A Study of Energy Savings with Focus on Demand Side Management in ASEAN

Moving Forwards from Energy Efficiency Standards and Labelling

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Foreword

ASEAN is one of the largest economic regions globally and will become the 4th largest energy consumer in the world in 2040. Increased energy demand is noted by 70% compared to the energy demand in 2000 and currently accounts for 5% of the total global energy demand. It is crucial to efficiently govern and use finite energy resources to address the infinite energy demand and continue unbridled economic development.

Energy Efficiency is the most cost-effective way of enhancing energy security and transitioning into net-zero targets while promoting economic competitiveness. As a significant achievement, ASEAN 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 a low-carbon economy.

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

This study is part of the 'Energy Savings with Focus on Demand Side Management' project which is supported by the ASEAN Plus Three Cooperation Fund and intended to provide knowledge sharing and experiences from ASEAN+3 in the pursuit of energy savings. This study identified 4 enabling environments for energy efficiency as demand side management, which are ESCOs, Standards and Labelling, EE Financing, and EE business innovation. A supportive environment for greater energy efficiency will surely reduce energy intensity. We hope this study will provide recommendations for future collaborative endeavours in demand side management initiatives among ASEAN +3 Member States.

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EXECUTIVE SUMMARY

INTRODUCTION

Currently, the ASEAN region accounts for 5% of the total global energy demand and targets to reduce its Energy Intensity (EI). From the ASEAN Plan of Action for Energy Cooperation (APAEC), ASEAN has reduced EI by 21% in 2018 (over the 2005 level) and targets to achieve a further 32% reduction in EI by 2025. Options for achieving EI targets do not only depend on shifting gradually the conventional energy sources and heavy industries but also on improving Demand Side Management (DSM), mainly improving Energy Efficiency (EE). Not only residential sector, but EE-DSM could also potentially contribute to industrial sector, as the most energy-intensive sector that mainly contributes to economic activity, and performance by reduction of both energy and operation costs apart significantly improving productivity.

The EE targets and initiatives serve a crucial role in materialising the regional sustainability agenda as indicated in the ASEAN Socio-Cultural Community Blueprint 2025. Promoting a greater enabling environment for DSM which constitutes market, regulatory, information, fiscal, and technology and services that focus on various instruments and programmes would provide a strong response to DSM, mostly through EE approaches.

KEY FINDINGS ON THE 4 ENABLING ENVIRONMENT

Enabling Environment 1 (ESCOs)

Energy Service Companies (ESCOs) play a vital role in offering energy-saving solutions to customers and most of the ESCOs in AMS are initiated via national energy policy and energy related projects. ESCO participation is crucial due to its supporting roles in various technical and financial solutions for energy supply and services. However, there are several key barriers to ESCOs implementation such as lack of information on EE benefits, lack of energy efficiency technologies and infrastructure and limited access to EE debt finance due to limited collateral.

Thus, several measures should be considered in enhancing ESCOs role regionally such as facilitating institutionalisation like developing an ESCO association, conducting training and strengthening the quality of ESCOs by promoting certification schemes, and improving public procurement regulations to facilitate domestic and/or overseas ESCO investment, and leveraging finance for ESCOS development.

Enabling Environment 2 (EE Financing)

AMS has made various progress in EE financing, but the development is uneven. Supportive EE financial instruments such as grants, loans, tax rebates, direct tax deductions, and exemptions are critical. The financial system in ASEAN seems to prioritise short-term lending rather than long-term investments. Additionally, as an investment in EE has a long payback period, traditional financial regulations could impose high

Hence, several measures should be considered in accelerating EE finance in ASEAN notably disseminating information on EE technologies and projects, establishing project pipeline /trust between ESCOs and financial institutions and facilitating knowledge exchange and inspiring other agencies to support EE finance efforts.

Enabling Environment 3 (Standards and Labelling)

Countries like Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam lead in setting up national standards for methods of energy performance and adjusting national standards to the international level. Minimum energy performance standard (MEPS) allows for specifying the minimum amount of energy consumed in performing the equipment task while EE labelling acts as an informative label to inform consumers about the energy performance. As a whole package, standards and labelling can also lead to coherent targets such as green industry and net-zero building.

However, the rating methods and requirements on labels vary between countries, and there is no coherence in terms of labelling across these countries. Lack of standardisation creates hurdles in achieving optimum intra-ASEAN as well as world trade flows. The harmonisation of standards and labelling is critical to facilitate EE trade given that AMS are highly import dependent on EE technologies. In achieving a structured EE DSM, common standards and labelling for energy efficiency and energy savings are required for energy-intensive products.

Moving forward- AMS is required to develop a framework on EE standards and labelling in an appliance to monitor, verify, and enforce at the national and regional levels.

Enabling Environment 4 (EE Business Model Innovation)

In the context of EE, digitisation can lead an essential role in opening the opportunities for integration of newer grid technologies, mainly in the wind, polar, and batteries. The current efforts of digital application in energy sectors are in exploiting the potential of the ASEAN Power Grid (APG), significantly by improving interconnectivity and associated digitalisation.

ASEAN has substantial investment potential in promoting innovative business models and energy markets, but it is burdened with numerous barriers such as a lack of structured incentive mechanisms, capital and financial services, low energy prices in many ASEAN nations, the existing banking and financial services structure which hinders innovation and extensive bureaucratic red tape creates lesser and lesser space for environmental disclosure and information sharing.

Key takeaways to accelerate EE innovative business models in AMS include - engagement in new business models for EE initiatives using digital technologies, enabling new business models for EE is stakeholder engagement at the national and regional levels, energy market reformation, and leverage on regional cooperation notably leveraging ASEAN Trade in Services Agreement (ATISA) to enhances the existing ASEAN services agreements related to energy service providers, technology platform services.

CONCLUSION

There are great opportunities for energy saving and the government can encourage actions through EE programs and policies that can be applied in various sectors. EE improvements can be realised by having an effective EE-DSM that encourages greater energy-efficient technological deployment and making structural changes in the production and consumption of goods and services with lower energy intensity.

As a way forward, AMS also need to implement Demand Response (DR) in the DSM programme. While EE-DSM can greatly reduce energy demand, DR-DSM can manage the energy demand peak through smart forecasting, load shifting, and peak clipping. Thus, with DSM in place, the energy system will be lean and responsive to renewable energy to achieve the net-zero target.

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LIST OF ACRONYMS

ABS	Asset-Backed Securities
ACE	ASEAN Centre for Energy
ADB	Asian Development Bank
ADIFAP	ASEAN Digital Integration Framework Action Plan
AFTA	ASEAN Free Trade Area
AMS	ASEAN Member States
APAEC	ASEAN Plan of Action for Energy Cooperation
APEC	Asia-Pacific Economic Cooperation
APEIA	Asia-Pacific ESCO Industry Alliance
APG	ASEAN Power Grid
ASEAN	Association of Southeast Asian Nations
ATIGA	ASEAN Trade in Goods Agreement
ATISA	ASEAN Trade in Services Agreement
BAU	Business as Usual
BEV	Battery-Operated EVs
BIS	Bank for International Settlements
CCAs	Climate Change Agreements
CCL	Climate Change Levy
CEEP	China Energy Efficiency Project
CEFIA	Cleaner Energy Future Initiative for ASEAN
CFL	Compact Fluorescent Lamps
CNY	Chinese Yuan
CO2	Carbon Dioxide
COVID-19	Coronavirus Disease 2019
DBP	Development Bank of the Philippines
DTIE	Division of Technology, Innovation and Economics (United Nation Environment Program)
DSM	Demand-Side-Management
ECA	Energy Conservation Act
EE	Energy Efficiency
EE&C	Energy Efficiency & Conservation
EEDP	Energy Efficiency Development Plan
EERF	Energy Efficiency Revolving Fund
EI	Energy Intensity
EEIs	Energy Efficiency Indicators
EEOs	Energy Efficiency Obligations
EEP	Energy & Environment Partnership Program
EES&L	Energy Efficiency Standards and Labels
EGA	Environmental Goods Agreement
EMEER	The Efficient Management of Electrical Energy Regulation
EPC	Energy Performance Certificate
ERIA	Economic Research Institute for ASEAN and East Asia
ESAs	Energy Service Agreements
ESC	Energy Supply Contracting
ESCO	Energy Services Company
ESI	Energy Savings Insurance
EU	European Union
ESG	Environment, Social, and Governance
EV	Electric Vehicles
FBMC	Flow-Based Market Connections
FIT	Feed-in Tariff
GBI	Green Building Index

GBS	Green Bond Standards
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GTFS	Green Technology Financing Scheme
GWP	Global Warming Potential
HAPUA	Heads of ASEAN Power Utilities/Authorities
HCFC	Hydrochlorofluorocarbons
HVAC	Heat, Ventilation, Air Conditioning
ICT	Information Communication Technology
IEA	International Energy Agency
IEC	International Electronical Commission
IGA	Investment Grade Audit
IoT	Internet of things
IRR	Internal Rate of Return
ISO	International Organization for Standardization
ITSF	Inter-Agency Technical Working Group -Sustainable Finance
JAESCO	Japanese Association of ESCOs
LED	Light-Emitting Diode
MCO	Movement Order Control
MDV	Malaysia Debt Venture
MEMR	Ministry of Energy and Mineral Resources
MEPS	Minimum Energy Performance Standard
MFN	Most-Favored Nations
MOF	Ministry of Finance
MRV	Measurement, Reporting, Verification
NDCs	Nationally Determined Contributions
NECIDC	The Energy Conservation Information Dissemination Centre
NGO	Non-Government Organisation
NPSA	National Personel Service Agreement
NTM	Non-Tariff Measures
P2P	Peer-to-Peer
PNB	Permodalan Nasional Berhad
PNS	Philippines National Standard
PPF	Project Preparation Fund
PPP	Public Private Partnership
PV	Photovoltaics of Solar
QESS	Qualified Energy Service Specialist
R&D	Research and Development
RAC	Room Air Conditioners
RBF	Results-Based Financing
RE	Renewable Energy
SMEs	Small and Medium-Sized Enterprises
SNI/RSNI	Standard National Indonesia
TCVN	Vitnamese *Tiêu chuẩn Việt Nam;* in English Vietnam Standards
TFEC	Total Final Energy Consumption
THB	Thailand Bath
UN	United Nation
UNEP	United Nations Environment Programme
US	United States
USD	United States Dollar
VAT	Value Added Tax
VEET	The Victorian Energy Efficiency Target Scheme
WITS	World Integrated Trade Solution

1. BACKGROUND

The Association of Southeast Asian Nations (ASEAN) is one of the most important participants in the global economy being the seventh-largest economy with an approximate cumulative GDP worth of USD2.5 trillion which has significant implications for energy portfolio. Noteworthy that the Post Covid-19 economic growth skyrocketed energy demand by 4.6% in 2021 compared to 4% contraction in 2020 (IEA, 2021). Currently, the ASEAN region accounts for 5% of the total global energy demand and targets to reduce its energy intensity (EI)[1]. An assessment of ASEAN's EI achievement indicates that ASEAN has reduced EI by 21% in 2018 (over 2005 level) and targets to achieve a further 32% reduction in EI by 2025 (ACE, 2020). According to the 7th ASEAN Energy Outlook (AEO7), the region reached 23.8% of energy intensity reduction in 2020 (ACE, 2022d).

Options of achieving EI targets do not only depend on shifting gradually from conventional energy sources to renewable energy sources but also mainly on improving energy efficiency demand side management (EE DSM) that has more energy saving potentials. However, there are a few growing challenges in terms of energy saving mainly on demand-side-management (DSM) in the ASEAN context. Among them include considerable financing and investment requirements for energy efficiency in ASEAN region. For instance, it is projected that approximately US$ 10.6 billion/11 billion is required by 10 AMS for capacity assessment and investment between 2016-2025 (ACE, 2019). In addition, lacking the technology transfer from developed nations remained another critical challenge for most ASEAN countries to attain EE goals. The financial commitment to providing US$ 100 billion to developing nations as agreed in Paris Accord is still far. In addition, challenges remain within ASEAN in addressing DSM effectively given the different sectorial demand profiles and lack of awareness. Besides, difficulties to materialize energy efficiency in terms of DSM among AMS is also due to the heavily subsidized fossil fuel industry as well as underdeveloped institutional mechanisms and regulatory systems. And, with the current COVID-19 pandemic, most of the AMS shifted a larger proportion of their annual budget intensifying the national healthcare sector. And, with slow economic growth since 2020 and a high unemployment rate due to lockdown and movement order control (MCO) restrictions, one option for recovery plans is to identify new sources of growth with the involvement of private sectors within the energy-saving sectors. In this aspect, intensifying DSM may provide new investment opportunities and new sources of growth for recovery.

In general, energy efficiency (EE) refers to using less energy input to delivery any production and services within a system. The action requires minimal energy usage that can be achieved by deploying energy saving technologies and equipment as well as services that improvise equipment as smart systems that allow energy saving potentials. In a broader context, EE plays a vital role in securing and strengthening the domestic energy supply, reducing energy transmission costs as well as mitigating carbon emission risks. Further, EE could potentially contribute to industries performance by reduction of both energy and operation costs apart significantly improving productivity. EE DSM refers to a series of acts/actions that are intended to encourage specific groups to modify their energy usage patterns with a focus on achieving energy saving and efficiency objectives. In a broader context, EE

[1] EI is used as a proxy to measure the progress in energy efficiency improvements

DSM comprises both management and optimisation of energy consumption to ensure energy usage is minimal by not only can controlling the consumer's energy consumption behaviour optimally but also by promoting EE through elimination of energy waste. EE improvements can be realised by having an effective EE DSM that encourages greater energy efficient technological deployment and making structural changes in the production and consumption of goods and services with lower energy intensity[2]. Table 1 demonstrates several of the potential approach and impacts of EE policy measures.

Table 1 ***Approach and Impact of Selected EE Policy Measures***

EE Policy Measures	Approach and Impacts
Regulatory - Labelling, Standards & Requirements	Saved 1 500 TWh of electricity per year in 2018 in United States, European Union, Australia, Mexico, China, India, Brazil, South Africa & Malaysia. The United States recorded net annual fuel savings of around USD 40 billion in 2020 or a reduction in the average annual household fuel bill of USD 320[3]. The EU EES&L programme – eco-design and mandatory labelling – has reduced emissions by 311 Mt CO2, or 10.7% of the European Union's total energy-related emissions for 2019. This is 7% of total EU CO2 equivalent emissions from all sources in 2018[4].
ESCOs and energy-as-services approach	ESCO industry's energy conservation efforts have the potential to significantly reduce the climb in China's coal use-a major source of greenhouse gases. However, the taxes and fees are high for ESCOs in China, existing tax and fiscal system discourage energy efficiency[5]. A super ESCO in India, Energy Efficiency Services Limited, successfully adopted the deemed savings approach for its street and residential lighting projects[6]. *BeeBryte*, a France- and Singapore based "software-as-a-service" company, provides cloud-based intelligence software that can monitor real-time load in large commercial and industrial facilities. The software can automatically switch loads like HVAC systems to battery storage based on time-of-use charges and delivers up to 40% savings in utility bills. Finland based-*Fortum* built a 1-megawatt virtual battery using the water heaters of 1 000 customers. The controlled residential water heaters, behaving as a battery, play an increasingly important role in maintaining energy system balance through demand-side Management. New Zealand based- *Solarcity* provides a battery to store electricity and smart plug systems that can control appliances based on the availability of solar energy. The company has installed more than 6000 systems, generating over 9 million kWh of electricity, resulting in total annual customer savings of nearly USD 1.7 million. US based *ENGIE* uses data from meters and energy management systems to reduce electricity costs for clients. Between 2012 and 2017, ENGIE enabled an estimated USD 3.2 billion in savings for its customers[7].

[2] IRENA and C2E2 (2015), Synergies between renewable energy and energy efficiency, Working paper, IRENA, Abu Dhabi and C2E2, Copenhagen.
[3] Energy Efficiency (2021), International Energy Agency.
[4] Achievements of Energy Efficiency Appliance and Equipment Standards and Labelling Programmes (2021), International Energy Agency.
[5] Da-li, G. (2009). Energy service companies to improve energy efficiency in China: barriers and removal measures. Procedia Earth and Planetary Science, 1(1), 1695-1704.
[6] Energy Efficiency (2021), International Energy Agency.
[7] Energy as a Service (2020), International Renewable Energy Agency.

Building Codes	As of November 2021, 80 countries had mandatory or voluntary building energy codes on the national or subnational level. Out of 80 countries, 54 countries had mandatory codes on the national level for both residential and non-residential buildings[8]. In China, the energy savings of new buildings per floor area per year increased from 20.4 kWh/m2 to 28.4 kWh/m2 along with compliance rates in the construction stage, which increased from 71% to 100%[9]. Japan and Australia, have reduced their demand for energy by 1.6 % per year on average through the application of energy-efficiency codes[10].

Source: Compilation by Study Team

2. ENERGY EFFICIENCY TARGETS & INITIATIVES IN ASEAN

Table 2 highlights the details of energy efficiency (EE) targets and initiatives by respective ASEAN Member States (AMS). Impressively, Brunei Darussalam, Thailand and Singapore aimed to reduce energy intensity (EI) by 45%, 30% and 35% respectively in 2030s. Apart from EI, there are several other AMS intended to reduce total final energy consumption (TFEC) drastically by 2030. For instance, Cambodia targeted to reduce TFEC by 20%, Indonesia (on average 17%) and Lao PDR (10%). At the same time, minimisation of electricity consumption remains crucial as a part of EE target. For example, several AMS intended to reduce electricity consumption gradually such as Malaysia (8%) in 2025, Myanmar (20%) in 2030 and Philippines (1% / year) until 2040. Crucially, most of the EE targets set by respective AMS were in-tandem with their EE initiatives at the national level. The EE targets and initiatives serve crucial role in materialising the regional sustainability agenda as indicated in the ASEAN Socio-Cultural Community Blueprint 2025.

Table 2 ***Current State of Energy Efficiency Targets & Initiatives, AMS***

Country	Energy Efficiency (EE) Targets	EE Initiative
Brunei Darussalam	Reduce EI by 45% in 2035.	Feed-in Electricity Scheme
Cambodia	Reduce total final energy consumption (TFEC) by 20% in 2035.	National Policy- Strategy and Action Plan on Energy Efficiency
Indonesia	Reduce TFEC in 2025 by 17% in industry, 20% in transportation, 15% in households, 15% in the commercial building sector.	Green Building Programme. Green Chiller Financial Incentive Programme.
Lao PDR	Reduce TFEC by 10% in 2030.	Renewable Energy Development Strategy
Malaysia	Reduce electricity consumption by 8% over a decade, from 2016 until 2025.	Fiscal Incentives for Energy Efficiency- 2001 Green Technology Finance Scheme- 2013. Green Investment Tax Incentive- 2014. Energy Performance Contracting Fund.
Myanmar	Reduce electricity consumption by 20% in 2030.	The Foreign Investment Law- 2012

[8] Energy Efficiency (2021), International Energy Agency.
[9] Guo, Q., Wu, Y., Ding, Y., Feng, W., & Zhu, N. (2016). Measures to enforce mandatory civil building energy efficiency codes in China. Journal of Cleaner Production, 119, 152-166.
[10] The experience with energy efficiency policies and programmes in IEA countries: learning from the critics (2005) Information Paper, International Energy Agency.

Philippines	Reduce electricity consumption by 1% every year compared to BAU till 2040. Reduce EI by 40% until 2040.	Feed-in tariff (FIT)
Singapore	Reduce EI by 35% in 2030. Greening 80% building (by gross floor area).	Building Retrofit Energy Efficiency Financing Scheme. Green Mark Incentive Scheme for Existing Buildings. Zero Capital Partnership Scheme.
Thailand	Reduce EI by 30% in 2036.	EE Revolving Fund
Vietnam	Reduce TFEC by 8% in 2020. Reduce EI industries by 10%.	Environment Protection Fund. Feed-in tariff (FIT).

Source: ASEAN Centre for Energy (ACE), 2022a.

As shown in Table 3, AMS have embarked progressively in various EE DSM initiatives with standards and labeling being the most common initiatives across AMS. These efforts provide opportunities to scale up energy efficiency initiatives and detail understanding on the critical barriers and best practices are imperative in selected areas given that AMS continues to face barriers to implementing EE DSM programmes.

Table 3 ***EE-DSM- related policies implemented in AMS***

Country	EE Policy	EE-Initiative/Programme
Brunei Darussalam	• The first EE-related policy was introduced back in 1981 when the Oil Conservation Policy was issued. • The EE&C Action Plan focusing on four major sectors, namely, residential, commercial, industrial and transportation.	Energy audit policy for buildings and industries. Promoting ESCOs. Established EE&C standards for buildings. In developing stage (standard and labelling) for lighting and air conditioners. Smart metering. Smart tariffs.
Cambodia	• National Energy Efficiency Policy- encourage the efficient use of energy; as well as to minimise the detrimental environmental affects resulting from energy supply and consumption. • Focusing on five sectors as priority areas, namely industry, end-user products, buildings, rural electricity generation and distribution, and efficient use of biomass resources for residential and industrial purposes.	In developing stage (ESCOs and Energy audit)
Indonesia	• Requires the government departments, agencies, and regional government office buildings to implement EE&C measures and to report it every six months. • Mandatory requirement to conduct energy management for energy consumers of more than 6,000 toe.	Energy Saving Performance Contract (ESPC) Energy Efficiency Label Energy auditing Smart metering Voluntary Reporting

Country	EE Policy	EE-Initiative/Programme
Lao PDR	• A mix of regulations, information and incentives will be the key policy drivers to enforce a step wise approach toward improving cooling efficiency. • Promoting energy efficient equipment within the industry, improving the energy management of industrial buildings and factories, collecting data of new and existing buildings, and promoting innovative designs and building codes for the buildings sector. • Key challenges to implement EE&C Policy are (1) insufficient national regulations and standards; (2) low level of public awareness; (3) lack of information on efficient technologies; (4) inadequate financial incentives and funding support.	ESCO development (nascent stage) The Low-Cost Technology Incentive-financing energy saving activities.
Malaysia	• Energy efficiency was one of the main principals of the first National Energy Policy since it was enacted in 1979. • Malaysia's current legal and regulatory framework on EE such as (1) Efficient Management of Electrical Energy Regulations 2008; (2) Regulation 97 under Electrical Regulation 1994. • Standardize 2-star to 5-star electronic appliances, such as air conditioner, fan, refrigerator, television, lamp, microwave oven, washing machine, electric rice cooker, and freezer as a part of EE- DSM initiative. • Provide rebate RM 200 for those purchase 4* or 5* air-conditions and refrigerator (*still at initial stage of implementation*). • National building energy label for government building in Malaysia has labelled 250 government buildings.	Energy Audit Conditional Grant Energy Efficiency Label (Star Rating) Smart metering Qualification, accreditation & certification schemes (ESCOs) Energy Performance Contracting Programme
Myanmar	• National Energy Efficiency Policy- address 3 core values, such as economic values, social values, and environment values. • Myanmar set policy targets to reduce energy consumption by 20% in 2030 based on 2012. • Myanmar Energy Master Plan (2016)- efficient use of energy resources, to create effective investment environment, to employ innovative technologies and to minimise the environment and social impacts. • Energy Efficiency and Conservation Policy, Strategy and Roadmap (EECPSR)- strengthen the capacity building in EE&C in the building and industry sector.	No dedicated ESCOs.

Philippines	DSM policy focused to reduce electricity consumptions which would subsequently contribute to grid system reliability, reduce the carbon footprint and greenhouse gas emission. • From the commercial sector, the Philippines promote the utilisation of energy-efficient equipment such as inverter-type air conditioners and LED lightnings • The utilisation of highly efficient motors, variable frequency drivers, and interruptible/curtailable agreements are settled to support DSM for industrial sectors. • The way-forward for DSM programmes are identification of current programmes that cater to current system status, policy formulation and development, public consultations with stakeholders, implementation, and continuous programme promotion.	Efficient Lighting Initiative. Energy Efficiency Label. ESCO Accreditation. Government Energy Management Programme (GEMP)- to reduce the monthly consumption of electricity and transport of petroleum products by all government offices by at least 10 per cent every year. Mandatory requirement- Quarterly Energy Consumption Report & Annual Energy Conservation Programme Report. Green Building Certification System.
Singapore	• Based on three approaches: regulation and standard, incentive to encourage the DSM EE, and capacity building. • Three key strategies for EE technological advancement- adopt structured energy management system, conduct regular EE assessment, and design and review facilities and plan.	Energy Efficiency Label. Smart metering. Periodic energy audits - building Energy Efficiency Programme Office (E2PO)- improve EE. Energy Efficient Singapore (E2 Singapore)- promoting the adoption of EE technologies and measures. (ESCO) Accreditation Scheme. Guaranteed Energy Savings Performance (GESP)- contracting model to secure the energy savings. Grant for Energy Efficient Technologies (GREET). Energy Efficiency Improvement Assistance Scheme (EASe).
Thailand	• Energy Conservation Promotion Act (ECP Act) was enacted in 1992. • ECP Act measures for energy conservation in various sectors such as factories, building, machinery, equipment, and the promotion of energy-efficient materials. • Energy Efficiency Development Plan (2011-2030) was released with a target to reduce energy intensity by 25 per cent by 2030. • Thailand has established (1) MEPS, with 18 products voluntary and 5 products mandatory certification mark; (2) HEPS, with 21 electrical appliance products in voluntary programme; (3) DEDE, for non-electrical appliance and industrial equipment for 4 groups (building material, business and industrial, household, agriculture) and 19 products. • Building Energy Code (BEC) in Thailand has labelled 31 buildings that complied to the BEC criteria.	Energy Management System. Third-Party Energy Auditor. Building Energy Code. Smart metering. Energy Efficiency Label. ESCO development- capacity buildings and certification. Thai Energy Efficiency Revolving Fund.

