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A Green Vision vs. a Brown Outlook: The Future of ASEAN'S Energy Mix

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EXECUTIVE SUMMARY

This working paper assesses competing outlooks for ASEAN's energy mix—highlighting the paradox of its fossil fuel–dominated outlook when contrasted with its aspirations to move toward a greener energy mix—and reviews regional energy security strategies using the SWOT analysis method to evaluate strengths, weaknesses, opportunities, and threats.

Main Argument

Southeast Asia's energy consumption is expected to grow continuously over the next two decades, increasing by as much as 80% according to the International Energy Agency's "new policies scenario." While ASEAN has great ambitions to move toward a cleaner, more secure energy mix, its current outlook is that fossil fuels will dominate the energy mix even in 2035. This paradox between a green vision and a brown energy outlook needs to be addressed in ASEAN. The region has many advantages and disadvantages in its aim to achieve its green vision. Overall, ASEAN has made significant strides toward achieving a greener energy mix; such efforts include advancing energy efficiency, boosting physical connectivity, deploying renewable and alternative energy supplies, promoting the cleaner use of fossil fuels, and reforming fossil fuel subsidies. However, reduction of CO_2 emissions has not been explicitly set in the region's policy agenda, and current progress in the energy action plan is insufficient to secure a green ASEAN. As such, achieving ASEAN's environmental goals will require greater leadership and cooperation among countries in the region.

Policy Implications

To strengthen efforts to move toward a cleaner, greener, more sustainable energy mix, policymakers and other stakeholders in ASEAN should pay particular attention to the following goals:

- Supporting further energy market integration to allow for greater optimization of regional resource endowments and the overall reduction of energy system costs
- Revising energy connectivity plans and promoting the development of both physical and institutional connectivity to enable optimal use of low-carbon energy resources
- Strengthening overall institutional frameworks for cooperation on energy challenges through changing the region's energy security paradigm and building political trust
- Realizing member countries' commitments to the environmental and energy goals outlined in the "ASEAN Vision 2020" and other action plans while enhancing state capacity to carry out these initiatives

With a rising population of 571 million in 2010 and economic growth resulting in an increasing share of global GDP, Southeast Asia is seeing rapid growth in its energy demand and is consequently shifting the center of gravity of world energy demand to Asia, along with its neighbors China and India.[1] Such dramatic and rapid shifts create challenges in providing for energy supply, energy security, and environmental management.[2] Consequently, conflicts between increasing demand from economic growth and declining indigenous supply capacity—and between increasing energy use and mitigating adverse impacts on the environment—are emerging concerns in Southeast Asia that will linger for the near future.

In order to deal with these conflicts collectively, the ten countries of the Association of Southeast Asian Nations (ASEAN)—Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam—initiated formal cooperation in the energy sector in the 1990s under the auspices of the *ASEAN Plan of Action on Energy Cooperation* (APAEC), which serves as the blueprint for the region's cooperation in the energy field.[3] The current plan, *APAEC 2010–2015*, includes seven program areas: the ASEAN power grid (APG), the trans-ASEAN gas pipeline (TAGP), coal and clean coal technology (CCT), renewable energy, energy efficiency and conservation (EEC), regional energy policy and planning, and civilian nuclear energy.[4] These areas cover almost all the potential dimensions of energy cooperation. However, one notable exception is the question of greater explicit cooperation on environmental challenges. The absence of this dimension, combined with evidence that the regional mix is moving toward a more coal-dominant mix, indicates that carbon dioxide (CO_2) emissions from the energy sector have not been appropriately checked and thus at a regional level the development of ASEAN's energy sector is not bounded by any limitation on CO_2 emissions.

To address these concerns, this essay examines the paradox that exists between ASEAN's "green" aspirations and its "brown" outlook and suggests actions that may contribute to reconciling this paradox. Section one outlines this divergence between the region's green ambitions and its brown outlook. Section two presents a SWOT analysis of ASEAN's energy sector, highlighting strengths, weaknesses, opportunities, and threats facing the future

[1] IEEJ 2013. *The Asia/World Energy Outlook 2012*, Tokyo, Institute of Energy Economics, Japan.

[2] IEA 2013. *Southeast Asia Energy Outlook*. Paris: International Energy Agency.

[3] SHI, X. & MALIK, C. 2013. *Assessment of ASEAN Energy Cooperation within the ASEAN Economic Community*. Jakarta: Economic Research Institute for ASEAN and East Asia.

