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Economic Integration in Southeast Asia: The Case of the ASEAN Power Grid

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Abstract The Association of Southeast Asia Nations (ASEAN) Power Grid (APG) is an interesting case study on how and why beneficial economic integration may not proceed smoothly. This paper explores the discrepancy between the feasible and beneficial prosperity and the current modest progress for the APG, and its reasons and possible solutions informed by lessons from European power market integration. It compares Europe's experiences in energy market integration with the ASEAN's and identifies two models of regional power connectivity: the European Union (EU) and the Nordic Power Pool, respectively. The bottom-up approach in the Nordic Power Pool suggests that the ASEAN could still promote regional power connectivity even without a supranational authority as in the EU. The paper further suggests that the APG should not be limited by political boundaries. Full benefit recognition, cost-benefit sharing, soft enforcement mechanisms, and human capacity building are the ways forward for the ASEAN to attain power connectivity.

Keywords: Economic Integration, Power Connectivity, ASEAN Power Grid, Southeast Asia, Europe.

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I. Introduction

The Association of Southeast Asia Nations (ASEAN) Power Grid (APG) is an interesting case study regarding how and why economic integration may not proceed smoothly. Over the past 30 years, the ASEAN has become increasingly known for its economic integration initiatives, of which energy has always been a key focus (APAEC 2015). The ASEAN has evolved dramatically since its establishment in 1967 and has become East Asia's main source

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of regional economic integration initiatives, including ASEAN Plus One, ASEAN Plus Three, and the East Asia Summit (Dent 2017, Frost 2008). Originally founded in 1967 by just five countries—Indonesia, Malaysia, the Philippines, Singapore, and Thailand—this regional organization gradually expanded to also include Brunei, Vietnam, Laos, and Myanmar. Cambodia was the last country to join the ASEAN in 1999, making for a total of 10 member countries that comprise the organization today. The ASEAN Vision 2020, adopted by ASEAN leaders in 1997, provided a fundamental cooperation framework for the region and served as the foundation for the eventual establishment of the ASEAN Economic Community (AEC) in 2015. The AEC Blueprint 2025 (AEC 2025) envisions an integrated, competitive, and resilient region, as well as “a more dynamic and resilient ASEAN,” that can address challenges such as energy security issues, including the incorporation of “a sustainable growth agenda” that promotes green technologies (ASEAN Secretariat 2015).

The APG is a core project of the AEC and provides an excellent case study in the examination of Southeast Asian regional integration. Of the five characteristics, or pillars, of the AEC 2025, four are related to energy connectivity.¹⁾ The connectivity of energy networks, including the APG and the Trans-ASEAN Gas Pipeline (TAGP), is one key component (pillar iii) required for a fully integrated ASEAN (pillar i), in addition to enhanced resilience (pillar iv). It is recognized that to make the ASEAN more competitive (pillar ii), the energy sector must be competitive, open, and aligned with the greater economy. Energy is an important area in which equitable economic development (pillar iv) can be implemented, because electricity services must eventually traverse the entire region. As of 2016, about 65 million people did not have access to electricity in the ASEAN, mainly in Indonesia (23 million), Myanmar (22 million), and the Philippines (11 million) (IEA, 2018).

Although quite a few papers do exist in the academic literature on the topic of the APG, little attention has been paid to its implications for overall economic integration or how the European experience might help the APG surpass the limitations of its current plan. Ahmed *et al.* (2017b) summarized the current complications that member countries must confront in order to develop an ASEAN transmission structure, with a central focus on the technical issues related to the exchange of clean and sustainable energy during transmission. Chang and Li (2013) advocated for the improvement of optimal paths for power generation capacity in the ASEAN. This study, as well as a subsequent one by Ahmed *et al.* (2017a), focused on infrastructure development. Huber *et al.* (2015) examined cost-optimal pathways for creating a sustainable ASEAN power system. Huang *et al.* (2019) assessed the ASEAN's current power grid flexibility and found that the ASEAN member states (AMS) must enhance their grid

1) The AEC 2025 consists of five interrelated and mutually reinforcing characteristics (pillars), namely, (i) a highly integrated and cohesive economy; (ii) a competitive, innovative, and dynamic ASEAN; (iii) enhanced connectivity and sectoral cooperation; (iv) a resilient, inclusive, people-oriented, and people-centered ASEAN; and (v) a global ASEAN (ASEAN Secretariat 2015).

