The Approach to Development Interconnected Transmission System in ASEAN (ASEAN Power Grid)

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ABSTRACT

The research's purpose is to study development, problems and solutions of the interconnected transmission system in ASEAN, for efficient allocation of energy resources. To comply with the objectives of sustainable energy in the ASEAN Power Grid, optimization of the region's energy resources towards an integrated ASEAN Power Grid system and standardization all aspects of technical standards and operating procedures as well as regulatory frameworks among member countries are required. This qualitative research is based mainly on a documentary study through data analyzed and collected from articles and internet documents contributed by related government and private sectors together with collective data from the Electricity Generation Authority of Thailand (EGAT) as one of the participants in the ASEAN Power Grid.

It has been found that ASEAN as a whole has abundant and diversified energy resources. There is potential in hydropower, oil, natural gas and coal. This diversity provides vast opportunities to exploit these energy resources collectively within ASEAN thereby reducing the need and dependency on imported fuel from other regions. The committee of the ASEAN Interconnection Master Plan Study (AIMS) under the supervision of the Heads of ASEAN Power Utilities/Authorities (HAPUA)

has been set up to study the master plan of the interconnected transmission system in ASEAN. This master plan lasts 16 years (A.D.2009-2025). Its result shows that there are 16 potential projects to improve interconnected transmission system in ASEAN. However, the Trans-ASEAN Energy Network is likely to have major problems like route selection in the transmission lines. The solution of the development of an interconnected transmission system is to set the least impacting transmission line criteria. For legal and regulatory obstacles and trade barriers in the region, the center for electricity trade, standardizing technical codes and establishing a financial platform will be set up. For environmental concerns, clear publicity of energy projects is mandatory. In conclusion, all solutions above are based on the balance between public interest and energy security.

The study indicated that investment in transmission system development is worthy. The overall cost of electricity will be reduced. The electricity supply will be more available and reliable. Last but not least, the policies in supporting of renewable energy are important for sustainability.

The suggestion for further research is to study other working groups of HAPUA: Generation and Renewable Energy , Transmission and APG, Distribution and Power Reliability & Quality, Policy and Commercial Development, and Human Resources to determine and analyze the barriers of the interconnected transmission system in ASEAN for future achievement in the ASEAN Power Grid.

Keywords: ASEAN, ASEAN Power Grid, HAPUA, The Electricity Generating Authority of Thailand

Introduction

The ASEAN Power Grid is a network of electricity in ASEAN which works on accumulating energy resources within ASEAN countries in order to manage the energy as efficiently and sustainably as possible for the purpose of economic security. This is a drive for ASEAN to equalise themselves with other regions in the world. The ASEAN Power Grid is part of the ASEAN Vision 2020 that was a result of 2nd ASEAN Summit on 15th December 1997 in Kuala Lumpur. There was a working team establishment on the ASEAN Inter-connection Master Plan Study (AIMS) under the supervision of the Heads of ASEAN Power Utilities/Authorities or HAPUA which consists of specialists from the Electricity Generating Authorities of each ASEAN country who study, evaluate and plan the operation of the ASEAN Power Grid.

There are many energy sources for generating electricity throughout ASEAN region such as along the Mekong river, some parts of Indonesia and Sarawak in Malaysia, that make it possible for effective generation of hydroelectricity, as well as the countries in the southern part including Indonesia and Malaysia that are have much oil, coal and natural gas. The abundance of natural resources provides a way for development and cooperation in terms of energy. Nowadays, the demand for electricity in ASEAN countries has been increasing continuously and will tend to keep on rising in the future. As a result, each country needs to improve their ability to generate electricity to fulfill the increase in demand which leads to the use of the country's budget. Therefore, the most appropriate way to resolve the matter is through cooperative management and an efficient usage of energy for mutual benefit.

