Chapter 3

Challenge One: Getting to the Right Power Mix

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1. Supply Outlooks for Regional Power Mixes

As of 2020, coal, natural gas, and hydropower dominate power-generation mixes in much of South and Southeast Asia, with many countries disproportionately reliant on coal.[31] **Table 2** provides a breakdown of the power mix for each EAS country. Although many countries in the region are working toward decarbonisation, they face the pressing challenge of scaling up energy supply while trying to minimise carbon emissions. During the NBR–ERIN workshop, the importance of fossil fuels in the region's energy future was discussed. Some participants claimed that fossil fuel investments will continue to provide the majority of new energy capacity added in the region due to many countries trying to make electricity more affordable and reliable.

[31] India, for example, gets roughly 70% of its electricity from coal-fired plants. IEA, 'Coal Demand by Region and Scenario, 2018–2040,' https://www.iea.org/data-and-statistics/charts/coal-demand-by-region-and-scenario-2018-2040.

Table 2: Existing Installed Energy Capacity (Percentage of Energy Mix)

Country	Coal	Gas	Oil	Hydro-power	Small-scale hydropower	Biomass	Geothermal	Renewables	Nuclear	Other
Brunei (2017)	–	99.0	0.5	–	–	–	–	0.5	–	–
Cambodia (2020)	30.2	–	2.5	62.3	–	–	–	3.5	–	1.5
Indonesia (2018)	57.0	29.0	1.6	-	–	–	–	12.4	–	–
Lao PDR (2020)	19.0	–	–	79.0	1.0	1.0	–	–	–	–
Malaysia (2017)	44.0	38.0	1.0	16.0	–	0.5	–	0.5	–	–
Myanmar (2016)	3.0	35.6	1.0	60.3	–	-	–	0.1	–	–
Philippines (2017)	50.0	22.0	4.0	10.0	–	1.0	11.0	1.0	–	1.0
Singapore (2017)	1.3	94.9	0.7	-	–	0.5	–	0.3	–	2.3
Thailand (2018)	18.0	57.0	1.0	5.0	–	–	–	19.0	–	–
Viet Nam (2018)	38.0	15.0	–	35.0	6.0	–	–	6.0	–	–
India (2019)	71.0	4.5	0.5	10.9	–	2.9	–	7.3	2.9	–
China (2019)	64.6	3.3	0.1	17.3	–	1.6	–	8.4	4.6	–
Japan (2019)	31.6	33.9	4.8	8.8	–	4.1	0.3	8.2	6.4	1.9
Rep. of Korea (2019)	40.3	26.0	2.5	1.2	–	1.8	–	2.7	25.1	0.4
Australia (2019)	58.4	20.0	1.9	6.1	–	1.3	–	12.3	–	–
New Zealand (2019)	5.2	13.0	–	57.2	–	1.4	17.8	5.3	–	0.1
United States (2019)	24.2	37.4	0.8	6.8	–	1.7	0.4	9.2	19.3	0.1

Note: All values are rounded up. Information for Cambodia, Lao PDR, and Viet Nam is installed capacity. This table is based on Weatherby, 'Renewable Energy in Southeast Asia,' 16.
Source: IEA country profiles; 'ERIA 2020 Outlooks for Individual Countries'; and 'Mekong Infrastructure Tracker.'

1.1. Coal

Both South and Southeast Asia still depend heavily on coal as a consistent energy source that can meet the rising demand for electricity and bolster economic growth.[32] Coal-fired power plants remain in demand due to the abundance of coal in the region and the perceived lower economic costs compared to natural gas and renewables. Coal is also regarded as easier to feed into power grids compared to methods that could integrate renewables like solar or wind.[33] Additionally, South and Southeast Asia as a whole have been somewhat slower to adopt policies that would raise emission standards and phase out coal projects, although recent NDC efforts are seeking to change this status quo. This is largely due to the fact that emerging Asia is still seeking to expand electricity access, and implementing policies that could raise capital costs during a period of expansion is unattractive to financers.

