Chapter 2

Review of Energy Policies

February 2022

This chapter should be cited as
ERIA (2022), 'Review of Energy Policies', in Hisashi Yoshikawa (ed.), *Public Attitudes Towards Energy Policy and Sustainable Development in ASEAN Countries.* ERIA Research Project Report FY2021 No. 22, Jakarta: ERIA, pp.3-29.

Chapter 2

Review of Energy Policies

1. Introduction

This chapter reviews the energy situation and main energy and climate policies of the Association of Southeast Asian Nations (ASEAN) region and three selected countries: Malaysia, the Philippines, and Thailand.[1]

The policy review is based on qualitative and quantitative data, and the materials herein are mainly collected from (1) academic papers; (2) reports and documents of international organisations such as the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and REN21; (3) documents and information from regional intergovernmental organisations such as the ASEAN Centre for Energy (ACE); and (4) government websites.

This chapter is structured as follows. Section 2.2 gives a general review of the energy situation and policies across the ASEAN countries. Section 2.3 presents the ASEAN engagement in climate change and energy scenarios. Section 2.4 provides a more detailed review of the energy situation and policies in Malaysia, the Philippines, and Thailand. Section 2.5 concludes the chapter.

2. Overview of the Energy Situation and Policies in ASEAN Countries

2.1. General Energy Situation

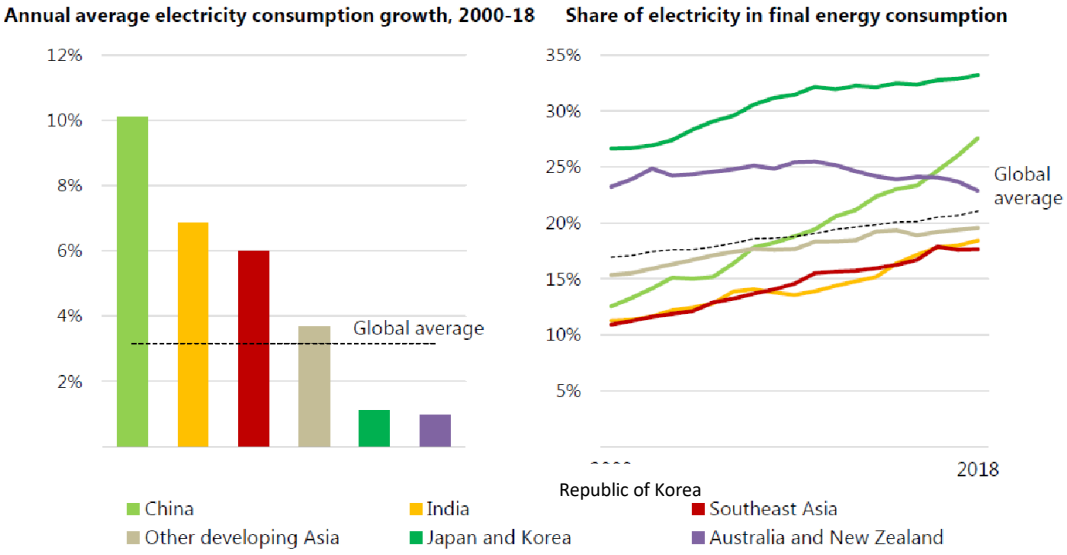
Currently, ASEAN countries possess 8.5% of the global population, and their economic growth has been amongst the fastest worldwide. This economic community is expected to have over 5% economic growth per year to become the fourth-largest economy globally by 2030 (ACE, 2020b). Although the COVID-19 pandemic has induced a downturn in this area (as in many countries worldwide), as the economy rebounds, energy demand supporting economic and industrial development is experiencing significant growth.

[1] Viet Nam is skipped because it was covered in the 2020 report (see Yoshikawa, 2020).

Achieving energy needs from economic growth is a key challenge for ASEAN's energy and climate policies.

Electricity demand in ASEAN countries is amongst the fastest-growing areas worldwide, growing by more than 6% annually over the past 20 years on average (Figure 2.1). For the past 2 decades, the four largest electricity consumption countries were Indonesia (26%), Viet Nam (22%), Thailand (19%), and Malaysia (15%), comprising more than 80% of total demand in the region (IEA, 2019b, 2020a). According to ACE's sixth ASEAN Energy Outlook, ASEAN's demand for primary energy is projected to more than double from 2017 to 2040; that is, from 625 million tons of oil equivalent in 2017 to 1,589 million tons of oil equivalent in 2040, in the baseline scenario (ACE, 2020b).

Figure 2.1: Annual Average Electricity Consumption Growth (2000–2018)



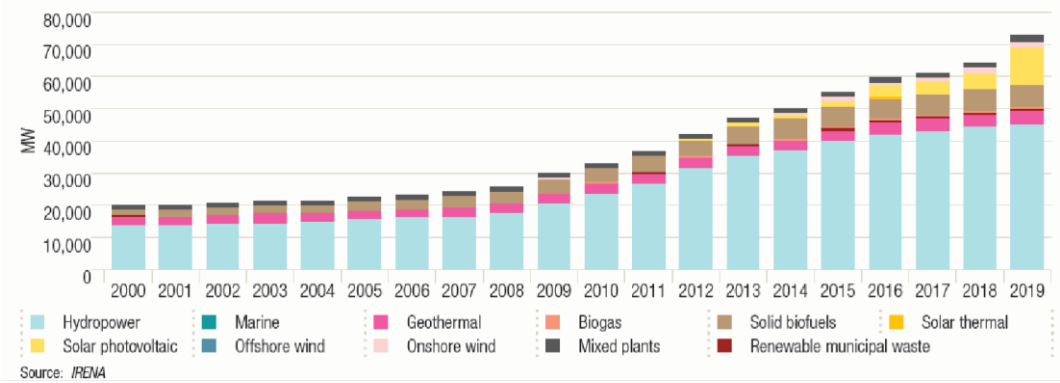
Source: IEA (2019b).

However, fossil fuels have mainly driven the approximately 80% growth in energy demand for the past 2 decades. Although Southeast Asia has abundant resources for developing RE, particularly solar energy, modern renewables currently support only approximately 15% of the energy demand (IEA, 2019b). Besides, not all have access to electricity. The current electricity access rate is 95%, with a plan that ASEAN countries will achieve universal access to electricity by 2030. Moreover, only 60% of the population has access to clean cooking, presenting as another issue to be solved (IRENA, 2020b).

A closer look at the deployment of renewables in ASEAN countries shows that conventional hydropower has been the main source of RE, whilst diversification of the

power sector has been observed in recent years (Figure 2.2). In 2019, for the first time, variable RE capacity additions surpassed hydropower additions (UNESCAP, 2020) (Figure 2.3). A comparison amongst ASEAN countries shows that the share of modern renewables in energy consumption has recently been increasing in several countries, such as Viet Nam, Thailand, and Malaysia, whilst it is falling in others like the Philippines (Figure 2.4).

