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ENERGY EFFICIENCY IN ASEAN: TRENDS AND FINANCING SCHEMES

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Abstract

ASEAN's unprecedented economic growth in recent years has required access to an uninterrupted energy supply across the region. As it plans to ensure a 20% energy intensity reduction by 2020 and 30% by 2025, ASEAN must realize and harness the benefits of energy efficiency and optimize its use for the regional and national energy sectors, which is now dubbed "first fuel" rather than "hidden fuel" or "fifth fuel" due to its viability and usability in the states.

Two ASEAN countries, e.g., Malaysia and Thailand, are already initiating advanced and innovative financial instruments and specialized financial models that offer the best of public and private sector participation and investment in energy efficiency projects. Based on common findings, other countries can also adopt the mechanisms for harnessing the maximum benefits of innovative energy efficiency initiatives.

This paper will discuss and analyze sectorial practice and challenges and policy instruments used for energy efficiency management in the ASEAN countries. It will also assess institutional capacity, financial mechanisms, and relevant cases of innovative financing schemes, energy investment mechanisms, and the integration modality of demand- and supply-side energy management. Based on the study's findings, finally, the paper will provide policy guidance aimed at achieving harmonized and sustainable management of energy efficiency for the ASEAN energy sector.

Keywords: ASEAN energy sector, energy efficiency, financing energy efficiency, financial models

JEL Classification: Q200

Contents

1. INTRODUCTION

1.1 Background of the Study

The Association of Southeast Asian Nations (ASEAN) is one of the most important participants in the global economy and energy portfolio and was considered the seventh-largest economy and the fifth-largest investment destination in 2016. As one of the largest economic coalitions, ASEAN has a cumulative GDP of USD2.5+ trillion. This robust economic growth has increased energy demand by 70% compared to the energy demand in 2000 and the region currently accounts for 5% of the total global energy demand. However, it is crucial to efficiently govern and use the finite energy resources to address the infinite energy demand and continue the unbridled economic development.

In this regard, the ASEAN countries intend to reduce the regional energy intensity (EI) by 20% by 2020 and 30% by 2025, relative to the 2005 level. As the region is experiencing increasing energy demand, each country will need to make a concerted effort to meet the projected target. More specifically, ASEAN should strengthen its cooperation in terms of effective policy development and harmonization. Most of the ASEAN states have already integrated relevant policies on energy management, which can be replicated by the remaining countries as successful cases. The potential and momentum of collaboration in reducing energy intensity and sustaining energy efficiency (EE) is one of the greatest drivers to foster dynamic regional and economic growth in ASEAN.

Energy efficiency is the concept of improving energy productivity, measured as the inverse of energy intensity, which implies increasing economic output per unit of energy consumed. It can reduce import dependency and result in less environmental pollution. It reduces energy consumption without trading off consumer usage or a country's energy competitiveness. For example, 1 MW of power saved through energy efficiency is equivalent to about 50% less than adding 1 MW from coal-fired power plants. Energy efficiency is increasingly becoming a critical consideration for countries, especially those in the ASEAN region, as a way to promote sustainable growth in the face of fast-growing energy demand. Widely known as a low-hanging fruit, energy efficiency is regarded as the fifth fuel for providing the "cheapest and cleanest" option for balancing between energy supply and demand for sustainable development. More recently, it has been termed "first fuel" from "hidden fuel" in the ASEAN context.

Some of the key trends in Southeast Asia (SEA) are discussed below:

- Indonesia accounts for 35%+ of the region's total energy demand.
- In terms of regional energy mix, ASEAN is dominated by fossil fuel (75%). The main forms of fossil fuels used are oil (34%), gas (22%), and coal (17%).
- The use of clean energy forms such as hydropower is growing rapidly.
- Although only to a small extent, solar PVs and wind-powered plants are being deployed in most countries.
- Although solid biomass is predominantly used for cooking, it accounts for a decreasing share of primary energy use.

- Most of the ASEAN member states (AMS) are adopting joint measures for addressing environmental concerns and energy security issues. To address the pressing problems with local pollution and carbon emissions, many countries are adopting revamped policy dimensions to reduce energy intensity and speed up the deployment of renewable energy (RE).

2. LITERATURE REVIEW

2.1 Nexus of Energy Access and Energy Efficiency: The ASEAN Landscape

ASEAN is assumed to hold the fourth-largest economy in the world by 2030 while the population will rise by 10%+ to 690 million by 2020. For harnessing and sustaining this growth, uninterrupted access to universal energy is absolutely crucial. More specifically, a huge investment is required in ASEAN's infrastructure and power generation capacity to meet the required energy demand, which has increased by 60% in the last 15 years.

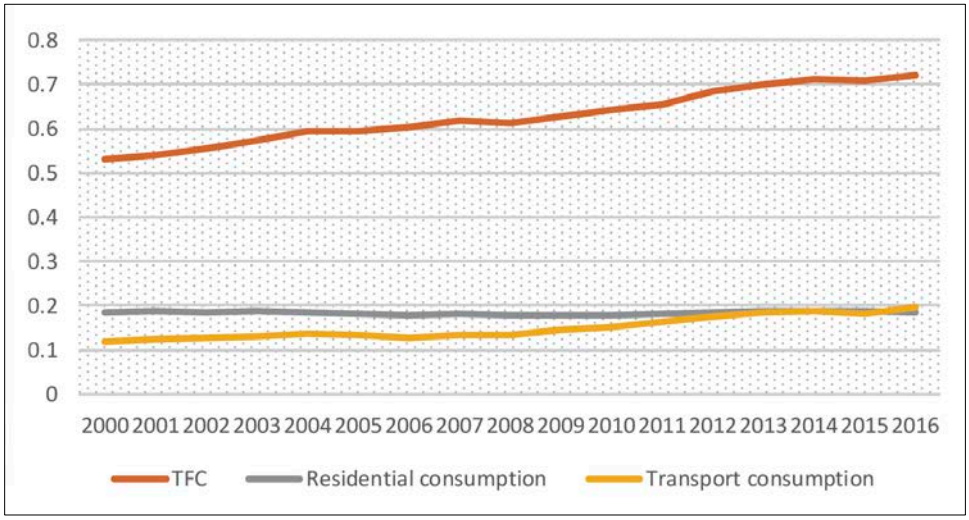
Robust economic transition and rising demography have increased energy demand 4.5 times in the total final energy demand over the period 1971–2015. One of the most effective ways to meet this increasing energy demand is to improve energy access in the region, which can be improved predominantly through energy efficiency. Of the 625 million people living in Southeast Asia (10% of the total population), about 125 million do not have access to stable electricity sources and 40% of the population relies on biomass. In the communities living in the remote islands of Indonesia and the Philippines, it is particularly difficult to provide electricity. Furthermore, the geographical distance among islands makes it difficult to connect macrogrids. Global Climatescope forecasts that the ASEAN countries will spend USD14 billion by 2030 to ensure universal electricity access. Among this population, 75% of the off-grid population will be served through remote microgrid systems where both the supply and demand sides of energy efficiency will be crucial in increasing the existing transmission, generation, and distribution networks (Brasington 2018).

It has been shown that only a 1%–4% investment in energy efficiency is sufficient to meet 25% of the projected increase in primary energy consumption by 2030. Twenty-five years from now, most countries in ASEAN will produce 50% or less energy than they require now. This will be achieved by harnessing the cost-effective investment where regional energy security will be boosted by lowering the need for imported energy (ADB 2013).

2.2 Growing Challenges of Future Energy Demand in ASEAN

Per capita total final energy consumption (TFC) in ASEAN grew significantly from 530.9 ktoe in 2000 to 721.7 ktoe in 2016 when per capita energy consumption dropped by 0.3% in the regional building and residential sector. However, the latter was offset by a 63.3% growth in the transport sector. Although 6 out of 10 ASEAN states are not energy-exporting countries, many of them will fail to maintain this self-independency in the coming decades, as energy demand and usage are rapidly exceeding domestic production and supply. Hence, it is crucial to manage and sustain energy demand growth to ensure energy security and sustainable development.

Figure 1: Trends in Energy Consumption per Capita in ASEAN



However, energy efficiency has different implications and dimensions in ASEAN because of the great intraregional economic disparity. Using UNDP taxonomy, in 2014, Brunei Darussalam and Singapore were classified as countries of "'Very High Human Development," Thailand and Malaysia fell into the category "High Human Development," Indonesia, the Philippines, Cambodia, Viet Nam, and the Lao PDR were countries of "Medium Human Development," and Myanmar was classified as a country of "Low Human Development." Within these broad categories, there were also large variations in the precise level of development a country has achieved, as reflected by disparities in HDI rank and value. Table 1 below displays each ASEAN member state's level of development next to its energy consumption. As illustrated in this table, energy consumption is positively correlated with development.