[4] APAEC 2010. *ASEAN Plan of Actions for Energy Cooperation 2010-2015*. Jakarta: ASEAN Secretariat. Available: http://aseanenergy.org/index.php/about/apaec.

development of the sector. The paper concludes by ultimately arguing that becoming greener, even if not completely green, is likely to be a practical goal for ASEAN's energy sector. It further notes that market integration, infrastructure connectivity, the region's prevailing energy security paradigm, and the successful execution of plans are key issues in moving toward a cleaner, more sustainable energy mix for ASEAN.

The Paradox: Brown Outlook vs. Green Vision

ASEAN's energy consumption is expected to grow continuously over the next two decades due to a number of key factors. These include significant economic and population growth, economic and infrastructure catch-up by less-developed countries, efforts to increase access to electricity, expanded car ownership, increased living standards, and demand spurred by industrialization and urbanization. According to the International Energy Agency (IEA), ASEAN's energy demand has expanded two and a half times since 1990. With an estimated tripling of the region's economy and 25% growth in the area's population, ASEAN's energy demand is projected to increase by over 80% between 2011 and 2035 under the IEA's "new policies scenario," a rise equivalent to current demand in Japan.[5]

Such high increases in energy demand are expected to be accompanied by the continued dominance of fossil fuels in the region's energy mix, even in 2035. While gas is projected to retain a 21% share in both 2011 and 2035 and oil's share will be reduced from 38% in 2011 to 31% in 2035, coal is expected to jump from a 16% share of the primary energy mix in 2011 to 28% in 2035. The relative abundance and cost competitiveness of coal in the region and unchecked CO_2 emissions will continue to boost the share of coal in the power sector in particular, rising from a 33% to a 50% share in the region's generation mix between 2011 and 2035. Thus, after having experienced double-digit annual growth rates since 1990, total demand for coal supplies in Southeast Asia is predicted to triple over the next two decades, accounting for nearly 30% of global growth.[6] Notably, coal is being used in situations where gas could otherwise be used.

This rising use of fossil fuels, particularly coal, will lead to considerable increases in greenhouse gas emissions, assuming the use of today's technologies. ASEAN's energy-related

[5] IEA 2013.

[6] IEA 2013.

CO_2 emissions have more than tripled since 1990 and are expected to almost triple again between 2011 and 2035. The rapid growth in primary energy supply and the dominance of fossil fuels will result in a corresponding 4.0% annual growth in CO_2 emissions from 1,086 million tonnes (Mt) in 2010 to 2,864 Mt in 2035.[7] Compared with current estimates, the amount of expected additional CO_2 emissions from ASEAN is roughly equivalent to that of the world's fourth-highest emitter (Russia) and about 21.4% of that of the world's largest emitter (China) (in 2010 data).[8] Such growth in CO_2 emissions, if it cannot be offset by reductions in the rest of the world, would create longer-term threats to the region's living standards and economic vitality, particularly as Southeast Asia is deemed to be very vulnerable to climate change.[9]

Yet despite these projections, ASEAN aspires to be green. ASEAN has embraced a green growth strategy, and stakeholders in the region have worked together closely to achieve this vision. In the energy sector, ASEAN has highlighted an intention to be "a clean and green ASEAN," as outlined in the "ASEAN Vision 2020."[10] Since 2007, member states have made a number of declarations and statements supporting climate change, and ASEAN itself has been actively engaged in international negotiations on a new climate change regime.[11] However, ASEAN collectively does not have a binding target, although some member countries have made efforts toward setting national CO_2 emission-reduction targets.[12]

As aptly argued in a seminar report by Munir Majid, the consensus is that Southeast Asia to date has not been up to the challenge of meeting its green ambitions. This is due to a number of factors. One reason is the enormous gulf between statements of good intentions and actions in Southeast Asia.[13] Another reason could be that climate change is not a top priority on the region's overall policy agenda because of the urgent need to further economic development

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[7] IEA 2013.

[8] WORLD BANK 2013. *World Development Indicators 2013.* Washingtong, D.C.: The World Bank.

[9] MAJID, M. 2010. "Climate Change: Is Southeast Asia Up to the Challenge?" *Climate Change:Is Southeast Asia Up to the Challenge.* London: LSE IDEAS.

[10] ASEAN WEBSITE. 1997. "ASEAN Vision 2020." Available: http://www.asean.org/news/item/asean-vision-2020.

[11] LETCHUMANAN, R. 2010. "Is There an ASEAN Policy on Climate Change?" *Climate Change: Is Southeast Asia Up to the Challenge.* London: LSE IDEAS.

[12] IEA 2012. *Energy Technology Perspetive 2012,* Paris, International Energy Agency.

[13] MAJID, M. 2010.

and access to modern energy supplies, which may suggest an "all of the above" approach to securing supplies. However, the ASEAN Economic Community (AEC) recognizes that there are limited global reserves of fossil energy, highlights that current world prices for fuel oil are unsustainable, and emphasizes the need to strengthen renewable energy development and cooperation.[14] Thus, observers should expect to see many more changes in and pursuit of opportunities for regional energy cooperation if the paradox between green goals and a brown outlook is to be resolved.