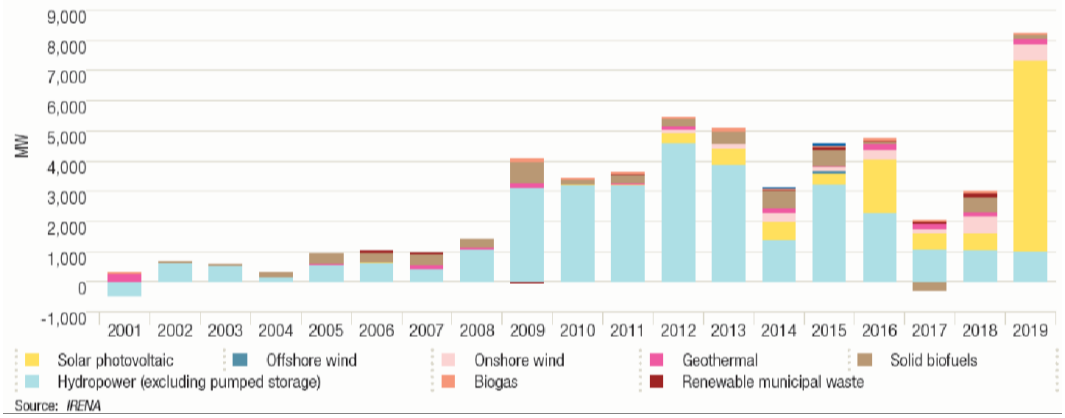
Figure 2.2: Renewables Cumulative Installed Capacity in the ASEAN Countries (2000–2019)



MW = megawatt.

Source: Figure created by UNESCAP (2020) based on IRENA data.

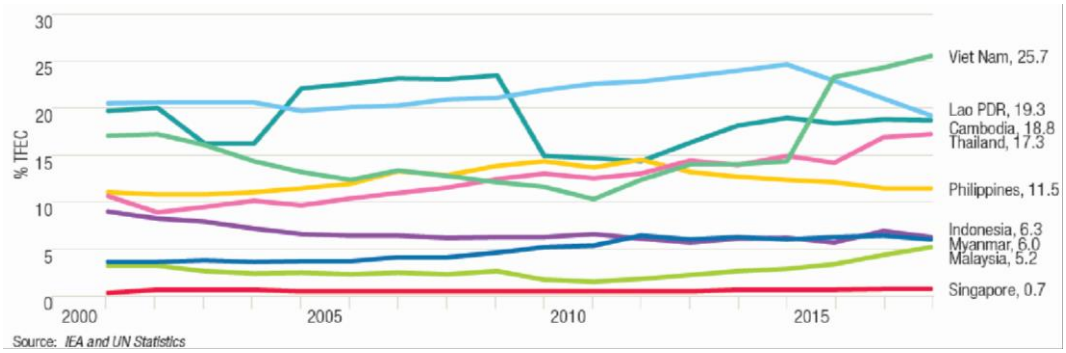
Figure 2.3: Annual Renewables Capacity Addition in ASEAN Countries (2001–2019)



MW =megawatt.

Source: Figure created by UNESCAP (2020) based on IRENA data.

Figure 2.4: Modern Renewables Share in Total Final Energy Consumption (2000–2017)



Lao PDR = Lao People's Democratic Republic, TFEC = total final energy consumption.

Source: Figure created by UNESCAP (2020) based on IEA and UN statistics data.

2.2. Energy Policies and Targets of Renewables in ASEAN

ASEAN Member States (AMS) target to increase RE to 23% of ASEAN's total primary energy supply (TPES) by 2025, according to the official documents: the ASEAN Plan of Action for Energy Cooperation (APAEC) (2016–2025) (Phase I: 2016–2020) and the ASEAN Economic Community 2025 Consolidated Strategic Action Plan. APAEC, a series of documents endorsed by the ASEAN Ministers of Energy Meeting, serves as the 'guiding policy document that aims to promote multilateral energy cooperation and integration to attain the goals of the ASEAN Economic Community' and 'the platform for deeper cooperation both within ASEAN as well as with Dialogue Partners… and International Organizations… toward enhancing energy security, accessibility, affordability, and sustainability within the framework' (ACE, 2020b). Before the current — fourth — APAEC (i.e., APAEC 2016–2025), APAEC 1999–2004, APAEC 2004–2009, and APAEC 2010–2015 were announced.

APAEC 2016–2025 spans a longer period of 10 years. It is divided into two phases (Phase I: 2016–2020 and Phase II: 2021–2025). The ongoing APAEC Phase II was endorsed in November 2020. It maintained the short- to medium-term strategies (Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All) as in Phase I, with a new subtheme: Accelerating Energy Transition and Strengthening Energy Resilience through Greater Innovation and Cooperation.

APAEC 2016–2025 indicated seven programme areas and key strategies (Table 2.1). Amongst these programme areas, the ASEAN Power Grid is a way to achieve the ASEAN target of 23% RE, aiming at regional interconnection and trade of electricity (Figure 2.5).

The idea is to connect on cross-border bilateral terms, expand to the sub-regional level, and achieve an integrated Southeast Asian power grid system (IEA, 2020a).

Table 2.1: APAEC Phase II: 2021–2025 Key Strategies

Programme Areas	Key Strategies
ASEAN Power Grid	To expand regional multilateral electricity trading, strengthen grid resilience and modernisation, and promote clean and RE integration
Trans-ASEAN Gas Pipeline	To develop a common gas market for ASEAN countries by enhancing gas and liquefied natural gas connectivity and accessibility
Coal and Clean Coal Technology	To optimise the role of clean coal technology in facilitating the transition towards sustainable and lower emission development
Energy Efficiency and Conservation	To reduce energy intensity by 32% in 2025 per 2005 levels and encourage further energy efficiency and conservation efforts, especially in transport and industry sectors
Renewable Energy	To achieve an aspirational target for increasing the RE component to 23% by 2025 in the ASEAN energy mix, such as increasing the share of RE in installed power capacity to 35% by 2025
Regional Energy Policy and Planning	To advance energy policy and planning to accelerate the region's energy transition and resilience
Civilian Nuclear Energy	To build human resource capabilities on nuclear science and technology for power generation

APAEC= ASEAN Plan of Action for Energy Cooperation, ASEAN = Association of Southeast Asian Nations, RE = renewable energy.

Source: ACE (2020b).

Figure 2.5: ASEAN Power Grid in the Three Regions

Note: Lao PDR = Lao People's Democratic Republic.

ASEAN = Association of Southeast Asian Nations, Lao PDR = Lao People's Democratic Republic.

Source: IEA (2019a).

However, the regional AMS commitments are not binding, and the ASEAN secretariat cannot intervene (i.e. the so-called principle of non-interference in ASEAN countries), which induces policy design 'flexibility' (Malahayati, 2020). It may lead to a gap between actual AMS policies and achievements and committed ambitious, regional targets. Moreover, no monitoring and evaluation mechanisms have been noted as a flaw where AMS progress may go unchecked (Malahayati, 2020).

Apart from cooperation under the ASEAN secretariat, some ASEAN countries have still not joined IRENA, comprising most of the emerging and developing countries. As of April 2021, the Lao PDR, Viet Nam, and Myanmar are not member states of IRENA; Cambodia is in the process of accession.[2]

