about 54% of its primary energy needs and the only net energy exporter among the 28 member states was Denmark. Dependencies for individual fuels were 88% for oil, 66% for gas and 42% for solid fuels. In each case, the dependency had grown significantly over the previous decade.[32]

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31 International Energy Agency, *History,* available at < http://www.iea.org/aboutus/history/> (visited on 3 September 2014).

32 European Commission Eurostat, *Energy Production and Imports*, data from March and May 2014, available at <http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Energy_production_and_imports> , (visited on 3 September 2014).

Like the IEA, the EU is a rule-bound organization, but unlike the IEA its energy strategies and powers are very wide ranging. Formal collaboration between European countries in the field of energy began in the early 1950s with the establishment of the European Coal and Steel Community and the European Atomic Energy Community. The first of these was created with the express ambition of building a common market for coal, then the most important source of energy. The next significant step taken was progressive development from 1968 onwards of emergency response mechanisms to react to disruptions to oil supplies, including the construction of oil stocks (Matlary, 1997). This measure preceded the creation of the IEA by seven years.

A key feature of the EU is that the member states cede partial sovereignty to the institutions of the EU: to the Council of Europe which comprises the heads of government of each member state, to the European Commission which is a large and powerful civil service, and to the European Parliament which has members directly elected from the member states.

From the mid-1980s, a key component of the EU's energy strategy has been the creation of a single energy market with the twin objectives of enhancing security of supply and economic competitiveness. A decade of proposals, drafting and negotiating then took place. The most significant measure to emerge was the Directive on Hydrocarbons Licensing which was issued in 1994 (Cross et al., 2001). At the same time, the Commission issued legally-binding directives relating to price transparency and to electricity and gas transit, as well as Common Rules covering the removal of monopoly rights, the unbundling of vertically-integrated utilities and third-party access to transmission infrastructure were drafted (Lyons, 1996; Cameron, 2002). Despite all these formal measures, little was achieved towards building a single energy market until 1996 and 1998 when the Electricity and Gas Directives respectively were adopted. This breakthrough was assisted by the progressive emergence of competitive energy markets at national level, for example in the United Kingdom, Germany, the Nordic countries, the Netherlands and Spain (Egenhofer, 1997). Despite this positive influence, the level of opposition to the Commission's core ideas remained high. As a consequence these directives reflected compromise solutions to many key issues including third-party access to energy infrastructure and unbundling of utilities.

Further directives concerning the development of Europe-wide electricity and gas markets were adopted in 2003, but little progress was being made towards the creation of a single energy market. In 2007, the Council of Europe issued an 'Energy Policy for Europe' which showed renewed political commitment at the highest level to the single European energy market, with three objectives: security of energy supply, a competitive energy market, and the environment, particularly climate change (de Jong, 2008). A particular problem relating to security of supply arose from the shortage of cross-border transmission capacity and high prices for access to such capacity (Nowak, 2010).

A so-called 'Third Energy Package' of proposed measures was published in 2009 and took effect from March 2011. The main components are (Stanic, 2011): unbundling of transmission from production and supply activities; allocating stronger powers and independence of national regulators; issuing new rules to harmonize market and network operations across Europe; setting higher standards of public service obligations and

consumer protection; establishing new institutions to promote cooperation between regulators and between transmission system operators.

As of 2014, progress towards implementing this new package of measures and thus promoting energy security and the internal energy market have been much slower than hoped, In particular, investment in infrastructure and inter-connections has been too low (Yafimava, 2013; European Commission, 2013). In addition, the EU's energy policy is torn between three priorities: promoting the internal energy marker, mitigating climate change and addressing external energy security challenges, notably those relating to oil and gas supplies from Russia. With respect to the last factor, two issues are of particular concern. The first relates to Gazprom's insistence of indexing the price of its gas to oil, and the second arises from the worsening political relations between the EU and Russia

In conclusion, although (and possibly because) the EU attempts to address all aspects of energy security, progress continues to be slower than hoped by its leaders. National interests relating to the support of national champions and the management of domestic energy markets still act to constrain progress on key issues. These constraints have been exacerbated in recent years by the impacts of the financial crisis, the tension between energy supply security and climate change mitigation, and varying attitudes towards Russia among the member state governments.

c. East Asia

Savacool and Khuong (2011)[33] indicated that the International Energy Agency mentioned a double increase in global energy demand by 2040 and more than half of this increase in demand will come from Asian countries (and 45% alone from China). However, from the supply side, most of Southeast Asia countries face the decline in their large mature oil fields and having limited large new oil prospect. It estimated that regional oil production will decrease from about 2.6 million barrel oil per day in 2012 to about 2.4 million barrel per day in 2018 and 1.7 million barrel per day in 2035 (IEA, 2014)[34]. On the other hand, the energy demand will increase from about 5.7 million barrel per day in 2012 to about 6.7 million barrel per day in 2018. This indicates that energy security will become the important challenge for the region in the future.

Energy demand in Asia is predominately driven by two factors such as consumption-led and industrial-led (Savacool and Khuong, 2011). Consumption led is driven by increasing in the standard of living that demand more energy while industrial-led refers to industrial transformation to more energy-intensive. It is important to note that a growing trend on fossil fuel demand in Northeast Asia especially in China has become a major concern. China has become the second largest crude oil importer and a net importer of coal. This will have

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[33] Savacool and Khuong (2011). Energy Security and Competition in Asia: Challenges and Prospect for China and Southeast Asia, Darryl S.L. Jarvis and Anthony Welch (eds.) *ASEAN Industries and the Challenge from China*, New York, Palgrave Macmillan.

[34] IEA (2014). *Energy Supply Security 2014*, Paris, IEA

major consequences for financial and fuel markets and pollution both regionally and globally (Von Hippel et. al., 2008).

At the ASEAN level most of countries depend on industry stockholding obligations. APSA has become the framework of regional consultations and coordination for oil allocation in the case of emergency. Energy diversification has become an important agenda for region. Production of natural gas will continue to grow and countries such as Indonesia, Malaysia, Myanmar, and Brunei Darussalam will become the supplier of gas in the region. However, an emergency policy for natural gas disruptions has not been obtained as a top priority in the region (IEA, 2014).

Energy subsidies have put huge burdens on the national economies. Energy subsidy can hamper energy security because it can create overconsumption of energy, traffic congestion, and other external costs (Davis, 2014)[35]. Two of the ASEAN countries, Indonesia and Malaysia, are among the top ten countries in the world that provide substantial energy subsidies, and Indonesia is among the top five countries with the highest deadweight loss from fuel subsidy and deadweight loss relative to full social cost (Davis, 2014). In Indonesia, the allocation of energy subsidy reached 21% of total government expenditure in 2014. Failure to reduce the subsidies may leave these countries more vulnerable to potential supply disruptions especially when the price of oil is increasing. Howes and Davies (2014)[36] pointed out that the enemy of subsidy containment is inflation because the current regulated oil price in Indonesia is 22% lower than it was immediately after the large price hikes in 2005.

One of important event that alters development of clean energy is the nuclear disaster at the Fukushima Daiichi plant in March 2011. It has brought a big impact on the role of nuclear power as the key to reduce dependency on fossil fuels and climate change. IEA (2014) said that electricity production from nuclear declined by 10% between 2010 and 2012 due to safety evaluation.37 However, some counties such as Viet Nam are constructing the first unit while China announced that it will build only Generation III reactors.38 Indonesia plans to resort to nuclear energy as the last option.39

Along with the ERIA, APERC and IEEJ have constructed the energy security index (ESI). As stated in section 2, the ESI is mainly based on the availability and reliability of energy

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35 Davis, L.W. (2014). The Economic Cost of Global Fuel Subsidies, *American Economic Review: Papers and Proceedings*, 104(5):581-585.

36 Howes, S., and Davies, R., (2014). Survey of Recent Development, *Bulletin of Indonesian Economic Studies*, 50 (2): 157-83

37 Nuclear energy's rebirth is not robust enough to limit climate change, http://www.iea.org/ieaenergy/issue6/nuclear-energys-rebirth-is-not-robust-enough-to-limit-climate-change.html, accessed 8 September 2014

38 ibid

39 Rancangan Kebijakan Energi Nasional (R-KEN) disetujui [Draft on National Energy Policy is approved], http://www.esdm.go.id/index/37-umum/6668-rancangan-kebijakan-energi-nasional-r-ken-disetujui.html

resources regardless of domestic or overseas sources. Table 4 presents the correlation between policy and ESI.

Table 4: Correlation between Policy and ESI

ESI	Number of Yes *	% of Yes ***
TPES self-sufficiency	6/12	50
Coal self-sufficiency	7/11	64
Crude oil self-sufficiency	4/6	**67**
Natural gas self-sufficiency	4/7	57
Coal R/P	6/8	**75**
Crude oil R/P	2/4	50
Natural gas R/P	1/6	*17*
Coal R/C	7/8	**88**
Crude oil R/C	5/5	**100**
Natural gas R/C	5/6	**83**
Coal import source country diversity	2/2	**
Crude oil import source country diversity	1/3	*33*
Natural gas import source country diversity	1/2	**
TPES diversity	9/10	**90**
Power generation fuel diversity	8/10	**80**
Crude oil Middle East dependence	0/3	*0*
Natural gas Middle East dependence	1/1	**
Reserve margin of generation capacity	5/9	56
Power outage frequency	4/5	**80**
Power outage duration	3/5	**60**
Commercial energy access	9/12	**75**
Electrification	9/9	**100**
TPES / GDP	10/11	**91**
TFEC / GDP	10/11	**91**
Days of on-land oil stocks	4/5	**80**
CO_2 Emissions / TPES	3/12	*25*
CO_2 Emissions / Fossil fuel	2/12	*17*
CO_2 Emissions / GDP	3/12	*25*
CO_2 Emissions / Population	1/12	*8*

* See Table 2-4-1 for the detail. "Yes" means that the country is assessed as there was a correlation between policy and ESI. Denominator represents number of countries which has relevant policy.
** sample country 2 or less.
*** **Bold** type number shows percentage of two third or more.
Italic type number shows percentage of one third or less.

Source: ERIA (2011)

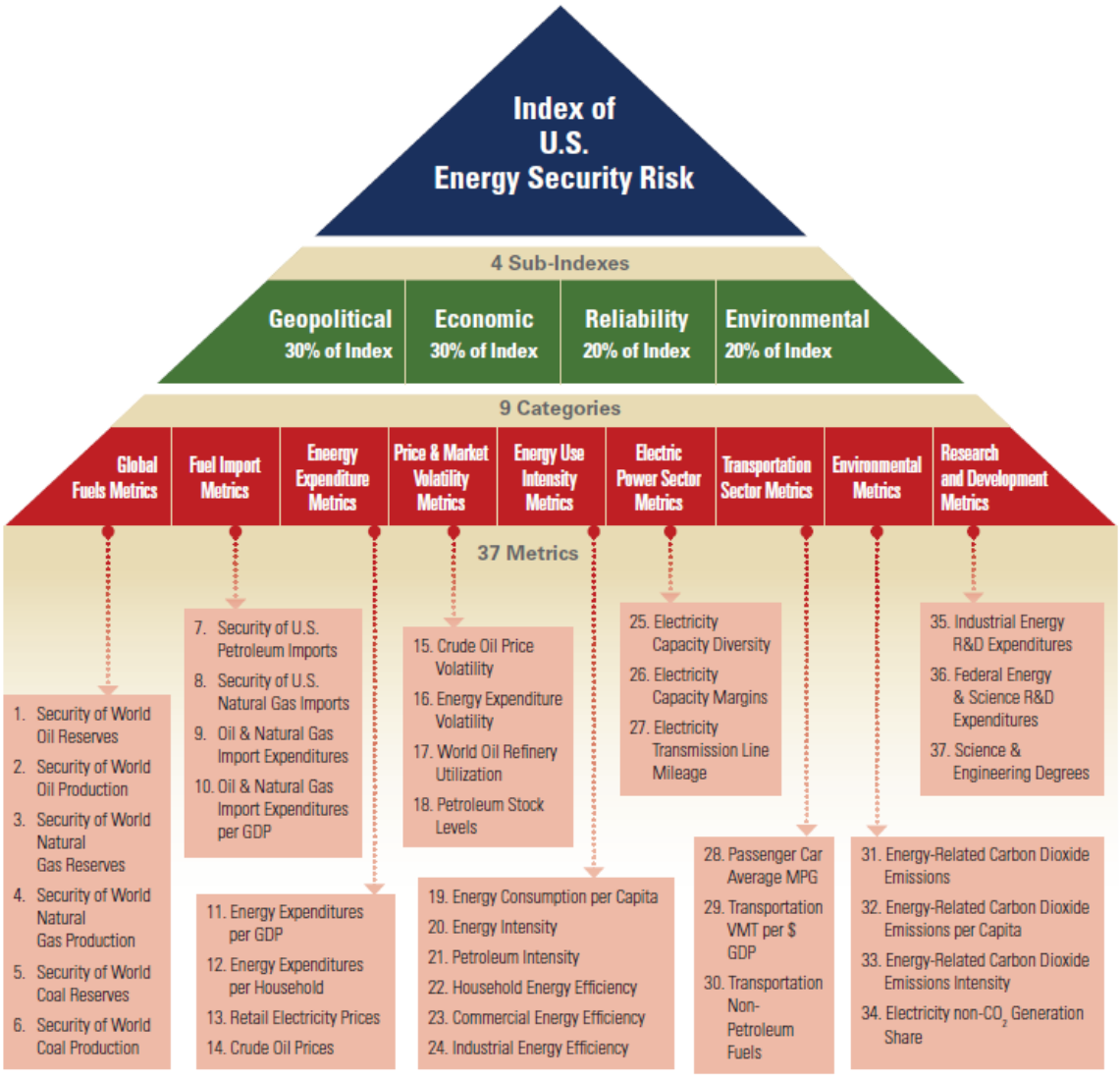
d. North America

Index of U.S. energy security risks were developed by the Institute for 21st Century Energy and the U.S. Chamber of Commerce (2010). The metrics of the index are classified into nine categories: global fuels, fuel imports, energy expenditures, price and market volatility, energy use intensity, electric power sector, transportation sector, environmental and research and development. It employs 37 specific metrics covering fossil fuel reserves and production, oil and gas import costs, energy expenditure, oil price and volatility, energy per capita, energy intensities and efficiencies, electricity, fuel mileage, various carbon emissions, energy and science R&D expenditures, and science and engineering degrees. These

indicators are merged into four sub-indexes and the overall index is calculated by the weighted average of the four sub-indexes. The four sub-indexes are Geopolitical, Economic, Reliability and Environmental and their weights are 30%, 30%, 20% and 20%, respectively.

Figure 2 present how the Index of U.S. Energy Security Risk is constructed. There are four sub-indexes followed by nine categories and 37 metrics in all. The nine categories have a different number of metrics.

Figure 2: Index of U.S. Energy Security Risk: A Schematic Diagram



Source: U.S. Chamber of Commerce (2010)

IV. Energy Security for ASEAN – Definition and Policies

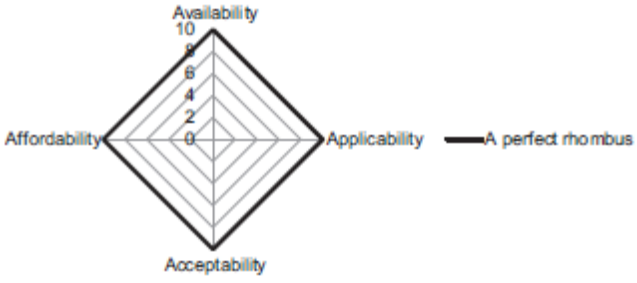
a. Definitions

Energy security has many dimensions and a few studies have tried to construct indicators for energy security by utilizing a single dimension or multiple dimensions. A notable study of a single dimension is one by International Energy Agency in which price volatility and volume volatility is suggested as the indicator of energy security. Studies of multiple dimensions are notably by Sovacool and Mukherjee (2011), Chang and Yong (2007), Chester (2008), Kruyt et al (2009) and von Hippel et al (2009).

The APERC, the ERIA and the IEEJ have worked on building metrics of energy security for ASEAN. This is mainly based on the availability and the reliability of energy resources. Energy security has various dimensions but it could be summarized in four dimensions such as the availability of energy resources including fossil fuels and renewable resources, the applicability of technologies for harnessing available energy resources, the societal acceptability towards a certain energy resource and the affordability of energy resource. Altogether they work towards securing the adequate and reliable supply of energy resources at a reasonable price.

Sorting out various dimensions adopted for the indicators of energy security in earlier studies, Yao and Chang (2014) constructed an analytical framework of energy security based on four dimensions, namely the availability of energy resources including fossil fuel reserves and renewable potential, the applicability of technology for harnessing fossil fuel reserves and renewable potential, the acceptability by society for energy resources and affordability of energy resources (it is called 4A's). The overall level of energy security for a country is the sum of the ordinal scores of the four dimensions (i.e., 4A's) that are converted from cardinal scores of all indicators. Each dimension has the equal number of indicators and each indicator contributes equally to each dimension. The ordinal scores of the four dimensions are plotted over a rhombus and the area of the rhombus is considered the status of energy security. The larger the area of the rhombus is, the higher the energy security is. Figure 3 present a perfect rhombus that is considered the highest level in energy security by given data.

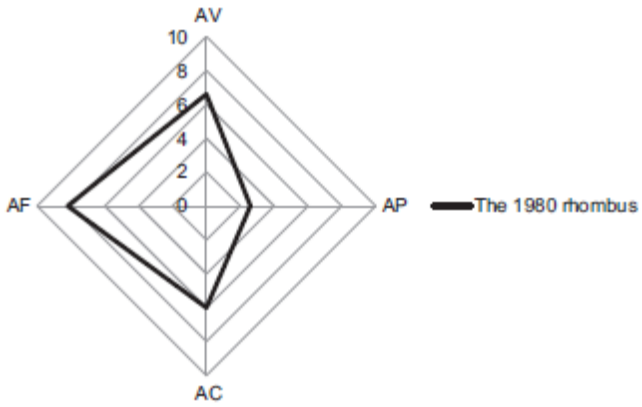
Figure 3: A Perfect Rhombus



Source: Yao and Chang (2014)

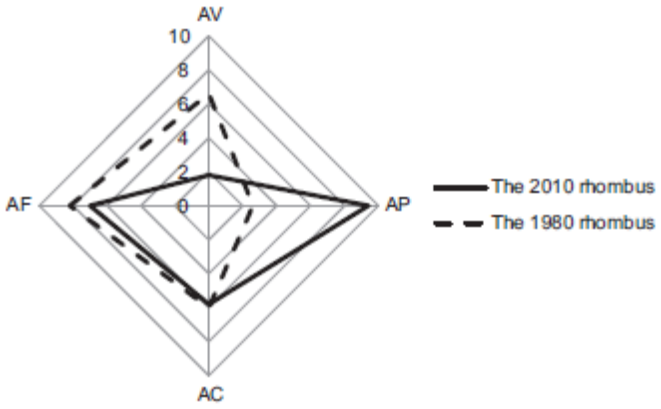
The framework was applied to evaluate the status of energy security in China. Figure 4 presents energy security status of China in 1980 and figure 5 presents energy security status of China in 2010. The area of the rhombus in 1980 is 68.04 and that in 2010 is 62.32. This implies the status of energy security in China has worsened a little bit in 2010 compared to 1980. The slight worsening in the status of energy security is due to a huge decrease in the availability of energy resources that offset a relatively high increase in the applicability of energy technologies in China. Figure 6 shows an example of how energy security index has changed over time.

Figure 4: Energy Security Status in 1980



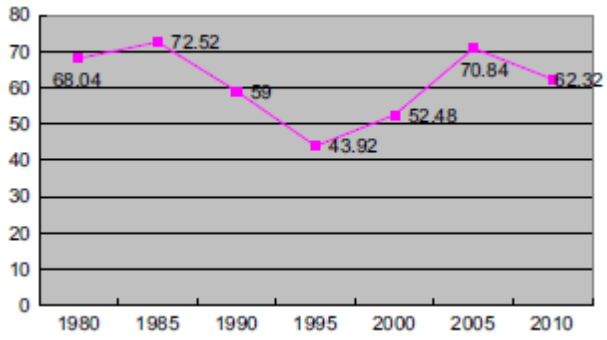
Source: Yao and Chang (2014)

Figure 5: Energy Security Status in 2010



Source: Yao and Chang (2014)

Figure 6: An Example of Energy Security over Time



Source: Yao and Chang (2014)

This four-dimension framework of energy security can be applied to examine the status of energy security in ASEAN countries. The Energy Research Institute (ERI) of the Chulalongkorn University, Thailand is constructing the four dimension framework of energy security in ASEAN countries and the result is expected to be available in October 2014.[40]

b. Policy recommendations

The four-dimension framework of energy security emphasizes equally on improving each dimension. The availability of energy resources could be done by new exploration, diversifying the sources of energy import, increasing stockpiling for oil and increasing capacity of harnessing renewable energy. The relevant policies recommendations are as follows. First, with help from the World Bank, the Asian Development Bank and other international aid agencies, ASEAN promote and subsidize those exploration and production efforts. Second, ASEAN needs to introduce Feed-in-Tariffs (FIT) and Renewable Portfolio Standards (RPS) or Renewable Energy Obligation. Third, ASEAN should make oil stockpiling compulsory with a different degree of stockpiling requirement to which a common but differentiated rule is applied.

The applicability of energy technologies to harness various energy resources can be developed by R&D activities. ASEAN could establish renewable energy R&D center to develop appropriate and applicable renewable energy technologies for ASEAN countries. Each member country contributes a differentiated amount commensurate to its economic capacity.

The acceptability of society towards energy resources can be improved by education and awareness campaign. ASEAN Centre for Energy could strengthen existing efforts to educate people in the region and propagate correct information about using energy resources.

[40] The preliminary results of this study will be presented at the Brainstorming Session of AEMI II from 14 to 16 October 2014 in Bangkok.

The affordability of energy resources can be improved by removing blanket energy or fuel subsidies and implementing ear-marked subsidies. In addition, stockpiling for oil can mitigate the short-term impact of oil supply disruption. ASEAN can build energy fund to help those who suffer from high energy prices by aiding them with an energy voucher.

V. Energy Security Strategy for ASEAN

a. Strengthening existing efforts

IEA (2014) pointed out four major elements that need to be considered such as increasing dependency on oil import, the importance of the Malacca Strait chokepoint for oil, LNG import and the potential for maritime border dispute in the South China Sea. Current development on the South China Sea may confirm Savacool and Khuong (2011:226) statement that said 'China and ASEAN countries talk about "regionalism" and "cooperation" on energy issue, but this talk seems to be designed only to mask opportunistic and protectionist thinking. The Chinese remains dedicated to procuring energy supply from as many sources as possible, and Southeast Asian leaders remain suspicious of each other and distrustful of Chinese plans for expansion, especially in areas of the region where sovereignty claims are actively contested.'

Further, a media review conducted in Indonesia (see Table 5) indicates that power trading will increase risks on national energy supply. People think that energy trading reflects a bad policy on power management in Indonesia. On the other hand, there are also many positive feedbacks in looking at the benefits of power trading. Reflecting the two cases China-ASEAN and Indonesia- Malaysia in quest for energy indicates that building trust and solidarity need to be developed. The spirit of solidarity and cordiality needs to be materialized by promoting people to people connection.

Table 5: People Attitude on Power Trading Between Indonesia and Malaysia

Positive attitude	Negative attitude
1. Reduce oil consumption (replacing diesel power plant) 2. It is much cheaper 3. Reduce carbon emissions 4. Benefited 8,000 household in Kalimantan 5. Supply reliability increase (quality) 6. Optimizing energy reserve 7. No impact on electricity supply in Sumatera (reserve 40%) 8. We still net exporter 9. Exchange power (day-head agreement) 10. Transition before preparing large power project 11. Promote industrial development (palm oil and smelting) 12. It is nice export electricity to Malaysia	1. Temporary solution before new plant coming 2. Risk on national energy security 3. Rich energy supply but need import (ironic) 4. Shameful Indonesia 5. Export coal, buy electricity

Source: brief review on media

While building trust among the decision makers and people become important, there is growing concern on the important promoting country resilience on supply disturbance especially for oil. There are several mechanisms that have been implemented such as APSA in 1986 that was revised in 1999. The ASEAN CERM (Co-ordinated Emergency Response Mechanism) has become a framework for regional consultations and co-ordinations to facilitate the oil allocation in emergency cases and the assistance will be delivered based on voluntary and commercial basis (IEA, 2014). There is ongoing activity on development the Oil Stockpiling Roadmap (OSRM). Countries such as Thailand and Viet Nam committed to obtain stock levels comparable with 90 days of net imports held by International Energy Agency (IEA), while others plan to reach lower levels of under 50 days of consumption or net imports.

Further, Southeast Asia is a key exporter of LNG to global market, but volume of export will decline due to increases in domestic consumption and maturing and declining output. Most of ASEAN countries have developed the LNG liquefaction capacity and now the capacity was about one-quarter of the total world capacity (IEA, 2014). In the future the capacity is expected to grow. This indicates that each country aims to promote regasification capacity and storage facilities. Although natural gas has become important for the region, there is no mandatory industry stock or government stock of natural gas in the region.

The existing efforts of improving energy security, mainly the availability dimension, need to be strengthened collectively and individually. There should be more efforts to improve the other dimensions of energy security such as applicability, acceptability and affordability. Developing technologies for harnessing renewable energy and sharing them among member

countries deserves a special attention. The acceptability towards coal or nuclear energy could be worse than as expected.

b. New strategies

To enhance the status of energy security, ASEAN need to work collectively and share the information available such as fossil fuel reserves, renewable energy potential, energy and fuel subsidies.

Chester (2010) said that because energy security has multiplicity of meanings, there can be no 'one-size –fits-all' solutions. For example pursuing energy affordability and reducing import dependency needs different policy formulation. Improving energy security can be promoted at a country level and a regional level.

At the country level we propose six agendas that need to be promoted.

- First, promoting energy infrastructure at the country level will significantly improve connectivity at the regional level. This can be done by reallocation of energy subsidy to energy investment.

- Second, energy subsidy may need to help the poor. Thus better targeting on energy subsidy beneficiaries need to be promoted.

- Third, promoting technology capacity by allocating more fund for research and development. Research and development needs to be promoted to support appropriate technologies such as for rural electrification program.

- Fourth, the environmental dimension needs to be promoted as a mainstream of energy development. Environmental degradation due to unsustainable practice such as coal mining has caused huge economic, social and ecological cost. Further, energy subsidy also has hampered the development of renewable energy. On the other hand, government needs to allocate more subsidies for the production of more renewable energy.

- Fifth, it is necessary to strengthen organizationally and institutionally the national energy council. The experiences from Indonesia indicate that if the committee is dominated by government officials or people who has affiliated with political party, it may lead to conflict of interest such as in providing advices to government or in reviewing energy pricing policy.

- Finally, it is important to administrative capacity in conducting monitoring, evaluation, and enforcement on energy saving programs.

At the regional level, it is important to promote connectivity because energy security also cannot be capitalized without any connectivity. Connectivity basically covers three elements: (i) infrastructure development including physical and financial; (ii) institution or regulatory frameworks, and (iii) people to people exchange. The three elements are connected. Under

the physical infrastructure there are several areas that have been developed such as ASEAN Strategic Plan for Transport, ASEAN ICT Master Plan, and ASEAN Plan of Action for Energy Cooperation. Physical connectivity has been developed in the area of oil, gas and electricity (see the Figure 7, 8 and 9). The financial infrastructure for energy connectivity needs to be studied further by benchmarking a successful case such as Nord Pool (this is the topic of Paper 5 and rigorously discussed in the paper).

West Kalimantan-Sarawak interconnection (BIMP-EAGA) has become one of the priority projects in the energy sector. Further, one of the key strategies for ASEAN Connectivity is 'prioritise the process to resolve institutional issues in ASEAN energy infrastructure projects'. Promoting connectivity in power sector both for adding new capacity and maintenance required huge investment costs. The ASEAN Infrastructure Fund (AIF) that is recently created is able to fund partly to all the identified list of priority projects and it is necessary to develop and optimize the financing infrastructure.

Strengthening competition policies and laws is necessary to increase the efficiency of the energy sector because most of the energy sector is still dominated by the state companies and it has been managed inefficiently. Corruption mentality and rent-seeking behavior have influenced poorly the quality of services and increased the burden of tax payers. Because the energy sector is capital-intensive and energy trading is under pressure of monopoly and collusion behavior, it is necessary to ensure that energy trading should be done in a transparent and efficient way. Along this line, ASEAN Competition Authority (ACA) has been suggested to be established before 2030.

This paper proposes to evaluate the state of energy security for each country, following the ASEAN Community progress monitoring system 2012. It also proposes to include additional information on the report such as stockpiling on oil and gas, and energy price (currently it covers only diesel fuel and gasoline), energy intensity, and energy diversification. This will generate more comprehensive understanding on energy security in the region.