Table 1: 2014 Data on the Development and Energy Use of ASEAN Member States

ASEAN Member States	HDI Rank	HDI Value	Energy Use (Kg of Oil Equivalent per Capita)
Very High Human Development			
Singapore	11	0.912	5,122
Brunei Darussalam	31	0.856	8,632
High Human Development			
Malaysia	62	0.779	2,968
Thailand	93	0.726	1,970
Medium Human Development			
Indonesia	110	0.927	884
Philippines	115	0.668	476
Viet Nam	116	0.666	655 (2013)
Lao PDR	141	0.575	Data not available
Cambodia	143	0.555	417
Low Human Development			
Myanmar	148	0.536	293

The convergence between economic growth and energy consumption is worth consideration, especially when economic growth is dependent on structural and

infrastructural changes that are subject to changes in the gradual and economic development of the energy system. Therefore, we discover three energy transition processes, reflected by energy intensity trends in ASEAN. We can further theoretically establish a causal relationship between energy consumption and economic growth.

Households in countries classified in the "Low Human Development" and at the lower end of the "Medium Human Development" categories, due to high rates of poverty, are less able to afford the use of electricity or alternative energy sources. These factors contribute to the low energy use of these countries since many of their residents are excluded from energy consumption.

Countries classified at the higher end of the "Medium Human Development" and in the "High Human Development" categories are in the process of transitioning to higher energy consumption due to their greater wealth. Additionally, the process through which they develop necessitates higher energy consumption due to the installation of manufacturing and processing systems as well as the construction of new facilities to attract investment. To stimulate economic growth, Thailand has invested in numerous large-scale infrastructural development projects such as roads to facilitate trade by improving connectivity in the Greater Mekong Subregion. The Indonesian government, in 2015, also embarked on an extensive infrastructure improvement plan to boost foreign investment.

Countries in the "Very High Human Development" category exhibit high rates of energy consumption as their populations are generally able to purchase high amounts of energy. As these populations are also accustomed to, and desire, a high standard of living, they also demand higher energy consumption to support access to a multiplicity of services and goods.

3. ENERGY EFFICIENCY IN ASEAN

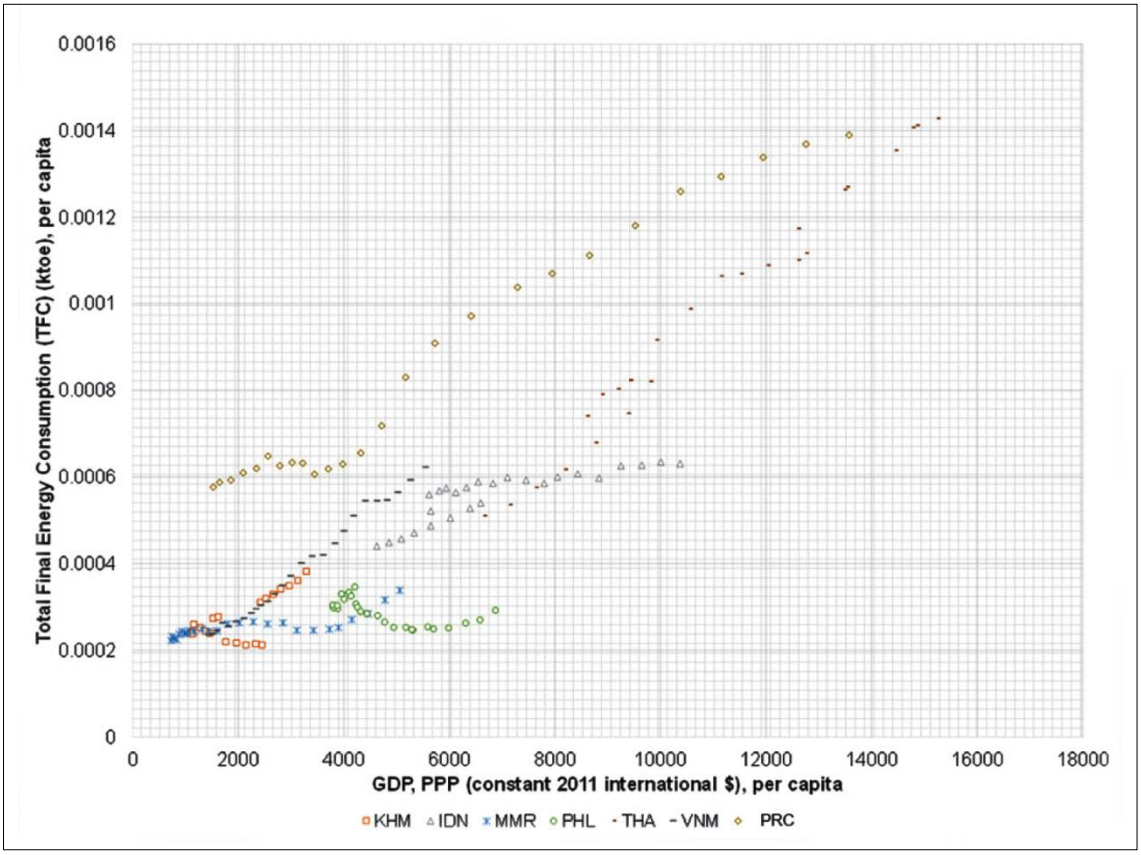
3.1 Trends in ASEAN

In the scatterplot in Figure 2, we have charted the relationship between per capita GDP and per capita energy use for six ASEAN countries: Thailand, the Philippines, Indonesia, Cambodia, Viet Nam, and Myanmar. The People's Republic of China (PRC) is used as a benchmark as its economic growth occurred in the same time frame and at the same rate as that of the fastest-growing ASEAN economies.

Beyond illustrating a general relationship between TFC per capita and GDP per capita, Figure 2 provides notable details on energy growth trends in ASEAN.

First, at present, the TFC per capita in Thailand is surpassing that in the PRC and expanding quickly. Thailand's current income per capita of USD15,000 exceeds that of the PRC and is on a par with that of the Republic of Korea in 1989 and Japan in 1968. Based on a simple linear regression performed on data from 2007 to 2015, a 1% change in Thailand's GDP was associated with a 1.308% change in its TFC. If all other states in ASEAN follow Thailand's trajectory while economically growing at the same rate as they did from 2007 to 2015, the energy consumption will be approximately 1,228 Mtoe in 2030 – an increase of 783 Mtoe. The slopes of the curves for Viet Nam and Cambodia already show the same upward trend as Thailand's and the TFC per capita in Viet Nam is the highest at the same level of GDP per capita across ASEAN.

