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, the authors examined the studies that either indirectly addressed ASEAN or ASEAN members. A summary of the general benefits is presented in section 1. Furthermore, it elaborates the benefits from five perspectives: trade liberalisation; investment liberalisation; regional energy infrastructure development; energy pricing reform; and liberalisation of domestic energy markets. The study finds significant benefits have been derived from those initiatives, although the benefits may vary among the ASEAN members. Based on this survey and estimation, policy implications are proposed.

Introduction

ASEAN is working towards a single market by the end of 2015, under the guidelines of AEC (Bali Concord II, 2003). Considerable progress in energy market integration (EMI) has been made as a result of co-operation achieved through the ASEAN+3 (APT) process and later through the East Asian Summit (EAS) process (Shi and Kimura, 2010).

Section 1 examines the potential benefits of EMI in ASEAN, both at the national and regional levels. The benefits could be economic, social and/or environmental. The section provides quantitative information for 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, only those studies that indirectly addressed ASEAN or ASEAN member countries were reviewed. Earlier, the Economic Research Institute for ASEAN and East Asia (ERIA) conducted a series of studies for ASEAN+3 and EAS countries. Most of the reviewed studies come from work by Shi and Kimura (2010), Kimura and Shi (2011), Wu and others (2012), and Kimura and others (2013). Whenever possible, the review results try to exclude other countries, particularly China and India, which are heavyweights in ASEAN+3 (China, Japan and the Republic of Korea) or EAS. Such exclusion is not possible in many cases; however, many empirical studies are applicable to ASEAN without geographical prejudice. The present study also attempts to interpret the results in the ASEAN context where the results are not directly relevant to ASEAN.

Following the conceptual framework for analysing the EMI issue in the literature (Shi and Kimura, 2010 and 2014), the findings of the present study are presented by an integrated perspective plus the five pillars of EMI. The final section presents the policy implications and conclusion.

A. Overall benefits of energy market integration

Chang and others (2013), and Widodo and Rafiazka (2014) simulated the welfare impacts of energy price decreases due to ASEAN EMI (AEMI). The welfare impacts of AEMI are divided into two categories (Widodo and Rafiazka, 2014): (a) the direct impact (solely due to price equalisation in a specific energy price); and (b) the indirect impact (due to price changes of other goods as responses of price equalization in a specific energy price). The direct impact was estimated in a previous study (Chang and others, 2013), while the indirect impact was estimated in a recent study (Widodo and Rafiazka, 2014), which found that the indirect impact was often a few hundred to a few thousand times greater than the direct impact. Table presents the aggregated results of benefits from a 10 per cent reduction of the product price due to AEMI. Benefits are measured both as Compensating Variation (CV) and Equivalent Variation (EV) from different sub-groups of products as per the Standard International Trade Classification (SITC) 3-digit level.

Table 1. Welfare impact of a 10 per cent decrease in energy product prices

(Unit: Million US dollar

Product	Measure	Indonesia	Malaysia	Philippines	Thailand	Singapore	Viet Nam	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 and others (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 Philippines and Cambodia, both of which have high energy prices due to a relatively liberalised market, will suffer from an energy price decrease. However, the sources of loss are different. In the Philippines, the loss mainly originates from electricity, while in Cambodia the loss is sourced from the petroleum group (Widodo and Rafiazka, 2014). These losses suggest that those sectors in the two countries currently have excess profits. One example is that in the Philippines electricity prices (averaged at US$ 0.24 cents per kWh) was the fifth highest in the world in 2013 (Tiglao, 2014).

Sheng and Shi (2011 and 2013) formulated two indexes, the energy trade index and the energy market competition index, to measure EMI at the country level by applying the PCA approach. They used these measurements to examine the impact of EMI on growth convergence by estimating both the σ-convergence and the β-convergence. Data used in that study were drawn from four major sources – the World Development Indicator (WDI) Database, the cross-country historical adoption of technology (CHAT) dataset, the United Nations Comtrade Database, and Subramanian and Wei (2007) – and covered 49 countries in 1960 and 118 countries in 2008. Pooled ordinary least square (OLS) and country-fixed effects (FE) econometrics techniques were applied. It was found that an integrated energy market might significantly help poor countries to catch up with rich countries in economic growth, thus reducing income disparity across countries and accelerating the step of the catch-up. When EMI has been implemented and investment and technology progress are well-controlled, 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., the European Union, the North American Free Trade Agreement and EAS, shows that the energy market in the EAS region has integrated more quickly than that in the European Union or North American Free Trade Agreement regions in recent years; thus, 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 the European Union. 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 be no less than that of EAS EMI.