	• Presented the current practice on DSM of supporting ESCOs with dedicated programme, financial incentives, and networking. • Pilot project by installing smart meter in public buildings.	
Vietnam	• Energy Conservation and Energy Efficiency (2003)- requires the suppliers of energy-consuming equipment and facilities to declare the energy consumption of the equipment in the user instructions and on the label of such equipment and facilities. • EE&C National Target Programme (2016-2020) that set the direction for a 5 per cent reduction from BAU on energy consumption and a 10 per cent energy intensity reduction on energy intensive industries.	Energy Efficiency Label. ESCOs Development Vietnam National Energy Efficiency Programme (VNEEP). Energy audit. Applying specific energy saving measures. Annual energy consumption planning. Energy Efficiency Building Code. Smart meters for Automatic Meter Reading (AMR)

Source: ASEAN Centre for Energy (ACE), 2022a.

In tandem with the EE DSM efforts, AMS have shown significant progress in reducing the energy intensity (Figure 1) over the years (2005-2020). On average, energy intensity for ASEAN reduced from 0.11 Mtoe/billion USD (2017 PPP) in 2005 to 0.08 in 2020, recording a decrease of 21% over the years. Equally important to note that several AMS have recorded significant reduction than others and the energy intensity various across AMS.

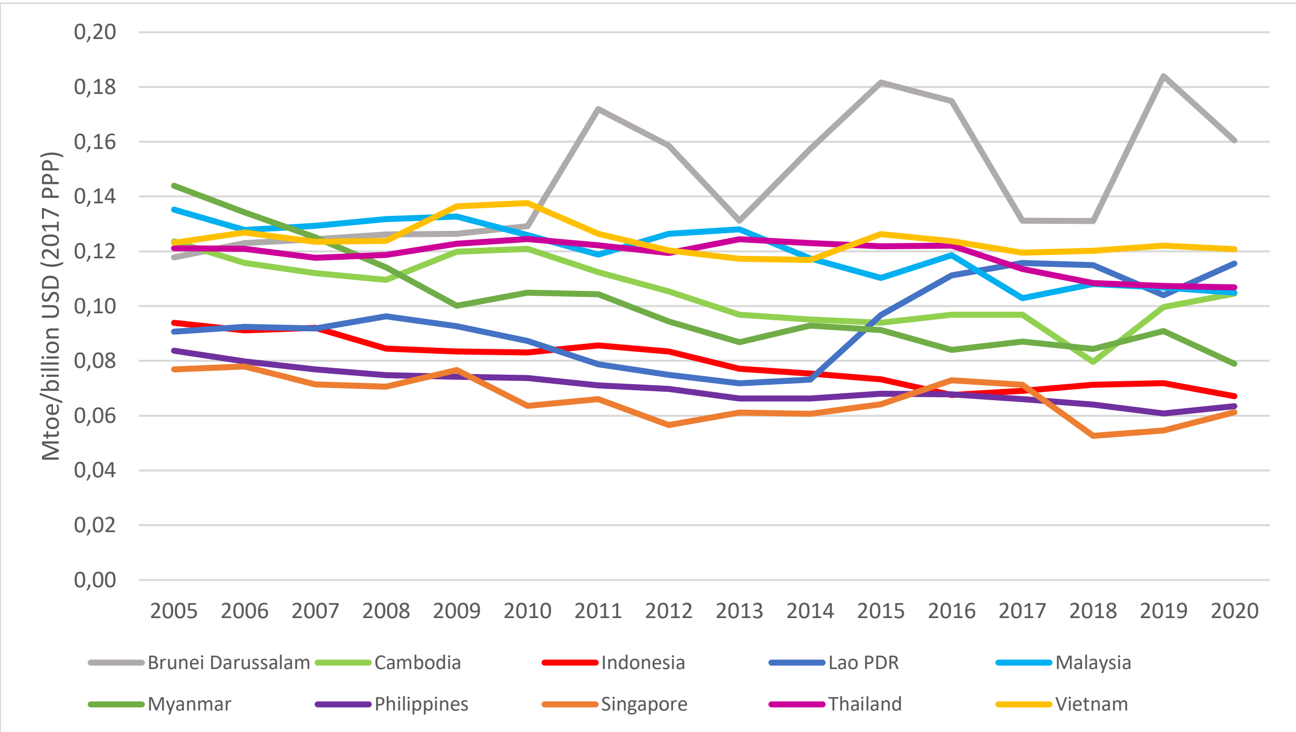

Figure 1 ***Energy Intensity of AMS, 2005-2020***

Source: ACE, 2022d.

Note: Energy intensity level of primary energy (Mtoe/$2017 PPP GDP) is used as a proxy (but imperfect) to measure the progress in energy efficiency improvements.

3. FOCUS, SCOPE, AND OUTCOME OF THE STUDY

In general, the enabling environment for EE DSM constitutes 5 major pillars (market, regulatory, information, fiscal and technology and services) that focuses on various instruments and programmes as to respond to DSM. Table 4 illustrates the 5 key pillars, instruments, and DSM responses. While AMS has embarked in some of these initiatives (as highlighted in Table 3), critical understanding on new areas that AMS have ventured, which is still in a nascent stage, such as strengthening the role of ESCO, financing EE, and further enhancing and appropriating the energy efficient labelling, building codes and energy services are central. Indeed, the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II strategies, put a strong emphasis on market transformation by promoting harmonisation of standards to improve EE trade efficiency that would reduce cost and uptake of energy efficiency technologies. Indeed, focus on financing and application of digital as well as data science on EE market was highlighted as central in attracting the interest of private sector and financial institutions in EE development. Involvement of private sectors are critical to unleash more resource deployment for EE development. More scrutiny is needed in these areas as to support the EE DSM. Therefore, in this study, making transition in improving energy efficiency (EE) to combat climate change challenges requires better demand side management (DSM) that resides within the key pillars namely (1) Market and Fiscal mainly in enhancing private sector engagement and EE financing capacity especially demand-side incentives and financing, (2) Regulatory specifically harmonisation of EE standard and labelling for trade facilitation in EE product and services as well as building codes; and (3) Information and Technologies/Energy Services in the context of improving EE innovation ecosystem. Specifically, the scope of the study is on:

a) Private Sector Engagement – ESCOs roles and potential
b) Finance Institutions and Supports for EE (Demand-side incentives and financing)
c) Harmonisation of EE standard and labelling and as well as building codes
d) Innovation for EE in terms of energy-as-services and energy market design

The study further deep dives in understanding (1) the current state of progress in ASEAN in the above EE DSM areas, (2) key barriers and challenges (3) Global best practices (4) way forward for ASEAN. Moreover, the scope was established in the 4 areas for the following reasons. (1) Private sector engagement (ESCO and other services providers), energy management services and financing are areas that is less explored and requires more understanding for better DSM. (2) These enabling environment has been the future areas of concern in the APAEC strategic plans in moving forward the EE DSM agenda. Currently there are limited knowledge on the role and challenges of ESCOs in ASEAN within the global supply chain especially providing high value-added based EE solutions. Therefore, new business models in EE are highly required to ensure competitive advantage over the regular and mundane models. An innovative business models in EE potentially can foster DSM in long-run by unlocking the value of EE technologies including energy-as-services business as well as promoting energy market design.

The outcome of this study provides the baseline knowledge, information, and data requirements on EE DSM in: (a) understanding some EE thematic policy and its enabling environment for DSM market demand strategy and policy gap for ASEAN. (b) assisting stakeholders for capacity building activity with need assessment. (c) establishing recommendations from DSM study and workshop report and (d) sharing knowledge, experience, and best practices among ASEAN in achieving EI reduction.

*Table 4: **EE DSM Pillars, Instruments and Responses***

Pillars (Enabling Environment)	Instruments	DSM Responses	Our Study Focus
Market	Market Transformation Incentive Payment based responses Price based responses Market Participation	Alter energy use behavior	ESCO ESCO Financing
Regulatory	Standards and Labelling EE Regulations and Acts EE Trade liberalisation Building Codes	Enabling adoption of reliable energy efficiency technologies	Standard and Labelling EE Technology Trade Building Codes
Information	Energy Management System Equipment Labelling Innovation Energy Audits Energy Services	Alter energy use patterns	Innovation – Energy as Service Business Models Standard and Labelling
Fiscal	Tax Incentives Grants/Subsidies Loans Investment Incentives Financing EE Markets	Deployment of EE technologies for energy saving	EE Financing - Demand-side incentives and financing
Technologies & Energy Services	Energy as Service Business Smart Metering	Deployment of smart technologies to optimizing use of energy	Innovation – Energy Market Design

Methodologically, the study employs desk review and focus group discussion which involves stakeholders (public and private sectors) across AMS. In the first stage the study undertakes desk review in understanding the progress and barriers to EE DSM in the 5 areas of focus. Essentially, desk review provides credible background insights despite intensifies the overall study focus for greatest impact. The findings were presented in the first focus group discussion held on July 6, 2022, to obtain feedback. In the second stage the study deploys qualitative research method to collect information and data. Feedback and insights were also obtained from the second capability building workshop and focus group discussion held on the 18 & 19 August 2022[11] that involves energy service companies (ESCOs) and policymakers across AMS specially to gather in-depth insights and best practices in the context of EE-DSM to generate new insights for the study.

[11] See Appendix for details

4. KEY FINDINGS: ENABLING ENVIRONMENT FOR EE DSM

The next section describes the state of progress of the 5 key areas of EE DSM in ASEAN. It further discusses the best practices (benchmarking) to draw some lessons learned as well as key challenges and recommendations for ASEAN to move forward in implementing an effective EE DSM initiative.

4.1 Private Sector Engagement – Energy Service Company (ESCO) in ASEAN

4.1.1 Current State of ESCOs in ASEAN

In general, ESCO exists in most of AMS except in a few countries namely Brunei Darussalam, Cambodia, Lao PDR, and Myanmar (see Table 5). Although ESCOs existence is not captured in these four AMS, there are local firms rendering energy management services nationally. Noteworthy is that ESCO plays a vital role in offering energy saving solutions to customers and most of the ESCOs in AMS initiated via national energy policy and energy related projects. The ESCO in most of the AMS is supported via regulatory and financial incentives mainly to promote the development of the ESCO industry ecosystem. However, there is still limited domination of ESCOs from ASEAN in the global supply chain especially providing high value-added based EE solutions. Therefore, it is crucial for AMS to devise an effective mechanism notably technology transfer and trade barriers harmonisation to enhance ESCOs performance regionally and globally (ACE, 2017).

Table 5 ***ESCO in ASEAN Member States***

Country / Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia
Number of ESCOs	No ESCO. However, some architecture firms provide energy management services.	-	25 ESCOs	-	205 ESCOs and 61 registered in MAESCO

Country / Indicator	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia
ESCO Development	Industry EE Initiatives, Promoting ESCO (APEC, 2017)	By 2020, ERIA recommended a roadmap for Establishing ESCO Market in Cambodia (ERIA,2020)	- State-own ESCO was established in 1986 - IGA for industries potential saving 110GWh/y with total investment RP 284 billion - APKENINDO joined APEIA (Asia Pacific ESCO Industry Alliance)	ESCO services do not yet exist.	The Malaysian Industrial Energy Efficiency Improvement Project 1999-2007; trained and supported local ESCOs and produced the Master Energy Service Agreement and the Industrial Energy Audit Guidelines. EPC in government sectors boosted ESCO market.
Regulatory Support	The launch on the EEC Building Guidelines for non-residential sector is pertinent for any potential ESCOs	NPSA PEE is expected to develop a pool of qualified ESCO that can provide EE&C services to private and public customers	- GR No.70/2009:>6 000 toe/y should appoint energy manager, conduct an energy audit, and implement the energy conservation best practice - Ministerial regulation of MEMR No.14/2016 on ESCO Business Implementation/Revoked in 2018. - Ministerial Regulation of MEMR No.16/2020 on Strategic Plan MEMR 2020 -	National Policy on EE&C aims the ESCOs establishments with technology transfer, capacity building, financing mechanism (by tax exemption and incentives)	- Electrical Energy Regulation (EMEER) 2009 under the Electricity Supply Act 1990 - The Government Leads by Example initiatives through EPC Programme in the government sector - ESCO registration code 222801 requires registration with the Energy Commission

			2024: ESCO Business development - Revision GR No.70/2009		
Financial Incentives	Will be established after the implementation of Energy Management Policy		- Industries /users that are conducting energy management 3 years in a row are eligible for incentives, such as reimbursement in energy audit cost and priority on energy supply		- Investment Tax Allowance and Income Tax Exemption for 2013-2020 - Implementation Energy audit conditional grant under the 11th Malaysia Plan, financed by government - GTFS - EPCF (Energy Performance Contracting Fund)
ESCO Association	Green building Council (NGO consisting of architecture firms, engineers, and government bodies)		- APKENINDO (Indonesia ESCO Association) - member of APEIA		MAESCO (Malaysia Association of Energy Service Company) - member of APEIA

Country / Indicator	Myanmar	Philippines	Singapore	Thailand	Vietnam
Number of ESCOs	-	54 registered in PE2	25 accredited ESCO	69 registered ESCOs and 23 registered members in Thai ESCO	Less than 20 ESCOs
ESCO Development	Some RE companies are also trying to perform Energy Performance Certificate (EPC) but still no sizeable projects	- The Efficient Lighting Initiative project initiate a promotion of ESCO-led efficient lighting projects - The Philippines EE Project: Intention to establish Super ESCO but failed	- Public Sector Taking the Lead in Environmental Sustainability initiative in 2006. - Guaranteed Energy Saving Performance (GESP) for public agencies building retrofit projects. E2PO administered the ESCO Accreditation Scheme	Kick-off with the 1993 Promotion of Electricity EE Project in Thailand 2014: the total amount of EE and RE investment was THB 3,964.49 million coming from 101 EPCs Cumulative investment since 2009: THB 19,836.8 million by 466 EPCs	Vietnam - National EE Programme recognised the existence of the so-called ESCO to contribute to the achievement of its national EE target The government started to help the industrial enterprises and EE service providers to develop bankable projects
Regulatory Support	EECPSR set to strengthen the capacity building in EE&C in the industry sector and building, by providing the support for the development of ESCO	DC 2008-09-0004 on ESCO Accreditation enforces the requirement for ESCO in engaging any EPC DOE Department Order No. DO2019-07-0013: Constituting the Committee on the Accreditation	The Energy Conservation Act (ECA):>54 TJ of energy consumption/ year required the appointment of at least one certified energy manager	The Energy & Environment Partnership Programme (EEP) 2015 recognised the use of professionals and ESCO as an important tool.	- GD No. 102/2003/ND-CP on Energy Conservation and EE projects with a subsidy ceiling of USD 250,000 for each project MoIT issued guidelines for implementation of ESCO EPCs. - Circular 25/2020/TT

		of Energy Service Companies (ESCOs)			- Investment and Civil Code Law
Financial Incentives			- EE Improvement Assistant Scheme - The Grant for Energy Efficiency Technologies (GREET) - EE Improvement Assistant Scheme (EASe)The Grant for Energy Efficiency Technologies (GREET)Energy Efficiency Fund (E2F) Green Mark Incentive Scheme (GMIS) - BREEF - max loan 4 Mio SGD - Guaranteed Energy Savings Performance (GESP) contracting model	- The Thai EERF in 2003 for large companies - ESCO Fund Project in 2018 for small companies	- USD 1 Mio EE Subsidy Fund, which provides up to 30% Investment a subsidy ceiling of USD 250000 for each project
ESCO Association		PE2 (Philippines Energy Efficiency Alliance) - member of APEIA	SEAS (Sustainable Energy Association of Singapore) - member of APEIA	Thai ESCO Association	

Source: ACE, 2017; Industrial Energy Accelerator, 2019; SEAS, 2022; ACE, 2022a; ACE 2022c

4.1.2 DSM Initiatives accelerated by ESCOs- Case studies

There is great potential for Energy Service Companies (ESCO) to accelerate DSM in any given country. In fact, the 'energy services company' (ESCO) term is used extensively in AMS. In general, ESCOs deliver energy services and /or other energy efficiency improvement measures in a user's facility or premises besides being exposed to certain degree of financial risks (ACE, 2022, p.21). By applying the performance-based contracts concept, ESCO started out by providing engineering or consulting services to clients, but later moved on to providing financial solutions as well as risk mitigation services for EE activities. ESCOs then began to support their services with performance guarantees, securing financing for projects and introducing methods of loan repayment (ACE,2017).

ESCO participation is increasingly important because it can support various technical and financial solutions for energy supply and services. Under certain conditions, the energy contract model by ESCO can offer a solution to several constraints in energy efficiency projects such as access to financing, reducing transaction costs, comprehensive aggregation of different technologies and possibility to provide performance guarantees over the whole project. At the same time, ESCOs serve as EE solutions for commercial buildings and industries as a part of energy conservation initiative (ACE,2017). In the long run, there are crucial needs for ESCO market development especially in ASEAN region context to implement energy efficiency projects. Therefore, it's crucial for ESCO to identify the current barriers and overcome the challenges to undertake or commission EE projects (GIZ, 2010).

Benchmarking the international ESCOs initiatives provide international examples of policy activities and state of ESCO markets. Table 6 provides example of ESCOs across six countries of developed and emerging economies (Nurcahyanto 2017). Success factors seem to be to set clear, long-term EE regulations, targets which also break down into certain sectors (e.g. public buildings or energy-intensive industry). Aggregation models, standardised contracts that can mitigate high transaction costs for the generally rather small EE investments and programmes that support EE finance (Nurcahyanto, 2017).

Table 6 ***Current Status of International ESCOs in Developed Nations***

Country	Implementation				
	Types of Projects	Regulatory Factors	Market Factors & Association	Financing	Barriers
China	- Integrated smart-energy industrial innovation parks - Energy service cloud platform of Yangzhou Municipal People's government - Energy saving renovation of	- Five-year plan (2010-2015) set fiscal incentives for ESCOs. Encouraged voluntary action at provincial level - Five-year plan (2016-2020) phasing out subsidies and introduced EE	- Carbon neutrality - Technological innovations – connectivity and monitoring technology	- Private and public	- Upscale beyond pilot projects (2nd phase)

	public buildings in Zhejiang province - Combined cooling and heating generation in Giyang, Guizhou province - EPCs	targets and mandatory targets on energy intensive industries.			
India	- Pay-as -you-Save (PAYS) - LEDs for ALL - Street Lighting National Programme (SLNP) - Smart Meter National Programme (SMNP) - Building Energy Efficiency Programme (BEEP)	- Energy Conservation Act 2022, - Standards and labelling MEPS - National action plans on cooling (2018) and climate change (2008) - Energy conservation building codes	- DSM and DR programs by utilities - Bulk Procurement by state run Energy Efficiency Service Limited has been set up as a Super-ESCO	- Public via ESCO and PMC models	- Information on the programme and capacity in the public sector
Japan	- The long payback period for many ESCO projects - Large-scale ESCOs and other customers	- Strengthening standards and regulations - implemented in public facilities	- Private sector facilities (industrial sector) (Murakoshi and Nakagami 2009) - Japanese Association of ESCOs (JAESCO)	- Shared Savings contracts (90%) - Incentives (e.g. subsidies) - Excellent financing mechanism for large scale customers	- Financing in small and medium scale is not quite attractive

Country	Types of Projects	Regulatory Factors	Market Factors & Association	Financing	Barriers
Australia	- EPC	- Government involved in accrediting ESCO - Development of EPC facilitators - Regulations for guaranteed savings loans, multi-year budgets, and commercial leasing - Standard contracts and ESCO guidance documents	- Industry, commercial, and municipal, - Australasian Energy Performance Contracting Association Limited / Energy Efficiency Council	- Multi Year budget (5 years) - Treasury funds for repaying the guaranteed savings loans - Establishing commercial leasing arrangement	- - The time delay in project implementation due to negotiations of contracts
Belgium	- Public ESCO, Fedesco. - Public sector buildings and private industry facilities project. - Main targets include healthcare facilities, educational and office buildings	- Establishment and funding of public ESCO - Information campaigns, - The obligation of recruiting energy managers and mobility officers	- 4 public ESCOs and 10-15 private firms (6 large, 5-7 SMEs) - Public ESCOs that act as market facilitators. - Slow growth - BELESCO: The Belgian Association of ESCOs and energy service providers and AGORIA Green Building platform	- Public energy service contracts - Third Party Financing - EPC and Smart EPC (Energy, Maintenance, Comfort and Building Value Performance Contract)	- Lack of policy support (legislative focus on the ESCO market).
Austria	- Space heating, AC, control and automation, lighting. - Public sector buildings	- Certification and accreditation scheme - Standards and ecolabels - Mandatory energy consultation - Standardisation	- Small Medium Enterprises - 'Dachverband Energie Contracting Austria' (Professional Association for Energy	- EPC - shared savings model - Commercial banks are ready to engage in ESCO	- High transaction costs, small project sizes, perceived risks, and lack of best practice examples

		contracts	Contracting)	financing	
Germany	- All energy efficiency sectors	- National and European legislation (key movers) - The European directives	- Numerous associations. - Around 550 companies so far involved with ESCOs - EPC market - increasing energy prices	- 80-85% Energy Supply Contracting (ESC), 8- 10% EPC. - Mainly shared savings model)	- The regulatory framework (the Renewable Energy Act disadvantage of EPC in ownership operation)
United Kingdom	- The industrial sector, public buildings, hospitals, schools, offices, social housing - supply side and networks (district heating), HVAC, control technologies, lighting, and public lighting	- Climate and energy conservation policy. - financial incentives	- Various trade associations - cost and environmental motivations	- The Green Investment Bank - EPC (both shared savings and guaranteed savings)	- High transaction cost because of large contract variation and the lack of standardisation

Source: Compilation by Study Team, 2022.

4.1.3 Challenges in Private Sector (ESCO) Engagement

Understanding the barriers are key to take mitigative action to ensure active ESCO's engagement in EE initiatives. Various barriers encountered during the implementation of ESCOs in different countries which can be attributed to cultural, financial, institutional, and policy barriers (Nurcahyanto, 2017, ACE, 2022a; ACE, 2022b) as illustrated in Table 7. Unbinding the constraints are crucial.

Table 7 ***Key Challenges in ESCOs Implementation***

Challenges	Details
Lack of Information	• Lack of information and understanding of the benefits of EE. • A lack of information, education, and training to build up capacity (MRV, IGAs, negotiating performance contracts) (ACE, 2022a)
Policy	• ESCOs need to be supported by an accreditation system for the customers (ACE, 2022; Nurcahyanto, 2017) • The delayed phase-out of energy subsidies makes an investment into EE unattractive for the private sector as the IRR is too low. Only the Philippines and Singapore have phased out, and Thailand and Indonesia are still in the process (ACE, 2022).

Market Readiness	• Depending on the stage of their development (e.g. Thailand vs Cambodia), the role of markets and competition in the economy (e.g. familiarity with the market practices), • A lack of energy efficiency technologies and infrastructure. EE technologies are fragmented and complex (ACE, 2022a; ACE, 2022b; Nurcahyanto, 2017)
Access to Finance	• The biggest potential customers—governments—have limited finances and cannot provide financing for EE projects in their facilities due to procurement regulations. Also, sometimes the government disfavours ESCOs, as they want to involve more NGOs, academia, or not-for-profit organisations. (ACE,2017; ACE, 2022a, ACE, 2022b) • Lack of financial incentives and Risk of investment (Nurcahyanto, 2017, ACE 2022b) • ESCOs have limited access to EE debt finance due to limited collateral (ACE, 2022a; ACE, 2022b) • Incentives need to be implemented to create an attraction to this investment (ACE, 2022a; ACE, 2022b).

Source: Nurcahyanto, 2017, ACE, 2022a; ACE, 2022b

4.1.4 Innovative initiatives to support ESCOs

Supporting the development of ESCOs is critical and there are various opportunities and innovative initiatives to support ESCOs engagement in EE DSM. Box 1 demonstrates the potential opportunities and case illustration that can provide lessons for ASEAN.

BOX 1: OPPORTUNITIES AND CASES TO SUPPORT ESCOs

Use of Digital Monitoring Technology - New digital technology will push for ESCO markets, digital energy start-ups will reach 64% of all energy start-ups in 2020 (ACE, 2022a).

Financial incentives – (a) Corporate VAT exemption and reduction for ESCOs; (b) The revenue of EPC contracts is exempted for VAT (c) Corporate Income tax is exempted for the first three years of ESCO operation and half for the following three years (d) Transfer of equipment of ESCOs to customers without tax implications

Super-ESCO - It is an entity that is usually backed up by the government to implement EE projects and carry out energy services for public buildings such as universities, schools, public hospitals, and offices (ACE, 2019b).

Case 1: China's ESCO industry has started supporting Global Environment Facilities and the World Bank. From 1992 to 1994, February and the World Bank conducted China's questions and options for greenhouse gas emissions survey and reviewed the potential energy efficiency as much as possible. The China Energy Efficiency Project (CEEP) consisted of two phases. Phases 1 and 2 were conducted from 1998 to 2003 and from 2003 to 2008. Phase 1 included the establishment of three pilot ESCOs, the provision of information, and the creation of NECIDC (NDRC2 Energy Conservation Information Dissemination Centre). (Murakoshi, C and Nakagami, H, 2009). In India, is currently working on a programme energy service limited project, which creates a Super ESCO by the government, who get access to funds to public retrofits such as streetlight and retrofits on buildings (ACE, 2022a).