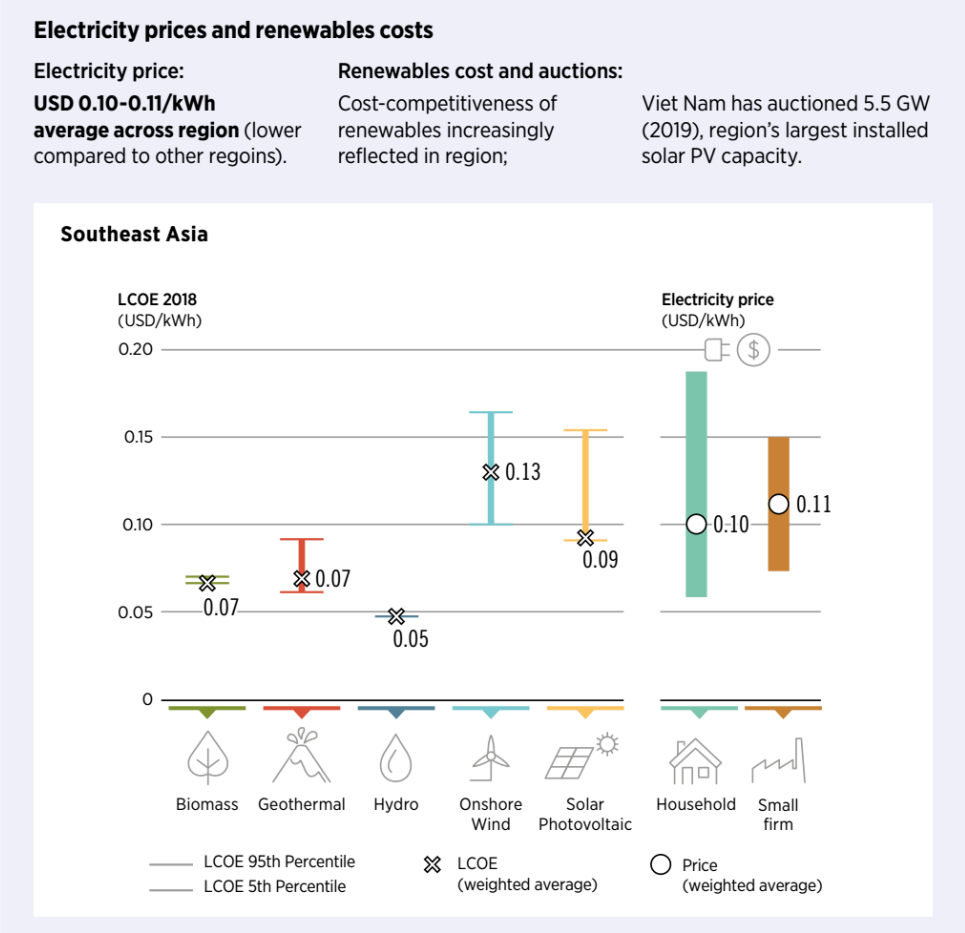
2.3. Costs of Renewables

In the last decades, the world has witnessed a remarkable drop in the cost of RE. During the 2010–2019 period, the levelised cost of energy (LCOE) of solar photovoltaic (PV) declined by 82%, and onshore wind power declined by 39% (IRENA, 2020a). LCOEs of solar PV and wind power are even cheaper than those of conventional coal-fired and nuclear power in some countries. This observation shows that RE is a more competitive and economical deployment option. A similar trend also appears in ASEAN countries, where RE is becoming increasingly competitive, with the LCOE close to the electricity rates (Figure 2.6) (IRENA, 2020a, 2020b). In Malaysia and Cambodia, solar power auction rates are lower than coal-fired power (Bellini, 2020; REI, 2020).

Whilst power generation from onshore wind power is usually cheaper than that from solar PV in other RE early-mover countries, solar power is generally cheaper than wind power in ASEAN countries. Further, the average LCOE of solar PV in ASEAN countries remains higher than the global average rate (IRENA, 2020a), revealing that further work to reduce cost is vital for diffusing RE in the ASEAN regions.

[2] See https://www.irena.org/irenamembership

Figure 2.6: Electricity Prices and Renewables Costs in ASEAN



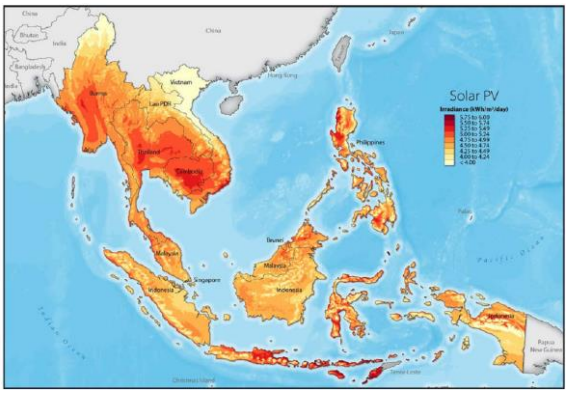
GW = gigawatt, kWh = kilowatt hour, LCOE = levelised cost of energy.

Source: IRENA (2020b).

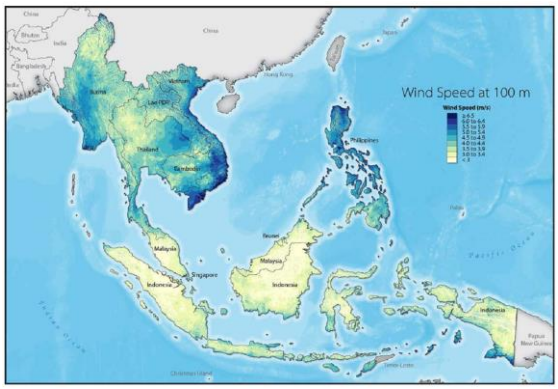
Research by the National Renewable Energy Laboratory of the United States demonstrated the abundant solar and wind resources and potentials in ASEAN countries (Figure 2.7, Table 2.2) (Lee et al., 2020). Moreover, the resources are not equivalently distributed across the region, implying that promoting RE in each country requires different considerations, and the power grid interconnection between countries may further facilitate the utilisation of RE.

Figure 0.1: Potentials and LCOEs of Solar PV and Wind Power Across ASEAN Countries

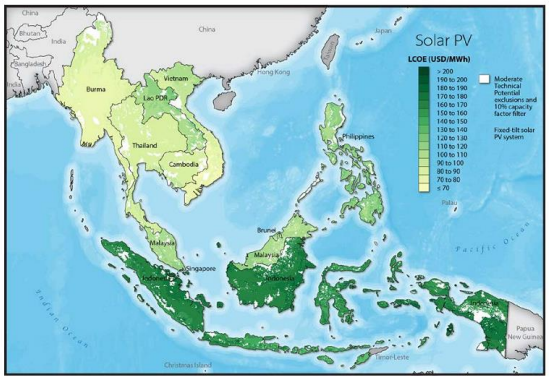
Solar resource potentials



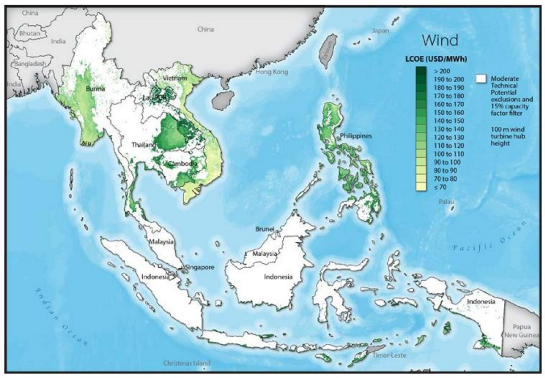
Wind resource potentials



Solar photovoltaic levelised cost of energy



Wind levelised cost of energy



ASEAN = Association of Southeast Asian Nations, kWh = kilowatt hour, LCOE = levelized cost of energy, m/s = metres per second, MWh = megawatt hour, PV = photovoltaic.

Source: Lee et al. (2020).

Table 2.2: Opportunities and Barriers for Renewables Development in Selected ASEAN Member States

Country	Potential Opportunities*		Potential Barriers
	Solar PV Capacity (GW) (suitable land area [km^2])	**Wind Capacity (GW)** (suitable land area [km^2])	
Malaysia	1,965 GW (54,575 km^2)	2 GW (526 km^2)	• Lower-quality wind resources given currently available technologies (and data) • Potentially high installed wind costs • Limited or non-existing utility-scale wind development
Philippines	1,910 GW (53,062 km^2)	217 GW (72,337 km^2)	• High installed solar PV and wind costs
Thailand	10,538 GW (292,713 km^2)	239 GW (79,718 km^2)	• High installed wind costs

*Note: LCOE of less than USD150/MWh.

ASEAN = Association of Southeast Asian Nations, GW = gigawatt, km^2 = square kilometres, LCOE = levelized cost of energy, MWh= megawatt hour, PV = photovoltaic.

