ASEAN PLAN OF ACTION FOR ENERGY COOPERATION (APAEC) 2016-2025

PHASE II: 2021-2025

One Community
for Sustainable
Energy

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One Community
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EXECUTIVE SUMMARY

Energy is a key component in advancing the ASEAN Economic Community's pursuit for an inclusive and dynamic regional economic integration towards 2025 and beyond. It has been a valuable input for a well-connected ASEAN which continuously drives a highly integrated, competitive, innovative, and global ASEAN.

The economic growth of ASEAN has been one of the most dynamic and the fastest in the world. ASEAN is one of the most preferred investment destinations in the world, and the region's economy is expected to grow at over 5% per year to become the 4th largest economy in the world by 2030. Yet, such economic growth prospects could be affected by the COVID-19 pandemic which has caused unprecedented shocks to industries and sectors across the global economy. The energy sector, which is vital to economic growth, has not been spared. However, energy has the potential to play a critical role in global reconstruction and recovery efforts.

ASEAN remains cautiously optimistic that economic growth would rebound or achieve an even higher growth if ASEAN addresses, at the regional and national levels, the challenges of greater integration and innovation in the areas of trade, investment, human capital, and regulatory coherence, while capitalising on global megatrends and other emerging trade related issues.

To fuel this growth, the demand in primary energy is projected to more than double from between 2017 and 2040, from 625 MTOE in 2017 to 1,589 MTOE in 2040 in the baseline scenario, according to the ASEAN Centre for Energy's (ACE) 6th ASEAN Energy Outlook (AEO6). Taking the COVID-19 pandemic into account, ACE projections indicate that regional Total Primary Energy Supply (TPES) could slightly decrease by 3% in 2040 in the same baseline scenario.

The 38th ASEAN Ministers of Energy Meeting (AMEM) held virtually on November 19, 2020 and hosted by Vietnam, endorsed the APAEC Phase II: 2021-2025, retaining the same theme of *"Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All".* A sub-theme was added: *"Accelerating Energy Transition and Strengthening Energy Resilience through Greater Innovation and Cooperation."*

The theme and sub-theme reflect the key elements of the 35th ASEAN Leaders Summit, held on November 3, 2019 in Bangkok/Nonthaburi, Thailand on connectivity and sustainability within ASEAN and in ASEAN's relations with the international community.

The APAEC Phase II: 2021-2025 builds on the success of APAEC Phase I: 2016-2020 and sets out ambitious targets and initiatives to enhance energy security and sustainability. It also supports *the United Nations Sustainable Development Goal 7 (UN SDG7).*

Under the APAEC Phase II, ASEAN will enhance its efforts towards building an ASEAN Power Grid by expanding multilateral electricity trading to provide affordable and resilient electricity, while accommodating higher shares of renewable energy towards the energy transition and a sustainable energy future. In the gas sector, ASEAN will pursue the development of a common gas market by implementing the recommendations of the 2018 Gas Advocacy White Paper (GAWP), which includes developing communication strategies to promote gas advocacy and strengthening regional cooperation to improve commercial and infrastructure readiness.

In the acceleration of energy transition and sustainability, ASEAN will optimise the role of Clean Coal Technology (CCT) and Carbon Capture Utilisation and Storage (CCUS) towards a low carbon economy. On energy efficiency and conservation, market transformation initiatives in favour of energy efficient technologies will be implemented in buildings, transport, and industry sectors to achieve the 32% Energy Intensity reduction aspirational target by 2025 based on 2005 levels. On Renewable Energy (RE), ASEAN will aim to achieve its aspirational targets of 23% share of RE in Total Primary Energy Supply and 35% share of RE in ASEAN installed power capacity by 2025 through deploying large-scale renewable energy systems, accommodating higher shares of RE in the APG, increasing RE investments, and exploring new and emerging energy technologies such as hydrogen and fuel cells.

Under the Regional Energy Policy and Planning, ASEAN will expand partnerships with Dialogue Partners (DPs) and International Organisations (IOs), and advance energy policy and planning to accelerate the region's energy transition and resilience. In the civilian nuclear energy sector, ASEAN will promote regional initiatives to enhance human resource capability on nuclear science and technology for power generation.

The key strategies of the seven (7) Programme Areas of the APAEC Phase II: 2021-2025 are as follows:

Table 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 renewable energy integration.
Trans-ASEAN Gas Pipeline	To pursue the development of a common gas market for ASEAN by enhancing gas and LNG 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.

Programme Areas	Key Strategies
Energy Efficiency and Conservation	To reduce energy intensity by 32% in 2025 based on 2005 levels and encourage further energy efficiency and conservation efforts, especially in transport and industry sectors.
Renewable Energy	To achieve aspirational target for increasing the component of renewable energy to 23% by 2025 in the ASEAN energy mix, including through 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.


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1. INTRODUCTION

1.1 Development of APAEC

The ASEAN Plan of Action for Energy Cooperation (APAEC) is a series of guiding policy documents that aims to promote multilateral energy cooperation and integration to attain the goals of the ASEAN Economic Community (AEC). It serves as the platform for deeper cooperation both within ASEAN as well as with Dialogue Partners (DPs) and International Organisations (IOs) towards enhancing energy security, accessibility, affordability, and sustainability within the framework the AEC.

APAEC 1999-2004 was the first phase of the implementation plan of the ASEAN Vision 2020 as prescribed by the 1998 Hanoi Plan of Action. Six (6) Programme Areas were introduced namely the: 1) ASEAN Power Grid (APG); 2) Trans-ASEAN Gas Pipeline (TAGP); 3) Energy Efficiency and Conservation (EE&C); 4) New and Renewable Energy (NRE); 5) Coal and Clean Coal Technologies (CCT); and 6) Regional Energy Outlook, Energy Policy and Environmental Analysis. APAEC 1999-2004 laid the foundation for robust policy frameworks and implementation modalities for energy cooperation amongst the AMS and for initiating cooperative partnerships with relevant DPs and IOs.

APAEC 2004-2009 supported the energy cooperation agenda of the 2004 Vientiane Action Plan under the ASEAN Vision 2020. Notable achievements included the signing of the Memorandum of Understanding (MOU) for the APG and the introduction of the annual ASEAN Energy Awards (AEA) for energy efficiency and renewable energy. During this period, the Programme Area on "Regional Energy Outlook, Energy Policy and Environmental Analysis" was replaced by "Regional Energy Policy and Planning (REPP)", expanding its role to overseeing the overall implementation of the APAEC and undertaking policy reviews and recommendations towards deeper and closer regional energy cooperation.

The third APAEC cycle, **APAEC 2010-2015**, supported the energy cooperation agenda of the AEC Blueprint 2015. Significant achievements during this period include: (a) Signing of the MOU between the ASEAN Secretary General and the Executive Director of the International Energy Agency (IEA) in 2011 in Brunei Darussalam, which established the annual ASEAN Ministers on Energy Meeting (AMEM)-IEA Energy Dialogue; (b) Signing of the MOU on the "Instrument to Extend the TAGP" for another term of 10 years until 20 May 2023; and, (c) exceeding ASEAN's aspirational targets of 8% reduction in energy intensity reduction (over 2005 levels) and 15% share of renewable energy in total installed power generation capacity mix by 2015. In addition, ASEAN expanded its energy cooperation by establishing the seventh programme area on Civilian Nuclear Energy (CNE) to facilitate information exchange and capacity building in nuclear energy.

The **APAEC 2016-2025** is the fourth and current APAEC extended over a longer period of 10 years. The implementation plan is divided in two (2) phases, namely, Phase I: 2016-2020 and Phase II: 2021-2025.

The **APAEC Phase I: 2016-2020** focused on the short- to medium-term strategies with the theme *"Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All"*.

The **APAEC Phase II: 2021-2025** is the continuation of Phase I with higher aspirational targets and new initiatives to enhance energy transition and resilience towards a sustainable energy future. The theme is maintained as in Phase I with a new sub-theme, *"Accelerating Energy Transition and Strengthening Energy Resilience through Greater Innovation and Cooperation"*. The APAEC Phase II takes into account the impacts of COVID-19 pandemic and its recovery plans, recent global economic and energy trends, cross-cutting issues such as climate change and decarbonisation, energy investment and financing projects, inclusion of private sectors through business forum activities, new and emerging energy technologies, and digitalisation in the energy sector.

1.2 Key Achievements in the APAEC Phase I: 2016-2020

APAEC 2016-2025 Phase I: 2016-2020 served as the blueprint for enhancing energy connectivity and market integration in the ASEAN region. It addressed the challenges and opportunities for energy transition and sustainability against the backdrop of the Fourth Industrial Revolution (4IR). The APAEC Phase I established specific energy targets for energy intensity and renewable energy which sent a strong signal to the global energy community on ASEAN's commitment to energy sustainability.

In APAEC Phase I: 2016-2020, the key achievements under the seven (7) programme areas are summarised below.

Under the **ASEAN Power Grid (APG)** programme, the first multilateral power trade was successfully initiated under the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). A total of 30.2 GWh of electricity traded under LTMS-PIP Phase I and LTM-PIP Phase I and II, as of August 2020. Moving forward, the three (3) countries agreed to further increase the maximum committed energy capacity trading of the LTM-PIP up from 100 MW to 300 MW. Lao PDR, Thailand, Malaysia, and Singapore have initiated the discussion on the next phase of the LTMS-PIP which will further expand the electricity trading to Singapore post-2021. Several notable studies have been published on multilateral power trade in ASEAN, including (i) Study on Establishment of ASEAN Power Grid Transmission System Operator (ATSO) and ASEAN Generation and Transmission System Planning Institution (AGTP), (ii) Study on ASEAN Primary Energy Resources for Power Generation, (iii) Study on Harmonisation of Legal and Regulatory Framework for bilateral and cross-border power interconnection and trade, (iv) ASEAN-China Power Cooperation Report by ACE and China Renewable Energy Engineering Institute (CREEI), (v) Study on Taxation on Cross Border Power Transaction, (vi) Study on Guideline for PPP Financing Modalities in ASEAN Power Project, and (vii) Feasibility Study on Multilateral Power Trade and the ASEAN Renewable Integration Analysis Study on integrating renewable energy into cross-border power trade.

The **Trans-ASEAN Gas Pipeline (TAGP)** programme links six (6) ASEAN Member States through 13 interconnection pipelines with a total length of 3,631 km and nine (9) LNG regasification terminals (RGT) with a combined total capacity of 38.75 MTPA as of 2020. ASCOPE also successfully completed the following: (i) Model LNG Sales and Purchase Agreement (SPA) without destination restriction, (ii) the Master LNG SPA, Gas Advocacy White Paper (GAWP), (iii) Study on small-scale LNG (ssLNG), and (iv) study on LNG bunkering.

Under the **Coal and Clean Coal Technology (CCT)**, the ASEAN Member States have endeavoured to increase the deployment of cleaner coal technology, with a total combined installed capacity of 10,021 MW of super critical and ultra-super critical coal-fired power plants in 2019. Several capacity building activities and workshops on CCT were held to enhance information sharing on environmentally responsible practices on coal development and utilisation as well as to assess the new role of coal in the energy transition and sustainable development. The ASEAN Forum on Coal (AFOC) conducted a High-Level Policy Dialogue in 2018 in Malaysia and launched the 1st ASEAN Coal Business Roundtable Dialogue in 2020. Several studies were published such as (i) ASEAN CCT Handbook for Power Plans by ACE and Japan Coal Centre (JCOAL), (ii) ASEAN's Energy Equation: The Role of Low Emission Coal in Driving a Sustainable Energy Future by ACE and World Coal Association (WCA), (iii) Feasibility Study on Coal Upgrading, (iv) CCT Financial Model Study, and (v) Study of Cleaner Coal Utilisation Roadmap by ACE and China Energy Technology and Economics Research Institute (CETERI).

In the area of **Energy Efficiency and Conservation (EE&C)** programme, ASEAN achieved an Energy Intensity (EI) reduction of 21% by 2018, surpassing its aspirational target of 20% in 2020 (over 2005 levels). Three policy documents were endorsed by the ASEAN Ministers on Energy Meeting (AMEM), namely, (i) Regional Policy Roadmap on Harmonisation of Minimum Energy Performance Standards (MEPS) for Air Conditioner in 2017, (ii) Regional Policy Roadmap on Harmonisation of MEPS for Lighting in 2019, and (iii) Guidelines of Integration of Energy Efficiency into ASEAN Electrical and Electronic Equipment (EEE) Mutual Recognition Arrangement (MRA) in 2019, which is the first cross-sectoral initiative by the ASEAN Energy sector. Major efforts in the promotion of green building codes, zero energy building awards, and EE financing were also initiated in Phase I. Additionally, 54 Energy Manager Trainers were certified under the ASEAN-Japan Energy Efficiency Partnership (AJEEP). The ASEAN SHINE Project for Lighting Phase I was completed in 2017. The ASEAN+3 Mitigation Cooperation Programme Phase I was implemented in Cambodia, Lao PDR, and Myanmar. Several publications on EE&C were completed, namely (i) ASEAN Regional Efficient Lighting Market Assessment, (ii) ASEAN ESCO Report, and (iii) ASEAN Best Practices in EE&C.

The steady progress in the deployment of **Renewable Energy (RE)** projects has enabled ASEAN to increase the share of RE in ASEAN's total primary energy supply (TPES) mix to 13.9% as of 2018. However, more needs to be done under the RE Programme Area to achieve the aspirational target of 23% RE share in the Total Primary Energy Supply (TPES) by 2025. A MOU was signed between ACE and the National Science and Technology Development Agency (NSTDA), Thailand at the 37th AMEM to support the higher utilisation of biofuels, bioenergy, and human resource capacity development. Several capacity building workshops and studies were carried out with the support of ASEAN-German Energy Programme (AGEP) including the (i) RE Research and Development (R&D) Outlook in ASEAN, (ii) Levelised Cost of

Electricity (LCOE) for Selected RE Technologies Part II, (iii) Insurance and Guarantee Schemes of RE in ASEAN, and (iv) Review of Grid Codes for Variable Renewable Generation in the ASEAN Region: Malaysia, Thailand, and Indonesia. Other notable studies include the ASEAN Feed-in-tariff Mechanism Report by ACE and China Renewable Energy Engineering Institute (CREEI) and RE Investment Series by ACE and Norwegian Institute of International Affairs (NUPI) through the ASEAN Climate Change and Energy Project (ACCEPT).

To better profile the ASEAN energy cooperation internationally and to aid AMS in policy and planning processes, multiple initiatives were launched under the **Regional Energy Policy and Planning (REPP)** programme. ACE published the 5th and 6th ASEAN Energy Outlook (AEO5 and AEO6) in 2017 and 2020 respectively, with the support of AGEP. The energy outlooks highlighted the key trends in the region's energy landscape and policy directions to enhance energy security, energy transition, and energy resilience. A key milestone was the signing of the MOU between ASEAN and the International Renewable Energy Agency (IRENA) at the 36th AMEM in October 2018 in Singapore, with the first AMEM-IRENA dialogue held during the 35th AMEM in September 2017 in Manila, Philippines. In addition, the first ASEAN Energy Cooperation Report (AECR) was published in 2017 showcasing the key achievements of the APAEC and strategic directions going forward for ASEAN's energy stakeholders. Also published in 2017 was the ASEAN Energy Statistics Report. In 2018, a Capacity Building Roadmap on Energy Investments and Financing for ASEAN was developed during Singapore's chairmanship of 36th AMEM.