Strengths, Weaknesses, Opportunities, and Threats: A SWOT Analysis of ASEAN's Energy Sector

Understanding the observations above, ASEAN faces both advantages and disadvantages in addressing how to best strengthen the outlook for its energy sector, and thus the sector's future trajectory is not clear. With this in mind, the following section employs a SWOT analysis, highlighting select factors that will shape the extent to which ASEAN is able to achieve its vision for a cleaner and more secure energy mix. A SWOT analysis (alternatively called a SWOT matrix) is a structured planning method used to evaluate the strengths, weaknesses, opportunities, and threats involved in a project or in a business venture. Strengths and weaknesses are internal helpful and harmful factors, respectively, while opportunities and threats originate from the outside environment. We apply this analytical framework to assess the ASEAN energy sector against its aspiration to be green in the future.

Strengths: Endowment of Low-Carbon Energy Resources

First and foremost, a core strength that ASEAN possesses as it seeks to move toward a cleaner, more sustainable energy mix is that it has vast potential for the greater use of low-carbon primary energy sources. It is predicted that hydropower projects from Cambodia, Laos, and Myanmar may provide 18.9 gigawatts (GW) of power for China, 7.68 GW for Thailand, and 5.1 GW for Vietnam in 2025.[15] As a reference, total electricity installed in China, Thailand, and Vietnam in 2011 was 1100.5 GW, 48.5 GW, and 22.0 GW, respectively.[16] As the actual

[14] ASEAN 2008. *ASEAN Economic Community Blueprint.* Jakarata: Association of Southeast Asian Nations.

[15] PISETH, C. 2014. "Case Studies of the Greater Mekong Sub-region: A Pioneer of Regional Integration in Power Trade and Hydropower Development." *2nd Meeting of ERIA's Working Group on Energy Market Integration in East Asia (FY2013–2014)* Jakarta.

[16] ENERGY INFORMATION AGENCY 2014. *International Energy Statistics: Total Electricity Installed*

share of potential hydropower resources that have been developed so far remains quite low (only 1.6% in 2009), it could still be greatly expanded, and thus shift the prevailing mix toward lower-carbon sources.[17] Given that demand for electricity is expected to rise, the development of ASEAN's hydropower potential could replace many planned coal-fired power plants and provide greener electricity for the region without increasing generation costs. Additionally, given its favorable climate, Southeast Asia as a region is also highly suitable for solar photovoltaics, including in otherwise resource-poor countries such as Singapore.

Yet despite this overall potential, it should be noted that low-carbon energy resources in ASEAN are unevenly distributed. Some countries are rich in fossil fuel resources but not low-carbon resources; others are resource-poor overall and have limited indigenous energy potential. This further limits each individual country's choices in energy supply. This mismatch leads to a large potential for hydroelectricity in Laos, Cambodia, and possibly Myanmar that is still waiting to be tapped, even though the sustainable development of hydropower has been demonstrated by the Nam Theun 2 Hydroelectric Project in Laos.[18] Such a development means that some consuming countries may need to import electricity supplies even though demand can otherwise be met by the development of nonrenewable power generation domestically.

Weaknesses: Abundance of Fossil Fuel Resources and Prevailing Fossil Fuel Subsidies

A weakness for ASEAN's energy sector is the relevant abundance of fossil fuel resources. It is estimated that the ten countries of ASEAN have 14 billion barrels of oil reserves, 286.6 trillion cubic feet of natural gas reserves, and 9,408.4 billion tonnes of coal reserves.[19] Indonesia is also the world's largest exporter of thermal coal. Moreover, the relative abundance and cost competiveness of coal motivates countries in ASEAN to use more coal rather than further develop other energy sources.

Capacity. Energy Information Agency. Available: http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=2&pid=2&aid=7.

[17] KIMURA, S. 2011. "Analysis on Energy Saving Potential in East Asia." *ERIA Research Project Reports.* Jakarta: Economic Research Institute for ASEAN and East Asia.

[18] PORTER, I.C. 2007. *Sustainable Hydropower Can Benefit Us All*. World Bank. Available: http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21465445~menuPK:51340358~pagePK:64257043~piPK:437376~theSitePK:4607,00.html.

[19] IEA 2013.

