ERIA Research Project Report 2009, No. 13

ENERGY MARKET INTEGRATION IN THE EAST ASIA SUMMIT REGION: REVIEW OF INITIATIVES AND ESTIMATION OF BENEFITS

EAS ECTF EMI Phase II Study

Economic Research Institute for ASEAN and East Asia

July 2010

STRUCTURE OF THE REPORTS

These two reports, an overview report and an auxiliary technical report, contain results of a study commissioned by the EAS Energy Cooperation Task Force (ECTF) as the phase two study of the Energy Market Integration Work Stream under the ECTF. The overview report is the one that was reported to the ECTF and should be deemed as the official report of the study. The technical report provides details of the estimations but not all of it was accepted by the overview report.

The project team has four members: Fukunari Kimura (leader), Xunpeng Shi (Coordinator), Satoshi Kojima and Anindya Bhattacharya. The topics and authors are as follows:

(1) Overview Report:

Review of Initiatives Toward, and Estimated Benefits from, Integrating the Energy Market in the East Asia Summit Region;

By Xunpeng SHI and Fukunari Kimura

(2) Technical Report:

Technical Report: Economic Impact Analysis of East Asia Energy Market Integration

By Anindya Bhattacharya and Satoshi Kojima

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

The project team wishes to acknowledge the guidance given by the 11th to 13th EAS Energy Cooperation Task Force (ECTF). In particular, thanks are due to the Singaporean Energy Authority and the Australian Department of Resources, Energy and Tourism for their leadership of the ECTF energy market integration work stream and to the Thailand Minister of Energy as a volunteer to guide the project. The project team has benefited greatly from discussions with officials from these three government agencies, in particular with Ms. Jacqueline Lam (Singapore), Mr. Michael Gunner (Australia), and Dr. Prasert Sinsukprasert (Thailand). Although we had support and guidance from the ECTF and various government agencies, the content of this report does not reflect the views of ECTF and those government agencies and is entirely the responsibility of the authors.

EXECUTIVE SUMMARY

This study reviews the current status of, and policy initiatives toward energy market integration (EMI) in the EAS region with focuses on five policy issues: trade liberalization, investment liberalization, cross border linkage of energy infrastructure, energy pricing reform and liberalization of domestic energy markets. It also attempts to demonstrate the economic and environmental impacts of these five policy initiatives. The two main issues that have been highlighted by the EAS Energy Ministers Meeting (EMM) and the ECTF -i.e. removal of trade and investment barriers- are the crux of this study, alongside brief analyses of the remaining 3 issues. The review of status and initiatives has been fruitful for all five areas, though estimations for two of these policy initiatives, viz. linkage of energy infrastructure and energy pricing reform, were not fully accomplished due to data and modeling limitations. Among successful simulations of the other three initiatives, results are encouraging. A summary of this review and estimations of five different initiatives possible under the integrated energy market is present in the Table ES1.

The study finds that general trade and investment liberalization has been covered in the existing bilateral/multilateral free trade agreements. The remaining task is to make sure that energy goods and services, as well as investments in the energy sector, are covered in the scope of these agreements. More broadly, current agreements could be harmonized and simplified into fewer agreements with broader coverage. A detailed review of energy trade and investment in the current regional agreements and frameworks will provide background for policy discussions on potential areas for improvement in these existing agreements.

Perhaps due to geographical proximity, ongoing and proposed energy infrastructure projects have been limited to the ASEAN plus China region. Though India could establish potential linkages with other EAS countries, no feasible plans have yet been discussed. With the development of more comprehensive infrastructure, such as

oil/gas pipelines and the introduction of advanced and efficient marine transportation systems, the networks of energy infrastructure may be expanded across the region, such as enhanced LNG trade between Singapore and Australia. The development of energy infrastructure projects should conform with current regional plans, such as the Comprehensive Asia Development Plan.

Table ES1 Overview of initiatives covered in this study

Policy Issue	Status	Estimation	Outlook
Trade liberalization*	Trade and investment has been broadly covered in the existing bilateral/multilateral free trade agreements	EAS as a whole will gain in real and in nominal GDP, but CO2 emissions will increase as well. The distribution of economic benefits is not balanced, but the magnitude of negative impact in most countries is close to zero.	The remaining task is to make sure that the energy sector is not restricted or excluded by these agreements. Current agreements could be harmonized and simplified into fewer agreements with wider coverage.
Investment liberalization*		Real GDPs for the investing country reduce, but rise for all the recipient countries. The overall negative impact to the EAS region could due to factors such as productivity gains which cannot be captured by the model.	
Linkage of energy infrastructure	Currently proposed energy infrastructure projects have been limited to the ASEAN + China region only, though India has the potential to link	No detailed data	With the development of more infrastructure, such as oil/gas pipelines and marine transportation, the networks of energy infrastructure may be expanded. The development of energy infrastructure projects should conform with current regional plans, such as the Comprehensive Asia Development Plan.
Energy pricing reform	Price restrictions and subsidies for energy commodities are often used in many EAS countries	No variable can represent energy subsidies due to the aggregation of subsidies and taxes in the global GTAP dataset.	Phasing out subsidies is very difficult and politically sensitive. Member countries need to have a comprehensive roadmap which integrates economic, political and social issues.
National market liberalization	Market liberalization has been attempted in some countries, but lot more remains to be done	Double benefits demonstrated: overall economic growth and reduction of CO2 emissions.	Cooperation on these common challenges could be a valuable topic for EAS energy cooperation.

Note: * indicates the task is required by the ECTF; the rest are researchers' additional attempts.

Compared to regional agreements and physical energy infrastructure development, much more work is needed at the national level. Prominent challenges at the national level are to create national competitive markets and to remove inefficient fossil fuel subsidies. Market liberalization has been undertaken in a number of EAS member countries, but there remains substantial work to be done in many countries. For example, price restrictions and subsidies for energy commodities are used in many EAS countries. Phasing out subsidies is difficult and politically sensitive, but this is a key step towards establishing a competitive and sustainable energy market. As such, it would be imperative for EAS members to look at policies for phasing out energy subsidies as part of their long-term domestic planning process. The development of a comprehensive long-term roadmap which integrates economic, political and social issues, so as to achieve market-oriented energy pricing mechanisms, is crucial for progress in regional energy market integration. Cooperation on these common challenges could also achieve traction and progress as part of the EAS energy cooperation framework.

While the outcome of the study indicates that the benefits of energy market integration generally outweigh the costs, there were unique situations for one or two EAS members who may reap fewer benefits from a specific market integration initiative. However, this is based on the assumption that energy market integration initiatives are undertaken on a national basis, which would be piecemeal compared to taking a regional approach. With a broader base for common regional market liberalization initiatives, EAS members can ensure that the benefits of these initiatives are broadly distributed. At the initial stages, adjustment mechanisms may be required to offset the costs of the EMI initiatives, including immediate impact on less competitive industries, consumer dependencies on energy subsidies, and even the potential environmental effects of increased economic growth. These adjustment mechanisms should be implemented bearing in mind the long-term advantages of a regional energy market.

In particular, good investment policy and governance should be implemented to facilitate energy market integration, through initiatives such as strengthening the investment regulatory framework and improving national competitiveness. To deepen the integration of energy markets, it is also necessary to improve the regional political trust among the member countries. Specialized regional architectures, such as

specialized forums for EMI and institutions like International Energy Agency (IEA), might be able to facilitate policy dialogue for progress toward EMI.

OVERVIEW REPORT

REVIEW OF INITIATIVES TOWARDS AND ESTIMATED BENEFITS FROM INTEGRATING ENERGY MARKET IN THE EAST ASIA SUMMIT REGION

Xunpeng Shi[1] and Fukunari Kimura[1,2]

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

2. *Faculty of Economics, Keio University, Japan*

ABSTRACT

This study reviews the current status of, and policy initiatives towards, energy market integration (EMI) in the East Asian Summit (EAS) region with focuses on five policy issues: trade liberalization, investment liberalization, cross border linkage of energy infrastructure, energy pricing reform, and liberalization of domestic energy markets. It also attempts to demonstrate the economic and environmental impacts of these five policy initiatives. Three policy initiatives are successfully estimated and results are modestly encouraging. The study finds that general trade and investment liberalization has been covered in the existing bilateral/multilateral free trade agreements; ongoing and proposed energy infrastructure projects have been limited to the ASEAN plus China region, and much more work towards energy market integration is needed at the national level. Based on this survey and estimation, policy implications are offered.

Key Words: Energy, Market Integration, East Asia Summit

1. INTRODUCTION

Energy cooperation in the EAS has great potential for capturing many opportunities and advantages. Australia, New Zealand, Japan and South Korea are leading countries in energy, and thus could cooperate with China and ASEAN countries in technologies, management and regulatory frameworks. Australia is also important to the EAS region for its endowment of energy resources, including coal, natural gas (distributed as Liquefied Natural Gas (LNG) and uranium, which can help secure the energy supplies of other EAS countries. Brunei, Indonesia, Malaysia and Vietnam have large potentials in oil and gas and thus can provide opportunity for technology transfer and investment from the Plus Six countries (Australia, China, Japan, Korea, India, and New Zealand). The refinery capacities in South Korea and Singapore, and the oil storage capacity in Japan, can provide further benefits with more integration. ASEAN plays an important role in the security of energy supply for major oil importers, such as China, Korea and Japan. More integration with ASEAN can improve the security of energy for the EAS region at large.

Energy Market Integration (EMI) for the entire East Asian region has been proposed in the past decade or so with the emergence of cooperation frameworks between ASEAN and its dialogue partners. Considerable progress in these ASEAN energy cooperation and related areas had been made as a result of cooperation achieved through the ASEAN plus Three (APT) process and, from 2005, through the EAS process. Under the EAS framework, there is an annual meeting of Energy Ministers and periodical meetings of the Energy Cooperation Task Force (ECTF), which was established by EAS in 2007. One of the three work streams under ECTF is EMI.

In the First Energy Ministers' Meeting (EMM), the Ministers launched a study to examine the status of energy markets and explore policies and measures to develop an integrated EAS energy market (ASEAN website, 2007b). The phase 1 of the Energy Market Integration (EMI) project was conducted by Australian consultants, funded by AusAID. It involved a study to identify trade and investment barriers and determine

opportunities for progressing improved energy trade linkages and trade promotion in the EAS region. The EMI Phase 1 report on "Energy Market Integration in the East Asia Summit Region" (Bannister et al., 2008), including the completion of 16 country reports was welcomed by Energy Ministers at their second meeting, but the study was not continued. In the third EMM, Economic Research Institute for ASEAN and East Asia (ERIA) committed to take over the EMI study and started phase two for the 2009/10 financial year.

For the Phase 2 study, Singapore and Australia, as chair and co-chair of the ECTF EMI work stream, asked ERIA to estimate the potential economic benefits for the EAS region from the removal of trade and investment barriers and to review existing initiatives for enhancing energy market integration in the EAS region. In addition to the two requested issues, three other issues have also been studied by the team, namely physical linkage of energy infrastructure, that is, gas pipelines (including LNG terminals) and power grids, liberalization of domestic energy markets, and energy pricing reform, in particular, removal of fossil fuel energy subsidies.

Selection of these issues was based on our understanding of overall EMI in this region. A well-functioning and transparent national market is essential to develop an open, competitive and more integrated EAS regional energy market. To increase the efficiency of energy markets, it is necessary to remove impediments and distortions that prevent the efficient functioning of the market. This will include, but not be limited to, encouraging trade and investment liberalization and the reduction or removal of barriers, such as price restrictions, subsidies and monopolies. Physical linkage of energy infrastructure, which can optimize energy use and improve security of supply, is also a basic issue in the study of EMI as a concept. It is needed to facilitate trade, attract investment and reduce friction costs among markets.

Deepening EMI must take into account national economic, social and political circumstances. Open access of energy infrastructure is a prerequisite for market integration as otherwise there will be monopoly and thus limitation of competition. To make it possible for new investors to enter into energy markets, it is important to liberalize domestic energy markets. The energy industry is often monopolized and vertically integrated. For example, in many EAS countries, there is only one electricity company, which is often state-owned. In such cases, there will be no chance

for new investors, private or foreign, to enter the market and thus the electricity market will be segmented by national boundary. To promote 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. In the case of electricity supply, for example, the sector could be split into generation, transmission and retailing. The transmission sector is a "natural monopoly", and therefore it is not economically viable to bring new transmission systems. But it can promote competition by allowing open access for any investors.

EMI documented in the literature is challenging. Although having over many years worked to encourage EMI between its member countries, the European energy markets are still highly concentrated with low competition, lacking cross-border integration and having insufficient price transparency. In early 2007, the European Commission decided to form a common European energy policy to facilitate the establishment of a single and competitive internal pan-European market (EU Website, 2007). The Nordic electricity market was one of the first international electricity markets in the world and has become a well-functioning multi-national electricity market (Nordic Energy Research Website, 2010). The reform toward a single and competitive national electricity market in Australia may also offer some lessons for other EAS members (Bannister *et al.*, 2008). However, a complete review of EMI in the EAS region is absent from the literature.

Turning to quantitative studies, there have been estimations of the impact of free trade agreements involving ASEAN. Park (2000) finds that ASEAN Free Trade Agreement (AFTA) will enhance intra-ASEAN trade and accelerate the economic growth of ASEAN member nations. The author concludes that economies with higher pre-FTA tariff barriers and larger intra-regional trade volumes, such as the Philippines and Thailand, share larger gains from freer trade. Lee et al. (2009) evaluate the extent of trade adjustments and other economic effects that the enlargement and redefinition of a free-trade agreement to encompass ASEAN+3 or ASEAN+6 could have on the EU and North America. Lee and Plummer (2010) investigate the effects of the ASEAN Economic Community (AEC) on economic welfare, trade flows and sectoral output. They find that streamlining customs procedures and other reductions in administrative and technical barriers, as well as increased competition and improvements in

infrastructure, would be significant in enlarging the benefits of the AEC. The only quantitative study about EMI in the EAS region was the study (Bhattacharya and Kojima, 2010) that was conducted to support this study.

This research studies the benefits and status of initiatives related to the selected issues. The next section will briefly outline the history of energy cooperation in East Asia. Section 3 reviews the current status of existing initiatives regarding the selected issues. Section 4 summarizes the economic and environmental impacts of three different initiatives in the five groups of policy by a Computable General Equilibrium (CGE). Discussions and policy implications are presented in Section 5 and the last section concludes.

2. HISTORY OF ENERGY COOPERATION IN EAST ASIA

In the EAS region, ASEAN has long pursued EMI. The first energy agreement, concluded between Thailand and the Lao PDR, was signed in 1966, one year before the first ASEAN Declaration in August 1967. After the establishment of the ASEAN Council on Petroleum (ASCOPE) in 1975, cooperation widened to include all other fuels. In 1981 the Heads of ASEAN Power Utility Authorities (HAPUA) was established for work on electricity interconnection, and in 1986 the ASEAN Energy Cooperation Agreement outlined a wide range of areas for cooperation.

The series of ASEAN Plans of Actions for Energy Cooperation (APAEC) recognized the importance of establishing an efficient, transparent, reliable and flexible energy market in the ASEAN region and of improvement of access to affordable energy to eradicate energy poverty. In July 1999 ASEAN adopted the APAEC 1999-2004 (APAEC, 1999), which, for the first time, involved the region-wide participation of all ten ASEAN countries and a sharper focus on regional energy cooperation and integration. The APAEC 2004-2009 (APAEC, 2004) specifically mentioned the integration of regional energy infrastructures, promotion of energy security and market reform and liberalization, as well as environmental sustainability. This second series

of APAEC also approved the Initiative on ASEAN Integration (IAI) designed to reduce the development gap between the new and the old ASEAN members. The third and current series of APAEC (APAEC, 2009) approved by the 27th ASEAM Meeting of Economic Ministers (AMEM), essentially maintains and continues those programs identified in AEAEC 2004-2009. The newly added program in the latest action plan is Civilian Nuclear Energy.

Currently, ASEAN member states are working toward an ASEAN single market and production base described and guided by the ASEAN Economic Community (AEC) Blueprint which was adopted at the 13th ASEAN Summit in Singapore in 2007. The AEC blueprint highlights the establishment of interconnecting arrangements towards achieving long-term security, availability and reliability of energy supply through regional cooperation in Trans-ASEAN Energy Networks comprising the Trans-ASEAN Gas Pipeline (TAGP) and the ASEAN Power Grid (APG), and proposes to promote cooperation in energy efficiency and conservation, as well as the development of new and renewable energy sources (APAEC, 1999).

Within ASEAN structures there are regular meetings of ministers in a wide range of areas devoted to pursuing common goals. Of particular relevance to the EMI is the ASEAN Ministers of Energy Meeting (AMEM). Beyond ASEAN, many institutional cooperation frameworks have emerged in East Asia under the principle of ASEAN centrality in the past decades, such as ASEAN Plus One, ASEAN Plus Three (ASEAN plus China, Japan, and Korea (APT)) and EAS. There are also regular energy ministers' meetings under these frameworks. In the APT, there is a regular meeting of energy officials and ministers, which started in 2003. The APT has adopted a 10-year Cooperation Work Plan 2007-2017 and several activities are scheduled for implementation, including in the energy area. The work program of the Senior Officials Meeting on Energy (SOME)+3/AMEM+3 include five fora on energy security, oil stockpiling, oil markets, renewable energy and energy efficiency and conservation, and natural gas and business dialogue. The work program was expanded to include cooperation on Clean Development Mechanism (CDM) and civilian nuclear energy recently, and discussions took place in the 9th SOME Plus Three in July 2010 on the possibility of merging the Energy Security forum with the Oil Stockpiling forum, and the Oil Market forum with the Natural Gas and Business Dialogue forum. However,

electricity, which plays an important role in the liberalization of national energy markets, is not included in the existing fora.

Under the EAS framework, energy cooperation is guided by the Cebu Declaration. The Cebu Declaration, published by the second EAS, outlined the potential energy challenges the region could face in the future, driven by a number of factors including: the limited global reserves of fossil energy, fluctuating world fuel oil prices, worsening energy related environmental and health issues and the urgent need to address climate change (Cebu Declaration, 2007). To deal with these issues, the EAS leaders agreed to create a working group on energy cooperation, that is the ECTF. Three work streams are established under the EAS ECTF: energy efficiency and conservation (Chaired by Japan); energy market integration (co-chaired by Singapore and Australia); and the use of bio-fuels for transport and other purposes (co-chaired by the Philippines and India).

The EAS Energy Ministers at their inaugural meeting recognized that there was significant scope for increasing intra-EAS energy trade and investments. They encouraged the establishment of efficient, transparent, reliable and flexible energy markets, which will help to provide affordable, secure and clean energy supplies for the region. Energy Ministers recognized the importance of addressing impediments to the efficient functioning of markets and supported the EAS Energy Cooperation Task Form (ECTF) work plan to promote better understanding of integrated and liberalized energy markets (ASEAN website, 2007b).

The EAS Energy Ministers at their 3rd meeting (EMM3) in July 2009 noted the importance of promoting EMI in the EAS region again and reaffirmed that the facilitation of energy trade linkages should be advanced as a priority, together with the integration of regional energy markets. The Energy Ministers noted that integration is a long term goal. So the Energy Ministers considered it appropriate that Phase 2 work should highlight the benefits of integrated markets (ASEAN Center for Energy website, 2009).

It is worthwhile to mention the financial resources that support the energy cooperation. ASEAN gets major funds for programs on coal and clean coal technology, energy efficiency and conservation (EE&C), renewable energy and regional energy policy and planning from dialogue partners, namely, the European Union, Japan, Australia, China, Korea, and India. Japan has been providing support to ASEAN

energy cooperation since the establishment in 2000 of the SOME-METI (Ministry of Economy, Trade and Industry, Japan) Consultations. There are two projects under the SOME-METI Work Program, namely: a) energy supply and security planning for the ASEAN region (ESSPA), and b) promotion of energy efficiency and conservation (PROMEEC). The implementation of ESSPA and PROMEEC started in 2000 and will still be continued in the APAEC 2010-2015. In addition, METI of Japan is also supporting the training of ASEAN energy efficiency and conservation specialists in Japan since 2005 (APAEC, 1999). To promote ASEAN-China infrastructure and inter-connectivity, China set up the US$ 10 billion China-ASEAN Investment Cooperation Fund to finance major ASEAN-China investment cooperation projects in infrastructure, energy and resources, information and communication technology and other fields (ASEAN website, 2009a).

3. STATUS AND EXITING INITIATIVES TOWARD EMI IN THE EAS REGION

Under the principle of maintaining "ASEAN Centrality", the existing regional architectures in East Asia all have the characteristics of "ASEAN plus X". Therefore, it is logical to start the review from ASEAN.