The **Civilian Nuclear Energy (CNE)** programme has made progress in increasing the capacities of AMS in the policy, technology, and regulatory aspects of nuclear energy. In 2018, the ACE-Canada Nuclear Radiological Programme Administrative Support (NRPAS) was completed, which provided regional approaches to build capacities in nuclear and radiological security for the long-term development of nuclear power programmes. Under NRPAS, several publications were released, namely (i) Pre-Feasibility Study on Establishment of Nuclear Power Plant in the AMS and (ii) Study on Nuclear Legal and Regulatory Framework in AMS. On capacity building, through the ACE-Japan Atomic Energy Agency (JAEA) Programme, series of seminars on Nuclear Security and Good Practices of Regional Cooperation on Nuclear Security were conducted in April 2017 and May 2019, respectively. The Civilian Nuclear Energy Factsheet and ASEAN Nuclear Energy Portal were developed in 2020.

1.3 Global Energy Trends

There are a number of global perspectives that could shape the energy landscape of ASEAN during the Phase II implementation of APAEC 2016-2025.

First, global energy transition is gradually shifting from a carbon-intensive to a cleaner energy system. Furthermore, the transition is accelerated by the volatility of global oil and gas markets and the increasingly competitive prices of renewable energy such as solar photovoltaics, geothermal, and hydropower. According to IRENA, new solar and wind farms are becoming increasingly cheaper to build when compared to the operating costs of existing coal plants, making the cost of renewable energy more attractive.

ASEAN sees this as a crucial development in shaping the regional energy development plan and will continue to pursue its ambitious RE and EE targets under the APAEC Phase II. Rapid transition to decentralised and decarbonised power generation are among the challenges of the ASEAN energy transition. To this end, the APAEC Phase II aims to identify strategies for balancing the energy trilemma of energy security, energy equity and environmental sustainability.

Second, the impact of the COVID-19 pandemic on global energy demand and supply could change how ASEAN approaches the energy transition over the next few years.

According to the IEA's Global Energy Review 2020, the COVID-19 pandemic has caused multiple shocks to global economic and energy markets. Countries that have implemented full lockdowns experienced an average 25% decline in energy demand, while those with partial measures are showing an average of 15-18% decline in energy demand per week. Other containment measures such as travel restrictions also caused a fall in oil demand, oil supply, and demand imbalance as well as a crash in oil prices. Global coal demand was hardest hit, falling by almost 8% in the first quarter of 2020 compared to the first quarter of 2019. For ASEAN, there has been some impact on the oil and gas demand due to the Covid-19 movement restrictions policy. In particularly, there has been a decrease of demand for petroleum products in the commercial, industrial, and transportation sectors. Meanwhile, the decrease of natural gas demand has been largely restricted to the commercial sector. On the other hand, the supply-side activity of oil and gas has not been as heavily impacted as the demand side.

Third, the UN SDG 7 on access to affordable, reliable, sustainable and modern energy for all. The APAEC Phase II will play an important role to support the AMS in achieving the five (5) main targets of UN SDG 7.

Fourth, the Fourth Industrial Revolution (4IR) which is fast transforming the energy sector in the region. Key developments include digital technologies such as internet of things, artificial intelligence, big data, and cloud computing in generation, distribution, consumption, and smart production of cleaner and more efficient energy. The future trend of electrification and digitalisation will bring about revolutionary changes, including through digital technologies such as smart grids and distributed power generation with advanced supply and demand management systems, prosumers, and peer-to-peer trading platforms. Building up regional knowledge capabilities in managing big data system will ultimately help to improve the ASEAN Energy Database System (AEDS) and the ASEAN Energy Outlook when more energy data and statistics are available at regional level.

Finally, emerging low carbon technologies such as hydrogen and fuel cells are potential alternative energy options for the future that ASEAN should keep abreast of.

1.4 ASEAN Energy Development Directives

The ASEAN Energy Cooperation Agreement signed in 1986 by the ASEAN Leaders has continually served as the basis to advance energy cooperation goals which have been captured in great details in the APAEC.

The implementation of APAEC Phase II will be guided by the relevant policies and the directions of the ASEAN Leaders. First, the ASEAN Leaders' Vision Statement on *"Partnership for Sustainability"* to ensure sustainability in all dimensions. Second, the ASEAN Leaders' endorsement of the complementarities between the ASEAN Community Vision 2025 and the UN 2030 Agenda for Sustainable Development, creating the Complementarities Roadmap. This will serve as guidance for further advancing the Complementarities Initiative during 2020 – 2025. Lastly, the ASEAN Declaration on Industry Transformation to Industry 4.0.

Through ASEAN 2025 Forging Ahead Together, ASEAN Leaders requested to strengthen the effectiveness of ASEAN-led mechanisms, including to enhance information sharing and institutionalise the practice of cross-briefing and exchange of calendars of activity of relevant meetings of ASEAN Sectoral Bodies and cross-cutting issues. Such mechanisms would strengthen cross-sectoral and cross-pillar coordination in the region.

During the 35th ASEAN Summit in 2019, the Leaders reiterated their commitment to the ASEAN Power Grid and Trans-ASEAN Gas Pipeline. AMS will stride for greater expansion of connectivity arrangements in gas and electricity for better energy security of the region. The Leaders commended the continuing efforts to secure a sustainable energy future by surpassing the energy intensity reduction target of 20% by 2020 and encouraged an intensified effort to achieve the ASEAN aspirational target of 23% renewable energy share in total energy mix. The region will promote energy cooperation initiatives that will take into account the digital economy, interlinkages of global value chains and ASEAN Guidelines on Good Regulatory Practice (GRP) for technical regulations, as well as the ASEAN Principles on Harmonisation of Regulatory Regime. Moving forward, the initiatives in addressing non-tariff barriers, mutual recognition arrangements and other patent cooperation will also contribute to a more open, inclusive and rules-based international trading system, and expansion of the region's value chains.

1.5 Overview and Key Findings of the 6th ASEAN Energy Outlook

The 6th ASEAN Energy Outlook (AEO6) projects the future of energy landscape of ASEAN from 2018 to 2040.

The region's total primary energy supply (TPES) is projected to grow by 2.5 times from 625 MTOE in 2017 to 1,589 MTOE in 2040 in the baseline scenario. In 2025, the region's TPES will reach 874 MTOE. In the same period, ASEAN's total final energy consumption (TFEC) is forecasted to reach 518 MTOE in 2025 and 922 MTOE in 2040 under baseline scenario. By 2025, the region's TFEC is projected to be 474 MTOE in the ASEAN Target Scenario (ATS) and 450 MTOE in the ASEAN Progressive Scenario (APS).

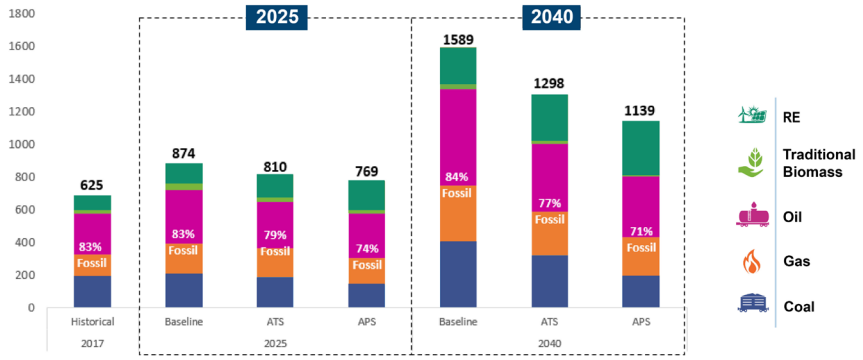


Figure 1. ASEAN Total Primary Energy Supply based on 6th ASEAN Energy Outlook

By 2025, the AEO6 projects that the share of renewable energy will be 14% of the total 874 Mtoe at TPES in baseline scenario (Figure 1), 18% of the total 810 Mtoe in the ATS, and 23% of the total 769 Mtoe in the APS. On the other hand, the energy intensity reduction target in 2025 compared to 2005 level is projected to reach 24% in baseline scenario, 29% in the ATS, and 32% in the APS.

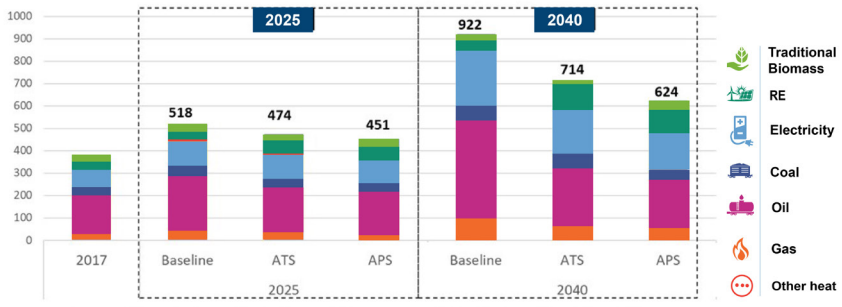


Figure 2. ASEAN Total Final Energy Consumption based on 6th ASEAN Energy Outlook

The power sector plays a significant role in stimulating the share of renewable energy in the region. By 2025, the share of RE in installed power capacity will be 33% in ATS and 48% in the APS. The RE share in installed capacity is dominated by hydro (19%), followed by solar power (7%) in the ATS. Solar will triple its installed capacity in the APS, and the shares in installed capacity will increase to 20% of total capacity.

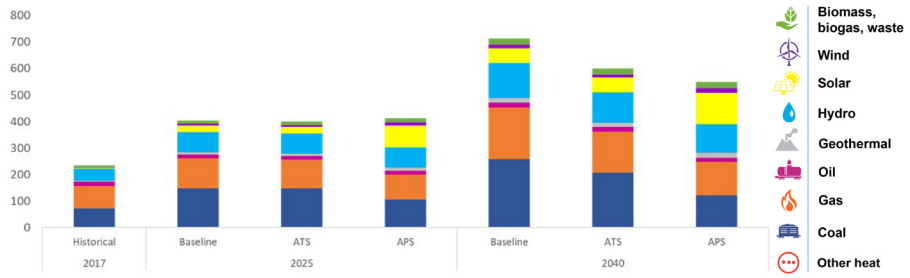


Figure 3. ASEAN Installed Capacity based on 6th ASEAN Energy Outlook

2. PROGRAMME AREAS

The APAEC Phase II: 2021-2025 will continue to focus on the seven (7) programme areas as in the APAEC Phase I: 2016-2020, namely:

1. ASEAN Power Grid (APG)
2. Trans-ASEAN Gas Pipeline (TAGP)
3. Coal and Clean Coal Technology (CCT)
4. Energy Efficiency and Conservation (EE&C)
5. Renewable Energy (RE)
6. Regional Energy Policy and Planning (REPP)
7. Civilian Nuclear Energy (CNE)

Under the overall theme of APAEC 2016-2025, *"Enhancing Energy Connectivity and Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All"*, the strategies of the APAEC Phase II will be driven by the sub-theme *"Accelerating Energy Transition[2] and Strengthening Energy Resilience[3] through Greater Innovation and Cooperation"*.

2.1 Programme Area No.1 – ASEAN Power Grid

Background

Advancing multilateral power trade will be a key focus of the ASEAN Power Grid (APG) to achieve the goal of the ASEAN Economic Community (AEC) 2025 to enhance connectivity, energy security, and sustainability.

The APG has progressed gradually from bilateral to sub-regional arrangements. Overall, the APG has made significant strides in enhancing electricity trade across borders and in providing opportunities to tap sustainable power generation sources like renewable energy and liquefied natural gas (LNG). The APG contributes to the economic development of ASEAN to meet the rising electricity demand, improve access to energy services, and develop the growth of the regional industry players.

The Heads of ASEAN Power Utilities and Authorities (HAPUA), as a Specialised Energy Body (SEB), drives the APG to ensure regional energy security in collaboration with ASEAN energy bodies including the ASEAN Energy Regulators Network (AERN), which consists of energy regulators from AMS and the ASEAN Power Grid Consultative Committee (APGCC).

[2]Energy transition: a decarbonisation pathway to transform the energy system from carbon-intensive to cleaner energy.
[3]Energy resilience: the capability of an energy system to withstand and recover from high-impact events and reduce the duration, cost and impact of outages on critical services.

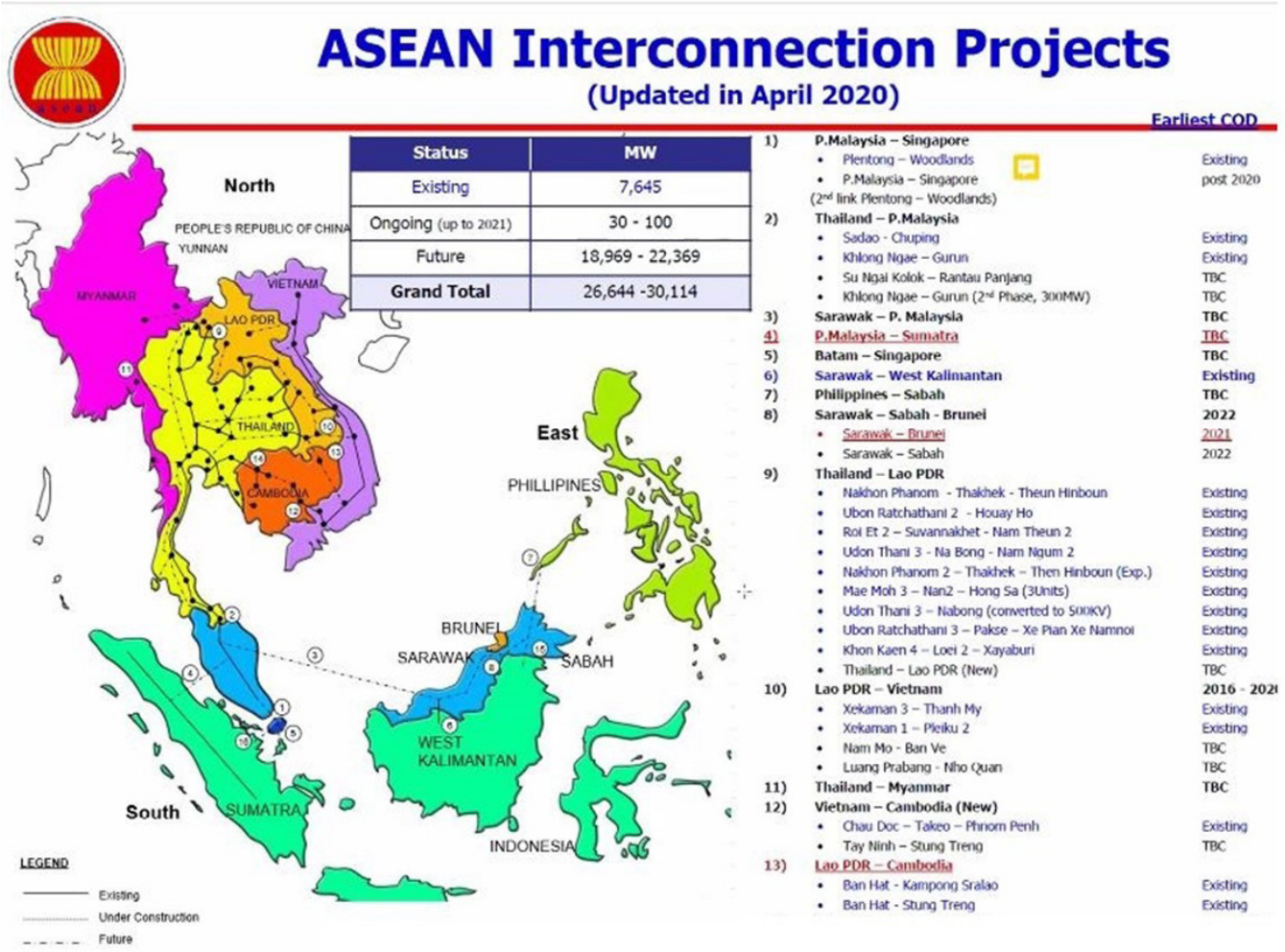


Figure 4. ASEAN Power Grid Interconnection Project Status

Key Achievements in APAEC Phase I

A major initiative of the ASEAN Power Grid in APAEC Phase I was the operationalisation of the first multilateral power trade pilot project, namely the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project (LTMS-PIP). Initiated in 2014, the LTMS-PIP was a path finder for cross-border power trade of up to 100 MW of hydro electricity from Lao PDR to Singapore using existing interconnections.