Source: Lee et al. (2020).

3. ASEAN and the Paris Agreement

3.1. Intended Nationally Determined Contributions (NDCs)

As noted, all AMS have participated in the Paris Agreement and submitted Intended NDCs (Table 2.3). In addition, Singapore, Viet Nam, Thailand, Cambodia, Brunei Darussalam, and the Philippines have submitted updated NDCs (as of 15 April 2021) (Yumaidi, 2021).[3]

Although ASEAN countries are historically not blamed for greenhouse gas (GHG) emissions, which contribute to climate change, they rely on fossil fuels and are expected to continue this trend in the future. Moreover, per the Long-Term Climate Risk Index, four out of 10 most affected countries from 1999 to 2018 are ASEAN countries: Myanmar, the Philippines, Viet Nam, and Thailand (Germanwatch, 2019; Greenpeace Southeast Asia, 2020). ASEAN countries are vulnerable to climate change, and hence, it must be addressed with a sense of emergency. Nevertheless, although ASEAN countries already play a role in combating climate change via their commitment to NDCs, some studies note the paradox between their energy policies and climate ambitions, indicating that more efforts are needed to progress towards a more sustainable, low-carbon future (Overland et al., 2021; Shi, 2016).

Table 2.3: ASEAN Countries' Individual (Intended) Nationally Determined Contributions

Brunei Darussalam	• Brunei Darussalam commits to reducing 63% of its total energy consumption by 2035 • Updated NDC: 20% reduction of GHG emissions by 2030 relative to its BAU
Cambodia	• Cambodia commits to reducing 27% of its GHG emissions conditionally, taken from aggregate reductions from sectors such as energy, transport, and manufacturing, and an additional contribution from the land use, land-use change, and forestry (LULUCF) sector • Updated NDC: GHG targets (1) 27% GHG reduction by 2030 relative to BAU or equivalent to 3.1 MtCO2e, (2) LULUCF contribution of 4.7 MtCO2e/ha/year; 41.7% GHG reduction (of which 59.1% is from food and land use) by 2030 relative to BAU or equivalent to 64.6 MtCO2e

[3] UNFCCC NDC Registry: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx

Indonesia	• Indonesia commits to unconditionally reducing 26% of its GHG emissions by 2020 and 29% by 2030 relative to its BAU scenario. The reduction target will increase to 41% by 2030 with international cooperation
Lao People's Democratic Republic (Lao PDR)	• Lao PDR has set policies and measures to reduce GHG emissions in multiple sectors to be implemented by 2030
Malaysia	• Malaysia intends to reduce its GHG emissions intensity in GDP by 45% by 2030 relative to the emissions intensity in 2005; This reduction comprises 35% on an unconditional basis and a further 10% upon receipt of climate finance, technology transfer, and capacity building from developed countries
Myanmar	• Myanmar has set policies and measures to reduce GHG emissions in multiple sectors to be implemented by 2030
Philippines	• The Philippines commits to reducing 70% of its GHG emissions by 2030 relative to its BAU scenario; the mitigation contribution is conditioned on the extent of financial resources, including technology development and transfer and capacity building • Updated NDC: Philippines commits to a projected GHG emissions reduction and avoidance of 75%, of which 2.71% is unconditional, and 72.29% is conditional, representing the country's ambition for the 2020–2030 GHG mitigation in agriculture, waste, industry, transport, and energy. This commitment is referenced against a projected BAU cumulative economy-wide emissions of 3,340.3 MtCO2e for the same period
Singapore	• Relative to the 2005 base year, Singapore intends to reduce its emissions intensity by 36% by 2030 and stabilise its emissions to peak around 2030 • Updated NDC: Peak emissions at 65 MtCO2e around 2030 to achieve a 36% reduction in emissions intensity from 2005 levels
Thailand	• Thailand commits to reducing its GHG emissions by 20% from the BAU level by 2030. The target could increase by up to 25%, subject to adequate and enhanced access to technology development and transfer, financial resources, and capacity-building support through a

	balanced and ambitious global agreement under the UNFCCC • Updated NDC: 20% (unconditional) up to 25% (conditional) GHG reduction by 2030 relative to BAU
Viet Nam	• Viet Nam intends to reduce its GHG emissions by 8% unconditionally by 2030. The target could be increased to 25% if international support is received through bilateral and multilateral cooperation and the implementation of new mechanisms under the Global Climate Agreement, in which emission intensity per unit of GDP will be reduced by 30% relative to 2010 levels • Updated NDC: 7.3% (unconditional) GHG reduction by 2025, 9% (unconditional) up to 27% (conditional) GHG reduction by 2030 relative to BAU

ASEAN = Association of Southeast Asian Nations, BAU = business-as-usual, GHG = greenhouse gas, MtCO2e = metric tons of carbon dioxide equivalent, NDC = naturally determined contributions, UNVCCC = United Nations Framework Convention on Climate Change.

Sources: ERIA (2021, p. 313), with the authors' updates based on (Yumaidi, 2021) and the UNFCCC website (NDC Registry: https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx)

3.2. Energy Scenarios

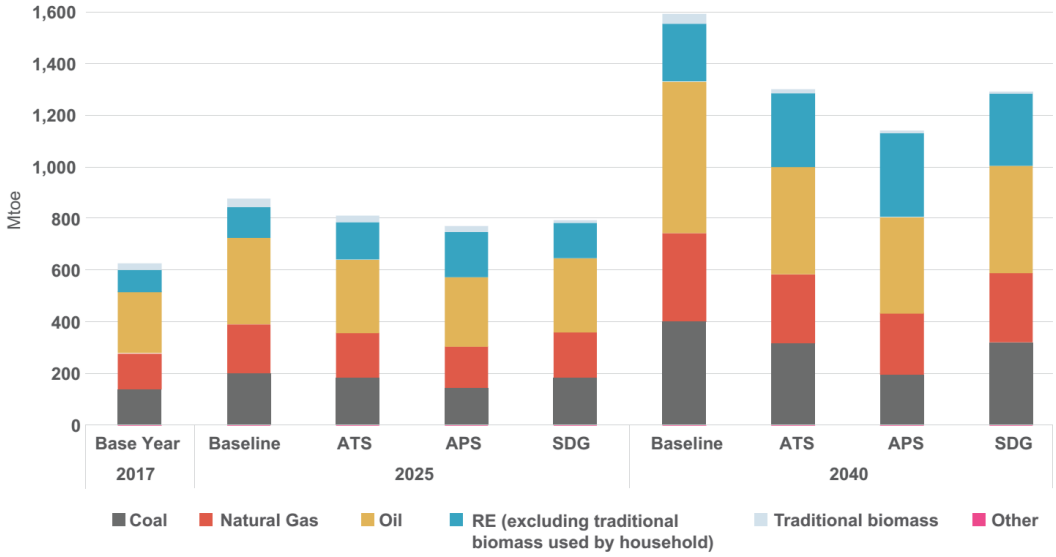
Several organisations have conducted energy scenario analyses for ASEAN countries, such as ACE (ACE, 2020a), IEA (Southeast Asia Energy Outlook 2019), IRENA (Global Renewables Outlook: Energy Transformation 2050, 2020), and Greenpeace (Southeast Asia Power Sector Scorecard, 2020). This section considers the results from the ACE scenarios (ACE, 2020a).

