

## Power Interconnection in the ASEAN Region: Lessons Learnt from International Experience

Anton Finenko, Anthony D Owen, and Jacqueline Tao

### SYNOPSIS

This policy brief discusses the development of power interconnection in ASEAN, focusing on the recently announced interconnection concept between Lao People's Democratic Republic (PDR), Thailand, Malaysia, and Singapore (LTMS). As templates, we use the evolutionary experience of electricity interconnection and trade in three international markets that we believe have relevance for ASEAN, specifically: the Southern African Power Pool (SAPP), European electricity markets, and Nord Pool. We also discuss the progress among ASEAN countries in regional energy integration with a particular focus on the Greater Mekong Sub-region (GMS) interconnection; the first significant project in the ASEAN region that involves several countries sharing power.

### KEY POINTS

- Driving factors for an integrated electricity market in ASEAN are growing regional electricity demand, diverse distribution of supply sources, and different national socio-economic circumstances. Compared to markets in developing countries, such as Europe and Scandinavia, ASEAN member states need to focus on removing electricity supply constraints that currently restrict their economic growth.
- One of the main priorities for ASEAN is to develop coordinated planning of generation and transmission infrastructures. Lack of such mechanisms can severely undermine the benefits of market integration, as shown by experience in Southern Africa. Other important steps for market integration are harmonisation of technical and market standards, and a higher degree of empowerment in the regulatory area.
- Privatisation of state-owned utilities is not required to launch a cross-border competitive market. As is evident from the Southern African Power Pool and the "old" Nord Pool models, electricity markets can reach a fairly advanced stage of integration even in the presence of vertically integrated state-owned monopolies. Nevertheless, separation of generation and transmission is highly recommended in order to make such markets more efficient and transparent.
- More research is required to understand the actual and potential environmental and socio-economic impacts arising from the damming of large rivers for exports of hydropower. This aspect is missing in virtually all existing regional interconnection studies.

### INTRODUCTION

ASEAN countries are widely diverse in geographical, economic, and cultural terms but, as an entity, form the seventh-largest economy in the world with a combined GDP of US\$2.4 trillion in 2013. The general notion about the ASEAN region is that it is expected to grow rapidly over forthcoming decades to become the world's fourth-largest economy by 2050. In

2013, ASEAN accounted for about 8.5 per cent of the world's population, consumed about 4.5 per cent of world's primary energy and produced 5.7 per cent of the total global energy. Total electricity consumption in ASEAN has increased from approximately 180 TWh in 1990 to over 800 TWh in 2013. Factors behind this trend have been strong levels of population and economic growth as well as

increased energy consumption per capita. However, per capita electricity consumption and electricity access are currently well below those of more developed economies, creating a prospect for an even higher pace of growth in demand if these constraints can be removed.

ASEAN member states have abundant primary energy resources to address these needs, but they are unevenly distributed in the region. Utilising these reserves without cooperation may be a challenging task, which presents a compelling case for ASEAN to coordinate and integrate energy systems between its countries.

### **KEY ELEMENTS OF MARKET INTEGRATION**

In this review of the experiences of selected regional electricity markets around the world, we identify some key elements of integration that emerged independently as those markets have evolved. These are:

- coordinated physical infrastructure development;
- standardised and harmonised rules of operation;
- some form of market competition; and
- empowered governing or coordinating institutions.

Prioritisation of these elements and the sequence of steps to achieve them are not straightforward, as they depend on the regional market's environment and history. As such, these elements are still undergoing development in the international markets considered in this study.

Market integration in Europe adopted a top-down integration approach, capitalising on the legal system of the European Union (EU). In contrast, the Nordic and Southern African markets developed on an incremental and voluntary basis, largely driven by the utilities themselves. Given diverse regional circumstances in ASEAN, and the absence of an overarching legal system similar to that of the EU, we believe that the latter approach is more suitable for ASEAN. The importance of coordinated infrastructure development is particularly critical in markets with growing electricity demand, such as SAPP and ASEAN. Insufficient generation and transmission infrastructure in Southern Africa has seriously

limited the progress of an otherwise successful market and undermined the benefits of market integration. Lack of infrastructure development in SAPP is principally due to non-cost reflective tariffs, low market transparency, and weak protection of third party investors. These aspects deserve consideration by ASEAN, where the required generation capacity is expected to double by 2040.

Another important question is whether regulated electricity sectors, in particular ASEAN countries create barriers for cross-border power trade. While this is a matter for national policy in each sovereign country, it is of particular significance for the LTMS project, where Laos, Thailand, and Malaysia have single buyer models, while Singapore has a competitive electricity market. Consequently, hydropower imports by the latter may undermine the competitiveness of the non-subsidised gas-fired power generators in Singapore given its significantly lower short-run marginal cost. Clearly a benefit to consumers in Singapore, but at the cost of reduced domestic supply security.

### **BENEFITS TO PARTICIPATING COUNTRIES**

At its current stage, market integration is mainly focused on the development of the physical interconnection capacity between single member states. There has been little progress in other areas, such as development of complimentary institutional, as well as legal and commercial frameworks for an integrated electricity market. It could be argued that this is because there is no clear vision about the fully developed market. One way would be developing a competitive electricity market open for all participants, such as the Nord Pool market, which would require ASEAN countries to maintain a very high level of cooperation and trust between the member states. Another option could be a physical interconnection scheme with a limited market framework which links several heterogeneous grids and markets in the region, similar to that of the SAPP.