Although clean-coal technologies are being utilised in parts of the world, some South and Southeast Asian nations lack the means to afford these technologies. The transfer of knowledge regarding these technologies to the developing world also has been slow.[34] The staying power of coal can be attributed not just to a lower perceived price but to the fact that it is convenient to implement and familiar to constituencies that know how to deploy and scale up coal projects.[35]

1.2. Natural Gas

Meanwhile, virtually all EAS members in South and Southeast Asia have articulated plans to increase their natural gas consumption, either as a means of reducing reliance on less desirable forms of generation or as a baseload partner that helps alleviate variability concerns with wind and solar power. Although still a fossil fuel, natural gas is a cleaner alternative to coal and offers an improvement to the air quality in urban environments. This a major incentive for many nations in the region. Nearly seven million deaths occur globally due to air pollution, two million of which happen in Southeast Asia.[36] In an effort to curb air pollution, reduce oil dependence, and diversify its energy mix, India plans to raise the share of natural gas from 6.5% to 15% by 2030 by dramatically increasing LNG imports.[37]

However, much of regional growth will depend on the price stability of LNG and whether countries in the region can develop the infrastructure necessary to support a gas-based economy.[38] As Nikos Tsafos writes in an NBR report on Southeast Asia's energy demand,

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[32] Han, 'The Need for Quality Infrastructure,' 36.
[33] Mikkal E. Herberg, 'High-Quality Infrastructure and the Free and Open Indo-Pacific Vision,' in 'Powering Southeast Asia,' 29.
[34] Han, 'The Need for Quality Infrastructure,' 36.
[35] Nikos Tsafos, 'The Outlook for Power Generation in Southeast Asia and the Geopolitics of the Indo-Pacific,' in 'Powering Southeast Asia,' 7.
[36] Han, 'The Need for Quality Infrastructure,' 36.
[37] Cedigaz, 'Oil and Gas Majors in India: Co-creating the Gas and LNG Market,' July 15, 2020, https://www.cedigaz.org/oil-and-gas-majors-in-india-co-creating-the-gas-and-lng-market-report.
[38] Han, 'The Need for Quality Infrastructure,' 38.

all the gas consumed in Viet Nam and the Philippines is produced locally because 'both countries have failed, despite ongoing efforts, to build the infrastructure to import LNG.'[39]

As participants at the NBR–ERIN workshop discussed, stable and reasonable prices are a prerequisite for LNG to remain competitive with coal. There is a call for international cooperation between governments and private firms to stabilise prices so that LNG can be better utilised as a transition fuel to renewable energy. This is a popular notion amongst South and Southeast Asian countries, given that demand for LNG is expected to increase over the coming decades. However, as more countries transition to a low-carbon or carbon-zero future, questions have emerged about the staying power of natural gas.

1.3. Renewable Energy

Currently, Asia represents nearly half of global energy consumption. Even in the face of rising energy demand, there are renewed concerns about carbon emissions, climate change, and sustainability, with several countries and regional forums outlining ambitious plans to radically reshape regional power mixes. The members of ASEAN, for example, have agreed to a collective target for 23% of the region's primary energy supply to come from renewable energy sources by 2025.[40] This goal poses a monumental challenge as member countries are coming from different starting points in their decarbonisation journey.

For example, Singapore and Brunei are still heavily reliant on fossil fuels, with approximately 95% of Singapore's electricity coming from natural gas[41] and virtually all of Brunei's energy mix consisting of natural gas and oil.[42] Other countries are at a better starting point to meet this 2025 goal, such as Myanmar, Lao PDR, and Cambodia, which draw most of their power from hydroelectricity.

Hydropower is the largest renewable energy source globally and makes up the vast majority of the 15% of power that comes from renewables in the ASEAN region.[43] This gives regional policymakers confidence in their ability to manage the seasonality challenges that come with hydropower. Looking toward the future, hydropower is common in national plans due to its abundance, affordability, familiarity, and remaining untapped capacity. However, hydropower is also controversial and faces social and political constraints because of the impact on fish migration, large land use, deforestation, and displacement of residents. Because of these negative impacts, hydropower can be slow to develop.

[39] Tsafos, 'The Outlook for Power Generation in Southeast Asia and the Geopolitics of the Indo-Pacific,' 8.
[40] Weatherby, 'Renewable Energy in Southeast Asia,' 14.
[41] Shigeru Kimura and Han Phoumin, eds., 'Energy Outlook and Energy Saving Potential in East Asia 2020,' ERIA, March 2021, 250, https://www.eria.org/uploads/media/Books/2021-Energy-Outlook-and-Saving-Potential-East-Asia-2020/Energy-Outlook-and-Saving-Potential-East-Asia-2020-1603.pdf.
[42] IEA, 'Brunei Darussalam,' 2018, https://www.iea.org/countries/brunei-darussalamm.
[43] IEA, 'Southeast Asia Energy Outlook 2019,' October 2019, https://www.iea.org/reports/southeast-asia-energy-outlook-2019.