A related looming concern in ASEAN's ability to meet its energy goals is the question of fossil fuel subsidies. The IEA estimates that in 2011 the total cost of fossil fuel subsidies among the countries of ASEAN amounted to $51 billion, despite progress that has been made in reducing the overall amount.[20] Most ASEAN countries still provide energy subsidies at levels above the world average. In 2011 the after-tax energy subsidies on petroleum products, electricity, natural gas, and coal amounted to a share of GDP that was roughly 8.41% in Brunei, 5.36% in Indonesia, 7.21% in Malaysia, and 4.72% in Thailand, compared with a world average of only 2.72%.[21] In terms of the ratio of energy subsidies to overall government budgets, the government of Malaysia had the highest ratio at 32.94%, followed by 30.07% and 20.85% in Indonesia and Thailand, respectively. Of this set, Brunei had the lowest ratio, coming in at 13.51%. However, compared with a world average of 8.13%, financial energy subsidies still account for too high a share of government spending in ASEAN.[22]

Subsidies will not only discourage investment in clean energy, fossil fuel exploration, and infrastructure, but also prevent greater integration of regional energy markets and thus make it impossible to optimize the trade of low-carbon resources at a regional level.[23] With the presence of heterogeneous subsides in neighboring countries, a country with higher subsidies may decide to "strengthen the fence" along its boundary to prevent a leak of its subsidies to others. For example, in order to prevent cars from Singapore from benefitting from subsidized fuels in Malaysia, the Malaysian government banned the sale of fuel to foreign cars in the areas bordering Singapore and Thailand. As a response, the Singaporean government set the requirement that anyone leaving Singapore in a Singapore-registered motor vehicle must have more than three-quarters of a tank full of motor fuel.[24] Such a "border closure" policy works against fulfilling the need for energy market integration, and the implementation of such closed-border policies is costly. Ultimately, such a fragmented energy market will limit

[20] IEA 2013.

[21] According to the International Monetary Fund, consumer subsidies include two components: a pre-tax subsidy (the difference between the price paid by consumers and supply and distribution costs) and a tax subsidy (when taxes are below their efficient level).

[22] IMF 2013. *Energy Subsidy Reform: Lessons and Implications.* Washington, D.C.: International Monetary Fund.

[23] SHI, X. & KIMURA, F., 2014. The Status and Prospects of Energy Market Integration in East Asia. *In:* WU, Y., KIMURA, F. & SHI, X. (eds.) *Energy Market Integration in East Asia: Deepen Understanding and Move Forward.* Oxon, New York: Routledge.

[24] SHI, X. & KIMURA, F., 2014.

ASEAN's utilization of low-carbon energy resources by continuing the mismatch between available resource endowments and regional access to supplies to meet energy demand.

Opportunities: A Looming Supply-Demand Gap and the ASEAN Economic Community

Given the region's projected rapid demand growth, current energy supply sources may be insufficient to meet ASEAN's demand. That is, the supply-demand gap could keep increasing over an outlook horizon of twenty years, leading to growing import dependence, particularly for oil and natural gas supplies.[25] It is estimated that ASEAN's net imports will rise from 1.9 million barrels per day (mb/d) to just over 5 mb/d, and thus oil-import dependency will increase from 44% in 2011 to 75% in 2035. ASEAN will thus become the world's fourth-largest oil importer, behind China, India, and the European Union.[26]

ASEAN's looming energy supply-demand gap, while raising some stakeholder concerns about supply security, does ultimately create a greater incentive for the development and use of new energy-efficient technologies and renewable technologies such as nuclear, solar, and wind power, among other greener supplies. Greater pursuit of these technologies could provide opportunities for meeting ASEAN's green growth aspirations.

In addition to the points above, a key opportunity for ASEAN to achieve its green growth goals lies in the realization of the AEC. The "ASEAN Vision 2020," adopted on the 30th anniversary of ASEAN in 1997, agreed on a shared vision of ASEAN as a concert of Southeast Asian nations. In January 2007, ASEAN's leadership agreed to accelerate the establishment of an ASEAN Community to 2015. The ASEAN Community comprises three pillars, namely an ASEAN Political-Security Community, an AEC, and an ASEAN Socio-Cultural Community. The AEC provides an institutional framework for the integration of energy markets in ASEAN and should facilitate integration and cooperation in the region's energy sector. The AEC Blueprint consists of four pillars that are interlinked with each other, namely fostering (1) a single market and production base, (2) a competitive economic region, (3) equitable economic development, and (4) integration into the global economy. A single market and production base

[25] SAHID, E.J.M., ISA, A.M., LEONG, Y.P. & SHI, X. 2013. Rational for AEMI. *In:* AEMI GROUP (ed.) *ASEAN Energy Market Integration (AEMI): From coordination to Integration.* Bangkok: The ASEAN Studies Center, Chulalongkorn University.

[26] IEA 2013.

is a key aspect of an integrated energy market and will allow low-carbon resources such as hydro to be exported to other countries.