ACE's sixth ASEAN Energy Outlook explored four scenarios: (1) the baseline scenario assumes AMS continue to develop along with historical trends, which present the business-as-usual (BAU) case as the reference for other scenarios. (2) AMS targets scenario (ATS) projects the future development if AMS do what is needed to fully achieve their national energy efficiency and RE targets and their climate commitments. (3) APAEC targets scenario (APS) projects what it would take to achieve the regional targets announced in APAEC 2016–2025, achieve 23% of TPES from RE, and reduce the energy intensity by 30% from 2005 levels in 2025. (4) Sustainable Development Goals (SDG) scenario builds on the ATS to explore what the AMS would have to do to achieve the three targets of SDG7 by 2030: 'to ensure universal access to affordable, reliable, and modern energy services; increase substantially the share of renewable energy in the global energy

mix; and double the global rate of improvement in energy efficiency (from 2015 levels)' (ACE, 2020a).

The results (Figure 2.8) show that only the most ambitious scenario (APS) can achieve a 23% RE target by 2025, whilst the current national targets of ASEAN countries (ATS) would attain 17.7% (22.1%) RE in TPES by 2025 (2040), far behind the ASEAN regional target. Moreover, even under the APS, fossil fuels are projected to possess a 71% share of TPES in 2040, showing how the AMS would depend on fossil fuels and the importance of reducing this dependency. Regarding GHG emissions, the baseline scenario shows 2.4 times the current level of emissions if the AMS follow their current pattern to support economic development (Figure 2.9). If AMS follow their national policies and commitments (ATS), emissions will grow by 78% from more than the current level (2017) in 2040. Even the ambitious APS projects a 34% growth in 2040, relative to 2017.

Figure 2.8: ASEAN Total Primary Energy Supply across Scenarios

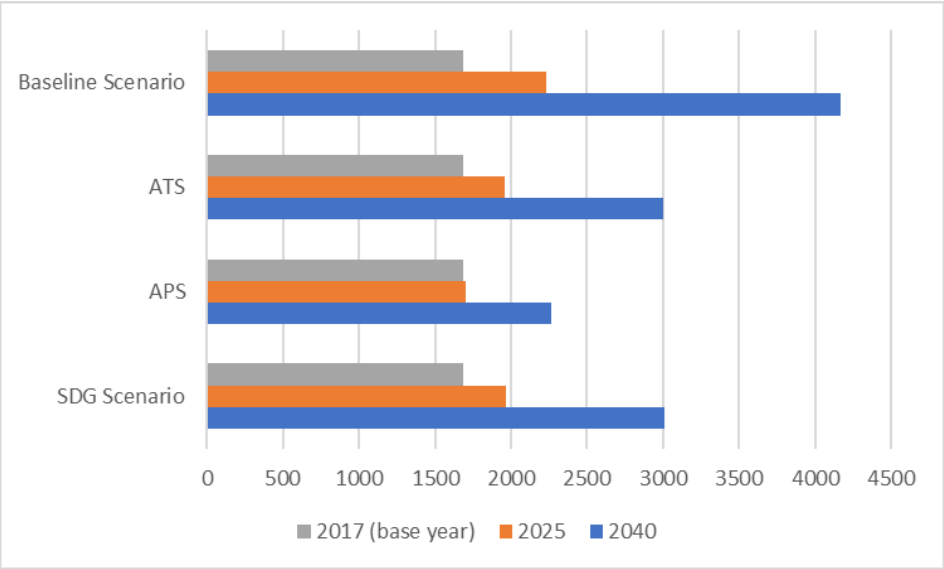


APS = APAEC targets scenario, ASEAN = Association of Southeast Asian Nations, ATS = AMS targets scenario, Mtoe = million tons of oil equivalent, RE = renewable energy, SDG = Sustainable Development Goal.

Source: ACE (2020a).

Figure 2.9: ASEAN GHG Emissions across Scenarios

(Mt CO_2-eq)



APS = APAEC targets scenario, ASEAN = Association of Southeast Asian Nations, ATS = AMS targets scenario, GHG = greenhouse gas, SDG = Sustainable Development Goal.
Source: Charted by the authors based on data from ACE (2020a).

4. Energy Situation and Related Policies in Selected Countries

4.1. Malaysia

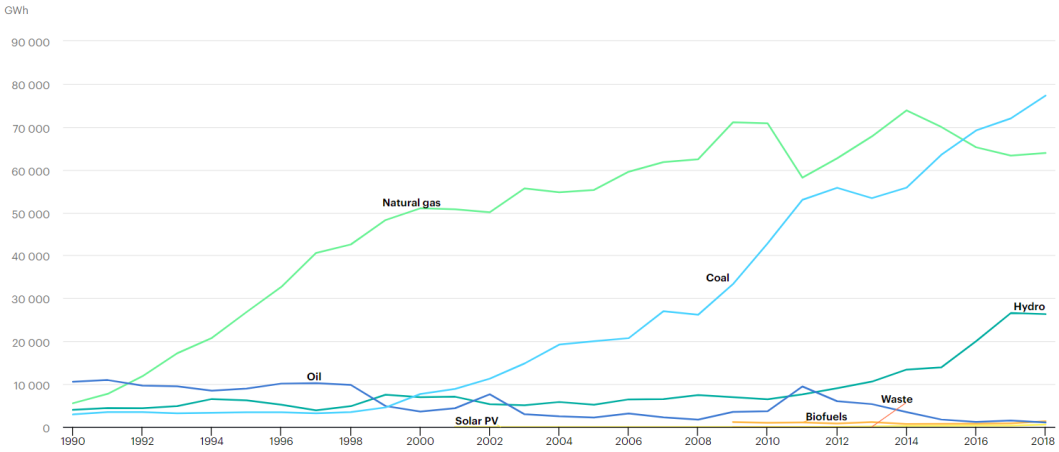
Malaysia is rich in fossil fuels such as oil, coal, and especially natural gas, where it ranks as the largest in Southeast Asia and the 12th largest worldwide in reserves (ERIA, 2021; Malahayati, 2020). Malaysia has relied on natural gas for power generation. Recently, coal has played a more important role in its power mix and now surpasses gas as the main source for power generation (Figure 2.10, Figure 2.11).

The Malaysian government started to realise the importance of RE, incorporating it into its energy mix in the Five Fuel Diversification Policy (2001) (the other four fuels are oil, coal, gas, and hydro) (Khor and Lalchand, 2014; Malahayati, 2020). The Five Fuel Diversification Policy is amongst the components of its national five-year development programme: the Eighth Malaysia Plan (2001–2005) (Umar, Jennings, and Urmee, 2014). The following Malaysia Plans included RE policies (Table 2.4). The announcement of the Twelfth Malaysia Plan (2021–2025) was delayed because of the COVID-19 pandemic, but

it was finally tabled on 27 September 2021, setting the target of 31% RE of the total installed capacity by 2025.[4]

Malaysia set the target of 20% RE in the power capacity mix by 2025 (excluding large-scale hydro) in its Renewable Energy Transition Roadmap 2035 (ACE, 2020a; UNESCAP, 2020);[5] and the latest targets announced are 31% RE by 2025 and 40% by 2035.[6] Several RE targets have been indicated in documents on Malaysia's energy policies, compiled in Table 2.5. Moreover, biomass (biofuels extracted from oil palm) is also regarded as a potential RE source in Malaysia (Hamzah, Tokimatsu, and Yoshikawa, 2019; UNESCAP, 2020).

Figure 2.10: Electricity Generation by Source, Malaysia (1990–2019)



PV = photovoltaic.