Figure 2: Energy Use per Capita



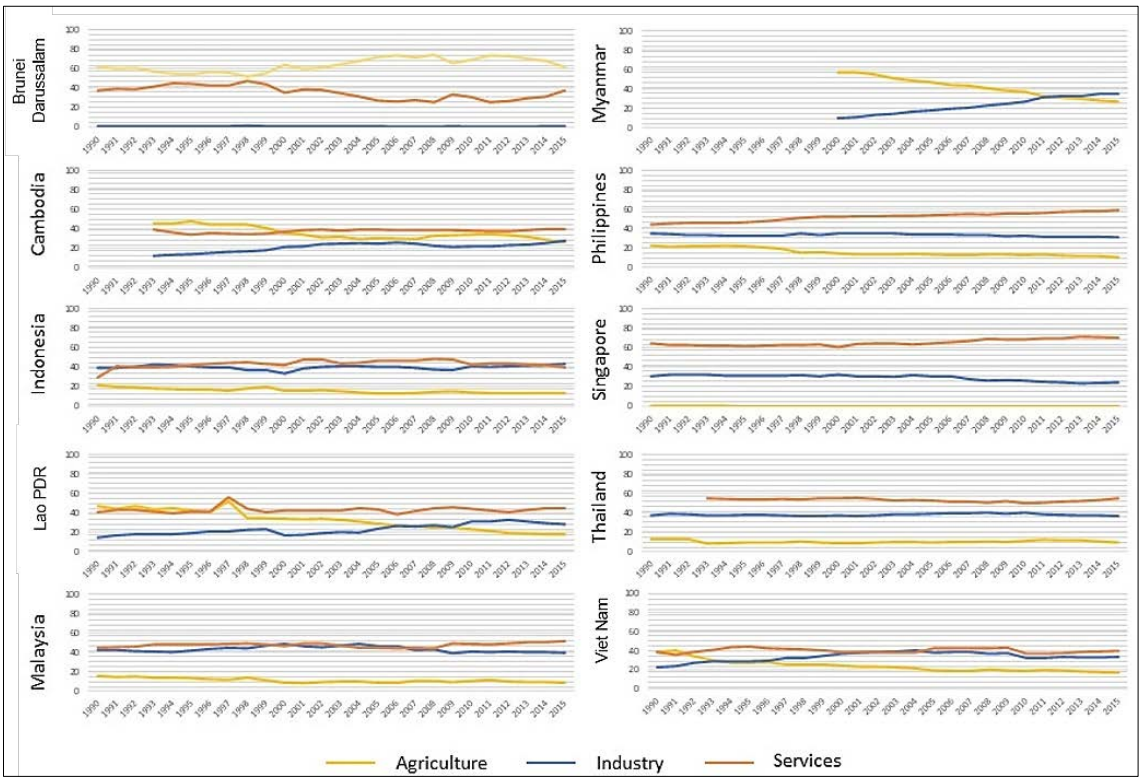
Second, while the relationship between TFC and GDP per capita is linear for most countries in Figure 2, which for Myanmar and the Philippines is U-shaped, and likely announces the beginning of exponential growth. Increases in energy consumption are likely to sharpen accompanying increases in GDP in these two countries. Hence, Myanmar and the Philippines will need to investigate and implement effective policies to reduce energy intensity.

Second, according to this figure, Cambodia, Viet Nam, and Thailand experienced the highest rise in TFC relative to GDP per capita, whereas Indonesia, Myanmar, and the Philippines experienced much more modest increases in TFC per capita. How can this difference be explained?

We first examine whether this difference can be explained by variation in economic structures. The conventional wisdom that aims to explain the relationship between energy consumption and economic growth posits that energy consumption is intimately related to the economic structure of a country. Given that development theory argues that the economic structure of a country is linked to its developmental phase, since countries transition from specializing in agriculture to industrial economies and finally to tertiary and quaternary service-based economies, it would follow that economic growth is related to energy consumption. This would suggest that economic structure, not economic growth, is the primary factor that influences energy consumption, given that it is the intervening variable through which economic growth results in higher energy consumption. Presumably, a country's energy consumption depends on its economic structure as industrial processes are highly energy-intensive relative to agricultural processes and the provision of services.

However, a closer look at data on the economic structures of ASEAN member states will inform us that the different economic structures in ASEAN are not a key explanatory factor of the differences in rates of increase in energy consumption alongside economic growth.

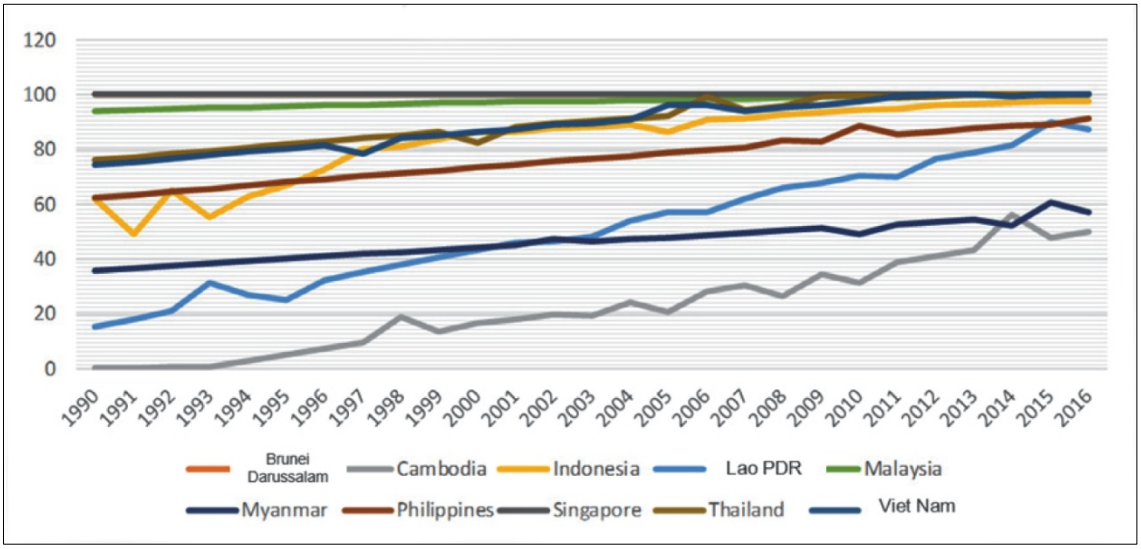
Figure 3: Economic Structure of Different ASEAN Member States



As shown in Figure 3, Indonesia and the Philippines have similar economic structures that were largely static between 1990 and 2015. However, compared to the Philippines, Indonesia's energy consumption per capita rose more dramatically as its GDP per capita rose. At the same time, while Viet Nam and Thailand have different economic structures, as Thailand has a larger service sector and Viet Nam's economy is more agriculture based, their energy consumption trajectories in Figure 3 are similar.

An examination of more data regarding the characteristics of these countries would lead us to conclude that perhaps differences in electrification rates are the main determinant of energy consumption in the ASEAN region. Thailand and Viet Nam, on the other hand, have the highest electrification rates, as shown in Figure 4, which could explain their comparatively higher rates of energy consumption relative to GDP. However, Cambodia is still anomalous, as it has the lowest electrification rate but has the highest TFC per capita when compared to Myanmar and the Philippines, countries in which residents have greater access to electricity.

Figure 4: Electrification Growth among ASEAN Member States (1990–2016)



As regards EI reduction trends, energy intensity levels experienced the sharpest decline in the least developed countries, i.e., Cambodia and Myanmar, even in the virtual absence of energy efficiency policies. This appears to be counterintuitive, but may be explained by the transition from the application of biomass-generated energy like straw, firewood, and coal to traditional commercial energy such as liquefied petroleum gas (LPG), electricity, and solar energy. This transition enabled a significant reduction in per capita energy consumption that led to a huge improvement in energy intensity.

Electrification rates therefore do not completely explain energy trends in ASEAN: While higher electrification rates may mean higher energy consumption, in the early stages of electrification, they may also mean a concerted government effort to switch from inefficient means of energy production to more efficient methods. Energy consumption per capita may therefore follow a U-shaped curve when plotted against electrification rates. Indeed, Viet Nam and Thailand, which exhibit the highest electrification rates and electrification growth, also experience the strongest growth in TFC relative to GDP, whereas the Philippines and Indonesia, which have experienced slower rates of growth in electricity access, have a flatter TFC relative to GDP slopes. This also explains the anomalous result described earlier: Cambodia is still in an early stage of transition to more energy-efficient sources, which is why its energy intensity remains high as electricity consumption outstrips the rate of increase in energy efficiency. However, energy intensity in Cambodia has been falling in recent years, and as Cambodia continues on its electrification path it is likely too that per capita TFC relative to GDP will fall more rapidly.

To summarize the energy transition stages, with increasing income, households and industries in ASEAN member states adopt more advanced commercial energy as substitutes for traditional energy. This is in line with the energy ladder hypothesis, a concept attributable to Hosier and Dowd (Hosier and Dowd 1987), whose paper was one of the first to discuss the relationship between economic development and the type of fuel predominantly used. The hypothesis states that as national income rises, a country consumes more energy-efficient fuels that can be said to occupy higher rungs on the energy ladder. Indeed, one of the core energy transition processes that emerging ASEAN countries are undergoing is the switch from low-efficiency to high-efficiency fuels. Offsetting this reduction in energy intensity is the increased consumption of energy resulting from the rising affluence of a country. With growing incomes and

improving living standards, the population will access more energy-consuming products and services, and the economic production of the country may be dominated by energy-intensive activities. This increases energy intensity, explaining the flat trends of energy intensity in Thailand, Malaysia, and Brunei Darussalam.

3.2 Energy Targets

Moving beyond energy trends to look at concrete actions states have taken or intend to take to ensure enduring progress in energy efficiency, the ASEAN Plan of Action for Energy Cooperation (APAEC) designated collective energy targets for all member states in 2015. These targets included a 20% energy intensity reduction by 2020 and 30% by 2025 relative to the 2005 levels, and a 23% renewable energy share in the total primary energy supply (TPES) by 2025.