As mentioned above, the contributor consequently has a strong interest in the connection of the ASEAN Power Grid for an effective management of energy resources because the Electricity Generating Authority of Thailand (EGAT) is the major organisation that aims to drive Thailand to achieve its main purpose which is to support the regional cooperation in the matter of electricity and to reinforce the stability of electricity in ASEAN due to the mutual goal to push forward the Interconnected Transmission System.

Research Objectives

1. To study the condition of energy sources used to generate electricity across ASEAN
2. To study the development of the ASEAN Power Grid
3. To study the problems in developing the ASEAN Power Grid

Research Contributions

1. To recognize the condition of energy

sources used to generate electricity in each ASEAN country.

2. To recognize the condition of the development of the ASEAN Power Grid.

3. To recognize the problems in developing the network of electricity generation system within the ASEAN region.

Literature Review

1. Conceptual idea of development

To develop is to systematically apply scientific, technological and other fields of knowledge in order to create or upgrade the products which can continuously bring prosperity to a particular society with a clearly defined and predetermined purpose, method and duration.

2. A conceptual idea of an electric power system

An Electric power system is commonly composed of an electricity generation system and a distribution and transmission system before it is accessed by the public. Furthermore, there is also a review of written works related to the notion of the electricity network in the European Union along with other research.

3. A conceptual idea of a Smart Grid

The idea is generally referred as the improvement of the electric power system, to be able to work more efficiently and to possess better potential, credibility, safety, sustainability and eco-friendliness while consuming fewer resources. This can be done through the appliance of ICT, censorship, data gathering system and artificial intelligence within the system so that decisions can be made automatically. However, this method has to cover the whole electrical system, the distribution and transmission system and electricity users.

4. A conceptual idea of ASEAN

ASEAN stands for Association of South East Asian Nations. ASEAN was established with an initial purpose to support and cooperate in terms of harmony, national security, economy, knowledge, social and cultural aspects based on the equal standards and the mutual benefit of the member countries.

5. A conceptual idea of the allocation

Allocation means the distribution that is determined for the defined purpose. Resource Allocation refers to the accumulation of rare resources that can bring benefit to people in the society.

6. A conceptual idea of efficiency theory

Efficiency means the ability to work and achieve the most effective result that is in accord with the aim of the organisation through sustainable management of resources in all areas, including time, labour and material. Moreover, efficiency also refers to the potential to reduce the capital budget and the amount of supplies for the production per unit to lower than the initial plan. On the other hand, the potential to increase the number of products and benefits that can be produced per unit higher than that what is initially

planned can also be defined as efficiency. Efficiency also expresses the ratio of the outputs and profits, the actual invested capital and supplies, and the pre-calculated budget and resources in the initial plan.

7. A conceptual idea of Power Development Plan (PDP)

PDP is a plan to look for a supply for a long-term electricity generation that is sufficient for the use of state development in social and economic terms. The plan is necessary due to the long duration of the power plant construction that can take up to 3-5 years, depending on the type of the plant. The PDP focuses on a plan to expand the capacity in the electricity generation and transmission in Thailand in the next 15-20 years. The plan will be revised after the update of the electricity demand which varies in accordance with the change of economic condition.

8. A conceptual idea of PDP 2015 in Thailand put an emphasis on the energy security in response to the demand of electricity which is a basic element of the National Economic and Social Development Plan. PDP 2015 also focuses on the reasonable capital budgeting and the reduction of the impact on the environment.

Conceptual Framework

A way to manage the use of energy resources in each country to achieve the most effective result.

Research Methodology

The study is a qualitative research based on data collection and analysis from related documents and other information published on the internet by both governmental and private organisation. The data will also be collected from Electricity Generating Authority of Thailand which is directly responsible for the network of electric power transmission of the ASEAN Power Grid.

Research Findings

Nowadays, there is a development in every field throughout ASEAN region. The process of development continuously and increasingly requires higher amount of electricity while the region still lacks primary sources of energy and effective management for mutual benefit. The efficient solution is to reconsider the overall image of the demand for electricity, the ability to generate electricity and the energy resources in each country so that together, we can effectively manage and distribute the resources in ASEAN while reducing the amount of wasted resources and economic loss in order to achieve sustainable development in ASEAN.