3.1. Regional Agreements on Energy Trade and Investment

Within ASEAN, AEC is the flagship program for economic integration. One important component of AEC is the establishment of a single ASEAN market by 2015. The single market should have a free flow of goods, services, and investment, and a free flow of capital, etc. Economic initiatives under the AEC blueprint include: the ASEAN Free Trade Area (AFTA), the ASEAN Framework Agreement on Services (AFAS) and the ASEAN Investment Area (AIA) (Bali Concord II, 2003). Under AIA, all industries shall be open and national treatment will be granted to investors. The ASEAN Comprehensive Investment Agreement (ACIA) is expected to build on and

enhance the existing AIA agreement and the ASEAN Agreement on the Promotion and Protection of Investments (IGA).

Beyond its own area, ASEAN has conducted negotiations for free trade (FTAs) and comprehensive economic partnership agreements (CEPAs) with many dialogue partners, including the "plus six" countries (Table 1). All FTAs/CEPAs between ASEAN and "Plus Three" cover trade in goods, trade in services, investment, and other areas of economic cooperation (ASEAN website, 2009b). The ASEAN-Australia-New Zealand Free Trade Agreement, which covers trade in goods and services (including financial services and telecommunications), investment, electronic commerce, movement of people, intellectual property, competition policy and economic cooperation, is the single most comprehensive economic agreement entered into by ASEAN to date (ASEAN website, 2010). The ASEAN-India Trade in Goods Agreement and other free trade agreements was signed on 13 August 2009 while the negotiations for services and investment are ongoing (ASEAN website, 2009c). For the ASEAN Plus Three (APT) together, Phase II of the East Asian FTA (EAFTA) Study has been finalized by the Experts Group. The Study aims to examine the key elements of market access for goods, services and investment as well as trade facilitation cooperation with a view to identifying some possible options for such a FTA.

Table 1 FTA/CEP Agreements Between ASEAN and Dialogue Partners

Agreement	Date of Sign	Date of Implementation
Framework Agreement on Comprehensive Economic Cooperation between ASEAN and China	November 2002	To establish the ASEAN-China Free Trade Area (ACFTA) in 2010 for ASEAN-6 and China, and 2015 for CLMV.
Agreement on Trade in Goods	2004	Implemented since July 2005
Investment Agreement	August 2009	
ASEAN-Japan Comprehensive Economic Partnership (AJCEP)	April 2008	Goods, trade in services, investment and economic cooperation. Entered into force on 1 December 2008. As of July 2009, Brunei Darussalam, Lao PDR, Malaysia, Myanmar, Singapore, Thailand, Viet Nam and Japan have ratified the Agreement.
Framework Agreement on Comprehensive Economic Cooperation between ASEAN and ROK	13 December 2005	Targeting for an ASEAN-ROK Free Trade Area by the year 2008 (with flexibility to 2010) for ROK, 2010 (with flexibility to 2012) for ASEAN-6, 2016 for Viet Nam and 2018 for CLM
The Agreement on Trade in Goods with ROK	August 2006, except Thailand, which signed in February 2009	Implemented since 1 June 2007
The ASEAN-ROK Investment Agreement	June 2009	
ASEAN-India Framework Agreement on Comprehensive Economic Cooperation	At the 2nd ASEAN-India Summit in 2003.	Targeting for the establishment of an ASEAN-India Regional Trade and Investment Area (RTIA), which includes FTA in goods, services, and investment.
ASEAN-India Trade in Goods (TIG) Agreement	13 August 2009	entered into force on 1 January 2010

	ASEAN-India Investment Agreements	Being processing	
ASEAN-Australia-New Zealand Free Trade Area (AANZFTA)		27 February 2009.	Entered into force on 1 January 2010 and is now being implemented by all Parties, except Cambodia, Indonesia and Lao PDR

Source: Compiled from ASEAN External Relations (ASEC, 2010).

Bilateral FTAs between individual ASEAN member country and ASEAN dialogue countries have been moved forward as well. Singapore has FTAs with all six countries. China-Singapore FTA and Japan-Viet Nam EPA was signed in October and December 2008, respectively. Malaysia-New Zeland FTA was concluded in May 2009 (CEPEA Track II Study Group, 2009).

Bilateral FTAs among the ASEAN dialogue partners are largely under negotiation. While there are nine FTAs under negotiations or implementation, only New Zealand has implemented FTAs with Australia and China. Noticeably, as a major player, Chinas has not started negotiation of FTAs with India, Japan and South Korea; India, has kicked off the FTA negotiation with Japan and South Korea while has no progress with Australia, New Zealand, and China; and South Korea are negotiating FTAs with four other ASEAN dialogue partners with China as an exception. A brief summary status of FTA/EPAs in the EAS region can be found in Table 2.

Table 2 Status of FTA/EPAs in the EAS region

	Australia	China	India	Japan	New Zealand	South Korea	ASEAN
Australia		□		□	●	□	●
China	□				●		●
India				□		□	●
Japan	□		□			□	●
New Zeland	●	●				□	●
South Korea	□		□	□	□		●
ASEAN							

Note: ●: FTA singed/concluded; □: under negotiation

Source: Phase II Report of the Track Two Study Group on Comprehensive Economic Partnership in East Asia (CEPEA2009).

Specific to the energy issue, the policy makers have affirmed their desire for an integrated market. The ASEAN energy ministers' meeting wants to "create suitable conditions that facilitate energy infrastructure investments, in particular in energy production, to secure an adequate and stable supply of energy" (ASEAN website, 2007a). The ASEAN Plus Three (APT) Energy Ministers called for greater cooperation and integration to address the challenges faced by the region. Under the EAS framework, the 'Cebu Declaration' in 2007 specified the major goals of 1) pursuing and encouraging investment in energy resource and infrastructure development by greater private sector involvement; and 2) the promotion of stable energy supplies through investment in regional energy infrastructure. The issue of energy market integration was also discussed by the first EAS EMM and followed up closely.

3.2. Energy Infrastructure Development

Linkage of energy infrastructure has been pursued progressively in ASEAN. Under AEC, 12 priority integration sectors have been identified. Of particular relevance to the EMI is Infrastructure Development, which includes mining cooperation and the two flagship projects of ASEAN energy cooperation, APG and TAGP (APAEC, 1999).

TAGP aims to interconnect the gas pipeline infrastructure of ASEAN Member States and to enable gas to be transported across the borders of the Member States. The updated ASCOPE-TAGP Masterplan 2000 involves the construction of 4,500 kilometers of pipelines mainly undersea, at a cost of USD 7 billion. Nine bilateral gas pipeline interconnection projects, with total length of approximately 2,300 km, were operating by April 2009 (APAEC, 2009). ASCOPE has set up the ASCOPE Gas Centre to carry forward some of the technical, commercial, regulatory and governance issues that would be needed to realize a working TAGP.

APG, on the other hand, ensures that gas for power is also being optimized with other potential sources of energy. To pursue the program, ASEAN has adopted a

strategy that encourages interconnections of 15 identified projects, first on cross-border bilateral terms, then gradually expanding to a sub-regional basis and, finally to a totally integrated Southeast Asian power grid system. Currently, the APG is in progress with 4 on-going interconnection projects, and an additional 11 projects are planned for interconnection through 2015 (APAEC, 1999). However, interconnection within individual countries has not been fully realized. For example, even in Brunei and Cambodia, there are no national interconnected power networks (Bannister et al., 2008).

For geological reasons, current by proposed energy infrastructure projects concentrate within ASEAN plus China. The "plus 6" countries of EAS are, with a few exceptions, somewhat physically remote from the ASEAN countries. Therefore, electricity interconnection mainly focuses on ASEAN, although southern China and, potentially, India, could become interconnected through ASEAN. India has the potential to link with other EAS countries because of its good location between gas supply centers and East Asian demand regions, but no feasible plan has been set yet. For the gas interconnection, India and China are large current and potential gas consumers with current and planned pipeline access to rich gas reserves in Russia and Central Asia (for China) and Central Asia and parts of the Middles East (for India).

The major energy infrastructure involving China is cooperation under the Greater Mekong Sub-region (GMS) program. The GMS sub-region includes the two southern provinces of China as well as Thailand, Viet Nam, the Lao PDR, Cambodia and Myanmar. The ultimate aim of energy cooperation in the GMS is to develop a staged regional power market between the six GMS countries. With the support of the Asian Development Bank (ADB), GMS countries formed the Electric Power Forum (EPF) in 1995 to promote closer cooperation and integration between the GMS countries. The World Bank joined the GMS/ADB effort in 1996. The Intergovernmental Agreement for Power Trade (IGA) was signed in late 2002 and came into force in November 2003, followed by the formation of the Regional Power Trade Coordination Committee in 2004 and the signing of the Regional Power Trade Operating Agreement in July 2005. According to current plans, it is likely that before 2020 all GMS countries will be interconnected and internal countries grids are sufficiently to support significant transactions by a third party country (Bannister et al., 2008).

However, lack of trust, in particular, political trust is a huge barrier to trade in pipeline gas and electricity, and thus the demand for energy infrastructure. On the one hand a consumer linked to a supplier with pipeline hardware might be regarded as secure because of the supplier's sunk investment, but at the time of contract renegotiation the buyer may have few options also and may be disadvantaged commercially (Bannister *et al.*, 2008). More serious concern is that once a physical network is established and supply is set relying on the trans-boundary trade, the importer will be hurt if the supply is interrupted. This kind of interruption is often caused by political rather than economic disputes. An example is the dispute over gas transmission prices between Ukraine and Russia which left some European countries without heating for a short period in the winter (Fox News, 2009).

Electricity raises particularly sensitive political issues as it supports, like no other fuel, the immediate, day-by-day conduct and welfare of modern societies. Although limited integration can increase energy security by providing additional energy sources to reduce the chances of interruption, history has shown that governments are reluctant to compromise their control of all the resources needed for everyday use and system security. However, when in full integration, 'base-load' supply may rely on imported energy, which then highlights the importance of political trust.

3.3. National Energy Market Liberalization

When discussing market liberalization, it is useful to distinguish energy markets that are essentially global, of which oil is the obvious example, from those which are more regional and sub-regional and which tend to be more subject to government and administrative oversight, such as pipeline gas and electricity. The latter is often the most difficult part of reform and thus subsequently the most challenging step toward EMI.

Building an open and competitive national energy market is challenging but crucial and beneficial toward EMI. Compared with regional agreements and physical energy infrastructure, much more work needs to be done at national level. Prominent challenges at the national level are to construct national competitive markets and to

remove inefficient fossil fuel subsidies. National energy market policy and regulation have an important role in the process of EMI, as an outside agreement cannot be effective if it cannot be implemented in the national markets. Investment in energy mining sectors is often affected heavily by national regulations in areas such as security of mining tenure, access to land, and registration procedures. Trans-boundary energy infrastructure, like investment, is also heavily affected by domestic policy and regulations. In a large country like India, progress in sector restructuring, open access to transmission systems and fair and transparent sector regulation were needed even for stimulating internal trade among the various regions of the country (World Bank, 2008).

In the EAS region, energy market liberalization has been conducted in Australia, Japan, New Zealand, the Philippines, and Singapore, while in others, energy markets are more or less restricted in some of the following ways: markets are dominated by some vertically integrated suppliers, prices are regulated, trade qualification is limited, electricity networks/gas pipelines are not open to access, and so on. Electricity is the most regulated energy product among all major energy products. It is often managed by an integrated state-owned company. Oil, on the contrary, is the least regulated energy product.

The Australian National Electricity Market is one example of how national markets can be liberalized and integrated. The Australian electricity sector originally developed as a set of distinctly owned and operated electricity grids. Under the Australian constitution, States have major power in matters such as infrastructure management, which was a situation rather similar to that now existing in ASEAN. During the Australian market reforms in the late 1980s and early 1990s, the federal Government advanced the process of integration by implementing an interventionist competition policy, not only in electricity but also across many industry sectors. Currently, the development of political, legal and economic governance arrangements, efficient market design and the strengthening of physical transmission infrastructure and its management remain works in progress. But the integration of the markets was actually achieved relatively quickly, over a period of a few years. The domestic energy sectors are also subject to open access, and competition has been encouraged at both the wholesale and retail levels. Even private infrastructure is subject to Australia's "open access" regime, intended to allow even privately owned infrastructure

to be shared by multiple parties on fair terms. Details of this reform can be found at Bannister at al. (2008).

Australian experience in integrating domestic electricity markets may offer lessons relevant to similar developments in the EAS region (Bannister et al., 2008). The core of the reform in the Australian electricity sector was: a single "National Electricity Market" (at least in the eastern, most heavily populated part of the country) with a single, national system and market operator; separation of transmission and distribution from generation and retailing and its regulation under transparent procedures; competitive generation to be dominated by the private sector; competitive retailing to be dominated by the private sector, with customer choice; and an independent regulator and manager of the electricity market rules, who runs an open and transparent process for rule change, within cooperative Federal-States governance agreements. The "competition payments" were also designed to anticipate and compensate for the myriad of complaints about financial and other disadvantages that might flow to specific States or Territories from the development and integration of competitive markets.

Among the EAS developing members, India and the Philippines are pioneers in liberalizing their domestic energy markets. The Philippines has opened its oil, gas, coal and renewable energy industries to foreign investment and has transparent/stable procedures for the exploration for, and production of, these resources. India has opened up of its energy sectors except coal. In many sectors – especially oil and gas exploration and refining, petroleum production and retailing, and electricity generation– energy markets have matured considerably. This liberalization could be driven by internal incentives as pointed by the World Bank (World Bank, 2008).

The current market liberalization is far from enough, which can be demonstrated by the outline status of EMI in the EAS region presented in Table 3. The past study shows that investment to the energy sector may still be restricted in some EAS countries. Countries of the EAS region have widely different approaches to foreign investment in the energy sector. Some countries such as Australia broadly welcome foreign investment in the resource sector and do not have rules banning majority or even complete foreign ownership. Others such as Indonesia require majority ownership locally or apply other restrictions. Such restrictive rules on investment are likely to limit, or even inhibit actual foreign investment (Bannister *et al.*, 2008).

However, it is not unusual as liberalization of national markets is a challenging and long lasting task. Even in the European Union (EU), the single energy market has not been fully created due to lack of unconstrained competition in the national markets. Currently, gas and electricity markets are still largely national and France and Germany have not been convinced by the competitive energy utility model (Bannister et al., 2008).

Table 3 Energy Market Integration Status and Issues

ISSUES	OIL	COAL	GAS	ELECTRICITY
Australia	(+) Stable governance and procedures (+) Fully integrated into international markets	(+) Fully deregulated (+) Stable governance and procedures (-)generally lagging in infrastructure investment	(+) Deregulated except for some pipelines (-) Gas retail market in early stages and disjointed (-) Gas pipeline access issues	(+) Successful National Electricity Market in east (+) Industry deregulated except in NT (+) Highly competitive wholesale spot market (+) Open to foreign investment
Brunei Darussalam	(-) Ownership concentrated (+) Increase in value added exports if proposed refinery proceeds (+) Previous oil conservation policy no longer in force (-) Domestic petroleum product prices are regulated and subsidized	n/a	(-) Ownership concentrated (-) No infrastructure for cross border pipeline trade (-) Regulated prices	(-) Only two players, both vertically integrated. (-) No current plans to change industry structure (-) Use of subsidized gas for electricity generation makes it unavailable for high value export. (-) Pricing is regulated. (-) No immediate plans to introduce more independent generators or retail competition.
Cambodia	(+) Fiscal regime in place for oil exploration, development and production	n/a	(+) Fiscal regime in place for gas exploration, development and production (-) No onshore gas network or facilities in place	(+) Bilateral cross-border power exchange agreements negotiated with neighbouring countries (+) Plans for further transmission system expansion, although timing uncertain (-) Fragmented power system combined with private Rural Enterprises (REEs) in industry results in uncompetitive prices for electricity in many areas (-) Legal and policy framework for investment not mature
China	(-) Tightly regulated domestic markets (-) Dominated by three state-owned firms (-) Foreign trades through only designated firms with quotas	(+) Nominally deregulated (+) Industry is consolidating (-) Governmental interventions	(+) Improving pipeline network and LNG terminals (-) Market highly concentrated from production to distribution (-) Highly regulated industry (-) Government intervention, e.g., priority of gas utilization	(+) Generation separated from grid and consumption (+) Planned progressive liberalization of electricity industry (+) Large system facilitating trades and exchanges (-) Volatile industry structure and policies (-) Lack of experience of market-based operation (-) Inefficient dispatch processes (-) Government interventions
Indian	(+) Relatively open domestic exploration and production system (NELP) (+) Crude oil pricing linked to international markets (-) Domestic market dominated by ONGC and OIL	(-) Industry is nationalized and tightly regulated (-) Government controlled exploration and mining except for captive mining; no competition. (-) Land access issues	(+) Relatively open domestic exploration and production system (NELP) (-) No retail gas market (+) Potential international gas pipeline links (+) Good location between gas supply regions East Asian demand centres (-) Segmented domestic gas	(+) Open access assured (+) Large regional exchanges (-) No direct connections with EAS countries (-) Weak State electricity systems and management, physically and financially (-) No transparent planning and dispatch processes (-) Insufficient metering and law enforcement

ISSUES	OIL	COAL	GAS	ELECTRICITY
			pipelines	
Indonesia	(+) Oil development licenses Issued by independent BPMIGAS, not Pertamina, but not seen externally as transparent (-) Pertamina still dominates downstream sector. (-)Large proportion of population unable to pay world prices.	(+) Foreign investment in coal mining encouraged. (+) Subject to world market trading conditions. (+) Policy to encourage more domestic use of coal for power generation.	(+) No upstream sector monopoly by Pertamina. (+) International companies involved in gas production. (+) State owned PGN separated from supply and responsible for all transmission and distribution. (+) Important link in TAGP, although progress is slow. (-) Limited interconnectivity in domestic gas network.	(-) Sector dominated by a single state owned enterprise, PLN. (-) No retail market competition, customers purchase power from PLN. (-) No open access. (-) Little interest from private and foreign firms in investing in the sector. (+) Plans to introduce more retail competition.
Japan	(+) Oil industry liberalized and not concentrated (+) Open access to pipelines (+) Good investment environment and advanced technologies	(+) Fully dependent on international coal markets (*) Relatively few companies dominate import channels. (+) Overseas investment strong (+) Competitively priced fuel	(+) Gas market liberalized step-by-step. (+) Open access to pipelines	(+) Electricity market being liberalized step-by-step. (+) Open access to electric grids (-) Limited competition in the wholesale market.
ROK	(+) Exposed to world trading conditions (+) Downstream sector subject to some competition (-) Upstream oil sector dominated by a single state owned enterprise (+) The oil and petroleum sector is open to international competition and markets are well established	(+) Subject to world coal market trading conditions (+) Non signatory to Kyoto protocol	(+) Gas sector in Korea is exposed to world trading conditions (+) The structure aims to support open trading (-) All importing and distribution in the hands of government owned enterprise	(-) Industry is vertically integrated and ownership in government hands (-) Very limited competition in the market (-) No opportunities for electricity trading
Laos		(+) Lao PDR enables private sector participation in the development of its coal deposits	n/a	(-) Bilateral deals struck for the development of hydro potential may diminish incentive for a multilateral regime (-) Trading regime for export / import of power into / out of Lao PDR not well developed
Malaysia	(-) Petronas has exclusive rights to own and explore oil resources (-) Petronas is vertically integrated but some competition in downstream	(+) Planned promotion of coal-fired generation	(+) Already a key LNG exporter to EAS countries (-) Petronas has exclusive rights to own and explore gas resources (-) No mechanism for cross border trade. (-) Demand managed by “five fuel” policies rather than pricing.	(-) Highly concentrated and regulated market (-) Vertically integrated (though IPPs exist) (-) No market based pricing mechanism (-) No mechanism for cross border trade.

