ERIA Discussion Paper Series

Assessment of ASEAN Energy Cooperation within the ASEAN Economic Community*

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December 2013

Abstract: This paper assesses all the programmes and projects proposed in the ASEAN Economic Community (AEC) Blueprint and the ASEAN Plan of Action of Energy Cooperation (APAEC) 2010–2015. This paper also creates a scorecard to quantitatively assess the progress. A low score may imply that the targets are either not clearly defined or not realistic. This paper finds that there are significant challenges in the energy sector to meet the targets for the AEC in 2015. Progress, in terms of cooperation and referred to as 'soft infrastructure' in this paper, has been slower than that of the physical infrastructure. ASEAN energy cooperation is also challenged by factors such as financial constraints, the lack of fiscal arrangements, and the technical and regulatory differences between countries. To facilitate the implementation of AEC by 2015, we propose that ASEAN does the following: (1) coordinate national energy policies and regulations, project development, and monitor ASEAN Member States (AMSs) to fulfil their commitment; (2) strengthen the institutional infrastructure and cooperation, since this is as important as the physical infrastructure; (3) effectively mobilse resources for infrastructure projects via the leverage of public funds and the participation of the private sector; and (4) expedite the implementation of priority actions. It also suggests that "AEC beyond 2015" sets a clear vision and has a comprehensive coverage of the energy sector. It should update the plans on energy cooperation and the development of an energy infrastructure and continuously promote those tasks left over from the AEC 2015. It should also establish a regional governing institution on energy, follow economic principles, and use market instruments.

***Keywords*:** ASEAN Economic Community, Energy Cooperation, ASEAN
***JEL Classification*:** Q48; P48;N95

* The paper was initially prepared for ERIA's project on "Mid-term Review of ASEAN Economic Community". By default, information reflects the status at the end of 2012.

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1. Introduction

The ASEAN Economic Community (AEC) aims to transform ASEAN into a stable, secure, prosperous, rules-based, competitive, resilient, and integrated economic community by 2015 (APAEC, 2010). The ASEAN Vision 2020 (ASEAN website, 1997) envisions a clean and green ASEAN with fully established mechanisms for sustainable development to ensure the protection of the environment, the sustainability of its natural resources, and a high quality of life for its people. Such a vision was incarnated at the Bali Summit in October 2003 as the AEC by 2020 (Bali Concord II). The adoption of the AEC Blueprint by the ASEAN Heads of State / Government in November 2007 expedited the implementation of the AEC to 2015.

The energy policy agenda of the AEC is designed to ensure a secure and reliable supply of energy that includes biofuels, as well as expediting the development of the APG (ASEAN Power Grid) and the TAGP (Trans ASEAN Gas Pipeline). This would allow for the optimisation of regional energy resources, ensure sustainable energy development by mitigating GHG (greenhouse gas) emissions and strengthen renewable energy development and cooperation (APAEC, 2010). In the AEC Blueprint, there are statements about specific projects such as APG and TAGP and about general visions, such as "Secure and reliable supply of energy including bio-fuel", "Strengthen renewable energy development, such as bio-fuels", and "investment in the requisite infrastructure for renewable energy development". The AEC also recognises the limited global reserves of fossil energy and the unsustainable world prices of fuel oil and emphasises the need to strengthen renewable energy development and cooperation (ASEAN, 2008).

The energy sector is an integral part for achieving the AEC by 2015. Energy is closely related to three of the four pillars under the AEC. As a commodity group and production input, energy is a necessary part of the single market and production base (pillar 1), which requires the free flow of energy goods, energy investment, energy services, etc. In order for the region to become more competitive (pillar 2), the energy sector must be open, competitive, and in line with the economy in general. Energy is also important in relation to equitable economic development (pillar 3), as electricity services must be provided to more than 100 million people who have no access to electricity in ASEAN. This is in keeping with the UN Conference on Sustainable Development (Rio+20).

ASEAN energy cooperation was developed in parallel with the establishment of ASEAN. The first energy cooperation agreement between Thailand and Laos 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 Utilities/Authorities (HAPUA) was established to work on electricity interconnection. In 1986, the ASEAN Energy Cooperation Agreement outlined a wide range of areas for cooperation among member countries. This was further targeted in 1990 when the ASEAN Ministers on Energy Cooperation approved a programme of action for enhanced cooperation, which included all energy sources such as coal, electricity, petroleum, geothermal resources, and other alternative energy. It also included institutional areas such as energy efficiency and conservation, energy policy and planning, technical cooperation, training, and resource development.

However, the AEC Blueprint does not have a detailed programme for the energy sector and there are no specific roadmaps in the AEC Blueprint, except for the APG and TAGP. Instead, the energy cooperation portion is collectively documented in the sequential ASEAN Plan of Action on Energy Cooperation (APAEC, 1999, APAEC, 2004, APAEC, 2010). The first APAEC (1999–2004) involved the region-wide participation of all 10 ASEAN Member States (AMSs) and the comprehensive focus on regional energy cooperation and integration. The later APAECs directed actions to ensure the security and sustainability of the energy supply, the efficiency and management of energy, an appropriate policy framework, and implementation arrangements. The third stage of APAEC, the APAEC 2010–2015, added a new programme, the Civilian Nuclear Energy (CNE) programme. Consequently, under the current APAEC (2010–2015), there are seven energy cooperation areas being pursued in ASEAN to ensure greater energy security and the sustainability of ASEAN 2010–2015.

Assessing the development of the energy sector, within the work programmes of APAEC 2010–2015, can demonstrate the progress of AEC from the energy perspective. The purpose of this paper is to understand the implementation of the AEC in the energy sector, guided by the APAEC 2010–2015, and put forward recommendations that will ensure the timely and practical implementation of the AEC by 2015.

This paper is organised as follows. After the introduction, section 2 presents the methodology. Sections 3 and 4 present the status and assessment of the two flagship energy infrastructure programmes in the AEC, namely the APG and the TAGP, and their related institutional aspects. Section 5 presents the status and assessments of the other energy cooperation programmes in the APAEC 2010–2015 and finally, the paper summarises the findings and recommendations of the assessment.

2. Methodology

This paper assesses the energy programmes and projects proposed in the AEC Blueprint and the APAEC 2010–2015. In the APAEC, there are different levels consisting of programmes, strategies, action plans and project / activity, and are listed in order from top to bottom. On the top is "programme", of which there are seven. In each programme, such as APG, there are many "strategies", each of which is supported by many "action plans". Each action plan is further divided into various projects / activities, which are at the bottom of the hierarchical system.

This paper quantifies the gaps between the current status and the targets set, or the results needed, for realising the AEC at the project / activity level. We created an original scorecard to score each project / activity. In addition to the existing projects / activities listed in the APAEC 2010–2015, we considered other projects / activities that are necessary to achieve the action plans. For example, in order to capture the dynamics towards 2015, we accessed some key performance indicators (KPIs), such as the percentage of renewable energy in the energy mix and the percentage of energy saving achieved. In the case of "harmonisation work" in the APG programme, besides the studies, we added an item to measure the actual level of harmonisation, which should be zero at the study stage.

The scores of project / activities were evaluated subjectively. The scoring system that was used by us is listed in the following table.

Table 1: ERIA Scoring System for Projects/Activities

Scores	Institutional Progress	Physical Progress	Quantitative Targets
5	Operational	Construction finished	80% - 100%
4	Endorsement/approval/ ratification	Construction half complete	60% - 80%
3	Finalization	Construction starts	40% - 60%
2	Discussion/assessment	Approved, waiting for start	20% - 40%
1	Draft, TOR	Plan prepared	0% - 20%
0	No action	No activity	0%

In the scoring system, we differentiated between progress and targets. Institutional progress and physical progress are also differentiated (Table 1). The score would be zero if no implementation is observed. However, it should be pointed out that this scoring system is only applied to the levels of projects / activities. Scores for action plans, strategies, programmes, and the energy sector as a whole are aggregated as follows.

After giving scores for each project / activity, we aggregated them to get the score for each action plan by weights. The scores of the action plans will be further aggregated to get the score of a strategy by weights. Details for the scorecard systems are demonstrated in the appendix. Finally, the score for each programme is an average of the scores of its key strategies:

$$\text{program score}_j = \sum_{i=1}^{n} \varphi_i \text{score of strategy}_i \quad (1)$$

where n is the number of strategies under each programme and φ_i is the weight of the i^{th} strategy.

All of the weights here are "within group" weights. We give weights for an item considering its relative importance to its fellow items. For example, under the APG programme area, "Accelerate the development of the ASEAN Power Grid

Interconnection projects" is considerably more important than the other stated aims and thus is given a weight of 70%, while the other two have a total weight of 30%.

Finally, we aggregated the programme's scores to get a single score for the energy sector:

$$\text{Energy Sectoral score} = \sum_{i=1}^{6} \varphi_i \text{ score of program}_i \quad (2)$$

The weights are specified in Table 2. The APG and TAGP and their related cooperation components are two flagship projects in the AEC Blueprint and thus were given the highest weights. Energy efficiency and conversation (EEC), although not specifically stated in the AEC, are viewed as one of the most cost-effective ways of enhancing energy security and mitigating climate change impacts, as well as promoting competitiveness in the ASEAN Member States (AMSs). Therefore, the EEC programme was given the second highest weight. By contrast, the nuclear programme is in its early days, since nuclear energy is relatively new for ASEAN countries and there is little potential for cooperation among the AMSs, as there are no complementary resources among them. Due to these considerations, we gave a 5% weight for this programme area. Regional policy and planning (REPP) was given a zero weighting, since its activities are often embedded in other programmes and its inclusion could cause double counting.

Table 2: Weights for Different Programme Areas

Programme area	Programme name	Programme weight
1	ASEAN Power Grid (APG)	0.25
2	Trans-ASEAN Gas Pipeline (TAGP)	0.25
3	Coal and Clean Coal Technology (CCT)	0.1
4	Energy Efficiency and Conservation (EEC)	0.2
5	Renewable energy (RE)	0.15
6	Civilian Nuclear Energy (CNE)	0.05
7	Regional policy and planning (REPP)	0

The final result is shown within a band of 0-5, with five representing full achievement of the targets set in the APAEC 2010–2015 and zero representing no change. However, it should be noted that a score of five does not mean the AEC will be achieved, since the goals set in the APAEC 2010–2015 do not meet all of the requirements of the AEC, which will be explained later.