flexibility in order to encourage the increased use of renewable electricity and foster a reduction in overall system costs. Adsoongnoen *et al.* (2007) proposed a transmission pricing method for cross-border electricity trading in the ASEAN. Her *et al.* (2018) studied various methods that would enable the fair distribution of the APG's benefits to its constituent member countries. Shi *et al.* (2019) identified challenges to regional power connectivity within the ASEAN and between ASEAN members and neighbors and suggested how and when regional cooperation may be leveraged to facilitate enhanced connectivity. Although all of these papers studied the many critical issues surrounding the development and operation of the APG, they did not assess whether or not the APG is either economically or politically feasible and why economically feasible integration projects sometimes do not proceed well. In 2014, Shi assessed the progress of the APG and the TAGP in relation to targets defined in 2015 by the AEC Blueprint. However, this work is outdated. A comprehensive research report edited by Li and Kimura (2016) examined the institutional and political barriers to the formation of an integrated ASEAN electricity market and the possible business models and market design methods proposed for the advancement of the ASEAN based on similar European experiences. It was argued that the example of the well-integrated European Union (EU) electricity market provided experiences and lessons for the integration of the ASEAN's electricity market. However, its emphasis is more on market design rather than how the broader institutional and political environment interacts with efforts to advance the APG. Yao *et al.* (2019) assessed how China's Belt and Road Initiative could play a role in the facilitation of ASEAN electricity market integration.

The goals of this paper are to explore the discrepancies between feasible and beneficial prosperity and reasons for the modest progress of ASEAN electricity market integration, as well as possible solutions informed by lessons learned from European power market integration. The EU leads the world in electricity market integration, so decision makers involved in the APG development might learn from the European experience, especially from the Nordic Power Pool (Nord Pool), which shares several similarities with the ASEAN's current circumstances.

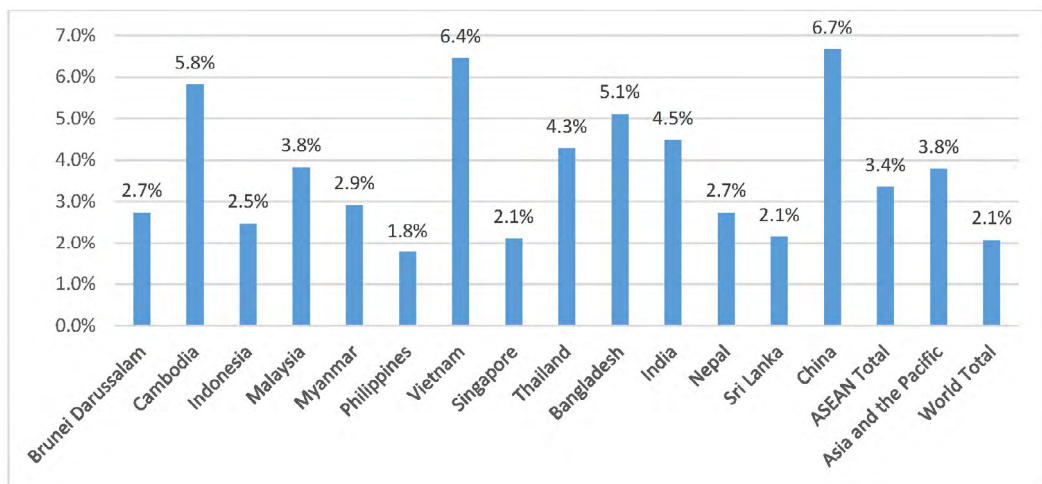
The next section of this paper briefly explains the need for, and current status of, regional power connectivity among the AMS. This is followed by an examination of regional power connectivity in Europe and lessons that can be gleaned for the benefit of the ASEAN. The concluding section discusses policy implications.

II. Regional Power Connectivity in the ASEAN

A. The ASEAN's energy landscape

The ASEAN's annual gross domestic product growth averaged 5.1% (at constant prices) between 2000 and 2015, a higher average growth rate than that of the Asia and Pacific Region as a whole (4.6%) and almost twice the world average of 2.8% (ESCAP 2019). The ASEAN's rapid economic growth has inevitably led to a concurrent growth in energy consumption. Its total primary energy supply (TPES) during this period averaged 3.4% per year, which was much higher than the global average of 2.1% (see Figure 1).

Figure 1. Average annual TPES growth rate, 2000–2015



(Source) Asia Pacific Data Portal.

However, there is a large imbalance in the ASEAN's energy consumption as compared with that of its neighbors. Their per capita greenhouse gas emissions also vary considerably. The ASEAN's energy use per capita was only 53.5% of the global average in 2015. As shown in Table 1, there is a big gap between per capita energy use in Southeast Asia and in its neighboring countries. In 2015, the highest per capita TPES in Southeast Asia was 6.51 tons of oil equivalent (toe) in Brunei, whereas the lowest was 0.38 toe in Myanmar. Emission patterns are similar to those of per capita energy consumption. Brunei discharged 14.4 tons of carbon dioxide (CO₂) per capita in 2015, whereas Myanmar discharged only 0.5 tons of CO₂ per capita (see Table 1).