ISSUES	OIL	COAL	GAS	ELECTRICITY
Myanmar	(+) Foreign investment to explore and produce oilfields is encouraged	(+) Foreign investment in coal mining is encouraged.	(+) Foreign investment to explore and produce gas fields is encouraged;	(+) Foreign investment encouraged in generation, particularly in relation to development of hydro resources. (-) No move toward a competitive market structure
New Zealand	(+) Oil market is liberalized and open to world competition (+) New policy initiatives for oil exploration are in place	(+) Market is liberalized (+) Export of coking coal (-) Solid Energy dominates the small coal market (-) Weak investment	(+) Market is liberalized (+) Open access to gas pipelines	(+) Market is liberalized (+) Open access to grid (+) Customers free to choose suppliers
Philippines	(+) Foreign involvement in upstream oil sector promoted, with transparent / stable fiscal terms for Service Contracts (+) Downstream oil sector has been deregulated	--	(+) Foreign involvement in upstream oil sector promoted, with transparent / stable fiscal terms for Service Contracts (-) Only one major gas field currently produces gas (-) Minimal piped gas network infrastructure	(+) Industry has been reformed and opened up (+) Market arrangements in operation but yet to be expanded to Visayas (+) Selling generation assets (+) Plans to introduce more retail competition through open access regime
Singapore	(+) The oil and petroleum refining sector in Singapore is lightly regulated and exposed to world trading conditions. (+) Upstream sector is competitive but most players necessarily work offshore as no real oil potential. (+) The petroleum sector is open to international competition and markets are well established.	n/a	(+) Singapore is horizontally disaggregating its gas sector but this process is not yet complete. (+) The new structure aims to support open trading. (+) ASCOPE is working on issues that would support cross-border trading. (-) Associated ban on new contracting for imported pipeline gas are a possible restraint on future trade.	(+) Industry is vertically and horizontally disaggregated. (+) Market arrangements are already operating. (-) With current portfolios the level of market competition is limited. (+)Opening up to competition from neighboring countries could improve the level of competition for dispatch. (-) For security, Singapore will insist on being able to generate its own needs. (+) But this does not rule out possible opportunity trading with neighboring countries (including purchase).
Thailand	(+) Oil sector open to foreign investment (-) PTT dominates downstream sector (+) Transparent process for allocating oil and gas exploration blocks (+) Open market downstream	(-) Open market in domestic and imported coal but use dominated by power sector which is concentrated.	(+) Key player in TAGP if it progresses (+) New market structure aims to support open trading. (+) Transparent process for allocating oil and gas exploration blocks	(+) A central participant in GMS market integration strategy (-) Regulated market with EGAT as single buyer and dominant producer (-) No market competition. (-) Incentives to seek low cost bilateral supply deals appear to dominate incentives for further market integration (+) Plans to introduce more retail competition.
Viet Nam	(+) Laws encourage foreign company involvement in oil activities in the country.	(+) Plans to liberalize ownership of the industry within a few years. (-) Reported difficulty organizing import coal contracts	(+) Foreign involvement encouraged. (-) Dominated by PetroVietnam (-) No plans for complete liberalization (-) Upstream development	(+) Laws allow foreign ownership of gen. assets Extended electricity reform process has been stalled (-) Sector dominated by EVN (+) Cross-border trade based on bilateral arrangements (+) IAG and RPTCC membership (+) Policy encourages power purchase or exchange with

ISSUES	OIL	COAL	GAS	ELECTRICITY
			delayed by failure to agree on price	neighboring countries

Sources : Adapted from Bannister et al. (2008); (+)/(-) indicates the point is desirable/ undesirable.

3.4. Energy Pricing Reform and Fossil Fuel Subsidies

Energy subsidies will cause problems in investment, consumption, national economies, and so on. Energy subsidies not only distort national budgets but also cause inefficient and, ultimately, unsustainable usage patterns and discourage investment. They may delay some production developments and reduce the opportunity for mutually beneficial trade as the case of gas subsidies in Malaysia and Indonesia (Bannister et al., 2008). If the world energy prices increase, subsidies to energy imported at world prices can become so expensive that they dominate national budgets, as in Indonesia and Malaysia (Alibaba.com, 2010; The Straits Times, 2010).

However, price regulation of, and subsidy to, the energy sector are being implemented in many countries. Energy prices have been liberalized in Australia, Japan, ROK, New Zealand, and the Philippines. Prices of electricity are more often regulated than coal, oil and natural gas. This may be due to the "natural monopoly" characteristic of power grids and the necessary of electricity in daily life. Oil, despite being exposed to international markets, is often subjected to regulation and subsidy. For example, India and Laos, which have limited domestic oil production, have regulations on oil prices. Prices of coal are regulated only in a few countries such as China and Vietnam. One reason for the less frequent regulation of coal prices is that many EAS countries do not have coal resources and thus are subject to international markets. Details of energy pricing and subsidy for the EAS region are presented in Table 4.

Table 4 Status of Energy Pricing and Subsidy in the EAS countries

ISSUES	OIL	COAL	GAS	ELECTRICITY
Australia	(+) Market based pricing with reference to Malaysia and Singapore benchmark prices	(+) International market and market based pricing	(+) Market based pricing (+/-)prices of sales to small customers are regulated	(+)Competitively priced based on bids (-) prices are subsidized for certain customer classes
Brunei	(-) Petroleum product prices are regulated and subsidized	n/a	(-) Regulated prices	(-) Use of subsidized gas for electricity generation

ISSUES	OIL	COAL	GAS	ELECTRICITY
				(-) Pricing is regulated.
Cambodia	(-)Upstream oil and gas activities are managed	n/a	(-)Upstream oil and gas activities are managed	
China	(-) Regulated prices (-) Subsidies to refinery and some consumption sectors	(-) Early stage of market-based pricing (+) World pricing in regions near trading ports	(-)Subsidies exist at various levels (-) Gas price is regulated (+) Pricing reform is being debated	(-)regulated on-grid and sale prices of electricity (+)Part of the generation capacity was subjected to a pricing test by a competitive bidding process
India	(-) Prices are controlled by government	(-) Prices are regulated (+)Market pricing for nonallocated demand	(-) Part subjected to Administered Pricing mechanism (+) Others are market determined	(-) Subsidy schemes (-) Prices are controlled in all steps of the supply chain
Indonesia	(-) Gasoline and diesel subsidized.	(+) Domestic and international prices similar	(-)Prices subsidized	(-) Prices subsidized (-) Regulated tariffs are insufficient to cover the cost of new entrants
Japan	(+) Market based pricing	(+) Market based pricing	(+) Market based pricing	(-)Residential and small business customer prices are regulated. (+) Other prices are marketed based
ROK	(+)Prices for petrochemicals are liberalized. (+)Existing intervention procedures and rules on raising prices.	(+) Subject to the international price regime	(+)Existing prices reflect world prices.	(+) Pricing is regulated but generally aims to be cost-reflective.
Laos	(-) Imported oil sold at regulated prices.		(-)Prices are regulated	(-)Prices are regulated
Malaysia	(-) Gasoline and diesel subsidized.	A matter for state governments	(-) Regulated and distorted pricing	(-) Regulated and bundled prices
Myanmar	(-)Prices are regulated and petroleum products are subsidized;		(-) Gas is subsidized to end users	(-) Prices regulated to be “affordable”
New Zealand	(+)No price controls	(+) Deregulated	(+) Market is liberalized	(+) Market is liberalized Transmission and distribution prices are partly regulated
Philippines	(+)Downstream is deregulated (+)Upstream is	(+)Transparent	(+)Upstream is transparent	(+) Pricing regulated but generally aims to

ISSUES	OIL	COAL	GAS	ELECTRICITY
	transparent			be cost-reflective
Singapore	(+) Open to competition across refining, trading and retailing	n/a	(+) Prices are set by the individual companies	(+) Only a small portion is regulated; not sufficient to lead to distortion
Thailand	(-) Pricing distortions, especially with low price set for LPG	(+) Prices are not regulated	(-) Regulated domestic prices	(-) Pricing is regulated with cross-subsidies and subsidies
Viet Nam	(-) Prices are regulated (+) Oil product pricing may be liberalized soon	(+) Plans to liberalize pricing within a few years.	(-) Prices are regulated	(-) Electricity use is subsidized

Sources : Major information was extracted from the country report of the first stage EMI study (Bannister et al., 2008); (+)/(-) indicates the point is desirable/ undesirable; n.a: not applicable.

The adoption of market oriented pricing mechanisms in member countries is a prerequisite for a regional EMI. Pricing reforms, in particular, removal of energy subsidies, have been clearly needed, demonstrated and even attempted, but their implementation is far from complete. The Asia-Pacific Economic Cooperation forum (APEC) leaders have committed to rationalise and phase out fossil fuel subsidies over the medium term (APEC, 2009). The plans and actions for liberalizing energy prices and removing subsidies for fossil energy have been demonstrated in many countries, such as China, India, Indonesia, and Vietnam. In China, energy subsidies are gradually going down, and the government is driving the price more towards a market determined price. China has implemented market-based pricing for coal in the past few years (Yu, 2008). Their attempts to break down vertical integration in electricity were initiated a decade ago starting with the separation of generation transmission and distribution (Shi, 2002). However, transmission, distribution and retailing are still highly aggregated. Based on personal contact, the authors are aware that the Chinese government is now also studying means to formulate market oriented pricing regime for electricity transmission and distribution. Discussions have taken place in Indonesia about removing energy subsidies (Alibaba.com, 2010). The immediate first step could be rationing of subsidized fuel while not raising their prices. Malaysia may begin cutting fuel and other subsidies under a proposed five-year plan (The Straits Times, 2010).

Phasing out subsidies, a core handicap for pricing mechanisms, is very difficult socially and sensitive politically. The affordability issue could also be an economic barrier to removal of subsidies. Energy subsidies are not good theoretically but prevail in practice. One major concern is that many people may not be able to afford world prices of oil. So in many developing countries, such as China, India, Indonesia, Myanmar, price regulation is used to provide "affordable" energy. Such affordability issues slowed down the reform of oil pricing in India (Bannister *et al.*, 2008).

4. ESTIMATED BENEFITS FROM EMI

The five groups of selected issues were estimated 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 current version of the REPA model employs a 22-region 32-sector aggregation of the GTAP database Version 7.[1] Impacts estimated by this model are not comprehensive and often are partial and conservative. Many benefits cannot be estimated by the model. For example, productivity is exogenously given in the model, and thus expected productivity improvement due to EMI will not be fully captured. Neither is the full potential of investment liberalization is estimated, due to the crude specification of saving-investment mechanisms in the model. Another uncovered benefit is the improvement of energy security resulting from integrated energy infrastructure.

With these caveats in mind, we not only meet the requirements of ECTF Phase 2 TOR, namely, estimating the impact of trade and investment liberalization, but we also try three additional simulations. However, two of the additional simulations, the linkage of infrastructure and the removal of subsidies are not very successful, due to lack of data in the infrastructure case and the high aggregation in the GTAP database. Although we cannot estimate the impact of all energy infrastructure, a previous study has shown that linkage of electricity grids can create both economic and environmental benefits (Bhattacharya and Kojima, 2008). The results of this study are detailed in the Technical Report by Bhattacharya and Kojima (2010). The following is a summary of relevant results.

In the case of the removal of energy subsidies, although this would be theoretically beneficial, we cannot estimate impacts with the current EAS regional CGE model. Due to lack of a more disaggregated dataset in which energy commodities are composites of subsidized energy commodities, and taxed energy commodities are subject to net tax,

[1] GTAP Ver.7 comprises all East Asian countries. However, the dataset aggregates Brunei Darussalam and Timor-Leste as one region (other South-east Asia), but we assume that this region represents the economy of Brunei Darussalam as its GDP share (based on 2008 World Bank GDP ranking) is 95.8%.

energy subsidy removal can only be modeled through equivalent tax increases, which introduces further market distortions. In the real world, however, removal of subsidies should reduce market distortions. Therefore, their simulation results are not presented at the overview report, but details are reported in the technical report prepared by our simulation team. Furthermore, the simulations of domestic market liberalization and trade liberalization are only indicative, because the impacts are only partially estimated and the method of choosing parameters is arbitrary.

The estimation results of trade liberalization, investment liberalization and domestic market liberalization are presented in Tables 5, 6, 7 and 8.

In the simulation of trade liberalization, tariff and export subsidy/tax are removed. The results show that the EAS region as a whole will gain in real and in nominal GDP due to energy trade barrier liberalization. The distribution of economic benefits is not balanced, but the magnitude of impact in most countries is close to zero. Some countries like Australia, Indonesia, Malaysia and Singapore will lose in that context. However, such loss is very small and in some cases negligible (viz. Australia). 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, in Australia the largest negative impacts are observed in the non-ferrous metal and the other manufacturing sectors; 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 (Table 5).

Table 5 Impacts on GDP and CO_2 emissions due to trade liberalization, % change from 2020 Baseline scenario

Region	Real GDP	CO_2 emissions
China	0.000	0.05
Japan	0.003	-0.19
Korea	0.052	0.02
Cambodia	0.128	1.25
Indonesia	-0.065	-0.37
Lao PDR	-0.130	0.96
Myanmar	-0.044	-0.37
Malaysia	-0.078	-0.47
Philippines	0.011	0.38
Singapore	-0.070	0.12
Thailand	0.011	-0.13
Vietnam	0.263	3.21
Brunei Darussalam	-0.147	-0.02
India	0.368	6.83
Australia	-0.002	-0.95
New Zealand	-0.003	-0.23
Brazil	-0.012	-0.07
EU	-0.004	-0.09
USA	-0.001	-0.05
Russia	-0.035	-0.06
MENA and Venezuela	-0.052	-0.13
Rest of the World	-0.010	-0.11
World Total	0.000	0.14
EAS Total	0.024	**0.58**

Source: Bhattacharya and Kojima (2010)

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 6). Due to increases in imports of cheaper energy, domestic production of energy might fall because of lack of demand and thus create downward pressure on market prices. For example, the Indian domestic consumer price for coal will reduce by 28%, which could attribute to an increase in imports of energy commodities.

Table 6 Impact of energy trade liberalization on consumer prices of energy commodities

Region	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	0.01	0.13	-0.24	-0.04	-0.06	-0.23
Japan	2.35	0.11	-0.27	0.08	0.04	-0.01
Korea	1.15	-0.13	-0.78	-0.16	0.02	-0.06
Cambodia	1.79	1.7	-0.23	-4.28	-0.26	0.02
Indonesia	3.37	1.15	0.17	0.18	0.28	0.02
Lao PDR	-2.96	-0.03	-0.07	-1.89	-0.25	0.02
Myanmar	2.62	-0.03	1.42	-0.84	0.43	0.24
Malaysia	2.54	-0.21	0.49	0.57	0.34	-0.01
Philippines	-2.36	0.56	-0.04	-0.34	-0.22	0.02
Singapore	1.85	1.19	-0.14	0.11	0.02	-0.05
Thailand	0.95	0.28	-0.09	0.22	0.01	-0.02
Vietnam	5.16	-0.59	-6.14	-8.44	0	0.34
Brunei Darussalam	1.19	1.79	-0.22	0.41	0.07	0.16
India	-28.73	0.03	0.33	-0.57	-2.02	-0.01
Australia	3.83	0.83	-0.2	1.12	0.52	0.05
New Zealand	2.84	0.72	-0.1	0.53	0.04	-0.01

Source: Bhattacharya and Kojima (2010).

In the estimation of investment liberalization, capital was reallocated from investing countries to recipient countries, the national capital endowment of which is increased to that amount. The allocation of such endowment among all sectors including energy sectors within a country is endogenously decided by the model. Simulation shows that real GDPs for the investing country reduce but the real GDPs increase for all the recipient countries. The negative impact on GDP in the investor countries do not mean their welfares will be damaged. Actually, their national income can be increased because profits will be repatriated and thus compensate for the loss of production of transferred capitals.

The overall negative impact of investment liberalization to the EAS region could be due to the fact that potential positive impacts are not fully captured by the model. For example, with capital shortage, the marginal productivities of capital in the recipient country usually are much higher than those in the investing countries. With capital transfer, some low marginal productivity capital will be transformed to high differences between GDP and GNP natural welfare marginal productivity capital. This productivity gain, although is predicted in economic theory, cannot be modeled by the

current model. Furthermore, in this estimation the investor countries are simply transferring a portion of their capital to the recipient countries without any revenue gain, and reduced capital endowments as a result of transfer simply reduce the production capacity of investing countries. It highlights the importance of proper specification of full dynamics and investment mechanisms, which remains as an important future task.

As a consequence of real GDP growth, corresponding CO_2 emissions also increased for the recipient countries compared to the investing countries (Table 6).

Table 7 Impact on GDP and CO_2 emissions due to capital reallocation (Investment Liberalization), % change from 2020 baseline

Region	real GDP	CO2 emissions
China	-0.086	-0.05
Japan	-0.305	-0.45
Korea	-0.225	-0.26
Cambodia	0.973	0.82
Indonesia	0.819	1.42
Lao PDR	0.476	1.71
Myanmar	0.848	2.95
Malaysia	0.825	1.26
Philippines	1.218	1.21
Singapore	-0.170	-0.10
Thailand	1.276	1.16
Vietnam	0.907	1.37
Brunei Darussalam	1.037	2.03
India	1.041	0.88
Australia	-0.248	-0.33
New Zealand	0.346	0.41
Brazil	-0.011	-0.01
EU	-0.003	-0.01
USA	-0.001	-0.01
Russia	-0.027	-0.01
MENA and Venezuela	-0.052	-0.01
Rest of the World	-0.008	-0.01
World Total	-0.011	0.04
EAS Total	-0.026	0.15

Source: Bhattacharya and Kojima (2010)

Liberalization of domestic energy markets is assumed that it will reduce the monopoly of energy distribution and retailing in domestic energy market through open access to transmission system by other retailers, domestically and internationally. Consequently, it is expected to improve the efficiency of these energy services. In our simulations this improved efficiency of energy services is modeled as improvements of total factor productivity (TFP) of the electricity sector (ely) and the gas manufacturing and distribution sector (gdt).

To estimate the impact of domestic market liberalization, 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[2] (Table 8).

The simulation results demonstrate significant benefits overall to the EAS region from integrating energy markets. 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 8 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

[2] The study although test 10% and 15% TFP growth and the observation is the same to this one.

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)

To better understand the impact of EMI on a broader context, the study also estimates a combined scenario where all three policy initiatives estimated above are assumed to be implemented together. That is, the scenario estimates a combination of the following three policy scenarios: trade liberalization; investment liberalization and market liberalization (20% increase in TFP for distribution service sectors). The results show the potential of win-win outcomes of energy market integration for the EAS region as a whole: in the combined policy scenarios, regional total CO_2 emissions will be reduced while there positive economic impacts (Table 9). Another important finding is that all EAS countries gain in terms of GDP growth. In terms of CO2 emissions, even though some member countries will increase their emissions, the overall impact is negative and thus desirable. The result that less developed countries will gain more economic benefits than developed ones is also desirable for the region because narrowing development gaps are beneficial for the process of regional integration.

Table 9 Impact on GDP and CO_2 of combined policy scenarios, % change to baseline 2020

Region	Real GDP	CO_2 emissions
China	1.472	-1.03
Japan	0.425	-2.73
Korea	0.684	-1.64
Cambodia	1.840	3.89
Indonesia	1.729	2.20
Lao PDR	1.620	11.61
Myanmar	2.893	13.80
Malaysia	2.119	1.51
Philippines	2.188	-0.44
Singapore	0.503	-2.73
Thailand	2.815	1.92
Vietnam	3.781	8.65
Brunei Darussalam	2.278	3.82
India	2.733	4.81
Australia	0.370	-3.18
New Zealand	1.174	2.90
Brazil	-0.013	0.23
EU	-0.001	0.51
USA	0.002	0.41
Russia	-0.083	0.35
MENA and Venezuela	-0.034	0.04
Rest of the World	-0.007	0.42
World Total	0.252	0.14
EAS Total	1.069	-0.31

Source: Bhattacharya and Kojima (2010)

The overall benefits for each member country are positive from the combined scenario, which shows a trade-off among various initiatives toward EMI.

In summary, the simulation results suggest that policy determination and intervention are required to balance the tradeoff between economic growth and CO_2 emissions. In the case of trade and investment liberalization, CO2 emissions will grow. However, in the case of liberalizing domestic markets, economic growth will be accompanied by a decline in CO2 emissions. These results indicate that liberalization of domestic markets can bring double benefits, and thus imply that such liberalization

should be promoted. The fundamental point is that an integration of energy markets should be accompanied by necessary policy to safeguard the environment.

5. POLICY IMPLICATIONS

Since trade and investment in broad terms has been covered in the existing bi/multilateral free trade and investment agreements, the remaining task is to make sure that energy goods and services, and investment in the energy sector, are not restricted or excluded by these agreements. More broadly, current agreements could be harmonized, through unification of such thing as Rules of Origin, and simplified to fewer agreements with broad coverage, like CEPEA. A further detailed review of energy trade and investment in the current regional agreements and frameworks will add value to further policy decision.

With development of more infrastructures, such as introduction of marine transportation, the networks of energy infrastructure may be expanded to other countries, in particular in the case of LNG, such as the Philippines and Australia. The planning of such projects should take into account current studies, such as the ASEAN Connectivity Master Plan and the Comprehensive Asia Development Plan which are under formulation.

Although regional and bilateral agreements have proceeded well, an even more challenging task is to construct open and competitive markets and to remove inefficient fossil fuel subsidies at national levels.

Phasing out subsidies has to be a long-term process and needs to be carefully planned in consideration of each individual country's circumstances. Each country needs to have a comprehensive road map which integrates economic, political and social issues, to achieve market oriented energy pricing mechanisms. Despite the process requiring an extended time-frame, immediate actions in terms of planning could facilitate the process and reduce difficulty. In countries where subsidies cannot be removed, immediate actions could include: increasing public awareness of and

promoting debates on subsidy issues; making plans to avoid further deterioration of subsidies; and removing subsidies in the least controversial sectors.

In order to build an open and competitive domestic market, it is important to establish clear and transparent market rules and principles. This will provide strong legal protection, reduce transaction costs to business, enhance investor confidence, and enable the free flow of goods, services, and capital[3]. In the case of electricity industries in two countries, operating by state-owned and private companies respectively, such as in Indonesia and Malaysia, it would be difficult to do trans-boundary trade between these two kinds of companies, and thus change of domestic legislation is necessary. Technical standards should also be harmonized to allow smooth utilization of energy across the board. Diversification in standards for electricity appliances, for example, is a major barrier for the development of APG. Even the successful Nordica electricity market still needs further development to change and harmonize regulations, standards, and others matters, (Nordic Energy Research Website, 2010).