3. Status and Assessment of the APG

APG, one of the two flagship energy programmes in the AEC Blueprint, has been developed over a long period. Electricity trading in ASEAN goes back to 1966, when Thailand supplied power to Laos. ASEAN made the first big push to develop a regional power grid in 1981, when it set up its forum of HAPUA to study interconnection and other specific projects. These included cooperation on electricity generation sources (i.e., hydro, nuclear, and geothermal sources) and utility operations such as computer applications, electrical interconnections, R&D, engineering, training, rural and urban electrification, and standardisation.[1] The establishment of HAPUA served as a basis for the formation of the 1982 ASEAN Cooperation Project on Interconnection. Since then,

HAPUA gradually firmed up the plan for the APG. The eventual establishment of the APG was planned in the APAEC 1999–2004. By 1999, HAPUA had identified 14 interconnection projects, including the existing interconnections of Thailand–Laos PDR and Peninsular Malaysia – Singapore.[2]

In the updated report of the ASEAN Interconnection Master Plan Study (AIMS II) that was finalised in 2010, 16 interconnection systems were identified to have been developed under the APG programme. The East Sabah (Malaysia)–East Kalimantan (Indonesia) interconnection system and the Sumatra–Singapore interconnection system are two new systems in the AIMS II that were not considered in the original 2003 AIMS. Meanwhile, the Sarawak–Sabah–Brunei interconnection system was modified by dropping the Sabah–Brunei line.

Both AIMS and AIMS II divide the APG into three sub-systems (Roesli, 2006), namely:

- System A (Upper West System), consisting of ASEAN countries under the Greater Mekong Sub-region (GMS) including Cambodia, Laos PDR, Myanmar, Thailand and Vietnam
- System B (Lower West System), consisting of countries under the IMT (Indonesia, Malaysia and Thailand) and IMS Growth Triangle Sub-region, Indonesia (Sumatra, Batam), Malaysia (Peninsular and Singapore)
- System C (East System), consisting of countries under the BIMP/EAGA Sub-region, including Brunei, Malaysia (Sabah, Sarawak), Indonesia (West Kalimantan), and the Philippines

The possibility of integrating these three sub-systems into a single APG was assessed as part of the consideration for the upgrading of the 300 MW Thailand–

Peninsular Malaysia HVDC Link and the power trade of the Bakun Hydroelectric Project between Sarawak and Peninsular Malaysia.

The APAEC 2010–2015 Program No. 1 on the power grid serves as a platform to facilitate and expedite the implementation of the ASEAN Interconnection Master Plan and to further harmonise the technical standards and operating procedures, as well as the regulatory and policy frameworks among the AMSs.

3.1.Infrastructure Development of the APG

In order to pursue the APG programme, HAPUA adopted a strategy that encourages the gradual development of the identified interconnection projects. First on cross-border bilateral terms, then gradually expanding to a sub-regional basis and finally to a totally integrated South-east Asian power grid system. The APG had five interconnection systems in operation by the end of 2012 (Table 3).

Table 3: Existing Linkages under APG

No.	Interconnection systems	Capacity (MW)
1.	Thailand–Peninsular Malaysia	
	*Sado–Bukit Keri	80
	*Khlong Ngae–Gurun	300
2.	Thailand–Lao PDR	
	*Roi Et 2–Nam Theun 2	920
	*Udon Thani 3–Nabong	597
	*Ubon Ratchathani 2–Houay Ho	126
	*Sakon Nakhon 2–Theun Hinboun	210
3.	Singapore–Peninsular Malaysia	2 x 200
4.	Cambodia–Vietnam	135
5.	Thailand–Cambodia (115kV)	80

Source: Hermawanto (2011) and updated to October 2012.

HAPUA is pursuing the realisation of the remaining 11 interconnection systems in light of the accelerated AEC by 2015. At the 8th APG Consultative Council (APGCC) Meeting in June 2011, the Commercial Operation Date (COD) was revised and the

revised schedule showed only four interconnection lines which will be in operation by 2015 (Table 4).

Table 4: APG Schedule as Revised in 2011

No.	Interconnection	Revised earliest COD
1)	Peninsular Malaysia–Singapore (new)	2018
2)	Thailand–Peninsular Malaysia	
	*Kolok–Rantau Panjang	Newly proposed
	*Khlong Ngae–Gurun (additional)	2016
3)	Sarawak–Peninsular Malaysia	2015–2021
4)	Peninsular Malaysia–Sumatra	2017
5)	Batam–Singapore	2015–2017
6)	Sarawak–West Kalimantan	2015
7)	Philippines–Sabah	2020
8)	Sarawak–Sabah–Brunei	
	*Sarawak–Sabah	2020
	*Sabah–Brunei	Dropped
	*Sarawak–Brunei	2012–2016
9)	Thailand–Lao PDR	
	*Sakon Nakhon 2–Thakhek–Then Hinboun (exp.)	2012
	*Mae Moh 3–Nan–Hong Sa	2015
	*Udon Thani 3–Nabong (converted to 500kV)	2017
	*Ubon Ratchathani 3–Pakse–Xe Pian Xe Namnoy	2018
	*Khon Kaen 4–Loei 2–Xayaburi	2019
	*Thailand–Lao PDR (new)	2015–2023
10)	Lao PDR–Vietnam	2011–2016
11)	Thailand–Myanmar	2016–2025
12)	Vietnam–Cambodia (new)	2017
13)	Lao PDR–Cambodia	2013–2014
14)	Thailand–Cambodia (new)	2015–2017
15)	East Sabah–East Kalimantan	Newly proposed
16)	Singapore–Sumatra	2020

Source: Hermawanto (2011)

3.2. Energy Cooperation on the APG

In addition to constructing the infrastructure, ASEAN cooperation on the APG involves institutional components such as a regulatory framework and the harmonisation of regulations. This is necessary to promote regional energy security and development, including the regional power interconnection. However, there are many institutional barriers in moving towards the APG. These barriers include: licensing

requirements, the expropriation of assets, and contractual confidentiality, if justified; consumer protection and safety standards, including grid codes; anti-competitive practices; third party access;[3] investment recovery; and information access (Mulqueeny, 2011).

In addressing those challenges and barriers, APAEC 2010–2015 specifies three strategies for the APG programme: (1) accelerate the AGP interconnection; (2) optimise the generation sector; and (3) encourage and optimise the use of resources. The regulatory framework for trade, investment, and cross-border transmission of AGP is one of the issues being assessed by the ASEAN Energy Regulatory Network (AERN). The major accomplishments on the institutions to date include the:

- adoption of the AIMS and the updated AIMS II, which serves as a reference guide for the implementation of the ASEAN interconnection projects;
- restructuring of HAPUA to streamline operations and the establishment of a permanent HAPUA Secretariat, which rotates every three years;
- signing of a Memorandum of Understanding on the ASEAN Power Grid (MOU on the APG)[4] to serve as a reference document for the coordination and facilitation of programmes to implement the APG; and
- establishment of the APGCC to oversee the overall development and implementation of APG projects.

The Terms of Reference (TOR) for the studies that will be conducted by the HAPUA Working Groups (WGs) to investigate the barriers related to interconnection, cross-border trade and investment, was endorsed by the APGCC and has been submitted to the ASEAN Secretariat to examine for possible funding sources.

HAPUA conducted two harmonisation studies, Technical Standard Codes and Guidelines and Legal and Regulatory Framework, to investigate the barriers to interconnection and cross-border trade and investment. The study on the harmonisation

of the legal and regulatory framework for bilateral and cross-border power interconnection and trade was completed by HAPUA WG-5 in April 2010 and the report was accepted in 29 June 2010. The APGCC decided to seek assistance to conduct a further study to develop a framework for the ASEAN electricity industry concerning legal and regulatory issues. HAPUA has also prepared a TOR to conduct a study on financing modalities for realising the APG. These studies are important for APG development and operation, since the outcome will provide a mechanism for harmonisation and financing modalities in order to accelerate the realisation of the APG for the establishment of the AEC.

To optimise the generation sector, vis-à-vis the available indigenous energy resources in the region (the second strategy), HAPUA will conduct optimisation studies on the most economic operations and a possible reserve-sharing scheme within the region. Further works need to be conducted by the HAPUA WG to optimise the regional power generation for supplying electricity through the APG.

As for the third strategy of the APG to "Encourage and optimize the utilisation of ASEAN resources, such as funding, expertise and products to develop the generation, transmission and distribution", there has been no activity at the time of this writing.

3.3. Assessment of the APG and related cooperation

Before assessment, it is worthwhile to point out that the plan for the APG in APAEC 2010–2015 is different from that in the AEC Blueprint. In the AEC Blueprint, the APG should be realised by 2015 with appropriate institutional and implementing arrangements as support (Table 5).

Table 5: Strategic Schedule of AGP in the AEC Blueprint

Strategic approach	Priority actions		
	2008–2009	2010–2013	2014–2015
ASEAN Power Grid	Ratify/accept MOU on ASEAN Power Grid (by December 2008) Review the 2003 AIMS (by December 2008) Adopt the revised AIMS as an updated reference document (by May 2009) Establish APGCC (by May 2008) Approve the TOR (by December 2008) Report the TOR to SOME/AMEM (by July 2009) Establish ask-groups for relevant studies (by May 2009) Implement interconnection projects and report progress to HAPUA Council and SOME/AMEM (2008–2015)	Not specified	Adopt key findings and recommendations of the study and submit to SOME/AMEM (by 2014) Firm up the institutional and implementing arrangements to realise the APG (starting 2015)

Source: ASEAN Secretariat (2009).

However, in the actual action plans, many interconnection projects are scheduled to be completed after 2015 (Table 4). One reason that the plans for the APG lag behind the AEC's target of realising it by 2015 is that many APG projects currently lack economic viability. However, some interconnection systems are more realistic than others because their sources of funding are articulated in major initiatives. In the case of the Sarawak–West Kalimantan interconnection and the Malaka (Peninsular Malaysia)–Pekanbaru (Indonesia) interconnection, the funding will be provided by the ASEAN Infrastructure Fund, since both of these projects are under the Master Plan on ASEAN Connectivity (MPAC). The Sarawak–West Kalimantan interconnection has a term sheet for the Power Exchange Agreement (PEA) between Sarawak Energy Berhad (SEB) and PT PLN PERSERO (PLN). It was signed on 19 July 2011. The Nukhon 2–Thakhek–Then Hinbouh (exp.) and the Mae Moh 3–Nan Hong Sa interconnections within the Thailand–Laos interconnection system will be funded by the ADB as part of the GMS development plan.

It should also be noted that there is no clear vision about whether the APG should be an integrated and harmonised ASEAN single grid, or a few heterogeneous national grids that are linked by an ASEAN region-wide backbone power grid. Essentially, it is likely to be just a few interconnected ASEAN national power grids, which offer bilateral exchange of electricity and emergency backup. Therefore, this paper will evaluate the APG against the connection plans as identified by AIMS II, rather than an ideal vision of a single APG.

The development in terms of the integration of physical infrastructure are proceeding slowly, even against the targets set by the sectoral body such as HAPUA through AIMS II. These developments have been going well, but at the time of this writing it was less than half complete, with only 5 out of the 16 systems in operation. The additional interconnection systems to be in operation by 2015, as per the latest COD, will be around three to four systems. The remaining systems are scheduled to be completed after 2015. With these concerns, we believe that 40% of the plan on APG infrastructure has been achieved.

