Chapter 4

Major Findings and Policy Recommendations

December 2015

This chapter should be cited as

Fukawasa, K., I. Kutani, Y. Li (2015), 'Major Findings and Policy Recommendations', in *Study on Effective Power Infrastructure Investment through Power Grid Interconnections in East Asia*. ERIA Research Project Report 2014-30, Jakarta: ERIA, pp.63-70.

CHAPTER 4

Major Findings and Policy Recommendations

In this report, specific routes for further examination were selected from prospective international interconnection lines obtained from the FY2013 survey. The study carried out preliminary planning work and cost estimation for the selected interconnection routes. Then it estimated unit power transmission cost based on projected transmission demand. The concept of electric power interchange in the ASEAN region has already taken off in the form of the ASEAN Power Grid and GMS Power Master Plan.

1. Analysis Results of Specific Routes

For some auspicious routes, the benefits and costs of transmission interconnection were evaluated. The results are shown in Table 4-1.

Table 4-1. Possible Interconnection and Cumulative Costs and Benefits

Case		Gross benefit (A)		Cost (B)		Net benefit (C)=(A)-(B)		Benefit/Cost ratio (D)=(C)/(B)
		[Million US$]	[US¢/kWh]	[Million US$]	[US¢/kWh]	[Million US$]	[US¢/kWh]	[-]
B	THA—LAO	21,387	3.77	1,506	0.26	19,881	3.51	13.2
E	VNM—LAO—THA	24,707	3.68	2,097	0.32	22,610	3.36	10.8
G	LAO—THA—MYS—SGP	27,490	3.88	2,000	0.28	25,490	3.60	12.7

kWh = kilowatt-hour, LAO = Lao People's Democratic Republic, MYS = Malaysia, SGP = Singapore, THA = Thailand, VNM = Viet Nam.
* Case G is estimated not as a new route but as reinforcement of existing facilities.
Source: Author.

- In terms of net benefit from 2025 to 2035, Case G is estimated as the most beneficial interconnection.
- In terms of unit net benefit, Case G is estimated as the most beneficial interconnection.
- In terms of average return on investment, Case B is estimated as the most beneficial interconnection.

How much is the construction cost for specific routes? A comparison is made here using the electricity charge in Thailand as an example. The construction cost was estimated to be US¢0.25, US¢0.29, and US¢0.26 per kWh for Cases B, E, and G, respectively. Meanwhile, according to the Energy Regulatory Commission of Thailand, total retail tariffs (as of June 2012) broken down by business are US¢10.20 per kWh, where generation accounts for US¢7.96 (of which Electricity Generation Authority of Thailand fuel cost accounts for US¢2.10); transmission, for US¢0.89; and distribution and retail, for US¢1.33[1].

As a result, to recover the construction costs in the form of consignment charges, the current transmission costs will have to be raised by around 30 percent. However, taking into account the long-term benefits from the interconnection including improved supply reliability for the entire region and reduced generation fuel costs, investment into establishment of international interconnection should be seriously considered.

2. Policy Recommendations

Operation of interconnecting transmission lines may be roughly divided into passive and active operation. In passive operation, interconnecting transmission lines are used only when an excess or shortage in power supply ability emerged for some reason. This is premised on the concept of self-sufficiency where each country maintains the supply and demand balance. In active operation, interconnecting transmission lines are used to maximise the economy of facility operation by balancing the power supply capacity of each country and the demand in the entire region. The latter may be what ASEAN is aiming for since power demand is rapidly increasing in every country and improved power trading within the region is desired.

However, as cross-border transmission interconnections develop and the use of interconnections expands along with the increase in benefits receivable by the entire system in the region, reliance on system interconnections also increases. For that reason, it becomes necessary to carefully carry out structure formulation and system design for the management and operation of interconnections while the ASEAN countries are still

[1] Total retail tariff: 3.2387 baht/kWh, generation: 2.5261 baht/kWh (of which EGAT fuel cost: 0.6656 baht/kWh), transmission: 0.2817 baht/kWh, and distribution and retail: 0.4210 baht/kWh converted in to US dollars using the monthly average exchange rate of 1 baht = 0.0315 US$ as of June 2012.

considering and deliberating. Additionally, to accelerate the current interconnection projects in the ASEAN region and obtain the benefits of electric power interchange, some potential conditions need to be satisfied.

This study proposes the establishment and appropriate authorisation of ASEAN-wide regulatory and consultative bodies, overall optimisation and adjustment of power infrastructure development plans, and harmonisation of technical standards.

2.1. Establishment and Appropriate Authorisation of ASEAN-wide Regulatory and Consultative Bodies

Many ASEAN countries currently adopt the single-buyer system where a single buyer purchases all electricity generated and sells it exclusively to power distributors. In some ASEAN countries such as Singapore, the introduced principle of competition includes the wholesale and retail sectors and where the price pool system is also adopted. Amidst the gradual structural reforms for traditional vertically integrated power systems, it is important to strengthen the roles of regulatory bodies that control the power sector in the ASEAN region.