With a similar measurement of EMI, Sheng and Shi (2012a and 2012b); Sheng and others, 2013) showed that rapid economic growth due to industrialisation and urbanisation tend to increase 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 during1965-2010. The econometric results show that an increase in economic growth may increase by 0.6 per cent of energy consumption per capita.

Moreover, economic growth also leads to lower prices and income elasticity (in absolute terms). However, energy market integration can help to reduce the energy demand pressure as well as smooth the demand shock through decreasing income elasticity and increasing price elasticity, particularly in the long term. This finding is important for ASEAN where energy demand, according to a recent International Energy Agency (IEA) (2013) projection, will increase by more than 80 per cent between 2011 and 2035 under the IEA's "New Policies Scenario", which is a rise equivalent to current demand in Japan. Without AEMI, energy demand – at least in some countries – may experience some shocks and thus create stress for energy security.

The benefits of the EMI impact on energy market prices in the case of China also have implications for ASEAN. Using the panel data for 27 provinces between 1978 and 2008, Sheng and others (2014) employed an instrumental regression technique to examine the relationship between economic growth, energy demand/production and related policies in China. The empirical results showed that forming a cross-province EMI would, in general, reduce the response of equilibrium user costs of energy products to their local demand and production. The findings implied that AMEI could also help to reduce price variability in ASEAN where energy demand will grow dramatically.

Since many ASEAN members are agricultural exporters, they may be vulnerable to an increase in energy price, particularly with regard to crude oil price hikes, because energy costs may play an important part in the food industry. Hamid and others (2011) applied the input-output table methodology to selected East Asian countries in order to evaluate whether any potential benefits from EMI existed for the food industry. They found that resilient economies, especially those of developed East Asian countries, showed consistent performance in terms of value-added creation and imported inputs during energy price surges. In addition, the price spread model implies that a doubling of crude oil price will cause the Consumer Price Index for food to rise by approximately 22 per cent.

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). This suggests that ASEAN would benefit from AMEI if AMEI is able to help mitigate price hikes.

Table 2. Total effects of oil price increases in 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 and confectionery	0.559	0.439	0.784
Fruit	0.828	0.161	0.195	Sugar, chocolate and related products	0.300	0.699	2.332
Poultry farming	0.754	0.232	0.307	Oils and 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 and tea	0.408	0.590	1.444
Meat, meat production	0.721	0.257	0.356	Other food products	0.423	0.575	1.359
Preservation of	0.674	0.292	0.434	Soft drinks	0.484	0.513	1.061
Preservation of fruit, vegetables	0.652	0.324	0.497	Alcoholic drinks, tobacco products	0.568	0.426	0.751
Dairy products	0.518	0.455	0.878	Food and 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 spirits	0.495	0.340	0.688				
Soft drinks	0.496	0.468	0.944				

Source: Hamid and others, 2011.

B. Trade liberalisation

The impact on trade liberalisation in ASEAN (Lee and Plummer, 2010; Park, 2000) and East Asia (Lee and others, 2009) is sometime addressed in the literature but little attention has been focused on the case of energy. Bhattacharya and Kojima (2010) produced the only relevant study on region-wide energy trade liberalisation in ASEAN and East Asia. In their study, they simulated the impact by removing tariffs and export subsidies/tax using the REPA model, which is a multi-regional computable general equilibrium (CGE) model developed for conducting integrated policy impact assessments encompassing environmental, economic and poverty impacts in East Asia (Kojima, 2008).

The results show that although the distribution of economic benefits was not balanced, the magnitude of the impact in most countries is close to zero. Cambodia and Vietnam Viet Nam will benefit the most from trade liberalisation. Other ASEAN countries such as Indonesia, Malaysia and Singapore would lose in that context. However, such a loss would be comparatively minor. The reasons for the negative impacts are complicated in the CGE representation, which measures the impact through complex intersectoral and international linkages. For example, the real GDP loss of Singapore would mainly be due to a reduction in the trade balance, as trade liberalisation would undermine the comparative advantage of the country's current free trade policy. With a rise in GDP, CO_2 emissions would also increase. Due to border tax reduction to zero, all the countries except Indonesia and Malaysia would experience reduced levels of domestic energy prices (table 3).