So far, ASEAN has progressed in meeting its joint energy intensity reduction targets, and at a good pace in terms of harnessing a more sustainable and secure future. Surpassing its 2020 target, ASEAN had already reduced energy intensity by 21.9% by 2016. At an MoU between ASEAN ministers and the International Renewable Energy Association (IRENA) in October 2018, this achievement was extolled by the ministers as a sign of progress and an augury of future success in the area of energy conservation. Although a praiseworthy initiative, it also raises questions about whether APAEC set targets that were unmeaningful.

To demonstrate how APAEC may benefit from setting more ambitious targets, if we take the differential between APAEC's 2020 and 2025 EI reduction targets—5% every five years—to be indicative of the trajectory APAEC seeks to achieve, then its 2035 goal is likely to only stand at 40%. This target is short of the Asia-Pacific Economic Cooperation (APEC) aggregate 2035 energy intensity reduction target of 45%. Perhaps this difference is qualified by the economic disparity between ASEAN and APEC states, since APEC has a higher average GDP per capita. However, if the ASEAN states continue to reduce energy intensity at 2% per year until 2030, this will amount to a 30% reduction in energy intensity by 2020, and an estimated 50% by 2030. This means that if ASEAN continues the current trend, it will achieve the 2025 target five years ahead of schedule.

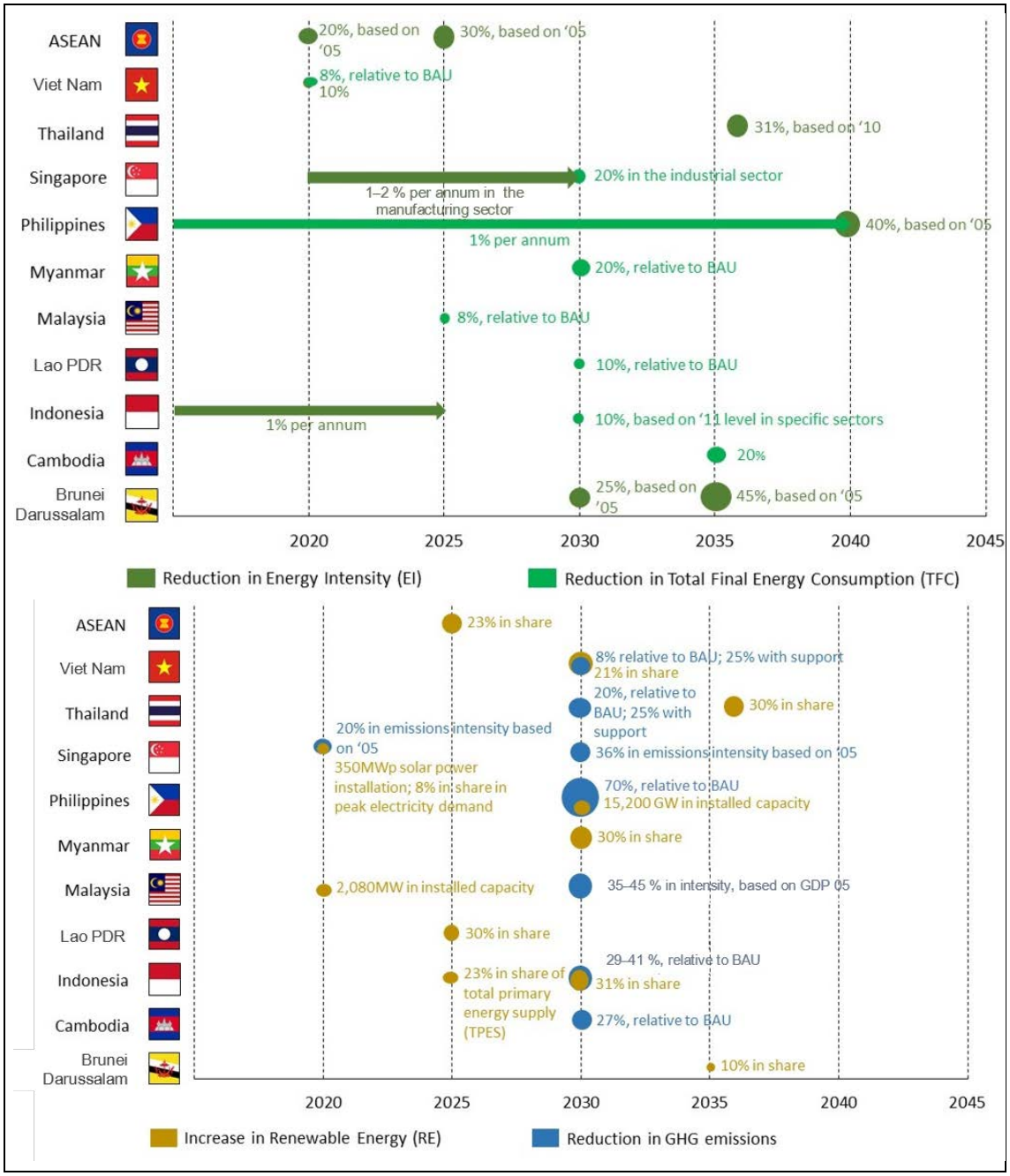
Given the likelihood of exponential growth in energy intensity reduction, the gradated targets may forecast the reduction conservatively. As the state governments adopt strong policy measures and deploy reassuring financial instruments conducive to energy efficiency, all energy industries develop in a self-sustainable way in these countries. If the governments and regulators place more emphasis on energy efficiency, more market options, products, and market entrants and competitions will follow, which will ensure further a reduction in the energy intensity rate and consequently tremendous market growth. APAEC may issue further aspirational goals and targets, i.e., mandating the states to remain active in the pursuit of energy intensity reduction even after they achieve their business-as-usual (BAU) targets.

Sharper reductions in energy intensity are desirable even though ASEAN has discharged its responsibility to become more energy efficient and sustainable, because a progressively higher reduction in energy intensity rates benefits economic growth. First, higher energy efficiency reduces the expenditure each ASEAN member state allocates to energy, relative to its GDP. Second, the zealous implementation of energy policies may result in higher rates of research and development in the energy sector, potentially breeding innovations in energy efficiency. ASEAN states can then capitalize on opportunities in the greenifying global market. Additionally, as ASEAN member states experience economic growth, the energy demand in ASEAN rises. Without an accompanying increase in energy efficiency that overwhelms and offsets the growth in

energy demand, the TFC in ASEAN will continue to grow. Although the current energy intensity reduction trend, if it does not abate, will mitigate some of the environmental impact of energy demand increases in the future, it will be insufficient to eliminate the prospect of more damage wrought on the environment.

Beyond the aggregate targets, ASEAN member states have also specified energy efficiency targets for their own countries to aspire to. These are showcased in Figure 5a and Figure 5b.

Figure 5a: EI and TFC Targets Designated by ASEAN and ASEAN Member States



While the establishment of national-level targets implies that each member state is committed to increasing energy efficiency in the region, the diversity apparent in these

targets may jeopardize regional cooperation to increase energy efficiency. Across ASEAN, each country has created a dedicated timeline and demarcated its national areas of focus. Such specificity allows countries to nuance targets to their unique characteristics and interests but may result in negative spillover effects on other states that result from uncoordinated policy action.

There are a few more problems with the designated targets. First, each of the AMSs has multiple timelines for their targets ranging from short- and medium term (2020–2025) to long-term (2035). Second, the targets specify multiple emissions-intensive sectors (electricity, commercial, transport, industrial, etc.) and renewable energy sources (solar, wind, biomass, etc.). Third, the energy efficiency targets vary in terms of energy-related indicators on the supply side (TPES, installed electricity capacity) and demand side (TFEC, electricity consumption). Fourth, only half of the AMSs have committed to a national GHG emissions target in their NDCs. Finally, and most critically, all the targets are specified in relative terms (as per GDP or a year-wise baseline) and not as absolute values.

3.3 Investment in Energy Efficiency

Driven by massive industrial growth, energy demand in Asia and the Pacific is projected to increase by 200% between 2010 and 2035, reaching more than 16,169 TWh by 2035. Unless any alternative measure is taken, the region will need investment of approximately USD11.7 trillion in the power and energy sector. For the same MW power generation, it will take about 1.8 times (average) more investment than fossil fuel-based technologies.