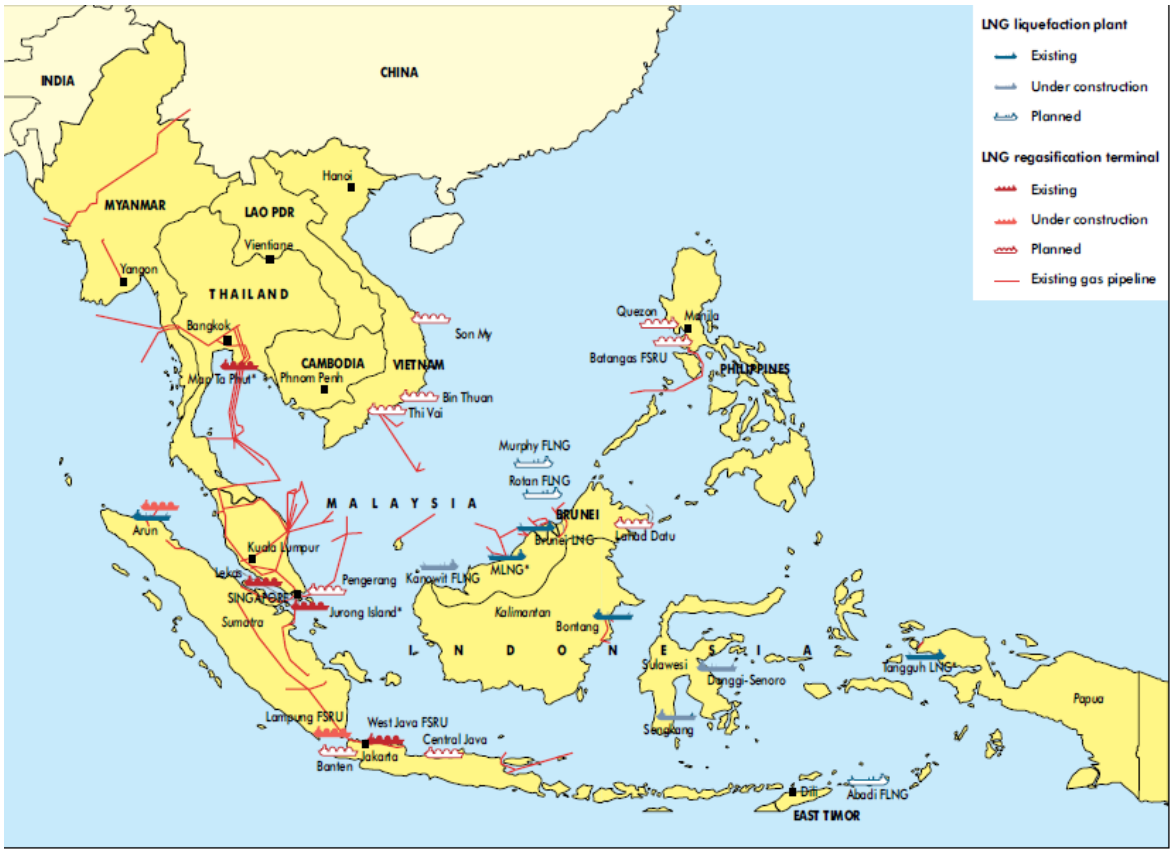
Affordability becomes important element in energy security. Affordability has become two swords of edges in promoting energy security. Due for an affordability reason, energy price has been depressed below the economic price. On the other hand, due to an open subsidy policy, most of energy subsidy goes to the rich. As a result, energy demand increased rapidly and so did income inequality. It should be common understanding among the ASEAN countries that energy subsidy should go to poor people. However, there has not established a common framework how to phase out energy subsidy in the regions.

Finally, there is interdependency among energy, water, road, rail, information and sea shipping connectivity. Integrating the infrastructure networks is necessary to avoid duplication and to ensure sustainability of the project.

Figure 7: Oil Infrastructure of ASEAN

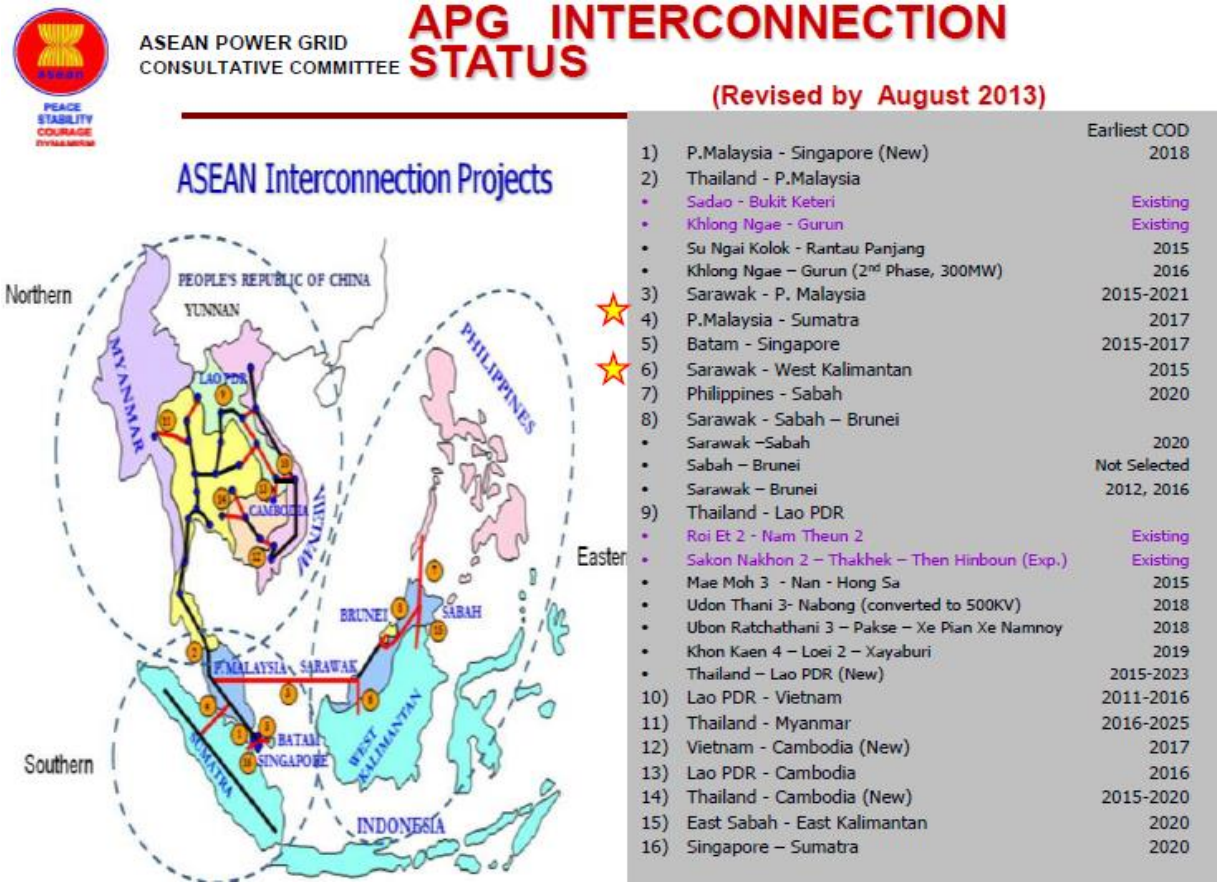
Source: IEA (2014)

Figure 8: Gas Infrastructure of ASEAN



Source: IEA (2014)

Figure 9: ASEAN Power Connectivity



Source: HAPUA Secretariat, Sustainable Energy Training, Bangkok, 25th November 2013

VI. **Conclusion**

Energy security has diverse dimensions to which many factors constitute. This requires the approach to enhance energy security needs to be multi-facet, collective and cooperative. There have been a few attempts to define energy security for ASEAN and the member countries have put efforts to improve energy security in the region. Connecting power grids and gas pipelines such as APG and TAGP respectively and promoting voluntary oil stockpiling are the examples of the efforts. Considering rapid increases in energy demand and fast declining in fossil fuel endowments, ASEAN countries need to establish new strategies for enhancing energy security. The experiences from OECD and EU could shed light on how ASEAN should build its energy security strategies. This paper suggests strengthening existing efforts of improving interconnectivity, introducing competition and market mechanism to the energy sector and establishing a transparent, anti-corrupt and efficient governance structure among others. Iit is necessary to highlight that institutional reform needs to be a basis for improving the state of energy security in ASEAN. The reform itself needs to balance between their national interest and regional interest. Energy subsidy is one of the critical

elements of institutional reform. As this issue is related to political dimension, it is better to quote one of the statement from a book “ASEAN 2030 Toward a Borderless Economic Community” that said “Eventually, ASEAN members need to appreciate that growing together for shared prosperity requires more decision-making powers to be shared in a flexible way. Political leadership is crucial in successfully addressing this important policy option” (ADBI, 2014).41

41 ADB (2014). ASEAN 2030 Toward a Borderless Economic Community. ADBInstitute, Tokyo.

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ENERGY POVERTY – ADDRESS ENERGY POVERTY THROUGH AEMI

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ABSTRACT

By 2030, it is expected that there is no energy poor people in ASEAN countries. The challenge is how AEMI can facilitate the member countries in providing a modern energy services with the different stages of energy development among the member countries. There are five main outcomes from this section. First, it needs more strong political action in tackling energy poverty in the regions. Second, there is an indication of narrowing gap in per capita energy use and electricity consumption. This situation is corresponded with increasing the ratio of GDP per capita between the CLV countries and ASEAN-6. This shows a positive signal on the important of narrowing energy gap for economic development in the region. Third, most of energy poor people live in rural areas. The rural electrification (RE) program need to be promoted because it provides income and non-income benefits. AEMI can promote RE both in directly and indirectly ways such as in providing financial assistance, technical and quality of service, basic services and economic opportunities. Fourth, in the area of financing, AEMI can promoted the existing scheme, and micro finance can be one areas that need to be focused. Finally, we argue that promoting the renewable energy target can be an intermediate target for universal energy access and AEMI simultaneously can determine incremental targets on electrification ratio and modern access cooking fuel.

SECTION 1

BACKGROUND

The World Summit on Sustainable Development, in Johannesburg, South Africa, 2002, was highlights the energy for sustainable development. The summit mention that:

> …access to energy facilitates the eradication of poverty…improve access to reliable, affordable, economically viable, socially acceptable, and environmentally sound energy services and resources…

In September 2011, the UN General Assembly launched the 'Sustainable Energy for All' initiative. UN Resolution 65/151, decided to declare year 2012 as the International Year of Sustainable Energy for All. There are three objectives that are going to be pursued up to 2030, namely[45]: (1) ensuring universal energy access; (2) doubling the share of renewable energy; and (3) doubling the rate of improvement in energy efficiency. Every country may have different pathways to attain the objectives given the differences in the characteristics of each country. The global action agenda has identified 11 action areas (seven sectoral areas and four enabling areas) to attain the three goals. The seven sectoral areas are: (1) modern cooking appliances and fuels; (2) distributed electricity solution; (3) grid infrastructure and supply efficiency; (4) large-scale renewable supply; (5) industrial and agricultural processes; (6) transportation; (7) building and appliances; the four enabling areas are: (1) energy planning and policies; (2) business model and technology innovation; (3) finance and risk management; and (4) capacity building and knowledge sharing.

Further, the UN Resolution 66/288, 'the future we want' (27th July 2012), section on Energy mentioned that:

> …"Sustainable Energy for All"…focuses on access on energy, energy efficiency, and renewable energies.

UN Resolution 67/215, in 61st plenary meeting, 21 December 2012, decides to declare year 2014 – 2024, as the "UN Decade of Sustainable Energy for All". In the spirit of UN resolutions, countries and regional cooperation need to follow up and prepare strategic to achieve the targets.

Similarly, ASEAN also needs to move forward to implement the resolutions because energy poverty has become the real problem in the region. Measuring energy poverty at ASEAN level need to be framed under the 'Sustainable Energy for All' initiative. In this regard, the energy development index (EDI), which measures the transition toward modern fuel and modern energy services, is a useful indicator that we can look at. The EDI among the ASEAN

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45 http://www.se4all.org/wp-content/uploads/2014/01/SEFA-Action-Agenda-Final.pdf, accessed 18 June 2014

countries shows a quite wide development divide. In 2012, Malaysia has the highest rank while Myanmar has the lowest rank within ASEAN. (A total of 80 countries were ranked in the original list). Indonesia, Vietnam, and the Philippines have almost similar ranking; the same is true for Laos and Cambodia. However, although countries have almost the same EDI, it does not necessarily mean that they share the same problems at the household level and community level.

Table 1 Energy Development Index 2012

No	Country	Rank	Energy Development Index (EDI)
1	Myanmar	71	0.10
2	Laos	59	0.14
3	Cambodia	56	0.16
4	Indonesia	37	0.34
5	Vietnam	36	0.35
6	Philippines	34	0.38
7	Thailand	15	0.64
8	Malaysia	4	0.78

Source: World Energy Outlook 2012

We argue that ASEAN needs to address and emphasize the growing concern on modern energy access in the region. It is necessary to design a set of policies and frameworks to improve access to energy and eradicate energy poverty across ASEAN by 2030 under the AEMI framework. Promoting energy trade and investment is a precondition to improve energy access. In view of this, ASEAN energy market integration (AEMI) can facilitate a more vigorous energy trade and investment in the ASEAN region. An AEMI approach in investment can be optimize by promoting local energy resources, especially renewable energy sources such as biofuel, animal waste, wind power, solar panel, microhydro, etc.

Lack in modern energy access is reflected by lack in electricity access and cooking fuel. In ASEAN, about 134 million people without electricity access and Indonesia was contribute about 49%, while Philippines and Myanmar were contribute 21% and 18.6% respectively. Thus by ensuring the effectiveness of electricity access on those countries more than 88% of energy poverty problem in the region can be resolved. In terms, of energy for cooking, about 279 of ASEAN population was depended on traditional use of biomass for cooking. It seems that penetration on modern energy for cooking was lower than electricity. In many countries such as Cambodia, Lao PDR, Myanmar, and Vietnam, the share of population with traditional energy used for cooking was more than 50%. Most people who lack in electricity and a modern energy for cooking live in remote and isolated areas. The AEMI strategy by

promoting APG and TAGP may not reach those people. Thus, AEMI ways also need more flexible in promoting project both large and micro projects. The main objective is to facilitate more sustainable energy supply with acknowledging local resources, technology and community.

Table 2 Energy Poverty in ASEAN, 2011

	Population without access to electricity		Population relying on traditional use of biomass for cooking*	
	Million	Share (%)	Million	Share (%)
Brunei Darussalam	0	0%	0	0%
Cambodia	9	66%	13	88%
Indonesia	66	27%	103	42%
Lao PDR	1	22%	4	65%
Malaysia	0	1%	1	3%
Myanmar	25	51%	44	92%
Philippines	28	30%	47	50%
Singapore	0	0%	0	0%
Thailand	1	1%	18	26%
Vietnam	3	4%	49	56%
Total ASEAN	**134**	**22%**	**279**	**47%**

* Preliminary estimates based on IEA and World Health Organization (WHO) databases. Final estimates for 2011 will be published online at *www.worldenergyoutlook.org*.

To address problems on energy poverty in ASEAN, this paper is organized into six sections. Section one explore the background of this paper. Section two aims to evaluate to what extent energy poverty has been addressed at existing ASEAN energy framework. We analysed the regional initiatives in addressing energy poverty under the framework of the ASEAN Medium Term Programme of Action on Energy Cooperation APAEC. By providing example on the long process in realizing APG between Indonesia and Malaysia, this section aims to emphasize that real action is needed to realize energy for all. The three main bodies of ASEAN (politic and security; economic; and socio cultural) need to conduct more robust coordination in tackling multidimensional issues of energy poverty.

In section three, we investigate the convergence in energy access in ASEAN and we indicate a possible correlation with the GDP per capita. We found that in electricity sector, the convergence has been continued, but more energy use, the convergence has showed mix results. This indicates that more broad strategy is needed to narrow the energy gap such as for cooking and other energy used (transportation, industry, and commercial sector). However, there is an indication that energy convergence and narrowing GDP gap (between CLV and ASEAN-6) move in the same direction. The challenge that needs to be solved is how to ensure sustainability of energy supply if most of ASEAN countries depend on energy import outside the region in the near future.

In section four, we argue share national program in rural electrification program. We shared experiences from three countries such as Vietnam, Malaysia and Indonesia in promoting rural electrification program. We indicated that there are four areas where AEMI can support suitability of RE program such as in financing, technical and quality of service, integrating with other basic services, and providing economic opportunity. In this section, we also quantify the benefits of electricity access. We found that electricity access increased welfare through income and non-income benefits. Even, in the case of Indonesia, we found electricity access can reduce kerosene subsidy and CO2 emissions. Thus, by tackling energy poverty, government can obtain four benefits simultaneously such as economic, social, energy and environment.

In section five, we identify possible channels for financing the universal energy access. There are many possible scheme that can be utilized. However, the challenge is how to utilize the opportunity in more effective and efficient ways. At the national level, energy subsidy still become the major obstacle in acquiring larger fund for energy investment. The objective of AEMI to allow the free flow of energy, products, services, investment and skilled labour for all ASEAN member states. Thus, AEMI is not only can provide resources for better energy services in the region, but also AEMI can create greater opportunities in tacking energy poverty. In section six, we identified policy agenda that need to be done under the AEMI framework.

SECTION 2

APAEC AND ENERGY MARKET INTEGRATION

The ASEAN Medium Term Programme of Action on Energy Cooperation-APAEC (1995-1999) covered 7 areas: (1) electricity; (2) oil and gas; (3) coal; (4) new and renewable sources of energy; (5) energy conservation; (6) energy and environment; and (7) energy policy and planning. There are three plans of energy actions such as: APAEC 1999-2004; 2004-2009; 2010-2015; (for detail footprint refer to Table 3). The objectives of APAEC 2010-2015 are: to enhance energy security, accessibility and sustainability for the ASEAN region with due consideration to health, safety and environment through accelerated implementation of action plans, including, but not limited to: (i) ASEAN Power Grid; (ii) Trans-ASEAN Gas Pipeline; (iii) Coal and Clean Coal Technology; (iv) Renewable Energy; (v) Energy Efficiency and Conservation; (vi) Regional Energy Policy and Planning; and (vii) Civilian Nuclear Energy.

Table 3 APAEC's Footprint

1999-2004	2004-2009	2010-2015
1. Completion TAGP Master Plan by ASCOPE 2. Completion Interconnection Master Plan Study by HAPUA 3. Created Trans-Borneo Grid Interconnection Coordination Committee 4. Launch first energy competition (energy efficiency, conservation, renewable energy)	1. Signing of MOU for APG 2. Established AGP Consultative Council 3. Established ASCOPE Gas Center (AGC) 4. Promoting clean coal dialogue 5. Implementation of 19 EE&C projects 6. Implemented 48 projects on RE	1. Capacity building on EE&C (PROMEEC, AEMAS) 2. Completion of phase II, ASEAN interconnection master study 3. Extensive cooperation on Trans-ASEAN Gas Pipeline and LNG infrastructure 4. ASEAN Energy Award 5. Master Plan for ASEAN Connectivity 6. Finalization guideline on APG 7. Extend the Memorandum of Understanding (MoU) on the Trans- ASEAN Gas Pipeline (TAGP) Project for another term of 10 years until 20 May 2024 8. ASEAN fuel Policy for power generation 9. ASEAN's energy intensity reduced by 4.97% (2005-2009) target 8% in 2015 10. Collective target of 15% RE in total power installed capacity by 2015 11. New strategies focus on LNG developed

Source: brief summary from ASEAN Ministers of Energy Meeting

However, the discussion at the ASEAN Minister Meeting on Energy is lack to address issue on energy poverty. As seen from figure 1, the number of words count from the meeting only mention few words on access, even we have not found any words on poor, poverty, even energy poverty. We expect that more intensive discussion on the benefits of energy market integration especially for the poor need to be promoted. We argue that energy market integration needs to inclusive. This important to gain trust from ordinary people that though energy integration will not bring benefits to their life.

This picture shows electricity trading between Indonesia (PLN – State Owned Electricity Company) and Malaysia. The two people discussed that we (Indonesia) rich in natural resources, why we need to buy electricity? The other person said may be due to mismanagement. (Investor Daily, 12 April 2012)

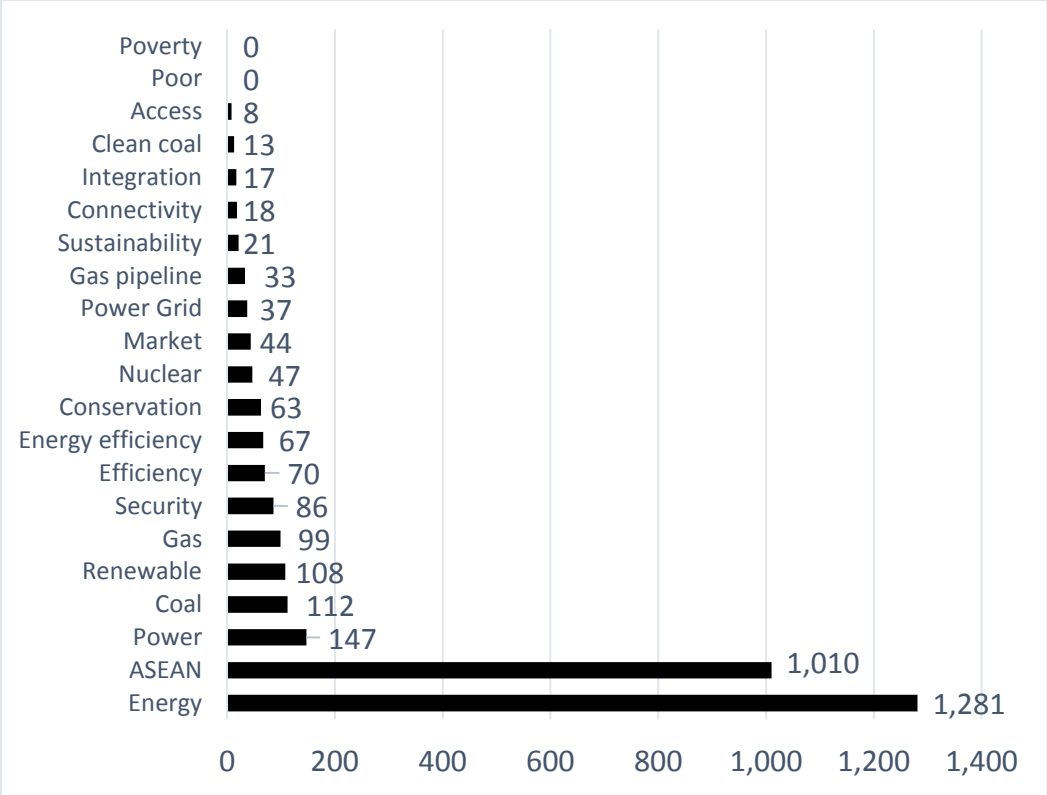


Figure 1 Word count on the Joint ministerial statement of the ASEAN Minister on Energy Meeting 1980 – 2013

We also argue that through energy market integration, poverty problem in the region can be partly solved. As seen from Table 3, the ten indicators on multidimensional poverty showed that electricity and cooking fuel has become important source of deprivation to poverty. If we combine both electricity and cooking fuel, the energy poverty indicator become the second largest contributor on poverty deprivation such as in Thailand, Indonesia, Vietnam, and Laos, even for Cambodia, it is has the highest shares. This implies that energy poverty needs to be solved seriously by all the leaders in the regions.

It is also necessary for AEMI to develop more active role in integrating both economic and social dimension. Most of poverty issues is handle by the ASEAN Socio-Cultural Community (ASCC). It has 13 ministerial meetings, one of them ASEAN Ministers and Senior Officials Meetings on Rural Development and Poverty Eradication (AMRDPE and SOMRDPE), the first informal meeting was held in December 1998. AMRDPE has produced two frameworks: (i) Framework Action Plan on Rural Development and Poverty Eradication (2004-2010); and (ii) Framework Action Plan on Rural Development and Poverty Eradication (2011–2015). The priority areas for the first framework aims to deal with globalization, basic access, and ICT. The second framework focus on sustainable development, social protection, food and climate change.

Table 4 Percentage contribution of deprivations of each dimension to overall poverty

Country	1 Years of Schooling	2 Child School Attendance	3 Mortality	4 Nutrition	5 Electricity	6 Improved Sanitation	7 Drinking Water	8 Flooring	9 Cooking Fuel	10 Asset Ownership
Thailand	29.2	11.5	19	12.2	1.2	4.8	4.4	2.5	10.6	4.6
Vietnam	18.5	14.3	12.9	12.2	1.5	12.1	5.5	5.5	13.1	4.4
Philippines	15.8	-	56.5	-	3.8	5.3	2.5	1.5	9.6	4.9
Indonesia	6.2	6.4	60.7	-	1.5	6.7	5.1	1.9	8	3.5
Lao PDR	16	15.4	18.9	11.5	6.3	9	5.3	2.3	10.9	4.4
Cambodia	14	8.1	13.5	19.3	10.9	10.6	6.8	1	11.9	4

Note: Years of schooling = number of household member has completed five years of schooling; Child school attendance = no child is attending school up to the age at which they should finish class 6; child mortality = any child has died in the family; nutrition = any adult or child for whom there is nutritional information is malnourished; electricity = the household has no electricity; improved sanitation = the household's sanitation facilities is not improved, or it is improved but shared with other households; safe drinking water = the household does not have access to safe drinking water of safe drinking water is more than a 30-minute walk from home, roundtrip; flooring = the household has a dirt, san or dung floor; cooking fuel = the household cooks with dung, wood or charcoal; and asset = the household does not own more than one radio, TV, telephone, bike, motorbike or refrigerator and does not own a car of truck.

Source: Alkire, S., A. Conconi, and S. Seth (2014): "Multidimensional Poverty Index 2014: Brief

We highlights that political priority is necessary to acknowledge the energy poverty problem. The concern needs to be translated not only into more innovative policy actions, but also in ensuring sustainability of existing framework. There are two main pillars on infrastructure connectivity such as APG and TAGP that have been developed. Those infrastructure has improved a modern energy access for electricity and cooking. For example, currently, APG has capacity more 3.5 GW and electricity trade has involved six countries such as Thailand, Malaysia, Lao PDR, Singapore, Cambodia and Indonesia. Similarly, TAGP interconnection has length more than 3,019 km and it involved five countries such as Malaysia, Singapore, Thailand, Indonesia, and Viet Nam. Although, the energy facilities will increase in the future, there is a limitation on the program reach due to limitation on primary energy supply, geographic and region topology constraints. In the case of remote areas and rural areas, promoting infrastructure on LPG, biogas and advanced cook stoves will be more cost

effective than extending the TAGP facilities. Similarly, developing off grid and mini-grid facilities are more feasible than extending the APG. Further, sustainability of energy supply also need to be considered. For example, Mekong River has become the source of water for hydropower, but the source has showed declining in environmental quality. Kristensen (2001) said that "the pressure on the environment and the region's natural resources is increasing dramatically, as is the demand for additional food, water and energy, and is well known that such expediential growth puts untenable pressure on the environment and gives rise to conflict at all levels".

More political actions are needed: from planning to action - a story on the long road of APG

Energy access needs to be promoted both at national pathway and regional pathway. It is necessary to integrate both pathways. In the case of electricity, we observed that there have been slow progress. It needs more than 25 years preparation for ASEAN Power Grid (APG) between Kalimantan – Indonesia and Sarawak – Malaysia. We attempt so summarize the milestone as follow:

1. The Ministers noted the progress achieved in the Interconnection Project where the feasibility studies of four interconnection projects namely, Sarawak-West Kalimantan; Sarawak-Brunei Darussalam-Sabah; Sumatra-Peninsular Malaysia; and Batam-Singapore, have been completed and compiled in one document and is ready for submission to potential sources for technical assistance. (Joint Press Statement The Tenth Meeting Of The ASEAN Economic Ministers On Energy Cooperation, AEMEC Singapore, 22 August 1991**)**.

2. In particular, they expressed strong confidence in the growing opportunities for long term mutual cooperation in electricity and gas interconnections, joint exploration and production etc., in the region, as exemplified by the following cooperation projects among the ASEAN Member Countries... Sabah-West Kalimantan (Indonesia) Power Interconnection. (The 16th ASEAN Ministers on Energy Meeting Singapore, 1 August 1998)

3. The Ministers welcomed the new developments in the implementation of the ASEAN Power Grid (APG) project, particularly the signing of the MOU between Indonesia and Malaysia on the Interconnection Project No.4 Peninsular Malaysia-Sumatra (with its commercial operation date (COD) expected in 2017), and the agreement that the two Member States would start power exchanges of the Interconnection Project No. 6 West Kalimantan-Sarawak in 2015. (The 30th ASEAN Ministers on Energy Meeting (AMEM) was held on 12 September 2012 in Phnom Penh, Cambodia)

4. The Ministers also noted the progress of the six interconnection projects that are currently under construction, particularly the new interconnection projects … and between Sarawak in Malaysia and West Kalimantan in Indonesia. (The 31st ASEAN

Ministers on Energy Meeting (AMEM) was held on 25 September 2013 in Bali, Indonesia)

Figure 2 ASEAN Power Grid Indonesia – Malaysia

Power contract purchase between Indonesia and Malaysia is implemented by 2015 with capacity about 230 MW (50 base load and 230 for peak load). The period of contract between 2015 and 2019, but it can be extend. Now, Indonesia government is constructing a new capacity in West Kalimantan with capacity about 100 MW. Currently power is ongoing in Sajingan with 200 kVA and Badau with 400 kVA and forthcoming Entikong 1,500 kVA. Power trading will help West Kalimantan to increase electrification ratio that currently is about ratio 69.25% and improve electricity sold per capita that is about 375 kWh (national level 753.7 kWh/capita).

Another APG project that also important is the interconnection Peninsular Malaysia-Sumatra. As mention before this project will be ready for commercial operation date (COD) by 2017. There is a coal fired power plant (*mulut tambang* - mouth coal mining) in Indonesia, with capacity 1,200 MW. The site is located in Bukit Asam-Peranap, Indragiri Hilir, Riau. This project is a collaboration among PLN (Indonesia) – TNB (Malaysia) – PT.BA (Indonesia). Rupat Island as landing point for undersea cable (see Figure 3). The existing installed capacity in Riau 165 MW (Diesel Power Plant) with peak load 406 MW. Supporting system in Riau is driven by hydropower (21%). Thus it very risky especially risks during dry season. Currently, the electrification ratio in Riau is about 60.84% and electricity consumption is about 497 kWh. People expect that this project can improve power capacity in Riau province, but before PLN sell electricity to Malaysia, the project needs to be benefited people in Riau first.