Table 1. Energy and environmental indicators for the ASEAN and its neighbors

Country	TPES, toe/person	Emissions per capita, t/person	Emission intensity, g/dollar (2011 PPP)	Electricity consumption, kWh per capita		SDG-7 Access to electricity (% of population)	
	2015	2015	2015	2000	2014	2000	2016
Brunei Darussalam	6.51	14.4	193	7544	10,243	100	100
Cambodia	0.45	0.5	157	33	271	16.6	49.8
Indonesia	0.87	1.7	165	390	812	86.3	97.6
Lao PDR				.	.	43.2	87.1
Malaysia	2.80	7.2	287	2748	4596	97	100
Myanmar	0.38	0.5	92	76	217	44.1	57
Philippines	0.51	1	149	499	699	73.5	91
Vietnam	0.79	1.8	324	285	1411	86.2	100
Singapore	4.63	8	99	7575	8845	100	100
Thailand	1.97	3.6	237	1448	2540	82.1	100
Bangladesh	0.24	0.4	140	101	310	32	75.9
India	0.65	1.6	274	395	806	59.4	84.5
Australia	5.27	16	365	10,194	10,059	100	100
China	2.13	6.5	486	993	3927	96.2	100
ASEAN Total	0.99	2	194			78.7	92.7
Asia and the Pacific	1.53	4	352			79.2	92.7
World Total	1.85	4.4	289	2384	3127	77.9	87.4

(Source) Electricity consumption per capita was extracted from *World Development Indicators*; the other data were extracted from the *Asia Pacific Energy Portal* (ESCAP 2019).

In terms of electricity, imbalances exist in both the levels of consumption and rates of access. As of 2016, five of the AMS achieved universal access to electricity, but over half of Cambodia's population remains limited access to electricity. Only three countries (Brunei, Malaysia, and Singapore) had an electricity consumption level that exceeded the world average. In 2014, Myanmar exhibited the lowest electricity consumption per capita (217 kWh) in the ASEAN, slightly lower than that of Cambodia (271 kWh), whereas Brunei (10,243 kWh) had the highest electricity consumption per capita (*see* Table 1). According to one United Nations standard (AGECC 2010), as of 2014 only Brunei, Malaysia, Singapore, and Thailand had achieved the minimum electricity consumption level required for a modern society (2000 kWh per capita per year). According to the International Energy Agency (IEA) (2018), as of 2016 there were still some 65 million people who did not have access to electricity in the ASEAN, concentrated mainly in Indonesia, Myanmar, and the Philippines.

Because the ASEAN remains to be one of the fastest growing regions in the world, its demand for energy is expected to soar over the next two decades. The fifth ASEAN Energy Outlook, in its business-as-usual (BAU) scenario, projected that the ASEAN's TPES will grow

at an annual rate of about 3.4% between 2016 and 2040, while electricity demand will be tripled (ASEAN Centre for Energy 2017c). Increases in the demand for energy are expected to continue to be dominated by demand for fossil fuels, notably coal; the share of fossil fuels in TPES is expected to increase from 76% in 2016 to 78.6% in 2040, whereas coal's share of the TPES will increase from 12% in 2015 to 23% in 2040 in this BAU scenario (ASEAN Centre for Energy 2017c).

B. The need for regional power connectivity in the ASEAN

These significant increases in energy consumption that are expected to occur over the next two decades and the fossil fuel-dominant energy mix creates two challenges for the ASEAN's energy sector. First, there will be a widening gap between supply and demand, which will create new risks in the security of the energy supply and its affordability. The supply-demand gap will continue to expand over the next two decades, leading to growing import dependence, particularly on oil and natural gas supplies (ASEAN Centre for Energy 2017c). It is estimated that the ASEAN's oil import dependency will increase from 44% in 2011 to 75% in 2035. By 2030, all ASEAN member countries will be net importers of fossil fuels, with the exception of Brunei and Indonesia (IEA 2015).

Second, the increasing consumption of fossil fuels, particularly coal, will lead to growth in CO₂ emission levels from 1446 million tons (Mt) in 2015 to 3460 Mt in 2040 in the BAU scenario (ASEAN Centre for Energy 2017c). Between 2015 and 2040, these additional CO₂ emissions from the ASEAN are expected to grow roughly equivalent to those of the world's fifth highest emitter, Japan, in 2014 (World Bank 2018). This increase in the ASEAN's CO₂ emissions could offset global efforts to reduce emissions. Also quite concerning is an assessment of whether a country's intended nationally determined contribution goals were sufficient to meet the 2 °C pathway limit, which determined that the goals of all of the assessed ASEAN countries, namely, Malaysia, Thailand, Indonesia, and Vietnam, were “insufficient” (Gao *et al.* 2019).