The following table shows energy capacity assessment and required investment in the 2016–2025 for the ASEAN states:

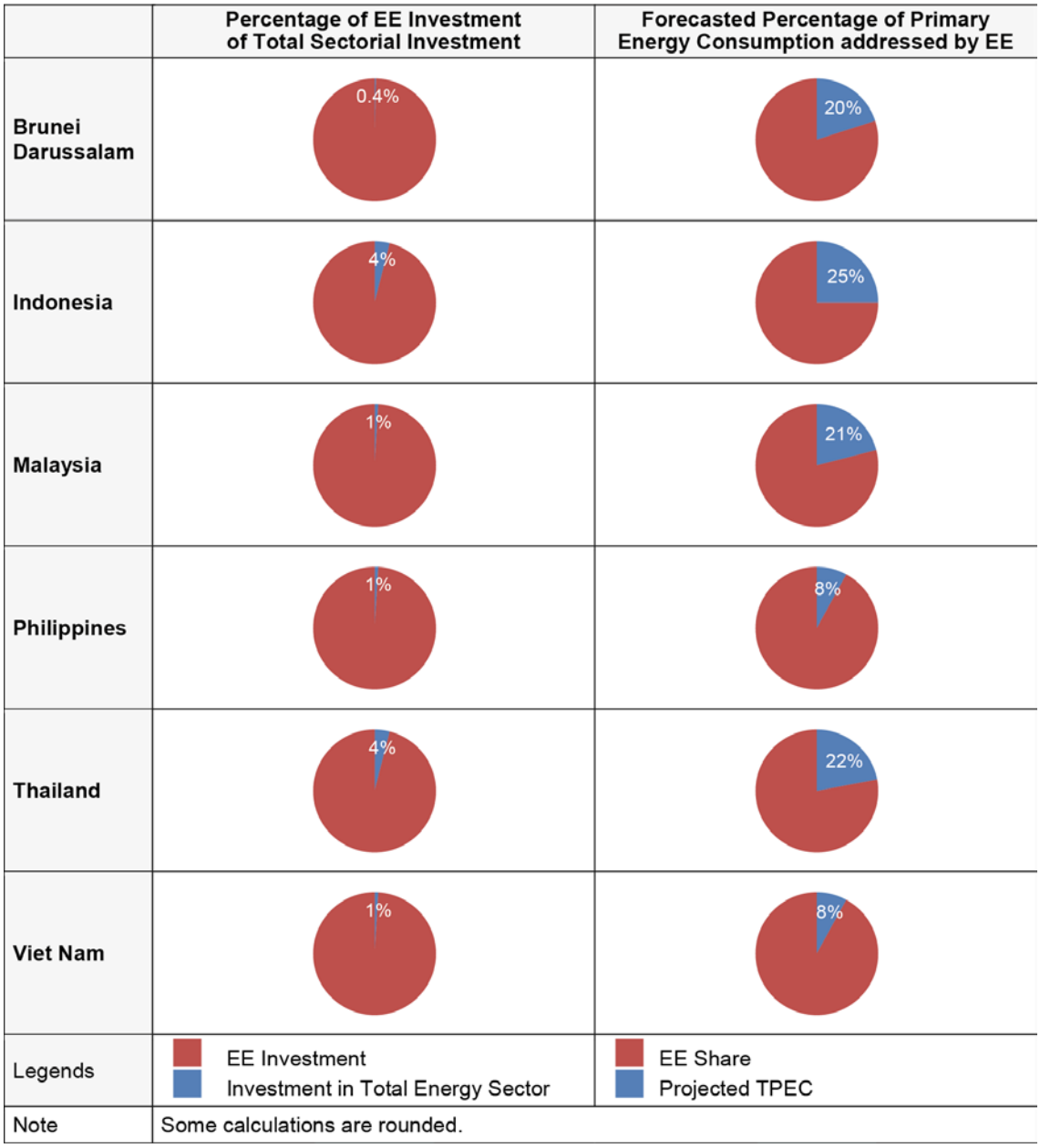
Table 2: Need Assessment and Investment Required Between 2016 and 2025

AMS Economy	**Capacity/Need Assessment**	**Required Investment** (USD million)
Brunei Darussalam	N/A	48
Cambodia	N/A	126
Indonesia	56 GW of additional capacity is required according to RUPTL 2018–2027 (PWC Indonesia, 2018).	6,019
Lao PDR	N/A	29
Malaysia	N/A	901
Myanmar	Myanmar has massive demand for power. However, most government policies do not cover any investor interest.	165
Philippines	N/A	601
Singapore	Overcapacity in Singapore with Malaysia unlikely to require much additional capacity.	97
Thailand	Overcapacity in Thailand with Malaysia unlikely to require much additional capacity.	2,006
Viet Nam	Additional 90 GW of new IPP capacity to be required by Viet Nam by 2030.	649
ASEAN Total		10,641

Sources: Sector Study on Environmental Services: Energy Efficiency Businesses, International Institute for Energy Conservation (IIEC) (2017); and ADB calculations (ADB 2013).

Assuming national energy efficiency targets are met, Figure 6 shows the predicted impacts of investment in energy efficiency by 2030. In Malaysia, the Philippines, Indonesia, Thailand, Brunei Darussalam, and Viet Nam, an energy efficiency investment increase of a mere 1%–4% in the total energy investment serves to meet 8%–25% of the forecasted increase in primary energy consumption. This projection provides relevant reinforcement of energy efficiency as a least-cost method to address ASEAN's growing energy demand.

Figure 6: Energy Efficiency in Forecasted Energy Investments and Primary Energy Consumption in ASEAN



Source: Data from ADB (2009a) and IEEJ.

4. FINANCING SCHEMES FOR ENERGY EFFICIENCY

4.1 Institutional and Policy Framework of ASEAN EE&C

EE improvement, i.e., harnessing energy accessibility, security, and environmental sustainability, has been set as one of the region's top priorities. All of the regional countries have adopted adaptive energy efficiency policies to maximize energy savings in different sectors. Most ASEAN countries have adopted and enacted required acts, laws, and regulations, prioritized a focus on energy conservation, and designated mandated agencies to formulate strategies to promote energy efficiency and conservation (EE&C). Different policies and programs set by different ASEAN countries targeting a designated energy-saving portfolio are shown below in Table 3.

Table 3: Policy Framework and EE Targets in AMSs

Country	EE Targets of AMSs
ASEAN region	• By 2020, 20% reduction of energy intensity and 30% by 2025, relative to a 2005 baseline
Brunei Darussalam	• TFEC reduction of 63% and EI of 45% by 2035 (based on 2005 level)
Cambodia	• TFEC reduction of 20% by 2035 (BAU)
Indonesia	• TFEC reduction of 17% in industry by 2025, 20% in transportation, 15% in household, and 15% in commercial building (BAU) • Achieve 1% EI reduction per annum till 2025 and energy elasticity of less than 1 by 2025
Lao PDR	• Reduce TFEC by 10% by 2030 (BAU)
Malaysia	• Reduce TEFC electricity consumption by 8% by 2025 (BAU)
Myanmar	• Reduce TEFC electricity consumption by 20% by 2030 (BAU)
Philippines	• TFEC reduction of 1% per annum until 2040 (BAU), equivalent to the reduction of 1/3 of total energy demand. • Reduce energy intensity by 40% by 2040 (based on 2005 level)
Singapore	• EI reduction of 35% by 2030 (based on 2005 level)
Thailand	• EI reduction of 30% by 2036 (based on 2010 level)
Viet Nam	• TFEC reduction of 8% by 2020 (BAU) • EI reduction of energy-intensive industries of 10% by 2020

Sources: ERIA Annual Report 2016 (ERIA 2017), 5th ASEAN Energy Outlook 2017 (Energy 2017).

4.2 Financing Schemes and Instruments for EE&C Projects Used in ASEAN

Some of the ASEAN countries, such as Malaysia, Indonesia, Thailand, Singapore, and Viet Nam, have been able to develop more advanced financial schemes, frameworks, and instruments to finance EE&C. For instance, Thailand has initiated the Energy Efficiency Revolving Fund (EERF), which allows stakeholders and participants from the private sector to use the paid-back funds when the projects go to operational and implementation stages. Similarly, Malaysia has implemented the Energy Performance Contracting Fund (EPCF), which utilizes government guarantees to make the projects more bankable and commercially lucrative for investors. Malaysia has also developed the Sustainability Achieved via Energy Efficiency (SAVE) program, which deploys rebates as a cost-effective way to promote the adoption of efficient technologies in households.