Table 3. Impact of energy trade liberalisation 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	1.70	-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
Viet Nam	0.263	3.21	5.16	-0.59	-6.14	-8.44	0.00	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 the subregional level, there are more studies. Watcharejyothin and Shrestha (2009b) evaluated the effects of energy resource development within the Greater Mekong Subregion (GMS) during 2000-2035 with a MARKAL-based integrated energy system model of the five GMS countries. The study found that unrestricted energy resource development and trade within the GMS region would reduce the cost of total regional energy systems by 18 per cent and would abate total CO_2 emissions by 5 per cent compared with the base case.

C. Investment liberalisation

Kojima and Bhattacharya (2011) developed a dedicated multi-regional CGE model for conducting a quantitative assessment of the electricity sector investment scenario, in which the investment demands in the EAS member countries, as projected by IEA, were met. The assessment results showed that in meeting energy sector investment demands, FDI would 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 showed that introduction of foreign direct investment would increase not only the national GDP of the investing countries but also the regional GDP of the whole EAS region by 0.04 per cent. However, the study also showed that many ASEAN countries would experience losses due to investment liberalisation. However, Kojima and Bhattacharya explained that the estimated losses were due to the limitation of the CGE technique. Therefore, better methods for estimating investment liberalisation are needed.

D. Regional infrastructure development

Various studies have been undertaken on the impact of ASEAN regional infrastructure development. In a study on the impact of cross-border energy infrastructure development projects in ASEAN region, Bhattacharya and Kojima (2008) assessed the potential impacts of two major projects: the China-Thailand Power Trading: Jinghong and Nuozhadu HPP Project; and the Malaysia-Indonesia Power Grid Interconnection (Peninsular Malaysia-Sumatra, Indonesia, 600 MW PTL and Malaysia-West Kalimantan, 300 MW PTL). They showed that increasing physical linkages between two countries would bring greater economic benefits as well as reduce CO_2 emissions to a great extent than in a business-as-usual situation. Due to co-operative infrastructure development activities, the economic burden on individual countries would be reduced significantly together with increased efficiency of resource use in producing energy.

In the case of power grid connections, Chang and Li (2012) built a dynamic linear programming model and simulated optimal development paths of power generation capacities in ASEAN countries. They considered three scenarios (no trade, 20 per cent trade and 50 per cent trade in electricity) for developing optimal power generation capacity and the impacts on market integration in ASEAN. Their findings showed that a more open power trade regime would encourage the development of renewable sources of power generation, and accrue more savings in the total cost of meeting growing future power demand from 2010 to 2030. Specifically, under the scenarios of partial trade (20 per cent and 50 per cent capacity), the present value of cost savings would be US$ 20.9 billion (3 per cent) and US$ 29 billion (3.9 per cent), respectively. Thus, even with partial integration (cross-border power trading), substantial cost reduction could be realised.

As an example bilateral case, Watcharejyothin and Shrestha (2009a) analysed the effects of hydropower resource development in the Lao People's Democratic Republic, and power trade between the Lao People's Democratic Republic and Thailand, using a MARKAL-based model for an integrated energy system between the two countries. They found that 80 per cent exploitation of hydropower resources in the Lao People's Democratic Republic would induce power trade between the countries. Although the energy system cost saving would be marginal, the trade would mitigate CO_2 emissions by 2 per cent compared with the base case. Thailand would benefit from the trade in terms of lower energy system costs, better environmental quality and, greater energy diversification, while the Lao People's Democratic Republic would earn significant export revenue.

In the case of ASEAN natural gas pipeline connections, Chang and Li (2011) used a competitive equilibrium model to analyse the implications of an integrated and competitive natural gas market in the region. They found that by adopting such a market in the region, overall welfare of the countries involved in natural gas trade in the region improved by 5.5 per cent. In general, their study showed that the supply of natural gas from the region, which involves cheaper transportation costs, increased its share of the total supply of natural gas. By introducing new natural gas infrastructure in the region, Chang and Li noted that the welfare of the countries involved increased further by 0.3 per cent.

E. Energy subsidy removal

Energy subsidies in ASEAN have frequently been studied. Oktaviani and others (2005) analysed the impact of a fuel subsidy reduction on macroeconomic variables, the agricultural sector and income distribution, using a recursive CGE model. They found that increased fuel prices at the consumer level reduced Indonesian real GDP. Their results showed that reductions in the fuel price subsidy tended to increase prices of industrial outputs that were highly dependent on fuel, such as the transportation and fishery sectors.