Overall, the soft infrastructure of cooperation in terms of institutional arrangements needs to be pursued more actively than the infrastructure developments. The institutional infrastructure is seriously lagging behind the targets and the progress is slower than that of the physical infrastructure. The APGCC is the body that oversees the overall development and implementation of APG projects. It has been considered that the APGCC is already in operation and fully functioning. However, institutional support such as the removal of barriers to interconnection; cross-border trade and investment; the harmonisation of legal, regulatory, and technical standards are only in the preparation phase for study (TOR preparation). The actual implementation of the

many activities proposed under the APGCC depends on funding. Even when the studies have been concluded, the actual activities have to be initiated later to apply the harmonisation. With regards to the studies that investigate the barriers to interconnection, cross-border trade and investment by the eight HAPUA WGs, the assessments are as follows: activities enacted in this strategy include identifying the available expertise to assist APGCC to expedite the implementation of the APG. Overall, the first strategy has a score of 1.75.

For the optimisation study to identify the least costly options for generating electricity, the AIMS II did not study the least cost options. Instead, it asked each country to submit their future plans, which may be optimised in some countries, but not at the regional level. There were also two fuel supply policy workshops organised by Thailand, which is working towards an optimal use of sources for generating electricity in the next step. Although it is not a pure optimisation study *per se*, the outcome can provide some guidelines on how to optimise the resources. Thus, they can be considered as a form of progress towards the implementation of the optimisation study and thus a 1.7 score was obtained. Not surprisingly, the score for the third strategy is zero, since there have been no activities to date. Detailed information on the scores of the project / activities and the weights are presented in the appendix.

The overall assessment of the strategies to accelerate the development of the APG showed that a considerable amount of work still needs to be done on both the physical and institutional aspects and more on the latter because it has lagged behind schedule.

For the future, development of the physical infrastructure should be continuously moving forward. Member countries must put a priority on developing the infrastructure under their jurisdictions with bilateral or even multilateral approaches. Developing the

infrastructure requires available funding. Thus, it needs private sector participation and non-ASEAN countries' cooperation and some mechanisms, such as BOT (build-operate-transfer) and PPP (public private partnership) are needed.

Since 'behind-the-border' reforms (i.e., reforms within a country rather than between countries) have been a primary barrier for achieving a functional APG, it is necessary to put behind-the-border institutional changes at the top of the agenda. The harmonisation of technical specifications for the APG to internationally recognised standards is needed. This includes design and construction standards, system operations and maintenance codes, guidelines, safety and environment, and measurement standards.

The coordination of policy in promoting potential interconnection projects among the related member economies will be important for tackling the barriers or difficulties that hinder the achievement of the APG. The APGCC needs to push members' commitments in the MOU of APG. In this regard, the APGCC's role should be very strong in the development of the APG and its role has to be strengthened.

4. Status and Assessment of the TAGP

The TAGP is the other flagship programme referred to in the AEC Blueprint. The proposed TAGP aims to connect various gas fields in the region such as in the Andaman Sea, the Gulf of Thailand, and the South China Sea to ensure the reliability of gas supply for AMSs and to encourage the use of environmentally friendly fuel. The germination of the TAGP goes back as far as 1994 when ASEAN commissioned a regional study on the master plan for natural gas development and utilisation

(AEEMTRC, 1996). The study showed that the trade in gas by pipeline could bring high returns on investment and recommended a trans-ASEAN gas transmission network of 8,000 to 10,000 kilometres be constructed from 2000 to 2020. Once realised, the TAGP would have the potential of linking almost 80% of ASEAN region's total gas reserves and the distribution of gas made possible through the TAGP would reduce the region's dependence on crude oil (Zhao and Yang, 2012). In July 1999, the Senior Officials' Meeting on Energy and the 17th ASEAN Energy Ministers' Meeting (EMM) approved a plan of action to establish the TAGP and to incorporate it as part of the APAEC 1999–2004.

Work on the TAGP project is spearheaded by ASCOPE. In October 2000, ASCOPE finalised the TAGP Masterplan, which serves as the blueprint in undertaking the gas pipeline projects in the region. Initially, the TAGP Masterplan identified seven interconnections that if constructed, would achieve full integration. These seven elements did not include any of the existing connections and ones still under progress. Later, those existing connections were included in the updated 2008 TAGP Masterplan, along with the other connections, bringing the total number of connections under the TAGP to 16.

The TAGP Masterplan puts forward the view that TAGP realisation is premised on an evolutionary process of integrating the national gas pipeline infrastructure projects among AMSs. The TAGP would gradually build up and then link each ASEAN country's gas pipeline. Thus, the cross-border gas pipelines, mostly implemented as bilateral arrangements, would evolve to become an integrated regional TAGP.

4.1. Infrastructure of the TAGP

At the time of this writing, there were 11 bilateral gas pipeline interconnections in operation. The Indonesian gas piped to Singapore in 2001 marked the first achievement of the TAGP Masterplan. In 2001, after the Masterplan was finalised, there were already five bilateral gas pipelines in operation totalling 1,575km in length. By 2012, the TAGP infrastructure had almost doubled to 3,020km as a result of the development of six new cross-border gas pipeline interconnections. The 12th pipeline connection, a 150km new pipeline connection from Myanmar to Thailand, will be in operation in 2013 (ASCOPE, 2012).

The TAGP implementation will be complete once the East Natuna development and Indonesia's gas pipeline development are finalised. In the updated TAGP Masterplan, four pipeline connections will be constructed after the field is producing. These are:

- East Natuna, Indonesia – JDA – Erawan, Thailand (~ 1,500km)
- East Natuna, Indonesia – Kerteh, Malaysia (~600km)
- East Natuna, Indonesia – Java, Indonesia (~1,400km)
- East Natuna, Indonesia – Vietnam (~900km)

The COD of the four pipelines will be approximately seven years from the East Natuna gas supply sanction. The approximate volume to make each pipeline viable is 1 billion cubic feet (BCF)/day (i.e. 36"- 42"diameter of pipeline).

There was a fifth link connecting East Natuna with the Philippines (East Natuna–Indonesia–Brunei Darussalam–Sabah–Malaysia–Palawan), but this was deferred in view of the commercial viability and other economic considerations in establishing the interconnection for the Philippines leg. It was also in the plan to link the East Natuna

gas field with the West Natuna field, which has pipeline connections in operation to Singapore and the Duyong gas field of Malaysia.

The East Natuna gas field is important for the TAGP because 4 of the 16 TAGP major links are those from East Natuna and its reserves amount to over 40 trillion cubic feet (TCF). There have been delays in the development of the East Natuna gas field due to the fact that the resources are too expensive to exploit, because of a high CO_2 content. At the time of this writing, the Indonesian Government was in discussions with the East Natuna Consortium consisting of Pertamina, Exxon Mobil Corp., and Total E&P Indonesia about the development plan and required incentives. It is expected that the East Natuna field will start producing in 2020. However, ASCOPE finds that even if the East Natuna field can be put into operation, the gaps between demand and indigenous supply in ASEAN are still large and becoming larger, due to the increasingly rapid depletion of indigenous reserves.[5]

With this consideration, in the updated 2008 TAGP Masterplan LNG was included as a supply alternative to gas pipelines. Many countries have initiated the construction of LNG regasification terminals to bring gas from outside the ASEAN region. LNG terminals are operational in Indonesia and Thailand. Indonesia is also considering the option of building LNG regasification terminals in East and West Jawa to tap the gas from Papua and Sonoro or for imports. Construction of LNG receiving terminals has been progressing well in Singapore, Malaysia, and Vietnam. The Singapore LNG terminal is expected to be operational by 2013 at 6 mtpa. Similarly, Thailand is increasing its capacity of LNG terminals and Vietnam will also build an LNG terminal to diversify its gas supply sources.

4.2. Energy Cooperation on the TAGP

The existing infrastructure for gas distribution across Asia is not yet sufficient to achieve the TAGP targets. There are many barriers and challenges that must be overcome in order for the TAGP to be realised. Such as a national legal framework on natural gas transmission and distribution, which is still being worked out in most AMSs. Another issue is legislation concerning energy and the environment, which differs greatly between the AMSs. The legal protection of investor funding is not clear in some AMSs and thus there is a reluctance from the private sector to invest and a deregulated market has not yet been created in most AMSs. There are also insufficient mechanisms in place to handle disputes relating to gas pipeline / LNG utilisation in most AMSs. Other key differences include the design of pipelines and gas quality specifications, which differ among countries, the gas swapping mechanism is still unfamiliar in most AMSs, and the market environment varies according to whether the countries are primarily operating a buyer's market or supplier's market.

A number of institutional issues such as the open access system, harmonisation of gas quality specifications, gas transit principles (transport of gas involving three or more countries), gas swapping mechanism, safety, government support, and business models need to be ready when the time comes to transport gas in the most economical and efficient manner. The Updated TAGP Conceptual Master Plan, finalised in December 2008, covers those institutional issues, as well as dispute resolution mechanisms, the structure of the gas industry in an 'open access' environment (where gas can be transported by multiple traders and marketers), and ASEAN gas outlook to 2030. Drafts of these transit principles, gas quality specification, pipeline emergency repair

mechanism, etc., are being reviewed by the ASCOPE and the ASEAN Gas Consultative Council (AGCC). Finalisation is targeted for 2015.

There are four strategies in the TAGP programme: (1) collectively implement MOU on TAGP; (2) leverage on the existing infrastructure interconnections; (3) cooperation with HAPUA; and (4) ASCOPE gas sent to implement work programmes. Each strategy is supported by one or more action plans, each of which is further supported by a number of projects / activities.

The projects / activities to be implemented for the period 2010–2015 and their status are as follows: ASCOPE members formed a task force to assess the progress of the TAGP project and set a new strategic direction to move forward. The first meeting was held in March 2011. At the 30th AMEM in Cambodia, the energy ministers welcomed ASCOPE's new strategic directions which will be implemented through: (a) bilateral connections; (b) LNG cooperation with a focus on destination flexibility; (c) harmonisation of LNG specifications; (d) ship-shore compatibility; (e) promotion of regional technical support; and (f) studies on establishing proactive strategic gas supply buffer management to ensure supply availability during gas shortage.

Although ASCOPE members agree to prioritise gas swapping for the benefit of the ASEAN region, for the time being the ASCOPE Task Force will focus on LNG cargo diversion, which is part of the new strategic direction to ensure energy security in the region. On trade and marketing, ASCOPE trade and marketing business group recently established the LNG Task Force to study LNG business among AMSs, among others.

Implementation of the TAGP is based on the signed MOU[6], which expired on 2 July 2012. At the 29th AMEM, held on 18–19 September 2011 in Brunei, the energy ministers approved the extension of the TAGP MOU for another term (10 years).[7]

The AGCC is in the process of resolving the legal and regulatory framework for cross-border gas pipeline transportation and LNG terminals. The AGCC is still seeking opinions from members on the gas transit principles and its comparison with the ASEAN Framework Agreement on Goods in Transit. On the advantages and disadvantages of the gas swapping mechanism, Pertamina shared inter-company gas swapping practices in Indonesia. The IEA agreed that experts from their networks would come to ASEAN to do presentations.