The development of the ASEAN's abundant low-carbon energy sources could enable the simultaneous addressing of these two challenges. The ASEAN could potentially create 241 GW of hydropower capacity. This is more than the ASEAN's total generation capacity as of 2015. Southeast Asia also has a large potential to employ solar photovoltaics and biomass for energy use. Indonesia alone possesses over 32.6 GW of geothermal resources (see Table 2). The development of the ASEAN's low-carbon energy resources could replace many of the planned thermal power plants-without increasing generation costs. At present, even the most cost-effective hydrothermal and geothermal resources are underdeveloped, due mainly to an uneven distribution in low-carbon energy resources and a mismatch between energy demand and production (Shi 2016).

Table 2. ASEAN member states' renewable power potential

Country	Biomass (GW)	Geothermal (GW)	Hydro (GW)	Wind (GW)	Tidal (GW)	Solar (kWh/m ² /day)	Installed capacity (GW), 2015
Brunei			0.07			9.6-12	0.9
Cambodia	-		10			5	1.69
Indonesia	32.6	28.9	75		49	4.8	73.7
Lao PDR	1.2	0.05	26	0.68*		3.6-5.3	5.8
Malaysia	0.6		29			4.5	30.0
Myanmar			40.4	4		5	5.3
Philippines	0.24	4	10.5	76	170	5	18.8
Singapore			0	0	0.03-0.07	3.15	13.0
Thailand	2.5		15	5.3-6.4	-	5-5.6	58.6
Vietnam	0.56	0.34	35	7	0.1-0.2	4.5	38.6
ASEAN	37.7	33.3	241.0	87	219		246.7

(Source) The installed capacity data were for 2015 and were sourced from the *Asia Pacific Energy Portal*; the other data were extracted from the *ASEAN Power Cooperation Report* (ACE & CREEI 2017); Lao PDR's wind potential data were from IRENA (IRENA 2018).

The presence of underdeveloped clean energy resources amid an increasing electricity demand and progressively stiffer emission control measures justifies the importance of regional power connectivity. The surge in variable renewable energies, namely, solar and wind, enhance the case for improving regional power connectivity. Although some of the AMS are rich in fossil fuel resources rather than low-carbon resources, others are resource-poor, with a limited indigenous energy supply. This further constrains each individual country's choices in terms of their energy supply. However, it is precisely this mismatch that makes the development of hydropower in Vietnam, Myanmar, Laos, and Cambodia very logical.

Pumped hydro capacity is undergoing significant development in the region. Most of its existing pumped hydro capacity, totaling around 1.7 GW as of 2016, is located in the Philippines and Thailand, which are two major consumers of power. Indonesia was expected to commission its first pumped hydro plant generating 1.04 GW in 2019, and Vietnam's first project to generate 1.2 GW was approved in January 2017 (IRENA 2018). These projects may function as large-scale energy storage and play an important role in the integration of a variety of renewables for the region as a whole.

Given the mismatch between low-carbon electric power generation potentials, high-power consumption among member states, and the fossil fuel-dominated energy mix, regional power connectivity could increase the penetration of low-carbon energy at lower prices (UN-DESA 2006). In addition to the economic and environmental benefits, regional power connectivity in the ASEAN might enhance regional energy security, improve generation flexibility and load factors, and mitigate the intermittence of variable renewable energies (ACE *et al.* 2018).

C. The APG

The ASEAN recognizes the great importance of a reliable, efficient, and resilient electricity infrastructure to promote regional economic growth and development (APAEC 2015). Of particular interest is (i) the development of hydropower potential in the member states of Cambodia, Laos, and Myanmar for domestic use; (ii) the construction of cross-border interconnections to supply the growing power demand of Malaysia, Thailand, Singapore, and Vietnam; and (iii) facilitating trade and promoting a regional power market. To achieve these goals, the ASEAN established regional power grid interconnection arrangements throughout the APG under the auspices of the ASEAN Vision 2020.

It is envisaged that the development of the APG will occur step by step: initially on cross-border bilateral terms and then be expanded to include sub-regional arrangements (ASEAN Secretariat 1997). The “Lao PDR-Thailand-Malaysia-Singapore (LTMS) Power Integration Project” is the first pilot project for multilateral electricity trade in the ASEAN. The LTMS project is now selling 100 MW electricity from Lao PDR to Malaysia through Thailand (Yao *et al.* 2019). Because of difficulties in incorporating Singapore's electricity market into fixed-volume trading, Singapore is not participating at this stage.

At the sub-regional level, the Greater Mekong Sub-region (GMS) is promoting grid connectivity and power trade among five of the AMS: Cambodia, Lao PDR, Myanmar, Thailand, Vietnam, and China's Yunnan and Guangxi Provinces. GMS power market development adopts a “building block approach” to physically facilitate the cross-border transmission of power by developing essential grid interconnection infrastructure (ADB 2018). The GMS countries' experiences demonstrate that the factors that have enabled GMS countries to implement high-priority, sub-regional projects and initiatives are both pragmatic and action oriented. A results-focused approach is necessary, as well as the development of mutual trust and goodwill (ADB 2011).