To accelerate several interconnecting transmission line plans that have already been formulated for the ASEAN region and relevant projects currently in progress, it is important to coordinate the interests and formulate various rules pertaining to establishment and management of interconnecting transmission lines; establishment of consultative bodies that ensure fair and transparent operation, and appropriate authorisation of the bodies; and cooperation and collaboration by all countries.

To realise the ASEAN Power Grid, the HAPUA working group is studying the formation of the ASEAN Power Grid Transmission System Operators Institution and the formation of the ASEAN Power Grid Generation and Transmission Systems Planning Institution as two consequent activities. Findings from these studies are expected to contribute to the establishment of the ASEAN Electricity Regulators, the ASEAN Transmission System Operators, and the ASEAN Grid Planners as federations of relevant organisations from countries to ensure fairness and transparency in the use of a region-wide power system.

For this, ASEAN countries may reference the structure of Nordel. As mentioned, most of Nordel's work was carried out by permanent committees of leaders responsible for

the corresponding sectors in the Nordic TSOs and working groups of technical specialists from the Nordic TSOs. The role sharing of Nordel's planning and operations committees is most likely to be referenced and applied on ASEAN transmission network operation where many countries adopt a single-buyer system.

2.2. Overall Optimisation and Adjustment of Power Infrastructure Development Plans

In general, power demand in ASEAN countries is expected to keep increasing greatly due to steady population growth and robust economic growth. Construction of many power plants may take place in the future. Along with the increase in electric power generation, new establishment and reinforcement of transmission lines will become necessary. Amidst such situation, the power infrastructure development plans for the ASEAN countries are generally formulated so that there will be no shortage in power supply capability without relying on power interchange. Meanwhile, transmission interconnection projects by the ASEAN Power Grid and GMS Power Master Plan are progressing, and duplicated investments are a possibility if these plans remain uncoordinated.

Interconnecting transmission lines reduces power source facility development and improves the system's supply reliability. Such benefit, however, can mean something only when the relevant parties of each country recognise this and postpone the construction of power source facilities which may become redundant anyway with interconnection. For that, it may be essential to formulate power supply plans that assume power interchange with neighbouring countries and associated transmission line development plans for the entire ASEAN region. Specifically, revaluation of power source development and transmission line development plan of individual countries, and proposals for overall optimisation by an organisation of specialists in the region may prove helpful.

Meanwhile, it is also important to ensure that domestic system development projects are integrated with the overall optimisation of power infrastructure development. Looking at the current situation of domestic systems in the ASEAN region, undeveloped areas in countries with hydropower potentials such as Lao PDR, Cambodia, Myanmar, and Viet Nam have problems in the transmission line capacity that interconnects the north and the south. In a feasibility assessment of selected routes of this study, interconnecting transmission lines across countries are to interconnect substations closest to the borders, assuming there are no restrictions on inter-region power transport by the domestic system

in each country. Such assumption implies that the actual benefits received vary depending on the situation of domestic system development.

In countries and areas where domestic transmission networks are insufficient, international interconnection lines are expected to cover the insufficiency. On the other hand, to fully utilise the energy resources in the region, it is important to establish and enhance the domestic transmission networks so that the domestic systems do not become a cause of bottlenecks.

2.3. Harmonisation of Technical Standards

The current international interconnections in the ASEAN region are limited to bilateral trading and, therefore, no region-wide common grid code or interconnection rules and system operation are carried out by the technical standards of each county or project. Meanwhile, some countries have weak organisation systems of the power business and have no organisations monitoring the system for the entire nation, or have inadequate technical standards and improper system operation.

At present, where interconnections are minimal, there is little concern over such problems making huge impact on the stability of the power supply or system for the entire ASEAN region. However, once interconnection expands and the system becomes complex, the risk of an interconnection's failure infecting the entire system becomes higher. Therefore, to operate the system as a stable ASEAN-wide network, harmonisation of standards for operating the system or connecting to the system in each country will be required.

To maintain a certain level of system stability in the ASEAN region, all participating countries should coordinate operations. To that end, it is necessary to formulate several standards including those for maintaining stability when equipment faults occur in a system (reliability standards), for maintaining balance amongst systems, and for protecting the system in preparation for potential system instability.

Regarding connection standards, maintenance of system stability will require formulation of minimal transmission connection rules which focus on the power quality. Matters to be addressed in connection rules include frequency, voltage, and tolerance for sudden voltage fluctuations and for voltage drop.