Some mechanisms to share the benefits and offset losses from EMI, such as a broader set of binding initiatives, are necessary. Different impacts among various initiatives and possible benefits from the combined scenarios imply that more initiatives and a broader coverage of market integration are better than less, because each country may be able to achieve an overall benefit despite losses from some other aspects. It is also implied that member countries need to face possible losses and to prepare for trade within sectors in their own country and with other member countries.

In the worse scenario where some countries cannot get a positive benefit, the negative impacts could be either offset by gains from other sectors, or through regional compensation mechanisms. EAS may learn from the Australian experience in establishing compensation and financial incentive schemes. The Australian Federal Government, like ASEAN and other regional organizations, did not have the constitutional power to force the reform but relied instead on its financial strength to

[3] This need for "software" has been well recognized. For example, the AGP action described by the AEAEC 2010-2015 is "Harmonization of legal and regulatory framework for bilateral and cross border power interconnection and trade and formulation of institutional and contractual arrangements for cross border trade to include taxation, tariff and Third Party Access".

offer “competition payments” to states when they achieved certain milestones in the reform process, the goal of which was to advance competition.

For less developed countries, even though they seem to be able to gain more than developed countries from EMI, it is important to improve their investment policy and governance and thus improve their national and regional competitiveness. Such improved competitiveness is necessary for less developed countries to be able to gain from EMI, because more competition will not only generate overall benefits but also generate winners and losers. Apart from compensation mechanisms, capacity building is also necessary since there are huge divergences among EAS member countries.

To deepen the integration of energy markets, it is also necessary to improve political trust. Theoretically, an integrated energy market reduces dependence on a particular country, fuel or trade partner and such a connected supply structure would facilitate crisis support between countries. However, if countries are not trust each other in respect of cross-boundary transmission, the impact of EMI on energy security will be discounted. Unfortunately, lack of political trust is a prevalent situation in the trade of energy by networks, such as gas and electricity, in this region. Within ASEAN, there are many mutual suspicions among potential trading partners (ACE2006). In East Asia, one prominent hurdle to integration is the unresolved different perspectives on history among China, Japan and Korea.

Regional architectures, such as specialized regular forums and institution like an East Asia Energy Agency, may be able to facilitate the EMI. Member countries can learn from each other, and thus policy forums with specific focuses may be needed from time to time. With more and more energy cooperation activities emerging and the institutionalization of regional architectures, such as EAS, and, in particular, the move towards an East Asia Community, the existing regular meetings of energy ministers and senior officials are not sufficient. More work is needed to turn discussions into actions and to set up monitoring mechanisms. It is also important to share information and to understand the energy status and potentials, which needs solid support from data. An East Asian Energy Agency could undertake these regular activities and provide information.

A step further could be to establish a regional energy regulator, coordinating energy policy and monitoring the process of market integration. In addition, a common energy

policy is desirable for an integrated energy market (EU Website, 2007), although the road towards such a common policy will be very long.

6. CONCLUSION

EMI has been pursued for many decades, and the movement has accelerated in the past decade. A range of visions about regional communities of various kinds has boosted the need for EMI. This report reviews the current status and policy initiatives of EMI and the results of a technical study of the economic and environmental impacts of EMI in the EAS region. Two issues that have been highlighted by EMM and ECTF, namely removal of trade and investment barriers, are studied. The study also attempts to address three other key issues in EMI, these are: linkage of energy infrastructure, energy pricing reform, and liberalization of domestic energy markets.

A review of the current status of these five issues demonstrates that trade and investment liberalization have been well attempted at the regional level; the linkage of energy infrastructure also has been planned in ASEAN and China, though its potential with India and with pipelines and marine transportation has not been explored yet. The review shows that major challenges exist at national levels, such as the need for relaxation of domestic restrictions on investment and competition and the establishment of market-oriented energy pricing mechanisms. It concludes that for sensitive and challenging issues such as deregulation and subsidy removal, policy discussions should be undertaken for long-term implementation of these goals with immediate actions.

The estimation results show that the economic benefits of EMI often come with increasing CO2 emissions, which thus needs technical innovation and policy intervention. Different impacts among individual policies demand more initiatives and broader policy coverage. Capacity building is necessary to help countries deal with the challenge from increased competition and reap benefits from EMI. Political trust and regional architectures are also demanded to facilitate EMI in the EAS region.

Steps towards EMI may be a study on the removal of energy subsidies and creation of a roadmap toward a market oriented energy pricing mechanisms. This further step

can be tested in the electricity sector, where improvements can be made in deregulation, disaggregation, and pricing reform. It is also necessary to work toward transparent and regionally harmonized regulatory systems, such as harmonization of policies, legislation, and regulatory practices as well as energy investment frameworks in the member countries.

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.

REFERENCES

Alibaba.com, 2010. Indonesia may remove energy subsidies - energy minister. Available at: ://news.alibaba.com/article/detail/energy/100265843-1-indonesia-may-remove-energy-subsidies.html (Accessed on: 16 July 2010).

APAEC, 1999. ASEAN Plan of Actions for Energy Cooperation 1999-2004. Available at: ://www.aseansec.org/6577.htm (Accessed on: 15 July 2010).

APAEC, 2004. ASEAN Plan of Actions for Energy Cooperation 2004-2009. Available at: ://www.aseansec.org/pdf/APAEC0409.pdf (Accessed on: 15 July 2010).

APAEC, 2009. ASEAN Plan of Actions for Energy Cooperation 2010-2015. Available at: ://www.aseansec.org/22675.pdf (Accessed on: 15 April 2010).

APEC, 2009. The 17th APEC Economic Leaders' Declaration on Sustaning Growth, Connecting the Region. Available at: ://www.apec.org/apec/leaders__declarations/2009.html (Accessed on: 16 July 2010).

ASEAN Center for Energy (ACE), 2006. Policies and Strategies toward Energy Trade and Sustainable Development in ASEAN. ASEAN Center for Energy (ACE), Jakarta.

ASEAN Center for Energy website, 2009. Summary Record of the Third East Asia Summit. Available at: ://www.aseanenergy.org/download/reports/energy_organisastion/eas/Summary%20Record%20of%20the%20EAS%20EMM3%20_Final_.pdf (Accessed on: 16 July 2010).

ASEAN website, 2007a. Joint Ministerial Statement of the 25th ASEAN Ministers on Energy Meeting (AMEM. Available at: ://www.aseansec.org/20843.htm (Accessed on: 16 July 2010).

ASEAN website, 2007b. Joint Ministerial Statement of the First EAS Energy Ministers Meeting. Available at: ://www.aseansec.org/20848.htm (Accessed on: 16 July 2010).

ASEAN website, 2009a. ASEAN-China Dialogue Relations. Available at: ://www.aseansec.org/5874.htm (Accessed on: 16 July 2010).

ASEAN website, 2009b. ASEAN Plus Three Cooperation. Available at: ://www.aseansec.org/16580.htm (Accessed on: 16 July 2010).

ASEAN website, 2009c. Joint Statement of the Seventh AEM-India Consultations. Available at: ://www.aseansec.org/JMS-7th-ASEAN-India-Consultations.pdf (Accessed on: 16 July 2010).

ASEAN website, 2010. Overview of ASEAN-Australia Dialogue Relations. Available at: ://www.aseansec.org/23213.htm (Accessed on: 16 July 2010).

ASEC, 2010. ASEAN External Relations. Available at: ://www.aseansec.org/20164.htm (Accessed on: 16 July 2010).

Bali Concord II, 2003. Declaration of ASEAN Concord II. Available at: ://www.aseansec.org/15159.htm (Accessed on:

Bannister, H., McDonell, G., Thorncraft, S., Hu, X., Whitelock, B., Malik, C., 2008. Energy Market Integration in the East Asia Summit Region.

Bhattacharya, A., Kojima, S., 2008. Impact of Cross Border Energy Infrastructure Investment on Regional Environment, Society and Climate Change, Background paper to Infrastructure for Seamless Asia. Asian Development Bank Institute, Tokyo.

Bhattacharya, A., Kojima, S., 2010. Economic Impact Analysis of East Asia Energy Market Integration, ERIA Research Project Report 2010. Economic Research Institute for ASEAN and East Asia, Jakarta.

Cebu Declaration, 2007. Cebu Declaration on East Asian Energy Security Cebu, the Philippines.

CEPEA Track II Study Group, 2009. Phase II Report of the Track Two Study Group on Comprehensive Economic Partnership in East Asia.

EU Website, 2007. An Energy Policy for Europe. Available at: ://europa.eu/legislation_summaries/energy/european_energy_policy/l27067_en.htm (Accessed on: 28 July 2010).

Fox News, 2009. Russia, Ukraine Dispute Leaves European Nations Without Gas, Fox News, 6 January 2009.

Kojima, S., 2008. REPA Model for Impact Assessment of Environmental Policies under Regional Economic Integration in East Asia, IGES-EA Working Paper 2008-001. Institute for Global Environmental Strategies, Hayama.

Lee, H., Owen, R.F., Mensbrugghe, D.v.d., 2009. Regional integration in Asia and its effects on the EU and North America. Journal of Asian Economics, 20, 240-251.

Lee, H., Plummer, M.G., 2010. Estimating the Medium-term Effects of the ASEAN Economic Community, GTAP Resources.

Nordic Energy Research Website, 2010. Integration of the Energy Market Available at: ://www.nordicenergy.net/section.cfm?id=3-0&path=4 (Accessed on: 15 July 2010).

Park, I., 2000. Trade Liberalization and Long-run Economic Growth - A CGE Model Analysis of AFTA. Korea Review of International Studies, 3, 107-130.

Shi, X., 2002. How Should the Coal Industry Response to the Market Liberalization in the Electircity Sector. Coal Economic Research, 2002, 6-14.

The Straits Times, 2010. Malaysia plans subsidy cuts The Straits Times, 27 May 2010.

World Bank, 2008. Potential and Prospects for Regional Energy Trade in the South Asia Region. The World Bank, Washington, D.C.

Yu, T., 2008. China to Remove Caps on Coal Prices, China Daily, 10 Dec 2008.

TECHNICAL REPORT

ECONOMIC IMPACT ANALYSIS OF EAST ASIA ENERGY MARKET INTEGRATION

Anindya Bhattacharya* and Satoshi Kojima

Institute for Global Environmental Strategies, 2108-11 Kamiyamaguchi, Hayama, Kanagawa 240-0115, Japan

1. INTRODUCTION

Being the hot spot of economic development of the world, the East Asia Summit (EAS) region needs an uninterrupted supply of energy at a reasonable and affordable price for a longer period of time to meet the development needs in the future. With the given condition, it is rather difficult to achieve a sustained growth path supported by steady energy resource supply just depending on individual domestic efforts. In the continued process of globalization it is economically, socially and environmentally prudent to have a regional approach. Following this, energy market integration in this region is an essential action for sustainable development. However, four major issues need to be considered in the whole process:

(1) Dispersed and heterogeneous energy demand across the region

(2) Asymmetric distribution of energy resource availability

(3) Asymmetric distribution of income and poverty

(4) Heterogeneous development prospect (combination of five developed, two transitional, seven developing and two least developed countries)

* Corresponding author. E-mail address: bhattacharya @iges.or.jp

Observing the EAS regional distribution of capital formation over the last couple of decades, it is imperative that the distribution of financial resources for EMI in the EAS region is much skewed towards China, India, Australia, Japan and Korea. Interestingly, these are the countries enveloping the EAS region comprising of total 16 countries (ASEAN+6). In addition, the central region of EAS, which is mainly the ASEAN sub region, is the gravity center of energy resource endowment which can share the surplus resources with the rest of the region provided a seamless network is established.

As a matter of fact, there are three major components need to be in place to create an energy market: technology, finance and policy & regulation. The hardware part of market creation covers the infrastructure development for energy production, supply and distribution whereas the software part creates the enabling environment for the smoother flow of energies across the border. Technology and finance are required for hardware development whereas policy and regulations are required for the software development. Finally, it has been envisaged that the basic structure of the EAS Integrated Energy Market (henceforth EIEM) would be follows:

1. Four major developed countries (Japan, Korea, Australia and New Zealand) will provide the necessary financial and technical resources to the rest of the region to create the market. Two transitional economies India and China will also provide financial and technical resources to the developing counter parts.
2. Rest of the developing member countries will receive the financial and technical supports from the rest of the countries to develop the hardware for cross border energy flow in exchange of allowing their surplus energy resources to trade across the border seamlessly.
3. Due to market integration, energy sector investment will be liberalized, and enabling environment will be created for foreign direct investments. Investors will be interested to increase the flow of fund to develop the energy sector in the developing countries.

4. Countries' domestic energy markets will also be liberalized and deregulated to cope up with the changes in the market structure. This will entail efficiency improvement of the domestic production, distribution and consumption of energy commodities.
5. Finally, a supra national watch-dog body has to be in place for implementation and enforcement of regulations and laws related to the functioning of the unified energy market in the region.

2. TERMS OF REFERENCE AND OBJECTIVE

Taking the note of conclusions and recommendations made in the AAECP Energy Policy and Systems Analysis Projects – ASEAN Energy Market Integration (Aug. 2005) (we considered this project report as our starting point) we identified that intra and inter regional energy commodity trade, which are by far not fully integrated in terms of export and import tariffs and other trade barriers, plays a crucial role for realization of market integration. In addition, we also noted that energy subsidies reform is very important in the context of market liberalization and unification thereafter. Besides, physical linkage of energy infrastructures like cross border gas and oil pipeline along with interconnected electricity grid are crucial for achieving successful integrated energy market. As a matter of fact, energy sector investment liberalization at the international and domestic level are considered as one of indicators of energy market integration which provides level playing field for all investors. In this report, we discussed about the following five specific issues in the context of energy market integration:

1. Removal of energy trade barriers
2. Improving physical linkages of energy infrastructure across the East Asia region.

3. Liberalization of investments in the energy sector in the region as a consequence of market integration.
4. Energy pricing reform
5. Liberalization of domestic energy market and deregulation.

It is envisaged that in the process of energy market integration in the EAS region, cooperating countries will liberalize their energy commodity trade through respective tariff and export subsidy/tax removal. This is to achieve unification of border taxes to the energy traded commodities. This is a step forward towards the formation of regional market of energy commodities.

In the process of achieving the benefits of energy market integration, it is required to have better physical linkages of various energy infrastructures in the region. In this context, it is envisaged that the EAS region will improve its cross border oil, gas and electricity transportation facilities through pipelines and electrical grids. Such interconnection will not only reduce the costs of transportation of energy commodities within the regions but also reduce the losses and improve the supply reliability. From the energy security perspective this is an excellent option for this region to reduce the energy supply vulnerability.

Energy commodity trade liberalization envisaged under the market integration is further expected to be followed by energy investment liberalization in the region. As a matter of fact, fund will flow from the developed countries to the developing countries to explore, develop and trade the energy commodities across the region. It is envisaged that due to eased border restrictions and improved investment security and environment, foreign direct investments will be increased in the developing economies in the energy sector. However, it is also envisaged that China and India being the two major transitional economies in this region might also get involved in supporting energy resources and infrastructure development in other developing countries.

This is also envisaged that in the process of energy market integration, member countries will make some attempt to rationalize their respective energy markets through energy price reform and more specifically by removing energy subsidies. In the EAS developing countries energy subsidies are quite significant in terms of their GDPs and therefore, reduction and removal of subsidies will affect the overall economic condition.

As an effect of energy market integration it is also envisaged that the respective domestic energy markets will also be liberalized and deregulated. So far in the East Asia region most of the domestic markets are regulated by the Governments which often bar the market to behave by itself. Under the integrated condition it is expected that the domestic market controls by the Government especially the prices of energy commodities will be removed or reduced so that investors can feel free to invest. It has been estimated that there are around USD 6 trillion investment requirements in this region over the next twenty years only in energy sector to meet the future demand and keep the economic growth at a reasonable rate of around 6% on average (IEA, 2003). Under this demand situation, it is obvious that only public investment cannot fulfil the need unless private sector investments pitch in. Domestic and regional market liberalization is therefore key to encourage private sector investors to invest in energy sector development.

3. MODEL

3.1 Outline of the REPA model

We employed the Regional Environmental Policy Assessment (REPA) model for assessing the potential impacts of policy scenarios representing the East Asia Energy Market Integration. The REPA model is a multi-regional computable general equilibrium (CGE) model developed based on the GTAP-E model (Burniaux and Truong 2002) for conducting integrated policy impact assessment encompassing

environmental, economic and poverty impacts in East Asia (Kojima 2008). The current version of the REPA model employs 22-region 32-sector aggregation of the GTAP database Version 7 (see Tables 3.1 and 3.2), in which all the 16 EAS members are treated as a single region.[1] The sectoral aggregation maintains the most detailed energy sector (commodity) classification of the GTAP database where six energy sectors (coa, oil, gas, p_c, ely, and gdt) are classified.

Table 3.1 Regional aggregation

No.	Code	Description
1	chn	P.R. China (main land only)
2	jpn	Japan
3	kor	The Republic of Korea
4	khm	Cambodia
5	idn	Indonesia
6	lao	Lao PDR
7	mmr	Myanmar
8	mys	Malaysia
9	phl	Philippines
10	sgp	Singapore
11	tha	Thailand
12	vnm	Viet Nam
13	brn	Brunei Darussalam (see footnote 1)
14	ind	India
15	aus	Australia
16	nzl	New Zealand
17	bra	Brazil
18	eu	European Union (25 members)
19	usa	United States of America
20	rus	Russia

[1] GTAP Version 7 data set aggregates Brunei Darussalam and Timor-Leste as one region (other South-east Asia), but we assume that this region represents the economy of Brunei Darussalam as its GDP share based on 2008 World Bank GDP ranking reaches 95.8%.

21	mev	Middle East and North Africa (MENA) and Venezuela
22	row	Rest of the world

Table 3.2 Sectoral aggregation

No.	Code	Sector classification	No.	Code	Sector classification
1	pdr	Paddy rice	17	lum	Wood products
2	ogr	Other grains	18	ppp	Paper products, publishing
3	v_f	Vegetables, fruit, nuts	19	p_c	Petroleum, coal products
4	osd	Oil seeds	20	crp	Chemical, rubber, plastic products
5	c_b	Sugar cane, sugar beet	21	i_s	Ferrous metals
6	lvd	Livestock and daily	22	nfm	Metals nec
7	oag	Other agriculture	23	mvh	Motor vehicles and parts
8	frs	Forestry	24	ele	Electronic equipment
9	fsh	Fishing	25	mfn	Manufactures nec
10	coa	Coal	26	ely	Electricity
11	oil	Crude oil	27	gdt	Gas manufacture, distribution
12	gas	Gas	28	cns	Construction
13	omn	Minerals nec	29	tpn	Transport nec
14	pcr	Processed rice	30	atp	Air transport
15	fdp	Food products	31	dwe	Dwellings
16	twl	Textiles, wearing apparel and leather	32	osv	Other services

3.2 Recursive dynamic setting

The REPA model incorporates dynamics towards 2020 by solving for a series of static equilibria connected by exogenous evolution of macroeconomic drivers. For each time step, the following macroeconomic drivers were exogenously shocked to update the data sets:

Population

Capital stock

Skilled and unskilled labour

Economy-wide total factor productivity (TFP)

Except for economy-wide TFP, growth rates of exogenous drivers and GDP were estimated based on the unpublished macroeconomic projections of the Center for Global Trade Analysis at Purdue University. Then, growth rates of economy-wide TFP were obtained by calibration against the projected GDP growth and other macroeconomic drivers.

It might be worth noting that the employed methodology does not use equation of motion of physical capital to update the stock of physical capital. The employed methodlogy assumes that the evolution of the economy during each time step is represented as the shift of steady-state equilibrium caused by exogenous shocks. This method is consistent with the steady-state equilibrium assumption underpinning static general equilibrium theory.

The current study employed single time step for the entire simulation period (2004-2020).

3.3 CO_2 emission module

The current version of REPA model employs a different approach to calculates CO_2 emissions from the GTAP-E model. The REPA model calculates CO_2 emissions based on fossil fuel consumptions by each industrial sector as well as final consumers (private households and the government), with deducing fossil fuel uses as feedstocks, while the GTAP-E model focuses on the supply of fossil fuels to the domestic market. The GTAP-E model deduces crude oil use by the petroleum and coal products sector only, but applying this method to the energy volume data included in the GTAP version 7 data sets with coefficients provided by Lee (2008) resulted in a significant overestimation (by 11.8 % as the whole world) compared with the CO_2 emission data for the GTAP version 7 (Lee 2008). Therefore we added other potential feedstock usage of fossil fuels and we finally deduced the following fossil fuel uses as feedstock purposes:

- Coal (coa), crude oil (oil) and petroleum and coal products (p_c) used by the petroleum and coal products sector (p_c)
- Natural gas (gas) used by the gas manufacture/distribution sector (gdt)
- Petroleum and coal products (p_c) used by the chemical, rubber, and plastic products sector (crp)

This method resulted in a slight underestimation (by - 0.9% as the whole world), which seems reasonable as some portion of the above deduced usage may include combustion usages in reality.