Cooperation on technical and safety issues relating to the gas pipelines, such as establishing a web-based system for the sharing of emergency pipeline repair equipment and research to find better ways to protect pipelines from corrosion, was conducted by the AGC (ASCOPE Gas Center). The AGC will also work on the common technical standards for construction and the operation and maintenance of ASEAN gas pipeline projects. The activities of the centre, however, have been suspended while awaiting the resolution on the next ASCOPE member country to host the centre.

4.3. Assessment of the TAGP and Its Cooperation

Similar to the case of APG, the progress schedule for TAGP is divided between the AEC Blueprint and APAEC 2010–2015. The AEC Blueprint emphasises the realisation of the TAGP by 2015 through two actions, accelerate implementation of the TAGP and promote greater involvement of private sectors in TAGP. The priority actions for the different periods to 2015 are shown in Table 6 below. However, the target stated by ASCOPE was to have the TAGP backbone in place by 2015, via commercial bilateral connections within AMSs. Beyond 2015, the ASCOPE TAGP task force will continue

its current work on the required framework where the entire network could be optimised for gas trading beyond bilateral interconnections.

Table 6: Strategic Schedule for AEC: TAGP

Strategic Approach	Priority Actions			
	2008–2009	2010–2011	2012–2013	2014–2015
Trans-ASEAN Gas Pipeline	Adopt the Updated TAGP Conceptual Master Plan Adopt legal and regulatory framework for cross-border gas pipeline transportation	Formation of model ASEAN Joint Venture (JV) Gas Pipeline Company Adopt common technical standards for construction, operation and maintenance of ASEAN gas pipeline projects	Adopt business model for ASEAN gas pipeline ownership and operation Develop and implement regional safety and security plan for TAGP pipelines and facilities	Optimize Trans-ASEAN Gas Pipeline

Source: ASEAN Secretariat (2009).

Although only 3,300km of TAGP pipeline connections will be in operation by 2015, these existing pipelines have already formed the TAGP backbone in the eastern part of ASEAN. The ASCOPE has already put in place 11 bilateral pipeline connections that form the mainstay of the TAGP. These connections were developed purely on a commercial basis. It is already possible to transmit gas from Myanmar to Vietnam or even to Indonesia. It is also possible for Singapore to export gas from its LNG imports to Thailand through the existing pipeline connection. For this reason, the infrastructure development of the TAGP gets a score of 2.8 out of 5. The strategies on the gas transit

principles and swapping mechanisms also score relatively well at 2.0. However, the other two strategies are progressing slowly and achieve scores of less than 0.6.

The bilateral pipeline interconnections have yet to be optimised for the benefit of the region. In addition, those LNG receiving / regasification terminals, which are planned, imply that the vision of TAGP must be changed. With the emerging role of LNG and the increasing need of gas imports, the optimisation of the TAGP will be inevitable.

Physical pipelines are the key components of TAGP but interconnections between LNG terminals are also important. Such interconnections do not necessarily need to be physical (permanent), since they can be achieved through altering the destinations of an LNG tank. In addition, strategic buffer management should be a part of the new vision. The TAGP MOU is broad enough to include the LNG cooperation and strategic buffer management. However, implementation of such a change needs to be approved by the Senior Officials Meeting of Energy and ASEAN Energy Ministers Meeting.

The overall assessment of the strategies to accelerate the development of the TAGP has shown that the physical part is more advanced than the institutional part, as in the case of APG. Therefore, the main concern must be to speed up the adoption of principles, mechanisms, and the harmonisation of the institutional, regulatory, technical, commercial, and safety issues in cross-border trade of natural gas.

To address these challenges, clear and transparent national regulatory frameworks for natural gas transmission, investment, market access, etc., should be established. AMSs' capacity for formulating regulatory frameworks for the gas swapping mechanism needs to be enhanced. Private sector participation is necessary and this can be achieved through the JVC pipeline model developed by ASCOPE. Further work is

also needed to enhance ASCOPE exploration and production activities in exploring not only conventional natural gas resources but also non-conventional including CBM (Coal Bed Methane) resources, which are abundant in Indonesia and Vietnam.

4.4. Other Cooperation under ASCOPE

One form of energy cooperation that has not been discussed or included in the APAEC 2010–2015, is the cooperation for oil supply security. For this, ASEAN has had in place the APSA (ASEAN Petroleum Security Agreement) since 1986, which was updated in 2008 to include its Annex CERM (Coordinated Emergency Response Measures). The APSA is a mechanism for responding to an emergency situation, either individually or collectively, and to minimise the exposure to an emergency situation. The CERM is a mechanism that has been designed to facilitate the activation/deactivation of emergency measures to assist the AMS in distress and foster closer cooperation among the AMSs and the oil and gas industry. The revised APSA, including CERM, was signed on 1 March 2009. Currently, the APSA and its Annex CERM have been ratified by all 10 AMSs, with Indonesia the latest in January 2013.

At the 30th AMEM, the energy ministers endorsed the ASCOPE initiative to establish the Task Force on APSA/CERM Operationalisation with the task to propose the necessary procedures, guidelines and plan of action, and required infrastructure for the operationalisation of the CERM mechanism under the APSA.

ASEAN and ASCOPE have been working closely with the IEA on a capacity building programme to increase the awareness and capability of staff for the emergency response programme.

5. Status and Assessment of the Other Areas of Energy Cooperation

As mentioned previously, this assessment also covers five other programmes under the APAEC 2010–2015, which are implicitly mentioned in the AEC Blueprint. They are; coal and clean coal technology, energy efficiency and conservation, renewable energy, regional energy policy and planning, and civilian nuclear energy.

5.1. Coal and Clean Coal Technology (Coal & CCT) programme

As specified in the AEC Blueprint, the establishment of the AEC will be sustainable through the mitigating of GHG emissions by means of effective policies and measures, thus contributing to global climate change abatement. The increasing use of coal, in particular low rank coal, which is abundant in the region, has a serious influence on the environment. Thus, it is a relevant issue for the achievement of the AEC Blueprint. The increasing use of coal and the increasing concern of its impact on the environment presents ASEAN with an opportunity to promote and increase cleaner coal use and trade, which could bring in mutual economic benefits towards regional energy security. Therefore, a collective action is required for strengthening the cooperation in coal and clean coal technology.

The objective of programme number 3 on Coal & CCT in the APAEC 2010–2015 is to promote the development and use of clean coal technologies (CCTs) and to facilitate intra-ASEAN coal trade for enhancing regional energy security, as well as to promote cooperation and sustainable development and utilisation of coal while addressing environmental issues. The activities for the Coal & CCT programme

pursued include data collection, resource analysis, trading and studies on CCT, cover upgrading brown coal, integrated coal gasification, and CCS (carbon capture storage).

5.1.1. Status of the Coal & CCT Programme

There are four strategies in the programme: (1) strengthening the institutional and policy framework; (2) the promotion of CCTs; (3) promoting intra-ASEAN coal trade and investment; and (4) enhancing environmental planning and assessment for coal projects. The relevant activities for this transformation to AEC was drafting the ASEAN Agreement on Coal Use and Trading, developing guidelines for facilitating bilateral negotiations to procure coal supply, and establishing the AFOC (ASEAN Forum of Coal) Coal Price Index. These activities, however, are still in the early stages with the drafting of the concept paper and TOR. AFOC aims to have these planned activities ready by 2015.

To promote private sector investment, the AFOC will organise Coal Business Forums where the private sector will be presented with business opportunities. These Coal Business Forums have the objective of creating a bond between industries and the AMSs, while the promotion of clean coal technology will rely on cooperation between the state, private developers, and media to educate and promote the advantages of present generation coal power plants. The AFOC will conduct feasibility studies, compile the feasibility studies of AMSs, and make them available to prospective investors. In October 2012, AFOC organised a workshop on Clean Coal Technology at the Coal Center in Palimanan, Cirebon, Indonesia.

In regards to providing information for investors, the AFOC will conduct regional analysis on coal policy, plans and programmes of the AMSs, and present the findings in

AFOC annual meetings. The AFOC has developed the ASEAN Coal Database and Information System (ACDIS), which was launched in Jakarta, Indonesia in July 2012.

For Coal & CCT, as with EEC and RE programmes, a Board of Judges (BOJ) will be established for the Clean Coal Competition under the ASEAN Energy Awards. This will encourage the use of CCT in power generation and industry of AMSs. The BOJ meeting was conducted and competition guidelines are still in the preparation stage.

Harmonising instruments to enhance the coal supply and to facilitate delivery arrangements, harmonising emission standards and minimum efficiency requirements for coal-fired power plants, and coal quality testing are viewed as necessary for setting up the effective and efficient use of coal in the region. The AFOC coordinators prepared discussion papers in several areas such as encouraging private sector participation, harmonising emission standards, establishing minimum efficiency requirements for coal-fired power, and the ASEAN agreement on coal use and trading.

The work on CCT will be pursued with the cooperation of JCOAL from Japan.[8] Work is in progress for brown coal upgrading and coal gasification. Future work includes looking at coal liquefaction, coal water mixture, etc. Indonesia has constructed a Clean Coal Centre in Cirebon, west Jawa. Such a centre can become a regional centre for the testing of pilot projects and can expedite the development and use of clean coal in the region.

5.1.2. Assessment of the Coal & CCT Programme

The overall assessment of the strategies for the Coal & CCT is that progress is still in the early stages. Several TORs have been prepared and discussed by the AFOC and will be implemented as the AMSs provides input and as financial support is made available. However, the AFOC's proposal on activities has undergone review and

discussion at the annual meeting of the AFOC Council. Further action still needs to be undertaken to realise the objectives of these papers. The realisation needs some mechanism to provide the technical, financial, and expert assistance.

For this programme, the overall progress is assessed at about one fifth, which is relatively low due to the level of progress throughout 2010–2012. Among their strategies, the promotion of Coal & CCT has been the most advanced, while the promotion of intra-ASEAN coal trade and investment has not begun. This could be explained by the economics of externalities, which predicts that those policies that can generate significant nation-wide benefits are easier to advance than those that can generate only regional benefits.

5.2. Energy Efficiency and Conservation (EEC) Programme

Although the energy component of the AEC Blueprint 2015 does not specifically cover EEC, the EEC is closely related to the AEC. However, the AEC Blueprint does iterate that a secure and reliable supply of energy is crucial to support and sustain economic and industrial activities, while promoting cooperation in EEC can ensure regional energy security and sustainability.

Recognising the importance of EEC for meeting growing energy needs with a lower environmental impact, ASEAN governments agreed to further intensify cooperation on EEC to enhance the mitigation of GHG emissions. The objective of the EEC programme is to strengthen cooperation in energy efficiency and conservation through institutional capacity building and increasing private sector involvement, including enhancing public awareness, as well as expanding the markets for energy efficient products.