Linking ESCOs and carbon market - EE was announced as the first fuel before and provided a good return of investment. ESCOS do not feature much on global carbon discussion. Considering the carbon credits as an additional source of incentive for end customers, could increase the demand for EE projects and ESCO support (Ren et al. 2011).

Case 2: Change of the focus in Japan from energy savings to carbon savings (see Figure 2). The Japanese ESCO association (JAESCO) is now working with the Ministry of Environment to change the definition of ESCOs in their law for ESCOs to contribute to the carbon goals of Japan.

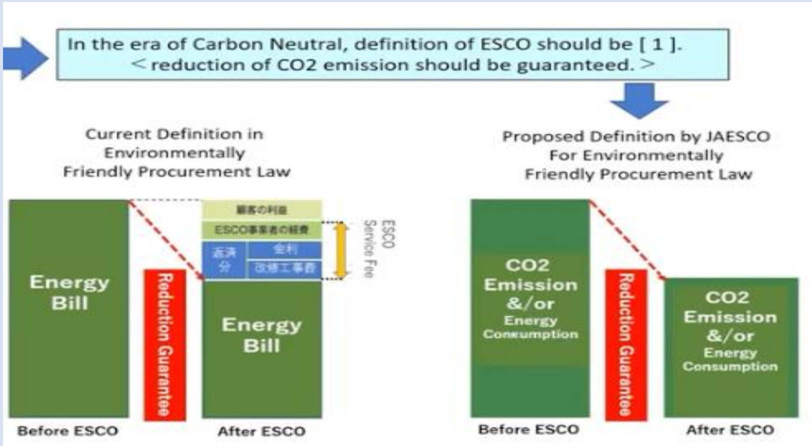

Figure 2 ***Switch from energy savings as a communication tool to carbon savings*** *(ACE, 2022a)*

4.1.5 Policy Recommendations for accelerating Private Sector Engagement (ESCOs)

The initial literature research and an FGD conducted for ASEAN Member States in July 2022 was used to reflect the identified barriers and identify innovative areas of interventions to accelerate the involvement of the private sector (ESCOs). The following recommendations are a summary of this and the literature research:

An **entire ecosystem must be built** to establish and develop the ESCO industry. It needs to be an essential part of any national EE strategy. The IEA sees long-term regulations and targets as crucial for any ESCO market development (ACE, 2022a). International support in developing and emerging countries can support training and understanding How to engage with the private sector. For example, ADB has recently updated its energy policy, and energy efficiency is focused on supporting the transition towards sustainable energy (ADB, 2021). For sustainable energy/climate finance they have increased their budget by 100 billion USD until 2030 (ACE, 2022a). As part of the ecosystem, the following is recommended:

Review and amend EE laws to reduce regulatory barriers and support programmes that require more mandatory action from end-users across different business sizes and sectors. For instance, developed countries like Austria have efficient market policies for SMEs. Also, link climate policy -

NDC- with ESCO support programmes (ACE, 2022a; Nurcahyanto, 2017). Recognise the cross-institutional relevance of central government agencies regarding EE policies. For instance, the Ministry of Trade and Industry can run Programmes on Energy efficiency for strategic industries; the Ministry of Environment can draft environmentally friendly procurement laws; the Ministry of Land, Infrastructure & Transportation can issue operational manuals for procurement regulations that allow for ESCO services in the public sector. Local governments can also lead energy efficiency, as in Japan. Since 1995, the local government has run the Emission reduction programme (ERP), where some prefectural governments give incentives for an EE improvement for climate change mitigation efforts and information on GHG reduction (Yajima & Arimura, 2021)

Supporting activities for an ESCO market, **clients, financial institutions and fund managers** through various government actions (ACE,2017; ACE, 2022a; Nurcahyanto, 2017):

- Facilitate institutionalisation like developing an ESCO association,
- Raising awareness through extensive information campaigns,
- Exchanging best practices,
- Supporting standardisation of EPC contracts,
- Providing training and capacity-building programmes,
- Support for networking events and conferences, ESCO associations and more

Examples: Malaysia has ESCO EPC Awards to raise awareness of EE and ESCO development. China also developed over 200 energy-saving standards and General Technical Rules for Energy Performance Contracting, which are regularly updated. Thailand has conducted a yearly ESCO fair, which rose awareness of the market and its most recent technologies (ACE, 2022a; ACE, 2022b; ACE 2022c).

Training and strengthening the quality of ESCOs by promoting certification schemes CEMS, CMVPs and EE/ESCO professionals, ESCO accreditation and developing industry performance contract templates. It will attract more debt and equity capital (ACE, 2022a; Nurcahyanto, 2017). For instance, between 2016-2020, Malaysia created a grant fund to support energy audits for designated industry sectors via ESCO companies. Participating ESCOs need to be registered with the Energy Commission and fulfil the criteria. Due to its success, the second wave of Energy Audit conditional grant 2.0 was created (ACE, 2022a, ACE 2022b).

Improving public procurement regulations to facilitate domestic and/or overseas ESCO investment, ESCOs may provide better leverage for the potential of key markets in this sector. Supported activities may include capacity-building measures for independent projects and market facilitators, subsidies for preparing investment-grade audits, tenders, feasibility studies, and other activities mediating ESCO and potential clients. Thailand is currently revisiting necessary regulations to engage ESCOs to retrofit government buildings. Vietnam conducted a study focusing on private financing. One of the conclusions was that developing guidelines legal documents and certification procedures for EE services will strengthen the quality of ESCOs (ACE,2017; ACE 2022b; ACE, 2022c).

Leverage finance for ESCOS: On-vs- Off-balance sheets. It requires capacity building of financial institutions as well as establishing the following:

- ESCO performance contracts
- PPP transactions
- Large-scale government programmes

It is also critical to mobilise viability gap funding for EE projects and promote innovative financial products to ESCOs. Enable de-risking mechanisms to banks' lending/leasing into the market via a guaranteed mechanism or insurance products. Currently, insurance products are only available in the United States and the EU. These insurances provide de-risking for long-term EE capital investments (ACE, 2022a, ACE 2022b).

Intensifying ACE Roles to Promote Knowledge Sharing and Knowledge Dissemination. ACE can consider adding EPC projects as a required category for the ASEAN Energy Awards to encourage specific ESCO activities. For example, Lao wondered about the initial steps to promote ESCOs in their countries. Vietnam wanted to learn how to draft EPC regulations from the China and Malay example. Thailand wanted to hear more about the Japanese model of how to link the carbon market with ESCOs. Regional ESCO knowledge exchange could be facilitated via an online platform among ASEAN member states. Overall, the FGD has confirmed that sharing information on best practices and experiences is valuable. (ACE, 2022b).

4.2 EE financing initiatives in ASEAN and Financing Instruments

4.2.1 Current State of EE Financing in ASEAN

To increase financing and investments into EE, the public policy can support three broad categories: 1) EE finance mechanisms, 2) Incentives for EE projects/businesses; 3) Market-based mechanisms. EE financing mechanisms can be categorised into two groups, namely traditional and specialised financing instruments (Table 8). Traditional financing instruments are the conventionally available options, such as publicly supported grants, on-bill financing via public utility, revolving funds guarantees and privately provided depth, leasing, and insurances for providing public financing policy support for EE&C financing. While a more specialised financing instruments can be payment security schemes, e.g. on tax finance, PACE, Crowdfunding, results-based financing (RBF)/voluntary agreements, Carbon Financing, Asset-backed securities (ABS) & revenue bonds, Green bonds, insurance, e.g. energy savings insurance (ESI) and Advanced project, or Energy Performance Contracting (EPC) financing, and energy service agreements that enables EE&C Investments at scale and depth (ACE, 2019, ACE&GIZ, 2019).

Table 8 ***Typology of EE&C Financing Instruments***

Traditional Financing Instruments	Specialised Financing Instrument
Debt, Including Dedicated Credit Lines (Soft Loans)	Payment Security Schemes, e.g., On-bill Repayment, On-Tax Finance, PACE Crowdfunding
Grants, e.g., Project Development Leasing	Results-Based Financing (RBF)/ Carbon Financing Asset-backed Securities (ABS) and Revenue Bonds
Infrastructure, EE, and Revolving Funds, Risk-Sharing Facilities	Green Bonds
Energy Performance Contracting (EPC), Public Energy Service Companies (ESCOs), Energy Service Agreements (ESAs)	New Guarantees and Insurance, e.g., Energy Savings Insurance (ESI).

Source: Burg Capital (2017), Leventis, et al. (2016), Rugova (2016), The World Bank CIF (2013)

EE&C financing instruments can also be seen from a trajectory of public financing to that of commercial financing (see Figure 3) starting from public driven efforts towards more private driven, commercial financing options. However, internationally it is recognised that EE will always need some sort of public support, due to its complexity, small investment amount and not primary pressure due to still-low electricity prices (Streitferdt, 2016).

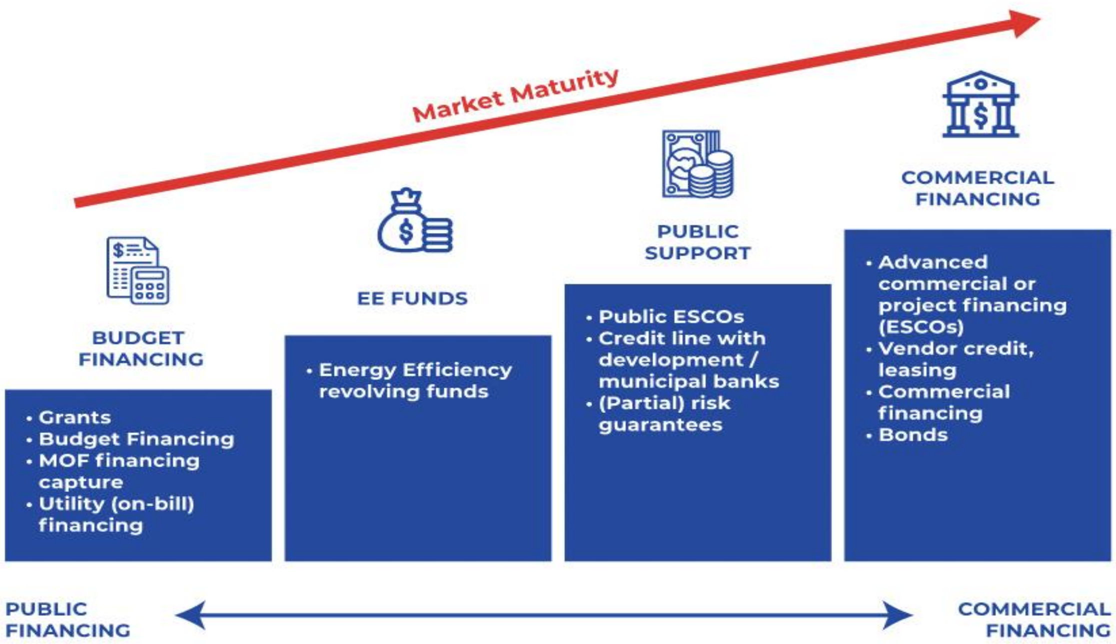

Figure 3 Financing Ladder

Source: (ASEAN, 2019)

Additionally, market-based instruments are another option. Market-based instruments that set a policy framework specifying the outcome to be delivered by market actors, without prescribing the delivery mechanisms and the measures to be used. Various examples of market-based instruments are Energy efficiency obligations (EEOs), energy efficiency resource standards, or white certificates. The idea is that a target for EE is set for a sector/ industry and then the sector /industry can choose how to achieve those targets. Once achieved and verified, financing can be made available for those companies (ADB, 2020). Auction system is another market-based instrument used. It means that actors can submit a bid for implementing an energy efficiency project. It usually contains the amount saved as well as the budget needed. Usually the bid includes 20-40% of the overall project implementation costs. It is a rather new scheme and needs funds raising via different mechanisms such as taxation or levy on energy bills (Sarkare et al. 2020).

AMS has made various progress in EE financing, but the development is uneven (see Table 9). In 2019, the ASEAN Centre for Energy reviewed innovative EE financing mechanisms among ASEAN Member States. Given the different stages of EE framework development, the AMS is split into two groups; Group 1; Cambodia, Lao PDR, and Myanmar, which were still in the process of creating public support for their existing EE regulatory system to create a market for EE and Group 2: Brunei, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam which has had initial public EE finance experiences and plans to attract private sector investments (ACE, 2019). Assessment of the progress of the EE financing by AMS are as follows.

Cambodia

Cambodia is just in the beginning of its EE journey. Due to rising demand for energy, EE management is critical. And the government has started to act by publishing the Energy Efficiency and Conservation Master Plan in 2020 (ERIA, 2020). A 5-year roadmap was developed, and the focus of policies are around the topics of: 1) energy service company (ESCOs); 2) growing of energy managers; 3) Standard and labelling system; 4) education and campaign; and 5) preparation of energy efficiency indicators (EEIs). The Central bank of Cambodia has set policies and guidelines related to environment, social and governance investments (ESG). The central bank has invested into green bonds launched by the Bank for international Settlements (BIS) in 2019.

Lao PDR

Lao PDR has developed a National Green growth Strategy for 2030 which was also supported by the World Bank. So far there are no dedicated EE financing schemes in Lao PDR. Some tax incentives might be utilised for EE&C investments. such as corporate tax holidays of up to 7 years, exemption of import duty and reduced tax rates for larger projects (ADB, 2020).

Myanmar

Myanmar has set national EE targets, such as TFEC 5% by 2020 and 8% until 2030 compared with 2005. Improve overall EE by 20% in all sectors by 2030 (based on 2012 levels. partners. National Energy Efficiency and Conservation Fund covers financial incentives as given below (ACE, 2020):

- Tax incentives for investment in EE technologies and import of energy-efficient appliances
- Subsidies for procurement of EE technologies, energy audits
- Leasing systems for solar home systems
- Revolving fund for community-based energy projects.

Brunei Darussalam

Brunei's national economy is driven by the oil and gas sector. However, the government has started to reduce the electricity subsidies and is currently developing incentive mechanisms to foster energy efficiency conservation. The government is also exploring financial incentives for efficiency in the transport sector to focus on hybrid cars and fuel-efficient vehicles (ASEAN, 2019).

Indonesia

Push from MOF and financial authority to investigate sustainable finance. PT. SMI has been accredited with the green climate fund and has started to implement a transport project. lots of EE finance mechanisms developed, but only with very limited implementation success. Also, in 2019 Indonesia issued a sovereign green sukuk, but so far, no proceeds were particularly utilised for EE finance. The only consistent mechanism to implement EE was the Japanese Carbon Mechanism (JCM) (ACE, 2019).

Malaysia

Malaysia is well advanced with EE finance. Since 2010 Malaysia has had the green technology financing scheme (GTFS), which in 2017 had already implemented 319 projects and all approved ones for EE about 5%. Grant audit programmes supported ESCOs and companies to identify the potential of EE. The EPC fund was introduced in 2019. ESCOs can apply for this. Hospitals and government institutions were implemented. This also provides a guarantee under MDV (ACE, 2022a). SAVE programme provides cash rebates for the purchase of energy-efficient air-conditioner, refrigerator, and chiller. Also, they do have green sukuks more focused on the Private sector (ACE, 2019).

Philippines

UNIDO and GEF supported an industrial 5-year programme in 2014 which also included EE loans, Further, in 2019 the Government of the Philippines Issued the Energy Conservation Act in April 2019 and at the end of 2021 launched the sustainable finance roadmap. Consequently, the Energy Efficiency Savings (E2SAVE) financing Programme was born. DBP was the bank with the most successful implementation of this programme, which allows loan repayment through electricity savings. Discussions are ongoing on how to support the EE market further, via tax incentives or Project Preparation Fund (PPF) (ITSF, 2021).

Singapore

Singapore has a couple of EE finance initiatives that are targeting the industry, household and public-sector. The form is mainly via grant, loan, and tax incentives. Energy efficiency fund and productivity grant provide the customer with grants for energy efficiency projects. An investment allowance can be increased to 30% against taxable income (ACE, 2020).

Thailand

Thailand has had an energy conservation Promotion Act since 2015 and Thailand has implemented the 20/80 and 30/70 subsidy grant, Energy efficiency Revolving Fund (EERF), the ESCO fund (ACE, 2020; ACE, 2022c), The DSM (Bidding) and the Energy Conservation Promotion Fund

(ACE,2022). In 2008, Thailand also has as part of its EEDP the objective to implement an Energy efficiency obligations scheme in the utility sector. However, so far it has not yet been implemented.

Vietnam

Vietnam has passed the law on energy efficiency and conservation. Further they have tax incentives via the investment law and enabled EPC contracts via the Civil Code Law which enables asset owners to pay services via fees. (ACE, 2022c)

Table 9 ***EE&C Financing Schemes in the ASEAN Member States***

Country	Traditional			Emerging				Incent-ives	Market-based Mechanisms
	EE Grants	EE Loans	EE leasing	Dedicated EE Guarantee	Green Bond/ Sukuk	Carbon Financing	ESCO (EPC) Financing	Incentives	Market-mechanism
Group 1									
Cambodia					Yes				
Lao PDR	Yes							Yes	
Myanmar								Yes	
Brunei Darussalam								Yes (develop-ing)	
Group 2									
Indonesia	Yes				Yes	Yes (JCM)			
Malaysia	Yes	Yes		Yes	Yes		Yes	rebates	
Philippines	Yes				Yes		Yes		
Singapore	Yes	Yes	Yes		Yes	Yes		Yes	
Thailand	Yes	Yes	Yes	Yes	Yes	Yes (VEET)			V-ETS
Vietnam	Yes					Yes			

Sources: ERIA (2016), IEA (2018a; 2017), 5th ASEAN Energy Outlook 2017, World Bank 2021

4.2.2 Challenges of EE financing in ASEAN

Supportive EE financial instruments such as grants, loans, tax rebates, direct tax deductions, and exemptions are critical. However, the challenges of such approach are that they rely on the government's budget. Equally important, in the longer term, is to increase private sector investment. In ASEAN, the identified barriers in EE financing covers a broad spectrum. A conducive policy side and capacity of the financial institutions and project providers are some critical areas to overcome. Table 10 illustrates the critical barriers for EE financing.

Table 10 ***Challenges in EE Financing***

Barrier	Description	Mitigation	Reference
Lack of information	On EE reference projects, reliable report for EE projects	• Public data managements • Capacity building of developers for project pipeline • Information dissemination • Technology benchmarking	(APEC, 2017; ADB 2020)
EE projects are too small	Transaction costs are too high compared to project volume;	Aggregation; escalate	(APEC, 2017)
Lack of Capacity	ESCOs lack quality, Public sector does not understand ESCOs concept and financial institutions perceive the risks of ESCO funding as too high as the project is too small to get the financing	Certified energy auditors, Launch an energy audit support programme	(ADB, 2020; ASEAN,2020)
Lack of incentives	No incentives or disincentives for ESCOs, for the required capital and relevant financial service providers which makes it challenging to	Build incentive incentives from tax exemptions, tax reductions, on-bill repayment	(ADB, 2020)
Lack of project pipeline	Project are not trusted by financial institutions	Capacity of the EE project developers regarding project pipeline preparation	(APEC, 2017)
Dominance of fossil fuels	Heavily depending on fossil fuels limits the penetration of renewable energy	Diversification and energy security	(Industrial Energy Accelerator, 2019)

Source: Compilation by Study Team, 2022.

Critically, review of literature also suggested critical barriers to investment in EE that relates to lack of policy measures, lack of project pipeline, lack of information, limited ESCOs capacity to create bankable projects and others. The following further illustrates the barriers.

i. Lack of Coherent Policy Measures

Dependence on fossil fuels, which still dominates the energy mix in ASEAN, makes it challenging to prioritise energy efficiency in policy planning. The lack of fossil fuel subsidies leads to lower energy prices and hampers investment in EE projects (APEC, 2017). Meanwhile, to push the green energy mix, most of the governments in ASEAN are prioritising infrastructure and small-scale RE projects over EE projects (ACE, 2019a). With limited policies and mechanisms and mandatory mechanisms to encourage the adoption of energy-efficient technologies, advancement in energy efficiency is unlikely. Also, the uncertainty regarding the enforcement of policies makes the private sector hesitant to implement energy efficiency (ACE, 2019a). Missing energy management programmes further cause that there is no pressure on the private sector to invest into energy efficiency (ADB, 2020; Liu, Y. and R. Noor, 2020). The lack of incentives for EE service providers and financial institutions makes it challenging to invest in EE (ADB, 2020). Instead of focusing on mandatory measures and incentives, the policies are focused on voluntary activities, awareness, and capacity-building programmes (Liu, Y. and R. Noor, 2020). Therefore, it is crucial to implement a fleet of policy measures that can promote energy efficiency and thus induce the need for energy efficiency investments in the public and private sector (ACE,2019a).

ii. Lack of project pipeline

The limited project pipeline development and bundling of EE projects by the EE consultants and project developers is one of the challenges for EE finance (APEC, 2017). The private sector is not providing enough evidence to financial institutions that the project amount and sizes can be attractive for financing. The missing project pipeline hinders commercial banks from being interested to provide EE finance (APEC,2017).

iii. Lack of information

There are not enough EE project references, so proper risk assessments by financial institutions are challenged. With the lack of access to reliable knowledge of how EE technologies perform and whether energy savings can be achieved limit the confidence to invest into EE technologies (ACE,2019a; APEC, 2017; Liu, Y. and R. Noor, 2020).

iv. ESCOs lack capacity to create bankable projects

ESCOs often cannot develop bankable projects or convincing project proposals. In ASEAN, there needs to be more certified energy auditors and energy savings managers as staff members of ESCOS (ADB, 2020). ESCOs often lack the skills and knowledge needed to convince the CEOs of property companies that EE investments are an important business area (ADB, 2020). Domestic ESCO companies have difficulties with balance sheets and with access to finance. Most ESCOs are rather young companies which lack a track record of lending, which make them risky customers for banks (ADB, 2020; APEC, 2017). The lack of a public/private finance mechanism increases banks' risks of investing in EE projects and project developers.

v. Financial characteristics of EE projects

The current ASEAN finance market, as well as the nature of EE projects make large scale financing for EE difficult. The financial system in ASEAN seems to prioritise short-term lending rather than long-term investments. Most of the ASEAN economic systems are either held in hard cash or deposits, making it easier for bank lending to dominate over investment funding (ADB, 2020; Liu, Y. and R. Noor, 2020). Due to the small size of EE projects, the finance sector finds them unattractive and necessitates aggregation (ADB, 2020). Usually, the customer requires IRR of 20%, which is challenging for many EE projects (ACE, 2019a). The risk of an EE project is that EE financing requires

a different approach, as funding comes from "invisible" resource savings and a lack of knowledge about EE technology. (ADB, 2020).
In general, the role of finance to promote EE has been recognised by AMS and EE financing instruments can only be useful once demand from the private sector has been created in a country to implement EE and thus necessitate financing. Therefore, implemented financing policy and instruments should be linked to:

- EE regulations (EE targets, rating systems and Minimum Energy Performance Standard (MEPS), reduce fossil fuel prices)
- Finance sector (diversity of financial institutions)
- Political drive/will
- International support and financing efforts

4.2.3 Innovative EE financing Framework and Mechanism- Case Studies and Lessons Learned

Box 2, 3 and 4 illustrates few of the innovative EE financing framework and mechanism for promoting EE as well as key lessons from such cases.

BOX 2: EE FINANCING FRAMEWORK AND MECHANISM

Policy Initiatives - Setting up enabling framework conditions

Not only the framework conditions in the electricity sector but also in the financial sector and structural relationships have been recognised as important to create a conducive environment for EE finance and also point towards which mechanisms might be appropriate given the current framework conditions (Streitferdt, 2017). Three important sectors need to be analysed: 1) The electricity sector, with regulations/targets and capacity; 2) Financial sector with regulations to support sustainable finance and the availability of capital; and 3) Deep structural relationships and external events, e.g. int. conferences, development aid support or other transregional treaties. Some examples of enabling framework conditions are:

Electricity sector:

- no subsidies
- enforced EE regulations and targets

Financial sector:

- Provide instructions to banks to support green/sustainable finance.
- Ensure public procurement can be aligned with private sector engagements (e.g. ESCOs).

Deep structural relationships and external events

- List the international organisations active in the EE sector in your country
- identify which political push currently exists (e.g. for public or private sector initiatives)

Example: Indonesia: OJK 50/2017 SR for financial institutions, risks and green financing sustainable finance roadmap.

Online platforms that facilitate matchmaking between public and private

Cleaner Energy Future Initiative for ASEAN (CEFIA)
Examples: ESCOs can pitch their EPC contract on China asset transaction platform based on EPC assets (ACE, 2022).

Voluntary Agreements - Volunteer companies set specific emission reduction targets and, upon their achievement, receive some tax breaks or discount rates from the government.

Support companies to recognise EE's benefits on their bills and operators. Three design elements are essential: 1) Effectively enforceable incentives and Penalties, 2) robust monitoring and evaluation mechanism and three ambitious and realistic targets. Transparency is also essential. (Kim, J.W. & Liu, Y. 2021)

Examples:
Climate Change Agreements (CCAs) in the United Kingdom. If companies set targets and achieve them, they would receive an 80% discount on the newly introduced Climate Change Levy (CCL). In China the Top-1000 Industrial Energy Conservation Programme which made agreements between government and large-scale enterprises in energy intensive industries to reduce energy consumption. Government supported with audits, knowledge about advanced technologies (Sarker et al., 2020).

Market-based instruments/ Carbon Market - A carbon price has been praised internationally for reducing energy intensity in many countries.