As of May 2017, there were 14 cross-border connections at eight out of the 16 planned APG interconnection systems. The capacity under the APG connections had increased from 3489 MW in 2015 to only 5212 MW in 2017 in the ASEAN region (ASEAN Centre for Energy 2017a). In November 2017, a targeted capacity of 30,000 MW was set as a goal for the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase I (2016-2020), in order to achieve a stable and high-quality multilateral power trading system (ASEAN Centre for Energy 2017b).

The establishment of the AEC in 2015 and its further advancement provided the political, regulatory, and policy framework for the establishment of a regional energy market. Building on the successful realization of the AEC in 2015, the AEC 2025 envisions that power connectivity will contribute to the development of an integrated, dynamic, competitive, and resilient ASEAN (APAEC 2015).

The key implementation arrangements for ASEAN energy cooperation such as the APG

include summits, ministerial meetings, senior official meetings, and the ASEAN Centre for Energy (ACE). The ACE and the Regional Policy and Planning Sub-Sector Network will monitor the progress of the APG, as well as other measures set forth in the APAEC (APAEC 2015). Similar to the ASEAN approach, the GMS program has been pursued through institutional arrangements consisting of leaders' summits, ministerial-level conferences, and various levels of meetings (Shi *et al.* 2019).

Despite support from the AEC and the efforts of utility companies, the ASEAN's power connectivity is still in its preliminary stages of development. There is neither a single regional electricity network nor a unified ASEAN regional energy market (Halawa *et al.* 2018). Power grids are, to a large extent, restricted by national boundaries, and all trans-national power grid connections under the APG plan continue to be governed by bilateral arrangements. Existing cross-border energy exchanges are either very small or based on pre-established bilateral purchase agreements. Furthermore, the completion of all currently planned interconnection systems, which are bilateral, will not lead to the development of any complete regional power grid. There is no clear vision regarding the future of the APG: whether it should be a harmonized and integrated single grid or a few heterogeneous national power grids that are linked by an ASEAN-wide backbone (Shi & Kimura 2013).

There are numerous obstacles to the APG and the establishment of an integrated ASEAN energy market. First, the AMS has long attached great importance to the concepts of sovereignty and nationalism. This position has not changed—even after the AEC was established—subsequently prompting the AMS to protect their own markets rather than cooperate with energy trading. Second, some members of the AMS do not have the capacity to govern a technically and economically complex energy sector. Third, the ASEAN region covers a wide area with hundreds of peninsulas and thousands of islands. The absence of a single, clearly bounded continental region makes it difficult to construct power grids across the entire ASEAN region. Last, political, economic, and social cultures vary greatly, making ASEAN energy market integration less efficient (Andrews-Speed 2016).

To address these challenges and achieve an integrated ASEAN electricity and energy market, the ASEAN ultimately needs to harmonize intra-regional policies and legal standards and establish a standardized power purchasing license in order to formulate a taxing framework for power trading and create clear pathways for cross-border investment (ASEAN Centre for Energy 2017a).

III. Approaching Regional Power Connectivity: The European Experience

Since the establishment of the European Coal and Steel Community (ECSC), energy always played a key role in European economic integration (Alter & Steinberg 2007). In the electricity sector, three legislative packages that passed in 1996, 2003, and 2009 gradually opened the European electricity sector up to competition from an internal European electricity market (KUL Energy Institute 2015). As the EU leads the world in electricity market integration, those involved in the development of the APG can learn from European experiences, specifically those of the Nord Pool, which shares several similarities with the ASEAN's circumstances. As one of many research methodologies used in the social sciences, the qualitative case study method is employed to investigate a phenomenon within its real-life context (Baxter & Jack 2008). This section analyzes two cases in the European electricity market to highlight different approaches to electricity market integration and how a bottom-up approach could be applicable to the ASEAN region.

A. The EU's single energy market: the top-down approach

The creation of the European electricity market is considered to be the world's most extensive integration of various state-level and national electricity markets (Li & Kimura 2016). Energy cooperation in Europe dates back to the 1950s with the creation of the ECSC and Euratom, upon which the foundation of the EU was built. In 1988, the single energy market goal was identified as a key component of the establishment of a single European market for goods, services, capital, and labor (Andrews-Speed 2016).

The electricity and gas markets are two key areas of EU energy market integration. However, the starting point for the European electricity market has few differences from the ASEAN situation of today. Before the 1990s, the European electricity sector was a regulated monopoly in which vertically integrated companies in each country were responsible for the generation, transmission, distribution, and supply of electricity (KUL Energy Institute 2015). Over time, continental Europe established a synchronous grid that includes most continental EU member states. Currently, the continental European power system includes 26 countries and is one of the largest interconnected power systems in the world (ENTSO-E 2019). Power exchanges such as the Nord Pool are considered to have played a critical role in facilitating the development of infrastructure interconnections.