5.2.1. Current status of the EEC programme

Collaboration in promoting EEC in the region has significantly progressed since the declaration of ASEAN Vision 2020 in 1997 and since the last decade, much progress has been achieved. For example, EEC regulations are in place and operational in most AMSs. Standards and labelling are being promoted for appliances (CFL, AC, TV, etc.) and industries have improved their processing system. Buildings are also being constructed using the "green" concept. Malaysia Energy Commission's office building in Putra Jaya is the first building to be awarded the Malaysian Green Building Index (GBI) Platinum award and the Singapore Building & Construction Authority (BCA) Green Mark for Buildings (Overseas) Platinum award.

The EEC-SSN (Subsector Network) has set a regional target in the APAEC 2010–2015 to reduce energy intensity by 8% by 2015, based on the 2005 level. This is an important step in the transformation of ASEAN towards a green growth path, as emphasised in the AEC Blueprint. The data for 2010 indicated that the regional energy intensity reduction had reached almost 5% from its 2005 level by the beginning of the APAEC 2010–2015.

However, at the 30th AMEM in Cambodia, the ministers encouraged the EEC-SSN to expedite work on establishing a long-term target for ASEAN Energy Intensity (EI) improvement beyond the current 8% reduction from 2005 levels by 2015, in order to help transform ASEAN towards a low-carbon and smart-energy region. The ministers requested that the EEC-SSN submit their recommendation to the next AMEM for adoption.

ASEAN will develop a clear policy and a plan to promote energy efficiency in the region. Eight of the AMSs have already set targets for their EEC and the energy

intensity data of these countries will be compiled annually from 2010 to 2015. In addition, the EEC-SSN started to compile EEC policy and measures of the AMSs through workshops and seminars. These measures will be further assessed to create a possible regional policy and plans for the promotion of EEC in ASEAN. ASEAN will continue to promote EEC and enhance the regional capacity on EEC through the Promotion of Energy Efficiency and Conservation (PROMEEC) and the ASEAN-Japan Multi Country Training Program on EC (MTPEC).

The ASEAN Energy Manager Accreditation Scheme (AEMAS),[9] which aims to reduce energy consumption from the manufacturing industry and to cut GHG emissions in AMSs, was established in 2010. This programme, as well as the PROMEEC, is expected to facilitate the development of regulation and provide incentives to encourage good energy management practices in facilities. This will promote good energy management practices, especially for the industrial and commercial sectors. Under the PROMEEC programme, the EEC-SSN conducted audits of buildings, industries, and visited factories to introduce the Energy Management (EM) Handbook. The PROMEEC also included seminars and workshops for the AMSs.

The AEMAS will train and certify energy managers who will then implement sustainable energy management systems within their industries / companies. By the end of 2012, the following progress had been made. AEMAS National Councils have been established in Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. AEMAS tools have been further improved and country experts have been trained. There are also 779 Certified Energy Managers and six certified energy end users. Promotional materials and webpages have been set up and the AEMAS has secured

product positioning with ISO50001. The EEC-SSN has compiled regulations and incentives of the AMSs from the country reports submitted at the annual meeting.

In addressing the issue on the financing mechanism, the EEC-SSN prepared a discussion paper for developing a mechanism to enhance the financing of EEC projects in the AMSs. This paper was discussed at the15th EEC-SSN Meeting on 25 May 2011 in Singapore and the EEC-SSN will begin conducting activities on funding availability. Another concept paper that is being drafted is about how to increase the involvement of the banking and financial sector in EEC. The financing mechanism is crucial for promoting further EEC in the AMSs. Currently, commercial banks in most countries are still applying a similar scheme for EEC projects as they would for a loan to buy a house or car.

ASEAN will continue the annual ASEAN Energy Awards for the Energy Efficient Buildings and Energy Management category. These awards will demonstrate the best energy practices and successful cases through public-private partnerships and sector collaboration on EEC.

The EEC-SSN also conducted EEC Promotional Campaigns/Programmes of AMS to disseminate information using all appropriate media, including energy labels, to help energy consumers make the right decision. The promotional campaigns and programmes are conducted annually and the summary of the campaign are drafted and discussed at the annual EEC-SSN meetings for finalisation.

Related to the promotion of high-performance energy efficiency technologies and practices, the EEC-SSN formulated a strategic framework for the harmonisation of Standards for Household Appliances in ASEAN, with air conditioners being selected as

the first product for harmonisation. The specific objectives were to harmonise standards for testing methods, EE standards, and develop a roadmap for MEPS and HEPS.

5.2.2. Assessment of the EEC Programme

Assessment of the strategies for the EEC under the APAEC 2010–2015 has indicated that the EEC programme is progressing according to plan. Most of the activities and projects defined for the period 2010–2012, have been implemented. Such as: monitoring of energy intensity of AMSs; PROMEEC for major industries, buildings, and energy management; MTPEC; ASEAN Energy Award for energy efficient buildings and energy management; AEMAS; EEC promotional campaigns and programmes of AMSs; developing a mechanism to enhance financing for EEC projects; and developing a concept paper to increase the involvement of the banking and financial sector in EEC.

Programmes of the EEC-SSN such as the PROMEEC (with the support of METI Japan through the EE Centre of Japan) AEMAS (with support from the EU), and ASEAN Energy Awards for Energy Building and Management, will be continued on a yearly basis. These types of programmes will strengthen cooperation in EEC through institutional capacity building and increasing private sector involvement, including enhancing public awareness. We expect the EEC programme will be able to meet its objectives by 2015.

5.3. Renewable Energy (RE) Programme

The AEC Blueprint emphasises that the development of the AEC must be sustainable and contribute to global climate change abatement. Effective policies and measures to mitigate GHG emissions include among others, the development and

utilisation of RE. The RE-SSN had taken this concern into consideration and is committed to continuing the developing of RE and its technologies in a sustainable manner. This is highlighted in the RE programme under the APAEC 2010–2015, as follows: Enhance the share of RE in regional installed capacity for power generation; Facilitate intra-ASEAN trade for RE and turn ASEAN into the hub for RE; Promote biofuels as a substitute fuel for the transportation sector; Promote enabling mechanisms or policy instruments to accelerate research, development and demonstration of RE; Promote RE for CDM in the light of climate change and mitigation; and Promote the development and synergy of research and development centres for RE in the region.

5.3.1. Status of the RE Programme

The RE-SSN actions will include the monitoring of the RE installed capacity bi-annually, promoting technical cooperation to complement efforts on RE targets of the AMSs, and promoting national RE programmes. The programme will ensure that market and feasibility studies are made available to investors, project developers, power utilities, and funding institutions.

For 2010–2015, the RE programme plans to institute and maintain sustainable development relating to the use of renewable energy and its technologies. One of the strategic goals is to achieve a collective target of 15% for regional renewable energy use out of the total installed power capacity by 2015. The RE-SSN is monitoring RE activities in the AMSs to achieve the 15% target. The RE-SSN, in cooperation with HAPUA WG 4 (Renewable Energy and Environment), is working on the assessment of the capability of ASEAN power utilities to achieve the 15% RE capacity in total installed capacity.

The RE-SSN also has the support of the German company GIZ through the Renewable Energy Support Programme for ASEAN (ASEAN-RESP). The ASEAN-RESP programme is indicative of Germany's continous support in promoting technical cooperation to complement efforts for achieving the ASEAN RE targets. A study and a workshop were conducted entitled Innovative Rural Electrification Approaches in ASEAN to encourage the development and utilisation of RE for rural electrification.

Through the previous ASEAN-Germany Mini Hydro Project (AGMHP) which started in 2007 and ended in January 2011, the AMSs had enhanced their capacity to develop and utilise mini-hydro projects, built up a network to provide information and advice on mini-hydro, published a report on policy and regulations for off-grid electrification, and enhanced private sector participation. In fact, Germany's success in supporting Indonesia with mini hydro development through the MHP project had initiated this expansion in the region through the AGMHP.

The ASEAN-RESP has also supported RE-SSN activities for the promotion of the renewable energy financing scheme. The RE-SSN prepared a concept paper on the 'Framework for Promoting Innovative Financing Instruments or Mechanism to Support and Enhance RE Projects Implementation' and a concept paper to 'Encourage Involvement of the Banking Sector and Financial Institutions in RE Projects'. Related to these papers, the ASEAN-RESP conducted the activity 'Support Mechanisms for Bankable Project' that conducted a survey in selected ASEAN countries, a regional stakeholder workshop and formulating policy guidelines.

To promote intra-ASEAN cooperation on ASEAN made products and services, the AEC has taken the initiative to compile the existing RE specifications and standards of AMSs, which will be published in its website. For the APAEC 2010–2015, the RE-

SSN prepared a concept paper to conduct a survey on the existing international RE technical standards and the harmonisation of these standards. The ASEAN-RESP supported this activity by conducting a regional stakeholder workshop and by facilitating its continuation as a regional expert network.

With regard to the development of the ASEAN RE Centre, initially the RE-SSN prepared several concept papers relating to specific components of the centre. Later, the RE-SSN agreed to combine all the concept papers into one proposal, namely the ASEAN RE Centre development proposal. The revised proposal is being finalised by the RE-SSN.

Related to hydropower, the ASEAN-RESP set up the ASEAN Hydropower Competence Centre (HYCOM) and promoted its services through its regional and international networks. The training and expertise provided by the HYCOM will serve as a role model and will form part of the capacity building measures of the ASEAN-RESP.

The RE-SSN programme to enhance awareness and information sharing and strengthening networks is conducting annual ASEAN Energy Awards for RE projects. The RE-SSN also intends to establish an ASEAN RE association, which would conduct RE forums on a regular basis. The concept paper has been distributed to the members and is now in the finalisation stage.

Another initiative of the RE-SSN is promoting CDM. In this regard, ASEAN and the three other countries (China, Japan and Korea) have already identified 15 CDM projects in Indonesia, Malaysia, Philippines, and Vietnam and conducted match-making process at the Green Business Forum in 2011. The RE-SSN will further explore the carbon market, the offset programme of credited Nationally Appropriate Mitigation

Action (NAMA), the provision of support programmes to AMSs in policy development, formulating a roadmap on CDM and GHG reduction, and the carbon market.

The gradual emergence of biofuels as one of the alternatives to reduce ASEAN's fossil fuel consumption requires the AMSs to foster closer cooperation in promoting biofuels produced in a sustainable manner. The RE-SSN will enhance the commercialisations of biofuels and develop harmonised specifications for biofuels, which are diversified among AMSs (Shi and Goto, 2013). They have prepared the concept paper, which is in the process of refinement. The AMSs also agreed to forge further regional cooperative partnership to promote solar, wind, geothermal, hydro, and biomass energy.

The RE-SSN will also focus on developing a proposal for a pilot project on ocean energy technology, but the concept paper is still in the preparation stage.