Examples:
The National Development and Reform Commission started a pilot programme of emission trading in Beijing and six other provinces. In 2014, the seven pilot regions had trading quotas of 30.53 Mt of CO2 and a turnover of CNY814 million (Sarker et al., 2020).

Energy Saving Certification and Investments - 'Perform, Achieve and Trade' is an energy-savings certificates programme of India which has been in operation since 2011. It started with 400 energy - intensive firms, known as 'designated consumers' and reduced their consumption by 9,4%. Each certificate is equal to 1 ton of oil equivalent to energy savings (Sarker et al. 2020). It is critical to simplifying the bidding process and bundling many small projects. (Murakoshi, C and Nakagami, H, 2009)

Lessons learned:
Burden on the industry could be curtailed by introducing tax exemption in parallel. For example, in Sweden the manufacturing industry only pays 50% of the tax rate (Sarkar et al., 2020). Also, EEOs sometimes cause high costs of monitoring, administrative costs, and information dissemination to get enough participation (Sarkar et al. 2020). As it is a rather new mechanism, auction schemes still need to be evaluated. One of the recommendations is to reduce the administrative burden in order to broaden participation (Sarkar et al. 2020).

Energy Efficiency de-risking schemes - An EE savings insurance provides the security for banks that the applied technology will perform and thus secure the repayments of the loans provided to SMEs/ESCOs. Instead of insurance also, a supported public guarantee can do the same. In this case, it is a credit guarantee provided to banks by state-owned financial institutions.

Examples:
Mexico is supported by the inter-American Development Bank. Other areas are Morocco and run a Europe wide campaign (BASE, 2022). The Thai Credit Cooperation provides a guarantee for EE investments for SMEs and is currently in development to improve the scheme. Other countries that have voiced interest in developing are Indonesia and Malaysia (ACE, 2019). The Partial Risk Guarantee

fund for Energy Efficiency in India has provided a 50% guarantee of loan amounts for EE projects for private and government buildings. So far five financial institutions participate (Sarker et al., 2020). China has also implemented guarantee system introduced in China is one way to reduce the credit risk borne by financial companies (Murakoshi, C and Nakagami, H, 2009).

Lessons learned: The fees and technology choices need to be adapted to the local context. Technical assistance is required to build capacity for insurance/state-owned companies and technology providers. The payback needs to be synchronised with the financial terms for loans (ACE, 2019).

BOX 3: FINANCING TOOLS - CARBON MARKET AND GREEN BONDS/SUKUKS

Market-based instruments/ Carbon Market - A carbon price has been praised internationally for reducing energy intensity in many countries.

Examples:

The National Development and Reform Commission started a pilot programme of emission trading in Beijing and six other provinces. In 2014, the seven pilot regions had trading quotas of 30.53 Mt of CO2 and a turnover of CNY814 million (Sarker et al., 2020).

Green bond Sukuks for energy efficiency in buildings - green bond proceeds have already been channelled for green buildings in ASEAN. So green bond issuance in ASEAN is still minimal (1-2%) compared to the rest of the world. Institutional support is vital, especially in Singapore, Malaysia, and Indonesia. Between 2017-2019, the largest issuer was Indonesia with 49%, followed by Singapore (19%), Malaysia (15%), Thailand (9%) and the Philippines (9%) and 36% were issued for green buildings. Green Sukuk are green Islamic financial certificates that function similarly to green bonds and are gaining popularity in Indonesia and Malaysia (Climate Bond Initiative, 2019). Green buildings are seen as covering niches. Green buildings are usually too risky for bank lenders, but developers and investors share the risks in bonds or Sukuk projects. The long-term nature of maturity makes it also interesting as a source of finance.

Examples: Malaysia established its green building Index (GBI) in 2009 and Green Mark, a private sector-led green building code for large buildings, in 2005. The development bank of Singapore issued 2017 the green bond Framework, a five-page document outlining criteria for green projects and reporting guidelines. In 2017, Permodalan Nasional Berhad (PNB) issued a green sukuk to fund the 118-storey Merdeka PNB118 Tower, a green mixed-use building. Green features include chilled water energy storage, solar panels, daylight sensors, tenant submetering, and energy-efficient lighting (PNB, 2017). China also encourages its ESCOs to issue green bonds, and grants are available for the bond issuance process (ACE, 2022a).

Lesson learned: An established bond market and green building schemes are prerequisites for launching green bonds for green buildings. External verification (e.g. Climate Bond Initiative) can help raise the bond's attractiveness. Sometimes the tenor of green bonds must be aligned with the private sector or local government financing terms. Thus, guidelines from MOF should be developed jointly with the users of green bonds, namely the private sector and local governments. Facilitating demand-side financing by linking the funding and the specific initiatives would accelerate the EE DSM.

BOX 4: EE FINANCING FOR SERVICE MODELS

For the service model to work, it's essential to make sure the potential service providers have access to finance (refer to Figure 4).

Energy Performance Contract-based finance - Especially ESCOs have difficulty accessing finance, due to small collateral and often short-lived track record. EPC funds and equipment leasing are necessary aggregation models. Three current innovations in ASEAN to observe:

In Malaysia, in 2019 the **EPC fund was implemented**, which focused on ESCO finance from a project financing perspective coupled with a guarantee for the financial institution. The 50 Mio. USD fund was provided by Malaysia debt ventures Bhd, a subsidiary of the Ministry of Finance (MOF) and supported by a credit guarantee fund from the Ministry of Finance and Global Environment Facility (GEF) (ACE, 2022a). The fund is used for retrofits in hospitals and the government sector.

In the Philippines, the **Energy Efficiency Savings (E2SAVE) financing Programme** allows repayment of the loan via energy savings and lessens the requirement of collateral. Further, a new programme was launched that identified a Third-Party investor and created a facility for EE investments via ESCOs, called **Climargy** (ACE, 2022a). Third-party investors could be Special purpose vehicles, Equity providers, government funds, Super ESOC, State-owned enterprises, or private portfolio investors. It's an aggregation model

The **lesson learned** is that of government buildings are supposed to be targeted, procurement regulations and standard templates are important (ACE, 2022a)

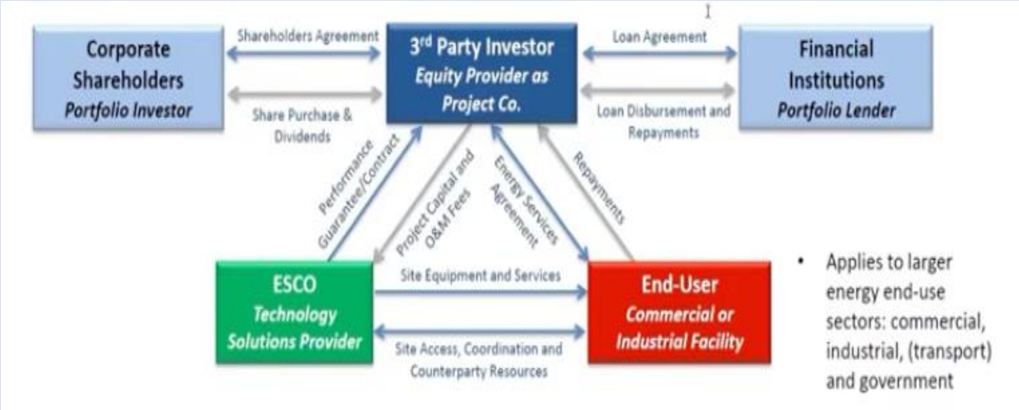

Figure 4 Third party investor EE finance model

Public-Private Partnerships for public infrastructure - Promotion of transition from the low-bid approach in infrastructure procurement towards evaluating life cycle costs is recommended.

Example: Experiences have been in Tacloban City, Leyte, where 3,603 LEDs were exchanged by private companies and paid back over time by the city government (ASEAN, 2019). Efforts are also ongoing in Indonesia, e.g. Denpasar city.

In China Energy Performance Contracts (EPSCs) provided ESCOS with initial management of EE projects and finance for the firms and mitigated the high perceived risks of upfront costs (Sarker et al, 2020).

Lessons learned: The PPP mechanism might be more costly than direct public procurement (Petersen, 2019). However, the private sector might be better in implementation due to their technical expertise, and local governments can access the funding they otherwise could not access.

4.2.4 Policy Recommendations to accelerate EE finance in ASEAN

Policies - Given the multiple areas of policies (energy price, customers, demand from the industry as well as incentives) it is crucial to implement a fleet of policy measures that can promote energy efficiency and thus induce the need for energy efficiency investments in the public and private sector (ACE,2019a).

Project pipeline /trust between ESCOs and financial institutions - The public might have to step in to demonstrate the market to commercial lenders. Also, building the capacity of the EE project developers regarding project pipeline preparations and bundling to make the projects attractive to commercial bank, is needed (APEC,2017). Dialogue between the financial institutions and project developers on case studies of ESCO projects and discuss financial institutions' concerns could facilitate further the capacity building of ESCOs/ project developers in ASEAN (ACE,2019a & APEC, 2017).

Disseminate information on EE technologies and projects - Technology benchmarking is essential to create knowledge on reliable energy-efficient technology for building owners and financial institutions (APEC, 2017). Moreover, improving the data collection by building big data analytics on energy consumption, creating energy efficiency products standardisation, evaluating building codes for the necessary climate buildings, and establishing maximum energy consumption standards of the facilities that are publicly available could mitigate this barrier (ACE, 2019a). The availability of information for the EE project will make it easier for financial institutions to assess its feasibility of the EE project.

Characteristic of EE finance demand for more innovative financing mechanisms - AMS can adopt other specialised financing instruments which take the EE project properties into consideration such as property assessed clean energy (PACE) financing, credit enhancement, and on-bill repayment schemes. Therefore, some public/private mechanism as well as de-risking mechanisms would be useful to build trust between ESCOs and financial institutions.

The **Focus Group Discussion** also indicated that **ACE could further facilitate in knowledge exchange and push other agencies to support EE finance efforts (e.g. AFMM).** There is a need for Group 1 countries to learn from Group 2 countries. For instance, Lao indicated the need to learn from the Thai ENCON Fund. Vietnam required concrete regulations on private financing and learning from the experience in China and Malaysia can provide innovative solutions. Also, the request for future action going beyond a study is to enable knowledge exchange via workshops. Another input was that ACE could collaborate with the ASEAN Finance Minister Meeting (AFMM) to promote regulations via central banks to foster sustainable and specific energy efficiency finance. Finally, sharing experiences of lessons learned with more innovative financing mechanisms such as green bonds or the PPP mechanism could benefit all AMS (ACE, 2022b; ACE, 2022c)

4.3 Developing green building codes which support the use of high energy efficient products.

Regional cooperation has been present in the past few decades fuelled by ASEAN dialogue countries and is further boosted by the building of ASEAN Economic Community. During the few decades, ASEAN EE&C cooperation programme has indicated that the programme is progressing according to the plan. Most of the action line and activities have improved energy efficiency of energy end-users. Specifically, energy efficiency programmes have been directed toward increasing energy efficiency in residential and commercial buildings, as well as toward increasing energy efficient appliances. These policies and programmes by the EE&C-SSN have successfully raised awareness and educated the market on the benefits of implementing energy efficiency activities. These efforts have led to the reduction of energy intensity to 23% in 2018, based on 2005 levels, keep the region on track towards its long-term target to achieve 32% EI reduction by 2025 under the APAEC 2016-2015.

The development of energy efficiencies in ASEAN members, in terms of sectoral goals, action plan, policy measures, activities, and achievements, however, are in different stages of maturity, with some having done extremely well to adopt energy efficient building design to economies who have yet to start on the journey., which offer opportunities for regional cooperation. Good practice in some ASEAN members in the areas of goals, policy instruments for building, standards, labelling, and financing offers lessons for the others as highlighted in this chapter.

4.3.1 Current State of Buildings and Code Standards in ASEAN

According to the Roadmap for Energy-Efficient Buildings and Construction in ASEAN, buildings account for about 23% of total final energy consumption and energy-related CO2 emissions in ASEAN. With continued economic development, urbanisation and population growth across the region, ASEAN's building energy consumption is expected to grow by around 60% by 2030 and by 120% by 2040. Therefore, the building sector poses a tremendous opportunity in addressing energy demand challenge and climate change issue, with the potential to significantly reduce carbon emissions and attain net-zero carbon targets. The lowest cost and fastest way to reduce energy demand in buildings can be achieved by implementing building energy codes, which provide clear standards for constructed buildings. Stringent energy requirements and the approach used in the design of building energy codes will lead to enormous energy savings potential and reduce emissions, aligning with the regional target set under the APAEC to reduce EI by 32% in 2025 based on the 2005 level.

Some AMS have been successfully implemented Building Codes on a mandatory or voluntary basis. Countries such as Singapore and the Philippines impose building codes in mandatory basis for all type of buildings whilst Thailand enacts mandatory building codes for new commercial buildings, whereas Indonesia has implemented mandatory building codes in commercial buildings on a provincial level, with Jakarta and Bandung are the front runners. For Brunei Darussalam, Malaysia, Vietnam, Myanmar are currently implementing their building codes in voluntary standard. AMS who has yet developed building codes are Cambodia and Lao PDR, however, they are currently underway in developing the standards. Table 11 below provides an overview and status of building codes which being adopted by AMS.

Table 11 Overview and status of building codes in ASEAN[12]

Country	Building Codes	State of Enforcement
 **Brunei Darussalam**	Ministry of Development PBD 12:2017, with input from the Public Works Department, Town and Country Planning Department, Ministry of Health, Fire and Rescue Department, Ministry of Home Affairs. EE&C Guidelines: the target to reduce energy intensity by 45% by 2035 with 2015 baseline through building guidelines for non-residential sector among other measure.	In force
 **Cambodia**	Ministry of Development with Cambodia Ministry of Energy and Industry launched the Construction Law in November 2019 which determines the guiding principles for the regulatory framework of the construction sector. The development of technical building regulations will follow in the coming years	In force
 **Indonesia**	Government Regulation No. 36/2005: mandatory for new buildings above 5 000 m² (commercial) and 500 m² (residential), but not strictly enforced. Government Regulation No.16/2021 on Buildings defines the function and classification of buildings, technical standards, building implementation, administrative sanctions, the role of community and capacity building. Government Regulation No. 21/2021 on the Assessment of Green Building Performance with mandatory energy efficiency for defined building types. National Energy Efficiency Standard for Buildings (updated 2020): covering energy conservation measures for building envelope, air conditioning system, lighting system and energy audit procedures for buildings (SNI 6389:2020). Local Building energy codes are mandatory in Jakarta, Bandung, and Semarang, in development in Surabaya.	In force
 **Lao PDR**	Proposals to develop policies for building codes covering fabric, heating/cooling systems and lighting and appliances (In development)	*Pending*

[12] IEA (2022), Roadmap for Energy-Efficient Buildings and Construction in the Association of Southeast Asian Nations, IEA, Paris https://www.iea.org/reports/roadmap-for-energy-efficient-buildings-and-construction-in-the-association-of-southeast-asian-nations

 **Malaysia**	Code of Practice Use of Energy Efficiency and Renewable Energy for Buildings: Voluntary for residential (MS2680) and non-residential (MS1525). Voluntary standards for residential, Mandatory for non-residential (for those > 4000 m2)	In force
 **Myanmar**	In development, as a Green Building chapter in Myanmar National Building Code (MNBC).14 Adopted on voluntary basis by one city (Yangon), EE&C Guidelines being developed by the Ministry of Information.	*Pending*
 **Philippines**	Philippines Green Building Code (mandatory): seeks to improve the efficiency of building performance through a framework of standards.	In force
 **Singapore**	Code for Environmental Sustainability of Buildings 3rd Edition (2012) - Mandatory for all sectors.	In force
 **Thailand**	Building Energy Code (BEC) for new buildings; Mandatory for nine types of buildings with area larger than 2 000 m2. Ministerial Regulation Prescribing Type or Size of Building and Standard, Criteria and Procedure in Designing Building for Energy Conservation B.E. 2563 (2020).	In force
 **Viet Nam**	The Viet Nam Energy Efficiency Building Code (QCVN 09: 2013/ BXD) developed as the national technical guide on energy efficiency for buildings. Energy Efficiency Building Code (EEBC) developed in 2013. Voluntary for large buildings (all sectors). Development for high rise, commercial and residential buildings ongoing.	In force

According to the mapping study[13], while some AMS have clearly defined policies, laws, rules, regulations, codes, and incentive schemes, others are still in the planning stages. The figure below provides an overview stakeholder mapping related to buildings including building and energy ministries and Green Building Councils in each AMS.

[13] ASEAN Centre for Energy. (2018). Mapping of Green Building Codes and Building Energy Efficiency in ASEAN: Towards Guidelines on ASEAN Green Building Codes. [online] Available at: https://aseanenergy.org/report-on-mapping-of-green-building-codes-and-building-energy-efficiency-in-asean-towards-guidelines-on-asean-green-building-codes/ [Accessed 22 Jul. 2022].

Figure 5 Green Building Stakeholder's Map

Green building codes and rating tools were adopted in Singapore as early as 2005, Malaysia in 2008, the Philippines in 2009, Indonesia in 2010, Vietnam in 2010, Thailand in 2012, and Brunei Darussalam in 2016.

ASEAN has several models for administering national green building certifications, including Green Building Councils in Indonesia, Thailand, and Vietnam; government agencies such as the BCA in Singapore and the Ministry of Development-Public Works Department in Brunei; and private organizations (PAM and ACEM) in Malaysia supported by the Malaysia Green Building Confederation. Regardless of how the GBC and EE standards are administered in AMS, all the associated energy codes (Brunei, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) are controlled by governmental bodies, even if the certification is run by a private organisation.

Certification of Singapore's BCA Green Mark is mandatory for all new buildings and for major retrofitted buildings to achieve different levels of certification. In Brunei Darussalam, while the green building rating tool is a requirement for government buildings, it is voluntary for commercial buildings. In Malaysia, The Philippines, Thailand and Vietnam, the green building certification is carried out on a voluntary basis. Indonesia (in Jakarta and Bandung) has a Green Building Code in addition to their voluntary green building rating tool. However, these codes have yet to be fully enforced by government and is used as reference to the national building code.

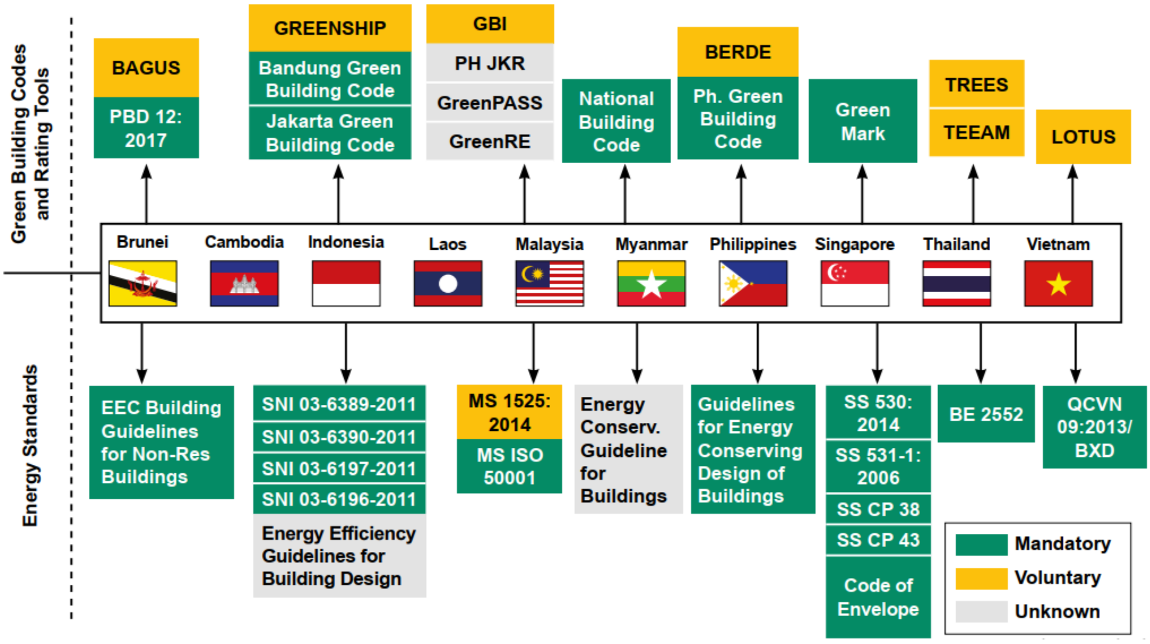

Figure 6 National Green Building Standards /associated Energy Code

4.3.2 Challenges of Building Codes and Standards in ASEAN

In general, the implementation of energy efficiency (EE) in buildings faces several challenges, such as two or more codes being in existence for EE in buildings and Green Building Codes (GBC). The codes are often not updated regularly. ASHRAE 90.1 has been revised 5 times since 2000 (once every 3 years on average), some ASEAN codes' last revision date back more than 8 years.

Countries like Singapore and Thailand have implemented measures that overcome most of the identified challenges. Brunei, Indonesia, Malaysia, Philippines, and Vietnam are at an advanced stage of implementing EE in their respective building sectors whereas Cambodia, Myanmar and Lao PDR are yet to put suitable mechanisms in place. The barriers have been categories into policy, technical, and financial barriers.

Policy barriers

- **Stakeholder engagement**
  The building sector is complex as it involves two or more Ministries and their departments dealing with several topics such as building construction and approval, and energy utilisation among others. Often various government ministries and departments do not communicate on the common issues (building construction, EE & financing measures). The collection of relevant information such as building energy demand and usage is under the jurisdiction of local government. However, policies are generally made at a federal level and often these are not implemented at local level due to priorities by provincial or state governments. Building law being under local government is often difficult for data collection. Non-availability of centralised institutions within the Ministries that deal with the building sector, energy sector, and financing of EE measures are considered as challenges that should be overcome.

Moreover, policies, codes and other relevant regulations are developed by the Ministries with limited or minimal consultation from other stakeholders. Therefore, feedback from project developers, financing institutions, and users is not well-received and addressed. Codes that promote EE developed by private institutions and associations such as Energy Service Companies (ESCOs) and Green Building Councils often have different focus areas and approaches compared to similar Codes from the Government. This leads to limited success and implementation of such measures.

- **Complementary policies/laws/regulations**

  A lack of legal and regulatory measures in some AMS hinders the implementation of EE measures in the building sector, and professionals working in the sector. The regulatory framework is often not backed up by laws to mandate building owners or project developers through incentives or penalties on performance of building as a whole or at equipment level.

Financial barriers

High initial cost of energy-efficient technology makes it unattractive for investors; lack of financing and incentive schemes and difficulties accessing them further prevent investment in EE, in the building sector. Commercial banks do not find the sector attractive due to the non-existence of schemes in some AMS; mandatory compliance to EE targets in the building sector is impacted by the unavailability of financing schemes and mechanisms. EE investments are limited due to a lack of buy-in from top management or building owners. EE measures compete with cheaper and subsidised fossil fuel, making it challenging for the top-management to decide in favour of EE measures in buildings.

The low energy prices and subsidised fuel prices make the implementation of EE difficult as the return on investment of capital investments will be over a longer period. Some AMS lack the necessary laws that focus on EE and road maps to reduce subsidies on fossil-fuel based energy.

Technical barriers

- **Low EE measure and passive building design strategies**

  The BEC applied at the initial stage of building design and implemented during building construction is not common in most of the AMS; focus on EE in buildings from the beginning of design and construction phase. The absence and non-availability of codes and lack of monitoring mechanisms of implementation of EE measures during and after the construction phase, result in lower EE.

  In some of the AMS, the Building Energy Codes and GBC have limited information on passive building design strategies. Often EE measures for the active energy systems are considered while passive design features using natural resources to optimise the use of solar and wind power are ignored. Limited consideration for passive features and alternatives in building design, and increased reliance on active equipment and systems, limits the overall energy consumption in the building.

- **Measurement, Reporting and Verification (MRV)**

  An institution or centralised body that undertake necessary audits for EE measures are often non-existent or lack the competency and tools to monitor, verify and audit measures taken in designated buildings. In their absence the real impact of the implementation of EE measures becomes challenging. These are further affected by unclear rating systems and time frames for such measures. The authenticity of data collected is often not cross-checked and verified.

The unavailability of certified energy auditors' results in inaccurate data collection, analysis, and recommendation of improvement opportunities and ultimately the passing-on, of the incentive or certification. Often, standard operating procedures are not followed or are missing, and this affects monitoring and evaluation of EE implementation and related certification, incentives, or penalties.

Most countries lack the implementation of EE measures in buildings that do not comply with codes and standards. A mechanism to penalise such projects is often missing. Not all the ASEAN EEC/GBC have implemented the MRV as part of the EEC fundamental. Including the MRV system will ensure that the building will meet the expectations and requirements beyond the first day of occupancy. In the case of building measures existing, they cover mostly mechanical and electrical systems, and aspects such as occupancy. Occupancy-based control systems are often not implemented.

- **Limited skilled manpower**

  Often EE measures are not implemented according to standard procedures due to the inadequacy of skilled manpower. Skilled manpower is often scarce due to insufficient training undertaken and institutions that offer such courses. Implementation of EE measures such as building management systems, green building ratings, ISO 50001 are impacted by the insufficient numbers of experienced and certified energy auditors and energy managers. Lack of skilled manpower to implement various codes and guidelines for increasing EE in the buildings sector impedes the implementation of EE in building codes even if the country has policies in place to promote EE in buildings.

- **Limited scope of the building Energy Efficiency codes and standards**
  The existing codes for improving energy efficiency in buildings in ASEAN Member States do not cover a large range of equipment but apply to selected technology, approaches, or systems. This selective approach makes it challenging to implement overall EE measures in buildings. It was observed that some energy-related systems such as sub-metering, lifts, renewable energy operation and maintenance, and total building energy use are still underestimated or missing in several AMS even though they are considered as standard items in most international standards like ASHRAE.