EU energy market integration was elaborated in three steps, referred to as the first, second, and third "energy packages." A common goal during each of these three packages was the liberalization of the energy market. The first energy package included the EU directive of 1996 (1996/92/EC), which set common rules for electricity in the internal market. The unbundling

of generation and transmission was a key requirement in this first package. The second energy package, adopted in 2003 (2003/54/EC), further advanced market liberalization by separating transmission and distribution, establishing national energy regulators, and enabling free choice in the retail markets for industrial consumers by 2004 and for domestic consumers by 2007. The third energy package, adopted in 2009 (2009/72/EC), further strengthened market liberalization by means of “ownership unbundling” or the effective separation of transmission and distribution systems from other business activities. The third package established binding rules for cross-border power grid management and created the Agency for Cooperation of Energy Regulators (ACER) and the European Network of Transmission System Operators for electricity and gas (Li and Kimura 2016).

The third energy package was passed into law in March 2011 with the goal of fostering the maintenance of a more harmonized, integrated European energy market. It consisted of directives and regulations for the establishment of common rules pertaining to the internal energy market and access to the network for cross-border power trading. It reformed several aspects of the market, including unbundling ownership in order to stipulate a separation between energy suppliers and network operators, strengthening the independence of regulators to generate internal energy market competitiveness, and establishing the ACER. The ACER plays a central role in encouraging electricity market integration by promoting cooperation among national energy regulatory entities and monitoring their activities (ACER 2019). It provides a non-binding framework for European electricity market integration. This framework is a base for drafting network codes, namely, a set of arrangements that covers technical, physical, and operational interconnectivity, as well as market design fundamentals. It also governs how market participants generate, trade, and consume electricity within an effectively integrated electricity market (Rakhmah and Li 2016).

All of these arrangements reinforce a top-down approach to facilitating the EU single energy market. The EU market's integration has benefited from the EU's rules and policies on energy market liberalization and integration. European energy policies have been implemented through a legal system governed by EU regulations and EU directives. Under the EU framework, member states streamline their national laws and regulations to conform to the regulations and directives of the EU. This enables member states to avoid inconsistencies in their institutional aspects. The regional court also ensures that EU plans and targets are enforced in member countries and may step in to resolve any disputes. The European Commission can refer cases of non-compliance to the European Court of Justice (European Commission 2019). This institutional arrangement helps to find ways to achieve technical and other types of harmonization, thus allowing the establishment of a synchronized grid.

B. The nord pool experience: the bottom-up approach

Although pan-EU energy market integration, including power connectivity, has been promoted by a top-down approach, the success of the Nord Pool demonstrates that a bottom-up approach can also facilitate power connectivity. Such a bottom-up approach is particularly valuable in the absence of overall architecture.

The Nordic electricity market, or the Nord Pool that launched in the early 1990s, is one of the most important and tangible outcomes of energy cooperation in the Nordic region (Andrews-Speed 2016). The Nord Pool consists of operators from four Nordic countries: Sweden, Finland, Norway, and Denmark. Unlike the EU top-down model, the Nord Pool was initiated and driven by the utility companies and developed gradually on a voluntary basis. It started with bilateral exchanges between Norway and Sweden and then gradually expanded to include Denmark and Finland, ultimately achieving overall integration with the greater EU market (Bredesen and Nilsen 2013).

The Nord Pool is distinct from the EU model of integration in that it regulates the energy market on the basis of general principles rather than detailed rules (Andrews-Speed 2016). Since the beginning of the Nord Pool's formation, the utilities of its constituent countries were the decision-making bodies of the Nord Pool market, which were required to behave in accordance with market principles rather than according to the supervision or regulation of a supranational body. On the basis of principles, electricity utilities in the Nordic region were regulated or subjected to different roles on the part of regulators, market operators, transmission system operators, and market players. As for the regulator role, the national authorities of the respective countries still regulate power trading; as for the market operator role, the Nord Pool is the only common market for power trading; as for the transmission system operator role, system operators in the respective countries own their national grids; and as for the market player role, electricity producers, consumers, and traders are all registered as exchange members in the Nord Pool (Flatabø *et al.* 2003). All of the participants entered the Pool on a voluntary basis. Working based on market rules, the Nord Pool is a non-mandatory pool, and there is no single significant market power in the entire Pool area (Hjalmarsson 2000).

Nordic experiences in energy cooperation indicate that regional power connectivity can take place within a small group of countries that have convergent interests. The pragmatic, bottom-up Nordic approach has been applied to the Indian and southern African power pools, suggesting that a regional power market can be established between states or sub-national entities even if the overall power industry is state owned and vertically integrated and electricity tariffs are subsidized. This further implies that ASEAN power connectivity might be advanced under the current circumstances if a pragmatic, step-wise approach is adopted (Andrews-Speed 2016).