The ASEAN region has various resources. In the northern part, such as Lao PDR and Myanmar whch are able to use a lot of hydro-electric power while in the southern part, such as, Malaysia and Indonesia, possesses coal, oil and natural gas. In some countries, however, there are less resources which are

insufficient for the usage of their people and it is necessary for them to rely on other countries; while other countries which have plentiful resources are still lacking effective management to make the best use of their resources. Therefore, since all countries need sources of electric power from both domestic and abroad to keep up with the demand in their own countries, the segregated management of resources can cause many disadvantages to ASEAN region as follows.

1. The inefficient management of energy resources.

2. The loss of the country's budget due to the import of energy supply.

3. The cost of electricity is higher than it should be.

4. The rise of capital budgeting which reduces the opportunity for economic competition with other regions.

Because of these problems, the ASEAN Power Grid that connects the electric power system, is established as the solution. The cooperation of ASEAN member countries in the management and distribution of energy resources can cause benefit for all. This is part of the ASEAN Vision 2020 from the 6th meeting of the Heads of ASEAN Power Utilities/ Authorities (HAPUA) in Chiang Rai in 2000. Thailand has established a team to work on the ASEAN Interconnection Master Plan Study (AIMS) under the supervision of HAPUA which consists of specialists from Electricity Generating Authority of each ASEAN country who study, evaluate and plan theinterconnection of ASEAN Power Grid. It supports the ideas of sustainable energy usage and energy security in terms of power and economy which drives ASEAN to equalize themselves with other regions in the world. Furthermore, AIMS has already studied the master plan and summarized into the ASEAN Power Grid plan study for a long term research of up to 16 years from 2009 to 2025. The outcome of the research appears that there are 16 ASEAN Power Grid interconnection projects that are successfully operating which are shown in the table below. Chart 1

However, the establishment of the ASEAN Power Grid within ASEAN member countries also has a tendency to cause problems. The Electricity Generating Authority of Thailand (EGAT) has tried to figure a way to solve the problems that arise from the development of ASEAN Power Grid in order to effectively manage the energy resources. The problems and the solutions are explained hereafter.

1. The site to establish the electric transmission line to connect the network together causes a direct effect on local people, especially in local communities and forest conservation areas that the electric transmission line goes through. However, EGAT has found out a way to fix the problem by setting a clear direction for the installation of electric transmission line which can be summarized as follows:

No.	Power Grid Interconnection Project	The Transmission of Power to the System (The data as in May 2015)
1.	Malaysia – Singapore (New Project)	Post 2020
2.	Thailand – Malaysia	
	• Sadao – Bukit Keteri	Existing
	• Khlong Ngae – Gurun	Existing
	• Kolok – Rantau Panjang Operating	
	• Khlong Ngae – Gurun (Expansion, 2nd phrase, 2,300 MW)	Operating
3.	Sarawak – Malaysia	2025
4.	Malaysia – Sumatra	2020
5.	Batam – Singapore	2020
6.	Sarawak – West Kalimantan	2025
7.	Philippines – Sabah	2020
8.	Sarawak – Sabah – Brunei	
	• Sarawak – Brunei	2018
	• Sarawak – Sabah	2020
	9. Thailand – Lao PDR	
	• Roi Et 2 – Nam Theun 2	Existing
	• Sakon Nakhon 2 – Thakhek – Then Hinboun (Expansion)	Existing
	• Mae Moh 3 – Nan – Hongsa 2015	
	• Udon Thani 3 – Nabong	2019
	• Ubon Ratchathani 3 – Pakse – Xe Pian Xe Namnoy	2019
	• Khon Kaen 4 – Loei 2 – Xayaburi	2019
	• Thailand – Lao PDR (New Project)	2019-2023
10.	Lao PDR – Vietnam	2016
11.	Thailand – Myanmar	2018-2026
12.	Vietnam – Cambodia (New Project)	Operating
13.	Lao PDR – Cambodia	2017
14.	Thailand – Cambodia (New Project)	Post 2020
15.	East Sabah – East Kalimantan (New Project)	Post 2020
16.	Singapore – Sumatra	Post 2020

1.1 The effect on communities and the society.

1.1.1 Avoid the installation of electric transmission lines in a local area or an area that has already been developed.

1.1.2 Avoid the installation of electric transmission lines in an area that is close to an archaeological site or any infrastructure that is spiritually significant for the people.