- **Unclear support of digital technology adoption for building energy management**
  Lack of government support in developing guidelines or other supporting documents to promote standards or criteria for digital technology adoption (e.g., building energy management system/BEMS) in buildings. Uncertain directions have a negative impact on market development and building owner engagement in the implementation of EE measures through digital technology implementation. Society will continue to be unaware of the untapped benefits of digitalisation in buildings which can also benefit for demand-side management.

4.3.3 Cost Effectiveness on Sustainable Building and Cooling, including case study and Lesson learned

The energy efficiency performance of buildings is typically measured by the energy intensity metric typically expressed in kWh/m2/year. This metric while may still have gaps (does not account for occupancy) is still used widely due to its simplicity. kWh/m2/year is often mentioned in building energy codes as well. Building codes are used in most countries to dictate the minimum functional requirements of a building in all jurisdictions, developers often use these guidelines to subsequently dictate the design requirements according to the product and market type that they intend to develop.

Since buildings are essentially enclosures made from a variety of materials to achieve a set of indoor environment, engineers and architects in adherence and compliance with these minimal requirements will produce designs that yield a certain kWh/m2/year.

Minimal functional requirements which are set against specific technical performance criteria can be improved to yield a design with lower kWh/m2/year. The increase in technical specification most often than not causes an increase in construction cost. A simple way to explain this is through the illustration of inverter air cooled split unit air conditioning. Inverter air conditioning due to the lower volumes at the onset and use of more electronics in the manufacture will often need to be priced higher. While increases in volume will drive down cost to eventually reach parity of the existing baseline, subsequent changes in the definition of what is deemed energy efficient will create an endless loop of products of higher efficient to be priced higher up to the point of when we reach near net zero buildings.

Developers and policy makers therefore have a tough time managing the economics of projects while at the same time ensuring that due consideration is made to the environment. The following are claims of green buildings:

Green buildings have been shown to save money through reduced energy and water use and lower long-term operations and maintenance costs. Energy savings in green buildings typically exceed any design and construction cost premiums within a reasonable payback period. The caveat here is that there still requires for an investment to be made for the promise of future savings because for green buildings to achieve their predicted performance, high-performing green buildings need to be backed up by robust commissioning, effective management, and collaboration between owners and compliant tenants.

Some will argue that such arguments can lead to detractors from building energy efficient buildings however many forget that buildings unlike a computer cannot be replace easily and once a building is completed it will be unlikely to be demolished for at least the next 30-50 years. With such detrimental lock in consequences, the need to be energy efficient must be outweighed and incentivized.

How sustainable buildings contribute to improve Asset Value

Japan’s CASBEE rating tool for property appraisal which was launched in 2010 provided some guidance on the impact of green building design measures on property value. It was the only attempt worldwide to bridge the green building construction industry and the property appraisal industry

Using a net income approach to derive a higher valuation, energy efficient buildings have the advantage of lower operational expenditure which often translate to a higher net income produced by the property. Green or energy efficient buildings are often constructed with better materials are likely to be able to endure more environmental risks. As the materials and equipment used in the building would be of a higher specification, depreciation risks would also be lower.

A summary of the common green building tool assessment criteria that impacts building valuation is listed in table 12 below.

Table 12 Common Green Building Tool

CASBEE assessment items	Property appraisal items			
	Increased total revenue	Reduced costs	Reduced risks	Improved image
Q1-1 Noise & Acoustics	○			
Q1-2 Thermal Comfort	○			
Q1-3 Lighting & Illumination	○			
Q1-4 Air Quality	○			
Q2-1 Service Ability		○	○	
Q2-2 Durability &Reliability		○	○	
Q2-3 Flexibility & Adaptability		○	○	
Q3 Outdoor Environment on Site				○
L1 Energy		○	○	
L2 Resource & Material			○	
L3 Off-site Environment			○	
CASBEE Ranking				○

4.3.4 Policy Recommendations

Addressing associated challenges of stakeholder engagement should be taken into consideration by setting up mechanism to received inputs from Government Ministries and departments such as Green Building Councils, ESCOs, private institutions, project developers, associations, and the public through consultation, joint working sessions and feedback sessions among others. Stakeholder engagement will avoid several documents being produced for the same focus areas, resulting in more comprehensive policies, codes, and regulations. Increased collaboration and coordination between public and private institutions through joint projects and activities initiated by governments.

Another important aspect is that government should take immediate action in developing comprehensive road map which sets clear targets with an objective to implement various technological measures needs to be developed based on data collected at local or state/ provincial level. This could further be supported by a suitable policy that mandates the states of the provincial Government to strictly follow and implement federal Government policies at local level. Increase coordination and collaboration between Ministries and departments through regular meetings dedicated to specific topics. Establish a web-based platform to exchange under-development policies, laws, rules, and regulations to establish an integrated roadmap for EE in buildings.

Incorporate measures into BECs to increase structural and thermal resilience, including passive measures that enable occupants to use buildings when energy services are not available in an extreme weather event or natural disaster. This includes insulating, shading, load-bearing roofs, wind- and seismic-proof walls, and water drainage and storage systems. Given the long life of the massive building stock under development as Asia rapidly urbanises, there is a unique opportunity to integrate the dimension of resilience into BECs within the next decade to ensure that new as well as existing buildings will be able to withstand long-term climate change effects.

Lastly, overcoming issues related with financial barrier through providing financing mechanisms such as a revolving fund or soft loans among others. These funds can be provided as soft loans to financial institutions at zero interest rate or very low interest to attract financial institutions and investors. These initiatives may be voluntary, initially, and later made mandatory. The financing mechanisms above can be further supported through imposing taxes on fossil fuels and/or incentivising EE in buildings. To begin with, EE measures should be made mandatory for public buildings through state budget financing and voluntary for private buildings. This may become mandatory for private buildings through well-established financing mechanism.

Reducing and slowly phasing out subsidies on fossil fuel and energy prices through policy road mapping and action plans while supported by incentive schemes, would help the implementation of EE. Various schemes related to EE and conservation must be made mandatory for faster implementation. These mandatory schemes must be supported by MRV mechanisms.

4.4 EE Standard and Labelling and Harmonisation for EE goods and services trade

Standard and labelling plays a critical role within the EE DSM. AMS have had made various progress in setting EE standards and labelling in promoting EE. Indeed, standard and labelling has high energy saving potentials. Table 13 shows the energy saving potentials of selected EE technologies.

Table 13 Energy Saving Potential (Annual Target) by 2030 for selected EE technologies

Country	RACs (Gwh)	Refrigerators (Gwh)	Distribution transformers (Gwh)
Brunei Darussalam	14.8	22.1	65.6
Cambodia	101.5	27.6	64.5
Indonesia	4000	11800	4900
Lao People's Dem. Rep.	59.9	11.8	61.7
Malaysia	600	1100	3200
Myanmar	122	82.1	166.8
Philippines	3000	1800	1800
Singapore	700	200	500
Thailand	1900	3000	3200
Vietnam	1100	3600	1200

Source: United for Efficiency, 2021

4.4.1 Current State of EE Standards and Labelling

Countries like Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam lead in setting up national standards for methods of energy performance and adjusting national standards to the international level. A similar effort for MEPS and labelling among these nations indicate improvement in the public awareness and national commitment toward achieving their energy policy targets. Table 14 shows the labelling programmes for selected technologies among AMS.

Table 14 ***Status of labelling programmes for selected technologies for ASEAN nations***

Countries	RACs	Refrigerators	Electrical distribution transformers
Brunei Darussalam	Under development: Voluntary; Comparative Label	None	None
Cambodia	None	None	None
Indonesia	Under development (1–5 star rating)	Under development (1-5 star rating)	None
Lao People's Dem. Rep.	None	None	None
Malaysia	Voluntary (1-5 star rating)	Mandatory (1-5 star rating)	None
Myanmar	Under Planning	Under Planning	None
Philippines	Comparative Labelling	Mandatory (1-5 star rating)	None
Singapore	Mandatory (1-5 tick rating	Mandatory (1-4 tick rating	none
Thailand	Voluntary Comparative Labelling	Voluntary (1-5 star rating)	None
Vietnam	Comparative Labelling	Comparative Labelling	Mandatory-Endorsement

Source: Compilation by Study Team, 2022.

Minimum energy performance standard (MEPS) allows specifying the minimum amount of energy consumed in performing the equipment task while EE labelling acts as an informative label to inform consumers on the energy performance. Both complements each other and acts as the important instrument for DSM in making the necessary market transformation. MEPS is critical for product usage at a large scale, such as LED lights or refrigerators or air conditioners, to promote efficiency and saving energy for a sustainable future. Assessment of the MEP and energy labelling requirements for selected appliances among AMS shows progress in few AMS while in others some initiatives including pilot projects have been implemented but there is no specific roadmaps and initiatives to progress into the entire spectrum of appliances (Refer Table 15).

Table 15 ***MEPs and Energy Labelling Requirement for Selected Appliances***

Country	RACs	Fan	Refrigerator	Lamp	Television	Washing Machine	MEPS*	Label*
Brunei	√	x	x	x	x	x	Mandatory (Jun 2022)	Mandatory (Jun 2022)
Cambodia	x	x	x	x	x	x	None	None
Indonesia	√	√	√	√	√	√	Mandatory	Voluntary
Lao PDR	x	x	x	x	x	x	None	None
Malaysia	√	√	√	√	√	√	Mandatory	Voluntary
Myanmar	√	x	x	x	x	x	None	None
Philippines	√	x	√	√	x	x	Mandatory	Mandatory
Thailand	√	√	√	√	√	√	Mandatory	Voluntary
Singapore	√	x	√	√	√	x	Mandatory	Mandatory
Vietnam	√	√	√	√	√	√	Mandatory	Mandatory

Source: ERIA, 2020[14] (Updated)
Note: * shows the status of the MEPS and Labelling Programme.

The MEPS for room air conditioners is mandatory in certain ASEAN countries like Indonesia, Malaysia, Singapore, Thailand, and Vietnam. These mandatory rules indicate that these five countries are ahead of the other five ASEAN members. The labelling programmes in Malaysia, Singapore, Thailand, and Vietnam all follow a five stars/ticks rating system. In all these countries and Indonesia, a higher number of stars/ticks represents higher performance and energy efficiency. However, the rating methods and requirements on labels vary between countries, and there is no coherence in terms of labelling across these countries. Though there have been a few discussions on working on a process for a regional label in the past, there hasn't been any significant work on the same. Table 16 shows the existence of MEPS programmes for selected EE technologies in ASEAN nations.

Table 16 ***Status of MEPS programmes for selected EE***

Countries	RACs	Refrigerators	Grid Transformers
Brunei Darussalam	Under Development	None	None
Cambodia	None	None	None
Indonesia	Mandatory	Final Stage	None
Lao People's Dem. Rep.	None	Under Development	None
Malaysia	Mandatory	Mandatory	None
Myanmar	Mandatory	None	None
Philippines	Mandatory	Under Development	None

[14] Refer to ERIA available at https://www.eria.org/uploads/media/Research-Project-Report/2020-07-Energy-Efficiency-Master-Plan-Cambodia/11_Chapter-4.pdf and updated details on policies are available at International Energy Agency, https://www.iea.org/policies?country%5B0%5D=Malaysia&country%5B1%5D=Indonesia&country%5B2%5D=Singapore&country%5B3%5D=Thailand&country%5B4%5D=Philippines&country%5B5%5D=Viet%20Nam&country%5B6%5D=Brunei%20Darussalam&qs=brune&type%5B3%5D=Codes%20and%20standards

Singapore	Mandatory	Mandatory	None
Thailand	Mandatory	Mandatory	Planning Phase
Vietnam	Mandatory	Mandatory	Mandatory

Source: ACE, 2022

In the context of ASEAN, assessment on potential saving in 2030 due to the implementation of MEPS for lighting, cooling and equipment products showed great saving for ASEAN. Table 17 shows the overall potential benefits and saving.

Table 17 ***Potential Annual Saving in 2030***

Country	Electricity Reduction	Potential Saving on Electricity	Electricity CO_2 Reduction
Brunei	240 GWh	US$ 14 million	190,000 tonnes (equal to 110,000 passenger cars
Cambodia	810 GWh	US$ 180 million	660,000 tonnes (equal to 370,000 passenger cars
Indonesia	39 TWh	US$ 3.9 billion	27 million tonnes (equal to 16 million passenger cars)
Lao PDR	380 GWh	US$ 27 million	220,000 tonnes (equal to 130,000 passenger cars)
Malaysia	11TWh	US$ 880 million	7.3 million tonnes (equal to 4.1 million passenger cars)
Myanmar	1.8 TWh	US$ 66 million	550,000 tonnes (equal to 310,000 passenger cars)
Philippines	14 TWh	US$ 2.6 billion	11 million tonnes (equal to 6.6 million passenger cars)
Singapore	2.2 TWh	US$ 430 million	1.1 million tonnes (equal to 660,000 passenger cars)
Thailand	16 TWh	US$ 1.9 billion	9.3 million tonnes (equal to 5.2 million passenger cars)
Vietnam	22 TWh	US$ 1.8 billion	15 million tonnes (equal to 8.7 million passenger cars)

Note: * Denotes savings are from the Minimum Ambition Scenario.
Source: U4E, Country Assessment, October 2020 available at https://united4efficiency.org/countries/country-assessments/

By products, the estimated cumulative saving potential are illustrated in Table 18. Thus, harmonising the saving potential technologies would allow better saving by limiting the distorting impact of MEPS and labelling on trade of such technologies.

Table 18 ***Potential Cumulative Savings (2020 - 2030) for Selected EE Technologies***

Country	Lighting (Gwh)	Refrigerator (Gwh)	Air-Conditioner (Gwh)	Distribution transformers (Gwh)	Electric Motor (Gwh)
Brunei Darussalam	422	76.4	971	59.3	53.9
Cambodia	1.07	567	2.63	135	436
Indonesia	48.6	59.5	618	3.02	152

Country	Lighting (Gwh)	Refrigerator (Gwh)	Air-Conditioner (Gwh)	Distribution transformers (Gwh)	Electric Motor (Gwh)
Lao PDR	958	167	1.22	98.7	145
Malaysia	3.47	2.55	45.2	2.75	10
Myanmar	2.17	1.58	6.38	314	804
Philippines	10.9	5.97	59.4	1.6	3.39
Singapore	6.49	889	6.56	851	927
Thailand	4.67	7.1	64.5	3.44	11.8
Vietnam	4.16	8.92	89.3	2.01	18.6

Source: United for Efficiency, 2022

Benchmarking with EE standards and labelling of some of the developed countries, provides insights on expanding the efforts to other appliances and equipment. Table 19 shows that EU, US and UK have expanded its standards and labelling efforts to include industrial equipment such as boilers, welding equipment, furnaces, electric motors and power transformers. In the capacity building workshop, the sharing of Japan's top runner programme was instrumental in providing some lessons. The Top Runner programme in Japan has a long history of promoting energy efficiency improvements in various sectors. In fact, manufacturers and importers of appliances and building materials are required to meet energy efficiency criteria despite declaring energy efficiency and other related information for each appliance. Importantly, the number of targeted appliances and building materials has been expanded to 32, covering about 70% of household energy consumption.

Table 19 ***Standards and Labelling Implementation by Appliances and Countries***

Appliances	Hong Kong	South Korea	European Union	United States	United Kingdom
Air-conditioning system	√	√	√	√	√
Fan	x	√	x	x	√
Refrigerator	√	√	√	√	√
Lamp	√	√	√	x	√
Television	x	√	√	√	x
Washing Machine	√	√	√	√	√
Dehumidifiers	√	√	x	x	√
Dishwashers	x	x	√	√	√
Electronic displays	x	x	√	x	√
External power supplies	x	x	√	x	x
Electric motors	x	x	√	x	√
Power transformers	x	x	√	x	x

Welding equipment	x	x	√	x	x
Furnaces	x	x	x	√	x
Boilers	x	x	x	√	x
Water heater	x	x	x	√	√
Vacuum cleaners	x	x	x	x	√

Source: Compilation by Study Team, 2022.

4.4.2 Harmonisation of EE Standards and Labelling

While AMS is progressing and making efforts in placing the needed EE standard and labelling as part of the DSM, often the harmonisation of standards and labelling is critical to facilitate EE trade given that AMS are highly import dependent for EE technologies (see Appendix 2 for trade flow analysis)[15]. In achieving a structured EE DSM, common standards and labelling for energy efficiency and energy savings is required for energy-intensive products. In demand side management of energy efficiency, trade plays an important role and can affect EE market and technology availability in the following ways:

1. National and regional market for energy consuming products or energy efficiency products (demand) is shaped by trade policies.
2. National EE standards and labelling can limit or complement the effectiveness trade policy by restricting or enabling the access to EE products and technologies and, if standards and labelling related to energy efficiency is not harmonised it can affect EE products and technologies from entering the markets.
3. Harmonisation is also critical to reduce the complexity and manufacturer's cost of compliance as well as in alleviating enforcement challenges.

The APAEC has proposed to expand the harmonisation efforts for larger context of appliances and industry equipment to increase trade efficiency, lower energy system costs and reduce consumer cost to improve uptake of EE technologies.

It is essential to harmonize standards among ASEAN countries to facilitate trade in the selected technologies. In alignment with the ASEAN Plan for Action in Energy Cooperation 2016-2025, and in the context of trade as well as enhancing energy efficient measures, it is essential to promote intra-cooperation of ASEAN member nations towards utilisation of International Standards. Overall, 10 EE related products were earmarked in ASEAN to be harmonised in tandem with international standards. Notably, EE products such as air-conditioners, refrigerators and motors & generators were amended several times (see Table 20).

[15] Trade allows countries to export and import EE technologies and with trade those technologies can be made available for the masses. Nevertheless, trade policy and EE policy should be aligned accordingly for countries to leverage the EE technologies. Furthermore, market and non-market trade policy and regulations may restrict countries from benefiting for EE technology trade due to the local standards and labelling.

Table 20 ***Standards Harmonisation in ASEAN based on International Standards***

Products	International Standard
Air-conditioners	IEC 60335-1: 1991, Amd 1 (1994) & Amd 2 : 1999 IEC 60335-2-40: 1995 ISO 5151
Refrigerators	IEC 60335-1:1991, Amd 1 (1994) & Amd 2 : 1999
Motors & Generators	IEC 34-1: 1996 IEC 34-2: 1992 IEC 34-3: 1998 IEC 34-8: 1972 Amd 1 (1990) & Amd 2 (1996) IEC 34-9: 1990 Amd 1 (1995)
Radio	IEC 65:1985 Amd 2 (1989), Amd 3 (1992)
Television	IEC 65:1985 Amd 2 (1989) (IEC 60065:1998)
Dishwashers	IEC 60335-2-5
Washing machines	IEC 60335-2-7
Microwave ovens	IEC 60335-2-25
Room heaters	IEC 60335-2-30
Fans	IEC 60335-2-80

Source: ASEAN Energy Centre (2020) available at https://asean.org/asean2020/harmonization-of-standards-in-asean/#content

For the energy efficiency technologies, the focus should be on moving the national standards for performance testing methods, minimum energy performance standards and labelling towards the relevant and recognized international standards. Lack of standardisation creates hurdles in achieving optimum intra-ASEAN as well as world trade flows[16]. Establishing an international standard free of protectionist motives could boost the trade by eliminating the trade distortion effects of regional standards. Differences in the standard testing methods and required energy performance put substantial barriers for the market to allow integration and trade. On the other hand, manufacturers should also be made aware of the mandatory labelling requirement for exports. Hence, when the national standards adhere to the international level, including minimum requirements for energy performance and coherent labelling, it would facilitate the trade flow of EE products between ASEAN and other nations. But regulatory incoherence in the form of inconsistent technical standards (labelling and testing, apart from the energy-efficiency rating) across countries has already been identified as impeding trade. In addition, compliance with country-specific technological requirements imposes an additional burden on firms in terms of financial strain. Due to the inefficiency at the government and management level, many firms dealing with energy finds it challenging to track frequent changes in the regulations and gather sufficient information. In this context, the effort should be urgent to harmonize the testing standards and methods to achieve the common performance standards. Hence, the harmonisation of standards will facilitate intra-ASEAN and worldwide value chain integration in energy efficiency and renewable energy technologies. Incoherence in labelling and testing across ASEAN countries has been identified to impede trade. Though the standards are not uniform across the ASEAN countries, efforts are being made to achieve standardisation. Table 21 summarises the national energy performance testing standards for selected EE technologies for the ASEAN nations.

[16] Please refer to the Appendix 2 on the discussion of tariff and the business environment as barrier for trade.

Table 21 ***National energy performance testing standards for selected EE technologies***

Countries	RACs	Refrigerators	Electrical distribution transformers
Brunei Darussalam	Under development	NA	NA
Cambodia	Under development	NA	NA
Indonesia	Aligned to ISO 5151	Aligned with IEC 62552	Aligned with IEC 60076-1 (electric Utilities)
Lao PDR	NA	NA	NA
Malaysia	Aligned to ISO 5151	Aligned with IEC 62552	Aligned with IEC 60076-1
Myanmar	NA	Aligned with IEC 62552	NA
Philippines	Aligned to ISO 5151	Aligned with IEC 62552	Aligned with IEC 60076-1
Singapore	Aligned to ISO 5151	Aligned with IEC 62552	Aligned with IEC 60076-1
Thailand	Aligned to ISO 5151	TIS 455-2537 and TIS 2186-2547 (Different from the international standard)	Aligned with IEC 60076-1
Vietnam	Aligned to ISO 5151	TCVN 7829:2016 (Aligned with IEC 62552)	TCVN 6301-1:2015; (Aligned with IEC 60076-1)

Source: Adopted from International Electrotechnical Commission, 2022.

Table 22 shows that existing efforts of harmonisation has been on air conditions and lighting. It involves harmonisation of test standards and MEPS. Indeed, for lighting, efforts have been recognized to establish MRA in areas such as testing results, certification of test laboratories, certification, laboratory accreditation, inspection accreditation, and testing certification.

Table 22 ***Harmonisation of Selected Products in ASEAN***

Harmonisation	Initiatives
Air-Conditioner	Harmonisation of test methods- ISO 5151:2010 benchmark test standard Harmonisation of metrics- in accordance ISO 16358-1 (incorporate Cooling Seasonal Performance Factor)
Lighting	➢ Harmonisation of Test Methods- a. CIE S025 (testing of photometric requirements) and IEC 62612 (testing of functional performance requirements) for non-directional Light Emitting Diode lamps. b. CIE S025 (testing of photometric requirements) for double-capped linear Light Emitting Diode lamps. c. CIE 084 (testing of photometric requirements) and IEC 60081 (testing of functional performance requirements) for double-capped Linear Fluorescent Lamps.

	➢ Harmonisation of Minimum Energy Performance Standards- mandatory MEPS for all non-directional LED lamps and linear LED and fluorescent lamps. ➢ Mutual Recognition Agreements- a. Information exchange agreement e.g., compliance outcomes b. Mutual recognition of test results c. Mutual recognition of certification of test laboratories (International Laboratory Accreditation Cooperation (ILAC), Asia-Pacific Laboratory Accreditation Cooperation (APLAC) d. Laboratory accreditation e. Inspection accreditation f. Testing certification

Source: 37th ASEAN Ministers of Energy Meeting, 2019 and Energy Studies Institute, 2019

Moreover, the absence of harmonisation of standards for energy performance testing methods, MEPS, and labelling can pose a significant barrier to the ASEAN trade with the rest of the world. On the other hand, lack of mutual agreement on energy performance standards also imposes a substantial non-tariff barrier for EE and RE technology-driven products. By achieving regional cooperation on energy efficiency, it is expected to yield substantial energy savings for the consumers. Certain fiscal incentives such as tax exemptions are there in Indonesia, Singapore, the Philippines, and Thailand to import EE/RE products. These incentives help facilitate the expansion of the EE/RE technology market, which ultimately supports intra-ASEAN and the rest of the world trade integration. Moreover, trade in these technologies also depends on to what extent the energy and power market is regulated. In the ASEAN region, since the electricity and energy markets are driven by policy and regulations, to achieve an optimum trade, policymakers should focus on increasing the awareness and harmonisation to foster the demand allowing the markets to function smoothly. The establishment of regional labelling for EE/RE technologies would thus facilitate market access, notably through trade for the selected technologies.

The study further explored the non-tariff measures through the lenses of trade policies and energy efficiency policies linking to the promotion of efficient and sustainable usage of energy.
Despite the progress of harmonisation efforts, the key challenges of non-tariff measures for EE and RE markets is the existence of different standards, which adds to the cost of compliance burdening the exporters as well as manufacturers. Table 23 shows the number of technical barriers to trade in key EE products. It shows that most of the NTMs are related to conformity assessment, labelling (B8), marking and packaging requirements (B3) as well as product quality, safety, or performance requirements (B7). Within B8, certification, testing and product registration features as the key NTMs. Specific opportunities should be investigated on a country-by-country basis as well as on a regional basis, particularly regarding the benefit of the Environmental Goods Agreement (EGA) for enhancing ASEAN trade with other countries or economic regions. Indeed, MRA can be further established to ensure technical barriers are reduced.