IV. Europe's Lessons and the Implications for ASEAN Power Market Integration

A. Lessons learned from the EU's energy market integration

The European experience demonstrates that although a top-down approach is efficient for realizing an integrated energy market, it is possible to establish such a market using a bottom-up approach. This fact has reference value for ASEAN electricity market integration.

On one hand, the EU's top-down approach is not applicable to the ASEAN; pan-ASEAN power connectivity and trade are unlikely to be achieved in the new few decades. A successful regional integration requires that the constituent countries share a strong political desire to cooperate with their neighbors and that the necessary region-wide institutions exist. The EU experience demonstrates that political will and relevant enforceable plans under regional governance are key factors for facilitating the establishment of regional power connectivity. A desire to achieve energy competitiveness, energy sustainability, and energy supply security has motivated Europe's integration of its electricity market. The EU reformed the electricity market-by liberalizing, privatizing, and restructuring the electricity sector-in order to create a competitive, single, and integrated European electricity market. The accomplishment of such results depended on a tremendous effort driven by a motivated European Commission (Li & Kimura 2016). The EU legal framework mandated members to comply with the laws and regulations mutually agreed upon at the EU level. In contrast to EU practice, a lack of political will create delays and constraints that thwart the growth of the electricity trade (ECA 2010).

Unlike Europe, in which the European Community functions as a strong supranational authority to drive the alignment of technical standards, the ASEAN does not have the benefit of such a region-wide, supranational authority (Lee 2017). The ASEAN region is governed in the so-called unique ASEAN way (Deloitte 2015), founded upon a multilateral approach firmly based on the principles of consensus, non-interference, and non-confrontation (Bosch 2015). Aside from the AEC, there is no single regional authority that can make and enforce standards, laws, and regulations across member countries in order to achieve ASEAN regional integration.

Furthermore, many countries, including AMS, lack the power, capacity, and capability to harmonize technical standards effectively (ECA 2010). Apart from the significant differences in technical standards, regulations, and laws that are impediments to integration in ASEAN power markets, electricity markets in many AMS have not yet been liberalized and do not even have a vision of future liberalization (Wu *et al.* 2012).

There even exists a fundamental lack of political willingness to realize regional power market integration. Multiple reasons could explain this lack of political will. Currently, individual

ASEAN nations continue to prioritize their individual national energy security over regional integration. This causes a fragmentation in the energy market because a national energy security concept requires self-sufficiency and thus limits regional energy trade (Shi and Kimura 2013, Taghizadeh-Hesary *et al.* 2019). Governments often do not pay attention to regional connectivity, as in the case of the GMS in the 1990s. Instead, they focus more on domestic power sector development (World Bank 1999). As a result, some governments are less keen to support the APG due to their individual need to prioritize the development of their own national grid and protect their own energy sector (Kumar 2015, Olchondra 2016).

On the other hand, bottom-up and incremental approaches are practical in advancing regional power connectivity in the absence of an overall regionally integrated architecture. The institutional mechanism underpinning Nordic energy cooperation is not laws or regulations as in the EU single market but consensus among its constituent members, which is also an ASEAN practice. Without an overall interconnectivity architecture, the formulation of person-to-person interaction might be useful in advancing a regional power market, as in the Nordic case, where regional power trading was initially performed without state agreements (Mundaca *et al.* 2013).

The ASEAN has adopted a gradual strategy to initially allow each possible interconnected system, even if it only covers two or three countries, to be operational. Trading between different systems can begin with power exchanges occurring according to respective production costs, with the savings shared by the participants. Then, more sophisticated and uniform trading systems can be established over time (ACE and CREEI 2017). However, as summarized in Section 2.3, the APG is limited to bilateral connections and power exchanges based on contracts rather than trade.

This bottom-up approach requires that regional power connectivity be able to create benefits for all stakeholders. Therefore, regional interconnection projects can be driven by economic incentives, with the assistance of political agreements, but must not be based solely on political willingness when the economic foundation is not strong enough. However, although there are economic benefits, a concern about energy security and a lack of political trust are still obstacles to the ability to reap all of the benefits (Shi *et al.* 2019).

The bottom-up and incremental approaches should also incorporate enforcement measures that can materialize future visions and plans to construct power grids and integrate the energy market within the ASEAN. Given the consensus-based approach that has been adopted in ASEAN community building, the ASEAN is adept at forging visions and plans for energy development but poor at the ultimate delivery of projects and the realization of such plans (Andrews-Speed 2016).

Despite the fact that a bottom-up approach might advance ASEAN power market integration, further development of regional integration willingness is always desirable. The AEC could advance political trust among the ASEAN countries and thus facilitate a shift away from a

national energy security perspective toward a regional paradigm, which is needed to promote regional energy market integration, including cross-border power trade (Shi 2016). However, since it took the EU two decades to move from an unbundled to an integrated energy market, the ASEAN's power market integration is unlikely to be achieved in the next two decades given ASEAN's lack of overall economic integration as in the EU.