The first multilateral electricity trading started following the signing of the Energy Purchase and Wheeling Agreement (EPWA) by Lao PDR, Thailand, and Malaysia in 2017. A total of 30.2 GWh of electricity traded under LTMS-PIP Phase I and LTM-PIP Phase I and II, as of August 2020. A Supplementary Agreement to the EPWA was signed by the utility companies from the three countries to increase the committed energy capacity trading from 100 MW to 300 MW for a 2-year period from January 2020 to December 2021. There are discussions among Lao PDR, Thailand, Malaysia, and Singapore to expand this electricity trading to Singapore as part of the next phase of the LTMS-PIP.

Several studies on regional power integration and multilateral power trade in the APG were completed, including the Feasibility Study on Multilateral Power Trade and the ASEAN Renewable Integration Analysis Study on integrating renewable energy into cross-border power trade in 2019. Additionally, "Study on Taxation on Cross Border Power Transaction" was conducted in 2017. During this period, HAPUA also began the ASEAN Interconnection Masterplan Study (AIMS) III to set out the interconnection infrastructure needed to enable expanded power trade as well as integrate higher shares of renewables into the APG.

The AMS are cognisant that increasing energy investment is a priority to advance the connectivity goals of the APG, which needs clear policy guidelines and best-practices, and investment-friendly conditions. Along this direction, HAPUA has completed studies to identify areas where indigenous resources can be utilised to benefit the region. The HAPUA Council approved the Final Report of the "Study on Guideline for PPP Financing Modalities in ASEAN Power Project" which provided recommendations on applying PPP to the APG Project.

Strategies and Action Plans under APAEC Phase II

Based on the 6th ASEAN Energy Outlook, the region would need power capacity additions of 479 GW by 2040 as electricity grows at triple the rate of overall energy demand. Coal and gas will continue strongly providing additional capacity of 186 GW and 109 GW, respectively, by 2040. Notably, a total of 160 GW capacity additions will come from renewables, especially solar PV with 51 GW additional capacity by 2040.

In APAEC Phase II, the AMS will continue their commitment to accelerate the realisation of the APG by securing favourable investments and financing and increasing the deployment of renewable energy to address the twin goals of energy transition and sustainable energy future for ASEAN.

Towards this direction, HAPUA's strategy is to accelerate the progress of APG Projects and initiate the expansion of multilateral electricity trading. The action plan of HAPUA is to establish the feasibility of at least four (4) APG projects.

Based on the results and other favourable factors, HAPUA will decide which ones will be continued for inclusion in the APG.

HAPUA plans to explore expanding multilateral power trade to another sub-region of the ASEAN Power Grid following the success of the LTMS-PIP. This will be guided by the key findings and recommendations of the APG studies such as (i) Study on the Formation of APG Institutions which consists of the ASEAN Power Grid Generation and Transmission System Planning Institutions (AGTP) and ASEAN Power Grid Transmission System Operator (ATSO), (ii) Feasibility Study for ASEAN Multilateral Power Trade, and (iii) ASEAN Interconnection Master Plan Study (AIMS) III.

The AIMS III will provide the new and updated plan of the APG to be used as the main reference for the region to pursue the development of a high-level plan for the realisation of multilateral power trading, including the comprehensive feasibility study on the design and implementation in delivering a fully operable bilateral and multilateral power trading. Moreover, the report identified 42 and 20 potential sites for solar and wind power, respectively, across the AMS, which are expected to enhance the higher share of renewable energy projects in the APG.

Since APG projects entail significant financing and capacity to design cross-border electricity projects, HAPUA will forge public-private partnership arrangements to mobilise expertise and resources to facilitate the integration process of these projects into the APG. To realise this, HAPUA will undertake capacity building activities to build regional support for human capital, investment and financing and thereby facilitate cross-border physical infrastructure connectivity.

HAPUA will follow up on the proposed minimum requirements of multilateral power trading, in close coordination with ACE, the APGCC, AERN, and other relevant energy bodies of ASEAN. Based on the recommendations of the Feasibility Study on Multilateral Power Trading, the three (3) aspects of minimum requirements (Political, Institutional, and Technical) are split into two key strategies, namely (i) developing institutional and regulatory capacity; and (ii) harmonising the minimum technical requirements.

On the strategy to develop institutional and regulatory capacity, HAPUA will (i) establish intergovernmental mechanism and develop capacities of the MPT/APG Institutions; (ii) assess the need and feasibility of new regional institutions for implementing multilateral power trade; (iii) develop dispute settlement mechanism; and (iv) analyse appropriate trade models for regional electricity market.

On the strategy to harmonise technical standards, HAPUA will implement the following action plans: (i) develop harmonised grid codes for transmission interconnection through grid codes assessment in ASEAN and the development of detailed grid codes; (ii) develop harmonised wheeling charges methodology including high-level formula for wheeling charges; (iii) develop Regional Market Third-party access guidelines; (iv) develop guidelines and best practices for data sharing and utilisation; and (v) develop coordinated transmission capacity calculation methodology; and (vi) strengthen grid resilience and modernisation by enhancing power system reliability and quality assessment methods in the region.

The fourth strategy of HAPUA is to explore integrating renewable energy and other digital developments into the APG, which is increasingly becoming an important vehicle in clean energy transitions. Wind, solar farms, and other flexible resources, including the emerging technologies such as energy storage systems, hydrogen, fuel cells, etc, will be increasingly connected to the electricity grid networks and significant investments in these networks will be essential in the coming years. HAPUA aims to accommodate higher penetration rate of renewable energy in the APG and to increase initiatives on energy transition and sustainable development goals through RE. The key actions of HAPUA are: (i) assess the potential of RE investment opportunities and contribution to the ASEAN Power Grid, including the initiation of the RE Integration pilot projects; (ii) analyse the expansion of APG considering other flexible resources and emerging technologies as well as demand side management; and (iii) conduct at least one activity on smart grid and Cyber Security technologies and policies for power grids in ASEAN. The implementation of this strategy will be in close coordination with Renewable Energy Sub-Sector Network (RE-SSN) and Regional Energy Policy and Planning Sub-Sector Network (REPP-SSN).

Table 2. Outcome-based Strategies and Action Plans for ASEAN Power Grid

OBS 1. Accelerate the progress of APG projects and initiate the expansion of multilateral electricity trading	
Action Plan 1.1	Complete the review of technical and commercial feasibility of planned at least four (4) APG projects considering the findings of the key APG studies including AIMS III
Action Plan 1.2	Expand existing MPT to other AMS or initiate multilateral electricity transactions (in another subregion/s)
Action Plan 1.3	Promote cross-border technical skills and knowledge transfer as well as capacity to promote financial investments into APG project
OBS 2. Work on institutional framework and regulatory capacity as minimum requirements to advance multilateral electricity trading	
Action Plan 2.1	Establish Intergovernmental coordination and facilitation mechanism and to develop institutional and regulatory capacities of the MPT/APG Institutions
Action Plan 2.2	Assess the need and feasibility of existing and new regional institutions for implementing multilateral power trade
Action Plan 2.3	Develop dispute settlement mechanisms
Action Plan 2.4	Analyse appropriate trade models for regional electricity market

OBS 3. Work on harmonising the minimum technical requirements to advance multilateral electricity trading	
Action Plan 3.1	Develop harmonised grid codes for the transmission interconnectors
Action Plan 3.2	Develop harmonised wheeling charges methodology
Action Plan 3.3	Develop regional market third-party access (TPA) guidelines
Action Plan 3.4	Develop data sharing guidelines and best practices
Action Plan 3.5	Develop coordinated transmission capacity calculation methodology
Action Plan 3.6	Strengthen grid resilience and modernisation by enhancing power system reliability and quality assessment methods in the region
OBS 4. Explore integrating renewable energy and other digital developments into the ASEAN Power Grid	
Action Plan 4.1	Assess the potential of RE investment opportunities and contribution to the ASEAN Power Grid
Action Plan 4.2	Analyse the expansion of APG considering other flexible resources and emerging technologies as well as demand-side management
Action Plan 4.3	Conduct at least one activity on smart grid and cyber security technologies and policies for power grids in ASEAN

2.2 Programme Area No. 2 – Trans-ASEAN Gas Pipeline

Background

Another important infrastructure project under the framework of ASEAN Energy Cooperation is the Trans-ASEAN Gas Pipeline (TAGP), which focuses on gas pipelines and liquefied natural gas. Its aim is to establish interconnection projects to ensure greater gas supply security and sustainability while connecting existing and planned pipelines and regasification terminals with the view of minimising the environmental impact.

The ASEAN Council on Petroleum (ASCOPE), comprising the heads of national oil and gas companies or the national entities responsible for oil and gas in each of the AMS, is the Specialised Energy Body mandated to implement the TAGP.

Key Achievements in APAEC Phase I

The TAGP has connected six (6) AMS through 13 pipelines with a total length of 3,631 km and nine (9) LNG regasification terminals (RGT) with combined total capacity of 38.75 MTPA. Under the TAGP, the Model LNG Sales and Purchase Agreement (SPA) without destination restriction and Master LNG SPA have been completed serving as a reference guide for long-term LNG contracts. To support this initiative, ASCOPE members will initiate the appropriate instrument to accommodate the LNG diversion in the region.

ASCOPE has on-going initiative for developing a consolidated information (Technical Database) on ASEAN Gas Infrastructure. The database provides technical information on gas pipelines, gas processing plants, LNG liquefaction and RGT terminals in ASEAN.

ASEAN recognised the significant potential of having third party open access systems to promote trade in regional gas market. To this end, Singapore's LNG terminal was the first in Asia to achieve open access and multi-user terminal in 2016. Thailand secured third-party access (TPA) approval followed by Malaysia in 2017. In this regard, Singapore, Thailand, and Malaysia are ready to implement their TPA code.

ASCOPE completed the Gas Advocacy White Paper (GAWP), which puts forward the region's immediate and long-term strategies to enhance gas competitiveness and establishes the roadmap for gas advocacy.

Another two (2) studies completed by ASCOPE were the small-scale LNG (ssLNG) study and LNG bunkering study, which aimed at promoting and facilitating sustainable collaboration between AMS for the development of small-scale LNG and LNG bunkering opportunities. This is expected to strengthen the value chain and gas trade across the region and create a greater and cleaner energy supply.

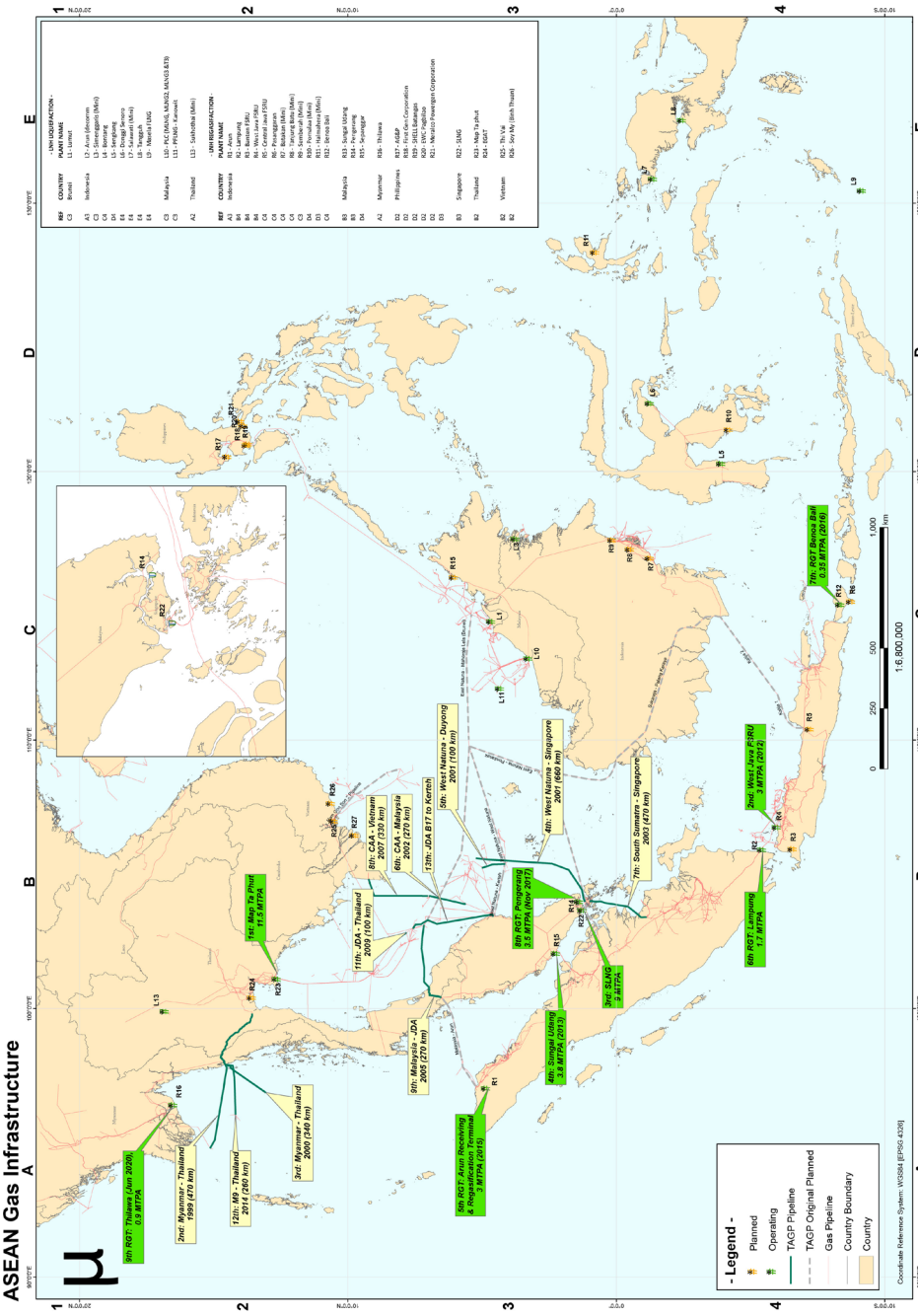


Figure 5. ASEAN Gas Infrastructures

APSA Task Force has completed the localisation guidelines and operationalisation manuals of the ASEAN Petroleum Security Agreement (APSA). In 2016, APSA Task Force identified gaps in APSA and the 35th Senior Officials Meeting on Energy (SOME) agreed to keep APSA in its current form until its expiry in 2023.