Table 23 ***Number of Non-Tariff Measures in Selected EE Products in ASEAN***

Products	RAC (Code:841510)	Refrigerators (841821)	Electrical Distribution Transformers (850421)	Lighting (940510)
Total NTM (Technical Barriers to Trade)	85	92	41	81
Top Three Technical Measures:				
B8 - Conformity assessment related to technical barriers to trade	Total: 41 (Top Three include): - Certification requirements (B83) - Testing requirements (B82) - Product registration/approval requirements (B81)	Total: 43 (Top Three include): - Certification requirements (B83) - Testing requirements (B82) - Product registration/approval requirements (B81)	Total: 19 (Top Three include): - Certification requirements (B83) - Inspection requirements (B84) - Testing requirements (B82)	Total: 39 (Top Three include): - Testing requirements (B82) - Certification requirements (B83) - Inspection requirements (B84)
B3 - Labelling, marking, and packaging requirements	Total: 29 (Top Two include): - Labelling requirements (B31) - Marking requirements (B32)	Total: 31 (Top Two include): - Labelling requirements (B31) - Marking requirements (B32)	Total: 13 (Top Two include): - Labelling requirements (B31) - Marking requirements (B32)	Total: 20 (Top Two include): - Labelling requirements (B31) - Marking requirements (B32)
B7- Product quality, safety, or performance requirements	9	13	4	15

Source: UNCTAD Trains Database, 2022
Note: The number represents the total NTM imposed by ASM.

In the context of trade policy regulations as well as EE policy, all AMS have adopted an e-custom mechanism that facilitates trade. However, there is variation among the nations in terms of average time from custom clearance. No specific import restrictions on energy-efficient or renewable energy technologies in ASEAN, however, few limitations on investments in renewable technologies with few local regulatory requirements can be observed in Indonesia and Myanmar (Table 24).

Table 24 ***Trade Facilitating Environment in ASEAN and EE Policy***

Country	E-Customs	Average Time of Custom Clearance	Import Restrict-ions on EE products	Limitation on Foreign Investments in EE/RE	Local Require-ments	EE and Energy Conservation Policy/ Regulation	RE and EE incentives
Brunei Darussalam	Yes	10 Hours	No	No	No	Under development	No
Cambodia	Yes	Less than one day	No	No	No	Under development	No
Indonesia	Yes	Up to 3 days	No	No. But electricity generation below 1MW is reserved for domestic enterprises.	Under consideration for certain RE products.	Yes	Yes, but underutilized
Lao PDR	Yes	8 hours	NA	NA	NA	Under development,	No
Malaysia	Yes	Up to 15 minutes	No	Equity shares restrictions in the Energy sector.	No	Yes	Yes
Myanmar	Yes	Up to 3 days	Requirement of import license to enter the country	Power generation below 10MW is reserved for domestic enterprises.	No	Yes	No
Philippines	Yes	Up to 2 days	No	No	No	Yes	Yes
Singapore	Yes	Maximum 10 minutes	No	No	No	Yes	Mix (No incentive in Solar PV, but in others, there are a bunch of fiscal incentives)
Thailand	Yes	15 hours at Seaports and Half an hour at the broader crossing	No	No	No	Yes	Yes
Vietnam	Yes	Up to 5 days	No	No	No	Yes	Under Development

Source: WTO database on tariff and non-tariff barriers, 2020.

4.4.3 Challenges in EE Standards and Labelling and Harmonisation

While setting standards and labelling are critical for DSM of EE, AMS still faces challenges given the various reasons. Table 25 illustrates some of the common challenges in promoting EE standard and labelling. Those challenges relate to EE technology adoption, capability and capacity, infrastructure, data availability and technical expertise. Addressing those challenges requires building partnership as well as developing regional capacity development programs in sharing best practices.

Table 25 ***Challenges and Causes***

Challenges	Reasons/Causes
Low EE Product & Technology Adoption	Residential - Lack of awareness & low priority for consumers - Low understanding of potential saving - Lack of data to demonstrate potential energy saving - Cost and financing Industrial Application - Cost and financing structure - Lack of information about production costs and market structure. - The incremental cost of energy-efficient products is likely to be high relative to average income in the developing country. - Low priority for manufacturers/retailers. - Low primary energy price.
Capability and Capacity in Standard and Labelling and Harmonisation)	- Lack of technology availability. - Lack of know-how - Lack of government programs/support. - Lack of Institutional and Regulatory Framework - Lack of harmonisation and universal standards and labelling leads to higher design costs (label) and other compliance cost. - Lack of testing methodology and procedures - Lack of capability in engaging multiple stakeholders e.g. manufacturers, service providers and others.
Infrastructure (laboratory and testing facilities	- Accuracy of the information supplied on EE appliances label. - Compliances issue- tendency of inaccuracies in energy consumption reporting (EE products). - Creating an energy test procedure requires investments in a physical setup, including test facilities and trained technicians. - Need for retesting a product in different countries/regions.
Data Availability	- Lack of data (historical time series) in terms of equipment annual sales volumes, sales prices, production volumes, import and export volumes and equipment distribution channels - Lack of engineering data - a comprehensive database of technical and energy characteristics for individual EE product models available on the market.

	- Lack of energy usage data - Historical, annual time series of equipment ownership levels and energy use or energy efficiency. - Lack of Behavioural data - Attitudes of consumers and equipment users toward energy savings, purchasing decisions, label designs, environmental concerns, and product service and retailer attitudes toward and knowledge of energy efficiency in general, labelling, selling priorities, and consumer preferences. - Lack of Ancillary data - known and forecasted energy prices and tariff, information on utility generation, transmission, and distribution, including capacities, demand, costs (peak and off peak.
Technical Expertise	- Lack of periodically review (MEPS) requirements for latest EE products. - Technical review group (standard & labelling) will be required to enhance and/or legitimize in-house government expertise. - People responsible for writing regulations, usually lawyers, are not experts in energy efficiency. - Lack of engagement with environmental groups such as NGOs that have relevant expertise.

Source: Compilation by Study Team, 2022.

Box 5: Tackling MELS/MEPS Challenges

In tackling some of the challenges mentioned in Table 23, the National Environment Agency of Singapore

i. Develops mobile applications and promotional materials to increase awareness of MELS /MEPS.
ii. Conducts an industry consultation to get early feedback on the new MELS/MEPS interventions.
iii. Conducts training for staff working in retail shops.
iv. Provides suppliers and retailers sufficient lead time to clear stock (at least 1 year).
v. Works with the research department and suppliers to collect sales data and other data related to appliances and equipment

Source: Compilation from (ACE) Focus Group Discussion, 19 August 2022.

Box 6 shows how some of the developed countries have addressed some of the challenges by developing a more collaborative and partnership model.

BOX 6 CASES OF COLLABORATIVE MODELS

Poland- The Poland Efficient Lighting Project (PELP), developed by the International Finance Corporation and funded by GEF, was designed in part to demonstrate to the Polish electric utility industry the benefits of using efficient lighting to reduce peak power loads in geographic areas with inadequate distribution grid capacity to meet existing or projected loads.

United States- The Super-Efficient Refrigerator Program (SERP), a consortium of government agencies, utilities, and NGOs in the U.S., organized a competition and awarded a US$30 million incentive (the so-called "golden carrot") to the winning manufacturer to build a new refrigerator that exceeded prevailing efficiency standards by 30%. Many participating utilities offered additional rebates to consumers to encourage them to buy the super-efficient refrigerator. SERP has been widely credited with helping to pave the way for industry and consumer acceptance of a tighter energy-efficiency standard adopted nationally by DOE.

Energy Star- International agreements with Europe, Japan, and other countries promote use of the ENERGY STAR® label in the increasingly global market for office equipment. Although the labelling program initially targeted individual consumers, EPA and DOE have also begun to work with government, corporate, and institutional buyers through the ENERGY STAR® Purchasing Program. A free Purchasing Toolkit as well as on-line information (www.epa.gov/appdstar/purchasing/) provide purchasing specifications and software to help buyers estimate their energy and cost savings.

Sources: Energy-Efficiency Labels and Standards: A Guidebook for Appliances, Equipment, and Lighting, 2005.

4.4.4 Policy Recommendations for EE Standard and Labelling

Establishing Institutional and Regulatory Framework – While AMS have progressed unevenly in establishing institutional and regulatory framework, more efforts is required for AMS that has not established such framework. Establishing regional cooperation within ASEAN to coordinate a more uniform institutional and regulatory framework as well as capacity development would be critical.

Expanding the efforts of EE Standard and Labelling – In countries that has progress is setting the EE Standard and Labelling, policymakers should adopt and regularly update the mandatory MEPS and labelling. The list of appliances and equipment should be further expanded. Important focus should be established in industrial, building and transportation sectors. For instance, targeted promotion of high-efficiency industrial equipment and systems building codes, fuel-efficiency standards and labelling for vehicles and EE for small and medium enterprises.

Harmonisation of EE Standard and Labelling – Aligning trade policy with that of EE standard and labelling is critical. Regular review and update of EE standards and labelling regulations should be initiated. In doing such update and reforms those policies should be aligned to the use of international standards and measurement protocols to reduce compliance cost and promote trade. Regional collaboration is needed in coordinating policies for EE appliance and equipment update and removing NTM specifically related to technical barriers to trade. Harmonisation efforts should target the most energy consuming appliance and equipment. This also provides opportunities for Mutual Regional Agreement across ASEAN for other appliances and equipment. Equally important is to revisit the tariff rates for EE technologies and components.

Monitoring, Data Management and Database – While the current efforts focus on EE standard and labelling in appliance, moving forward would require AMS to develop a framework to monitor, verify and enforce at national and regional level. Therefore, allocating resources to establish monitoring compliance, as well as performance verification accuracy is important so that efforts to promote MRA can be established. Capturing the energy saving data due to EE standard and labelling is also critical. In other words, effective implementation of EE standard and labelling requires market data such as current levels of forecast trend for efficiency products, insights on technology and energy performance characterises of domestic and imported products. Establishing a depository and registrar would be important.

Addressing the specific challenges with various programs and policies and ensuring market transformation – The existing EE standard and labelling programs encounter various challenges and Table 26 illustrates few potential solutions based on practices elsewhere and insights obtain from AMS stakeholders' engagement during Focus Group Discussion held on 18 & 19 August 2022.

Table 26 ***Potential Solution for Key Challenges***

Challenges	Potential Solution
Low EE Product & Technology Adoption	Residential Financing - Leasing accessibility of energy-efficient equipment. - Offer rebates to consumers to encourage them to buy EE appliances. Industrial Financing - Performance contracting (finance energy efficiency projects) - Vendor financing (targets energy-efficient products that are newly introduced) - Offering loans or loan guarantees to manufacturers who retool to produce energy efficient products. Other Solutions: - Initiate Manufacturer Incentives- Reduce needs for investment in electricity distribution systems (reduce peak power loads). - Ensure only EE appliances rated with three stars and above (out of five) will qualify for the easy payment scheme. - Stimulate public awareness on EE appliances (consumer education, mass media information and social media influencer). - Promote energy efficiency and strengthen measures to expand the uptake of non-fossil energy. - Creating initial demand (EE products) within the public sector.
Capability and Capacity in Standard and Labelling and Harmonisation)	- Strengthening system design, installation, operation, and maintenance of (EE products component). - Integration of test standards (with reference to IEC guidelines) across - ASEAN region. - Enable the recognition of test results from certified third-party laboratories for ease of registering qualified EE products. - Establish energy efficiency thresholds (only qualified products with ratings above the MEPS can enter the ASEAN market). - Establish EESL Task Force- provide professional guidance on harmonised test standards, energy efficiency thresholds, and MEPS. - Manufacturers and importers of EE appliances should oblige to declare energy efficiency and other related information. - Capacity Development Programs – Technology and Know How Transfer
Infrastructure (laboratory and testing facilities	- Intensifying support for R&D, designing (or revising) energy-test methods. - Ensure compliance with MELS and/or MEPS- enforcement conducted at retail stores and performing verification testing (VT) of registered models. - Establish regional testing and certification hub- (help manufacturers from low-income member states to certify their products and comply with energy-labelling requirements). - Recognise regional trade association of manufacturers and the domestic standards association- work together to establish a test procedure,

Data Availability	- Establish regional Standard and Labelling data / information sharing hub. - Forecasting energy use and strategic planning (Use data as inputs to an end-use stock model for long-term energy consumption and emissions forecasts). - Leveraging Socioeconomic data- understand the effectiveness of labelling and standards setting programs for different socio-cultural situations. - Strengthening Public-Private Partnership (cooperative agreements) to gather data on sales and efficiency levels. - Establishing a regional appliance database to monitor EE appliance efficiency trends (AMS context).
Technical Expertise	- Leverage international organisations & developed countries assistance e.g. grants and technical expertise- creating energy-efficiency labelling and standards programs. - Strengthening regional capability - Energy Auditing Programs (including standard & labelling assessment). - Stakeholder involvement- expertise from research institution, policymakers, industrial associations, and NGOs- to support efforts to build consensus on standards.

4.5 Innovation for EE: Energy-as-services business model and energy market design

4.5.1 Current State of Innovation

In the current context of climate change, innovation in the energy sector would mean the ability to advance digital technology to fight climate change and contribute toward sustainable development. Master Plan on ASEAN Connectivity, 2025 estimates that the value of digital technologies could reach $625 billion in ASEAN by 2030. On the other hand, Google estimates that ASEAN's internet economy will grow significantly with penetration of the internet up to $200 billion annually by 2025. Similarly, AT Kearney projects that ASEAN's digital economy could contribute around $1 trillion annually to the block's GDP by 2025[17]. The plan also notes that seizing the economic benefits from booming digitisation and the digital economy would require a structured existence of regulatory frameworks for data management and digital services (including financial services), secure and trustworthy data sharing keeping privacy in mind and enhancing the capacities of small and micro enterprises with new digital technologies[18]. Realising the opportunity, some ASEAN nations are already pushing for an ASEAN-wide digital integration (ASEAN Digital Integration Framework Action Plan (ADIFAP)[19]. In the context of EE, digitisation can lead an essential role in opening the opportunities for integration of newer grid technologies, mainly in the wind, polar and batteries. Well planned digitisation could transform the traditional way of energy production, transportation, and consumption.

Such innovation would have to include applying new and better EE technologies in the energy sector, keeping in mind the different stages of development of ASEAN nations and technological capacities. The required innovations are needed on the technological front and should happen simultaneously in the policy and finance space. Since ASEAN nations are at different stages of development, their innovation and technological capabilities vary significantly from each other. Hence, regional, and

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[17] The Master Plan on ASEAN Connectivity 2025. ASEAN Secretariat, August 2016. https://asean.org/wp-content/uploads/2016/09/Master-Plan-on-ASEAN-Connectivity-20251.pdf
[18] The Master Plan on ASEAN Connectivity 2025. ASEAN Secretariat, August 2016
[19] Thailand pushes for ASEAN Digital Integration Framework Action Plan. OPEN GOV, January 17, 2019.

international cooperation is required alongside establishing a supportive regulatory framework, which will attract foreign direct investments in renewable and efficient. On the other hand, to meet the increasing demand and support economic growth, ASEAN nations must incorporate and integrate booming cutting-edge digital technologies to address the challenges of the everchanging energy sector to meet the demand requirement of affordable and sustainable energy for the consumers. Recent examples of innovative digital technologies that economically strong ASEAN nations in the energy sector include smart buildings and electricity storage technologies.

The ASEAN master plan on connectivity 2025 (MPAC, 2025) prioritizes digital innovation and digital technology adoption by all sizes of enterprises and establishing themselves as essential players in the booming digital economies of the block. The current efforts of digital application in energy sectors are in exploiting the potential of the ASEAN Power Grid (APG), significantly by improving interconnectivity and associated digitalisation. By August 2018, connecting Singapore, Malaysia, Thailand, Cambodia, Lao PDR, and Vietnam total of 8 out of 16 planned power interconnections had been successfully executed with a power exchange of more than 5,200MW. Apart from the power sector, other energy-efficient and renewable energy sources where there is ample scope for innovation in the context of ASEAN are:

- Solar energy with blockchain technology: Install solar PVs and sell excess electricity via blockchain (via P2P transaction).
- Digitally enabled Battery storage: In this aspect, Singapore's energy market authority with digital battery storage investments in the public-private partnership model is leading digital innovation.
- Mobile management of power: Built on a digital machine learning infrastructure, advanced analytics and IoT communication[20].

To realise some of the efforts, not only in the power sectors, but also in the context of energy saving and efficiency, policymaker requires to adopt new innovative business models such as the energy-as-services models and the energy market design. Energy as a service model combines hardware, software, and services to deliver solutions for EE DSM. A review of the current progress among AMS in such activities indicates a lack of progress and investments. Table 27 maps the current state of energy-as-services market design in ASEAN

Table 27 ***ASEAN-wide status of energy services as market design***

Country	Energy Services & Technology					
	Ancillary Services & (Platform)	Energy Storage & (Batteries Power-to-anything)	Distributed Generation & (Renewables)	Energy Savings & (Smart meter)	External Supply Optimisation & (Software App)	Other
Brunei	NA	NA	NA	Yes	No	NA
Cambodia	NA	NA	NA	Yes	No	NA

[20] Refer to Digital Technology for ASEAN Energy available at https://aseanenergy.sharepoint.com/PublicationLibrary/Forms/AllItems.aspx?id=%2FPublicationLibrary%2F2021%2FPublications%202021%2FDigital%20Technology%20for%20ASEAN%20Energy%2Epdf&parent=%2FPublicationLibrary%2F2021%2FPublications%202021&p=true&ga=1

Country	Ancillary Services & (Platform)	Energy Storage & (Batteries Power-to-anything)	Distributed Generation & (Renewables)	Energy Savings & (Smart meter)	External Supply Optimisation & (Software App)	Other
Indonesia	In Plan	Initial Stage	Limited Capacity	Slowly increasing	In Plan	NA
Lao DPR	NA	NA	NA	Yes	NA	NA
Malaysia	In Plan	Intermediate Stage	Intermediate Capacity	Increasing at a fast rate	Yes	NA
Myanmar	NA	NA	NA	Yes	NA	NA
Philippines	In Plan	Intermediate Stage	Intermediate Capacity	Increasing slowly	Yes	NA
Singapore	Yes	Advanced Stage	Intermediate to advanced capacity	Increasing at a fast rate	Yes	NA
Thailand	In Plan	Intermediate Stage	Intermediate Capacity	Increasing at a fast rate	Yes	NA
Vietnam	In Plan	Intermediate Stage	Intermediate Capacity	Increasing slowly	Yes	NA

Source: Compilation by Study Team, 2022.

4.5.2 Challenges in Innovation for EE

Table 28 further summarises the challenges to fostering innovation in EE in the context of ASEAN nations. It is evident that appropriate policy and institutional mechanisms were lacking in Asia, followed insignificance by due to the financial barriers.

Table 28 ***Challenges to fostering innovation in EE in ASEAN***

Countries	Technological	Policy	Financial
Brunei	*Lack of Technological Capacity	*No prominent technology policy promoting innovation	NA
Cambodia	*Lack of Technological Capacity and infrastructure	NA	*No financial Support
Indonesia	*Lack of technology transfer *Fewer innovation	*Subsidized energy prices *Bureaucratic hurdles	*Fewer innovation grant *Less Financial support
Lao DPR	*No Technology infrastructure	NA	NA
Malaysia	*Lack of technology transfer *Low diffusion	*Subsidized energy prices	*Fewer innovation grant *Less Financial support

Countries	Technological	Policy	Financial
Myanmar	NA	NA	NA
Philippines	*Lack of technology transfer *Fewer innovation	*Bureaucratic red tapes *Information disclosure	*Fewer innovation grant *Less Financial support
Singapore	* Low diffusion	*Information sharing	*Not implement strongly
Thailand	*Low diffusion	*Subsidized energy prices * Bureaucratic red tapes	*Fewer innovation grant *Less Financial support
Vietnam	*Low diffusion	* Bureaucratic red tapes *Information disclosure	*Fewer innovation grant *Less Financial support

Source: Compilation by Study Team

Furthermore, other market related challenges include performance risk, lack of manufacturing capability, inconsistent demand, legal contracts, and long-term interest among developers (Table 29). It may indicate that there is a market failure in these aspects that intervention and incentives may be needed.

Table 29 ***Market Related Challenges to fostering innovation in EE in ASEAN***

Country	Performance risk	Lack of local/regional manufacturing capability	Inconsistent demand	Specialist legal contracts	No long-term interest for developers
Brunei	NA	Yes	No	Fewer Provision	Very less
Cambodia	No	Yes	Yes	No	High
Indonesia	Mild	Building up capacity	Sometimes	Provisions coming up	High
Lao DPR	NA	NA	NA	NA	NA
Malaysia	Mild	Building up capacity	Sometimes	Provisions coming up	High
Myanmar	NA	NA	NA	NA	NA
Philippines	Mild	Building up capacity	Sometimes	Provisions coming up	High
Singapore	No	High potential	No	Yes	High
Thailand	Mild	Building up capacity	Sometimes	Provisions coming up	High
Vietnam	Mild	Building up capacity	Sometimes	Provisions coming up	High

Source: Compilation by Study Team, 2022.

ASEAN has substantial investment potential in promoting innovative business models and energy markets, but it is burdened with numerous barriers. Several potential barriers are as follows:

1. Lack of structured incentive mechanisms, capital and financial services makes it hard for ASEAN members, mainly the developing ones', regulatory system to align with the sustainable development goal agenda, 2030. Rather than making EE measures mandatory, the ASEAN nation has predominantly focused on voluntary adoption, which delays EE adoption.
2. Low energy prices in many ASEAN nations such as Indonesia, Malaysia and Thailand provide disincentives for firms and industries to adopt EE innovation efforts in the energy sector.
3. Except for a few strong ASEAN economies, there is a low diffusion of EE technologies in the energy-driven industry sectors due to difficulty obtaining financial support.
4. Though there are energy codes in the building sector, their enforcement and strictness vary across ASEAN, putting barriers to cross country innovation cooperation.
5. The existing banking and financial services structure also put barriers to innovation. There is a dominance of the short-term financing system in ASEAN, which creates a confusing maturity system. On the other hand, the option of investment funding is not widespread due to its shallowness. Widespread cash holding also makes it easier for bank lending to dominate than investment funding.
6. The extensive bureaucratic red tape creates lesser and lesser space for environmental disclosure and information sharing. Lack of information makes it difficult for investors to identify the ecological risk, limiting new opportunities and funding for innovation in energy efficiency.

4.5.3 Innovative Initiatives in EE Business Model and Energy Market Design

ASEAN should leverage on the digital technologies and new forms of innovative business models and energy market design to further promote the EE DSM initiatives. The liberalisation of energy markets in ASEAN allows new players to get involved and develop new business models for the energy sector. Emerging business models approach energy from a decentralized, where promoting clean energy technology and innovative business models could simultaneously provide competitive commercial benefits and take care of sustainability. However, the process of finding out and working on a new business model in traditional business-driven ASEAN can be difficult for market entrants and actors.

New business models in EE could provide a competitive advantage over the regular and mundane models. New models in EE can be regarded as a way of unlocking the value of EE technologies and fostering innovations. This will not just help to commercialise early-stage EE technologies but would also have the potential to boost the start-up and commercial spinoffs (Chesbrough and Rosenbloom, 2002). The business model concept has been explored to work on new initiatives that have popped up since the liberalisation of energy markets in the developing world. Thus, it is essential for ASEAN block to strengthen their ESCOs business model based on developed nations success business models and innovations.

Energy entrepreneurs can create novel services to overcome the barriers of market access and upfront cost. Service-oriented business models in the energy sector emphasise the important role of the firm-consumer relationship (Apajalahti et al., 2015), focusing on providing long term energy services such as solar PV. Well acknowledged energy business models have been clustered into eight patterns shown in Table 30. Though clustering is independent, there can be some overlap in some business models. Innovation occurs primarily in replacing fossil fuels with renewable energy in the energy sector. Hence, innovation in the energy sector is ingrained in the content of the business model rather than the structure or the governance. The innovation can boost the diffusion and commercialisation of the RE and demand-side management services in the content of the business model, governance, and structure.

Innovative primary content of the energy business model stress fossil fuel replacement with RE sources. In energy-driven business models, the innovative structure is driven by joint initiatives, value creation, platforms, and product-service systems. On the other hand, innovative governance is driven by socio-economic and environmental conditions, local value creation, and public actors' involvement.

Table 30 ***Energy business model clusters***

Business Model Elements/Business Model Themes	Content	Structure	Governance	Business Model Example
Novelty (Innovation)	Going green	Building energy communities	Building energy communities	In EU: *Zero Generation PV *Customer-owned *Energy Cooperatives
Lock-in (Keeping customers)	NA	Offer Functionality	NA	In EU: * Energy service companies *Third Party Energy Business Model
Complementary (Generate more value)	NA	Optimizing Grip operations And Cross-Selling	Act Locally	In EU proposed: *Virtual Power Pants *E-Balance Energy Business Model *Energy Hub
Efficiency (Reduce transaction cost)	NA	Running Platforms and scaling up	NA	In Europe and Japan: * Peer-to-peer * Crowdfunding for renewable energy

Source: Compilation by Study Team, 2022.

Intermixing technology and energy could lead to numerous data-driven energy products and services that incorporate efficiency improvements and new technologies, where consumers will be able to manage the excess supply through P2P markets. In the energy market design, energy is bundled into consumer-based subscription models and sole in the market as a secondary product embedded in primary products like "Electric cars using power ". Hence, nowadays, the concept of energy as a service is starting to get significant traction not just in developed nations, but discussions are also in place in ASEAN. EU has the highest integrated electricity market, and its experiences on energy market integration could have beneficial and learning implications for ASEAN.