On energy cooperation, the AEC Blueprint focuses on two major infrastructure projects, namely the APG and the TAGP. However, the current action plan on energy cooperation, *APAEC 2010–2015*, does not mention the introduction of a trade/energy market.[27] Existing cross-border energy exchanges thus far are limited to zero exchange or pre-established purchase agreements (bilateral).[28] For regional energy markets to function properly, both physical and institutional infrastructure must be in place.[29]

Threats: Fragmented Energy Security Concept and a Lack of Political Trust

The region's current energy security paradigm is a threat to achieving green ASEAN. Rather than thinking of energy security as a regional challenge, many countries are focused on securing their own national energy security and thus limiting the extent of potential regional cooperation. Such a mindset is one of the main drivers in the current development of power exchanges and project interconnections and has resulted in a number of structural limitations. An example of such a fear coming into play is the case of the Sabah-Brunei line, which was planned to deliver hydropower to Brunei. Given the price advantage of hydropower over gas-fired electricity, this line would have reduced generation costs and CO_2 emissions in Brunei. Yet it was dropped from the current ASEAN power grid plan due to concerns about security of supply in Brunei. Consequentially, a prioritization of national energy security over regional energy security can become a barrier to future energy cooperation and thus limit the success of achieving a greener energy mix. Such a limitation to trade in energy will prevent the optimal use of energy resources in the region, which can gain from a more open market.[30]

Tying into this point, a lack of political trust is an additional factor that may prevent ASEAN from achieving its green vision. This lack of political trust has a significant impact on cross-border trade in pipeline gas and electricity. One frequently cited concern is that once a physical network is established and supply is set, relying on the cross-border trade, importers

[27] APAEC 2010. *ASEAN Plan of Actions for Energy Cooperation 2010–2015*. Jakarta: ASEAN Secretariat. Available: http://aseanenergy.org/index.php/about/apaec.

[28] SAHID, E.J.M., ISA, A.M., LEONG, Y.P. & SHI, X. 2013.

[29] SHI, X. & MALIK, C. 2013.

[30] CHANG & LI 2012.

could be hurt by a supply interruption. Such interruptions could be caused by political disputes as well as economic and technical reasons. One example of a disruption due to political reasons is Russia's suspension of gas supply to the European Union in 2009.[31] Overcoming such fears and transitioning from national energy security paradigms to regional ones will require efforts to facilitate strong trust in ASEAN.

An ASEAN Action Plan for a Greener and Cleaner Energy Sector

Ultimately, the SWOT analysis above shows that although ASEAN has vast potential for greater use of low–carbon emission energy resources, it is unlikely to shift away from fossil fuels, and thus a complete green vision is not attainable. However, with an appropriate action plan, ASEAN's energy sector can still be greener and cleaner. This section briefly introduces some policy measures that may be helpful in greening the region's brown outlook.

Enhancing Energy Efficiency

Enhancing energy efficiency is a key strategy that could contribute to reconciling increasing demand for energy access with emission reductions; thus, implementing energy-efficiency policies has been made a priority issue throughout the region. Currently, ASEAN has a regional target to reduce its energy intensity by at least 8% by 2015, based on 2005 levels.[32] ASEAN is also assessing a new target for beyond 2015 that would propose reducing energy intensity by a further 45% by 2035, compared with that of 2005, which was agreed on by Asia-Pacific Economic Cooperation (APEC) leaders.[33]

To date, all the countries within ASEAN have hit their energy saving targets, and many have adopted various policy measures to promote energy efficiency. More than half of ASEAN has minimum energy-efficiency standards and a majority has energy labeling programs.[34]

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[31] FOX NEWS 2009. "Russia, Ukraine Dispute Leaves European Nations without Gas." *Fox News*, 6 January 2009.

[32] APAEC 2010.

[33] SHI, X forthcoming. "Energy Efficiencies in ASEAN Region." *In:* YAN, J. (ed.) *Handbook for Clean Energy System.* Wiley.

[34] IEA 2013.