1.1.3 Avoid the installation of electric transmission lines along or close to the road so that it doesn't become an obstacle regarding the utilization of land.

1.1.4 Avoid the installation of electric transmission lines in a housing area.

1.1.5 If there is any necessity to install the electric transmission lines in an agricultural area, set the direction not to pass through the area as much as possible.

1.2 The effect on environment

1.2.1 Do not set the electric transmission lines in a wildlife sanctuary, a national park, a watershed area class 1A or a mangrove forest.

1.2.2 Avoid the installation of electric transmission lines in a forest park, an additional forest conservation area (Zone C) or a watershed area class 1B.

1.3 The engineering principles

1.3.1 The electric transmission lines should be in a straight line with points of intersection as few as possible to keep the line short.

1.3.2 The points of intersection can be made on a mountain landscape; however, it is better to avoid the installation of electric transmission lines on top of a mountain because of the strong winds and lightning.

1.3.3 For the electric transmission lines that goes over a road, a railway, a river or a canal, the intersection between the electric transmission line and these places should be over 45 degrees.

1.3.4 Avoid the installation of electric transmission lines near the main crossroads.

1.3.5 Avoid the installation of electric transmission lines on soft-soiled land.

1.3.6 Avoid the installation of electric transmission lines near an airport.

1.3.7 Avoid the installation of electric transmission lines near the sea.

1.3.8 Avoid the installation of electric transmission lines along with telegraph and telephone lines for a long distance.

1.3.9 The point of intersection with short span length should be adjusted properly regarding the distance between each electric pole.

1.3.10 Must not locate the point of intersection on a landscape that is not suitable for the installation of electric poles such as a water channel or marshland.

1.3.11 The point of intersection must not interfere with a right of way.

1.3.12 The point of intersection should be far from a river bank or natural water

channel of at least 50 meters.

1.3.13 It is mandatory to make an engineering plan that is designed to decrease the impacts on the society.

1.4 The economic principles that is concerned about the investment budget and the loss in the electric transmission system.

2. The cross-border problems involve the operation of laws, rules and tax policies that are related to cross-border power transmission as well as the technical and financial problems. A way out for these problems is to establish the Regional Power Coordination Centre. The following are the responsibility of this centre.

2.1 Produce and update the information about the operation of electric power system that can be applied in the planning of the electric system and the systematic operation and follow the electricity market in ASEAN regions.

2.2 Improve and arrange an activity for the crews in each ASEAN member country to develop the electricity market of ASEAN countries.

2.3 Set up common principles, along with the proposed ideas, for the technical standard of the cooperation related to the electric power system planning to achieve credibility and high operational standard of the ASEAN Power Grid.

2.4 Facilitate the construction of the ASEAN Power Grid projects, especially the ones needed urgently.

2.5 Support the efficient and high standard operation with a practical system for data exchange in order to improve the ability to transmit electric power throughout the ASEAN member states.

3. The environmental problems can be worked out by paying attention to public opinion and clearly publicising the project development procedures.

From the problems to the solutions of the development of the ASEAN Power Grid in order to practically manage the resources; it appears that the development of the ASEAN Power Grid aims to increase the prosperity and to reinforce the economic strength in the region by managing and utilizing the energy resources together. As a result, the member countries will possess higher potential in terms of energy and resources. However, the theoretical frameworks that are related to the knowledge about energy, the influence of the ASEAN Power Grid on the environment, the law and its issue between the involved countries, as well as the energy and environmental policy are necessary for the member countries to recognize in order to create the balance between the energy security and other aspects for public benefit.