In 2019, ACE and Japan Oil, Gas, and Metals National Corporation (JOGMEC) conducted the Oil Stockpiling Roadmap (OSRM) Review to update the OSRM status of AMS and to highlight the challenges and opportunities for the development of oil stockpiling in the region. The Oil Capacity Building on Energy Security was conducted annually by ACE and JOGMEC to address the challenges of the oil stockpiling development in ASEAN.

Strategies and Action Plans under APAEC Phase II

ASEAN's total gas consumption will increase from 13,713 mmscfd to 15,800 mmscfd by 2025 (20% LNG) and to 16,500 mmscfd by 2030 (27% LNG). In power generation, the share of natural gas is projected to be 27% in 2025 (about 9,000 mmscfd), and 22% in 2030 (approximately 9,300 mmscfd).

Noting the increasing demand for natural gas and LNG, ASCOPE's strategy in APAEC Phase II is to continue enhancing the accessibility and connectivity of gas and LNG through pipeline and regasification terminals. Key actions are to develop at least one (1) new LNG regasification terminal (RGT) or a cross border natural gas pipeline and to maintain and update the technical database by 2025.

ASEAN's long-term LNG demand ranges between 32 MT and 74 MT in 2035. To date, ASEAN has about 38.75 MTPA of LNG regasification capacity, with another 11 MTPA of capacity currently under construction and a prospective additional regasification capacity of 50 MTPA. To facilitate the deployment of the ssLNG and LNG Bunkering, AMS will further improve the readiness of the LNG plants and import terminals by identifying the support needed from ASEAN governments.

ASCOPE's new strategy in Phase II is to implement the recommendations of the GAWP to support the development of a common gas market for ASEAN. The GAWP's scan of the region's current gas industry landscape identified enhancing the compatibility of ASEAN's LNG terminals as a key strategy to realise a common and integrated ASEAN gas market. To this end, ASCOPE's action plans include: (i) developing communication strategies on the full value of gas and gas-related Infrastructures to promote gas advocacy; (ii) enhancing the capacity of the gas advocacy stakeholders to facilitate the development of common gas market which entails regulatory framework, pricing reform, and environmental regulation; and, (iii) strengthening regional cooperation to promote technology and knowledge transfer from mature to new markets among AMS to improve commercial and infrastructure readiness. The scope will include an analysis of standardising commercial agreement (transaction size, LNG quality etc), promoting support for intra-ASEAN trades and open access for gas infrastructure (if possible); importation of LNG across the value chain and building infrastructure; and promoting knowledge and technology transfer from mature to new markets.

Table 3. Outcome-based Strategies and Action Plans for Trans-ASEAN Gas Pipeline 2021-2025

OBS 1. Enhance gas & LNG connectivity via pipeline and regasification terminals.	
Action Plan 1.1	Support the development of at least one (1) new LNG regasification terminal (RGT) or cross border gas pipeline by 2025
Action Plan 1.2	Develop consolidated information (technical database) on ASEAN gas infrastructure
OBS 2. Enhance gas & LNG accessibility via pipeline and regasification terminals.	
Action Plan 2.1	Identify support required from ASEAN Government with regard to small scale LNG and LNG bunkering
Action Plan 2.2	Strengthen regional cooperation to promote technology and knowledge transfer among AMS to improve commercial and infrastructure readiness
OBS 3. Support the development of a common gas market for ASEAN	
Action Plan 3.1	Develop communication strategies on the full value of gas and gas-related infrastructures to promote gas advocacy
Action Plan 3.2	Enhance the capacity of the gas advocacy stakeholders to facilitate the development of common gas market and build capacity and capability of the national oil companies and stakeholders

2.3 Programme Area No. 3 – Coal and Clean Coal Technology

Background

Coal has been a key energy resource for energy security and affordability in the AMS for the last decades. With the increasing pressure of climate change, coal and clean coal technology are projected to play a new role in the imminent energy transition, balancing energy security with sustainable development goals, and strengthening energy resilience. In 2018, coal accounts for 19.5% in the total primary energy supply and is projected to double and reach 388 Mtoe by 2040. Coal's role in power generation will continue to dominate the fuel input mix which is 43% in 2018 to 41% in 2040. Significant amount of coal will be expected during the projection period which is equivalent to 179 GW additional capacity with 4% annual growth rate. ASEAN is projected to become a net coal importer region starting from 2036 and onwards.

The ASEAN Forum on Coal (AFOC) is the Specialised Energy Body that leads in the implementation of Coal and Clean Coal Technology[4] (CCT) programme under the APAEC. The vision of CCT Programme is to enhance ASEAN cooperation in the coal sector, promote intra-ASEAN coal business, disseminate best practices, and increase the deployment of CCT in the region to support energy transition and enhance environmental sustainability.

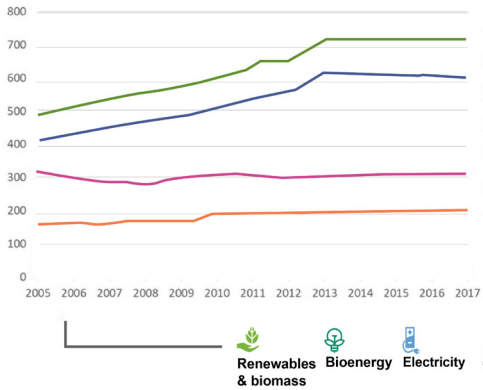


Figure 6. ASEAN Historical Production of Fossil Fuels in ASEAN based on 6th ASEAN Energy Outlook

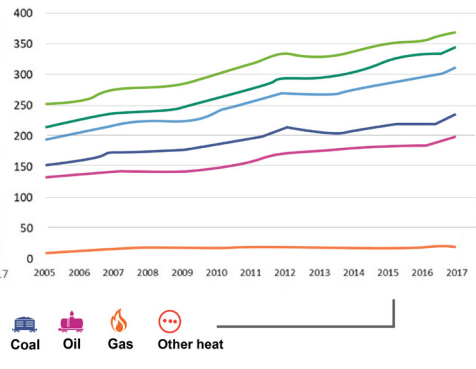


Figure 7. ASEAN Historical Consumption of Fossil Fuels in ASEAN based on 6th ASEAN Energy Outlook

Key Achievements in APAEC Phase I

In APAEC Phase I, the major achievement under this programme area was the deployment of additional installed capacity of 10,021 MW of coal-fired power generation, consisting of super critical (SC) and ultra-super critical (USC) coal-fired power plants (CFPP). The continued deployment of CCT is expected to shape a new role for coal in facilitating in the energy transition towards low carbon energy systems in the coming years. In order to increase understanding and planning for the energy transition, meet international climate goals, and reduce local pollution, AFOC has advanced critical discussions with DPs and IOs to explore policy pathways for the promotion and deployment of CCT in the region.

[4]Clean Coal Technology (CCT) are advanced processes and a collection of the latest technologies such as High-Efficiency-Low-Emissions (HELE), Carbon Capture Utilisation and/or Storage (CCUS), coal upgrading, etc. to reduce environmental impact from coal utilisation, by increasing efficiency and reducing air pollutants and emissions of Coal Fired Power Plants.

Capacity building and workshops on CCT were held to enhance AMS awareness and understanding towards the development of future regional approaches to enhance energy diversification and energy security of the region. In 2018, Lao PDR initiated the Regional Workshop on CCT while Thailand led the Workshop on Enhanced Coal Image and CSR Best Practices. In 2019, Thailand organised the International Seminar on CCT for Sustainable Development in ASEAN while Indonesia supported the ASEAN CSR Best Practices Workshop and Capacity Building on Low Rank Coal Utilisation. These initiatives have collectively recommended to design a future capacity building programme on emission standards for CFPP and to conduct in-depth study on the potentials of carbon capture utilisation and storage (CCUS) for CFPP in the AMS. DPs and IOs were also engaged in deepening knowledge sharing and technology transfer such as the CCT Transfer Capacity Building held in Japan with JCOAL in 2016, ACE-Global CCS Institute (GCCSI) CCS Workshop, and ACE-World Coal Association (WCA) CCT Workshop, both held in 2017.

The first High-Level Policy Discussion on Coal was held in 2018 and led by Malaysia. Key conclusions of the Policy Discussion included the recognition of the need to move towards a low emission pathway, commitment in meeting AMS' respective emission target under the Paris Agreement, and continuity of enhancing the communication strategy on the benefits of coal as well as exploring new technologies to reduce emissions.

The ASEAN Coal Awards were held every two (2) years to promote best practices and innovations in coal. During APAEC Phase I, a total of 45 entries were received from the AMS and 35 of them were awarded.

Led by Indonesia, the ASEAN Coal Database Information System (ACDIS) was established in 2016. It is a web-based application that aims to provide services for ASEAN coal resources and trade information to advance the key goal of enhancing intra-ASEAN cooperation and trade in coal and attracting support for investment in coal.

Joint research studies and publications on CCT were conducted by AFOC in collaboration with DPs and IOs. In 2017, ASEAN's Energy Equation: The Role of Low Emission Coal in Driving a Sustainable Energy Future was published by ACE and WCA. It provided comprehensive analysis for the energy security and sustainable development opportunities from CCT in the region. Another is the ASEAN CCT Handbook for Power Plants 2017 volume 2, a joint effort of ACE and JCOAL which featured best practices, trends, and opportunities for deployment of CCT. In 2019, the Study of Cleaner Coal Utilisation Roadmap by completed by ACE and CETERI. The Roadmap serves as a useful reference to accelerate the deployment of CCT in the ASEAN region and assist AMS to develop their national roadmaps. Lastly, the Feasibility Study on Coal Upgrading by Using Coal Upgrading Palm Oil (CUPO) Technology by Indonesia and Business and Financing Model on CCT by Vietnam were also completed and disseminated to the AMS, DPs, and IOs.

In 2020, ACE conducted a regional baseline study on coal to assess emissions from CFPP. The aim of the study is to adopt a regional reference to design and implement a capacity building programme and to use it as basis to collaborate with partners in the promotion of high efficiency low emissions coal technology.

Strategies and Action Plans under APAEC Phase II

Coal is expected take on a new role in planning of energy transition in the ASEAN region in APAEC Phase II. ASEAN has abundant supply of coal and it is an affordable source of electricity. Therefore, it is likely to see growing capacity additions from coal in the coming years in the AMS. In APAEC Phase II, capacity additions from CCT will be around 46 GW thus bringing the total installed capacity to 56 GW by 2040 (according to the AEO6).

AFOC will promote the new role of CCT and CCUS towards energy transition and low carbon economy. The deployment of CCT such as supercritical (SC), ultra-super critical (USC), and other advanced technologies is one of AFOC's long-term strategies in order to enhance energy security, environmental sustainability, and energy resilience. Advancement in CCT and low emission technologies are potential solutions to support the global action on climate change. Globally, research pathways towards zero emissions from coal are showing positive progress starting with high efficiency low emission (HELE) coal technologies to carbon capture, utilisation, and storage (CCUS).

Regional policy workshops will be organised to focus on approaches in investment planning and advances in smart and digital technologies to promote the adoption of CCT. The ASEAN Coal Awards will be continued every two (2) years as key action in Phase II. A Strategic Report on Coal will be published to provide an analysis of the technical and socio-economic impacts of CCT and CCUS towards a low-carbon emissions economy with a specific focus on energy security and climate-energy resilience. AFOC will implement the recommendations of the "Cleaner Coal Utilisation Roadmap in ASEAN" that was developed in APAEC Phase I and further explore the development and implementation of CCUS roadmap for CFPP in ASEAN.

AFOC will conduct strategic outreach programmes to enhance public awareness and image of CCT through seminars, workshop, and development of coordinated communication messages to the public. The focus of seminars and workshops includes initiatives that enhance coal's image in the light of global environmental concerns from government, civil society, academia, and private sector, as well as promoting the best practices of the ASEAN Coal Awards on corporate social responsibility. To advance sustainability in coal use, the AMS will continue to communicate coal's involvement in energy communities, the industry's scientific and technological advancement, and coal's role in propelling ASEAN towards a sustainable future. In line with this direction, AFOC will develop the "One ASEAN Voice" communication strategy to highlight the vital function of coal and to bring a coordinated-single message to create positive perception on the social and economic benefits of CCT to the public. Finally, AFOC will organise high-level policy dialogues to promote innovation and cooperation in CCT.

AFOC will organise the ASEAN Coal Business Roundtable and Conference every two (2) years as a regional platform to promote advancements in high efficiency and low emission coal technologies, public investment and financing of coal and CCT projects, digitalisation in the coal sector, and coal trade partnership. Success stories on coal projects will also be disseminated through the ASEAN Energy Business Forum.

Moreover, AFOC will reform the ASEAN Coal Database Information System (ACDIS) to enhance its functions and usefulness in facilitating the CCT investment and partnership. The ACDIS will be integrated into the ASEAN Energy Database System (AEDS) of ACE. AFOC will further analyse the future of coal trade in low carbon economy while also examining the potential of coal innovation, digitalisation, and partnership.

AFOC will systematically engage with key stakeholders with the aim to formulate sustainable approaches for CCT promotion and increased investment. AFOC will review and study the adoption of more advanced coal technologies such as co-firing technologies, integrated gasification combined cycle (IGCC), coal upgrading, coal conversion technologies, hybrid system, and CCUS.

The CCT research and demonstration project will be explored to establish a strong case for advancing coal technology development in the ASEAN region. Success in these efforts will be used as basis to seek regional commitment to establish the ASEAN Centre of Excellence for Clean Coal Technology (COE-CCT). The COE-CCT is envisioned as a regional centre for advancing international cooperation for research and development and technology transfer to accelerate innovation and commercial development of prototyped CCT technologies by the AMS. The role of the Centre will focus on pilot project development, policy research, and capacity building to enhance the institutional and human resource capability of AMS in energy transition. AFOC will also explore the potential of triple-helix interaction between government, industry, and academe sector to support the knowledge and technology transfer to advance CCT innovation and financing.