Harmonization of energy-efficiency standards for air conditioners is being moved forward.[35] In addition, some countries have already established the policy and legal framework and expect further activities focusing on more advanced EEC technologies and EEC business development. This includes the development of energy services companies that are dedicated to the provision of energy-efficient technology and services, including financing, design, implementation, and management of projects, to level up the contents of the cooperation. However, the level of implementation of EEC policies is quite different across countries. Singapore, Thailand, and Malaysia have adopted most policy instruments, whereas Cambodia, Laos, and Myanmar have taken barely any concrete actions.[36]

Although much progress has been made over the last decade, ASEAN's achievements on energy efficiency are still quite conservative when compared with those in the rest of the world. Between 1980 and 2011, energy intensity in ASEAN improved by only 12% overall, compared with an improvement of 26% worldwide—38% in member countries of the Organisation for Economic Co-operation and Development (OECD), 74% in China, and 44% in India.[37] Currently, ASEAN's energy intensity is still over twice that of the OECD average. In 2009, energy intensity in Indonesia, Malaysia, Singapore, Thailand, and Vietnam was 31% higher than in the United States, 86% higher than in Japan and Germany, and 123% higher than in the United Kingdom.[38] According to the IEA's estimations, even assuming that all current energy-efficiency plans are implemented and achieved, ASEAN's estimated intensity reductions will only account for one-quarter of the economically viable reductions that could be undertaken, with greater progress limited for reasons such as not implementing energy-efficient building regulations, lacking mandatory standards for appliances, requiring lower fuel-economy standards, and lacking market-based energy prices.[39]

Energy Connectivity: The ASEAN Power Grid and Trans-ASEAN Gas Pipeline

The APG, which was first proposed in the 1990s, would make it possible to trade electricity across the region so that electricity may be generated from more efficient and

[35] SHI, X. forthcoming.

[36] SHI, X. forthcoming.

[37] SHI, X. forthcoming.

[38] SHI, X. forthcoming.

[39] IEA 2013.

environmentally friendly sources. For example, with the APG, electricity generated by hydropower in Laos and Cambodia could be used to replace electricity generated from coal in Thailand. However, the development of the APG has not moved ahead satisfactorily. Even assuming that the currently planned APG can deliver a greener ASEAN, only five out of sixteen interconnection systems were in operation by 2013, with two to three more likely to be operational by 2015 and the rest coming online beyond 2015. A lack of economic viability is the main reason the APG has lagged behind the AEC's targets.[40]

Unfortunately, even if all sixteen interconnection systems are finished, a regional power grid is still far away, since those systems are largely bilateral connections. By 2020, there are likely to be only a few interconnected national power grids in ASEAN, and these will offer bilateral exchanges of electricity and emergency backups. It should also be noted that there is no clear vision about whether the APG should be an integrated and harmonized single grid or a few heterogeneous national grids that are linked by an ASEAN-wide backbone power grid.[41]

As a related issue, the TAGP has also been proposed to encourage the use of natural gas as well as to ensure the reliability of gas supply for ASEAN member states. Although the TAGP is already more than halfway completed, it is unlikely to be finished by 2015 because the East Natuna gas field does not appear to be attractive on a purely commercial basis. This field is expected to be the main supply source for the remaining pipeline.[42] By the end of 2013, there were eleven bilateral gas pipeline interconnections in operation, and the total length of the gas pipeline was approximately 3,000 km.[43] Yet although only 3,300 km of TAGP pipeline connections will be in operation by 2015, it is already possible to transmit gas from Myanmar to Vietnam or even to Indonesia. It is also possible for Singapore to export gas from its liquefied natural gas (LNG) imports to Thailand through the existing pipeline connection.[44]

However, there is a likely case in which no indigenous gas may be transported by TAGP in the future. The East Natuna gas field in Indonesia, which is technically and economically

[40] SHI, X. & MALIK, C. 2013.

[41] SHI, X. & MALIK, C. 2013.

[42] SHI, X. & MALIK, C. 2013.

[43] SHI, X. & MALIK, C. 2013.

[44] SHI, X. & MALIK, C. 2013.

challenging, is also unlikely to be operational before 2020.[45] Additionally, even with the development of the East Natuna gas field, ASEAN is still facing widening gaps between supply and demand from 2017 onward.[46]

The emerging approach to fill the widening gaps in gas demand and indigenous supply is to bring the construction of LNG regasification terminals into the TAGP master plan. Indonesia, Malaysia, Singapore, Thailand, and Vietnam have had, or have initiated the construction of, LNG regasification terminals to bring gas from outside the ASEAN region. The LNG terminals offer additional flexibility to the ASEAN gas market, provided that interconnections between LNG terminals can be achieved through altering the destinations of LNG tanks. The change of destinations, however, is often prohibited by LNG contracts.

Even assuming that the physical infrastructure is in place, actual trade of electricity and natural gas is unlikely to happen. To make the physical infrastructure workable, institutional components such as a regulatory framework, the harmonization of technical standard codes and guidelines, and legal and regulatory frameworks should be in place.[47] However, all these necessary pieces of soft infrastructure are still under development.[48]

New and Renewable Energy and Cleaner Use of Fossil Fuels

ASEAN has actively promoted the development and use of new and renewable energy resources in the region. It set a collective target of 15% of installed power-generation capacity for regional deployment that was already achieved in 2013.[49] Brunei has announced that it will have a 10% share of renewable energy in its power-generation mix, but the specific policies for achieving this target are yet to be revealed.[50] Malaysia, the Philippines, and Thailand have implemented a feed-in tariff (FIT) program for residency renewable power generation. However, such programs still face challenges, and limits on available financial resources from

[45] SAHID, E.J.M., ISA, A.M., LEONG, Y.P. & SHI, X. 2013.