They found that wages of skilled labour, land rent and capital rent declined steadily in response to changes in fuel prices. They also found households would incur income losses following a reduction in fuel subsidy, thus decreasing the overall household welfare. They suggested compensating the poor, either through direct transfer or through the development of infrastructure.

Widodo and others (2012) considered several scenarios for the removal of fuel subsidies in Indonesia and found that the removal of fuel subsidies without redistributing the money back into the economic system would reduce production output, GDP and labour income. At the sector level, it was found that fuel subsidy removal would have the greatest impact on the energy intensive sectors, with the chemical, cement, electricity, gas, drinking water, food, beverages and tobacco industries becoming the most affected sectors. Their simulation results also showed that the impact on labour income was higher than that on capital returns, with the lowest income group being affected the most.

In contrast, high-income earners as well as workers in the agriculture sector would be the least affected by fuel subsidy removal. If this amount of subsidy were to be reallocated to four targeted sectors – agriculture; trade; food and beverages; the 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 for the overall loss to the economy. These discouraging findings, however, may be due to the limitation of the methodology (Social Accounting Matrix). For example, their multiplier exercise is based on a fixed economic structure and does not take into account the dynamics over time, and cannot capture productivity gains. In addition, it does not allow for the substitution effect as prices are fixed.

In the case of Malaysia, Hamid and Rashid (2012) investigated the effects of subsidy removal, using the Malaysian input-output table supplemented by a static CGE model. They found significant economic benefits. The input-output table analysis shows that the removal of a subsidy of M$ 1 would increase the output by M$ 0.06 and GDP by M$ 0.08 at the final demand. Their findings implied that phasing out the oil subsidy would initially increase prices in general, which would especially affect the heavily oil-dependent sectors such as petroleum refinery, wholesale and retail trade, and motor vehicles.

Hamid and Rashid (2012) also argued that there were significant variations across industries, since different proportions of energy inputs were employed in the production process. In general, the less energy-intensive industries and domestic resources-based industries would be less affected by any subsidy removal. The greatest impact would be on workers' income, which would experience an increase of M$ 34 cents due to the removal of subsidies. They further argued that delaying the removal of subsidies would primarily increase costs for the Government and leave little room for policy changes should market prices become higher than expected.

In the Vietnamese case, Nguyen (2012) explored the impacts of an increase in the electricity tariff from US$ 0.06./kWh (domestic price) to US$ 0.095/kWh (international rate) (a rise of 58.3 per cent in the electricity tariff) in Viet Nam. He showed that prices in the five most affected sectors of water, gas, paper and paper products, chemicals and chemical products, and sorts and entertainment would increase by 11.15 per cent, 7.36 per cent, 4.82 per cent, 4.73 per cent and 4.30 per cent, respectively. Price increases in all other sectors would be less than 4 per cent. These increases would lead to a rise in the Consumer Price Index of 4.2 per cent. Lower income earners would suffer more from an electricity tariff increase because their payments for electricity represent a bigger share of their annual expenditure than that of the wealthy.

Nguyen (2012) argued that although 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 proposed a gradual approach towards subsidy removal and separate implementation in each sector. He further argued that an improvement in efficiency in the power sector would help to 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. This will discourage aggregate consumption and increase costs of production, which will likely decrease aggregate investment (Hamid and Rashid, 2012). The benefits of subsidy removal will be increased if the efficiency gains can be captured. With the subsidy removal, the energy price will direct energy to be used in the most efficient sectors, thus increasing the allocation efficiency of the economy as well as energy productivity. 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 CGE approach, Kojima and Bhattacharya (2011) found that even if a partial removal of energy subsidies could improve the benefits of market efficiency. It is estimated that a per annum subsidy reduction of approximately US$ 500 million in the EAS region could improve the regional economic condition in terms of real GDP by around 0.05 per cent and its welfare by some 0.14 per cent compared with the base line scenario of 2020. Energy subsidy reduction also helps to push down the demand for subsidised commodities and subsequently cuts the sales of subsidised energy commodities in the domestic market. This will generate economic and security benefits.