Furthermore, maintaining consistency in the level of supply reliability amongst

countries should be made as it is the foundation of harmonisation of technical standards. When systems with greatly different supply reliabilities are interconnected, those with lower supply reliability acquire more benefits than the other systems. At present, the supply stability of ASEAN countries varies, and discussions and investigations on the coordination of interests amongst countries and determination of appropriate reliability levels need to be carried out towards the establishment of the international interconnecting transmission network.

2.4. Other Necessary Actions

International interconnection projects essentially require establishment of an implementation system that takes charge of coordination of interests and formulation of various rules pertaining to development, management, and operation of power infrastructure, in addition to cooperation and collaboration by countries involved.

To establish such an implementation system, the following points need to be carried out in practice on both the hardware (tangible) and software (abstract) aspects.

On the hardware side, above all, financing the construction of interconnection lines and system operation facilities is required. In some cases, recovering costs by the earnings alone from the transmission line toll may be difficult. Additionally, a single company may not be able to raise funds for the entire project. On such occasions, power companies or agencies of each country may be required to supplement funds, considering the massive economic benefits each country will gain from such endeavour. Specifically, cost control will be required until profitability improves, including utilisation of low-interest public funds and promotion of public–private partnerships.

On the software side, cost sharing on the construction and operation of interconnection lines, setting of transmission line tolls, emergency cut-off measures, and other issues related to system operation need to be addressed. Since situations vary depending on the lines, including the facility system and the concept of benefits, sharing on development of transmission lines will require careful consideration to smoothly build consensus amongst a wide array of parties involved. Additionally, setting transmission line tolls poses dilemma between (a) the incentive for setting the unit toll as high as possible for improved profitability and (b) promoting interconnection by operating and managing each country’s consignment charge for interchange of electricity within the appropriate

price ranges. While the significance of international interconnection is in the reduction of generation costs through utilisation of potential hydropower and the cheap fuel costs of thermal power, overpriced transmission line tolls would dilute the benefits of power interchange. Regarding such software issues from precedents in Western countries, ASEAN countries may be required to thoroughly discuss the kind of wide-area operation system appropriate and effective in the ASEAN region.

Also note that an increase in the volume of power trading automatically results in non-negligible transaction costs incurred from power trading itself. If this becomes the case, it may be realistic to prepare in advance and utilise wisely a model contract that stipulates methods and conditions of power trading.

3. Summary

Nordel, a Nordic cooperation programme in electric power supply, was established in 1963, and its background circumstances are similar to the current situation in the ASEAN region. During the 1960s, when electric power consumption increased considerably in all the Nordic countries, the opportunities for cooperation, linking together different kinds of generation portfolios, and creating shared reserve margin attracted greater attention amongst members of Nordel who were seeking benefits from coordinating the expansion and operation of their grids.

As the rapidly growing electric power system would have to be connected to relatively weak transmission interconnections, Nordel had to solve problems of control and stability. The long-term solution was to make more robust transmission interconnections. Nordel's recommendations formed the basis of the technical regulations for generation and grid operations in the Nordic countries. The rules were complied with by all parties and came to provide the foundation for any formal regulations required in the individual countries.

Such establishment of transmission interconnection network in the Scandinavian region offers substantial useful suggestions to ASEAN countries. It tells us that a regional transmission interconnection network is not something that can be built in a day, but by slowly overcoming issues and repeatedly revising and improving the relevant standards. In the Nordic region example, it took about 50 years from the conclusion of the first interconnection operation agreement (1912) to the launch of Nordel (1963) and

approximately 30 years for liberalisation of the market (Nord Pool started in 1996). Activities to enhance the transmission interconnection in the ASEAN region have just started. While it may be possible to promote the projects efficiently by adopting lessons learnt from precedents, it is not something that can be achieved in a short time.

Also, the conditions unique to ASEAN countries need to be taken into account. While the stage of economic development of the four Nordel countries at that time was similar, there are major differences in those of ASEAN countries aside from the number (10) of countries constituting the regional body. It is not practical for ASEAN to uniformly formulate rules in accordance with the situation of its most developed member country. In that sense, searching for ASEAN's own power market model, instead of merely copying precedents from Western countries may be desirable.

Furthermore, the ASEAN region is in the stage of forming massive electric power infrastructure and extra attention is needed so as not to interfere with it. In Nordel, the liberalisation of the market and the formulation of the wholesale market were carried out as the final stage of international interconnection and power trading system development. In general, liberalisation of the market and introduction of competition bring higher efficiency to the market while they, in effect, suppress investment into infrastructure. Liberalisation of the market is appropriate in the Organisation for Economic Co-operation and Development (OECD) countries where the formation of basic infrastructure has been completed, but runs the risk of sparking shortage in infrastructure investment and supply in developing countries where infrastructure formation is under way. For that reason, step-wise activities and careful system designs are required.

Nonetheless, enhancing transmission interconnection lines and power trading in the ASEAN region obviously bring benefits to the region, and promoting activities towards their realisation would prove to be fruitful.