Figure 3 Project No.4 Peninsular Malaysia- Sumatra

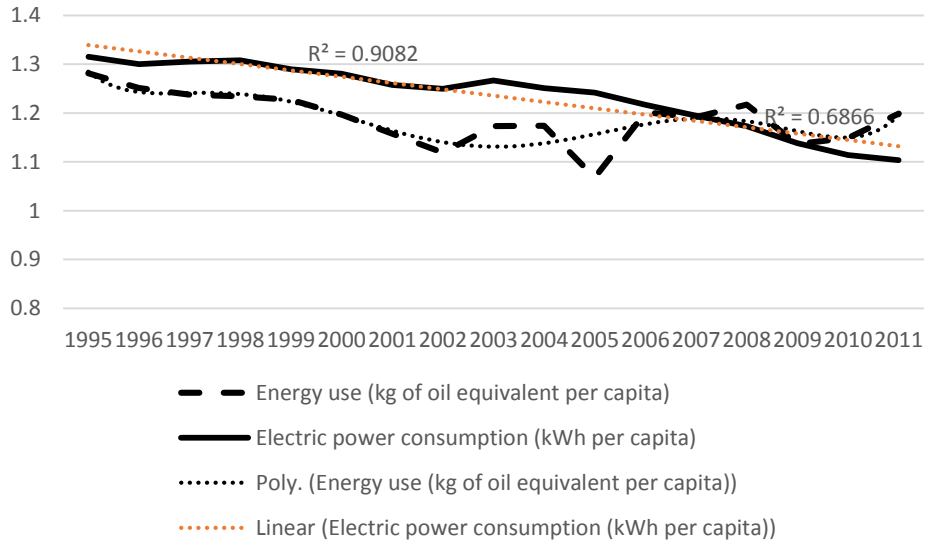
SECTION 3

ENERGY ACCESS CONVERGENCE OR DIVERGENCE

The previous sections clearly indicates that global objective on 'Sustainable Energy for All' needs to be transmitted in more real actions both at regional level and country level. There is also limitations in expanding the existing facilities under APG and TAGP. This section aims measure how the energy access has been promoted. This evidence can provide information on energy gap across the ASEAN countries. There are two indicators that we used to measure energy access such as energy use per capita and electricity consumption per capita. We applied the coefficient variation (CV) formula (σ) is given as:

$$\sigma_t = \left[\sqrt{1/N \sum (y_{it} - \bar{y}_{.t})^2} \right] / \bar{y}_{.t}$$

It is measured based on the standard deviation of energy consumption per capita normalized by the mean. A trend toward energy consumption per capita convergence is observed if the measured coefficient of variation decreased over time. It is simply based on the standard deviation (σ) of energy or electricity per capita (y_{it}) across countries divided by the mean $\bar{y}_{.t}$ in any given year; and *i* indicates country. The result can be seen from Figure 4 (we do not include Lao PDR for both indicators due to lack in data availability).



Note: Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants; Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.
Source: author's calculation

Figure 4 Convergence in Energy use and electricity consumption

As seen from Figure 4, the convergence index for electricity consumption per capita tends to decline. The CV parameter declined from 1.3 to about 1.1. This indicates that since the last seventeen years, the gap electricity consumption per capita across the ASEAN countries has decreased. This indicates that countries with relatively low level of consumption per capita can grow faster compare to countries with relatively high level of consumption per capita. This is happened because new investment on power generation on those countries grows much faster than other countries. In contrast, although energy use per capita showed declining trend for period 1995 – 2002, the trend increased after 2002, even the current level is similar with the level in year 2000. This indicates that there is a tendency for increasing the gap in energy used (other than electricity). By looking at the two trends we can conclude that inequality in energy indicators is not necessary moved in the same direction.

As seen by definition, energy use terminology reflects more complex elements than electricity consumption. Energy used covers both energy production and energy trade. Energy production depends on the availability of primary energy supply and for some countries such as Indonesia has become a net oil importer since 2004. Further, in terms of energy trade, as seen from Table 5, Singapore has become net importer for H4-270 and H4-277. Thailand also becomes net importer for H4-2711.

Table 5 Net Energy Export (in million USD)

Country	Commodity							
	H4-2701		H4-2709		H4-2710		H4-2711	
	2000	2012	2000	2012	2000	2012	2000	2012
Indonesia	1,290	24,269	3,565	1,490	-1,819	-26,263	6,621	17,439
Singapore	0	-8	-8,738	-39,879	2,164	-4,077	259	-5,727
Thailand	-117	-1,469	-5,720	-34,181	243	7,947	164	-5,586
Brunei Darussalam	NA	NA	NA	6,271	NA	-342	NA	6,176
Cambodia	NA	-20	NA	NA	-177	-910	-5	-40
Malaysia	-99	-2,137	2,589	1,477	-291	-177	3,465	19,187
Philippines	-130	-616	-3,171	-7,021	-47	-4,512	-210	-672
Viet Nam	94	991	3,503	7,750	-1,844	-7,680	-21	-610
Total	1,038	21,010	-7,972	-64,092	-1,771	-36,016	10,275	30,167

Note: H4-2701 (Coal; briquettes, ovoids and similar solid fuels manufactured from coal); H4-2709 (Petroleum oils and oils obtained from bituminous minerals, crude); H4-2710 (Petroleum oils and oils obtained from bituminous minerals, other than crude; preparations not elsewhere specified or included, containing by weight 70 % or more of petroleum oils or of oils obtained from bituminous minerals, these oils being the basic constituents of the preparations; waste oils); H4-2711 (Petroleum gases and other gaseous hydrocarbons such as propane, butane, and ethylene).

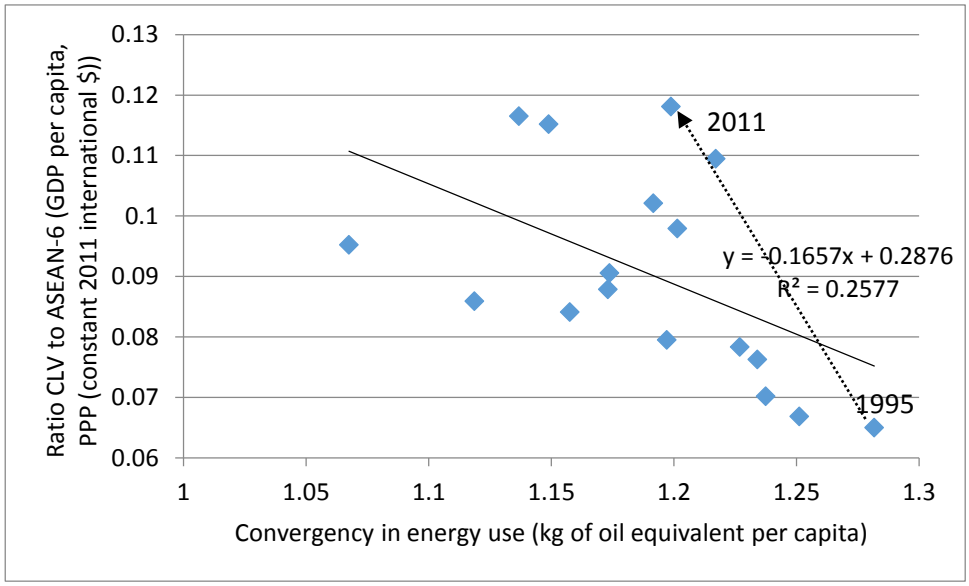
Source: author's calculation from UN Comtrade

Changing in indigenous energy production will affect the pattern of energy trade and it will influence the energy convergence. Countries with relatively rich in energy resource, will have more capacity to smooth the energy consumption with minor changing on energy pricing policy due to energy subsidy policy. On the other hand, countries with relatively poor energy resource will optimize energy trade and more often changing in domestic energy price. However, for resource rich energy supply, countries with poor energy management will face rapid depletion in energy supply. While production has showed declining trend and it may continue in the future, and it would be critical challenge at the ASEAN.

We conclude that there is convergence in electricity consumption per capita, but there is tendency for divergence for energy use per capita. The next section aims to investigate relationship or correlation between the convergence analysis and GDP per capita. We separated GDP per capita between the ASEAN-six (Brunei Darussalam, Indonesia, Malaysia, Singapore, Thailand, and Philippines) and CLV (Cambodia, Lao PDR, and Vietnam; we do not have information on Myanmar). When the ratio increases, this indicates that CLV countries can grow much faster than ASEAN-six, and vice versa. We expect that as the ratio increase, energy and electricity consumption per capita will decline (this is not causality relationship).

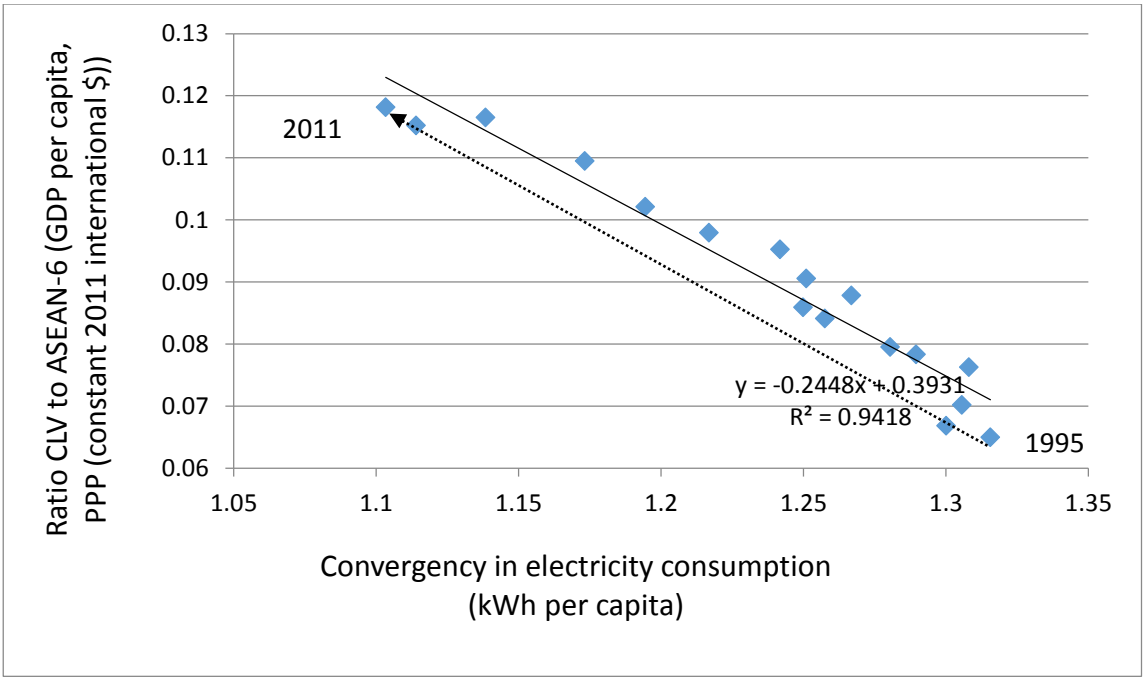
As seen from Figure 5, we have negative trend between the GDP per capita ratio and convergence energy use. If we compare the initial year (1995) and end year (2011), we obtain the direction move to the right. This indicates that between 1995 and 2011, there is indication that convergence in energy use correspond with increasing relative of GDP per capita growth on CLV country. Thus, we energy gap across the ASEAN countries can be reduce, the GDP per capita gap can also be reduce.

Similarly, as seen from Figure 6, we obtain that narrowing in electricity per consumption gap among ASEAN countries is corresponded with increasing the ratio of GDP per capita of CLV to the ASEAN-6 countries. Compare with convergence in energy use per capita, we obtain more strong relationship for electricity consumption per capita. Thus, the results indicates that if ASEAN countries can improve energy access for all, there is also strong indication that GDP per capita can also be reduced. AEMI can reduce gap in energy access across the countries, thus AEMI can promote economic growth for all countries.



Source: authors' calculation

Figure 5 Correlation between convergence in energy use and ratio of GDP per capita (1995-2011)



Source: authors' calculation

Figure 6 Correlation between convergence in electricity consumption and ratio of GDP per capita (1995-2011)

SECTION 4

RURAL ELECTRIFICATION PROGRAM

Map on energy poverty indicates that most of people without energy access live in rural area. Thus promoting energy access at rural level through the rural electrification program, become important. This section briefly share experiences from Vietnam, Malaysia, and Indonesia in implementing the rural electrification program.

Rural electrification in Vietnam

Missing or only little electrification is encountered in rural and sparsely populated areas in developing countries. For decades rural development enjoys special attention in the global development debate and electrification has since been a central factor for the same reasons energy or electricity are central to overall socio-economic development. Access to electricity can significantly improve consumers' quality of life and without electricity there are limits to any type of growth especially in rural areas (Cabraal et al., 2005, Alazraque -Cherni, Judith, 2008).

According to the World Bank (WB)'s assessment, Vietnam has achieved the highest rural electrification rate in the world as a developing country. World Bank's Country Director for Vietnam Victoria Kwakwa said that Vietnam was a typical example in terms of rural electrification and its program was one of World Bank's most successful projects in Vietnam. (Vietnam Energy, 2014)

Rural electrification has significantly grown. Only 2.5 percent of households used electricity in 1975 to 96.3% in 2009 and its figure increased to more than 98 percent in 2013. In particular, nearly 97 percent of rural households used electricity. Agricultural production index increased by 6.6 times in the 1998-2013 period and average income per person increased by 8 times in the same period. (Vietnam Energy, 2014). With the ASEAN region (Association of Southeast Asian Nations) reaching an average total electrification rate of 71,9% and 54,9% in rural regions, Vietnam shows an outstanding performance, although it is still behind more developed countries of the ASEAN like Brunei, Malaysia, Singapore or Thailand (Gencer et al., 2010).

The rural electrification program of Vietnam has been strongly developed. Together with investment capital from the state budget, donors have also actively contributed to bringing power to remote areas and improving the quality of rural low-tension power grid. Thanks to the rural electrification program, the face of regions has positively changed. According to Ha Tinh Provincial People's Committee Chairman Vo Kim Cu, to date, 100 percent of communes in the province have used power. The number of poor and nearly poor households has declined from 50 percent to below 10 percent. The rural electrification program has contributed 30-40 percent to socioeconomic development in rural areas, creating favorable

conditions to change the structure of the rural economy and improve people's living conditions (Vietnam Energy, 2014)

However, Deputy Prime Minister Hoang Trung Hai also said that challenges for the electricity sector in the implementation of the rural electrification program in the next time remain huge. 91 communes throughout the country have not yet used electricity. With the goals of 98 percent of rural households using electricity by 2015 and 100 percent of them using electricity by 2020, the electricity sector needs to make greater efforts. In the near future, ministries, departments and local governments need to meet set objectives. In particular, a focus on ensuring technical conditions and improving quality for the rural power grid is needed (Vietnam Energy, 2014)

There are many factors contributing to successful rural electrification in Vietnam. A handful of local factors can be considered instrumental in the rapid success of the program. One factor was unique to the country: Viet Nam's extensive hydropower resources were tapped quickly at a scale that generated sufficient electricity for the country. A large, indigenous source of renewable electricity is not a resource that all countries have, and Viet Nam has a clear advantage in this case.

A number of other factors also contributed to the success of rural electrification in Viet Nam. These factors include Viet Nam's strong national commitment to electrification, expressed in the government's dedicated rural electrification policies and institutions, and the premium placed on electrification in Vietnamese culture.

The rapid development of sources of energy, and indigenous energy resources, contributed greatly to Viet Nam's electrification, but it was the parallel development of the transmission and distribution system that enabled electricity to reach the whole country. The natural hydropower resources of Viet Nam also allowed for the development of complementary off-grid hydropower systems at mini and pico scales[46] (ADB, 2011).

Rural electrification in Malaysia

As seen from Table 6, Malaysia has the highest rank of EDI while Myanmar has the lowest rank within ASEAN (A total of 80 countries were ranked in the original list). Indonesia, Vietnam, and the Philippines have almost similar ranking; the same is true for Laos and Cambodia. However, although countries have almost the same EDI, it does not necessarily mean that they share the same problems at household level and community level.

Malaysia's top-ranking in ASEAN can be traced to its National Development Plans after its independence in 1957 which focused significantly on "Rural Development". The key

[46] Hydro power based on the size of power generating that can be produced are classified into six types as follows (IRENA, 2012): 1) large-hydro (more than 100 MW); 2) medium-hydro (20 MW – 100 MW); 3) small hydro (1 MW – 20 MW); 4)mini-hydro (100 kW – 1 MW); 5) micro hydro (5 kW – 100 kW0; and 6) pico-hydro (less than 5 kW).

objectives for Rural Development were the provision of essential services such as access roads, piped water supply and electricity supply to the rural communities. These essential utility services were intended to facilitate the provision of education, health services, communications and transport infrastructure to encourage overall economic development of these remote communities.

A concurrent but distinct initiative was to also enhance the growth of agriculture as a key revenue earning avenue for the predominantly under-privileged rural communities through government led commercial plantations such as for rubber and palm oil. These initiatives were supplemented with assistance for planting of cash-crops for the selected settlers while the larger plantation initiatives matured to generate the intended revenue streams.

Extension of electricity supply under a "Rural Electrification (RE)" program to the rural communities was a substantial component of the rural development under the national 5-year development plans, initially as Malaya Plans and then as Malaysia Plans after Malaysia was formed in 1963. An example of the RE development is shown in the figure below for RE projects completed in the utility's financial year 1981/82 (1st Sept 1981 to 3 1st August 1982).

Table 6 Progress of Rural Electrification up to 31 August 1982 (FY 1/9/81 – 31/8/82)

State	No. of projects under construction	Cost (RM mil)	No. of projects completed	Cost (RM mil)	No. of villages supplied	No. of houses supplied
Perlis	21	3.79	17	1.00	25	680
Kedah	111	27.00	62	9.22	102	5867
P. Penang	20	1.24	21	0.72	25	452
Perak	61	13.99	43	8.63	52	4767
Selangor	35	15.49	32	13.49	41	9403
Negeri Sembilan	41	9.01	38	6.20	59	2058
Melaka	47	4.24	41	1.44	42	549
Johor	157	49.59	78	16.35	145	10562
Pahang	48	32.59	44	13.96	62	8391
Trengganu	72	12.88	52	3.20	65	2241
Kelantan	102	37.57	73	4.54	133	6577

Source: Extracted from LLN Annual Report for 1981/82

This shows that 51,837 households were electrified during the financial year at a cost of RM 85.8 million (US$ 26.8 million at exchange rate of RM 3.2 to US$ 1.0). The electrification rate had slowed somewhat by the 1980s as the RE program had substantially covered the bulk of the Peninsular Malaysia area by then and was beginning to "wind down" in the 1980s. In the earlier decades (1960s and 1970s) the annual RE program electrified even over 100,000 households a year for many years, mainly in Peninsular Malaysia.

The overall rural development strategies, and in particular the RE program opened up large rural areas in most parts of Peninsular Malaysia for accelerated economic development by facilitating the establishment of "cottage industries" in the rural areas. These were mainly agriculture related processing activities, which allowed the agricultural produce to be processed for maximum utilization and distribution to the urban centers which had previously been "out of reach" to the producers.

Virtually all the RE projects were implemented with state funds (shared between the federal government, State governments and the local utility – Lembaga Letrik Negara [LLN] or the National Electricity Board, which was a federal Statutory Authority). The bulk of the RE power supplies was extended by grid extension but a part was by the establishment of isolated local small (mini) grids, operated by the utility LLN. A few isolated areas were electrified through licensing of private sector power generation and distribution entities, using diesel powered gen-sets. Consumers fed by such licensees had to pay a higher tariff than that charged by LLN.

Rural electrification of the remote areas attracted the enhancement of existing industries and development of small scale rural industries. Setting up of these successful and viable economic activities lagged behind the provision of electricity supply by varying periods at the different areas, predominantly according to proximity to the urban centers that they could serve. By 2010, the electrification status in Malaysia had extended electricity supply to approximately 99% of the population in Peninsular Malaysia, 77% of the population in Sabah and 67% of the population in Sarawak.

More recently, the Malaysian government has embarked on a more intense RE program for the remote populations in Sabah and Sarawak under a Rural Basic Infrastructure (RBI) Program (http://www.rurallink.gov.my/c/document_library/get_file?uuid=b7ca23df-7f4e-44bd-9ce6-baa2eef334fd&groupId=80191). This program aims to electrify about 140,000 rural households in the period 2010 to 2015, with about 95% of these being in Sabah and Sarawak. This program is fully funded by federal funds. Provision of "modern energy" to the remote communities, especially for the domestic and small commercial users has not been financially viable as private sector business enterprises. The RBI program also includes the upgrading and construction of about 7,000 km of rural roads, provision of 50,000 new and restored houses for the "poor and hard-core poor" and piping for the supply of clean or treated water to about 360,000 houses.

Rural electrification in Indonesia

Rural electrification (RE) program in Indonesia has been started since the late fifties and the program was based on small isolated diesel schemes (McCawley, 1978). McCawley (1978) said that the main reason for RE is the hope that productivity in agriculture and rural industries will improve. Munasinghe (1988) pointed out two objectives of rural electrification program such as promoting economic growth and creating equity. During his speech to celebrate the Gas and Electricity Day, in 1960, President Soekarno, said that in 1985 all of Indonesia would have been electrified. The director general of Department of Manpower, Transmigration, and Cooperative in 1976 also said that in 2000, Indonesia aimed to electrify the majority of its 60,000 villages. In 1978, for the first time President Soeharto mentioned electrification programme in the Indonesia's Broad Guidelines of State Policy (Garis-Garis Besar Haluan Negara, GBHN). However, Mohsin (2014) argued that during the new order regime, the rural electrification program or well-known as *Listrik Masuk Desa* had two functions. First, it is a tool to improve economic conditions of villages. Second, it is a political instrument for the GOLKAR party to secure votes (vote-buying strategy) from rural people in the general elections.

In 2014, the Indonesian government has targets to obtain 80% of electrification ratio and 98.9% of rural electrification ratio (Joko Widodo, the elected president said that electrification ratio needs to reach 100% in 2019). Rural electrification ratio is larger than the electrification ratio because by definition rural electrification is the ratio of people in the village having electricity to total number of villages. Thus if in the village, there is one household having electricity, means the ratio of rural electrification in that village is 100%. Extending the grid and off-grid connection has been done to obtain the targets.

Currently, there are two main agencies that intensively promote rural electrification program such as Ministry of Energy and Mineral Resources (MEMR) and PLN (state owned company for power sector). According to the Minister of Finance regulation No 201/PMK.07/2012 on 17 December 2012, the special allocated fund (*Dana Alokasi Khusus*/DAK) for rural energy in 2013 was provided for MEMR. The fund needs to be used to promote renewable energy at the local level and government allocates Rp 432.5 billion or US$ 43.25 million. Budget for rural energy is about 1.7% of total special allocated fund. To follow up this regulation, the Minister of Energy and Mineral Resources issued regulation No 3/2013 that consist of technical guide. The regulation said that the fund needs to be used for developing new micro hydro (less than 1 MW), rehabilitating micro hydro, conducting extension and improving the electricity services from micro hydro, developing solar panel (PV) (both concentrate and disperse)47, and installing biogas for households.

PLN develops two approaches such as extended on grid and off grid connection. For extended the grid connection, PLN planned to develop network infrastructure both for medium and low voltage (see Table 7). The total number of costumers that plan to be connected between 2012 and 2021 are about 2.2 million of households and 273,932 or about 12% of targeted household will obtain a cheap and power saving (*listrik murah dan*

47 Concentrate means the power is distributed and transmitted by cable to end user while disperse means direct use to end costumers. The minimum output for concentrate module is 100 Wp per unit while for disperse module is about 10 Wp.

hemat, LMH) program. The LMH program was launched by government in 2012. This program aims to help poor households in obtaining access on electricity. With this program, poor households obtain freely energy saving lamps and prepaid electric voucher for one month. Then, government also covers installation fee. Government said that in 2012, about 60,702 poor households are benefited from this program[48]. If we compare with the target in 2012, it seems that the rate of success from this program was about 73%. In 2013 and 2014, the program covered about 95,227 households and 71,429 households respectively.[49] This indicates that government's support for this program tends to decline.

Table 7 Summary of Rural Electrification Program in Indonesia 2012 – 2021

Year	JTM (kms)	JTR (kms)	Trafo		Number of customer (HH)	Number of LMH (HH)
			MVA	Unit		
2012	4,168	4,465	226	3,349	236,788	83,478
2013	6,345	4,736	398	3,446	220,170	95,227
2014	6,659	5,373	545	3,848	243,957	95,227
2015	6,863	4,964	632	3,576	223,404	0
2016	7,177	5,056	690	3,611	228,000	0
2017	7,417	5,112	729	3,635	230,493	0
2018	7,340	5,080	762	3,563	227,966	0
2019	7,532	5,143	807	3,524	230,679	0
2020	7,644	5,161	851	3,444	226,182	0
2021	7,303	4,481	882	2,979	170,617	0
Total	68,499	49,571	6,522	34,973	2,238,257	273,932

Note: Tahun or year; JTM = middle voltage network 20kv; JTR = low voltage network 220 v; Jumlah Pelanggan PLN = number of PT.PLN's customer, Listrik Murah & Hemat = Cheap and power saving; *DIPA= national budget.

Source: PT.PLN's business plan 2012-2021 (2012)

A massive solar PV program (off grid) is declared by PLN's letter No. 1227.K/DIR/2011. There are two types of supply and utilization of solar PV such as communal PV and autonomous (*mandiri*) PV. This program is called SEHEN stands for *Super Ekstra Hemat Energi* (Super Extra Energy Saving). PLN allocated about Rp 7 billion to support this program. There are two

48 Please refer to http://www.djlpe.esdm.go.id/modules/news/mbl_detail.php?news_id=3532, accessed 20 August 2014.

49 Ibid.

types of communal PV such as PV communal-autonomous and PV communal hybrid[50]. Table 8 indicates the characteristic of two types of PV. In the case of autonomous SEHEN, total electricity production per year is about 26.3 kWh per year.[51] The two programs aim to measure problem on electricity access, but they are different in program reach. Autonomous PV has lower capacity than the communal PV but it can reach household with longer distance from PLN's grid.

Table 8 Communal PV and Autonomous PV

Communal PV	Autonomous PV
1. Connected capacity Location is more than 5 km of PLN's grid 2. Population density relatively high 3. Costumer has income to pay the electricity bill 4. Total capacity 220 VA 5. PLN finances the program 6. Manage and supervise by PLN 7. The property belongs to PLN (except electricity equipments after the energy limiter) 8. Tariff for autonomous communal Rp 14.800 per month (plus connection fee). This follows the Presidential Regulation No 8/2011 (for S1 category) 9. Tariff for communal hybrid PV follows the Presidential Regulation No 8/2011 (plus connection fee)	1. Location is more than 10 km of PLN's grid or it is isolated due to sea, river chasm 2. The location need to be close between on costumer and other 3. Costumer has income to pay the electricity bill 4. The capacity only enough for 3 LED with total capacity about 3 watt 5. Total capacity 12 watt 6. Technical life span 15 years for solar PV 7. Technical life span 10 years for LED 8. LED belongs to PLN 9. PLN finances the program 10. This is a transition program before the customer is connected 450 VA 11. Manage and supervise by PLN 12. The property belong to PLN 13. Total monthly payment Rp 35.000 that consists of monthly fee (subscription Rp 14.800 per month) and rental cost of equipment Rp 20.200 per month)

Source: PLN's letter No. 1227.K/DIR/2011

We argue that grid connection is the best option to improve electricity access for rural community. Because it is managed by capable authority and it has higher voltage than off grid. However, promoting grid connection need huge investment cost and state owned company may not able to cover the investment spending. We also found that it is necessary to improve coordination between MEMR and PLN in implementing solar panel system. Based on our observation in East Nusa Tenggara Province, the solar home system (SHS) that funding by MEMR and SEHEN, we shared four major findings. First, the number of SEHEN's costumer increased by more than 113

[50] Communal autonomous is communal PV that is operated by individual; communal hybrid PV is communal PV that in terms of operation it is combined with non-solar energy in order to improve the efficiency level.

[51] It is calculated from: 12 watt x 6 hours x 365 days.

thousand households. This is a rapid increase in the number of PLN's costumer in very short period. As result, number of rural and electrification ratio can be improved. However, the voltage capacity of SEHEN is very low, and it is still below the standard of basic human need (see AEMI group report 2013). Second, SEHEN is managed by single authority (PLN) that responsible for maintenance and handling the technical problems. As consequence, customers need to pay monthly fee. However, there is almost zero maintenance fee for SHS. Third, head of local government is responsible on SHS program. However, local government does not have technical capacity to monitor the program, even there is lack in technicians to conduct monitoring and evaluation. SHS's recipients are responsible for any technical problems. Fourth, there is lack in coordination between MEMR and PLN to synchronize technical, administrative, and financial dimensions. As a result, the program seems competing one and another.

AEMI and Rural Electrification Program

By investigating the rural electrification (RE) program in Vietnam, Malaysia and Indonesia, there four main elements that can be follow up under AEMI's framework (please refer to Table 9)

Table 9 The Role of AEMI in Rural Electrification Program

Financing	Technical and Quality	Basic services	Economic opportunity
Most of RE program is finance by national budget. AEMI can provide more option on RE financing	It is important to ensure sustainability of RE program. Currently, ASEAN has a training centre for Small-Scale Hydropower. Capacity building also need to be promoted broadly to other areas such as solar panel, wind, biogas, etc.	Energy service (electricity and cooking fuel) is only one elements of basic infrastructure. The successful in RE program will also depend on availability of other infrastructures such as education, health, road, water, sanitation, and communication. AEMI's framework needs ensure sustainability of energy access.	Free flow of energy, products, services, investment, and labour can create economic opportunities. This may enable people to generate more income and create demand on energy.