The regional capacity for solar and wind power is rapidly being realised by South and Southeast Asian countries. Both energy sources have the potential to be widely available across the region and are attracting the most attention as an option for green energy mixes. This renewed interest can be attributed to the continued declining cost of wind and solar worldwide as a result of advancements in technology and wider deployment of these renewables.[44] As one workshop panelist stated, the higher price was a major barrier for solar and wind, which is no longer the case. From 2010 to 2019, solar dropped by 82% in cost, onshore wind by 40%, and offshore wind by 29%.[45]

However, policymakers still have reservations about these renewables. Unlike most other technologies, solar and wind cannot be produced on demand. Despite having a high level of solar irradiation across the region, and therefore a high potential to increase solar capacity, Southeast Asia has been slow to adopt supportive renewable policies that could capitalise on this potential for solar power.[46] With concerns over price fading, the remaining challenges for wind and solar involve integrating them into preexisting grids, managing weather variability and power intermittency, and waiting for improvements in battery storage technologies.

As was discussed by NBR experts and workshop participants, investment in renewable energy has proved to be lucrative, with interest significantly surpassing renewable capacity goals when the right policies are implemented. When the price of solar dropped in 2016, countries in Southeast Asia began to roll out pilot projects and significantly invest in solar power. As workshop participants noted, Viet Nam is a major success story, moving from no solar capacity in 2017 to more than 8,000 megawatts (MW) in 2020, with 15,000 MW or more planned. The rate of Viet Nam's development in solar capacity is significant, as the country has overtaken Thailand, which was an early adopter of solar energy.

Other countries in the region are seeing these successes and moving forward with supportive policies for solar power. Both Malaysia and Cambodia developed solar power projects in 2016 and 2017, respectively. Malaysia is currently developing approximately 1,500 MW of solar power, while Cambodia is pushing for solar to make up 20% of total installed capacity by 2023.[47]

Another potential power source specifically for Southeast Asia is geothermal. The region has significant potential for geothermal energy given its location along the volcanically active Ring of Fire. As noted by Courtney Weatherby in her essay for NBR's 2020 Energy Security Report, 'Indonesia and the Philippines currently have the second and third most installed capacity for geothermal energy globally, with 2,133 MW and 1,988 MW, respectively.'[48] Indonesia alone has a staggering potential for 29,000 MW of geothermal

[44] Tsafos, 'The Outlook for Power Generation in Southeast Asia and the Geopolitics of the Indo-Pacific,' 10.
[45] International Renewable Energy Agency, 'Renewable Power Generation Costs in 2019,' June 2020, https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019.
[46] Weatherby, 'Renewable Energy in Southeast Asia,' 17.
[47] Ibid., 18.
[48] Ibid., 16.

power, which remains largely undeveloped.[49] The capacity building that geothermal presents to countries like Indonesia and the Philippines should not be left out of national plans. (See Appendix I for analysis of current trends for renewable energy in the United States.)

1.4. Hydrogen

While falling costs have allowed more renewable energy production, the electrolysis technology used to produce hydrogen has also seen a drastic price reduction. From 2010 to 2020, the price of producing one kilogram of renewable hydrogen (that is, electrolysis of water using renewable energy sources) dropped 60% to between $4 and $6 per kilogram.[50] In addition to serving as a long-term storage option for renewables, thereby increasing their viability as power sources, carbon-neutral hydrogen has the potential to aid in de-carbonising the broader economy. Using renewable hydrogen for ammonia and fertiliser production, as well as synthesising liquid fuels, could allow renewable electricity sources to supply energy to new sectors by removing the need for fossil fuels as an input, thereby expanding the reach of renewable power while also facilitating its adoption through energy storage.[51]

According to past study from the Economic Research Institute for ASEAN and East Asia (ERIA), current cost reduction trends are encouraging, but hydrogen will still require significant investments in technology and infrastructure to achieve the needed economies of scale for cost parity with fuels such as gasoline.[52] Additionally, pricing greenhouse gas emissions will increase the competitiveness of hydrogen as a fuel option. The analysis also shows that the EAS region, which imports much of its fossil fuels but has abundant renewable energy, could benefit greatly from hydrogen as a fuel. The study concludes that establishing a hydrogen supply chain is key to integrating hydrogen as a clean fuel of the future.