5.3.2. Assessment of the RE Programme

Considering that at the time of writing APAEC 2010–2015 had passed two and a half[10] years of implementation, the progress of RE development is impressive and the probability of its success in achieving the goals is very high. The target of at least 10% has already been achieved, banking sector and financial institutions have become more involved in RE projects than ever before, biofuels are being sold in pump stations, and local manufacturing capabilities for RE technologies have improved, particularly for small-scale hydro (mini or pico hydro). Thus the RE programmes of RE-SSN are in line with the AEC objective to attain a sustainable future through RE development.

The progress for a high percentage of RE use has been the top performer among the six strategies. In contrast, the cooperation on ASEAN-made products and services is at the bottom. This again supports the findings that a programme with notable national

benefits will be advanced faster than those that are for the good of the region, but the national interests are not so clear. In another way, this implies that the regional cooperation part of the programme has progressed relatively slowly.

There remain some constraints that affect the harmonisation of standards for RE products and the specifications for biofuels, such as the lack of test facilities in some countries and the different preferences of member governments on the contents of the standards. Nevertheless, collaboration with dialogue partners or through multilateral and international cooperation has increased significantly. In this aspect, the EAS-ERIA Biodiesel Fuel Standard made by ERIA is ready to be used for harmonisation purposes (Goto, *et al*., 2010; Shi and Goto, 2013).

5.4. Civilian Nuclear Energy (CNE) Programme

Although civilian nuclear energy (CNE) is relatively new in ASEAN, its contribution to improving regional energy security and sustainability in the long term will be significant. The AMSs' interest in exploiting nuclear energy has developed and become more explicit over the current decade. Some AMSs have considered the use of nuclear energy for power generation as a long-term option. Thus, several regional initiatives relating specifically to civilian nuclear safety and security have emerged. At the 12th ASEAN Summit, held in Cebu in January 2007, heads of government collectively highlighted the need to diversify ASEAN's energy supplies through developing alternative energy sources such as biofuels and civilian nuclear power. This has resulted in a significant boost to nuclear safety initiatives under ASEAN auspices.

The sensitive nature of nuclear technology would require regional cooperation to encompass its security, technological, economic, and environmental aspects.

Embracing nuclear technology in ASEAN may be instrumental in fostering closer ties among AMSs and in tying the entire region's future together. In this regard, the ASEAN Energy Ministers at the 25th AMEM, held in Singapore in August 2007, agreed in principle to establish an ASEAN SSN to explore nuclear energy as an alternative source of energy and stressed that this source should be sustainable, safe, and environmentally friendly. The Special Senior Officials Meeting on Energy (SOME) in 2009 tasked the ASEAN CNE-SSN to proceed with the drafting of the programme No. 7 of the APAEC 2010–2015, for which the activities are limited to capacity building and institutional arrangements for cooperation on CNE.

The objective of the programme is to cooperate on a voluntary and non-binding basis, share and exchange information and knowledge, provide technical assistance, and networking and training on nuclear energy for power generation. The programme area will facilitate the discussion for the sharing of information and provide assistance in the support of civilian nuclear power plants, including but not limited to the following regional approaches: Provision of public information on nuclear energy for power generation; Capacity building, including human resource development and training; Establish a regulatory framework, including a nuclear energy regulators network; Ensure that emergency preparedness and response plans are in place; and Encourage cooperation among nuclear energy agencies in ASEAN engaged in promotion, project development and R&D.

In delivering the above approaches, this programme area may draw from the expertise, cooperation, training assistance, and resources of relevant international and regional organisations, including ASEAN's Dialogue Partners. Cooperation shall be achieved gradually in accordance with the laws and regulations of the respective AMSs

and the relevant international agreements, cooperation, and standards within the framework of existing international and regional organisations. As well as the cooperation on nuclear energy, such as the International Atomic Energy Agency (IAEA), Asian Nuclear Safety Network (ANSN), and the Forum for Nuclear Cooperation in Asia (FNCA), among others.

5.4.1. Status of the CNE Programme

By the end of 2012, the CNE-SSN was well established. The SSN not only initiated dialogue between governments and the private sector at the 2011 ASEAN Energy Business Forum (AEBF 2011), but also finalised the proposal on 'Public Education on Nuclear Energy and Nuclear as the Clean Energy Alternative Option'. The SSN also completed the survey of country needs, which would serve as a useful reference for the CNE-SSN in enhancing the work programme with ASEAN's Dialogue Partners and international organisations.

5.4.2. Assessment of the CNE Programme

Assessment of the activities of CNE under the APAEC 2010–2015 indicated that the CNE-SSN started to enhance the capacity of technical workers and senior policy-makers in addressing nuclear safety, security, and non-proliferation issues through technical training, seminars, and workshops.

The CNE-SSN still needs to enhance further the capacity building activities and institutional arrangements for cooperation on nuclear energy as outlined in the APAEC 2010–2015 in order to create public awareness and promote public education on nuclear power plants and build a positive image of nuclear use in a comprehensive and concrete

manner toward regional energy security; and encourage the information sharing relating to civilian nuclear energy among ASEAN Member States in a systematic way.

It is expected that by 2015 the CNE-SSN will have strengthened the institutional, legal, and regulatory capacities on nuclear energy for power generation in compliance with IAEA standards of safety and security. The CNE-SSN will set up nuclear regulatory bodies and networks, formulate the ASEAN plan on nuclear energy, and enhance capacity to support regional efforts to implement the agreement on civilian nuclear energy. The CNE-SSN will continue collaborating with ASEAN's Dialogue Partners and relevant international and regional energy bodies and organisations in overseeing the development of systems to utilise civilian nuclear energy and nuclear energy.

5.5. Regional Energy Policy and Planning (REPP) Programme

In order to ensure a secure, affordable, reliable, and competitive supply of energy in ASEAN in the context of sustainable development, the AMSs need to formulate energy policies that will address the key areas of the energy chain, from the supply side to the demand side and its impact on environmental protection. The need to strengthen the AMSs' capability in energy policy and planning was emphasised in the 1986 'Agreement on ASEAN Energy Cooperation', which stipulated that the form of cooperation will be in three areas: the sharing of methodologies, techniques, skills, and experiences in national energy planning; conducting regional studies of energy as and when AMSs desire; and developing strategies to promote energy- related trade within the ASEAN region.

As new energy landscapes and challenges arise, ASEAN views the need for AMSs to move beyond independent energy policies and planning to an inter-dependent, inter-country, and outward-looking policy for greater economic integration and to narrow the development gap. The end goal is to enhance the individual national energy policies and planning activities, and to integrate them into a cohesive and effective regional energy policy with analysis and planning towards sustainable development. Under the APAEC 2010–2015, the REPP-SSN as the ASEAN body overseeing the implementation of the REPP Programme, has set the objective of the REPP programme as follows: "to enhance cooperation on regional energy policy analysis and planning towards sustainable development and to effectively manage the implementation of APAEC" (APAEC, 2010).

The Strategic Goals to meet this objective are: to effectively manage the implementation, monitoring, and evaluation of the progress of the APAEC programmes; to develop tools and instruments for monitoring the APAEC; to strengthen the collaborative efforts towards regional energy policy and planning for sustainable development; and to strengthen capacity building in formulating sound regional energy policies and to follow a coordinated course of action to meet the overall goal of the APAEC (APAEC, 2010).

For the period 2010–2015, the REPP programme highlights are to: conduct work on regional energy policy including ASEAN fuel policy, producing an energy outlook, and related review and analysis; study on rural electrification programme to improve energy accessibility; effectively manage the deliverables of APAEC; and provide directions and guidance on APAEC programmes including cross-sector issues.

5.5.1. Status of the REPP Programme

By the end of 2012, the achievements include the regular update of the ASEAN Energy Database through AMSs' submission of the 'Harmonised ASEAN-APEC Annual Energy Questionnaire', compilation of AMSs' policy reports annually, the construction of the REPP-infonet, the preparation of the annual ASEAN Energy Review (AER), and the ASEAN Energy Indicators (AEIs).

In regards to the rural electrification programme of the ASEAN region, a draft discussion paper was developed by Indonesia and discussed at the First ASEAN Rural Electrification Workshop in November 2011 in Bali, Indonesia. For the monitoring and evaluation of the APAEC programmes 2010–2015, the REPP-SSN developed the KPI and scorecard for all SSNs and specialised bodies and was approved by SOME/AMEM. SSNs and specialised bodies provided the updates of their KPI to AEC and the progress of these SSNs and specialised bodies have been reported annually to the SOME/AMEM.

Other activities to date include the conduct of regular training and annual workshops, such as the energy outlook and energy data workshop under the ESSPA programme and the ASEAN Fuel Policy Workshop. ASEAN has also conducted assessment of ASEAN needs through a questionnaire prepared to assess the needs of ASEAN as inputs for the following year's ESSPA programmes.

Preparation of regional energy outlooks was done through the workshops of the ESSPA Programme and the Third ASEAN Energy Demand Outlook was published in 2011. The fourth Outlook is in the process of preparation at the time of writing and is scheduled be published later in 2013, if financial resources are in place.

For the ASEAN energy policy reviews and analysis, only one activity has been implemented, which was "Facilitating energy trade and investment towards strengthening regional energy security and sustainability".

In order to strengthen the collaboration and dialogue with ASEAN partners and with national, regional, and global institutions the REPP-SSN has initiated several activities, one of which was to undertake a comprehensive stock-take of ASEAN energy cooperation to date and identify barriers and gaps. Two recommendations from the stock-take were endorsed by SOME: (a) promoting trade and investment in RE and EE products; and (b) promoting EE programmes for the residential sector.

Other activities include organising policy dialogues with global and regional institutions such as the EU-ASEAN dialogue and pursuing studies on evolving regional energy policy reform and issues with partners and institutions, such as the IEA on the ASEAN Energy Technology Roadmap. The AEC is collaborating with ERIA and the IEA to prepare an ASEAN chapter under the IEA World Energy Outlook 2013.

5.5.2. Assessment of the REPP programme

As with other energy cooperation programmes, the REPP progress has been impressive, even though at the time of writing it was still in its early stages considering that the APAEC 2010–2015 has not yet reached its mid-term.

One constraint foreseen would be on the KPI and scorecard used to evaluate and monitor the progress of the individual APAEC programme area. The current REPP-SSN KPI and scorecard were developed to oversee yearly progress. An activity was considered accomplished with a high score within the year if the activity was implemented. Each activity, however, is only one of the activities under the action plan of a specific strategy. Thus, some scoring weights need to be developed for each of the

activities, action plans, and strategies for each specific programme area in order to analyse the overall progress at the end of the first year or the consecutive years.