Case Study from Indonesia[52] and Viet Nam

This section aims to evaluate the impact of electricity access on people welfare. We conducted survey in Satar Mese sub district, Manggarai, district, East Nusa Tenggara Province, Indonesia (see Figure 7). There are three villages that we focus on Tantong village (treatment group) and Damu village and Lungar village as a control group (see Table 10). We conducted preliminary survey (baseline study) in May 2013 before electricity was transmitted in Tantong village with total number of observation 311 household and we visited the same households in the three villages in June 2014 after the Tantong village obtained electricity by March 2014. Damu village has grid connection but in Lungar village, there is no grid connection. In Lungar some people used solar panel namely SEHEN.

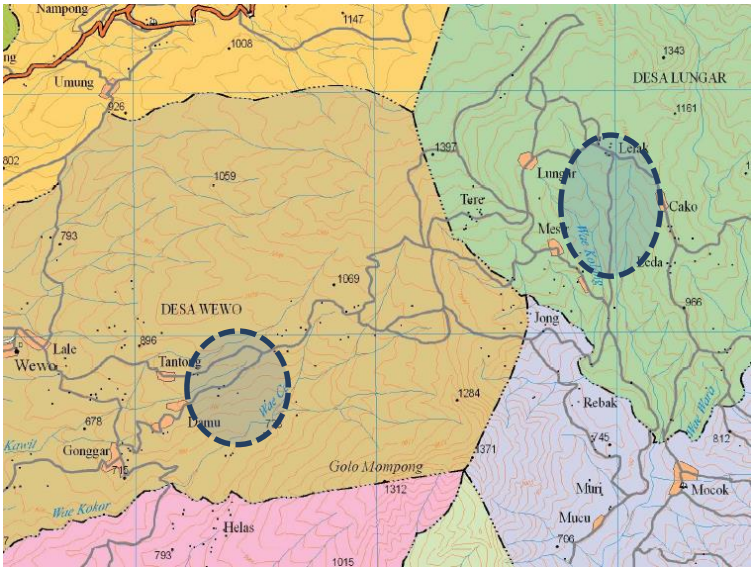


Figure 7 Geography of sample collection

52 This research project on the title '*Model dan Strategi Pengembangan Sektor Ketenagalistrikan di Daerah Dalam Upaya Pengentasan Kemiskinan* [Models and Strategies in Developing Electricity Sector in Region for Poverty Alleviation]' Year 2013-2014. Author is grateful to LIPI who provided the competitive research grant under the Sub-theme *Critical and Strategic Social Issues* (CSSI) program.

Tabel 10 Characteristics of Electricity Access (number of household)

Villages	2013	2014
Damu-on grid		
PLN-with meter	20	31
PLN-without meter	23	12
Number of household	43	43
Tantong-on grid		
PLN-with meter	0	47
PLN-without meter	21	0
Without electricity access	30	4
Total household	51	51
Lungar-off grid		
Connected	99	98
Not connected	85	55
Disconnected	-	13
New connection	-	21
Total household	187	187

Note: PLN = state electricity company

Source: primary data

We applied difference in difference estimation to measure the impact on electricity access on people welfare on grid connection. The econometric model we arranged as follows:

$$outcome\_\text{var}_i = \beta_0 + \beta_1.period_i + \beta_2.treated_i + \beta_3.period_i.treated_i + \beta_k x_{k,i} + \varepsilon_i$$

$\hat{\beta}_0$ = average outcome for control group in baseline period

$\hat{\beta}_0 + \hat{\beta}_1$ = average outcome for control group after having access on electricity

$\hat{\beta}_2$ = the outcome difference between treatment and control group at baseline

$\hat{\beta}_1 + \hat{\beta}_2$ = average outome for treatment group at baseline

$\hat{\beta}_0 + \hat{\beta}_1 + \hat{\beta}_2 + \hat{\beta}_3$ = average outcome for treatment group after obtain electricity

$\hat{\beta}_3$ = difference in diference or impact from electricity access

We used four outcome variables namely expenditure as a proxy of welfare. There are four indicators for expenditure such as total expenditure, food expenditure, kerosene expenditure and non food and enery expenditure. We expressed the expenditure in real value. There are three explanatory variables such as total area of floor, access on food for the poor and number of family member. Table 11 indicates the DID results. As seen from the Table, due to having electricity access, the total expenditure in treatment group (Tantong village) is 25.2% higher than the control group (ceteris paribus). Further, electricity access also lower the kerosene spending in treatment group by 61% than the control group (ceteris paribus). Finally, in terms expenditure other than non-food and energy, the treatment village spend 60% higher than control group (ceteris paribus). As seen in Box 1, we explored other benefit from electricity access. Electricity access in Tantong village can reduce kerosene subsidy.

It is important to note that in 2005, the Indonesian government launched the energy conversion program from kerosene to 3-kg LPG53. This program aimed to reduce subsidy on kerosene that reached 57% of the state's total petroleum product subsidy. By 2012, government could save the subsidy by more than 6.9 billion US$.54 Then the experiences from Tantong village indicates that kerosene subsidy can also be realized by increase electricity access to rural community.

In the case of Viet Nam, Khander et al, (2013) investigated causality between development outcomes (income, expenditure and chidren's education) and rural electrification. The project on rural electrification was financed by the World Bank in 2000. The study cover six regions North East, North West, North Central Coast, South Central Coast, Central Highlands, and Mekong River Delta. In 2002, about 1,262 households were surveyed and 1,120 households were surveyed in 2005. This study finds that household elctrification can rise income and expenditure by as much as 28% and 23% respectively. The study also revealed that household electrification increases school attendence by 6.3% for boys and 9.0 for girls.

Tabel 11 Estimation from DID Model

Independent variables	Outcome							
	Total spending		Food spending		Kerosene spending		Spending non-food and energy	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Period	0.051	0.056	0.102	0.063	0.074	0.071	0.048	0.088
Treatment	-0.127	0.092	-0.119	0.102	0.118	0.098	-0.299	0.143**
Impact	0.252	0.129***	-0.232	0.144	-0.609	0.141*	0.603	0.202*
Number of observation	537		531		383		536	
Adjusted R^2	0.1745		0.1804		0.089		0.125	

Note: *significant at 1%; ** significant at 5%; ***significant at 10%

53 In 2007, the Indonesian government conducted an energy conversion program from kerosene to LPG for more than 50 million household within 5 years.

54 http://www.exceptionalenergy.com/uploads/Modules/Ressources/Kerosene%20to%20LP%20Gas%20Conversion%20Programme%20in%20Indonesia.pdf, 25 February 2014

BOX 1

Simple Calculation: The benefits from reduction on kerosene consumption

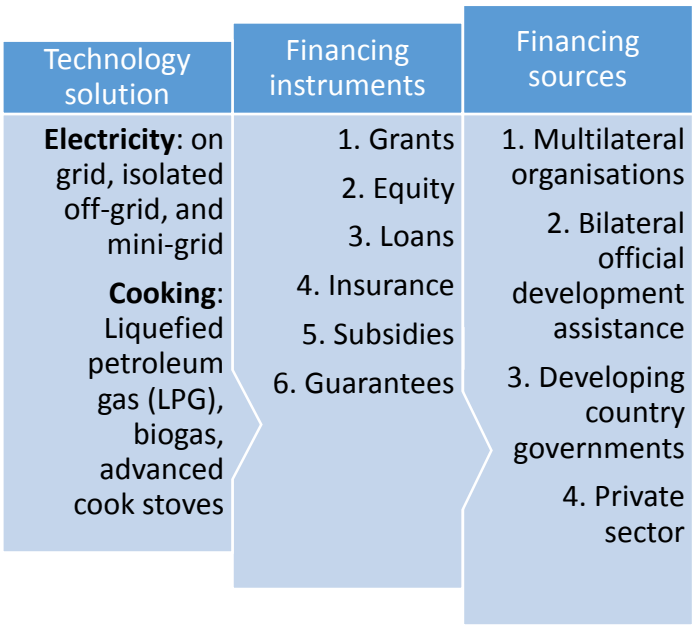
We calculate how much CO2 emission can be reduced by replacing kerosene lamp with electricity from geothermal (we assume that geothermal consume small amount of fossil fuel). Between 2013 and 2014, the average kerosene spending decrease by IDR 15,100/family/month. The price of kerosene is IDR 4,000/litter. Thus one household can save kerosene by 3.8 liter per month (IDR 15,100 / IDR 4,000). In Tantong village there are 52 number of households, thus in a year Tantong village can reduce kerosene consumption by 2,371 litter (3.8 litter/month/household x 12 month x 52 households). If we convert 2,371 litter kerosene to CO2 emissions is about 5.4 ton CO2 (1 litter petrol = 2.3 kg CO2)[55]. The market price of kerosene is about IDR 11,000 per litter, then gap between economic price and subsidy price is about IDR 7,000 (IDR 11,000 – IDR 4,000). Thus total amount of subsidy that can be save is about IDR 16.6 million (USD 1,421; we assume IDR 11,600/USD). (Picture of Village Tantong, May 2013).

[55] http://www.sunearthtools.com/en/tools/CO2-emissions-calculator.php

SECTION 5

FINANCING ENERGY ACCESS FOR THE POOR

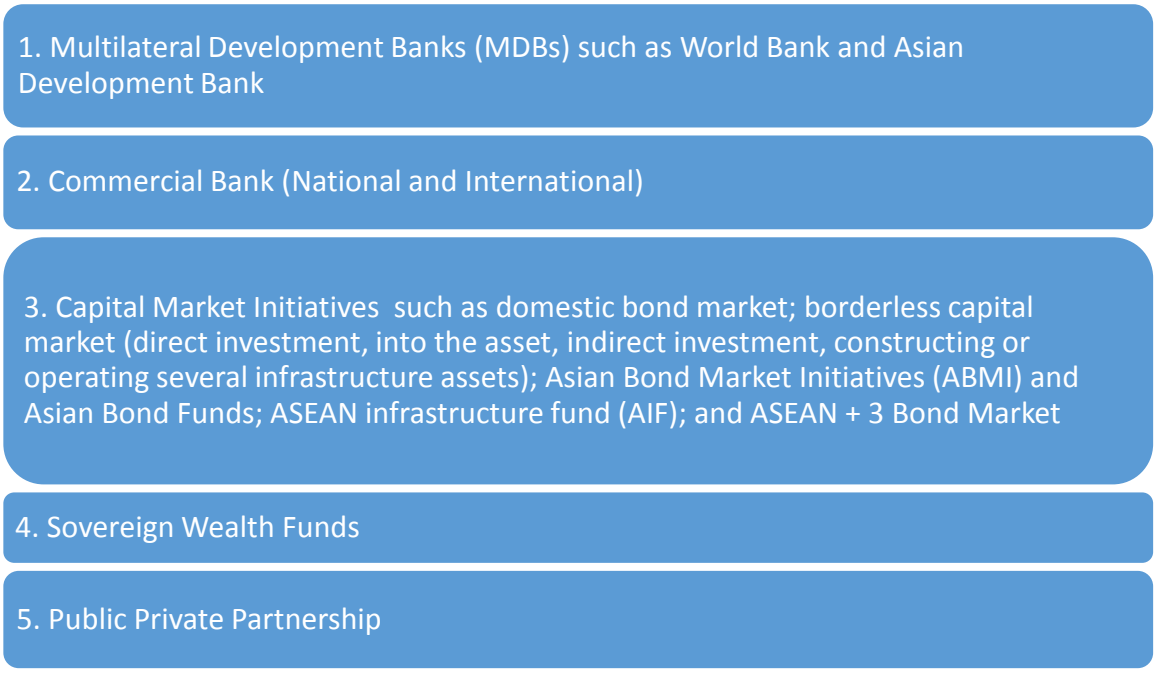
IEA (2011) provided several alternatives to finance universal energy access. Between 2010 and 2030, IEA estimated that about $ 296 billion of new investment is needed to support the universal energy access program. This investment will benefited 550 million people for electricity access and 860 million of people for clean cooking facilities. In the ASEAN between 2010 and 2020, total investment is about $ 596.1 billion (in 2008 US$ billion) and about 36.3% is allocated for power sector which is the highest among other sectors (transport, water and sanitation, and telecommunications) (Das and James, 2013).[56] As seen from Figure 8, there are six financing instruments such as grants, equity, loans, insurance, subsidies, and guarantees. Further, there are four financing sources that can be developed such as from multilateral organisation, bilateral official assistance, developing country government, and private sector. At the ASEAN level, we identify there are five channels of financing that can be promoted (see Figure 9). Even, currently, the new investment scheme such as Asian Infrastructure Investment Bank can be a new pipeline to strengthen the existing scheme.



Source: IEA (2011)

Figure 8 Financing Modern Energy Access at global scale

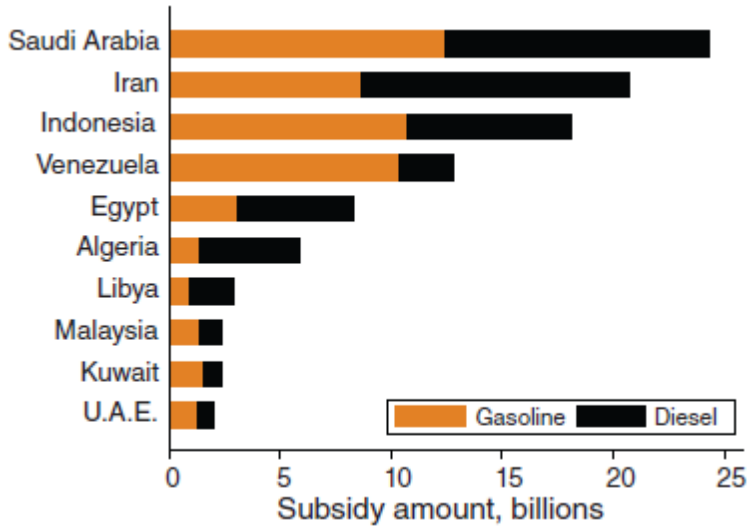
[56] http://www.iseas.edu.sg/ISEAS/upload/files/ISEAS-Perspective-2013-27-Addressing-Infrastructure-Financing-in-Asia.pdf, accessed 5 October 2014.



Source: Das and James, 2013

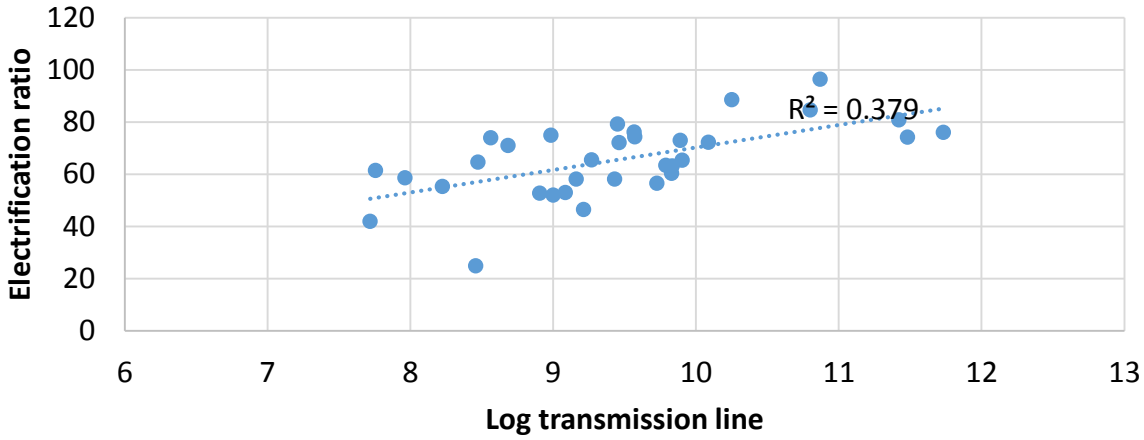
Figure 9 Source of investment funds to support energy for all in ASEAN

However, it is necessary to pick up the most suitable channel to finance universal energy access. We argue the there are five elements that need to be considers. *First* attempts to understand the technical and structural barriers. *Second* attempts to identify the potential buyers or customers. The level of income will determine a commercial-viable of the business model. *Third*, because most of government still provide subsidy on energy, promoting energy access can reduce subsidy burden by replacing the high cost energy sources such as kerosene and petrol to more affordable energy supply such as renewable energy. *Fourth*, due to decentralization, central government has substantially transfer fiscal autonomy to local governments. It is important to share responsibility between central and local government in promoting energy access. There are several participation that can be promoted such as in financing, providing land, easing tax and retribution, managing local organizations, strengthening rural cooperatives, and affirmative policy on local development banks to support energy access program. *Finally*, it is necessary to channel energy subsidy for the poor only. As seen from figure 10, Indonesia and Malaysia are among the top ten countries in the world in providing energy subsidy. Sadly, most of subsidy is enjoy by the rich. IEA (2011) indicated that less than 10% of subsidies go to lowest 20% income group. Energy subsidies should go to infrastructure development because as seen from Figure 11, lack in electricity access in Indonesia is correlated with low length of transmissions line. Furthermore, energy subsidy also has substantial social cost, as seen from Figure 12, taking into account the cost from CO2 emissions, local pollutants, traffic congestion, and accidents.



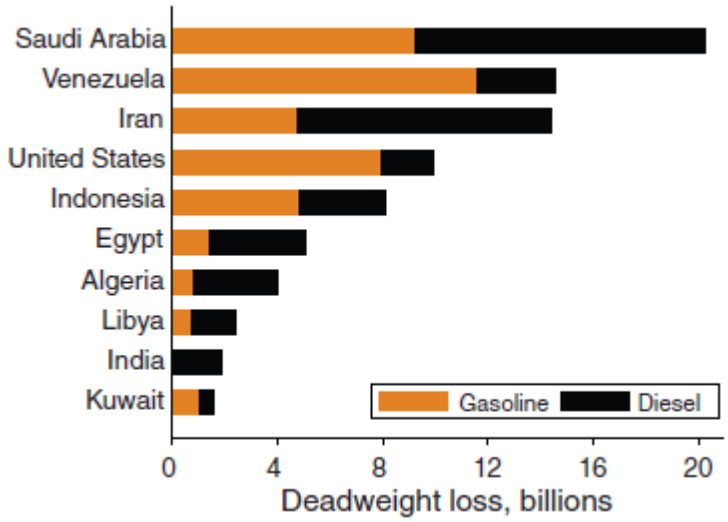
Source: Davis (2014, Figure 2)

Figure 10 Dollar Value of Fuel Subsidies in 2012, top ten countries



Source: author's calculation

Figure 11 Correlation between electrification ratio and transmission line in Indonesia 2012



Source: Davis (2014, Figure 4)

Figure 11 Deadweight loss relative to fuel social cost, top ten countries

SECTION 6

POLICY AGENDAS TO TOWARD MORE INCLUSIVE AEMI

AEMI can facilitate greater access on energy and propose energy access target such as in electrification ratio, modern access cooking fuel (LPG, city gas, and biogas), improved cook stove, and mechanical power. The area that AEMI needs to focus on promoting the rural electrification program. It is important to ensure that phase of APG and TAGP can move faster in the AEC era. However, there are limitations on APG and TAGP. Then, AEMI needs to find alternative pathway that can reach remote and isolated communities. It is necessary to implement small projects on energy access by optimizing the local endowment. AEMI can encourage the member country to develop the most cost effective way in tackling energy poverty.

A target on renewable energy (RE) could be an intermediate target for universal energy access. Currently, by 2015, ASEAN has a target on 15% renewable energy in total power installed capacity. Sambodo (2013) indicates that by 2020, it is possible for Philippines to reach 30% while for the same target can be reached in 2040. We expect by increasing target in RE, energy access for rural people will also increase. While target on renewable energy can be up graded, it is necessary to strengthen training centres on renewable energy, such as the Hydropower Competence Centre (HYCOM) as a training centre for Small-Scale Hydropower in ASEAN. However, it is necessary to expand the training program because now many rural areas also obtained benefit from solar panel, wind, and biomass. Behrens (2012) suggested that promoting renewable energy, small scale energy solution, and fitting the local needs and capacity are key areas for European Union in assisting energy access in rural areas. Promoting local small medium enterprises is important to scale up energy services and to increase developmental benefits (Behrens, 2012).

At national level, currently, financing has become the important challenge for rural electrification program. However, it seems that government needs to focus in preparing authority that can manage and synchronize rural electrification program. Experiences from Indonesia showed that PLN has capacity (administrative and technical skilled) but lack in financial capability, on the other hand, MEMR has allocation fund for rural electrification program, but lack in administrative and technical skilled. Both PLN and MEMR needs to work together for better allocation of resources. Considering the national constraints, AEMI can help the member countries in proposing the better way in developing organizational and institutional dimension. AEMI needs to create pool of public knowledge that possible for better understanding in managing the rural electrification program. For example, supporting rural electrification program needs strong support for microfinance. Supporting the micro financing link with the mega project financing needs to be connected one and other. It is possible that although electricity grid has been developed but people cannot

obtain electricity due to high connection cost. Microfinance and cooperative can provide financial assistance to those people. Reaching out credit access to rural community need substantial investment. Thus regional cooperation also need to develop the capacity of microfinance.

At the regional level, there are several financing instruments that can be promoted for infrastructure connectivity such as ABMI (Asian Bond Markets Initiatives), the Asian Bond Fund, and the Credit Guarantee and Investment Facilities, and the ASEAN infrastructure fund. However to ensure the instruments can work effectively, it is important to strengthen the regulatory framework such as on financial supervision. Before financing the infrastructure project it is important to conduct comprehensive assessments (economic, social, and ecology), and credit needs to be provided for projects that can bring more social inclusion and protecting the environment, although in terms of economic valuation is not attractive.

We argue that energy poverty is not only about economic dimension, but also it relates to politics, social, and environmental dimensions. Thus, it is necessary to prepare a guideline or criteria to ensure sustainability of energy access for the poor. Similarly, AEMI can enhance more collaboration works especially between ASEAN Economic Community Development and ASEAN Socio Cultural Community Development. It is necessary to integrate energy connectivity (physical) dimension with other dimension social, cultural, and political because one and others may not move in the same direction. Finally, by integrating the key elements of integration (politic-economic-social) the "RICH" ASEAN by 2030 can be realized.[57]

[57] RICH = Resilient, inclusive, competitive and harmonious. ADBI (2014:xxiv) said that "*resilience* refers to the capacity to handle volatilities and shocks from within or outside the region, reducing the likelihood of economic crises; *inclusiveness* refer to the need for ASEAN to achieve equitable economic development, providing opportunities through cooperation strategies that reduce income gaps within and across countries, and promoting citizen welfare; *competitiveness* requires a business environment where successful firms operate in efficient markets under effective national and regional regulation; and *harmony* stems from environmentally sustainable development and growth, with proper consideration of the need to mitigate and adopt to climate change".

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NATIONAL PERSPECTIVE – UNDERSTAND NATIONAL PERSPECTIVE IN JOINING ASEAN ENERGY MARKET INTEGRATION (AEMI)

Rashid Abdullah, Tran Van Binh, Aishah Mohd Isa, Endang Jati Mat Sahid.

Objective

The formation of an ASEAN Energy Market Integration (AEMI) can be an opportunity for an efficient energy market across this region, which may enable a better distribution of energy resources to the consumption points. The integrated energy market need to be design for a better production, conversion and end-use of the energy, where the population can have a better access to the energy supply at a better rate.

The objectives of this project paper are to:

(a) Provide an assessment of energy markets across ASEAN, which are at different stages of their development and have different structures and policies, covering the spectrum from the most liberalized markets to monopolistic structures.
(b) Review national perspectives in joining AEMI, highlight national benefits and challenges, and clarify to the governments what needs to be done and the minimum requirements for joining AEMI both at the policy and institutional levels.
(c) Formulate options for the deployment of AEMI, taking into account the ASEAN Member States (AMS) diversity and degree of preparedness. Such options include:
    - Sequencing, to allow each AMS to join AEMI at its own pace in a "progressive and incremental" approach; or
    - Gradual deployment, to allow AEMI components to be gradually deployed as all AMS are ready, through to 2030.

1. Introduction

ASEAN consists of countries with diverse cultures and economies. Some communities in this region use energy intensely while the other has limited access to energy. Some of those countries are net importer of energy for their daily need while the others has limited resources to extract the energy resources and rely heavily for external investment to exploit the resources.

The possibility to trade electricity through electical grids has been thought about some time ago and now has started to gain a higher momentum. In fact, the idea of power network interconnection has been developed since 1978 and it was approved by ASEAN's governments in 1997 in "ASEAN vision 2020". The power network interconnection has good opportunity to transport energy to a wider load centres across ASEAN nations. It will also provide a better supply security and many other economic benefits to the nation, if the network is deployed with a good market structure and mechanism.

This paper intend to cover the three main sections in order to meet its 3 objectives.

1.1 Section 1: An assessment of energy markets across ASEAN

This section will describe the country social-economic background, which are at different stages of development and have different market structures and policies. This section will cover the spectrum of the existing markets from the most liberalized markets to

monopolistic structures, as can be seen in a snapshot of the 6 countries reviewed in the next sections.

Subsequent work required to complete this section include the determination of:

- The trend and drivers in the perspectives of social, economics, technology, political & legal and environment & infrastructure.
- The opportunities areas for integrated market such as improve the local network performance for long haul energy distribution, wheeling charges, safety, investment to upgrade safety & standard and micro-grid development.
- The capabilities development in technical, legal support, research and cross-border trade, fit with skills, knowledge and production capability.
- The enablers including actions that address capability gaps and overcome barriers for successful AEMI.

This section would be concluded by the main observations on energy markets across ASEAN and identify how each may incorporate the market components for the successful AEMI.

1.2 Section 2: National perspectives in joining AEMI

This section will summarize the national perspectives in joining AEMI after carrying our literature survey and focus group discussion with key ASEAN energy market leaders. The summary would highlight:

- The national benefits and challenges
- The clarification required to the governments on what needs to be done.
- The minimum requirements for joining AEMI both at the policy and institutional levels.

1.3 Section 3: Formulate options for the deployment of AEMI

This section will first sought feeback from institution, agencies and industry to gauge the extent of policy reforms and institutional framework to support the AEMI. Therefrom, analyse the scenario to formulate the deployment options of AEMI framework and roadmap, taking into account the ASEAN Member States (AMS) diversity and degree of preparedness. The deployment options should consider:

- Diparity among the current policies.
- Sequencing, to allow each AMS to join AEMI at its own pace in a “progressive and incremental” approach. The sequence need a thorough study including the determination period of implementation.
- Gradual deployment, to allow AEMI components to be gradually deployed as all AMS are ready, through to 2030.
- Prepare a roadmap for the activities in the Trends & Drivers, Opportunities, Resources and actions over a time horizon of short, medium and long terms. The *Short Term* would spell out “where are we (ASEAN) now?”. The *Medium Term* would spell out “how can we (AEMI) get there?” and *Long Term* would spell out “where do we (ASEAN) want to be?”.

2. An Assessment of National Energy Markets.

This section is a preliminary review for Brunei, Singapore, Cambodia, Laos, and Myanmar. At the end of this section, a brief review for Vietnam, Malaysia, Thailand and Philipines is also given. This section is work in progress and need an update in the second part of the work. A logical framework approch is potentiall suitable for this purpose, which will cover headlines such as:

- Reform of Institutional Framwork.
- Create an integrated energy plan.
- Reform of energy companies.
- Formulation of National Energy Policy.
- Establish energy efficiency standars.
- Reform energy subsidies,

As a preamble, a brief summary of the country background are presented in the next few sections.

2.1 BRUNEI DARUSSALAM

Brunei Darussalam is a small country, located on the north-west coast of the island of Borneo, with a land area of 5765 square kilometres and has a 161-kilometre coastline along the South China Sea. Brunei's population is approximately 410 thousand, with more than 80% living in urban areas. Per capita gross domestic product (GDP PPP) is one of the highest in the world, at about $40492 [58].

Since discovery in 1929, oil and gas have dominated Brunei Darussalam's economy. Accordingly, the oil and gas sector is the economy's main source of revenue and constitutes around 95% of Brunei Darussalam's export earnings and around 68% of its GDP. In 2011, total primary energy supply in Brunei Darussalam was 3394 kilotonnes of oil equivalent (ktoe), of which 77% is from natural gas and the remainder from oil.

Energy in Brunei Darussalam is under the purview of the Energy Department, under the Prime Minister's Office (EDPMO). EDPMO is responsible for formulating Brunei's energy policy as well as presiding over matters related to energy. EDPMO envisions a "sustainable energy for Brunei prosperity" with a mission to "drive Brunei economy into sustainable future". Its goals include to strengthen and grow oil and gas upstream and downstream activities, ensure safe, secure, reliable and efficient supply and use of energy, and maximize economic spin-offs from energy industry. The recently released Brunei Energy White Paper

[58] APEC Energy Overview 2013 – Brunei Darussalam, http://aperc.ieej.or.jp/publications/reports/energy_overview.php

has set out ten Key Performance Indicators (KPI) towards reaching these three strategic goals for Brunei Darussalam[59].

At the operations level, energy is Brunei is mostly operated by monopoly. Upstream oil and gas development is dominated by the Brunei Shell Petroleum Co. Sdn. Bhd. (BSP), jointly owned by the Brunei Darussalam Government and the Royal Dutch/Shell Group of the Netherlands, with only one other concessionary; the French multinational oil company, Total E&P Deep Offshore B.V. For electricity, Brunei Darussalam has three power grids that are operated by two different utilities, the Department of Electrical Services (DES) and the Berakas Power Company Private Limited (BPC)[60].