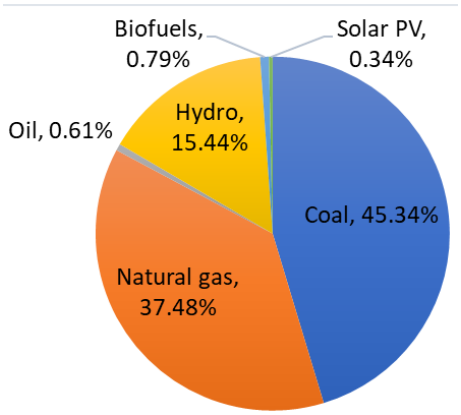
Source: IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

[4] Refer to https://www.mida.gov.my/mida-news/special-report-on-the-12th-malaysia-plan-2021-2025-12mp-success-needs-high-quality-investments-greater-public-accountability-whole-nation-participation/ For Twelfth Malaysia Plan (2021–2025), refer to https://rmke12.epu.gov.my/en

[5] Moreover, refer to www.seda.gov.my/2020/01/seda-malaysia-a-report-card-2019-strengthens-the-growth-of-renewable-energy-and-its-industry-in-malaysia/

[6] Refer to https://www.irena.org/newsroom/articles/2021/Jan/IRENA11ALiveDay1 Also see Twelfth Malaysia Plan (2021–2025). https://rmke12.epu.gov.my/en

Figure 2.11: Electricity Generation Mix in Malaysia (2018)



PV = photovoltaic.

Source: charted by the authors based on the data from IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

Table 2.4: Renewable Energy Policy Deployment and Development in Malaysia

Plans	Policies, Measures, Targets
Eighth Malaysia Plan (2001–2005)	• The fifth Fuel Diversification Policy 2001 • Small Renewable Energy Program • Renewable Share of 500 MW or 5% in Energy Mix 2005
Ninth Malaysia Plan (2006–2010)	• Renewable Share of 350 MW or 1.8% in Energy Mix 2010
Tenth Malaysia Plan (2010–2015)	• National Renewable Energy Policies and Action Plan 2010 • Renewable Energy Act 2011 • Sustainable Energy Development Authority 2011 • Feed-in Tariff • Renewable Share of 985 MW or 5.5% in Energy Mix 2015
Eleventh Malaysia Plan (2016–2020)	• Renewable Share of 2,080 MW or 7.8% from Peninsular Malaysia and Sabah Energy Mix 2020
Twelfth Malaysia Plan (2021–2025)	• 31% RE of the total installed capacity

MW = megawatt, RE = renewable energy.

Sources: Hamzah, Tokimatsu, and Yoshikawa (2019); Umar, Jennings, and Urmee (2014). For Twelfth Malaysia Plan (2021–2025), refer to https://rmke12.epu.gov.my/en.

Table 2.5: Energy Policies in Malaysia

Policy Area	Targets	References, Sources
Efficiency	Promote energy efficiency in the industry, buildings, and residential sectors via standard-setting, labelling, energy audits, and building design	(IEA, 2019b)
Renewables	Increase capacity of renewables to 2,080 MW by 2020 and 4,000 MW by 2030	(IEA, 2019b)
	20% RE in the power capacity mix by 2025 (excluding large-scale hydro)	• Malaysia National Renewable Energy Policy and Action Plan (NREPAP) 2011 (ACE, 2020a) • Renewable Energy Transition Roadmap 2035 (UNESCAP, 2020)
Transport	Introduce 100,000 electric vehicles by 2020 with 125,000 charging stations	(IEA, 2019b)
Climate change	Reduce GHG intensity in GDP by 35% by 2030 from the 2005 level, thereby inducing a 45% reduction with enhanced international support	(IEA, 2019b)

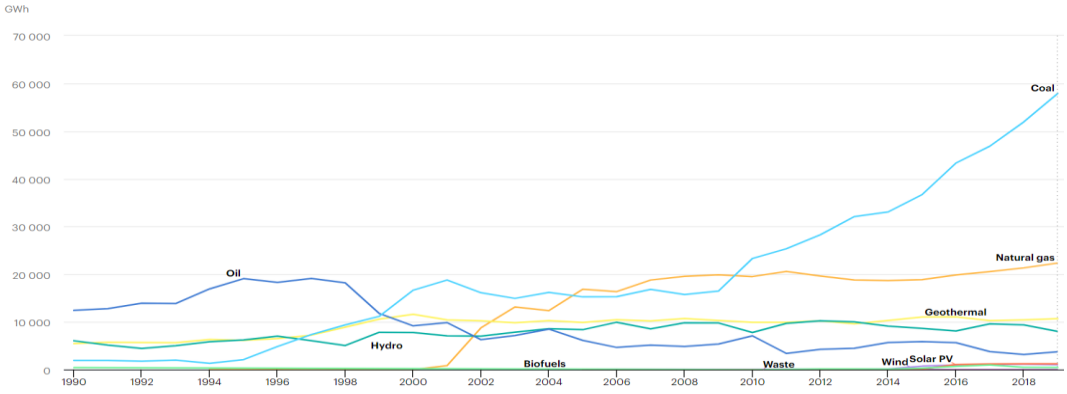
GHG = greenhouse gas, GDP = gross domestic product, MW = megawatt.

Sources: IEA (2019b), ACE (2020a) and UNESCAP (2020); compiled and edited by the authors.

4.2. The Philippines

The Philippines is rich in geothermal resources, utilising this advantage in power generation (Figure 2.12). Relative to other AMS, although the Philippines seems to have a relatively high RE share in its power generation at approximately 20% as of 2019, it has increasingly relied on fossil fuels, especially on coal, covering more than half the power generation (Figure 2.12,Figure 2.13). The import of fossil fuels has become a reason the rate of electricity in the Philippines is the most expensive in Asia (Overland et al., 2021).

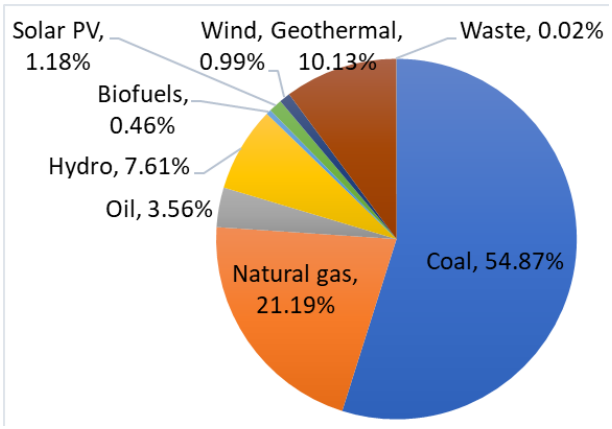
Figure 2.12: Electricity Generation by Source, The Philippines (1990–2019)



GWh = gigawatt hour, PV = photovoltaic.

Source: IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

Figure 2.13: Electricity Generation Mix in the Philippines, 2019



PV = photovoltaic.

Source: Charted by the authors based on the data from IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

The government of the Philippines promoted RE to reduce its vulnerability in depending on imported fossil fuels. Accordingly, the Renewable Energy Act was enacted in 2008 to provide incentives for the private sector's participation in RE investment (Malahayati, 2020). The National Renewable Energy Program (NREP) policy framework targets to increase the renewable-energy-based capacity to an estimated 15,304 MW by 2030, almost triple its 2010 level. Thus, the NREP planned installation targets and development goals, including the aim to 'increase geothermal capacity by 75.0%; increase hydropower capacity by 160%; deliver additional 277 MW biomass power capacities; attain wind power grid parity with the commissioning of 2,345 MW additional capacities; mainstream an additional 284 MW solar power capacities and work towards achieving the aspirational target of 1,528 MW; develop the first ocean energy facility for the country' (DOE, 2011).Tables 2.6, 2.7, 2.8, and Figure 2.14 highlight the detailed targets for developing RE and related energy policies.