1.5. Nuclear

Nuclear energy can provide zero-carbon baseload electricity, making it a strong alternative, at least in theory, to replace coal and other fossil fuels in regional power mixes. However, ERIA has estimated that the role for nuclear energy in Asia's power sector will decrease from 8.5% in 2017 to 6.7% by 2050.[53] China leads in construction of new nuclear energy capacity, with a target of increasing the share in the country's energy

[49] Hadi Setiawan, 'Geothermal Energy Development in Indonesia: Progress, Challenges and Prospect,' *International Journal on Advanced Science Engineering Information Technology* 4, no. 4 (2014), https://core.ac.uk/download/pdf/296920228.pdf.

[50] Hydrogen Council, 'Path to Hydrogen Competitiveness,' January 2020, https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf.

[51] Han Phoumin, Fukunari Kumura, and Jun Arima, 'Potential Renewable Hydrogen from Curtailed Electricity to Decarbonize ASEAN's Emissions: Policy Implications,' *Sustainability* 12 (2020), https://www.eria.org/uploads/media/Journal-Articles/2020-December-ERIA-Potential-Renewable-Hydrogen-from-Curtailed-Electricity-to-Decarbonize-ASEAN-Emissions-Policy-Implications.pdf.

[52] Shigeru Kimura, Yanfei Li, and ERIA Study Group members, 'Demand and Supply Potential of Hydrogen Energy in East Asia,' ERIA, May 2019, https://www.eria.org/uploads/media/RPR_FY2018_01.pdf.

[53] Kimura and Han, 'Energy Outlook and Energy Saving Potential in East Asia 2020,' 17.

supply by 7.2% annually through 2040.[54] India also has active plans to significantly expand its nuclear energy capacity. As stated in analysis by The Energy and Resources Institute (TERI), the National Electricity Plan targets an additional 9.5 GW by 2022.[55]

Other mature nuclear markets – Japan, the Republic of Korea, and the United States – have struggled to sustain the role of nuclear energy in their power mixes for social, political, and market reasons. Although Japan began restarting its reactors in 2015, following the March 2011 disaster in Fukushima, significant opposition from both the public and policymakers remains over safety concerns. The Republic of Korea faces similar social and political pushback, with President Moon Jae-in pledging to phase out the country's reactors.[56]

Both Japan and the Republic of Korea face additional pressure in the debate on nuclear energy, given their near complete dependence on trade for oil and gas supplies. Nuclear has been and could be a significant baseload power source for both countries. Nuclear energy has made up approximately 20% of power generation in the United States, but the sector is also in decline. This is largely the result of concerns over supply chain management, regulatory oversight, and high upfront costs. These and other factors led to the bankruptcy of the leading US nuclear energy company, Westinghouse, and decreased interest from the private sector in further investment.[57]

Many similar concerns exist in Southeast Asia. Although some countries, such as Indonesia and the Philippines, would consider nuclear power, most do not include it as a potential fuel source in any development scenario, as noted by ERIA. Lao PDR and Myanmar do not have a plan for nuclear power, even under their alternative policy scenarios, and Malaysia scrapped its plans for nuclear power due to concerns over handling nuclear waste.[58] Singapore has also cited the lack of land to both build a reactor and store waste as a critical impediment to nuclear energy development.

2. Management of Energy Use in the Transportation Sector

Although industry has been the largest consumer of energy and is projected to remain so under ERIA's business-as-usual scenario, transportation is the second-largest source of energy consumption in the region.[59] However, if the energy efficiency and savings policies outlined under the alternative policy scenarios are utilised, the transportation sector is also projected to see the greatest reduction in consumption by 2050, with energy use decreasing by more than 21% from business-as-usual projections. As developing Asia's large populations have grown wealthier, ownership of personal vehicles has become more

[54] Ibid, 104.
[55] Saxena et al., 'Transitions in Indian Electricity Sector 2017–2030,' 15.
[56] Kimura and Han, 'Energy Outlook and Energy Saving Potential in East Asia 2020,' 148.
[57] James E. Platte, 'Pathways to Trans-Pacific Cooperation in the Nuclear Sector,' NBR, Pacific Energy Summit Working Paper, 2018, 12, https://www.nbr.org/wp-content/uploads/pdfs/publications/pes_working_paper_platte_120518.pdf.
[58] Kimura and Han, 'Energy Outlook and Energy Saving Potential in East Asia 2020,' 176.
[59] Ibid, 20.

common. Although vehicle ownership per capita is still well below the level in developed countries, demand for transportation will expand across the region.