[46] SAHID, E.J.M., ISA, A.M., LEONG, Y.P. & SHI, X. 2013.

[47] SHI, X. & MALIK, C. 2013.

[48] SHI, X. & MALIK, C. 2013.

[49] SHI, X. & MALIK, C. 2013.

[50] PACUDAN, R., CHANTANAKOME, W., MIRMIRA, S., BROWNE, S. & JULAIHI, J. 2013. Workshop on Policies, Feed-in Tariff Frameworks and Best Practices for Grid Connected Solar PV Projects (Proceedings). Bandar Seri Begawan: Brunei National Energy Research Institute.

the government have restrained development. For example, Thailand's FIT for solar was suspended due to a lower deliver rate of FIT application. Some ASEAN member states have also considered the use of nuclear energy for power generation as a low-carbon power option. However, so far only Vietnam has started construction, while plans in Indonesia, Malaysia, and Thailand were suspended after the Fukushima nuclear accident.[51]

On the fossil fuel side, the combination of the increasing use of coal and an increasing concern about its impact on the environment presents both a requirement and an opportunity to promote and increase CCT use and trade. Given the outlook that about 50% of the region's electricity will be generated from coal-fired power plants,[52] the cleaner use of coal will be a crucial issue for ASEAN. Ignoring the presence of fossil fuels in national mixes will make the environmental performance of these countries worsen, as coal is the only indigenous energy source that realistically can meet growing demand for energy to sustain economic growth in the near future.[53] However, progress on the adoption of and cooperation on CCT and other coal-related policies in ASEAN is only at the early stages. Adoption of high-efficiency coal-fired power plants in member countries is constrained by cost concerns, since affordability is a big issue in the developing countries of ASEAN.[54]

Subsidies Reform

ASEAN has declared an intention to remove or reduce fossil fuel subsidies, but movement on the issue is proceeding slowly. Plans or actions for liberalizing energy prices and removing subsidies for fossil energy have been implemented in many countries, such as Indonesia, Malaysia, and Vietnam, and the list of countries making commitments to reform energy pricing has been growing.[55] Brunei replaced a regressive electricity tariff with a progressive electricity tariff in January 2013.[56] Indonesia increased prices for gasoline by 44%

[51] SHI, X. & MALIK, C. 2013.

[52] IEA 2013.

[53] ITOH, S. 2014. "A New Era of Coal: The 'Black Diamond' Revisited." The National Bureau of Asian Research.

[54] SHI, X. & MALIK, C. 2013.

[55] IEA 2013.

[56] APEC 2013. *Peer Review on Energy Efficiency in Brunei Darussalam.* Tokyo: APEC Energy Research Center.

and diesel by 22% in June 2013.[57] On September 3, 2013, the Malaysian government decided to cut fuel subsides for the first time since 2011, which will raise the price of certain gasoline and diesel fuels by 10.5%–11.1%. In Vietnam, a roadmap for energy price increases has been formulated, but so far implementation has lagged behind.[58] The International Monetary Fund indicated that the Indonesian fuel subsidy reform conducted in 2008 was partially successful, while fuel and electricity reform in the Philippines was successful.[59]

The phasing out of fossil fuel subsidies is politically sensitive, however. If the public is not convinced of the merit of removal, removing subsidies could induce unrest and possibly even riots. Fuel subsidy removal is also often used as a weapon in domestic politics.[60] Given the political sensitivity to and scale of energy subsidies in ASEAN, efforts addressing the removal of energy subsidies will need to be well planned, agreed upon by major stakeholders, and carefully implemented after conducting the necessary campaigns and educational outreach to the public.[61] All these preparations will take time, but the first steps toward them should begin as soon as possible.

Policy Implications

To achieve a vision for a green ASEAN while addressing rapid energy demand growth, ASEAN has undertaken many actions. Some of these programs are going well but require continued progress, and in some cases current policy action plans are insufficient to meet their stated goals. ASEAN could make more progress by moving forward on creating integrated energy markets, improving energy connectivity, shifting current energy paradigms to more regionally minded views of energy security, and enhancing overall plan implementation.

Integrated energy markets. In order to optimize resources across ASEAN and achieve a green energy sector, an integrated energy market is needed. An integrated electricity market will allow surplus hydropower resources to be developed, replacing the use of coal in power

[57] IEA 2013.