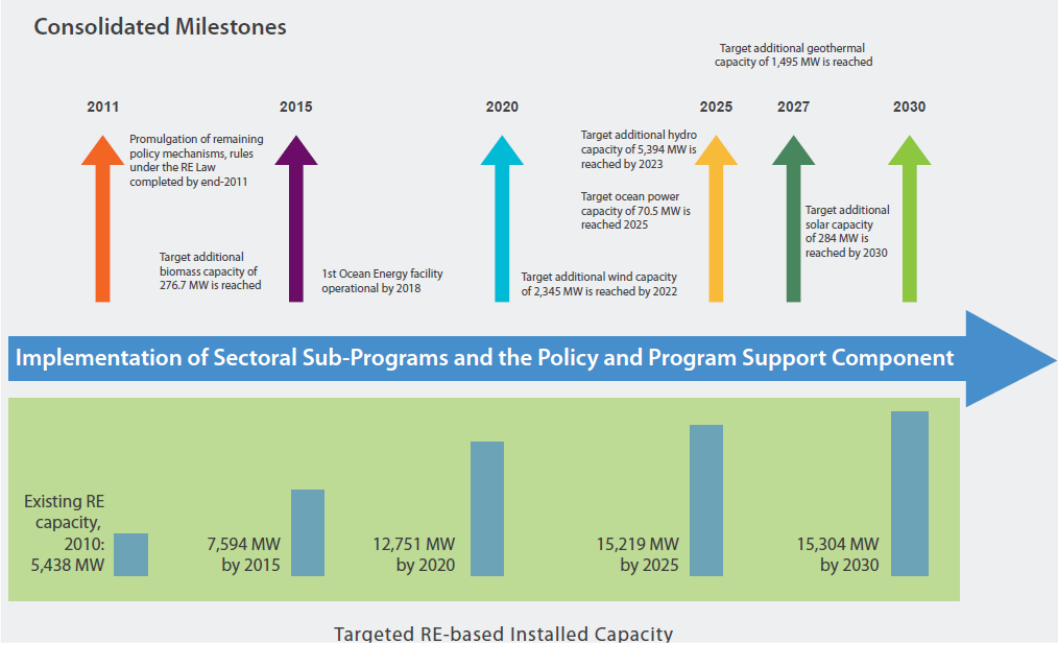
Table 2.6: Renewable-energy-based Capacity Installation Targets in the Philippines

Sector	Installed Capacity (MW) as of 2010	Target Capacity Addition By				Total Capacity Addition (MW) 2011–2030	Total Installed Capacity by 2030
		2015	2020	2025	2030		
Geothermal	1,966.0	220.0	1,100.0	95.0	80.0	1,495.0	3,461.0
Hydro	3,400.0	341.3	3,161.0	1,891.8	0.0	5,394.1	8,724.1
Biomass	39.0	276.7	0.0	0.0	0.0	276.7	315.7
Wind	33.0	1,048	855.0	442.0	0.0	2,345.0	2,378.0
Solar	1.0	269.0	5.0	5.0	5.0	284.0	285.0
Ocean	0.0	0.0	35.5	35.0	0.0	70.5	70.5
Total	**5,438.0**	**2,155.0**	**5,156.5**	**2,468.8**	**85.0**	**9,865.3**	**15,304.3**

MW = megawatt.

Source: DOE (2011).

Figure 2.14: Roadmap for Renewable Energy Development in the Philippines



MW = megawatt, RE = renewable energy.

Source: DOE (2011).

Table 2.7: Projected Milestones (2011–2030) (the Philippines)

Sector	Target Indicative Capacity Addition Achieved by	Others
Geothermal	2027	Low-enthalpy geothermal resource assessment completed by 2015
Hydro	2023	Construction of sea water pumped storage demo facility by 2030
Biomass	2015	Mandatory E10 blend for all gasoline vehicles by 2012
Wind	2022	Grid parity by 2025
Solar	2030	Smart grid and concentrated solar thermal power demo completed by 2015: Grid parity 2020
Ocean	2025	First ocean energy facility operational by 2018

Source: DOE (2011).

Table 2.8: Energy Policies in the Philippines

Policy Area	Targets	References, Sources
Electrification	Achieve 100% electrification by 2022	IEA (2019b)
Efficiency	Reduce energy intensity by 40% by 2030 from the 2010 level Decrease energy consumption by 1.6% per year by 2030 from baseline forecasts	IEA (2019b)
Renewables	Triple the installed capacity of renewables-based power generation from 2010 level to 15 GW by 2030	IEA (2019b)
	Triple RE installed capacity by 2030 from the 2010 level to 15.3 GW from 5.4 GW	NREP 2011 Sectoral Plans and Roadmap (ACE, 2020a)
	Biofuel blending ratio around 2% for biodiesel and 10% of bioethanol	Biofuels Roadmap Short Term: 2017–2018 — Sectoral Plans and Roadmap (ACE, 2020a)
Climate change	Reduce GHG emissions by 70% from the BAU level by 2030 with the condition of international support	IEA (2019b)

BAU = business as usual, GHG = greenhouse gas, GW = gigawatt, NREP = National Renewable Energy Program, RE = renewable energy.

Sources: compiled and edited by the authors from IEA (2019b) and ACE (2020).

Despite the ambitious RE goals, the Philippines has historically lagged some of its targets (UNESCAP, 2020). Thus, it is essential to monitor and check renewable practices for practicable ways to fulfil goals. The financing issue in RE projects where there is no transmission is amongst the challenges the Philippines face (UNESCAP, 2020). Further, given the geographic characteristics of an archipelagic state, off-grid areas could be a challenge and an opportunity in promoting RE.

4.3. Thailand

Relative to other AMS, Thailand is the frontrunner in RE development (UNESCAP, 2020). Thailand is amongst the first Asian countries to introduce a feed-in tariff (FIT) mechanism (Tongsopit and Greacen, 2013; UNESCAP, 2020). In 2002, set at an avoided-cost tariff, purchasing RE and cogeneration electricity by very small power producers was allowed.[7] The feed-in premium, called the Adder Programme, came into effect in 2007 (endorsed in 2006), where premium rates are added on top of wholesale electricity prices. This scheme then shifted to fixed FIT in 2013 (IRENA, 2017; Tongsopit and Greacen, 2012, 2013; UNESCAP, 2020). With well-balanced and responsive policies, a steady RE growth in its power mix has been witnessed during the past years (UNESCAP, 2020) (Figure 2.15).

Coal possesses and maintains a share of around 20% in Thailand's power generation during the past decades, and only 18% in 2019 (Figure 2.15, Figure 2.16), which is much less than in the Philippines and Malaysia. However, Thailand heavily relies on natural gas. The Thai government tried to correct this trend through the Alternative Energy Development Plan (AEDP) to increase RE and the 20 Years Power Development Plan 2010–2030 (PDP 2010–2030) to reduce approximately 12.6% of natural gas by 2030, introducing more RE and nuclear power (Malahayati, 2020).[8] The later revised PDP 2015–2036 set the target of 20% RE in electricity generation by 2036; PDP 2018–2037 updated the contents, which include reducing coal and imported hydro shares and increasing RE to 20% of the total power capacity by 2037 (UNESCAP, 2020). Table 2.9 compiles the energy-related targets.