Brunei is characterized by its energy subsidies; Brunei Darussalam's electricity price is ranked as the lowest among ASEAN economies at BND 0.06/kWh; half of the next lowest economies (Lao PDR, Thailand and the Philippines) and almost one-tenth of the highest ranked ASEAN economy, Myanmar[61]. This is one of the factors encouraging wasteful energy use in the Brunei which has lead to the economy becoming one of the highest energy consumer per capita in the region, as well as the fourth in the world for highest CO2 emissions on a metric ton per capita basis[62].

2.2 SINGAPORE

The Republic of Singapore is an island city-state located off the southern tip of the Malay Peninsula with a total land area of 714.3 square kilometres (km^2) and a population of 5.2 million, of which 1.4 million were non-residents. Despite its small land area and population, Singapore is one of the most highly industrialised and urbanised economies in Southeast Asia. In 2011, its gross domestic product (GDP) was USD 247.77 billion and per capita GDP was USD 47 797 (both in USD 2000 at PPP)[63].

Singapore is situated south of the Straits of Malacca on a major shipping route, well-located for the energy industry, therefore even though this ASEAN member state has negligible indigenous energy resources, it has emerged as the third largest oil and oil products trading hub in the world and a major regional supplier for oil and gas industry.

Singapore imports nearly all the fuel it requires for its energy needs, except for a small portion of energy produced from incinerating municipal waste. In 2011, the total primary energy supply was 20 587 kilotonnes of oil equivalent (ktoe), about 67% was oil and 32% gas.

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59 Brunei Energy White Paper, www.energy.gov.bn

60 APEC Energy Demand and Supply Outlook 5th Edition

61 APEC Peer Review on Energy Efficiency Policies– Brunei Darussalam, pg 40

62 The World Bank Database, http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries

63 APEC Energy Overview 2013 – Singapore, http://aperc.ieej.or.jp/publications/reports/energy_overview.php

Singapore has 10,216 megawatts of thermal installed capacity and about 6000 kWp of solar photovoltaic system installations.

The Energy Market Authority (EMA), a statutory board under the Ministry of Trade and Industry, is the regulator for Singapore's electricity and gas industries, and also serves as the Power System Operator for the electricity transmission system. Both the electricity and gas industries have been liberalised—the electricity industry since 1995 and the gas industry since 2008. The gas pipeline network is owned and operated by PowerGas Ltd.

The electricity industry structure for Singapore is shown as below:

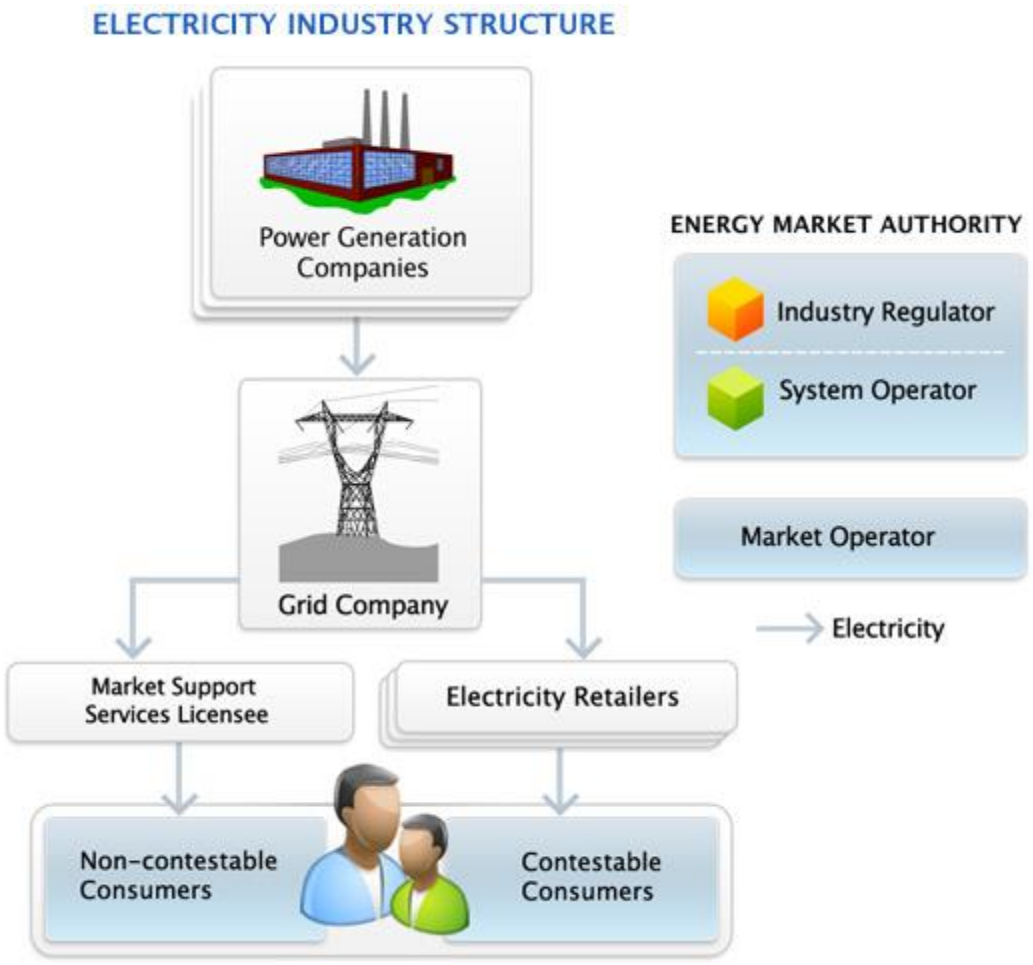


Figure: Singapore Electricity Industry Structure[64]

The National Electricity Market of Singapore (NEMS), a real-time electricity trading pool, commenced operation on 1 Jan 2003. Generation companies compete to sell electricity to the NEMS every half-hour. In addition to electricity, trading of operating reserves to maintain system security and reliability also takes place in the NEMS on a half-hourly basis. Electricity retailers buy electricity from the NEMS and offer packages to sell electricity to contestable consumers. The non-contestable consumers constitute 25% of the total

64 http://www.ema.gov.sg/page/3/id:27/

electricity sales in Singapore and purchase their electricity from SP Services Ltd at a regulated tariff.

The gas system in Singapore consists of two separate gas pipeline networks namely, the town gas pipeline network and the natural gas pipeline network. The town gas pipeline network serves about 50% of the households in Singapore. Town gas, used mainly for cooking and water heating by domestic and commercial customers, is manufactured and retailed by City Gas Pte Ltd.

The structure for Singapore's gas industry is as below:

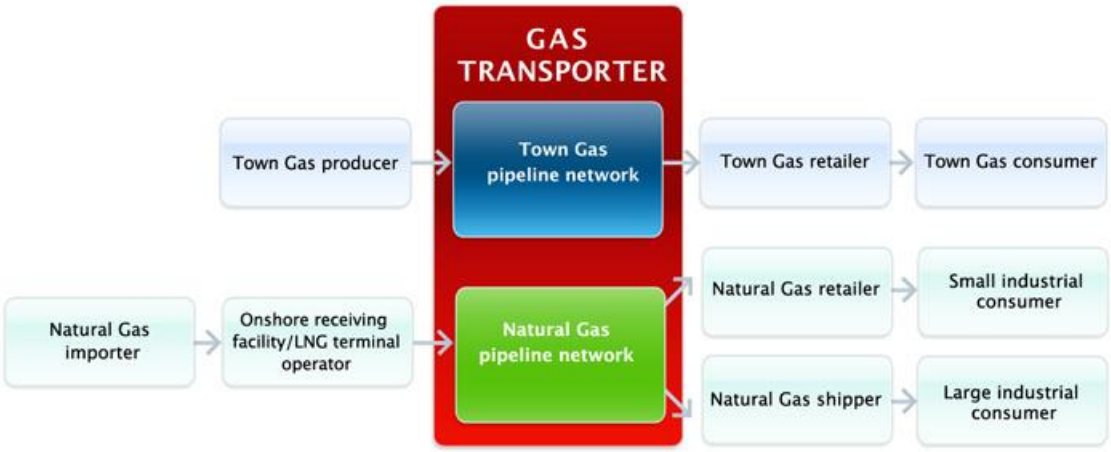


Figure: Singapore Gas Industry Structure[65]

The Singapore Government published the National Energy Policy Report in 2007. Under the policy, the economy has defined the following key energy strategies:

1. Promote competitive energy markets
2. Diversify energy supplies
3. Improve energy efficiency
4. Build an energy industry and invest in energy research and development
5. Promote greater regional and international cooperation
6. Develop a whole-of-government approach.

Energy efficiency is an integral part of Singapore's energy policy and the Energy Efficiency Programme Office (E^2PO) was established to promote and facilitate the adoption of energy efficiency in Singapore. E^2PO focuses on a sectoral approach to energy efficiency, targeting five sectors namely power generation, industry, transport, building and household.

In terms of interconnections, Singapore already has cross-border power interconnection with Malaysia and gas pipelines to fields in Indonesia and Malaysia. Given the high energy demands in the country and its negligible resources, Singapore continues to support ASEAN integration initiatives, particularly the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN

[65] http://www.ema.gov.sg/page/114/id:48/

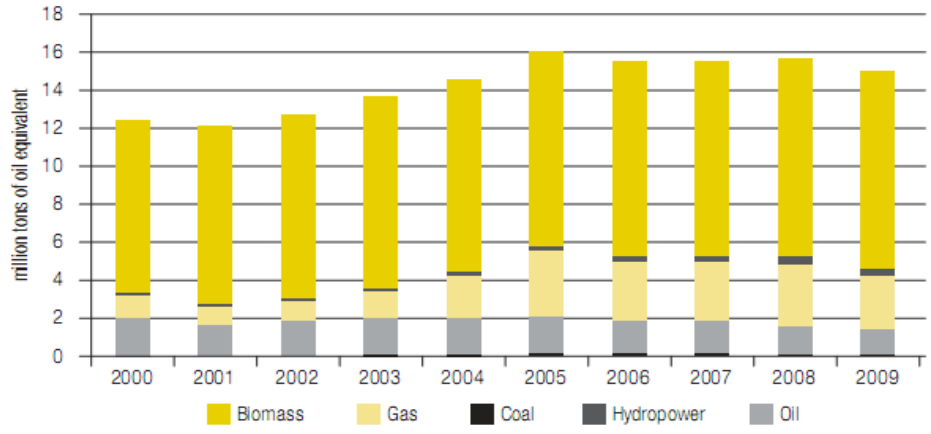
Power Grid (APG). Furthermore, given its free-market structure for both the power and gas industries, Singapore has an established institutional framework already in place to proceed with energy market integration.

2.3 MYANMAR

Myanmar is a large country, with a land area of 676,577 square kilometers (km2).Myanmar's population is approximately 60 million, with more than 70% living in rural areas. Per capita gross domestic product (GDP) is one of the lowest in Southeast Asia, at about $715[66].

Myanmar has abundant energy resources, particularly hydropower and natural gas. This country is one of the five major energy exporters in the region, particularly of natural gas. According to the latest data of IEA (2009), the total primary energy supply of Myanmar was about 15.1 million tons of oil equivalent(MTOE). The country's primary energy supply includes coal, oil, gas, hydropower, and biomass. But some two-thirds (69.9% or 10.5 MTOE) of Myanmar's energy supply was from biomass, followed by 18.2% (2.7 MTOE) from natural gas and 8.5% (1.3 MTOE) from oil. Coal and hydropower accounted for only small shares (0.9% and 2.4%, respectively) of total energy supply.

Figure 1 Myanmar's Total Primary Energy Supply, 2000–2009
(million tons of oil equivalent)



Source: International Energy Agency.

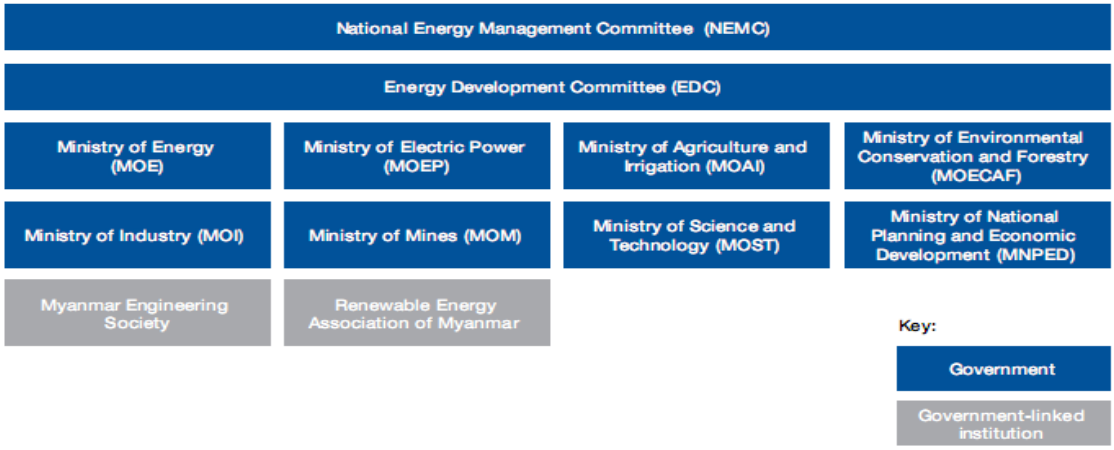
Concening the Policy framework and institutional structure, Four main goals form the basis of Myanmar's energy policy framework: (i) maintaining energy independence; (ii) promoting the wider use of new and renewable sources of energy; (iii) promoting energy eiciency and conservation; and (iv) promoting household use of alternative fuels.8 ministries in Myanmar are responsible for energy matters:

- Ministry of Energy is principally responsible for the oil and gas sector as well as for building and revising national energy policy.

[66] ADB Report (2012) : Myanmar : Energy Sector Initial Assessment

- Ministry of Electric Power (MOEP), which is responsible for hydropower, thermal power, and transmission and distribution.
- Ministry of Mines (MOM), responsible for coal production.
- Ministry of Agriculture and Irrigation (MOAI), responsible for biofuels and micro-hydropower for irrigation purposes.
- Ministry of Industry (MOI), responsible for energy efficiency.
- Ministry of Environmental Conservation and Forestry (MOECAF), which is responsible for fuel wood, climate change, and environmental standards
- Ministry of Science and Technology (MOST), responsible for research and development related to renewable energy technologies.
- Ministry of National Planning and Economic Development (MNPED)

To strengthen coordination and planning among the energy sector's institutionsin early January 2013, the National Energy Management Committee (NEMC) and an Energy Development Committee (EDC) were created. . The NEMC is a minister-level committee. It is responsible for formulating energy policy and plans in coordination with other key energy-related ministries. The EDC is broadly responsible for implementing the policies and plans of the NEMC. Institutional Framwork of Myanmar's energy sector is described in the following figure.



Source: ADB Report (2013): New Energy Architechture: Myanmar

In the operation level, energy system of Myanmar is organised complicatedly. There are three state-owned enterprises in Energy Ministry take the responsibility for oil exploration and mining (Myanmar Oil and Gas Enterprise – MOGE), oil refiner (Myanmar Petrochemical Enterprise - MPE) and petroleum products distribution (Myanmar Petroleum Products Enterprise - MPPE). Similarly, there are three enterprises in power sector take responsibility for electricity production, transmission and distribution for different regions of Myanmar.

According to evaluation of Asian Development Bank (ADB), some issues faced by Myanmar in energy sector are:

- Poor and inadequate infrastructure, institutional, and human resources capacity toprovide reliable and sustainable energy resources.
- Lack of coordination and poorlong-term integrated energy planning and development
- Ineffective energy institutions and lack of capability and capacity of staff

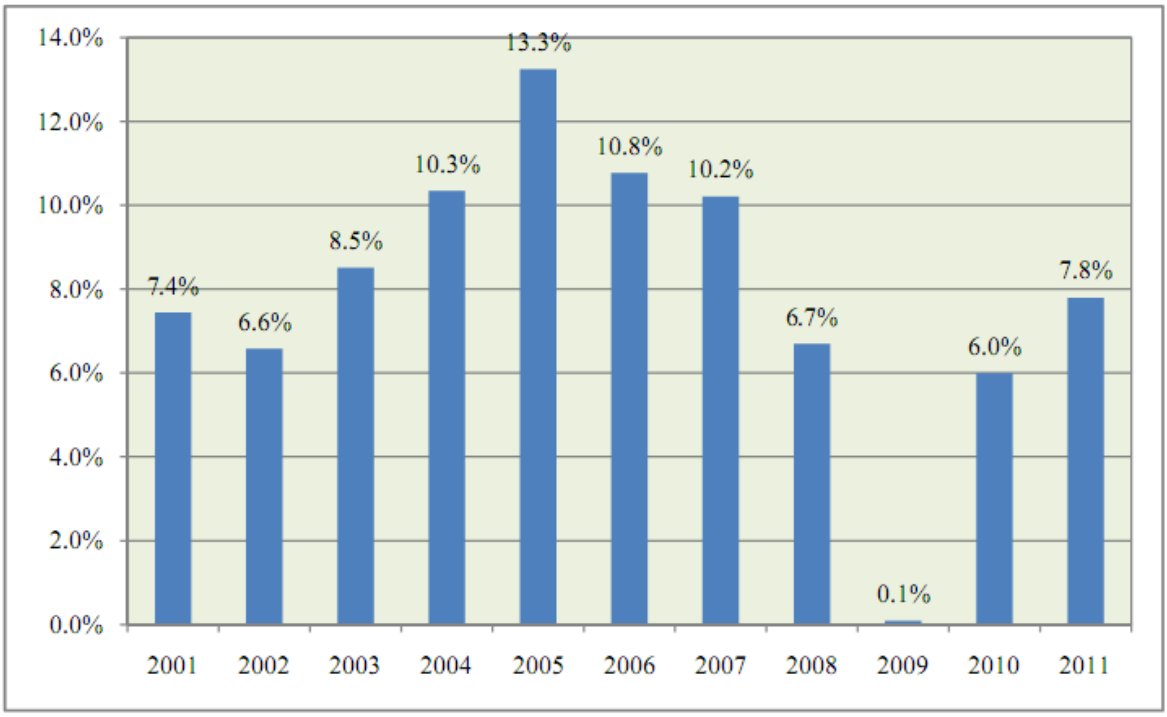
- Limited investment in energysector
- Lack of sector support forsocial, environmental, and economic sustainability
- There are some issues derived from above analyses need to handle in the integration:
- Create an integrated energy plan
- Establish institutions and frameworks to deliver the Integrated Energy Plan
- Reform energy subsidies
- Establish energy efficiency standards and regulations
- Develop a clear vision and legal framework for private investment
- Create an investment framework and reform state enterprises to expand domestic energy supply

2.4 CAMBODIA:

The Kingdom of Cambodia is located in the tropical region of Southeast Asia in the Lower Mekong region, with 800 Km border with Thailand in the west, 450 Km with Lao PDR in the north, 1,250 Km with Viet Nam in the east and a coastline of 440 Km long. Cambodia is a member of the Association of the Southeast Asian Nations (ASEAN) and Greater Mekong Sub-region(GMS).

In the last decade, Cambodia enjoyed exceptionally high rates of economic growth. The economy grew 8.0% per annum on average during 2001-2010. The economy experienced the highest growth rate at 13.3 percent in 2005. Later, it declined from6.7% in 2008 to 0.1% in 2009 due to global economic downturn in 2008/2009 because Cambodia's major economic sectors such as garment, tourism, and construction dramatically contracted. Real GDP growth started to edge up again to around 6.0% in 2010 and was estimated to realize a rate of 7.8% in 2011 (Khin, et al. 2012).

Cambodia's Real GDP Growth Rate over 2001-2011



Source: Data compiled from NIS and EIC estimate (2011).

Energy Resources and Production

Cambodia has substantial hydropower resources and indications of oil, gas an d coal deposits; there is an urgent needs to assess the extent of these energy resources. Other renewable energy sources are available and their use is being started, such as biomass, solar and mini-hydro. The problem is to diversify the sources of supply, and intensify the exploration for natural gas and the development of renewable energy resources.

Energy Sector Institutional Framework

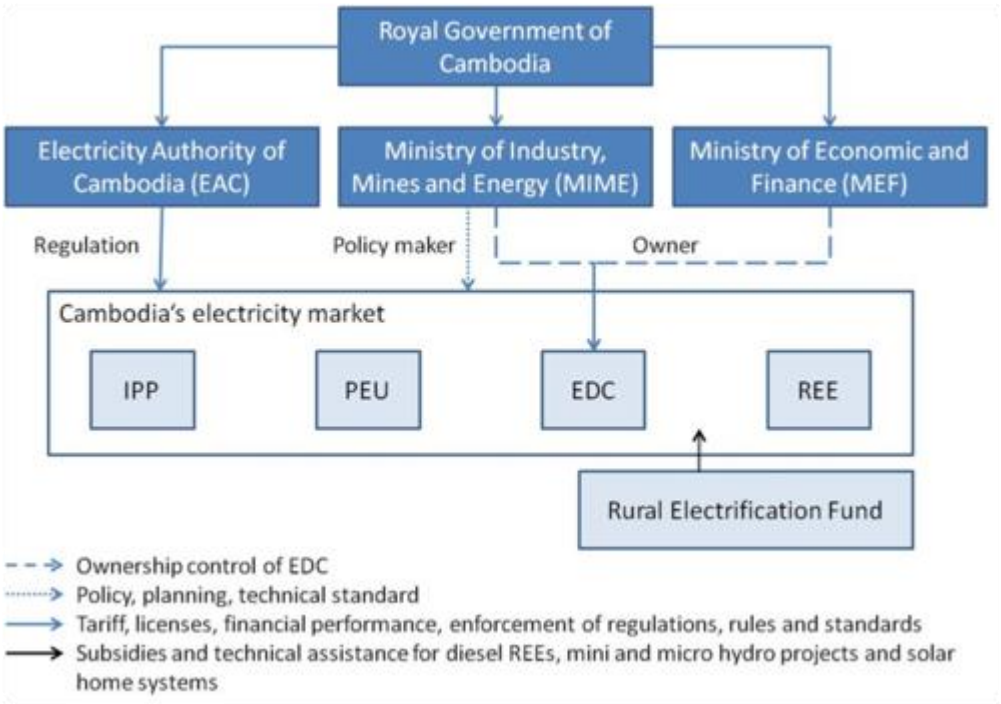
The main institutions involving in the Energy sector in Cambodia are the Ministry of Industry, Mines and Energy (MIME), Ministry of Economic and Finance (MEF), Electricité du Cambodge (EDC), the Electricity Authority of Cambodia (EAC), Provincial Electricity Utilities and private sector. EDC is owned and controlled by MIME and MEF.

a. Ministry of Industry, Mines and Energy: MIME has overall responsibility for policy formulation, strategic planning and Technical Standards. However, the oil and gas sector is handled by the Cambodian National Petroleum Authority (CNPA).As more specific responsibilities, the Ministry of Industry, Mines and Energy shall be responsible for setting and administrating the government policies, strategies and planning in the power sector.
b. General Directorate of Energy (MIME): The main objectives of energy policy (1995) cover the provision of adequate supplies of least cost energy for households, and to all sectors of the Cambodian economy, whilst minimizing environmental effects. To assist national development, energy planners must consider all economic,

financial, environmental and social factors. The Department of Energy Development is the principal government agency for the energy sector planning and consumption and data collection, and h as to work closely with other governmental departments.

c. Regulatory Authority (EAC): The Electricity Authority of Cambodia is the Regulatory Agency that was established according to the Electricity Law, and is becoming operational. The EAC performs the following duties: licensing, tariff setting, solving the disputes between producers/suppliers and consumers, setting up the uniform accounting standards, enforcing the regulation, review of planning and financing performance.
d. Ministry of Environment: The Ministry of Environment, an institution established in November 1993, after the National election, has a broad mandate to protect the natural resources of the country and to prevent environmental degradation, responsible for the sustainable management of national parks and protected areas. The long range goals of the ministry of environment include:
    - Management and protection of natural resources to ensure sustainable environmental development.
    - Strengthening cooperation with relevant ministries to control and improve environmental quality
    - Control and review of the environmental impact assessment (EIA) of all development projects within the country.

Overview of the institutional set-up of Cambodia's electricity sector



Some issues appeared in the energy market integration of Cambodia are:

- **Poor institutional synergies**: Cambodia, relatively a young democracy, is still in the process of building its institutions and the infrastructure is still remains poor.

- **Lack of policy and legal framework**: The legal environment in Cambodia is not yet strong, with many of the laws still being drafted.The legal and policy framework needs to be put in place.

2.5 LAOS

The Laos PDR is a country rich in natural resources. The population is only 6.4 million peoples. The key economic indicators for 2011 is in the following table:

Indicator	Unit	Value
Land area	km^2	236,800
Population	million	6.4
GDP	billion KN	64,960
GDP per capita	$	1,272

GDP = gross domestic product, km^2 = square kilometer.

Source: ADB. 2011. *Key Indicators for Asia and the Pacific*. Manila.

The data of energy resources, energy production and consumption of Lao in 2012 is:

Indicator	Unit	Value
Final energy consumption per capita	kgoe	366
Total electricity consumption	GWh	2,400
Total installed capacity	MW	2,570
Electrification rate	%	78.5
Per capita electricity consumption	kWh	376
Hydropower potential	MW	20,000
Coal resource	million tons	700
Renewable potential	MW (eq)	500

GWh = gigawatt-hour, kgoe = kilogram of oil equivalent, km^2 = square kilometer, kWh = kilowatt-hour, MW = megawatt.

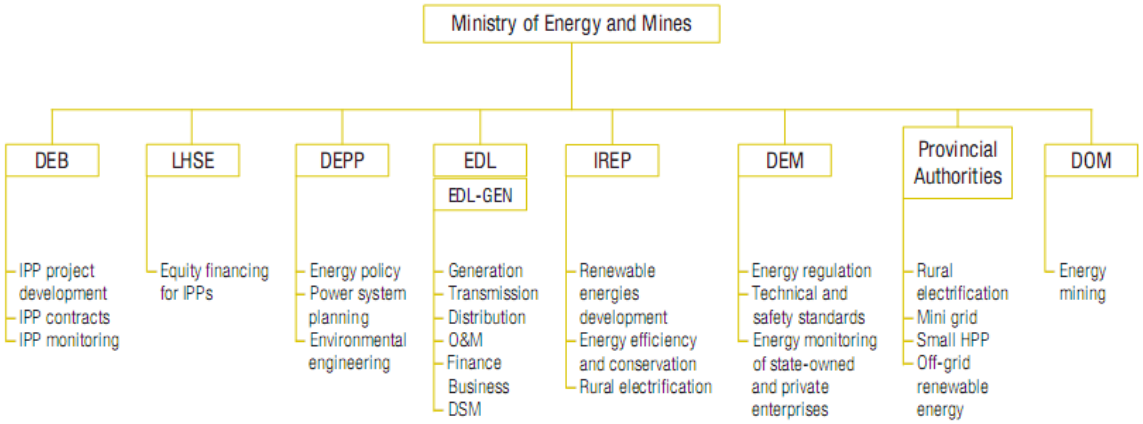
Source: Asian Development Bank (ADB).

The management of energy-related activities in the Lao PDR is mainly the responsibility of the Ministry of Energy and Mines (MEM), EDL, and Lao Holding State Enterprise (LHSE), with support from the Ministry of Finance and the Ministry of Natural Resources and the Environment (MONRE).

- The MEM is responsible for energy policy and overall strategic guidance, as well as management of sector development. In 2011, with technical assistance from ADB and other development partners, energy management in MEM is re-ogranised as follow:
  - ***Department of Energy Business***: Formerly the Department of Energy Promotion and Development, the Department of Energy Businesses (DEB) is in charge of private sector investments in the power sector.

- ***Department of Energy Policy and Planning***: The main responsibility of the Department of Energy Policy and Planning (DEPP) is formulating national energy policies and plans.
- **Department of Energy Management**: This newly created department is in charge of drafting energy-related laws, regulations, guidelines, and technical and safety standards.
- **Institute of Renewable Energy Promotion**: Equivalent to a department, the IREP is mainly responsible for promoting renewable energy and conservation by implementing the Renewable Energy Policy

- Electricité du Laos. EDL is a vertically integrated electricity utility and it performs the functions of generation, transmission, distribution, and services to all electricity customers served by the national grid in the Lao PDR.
- Lao Holdings State Enterprise. LHSE was established in February 2005 by the Government of the Lao PDR to facilitate investment in energy generation.



DEB = Department of Energy Business, DEM = Department of Energy Management, DEPP = Department of Energy Policy and Planning, DOM = Department of Mines, DSM = demand-side management, EDL = Electricité du Laos, EDL-GEN = EDL Generation Public Company, HPP = hydropower plant, IPP = independent power producer, IREP = Institute of Renewable Energy Promotion, LHSE = Lao Holding State Enterprise, O&M = operation and maintenance.

Source: Ministry of Energy and Mines.

Some issues appeared in the energy market integration of Lao are:

- The Lao PDR lacks a comprehensive national energy policy, setting out a systematic approach to energy planning, policy formulation, and sector development. Formulation of a national energy policy is urgently needed and is a priority for the MEM.
- The MEM's capacity to promote renewable energy and energy efciency is limited.