4. POLICY SCENARIOS FOR SIMULATIONS

4.1 Removal of energy commodity trade barriers within the EAS region

The first policy scenario represents complete trade liberalisation of energy commodities. This scenario is simulated by removing all the import tariffs and the export subsidies (or taxes) of energy commodities among 16 EAS members reflected in the base data as shown in Tables 4.1-4.8. Please note that there are neither import tariffs or export subsidies (taxes) on electricity (ely) and gas manufacture/distribution (gdt).

Table 4.1 Bilateral import tariff rates on coal among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	1.0	0.0	5.0	0.0	0.0	0.0	5.0	0.0	1.0	2.5	0.0	35.1	0.0	0.0
jpn	3.8	0.0	1.0	0.0	5.0	0.0	0.0	0.0	3.2	0.0	1.0	5.0	0.0	0.0	0.0	0.0
kor	3.3	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	1.0	4.6	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	4.4	0.0	1.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	3.6	0.0	37.7	0.0	0.0
lao	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mmr	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mys	3.7	0.0	0.0	0.0	2.9	0.0	0.0	0.0	3.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	15.0	0.0	0.0
tha	0.0	0.0	0.0	0.0	5.0	3.0	0.0	0.0	3.0	0.0	0.0	5.0	0.0	15.0	0.0	0.0
vnm	3.0	0.0	1.0	0.0	5.0	3.7	0.0	0.0	3.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0
brn	3.9	0.7	1.0	0.0	5.0	0.0	0.0	0.0	3.7	0.0	1.0	0.0	0.0	21.7	0.0	0.0
ind	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	4.5	0.0	1.0	0.0	5.0	0.0	0.0	0.0	4.9	0.0	1.0	0.0	0.0	35.2	0.0	0.0
nzl	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0

Source: GTAP database version 7

Table.4.2 Bilateral import tariff rates on crude oil among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	5.0	0.0	0.0	0.0	0.0	2.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	0.0	0.0	0.0	0.0	4.6	0.0	0.0	2.5	3.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	0.0	0.0	5.0	0.0	0.0	0.0	0.0	2.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lao	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mmr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mys	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	5.0	0.0	10.0	0.0	0.0
phl	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.7	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tha	0.0	0.0	5.0	0.0	0.0	0.0	1.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
vnm	0.0	0.0	5.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
brn	0.0	0.0	5.0	7.0	0.0	0.0	2.0	2.5	3.0	0.0	0.0	6.3	0.0	10.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.0	0.0	0.0	11.7	0.0	0.0	0.0	0.0
aus	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP database version 7

Table 4.3 Bilateral import tariff rates on natural gas among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	3.1	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
lao	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mmr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mys	0.0	0.0	1.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0
tha	6.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
vnm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
brn	3.0	0.0	1.0	0.0	5.0	0.0	0.0	0.0	7.0	0.0	0.0	3.0	0.0	10.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP database version 7

Table 4.4 Bilateral import tariff rates on petroleum and coal products among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	1.5	5.2	23.0	2.6	5.1	1.4	7.2	2.7	0.0	2.3	18.6	3.7	15.0	0.0	6.1
jpn	6.5	0.0	5.1	22.6	2.8	0.0	0.9	9.2	2.7	0.0	1.1	12.0	2.1	15.0	0.0	5.9
kor	6.5	3.4	0.0	23.2	2.7	9.6	1.2	7.8	2.7	0.0	1.0	18.8	0.0	15.0	0.0	6.1
khm	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	6.0	3.1	5.1	23.2	0.0	0.0	0.0	0.2	0.0	0.0	0.9	12.4	0.0	14.9	0.0	0.0
lao	0.0	0.0	0.0	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0
mmr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mys	6.4	3.7	5.1	18.8	1.9	0.0	1.2	0.0	0.6	0.0	1.0	16.4	1.8	11.4	0.0	1.0
phl	6.5	4.2	5.1	23.2	2.3	0.0	0.0	0.2	0.0	0.0	1.0	19.0	2.1	15.0	0.0	7.8
sgp	6.5	0.0	5.1	23.1	1.2	9.6	1.2	0.4	1.8	0.0	1.0	18.0	1.5	14.8	0.0	0.0
tha	6.9	4.1	5.1	20.0	1.8	9.4	1.2	0.2	1.5	0.0	0.0	13.1	1.8	14.6	0.0	5.8
vnm	6.4	3.0	5.1	23.1	2.8	5.0	0.9	0.4	1.9	0.0	1.0	0.0	0.0	13.3	0.0	4.8
brn	6.1	1.6	5.1	0.0	1.8	0.0	0.0	0.0	3.0	0.0	4.0	3.8	0.0	13.4	0.0	3.7
ind	5.0	2.8	5.1	23.2	2.7	0.0	1.1	10.1	2.9	0.0	1.4	18.6	0.0	0.0	0.0	4.4
aus	6.7	0.7	5.0	0.0	2.7	9.6	1.2	12.0	2.9	0.0	1.0	10.1	3.2	15.0	0.0	0.0
nzl	6.6	3.5	5.1	0.0	2.9	0.0	0.0	7.3	0.0	0.0	1.0	0.0	0.0	15.0	0.0	0.0

Source: GTAP database version 7

Table 4.5 Bilateral export subsidy rates on coal among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	-0.5	-0.5	-0.5	-0.5	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
lao	7.2	7.2	7.2	7.2	7.2	0.0	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
mmr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
mys	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tha	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	0.0	3.1	3.1	3.1	3.1	3.1
vnm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
brn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	0.0	0.0

Source: GTAP database version 7

Note: The negative figures indicate export tax.

Table 4.6 Bilateral export subsidy rates on crude oil among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	-0.5	-0.5	-0.5	-0.5	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
lao	-1.6	-1.6	-1.6	-1.6	-1.6	0.0	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
mmr	1.4	1.4	1.4	1.4	1.4	1.4	0.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
mys	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tha	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.0	1.3	1.3	1.3	1.3	1.3
vnm	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.0	1.4	1.4	1.4	1.4
brn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	-1.3	0.0	0.0

Source: GTAP database version 7

Note: The negative figures indicate export tax.

Table 4.7 Bilateral export subsidy rates on natural gas among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	-0.4	-0.4	-0.4	-0.4	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
lao	-5.8	-5.8	-5.8	-5.8	-5.8	0.0	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8
mmr	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	0.0	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9
mys	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	0.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tha	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	0.0	-3.0	-3.0	-3.0	-3.0	-3.0
vnm	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	0.0	-2.9	-2.9	-2.9	-2.9
brn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP database version 7

Note: The negative figures indicate export tax.

Table 4.8 Bilateral export subsidy rates on petroleum and coal products among EAS members (%)

	Importing country															
	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
chn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
jpn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
kor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
khm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
idn	-0.4	-0.4	-0.4	-0.4	0.0	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
lao	-5.8	-5.8	-5.8	-5.8	-5.8	0.0	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8	-5.8
mmr	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	0.0	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9
mys	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	0.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
phl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sgp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
tha	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	0.0	-3.0	-3.0	-3.0	-3.0	-3.0
vnm	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	0.0	-2.9	-2.9	-2.9	-2.9
brn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ind	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
aus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
nzl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: GTAP database version 7

Note: The negative figures indicate export tax.

For trade liberalisation simulations, we gave exogenous shocks to import tariffs and export subsidies of all the energy commodities among the EAS members such that these values become zero.

4.2 Physical linkage of energy infrastructure

Originally it was planned to assess the impacts of physical linkage of energy infrastructure by removing international margin transport costs of energy commodities among the EAS members, but it was found that no significant margin transport costs are recorded in the base data in 2004. Instead, we refer to a previous study on potential impacts of cross-border energy infrastructure development in order to provide policy

implications of physical linkages of energy infrastructure (Bhattacharya and Kojima 2008).

Bhattacharya and Kojima (2008) assumed that the cross border electricity infrastructure (CBEI) projects substitute a part of electricity development and that a half of the public investment directly contributes to capital accumulation of the electricity sector and the remaining portion is spent for government purchase of the outputs of the other services sector that include public administration etc. Bhattacharya and Kojima (2008) used a previous version of REPA model with the GTAP database version 6 (corresponding to the year 2001), and conducted simulations with giving the following four types of exogenous shocks to the database updated from the year 2001 to the year 2020:

- Total baseline public investment by 2020 for electricity sector without CBEI projects
- Incremental power generation between 2001 and 2020 due to the above baseline investment without CBEI project
- Total public investment by 2020 for electricity sector with CBEI projects
- Value of power traded between two countries due to CBEI projects

Then, the corresponding changes in capital stock in the electricity sector, in government purchase of outputs of the other services sector, and in outputs of the electricity sector due to electricity trade were endogenously solved. For the details about the estimation of these shocks, see Bhattacharya and Kojima 2008.

4.3 Liberalization of investment to the energy section

Although there have been some attempts to reflect investment liberalisation issues to CGE models (e.g. Hanslow et al. 2000), it is widely recognised that measurement of investment barriers and modelling investment liberalisation in straight forward manner are very challenging tasks. This study tackled this issue by estimating energy sector

investment demands of each EAS member country and reallocating capital stocks among the EAS member countries. Table 4.9 shows the estimated energy sector investment demands in the EAS region.

We assume that investment liberalisation will allow China, Japan, Korea, Singapore and Australia to be proactive to invest in the remaining EAS member countries. Among these five investing countries, the total energy sector investment demands of the remaining EAS member countries are shared based on the GDP share of each investing country. The investment outflow from these investing countries is modelled as a reduction in national capital endowment without financial return as if the investment took a form of grant. Modelling foreign direct investment in a realistic manner is left for future research.

Table 4.9 Estimated energy sector investment demands in the EAS recipient countries (million US$)

	khm	idn	lao	mmr	mys	phl	tha	vnm	brn	ind	nzl
coa	2.0	101.9	0.0	3.1	2.3	33.8	64.7	17.2	0.1	423.2	9.6
oil	5.7	295.5	0.3	9.0	158.6	1.7	187.6	49.9	6.5	327.3	30.4
gas	14.4	753.4	0.0	22.9	339.9	14.4	450.8	7.3	15.6	694.1	87.0
p_c	4.1	213.9	0.2	6.5	114.9	167.3	135.8	36.1	4.7	237.0	37.1
ely	69.4	3,616.8	37.7	109.8	1,631.6	1,199.6	2,296.1	611.0	81.4	12,273.7	299.0
gdt	2.2	112.6	10.8	3.4	50.8	272.9	99.0	139.0	3.4	152.4	19.1

Source: Authors' estimation based on the World Energy Investment Outlook 2003, IEA. (p51)

The inflow side of investment is also modelled as an increase in national capital endowment corresponding to the total of energy sector investment demands in that country, without payment of return to the investors. We also attempted to simulate *sectoral* capital allocation such that investment demands of each energy sector in the recipient countries are satisfied, by exogenising sectoral capital demand of energy sectors and endogenising sectoral factor productivities, but we could not get feasible solutions from this preferable simulation setting.

4.4 National energy pricing reform

Energy subsidy reform is one of top priority issues worldwide and particularly in some of the EAS member countries such as Indonesia and Malaysia. When fossil fuel commodities are highly subsidised, removal or reduction of such subsidies is expected to bring three types of benefits: environmental benefit of reduced CO_2 emissions through discouraging wasteful fossil fuel usage, economic benefit of improved efficiency through mitigating market distortion, and fiscal benefits from reducing the financial burden of the government. Unfortunately, in the GTAP database heavily subsidised fossil fuels and heavily taxed fossil fuels are aggregated and we cannot single out heavily subsidised ones (see Tables 4.10 and 4.11).

Table 4.10 Output subsidy rates on energy commodities (%)

	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
coa	-0.8	15.3	65.8	0.0	0.0	0.0	-5.2	0.0	0.0	-0.5	-4.6	-6.4	-0.4	-1.8	-1.0	-1.2
oil	-12.5	-1.9	0.0	0.0	0.0	0.0	-32.9	0.0	0.0	-0.4	-14.2	-4.3	-0.4	-1.2	-1.1	-0.1
gas	-4.6	-1.9	-4.9	0.0	2.6	0.0	-29.2	0.0	0.0	-3.7	-7.4	-4.3	-3.7	-1.0	-1.1	-0.3
p_c	-5.5	0.0	-26.4	-2.0	0.0	0.0	-0.4	0.0	0.0	10.7	-24.7	-9.4	-0.1	0.0	-0.8	-0.1
ely	-9.7	-4.7	-3.8	0.0	7.3	0.0	-3.3	0.0	0.0	-2.1	-2.8	-4.5	-2.0	-2.2	-1.0	-0.4
gdt	-4.6	-1.9	-5.0	0.0	2.6	0.0	-29.2	0.0	0.0	-3.7	-7.4	-4.3	-3.7	-1.0	-1.1	-0.3

Source: GTAP database version 7

Note: The negative figures indicate output tax.

Table 4.11 Consumption tax rates on energy commodities (%)

	chn	jpn	kor	khm	idn	lao	mmr	mys	phl	sgp	tha	vnm	brn	ind	aus	nzl
coa	0.0	5.7	0.0	0.0	0.0	2.5	0.0	0.0	0.0	16.5	-0.5	0.0	16.6	0.0	0.0	11.8
oil	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	16.6	0.0	-5.3	16.8	0.0	2.8	0.0
gas	0.0	45.2	57.7	0.0	0.0	8.4	0.0	0.0	0.0	16.6	0.0	0.8	16.6	0.0	0.0	65.1
p_c	0.0	202.0	115.3	43.9	1.9	49.9	135.6	0.0	41.2	16.6	29.8	0.0	17.0	118.3	120.6	145.1
ely	0.0	9.3	0.0	0.0	3.0	14.9	0.0	4.6	4.9	5.7	4.6	2.9	15.5	0.0	12.4	17.7
gdt	0.0	45.2	57.7	0.0	-7.7	3.0	0.0	-6.2	0.0	16.6	-6.2	-7.8	16.6	0.0	16.5	65.1

Source: GTAP database version 7

Against this data limitation, we conducted the following two types of simulations.

For the first type of simulations, we estimated the amount of energy subsidies directed to each of six energy commodities, and we shock output subsidy (or tax) and consumption tax (or subsidy) of energy commodities equivalent to certain portions (10%, 50% and 100%) of estimated energy subsidies. These simulations capture environmental benefits of energy subsidy reform as well as fiscal benefits of reduced government expenditure, but they cannot capture economic benefits because these simulations are implemented by increasing energy taxes in the model.

The second type of simulations demonstrate economic benefits of mitigating market distortion by removing energy commodity price distortion in terms of output subsidy (or tax) and consumption tax (or subsidy).

4.5 Liberalisation of domestic energy markets

This policy scenario assumes that liberalization of domestic energy markets will reduce the monopoly of energy distribution and retailing in domestic energy market

through open access of transmission system by other retailers, domestically and internationally. Consequently, it is expected to improve efficiency of these energy services. In our simulations this improved efficiency of energy services is modelled as improvements of total factor productivity (TFP) of the electricity sector (ely) and the gas manufacturing and distribution sector (gdt). As there is no empirical data to estimate the magnitude of consequent TFP improvements, we conducted sensitivity analysis by giving TFP improvement of ely and gdt in the EAS member countries by 10%, 15%, and 20%.

5. POLICY IMPACT ASSESSMENT

As we have already mentioned in Sections 2 and 3, we conducted four sets of new simulations and cited one previous study in the year of 2008 on cross border energy infrastructure linkage which is relevant to the 2nd objective of this study. In this report, we mainly discussed about currently conducted simulations on the policy issues like energy trade barrier removal, liberalization of energy sector investment, energy pricing reform and domestic energy market liberalisation. However, to satisfy our Terms of Reference and overall objectives of this study, we also briefly discussed about the policy impacts of cross border energy infrastructure linkages citing from our previously published work.

5.1 Impact of energy trade liberalisation

In the context of energy market integration, it has been envisaged that the regional trade on energy commodities will be liberalized mainly in terms of complete removal of trade barriers like export and import taxes and subsidies. Energy commodities are expected to be freely traded within the region. As the EAS region comprises of both energy exporter and importer countries and some countries like China, Indonesia are the net importer of energy though they are one of the biggest exporters of energy in the

region, free trade arrangement of energy commodities will have mixed economic impact on the regional economy. Heavily export driven countries are expected to be relatively big loser while the energy importers could be better of.

5.1.1 Impact on national economy (GDP)

In terms of real GDP, while some major countries in the EAS region gain due to tariff and export subsidy/tax removal, some major countries like Australia, Indonesia, Malaysia and Singapore also lose in that context. However, such lose is comparatively very small and in some cases negligible (viz. Australia). The following table 5.1 shows the percentage change in the GDP (in year 2020) due to complete removal of import tariffs and export subsidies/taxes of energy commodities among EAS member countries. The EAS region as a whole gains in real as well as in nominal term GDP due to energy trade barrier liberalization.

In the general equilibrium world reflected in CGE models, economic impacts of trade liberalisation occur through complicated inter-sectoral and international linkages. For example, this energy trade liberalization scenario negatively impacts Australian nationwide real outputs and the largest negative impacts are observed in the non-ferrous metal (nfm) and the other manufacturing sectors (mfn), and this real output reduction accounts Australian real GDP loss to a certain degree. On the other hand, the real GDP loss of Singapore is mainly due to a reduction in trade balance, as trade liberalisation will undermine comparative advantage of the current free trade policy of Singapore. Our simulation results are consistent with our expectation that trade liberalisation will improve economic performance as a whole even though some members or sectors will win and the others will lose. The most important political issue is how to share the overall benefits of trade liberalisation to all members in a convincing and effective way.

Table 5.1 Impacts of energy trade liberalization on GDP (Year 2020)

Region	% change from 2020 Baseline scenario **(nominal)**	% change from 2020 Baseline scenario **(Real)**
China	-0.030	0.000
Japan	-0.012	0.003
Korea	0.051	0.052
Cambodia	-0.177	0.128
Indonesia	0.102	-0.065
Lao PDR	-0.071	-0.130
Myanmar	-0.042	-0.044
Malaysia	0.150	-0.078
Philippines	-0.101	0.011
Singapore	-0.118	-0.070
Thailand	0.037	0.011
Vietnam	-0.451	0.263
Brunei Darussalam	0.807	-0.147
India	0.005	0.368
Australia	0.196	-0.002
New Zealand	-0.008	-0.003
Brazil	-0.011	-0.012
EU	-0.014	-0.004
USA	-0.014	-0.001
Russia	-0.003	-0.035
MENA and Venezuela	0.030	-0.052
Rest of the World	-0.006	-0.010
World Total	-0.006	0.000
EAS Total	**0.007**	**0.024**

5.1.2 Impact on sectoral real output

Sectoral output change after the trade liberalization shows due to energy trade liberalization all the major coal producing countries gain in their production except India (see Table 5.2). Indian coal sector will see around 1.2% output reduction by 2020. Similarly, the petroleum product output in Vietnam loses by around 13% but

gained around 11% in Cambodia. On the other hand, countries like Australia will gain in coal production by around 0.3% compared to the baseline scenario in 2020. Indonesia, China, Vietnam will also gain in terms of annual coal output.

Table 5.2 Impact of Trade Liberalization on sectoral real output: Difference from baseline (%)

Region	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	0.00	0.02	-0.03	-0.33	-0.02	0.07
Japan	0.19	0.03	-0.06	0.14	-0.04	-0.00
Korea	0.08	0.02	0.00	1.95	-0.05	0.47
Cambodia	0.11	0.22	-0.04	10.85	0.22	-0.36
Indonesia	0.20	0.18	0.02	-1.08	-0.21	-0.05
Lao PDR	-0.09	-0.02	0.00	-2.35	0.33	-0.21
Myanmar	0.12	-0.08	0.29	-0.08	-0.63	-0.71
Malaysia	0.13	0.14	0.31	-0.18	-0.31	0.21
Philippines	-0.13	1.41	-0.01	5.06	0.06	-0.18
Singapore	0.00	0.14	-0.36	5.02	0.16	0.25
Thailand	0.03	0.06	-0.01	1.08	0.00	0.03
Vietnam	0.13	-0.15	-0.48	-13.39	0.06	-1.99
Brunei Darussalam	0.05	0.21	-0.07	-0.18	0.15	-0.03
India	-1.21	-0.03	0.01	1.00	1.46	0.05
Australia	0.29	0.44	-0.08	5.12	-0.32	0.02
New Zealand	0.21	0.18	-0.01	-0.34	-0.02	-0.06
Brazil	0.07	0.01	-0.01	-0.08	-0.00	0.01
EU	0.08	0.01	-0.02	-0.11	-0.02	0.00
USA	0.01	0.01	-0.01	-0.12	-0.01	0.00
Russia	0.10	0.01	-0.02	-0.40	-0.03	-0.02
MENA and Venezuela	0.08	0.02	-0.06	-0.86	-0.03	-0.09
Rest of the World	0.08	0.02	-0.01	-0.21	-0.04	-0.00
World Total	0.03	0.02	-0.01	0.03	0.02	-0.02
EAS Total	0.01	0.08	0.08	0.63	0.11	-0.11

In the process of investigating the reasons of such changes we first looked into the existing tariff structures of different energy commodities in this region. Tables 4.1 to Table 4.8 show 2004 import tariff and export subsidy structure of the different energy

commodities in this region. The tables indicate that India has relatively moderate around 5% of import tariff for coal while there is no export subsidy. In terms of coal export, Indonesia and Australia have some tariffs whose removal could impact the coal markets in the rest of the region.