Table 4. Outcome-based Strategies and Action Plans of Coal and Clean Coal Technologies 2021-2025

OBS 1. Promote the Role of Clean Coal Technology (CCT) and Carbon Capture Utilisation and Storage (CCUS) towards Energy Transition and Low Carbon Economy	
Action Plan 1.1	Disseminate CCT best practices through the ASEAN Coal Awards
Action Plan 1.2	Organise at least two (2) policy workshops for power utilities, independent power producers, financial institutions, and energy planners
Action Plan 1.3	Develop Strategic Coal Report and study to explore the potential of CCT and CCU/S for promoting low-carbon energy system
Action Plan 1.4	Develop and implement CCT and Carbon Capture Utilisation and Storage Roadmap for Coal-Fired Power Plants in ASEAN
OBS 2. Conduct Strategic Outreach to Advance Regional Actions to enhance Public Awareness and Image of CCT	
Action Plan 2.1	Organise at least two (2) events to enhance coal's image and its role in energy transition in the light of global environmental concerns
Action Plan 2.2	Organise at least one (1) dissemination workshop on ASEAN Coal Awards Best Practices on CSR projects
Action Plan 2.3	Develop One-ASEAN Voice Communication towards a coordinated message on the role of CCT in sustainable energy future and resilience
Action Plan 2.4	Organise high level policy discussion with at least two (2) DP/IOs

OBS 3. Facilitate Investment, Innovation and Partnership on CCT through the ASEAN Coal Business Roundtable and Conference	
Action Plan 3.1	Organise every two (2) years the ASEAN Coal Business Roundtable and Conference
Action Plan 3.2	Analyse the future of coal trade in low carbon economy
Action Plan 3.3	Develop guidelines for CCT financing
Action Plan 3.4	Examine the potential of coal innovation, digitalisation, and partnership
Action Plan 3.5	Revamp ASEAN Coal Database and Information System (ACDIS) to facilitate CCT investment and partnership
OBS 4. Advance CCT Research, Development, and Innovation	
Action Plan 4.1	Formulate the operational plans for ASEAN Centre of Excellence for Clean Coal Technology (ASEAN COE-CCT)
Action Plan 4.2	Conduct & publish at least one (1) joint policy research paper.
Action Plan 4.3	Propose and explore one (1) CCT demonstration project with the involvement of one (1) DP
Action Plan 4.4	Intensify institutional and human capacity building in the ASEAN coal sector

2.4 Programme Area No. 4 – Energy Efficiency and Conservation

Background

Energy efficiency (EE) is viewed as the world's first fuel. It is considered to be the low hanging fruit and the most cost-effective way of enhancing energy security and addressing climate change while promoting economic competitiveness. In view of growing concerns of climate change as well as volatile energy prices, energy efficiency is regarded as one of the vital strategies for energy transition to support the region's sustainable development. By improving energy efficiency, it is expected that the purposes of energy savings and a reduction in total energy use can be achieved in a cost-effective way, while reducing CO_2 emissions and other environmental impacts and production costs, and increasing national energy security and overall economic productivity. AMS have steadily increased their EE&C initiatives over the years through a deliberate policy of diversifying and using energy sources efficiently to address the limited global supply of fossil fuels and volatile energy prices.

The Energy Efficiency and Conservation Sub-sector Network (EE&C-SSN) is responsible for the coordination of ASEAN's collective energy efficiency efforts towards achieving the aspirational target to reduce energy intensity under the APAEC. The EE&C-SSN facilitates the coordination and implementation of energy efficiency and conservation programme through the establishment of networks, fora, conferences, and seminars as well as encouraging new initiatives and knowledge exchange with the DPs, IOs, private sector, and financial institutions.

Key Achievements in APAEC Phase I

As a significant achievement, ASEAN has attained a 21% energy intensity level in 2018, surpassing the aspirational target of 20% set for 2020. This clearly showed a shift by ASEAN towards low carbon economy.

ASEAN has made progress in the promotion and establishment of MEPS for home appliances through the endorsements of the Regional Policy Roadmap on Harmonisation of MEPS for air-conditioners (AC) by the 35th AMEM and for Lighting by 37th AMEM. On air-conditioners, seven (7) AMS have established their National Roadmaps adopting the ISO 5151: 2010 as the testing standard method for EE performance of AC. Further works will be continued in APAEC Phase II for both AC and lighting and most likely to expand to include motors, transformers, and the like. The Guidelines for the Integration of Energy Efficiency into the ASEAN Electrical and Electronic Equipment (EEE) Mutual Recognition Agreement (MRA) announced at 37th AMEM in 2019 was another key achievement. The guidelines will be applied for energy performance testing of AC. This will pave the way for the adoption of other higher efficiency and climate-friendly appliances such as lighting and and air-cooling systems.

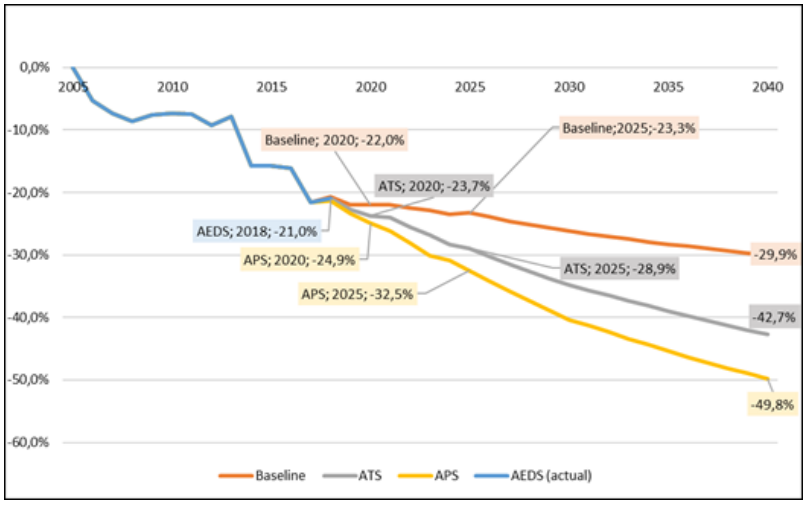


Figure 8. Status of ASEAN Energy Intensity Reduction

The IEA's study on The Future of Cooling in ASEAN indicates that cooling will become the single largest driver of energy demand growth in ASEAN to 2040, requiring more than 200 GW of additional generation capacity available. This amounts to approximately 45% of total capacity additions by 2040. However, the average efficiency of air conditioners in Southeast Asia remains low.

Moreover, the United Nations Environment Programme-United for Efficiency (UNEP-U4E) initiative estimates that by 2040 the region's stocks of cooling appliances, namely room air conditioners and residential refrigerators, will almost triple compare to 2020. This will cause the electricity consumption from air conditioners to more than double, while the residential refrigerator is expected to increase by over 80%. The annual saving potentials by 2040 are estimated at 144 TWh and 17 TWh of electricity consumption from the transition to energy efficient air conditioners and residential refrigerators, respectively.

Appropriate policy response is needed to guide consumers towards smart choices. In 2020, ACE joined the "Cool Coalition", an initiative of UNEP-U4E which aims to facilitate knowledge exchange, advocacy, and joint action towards a rapid global transition to efficient and climate-friendly cooling appliances. ASEAN will deepen efforts to promote policies that will encourage the deployment of more efficient cooling products, which are becoming less expensive to buy, cheaper to power, and potentially manufactured within ASEAN.

Several capacity building activities were initiated to translate the key direction on sustainability pathways into action by means of regional cooperation with DPs and IOs. The activities include information sharing on best practices, support to develop EE&C policies and regulations for selected AMS and technology, and capacity building and trainings. Under the SOME-METI cooperation, ACE and Energy Conservation Center Japan (ECCJ) continued the implementation of ASEAN Japan Energy Efficiency Partnership (AJEEP) which has trained and certified 53 energy manager trainers and conducted capacity building on legal and regulatory frameworks for EE&C in Cambodia and Lao PDR.

Under the Energy Conservation Workshop under AJEEP Programme (ECAP) capacity building was conducted to improve the ASEAN Energy Awards and enhance understanding on Zero Energy Building (ZEB) and Green Building Code. The ACE-Korea Energy Agency (KEA) ASEAN+3 Mitigation Cooperation Programme has provided valuable assistance in the establishment of regulations and capacity building for the development of standards and labelling systems in selected AMS.

On ASEAN Energy Management Accreditation Scheme (AEMAS), ACE has certified more than 1,000 energy managers as of 2019. The AEMAS will be further enhanced and expanded into the Sustainable ASEAN Energy Management Certification Scheme which is expected to commence in APAEC Phase II.

Started in 2000, the ASEAN EE&C Awards has been organised as a regular yearly event to promote the awareness in reducing energy intensity, to share best practices and to encourage private sector participation. In APAEC Phase I, a total of 321 entries were received, of which 174 entries were awarded for the period of 2016-2020.

In APAEC Phase I, the EE&C-SSN has conducted several joint research and publications on EE&C. They include "Study on Mapping of Green Building Codes and Building Energy Efficiency in ASEAN: Towards Guidelines on ASEAN Green Building Codes" and "Energy Efficiency Financing in ASEAN" by ACE and German Agency for International Cooperation (GIZ) under the AGEP, and the inaugural "Singapore-IEA Training Programme in Green Buildings". Another is the "Study on ASEAN Cooperative Project on Financing Mechanism Design for Energy Efficiency and Conservation (EE&C) Project Implementation" by ACE, with funding support from Japan-ASEAN Integration Fund (JAIF) through ASEAN Secretariat. They served as useful references for policy makers, funding agencies, and relevant stakeholders who are interested to engage with ASEAN on advancing the energy transition pathways through energy efficiency and conservation.

Strategies and Action Plans under APAEC Phase II

The ASEAN Member States will accelerate energy transition efforts by setting a more aggressive energy intensity reduction target of 32% by 2025 based on 2005 level. The reduction in EI will be achieved through strategic regional actions with focus in buildings, transport, and industrial sectors while enhancing the participation of private sector, research institutes, financial institutions, accelerators, and clusters to bring positive impact for developing a sustainable energy future.

Market transformation in favour of energy efficient technologies will be stepped up in APAEC Phase II. The EE&C-SSN will continue the good progress in developing harmonised regional standards to increase efficiency of trade, lower energy system costs, and improve the uptake of more efficient equipment thus reducing costs to consumers. The AMS will replicate the harmonisation of MEPS to other electrical and electronic equipment (EEE) such as motors, transformers, fans, refrigerators, etc. In Phase II, the EE&C-SSN will initiate discussion for the development of a gradual strengthening mechanism for MEPS. Additionally, the AMS will establish the process to start the implementation of the ASEAN EE MRA for AC energy performance testing. Once proven, the AMS will carry out the MRA for lighting and then for further expansion to other EEE.

Activities on market verification and enforcement (MVE) for energy efficiency will be initiated, including capacity building for industry stakeholders, and conduct of Round Robin Testing RRT) for AC. The EE&C-SSN will continue its partnership with UNEP U4E to establish a Regional Product Registration Database System. The partnership is expected to document the lessons learned from case studies in the region and thereby encourage the industry players to double efforts in the promotion of climate-friendly EE products and technologies.

In APAEC Phase II, data science on EE markets and investment are central to policy development to attract the growing interest of the private sector and financial institutions in EE development. To increase the availability of investment data and trends, the AMS will conduct quantitative market assessment of EE potential in various sectors and will use the key findings to design innovative financial instruments and structures to scale up the uptake for EE investments. To further increase EE investments, the AMS will stimulate business forum activities through the ASEAN Energy Business Forum and Cleaner Energy Future Initiative for ASEAN (CEFIA) and to encourage strategic clusters, accelerators, start-ups and incubation centres for promoting innovation and cooperation in energy efficiency. Moreover, MOU with at least two (2) financial institutions will be signed to further enhance the participation of financial institutions in the EE&C project development. The database for the EE&C projects funded by the financial institutions within the region will be developed and EE&C-SSN will publish factsheets on EE project financing best practices. The EE&C-SSN will continue the annual ASEAN Energy Efficiency and Conservation Awards to further disseminate the best practices in EE&C efforts and measures.

To achieve high-impact energy efficiency improvements and energy savings, the AMS will examine the benefits of new technologies, market mechanism, and policy support to serve as basis in forging cooperation amongst EE stakeholders. The AMS will continue the efforts to develop and promote the evolution of the Energy Service Company (ESCO) industry which is regarded as one possible way to increase both energy savings and energy efficiency. However, ESCO is still at the nascent stage of development. As an initial regional action, the EE&C-SSN will develop the ASEAN ESCO Association as a platform to stimulate investment and financing in EE projects by ESCOs. ESCO contractual model and financing scheme options, such as shared-savings and guaranteed savings of Energy Performance Contracting (EPC) Scheme will be further explored.

To strengthen energy management system and to professionalise the standing of energy managers and practitioners in the AMS, ACE and EE&C-SSN will develop and implement the Sustainable ASEAN Energy Management Certification Scheme. This will be built upon the achievements of AEMAS and AJEEP TOT Programme. It is expected to increase the number of certified energy managers and practitioners capable of implementing EE projects. Additionally, by 2025, the frameworks and doing guidelines for the ASEAN Building Energy Labels and Certification System will be further developed.

Noting the enormous EE potentials in the buildings sector, ASEAN will develop the Sustainable EE Building Roadmap and Sustainable Cooling Roadmap. The two (2) Roadmaps aim to provide policy recommendations as a pathway to efficient, resilient, and low emission buildings.

To complement these efforts, the AMS will conduct series of information sharing that will aim to enhance the capacity of the AMS to analyse and implement policies and incentives on sustainable EE in building towards net-zero energy consumption buildings, building energy codes, and building envelopes system. The opportunities in smart buildings sector will be further explored to advance smart cities in ASEAN.

Following the adoption of the ASEAN Fuel Economy Roadmap for the Transport Sector 2018-2024, the EE&C-SSN will explore EE opportunities in the transport sector, including smart transport. The EE&C-SSN will conduct information sharing on EE policy and measures, including fuel-efficiency standards and high-efficient vehicles promotion and capacity building in collaboration with DPs, IOs, and relevant stakeholders.

EE&C in the industry sector will be explored in APAEC Phase II. The EE&C-SSN will conduct policy workshop to cover analytical work on best practices, and EE policy and measures in the industry sector. Industrial energy management activities will be initiated through the introduction of energy performance benchmarking and guidelines. The EE&C-SSN will also analyse the opportunities from digital transformation and 4IR to modernise and unlock further efficiencies in industry and explore the potential of smart industry.