The REPP-SSN is tasked with conducting a mid-term review of APAEC 2010–2015 in 2013. It needs to revise the scorecard system and develop its own weights. However, such weights are very sensitive politically because different scores may be obtained with different weights. Some countries have suggested that these weights should be decided by SOME. However, it is doubtful whether SOME has the resources to do this. It can also be predicted that political negotiation will be long and complicated. Our suggestion is that such weights should be handled by an independent, non-partisan organisation, such as ERIA. In this regard, the weights used in this paper may be useful.

6. Findings, Recommendations and Way Forward

This paper assesses the status of those programmes and projects proposed in the AEC Blueprint and APAEC 2010–2015 as was at the end of 2012. The reasons for reviewing both are: (1) in the AEC Blueprint, many statements about the general vision, such as secure and reliable supply of energy, the development of renewable energy and biofuels have no specific roadmaps; (2) these roadmaps were elaborated, updated, or proposed in APAEC 2010–2015; and (3) APAEC 2010–2015 was created as the implementation plan of the ASEAN Vision as stated in the AEC Blueprint. All of the seven programme areas under the APAEC 2010–2015 are examined. However, the REPP is not scored due to its overlapping with other programs. The score reflects the

status at the end of 2012 against the targets of 2015. A low score, however, is not necessarily interpreted as a failure. It may imply the targets are either not clearly defined or not realistic. Given that interpretation, these targets have to be adjusted according to changing circumstance.

6.1. Main Findings

For the energy sector, the development of the increased use of target energy sources was less than one third by the end of 2012, which means that there are significant challenges in meeting the target for the AEC, if the original targets are to be met by 2015. None of the programme scores are more than a half and the overall score is only 1.54 out of 5 (Table 7). The TAGP and EEC are the most developed but both have scores of less than 2.0. Coal & CCT and CNE are at the bottom in terms of the development progress and the APG and RE programmes are in the middle. The REPP has been hampered because institutional cooperation is challenged by many factors, so it has lagged behind. The finding is that EEC and RE are likely to meet their targets for 2015. This is, however, not unusual as there are no targets in the AEC and the current targets are those set by organisations, which are more realistic than the AGP and TAGP plans.

Table 8: Scores of Programmes under APAEC 2010–2015

No.	Programme name	Programme weight	Score
1	ASEAN Power Grid (APG)	0.25	1.38
	Physical Infrastructure		2
2	Trans-ASEAN Gas Pipeline (TAGP)	0.25	1.81
	Physical Infrastructure		3
3	Coal and Clean Coal Technology (CCT)	0.1	1.00
4	Energy Efficiency and Conservation (EEC)	0.2	1.86
5	Renewable Energy (RE)	0.15	1.53
6	Civilian Nuclear Energy (CNE)	0.05	0.80
7	REPP	-	-
	Overall	1	1.59

Note: The larger the score, the better. 5 is the full score. 0 represents no implementation.

6.1.1. APG and TAGP

If we focus on those projects that are stated in the AEC Blueprint, we only have the physical part of TAGP and APG. These energy infrastructure projects are unlikely to be fully implemented by 2015.

The APG has 5 out of its 16 interconnection systems in operation. Two or three additional interconnection systems will be in operation by 2015 while the remaining will be operating by 2020. The main constraint in the development of the APG is that many projects are not yet commercialised. The lack of economic viability is the main reason why the APG has lagged behind the AEC targets. Without economic viability, it is difficult to secure financial viability. Thus, there will be issues to be addressed in terms of introducing an effective regulatory framework and mechanism for raising capital for the development of these interconnection systems. However, even when all the planned projects are completed, the APG is still a collection of bilateral interconnections, not a regional power grid.

Although more than half of the TAGP pipelines have been constructed, the remaining planned pipelines depend on the development of the East Natuna gas field in Indonesia, which is not yet developed due to technical and financial considerations. Even with the development of the Natuna gas field, ASEAN is still facing widening gaps between supply and demand in the future. ASCOPE has now included LNG supply to the region and consequently ASCOPE needs to review the targets of TAPG. The future development of TAGP needs a change in the understanding of TAGP from pipeline interconnections to include LNG regasification terminals.

The current working plans for the energy infrastructure are not sufficient for achieving the objectives of APG and TAGP, which will make regional-wide energy trade possible. For the APG, the primary question would be, who will build the interconnections? For commercialisation reasons, some links may not be attractive to private investors. It also may not be attractive to some governments. Since the APG and TAGP projects and cooperation are proposed for regional benefits, they have the characteristics of regional public goods, which mean some countries may not be able to harvest their benefits. Therefore, a regional governance mechanism and regional funding sources are expected. Considering the increasing gaps between demand and indigenous supply in ASEAN, the TAGP connectivity has been expanded to include LNG regasification terminals and so further optimisation is needed.

APG and TAGP programmes also include other cooperation aspects, as stated in APAEC 2010–2015. For the APG, these include proposals for harmonisation in technical standard codes and guidelines, legal and regulatory frameworks, financing modalities, development of a plan for private sector participation, and development of the guideline/mechanism to implement the recommendations in the ASEAN

Interconnection Master Plan. Most of these are in the early stages of development, such as the preparation of concept papers or TORs. For TAGP, the issues in the early stages are the gas transit principles (drafted and awaiting agreement among member countries), unbundling costs issues, and the gas swapping mechanism. Those activities related to ASCOPE Gas Center (AGC) are still pending due to the unresolved hosting issue of the AGC. Therefore, the overall score for APG and TAGP, when taking into considering these soft parts, becomes lower at 31.6% (vs. 40%) and 36.2% (vs. 50%).

6.1.2. Other Cooperation Areas

For the other energy cooperation areas under the APAEC 2010–2015, the overall progress is still in the early stages. The CNE programme is in the primary stage (mostly in the form of capacity building such as seminars and workshops), while the EEC Programme is more advanced than the RE and CCT programmes. The REPP programme is more or less the same as the average. Annual activities such as ASEAN Energy Awards for EEC, RE, and the monitoring of AMSs energy intensities under REPP are fully implemented. But others such as the commercialisation of biofuels, the enhancing of CCT, studies on and harmonisation in the areas of EEC, CCT, and renewable are still in the conceptual or proposal phases. The ratification of the ASEAN Petroleum Sharing Agreement (APSA) and its Annex Coordinated Emergency Response Measure (CERM) are already 80% completed. Once fully ratified, they will be ready to work if an emergency occurs.

Initiatives that can bring domestic benefits are easier to be advanced than those that are mostly beneficial on a regional basis. The cooperation on the CCT programme and RE programme is a good example. In economic theory, this is because regional

cooperation will generate externalities to other countries and thus advancing countries may not benefit, even though they have paid the costs. This implies that the strategies that bring regional integration lag behind the average rate of progress towards cooperation. Therefore, a regional policy framework to coordinate collective activities is necessary to move regional cooperation forward.

Progress in terms of cooperation, or soft infrastructure, has been slower than that for the physical infrastructure. The main reason for the slow progress of the soft infrastructure could be that countries are subject to behind-the-border barriers, removal of which requires changes in national institutional frameworks. It may also need AMSs to change their energy policy, such as energy security policy. As for the slow progress of those initiatives to strengthen institutional frameworks, it is because they involve a number of stakeholders and have limited funding. This slow progress may be an indicator that the importance of such soft infrastructure has not been well recognised. Therefore, the institutional part would be a challenging and key task for AEC beyond 2015. The best outcome by 2015 would be to have a plan for the establishment of the necessary institutional infrastructure. Therefore, major works for the institutional part will be left for the AEC beyond 2015.

6.1.3. Challenges in the ASEAN Energy Sector in Terms of Building AEC

Energy cooperation is challenged by financial constraints, technical and regulatory differences among countries, and some other factors.

1. *Shortage of funding is a common challenge.* Some of these projects, such as the conduct of studies, the harmonisation of EEC and renewable energy products, and the transfer of CCT technologies require funding to be available.
2. *Many technical challenges have to be overcome to make the multilateral connections of APG work fully.* One challenge is that countries may have a

different voltage of transmission lines. Diversification in standards for electricity appliances is another major barrier for the development of an energy infrastructure and the trade of electricity (Shi and Kimura, 2010).

3. *Economic regulations, such as taxation, may create challenges.* For example, Indonesia has not applied taxes on the export and import of electricity, while Malaysia and Thailand have. Therefore, electricity from Indonesia to Thailand will be costly. The harmonisation of regulatory systems requires a lengthy developmental process.
4. *Different regulations on the electricity sector could create challenges.* In Indonesia, private companies are allowed to construct transmission lines, but in Malaysia, only the government can build transmission lines. Subsequently, it is possible that trade in electricity would require a lengthy process for approval, even if there is an immediate trade opportunity for electricity between Indonesia and Malaysia.
5. *Energy cooperation is heavily affected by national regulations in areas such as security of supply, access to land, and registration procedures.* Because of concerns about energy security, some countries may limit their dependence on other countries for electricity and gas supplies. These energy security concerns will reduce the materialisation of trade opportunities.

6.2. Recommendations into 2015

Since the AEC has been planned for 2015, all areas, including APG and TAGP, have to be sped up. Nevertheless, the progress of the energy sector seems unable to keep pace with the acceleration. Therefore, it has to be practical when implementing the energy sector plans in the AEC. To facilitate the implementation of AEC, we propose that ASEAN do the following.

1. *Coordinate energy policies and project development and monitor AMSs to fulfil their commitments*

The energy infrastructure, APG, and TAGP are flagship projects under AEC and are indispensable for the regional optimisation of energy resources. The development of the physical infrastructure is the leading indicator and key measure for advancing energy cooperation and further development of APG and TAGP is required. Whenever possible and desirable, the planned physical infrastructure should be expedited.

The regional plans and agreements should be reflected in the individual AMSs' domestic policies and planning. The AMSs should ensure that infrastructures within their boundaries are constructed and operating. The agreements of regional cooperation should be implemented through either binding agreements or peer reviews. The implementation of cooperation plans should be monitored to ensure that they are realised. If there is a lack of economic attractiveness for the infrastructure, the governments of AMSs should intervene individually or collectively to attract private investors. ASEAN's role would be to ensure the cooperation and coordination of its members' infrastructure projects and their linkages, and to remove the economic and political barriers to such cooperation.

To facilitate the cooperation and create actions so that information will be delivered in various directions (bottom-up/top-down/parallel) accurately and in a timely manner, eliminating communication barriers among sectoral bodies, working groups and senior officials, etc., is necessary.

Monitoring and assessing the progress of energy cooperation could be controversial and politically difficult. It would be useful to introduce independent, non-partisan organisations, such as ERIA, to handle the technical details. Even though the organisation will report to the officials, this would not compromise the quality of the work. By so doing, it may be able to facilitate the monitoring and assessing process by avoiding debate among senior officials on the trivial technical issues. ASEAN has already seen a successful example in tasking ERIA to score economic cooperation.