F. Domestic liberalisation

The study by Bhattacharya and Kojima (2010) is also the only one that has tried to quantify the impact of liberalisation of domestic energy markets in ASEAN. To estimate the impact of domestic market liberalisation using the REPA model, the simulation assumes that due to such liberalisation there is an overall improvement in the total factor productivity of the energy distribution services (assumed as 20 per cent in the estimation) – i.e., electricity transmission and gas distribution – due to increased competitiveness through open access to transmission systems. The simulation shows double benefits of market liberalisation – i.e., overall economic development and reduction of CO_2 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 losses are often 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 liberalisation

(Unit: Percentage change to baseline, 2020)

Country/region	Real GDP	CO_2 emissions	Country/region	Real GDP	CO_2 emissions
China	1.551	-0.84	Viet Nam	2.479	4.52
Japan	0.737	-2.23	Brunei Darussalam	1.139	1.70
Republic of Korea	0.834	-1.53	India	1.825	-2.49
Cambodia	0.725	1.78	Australia	0.620	-1.29
Indonesia	0.852	1.87	New Zealand	0.829	2.59
Lao PDR	0.943	8.47	Brazil	-0.010	0.27
Myanmar	1.926	10.54	European Union	0.003	0.55
Malaysia	1.278	2.48	United States of America	0.003	0.43
Philippines	0.934	-2.11	Russian Federation	-0.079	0.38
Singapore	0.760	-2.85	MENA and Venezuela	-0.029	0.11
Thailand	1.464	1.05	Rest of the world	-0.004	0.49
EAS total	1.090	-0.80	World total	0.259	0.01

Source: Bhattacharya and Kojima, 2010.

G. Policy implications and conclusion

Based on this review, the following policy implications can be assumed. Trade and investment liberalisation and the development of infrastructure will generate net benefits for ASEAN. However, the distribution of such benefits could be different across the member countries. In the case of trade liberalisation, the countries that have a freer trade regime will lose more since their comparative advantages will be undermined. Furthermore, the economic benefits of EMI often come with increased CO_2 emissions, an issue that needs to be addressed through technical innovation and policy intervention.

Domestic liberalisation may achieve both economic growth and CO_2 emission reduction. However, the process of domestic liberalisation often presents a big challenge because it is subject to behind-the-board barriers, the removal of which requires changes in national institutional frameworks and thus is sensitive (Shi, 2014).

Phasing out subsidies is politically and economically challenging and needs to be carefully planned, taking into consideration 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 Governments from subsidy removal can be either used to develop much-needed infrastructure for economic benefits, or to assist the poorest segment of the population through social benefits. Some suggestions that are feasible with only minimal change in the current political, social and economic systems would likely be of interest to policymakers. The low crude oil prices as of early 2015 have created a golden opportunity for phasing out fossil fuel subsidies.

Although the models have various limitations, the estimated results present a more optimistic outlook. The estimated economic impacts are indicative in nature and could be less than the real benefits, mainly because many economic as well as most environmental and social benefits cannot be modelled. However, the present study shows the direction of economic and environmental impacts of EMI in the region, and thus can act as a building block for future policies in this context.

Different impacts resulting from different policies demand a comprehensive development AEMI policy portfolio. In that case, some of the negative impacts can be contained within a country's borders, thereby reducing resistance to such integration. Regional integration will also pay particular attention to the less-developed countries, which may not be able to reap the potential benefits due to a lack of national and regional competitiveness resulting from institutional weakness and capacity limit.

Although many of the current findings in the literature are applicable to ASEAN, carrying out studies dedicated to ASEAN are highly recommended. The review of studies on AEMI finds that while trade liberalisation and fossil fuel subsidy removal have been well-studied, there is much room left for future studies of other aspects. Even in the case of fossil fuel subsidies, the current macro models (such as GTAP) have limited capability due to high aggregation of data in the model. Since the impact of subsidy removal is more or less understood, future studies of that aspect are not that urgent. However, additional studies to strengthen understanding of the other three aspects of AMEI are needed.

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, in the bottom-up approach, an ASEAN TIMES model would be very useful to study the economic impact and investment requirement for AEMI. In the top-down approach, some global models with energy and environmental sectors, such as GTEM, are highly valuable. To construct the bottom-up models, however, data are needed on energy technologies, their penetration levels and associated costs in all ASEAN member countries. Such data collection is a significant challenge and needs regional collaboration. For building up a top-down model, the required macro data are easier to compile, but need verification.

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