Table 5. Outcome-based Strategies and Action Plans for Energy Efficiency and Conservation 2021-2025

OBS 1: Expand, Harmonise, and Promote Energy Efficiency Standards and Labelling on Energy-related Products	
Action Plan 1.1	Develop and implement regional and national policy roadmap for MEPS
Action Plan 1.2	Initiate discussion on gradual strengthening mechanism for MEPS
Action Plan 1.3	Introduce monitoring, verification and enforcement (MVE) initiatives, including product registration database and testing infrastructures enhancement
Action Plan 1.4	Expand and implement the EE MRA guidelines
OBS 2: Enhance Participation of Private Sector and Financial Institutions including Energy Service Companies (ESCOs) and Clusters for EE&C promotion	
Action Plan 2.1	Organise business forum and match making activities for EE&C projects
Action Plan 2.2	Continue and expand the Annual ASEAN Energy Efficiency and Conservation Awards

Action Plan 2.3	Establish at least two (2) partnership schemes for EE&C with clusters, incubation centres, financial institutions, and the private sector
Action Plan 2.4	Initiate the development of the integrated ASEAN Energy Management Certification Scheme
Action Plan 2.5	Conduct information sharing on innovative EE financing mechanisms
OBS 3. Strengthen Sustainability of Energy Efficiency in Buildings	
Action Plan 3.1	Develop and disseminate Sustainable EE in Building and Cooling Roadmap for ASEAN
Action Plan 3.2	Conduct information sharing on sustainable EE in buildings initiatives
OBS 4. Pursue Energy Efficiency in Transport Sector	
Action Plan 4.1	Conduct capacity building on vehicle fuel economy with DPs and IOs to promote policy and target of the AMS
Action Plan 4.2	Conduct information sharing on best practices for EE&C in transport
OBS 5. Advance Energy Efficiency and Energy Management in Industry	
Action Plan 5.1	Conduct capacity building and information sharing on EE&C best practices in industry
Action Plan 5.2	Promote energy management in industry to increase competitiveness and reduce energy consumption

2.5 Programme Area No. 5 – Renewable Energy

Background

Renewable Energy contributes to the acceleration of the energy transition, support climate change efforts under Paris Agreement, and meets sustainable development goals. Recognising the critical role of renewable energy, the AMS have developed policies and initiatives to shift to low carbon RE technologies that bring benefits of greater access and sustainability for all. ASEAN, as a preferred investment destination, provides many opportunities for RE development in terms of market, resources, and efficiency which can attract foreign direct investments (FDIs) to the RE sector, where the access to many natural and renewable resources are available in the region. Regional cooperation on RE thus requires capacity building, information sharing, technology transfer, and investment facilitation as well as market development which are all essential part of the sustainable energy transition process.

The Renewable Energy Sub-Sector Network (RE-SSN) is the Specialised Energy Body which is responsible for carrying out the implementation of renewable energy programme to increase the diversity of energy supply security and to reduce the environmental impact of energy use in the region. The RE-SSN plays a critical task in supporting the AMS in the energy transition, ensuring that RE is robustly growing and a catalyst for bringing energy access to attain a sustainable energy future.

Key Achievements in APAEC Phase I

ASEAN has implemented various initiatives which are aimed at harnessing the potentials of renewable energy sources such as wind, solar, hydro, geothermal, ocean and tidal, and bioenergy. The AMS witnessed the surge in FDIs and technical cooperation in RE with the support of DPs/IOs and the private sector. ASEAN has managed to achieve 13.9% share of RE in the ASEAN total primary energy supply in 2018. The aspirational target for RE is 23% share in TPES by 2025.

Several studies and capacity building activities were also conducted to promote the technical and financial aspects of RE projects, with the support of DPs and IOs such as AGEP, a Joint collaboration between ACE and GIZ, namely the mapping study of RE R&D in ASEAN, the updated study on the levelized cost of electricity (LCOE) for selected RE technologies in ASEAN as well as the study on insurance and guarantee schemes of RE in ASEAN.

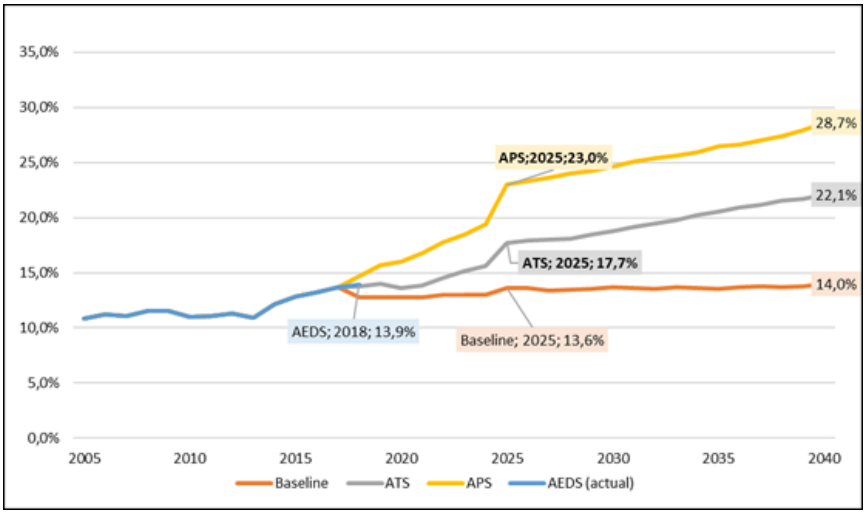


Figure 9. Status of ASEAN Renewable Energy Share in TPES

The annual ASEAN Renewable Energy Awards which showcase exemplary business models and best practices to demonstrate the affordability of RE resources, is drawing increasing numbers of entries yearly. A total of 148 entries were received, with 92 awards presented, between 2016-2020.

On the strategic thrust of sustainability for all, the MOU between the ACE and the NSTDA of Thailand was signed on 5 September 2019 to support higher utilisation of bioenergy and biofuels and human resource capacity development to support the decarbonisation in the transport sector in the ASEAN region.

To increase the awareness and technical capacity on RE, ACE and IRENA conducted dialogues with international RE developers and AMS' policy makers to share perspectives and vision. Several fora including high-level policy dialogues were organised under the ASEAN+3 work programme to facilitate energy planning for the integration of renewables and development of bankable RE projects such as the yearly ASEAN+3 New and Renewable Energy (NRE) and EE&C Forum, ASEAN+3 Clean Energy Roundtable Dialogue, and Cleaner Energy Future Initiative for ASEAN (CEFIA) Forum. CEFIA was launched in Makati City, Philippines in 2019 to serve as a platform for facilitating collaboration between public and private sectors in the development of cleaner and low carbon energy technology as well as acceleration of the energy transition in the ASEAN region. Under ACE-KEA ASEAN+3 Mitigation Cooperation Programme, the demonstration project on Renewable Energy Fuelled Pico Grid Village Demonstration Project was launched in 2018 in Siem Reap, Cambodia. With the completion of this pilot project, ASEAN aims to expand such initiative to other AMS to unleash the potential of RE at the local level and create opportunities for investors, power plant operators, equipment suppliers, and installers for technology transfer.

Strategies and Action Plans under APAEC Phase II

Planning the energy transition to renewable energies and increasing their deployment will require stronger efforts by AMS. The AMS are enhancing their respective national policy options and targets that will be aligned with regional aspirational targets to accelerate progress towards sustainable energy future. Strategies include the deployment of large-scale renewable energy systems, accommodating higher shares of RE in the ASEAN Power Grid, increasing infrastructure investment, promoting smart grids to accelerate RE deployment, and promotion of decentralised and distributed RE systems. With the improvement of technology and digitalisation, new and advanced RE technologies will also be explored such as waste-to-energy, RE-based hydrogen, energy storage, concentrated solar thermal, and distributed renewable for energy access. Moving forward, these efforts are expected to help meet the 23% RE share in TPES and 35% share of RE in ASEAN installed power capacity by 2025. RE-SSN will work closely with HAPUA, AERN, APGCC, and REPP-SSN to support the efforts towards integration of RE in the APG.

With growing focus on sustainability, job creation, and energy access, ASEAN will continue to improve its capabilities in the RE sector. In APAEC Phase II, the RE-SSN will lead in the development and adoption of the Long-term ASEAN Renewable Energy Roadmap which will aim to chart the pathways for future economy with due consideration of new and emerging sustainable system that transforms the way RE is produced, delivered, and used in a rapidly changing environment. The RE-SSN and ACE will develop the long-term ASEAN RE Roadmap which will take into account the findings and recommendations of AIMS III, 2nd ASEAN RE Outlook, and review on the readiness of RE supporting industries.

Innovation in RE financing will be explored. The AMS will study financing mechanisms to facilitate the creation of a more enabling environment to increase the uptakes on RE for R&D and commercial deployment through business partnership and incubation programmes. To support this strategy, ASEAN will further engage wider energy stakeholders including financial institutions and accelerators. Moreover, a network of stakeholders will be created to engage them in the deployment of RE technologies with growing focus on rural electrification and energy access. The AMS will expand its knowledge and capabilities in various RE market mechanisms and financial incentives such as feed-in-tariff (FiT), RE auction, RE certificates, RE obligation, among others.

With growing awareness on the global energy trends, ASEAN will promote energy resilience through new and emerging RE technologies to support energy security, access, and affordability. The RE-SSN will assess the opportunities from digital transformation of energy systems to enhance RE research, development, and demonstration in the region by establishing the pool of expertise in RE technologies. ASEAN will keep improving the human resources capability in the RE sector by enhancing the ACE capacity as the ASEAN RE Information and Training Centre Roadmap which will take into account the findings and recommendations of AIMS III and the 2nd ASEAN RE Outlook, and review the readiness of RE supporting industries.

In the APAEC Phase II, biofuel and bioenergy promotion will be strengthened to further increase the share of renewable energy use and to accelerate decarbonisation in the transport sector. Bioenergy in the forms of solid fuels (biomass), liquid (biofuels), gas (biogas and biomethane), as well as municipal waste will be promoted during the period.

With a high level of RE aspirational targets, the AMS will promote stronger policies to further increase the role of renewable energy in energy access and rural electrification. The RE-SSN will analyse the socio-economic and environmental impacts of both on-grid and off-grid RE systems and promote community-based approaches that enhance livelihood, job creation, and access to modern energy services.

Table 6. Outcome-based Strategies and Action Plans for Renewable Energy 2021-2025

OBS 1. Advance Renewable Energy Policy and Develop Decarbonisation Pathway for the ASEAN Member States	
Action Plan 1.1	Publish ASEAN Renewable Energy Outlook
Action Plan 1.2	Develop long-term ASEAN Renewable Energy Roadmap
OBS 2. Conduct High Level Policy Dialogue on Renewable Energy to Accelerate Energy Transition, Access, and Resilience	
Action Plan 2.1	Conduct in-depth analysis to increase renewable energy deployment
Action Plan 2.2	Engage at least two (2) DP/IOs to conduct dialogues and develop specific RE initiatives
OBS 3. Enhance Renewable Energy Research and Development (R&D) Network	
Action Plan 3.1	Establish a nodal network with at least two (2) research institutions or universities or incubation centres and clusters to promote cooperation on RE technology development, including sharing of research facilities, and exchange and mobility of researchers
Action Plan 3.2	Develop a nodal network with at least two (2) regional or international institutions on RE

OBS 4. Promote Renewable Energy Financing Schemes and Mechanisms for Greater Innovation and Partnership	
Action Plan 4.1	Establish a nodal network with at least one (1) national / regional / international financial institutions for RE financing
Action Plan 4.2	Develop RE support mechanism to promote bankable projects
OBS 5. Support Biofuel and Bioenergy Development towards Enhanced Sustainability	
Action Plan 5.1	Develop a nodal network on R&D promotion for increasing biofuel and bioenergy utilisation
Action Plan 5.2	Analyse the potential of biofuel and bioenergy for energy sector decarbonisation
Action Plan 5.3	Conduct information sharing on policy support and instrument to accelerate the deployment of biofuel and bioenergy
OBS 6. Enhance the ASEAN RE Information and Training Centre	
Action Plan 6.1	Enhance ACE capacity as the ASEAN RE Information and Training Centre
Action Plan 6.2	Conduct thematic capacity building and training annually
Action Plan 6.3	Monitor the development and utilisation of Renewable Energy in the ASEAN region

2.6. Programme Area No. 6 – Regional Energy Policy and Planning

Background

The Regional Energy Policy and Planning Sub-sector Network (REPP-SSN) oversees the overall implementation of the APAEC and it advances the region's energy policy and planning. To this end, the REPP-SSN monitors the global energy trends as well as analyses its impact on the ASEAN energy sector, including the growth of economy and energy demand and the Fourth Industrial Revolution, among others.

The REPP-SSN is also the platform to enhance engagements with ASEAN's DPs and IOs, and to better profile ASEAN energy cooperation internationally. Moreover, strategies and activities to build capabilities in energy investment and financing to support energy infrastructure growth are also part of this programme area. Consequently, helping the region to achieve the goals of ASEAN Economic Community (AEC) through better cooperation and partnership initiatives.

Key Achievements in APAEC Phase I

A major accomplishment of the REPP programme was the establishment of the 1st AMEM-IRENA Dialogue at 35th AMEM in September 2017 in Manila, Philippines. This was followed-up with the milestone signing of the ASEAN-IRENA MOU in October 2018, at the side-lines of the 11th Singapore International Energy Week (SIEW) during Singapore's AMEM Chairmanship. In addition, the ASEAN-IRENA Action Plan to facilitate the deployment of renewable energy in ASEAN was adopted in 2018.

The REPP-SSN published several important reports to profile the ASEAN energy cooperation to regional and global energy stakeholders. In 2017, the first ASEAN Energy Cooperation Report (AECR) was published, showcasing the key achievements from 2015 to 2017 and recommending strategic directions going forward. The Mid-Term Review (MTR) of the APAEC Phase I: 2016-2020 was conducted in 2018, which highlighted that ASEAN's energy priorities and deliverables were on track and also identified new opportunities to align ASEAN with latest global energy trends.

The 5th and 6th ASEAN Energy Outlooks (AEO), supported by AGEP, were published by ACE to project the region's future energy landscape with policy recommendations for the region's pathways towards a sustainable energy future. In 2018, the ASEAN Energy Database System (AEDS) of ACE was launched at the 36th AMEM in Singapore. This was part of the enhancement of ACE's Information and Communication Technology (ICT) infrastructure to better support ASEAN with reliable sources of information and statistics.

Notably, the REPP-SSN has strengthened collaborations with DPs and IOs through joint activities and publications. Several capacity building and regional activities were conducted such as the development of the ASEAN Energy Outlooks with the support from GIZ, which enhanced both ACE internal and AMS capabilities in conducting the energy data modelling works.

Additionally, human capital development activities were conducted such as a workshop with the US-ASEAN Business Council (US-ABC) in 2016, and a workshop on energy investment led by the Energy Market Authority (EMA) of Singapore together with the World Bank and Infrastructure Asia in 2019. ACE and the US-ABC also published the report on Digitalisation in ASEAN Energy which identified high-priority challenges and it provided recommendations for digital technology solutions for the power sector.