Further investigating the results of simulation we observed that the domestic coal prices in India drastically reduced by around 28% compared to the 2020 baseline price. This price change can be attributed towards the reduction of domestic coal demand compared to the cheaper imported coal. It could be envisaged that due to trade liberalization coal imports become cheaper for India than its domestic coal. In fact, due to high ash content, domestically produced coals in India are not attractive to the coal users like power plants and steel and cement companies. Given the situation of future demand of coal mainly coming from power plants (more than 70% of the total production) , due to import tariff reduction, power plants can avoid using domestic high ash content coal and can replace the same by imports. As a matter of fact, after the trade liberalization, Indian coal import increased by 78% from the 2020 baseline level. Table 5.3 below shows the % change in energy commodity import volume compared to the 2020 baseline scenario.

Table 5.3 Percentage change in energy import values compared to the baseline 2020

Region	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	3.421	-0.446	-2.427	10.048	-0.714	-0.599
Japan	-2.128	0.519	0.713	9.091	0.000	0.141
Korea	0.542	4.000	0.917	4.723	0.000	-0.134
Cambodia	16.726	26.923	15.315	63.946	-0.671	2.174
Indonesia	41.033	3.846	110.274	6.306	1.709	0.388
Lao PDR	-7.358	-5.729	-0.905	23.383	-1.481	-1.769
Myanmar	62.136	-4.911	86.141	1.042	3.140	-1.635
Malaysia	-1.705	10.000	88.387	4.000	1.481	0.254
Philippines	4.146	11.912	1.708	4.258	-1.733	0.000
Singapore	-1.754	9.231	1.351	2.963	0.741	0.000
Thailand	-3.873	2.157	1.047	12.472	0.000	0.000
Vietnam	18.807	-6.494	-23.419	22.727	0.420	-4.412
Brunei Darussalam	2.913	-0.862	-3.008	9.419	0.972	4.046
India	78.100	3.455	6.506	14.570	-17.508	0.000
Australia	22.386	22.238	4.762	11.624	2.752	0.000
New Zealand	-0.884	-0.778	0.655	3.983	0.259	-0.333
Brazil	-0.945	-0.562	0.000	0.000	-0.769	0.000
EU	-2.314	-0.431	0.229	-0.217	0.000	0.000
USA	-2.564	-0.552	-0.127	-0.174	-0.214	-0.181
Russia	0.000	-0.926	-0.877	-0.322	-0.658	0.000
MENA and Venezuela	-1.026	-0.832	-4.317	0.000	0.000	0.000
Rest of the World	-2.159	-0.943	0.000	0.000	0.000	-0.625

5.1.3 Impact on domestic prices of energy commodities

Another interesting finding is the domestic price changes of the energy sectors in the EAS region (See Table 5.4). Due to border tax reduction to level zero, more or less all the countries are experiencing reduced level of domestic energy prices except Indonesia and Malaysia. For example, Indian domestic consumer price for coal gets reduced by 28%. Such price reduction can be further attributed towards increase in imports of energy commodities. Due to increase in import of cheaper energy,

domestic production of energy might fall due to lack of demand and thus can create downward pressure on market price. This has been actually observed in the case of India coal sector.

Table 5.4 Impact of energy trade liberalization on consumer price of energy commodities

Region	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	0.010	0.131	-0.235	-0.037	-0.060	-0.227
Japan	2.351	0.111	-0.266	0.082	0.041	-0.009
Korea	1.148	-0.128	-0.783	-0.160	0.024	-0.058
Cambodia	1.792	1.705	-0.230	-4.275	-0.258	0.021
Indonesia	3.368	1.148	0.165	0.177	0.281	0.018
Lao PDR	-2.958	-0.032	-0.066	-1.894	-0.248	0.023
Myanmar	2.617	-0.031	1.418	-0.841	0.429	0.235
Malaysia	2.543	-0.214	0.494	0.568	0.338	-0.014
Philippines	-2.356	0.558	-0.036	-0.341	-0.224	0.021
Singapore	1.848	1.187	-0.141	0.114	0.023	-0.047
Thailand	0.951	0.284	-0.089	0.221	0.014	-0.018
Vietnam	5.161	-0.593	-6.136	-8.443	0.004	0.340
Brunei Darussalam	1.191	1.785	-0.220	0.405	0.071	0.155
India	-28.731	0.032	0.331	-0.569	-2.019	-0.011
Australia	3.834	0.835	-0.203	1.125	0.517	0.048
New Zealand	2.839	0.724	-0.101	0.533	0.037	-0.010
Brazil	1.242	0.047	-0.056	0.058	-0.003	-0.024
EU	0.617	0.050	-0.130	0.049	0.020	-0.015
USA	0.271	0.076	-0.060	0.053	0.009	-0.012
Russia	0.761	0.028	-0.081	0.033	0.018	-0.006
MENA and Venezuela	0.738	0.089	-0.214	0.041	0.009	-0.000
Rest of the World	0.879	0.069	-0.052	0.059	0.037	-0.011

5.1.4 Impact on GHG emissions

Trade barrier removal is also having an impact on emissions from economic activities in the region (See Table 5.5). Complete removal of barriers will increase the overall regional CO_2 emissions by 0.6%. But several countries will individually

reduce their emissions too. India will have the largest increase in CO_2 emissions under this scenario of around 6.8% increase.

Table 5.5 Impacts of energy trade liberalization on CO2 emissions

Region	% change from 2020 Baseline scenario CO_2 emissions
China	0.05
Japan	-0.19
Korea	0.02
Cambodia	1.25
Indonesia	-0.37
Lao PDR	0.96
Myanmar	-0.37
Malaysia	-0.47
Philippines	0.38
Singapore	0.12
Thailand	-0.13
Vietnam	3.21
Brunei Darussalam	-0.02
India	6.83
Australia	-0.95
New Zealand	-0.23
Brazil	-0.07
EU	-0.09
USA	-0.05
Russia	-0.06
MENA and Venezuela	-0.13
Rest of the World	-0.11
World Total	0.14
EAS Total	**0.58**

Two member countries, i.e. Singapore and Lao P.D.R., are associated with increase in CO_2 emissions and reduction in real GDP. The former is due to a combination of real output growth and reduction in the trade balance. The latter case, detailed analysis shows that energy trade liberalisation leads to increased CO_2 emissions from the electricity sector and the transportation sectors. Even though the current electricity generation in Lao P.D.R. is mainly from hydro power, our simulation indicates that electricity generation from coal and oil will increase.

5.2 Impact of physical linkage of energy infrastructure across the region

In the context of energy market integration, while the soft links work as the catalysts of unified market, the hard links like cross border infrastructural projects can really expedite the unification process and deliver the tangible benefits. Though the extension of the electric power grid and subsequent cross border interlinking brings varieties of benefits for the market integration but the economics plays the pivotal role.

It has been estimated that within East Asia region the total potential of electricity trading is about 160 Twh/year with total installed capacity of 32,000 MW exclusively for electricity trading. Net benefits of such cross border grid interconnection projects could be in the tune of USD 3 billion /year considering the environmental, social and economic advantages (Bhattacharya and Kojima 2008). This region has been extremely active in terms of its economic development. Since the early 1990s, the region has been the Asian economic growth centre with an average growth rate of 8-9% per year. In addition to tremendous energy demand growth rate of around 5% per year (APERC, 2006), the major characteristics of this region are plenty of diversified energy resources, scattered demand points and close geographical proximity of the countries, which are basically the ideal conditions for energy supply interlink and trade in the context of market integration.

As the total electricity demand forecasted by 2020 in this region is around more than double the current level of consumption and the total installed capacity required is around 232,573 MW (Phinyada, 2005), this region still needs additional energy production and cross border energy infrastructure development which no longer can be handled by single country (AMEM 2004). Tables 5.6 and Table 5.7 list out future cross border energy infrastructure projects in EA region.

Table 5.6 Future cross border grid interconnection projects in the EA region

Name of the project	Project Description	Expected Total Investment (Million USD)*
Thailand - Cambodia PTL Projects;	Total Capacity 300 MW, Type: HVAC EE Maximum power transmission: 2.3 TWh/y Year: 2007	7.0
Peninsular Malaysia- Sumatra, Indonesia PTL Projects;	Total capacity 600 MW; Type: HVDC EE Maximum power transmission: 4.6 TWh/year Year : 2012	143.0
Batam (Indonesia) – Singapore PTL Project	Total capacity:200 MW; Type: HVDC EE Maximum power transmission: 1.5 TWh/year Year : 2015	177.0
Malaysia - Brunei PTL Project	Total capacity:300 MW; Type: HVDC EE Maximum power transmission: 2.3 TWh/year Year : 2015	18.4
Malaysia - West Kalimantan PTL	Total capacity:300 MW; Type: HVDC EE Maximum power transmission: 2.3 TWh/year Year : 2012	18.4
Thailand – Lao PRD PTL Project	Total capacity:2000 MW; Roi Et- Nam Theun by 2009 Udon- Nabong by 2010 Mae Mo- Hong Sa by 2013 Maximum power transmission: 15.6 TWh/year	124.8
Thailand – Myanmar PTL Project	Total capacity: 1500 MW; Type: HVDC EE Maximum power transmission: 11.4 TWh/year Year : 2014	91.2
Lao PDR – Vietnam PTL Project	Total capacity: 1887 MW; Type: HVDC EE Maximum power transmission: 14.7 TWh/year Year : 2010	117.6
Vietnam- Cambodia PTL Project	Total capacity: 120 MW; Maximum power transmission: 0.9 TWh/year Year : 2008	7.2
Total of 9 projects in SEA	**Transmission capacity: 7200 MW;** **Power transmission: 55 TWh/year**	**697.6**

Source: ASEAN Centre for Energy, 2008 (Maximum power transmission has been estimated by the authors considering 90% of the transmission capacity utilisation).
* The investment costs have been estimated using the data provided in the Annex-1 of Von Hippel (2001).

Table 5.7 Future cross border hydro power projects in the EA region

Name of the project	Project Description	Expected Total Investment (Million USD)*
Nam Theun 2 HPP	Installed capacity: 1088 MW (PLF: 40%)	2477.6
Lao PDR- Thailand	Total Power Generation: 3.7 TWh/y	
Nam Ngum HPP	Installed Capacity: 615 MW	1400.5
Lao PDR- Thailand	Total Power Transfer: 2.1 TWh/y	
Xe Pian HPP	Installed Capacity: 390 MW	887.9
Lao PDR- Thailand	Total Power Transfer: 1.3 TWh/y	
Xe Khaman 1 HPP	Installed Capacity: 468 MW	1065.8
Lao PDR- Thailand	Total Power Transfer: 1.6 TWh/y	
Tasang HPP	Installed Capacity: 3600 ME	8200
Myanmar- Thailand	Total Power Transfer: 12.5 TWh/y	
Jinghong HPP	Installed Capacity: 1500 MW	3416.6
China – Thailand	Total Power Transfer: 5.2 TWh/y	
Nuozhadu HPP	Installed Capacity: 5500 MW	12,527.8
China – Thailand	Total Power Transfer: 19.1 TWh/y	
Sambor CPEC HPP	Installed Capacity: 465 MW	1059.0
Cambodia – Vietnam	Total Power Transfer: 1.6 TWh/y	
Total of 8 projects in EA	**Generation capacity: 13,625 MW; Power transmission: 47 TWh/year**	**31,035.3**

Source: ASEAN Centre for Energy, 2008 (Total power generation estimated by the authors using the capacity utilisation factor of 40% in average)
* The investment costs have been estimated using the data provided in the Annex-1 of Von Hippel (2001).

Understanding the immense importance of physical linkages of the energy infrastructures across the region for smooth and easy integration of the energy market, in this report we tried to refer couple of case study analysis done previously by these authors (for detail please see Bhattacharya and Kojima, 2008). The selected case studies aim to capture the spectrum of potential impacts of cross-border energy infrastructure linkages on energy market integration. The pre-selected four major case-study countries in this region which are expected to be heavily involved in the future cross border energy trading include China, Thailand, Indonesia and Malaysia.

There are mainly two set of transactions: China-Thailand with total power trading of 24.3 TWh/year and Indonesia- Malaysia with total power trading of 14.6 TWh/year by the end of 2020. Then we assess the potential impacts of these projects under the assumed market integrated condition mainly on national economy and environment. For the analysis purpose we have selected two major projects as follows:

1) China – Thailand Power Trading: Jinghong and Nuozhadu HPP Project

2) Malaysia-Indonesia Power Grid Interconnection (Peninsular Malaysia- Sumatra, Indonesia 600 MW PTL and Malaysia - West Kalimantan 300 MW PTL)

In our simulation setting we tried to capture the step wise benefits of cross border energy projects which mean observing the benefits at every step of adding new project in the region. Thus we first estimated the benefits of baseline scenario without any cross border projects but only with national energy investment plan. In the second step we added the China-Thailand project and observed the benefits. Finally we added the Malaysia-Indonesia project to the list to see the overall benefits.

5.2.1 Impact on national economy (GDP)

As we have considered only a couple of projects to demonstrate the impacts of such cross border projects, as a matter of fact, the real impact on GDPs is very small of these two projects. However, our main purpose was to indicate that these kinds of projects under the condition of integrated market might have positive impacts on the participating countries' national economy. In the estimation process we have also given the due importance to the national scale energy plans which are irrespective of the regional cooperation and market integration plan. We assumed that the physical linkages of the energy infrastructures will be purely additional to the national plans of energy sector development of each country and there is no scope of substituting the national plans. In spite of all such conservative assumptions, our simulation still shows some positive gain in terms of GDP by every participating country.

Table 5.8 Impact of energy infrastructure linkage on GDP

Country/region	BAU (2020) (Million USD)	Baseline (Million USD)	China-Thailand + Malaysia-Indonesia Project (Million USD)
China	3,322,748	3,361,013	3,361,089 (0.002) [1.15]
Japan	5,038,493	5,033,913	-
Korea	825,789	825,070	-
Indonesia	291,015	293,943	293,952 (0.003) [1.009]
Malaysia	183,687	183,889	183,843 (-0.024) [0.08]
Philippines	120,246	120,206	-
Singapore	160,161	160,048	-
Thailand	213,538	220,868	220,914 (0.02) [3.45]
Viet Nam	53,432	53,473	-
Other ASEAN	111,701	111,529	-
Other OECD	28,890,102	28,861,821	-
Rest of the world	7,570,850	7,560,629	-

(xx) : shows the % change of GDP to the baseline 2020 energy investment scenario
[xx]: shows the % change of GDP to the BAU scenario without any national energy investment

5.2.2 Impact on GHG emissions

In the context of GHG emissions reduction, cross border energy infrastructure linkage projects show some positive gain, too. Emissions reduction mainly happens due to reduced use of fossil fuels for energy trading. Both the exporter and importer countries optimize their primary energy extraction, refining and utilization due to combined and complimentary market of energy supply and demand. As a matter of fact, under and over capacity additions are avoided in the both the countries which further improves the system and operating efficiency. As a whole, less fossil energies are used and corresponding emissions are also reduced. The following simulation result shows how the physical linkage of the energy infrastructure can help to address

the GHG emissions (CO_2 emissions) reduction target under the energy market integration condition.

Table 5.9 Impact of energy infrastructure linkage on GHG emissions

Country/region	BAU (2020) (Million ton-CO_2)	Baseline (Million ton-CO_2)	China-Thailand + Malaysia-Indonesia Project (Million ton-CO_2)
China	9,774	9,447	9,446 (-0.01) [-3.35]
Japan	1,571	1,575	-
Korea	908	911	-
Indonesia	814	777	776.6 (-0.05) [-4.6]
Malaysia	450	439	439.8 (0.18) [-2.26]
Philippines	142	142	-
Singapore	135	135	-
Thailand	445	378	377.2 (-0.21) [-15.2]
Viet Nam	143	145	-
Other ASEAN	34	34	-
Other OECD	21,316	21,323	-
Rest of the world	15,267	15,245	-

(xx) : shows the % change of CO_2 emissions to the baseline 2020 energy investment scenario
[xx]: shows the % change of CO_2 emissions to the BAU scenario without any

5.3 Impact of energy sector investment liberalisation

It has been envisaged that due to energy market integration, energy sector investments will also get liberalized in the context of easier fund flow to the energy demand points. Due to various investment barriers, developing countries in the East Asia region are suffering from inadequate supply of money to develop their energy sectors. Market integration can remove this bottleneck and can create an enabling environment for the investors. In this simulation we assumed that under the integrated condition an enabling environment of easier fund flow has been created. As a matter of fact, investing countries like China, Japan, Korea, Singapore and Australia became

proactive to invest in the domestic and regional energy markets of the EAS region. Therefore, investment goes to the rest of the developing markets in this region which are funded by the above mentioned five major countries in the EAS region. Selection of investing countries is primarily based on the historic trend of their respective private and public fund allocation to other recipient countries. China has been recently added in the list of donors in the regional energy market mainly due to their massive investments in the renewable and off-shore oil exploration funding in this region.

At the beginning of this simulation, we first estimated the demand of capital investment for each energy sector in each country. For the developing countries (or the expected recipient countries) we assumed that these capital investment demands in the energy sector would be funded by the donor countries' investment due to liberalized investment market under the integrated market condition. Due to computational difficulties, instead of satisfying sector specific capital demand for energy sectors, donors' investment increases nationwide capital endowment. As a consequence, we left the simulation to endogenously determine how to allocate the fund among all sectors including energy sectors rather than exogenously allocate the investment to each energy sector. Major rationale of such assumption is energy being the input factor to all sectors of the economy. Finally, in our simulation, we considered no revenue gain by the investor countries in exchange of capital investment in the recipient countries. This further restricted the wider application of this result for the purely private sector investment in the sector.

5.3.1 Impact on national economy (GDP)

In the context of impact on national economy as whole, the simulation shows that due to capital flow from investor countries to the recipient countries, real GDPs for the investor countries reduce by certain percentage while the real GDPs increases for all the

recipient countries. Table 5.10 shows the percentage change in real GDP for each country in the region due to capital reallocation for energy sector development.

Table 5.10 Impacts of investment liberalization on GDP (Year 2020)

Regions	% change from 2020 Baseline scenario **(nominal)**	% change from 2020 Baseline scenario **(Real)**
China	-0.102	-0.086
Japan	-0.236	-0.305
Korea	-0.184	-0.225
Cambodia	0.830	0.974
Indonesia	0.593	0.819
Lao PDR	1.339	0.479
Myanmar	0.983	0.849
Malaysia	0.605	0.825
Philippines	1.123	1.218
Singapore	0.018	-0.170
Thailand	0.848	1.276
Vietnam	0.563	0.907
Brunei Darussalam	0.745	1.041
India	0.892	1.041
Australia	-0.113	-0.248
New Zealand	0.197	0.346
Brazil	-0.002	-0.011
EU	-0.009	-0.003
USA	-0.011	-0.001
Russia	0.014	-0.027
MENA and Venezuela	0.030	-0.052
Rest of the World	-0.002	-0.009
World Total	-0.009	-0.011
EAS Total	-0.016	-0.026

The overall negative impact of investment liberalization could be due to the fact that potential positive impacts are not fully captured by the model. For example, with capital shortage, the marginal productivities of capital in the recipient country usually are much higher than those in the investing countries. With capital transfer, some low marginal productivity capital will be transformed to the high marginal productivity

capital. This productivity gain, although is demonstrated in economic theory, cannot be modeled by the current model. Furthermore, in this estimation the investor countries are simply transferring a portion of their capital to the recipient countries without any revenue gain, and reduced capital endowments as a result of transfer simply reduce production capacity of investing countries. It highlights the importance of proper specification of full dynamics and investment mechanisms, which remains as an important future task.

Table 5.11 below shows the ratio of allocated investment in each energy sector against the investment demand of that sector. These results show the importance of careful investment strategies to fulfil the investment demands of energy sectors.