Developing Asia continues to use petroleum for nearly all of its transportation needs. However, advances in battery technology have made electrified transportation more affordable, with many automakers, including General Motors, Hyundai, and Toyota, planning on increasing the production of electric vehicles over the next decade.[60] Vehicle electrification also doubles as a means of improving air quality, which causes millions of deaths across Asia annually. Yet whether the region can take advantage of this opportunity will depend on efforts made to manage and adjust power supply outlooks.[61]

The rise of electric vehicles will likely affect the overall electricity grid in two ways; through improved energy storage and through growth in demand. Variable renewable energy resources like wind and solar become increasingly more effective at meeting energy demand as the ability to store their energy becomes cheaper. If global economies of scale begin mass production of electric vehicle batteries, it will likely have co-benefits for renewable energy sources. On the other hand, transportation itself requires immense energy expenditure, rivaling or surpassing electricity as the chief use of energy in many economies. The potential transfer of this demand for energy from petroleum products to the power sector is an important medium-term to long-term consideration for the sector.

3. Market Reform

What makes for the right electricity mix will likely continue to vary by country, in line with national priorities, local conditions, and available resources. Still, expert participants in a recent NBR–ERIN workshop noted that while major market shifts have had a profound impact on the potential availability and affordability of a range of energy supply options, regional capacity to capitalise on these opportunities is often deeply constrained.

Key challenges in South and Southeast Asia generally and for emerging economies specifically include rigid, opaque, and uncompetitive energy markets, particularly for natural gas and renewables; unresponsive energy pricing arrangements; and weak energy sector policymaking and governance.[62] On the issue of governance, Mikkal Herberg noted in discussions that bureaucratic, state-dominated energy sectors can lack transparency in decision-making. This can undercut signals to the private sector and other investors on the benefits of eschewing investments in dirtier (yet easier and faster to scale) energy

[60] General Motors, 'General Motors, the Largest US Automaker to Be Carbon Neutral by 2040,' January 28, 2021, https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2021/jan/0128-carbon.html; Hyundai, 'Hyundai to Expand Electrified Eco-focused Line-up to Ten Models in 2022,' November 11, 2020, https://www.hyundainews.com/en-us/releases/3194; and Toyota, 'Toyota to Debut Three New Electrified Vehicles for US Market,' February 10, 2021, https://pressroom.toyota.com/toyota-to-debut-three-new-electrified-vehicles-for-u-s-market.

[61] World Health Organization, 'One Third of Global Air Pollution Deaths in Asia Pacific,' May 2, 2018, https://www.who.int/westernpacific/news/detail/02-05-2018-one-third-of-global-air-pollution-deaths-in-asia-pacific.

[62] NBR–ERIN workshop discussions.

sources in favor of cleaner alternatives that may only be viable under certain legal, regulatory, or market conditions.

Nonetheless, if not well orchestrated, new national policies or reform efforts may invite their own challenges. As Herberg observed, 'although some Asian markets have moved toward greater deregulation and liberalization, various rates of reform pose new risks for outside investors.'[63] Dramatic, unexpected changes in price subsidies or other sectoral regulations, for example, may risk overheating markets or cause other unintended effects. Herberg highlighted the example of China. To reduce air pollution, in 2016 Beijing mandated a shift toward natural gas use in heating and cooking, which was an important reform for transitioning the country away from coal use. However, the resulting increase in demand was not met with an increase in natural gas supplies. When faced with a cold winter in 2017 and spiking demand for heating fuel, there was a shortage of natural gas, which marked a major social and energy policy failure.

Workshop participants also noted the imperative for countries to prepare their power sectors for so-called 'prosumers' – electricity consumers who could also produce their own electricity. Whether from solar panels on homes or out of the batteries in vehicles, electrical grids will need new market rules and management mechanisms to handle a two-way flow of power. As developing Asia improves and expands its electrical power grid, workshop participants reiterated that countries should consider the importance of this evolving relationship between the utility and electricity consumers in order to realise all the benefits of a smart and fully integrated grid.