There was active collaboration with the IEA in a number of areas, including the series of training courses on energy efficiency in 2017, clean energy financing in 2018, green building codes in 2019, and sustainable energy policies for smart cities in 2020, which were co-hosted with Singapore. The REPP-SSN continued to develop work programmes with partners like the USA, IEA, Russia, and IRENA and facilitated the Clean Energy Roundtable Dialogue under the auspices of SOME+3 EPGG in 2017. The ASEAN Climate Change and Energy Project (ACCEPT), the first energy cooperation project between Norway and ASEAN, aimed to support ASEAN in enhancing understanding of the energy-climate nexus and contribute to a more climate-friendly development of the energy sector.

Strategies and Action Plans under APAEC Phase II

Moving forward, the REPP-SSN will continue the good work on international cooperation of ASEAN in APAEC Phase II: 2021-2025. Key actions include the development of energy outlook studies in 2022 and 2024 to guide the region in addressing energy security, economic competitiveness, environmental sustainability, and international cooperation. During the period, the REPP-SSN will publish the ASEAN Energy Cooperation Report in 2023, ASEAN energy statistics, policy reviews and analysis series including issues related to energy and climate change, energy prices and new and emerging technologies. The REPP-SSN will work closely with other SEB/SSN to discuss cross-cutting issues within ASEAN energy cooperation.

Reliable energy data and statistics will be enhanced in order to assist the REPP-SSN in building sound energy strategies and policies to accelerate the energy transition and sustainable energy future. ACE will assist in conducting capacity building and training to improve the capabilities of energy statisticians and planners in the areas of data analytics, modelling, and data management. Secondment opportunities on data analysis with relevant DPs/IOs will be explored.

ASEAN will be looking at the opportunities given by the introduction of 4IR and the Internet of Things, as well as the integration of new technologies, such as artificial intelligence and big data.

The REPP-SSN will continue to engage ASEAN's DPs and IOs in the implementation of the energy agenda to ensure energy supply security in the region for the APAEC Phase II. In addition, the REPP-SSN will assist the AMS to engage a broad range of stakeholders from private, financial institutions, research institutes, academia, as well as the youth. The REPP-SSN will facilitate the engagement in ASEAN with at least 2 (two) new DPs/IOs in Phase II.

Energy investment and financing will be a key strategy to accelerate the energy transformation towards a sustainable energy future. AMS will develop a roadmap for 2021-2025 to enhance capabilities in enabling regulatory environments to attract investment in energy infrastructure and technologies. A workshop will be conducted on evaluating financial sustainability to enable bankability of power projects as well as deepen engagement between public and private sectors including financial institutions.

Another strategy under the REPP is to promote information sharing on the energy-climate nexus. Such information will provide insights into synergising the energy measures and climate actions, as well as the enablers and constraints pertaining to decarbonisation. Such knowledge will assist the ASEAN energy sector in addressing energy issues related to climate change and managing the energy trilemma, including the food-energy-water nexus.

The REPP-SSN will closely monitor and effectively manage the implementation of the APAEC Phase II in close collaboration with the ASEAN SEBs and SSNs. Moreover, a Mid-term Review of APAEC Phase II will be conducted in 2023. Starting in 2024, the AMS will commence the development of APAEC for the period 2026-2035.

Table 7. Outcome-based Strategies and Action Plans for Regional Energy Policy and Planning 2021-2025

OBS 1. To Enhance the Profile of ASEAN Energy Sector Internationally	
Action Plan 1.1	Develop the ASEAN Energy Cooperation Report highlighting the key activities of the SSNs and SEBs as well as the opportunities for further cooperation with DPs/IOs
Action Plan 1.2	Publish regular regional energy outlooks and strategic reports on thematic issue
Action Plan 1.3	Publish ASEAN energy statistics, policy reviews and analysis series including issues related to the APAEC programmes
OBS 2. Raise the Level of Data and Analysis on ASEAN's Energy Policy and Planning	
Action Plan 2.1	Conduct at least two (2) workshop/training courses on energy policy and planning with relevant DPs/IOs
Action Plan 2.2	Conduct at least two (2) workshop/training courses on in-depth data analysis with relevant DPs/IOs
Action Plan 2.3	Facilitate at least one (1) attachment/secondment opportunity on data analysis with relevant DPs/IOs

OBS 3. Strengthen Collaboration with DPs and IOs	
Action Plan 3.1	Organise policy dialogues with global and regional institutions on relevant energy developments
Action Plan 3.2	Organise a joint study and/or research with IOs, Research Institutes, Universities, and Industry
Action Plan 3.3	Sign an MOU or equivalent Agreement with two (2) new IOs by 2025
OBS 4. Effectively Manage the Implementation of the APAEC	
Action Plan 4.1	Monitor and evaluate the progress of the APAEC programmes
Action Plan 4.2	Conduct a Mid-term Review and Focus Group Discussion on the implementation of the APAEC 2016-2025 Phase II: 2021-2025
Action Plan 4.3	Develop the APAEC 2026-2035, starting in 2024 for endorsement by AMEM in 2025
OBS 5. Attract Investment and Financing to Accelerate ASEAN's Energy Infrastructure Growth	
Action Plan 5.1	Develop a Roadmap for 2021-2025 to enhance capabilities in enabling regulatory environments to attract investment in energy infrastructure and technologies
Action Plan 5.2	Conduct a workshop on evaluating financial sustainability to enable bankability of power projects
Action Plan 5.3	Deepen engagement between public and private sectors including financial institutions
OBS 6. Promote Information Sharing on the Energy-Climate Nexus	
Action Plan 6.1	Share information and best practices on energy-climate nexus, including through policy dialogues
Action Plan 6.2	Organise study visits to address energy and climate nexus
Action Plan 6.3	Organise regional seminars on ASEAN Low-Carbon Transition

2.7 Programme Area No. 7 – Civilian Nuclear Energy

Background

Globally, nuclear power supplied 10% of electricity generation in 2018. Nuclear energy power generation could improve the energy security through diversification of energy supply and provision of reliable energy source. Its low carbon characteristic gives nuclear energy competitive advantage in addressing climate change. As such, nuclear energy could play a key role in energy transition towards a sustainable energy supply. However, ensuring a safe and secure civilian nuclear energy in ASEAN would require building capacity and technical capabilities, coupled with resolute regional cooperation.

To this end, the Nuclear Energy Cooperation Sub-Sector Network (NEC-SSN), which was established in 2008 to forge ASEAN-wide cooperation on the use of nuclear energy for power generation, has embarked on a broad range of information exchange, capacity building, and technical assistance networking on safe and sustainable civilian nuclear power programmes. The NEC-SSN continues its efforts to raise public awareness and literacy on nuclear energy for power generation in the region.

Key Achievements in APAEC Phase I

ASEAN is on track to enhancing its capabilities in improving public acceptance and promoting public education in civilian nuclear energy through increasing cooperation with DPs/IOs including Canada, China, Japan, US, ASEANTOM, and IAEA.

In 2016, to enhance ASEAN capacity in promoting civilian nuclear energy programmes, ASEAN conducted a joint effort with the Canadian Government under the project "ACE-Canada Nuclear Radiological Programme Administrative Support (NRPAS)". NRPAS was aimed at establishing a regional approach to build capacities in nuclear and radiological security for the long-term development of nuclear power programmes in ASEAN. NRPAS was successfully completed in June 2018 where several capacity building activities were conducted and published results on the "Pre-Feasibility Study on the Establishment of Nuclear Power Plant in ASEAN" and "Study on the Nuclear Legal & Regulatory Framework in ASEAN". Additionally, ACE and China Nuclear Engineering and Construction (CNEC) published a joint study on "Clean Energy Technology Study in AMS" in 2017. These studies highlighted the current progress and situation of the civilian nuclear energy development in ASEAN, which served as a starting point for ASEAN to pursue nuclear energy for power generation.

Various capacity building, workshops, and study visits related to Safety, Security, and Safeguard (3S), legal and regulatory framework, and nuclear energy cooperation have been conducted by the ACE and NEC-SSN in partnership with the DPs and IOs. In 2016, ACE and U.S Department of Energy organised civilian nuclear workshop, which provided the essential policy elements for a safe, secure, and publicly accepted civil nuclear programme.

[5]IEA (2019), Nuclear Power in a Clean Energy System, IEA, Paris https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system

ACE and the Integrated Support Center for Nuclear Non-proliferation and Nuclear Security of the Japan Atomic Energy Agency (ISCN/JAEA) successfully conducted joint seminars, to raise the knowledge and capacity of the policy makers, with the topics on Nuclear Security in April 2017 and Good Practices of Regional Cooperation on Nuclear Security in May 2019. The seminars highlighted possible areas of future regional cooperation, which will be included in the APAEC Phase II. Under the ASEAN-China Capacity Building on Civilian Nuclear Energy, nuclear power technical training and visit to Nuclear Power Plant in China have been conducted in 2016 and 2018.

In the effort to improve public understanding on civilian nuclear energy, ACE conducted a webinar on "Nuclear Facts and Practices" in 2019 and on "Practices, Policies, and Plans in Civilian Nuclear Energy in ASEAN" in 2020, which highlighted the common practices on responsible and safe nuclear waste management and lessons learned from international best practices.

In 2020, ACE published the "Civilian Nuclear Energy Fact Sheets", which provided updated information related to the advantages, challenges, and current status of civilian nuclear energy in ASEAN. Likewise, ACE developed the "ASEAN Nuclear Energy Portal" as an information sharing and exchange platform. The portal, which provides links to journals and research papers relevant for the development of civilian nuclear energy in ASEAN, will be integrated with the ASEAN Energy Database System (AEDS) in the APAEC Phase II.

The NEC-SSN also supported the signing of the ASEAN-IAEA Practical Arrangement between the ASEAN Secretary General and the IAEA Acting Director General in 2019 which aims to develop and implement projects and/or research activities, exchange and dissemination of unclassified information and sharing of experiences and best practices, and assistance in training and capacity building.

Strategies and Action Plans under APAEC Phase II

In the APAEC Phase II, the Civilian Nuclear Energy programme will focus on building human resource capabilities on nuclear science and technology for power generation[6]. The NEC-SSN will assess the potential roles of nuclear energy in accelerating energy transition and strengthening energy resilience in the region, in close coordination with the ASEANTOM.

Building upon the achievements in the nuclear sector, ASEAN will commence public communication activities to increase awareness and general public knowledge to raise nuclear energy literacy in the region. The NEC-SSN will establish the regional public communication strategies through surveys. To support this strategy, the NEC-SSN will initiate the development of Information Education Communication (IEC) programme and knowledge-based management information system on civilian nuclear energy.

The NEC-SSN will continue to improve ASEAN's capabilities on policy, regulatory, and technology aspects of civilian nuclear energy through technical studies and assessment of emerging nuclear energy technology, such as Small Modular Reactor (SMR).

[6]Nuclear Science and Technology for Power Generation covers the scientific issues related to nuclear energy and its practical application for power generation. This will also cover the topics related to the design and operations of nuclear power plants, including, but not limited to, NPP project and operation management, financing, "nuclear safety, safeguard, and security (3S)", waste management, and nuclear fuel cycle.

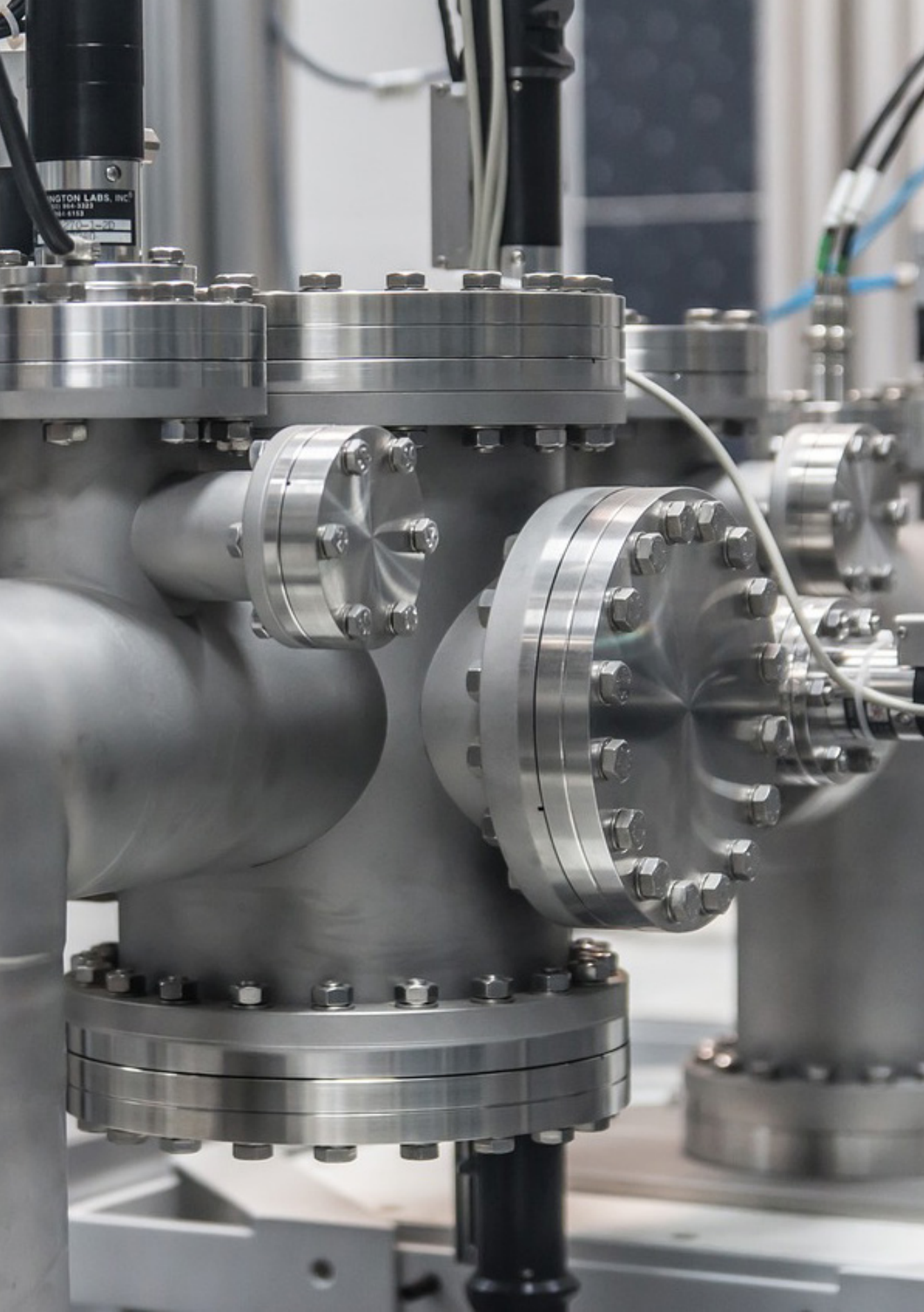
Noting the importance of advancing regional cooperation goals, ASEAN will also enhance collaboration with DPs and IOs. Following the signing of the ASEANTOM-led Practical Arrangement between ASEAN and IAEA, the NEC-SSN will conduct a study on the potential regional nuclear energy arrangement aligned with the priorities and policies of the AMS. Moreover, the NEC-SSN will widen its cooperation and partnership by establishing multi-year cooperation projects with DPs and IOs. The NEC-SSN will work closely with other relevant SEBs and SSNs.