Singapore has several financial instruments to finance energy efficiency projects, such as the Energy Efficiency Fund (E2F), which is used for the industrial sector, and the Green Mark Incentive Scheme (GMIS), which is used for the residential sector. Indonesia has developed several financial options, such as the Infrastructure Fund and the Viability Gap Fund (VGF), which are used for financing eligible energy infrastructure projects that lack proper investment capital and financial viability. Viet Nam has deployed several financing schemes, including the National Technology Innovation Fund (NATIF) and the Viet Nam Environment Protection Fund (VEPF), along with the Viet Nam Development Bank that can also be used to finance EE&C projects.

Table 4: Energy Efficiency Policies in ASEAN Member States

ASEAN-wide Projects	**ASEAN Energy Management System (AEMAS)** Training and certification of energy managers from various companies **ASEAN+3 Mitigation Cooperation** Competition with th Republic of Korea in expertise pooling on GHG reduction			**ASEAN-Japan Energy Efficiency Partnership (AJEEP)** Cooperation between Japan and ASEAN in information sharing and opportunity creation **Energy Conservation Workshop under AJEEP (ECAP)** Cooperation with Japan in hosting a training session on energy conservation			**ASEAN Standard Harmonization Initiative for Energy Efficiency (ASEAN Shine)** Aimed at increasing energy efficiency of air conditioners through harmonizing standards **Energy Efficiency Market Transformation with Information Provision Scheme (EMTIPS)** Providing information to consumers				
Energy Efficiency	**Policy**	**BRN**	**KHM**	**IDN**	**LAO**	**MYS**	**MMR**	**PHL**	**SGP**	**THA**	**VNM**
	Energy Labeling	√	√	√	√	√	√	√	√	√	√
	Incentives	√	√	√	×	√	×	√	√	√	√
	Tariff reform	√	×	√	×	√	√	×	√	√	√
	Dedicated EE grants			√	√	√		√	√	√	√
	Dedicated EE loans					√	√		√	√	
	Dedicated EE equity									√	
	Dedicated EE Guarantee					√	√				
	Others					EPC, rebates					
Renewable Energy	**Policy**	**BRN**	**KHM**	**IDN**	**LAO**	**MYS**	**MMR**	**PHL**	**SGP**	**THA**	**VNM**
	Feed-in-tariffs	×	×	√	√	√	×	√	√	√	√
	Incentives	×	×	√	√	√	×	√	√	√	√
	Financing Support	×	√	√	√	√	×	√	√	√	√
	Permits and Licenses	×	√	√	√	√	×	√	√	√	√
	Technical Aspects	×	√	√	√	×	√	√	√	√	√

Sources: ERIA Annual Report 2016 (ERIA 2017); IEA World Energy Outlook 2018) (IEA 2018); IEA World Energy Outlook 2017 (IEA 2017); and 5th ASEAN Energy Outlook 2017 (Energy 2017).

4.3 Types of EE&C Financing Required for ASEAN Countries

Financing of energy efficiency can be divided into two categories: 1) traditional financing and 2) emerging financing/specialized instruments. Traditional financing instruments (e.g., leases, grants, equity, and loans) are used to pay for energy efficiency programs and related technologies, products, and services. On the other hand, emerging or specialized instruments are used for reinforcing energy efficiency initiatives, and clean and renewable energy installations projects, as well as supporting energy efficiency activities and other clean energy installations, and mastering market entry options and overcoming existing market barriers.

Although policymakers, regulators, and financing institutions are familiar with traditional financing approaches, these instruments are not always applied due to multiple challenges. The obstacles include a lack of financial implementation and technical capacities, demand- and supply-side mismanagement, a lack of interest in, and awareness of, potential investors and project developers, and an absence of adaptive policy frameworks. To address such issues and to overcome the investment hurdles, further specialized financing instruments such as property assessed clean energy (PACE) financing, credit enhancement, and on-bill repayment can be adopted that are already being used in the developed countries (e.g., the US and Europe) (ACE 2019).

Below are some of the proven methods that can be used for harnessing better energy efficiency in the region (ADB 2013).

- **Utility (Gas and Electric) Financing:** Financing options such as subsidies, utility bill financing, and related financial assistance.
- **Funds for Special Purpose:** Used in a variety of ways, these funds are generally created by government agencies, regulators, or donor agencies.
- **Performance Contracting:** Private or public sector facilitators can adopt this type of approach of performance contracting, which is usually followed by energy service companies (ESCOs).
- **Equity Funds**: Serving as a form of "last mile/resort" equity investment, equity funds are provided by public sector agencies or venture capital firms. This fund can even be generated through public-private partnerships that can fund energy investment for ESCO projects.
- **Dedicated Credit Lines:** To provide investment funding in energy efficiency projects, donor agencies deploy these funds to the commercial banks and financial institutions. The objective of this credit line is to use these funds for harnessing additional financial opportunities from the increased participation of financial institutions.
- **Credit Guarantees:** Credit guarantee mechanisms are deployed as a strategy of risk-sharing and mitigation programs. The objective of this program is to decrease the risk of energy efficiency project financing for participation of banks and financial institutions.

More specifically, we can divide the instruments into traditional and emerging (specialized) financing instruments, which are outlined in Table 5 below:

Table 5: Traditional and Emerging (Specialized) Financing Instruments

Traditional Financing Instruments (for Portraying the Importance of EE&C Financing)	Specialized Financing Instrument (to Enable EE&C Investments at Scale and Depth)
Debt, Including Dedicated Credit Lines (Soft Loans)	Payment Security Schemes, e.g., On-bill Repayment, On-Tax Finance, PACE
Grants, e.g., Project Development	Crowdfunding
Leasing	Results-Based Financing (RBF)/Carbon Financing
Infrastructure, EE, and Revolving Funds; Risk-Sharing Facilities	Asset-backed Securities (ABS) and Revenue Bonds
Energy Performance Contracting (EPC), Public Energy Service Companies (ESCOs), Energy Service Agreements (ESAs)	Green Bonds
Traditional Guarantees and Insurance	New Guarantees and Insurance, e.g., Energy Savings Insurance (ESI)
Equity, e.g., Venture Capital (VC)	

4.4 Replicability of Innovative Financial Schemes

Below are some of the innovative financing schemes for the AMS energy efficiency sector. These schemes are presented here for their lucrativeness and high scope for replication in both public and private sectors of other countries.

4.4.1 ResponsAbility Scheme and PRASAC (Cambodia)

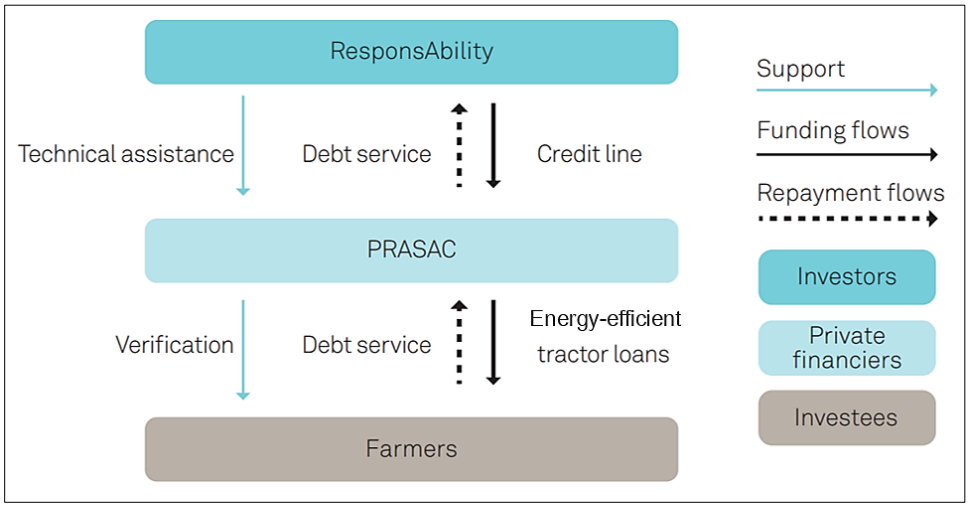
PRASAC is one of the leading microfinance institutions in Cambodia and was granted USD20 million by **ResponsAbility** – an EE fund lending facility focusing on climate financing. Jointly launched in 2016, the PRASAC and ResponsAbility green lending program targets funding and financing to areas and applications of energy efficiency. Under this funding mechanism, PRASAC offers loans to low-income households and farmers for improving energy efficiency. Under its current portfolio, PRASAC gives loans to Cambodian farmers to purchase tractors or power tillers that are equipped to meet 20% of the energy-saving criteria.