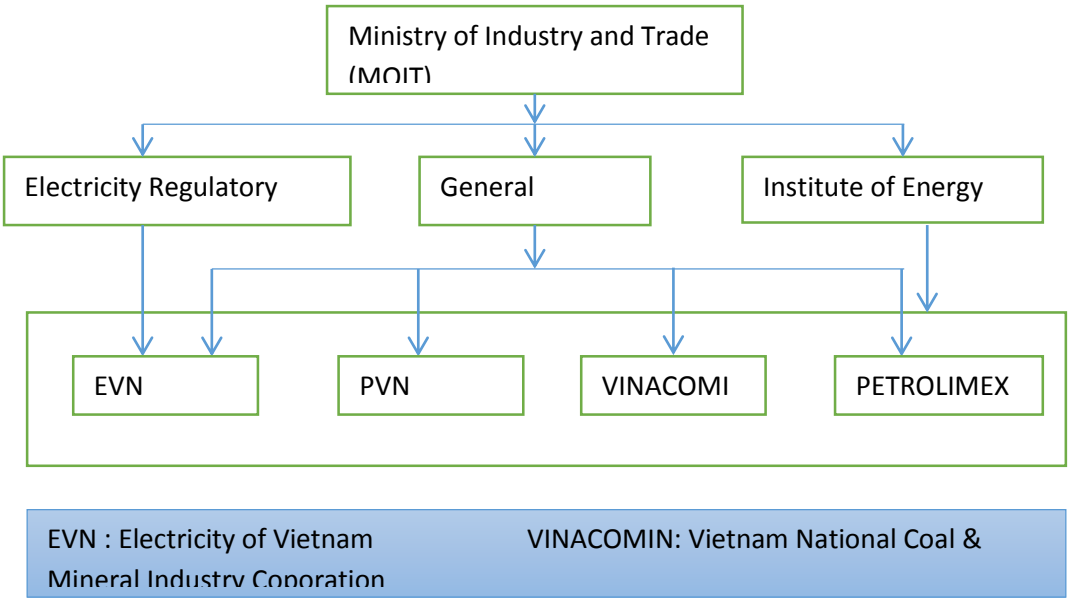
2.6 VIETNAM

General Information in 2010 (Prel)

Area	331150,4	Km2
Average population	88.927,7	Thous.pers
Population density	262,5	Person/km2
Number of Provinces	63	
Number of Households	22.673.159	
Average size of households	3,83	Persons
GDP(1994 Price)	551.609	Bill.dongs
GDP growth	6,78	%/year
GDP per capital	6.345,6	1000 VNdongs-1994/capital
Exchange rate	1USD=18.628 VNdongs	

The Ministry of Industry and Trade (MOIT) is the principal department of government for policy development in the energy sector. It is responsible for the review and submission of laws, regulations, master plans, and major investment projects for the Prime Minister's approval. Such materials generally need review and approval from the Ministry of Planning and Investment (MPI) and the Prime Minister's office, but MOIT is the initiator.

Present governmental management of energy system of Vietnam is described in the following figure:



EVN : Electricity of Vietnam VINACOMIN: Vietnam National Coal & Mineral Industry Coporation

On the up-stream, there governmental economic groups (EVN, PVN and VNACOMIN) are responsible for electricity, coal, oil and gas production. Vietnam is also deploying the pilot competitive generation in power market. However, EVN is the single buyer and the sole player in the power transmission and distribution. PVN, Vinacomin and other Independent Power Productions take part in the electricity generation. The Electricity Regulatory Authority of Vietnam (ERAV) is in charge to regulate the power market. PETROLOMEX is the other state-owned enterprise under the administration of the Ministry of Trade and Industry. The enterprise plays a key role in the distribution of petroleum products.

Some energy indicators of Vietnam:

Indicators	2006	2007	2008	2009	2010
Population (mill. persons)	83.3	84.2	85.1	86.0	86.9
GDP at 1994 prices (bill.VND)	425373	461344	490458	516566	551609
Total Energy Supply (ktoe)	45881	49670	53362	58370	64147
Total final Energy consumption (ktoe)	37449	40345	43277	46774	50547
Total final commercial Energy Consumption (ktoe)	22701	25619	28567	32070	35852
Total Electricity Consumption (ktoe)	4630	5275	5834	6614	7476
Total final commercial Energy Consumption per Capita (kgoe/capita)	272	304	336	373	412

Source: Energy Institute – Vietnam

2.7 PHILIPHINES

Philiphines has a land area of 298,170 square kilometers with an estimated population of 94.2 millions people in July 2014. Its key indicators in 2011 are GDP at current prices of 224.8 billion USD, GDP per capita of 2,386 USD, total primary energy supply was 40.5 MTOE, electricity consumption was 56.1 TWH, power generation capacity was 13.3 million kW (2010 figures), percapita primary energy supply was 0.429 TOE per person, energy intensity per GDP was 0.280 TOE/thousand USD, per capital electricity consumption was 596 kWh per person and electrification rate was 79% (2012 figures)[67].

67 Prof. Rowaldo del Mundo, 1st ERIN meeting, Brunei, Sep 2014.

Indonesia has a land area of 1,811,569 square kilometers with an estimated population in July 2014 of 253,609,643 people[68]. It is highly dependence on fossil energy, in 2012, of which 49.7% oil, 24.5% coal, 201% gas and 5.7% renewable energy. In the same year, Indonesia export of energy are 82% coal, 42% gas and 37% crude oil. It electrification rate is 81%. It energy capacity has limited and it has started fast track program utilizing coal, geothermal, hydropower and gas pump.[69]

Malaysia has a land area of 328,657 square kilometers with an estimated population in July 2014 of 30,073,353 people (ref: www.cia.gov assesed on 28/10/14). It borders with neighbours Brunei 381 kilometers, Indonesia 1,782 kilometers and Thailand 506 kilometers. It final energy demand per capita in 2011 was 1.5 tonne of oil equivalent per capita and its primary energy intensity was 112 tonne of oil equivalent per GDP (RM Million) at 2005 prices. The country electricity demand was 3,708 kWh per capita. The primary energy intensity has increased from 99 tonnes of oil equivalent/RM Million in 1990 to 118 tonnes of oil equivalent /RM Million in 2000. This increase was attributed to the shift in the economic structure from an agriculture-based economy to manufacturing and service-based economy[70].

2.8 THAILAND

Thailand has a land area of 510,890 square kilometers with an estimated population in July 2014 of 67,741,401 people (ref: www.cia.gov assesed on 28/10/14). It borders with neighbours Burma 1,800 kilometers, Cambodia 803 kilometers, Laos 1,754 kilometers and Malaysia 506 kilometers. Thailand is highly dependence on natural gas for electric power generation. In 2013, Thai government has implemented feed-in-tariff to promote solar rooftop 100 MW for each communities and commercial/industry. The application for implementation in the former was much less than the set quota but in the latter case, the application exceed the quota. Among the barrier on solar PV implementation, found in a survey, was the inconsistent policy framework and high initial cost[71].

The present situation of Institutional, Energy Industry Struture and Energy Policy issues in Vietnam is presented in Appendixes.

Although Vietnam is energy export country, with the energy demand rose 12 to 14 percent per year, Vietnam would become a net energy importer around 2017 or even earlier. Many challenges faced by Vietnam are:

- Each energy sector (coal, oil, gas sector) has its own Mater Plan but the plans are exclusive. There is a need of creating an integrated energy plan.

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68 www.cia.gov assesed on 28th Oct 2014

69 Rachmi A, 1st ERIN meeting, Brunei, Sep 2014

70 Peninsular Malaysia Electricity Supply Industry Outlook 2013.

71 Dr. Dawan Wiwattanadate, 1st ERIN meeting, Brunei, Sep 2014.

- Energy sector in Vietnam is controlled by state-owned companies. The interference of Government causes barriers for set up and operation process of energy market.
- Activities relevant to energy conservation and saving are serious considered. Vietnam needs to establish Energy Efficiency Standards for production sectors.
- There is a need of mitigation energy subsidy policies.

Although there is energy policy, but:

- Each country has Master plan for individual energy sectors but there is a Lack of consideration of links among coal, oil, gas and electricity sectors.
- Unclear discussion on logic behind energy policy objectives and strategies
- There is a huge difference among countries in energy system management models.
- Energy trading market has not really formed. There is an existence of interference of government, especially in energy subsidy.
- Although there is a different of resources, development levels, four countries is evaluated that the weakness is energy system infrastructure.
  Energy efficiency is low in both production and consumption. All four countries have demand in building product standard, promoting activities relevant to energy conservation and efficiency at national level.

According to evaluation of Asian Development Bank (ADB), some issues faced by Myanmar in energy sector are:

- Poor and inadequate infrastructure, institutional, and human resources capacity toprovide reliable and sustainable energy resources.
- Lack of coordination and poorlong-term integrated energy planning and development
- Ineffective energy institutions and lack of capability and capacity of staff
- Limited investment in energysector
- Lack of sector support forsocial, environmental, and economic sustainability

Another example of resource rich country is Cambodia, who has a substantial hydropower resources and possibly oil, gas and coal deposits. The country also has potential renewable energy sources such as biomass, solar and mini-hydro. The main institutions involving in the Energy sector in Cambodia are the Ministry of Industry, Mines and Energy (MIME), Ministry of Economic and Finance (MEF), Electricité du Cambodge (EDC), the Electricity Authority of Cambodia (EAC), Provincial Electricity Utilities and private sector. EDC is owned and controlled by MIME and MEF. Some issues appeared in the energy market integration of Cambodia are:

- Poor institutional synergies: Cambodia, relatively a young democracy, is still in the process of building its institutions and the infrastructure is still remains poor.
- Lack of policy and legal framework: The legal environment in Cambodia is not yet strong, with many of the laws still being drafted.The legal and policy framework needs to be put in place.

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Each energy sector (coal, oil, gas sector) has its own Mater Plan but the plans are exclusive. There is a need of creating an integrated energy plan.

Energy sector in Vietnam is controlled by state-owned companies. The interference of Government causes barriers for set up and operation process of energy market.

Activities relevant to energy conservation and saving are serious considered. Vietnam needs to establish Energy Efficiency Standards for production sectors.

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- There is a huge difference among countries in energy system management models.
- Energy trading market has not really formed. There is an existence of interference of government, especially in energy subsidy.
- Although there is a different of resources, development levels, four countries is evaluated that the weakness is energy system infrastructure.
- Energy efficiency is low in both production and consumption. All four countries have demand in building product standard, promoting activities relevant to energy conservation and efficiency at national level.

3. Review National Perspectives in Joining AEMI

To report in second part of this project.

4. Formulation of the recommendation on AEMI implementation

To report in second part of this project.

A brief review as a background material for discussion during brainstorming session.

4.1 Power Network Interconnection

The aim of setting up a Power Network Interconnection among AMS is to enhance energy security system for ASEAN region by common power network, in which the members can share the ability of supply, transmission. Therefore, the lack of electricity supply of one member can be fulfilled by the others through electricity trading.

The interconnection among 10 countries in ASEAN will bring a huge economical efficiency for both investors and users. It will also promote the development of power market, investment and ensure energy security for each country. It plays an important role in the process of meeting high energy demand during ASEAN modernization as the primary energy demand of the region are expected to increase approximately 3 times the from 2005 to 2030.

In the 27th ASEAN energy ministers Meeting held in Myanmar, The ASEAN Plan of Action for Energy Cooperation (APAEC) 2010 – 2015 was approved with the main content: *ASEAN Power Grid (*APG*); Trans-ASEAN Gas Pipeline (TAGP); Coal and Clean Coal Technology (CCCT); Energy Efficiency and Conservation(EE&C);* **Renewable Energy** *(RE); Regional Energy Policy and Planning (REPP) and; Civilian Nuclear Energy (NEC).*

There are seven working groups within the framework of the ASEAN Energy Cooperation*, including:* ASEAN Council on Petroleum*(ASCOPE); ASEAN Power Utilities/Authorities (HAPUA);* **ASEAN Forum on Coal***(AFOC);* **Energy Efficiency and Coservation Sub-Sector Network***(EE&CSSN);* **Renewable Energy Sub-Sector Network***(RE-SSN);* Regional Energy Policy and Planning Sub-sector Network*(REPP-SSN) and;* **Nuclear Energy Cooperation Sub-Sector Network***(NEC SSN).*

However, from concept to reality is a long way with difficulties, constraints, and challengers that countries should overcome. The road to developing TAGP, ASEAN Power Grid, and other energy cooperation projects, however, has been quite slow, due to financial constraints, technical difficulties, differences in the industry regulatory frameworks among ASEAN countries, and some other factors.

4.2 Tranporting and Delivery Energy Products

Transporting and delivering gas, electricity, renewable energy and energy efficicient products from one country to another are similar to the trading of commodities. So they will be subject to national, regional and/or international regulations. These could be pipeline permits, territorial boundaries, other licenses, taxation, quality standards, environment regulations etc.

Each country has its own power market, tariff system that is different from others. Besides, the difference among technical standards of power system is also a barrier. In fact, the power grid of each ASEAN country is far different, while power transmission of ASEAN 6 is better, the ASEAN 4 is almost backward and unstable.

For a cross-border power project, technical standards are essential throughout both the construction and operation if it is to maintain operational integrity. Differences in standards and procedures may contribute to the unreliability of interconnected power grids. For example: unstable voltage, frequent power outages and unguaranteed power level at 220kV could seriously affect the overall power grid.

4.3 Tax and subsidy

Another challenger is tax construction. Each country has its own market design. Energy subsidy is applied in most of countries in the region. The reduction of subsidy process is faced with negative reaction from public opinion. Recently, there are the demonstrations in Indonesia when the Congress supports government in process of raising petroleum products price by 33 percent. Some countries have independent power operators, but in some countries, the power sector still rely on subsidies, that lead to electricity price in these countries does not reflect the actual price. Therefore, some countries have to adjust power price before connecting to the region grid.

There is a need of investment for infrastructure development, technical capacity enhancement. But to promote Energy Market Integration (EMI), it is necessary to introduce competition in domestic energy markets, which often requires the restructuring of vertically integrated energy utilities into separate functional companies.

4.4 Market organization, mechanism and politics

The monopoly status of the national energy companies in most of the ASEAN countries is a major obstacle in attracting private investment and foreign investment for energy infrastructure development in the region. Besides, a contradiction of the few countries in the ASEAN region, such as border conflict between Thailand and Cambodia or the debate between Vietnam, Cambodia and Laos, Thailand in the construction of Xayaburi[72] hydropower around the impact of hydroelectric dams to the lower Mekong environment, is the obstacle in the negotiation process of establishing cooperation among these countries. These conflicts will delay the whole process of forming the ASEAN power grid.

Political and national independency (security) issues – including relevant bilateral and regional territorial disputes between ASEAN and ASEAN+3:

Asean is the region relatively rich in energy resources, even though only a few countries are genuinely self-sufficient. Oil, gas, coal, hydro, geothermal and biomass are available in

[72] Nhina Le (2013): Xayaburi and the Mekong Critical Point: Over-Damming the Shared River and Bigger Threats to the Shared Future. University of San Francisco's Peace Review, Vol. 25 (2).

Indonesia. There are oil, gas and coal reserves in Malaysia and Thailand. Brunei has quite large reserves for oil and gas. There are potential reserves of oil, gas and hydro in Myanmar, while oil and hydro are found in Cambodia. Laos has quite large hydro potential. Vietnam has oil, gas, coal, hydro and biomass; whereas the Philippines has oil, gas, coal, hydro and geothermal. Singapore has no indigenous energy resources, but the country is very important as a major processing center for oil and petrochemical, and oil bunkers.

Energy cooperation within ASEAN is challenged by its individual member's energy priorities, bilateral trade partners and development dynamics beyond the borders. Indonesia delivers natural gas through a pipeline to Singapore and Malaysia. Laos sends electricity to Thailand, Vietnam and Cambodia, while Cambodia also imports electricity from Thailand and Vietnam. A joint development area for energy resources development was established between Malaysia and Thailand. ASEAN crude oil is sent to Singapore for refining and parts of the products are sent back to the producing countries.

A typical example of bilateral and regional cooperation in ASEAN in the field energy is grid connection among Greater Mekong Subregion countries (GMS countries). In 2000, with the support of ADB[73], Master Plan on Power Interconnection has been developed for the period 2000 to 2020 and then adjusted in 2010 within the framework of the Technical Assistance Project TA 6440-REG[74].

The proposal to develop power trade in the GMS is anchored on the principle that integration should proceed in four well-defined stages, as follows:

Stage 1: Bilateral cross-border connections through power purchase agreements (PPAs);

Stage 2: Grid-to-grid power trading between any pair of GMS countries, eventually using transmission facilities of a third regional country;

Stage 3: Development of transmission links dedicated to cross-border trading; and

Stage 4: Most of the GMS countries have moved to multiple sellers–buyers regulatory frameworks, so a wholly competitive regional market can be implemented.

Grid connection process among the countries in the GMS is promoted from high-demand countries such as Thailand, Vietnam through investment projects of building power plants (mainly hydropower exploitation) together with the power purchase agreement among the countries.

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[73] ADB. 2000. Technical Assistance for the Regional Indicative Master Plan on Power Interconnection in the Greater Mekong Subregion. Manila (TA 5920-REG, $900,000, approved on 10 July 2000, financed by the TA Special Fund and the Government of Norway).

[74] ADB. 2007. Technical Assistance for Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity Infrastructure in the Greater Mekong Subregion. Manila (TA 6440-REG, $5 million, approved on 19 December 2007, financed by the Government of Sweden). A small component of the Technical Assistance for GMS Regional Power Trade Coordination and Development (TA 6304-REG) also undertook some simulations to update the regional indicative master plan

Asean + 3 energy cooperation emerged from an agreement emong Asean + 3 energy ministers at the eighth International Energy Forum (dialogue between energy producing and consuming countries) in Osaka in September 2002.

In the recent meeting of ASEAN+3 energy ministers in the Kingdom of Cambodia on 12 September 2012, ASEAN+3 energy cooperation focuses on the fields: civilian nuclear energy, oil stockpiling, development of the region's gas/LPG market, coal and clean coal technologies.

To the field of Oil Market and Natural Gas, ASEAN+3 countries agree on setting up the channel to share the market information (support for the Joint Organisations Data Initiative - JODI) and and encouraging private sector participation in the natural gas sector.

On oil stockpiling, the +3 countries focus on supporting activities: (i) continuing studies and development of the Oil Stockpiling Road Map (OSRM); (ii) collecting annual information on the progress of each country's oil stockpiling activities; and (iii) organising workshops to promote the implementation of each ASEAN country's OSRM.

In the field of nuclear energy for civil purposes, Korea and Japan are supporting the projects: Development of Human Resources for Civilian Nuclear Energy and Center of Integrated Support for Nuclear Non-Proliferation and Nuclear Security.

On the clean coal technologies, countries in Asean + 3 agree to concentrate on developing cooperation programmes such as the upgrading of low rank coal technologies, carbon capture and storage (CCS), coal gasification and coal liquefaction.

4.5 Market for energy reserve

Associated with the energy market is the need for spinning reserve to ensure supply availability and mitigate risk. There were many market models in operation since the privatation of the electricity market era. Examples by various continents is shown in Table 1[75].

[75] Nurul Farhana, Rashid Abdullah, Noor Miza, 2nd National Graduate Conference 2013, Putrajaya, Malaysia

Table 1 – Example of Spinning Reserve Examples.

Continents	Spinning Reserve Practiced by
Oceana	Australia (AEMO)
	New Zealand (Transpower)
U.S.A	California ISO
	NYISO
	ERCOT
	ISO-NE
	MISO
	PJM Interconnection for RFC area
	Southwest Power Pool (SPP)
	WECC
EUROPE	ENTSO-E
Africa	South Africa (Eskom)
South East Asia	Singapore (EMA)
	Thailand (EGAT)
	Philippines (NGC)
	Malaysia (TNB)

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GEO-POLITICAL STRATEGY – DEVELOP A GEO-POLITICAL STRATEGY FOR ASEAN ENERGY SECURITY

Philip Andrews-Speed, Christopher Len, Seksan Anantasirikiat

1. Introduction

The central purpose of this paper is to formulate the elements of an external ASEAN energy policy to promote a unified and cohesive external position on ASEAN energy policy in the framework of AEMI. The focus is on external threats, geopolitical trends and events external to ASEAN, and on possible geopolitical strategies to address these challenges.

The paper is structured as follows:

- Section 2 provides a brief summary of the internal dynamics of ASEAN and its external relations.
- Section 3 provides a brief survey of global energy trends and examines in some detail the context of energy in the region, in ASEAN as well as in South and East Asia, looking ahead to 2030. In particular, it provides an account of behaviours of Asian actors in field of energy that affects ASEAN member states, including both investment and trade flows.
- Section 4 identifies the implications of the preceding analysis for ASEAN. It first examines three issues: security of external energy supply, the management of domestic energy resources, and clean and efficient energy supply and use. It assesses ASEAN's capacity to address these challenges and identifies the threats if ASEAN fails to take action.
- Section 5 we briefly examine the international experience of regional organisations in trying to develop coordinated external action in the field of energy, and identify the difficulties. This analysis draws on the experience of the European Union.
- The final section proposes some potential priorities for developing a coherent external energy strategy for ASEAN.

2. The regional economic and political context

2.1 Internal Dynamics of ASEAN

The Association of Southeast Asian Nations (ASEAN) was established in 1967 in light of Cold War circumstances. At first, ASEAN was politically translated into a grouping of anti-communist countries by five founders, Indonesia, Malaysia, Philippines, Singapore, and Thailand whose leaders were keen to establish a framework for inter-state dispute management between members. As collaboration expanded, the ASEAN Secretariat was established in 1981 to assume a coordinating role within the organisation. The organisation underwent gradual expansion with Brunei's admission in 1984 as the sixth member, followed by Vietnam in 1995, Laos and Burma in 1997 and finally, Cambodia as its tenth member in 1999. The process of community building has been fostered by institutionalizing ASEAN. In 2003, ASEAN leaders committed to build the community by setting three pillars of ASEAN which cover the political-security, economic, and socio-cultural cooperation. Another important leap of ASEAN's institutional development is the adoption of the ASEAN Charter in 2008. It bestowed legal entities to ASEAN. The groundwork for ASEAN regional structure and governance has been laid in the Charter to strengthen the capacity of ASEAN to meet external and internal challenges.

As noted in the ASEAN Political-Security Community (APSC) Blueprint, ASEAN has been envisaged to be 'a dynamic and outward-looking region in an increasingly integrated and independent region'. This objective covers the concept of ASEAN centrality in regional

cooperation and community building; the promotion of ties with external parties; the consultations and cooperation on mutual issues of concern. Adding to that, the ASEAN Economic Community (AEC) Blueprint also draws attention to external economic relations and global supply networks to reinforce the idea of 'Global ASEAN'.

To make ASEAN more integrated, ASEAN leaders adopted the Master Plan on ASEAN Connectivity (MPAC) in 2009. It noted three main concepts of connectivity comprising logistics; institutional; and people-to-people connectivity. A very important issue of the relations between the concept of ASEAN Connectivity and ASEAN's dialogue partners is that MPAC itself aims to reinforce a more 'internally' integrated ASEAN but it requires a large number of economic engagement and assistance from the dialogue partners. It should be noted that many development projects are funded by ASEAN's dialogue partners.

2.2 ASEAN's External Ties

Throughout 47 years of its inception, ASEAN has gradually evolved and adapted in response to global and regional developments. Institutional development of ASEAN can be considered from the establishment of the ASEAN Regional Forum (ARF) in 1994 which focused on the security issues in the Asia-Pacific region.

Over the years ASEAN's external relations have expanded and external parties may be conferred formal status as Dialogue Partner, Sectoral Dialogue Partner, Development Partner, Special Observer, Guest, or other status to countries, regional and international organisations and institutions. Table 1 provides a summary of the ASEAN's relationship with key external parties.

Table 1. ASEAN's relationship with key external parties

External Parties	**Relationship**
Australia	Dialogue Partner (1974)
Canada	Dialogue Partner (since 1977)
China	Dialogue Partner (1996)
European Union	Dialogue Partner (since 1977)
India	Dialogue Partner (since 1995)
Japan	Dialogue Partner (since 1977?)
South Korea	Dialogue Partner (since 1991)
New Zealand	Dialogue Partner (since 1975)
Russia	Dialogue Partner (since 1996)
United States of America	Dialogue Partner (since 1977)
UNDP	Dialogue Partner (since 1977)
Pakistan	Sectoral dialogue status (in 1993)
ASEAN + 3	China, South Korea and Japan (1997)
Source: http://www.asean.org/asean/external-relations	

The Asian Financial Crisis in 1997-1998 provided the urgency and justification for ASEAN member states to develop closer economic links with external parties, especially China, Japan and South Korea in the Northeast Asian region through the ASEAN+3 framework. A key outcome from this framework is the Chiang Mai initiative which is the multicurrency swop arrangement to ensure the financial stability of the region.

Japan and Republic of Korea have played an active role in ASEAN member countries notably in the Greater Mekong Sub-region (GMS) from 1980s to the present. They promote logistical and institutional connectivity by funding road and rail construction, providing technical assistance and innovation to CLMV countries (Cambodia, Laos, Myanmar and Vietnam), and training officials and staffs from these countries. Large amounts of outward foreign direct investment in GMS come from Japan and Republic of Korea. Japanese and Korean companies also draw a great attention to oceanic ASEAN especially Indonesia due to great purchasing power and size of market. The statistics from JICA (2013) stated that Japan and Republic of Korea seized the highest amount of two non-ASEAN members' foreign direct investment in Indonesia in 2012, which is US$2,457 million and US$1,950 million respectively.

Apart from Japan and Republic of Korea, China is another main player in the region. The signing of the Declaration on the Conduct of Parties in the South China Sea in 2002, and China's subsequent signing of the ASEAN's Treaty of Amity and Cooperation in 2003 heralded a new phase of improved relationship between China the ASEAN politically, economically and socially. However, since 2008, there have been rising concern over China's influence in Southeast Asia due to Beijing's growing assertiveness and enforcement activities in the South China Sea, and the fact that negotiations for a Code of Conduct for the South China Sea has yet to be finalised between China and fellow Southeast Asian claimants.

ASEAN's external linkages have also extended to include India, Australia, New Zealand similarly through the ASEAN Plus Framework. ASEAN has also entrenched its position as Southeast Asia's key political and economic regional organisation through a number of free trade agreements signed with China, Japan, South Korea, and Australia-New Zealand.[76] Table 2 provides information on the Top Ten ASEAN Trade Partner countries/regions at the end of 2013. According to this table, China was ASEAN's largest trading partner in 2013 accounting for 14 per cent of total ASEAN trade. The EU was second place at 9.8 percent, while Japan was third with 9.6 per cent, followed by the USA and Korea.

[76] Overview of the various FTAs can be found here: http://www.fta.gov.sg/sg_fta.asp and here: http://www.asean.org/communities/asean-economic-community/category/free-trade-agreements-with-dialogue-partners

Table 2. Top Ten ASEAN Trade Partner countries/regions in 2013

Table 20 ASEAN Statistics

Top ten ASEAN trade partner countries/regions, 2013

as of 24 July 2014

value in US$ million; share in percent

Trade partner country/region[1/]	Value			Share to total ASEAN trade		
	Exports	Imports	Total trade	Exports	Imports	Total trade
ASEAN	330,379.3	278,253.1	608,632.4	26.0	22.4	24.2
China	152,521.1	197,962.5	350,483.6	12.0	16.0	14.0
EU-28	124,434.3	121,780.7	246,215.0	9.8	9.8	9.8
Japan	123,040.8	117,903.9	240,944.7	9.7	9.5	9.6
USA	114,509.8	92,439.4	206,949.2	9.0	7.5	8.2
Korea, Republic of	52,801.9	82,172.6	134,974.6	4.2	6.6	5.4
Taiw an	35,236.9	66,220.0	101,456.9	2.8	5.3	4.0
Hong Kong	82,085.0	13,135.9	95,221.0	6.5	1.1	3.8
Australia	45,505.6	22,531.3	68,037.0	3.6	1.8	2.7
India	41,936.7	25,937.3	67,874.1	3.3	2.1	2.7
Total top ten trade partner countries	1,102,451.5	1,018,336.8	2,120,788.3	86.7	82.1	84.4
Others[2/]	168,621.7	222,139.5	390,761.2	13.3	17.9	15.6
Total	**1,271,073.2**	**1,240,476.3**	**2,511,549.5**	**100.0**	**100.0**	**100.0**

Source: ASEAN Merchandise Trade Statistics Database (compiled/computed from data submission, publications and/or websites of ASEAN Member States' national ASEAN Free Trade Area (AFTA) units, national statistics offices, customs departments/agencies, or central banks)

Notes

- \- not available as of publication time
- x not available/not compiled

Some figures may not sum up to totals due to rounding off errors.
1/ identified/ranked based on share of total trade
2/ includes trade of all other countries and those that could not be attributed to specific countries

Source: http://www.asean.org/resources/2012-02-10-08-47-55/asean-statistics/item/external-trade-statistics-3

A number of ASEAN-linked regional economic arrangements have emerged over the years thereby making ASEAN the regional hub for FTAs in Asia. As noted by one observer, such economic diplomatic alignments play a role in reaffirming closer political ties. In addition to lowering trade and investment barriers, they also enable improving technology and skill transfer and infrastructure investment. Asia's economic rising powers are thus able to channel their resources from power politics to softer, more peaceful and influential politics. On the other hand, the growth in economic relations could also give rise to negative economic pressure as countries when countries face political disagreements.[77]

Besides the ASEAN + 1 FTAs and the Regional Comprehensive Economic Partnership (RCEP), there are also agreements that do not cover all ASEAN members states such as the Trans-Pacific Partnership (TPP). The FTA initiatives follow four tracks: (1) global, WTO-based; (2) trans-regional, APEC and TPP-based; (3) regional, ASEAN+1[78] and ASEAN+6 (or RCEP)-based and (4) bilateral initiatives[79]. Singapore has the largest number of bilateral and plurilateral

[77] Sanchita Basu Das, "Growing Economic Diplomacy in ASEAN: Opportunities and Threats" ISEAS Perspectives, No. 22, 10 April 2014.