Table 5.11 Ratio of allocated investment in each energy sector against the investment demand

Region	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-	-	-	-	-	-
Japan	-	-	-	-	-	-
Korea	-	-	-	-	-	-
Cambodia	0.55%	2.68%	0.25%	2.42%	1.23%	27.72%
Indonesia	27.14%	25.97%	5.26%	8.88%	4.10%	61.82%
Lao PDR	0.01%	0.04%	0.00%	0.67%	6.27%	20.88%
Myanmar	4.83%	18.21%	31.93%	1.67%	21.25%	376.68%
Malaysia	0.01%	29.27%	4.65%	4.91%	4.66%	137.30%
Philippines	0.10%	0.00%	0.02%	1.98%	5.78%	6.75%
Singapore	-	-	-	-	-	-
Thailand	2.63%	1.29%	0.66%	9.45%	3.23%	35.19%
Vietnam	8.40%	28.08%	0.12%	11.89%	16.48%	156.62%
Brunei Darussalam	0.12%	73.22%	15.76%	5.70%	1.09%	168.95%
India	3.07%	5.38%	1.29%	6.47%	6.84%	0.82%
Australia	-	-	-	-	-	-
New Zealand	0.69%	0.74%	0.44%	1.26%	7.47%	12.90%

5.3.2 Impact on sectoral real output

The simulation result further demonstrates that due to free capital flow the investor countries' national economy suffer mainly due to loss of real output in their respective energy sectors. Due to reduction in domestic capital flow, the investor countries might have lost some economic gain for their own country. Table 5.12 shows the percentage change in real output in the energy sector compared to the baseline 2020 scenario which demonstrates this issue.

Table 5.12 Impact of Investment Liberalization on sectoral real output: Difference from baseline (%)

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-0.01	-0.00	-0.02	-0.06	-0.09	-0.05
Japan	-0.02	-0.04	-0.03	-0.44	-0.56	-0.38
Korea	-0.01	0.00	0.00	-0.23	-0.32	-0.36
Cambodia	0.06	0.12	0.13	0.89	0.81	1.37
Indonesia	0.16	0.26	0.26	0.99	1.62	2.30
Lao PDR	0.06	0.05	0.00	1.22	2.11	3.40
Myanmar	0.14	0.35	0.43	0.35	3.38	6.62
Malaysia	0.04	0.13	0.12	0.70	1.55	2.12
Philippines	0.10	0.39	0.17	1.05	1.63	1.70
Singapore	0.00	-0.01	-0.05	0.27	-0.15	-0.27
Thailand	0.26	0.16	0.12	0.93	1.44	1.81
Vietnam	0.04	0.12	0.09	1.52	1.69	2.23
Brunei Darussalam	0.16	0.16	0.16	1.71	2.26	2.74
India	0.11	0.13	0.13	0.79	1.38	0.45
Australia	-0.03	-0.05	-0.06	-0.29	-0.43	-0.46
New Zealand	0.02	0.07	0.10	0.30	0.58	0.67
Brazil	0.00	0.01	0.00	-0.02	-0.00	-0.00
EU	0.00	0.01	0.01	-0.02	0.00	-0.03
USA	0.00	0.01	0.01	-0.03	-0.00	0.00
Russia	-0.00	0.01	0.00	-0.02	-0.01	-0.04
MENA and Venezuela	-0.00	0.01	-0.00	-0.04	0.00	-0.03
Rest of the World	0.00	0.01	0.01	-0.01	-0.00	-0.01

World Total	0.00	0.01	0.02	0.01	0.02	0.13
EAS Total	0.01	0.07	0.15	0.07	0.07	1.48

5.3.3 Impact on domestic energy prices

Simulation result also predicted the expected changes in the domestic market price of the energy commodities in our model. It mainly predicts up ward increase of all primary energy commodities in almost all member countries while showing reduction in electricity and gas prices in the domestic markets of the recipient countries. Electricity and gas prices increase in the investor countries. This further explains that majority of the investment will happen in the electricity and down stream gas market in the developing countries as they have major requirement their. As a consequence, the supply of electricity and gas will increase in the market which will push the price down. But for the investor countries, as we have already seen that all major energy sectoral outputs reduce, the price increases as demand remain unaltered. It has also been observed that, due to investment liberalization, investor countries' energy import overall reduces which further creates additional pressure on energy prices to move upward. The table 5.13 shows the percentage change in domestic price compared to the 2020 baseline scenario.

Table 5.13 Impact of investment liberalization on consumer price of energy commodities

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-0.210	0.030	-0.033	0.014	-0.005	-0.020
Japan	0.013	0.025	0.013	0.046	0.124	0.090
Korea	-0.012	0.042	0.015	0.044	0.058	-0.004
Cambodia	0.499	0.151	0.185	0.025	-0.198	-0.266
Indonesia	0.153	0.150	0.016	0.031	-0.371	-0.426
Lao PDR	1.485	0.098	0.033	0.045	-0.475	-0.596
Myanmar	0.886	0.158	0.160	0.310	-0.975	-1.477
Malaysia	0.066	0.046	0.017	0.072	-0.268	-0.357
Philippines	0.702	0.179	1.046	0.035	-0.339	-0.146
Singapore	0.266	0.103	0.016	0.043	0.072	0.036
Thailand	1.794	0.216	0.173	0.008	-0.098	-0.223
Vietnam	0.643	0.047	0.327	-0.047	-0.491	-0.590
Brunei Darussalam	1.368	0.070	0.007	-0.070	-0.615	-0.816
India	0.020	0.203	0.732	0.036	-0.257	0.039
Australia	0.011	0.071	-0.006	0.056	0.169	0.126
New Zealand	0.094	0.054	0.613	0.018	-0.182	-0.151
Brazil	0.005	0.032	0.016	0.023	-0.004	-0.000
EU	-0.000	0.036	0.015	0.028	-0.005	-0.014
USA	-0.004	0.038	0.016	0.028	-0.006	-0.008
Russia	-0.006	0.034	0.016	0.028	0.012	0.005
MENA and Venezuela	0.002	0.045	0.015	0.036	0.020	0.005
Rest of the World	0.010	0.036	0.017	0.028	0.000	-0.008

5.3.3 Impact on GHG emissions (CO2)

Due to investment liberalization sectoral outputs of energy commodities increase in all the recipient countries and while the majority of the energy outputs in the investor countries decrease. As a consequence the overall regional CO_2 emission increases. However, CO_2 emissions decease in the investor countries and increase in the recipient developing countries. Varied level of output efficiency across the investor and

recipient countries could be attributed for such overall negative impact on the regional GHG emissions. Table 5.14 below shows the percentage change of CO_2 emissions compared to the 2020 baseline emissions.

Table 5.14 Impact on GDP and CO2 emissions due to capital reallocation

Region	% change from 2020 baseline CO_2 emissions
China	-0.05
Japan	-0.45
Korea	-0.26
Cambodia	0.82
Indonesia	1.42
Lao PDR	1.71
Myanmar	2.95
Malaysia	1.26
Philippines	1.21
Singapore	-0.10
Thailand	1.16
Vietnam	1.37
Brunei Darussalam	2.03
India	0.88
Australia	-0.33
New Zealand	0.41
Brazil	-0.01
EU	-0.01
USA	-0.01
Russia	-0.01
MENA and Venezuela	-0.01
Rest of the World	-0.01
World Total	0.04
EAS Total	**0.15**

5.4 Impact of energy price reform and subsidy removal

It has been observed that the energy subsidy data recorded for various countries in the East Asia region are unclear and convoluted within various accounting headings. It is difficult to get the distribution percentage of the total subsidy paid by the

governments to the industries and households. Subsidies are also hidden in the intermediate goods and purchases which are often unrecorded. As a matter of fact, in this study, we first obtained data from IEA on total subsidy amount given by each Government to each energy sector like coal, oil, gas and electricity as our base information for energy subsidy. It is also understood that in the countries like India, Government is also collecting huge taxes on certain fuels which are more than the total subsidy amount paid. In China, energy subsidies are gradually going down and Government is driving the price more towards market determined price. Another important issue we observed is that most of the cases majority of the subsidies are for the consumers and end users rather than the producers. Unfortunately, consumers' subsidies are not properly recorded due to complexities of distribution. Anyway, in this study, we tried to simplify the issue mainly due to time and data non availability to the level of understating the energy subsidy removal is nothing but increasing tax on the respective energy commodities.

Subsidy data taken from IEA World Energy Outlook 2008 is of year 2007. Based on this 2007 data we estimated the corresponding percentage change in the tax level at GTAP 7 database (base year 2004) if the subsidy amount is to reduce by 10% at 2007. We consider that 10% subsidy reduction is reasonable start of subsidy reform.

Subsidy has been allocated between the producers and consumers at the general rate of 95% to consumers and 5% to the producers assuming that in most of the countries end users of energy are mostly subsidized. For producers subsidy removal the market price increased by equivalent amount through upward tax adjustment which increases the output value at market price (VOM). On the other hand for the consumers' subsidy removal the household consumers' purchase price increases which is reflected in the upward adjustment of the consumers' payment for the energy commodities in the market. 100% consumer oil subsidy has been allocated to the petroleum products sector which represents the oil end use. It is further assumed that majority of the oil sector

subsidy goes to transport fuel or refined fuels like kerosene for domestic consumption. 100% consumer coal subsidy has been allocated to the industrial consumption assuming that there is limited use of coal in the domestic households. For the gas subsidy, we allocated most of the subsidies to the downstream uses captured under the gas distribution sector in the model. However, to avoid computation difficulties we further adjusted certain distribution percentages of subsidies among produces and consumers in certain countries.

5.4.1 Impact on national economy (GDP)

Due to energy subsidy reduction by 10% most of the countries will suffer from corresponding real GDP reduction except India. India is expected to gain its real GDP by 0.22% due to 10% subsidy reduction. The negative GDP impacts are results of higher degree of market distortion, as energy subsidy removal was only modelled through equivalent tax increase due to lack of more disaggregated dataset which can single out subsidized energy commodity. Overall, EAS region will not suffer from any major GDP loss due to 10% energy sector subsidy reduction. Table 5.15 shows the impacts of energy subsidy reduction by 10% (SR20-10), 50% (SR20-50) and finally 100% (SR20-100) on respective national GDPs compared to their baseline 2020 scenarios.

Table 5.15. Impact of Energy Subsidy Reduction on GDP (Year 2020)

Region	**SR20-10 (nominal)**	SR20-10 **(Real)**	SR20-50 **(nominal)**	SR20-50 **(Real)**	SR20-100 **(nominal)**	SR20-100 **(Real)**
China	0.214	-0.017	0.913	-0.109	1.620	-0.265
Japan	0.019	0.005	0.065	0.009	0.110	0.009
Korea	0.036	-0.003	0.103	0.013	0.131	0.010
Cambodia	0.011	0.000	0.021	0.007	0.011	0.007
Indonesia	0.515	-0.083	1.120	-0.605	0.828	-1.371
Lao PDR	0.033	-0.150	0.083	-0.150	0.149	-0.150
Myanmar	0.018	-0.048	0.054	-0.021	0.089	-0.005
Malaysia	0.522	-0.117	1.040	-0.880	0.942	-1.660

Region	**SR20-10 (nominal)**	SR20-10 **(Real)**	SR20-50 **(nominal)**	SR20-50 **(Real)**	SR20-100 **(nominal)**	SR20-100 **(Real)**
Philippines	0.023	-0.004	0.062	-0.001	0.084	0.001
Singapore	-0.021	-0.035	-0.132	-0.186	-0.239	-0.321
Thailand	0.203	-0.031	0.870	-0.132	1.556	-0.313
Vietnam	0.284	-0.038	1.119	-0.209	2.223	-0.365
Brunei Darussalam	-0.195	-0.105	-0.488	-0.074	-0.525	-0.063
India	0.260	0.229	1.150	0.101	2.082	-0.095
Australia	0.144	-0.041	0.549	-0.213	0.868	-0.420
New Zealand	0.018	0.003	0.054	0.007	0.081	0.009
Brazil	0.017	-0.008	0.069	-0.005	0.126	-0.005
EU	0.012	0.001	0.047	0.006	0.089	0.006
USA	0.014	0.001	0.052	0.002	0.095	0.003
Russia	-0.043	-0.034	-0.061	-0.036	0.024	-0.028
MENA and Venezuela	-0.062	-0.043	-0.106	-0.032	-0.024	-0.029
Rest of the World	0.014	-0.005	0.055	0.000	0.105	0.002
World Total	0.037	-0.002	0.146	-0.019	0.255	-0.046
EAS Total	0.130	0.000	0.484	-0.080	0.796	-0.198

Legend: SR20-10: Energy subsidy reduction by 10 %
SR20-50: Energy subsidy reduction by 50 %
SR20-100: Energy subsidy reduction by 100 %

5.4.2 Impact on sectoral real output

As a matter of fact, due to energy price reform almost all countries' sectoral output in the energy sector decreases to adjust the upward revision of taxes. It is further envisaged that such loss in real output especially in the energy sectors will not affect the economy much as already reflected in the no change in the real GDP for 10% subsidy removal. Hence, such output loss is getting adjusted in other sectoral output of the economy with better efficiency. Table 5.16 shows the % change in real output compared to the baseline 2020 scenario.

Table 5.16 Impact of Energy Subsidy Reduction on real output (% change to the baseline 2020)

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-0.02	-0.06	-0.62	-0.21	-0.18	-1.31
Japan	-0.01	-0.03	-0.02	0.11	0.00	-0.01
Korea	-4.20	-0.02	0.00	0.19	0.01	0.02
Cambodia	-0.00	-0.02	-0.01	0.05	0.02	-0.06
Indonesia	-0.00	-0.22	-0.55	-4.73	0.17	-0.03
Lao PDR	0.00	-0.01	0.00	0.06	0.01	-0.10
Myanmar	-0.01	-0.01	-0.02	-0.01	0.05	0.01
Malaysia	-0.01	-0.15	-0.28	-5.25	-0.09	-0.13
Philippines	-0.01	0.02	-0.00	0.14	0.02	0.03
Singapore	-1.18	0.04	0.10	3.06	0.16	0.40
Thailand	-0.32	-0.16	-0.15	0.10	-0.43	-0.40
Vietnam	0.00	-0.01	-0.32	-25.11	-0.42	-1.51
Brunei Darussalam	0.00	-0.04	-0.01	0.12	-0.00	-0.01
India	-0.02	-0.17	-0.61	-0.08	-0.28	-0.06
Australia	-0.05	-0.23	-0.05	-1.51	-0.18	-1.36
New Zealand	-0.01	-0.06	-0.00	0.18	0.01	-0.01
Brazil	-0.00	-0.02	-0.01	0.06	-0.00	-0.01
EU	-0.00	-0.03	-0.01	0.09	0.00	-0.02
USA	-0.00	-0.02	-0.01	0.10	0.00	-0.01
Russia	-0.00	-0.02	-0.00	0.10	0.04	0.01
MENA and Venezuela	0.00	-0.02	-0.01	0.17	0.04	0.05
Rest of the World	-0.01	-0.03	-0.01	0.09	0.01	-0.01
World Total	-0.02	-0.03	-0.05	-0.05	-0.03	-0.05
EAS Total	-0.03	-0.11	-0.34	-0.37	-0.11	-0.55

5.4.3 Impact on domestic energy price

Due to energy subsidy reduction (mainly for 10% of the 2007 level), the region will not suffer from major loss of economic development in terms of GDP. Energy prices will also go down in most of the medium and less developed countries in this region. China and India will have larger adverse impact on energy prices due to subsidy

removal. Table 5.17 shows the percentage change of price due to subsidy removal by 10% to the baseline 2020 scenario.

Table 5.17 Impact of Energy Subsidy Reduction on consumer price of energy commodities: (Compared to the Baseline 2020 price)

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	11.886	-0.239	0.959	13.150	6.279	41.304
Japan	-0.124	-0.126	-0.105	-0.112	-0.002	0.011
Korea	0.299	-0.158	-0.093	-0.137	-0.013	-0.006
Cambodia	-0.072	-0.123	-0.049	-0.124	-0.016	0.009
Indonesia	-0.103	-0.889	-0.139	16.882	-0.153	0.010
Lao PDR	-0.062	-0.123	-0.040	-0.108	0.010	0.026
Myanmar	-0.125	-0.139	-0.050	-0.152	-0.008	0.017
Malaysia	-0.099	-0.162	-0.136	24.530	-0.034	0.004
Philippines	-0.142	-0.148	-0.052	-0.140	-0.028	-0.047
Singapore	-0.107	0.376	-0.066	-0.151	-0.040	-0.133
Thailand	-0.165	-0.190	-0.073	3.165	4.001	-0.011
Vietnam	-0.380	-0.254	-4.963	6.873	4.831	-0.139
Brunei Darussalam	-0.096	-0.341	-0.106	-0.164	-0.053	-0.031
India	-0.104	-0.126	0.224	3.586	5.686	0.025
Australia	-0.132	-0.389	-0.113	8.911	0.658	11.553
New Zealand	-0.139	-0.249	0.014	-0.190	0.011	0.014
Brazil	-0.055	-0.104	-0.038	-0.074	0.008	0.000
EU	-0.029	-0.111	-0.041	-0.090	0.001	0.004
USA	-0.014	-0.123	-0.039	-0.092	0.003	0.007
Russia	-0.054	-0.111	-0.037	-0.093	-0.041	-0.018
MENA and Venezuela	-0.049	-0.128	-0.052	-0.104	-0.058	-0.022
Rest of the World	-0.0606	-0.1259	-0.042	-0.0951	-0.0099	0.0026

5.4.4 Impact of complete removal of energy taxes/subsidies

Apart from subsidy removal, we also conducted simulation on removing existing taxes and subsidies on various energy commodities to avoid any market distortion. It

is assumed that, taxes and subsidies are all imposed on the economy to distort the normal market equilibrium. Removing taxes could also be possible for the countries under the complete integration scenario. As a matter of setting the policy shocks, we completely removed the energy taxes, private consumption taxes for domestic energy products and private consumption taxes for imported energy products. The results show that due to tax removal, overall regional economy will be benefited in terms of gaining real GDP by 0.4% compared to the base line scenario. The simulation results are as follows:

Table 5.18 Impact of tax removal on various energy commodities

Regions	% change to baseline 2020 GDP (Real)	% change to baseline 2020 GDP (Nominal)
China	0.111	-0.184
Japan	0.314	-1.533
Korea	2.090	-2.174
Cambodia	0.103	-0.264
Indonesia	-0.123	-0.224
Lao PDR	-0.108	-0.291
Myanmar	-0.006	-6.385
Malaysia	-0.129	0.081
Philippines	-0.003	-0.740
Singapore	0.286	0.936
Thailand	1.446	-3.158
Vietnam	0.049	1.598
Brunei Darussalam	-0.224	3.205
India	0.363	-3.361
Australia	0.120	-1.127
New Zealand	0.265	-1.742
Brazil	-0.072	-0.172
EU	-0.103	-0.333
USA	-0.031	-0.370
Russia	-0.020	1.201
MENA and Venezuela	-0.219	2.663
Rest of the World	-0.073	-0.089
World Total	0.038	-0.388

EAS Total	**0.393**	**-1.214**

Among 16 EAS members, six member countries will lose in terms of real GDP. In all six countries the nationwide real output will decrease as a result of energy tax/subsidy removal, and these output reduction account real GDP loss. The causal mechanism between energy tax/subsidy removal and real output reduction is not always straight forward in the general equilibrium world. For example, the most negatively impacted sector in Lao P.D.R. and Brunei Darussalam is the textiles, wearing apparel and leather (twl).

5.4.5 Impact on GHG emissions (CO_2)

As expected, energy subsidy removal and price reform has a positive effect on CO_2 emissions reduction in the region as a whole. However, energy commodity tax removal will have negative impact on environment as it would encourage more CO_2 emissions. Table 5.19 summarizes the CO_2 emissions result out of these policy scenarios:

Table 5.19 Impact of energy subsidy and tax removal on CO2 emissions

Region	SR20-10	SR20-50	SR20-100	TR20
China	-0.17	-0.70	-1.17	1.37
Japan	0.00	0.23	0.23	16.48
Korea	0.00	0.00	0.00	14.61
Cambodia	0.00	0.00	0.00	0.04
Indonesia	-1.56	-2.72	-1.17	-3.48
Lao PDR	0.00	0.00	0.00	1.17
Myanmar	0.00	0.12	0.23	25.34
Malaysia	-1.52	-2.27	-0.76	-1.77
Philippines	0.28	0.28	0.28	0.76
Singapore	0.34	0.68	1.02	-1.07
Thailand	-0.81	-1.61	-3.23	10.67
Vietnam	-3.14	-4.96	-5.29	4.67
Brunei Darussalam	0.00	0.17	0.17	2.08
India	0.00	-0.83	-1.38	1.06
Australia	-0.67	-2.68	-4.70	7.21

New Zealand	0.00	0.73	0.73	11.56
Brazil	0.00	0.00	0.00	-2.15
EU	0.06	0.12	0.18	-1.82
USA	0.03	0.10	0.10	-1.49
Russia	0.13	0.13	0.13	-0.76
MENA and Venezuela	0.09	0.18	0.27	-3.19
Rest of the World	0.04	0.11	0.15	-1.34
World Total	-0.06	-0.21	-0.31	0.13
EAS Total	-0.30	-0.86	-1.17	**3.52**

Legend: TR20: Energy tax removal

5.5 Impact of liberalization of domestic energy market

As a consequence of energy market integration in the region, we envisaged that the domestic energy markets will also be liberalized and deregulated. Governments will allow the markets to take the decision on price and quantity of supply of energy. This will encourage the private sector investors to pitch in for the development of the domestic market. In this study we have conducted two different sets of simulation in the context of domestic market liberalization. We assumed that there could two different scenarios: 1) due to market integration all the energy sectors will improve their corresponding overall efficiency through total factor productivity improvement and 2) only the secondary energy market like electricity and gas distribution sector will improve their overall efficiency due to market liberalization and deregulation. It is envisaged that domestic market liberalization will have greater impact on the secondary energy supply market than the primary markets. Therefore, in this scenario case we have two different sub sets of simulations which are coded as MR-20W and MR-20. MR-20W is about overall energy sector TFP improvement of 20% due to domestic market liberalization and MR-20 is about 20% TFP improvement for electricity and gas distribution sectors only. Hence, for overall improvement in the factor productivity of

the energy sectors, the model is shocked with output augmenting technological changes in each energy sector.