Table 6: PRASAC Intervention in Cambodia

Group Loan	Up to USD500 per group member	**Green financing Facilitation**	Renewable Energy and Energy Efficiency
Loan for Biogas Plants	8,411 plants amounting to over USD5 million	**Loan for efficient tractor and power tiller**	More than USD7 million to 529 borrowers
CO2 Emission Reduction	1,500 tons/annum or 429,700 liters of diesel/ annum equivalent		

Source: PRASAC (2018).

Figure 7: ResponsAbility Scheme and PRASAC Framework



Success

- This program offers loan availability for energy-efficient agricultural technologies, i.e., tractors and power tillers that enables farmers to use less energy-intensive technologies and thus reduce significantly GHG emissions and business operating costs.

Replicability

- This model can be extended and replicated to other sectors. However, to do this, PRASAC will need to create a new loan portfolio for contextualized technologies that meet the minimum eligibility criteria of ResponsAbility and PRASAC. This will also require meeting market and product demands that are sustainable, equitable, and profitable.

4.4.2 Clean Energy Revolving Fund (CERF) and Pioneer Facility (Cambodia)

The **Clean Energy Revolving Fund (CERF)** program provides uncollateralized loans to small agricultural farms in Cambodia for switching to cleaner forms of energy technologies. Managed by Nexus for Development, this fund merges its programs with that of the local solar energy technology companies and distributors. The fund is used to support solar water pumps and on-grid solar systems for use in spice, fruit, and livestock farms in Cambodia.

Table 7: CERF Intervention in Cambodia

Number of Loans Provided	15	**Loan Size**	USD7,000 to over 50,000, mostly in USD10–15,000 range
Loan Used for	Purchasing solar-powered water pumps and small on- and off-grid solar installations.	**Full Loan Repayment**	> 90%
Clean Energy Produced	116 MWH	**Cost Saved**	USD3500/annum by adopting renewable energy
Reduction of Operational Cost	34%	**Capacity Per Installation**	85.76 kw of clean energy

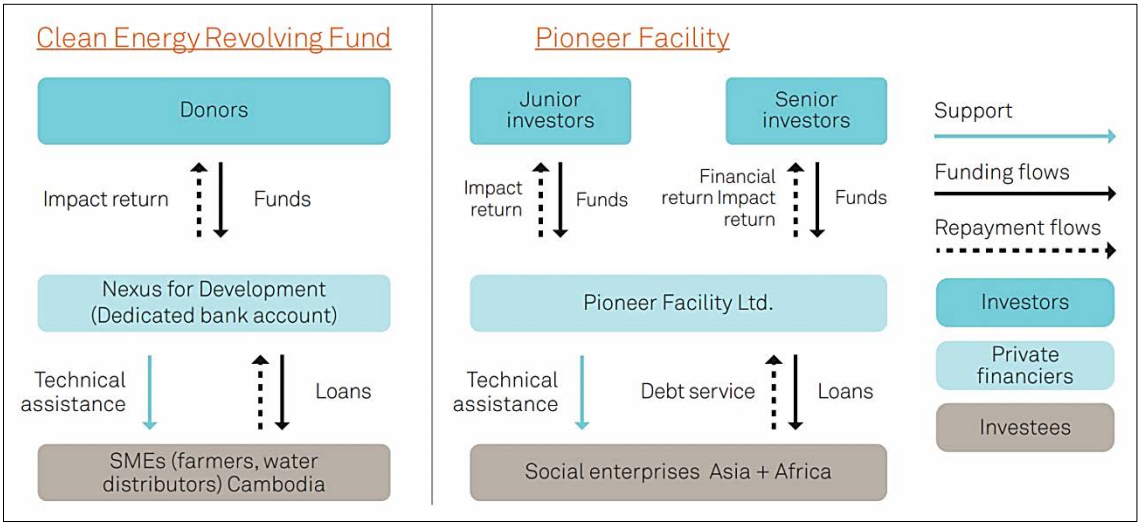
Source: REEEP (2019); CERF (2019).

Pioneer Facility is another funding mechanism that provides affordable uncollateralized working capital loans to SMEs and social enterprises that are selling clean water and energy technologies to the low-income populations in Southeast Asia. This is also facilitated by Nexus for Development, which helps the funded enterprises through technical assistance and financial support.

Success

- CERF gives loans to Cambodian agribusiness units to assist them in reducing their carbon usage. The facility also reduces operating costs by deploying clean energy technology, i.e., solar energy to utilize cost-effective forms of energy resources. Despite the farmers' financial literacy, the CERF loan profile has been proved successful in the country.
- Pioneer Facility provides debt funding to Khmer Water Supply Holding (KWSH), a social enterprise operating in rural Cambodia that greatly increases access to clean water. This initiative has already provided 13,000+ households with piped water and plans to provide clean water to 60,000+ households and 300,000 individuals. It is also planning to finance two additional piped water stations with a combined connectivity potential of approximately 12,500 households (Nexus for Development 2019).

Figure 8: CERF Module and Pioneer Facility



Replicability

- The financing models can be applied to other SEA states, i.e., Nexus is examining the feasibility of CERF usability for Myanmar.

4.5 Barriers to Improving Energy Efficiency

Although ASEAN has massive investment potentiality, it is also lumbered with numerous challenges:

- The national objectives of environmental sustainability and coherent financial policy frameworks should work in tandem. There is a lack of proper incentive mechanisms for the required capital and relevant financial service providers, which makes it difficult for the regulatory and financial system to align with the goals of the SDG Agenda 2030. Rather than focusing on mandatory measures and incentives, the policies are predominantly focused on voluntary activities, e.g., awareness- and capacity-building programs;
- The dominance of the heavily subsidized fossil fuel industry and underdeveloped institutional mechanisms to implement the energy efficiency measures;
- Suboptimal energy standards throughout the region:
  - No fuel economy standards in the transport sector;
  - Low diffusion of energy-efficient technologies in the industrial sector (except for a few countries and large industries) due to financing issues and a lack of proper awareness;
  - In the building sector, most countries have energy codes, but their enforcement and stringency vary across countries.

- ASEAN's existing structural setup of the banking and financial system creates a confusing maturity system due to the dominance of short-term bank financing. Investment funding and channels are relatively shallow compared to traditional bank lending. Most of the ASEAN household personal financial properties are either held in hard cash or deposits, which makes it easier for bank lending to dominate over investment funding.
- Most of the companies have bureaucratic red tape – resulting in minimum environmental disclosure, and limited information-sharing platforms. This makes it difficult for investors and policymakers to identify and address environmental risks. It also limits the process of harnessing new opportunities and attracting new sources of funding for securing energy efficiency.

Figure 9a: Barriers to Debt Financing, e.g., 7/10 Entrepreneurs Have Reported Heavy Collateral Requirements as a Major Blockade to Enrolling in Debt Finance Programs