Energy-as-services business can take few forms namely energy advice, energy assets and energy management. It involves leveraging various stakeholders like Distributed energy resource suppliers, ICT companies and smart device suppliers, telecommunication companies and others. Table 31 illustrates the services of different stakeholders. For instance, integrating ICT companies within the energy system would allow the use of digital technologies to monitor usage data and other energy data analytics for better planning and monitoring. Target customers can be the commercial and industrial building owners where demand management, energy efficiency services optimisation of demand and supply balance can be facilitated. The services require higher digital technology and analytics to be employed.

Table 31 **Energy-as-services by different stakeholders**

Electricity Suppliers	Distributed Energy Resource Suppliers	Smart Device Suppliers	ICT Companies
Retail Electricity Services	Installation of RE systems (rooftop solar, microturbines, etc)	Manufacturing of smart home devices	Consumption data
Demand Response Aggregation	Developing Community owned projects		Usage Patterns
Dynamic Pricing (time of use tariffs	Installation of battery storage systems		Real-time monitoring dashboards
	Developing of mini and microgrids		Energy Analytics as a service
	Deployment of EV smart charging infrastructure		
	Operating virtual power plants		

Source: KPMG, 2015

Box 7 highlights the Malaysian Energy Commission's commitment to promote energy saving in buildings but also to enhance energy-oriented businesses notably Malaysian ESCOs via designing an innovative Energy Audit Grant 2.0 initiative.

BOX 7: Malaysian Energy Commission's Energy Audit Grant 2.0 (EACG)

Energy audit conditional grant (EACG 2.0) is an energy efficiency programme implemented for 2021-2025. The programme supports the commercial and industrial sectors to collaborate with local energy service companies (ESCOs) registered with the energy commission (ST) to conduct energy audit in their buildings. The grant does not only be instrumental in creating the building owner awareness on energy saving potential but also promotes the development of energy as services business (ESCOs) especially energy audit services to larger context. The objectives of the programme are to:

- Provide financial facility (assistance) to building/installation owner to do energy audit to implement energy saving at their premises.
- To promote energy audit exercise to establish the current energy consumption baseline and identify potential energy saving in their premises.
- To provide platform for assistance and facilitation to commercial building and industrial installation owner to implement energy saving in a systematic way.
- Capacity development in energy management to commercial and industrial sector.
- To foster awareness the important of energy management among commercial and industrial premises owner in Malaysia to reduce energy consumption (save energy and save operational cost).

The amount of the grant is as - industrial (up to RM 100K) and commercial (up to RM 60K). Importantly, the requirements for applying for the EACG grant are those with a monthly electricity consumption of at least 100,000 kWh/month. There are six phases of the EACG 2.0 application process namely- (evaluation committee, technical committee, steering committee, offer letter to applicants, contract signature and disbursement of funds). While implementation phase of EE projects includes audit report, final payment, first year report, second year report, third year report and end of contract).

The EACG 2.0 offers several benefits, namely:

i. Direct financial assistance
ii. Assist in identifying potential energy savings
iii. Free facilitation
iv. Free training
v. Free awareness
vi. Free recognition

Source: SEDA and compilation from ACE Focus Group Discussion, 19 August 2022.

Box 8 illustrates other innovative business models employed in various countries that contributes to DSM of energy efficiency. AMS should explore some of these innovative business models and integrate such models within the existing initiatives in managing energy saving agenda such as the green building, smart buildings, energy services for households and industries as well as others.

BOX 8: INNOVATIVE BUSINESS MODELS

Choice (Australia) – Energy advice and Energy management

The company Choice provides a service that scans the prices of all retailers every quarter and helps customers save costs by switching to the cheapest electricity supplier. The company also helps customers secure funding for on-site solar PV facilities to generate savings in electricity bills. The price comparison tool has helped customers save over 50% on their electricity bills (Hitchick, 2018)

Crnogorski Telekom (Montenegro) - Energy assets installation and Energy management

Montenegro's leading telecom company has signed a 10-year contract with Ericsson to design, implement and manage lithium-ion batteries and power infrastructure solutions for the telecom company's sites (Ericsson, 2018). This is expected to reduce Crnogorski Telekom's total cost of energy infrastructure ownership by 40%.

EDP (Portugal) Energy advice • Energy asset installation • Energy management

EDP has launched a smart home solution, "EDP re:dy", enabling the customers to manage their home equipment and energy consumption through a smartphone app (Smart Energy International, 2017b).

Google Nest (US) – Energy Management

Google Nest focuses on smart homes and automation. Google Nest has introduced new software that will help customers manage consumption when enrolled in a "time-of-use" tariff plan. As such, the thermostat can reduce consumption during periods of peak demand, thereby increasing cost savings (Mooney, 2016; Nest Labs, 2016).

Uplight (US) - Energy advice and Energy Management

The company Uplight provides a set of over 20 solutions, from behavioural energy efficiency and dynamic rates enrolment to an e-commerce marketplace and automated device control. It guides customers to the best individualised actions available to save energy, which in turn helps utilities shift load during peak periods. For example, during summer heat waves, the utility Consumers Energy achieved load shift of more than 74% when relying on Uplight's residential demand response programme. Uplight also offers EV owners EV specific rates and charging at ideal times through a variety of self-serve and targeted recommendations (Uplight, 2020)

Source: IRENA (2020), Innovation landscape brief: Energy as a Service, International Renewable Energy Agency, Abu Dhabi.

As illustrated, digital technology and energy services integration will allow ASEAN to deliver better Energy Market Design such as incorporating the time of use tariff approach or the flexible pricing mechanism for energy systems. In terms of bringing the concept of a market in the energy sector across ASEAN, Singapore was the first country to initiate a fully liberalized, competitive, and deregulated electricity market. The Philippines and Vietnam have followed a similar step by launching a competitive wholesale market for electricity. On the other hand, Thailand is yet to launch a similar market concept in electricity; however, the state-owned electricity authority has the power to purchase electricity from private players as well as from other ASEAN nations (Wu, 2012). Though trying to develop the market concept, Indonesia has not seen much success, whereas Malaysia only has partial liberalisation. Given the low level of market regions, the ASEAN has a long way to go to achieve full liberalisation, deregulation and restructuring of the power markets. Energy Market Design can facilitate different design of the energy market so that DSM of EE is managed more effectively. Innovative energy market leveraging on digital technologies not only providing energy as service facilities, but it can empower the way that energy market is designed in areas related to time of use tariff approach (Energy Pricing) or even the net billing scheme. As Table 32 shows, mapping and integrating areas of application, services and technology is critical to create the full ecosystem. For instance, integrating the energy supply market, ancillary and energy storage services can be critical and technology in terms of platforms may help realize the management of those services in the energy supply market. The conventional power supply market that is vertically integrated, centralised and asset-focussed can be turned to be distributed and horizontally networked system.

Table 32 ***Integrating Areas of Application, Service and Technology***

Areas of Application	Services	Technology	Examples
Energy Supply	Ancillary Services	Platform	Distributed energy resource interconnection portal Transactive energy
	Energy Storage	Batteries Power-to-anything (P2X)	Microgrid; Residential and Commercial Energy Storage
Energy Transition Enabler	Distributed Generation	Renewables	Solar, wind, fuel cell, combined heat and power and others
	Energy Load Balancing	Front End Algorithm	Monitoring and load management services
Energy Demand (Optimisation)	Energy Saving	Smart Meters	Demand response, building energy management, advanced metering services and energy efficiency
	External Energy Supply Optimisation	Software Application	P2P trading, real-time pricing

Source: Deloitte, 2019[21].

[21] The report is available at https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/energy-resources/deloitte-uk-energy-as-a-service-report-2019.pdf

Leasing model operation and subscription-based models become some of the new strategies in operating the new business models. Box 9 illustrate some of the application of such models.

BOX 9 BUSINESS CASE

SolarCloud, an Australian company, offers solar energy to customers without requiring them to have their own installations, and customers can "transfer" the energy supply contract to their new address if they move. This service encourages consumers that are paying rent or that are not confident about making an investment in their house to still opt for clean energy supply. The solar energy generated by these panels is used by businesses that pay a fee to SolarCloud, and the company in turn transfers the monetary benefits back to the panel owners.

BeeBryte, a France- and Singapore based "software-as-a-service" company, provides cloud-based intelligence software that can monitor real-time load in large commercial and industrial facilities. The software can automatically switch loads like HVAC systems to battery storage based on time-of-use charges and delivers up to 40% savings in utility bills. The demand-side management software is essentially an energy efficiency device switching equipment on or off.

Source: International Renewable Energy Agency, 2020.

4.5.4 Policy Recommendations for Innovative Business Models

The progress on emerging new business model for EE is limited within ASEAN. It is important that ASEAN consolidates the efforts of digitalisation and align some of these initiatives for energy saving efforts in various sectors.

Regulatory Framework – Operating and optimising digital technology for energy saving efforts requires new form of regulatory framework to govern such market. While ASEAN inspires to create the digital community, efforts for such initiatives requires ensuring proper reform in the existing regulatory framework to stimulate the needed environment. Regulations and framework related to data management, data sharing, energy management and others need to be revisited. Also, regulations related to encouraging decentralised power systems, retail markets and infrastructure utilisation should be revisited.

Building Partnership – The core to enable new business models for EE are stakeholder engagement at national and regional level. Private sectors can play critical role in terms of investments and financing the EE service-related opportunities. Indeed, developing partnership with private sector would require new partnership framework at national and municipality level. Partnership should also be built with network providers and consumers. In doing so, pilot projects can be designed and encouraged. Incentives systems should be further deliberated to encourage partnerships with private and consumers at large. This includes creating deployment framework for such new business models. Align customer incentives with operational constraints- activate demand-side management, assist with the integration of energy services.

Technology and Services Identification for EE initiatives – Engaging in new business models for EE initiatives using digital technologies requires AMS to identify the critical technologies and services that would liberate the DSM for EE. For this, ASEAN should identify the needed energy services and potential technologies further. Mapping exercise on the identification of such technologies would be important. The current initiatives such as smart metering is some of the AMS can be further expanded and technology and know-how transfers would be critical in countries that requires such expertise. Others include energy efficient devices and energy storage as well as smart home technologies such as energy management and other smart appliances. Data analytics and advances in software and technology provide new opportunities to help customers save money within the energy as service models. Indeed, energy management through software or ownership of electric devices provides societal benefits by better matching of electricity demand with supply and reducing emissions. Likewise, energy management solutions through monitoring, remote control, and optimisation of the load (e.g Smart home solutions) enables energy saving initiatives. These initiatives must be aligned with the current efforts of building smart cities framework which is ongoing in few of the AMS. Identification of the extend of product and services range can be made the priority to move forward.

Market Reforms – Energy market reform is essential. For the reform to materialise critical issues such as distribution system operation methodologies to account demand side flexibility should be explored further. Energy pricing could be another potential area where implementation of time-of-use tariffs as well as deployment of a combination of assets such as solar PV, battery storage, smart devices, and smart meters to optimise energy consumption can be explored including demand response services to system operators and small and medium enterprise. The market reform can cover various sectors.

Regional Cooperation – There is great potential to leverage on regional cooperation to ensure the application of new business models. This includes exploring and leveraging ASEAN Trade in Services Agreement (ATISA) to enhances the existing ASEAN services agreements related to energy service providers, technology platform services. Indeed, financing and investment facilitation can be explored within ASEAN to promote investments in these areas. The cooperation should consider facilitating trade in services for EE via cooperation among relevant stakeholders namely business communities, governments, academia, and civil society.

4.6. Policy Recommendations and Way Forward

As shown above, the study assesses the enabling environment of EE DSM in ASEAN in 4 critical areas namely the role of private sector focusing on ESCOs, EE financing, standard and labelling as well as exploring innovative business models aligning the digital technologies. Equally important, there are great opportunities to energy saving and government can encourage actions through EE programs and policies that can be applied in various sectors. In the long run, EE improvements can be realised by having effective EE DSM that encourages greater energy efficient technological deployment.

The next section highlight detail policy recommendations for each of the EE DSM pillars. As a way forward, Table 33 summarises the key challenges, policy recommendations as a way in prioritising actions and capacity development to facilitate and strengthen the enabling environment for DSM of EE. The cross-cutting themes that supports and reinforces each of the pillars namely strengthening the ESCOs, EE standard and labelling and EE innovative business models relates to: (1) Developing Institutional and Regulatory Framework including assigning lead institutions to plan, implement and monitor EE programs and policies (2) Leveraging EE financing and investments and (3) Phasing out energy subsidies in various sectors. The implementation of such actions should consider the development stage of each of the AMS given the evidence showed that the EE DSM efforts are uneven among the AMS.

Table 33 ***Prioritising Way Forward for ASEAN***

Enabling Environment	Key Challenges	Broad Recommendations
ESCOs	- Energy Policies- favouring fossil fuels in certain AMS. - Market readiness- lack of energy efficiency technologies and infrastructure. - Limited access to finance & financial incentives and high risk of investment. - Limited understanding of the benefits of energy efficiency.	- Review and amend EE laws with a focus on reducing regulatory barriers and support programmes that require more mandatory action from end-users. - Training and strengthening the quality of ESCOs. - Improving public procurement regulations. - Leverage finance for ESCOs (EPC contracts, PPP, and large-scale government programmes). - Intensifying ACE roles to Promote Knowledge Sharing and Knowledge Dissemination (e.g. making a path for ESCOs market; drafting EPC regulations or how to link ESCO with the carbon market).
EE Financing	- Fossil fuel subsidies. - Lack of information to EE reference projects. - High transaction cost- EE projects. - Lack of Capacity- mismatch between project size and funding requirements. - Lack of incentives for EE projects- tax exemptions, tax reductions. - Drawback of existing financial institutional setting- keen short-term lending rather than long-term investments.	- Disseminate information on EE technologies and projects. - Enhance innovative financing mechanisms. - Create intermediatory to coordinate and bridge ESCOs with various EE projects. - Assist EE project development/pipeline and/or bundling of EE projects. - Seek for broader allies (e.g. equity investors). - Intensifying ACE roles to promote knowledge sharing and knowledge dissemination (e.g.Thai ENCON Fund, regulations on EPC contracts, green bonds and PPP mechanisms).

Note: For details, please refer to the individual policy recommendations in the respective sections.

Enabling Environment	Policy Action	Capacity Development Opportunities
ESCOs	- Offer energy saving solutions to customers via national energy policy and energy related projects. - ESCOs need to be supported by an accreditation system for the customers. - Connect climate policy - NDC- with ESCO support programmes. - Ensure public procurement can be aligned with private sector engagements (e.g. ESCOs). - Support cross-institutional alignment across national agencies (e.g. Ministry of Energy, Ministry of Trade and Ministry of Environment). - Connect climate policy - NDC- with ESCO support programmes. (e.g. Japan/Korea).	- Include capacity building measures for (a) independent projects and market facilitators, (b) assistance and support for the preparation of investment grade audits, tenders, feasibility studies, and other activities mediating ESCO. - Initiate an energy audit support program- certified energy auditors. - Share experiences to build ESCO market via e.g. a Super- ESCO (India and China). - Promote digital technology monitoring technology.
EE Financing	- Align and incorporate ESCOs financing within ASEAN Sustainable Financing Taxonomy. - Provide instructions to banks to support green/sustainable finance. - Introduce carbon tax or trading schemes.	- Establish capacity building of developers for project pipeline- to make the projects attractive to commercial bank - Dialogue between the financial institutions and project developers- disseminate information on EE technologies and projects.

Enabling Environment	Key Challenges	Broad Recommendations
Standards and Labelling	- Low EE Product & Technology Adoption - Capability and Capacity in Standard and Labelling and Harmonisation) - Infrastructure (laboratory and testing facilities: - Data Availability: Data insufficiency- lack of updates real-time basis and unable to conduct a program evaluation - Technical Expertise: Lack of know-how - Harmonisation Challenges: (1) non-tariff barriers (confirmatory, labelling and testing), (2) Different localised test standards - difficult to harmonize appliance standards or labels, either programmatically or on the technical level. - Others: Lack of adequate legal framework and institutional structures, Lack of understating of the roles and coordination among various agencies involved, small country/ market - higher cost of compliance.	- Establishing Institutional and Regulatory Framework - Expanding the efforts of EE Standards and Labelling - Harmonisation of EE Standards and Labelling - Monitoring, Data Management and Database - Ensure Market Transformation
Innovation - Business Model & Energy Market Design	- Lack of regulatory reform - Financing and Investments in innovative business models - Technology Availability - - Market Related Challenges including (1) High upfront cost of technologies (2) Political and regulatory uncertainty (3) Immature market – high unit costs & default risk (4) Lack of local/regional manufacturing capability	- Develop Regulatory Framework for digitalisation initiatives for EE - Explore Partnership models - Identify technology and services EE initiatives - Explore Market Reforms in EE - Establish Regional Cooperation

Note: For details, please refer to the individual policy recommendations in the respective sections.

Enabling Environment	Policy Action	Capacity Development Opportunities
Standards and Labelling	- Identify and update the institutional and regulatory framework - Identify the list of appliances and equipment for expansions - Create programs to increase the update of EE appliances and equipment. - Establish data monitoring and Management centres - Harmonisation S&L: (1) Trade policy and EE policy should be aligned accordingly for countries to leverage EE technologies. (2) Harmonising and promoting energy efficiency standards and labelling on appliances and equipment. (3) Adoption of uniform regional test procedures and initiating regional labelling programs via test labs.	- Establish capacity development for standard and Labelling - Capacity development in establishing data/information sharing hub/centres regionally.
Innovation - Business Model & Energy Market Design	- Leveraging ASEAN Trade in Services Agreement (ATISA) to enhance the existing ASEAN services agreements. - Regional and international cooperation is required alongside establishing a supportive regulatory framework, which will attract foreign direct investments in digital technologies. - Explore new business models e.g. leasing model operation, subscription-based models, revision of distribution system operator methodologies to account for demand-side flexibility and others. - Leverage Industry 4.0 initiatives and technology platforms for Energy-as-services and Energy Market Design.	- Build capacity to incorporate Energy-as-services and Energy Market Design into policy documents - Establish technological capacity building and EE technology transfer (know-how) among AMS to foster innovation. - Create dialogue on regional cooperation for new innovative business models for EE.

5. APPENDIX

Appendix 1: Mapping EE trade flows of ASEAN

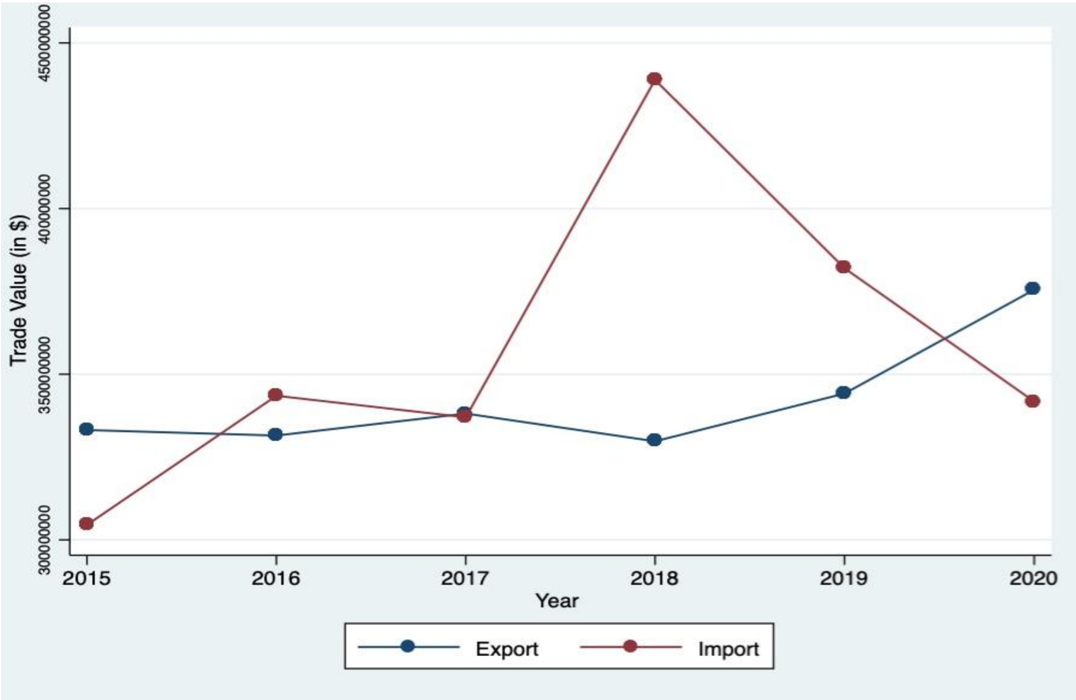
In demand side management of energy efficiency, trade plays an important role. Trade allows countries to export and import EE technologies and with trade, those technologies can be made available to the masses. Nevertheless, trade policy and EE policy should be aligned accordingly for countries to leverage EE technologies. Furthermore, market and non-market trade policies and regulations may restrict countries from benefiting for EE technology trade due to the local standards and labelling. One of the key strategic areas for energy efficiency and conservation strategies in the ASEAN Plan for Action for Energy Cooperation 2016-2025 (APAEC) is to harmonize regional standards to improve trade efficiency, reduce the energy system cost and improve the update of energy efficient equipment by reducing cost. And, linking the initiative to enhance intra-ASEAN trade and EE actions there is a potential to implement actions to integrate value chains of EE technologies through cooperation and trade among ASEAN members. In the context of regional cooperation and the prospect of better trade, this section closely looks into the ASEAN trade of selected EE technologies, identifying the potential to further enhance the ASEAN led supply chain for these technologies for EE DSM, especially in making these technologies available for adoption at a cheaper cost.

This section discusses the extent of trade flows among the ASEAN countries for the selected EE technologies. The trade flow for the ASEAN nations with the rest of the world for the chosen technologies is analysed based on the six-digit HS code closely representing the technology using the UN Comtrade database for the period 2015-2020. Looking at the existing trade flow data, it can be ascertained that there is growth in ASEAN sourcing of EE and RE technologies market. Hence there is also potential for integration in the global supply chain for the selected technologies. The trade mapping is done for selected technologies namely Electrical distribution transformers (HS Code: 850421, 850422), Room air conditioners (RAC) (HS Code: 841510), Refrigerators for household applications (HS Code: 841821, 841829), and Lighting (HS Code: 940510, 853950). These technologies have potential to reduce electricity consumption and contribute to energy saving. For instance, air conditioners, refrigerators and lighting contribute to more than 50% of electricity usage in the residential sector. In comparison, electric motors contribute to about 65% of electricity consumption in the industrial sector (UNEP, 2014). And the ASEAN Plan of Action for Energy Cooperation (APAEC) policy priority includes harmonizing and promoting energy efficiency standards and labelling various energy-related products. The prioritized focus is on day-to-day use products like room air conditioning and lighting. Indeed, those EE products that comply with MEPS as well as harmonised would have huge energy saving potentials.

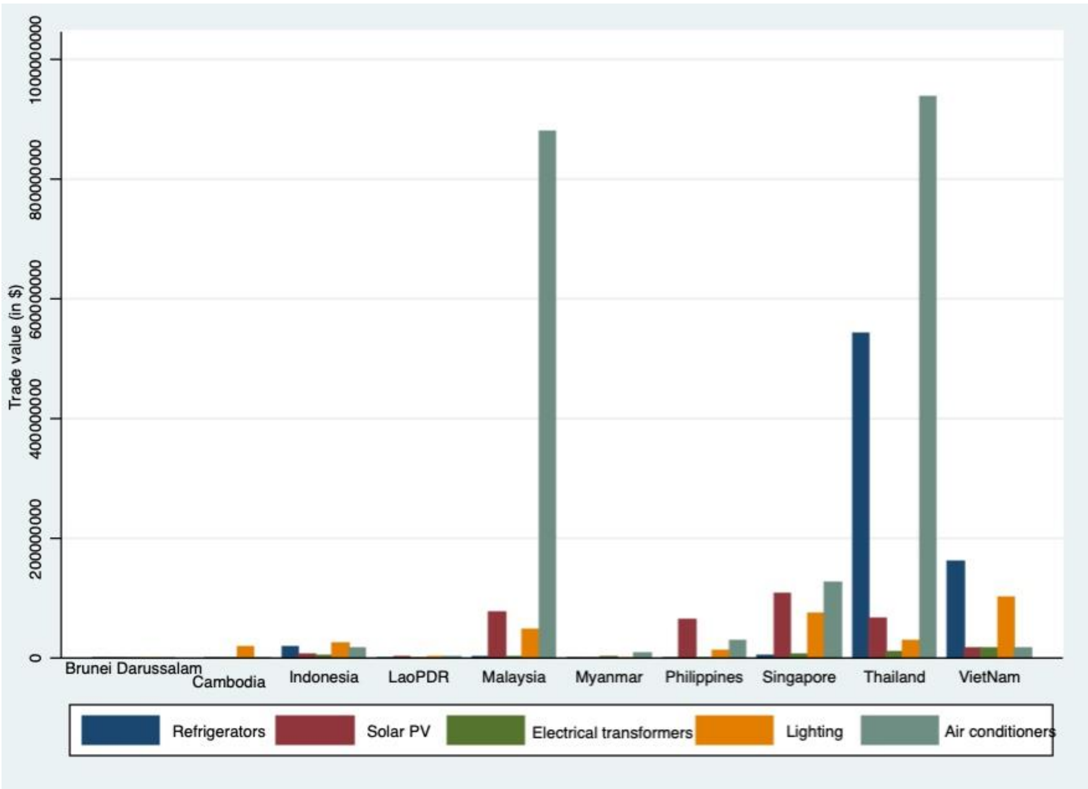
Figure 7 shows the ASEAN trade (overall trade, exports, and imports) with the rest of the world in selected technologies between 2015 to 2020. Country wide differences in export and import and the intra-ASEAN heterogeneity in trade are observed. Imports dominate trade in these technologies while for exports Thailand and Malaysia are dominant movers with stronger export capacity as well as manufacturing bases in RACs and Refrigerators.