Research Discussion

As for the unity of ASEAN member countries into the ASEAN Economic Community (AEC) in 2015, it came up with the idea of working together and the the ASEAN Plan of Action on Energy Cooperation 2010-2015

(APAEC) was established to work on the 7 following fields.

1. ASEAN Power Grid network.
2. Natural gas pipeline network.
3. Coal and clean coal technology.
4. Efficient energy usage and the conservation of energy.
5. Renewable energy.
6. Regional energy plan and policy.
7. Nuclear power.

As for the notion of the ASEAN Power Grid, it emerges from the idea that the ASEAN region is composed of diverse resources. In the northern part, such as Myanmar, Lao PDR and Vietnam, is prospering with hydro-electric power which is an important source to generate electricity. At the same time, the southern part and central part, including Cambodia, Malaysia, Brunei and Indonesia, consist of coal, oil and natural gas. The differences in the natural resources force the country with fewer resources, insufficient for the demand of people in the country, to rely on other countries. On the other hand, some countries are flourishing with natural resources but lack of effective management to efficiently make use of them. The segregated management of resources as mentioned above have caused many disadvantages to the ASEAN regions which are shown in the following examples.

1. The usage of unproductive energy resources.
2. The loss of the country's budget due to the import of energy supply.
3. The cost of electricity is higher than it should be.
4. The rise of capital budgeting which cuts down the opportunity for economic competition with other regions.

From all the reasons above, the leaders from ASEAN member countries have participated in the meeting for the discussion of ASEAN Vision 2020. One of the subjects talks about the participation of ASEAN countries in terms of regional development and economic reinforcement. One of the most important economic development strategies is to connect the network of energy and public utility within ASEAN which consists of electricity, natural gas and oil through the ASEAN Power Grid and the Trans ASEAN Gas Pipeline. This also requires the participation to improve the efficiency in energy usage and conservation, along with the renewable energy.

Therefore, the ASEAN Power Grid was meant to be connecting the electric power system in ASEAN so that all the member countries can manage the energy resources together for the benefit of the region. Besides, the ASEAN Power Grid supports the ideas of sustainable energy usage and energy security which drives ASEAN to equalize themselves with other regions in the world. This includes the inter-transmission of energy that gives rise to a communication network such as optical fiber network. In addition, the project strengthens the relationship between ASEAN

members “not only in technical and economic aspects, but also cooperation and good relations among the member countries”. According to the study of the ASEAN Power Grid plan, there are 16 ASEAN Power Grid interconnection projects that are successfully operating at present.

The Electricity Generating Authority of Thailand, as a member and an organisation that is involved in the Head of ASEAN Power Utilities/Authorities (HAPUA), it has been cooperating with the member organizations from the Electricity Generating Authority of each country in order to achieve the main purpose. Nonetheless, the establishment of energy networks in ASEAN tends to cause problems — the problem in selecting the site to locate the electric transmission lines to connect the network together including the direct impacts on local people, the cross-border problem with the operation of law, rules and tax policy that are related to cross-border power transmission, the technical and financial problem and the environmental problem.

In conclusion, in order to work in accordance with the Thailand Integrated Energy Blueprint (TIEB) and the Thailand Power Development Plan 2015 (PDP 2015) that has put emphasis on the subject of energy security, economic investment and environment, the Electricity Generating Authority of Thailand (EGAT) has been trying to set up criteria to resolve the problems that come with the development of the ASEAN Power Grid including a clear direction for the fair installation of electric transmission lines which cause less impacts on local people as much as possible, the establishment of the the Regional Power Coordination Center to deal with the situation regarding the framework of laws, rules and tax policies that are related to cross-border power transmission, the technical and financial problems and the environmental problem through the clearly set up methods and working procedures based on the balance of public benefit and energy security.