2. *Strengthen institutional infrastructure and cooperation, which are equally important*

Without an institutional infrastructure and cooperation, known as soft infrastructure, the regional energy network will not function and thus it should be viewed as important as the physical infrastructure. However, due to political sensitivity, aligning the soft infrastructure of the AMSs has not sufficiently progressed. Consequently, countries are required to apply more effort in this area than for what is needed for the physical infrastructure. It is therefore recommended that countries address the needs for institutional infrastructure at both the national and regional levels.

a. At the national level, address institutional barriers to establish an open, competitive, and transparent energy market

The behind-the-border institutional changes within AMSs should be placed at the top of the agenda in order to move towards the AEC, with the ultimate aim of an open, competitive, and transparent energy market. The improved institutional framework across countries would provide strong legal protection, reduce transaction costs to business, enhance investor confidence, enable the free flow of goods and services, and capital. Two areas that are in need of improvement are: the establishment of clear and transparent rules and principles in investment, regulation, and market access; and a shift in the concept of energy security from the national to regional level. So instead of pursuing their own energy security, countries should jointly pursue a collective energy security.

The quality and timeliness of energy data and statistics needs to be improved in order to enhance the transparency of the energy market and thus achieve a more integrated market. The involvement of all levels of stakeholders in the process of planning, from design to implementation stages, must also be ensured.

b. At regional level, formulate institutional and contractual arrangements for cross-border trade and harmonise legal, technical, and regulatory frameworks

Further formulation of institutional and contractual arrangements for cross-border trade must be in place and include the proper provisions on taxation, tariffs, and third party access. For example, the establishment of regional gas exchanges would be able to facilitate trading through the cross-border gas networks.

The harmonisation of legal, regulatory, and institutional systems for bilateral and cross-border power interconnection and trade will be particularly important for the cross-border transmission of electricity and gas, which is the aim of APG and TAGP. The AMSs can gradually harmonise the regulatory and technical standards in energy, such as electricity and gas, through regional agreements. A set of mutually agreed upon and harmonised standards can initially be implemented in the more developed markets and then extended to other markets over time.

Strong cooperation among AMSs is important for the region, as it becomes a net importer with more competition within ASEAN and other Far East consumers. Countries need to cooperate so that if any future crises regarding economic issues or conflicts should arise, countries can work through them to provide the best outcome for the region as a whole.

3. Effectively mobilise resources for physical infrastructure projects through the leverage of public funds and participation of the private sector

Public and private partnerships can play a significant role in improving the economic viability of physical infrastructure projects through attracting private capital investment, increase efficiency and use available resources more effectively; and reforming sectors via a reallocation of roles, incentives, and accountability (ADB, 2008).

Since energy cooperation may produce regional public goods, there must be a sharing of the costs by AMSs. Therefore, some kind of regional collective funds are desirable. These regional funds can work as partner and seed funding, which may be expanded in the future to compensate for externalities. The private sector has to play a leading role in the building of the physical infrastructure. ASEAN should also enhance

its cooperation with dialogue partners who can provide the technical and financial resources and help build capacity in the energy sector.

4. *Expedite the implementation of priority actions, such as trade facilitation, regulatory and technical specifications, harmonisation, numerical targets, and financing mechanisms*

The priority projects are actions that are important and measurable, and possible to be expedited. These are listed in the six programme areas.

On APG: address barriers to interconnection, cross-border trade and investment, financing modalities, and commission optimisation studies for the most economic operation and feasible reserve sharing scheme; develop guidelines and plans to accelerate the APG development; and undertake studies to examine how to resolve cross-border issues and encourage bilateral or multilateral interconnection projects. AMSs should make funding available for these study proposals.

On TAGP: finalise gas transit principles and gas specifications; establish swapping mechanisms and commission studies for dealing with high CO_2 content gas; and resolve the hosting issue of AGC to make it operational as early as possible.

On Coal and CCT: advance ASEAN Agreement on Coal Supply and Trading; standard coal nomenclatures; ASEAN standards for coal quality testing; harmonise emission standards; and the minimum efficiency requirements for coal-fired power plants.

On EEC: monitor the progress of reduction in regional energy intensity between 2005 and 2015 with the aim of an 8% reduction during this period and monitor the mechanisms to enhance financing for EEC projects.

On RE: monitor the implementation of a 15% share of RE in ASEAN's power generation mix by 2015; harmonise the standards of RE products, including biofuels; and establish innovative financing instruments and mechanisms. ERIA's research outputs on EAS-ERIA biodiesel fuel standards (Goto, *et al*., 2010) could be used to harmonise biofuels standards across the region.

On CNE: create a human network and cyber communities on nuclear energy and establish nuclear regulatory bodies and networks.

6.3. The Way Forward: AEC Beyond 2015

Considering that most issues in the current AEC Blueprint are ongoing, new and emerging issues should also be highlighted. We therefore propose the following actions for AEC beyond 2015.

1. Set a clear vision and have a comprehensive coverage of the energy sector

Although the target of a "single production base" is one of the aims stated in the AEC Blueprint, little has been done in this regard of the energy sector. For the sake of further energy cooperation, bearing in mind the importance of energy in national economies with regard to international cooperation, a clear vision of the energy sector in the AEC (possibly comparable to the EU's Single Energy Market), should be proposed. The AEC aims beyond 2015 should have comprehensive energy sector coverage. The AEC beyond 2015 should cover other areas under the APAEC 2010–2015, but not under the AEC Blueprint.

The easiest policies to implement and those that have fewer cross-border spillover effects, should be addressed first as they are less likely to be controversial among the AMSs. For example, the continuation of EEC activities should be highlighted in any future AEC plans, as this is relatively straightforward to implement.

A 'green ASEAN', which takes into account the impacts of climate change and sustainability, should be incorporated into the future AEC. Although energy-environment policy issues have been addressed by the APAEC under various programmes areas such as REPP, EEC, RE, and CCT climate change and sustainability

have not been explicitly dealt with in the AEC. The development of the biofuels market and other instruments to deliver a green ASEAN, such as sustainability assessment of biofuels (Sagisaka, 2010), should be highlighted.

Safety cooperation concerning nuclear energy is urgent. This was highlighted by the accident at the Fukushima Daiichi nuclear plant on 16 March 2011, where serious damage following a major earthquake and tsunami on 11 March 2011 resulted in the release of radioactive materials and equipment failures. Safety should be a key issue for any future energy cooperation. Standards for the safe operation of plants should be clarified and harmonised.

Institutional frameworks should be highlighted as a priority in AEC beyond 2015. For regional energy cooperation to function properly, both physical and institutional infrastructures need to be in place. The institutional, or soft, infrastructure is necessary to support the physical infrastructure and must be highlighted as being as important as the physical infrastructure.

2. Update plans for energy cooperation and the development of energy infrastructure and continuously promote those tasks left over from the AEC 2015

Since many energy cooperation and development plans cannot be finished by 2015, it is necessary to review and update them in consideration of the economic and financial constraints, the changing situation in political terms, and technical developments. Changes in technical aspects, such as the demand for and the shrinking supply of natural gas, and changes in political aspects, such as the emergence of Myanmar as a potential supplier for gas, should be closely monitored in order to modify the plans for soft and physical infrastructure. Technically, the dynamics in non-conventional energy sources,

such as coal bed methane and shale oil and gas, may also change the previous cooperation plans on infrastructure.

The updated plans should prioritise energy cooperation across the ASEAN region and essential programmes should be boosted with further efforts.

The APG and TAGP should be continuously promoted. Since they cannot be completed physically or institutionally by 2015, further work is necessary. In particular, the institutional frameworks should match the development of the physical infrastructure for APG and TAGP to function well. For TAGP, however, the vision needs to be redefined from pipeline extension to other forms of interconnections, in order to consider LNG and offer better flexibility of gas supply. For APG, it is necessary to define a clear vision of an ASEAN power grid with a necessary roadmap. Achieving such a regional power grid will be a long process and needs political trust to be in place and the energy security paradigm changed from national to regional.

3. Establish a regional governing institution on energy

Due to the public goods characteristic of some parts of energy cooperation, a regional governance mechanism is necessary. Regional energy cooperation requires relatively sophisticated systems of energy governance, some of which will need to be legally binding and will require member states to yield a certain degree of authority to a regional institution. ASEAN has taken the first step by establishing the ASEAN Energy Regulators' Network. Further work needs to be done to set up the institutions where regional policy decisions will be implemented at the national level.

Moreover, a single high-level organisation or an energy policy cooperation framework with authority similar to the International Energy Agency, should be

established to oversee regional matters. The ACE could assume this role, as originally envisioned, if it is equipped with the necessary resources.

4. *Follow economic principles and use market instruments to facilitate energy cooperation*

As the issues of economic viability have shown, the economic feasibility of projects should be added to the planning of AEC in the future. Economic viability, as revealed by the development of APG and TAGP, should be intervened if necessary. Governments can adapt policies to alter their commercial attractiveness to some extent by providing fiscal and financial incentives. These government interventions, however, should be restricted and justified because such projects have public benefits that cannot be garnered by private investors. In addition, market instruments, such as removal of fossil fuel subsidies and the development of biofuels markets, should be considered.

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[2]Joint Press Statement of the 15th Meeting of the Heads of ASEAN Power Utilities/Authorities, 21-23 April 1999, Singapore. Available at: http://www.eppo.go.th/inter/asean/asean-sec/hapua15.htm.

[3] This refers to arrangements for third party access for power interconnection and trade in accordance with internationally accepted standards in the electricity supply industry and formulation of a transmission pricing framework within ASEAN.

[4] Through establishing the policy framework and modalities for power interconnection and trade, the MOU will pave the way for the important implementation of the APG.

[5] This information was obtained during a personal visit by the author to Petronas in Kuala Lumpur on 29 September 2012.

[6] Basically the MOU is the framework for ASEAN Member States to cooperate towards the realization of the TAGP project to help ensure greater regional energy security. It requires member countries to cooperate in the various aspects of the realization of the TAGP project including joint studies (bilateral or multilateral basis); the pooling of resources by the governments and/or private sector for joint projects pertaining to TAGP but subject to commercial viability; and taking individual and collective initiatives to assess, study and review national and regional legal and institutional frameworks for natural gas concerning cross-border issues such as financing, access and use, transit rights, taxation, jurisdiction, security of supply and emergency supply arrangements.

[7] Joint Press Statement: 37th ASCOPE Council Meeting, 20–22 November 2011, Bandar Seri Begawa, Brunei Darussalam. Available at: http://www.ascope.org/news/86-joint-press-statement.html

[8] The proposed JCOAL support will be on: transfer of CCT technology; support for coal activities on a business-to-business (B2B) basis; support for CCT investment opportunities from Japan to AMSs; and cooperation activities for technical visits on coal image analysis, problem solving and promotion in ASEAN.

[9] This AEMAS project is funded under the European Union (EU)–Switch Asia Programme through the ASEAN Center for Energy (ACE) and in collaboration with the Energy Efficiency Practitioners Association of the Philippines (ENPAP).

[10] The starting point of APAEC is from July 2010. Therefore, it will still be in its third year by June 2013.

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