Figure 7 ***Trade Flows of EE Products, 2015-2020***

Panel 1: Overall Trade: Exports and Imports on the Selected Technologies, 2015-2020

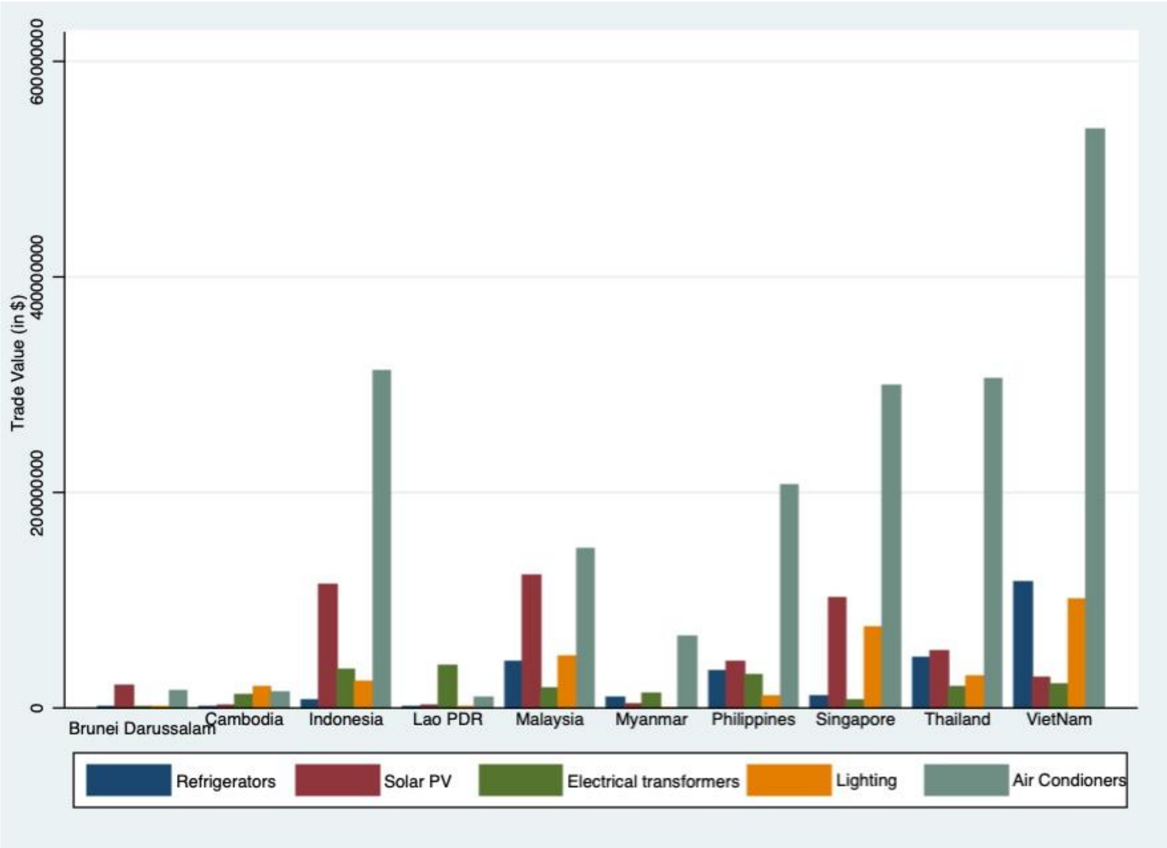


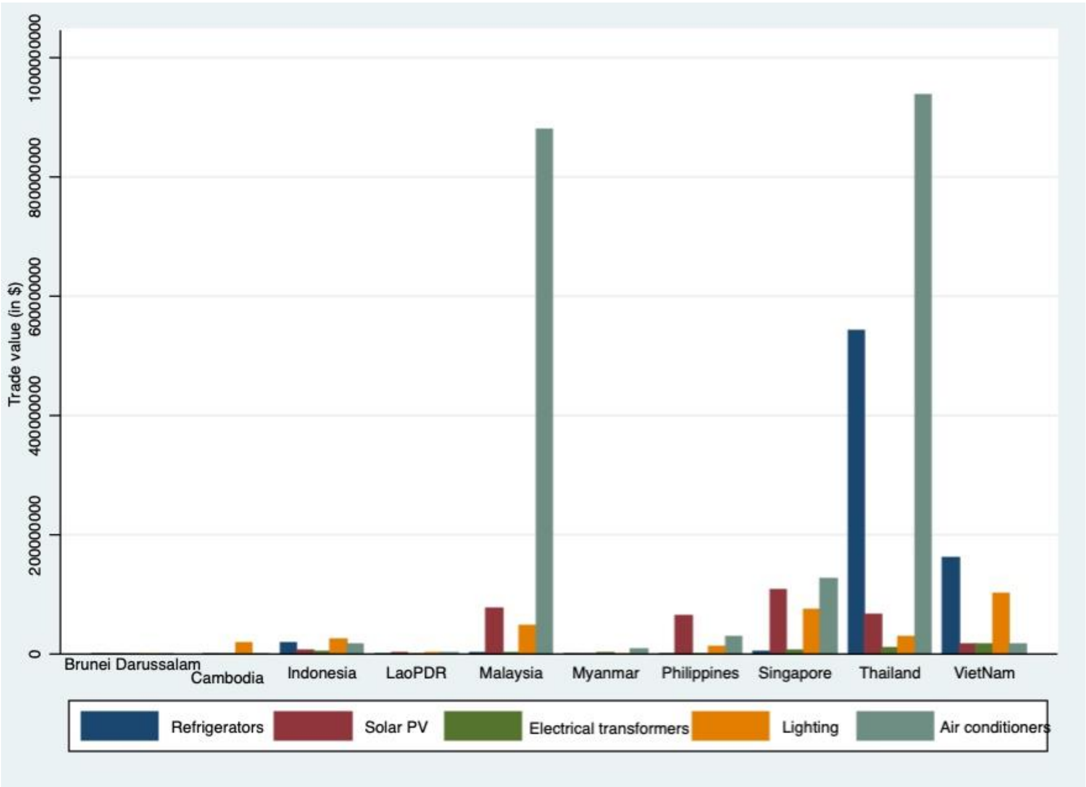
Panel 2: Exports of Selected Technologies, 2015-2020



Source: Computed from Comtrade, 2022.

Panel 3: Imports of Selected Technologies, 2015-2020





Source: Computed from Comtrade, 2022.

Figure 8 and Figure 9 show the trade in selected technologies namely distribution transformers, RAC, refrigerators, and lighting. Some of the observation at selected product and technology level indicates the following.

Distribution transformers: In ASEAN, the major end-users of the distribution transformer (mostly the wet-type transformer end users) are national/ public utilities and power companies. In 2015 the biggest markets having more than US$ 5 million were Thailand, Malaysia, Indonesia, Vietnam, Singapore, the Philippines, and Cambodia. In ASEAN, production/ manufacturing of distribution transformers is found in Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam (Goulden Reports, 2015). Figure 8 shows the extent of average imports and export for the period 2015 to 2020. It can be seen from the graph that all the ASEAN nations import transformers, and the extent of the gap between export and import is quite large for developing ASEAN nations. In this case, for nations like the Lao PDR, Indonesia and the Philippines, their imports dwarf the extent of exports. Vietnam's export value transformers (HS 850421 and HS 850422) rank the highest in ASEAN, followed by Thailand and Singapore. However, most of the exports for transformers occur within the boundary of the ASEAN, rather than with the rest of the world.

Room air conditioners (RAC): In terms of the market for RACs, Singapore, Malaysia, and Brunei drive the ASEAN demand for RACs. More than 78% of households and businesses own an AC. Whereas for countries like Cambodia, Lao, Myanmar, Indonesia and the Philippines, the ownership of ACs does not exceed 10%. In general, the prevalence of ACs is higher in the wealthier member states than in developing AMS. In this context, Singapore has a higher prevalence of ACs with inverters than ACs with no-inverters. This points to the fact that consumers in Singapore are better informed and aware of saving their energy bills using efficient technologies. Table 34 indicates the extend of local production and imports. Philippines and Singapore overwhelmingly import all of the RAC products. On the other hand, Thailand and Malaysia have significant local production capacity compared to other ASEAN members. Vietnam is building and improving its local production capacity for RACs. All of the ASEAN nations, except for Thailand and Malaysia, import RACs and the gap between export and import is relatively large (Figure 8). China is the world's largest AC manufacturer, but only 28% of imported ACs come from China in ASEAN, while 68% are imported from other ASEAN countries. The vibrant regional trade in ACs in Southeast Asia results from tariff reform. It is evident that most of these intra-ASEAN imports majorly come from Thailand and Malaysia.

Table 34 ***Local Production vs Imports, 2016-2016***

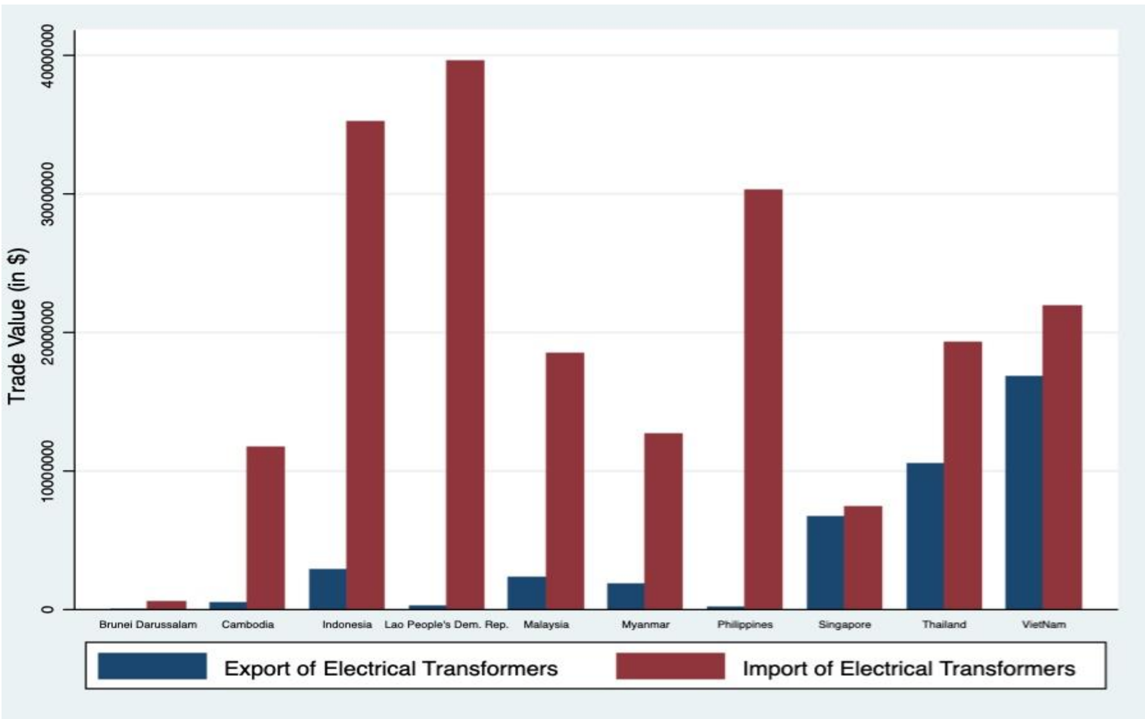
RAC production capacity	Indonesia	Malaysia	Thailand	Philippines	Singapore	Vietnam
Local production	15%	80%	82%	0	0	25%
Import	85%	20%	18%	100%	100%	75%

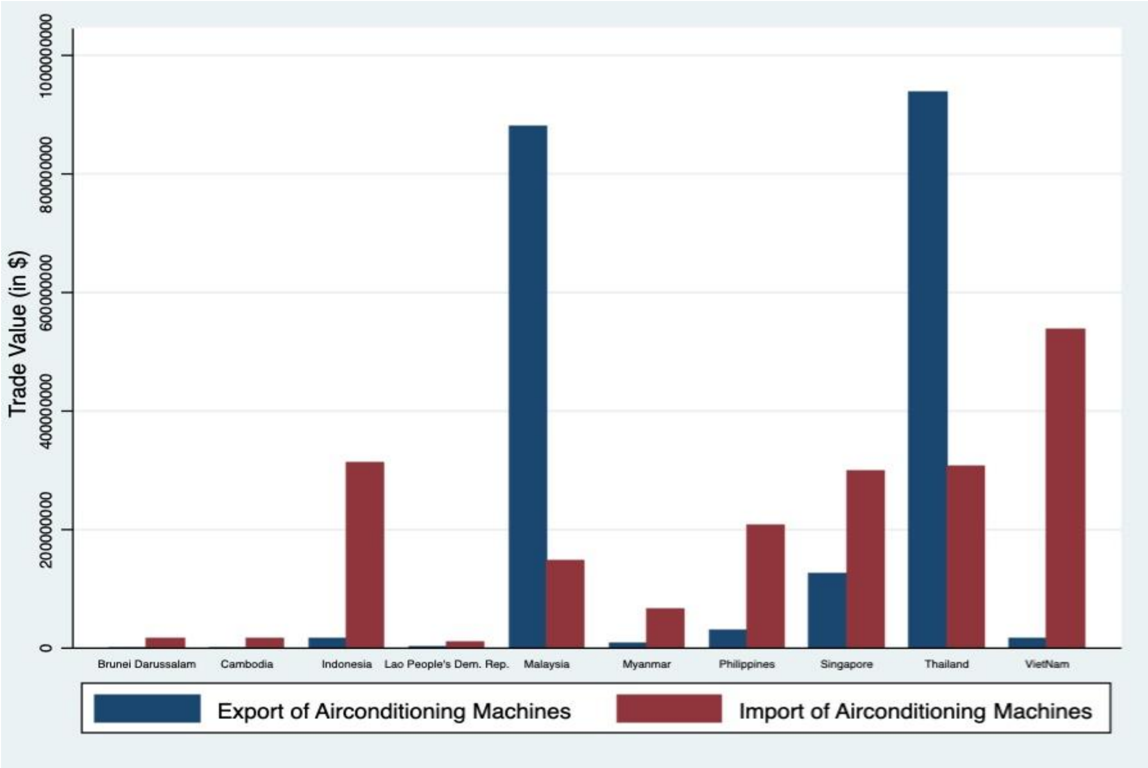
Source: United for Efficiency, 2022

Refrigerators for household applications: ASEAN market for refrigerators is dominated by Japanese and Korean brands (Asia Market Research, 2012) with a manufacturing hub established in AMS notably in Thailand with Vietnam catching up as a production hub. For instance, 80% of the Japanese brands and 40% of the Korean brands are manufactured in Thailand. The trade flows indicate that Thailand and Vietnam dominate the export of household refrigerators, representing about 88% of total ASEAN exports (Figure 9). Thailand's major export destination for refrigerators is the ASEAN block, and within ASEAN, it is mainly to Malaysia, the Philippines, Myanmar, and Lao PDR. It is also acknowledged that although the Philippines has local refrigerator manufacturing facilities, it barely meets the local demand; hence, the nation also relies majorly on imports.

Lighting: Estimates suggest that linear fluorescent lights are comparatively more prevalent in ASEAN than LED lights given the lack of demand and cost issues (DTIE-UNEP, 2016)**.** Nevertheless, their demand has increased in economically strong ASEAN nations and the market share for LED is predicted to increase over the next few years. Given that there are no separate HS codes for different types of light in the trade data, such as LED, CFL or linear fluorescent, we applied all lighting products, including LED to understand the trade flows. Based on trade flows, only to Vietnam, Singapore is significantly exporting within ASEAN and outside ASEAN. Most of the ASEAN export of Singapore's market destinations in ASEAN is for Indonesia, Malaysia, and the Philippines. The combined export of lighting from Vietnam and Singapore constitutes more than 75% of the total export of ASEAN. In intra-ASEAN trade for lighting, Malaysia, Vietnam, and Thailand mainly export, and more than 70% of export goes to Singapore. Nevertheless, ASEAN nations remain a major importing nations for lighting products (Figure 9).

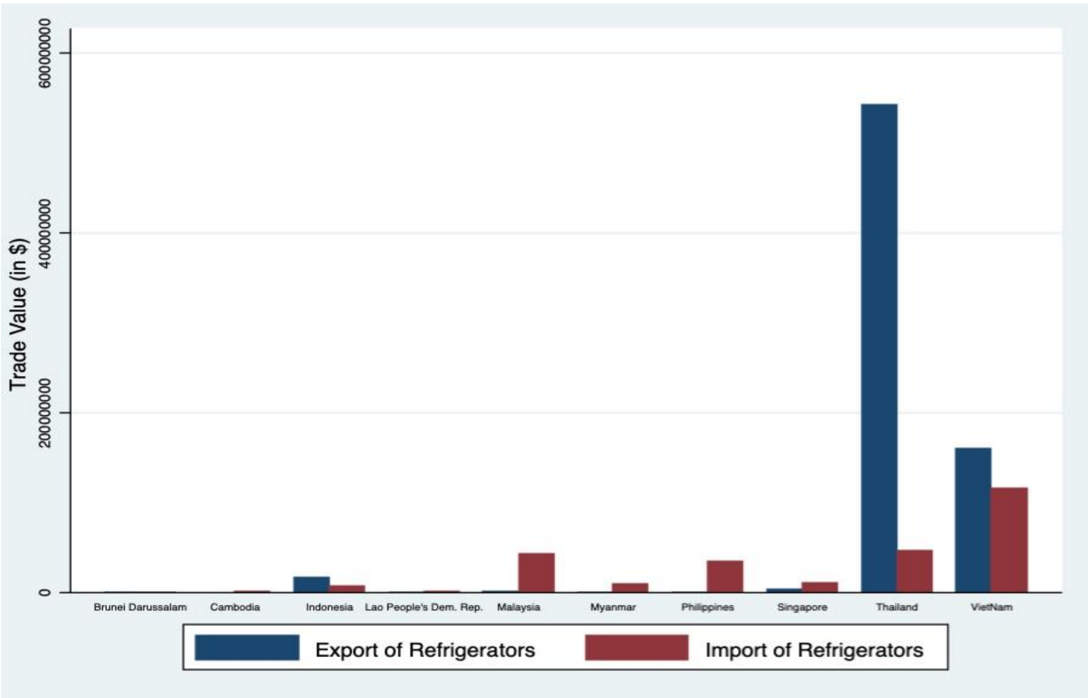
Figure 8 ***Average country-wise export and imports of Transformers and Airconditioning, 2015-2020****.*

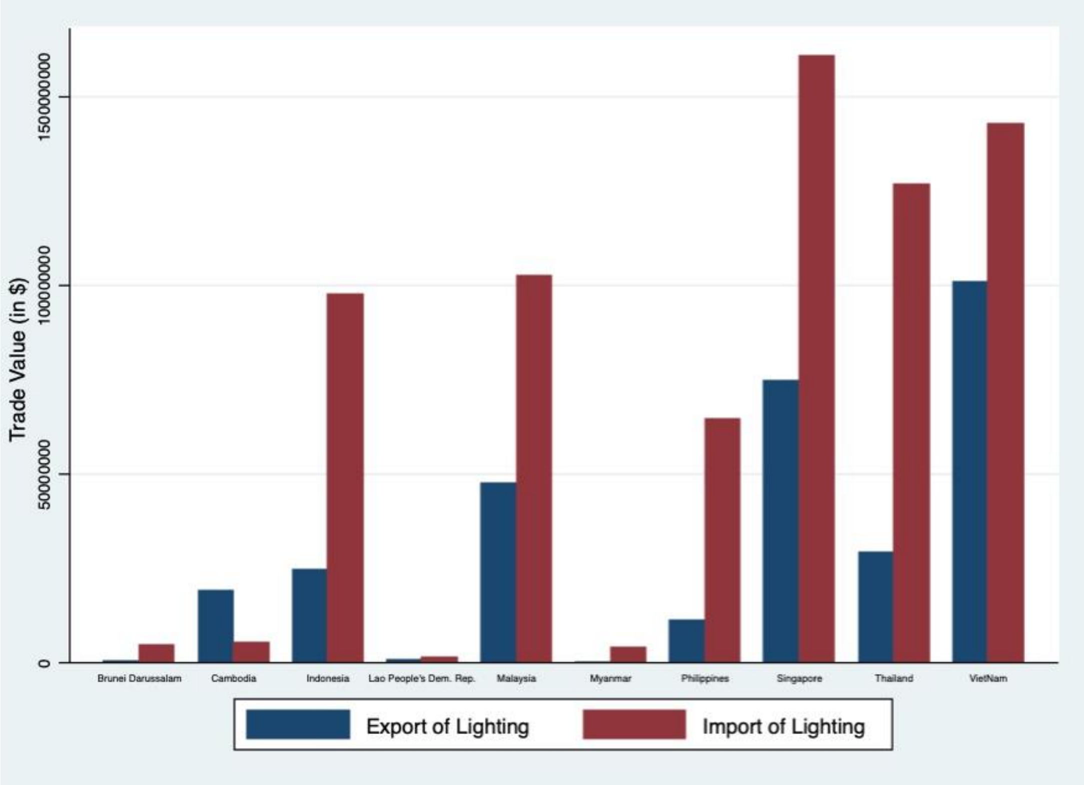




Source: Computed from Comtrade, 2022.

Figure 7: Average country-wise export and imports of Refrigerators and Lighting, 2015-2020.





Source: Computed from Comtrade, 2022.

Trade barriers for EE products: Tariff

This section discusses the institutional and regulatory factors that may potentially limit the trade in the selected technologies. In terms of obtaining licenses, Malaysia, Thailand, and Indonesia have a more favourable environment than other developing economies of ASEAN. Only in Thailand do processing licenses require less time, and the process can be described as somewhat less complicated. On the other hand, the days needed to get customs clearance shows that Indonesia and the Philippines have been comparatively slow in improving their policy and regulatory framework. Facilitating trade liberalisation and reaping the benefits of a liberal trade regime requires the creation of a favourable and less complicated regulatory and policy framework.

The first step toward trade liberalisation in ASEAN was the establishment of an ASEAN Free Trade Area (AFTA). A vital step in achieving the objective of AFTA is to liberalize trade by eliminating unnecessary tariff and non-tariff barriers among ASEAN countries. ASEAN nations have achieved slow yet significant progress towards the goal of free trade. For the technologies discussed in this section, under ATIGA, the preferential rate for ASEAN members is to apply "tariff-free" rates for many of the products. Theoretically, tariffs should not pose a significant trade barrier. However, for products imported beyond the boundary of ASEAN, tariffs still play a significant role as a trade barrier. In this circumstance, Singapore, the most developed nation in ASEAN and the trading hub, could play the role of trade facilitator for intra-ASEAN trade. This can be proposed because Singapore has the lowest "most favoured nation" (MFN) tariffs[22], with most tariffs for these products set to either zero or near zero. Table 35 shows the overall bound tariff rate and MFN tariff rates compared to the goals set by ASEAN Trade in Goods Agreement (ATIGA). It is evident from the table that the ASEAN members are way behind the goals set by ATIGA except for Singapore, and tariff rates still pose a significant barrier to achieving the optimum level of trade.

[22] A tariff level that a member of the General Agreement on Tariffs and Trade of the WTO charges on a good to other members, i.e. a country with a most favoured nation status (see UNCTAD, 2018)

Table 35 ***Overall tariff rates and MFN tariff rates in ASEAN nations in 2020.***

Countries	**Overall Bound Tariff[23] (%)**	**Average MFN Tariff (%)**	**Tariff under ATIGA for selected RE/EE technologies (%)**
Brunei Darussalam	24.74	0.21	0
Cambodia	17.57	10.4	0
Indonesia	35.21	8.1	0
Lao People's Dem. Rep.	18.15	8.5	0
Malaysia	15.41	5.62	0
Myanmar	28.73*	6.5*	0
Philippines	23.61	6.17	0
Singapore	5.76	0.08	0
Thailand	25.48**	11.02**	0
Vietnam	10.78	9.73	0

* Data only available till 2019; ** Data only available till 2015; Source: World bank trade database, 2020

Although most of the EE products are classified as "Zero Tariff" in most of the trade agreement (Regional & International) but the tariff for EE products components/parts still exist (see Table 36). In other words, the EE products cost is not relatively cheaper in terms of maintenance, and this will affect the consumption of such products in the market. Hence, harmonisation of those standards is critical so that compliance costs can be minimized. This section reviews the market as well as trade barriers that limit the demand side management of EE technologies.

Table 36 ***MFN Applied Duty (%) for Selected EE Components***

Product	PV Inverters	Solar power panels	Photovoltaic cells	Surge protection devices	Fuses and breakers	Charge controllers	Insulated wire, cable and other insulated electric conductors
Brunei	5	0	0	5	5	5	0
Cambodia	7	7	0	15	15	15	15
Indonesia	10	0	10	5	5	5	10
Lao PDR	5	5	0	5	5	5	5
Malaysia	1	7.5	0	1	1	1	10
Myanmar	0	0	20	0	15	0	30
Philippines	7	0	0	1	5	1	7
Singapore	0	0	0	0	0	0	0
Thailand	10	0	0	10	10	10	10
Vietnam	0	0	0	0	3	0	10

Source: Calculations based on World Integrated Trade Solution (WITS), 2018.

[23] The bound tariff is the maximum MFN tariff level for a given commodity line (See https://wits.worldbank.org/wits/wits/witshelp/content/data_retrieval/p/intro/c2.types_of_tariffs.htm#:~:text=The%20bound%20tariff%20is%20the,rather%20than%20actually%20applied%20rates. for details)

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