[78] For elements of the ASEAN Plus 1 Free Trade Agreements, refer to Suthiphand Chirathivat and Piti Srisangnam, The 2030 Architecture of Association of Southeast Asian Nations Free Trade Agreements, ADB Institute Working Paper Series, No. 419, April 2013, pp. 15-17, http://www.adbi.org/files/2013.04.25.wp419.architecture.asean.free.trade.agreements.pdf

[79] For elements of the ASEAN member states bilateral trading arrangements, refer to Suthiphand Chirathivat and Piti Srisangnam, The 2030 Architecture of Association of Southeast Asian Nations Free Trade Agreements, ADB Institute Working Paper Series, No. 419, April 2013, pp. 19-21, http://www.adbi.org/files/2013.04.25.wp419.architecture.asean.free.trade.agreements.pdf

FTAs that are signed and in effect among the ASEAN member states, followed by Malaysia and Thailand, while Cambodia and Myanmar have the least.[80]

Table 3. FTA status of Individual Asian Economies, 2013

	Proposed	Under Negotiation		Signed but not in effect	Signed and in effect	Total
		Framework Agreement Signed	Negotiation Launched			
ASEAN						
Brunei	6	2	2	0	8	18
Cambodia	4	0	2	0	6	12
Indonesia	6	1	6	2	7	22
Laos	4	0	2	0	8	14
Malaysia	7	1	6	1	12	27
Myanmar	4	1	2	0	6	13
Philippines	7	0	2	0	7	16
Singapore	6	1	10	2	19	38
Thailand	8	3	6	0	12	29
Vietnam	4	1	6	0	8	19

Note: the data is as of July 2013

Source: Free Trade Agreement Database, Asia Regional Integration Center (ARIC)

(Source: Sanchita Basu Das, "Growing Economic Diplomacy in ASEAN: Opportunities and Threats" ISEAS Perspectives, No. 22, 10 April 2014, http://www.iseas.edu.sg/documents/publication/ISEAS_Perspective_2014_22-Growing_Economic_Diplomacy_in_ASEAN.pdf)

This has led observers to comment on the "noodle bowl" of Asian trade agreements.[81] The multiplicity of trade agreements, while underscoring the recognition of ASEAN's economic potential by external parties, also reflects an ASEAN dilemma - it attempts to engage all external parties, have ironically disrupted the regional grouping's economic integration process. The multiple trade agreements also reflect a degree of strategic rivalry among the external parties as they seek to engage ASEAN. While this has enable ASEAN to leverage its position through such rival courtship, it has also had the effect of diluting of ASEAN resources.

In November 2011, the 10 ASEAN member states and its 6 free trade partners (China, Japan, South Korea, India, Australia and New Zealand) decided to establish a region-wide FTA under the ASEAN-led Regional Comprehensive Economic Partnership (RCEP) framework that is

80 Sanchita Basu Das, "Growing Economic Diplomacy in ASEAN: Opportunities and Threats" ISEAS Perspectives, No. 22, 10 April 2014, http://www.iseas.edu.sg/documents/publication/ISEAS_Perspective_2014_22-Growing_Economic_Diplomacy_in_ASEAN.pdf.

81 http://www.eastasiaforum.org/2012/08/27/asias-regional-comprehensive-economic-partnership/

WTO-consistent and would further enhance economic integration between ASEAN member states as well as between ASEAN and its partners.[82] The target date for completion for such negotiations is by end-2015 which appears to be optimistic given the complex nature of this agreement.

Table 4. Size of ASEAN FTAs, 2012

	Total Population, 2012	Total GDP, 2012		Total Trade to the World, 2012
	Persons in billion	US$ trillion	PPP$ trillion	US$ trillion
ASEAN-Australia-New Zealand FTA	*0.65*	*4.04*	*4.92*	*3.06*
ASEAN-China FTA	*2.0*	*10.55*	*16.09*	*6.34*
ASEAN-Japan CEP	*0.75*	*8.29*	*8.41*	*4.16*
ASEAN-RoK FTA	*0.67*	*3.46*	*5.43*	*3.54*
ASEAN-India FTA	*1.8*	*4.17*	*8.55*	*3.26*
RCEP (ASEAN+6)	*3.4 (48)*	*21.2 (29)*	*27.8 (32)*	*10.5 (28)*

Note: PPP – Purchasing Power Parity; RoK – Republic of Korea; CEP – Comprehensive Economic Partnership; FTA – Free Trade Agreement
Numbers in the bracket give % share in world total
Source: World Economic Outlook, October 2013 Database, IMF; World Trade Organisation Database; Authors' estimate

(Source: Sanchita Basu Das, "Growing Economic Diplomacy in ASEAN: Opportunities and Threats" ISEAS Perspectives, No. 22, 10 April 2014, http://www.iseas.edu.sg/documents/publication/ISEAS_Perspective_2014_22-Growing_Economic_Diplomacy_in_ASEAN.pdf)

Besides RCEP, the other mega-regional trade agreement (RTAs) is the Trans Pacific Partnership (TPP) which is being negotiated among twelve countries (Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the United States and Vietnam) but does not include major powers like China and India and key ASEAN members such as Indonesia; Thailand and the Philippines are still considering whether to join. The aim of TPP is to liberalise trade in goods and services, encourage investments, promote innovation, economic growth and development and support job creation and retention.[83] The TPP is known to be difficult to conclude and missed its December 2013 deadline. While there have been discussions that RCEP and TPP could be combined to lead to the creation of a free trade area for Asia-Pacific (FTAAP), the political rivalry between the US and China over Asia-Pacific will make it difficult to combine the two mega-RTAs.

82 http://www.asean.org/news/item/asean-framework-for-regional-comprehensive-economic-partnership

83 http://www.iseas.edu.sg/ISEAS/upload/files/Paper-ASCCC-2014-SBD.pdf

3. The global and regional energy context to 2030

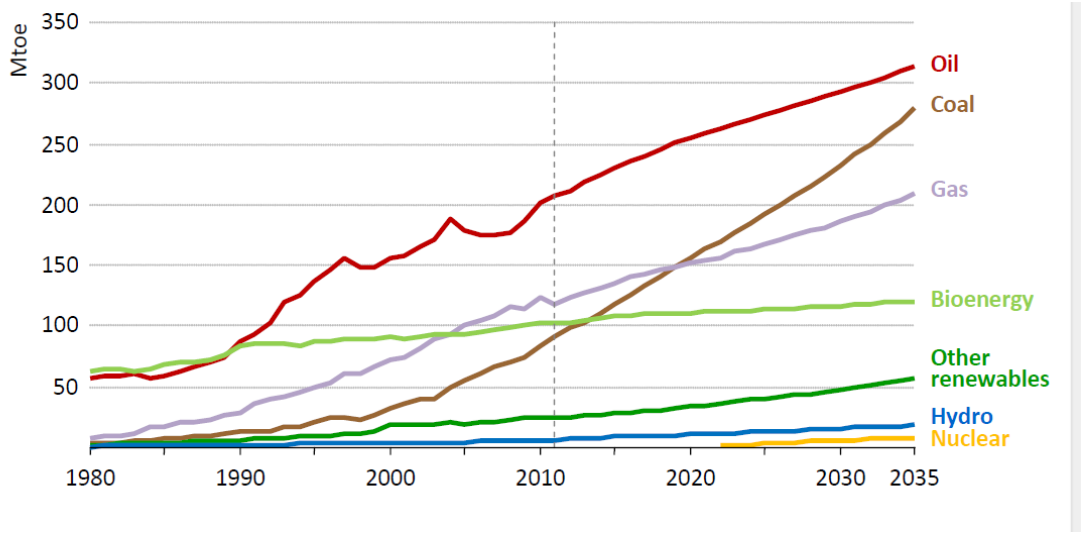
3.1 Global and regional energy trends

This section identifies those trends in global and regional energy supply, demand and flows and investment requirements that have the greatest potential significance for ASEAN (This section draws heavily on two sources: IEA, World Energy Investment Outlook, 2014. IEA, South East Asia Energy Outlook 2013).

3.1.1 Energy demand.

A combination of economic growth and population increase will drive rising demand for all forms of primary energy, especially gas, but also coal, oil and renewables. Sixty percent of this demand growth will occur in China, India and Southeast Asia. In ASEAN alone, energy demand may grow by 60% between 2011 and 2030. The absolute quantity of energy used and the energy mix will depend greatly on policy decisions taken by governments to improve energy efficiency and reduce the share of coal and other fossil fuels in the energy mix. The consumption of coal demand will grow across Asia, and most rapidly in Southeast Asia and India where it will be used for power generation and industry (Fig.1). Gas demand in Asia could increase more than two-fold to 2030, mostly in China, but also India and Southeast Asia.

Figure 1. ASEAN primary energy demand by source, IEA New Policies Scenario



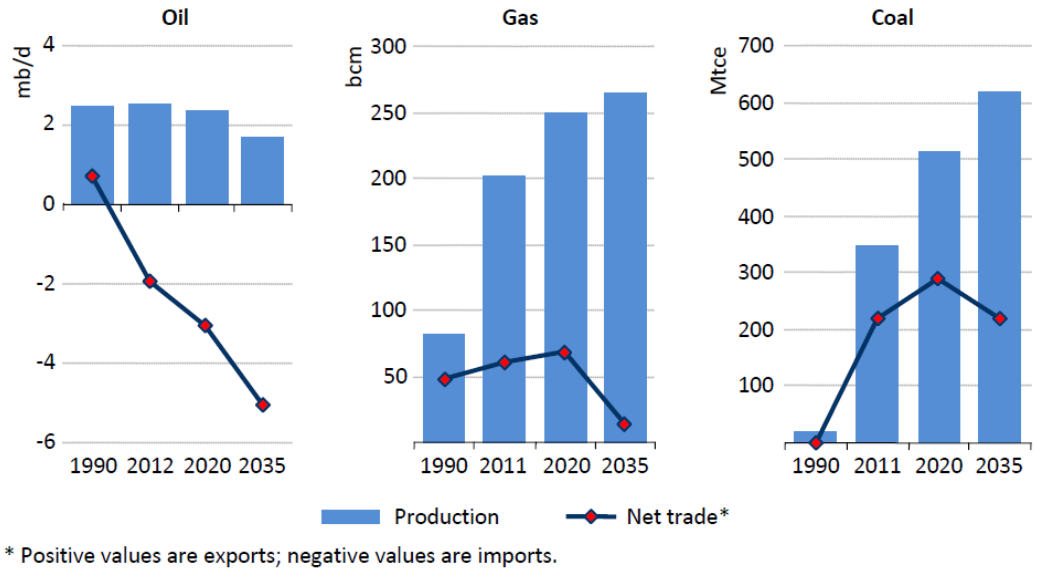
Source: IEA, South East Asia Energy Outlook 2013

In addition to the problem of changing the energy mix, governments across Asia face two energy challenges with a strong societal component. The first is to gradually reduce fossil fuel subsides in order to constrain demand growth and reduce the burden on the national budget. In 2012, the total amount of subsidies for fossil fuels in ASEAN is estimated to have reached US$51 billion. The second is to to provide electricity and clean cooking energy to the hundreds of millions of people in South and Southeast Asia. Within ASEAN in 2011, it is estimated that 134 million people, or 22% of the population, lacked access to electricity, and 279 million (47% of the population) were cooking using traditional biomass.

3.1.2 Energy production

The Middle East will remain the key oil producing region in the world, but North America will become increasingly important. Oil production within ASEAN will decline (Fig. 2). Likewise, incremental coal production will become increasingly concentrated in Asia, mainly China, India and Indonesia, and in Australia. In contrast, incremental production of natural gas will be distributed among a number of regions, notably the Middle East, Africa, China, Central Asia, the USA and Russia, in part due to the rise of unconventional gas. Renewable electricity generation other than hydroelectricity could start to make a major contribution to global electricity generation over the next 25 years, rising from 4% of total electricity generation in 2011 to 15-20% by 2030. China and, to a lesser extent, India and Southeast Asia will be major centres of growth for renewable energy. Although China and India both have ambitious plans for nuclear energy, its role on ASEAN is likely to remain very small over the period to 2030.

Figure 2. ASEAN fossil fuel production and trade



Source: IEA, South East Asia Energy Outlook 2013

3.1.3 Energy trade

The coming two decades will see dramatic shifts in the patterns of global trade in energy commodities as well as the continued growth in the quantity of trade. On the one hand, China's and India's net import requirements for oil and gas will keep growing. On the other hand, North America becomes a net exporter of oil and gas. The Middle East, Africa, Russia and the Caspian region will remain as net exporters of oil and gas, and this quantity of exports will increase, with the exception of some countries where domestic demand will take a growing share of production. Russia and Middle East will be sending more gas and oil to South, Southeast and Northeast, and Africa is set to become a new gas supplier to Asia. Developing Asia (China, India and Southeast Asia) changes from being a marginal net exporting region for gas in 2011 to a major importer by 2025, with net imports reaching more than 320 billion cubic metres per year, or 31% of gas consumption. ASEAN's net

imports of oil will continue to grow, whilst its capacity to be a net exporter of coal and natural gas is likely to reach a peak over the next 15-20 years (Fig. 2).

Along with changing trade flows, the nature of international gas markets will continue to evolve. The next 25 years will see a gradual increase in share of internationally-traded gas that is priced based on gas-to-gas competition, but this is mainly in Europe and North America. In Asia, prices for LNG have tended to be benchmarked against oil and are significantly higher than in Europe. But even here, there is a long-term trend towards more market based pricing, growth of spot markets and development of one or more Asian gas hubs.

3.1.4 Energy and the environment

Greenhouse gas emissions are set to continue rising, notably in the industrialising nations of Asia, not least because of coal use. India, China and Southeast Asia could account for 45% of global greenhouse gas emissions by 2035, though emissions intensity (emissions per unit of GDP) will decline. The growing use of coal and oil in ASEAN will add substantially to local and regional atmospheric pollution.

3.1.5 Technology

A wide range of technologies will be required across the world and in ASEAN. Some of these are already commercialised and require diffusion, others have been developed but have not been commercialised, whilst yet others are still at an early stage of development (Table 5). Within ASEAN, the priority over the next two decades should be to promote the diffusion of what are today the best available commercialised technologies along with best practices. In the case of energy efficiency, such policies would result in a reduction of total energy demand of 13% in 2035 compared to a less efficient scenario (IEA, 2013).

Table 5. Examples of energy technologies To be expanded at next brainstorming session

Commercialised	**Not commercialised/early commercialisation**	**Under development**
Shale gas, coal bed methane extraction	Smart grids	Fourth generation nuclear energy
Wind power and solar PV	Ultra High Voltage transmission	Carbon capture and storage
Small-scale LNG, floating LNG	Electric cars	Large scale electricity storage
Building insulation	Integrated gasification combined cycle technology	Methane hydrate production
Ultra-super critical technology		Fourth generation solar technology
Energy efficient industrial technologies		
Energy efficient vehicles technologies		
Energy efficient lighting		

3.1.6 Investment

In order to meet the world's energy demand, a massive amount of investment is required in energy supply and energy efficiency. Annual investment needs to increase from US$ 1.7 trillion in 2013 to US$ 2.5 trillion in 2035 in real terms. This amounts to a total of about US$ 48 trillion over the period to 2035 (Table 6). Whilst the investment needed in ASEAN's energy sector is only 4% of this total, this still amounts to US$ 2.0 trillion, or about US$ 100 billion per year in 2012US$ terms. Much of this investment will have to come from outside ASEAN, from international companies and international financial institutions, as well as from state-owned enterprises and their home governments.

Table 6. Estimates of total investment needs to the year 2035 for the world and for ASEAN, in billions of 2012 US$.

		World	**ASEAN**
		Total 2014-2035	**Total 2013-2035**
Fossil fuel supply	Oil	13,700	205
	Gas	8,800	460
	Coal	1,000	40
	Sub-total	23,400	705
Electricity supply	Power generation	10,000	440
	T and D	7,000	550
	Sub-total	17,000	990
Total energy supply		40,000	1,695
Energy efficiency		8,000	330
Total investment requirement		**48,000**	**2,025**

Sources: IEA, World Energy Investment Outlook, 2014. IEA, South East Asia Energy Outlook 2013.

3.2 Regional energy actor behaviours

This section will examine the recent and current behaviours of key energy actors across South and East Asia, with special reference to the governments and energy companies of China, Russia, India, Japan and South Korea, but also the Middle East. It will highlight the significant and growing engagement of Asian energy companies in the ASEAN region in a manner that has some neo-mercantilist characteristics. (Main source: unpublished ESI database of investments in ASEAN)

The engagement of these countries and their companies in ASEAN usually takes one or more of the following forms:

- Investment in the production of primary energy such as oil, gas, coal and hydro-electricity, as well as rare earth metals.
- Investment in energy transformation infrastructure such as oil refineries, gas liquefaction plants, and thermal power stations.

- The provision of construction and technical services relating to primary energy production, transformation and transportation.
- Trade in energy raw materials such as coal, oil and natural gas, as well as electricity.

3.2.1 Investment in the production of primary energy

Oil and gas. ASEAN is rich in primary energy resources and foreign investment in the extraction of these resources dates back to the 1890s when the founders of the company that would later become Royal Dutch Shell discovered oil in North Sumatra. Since that time, major international oil companies (IOCs) and many smaller independent companies, in partnership with Pertamina since 1957, have contributed to making Indonesia the largest producer of oil and gas in ASEAN. Oil production in Malaysia and Brunei also dates back to the beginning of the twentieth century. Each ASEAN country has its own national oil company (NOC) which plays an important role in either production or sector management, or both.

With the exception of a small number of licenses awarded Japanese companies in Indonesia and Thailand in the 1960s and 1970s, the IOCs in partnership with host country NOCs have dominated oil and gas exploration and production in ASEAN. In the meantime, in 1981 the Soviet Union had established Vietsovpetro as an oil and gas joint venture between Zarubezhneft and PetroVietnam which has played a major role in developing Vietnam's oil industry. The late 1980s and early 1990s saw renewed interest on the part of Japanese companies as they expanded into Vietnam, Malaysia, Cambodia and Myanmar, as well as the first investments in ASEAN oil and gas assets by companies from China, Korea (ROK) and India. Chinese NOCs took out licenses in Indonesia and Thailand, marking the first steps of what was to become a massive programme of overseas investment, whilst ONGC Videsh (OVL) of India and the Korean National Oil Company (KNOC) joined IOCs in the search for oil offshore Vietnam.

The marked increase in international oil prices in 2003 and 2004 triggered an upsurge of overseas investment in oil and gas assets by companies from the importing nations of Asia, notably China, Japan, Korea and India. China has been the most prominent actor, with a large number of onshore and onshore oil and gas projects in Indonesia and Myanmar, and minor interests in Thailand and Cambodia. Japanese companies have built up their ongoing presence across ASEAN, OVL took out new blocks in Vietnam and Myanmar, and KNOC acquired assets in Indonesia, Thailand and Cambodia. For the first time, the Overseas Petroleum Investment Corporation (OPIC) of Taiwan (Republic of China) started to invest in the region, partnering with IOCs in Indonesia and with China's Sinopec in Myanmar. Though from an oil and gas exporting country, Russian oil companies have also been showing greater interest in ASEAN resources, signing new contracts in Vietnam and starting to build a presence in Indonesia.

Despite the long period of their engagement in ASEAN's oil and gas sector, these external Asian oil companies have never played a prominent role in any one country, with the exception of Russian companies in Vietnam and Chinese companies in Myanmar before the first international licensing round was held in 2013.

With the exception of Russia, the motivations for these overseas investments are multiple. The government are supporting their oil companies in order to gain access to overseas sources of oil and gas supply in the (arguably mistaken) belief that this will enhance national

security of supply. For the companies, the objectives include a mix of internationalising their businesses, making profits and secure supplies for their downstream activities in their home countries. In these respects, their investments in ASEAN are part of global oil and gas strategies in which ASEAN plays a relatively minor role on account of the small size of its remaining resource. As Russia is a major exporter of oil and gas, its motivations are probably limited to corporate business goals and the government's desire to build influence in the region.

Hydro-electric dams. Chinese companies are involved in more than 100 hydro-electric dam projects across ASEAN, of which about 30 have a capacity greater than 500 MW. The largest projects exceed 7,000 MW and are in Cambodia and Myanmar. The Sinohydro Corporation is by far the largest actor. Other investors include the China International Water and Electric Corporation, China Power Investment Corporation, Guodian, Huaneng and the Three Gorges Corporation as well as companies from border provinces such as Yunnan and Guangxi. The involvement of these Chinese companies generally takes one of two forms: either a build-operate-transfer (BOT) contract, which is a true investment, or a construction only arrangement. Japan is the other country with a significant dam building on ASEAN but at a much smaller scale than China, whilst Russia and Korea have a very low level of activity. In most cases the projects receive financial support from the foreign country, through the government or state-owned banks

In all these cases, it is difficult to obtain sufficient information to determine whether individual projects involve investment by these foreign companies or just construction contracts. The motivations for undertaking the investment projects include corporate goals of profits and international business development as well as government objectives of development aid and regional influence. China is one exception, as electricity generated from neighbouring countries in Southeast Asia can be transmitted back to satisfy its growing domestic demand for energy.

Coal. In addition to oil and gas, Indonesia has substantial reserves of coal and both Chinese and Japanese mining companies have entered into joint ventures with local mining companies. Though the reserves are much smaller in these countries, Vietnam has received investment in its coal mines from Japan and Myanmar has Chinese investors. The corporate objectives are threefold: to internationalise their business, to make profits and to help satisfy their home countries needs for imported coal.

Nuclear energy. (Main sources: World Nuclear Association documents**)** No ASEAN member state has a nuclear power plant in commercial operation. The Fukushima accident put a temporary halt to development in those ASEAN states which had aspirations, but a number of governments have recently revitalised plans or are assessing their options. In all cases, the construction of a nuclear power plant will require technologies and skills from outside ASEAN and, in many cases, financial support. Japanese, Korean, Russian and, more recently, Chinese companies are all actively promoting their interest in these projects. In most cases, the foreign government is aiming to support the export of its companies' technology and expertise and could provide financial assistance to the projects.

Vietnam is the furthest ahead with plans for four reactors, two of Russian design and two of Japanese design. Korea is also reported to be in discussions to construct a plant in Vietnam. Construction of the first Russian plant was due to start in 2014 or 2015, but early in 2014 the Vietnamese government announced that this was being postponed by up to six years on safety grounds. In Thailand, the national power development plan has identified the

potential for nuclear power since 2007 and agreements have been signed with Japanese and Chinese nuclear power companies. Feasibility studies have been underway, but in August 2014 the government ruled out the nuclear option. Both Korean and Japanese companies have been working with the Indonesian government for several years to assess the options for nuclear power plants, and have identified a number of possible locations. More recently, Russia has been proposing the use of floating nuclear power plants for use by Indonesia's small islands. The Malaysian government has identified possible sites, is planning a feasibility study for nuclear power and has been in discussion with Korean and Russian companies. The Philippines built a reactor of US design as far back as 1985, but it was never put into operation on account of safety concerns. The government is now considering whether to refurbish and commission it and construct other plants. Myanmar also announced in 2014 that it wishes to revitalise its nuclear programme which dates back to earlier research and training cooperation with Russia's Rosatom.

Rare earth metals. Although not a source of energy in themselves, rare earth metals are vital inputs to appliances which produce and use energy. After China's curtailment of rare earth metal exports in 2010, both Japanese and Korean companies have been seeking to develop overseas sources of supply. This has included investigating mining opportunities in Vietnam and Myanmar, both of which have deposits of rare earth metals.

3.2.2 Investment in energy transformation

Most oil refineries and petrochemical plants, LNG liquefaction plants and thermal power stations in ASEAN are owned and operated by the companies from the host country itself or by international companies from outside of Asia. Involvement in ASEAN's energy transformation sector by companies from other Asian countries appears to be quite limited.

Oil refineries and petrochemical plants. China's companies are the most active with PetroChina owning a large majority of the shares of the Singapore Petroleum Company since 2006 and getting involved in the construction of petrochemical plants in Myanmar, and the privately-owned Zhejiang Hengyi Petrochemicals Company investing in an oil refinery and aromatics complex in Brunei.
NOCs from the Middle East have yet to take a strong position in ASEAN. Saudi Aramco sold its 40% stake in Philippines' Petron in 2008. Kuwait Petroleum has a 35% stake in a consortium which started construction of a refinery and petrochemical complex in Vietnam in 2013 after 5 years of negotiation. Mitsui and Idemitsu from Japan are the other foreign partners. Both Kuwait Petroleum and Saudi Aramco signed initial agreements with Pertamina in 2010 to build two new refineries by 2018, but in late 2013 the negotiations were terminated.

Liquefied natural gas (LNG). China National Offshore Oil Company (CNOOC) purchased a share of the Tangguh LNG project in Indonesia from BP in 2003, and a number of Japanese companies own. Much of this LNG is sent to China and Japan.

Thermal power stations. Both Chinese and Japanese companies are investing in thermal power plants in ASEAN, but at a very limited scale. Chinese companies have power plants associated with coal mines that they operate in both Indonesia and Myanmar. A Chinese company is also building a thermal plant alongside an aluminium smelter in Indonesia. Japanese companies are involved in coal-fired plants in Vietnam and Indonesia.

The aims of most of these projects appear to be corporate internationalisation and profits. In the case of the Tangguh LNG plant, these investments reflect the broader strategy of Chinese and Japanese companies to be involved in the full LNG supply chain back to their home countries.

3.2.3 The provision of construction and technical services

Oilfield services. In the past, oil field services across ASEAN were provided either by subsidiaries of the NOCs or by international services companies from Europe and the USA. The restructuring and internationalisation of China's NOCs in the 1990s led to a massive growth in the overseas activities of the subsidiaries of these NOCs, especially those of CNPC/PetroChina.

Pipeline construction. China's CNPC has great experience in building long-distance pipelines and was the key member of the consortia that constructed the oil and gas pipelines from Myanmar to China. These consortia also included companies from Korea and India.

Hydro-electric dams. As described above, companies from China, Japan, Russia and Korea are all involved in the construction of dams in ASEAN member states to a varying extent. Some projects involve investment whilst others are purely construction contracts.

3.2.4 Trade in energy raw materials

(Main sources: ASEAN Statistical Yearbook 2013; BP, Statistical Review of World Energy, 2014; IEA, Coal Information 2012 edition)

ASEAN lies between the Middle East, a major energy exporting region, and Northeast Asia, a major energy importing region. ASEAN is heavily dependent on the Middle East for crude oil imports. This dependence has grown in recent years from 42% by value in 2008 to 69% in 2012, and is likely to grow further as net oil imports grow. Crude oil imports from Russia and Azerbaijan are also increasing. The total volume of imports of oil products to ASEAN member states is also rising rapidly, as is the share provided by the Middle East which increased from about 4% in 2008 to 9% in 2012. Malaysia and Brunei continue to export crude oil. A growing proportion of these exports flows to Northeast Asia and Australasia, reaching 66% by value in 2012, but only 20% by value of the crude oil exports flow to other ASEAN member states. ASEAN member states also export a significant quantity of oil products. The share of these products which are sent to other ASEAN member states rose from 48% to 58% by value between 2008 and 2012. Over the same period the flow to Northeast Asia declined from 23% to 17% of total oil product exports.

Northeast Asia is also the major market for ASEAN's LNG exports, with 98% going to China, Japan, Korea and Taiwan and these countries relying on ASEAN for 30% of their LNG imports. In addition a new pipeline takes gas from Myanmar to China. Thailand became ASEAN's first importer of LNG in 2011. By 2013 it was importing 2 bcm/yr, of which 80% came from the Middle East and none from within ASEAN.

There are also strong connections between ASEAN and Northeast Asia in the coal trade. Indonesia accounts for nearly all of ASEAN's coal exports, as Vietnam is about to become an importer of coal having been an exporter for many years.60% of Indonesia's coal goes to

Northeast Asia, with 24% going to India. At the same time, about 30% of Northeast Asia's coal imports come from Indonesia. Of the total exports of coal from Indonesia approximately 14% by value went to other ASEAN member states in 2012, and this accounted for 80% by value of the coal imports of these countries.

Although the total volume of energy trade between ASEAN and Northeast Asia is relatively small, ASEAN lies astride the sealanes along which Northeast Asia's energy imports pass. More than 70% of the oil imports and about 45% of the LNG imports of China, Japan, Korea and Taiwan travel through ASEAN seas, principally the Malacca Straits from Middle East and Africa. A further 15% of northeast Asia's LNG travels from Australia through ASEAN seas further to the east. Coal imported to North Asia from South Africa and Australia also passes through ASEAN waters

4. Implications for ASEAN

4.1 ASEAN's external energy security challenges

From the evidence presented in the previous section we identify ASEAN's external energy security challenges under three headings:

- Security of external energy supply;
- Management of domestic energy resources
- Clean and efficient energy supply and use

4.1.1. Security of external oil supply

Security of external energy supply is most relevant to oil, as net oil imports to ASEAN continue to grow and the region is likely to remain a net exporter of coal and gas for to at least 2030. The security of oil supply is a threat to oil importers that has been recognised since the OPEC oil embargos of the 1970s. The threat has two inter-related components: a substantial physical interruption of oil supplies lasting for a significant period of time, and a sharp increase if oil prices. For ASEAN, as for many other regions, the most important location of a physical interruption of any size is the Straits of Hormuz through which a significant and growing share of ASEAN's oil imports flow (Mitchell, 2014).[84] A prolonged interruption at this point would have serious economic consequences for most ASEAN nations as oil prices was rise markedly. The Malacca Straits is another choke point which could be blocked easily, though the consequences for ASEAN would be less serious that from a closure of the Straits of Hormuz, as ships could take alternative routes to their destinations. This would raise costs and add time, but cause no sustained interruption.