In APAEC Phase II, the NEC-SSN will continue to conduct capacity building, training, and study visit on regulatory and technological aspects in order to scale up the competency of human resources in nuclear power development. Capacity building regarding the regulatory aspects will include a wide range of topics such as Nuclear Licensing, Nuclear Material Transport, and Regulation on Safety, Security, and Safeguard (3S). On the other hand, capacity building on technological aspects will include topics such as "As Low As Reasonably Achievable (ALARA)" Principle and Radiation Protection, Recent and Emerging Nuclear Technologies for Power Generation, Financing Scheme on Nuclear Power Generation, Radioactive Waste Management, and Nuclear Fuel Cycle. Practical training and table-top exercises on emergency preparedness will also be conducted in collaboration with ISCN/JAEA and IAEA.

Table 8. Outcome-based Strategies and Action Plans for Civilian Nuclear Energy 2021-2025

OBS 1. Improve nuclear energy literacy and public engagement	
Action Plan 1.1	Implement Information Education Communication (IEC) Campaigns to enhance nuclear energy literacy
Action Plan 1.2	Organise at least two (2) activities on public engagement to raise awareness on nuclear energy as an alternative energy option for ASEAN
Action Plan 1.3	Develop at least one (1) regional public communication strategy and plan to enhance understanding on nuclear power generation
Action Plan 1.4	Sustain and update the portal of nuclear communities and database
OBS 2. Strengthen Regional and International Cooperation on Nuclear Energy for Power Generation	
Action Plan 2.1	Conduct a study on the potential regional nuclear energy facilitation and coordination mechanism
Action Plan 2.2	Establish multi-year collaboration with at least two (2) DPs/IOs

OBS 3. Build Human Capabilities on Nuclear Legal and Regulatory Frameworks for Power Generation	
Action Plan 3.1	Organise at least one (1) activity on nuclear legal and regulatory framework for policy makers and regulatory bodies
Action Plan 3.2	Organise at least two (2) study-visits to the established international nuclear regulatory bodies
Action Plan 3.3	Conduct technical assistance/technical study on nuclear legal and regulatory framework
OBS 4. Enhance Human Resource Capabilities on Nuclear Science and Technology for Power Generation	
Action Plan 4.1	Organise at least one (1) activity including research and development, education, and training
Action Plan 4.2	Organise at least two (2) capacity building utilising the facilities of established nuclear institutions
Action Plan 4.3	Collaborate with DPs/IOs for secondment/educational opportunity on nuclear energy technology for power generation
Action Plan 4.4	Conduct of at least two (2) practical training activities with DPs/IOs



3. IMPLEMENTATION AND MONITORING MECHANISM

3.1 Implementation Arrangement

The AMEM also provides overall guidance and advice on the implementation of the APAEC. The AMEM also provides directives to address key issues, challenges, and concerns of common interest and to set policy directions to achieve the goals of the energy cooperation under the framework of the AEC.

The SOME collectively determines the implementation priorities and provides directions and advice on the APAEC to ensure coordination, and integration of APAEC strategies and actions. In addition, SOME guides the formulation and implementation of the yearly Work Plan of each of the APAEC Programme Areas and provides the annual progress updates to AMEM. To encourage the transfer of latest technologies, SOME provides guidance on deepening engagement with DPs, IOs, the private sector, and other relevant stakeholders.

The relevant SSNs and SEBs shall serve as the SOME's implementing arms in their respective Programme Areas. They shall convene their respective meetings as necessary, to identify the priorities, further develop the work programmes, and prepare the necessary project proposals and documents to achieve the outcomes.

ACE, in coordination with the ASEAN Secretariat, shall assist SOME, SEBs, and SSNs in carrying out the above responsibilities, including technical support and assistance in the supervision, coordination, and review of the cooperation programmes and activities. ACE shall provide technical coordination, facilitate and integrate the tasks of the implementing organisations, such as the planning and fund sourcing, and provide policy analysis and statistics. The ASEAN Secretariat shall be responsible for policy coordination and other requirements with other ASEAN sectoral/coordinating bodies such as minerals and mines, transport, nuclear, science and technology, health, standards and safety, environment, education, and agriculture, as well as with ASEAN's DPs and IOs.

Engagement with DPs and IOs will be conducted by SEBs/SSNs to achieve their respective outcome-based strategies. Recognising the contribution of ASEAN's DPs, IOs, academic institutions, and the industry in achieving the goals of the APAEC 2016-2025, ASEAN welcomes any interest and collaborative partnerships to implement concrete initiatives towards accelerating energy transition and enhancing energy resilience under the framework of the ASEAN Economic Community (AEC).

3.2 Monitoring Mechanism

The REPP-SSN and ACE will be responsible for the regular monitoring and evaluation of the APAEC Phase II:2021-2025 progress for submission to the annual SOME and AMEM meetings. The monitoring mechanism adopted will systematically track the annual progress of the activities by the SEBs and SSNs. This is to ensure the timely completion of the projects and will be reported annually at the annual meetings of REPP-SSN, SOME, and AMEM. To better reflect the actual progress of each action plan, a scoring system, based on a scale of 0 to 5 will be utilised, as shown below:

Table 9. APAEC Scoring System

Scale	Status	Indication
5	Done	100% of the work
4	Nearly Completed	80% or more of the work
3	Half-way	50% or more of the work
2	Ongoing	30% or more of the work
1	Just started	10% or more of the work
0	No action	
N/A	Not Applicable	

4. CONCLUSION

4.1 The APAEC 2016-2025 Phase II: 2021-2025

The APAEC 2016-2025 is a dynamic and living document to guide the implementation of the outcome-based strategies and action plans to accelerate energy transition and strengthen energy resilience in ASEAN to achieve energy security, accessibility, affordability, and sustainability for all under the framework of the AEC. As the continuation of APAEC Phase I: 2016-2020, the APAEC Phase II: 2021-2025 comprises comprehensive strategies to meet the challenges of ASEAN's energy transition and resilience in view of the changing landscape of global energy trends.

4.2 Preparations for APAEC 2026-2035 Phase I: 2026-2030

The preparation of the APAEC 2026-2035 Phase I shall be initiated in 2023 taking into consideration the various aspects of the implementation and progress of the APAEC Phase II: 2021-2025. The timeline is shown in Figure 10 below.

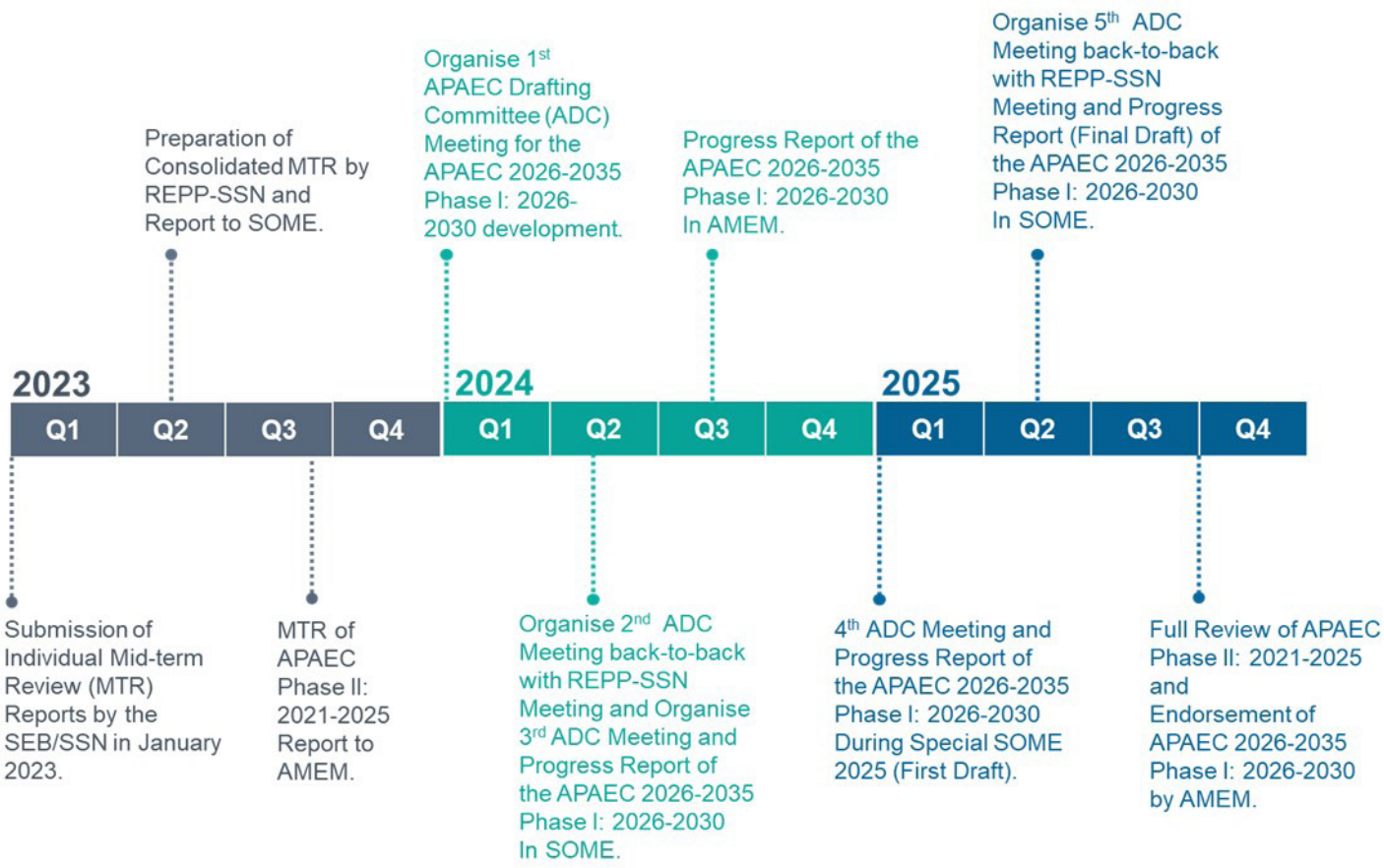


Figure 10. Timeline and Key Milestones (including MTR and Preparation of APAEC 2026-2035)

LIST OF ACRONYMS

4IR	: The Fourth Industrial Revolution
ACCEPT	: ASEAN Climate Change and Energy Project
ACDIS	: ASEAN Coal Database Information System
ACE	: ASEAN Centre for Energy
ADC	: APAEC Drafting Committee
AEA	: ASEAN Energy Awards
AEC	: ASEAN Economic Community
AECR	: ASEAN Energy Cooperation Report
AEDS	: ASEAN Energy Database System
AEO6	: 6th ASEAN Energy Outlook
AERN	: ASEAN Energy Regulators Network
AFOC	: ASEAN Forum on Coal
AGEP	: ASEAN-German Energy Programme
AGTP	: ASEAN Generation and Transmission System Planning
AIMS	: ASEAN Interconnection Masterplan Study
AJEEP	: ASEAN-Japan Energy Efficiency Partnership
ALARA	: As Low as Reasonably Achievable
AMEM	: ASEAN Ministers on energy Meeting
AMS	: ASEAN Member States
APAEC	: ASEAN Plan of Action for Energy Cooperation
APG	: ASEAN Power Grid
APGCC	: ASEAN Power Grid Consultative Committee
APS	: ASEAN Progressive Scenario
APSA	: ASEAN Petroleum Security Agreement
ASCOPE	: ASEAN Council on Petroleum
ATS	: ASEAN Target Scenario
ATSO	: ASEAN Power Grid Transmission System Operator
CCT	: Clean Coal Technology
CCUS	: Carbon Capture Utilisation and Storage
CEFIA	: Cleaner Energy Future Initiative for ASEAN
CETERI	: China Energy Technology and Economics Research Institute
CFPP	: Coal-fired Power Plants
CNE	: Civilian Nuclear Energy
CNEC	: China Nuclear Engineering and Construction
COE-CCT	: Centre of Excellence for Clean Coal Technology
CREEI	: China Renewable Energy Engineering Institute
CUPO	: Coal Upgrading Palm Oil
DPs	: Dialogue Partners
ECAP	: Energy Conservation Workshop under AJEEP Programme
EE&C	: Energy Efficiency and Conservation
EEE	: Electrical and Electronic Equipment
EMA	: Energy Market Authority

EPC	: Energy Performance Contracting
EPWA	: Energy Purchase and Wheeling Agreement
ESCO	: Energy Service Company
FDIs	: Foreign Direct Investments
GAWP	: Gas Advocacy White Paper
GCCSI	: Global CCS Institute
GIZ	: German Agency for International Cooperation
GRP	: Good Regulatory Practice
HAPUA	: Heads of ASEAN Power Utilities and Authorities
HELE	: High Efficiency Low Emission
IEA	: International Energy Agency
IEC	: Information Education Communication
IGCC	: Integrated Gasification Combined Cycle
IOs	: International Organisations
IRENA	: International Renewable Energy Agency
ISCN	: Integrated Support Center for Nuclear Non-proliferation
JAEA	: Japan Atomic Energy Agency
JOGMEC	: Japan Oil, Gas, and Metals National Corporation
KEA	: Korea Energy Agency
KWh	: Kilowatt-hour
LCOE	: Levelised Cost of Electricity
LNG	: Liquefied Natural Gas
LTM	: Lao PDR-Thailand-Malaysia
LTMS-PIP	: Lao PDR-Thailand-Malaysia-Singapore Power Integration Project
MEPS	: Minimum Energy Performance Standards
MOU	: Memorandum of Understanding
MRA	: Mutual Recognition Arrangement
MTOE	: Million Tonnes of Oil Equivalent
MTPA	: Million Tonnes per Annum
MTR	: Mid-term Review
MVE	: Market Verification and Enforcement
MWh	: Megawatt-hour
NDCs	: Nationally Determined Contributions
NEC-SSN	: Nuclear Energy Cooperation Sub-Sector Network
NRE	: New and Renewable Energy
NRPAS	: Nuclear Radiological Programme Administrative Support
NSTDA	: National Science and Technology Development Agency
NUPI	: Norwegian Institute of International Affairs
R&D	: Research and Development
RE	: Renewable Energy
REPP	: Regional Energy Policy and Planning
RE-SSN	: Renewable Energy Sub-Sector Network
REPP-SSN	: Regional Energy Policy and Planning Sub-Sector Network
RGT	: Regasification Terminals
SC	: Super Critical
SEB	: Specialised Energy Body
SOME	: Senior Officials Meeting on Energy
SPA	: Sales and Purchase Agreement
SSLNG	: Small-scale LNG

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