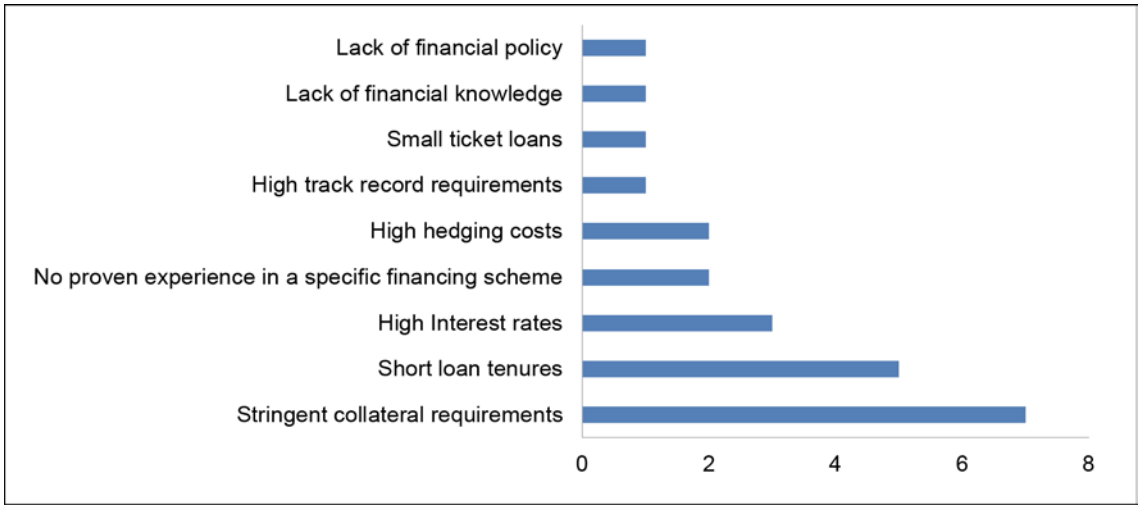
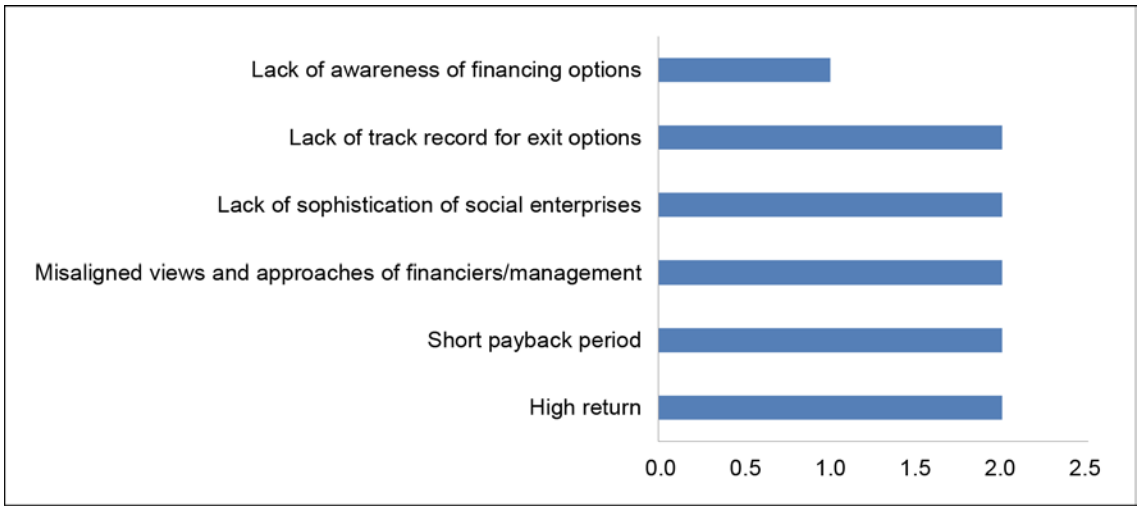


Figure 9b: Barriers to Equity Financing



Source: Data from the 10 entrepreneurs, 2017.

5. POLICY RECOMMENDATION

1. **Policy, Program, and Incentive Mapping:** Policy, especially market and nonmarket-based policy instruments, is required to empower energy efficiency. In this regard, APAEC has issued four strategies aimed at achieving the energy efficiency targets: (a) synchronization of energy efficiency standards for relevant products and services; (b) incorporation of ESCOs for increasing private sector involvement; (c) formulation of energy codes and green building codes; and (d) involvement of financial institutions and nonbanking financial institutes (NBFIs) in EE&C.

   However, there are still hurdles in implementation that governments are still trying to overcome. One such obstacle is inhibited access to funding. While governments have established grants to encourage R&D in energy efficiency, these schemes are not sustainable due to limits on government funding. Hence, the governments have attempted to encourage private means of financing for such forms of investment. This is impeded by the difficulty private institutions face in assessing the risk appropriately since the required technologies are nascent. Private institutions are therefore wary of investing in research and development in energy efficiency sources. This means that there is currently no sustainable, widespread funding mechanism for energy efficiency technologies. Governments will therefore have to work more intimately with the private sector to increase knowledge about investments in this sector. Fortunately, they will be equipped with the increasing body of research and literature produced on the risk characteristics of energy efficiency investments that accompany a global uptick in the adoption of required technologies.

2. **Energy Efficiency in the Policy Mix:** It is required to assess and evaluate the convergence of energy efficiency with targets in two related sectors: 1) increasing the usage and application of clean and renewable energy; and 2) reducing environmentally damaging GHG emissions to counter climate-borne changes.

   As a region, ASEAN does not participate in any international climate negotiations. As a result, the region has no joint climate change policy or defined GHG emission reduction target. In most cases, the countries' climate change mitigation targets are addressed either by their individual EI reduction target or by energy efficiency and emission reduction targets individually. These goals and targets are adopted by individual countries through their nationally determined contributions (NDCs).

   However, it is expensive to control energy consumption through energy efficiency technologies compared to sectorial investments in renewable energy and relevant infrastructure. On top of that, clean technologies are considered a cheaper option in the medium to long term whereas energy efficiency can be used for achieving ASEAN's low carbon energy transition in the short term. Therefore, to achieve this ASEAN renewable energy target, it is crucial to expand the region's energy efficiency portfolio.

   Albeit with declining usage, fossil fuels such as oil and coal continue to be the dominant sources for ASEAN's current as well as projected energy mixes. By 2040, these two resources will account for 57.5% of ASEAN's TPES (Energy 2017). Such a high fossil fuel share coupled with a rising energy demand also results in a proportional rise in energy-related GHG emissions. To mitigate these emissions and to decarbonize the primary energy supply, energy efficiency can be a major linchpin.

6. CONCLUSION AND KEY TAKEAWAYS

Financing is one of the most crucial factors in promoting EE&C implementation in ASEAN. This research paper provides an analytical overview of various financial options and mechanisms used for EE&C implementation in ASEAN, identifies bottlenecks, and lays out adaptive recommendations to expedite EE augmentation and EE&C development for its countries.

It is noticeable that energy efficiency projects that come with high rates of return often remain unimplemented. Other than high investment risks, investors shy away from such agreements because of a lack of required information on incentive schemes and awareness of the benefits of EE measures, and unskilled manpower. Implementation of energy efficiency is also hampered by the existence of low prices and subsidies of fossil fuel-based technologies, which makes it an easier choice than energy efficiency and EE&C projects that have limited financing options. Furthermore, the lack of supporting legislative measures and policy frameworks hinders the effective implementation of energy efficiency in the region. To address these financing obstacles, some advanced economies, such as Indonesia, Malaysia, Singapore, Thailand, and Viet Nam, have developed more advanced policy frameworks by adopting designated financing schemes targeted toward energy efficiency activities (e.g., Thailand provides grants, loans, equity, and guarantees for implementing energy efficiency projects).

One of the notable mechanisms in the region is the EERF in Thailand, whose emphasis is on large-scale investments in energy-intensive industries. The funding mechanism also provides capacity building for local banks that issue soft loans with minimum interest rates for energy efficiency projects. In Malaysia, the Energy Performance Contracting (EPC) fund grants loans with interest rebates. This funding mechanism also provides loan guarantees to entitled energy efficiency projects in the building sectors to help overcome capital shortage faced by the ESCOs.

Based on our findings, the following critical recommendations should be followed to provide an uninterrupted energy efficiency financing plan in the region:

- Revise subsidies in the fossil fuel industry and initiate market prices adaptive to real-world economic costs.
- Initiate and adopt policies, rules and regulations, and practices along with financial and incentive schemes such as energy technology rating systems and minimum standards for energy performance, e.g., MEPS.
- Initiate awareness-raising campaigns for government regulators, policymakers, and implementing financial agencies, i.e., commercial banks and NBFIs, and make the required documents and provisions publicly available for key stakeholders.
- Ensure private sector participation in different stages of EE&C projects, i.e., implementation, funding and financing, and monitoring and verification. This can be easily ensured if the governments make the financing monitoring and adequate regulatory frameworks publicly available.
- Implement and replicate necessary best practices and rewarding financing schemes for each country.
- Develop and regularly update required documents and information through stakeholder consultations.
- Develop instructional guidelines that provide step-by-step actions for project developers and other key program managers.

ASEAN has already championed the reduction of energy intensity by 18% by 2015. To reach the target of reducing energy intensity by 30% by 2025, however, the region will need to implement innovative financing schemes conducive to energy efficiency programs and develop reinforcing policy frameworks. Successful implementation of these financing schemes and mechanisms faces political, institutional, and administrative barriers as discussed in this research paper. To overcome these challenges, a collaborative approach between ASEAN governments, relevant stakeholders, and energy efficiency professionals can play a pivotal role in formulating policies, implementing practices, and confirming their fruitful implementation.

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