A sustained high level of prices or sudden spikes in oil prices are much more likely than a significant physical interruption. Such price increase can be driven by a wide range of economic and political factors occurring anywhere in the world as well as by natural disasters or military action. The economic consequences can be just as dire for ASEAN member states as a physical interruption at a single location because of the high level of subsidies on oil products sold in most ASEAN member states (See AEMI paper No.1 on prices

[84] Mitchell (2014) estimated that the share of national crude oil consumption passing through the Straits of Hormuz amounted to 88% for Singapore, 33% for Thailand, 29% for Malaysia and 15% for Indonesia

and subsides). The higher the level of fuel subsidies, the greater the impact on the national budget. Conversely, the higher the level of fuel tax, the less the impact on the consumer.

4.1.2 Management of domestic energy resources

Despite the declining output of crude oil, ASEAN is relatively rich in other primary energy resources such as coal, natural gas and hydro-electricity, and probably has significant resources of unconventional gas (coal bed methane shale gas and possibly methane hydrates) and geothermal energy.

As described in section 3.1, ASEAN has a massive requirement for investment in the production, transformation and transportation of primary energy in order to satisfy its rising energy demand. Much of this funding will need to come in the form of foreign direct investment or as bilateral or multi-lateral aid. Whilst traditional international energy companies are still investing in ASEAN, national and state-backed companies from other ASIAN countries are playing a growing role. Such countries include China, Japan, Korea, Russia, India, and the Middle East.

Such investment is to be welcomed, in principle, provided that (1) the energy produced is made available to the host nation and to the wider ASEAN community, (2) the environmental and social impacts of the projects are managed in a responsible way, (3) the technology used is the best available and/or most appropriate, and (4) the construction and operating practices meet international standards.

Concerning the first point, the construction of hydro-electric dams by Chinese companies in Myanmar and on the Mekong River in ASEAN member states and of a gas pipeline in Myanmar is being undertaken with the explicit purpose of sending energy from ASEAN member states to China. Whilst this may bring economic benefit to the host ASEAN member state in the short-term, such investments create the risk that limited ASEAN energy resources are being sent abroad rather than being kept to satisfy demand within ASEAN. Some of these same projects have caused significant dissatisfaction among local populations, notably in Myanmar, on account for the poor management of social and environmental impacts.

In order to ensure the long-term sustainability of its energy sector, ASEAN should ensure that all energy projects use the best or most appropriate technologies and apply international standards to construction and operation. Whilst these requirements apply equally to all sources of energy and along the full supply chain, the energy source that is causing the greatest concern is nuclear energy. In this industry, Russia, Japan, Korea and China are all competing to win projects in ASEAN countries. It is up to ASEAN and its member state governments to ensure that the suppliers and contractors meet the highest standards.

Two further issues relating to domestic primary energy resources also relate to countries in Northeast Asia. The first concerns the maritime territorial disputes in the South China Sea and China's persistence in proclaiming its historic rights over a vaguely defined area bounded by a nine-dashed line that it backs up with active oil exploration. Legal grounds (though not definitive) exist for a number of ASEAN member states to claim sovereign rights over energy resources that lie within the area of the nine-dashed line. Were it decided that such resources belonged to one or more ASEAN member states, this would in principle enhance ASEAN's security of energy supply.

The second issue concerning Northeast Asian countries arises from the large proportion of ASEAN's energy exports which go to this region and, conversely, the high level of dependence of Northeast Asian states on energy which flows from ASEAN suppliers and through ASEAN maritime waters.

Taken together, these considerations highlight the growing degree of interaction and interdependence between ASEAN member states, on the one hand, and governments and energy companies from Northeast Asia (China, Japan, Korea and Russia) as well as from India and the Middle East, on the other hand. This phenomenon provides opportunities in terms of investment, technology and skills, but poses a range of risks if these relationships are not managed well.

4.1.3 Clean and efficient energy supply and use

In addition to the massive investment in to raise the scale of energy supply, ASEAN also faces to need to boost investment in energy efficiency and clean energy along the supply chain. This will require funds, technology and skills, much of which is likely to come from outside ASEAN, at least over the next few years. If ASEAN can develop into a single market for energy technology, goods and services, this is likely to encourage investment and the provision of energy services from outside ASEAN.

4.2 ASEAN's current capacity to meet these challenges

In order to assess ASEAN's capacity to address these external challenges, we examine three aspects of energy governance in ASEAN:

- Progress towards ASEAN energy market integration.
- The nature of (energy) diplomatic relations between ASEAN and key external actors and organisations.
- The capacity of ASEAN to act cohesively and communicate externally with a single voice on energy matters.

4.2.1 Progress towards ASEAN energy market integration.

ASEAN energy market integration provides a number of regional public goods, one of which is enhanced security of energy supply (Andrews-Speed and Hezri, 2013; other AEMI 2 papers). This benefit arises through the free movement of energy commodities, energy services, technologies, investment and skilled labour across the region. Effectively managed, energy market integration enhances long –term energy security through the more effective allocation of resources between ASEAN member states of complementary energy endowments and capacities. It also boosts the region's ability to react to short-term crisis through sharing of energy supplies and emergency stocks.

Whilst progress has and continues to be made towards ASEAN energy market integration, progress has been slower than might have been hoped in a number of respects (Andrews-Speed and Hezri, 2013; other AEMI 2 papers):

- The Trans-ASEAN Gas Pipeline and the ASEAN Power Grid are behind schedule, constraining physical inter-connection between member states.

- The ASEAN Trade in Goods Agreement may have removed most tariffs but many non-tariff barriers to trade in energy remain in place.
- The ASEAN Comprehensive Investment Agreement has country specific annexes which list many exemptions relating to energy. These restrictions on investment flows within ASEAN are exacerbated by regulatory and fiscal measures at national level which constrain the flow of inward investment in energy regardless of the source of the funds.
- A revised ASEAN Petroleum Security Agreement (APSA) was signed in 2009 and ratified in March 2013. It provides for voluntary (not obligatory) measures in times of supply crisis, including emergency energy-saving measures and the sharing of oil or gas. It allows for, but does not oblige member States to construct oil stockpiles either individually or jointly. The sharing mechanism has never been implemented as supply problems have been solved bilaterally between ASEAN members, with non-ASEAN oil producers or through oil traders (Nicolas, 2009). As a result, it is very uncertain how the APSA mechanism would work in a supply crisis (Mitchell, 2014).
- One of the objectives shared by the strategies for renewable energy and energy efficiency is to promote the development of manufacturing capacity and trade across ASEAN in the relevant technologies and appliances. Progress in this regard has been hampered by a number of factors, such as weak technological capabilities and the lack of national technical standards (ASEAN Centre for Energy, 2013).

More fundamentally, energy does not appear to have been identified as a priority for the ASEAN Economic Community (AEC), either in official documents nor in published accounts which assess progress towards the AEC (cite books published in 2014).

Unless the pace of ASEAN energy market integration is accelerated, the capacity to manage external energy challenges will remain low.

4.2.2 The nature of (energy) diplomatic relations between ASEAN and key external actors and organisations.

Whilst ASEAN has a relatively good track record of external engagement relating to general political and economic issues, it is has been much less active on matters relating to energy. This is not to say that ASEAN members do not recognise the importance of international engagement to attain greater regional energy cooperation. The 2010 ASEAN Plan of Action for Energy Cooperation 2010-2015 adopted in July 2009 noted that the 25th and the 26th ASEAN Ministers of Energy Meetings held in November 2007 in Singapore and in August 2008 in Bangkok, Thailand had provided guidelines and directives towards enhancing regional cooperation on energy. The 2010 Plan of Action reiterated the call to,

> "Expand external energy cooperation and to continue joint programs under the ASEAN+3
> and the East Asia Summit (EAS) energy cooperation programs and dialogue partners, such as, the European Union, Japan, Australia, Germany, etc."[85]

85 2009 ASEAN Plan of Action on Energy Cooperation 2010-2015 adopted on 29 July 2009 in Mandalay, Myanmar by the Energy Ministers, Pg 11,, http://cil.nus.edu.sg/2009/2010-asean-plan-of-action-on-energy-cooperation-2010-2015/

Back in 1998, the East Asia Vision Group (EAVG) - composed of eminent intellectuals from the ASEAN Plus Three member states – was tasked with drawing up a vision for mid-to-long term cooperation in East Asia for the 21st century.[86] The EAVG Report was submitted to the leaders attending the 2001 ASEAN Plus Three Summit.[87] The report called for closer energy cooperation at the East Asian regional level. It called on East Asian governments, "to strengthen and increase efforts towards institutionalizing environmental and energy cooperation in the region" and had dedicated an entire section under the "Energy Cooperation" where it called for the region to "jointly develop and explore new sources and supplies of energy within the region, and promote the efficient use of energy", and called for a framework "to help the region develop a broad regional consensus for energy policies and strategies both for the short and long term".

Over a decade later, the East Asia Vision Group II (EAVG II) was established in 2010 and the EAVGII Report with recommendations titled, *Realising an East Asia Economic Community by 2020* was submitted to the ASEAN Plus Three Summit leaders in Phnom Penh, Cambodia in 2012. The authors in this report again called for,

> "Strengthening of cooperation efforts in the efficient supply and use of natural resources, energy saving practices, oil stockpiling, civilian use of nuclear energy, and development of green technology".[88]

The EAVGII report noted that ASEAN Plus Three Ministers had agreed in 2002 to a five point initiatives for energy cooperation among members, consisting of: (1) the creation of emergency energy security network, (2) the development of oil stockpiling, (3) joint studies on the APT oil market, (4) the improvement of natural gas development and (5) the improvement of energy efficiency and renewable energy. It went on to note that progress in these five areas remained limited,

> "Most of the initiatives are at very preliminary stage such as APT oil market, natural gas development and the improvement of energy efficiency and renewable energy. Some other initiatives such as oil stock piling are on voluntary and non-binding, causing a big gap between developed member countries and least developed member countries."

This observation by the EAVGII has highlighted the slow pace in developing these five energy cooperation initiatives over the past decade and raises the question on whether substantial progress can be achieved by 2020. It served to demonstrate how ASEAN's slow decision-making process has also hampered the organisation's ability to engage with its closest three neighbours, China, Japan and Korea.

ASEAN has recognised energy cooperation as a key area for external engagement and cooperation with external parties. Three examples are provided here relating to India, Russia

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86 ASEAN Plus Three Cooperation, 22 January 2014, http://www.asean.org/asean/external-relations/asean-3/item/asean-plus-three-cooperation

87 Towards and East Asian Community – Region of Peace, Properity and Progress (2001), http://www.mofa.go.jp/region/asia-paci/report2001.pdf

88 Report of the East Asia Vision Group II (EAVGII), 19 November 2012, http://www.mfa.go.th/asean/contents/files/asean-media-center-20130312-112418-758604.pdf

and Canada. During the 8th ASEAN-India Summit in Hanoi, Vietnam, in October 2010, ASEAN and India agreed on a Plan of Action Plan of Action To Implement the ASEAN-India Partnership for Peace, Progress and Shared Prosperity (2010-2015) which had called for greater energy cooperation between ASEAN and India.[89] In the case of Russia, the ASEAN-Russia Energy Cooperation Work Programme 2010 – 2015 was adopted in Danang, Vietnam, in August 2010 with focus on "capacity building programmes, development of alternative and renewable energy resources, energy infrastructure, peaceful use of nuclear energy, coal, and oil and gas exploration."[90] With Canada, ASEAN also had a *Plan of Action to Implement the Joint Declaration on ASEAN-Canada Enhanced Partnership* issued in July 2010, in Hanoi, Vietnam.[91] This plan similarly called for strengthen energy cooperation between the two sides and expressed support for the implementation of the ASEAN Plan of Action on Energy Cooperation (APAEC) 2010-2015.

Such Plan of Actions covering energy cooperation with the external parties are intended to facilitate the deepening of cooperation between ASEAN and the external parties. While holding great promise, they all also remain at the preliminary stage. One of the key reasons for the slow progress is probably because the ASEAN Secretariat has inadequate human and financial resources to manage the expanding energy cooperation agenda with multiple external parties. Another key reason is likely to be due to the slow progress in the implementation of the ASEAN Plan of Action on Energy Cooperation (APAEC) 2010–2015 between ASEAN member states themselves. Given that internal regional conditions remain inadequate, the contributions by external parties have also been limited as a result.

ASEAN has concluded a number of Free Trade Agreements with North-East Asian States (China, Japan, Republic of Korea and Taiwan), as well as with Australia, New Zealand and India. The 10 ASEAN members and their Free Trade Agreement partners – Australia, China, India, Japan, Republic of Korea and New Zealand – have also launched a new economic initiative called the Regional Comprehensive Economic Partnership (RCEP). This is a 16-party Free Trade Agreement aimed at broadening and deepening economic engagements with its FTA partners. ASEAN's growing interest in North-East Asia stimulated the formation in 1997 of ASEAN+3 (Japan, China and the Republic of Korea). This grouping started with its focus on financial and economic recovery, but later expanded to cover many fields, including infrastructure, energy, the environment, food, disease control and maritime piracy.

ASEAN+3 soon led to the creation of yet another, even larger cluster that became known as the East Asian Summit (EAS) with the objectives of (a) facilitating confidence-building and discussions on broad strategic issues that concern the region and (b) developing East Asian regionalism in an inclusive manner (Desker, 2005). At its first meeting in 2005, EAS

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89 Plan of Action To Implement the ASEAN-India Partnership for Peace, Progress and Shared Prosperity (2010-2015), http://cil.nus.edu.sg/rp/pdf/2010%20Plan%20of%20Action%20To%20Implement%20the%20ASEAN-India%20Partnership%20for%20Progress%20and%20Shared%20Prosperity%20(2010-2015)-pdf.pdf

90 ASEAN-Russia Dialogue Relations, June 2012 , http://www.asean.org/asean/external-relations/russia/item/asean-russia-dialogue-relations

91 Plan of Action to Implement the Joint Declaration on ASEAN-Canada Enhanced Partnership, http://www.asean.org/archive/documents/Plan%20of%20Action%20to%20Implement%20the%20Joint%20Declaration%20on%20ASEAN-Canada%20Enhanced%20Partnership_f.pdf

comprised the 13 members of ASEAN+3 and Australia, New Zealand and India. The United States of America and the Russian Federation joined in 2011. The agenda is mainly to promote strategic dialogue and cooperation in East Asia, including energy issues, but concrete progress is constrained by differences of opinion on the membership, role and objectives of EAS, and on its relationship with ASEAN+3 (Dent, 2008).

In addition, ASEAN participates in the Asia Cooperation Dialogue Pacific Economic Cooperation Council and in the Asia Pacific Economic Cooperation (APEC). It also has bilateral arrangements with other regional organizations such as the Gulf Cooperation Council (GCC), MERCOSUR, the Southern African Development Community, the Shanghai Cooperation Organization, and the Organisation for Economic Co-operation and Development as well as a number of United Nations organizations.

Although ASEAN has succeeded in building this wide web of general political and economic relations, in most cases these interactions are relatively shallow (references) and few have a strong focus on energy. In this respect it is notable the ASEAN has little engagement with key energy organisations. Indonesia and Thailand are the only two ASEAN member states which have close relations with the International Energy Agency (IEA), but ASEAN itself has no formal engagement with the IEA, nor with other energy-related international organisations such as the Energy Charter Treaty or the International Energy Forum IEF). Only the Philippines and Brunei are members of the IEF. ASEAN's window on the Middle East oil suppliers is provided through its formal relationship with the GCC, but this partnership seems to pay little attention to oil. The ASEAN-GCC Two-Year Action Plan 2010-2012 mentions the promotion of investment in energy, including alternative and renewable energy, but this is just one of many sectors including agriculture, tourism and construction.[92]

4.2.3 The capacity of ASEAN to act cohesively and communicate externally with a single voice on energy matters.

In this section we assess ASEAN's capacity to act and communicate cohesively on four types of issue:

- Response to energy supply crises
- Engagement with state-backed energy companies from outside ASEAN.
- South China Sea
- Sealane security

The most important contribution to alleviating a global oil supply crisis is effective communication by all actors. No ASEAN member states are members of the IEA, ASEAN has no formal engagement with the IEA, and the APSA is at a very early stage of development and has no binding obligations. As a consequence, at the time of an international energy crisis, the world will be looking to ASEAN and similar regional organisations to provide accurate and unambiguous up-to-date information about a range of matters including the state of energy supply, measures to constrain demand, the availability of strategic stocks, and plans for release of these stocks. It is not evident that ASEAN at present has the coherence to provide such information at short notice.

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[92] http://www.asean.org/archive/documents/ASEAN-GCC%20Two-Year%20Action%20Plan%20as%20of%201%20June%202010.pdf

A growing proportion of inward investment to ASEAN's energy sector is coming from state-owned and state-backed companies, notably from China, Japan, Korea and Russia. Whist such investment is to be welcomed, there are a number of risks involved, as discussed in Section 3.2. Whilst each sovereign state has the right to make its own choice of inward investors, ASEAN as a group has a role to play to ensure that such investments do not undermine collective interests. In particular, investment opportunities should be open to tender and not decided on the basis of political objectives, and energy flowing from such investments should be made available to the ASEAN energy market and not be committed to long-term export to the home country of the investor. If an effective ASEAN energy market were established, then such bilateral deals with a strong political element would be precluded.

One pressing area in which ASEAN has singularly failed to act cohesively relates to engagement with China over the South China Sea. In particular, Vietnam and the Philippines, which are actively confronting and challenging China's claims, have indicated that they would like to see ASEAN take a stronger stance over the South China Sea. However, the role of ASEAN in these disputes has been limited. This is because not all ASEAN members are directly involved in such disputes with China and it is therefore difficult for ASEAN as a consensus-based organisation to motivate all member states to adopt a collective stance. In fact, the ASEAN member states recognise that their relationships with China are multi-dimensional and they are thus mindful not to let the maritime disputes overshadow overall relations. Furthermore, ASEAN does not have much experience in resolving such a complex dispute.

Essentially, ASEAN's role is to serve as a facilitator by providing a framework for all parties to resolve their disputes peacefully, without resort to the use of force. It does not take a position on the respective claims and has instead repeatedly urged all disputing parties to finalise the long-delayed Code of Conduct as a way to reduce tension in the region. The organisation's focus in relation to these disputes is to ensure freedom of navigation and flight in the region, that the rule of law is applied as competing claimants assert their claims, and, most importantly, that Southeast Asia remains an open region and does not become beholden to any single external power.

4.3 External challenges to ASEAN's energy security

If ASEAN fails to act cohesively to address these challenges it faces a number of threats which include:

- Growing vulnerability to and dependence on the actions of other powerful Asian nations with respect to energy supplies.
- Growing vulnerability to and dependence on the actions of other powerful Asian nations as they gain access to ASEAN's energy resources.
- Greater vulnerability to the economic, social and political consequences of a major interruption to energy supplies, both for ASEAN as a group and for individual ASEAN member states.
- A shortage of inward investment and service provision in the energy sector across ASEAN, especially in the field of clean energy and energy efficiency.

One of the biggest challenges for ASEAN, both currently and looking ahead, would be its management of the relationship with China. ASEAN needs to strike a careful balance to ensure that the Southeast Asian region would benefit from China's growing economic and

political influence, while not becoming over-reliant on China to the extent where the organisation loses its central position in driving the evolution of the East Asian institutional architecture, which covers political, economic, and socio-cultural cooperation. In dealing with China, ASEAN also has to strike a fine balance in managing the varied expectations of the different member states, to ensure that ASEAN remain able to provide a common strategic vision for its members.

The South China Sea is suspected of holding significant resources of oil and natural gas, and may also host deep-marine gas hydrates. However, this sea is also home to a large number of maritime boundary disputes (reference). Most disputes between ASEAN member states have either been resolved or have been set aside in favour of establishing joint development arrangements for oil and gas. In contrast, China's claims to "historic rights" over a large area of the South China Sea bounded by a "nine-dashed line" means that it has overlapping claims with Vietnam, the Philippines, Malaysia and Brunei. Already there have been direct confrontations at sea between China and its immediate neighbours, Vietnam and the Philippines. Chinese oil companies have been carrying out geophysical surveys over the disputed parts of the South China Sea for several years, and in 2014 made the first move to drill an exploration well in waters claimed by Vietnam using the first deep-sea drilling rig to be made in China.

5. The international experience of multi-lateral cohesive action and effective communication on external energy matters

Rather than address the issue of energy market integration itself, this section focuses on how a group of nations have worked together successfully and unsuccessfully to address external energy challenges and opportunities such as those faced by ASEAN. We have chosen the example of the European Union (EU) in the first instance because it is a long-established regional group and has for many years tried to develop a coherent external energy policy, but with mixed success. Whist the EU can claim some success in launching strategic initiatives to support energy security, it has faced a number of profound challenges in implementation, mainly arising to differences of outlook among member states.

Whilst internal energy policy and energy market integration is managed by the Directorate-General for Energy,[93] it is the External Action Service which drives external energy policy.[94]The EU's external energy policies are focused strongly but not exclusively on security of supply. The European Commission has carried out extensive analysis and numerous policy documents are publically available.[95]

The EU has established or has been instrumental in establishing a number of instruments and institutions. These include:

[93] See http://ec.europa.eu/dgs/energy/index_en.htm

[94] See http://www.eeas.europa.eu/index_da.htm

[95] See for example:
http://ec.europa.eu/energy/international/security_of_supply/cooperation_en.htm

- The EU in 1968 set up requirements for all member states to build oil stock piles equivalent to 65 days of net imports. This was then raised to 90 days after the establishment of the International Energy Agency in 1972 (see paper 10).[96]
- The EU was the prime mover in creating the Energy Charter Treaty which was signed in 1994. The aim of this treaty was to support investment and trade in energy across the Eurasian continent, but especially between Europe and the countries of the Former Soviet Union.[97]
- The Energy Community was established by Treaty in 2005 by the EU as an international organisation dealing with energy policy. Membership includes the EU plus those Balkan states which are not EU members, Ukraine, and Moldova, with Norway, Turkey and Armenia as observers.[98]

The EU has formal energy dialogue or partnership relations with Russia, Algeria, Brazil, China, India, Iraq, Japan, Norway, South Africa, Turkey, Ukraine and the USA. It has regional energy partnerships in the 'near abroad' across the Mediterranean Sea and with countries in the Caucasus and central Asia. Finally, the EU has formal partnerships with the IEA, the International Energy Forum, the International Atomic Energy Agency (IAEE), the Organisation of Oil Exporting Countries (OPEC), the Gulf Cooperation Council (GCC), the Energy Charter Treaty, and the G8 and G20 groups of nations.[99]

Despite these steps being taken over several decades, it was only in 2011 that the European Commission published its first comprehensive external energy strategy document.[100] In addition to consolidating the thinking behind the measures already implemented, it included the need to more effectively share information between member states and promote a coherent EU external energy policy, and to promote the safe, sustainable and environmentally sound production and use of energy across the world.

Arguably the most important and most urgent measure within this external energy policy document was to promote greater investment in infrastructure to import energy and to transport it within Europe with the aim diversifying gas supplies away from Russia. The "Southern Gas Corridor" lies at the heart of this strategy. The concept of the "Corridor" was developed in the late 1990s and comprises a series of pipelines which would bring gas from Azerbaijan and Central Asia to Europe. However, the project has repeatedly been delayed by financial and political obstacles, in particular, by the competition between different options for routes.[101] Recent tensions with Russia have added urgency to the project,[102] and on

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96 See http://europa.eu/legislation_summaries/energy/external_dimension_enlargement/l27071_en.htm

97 See http://www.encharter.org/

98 See http://www.energy-community.org/

99 See http://ec.europa.eu/energy/international/index_en.htm

100 See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0539:FIN:EN:PDF

101 See: http://www.eurodialogue.eu/energy-security/Europe-southern-gas-corridor-The-great-pipeline-race; Sartori, 2012 file:///C:/Users/ESICPA/Downloads/iaiwp1201.pdf

21st September 2014 a ground-breaking ceremony was held near Baku, Azerbaijan, to mark the start of construction of a pipeline which will eventually take gas to mainland Europe.[103] In addition, the EU's LNG regasification capacity has risen from 175 bcm/yr in 201 to 217 bcm/yr in 2014, and is projected to grow to 355 bcm/yr by 2020.[104] This growing ability to import seaborne LNG will further reduce the EU's reliance on Russian gas, especially as total energy demand is projected to remain flat or decline over the next twenty years.

The most prominent source of division among EU member states over external energy policy relates to Russia. In simple terms, those states closest too and most directly reliant on Russian gas tend to take a different approach from those states which are more distant and less directly reliant. The European countries' perception towards Russian dependence is also coloured by their historical relationship with Russia. The European Commission is trying to make the EU less dependent on Russian gas which currently accounts for approximately 39% of EU natural gas imports and 27% of EU gas consumption in 2013.[105] Attempts to wean Europe off Russian gas and negotiate against Russia as a bloc have also been thwarted by the competing interests of individual European countries. For instance, Austria is very keen to develop a new gas pipeline connecting Russia via the Black Sea to Bulgaria and on to Central Europe called the "South Stream", which would bypass Ukraine. Meanwhile, Brussels have prevented the Nord Stream pipeline which connects Russia with Germany via the Baltic Sea and bypasses the traditional ex-Soviet transit countries from operating in full capacity. These cases show the challenges involved in attempting to develop a unified and coherent regional energy policy in the face of differing views and competing interests among different state actors.

Since the start of the crisis in Ukraine in 2014 the importance of the EU's energy relationship with Russia has been complicated by wider and more urgent strategic concerns. Following Russia's new assertive approach towards Ukraine, Russia is not regarded more as a strategic challenge, rather than a strategic partner to Europe. This has raised question on whether Russia would eventually become a direct threat to the EU and NATO members, particularly towards Poland and the Baltic states. The spectrum of views among European leaders and EU agony on how best to respond to Russia's activities against Ukraine as some leaders fear an economic fallout has shown the how some crises can threaten the cohesiveness even of a regional grouping with a relatively coherent external energy strategy.

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[102] See http://www.huffingtonpost.com/david-koranyi/revitalizing-the-southern-gas_b_5214501.html

[103] See http://www.oilandgastechnology.net/pipeline-news/bp-begins-construction-southern-gas-corridor-pipeline-between-azjerbaijan-europ

[104] See file:///C:/Users/ESICPA/Downloads/IFRI_deschuyteneer28414final.pdf

[105] European Energy Security Strategy, European Commission, 28 May 2014, http://ec.europa.eu/energy/doc/20140528_energy_security_communication.pdf

6. Towards an external ASEAN energy strategy

(We would really like to leave completion of this section till we see other reports and have the next brain storming session)

To set ASEAN's ambition in creating a cohesive regional energy strategy and the suggestion of an external ASEAN energy strategy in context, it is useful to consider the amount of time European integration took. The European had instituted supranational governance enabling the creation of binding rules for member states. This process could be traced way back to the Treaty of Paris in 1952, and it was only four decades on with the signing of the Maastricht Treaty in 1992 that the EU was established in 1993. It was only in 2009, - another further 16 years – before the EU created the role of a Representative of the Union for Foreign Affairs and Security Policy (HR), which is likened to be a EU foreign minister post for the EU.

On the subject of a common international energy policy, it has taken the Europeans decades to establish an internal energy market, and plan at the EU-level for the bloc's strategic energy imports , greenhouse gas emissions reduction plan, energy technologies development and finally, to speak with a single voice on international energy issues.[106] Even then, the EU's agony and internal debate over sanctions towards Russia has revealed the divisive nature of international energy politics.

The only other regional bloc in the world that is attempting to create a regional energy strategy besides the EU is ASEAN, which is neither a supranational organisation, nor possesses the human and financial resources to manage the expanding energy cooperation agenda both domestically and externally. Furthermore, given that ASEAN member states have traditionally been unable to present a united front due to narrow self-interest calculations, ASEAN's has typically prioritised agreement by consensus and the adoption of the lowest common denominator. This approach has undercut the bold and visionary approach set out by the EAVG to strengthen ASEAN.[107] Given the limited sense of community among ASEAN members, the organisation can only remain a modest institution.

This final section will identify the main elements of an external ASEAN energy policy which would promote a unified and cohesive external position in the framework of AEMI and which would enhance ASEAN energy security.

For each element or task, the text will describe:

- its objectives,
- the nature of the task,
- the political and institutional requirements,
- the current constraints on implementation,
- options for overcoming these constraints.
- the benefits of undertaking the task.

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[106] http://europa.eu/legislation_summaries/energy/european_energy_policy/l27067_en.htm

[107] Barry Desker, "Is the ASEAN Charter necessary?", RSIS Commentaries, 21 July 2008, http://www.rsis.edu.sg/wp-content/uploads/2014/07/RSIS0772008.pdf

Likely headings:

- Develop a coherent approach to external relations with large Asian energy importers and their energy companies
- Develop a coherent approach to managing disputes in the South China Sea
- Develop a coherent approach to relationships with key oil and gas exporters, especially in the Middle East
- Develop a coherent approach to speaking with one voice in the event of a supply crisis
- Develop a coherent approach (and international market) for attracting inward investment, technology and services relating to clean energy and energy efficiency
- Consolidate existing Free Trade Agreements

Key requirements:

- In order to develop these capabilities, the ASEAN Secretariat must have much greater capacity in terms of personnel, skills and authority.
- Member states must be able to set aside their individual narrow interests for the sake of larger regional interests in order to achieve a higher level of cooperation through ASEAN.

References

To be added later