The benefits of creating an ASEAN-wide interconnection system range from cost and fuel savings to enhanced energy security of the countries and environmental benefits for the region. The increased geographical coverage

and integration of a common grid permit advantage to be taken of a range of available resources. Most notable is displacing the use of hydrocarbons with cheaper hydropower from the Mekong basin region. Not only would this provide these economies with cheaper electricity, it would also reduce greenhouse gas emissions.

### **CHALLENGES FOR INTERCONNECTION PROJECTS**

A range of obstacles have delayed the progress of integration of electricity sectors in ASEAN. The member countries vary greatly in their size, landscape, levels of economic development, and national energy resources. They also vary considerably in power sector regulations, market structure, and technical characteristics. All of these creates barriers for effective regional energy cooperation.

In theory, large interconnected systems need less reserve capacity for the same level of system reliability compared to disconnected power systems. In the case of power shortages, interconnected regions can draw supply from other regions instead of relying on domestic generation capacity. This ability reduces required investments in power sector infrastructure and creates economic benefits in the form of cost savings. However, in order to reap these benefits, countries would need to give up a certain degree of self-sufficiency in domestic supply and rely on power exchange instead. However, energy security concerns of individual countries place emphasis on self-sufficiency rather than on cooperation. Currently, national power development plans in most ASEAN countries give clear priority to domestic power generation.

Different technical standards of power system operations between ASEAN member states is another limiting factor. Although countries have common technical standards for all national utilities, these standards can greatly vary between them. Currently, there is still no set of common technical standards for ASEAN.

It is also unclear how the financing for all these projects is going to be sourced. The completion of some interconnections is realistic because of existing funding from multilateral development banks, bilateral agencies, and the private sector. However, other ASEAN Power

Grid projects lack financial viability, although they may be justified for their public good benefits.

Institutional and administrative features of power systems in different countries are also likely to differ in many ways, hindering technical and operational dimensions of an interconnection. Even if funding is available, electricity grid interconnections are complex to develop and manage, not to mention that ASEAN countries are at different stages of market liberalisation. Power tariffs and electricity subsidies also differ markedly among ASEAN countries, and so do the taxation rules and the sequence of approval procedures. Such trade and investment barriers do not promote a secure investment environment, particularly for private investors.

Tapping into hydropower potential in the Mekong basin may create a range of environmental and socioeconomic damage, such as loss of biodiversity of global importance, increased food insecurity for millions of people, and increased international tensions – all of which could outweigh the benefits of integrated electricity markets. All of these aspects must be considered by policy makers in ASEAN when designing a vision for the use of a common, shared, resource.

### **CONCLUSION**

Given the commitment of ASEAN member countries to increase cross-border interconnection and power trade, we suggest in the table below, three market design options and the required steps to achieve them. In setting out these options, we have sought to incorporate important lessons derived from international experiences analysed in the study.

### **WHAT TO LOOK OUT FOR**

- Move towards the unbundling of power sectors in countries which to date have not done so;
- The phasing out of non-cost reflective tariffs that deter private investors; and
- Luke-warm interest from many countries due to security of supply concerns.

<b>Option 1</b> Multilateral trade of excess power via long-term contracts	<b>Option 2</b> Multilateral trade with spot exchange	<b>Option 3</b> Fully competitive power markets
<b>Closest analogue:</b> Nordic countries before 1990	<b>Closest analogue:</b> Southern African Power Pool	<b>Closest analogue:</b> Nord Pool, some European countries
<b>Steps required:</b> - Formulation of institutional and contractual arrangements for cross-border power trade - Some harmonisation of technical and regulatory standards - Coordination of system operation between countries for electricity transfers - Signing of contracts between state-owned utilities on pre-arranged terms - Setting up a separate entity to trade power in countries with competitive markets (e.g. Singapore) on pre-arranged terms - Transit charge is optional, although desirable	<b>Steps required:</b> - Formalising the market institution with relevant committees - Setting up independent and empowered association of energy regulators - Agreement on coordinated infrastructure development plans - Development and adoption of comprehensive network codes including grid connection codes, system operation codes, and market codes - Deeper harmonisation of existing national standards with grid codes - Setting up market operator and legal market entity - Phasing out energy supply subsidies	<b>Steps required:</b> - All steps under Option 2 plus: - Vertical unbundling of state-owned utilities - Full independence of Transmission System Operators from electricity production - Unrestricted and non-discriminatory grid access to all participants - High market transparency and access to information for all market players - Sophisticated methods of system balancing and transmission capacity allocation
<b>Pros:</b> - Easy to implement - Does not require power sector reforms - Provides mutual benefits in system security	<b>Pros:</b> - More efficient than Option 1 - Provides greater benefits to all efficient participants - Can react to market signals - Creates pathway for Option 3	<b>Pros:</b> - Most efficient of all options - Reduces wholesale electricity prices - Provides greater benefits to all efficient participants - Increased market liquidity - Attracts private sector investments
<b>Cons:</b> - Inefficient - Low flexibility as market signals are missing - Retains non-competitive practices - Infrastructure investments are difficult, particularly in transmission - Low private sector participation	<b>Cons:</b> - Presence of unbundled state-owned utilities deters private sector participation - Information asymmetry - Transmission System Operators are not independent	<b>Cons:</b> - Requires difficult domestic reforms - Requires high level of technical sophistication and experience in operating power markets - Requires stable political climate with high protection of participants' rights

*Anton Finenko, Anthony D Owen, PhD, and Jacqueline Tao are, respectively, Research Associate, Principal Fellow, and Research Associate at the Energy Studies Institute of the National University of Singapore.*

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