4. Regional Connectivity

More complicated still is the concern that some means of improving the region's energy security may only be viable if several countries move in tandem. Obstacles include ongoing regulatory and technical harmonisation issues, which continue to create a bottleneck impeding greater cross-border trade in electricity. This is not to say that the region is not actively working to overcome these challenges: efforts such as the Lao PDR–Thailand–Malaysia power interconnection project and several initiatives within the UN Economic and Social Commission for Asia and the Pacific represent success stories that should be reviewed, and even potentially expanded, as models for deepening regional integration and strengthening shared governance norms. However, success also is defined by how countries or the region as a whole achieve stated targets. In this case, infrastructure is key to both short-term and long-term success.

4.1. Lao PDR–Thailand–Malaysia power interconnection project

One notable example of regional connectivity efforts is the multilateral power-trading agreement between Lao PDR, Thailand, and Malaysia. The agreement centers on the sale of electricity that is produced in Lao PDR to Malaysia via Thailand, which acts as the

[63] Mikkal Herberg and Ashley Johnson, 'Introduction,' in 'Powering Southeast Asia.'

intermediary.[64] Thailand is the 'wheeling' country and charges a fee to provide the services of its own electricity grid, which facilitates power trade between Lao PDR and Malaysia. This 'wheeling model' for electricity is cited by the IEA as a possible template for more multilateral electricity trade across ASEAN. The Lao PDR–Thailand–Malaysia project raised the amount of power traded to 300 MW in 2019. One limitation, however, is that the power travels in only one direction. To add other participants like Singapore, which was originally included in the project, such a wheeling model would require multidirectional power trade between member states.[65]

While the IEA report mentions that political, economic, and institutional changes will be needed for ASEAN to benefit fully from such an integrated market, it concludes that there are no fundamental obstacles to such improvements. Indeed, the negotiating process for the Lao PDR–Thailand–Malaysia power interconnection project produced important lessons for future efforts, such as sharing responsibilities between all stakeholder countries and mutually agreed, firm timetables.

4.2. The potential for power trade in South Asia

South Asia has limited regional connectivity, with most instances being bilateral, one-way agreements between India and its neighbors. Although India and Nepal signed a power-trading agreement in 2014, trade between the two countries has remained modest, despite the potential for hydropower from Bhutan and Nepal to help supply some of India's most electricity-starved regions.[66] Analysis of the potential for more energy trading concludes that progress has been stalled in part by political difficulties and high upfront costs, but that environmental conflicts are an underappreciated barrier to cross-border electricity trade.[67] This research suggests that with sufficient local-level buy in and collective security frameworks, power trade can help South Asian countries meet growing demand for electricity.

4.3. Other factors

As countries strive to maximise the role for cleaner and zero-emission energy sources in their power mix, increased reliance on variable wind and solar inputs also raises distinct challenges that should be factored into policy planning. Managing sudden energy surges or drops in electricity production due to weather events can be a challenge for grid and power plant operators already struggling to ensure consistent power supply (and may even result in higher costs or unintended reliance on highly inefficient backup power).[68] Though some of these management challenges may need to be addressed with new and

[64] IEA, 'Establishing Multilateral Power Trade in ASEAN,' September 2019, https://www.iea.org/reports/establishing-multilateral-power-trade-in-asean.

[65] 'Lao PDR, Malaysia and Thailand Agree to Expand a Trilateral Power Deal,' Radio Free Asia, September 6, 2019, https://www.rfa.org/english/news/laos/asean-energy-09062019165748.html.

[66] Priyantha Wijayatunga, D. Chattopadhyay, and P.N. Fernando, 'Cross-Border Power Trading in South Asia: A Techno Economic Rationale,' ADB, https://www.adb.org/sites/default/files/publication/173198/south-asia-wp-038.pdf.

[67] Mirza S. Huda, *Energy Cooperation in South Asia: Utilising Natural Resources for Peace and Sustainable Development* (New York: Routledge, 2020).

[68] Weatherby, 'Renewable Energy in Southeast Asia,' 19.

more advanced infrastructure (as will be explored later), Weatherby stresses that levels of wind and solar energy penetration that exceed much of what is currently in the region are possible without significant upgrades to the grid or breakthroughs in battery storage.[69]

However, this may require greater support for various tools that can strengthen energy policy decision-making, such as improved weather forecasting so that planners can better predict conditions that may affect either overall electricity demand or wind and solar supply. Alongside this, additional tasks – such as the full implementation of planned and proposed energy efficiency and conservation measures – could help reduce and manage overall demand growth.

[69] Ibid.