[58] SHI, X. forthcoming.

[59] IMF 2013. *Energy Subsidy Reform: Lessons and Implications*. Washington, D.C.: International Monetary Fund (IMF).

[60] SHI, X. & KIMURA, F. 2014.

[61] WU, Y., SHI, X. & KIMURA, F. (eds.) 2012. *Energy Market Integration in East Asia: Theories, Electricity Sector and Subsidies*. Jakarta: Economic Research Institute for ASEAN and East Asia.

generation. Due to the cost competiveness of hydroelectricity, such a substitution can be acceptable even in developing countries. Energy market integration can also increase access to electricity through stimulation of investment and utilization of neighboring grids. The pooling of resources from national grids offers additional security of supply for each country. In an integrated market, countries with more limited options for engaging renewable energy domestically, such as Singapore, will provide additional market demand for renewables from resource-abundant countries without necessarily requiring investment in additional capacity. An integrated regional power market can also reduce vulnerability to variability of renewables, since in a large geological area peak demand and production of various renewable sources may have different cycles, and thus these resources can complement one another. Higher potential market penetration by renewable energy such as hydro, wind, and solar power under an integrated energy market scenario can make for a green overall mix, and thus reconcile addressing energy demand growth and mitigating CO_2 emissions.

Energy connectivity. Current working plans for energy connectivity should be enhanced to enable the region-wide energy trade that would occur under the integration of energy markets. The APG should be enhanced to form a regional power grid that allows for the free flow of electricity. For the TAGP, the key is to enhance interconnection of LNG terminals so that gas can be diverted to required destinations in case of an emergency. The current TAGP master plan can be revised so that existing pipelines may be used to transport gas from some shared LNG regasification terminals and LNG can be utilized where it will be most cost effective. Additionally, developing institutional infrastructure (also known as soft infrastructure) should be considered as important as developing the physical infrastructure for energy trade, and its development should match the sector's overall connectivity.

Shifting the view of energy security. A paradigm shift in ASEAN—from looking at national and fragmented energy security to looking at regional and integrated energy security—is necessary to improve energy security at a regional level. A regional energy security strategy can generate better security for each country because it will open up ASEAN to foreign investment and energy supply, providing a chance for optimizing the use of energy.[62] To that end, ongoing efforts toward implementing the AEC can provide a legal framework where all members can cooperate on energy to optimize the use of low-carbon resources in the region to meet rapidly growing demand.

[62] SHI, X. & KIMURA, F. 2014.

Execution of action plans. The implementation of cooperation plans should be monitored to ensure that they are followed accordingly. This requires ASEAN to strengthen its regional enforcement mechanisms. Currently, all efforts at the national level within member states have been undertaken voluntarily, which is consistent with ASEAN's principle of making decisions by consensus. However, this approach suffers the drawback of leading to unnecessarily slow development. Without changing the political principle of consensus, some peer-review mechanisms, such as the APEC Peer Review on Energy Efficiency, could be introduced to help members achieve their regional commitments.[63] Regional plans and agreements should be reflected in the domestic policies and planning of individual ASEAN member states. The end goal is to enhance individual national energy policies and planning activities and to integrate them into a cohesive and effective regional energy policy with analysis and planning toward sustainable development.

Conclusion

With continuous economic and population growth anticipated in Southeast Asia, alongside increasing urbanization and overall regional development, ASEAN's energy demand will rise dramatically over the next two decades. As noted above, this will create huge pressure on strategies for managing energy supply, energy security, and the environment.

The region will have numerous opportunities and challenges in terms of strengthening its energy security and pursuing strategies for a cleaner, more sustainable energy mix. On the one hand, ASEAN has vast hydropower resources and solar energy potential, which will provide electricity with lower carbon emissions. On the other hand, the region faces continued depletion of other indigenous resources and an overall widening energy gap. The uneven distribution of low-carbon resources requires regional cooperation and energy market integration, which is undermined by the heavy presence of fossil fuel subsidies. The abundance of fossil fuel resources is also a weakness for achieving the region's green vision. Yet ASEAN's green vision is boosted by a looming supply-demand gap in nonrenewable resources and by efforts at building the AEC. Still, the pursuit of individual national energy security strategies, due partly to a lack of political trust, limits the scope for optimizing energy resources and minimizing generation costs at a regional level.

[63] APEC 2013.

Fostering greater regional integration and energy connectivity, expanding energy security views, and executing in-place action plans are expected to facilitate the achievement of a greener and more sustainable future energy mix. However, addressing each of these concerns will require sustained leadership, support, guidance, and actions from stakeholders across the ASEAN region.