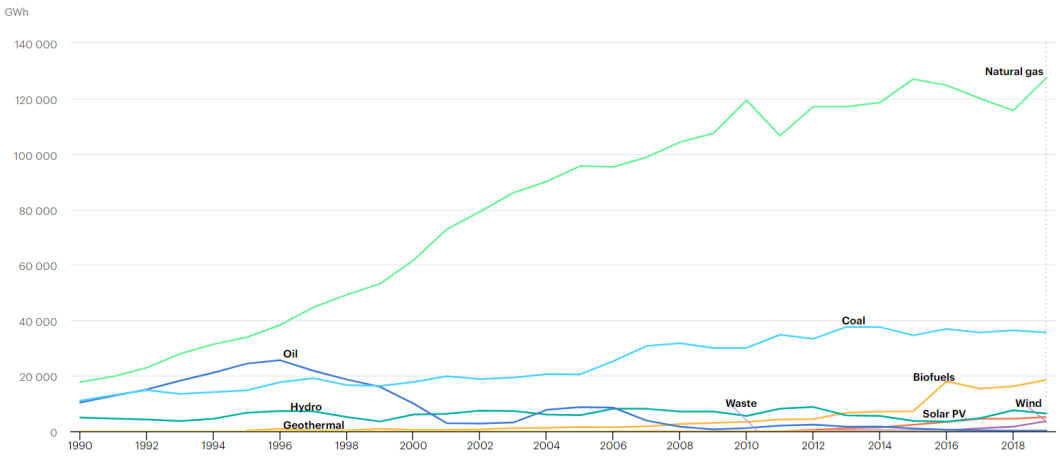
Thailand's community-based solar PV promotion brought it to the country with the highest per-capita solar installation rate in ASEAN countries (UNESCAP, 2020). Biofuels, including agricultural outputs such as rice, oil palm, sugarcane, and rubber, are the largest renewable electricity output sources in Thailand (Malahayati, 2020; UNESCAP, 2020).

---

[7] Even earlier, the purchase of power from small power producers using non-conventional energy (RE and cogeneration) was allowed in 1992 to facilitate the use of alternative energies and reduce the government burden to invest in power plant infrastructure (ERIA, 2019; Tongsopit and Greacen, 2012).

[8] Given the impact of the Fukushima Daiichi nuclear disaster, the Thai government has postponed the nuclear power plant plan. Safety issues have been a concern for local people. Refer to https://asia.nikkei.com/Economy/Thailand-s-nuclear-plans-inch-forward-with-new-bill, https://www.bangkokpost.com/opinion/opinion/2122807/renewables-are-the-future, https://www.bangkokpost.com/thailand/special-reports/1072704/power-play-tackles-hearts-and-minds

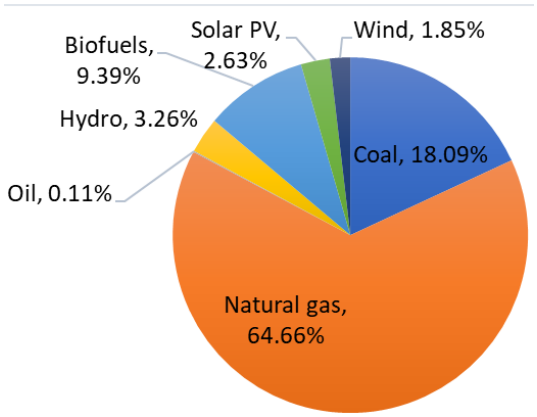
Figure 2.15: Electricity Generation by Source, Thailand (1990–2019)



GWh = gigawatt hour.

Source: IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

Figure 2.16: Electricity Generation Mix in Thailand, 2019



PV = photovoltaic.

Source: Charted by the authors based on the data from IEA electricity data browser: https://www.iea.org/fuels-and-technologies/electricity (accessed 4 May 2021).

Table 2.9: Energy Policies in Thailand

Policy Area	Targets	References, Sources
Efficiency	Reduce energy intensity by 30% by 2036 from the 2010 level	IEA (2019b)
Renewables	30% RE share in total final energy consumption (TFEC) by 2036, including 15% to 20% renewable electricity in total generation; 30% to 35% of consumed heat from renewables; and a 20% to 25% biofuel share in TFEC	Alternative Energy Development Plan (AEDP) 2015 (ACE, 2020a)
	The target for solar capacity increased from 6 GW to 17 GW by 2036 (under the Remap 2036)	(UNESCAP, 2020)
Transport	Increase to 1.2 million electric vehicles and 690 charging stations by 2036	(IEA, 2019b)
Climate change	Reduce CO_2 emissions from the power sector to 0.283 kg CO_2 in 2037 from 0.413 kg CO_2 in 2018 Reduce GHG emissions by 20% from the BAU level by 2030, inducing a 25% reduction with enhanced international support	(IEA, 2019b)

BAU = business-as-usual, GHG = greenhouse gas, GW = gigawatt,

Sources: Compiled and edited by the authors from IEA (2019b), ACE, (2020a) and UNESCAP, (2020).

5. Discussion and Conclusion

The above review on energy and climate policies of the overall ASEAN region and the selected three countries (Malaysia, the Philippines, and Thailand) show the willingness of the AMS to participate in the global fight against climate change and deploy sustainable RE. However, satisfying the rapidly growing energy demand driven by economic and industrial development whilst maintaining sustainability has become the main and common challenge for ASEAN countries. Whilst some analyses argued for the insufficiency in AMS' efforts on climate change and noted the paradox between their climate and energy policy and their global warming vulnerability (Overland et al., 2021), such a struggle, which may lead to a discrepancy between climate and energy policy, is not that rare and has also been observed in developed countries (e.g. Hattori and Chen, 2020).

Moreover, the ASEAN diversity requires more sophisticated policy designs in each country to meet their respective needs. The case of Thailand demonstrates that with a good policy lead, the fulfilment of RE targets can be achieved.

There is no doubt that deploying clean energy is vital and urgent for ASEAN countries. Beyond the climate risk, air pollution from fossil fuel combustion has caused public health issues, such as lung cancer, which is 'the leading and second leading cause of cancer-related death in men and women,' respectively, in Southeast Asian countries, inducing an economic burden in the long run, whilst the increase in RE and healthcare expenditure tend to reduce this health risk (Taghizadeh-Hesary and Taghizadeh-Hesary, 2020). Regarding the economy, although some countries have coal and natural gas resources, only Indonesia has comparatively rich reserves to avoid imports in the long run (Overland et al., 2021), resulting in an outflow of national wealth. Further, government investment in RE has been shown to bring more jobs than fossil fuels (Garrett-Peltier, 2017; Greenpeace Southeast Asia, 2020; McKinsey & Company, 2020) in the case of developed countries and Southeast Asia (IRENA, 2020a).

Environmental leapfrogging (Goldemberg, 1998; Watson and Sauter, 2011) is not a cliché; rather, it should be practicable more than ever for ASEAN countries at the crossroad of choosing an alternative pathway. The energy ladder is not a robust claim; more complicated models which consider more factors can shed more light on the energy use in emerging countries (Van Der Kroon et al., 2013).

There are at least four reasons and merits for which AMS should work on leapfrogging pathways.

First, good environmental practices address global climate change and regional and local AMS needs.

Second, the current competitiveness of RE technologies makes cleaner production technologies more attractive than end-of-pipe ones.

Third, AMS should feel fortunate that they can, to some extent, relative to advanced countries, avoid the stranded assets dilemma caused by the move towards a low-, zero-carbon society.

Finally, the global community, including international organisations and early-mover countries, engage in energy-related issues in Southeast Asia, which the AMS can leverage. Besides the inputs from the Economic Research Institute for ASEAN and East Asia (ERIA), some academic and policy-oriented documents are prepared with contributions from foreign and international units, which can serve as references for the AMS. Such documents include academic papers, such as (Overland et al., 2021) and 'Policy Brief' on the ACE website, issued by the ASEAN Climate Change and Energy Project (ACCEPT), both of which are funded by the Norwegian Government under the Norwegian–ASEAN Regional Integration Programme with joint implementation by ACE and the Norwegian

Institute of International Affairs; and the 'ASEAN Energy Outlook,' prepared by ACE with support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH through the ASEAN–German Energy Programme.

The policy review and analysis in this chapter, together with the following chapters that present the real attitudes and WTP to energies amongst the AMS citizens, can serve as a reference for policy design or discourse shaping to guide society in support of sustainable energy transition.