5.5.1 Impact on national economy (GDP)

The first set of results that we obtained is mainly the reflection of the improvement in the output efficiency in the six energy sectors in the model. It fundamentally means that coal, oil, natural gas, electricity, petroleum products and gas distribution sectors all improved their productivity through efficiency improvement. As a matter of fact, there is more energy commodity output per unit of input to produce them. Due to output efficiency improvement an overall economic development has been observed through improved GDP. The second set of results that we obtained shows the impacts of national economies in terms of GDP due to TFP increase only in the electricity and gas distribution sectors. Table 5.20 shows the impacts of such TFP increase on GDPs.

Table 520 Impact of energy sector output efficiency improvement on GDP

Region	% change to baseline 2020 GDP with 20% TFP growth in all energy sectors (MR20W)	% change to baseline 2020 GDP with 20% TFP growth in ely & gdt sectors (MR20)
China	4.411	1.551
Japan	1.436	0.737
Korea	3.632	0.834
Cambodia	1.978	0.729
Indonesia	4.012	0.852
Lao PDR	2.111	0.943
Myanmar	7.141	1.927
Malaysia	5.642	1.278
Philippines	1.772	0.934
Singapore	3.327	0.759
Thailand	5.168	1.464
Vietnam	6.363	2.479
Brunei Darussalam	14.715	1.146
India	4.248	1.825
Australia	2.176	0.620

New Zealand	1.591	0.830
Brazil	0.067	-0.010
EU	0.103	0.003
USA	0.036	0.003
Russia	-0.284	-0.079
MENA and Venezuela	0.143	-0.029
Rest of the World	0.087	-0.004
World Total	0.783	0.259
EAS Total	3.055	1.090

5.5.2 Impact on sectoral real output

Due to domestic market liberalization, market competition increases which bring back efficiency. As a consequence, domestic market liberalization increases real output of all energy commodities in the economy. The following table shows the relative changes in real outputs under two different scenarios of MR20W and MR20.

Table 5.21 Impact of domestic market liberalization on real output (% change to the baseline 2020)

Region	coal	crude oil	gas	petro prod	electricity	coal	crude oil	gas	petro prod	electricity
	MR20W					MR20				
China	18.70	22.04	38.39	24.73	25.09	-0.36	0.38	3.27	-0.31	17.30
Japan	18.13	21.65	22.27	22.68	13.31	-0.88	-0.43	-0.50	-0.92	14.32
Korea	18.17	21.05	17.00	30.08	18.00	-0.70	-0.14	0.00	-0.70	16.01
Cambodia	19.20	21.54	20.46	21.62	25.33	-0.36	-0.02	-0.11	0.00	19.56
Indonesia	18.34	20.12	20.70	17.90	18.08	-0.61	-0.29	-0.40	-1.41	12.42
Lao PDR	20.28	21.72	29.27	41.39	40.56	0.30	0.31	2.44	3.07	30.57
Myanmar	17.96	18.46	17.77	42.25	32.54	-0.67	-0.27	-0.84	-0.27	22.34
Malaysia	18.87	20.63	21.03	30.52	19.56	-0.51	-0.25	-0.34	-0.45	18.20
Philippines	20.79	49.09	16.73	17.54	14.72	-0.85	-1.07	-1.69	-1.97	12.84
Singapore	18.82	21.09	52.43	29.26	19.00	-1.18	-0.14	1.95	-1.47	13.63
Thailand	16.65	21.66	18.93	21.29	23.10	-1.04	-0.24	-0.57	-0.51	17.52
Vietnam	18.33	20.45	19.81	11.03	21.48	-0.45	-0.33	-0.25	2.12	18.93

Brunei Darussalam	19.17	20.80	20.99	20.69	21.72	-0.11	-0.12	-0.23	0.74	19.74
India	18.16	21.08	18.61	24.65	16.97	-0.85	-0.39	-0.62	0.02	14.39
Australia	18.46	21.46	22.08	26.99	15.68	-0.68	-0.21	-0.44	0.46	14.77
New Zealand	18.15	21.56	17.13	22.52	17.87	-0.74	-0.38	-1.30	0.35	17.56
Brazil	-1.03	-1.00	-0.98	0.65	-0.86	-0.20	-0.10	-0.18	0.11	-0.34
EU	-1.95	-1.15	-0.89	0.91	-0.31	-0.39	-0.09	-0.15	0.20	-0.16
USA	-0.68	-0.98	-0.78	1.61	0.61	-0.17	-0.06	-0.13	0.25	0.14
Russia	-2.43	-0.78	-0.39	-0.12	2.09	-0.51	-0.04	-0.08	0.06	0.21
MENA and Venezuela	-1.87	-0.91	-0.74	-5.35	1.38	-0.44	-0.08	-0.18	-0.16	0.11
Rest of the World	-2.31	-1.23	-0.90	-0.11	0.47	-0.47	-0.10	-0.16	0.14	-0.14
World Total	8.38	1.31	1.82	7.99	6.27	-0.38	-0.07	-0.17	-0.07	4.86
EAS Total	18.61	21.38	20.91	25.16	19.45	-0.44	0.04	-0.35	-0.52	15.82

5.5.3 Impact on GHG emissions (CO_2)

As a consequence of enhanced energy commodity output, CO_2 emissions are expected to be increased over the region. For the MR20W overall CO2 emissions drastically increases due to output increase. However, for the electricity and gas distribution sectoral TFP growth, CO_2 emission decreases in the region. As a matter of fact, it has been envisaged that due to efficiency improvement in the electricity and gas supply system, losses will be reduced. Subsequently, use of fossil fuel will also be reduced accordingly which will reduce the GHG emissions (Table 5.22).

Table 5.22 Impact of energy sector output efficiency improvement on CO2 emissions

Region	% change to baseline 2020 GDP 20% for TFP growth of 20% in ely & gdt sectors
China	-0.84
Japan	-2.23
Korea	-1.53
Cambodia	1.78
Indonesia	1.87
Lao PDR	8.47
Myanmar	10.54
Malaysia	2.48

Philippines	-2.11
Singapore	-2.85
Thailand	1.05
Vietnam	4.52
Brunei Darussalam	1.70
India	-2.49
Australia	-1.29
New Zealand	2.59
Brazil	0.27
EU	0.55
USA	0.43
Russia	0.38
MENA and Venezuela	0.11
Rest of the World	0.49
World Total	0.01
EAS Total	**-0.80**

5.6 Impact of combination policies of energy market integration

We assumed that for full scale implementation of the energy market integration in the EAS region all the above mentioned policies are introduced simultaneously. This combined policy scenario demonstrates the most optimistic situation of integrated energy market in the East Asia region. As a result, we simulated the economy with the following simultaneous shocks to observe the impacts on national economy, real output of each energy commodity, relative price changes and finally on GHG emissions in terms of CO_2:

Trade liberalization

Investment liberalization (capital reallocation)

Energy subsidy reduction (10%)

Market reform (20% increase in TFP for “ely” and “gdt” sectors)

In addition, we conducted this simulation with 15% increase in TFP for “ely” and “gdt” sectors for the purpose of sensitivity testing.

5.6.1 Impact on national economy in terms of GDP

Model result shows that due to simultaneous implementation of all the relevant policies for energy market integration, all the member countries of the East Asia region gain economically in terms of real GDP.

Table 523 Impact of combination policy on GDP

Region	% change from 2020 baseline real GDP (20% TFP)	% change from 2020 baseline nominal GDP (20%TFP)	% change from 2020 baseline real GDP (15% TFP)	% change from 2020 baseline nominal GDP (15%TFP)
China	1.459	1.996	1.111	1.562
Japan	0.427	0.365	0.261	0.227
Korea	0.695	0.576	0.502	0.419
Cambodia	1.844	1.355	1.665	1.187
Indonesia	1.692	1.897	1.483	1.733
Lao PDR	1.632	4.166	1.347	3.422
Myanmar	2.903	3.981	2.423	3.248
Malaysia	2.036	2.032	1.727	1.855
Philippines	2.190	1.699	1.976	1.548
Singapore	0.458	0.300	0.288	0.201
Thailand	2.802	2.393	2.460	2.094
Vietnam	3.760	1.778	3.172	1.429
Brunei Darussalam	2.291	1.038	2.008	1.123
India	2.709	4.371	2.353	3.631
Australia	0.329	0.886	0.188	0.734
New Zealand	1.176	1.163	0.985	0.934
Brazil	-0.011	-0.137	-0.011	-0.108
EU	0.002	-0.475	0.001	-0.371
USA	0.003	-0.476	0.002	-0.373
Russia	-0.087	-0.823	-0.076	-0.642
MENA and Venezuela	-0.028	-0.696	-0.033	-0.538
Rest of the World	-0.004	-0.328	-0.005	-0.254
World Total	0.252	-0.044	0.192	-0.031
EAS Total	1.059	1.305	0.815	1.033

5.6.2 Impact on sectoral real output

Due to simultaneous application of the relevant policies regarding energy market integration can further reduce the real outputs from the energy sector. Tables 5.24 and 5.25 show the changes in the baseline scenario under 20% and 15% TFP increase in "ely" and "gdt" sectors respectively.

Table 5.24 Impact of combined policy on sectoral real output: 20% TFP growth case (% change from baseline 2020)

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-0.39	0.34	2.51	-0.86	16.96	17.34
Japan	-0.71	-0.48	-0.63	-1.09	13.65	17.82
Korea	-5.23	-0.14	0.00	1.17	15.62	39.36
Cambodia	-0.18	0.31	-0.05	11.93	20.96	57.80
Indonesia	-0.25	-0.06	-0.67	-6.38	14.27	20.48
Lao PDR	0.30	0.33	2.44	2.03	34.46	56.38
Myanmar	-0.42	-0.00	-0.10	-0.00	26.03	36.69
Malaysia	-0.35	-0.12	-0.20	-5.38	19.61	34.36
Philippines	-0.91	0.74	-1.44	4.05	14.82	7.54
Singapore	-1.18	0.03	1.66	6.80	13.79	39.04
Thailand	-1.06	-0.17	-0.59	1.54	18.78	13.70
Vietnam	-0.26	-0.38	-1.02	-32.08	20.75	8.17
Brunei Darussalam	0.05	0.21	-0.16	2.42	22.69	10.62
India	-2.12	-0.47	-1.11	1.71	17.32	5.79
Australia	-0.47	-0.03	-0.66	3.70	13.76	11.39
New Zealand	-0.53	-0.18	-1.19	0.46	18.21	11.09
Brazil	-0.13	-0.10	-0.19	0.07	-0.35	-0.41
EU	-0.31	-0.09	-0.18	0.17	-0.18	-1.97
USA	-0.16	-0.07	-0.14	0.21	0.13	-0.16
Russia	-0.42	-0.04	-0.10	-0.25	0.21	-1.97
MENA and Venezuela	-0.36	-0.08	-0.24	-0.86	0.12	-0.92
Rest of the World	-0.40	-0.10	-0.18	0.01	-0.16	-1.02
World Total	-0.37	-0.06	-0.21	-0.08	4.88	1.28
EAS Total	-0.46	0.09	-0.46	-0.19	15.91	20.02

Table 5.25 Impact of combined policies on sectoral real output: 15% TFP growth case (% change from baseline 2020)

Regions	coal	crude oil	gas	petroleum products	electricity	gas distribution
China	-0.30	0.26	1.67	-0.77	12.65	12.39
Japan	-0.57	-0.41	-0.53	-0.88	10.15	13.33
Korea	-5.01	0.09	-3.67	1.33	11.67	29.54
Cambodia	-0.10	0.31	0.09	11.96	15.39	40.61
Indonesia	-0.11	0.01	-0.57	-6.04	11.16	15.64
Lao PDR	0.36	0.64	2.20	1.14	24.88	40.83
Myanmar	-0.27	0.15	0.09	0.02	19.93	28.31
Malaysia	-0.47	-0.06	-0.12	-5.24	15.05	25.22
Philippines	-1.09	1.15	-0.95	4.55	11.61	6.08
Singapore	-0.82	-0.01	1.17	7.15	10.42	29.24
Thailand	-0.88	-0.12	-0.45	1.66	14.35	10.74
Vietnam	-0.17	-0.30	-0.95	-32.37	15.76	5.72
Brunei Darussalam	-0.05	0.24	-0.11	2.20	17.60	8.61
India	-1.86	-0.38	-0.96	1.73	13.71	4.71
Australia	-0.31	0.02	-0.56	3.64	10.17	7.85
New Zealand	-0.35	-0.15	-0.94	0.37	13.80	8.63
Brazil	-0.01	-0.08	-0.09	0.04	-0.27	-0.30
EU	-0.22	-0.07	-0.15	0.12	-0.13	-1.43
USA	-0.12	-0.05	-0.12	0.15	0.10	-0.12
Russia	-0.30	-0.03	-0.08	-0.27	0.16	-1.45
MENA and Venezuela	-0.19	-0.06	-0.20	-0.84	0.10	-0.69
Rest of the World	-0.29	-0.08	-0.14	-0.03	-0.12	-0.75
World Total	-0.28	-0.05	-0.17	-0.06	3.68	0.96
EAS Total	-0.36	0.09	-0.38	-0.06	11.98	14.86

5.6.3 Impact on GHG emissions (CO_2)

In terms of CO_2 emissions, the combined policy drastically increases the emissions by 10% in the region as a whole. This happens mainly due to the increase in GDP in the region. Hence, it is a matter of policy choice for the policy and law makers to

prioritize the developmental aspects. Table 5.25 shows the impacts of the combined policy scenarios on CO_2 emissions.

Table 5.26 Impact of combined policies on CO2 emissions

Region	% change from baseline 2020 CO_2 emissions (20% TFP growth)	% change from baseline 2020 CO_2 emissions (15% TFP growth)
China	-1.03	-0.84
Japan	-2.73	-2.23
Korea	-1.64	-1.29
Cambodia	3.89	3.27
Indonesia	2.20	1.70
Lao PDR	11.61	8.95
Myanmar	13.80	10.83
Malaysia	1.51	0.90
Philippines	-0.44	0.03
Singapore	-2.73	-2.12
Thailand	1.92	1.63
Vietnam	8.65	7.46
Brunei Darussalam	3.82	3.35
India	4.81	5.47
Australia	-3.18	-2.91
New Zealand	2.90	2.27
Brazil	0.23	0.17
EU	0.51	0.38
USA	0.41	0.31
Russia	0.35	0.26
MENA and Venezuela	0.04	0.01
Rest of the World	0.42	0.30
World Total	0.14	0.14
EAS Total	-0.31	-0.13

5.7 Welfare measures of energy market integration

Equivalent variations (EVs) are considered as a measure for welfare change in the economy due to the policies. We report the percentage change of EVs for different policy scenarios as follows:

Table 5.27 Impact of policy shocks on EV (% change from baseline 2020)

Region	TL2020	CT2020	SR2020	MR2020	Combined
China	-0.02	-0.07	0.00	2.58	2.48
Japan	-0.02	-0.88	0.03	3.57	2.69
Korea	0.09	-0.33	0.04	1.92	1.72
Cambodia	-0.18	0.93	0.02	1.72	2.48
Indonesia	0.13	1.27	-0.06	1.53	2.86
Lao PDR	-0.00	0.77	0.03	2.98	3.82
Myanmar	0.08	1.31	0.04	3.92	5.45
Malaysia	0.24	0.81	-0.29	2.77	3.54
Philippines	-0.14	2.13	0.04	2.70	4.76
Singapore	-0.22	-0.01	-0.07	1.94	1.64
Thailand	0.07	1.54	0.02	3.84	5.53
Vietnam	0.06	0.71	-0.24	4.92	5.43
Brunei Darussalam	1.53	2.01	-0.36	1.62	4.83
India	0.14	1.74	-0.01	7.12	9.04
Australia	0.16	-0.42	-0.09	1.86	1.47
New Zealand	-0.06	0.80	0.02	3.18	3.95
Brazil	-0.00	0.00	0.02	0.45	0.47
EU	-0.01	0.00	0.02	0.05	0.06
USA	-0.00	-0.00	0.01	0.05	0.05
Russia	0.01	0.02	-0.05	-0.26	-0.29
MENA and Venezuela	0.06	0.04	-0.08	-0.26	-0.25
Rest of the World	0.00	0.00	0.01	0.12	0.14
World Total	0.01	-0.01	0.00	0.70	0.70
EAS Total	**0.02**	**-0.05**	**-0.01**	**2.84**	**2.81**

Legend: TL2020: Trade liberalization
CT2020: Energy sector investment liberalization
SR2020: Energy subsidy reduction by 10 %
MR2020: Domestic energy market liberalization (20% increase in TFP for ely and gdt)
Combined: Combination of the above four policy scenarios

Table 5.27 shows that energy market integration can benefit all EAS member countries quite significantly.

6. CONCLUSIONS AND RECOMMENDATIONS

In this study we tried to demonstrate the impacts of various policy measures to pave the path for integrated energy market in the East Asia region. Full scale integration is a highly optimistic proposal, but it has been envisaged that for overall economic, environmental and social development some regional cooperation is required. Energy being the primary input for all economic activities and thereafter causes of environmental pollution, it is prudent to begin with some attempt of systematic cooperation among the member states of the East Asia Summit to integrate the development of this sector across the region.

In the context of estimating five different policy measures for energy market integration, it has been observed that no single policy can create the miracle of integrated market where all the member countries are winning. Economy being a system of dynamic equilibrium, it is obvious that in the process of regional cooperation, some country will lose and some will win. This a policy decision of the law makers to pick up the most relevant and appropriate policy to expedite the process. "Winners will compensate the losers" could be an overarching policy to mitigate the negative impacts of integrated market. However, we observed that energy commodity trade liberalization and domestic energy market liberalization could bring the regional economic benefit while the energy price reform and energy sector investment liberalization could have negative or no impact of the regional economy. Our very optimistic policy scenario of implementing four policy measures simultaneously, proved to be most promising in terms of economic and environmental benefits. No other policy scenario could achieve the dual benefits like this. This indicates that some strong policy measure to integrate the energy market in this region could be effective without much economic and environmental loss.

BIBLIOGRAPHY

ADB. 2005. GMS Flagship Initiative: Regional Power Interconnection and Power Trade Arrangements. Manila: Asian Development Bank.

AMEM. 2004. *Report on ASEAN Ministers on Energy Meeting*. Jakarta, ASEAN Center for Energy.

APERC. 2006. *APEC Energy Demand and Supply Outlook*. Tokyo: Asia Pacific Energy Research Centre.

Bhattacharya, Anindya, and Satoshi Kojima. 2008. Impact of Cross Border Energy Infrastructure Investment on Regional Environment, Society and Climate Change. Background paper to Infrastructure for Seamless Asia. Tokyo: Asian Development Bank Institute.

Burniaux, Jean-Marc, and Truong Truong. 2002. *GTAP-E: An Energy-Environmental Version of the GTAP Model*, GTAP Technical Paper No.16. West Lafayette, IN: Purdue University.

Hertel, Thomas W. 1996. *Global Trade Analysis: Modeling and Applications*. New York, NY: Cambridge University Press.

Hanslow, Kevin, Tien Phamduc, and George Verikios. 2000. The Structure of the FTAP Model. Research Memorandum, Productivity Commission

IEA. 2003. *World Energy Investment Outlook*. Paris: International Energy Agency.

IEA. 2008. *World Energy Outlook*. Paris: International Energy Agency.

Kojima, Satoshi 2008. REPA Model for Impact Assessment of Environmental Policies under Regional Economic Integration in East Asia. *IGES-EA Working Paper* 2008-001. Hayama, IGES.

Lee, Huey-Lin. 2008. The Combustion-based CO_2 Emissions Data for the GTAP Version 7 Data Base. West Lafayette, IN: Purdue University.

Phinyada, A. 2005. *ASEAN Energy Cooperation: An Opportunity for Regional Sustainable Energy Development*. Boston, M.A.: Harvard Law School.

Von Hippel, David F. 2001. *Estimated Costs and Benefits of Power Grid Interconnections in North East Asia*. Nautilus Institute.