B. Implications for APG integration

On the basis of the aforementioned analysis, several implications can be drawn from which the development of the APG might be accelerated.

First, *the APG development plan should be more open and inclusive so that non-ASEAN countries, such as China, can be included.* The development of the APG is constrained by the current ASEAN institutions. First, the pan-ASEAN concept of the APG limits the progress of the APG to the capability of the weakest ASEAN member. The regional grid plan cannot proceed until Cambodia and Myanmar establish their national grids. What's worse is that, if connected, the unstable voltage and frequent power outages in some of the AMS could seriously affect the overall performance of the regional power grid (Zhang & Zha 2014). Second, the political boundaries of the APG plan limit its cost-effectiveness. Although it is much more cost-effective to integrate with China than the Philippines in the GMS case, GMS integration is seldom highlighted in the ASEAN's discussions on regional power connectivity. The inclusion of China would not only bring in additional financial and technical resources but also lead to higher integration benefits, because China's large power market size and its diversified power generation sources would add a higher comparative advantage to existing APGs. In contrast, the archipelago of the Philippines make the eastern part of the APG more challenged than the GMS.

Second, *governments should recognize the full value of interconnection projects and fairly share the benefits and costs.* A financially unfeasible project can become economically feasible if it has positive externalities on other industries or bring intangible political and environmental benefits (Yun & Zhang 2006). One key challenge faced by any trans-national infrastructure project, such as the construction of a hydroelectric power plant, is that costs and benefits are not evenly distributed. Some countries may incur higher costs while others receive more benefits. Government intervention is required to ensure that the distribution of costs and benefits is fair and acceptable to each of the key stakeholders. Financial feasibility can be improved by government support measures such as fiscal incentives, tax exemptions, and government guarantees. Furthermore, insurance agencies and multilateral banks can, to some extent, provide credit enhancement if government entities are involved.

Third, *regional soft enforcement mechanisms should be established.* Regional institutional cooperation through various regional dialog mechanisms could be a key instrument for the

implementation of interconnection projects. In the absence of a regional authority, the enforcement of APG plans will necessarily be soft and voluntary. Although the implementation of agreements in the ASEAN is voluntary and is thus uncertain and slow, some peer review mechanisms, such as the APEC Peer Review on Energy Efficiency, could be introduced to encourage national governments to implement actions to which they have committed (APEC 2002). A national inter-ministerial committee could be adopted for power connectivity projects and broader cooperation frameworks. The committee could be assisted by a designated focal point or national secretariat that is put in place under GMS cooperation (ADB 2011).

Fourth, *technical and human capacity at both the regional and national levels is necessary to facilitate regional power connections and trading*. Qualified human resources are necessary to advance the regional market through various different stages of development toward completion and for long-term management (Mercados Energy Markets *et al.* 2007). Further, human capacity is needed to understand impacts, make plans, and facilitate changes. For example, the creation of the necessarily complex legal structure requires legal capacities in the participating countries (Shi & Kimura 2013). In one sentence, expertise and human resources are required at the national and corporate levels to materialize the benefits of connectivity as well as maintain them in the long term. The ASEAN could seek assistance from international organizations such as the World Bank or the Asian Development Bank to improve the AMS's capacity to achieve and manage the APG (Li & Kimura 2016).

V. Conclusions

The APG is an interesting case study on how and why beneficial economic integration may not proceed smoothly. The uneven distribution of low-carbon energy resources and the mismatch between energy demand and supply requires a regional interconnection of power grids. Given the increasing energy demand, dependence on fossil fuels and their imports, and the need to control carbon emissions, regional cooperation will bring economic and environmental benefits as well as improvement in future energy security. The concept of the APG emerged at a similar time as did the Nord Pool and was similar to EU energy market integration. The APG development experience suggests that regional integration requires a comprehensive environment that includes not only economic benefits but also conducive institutions.

The European experience in regional power market integration provides two lessons for the ASEAN. On the one hand, the EU single energy market suggests that a top-down approach can effectively achieve regional electricity market integration in just two decades. On the other hand, the Nord Pool experience demonstrates the feasibility of integration in the absence of a supranational authority.

Because of the ASEAN principles of consensus, non-interference, and non-confrontation, the EU's top-down approach cannot be effectively applied in the ASEAN. In contrast, the bottom-up approach suggests that ASEAN power market integration could be advanced at each possible interconnected system within the current institution. However, the under-appreciation of GMS power market integration suggests that the APG needs to go beyond political boundaries in order to take advantage of economic momentum.

Given the specific context of the ASEAN, the key cornerstones to creating an integrated ASEAN power market are full benefit recognition, cost-benefit sharing, regional soft enforcement mechanisms, and technical and human capacity building.

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