

Chapter 6

Energy Efficiency in End-use Sectors – Implications for ASEAN and Lao People’s Democratic Republic

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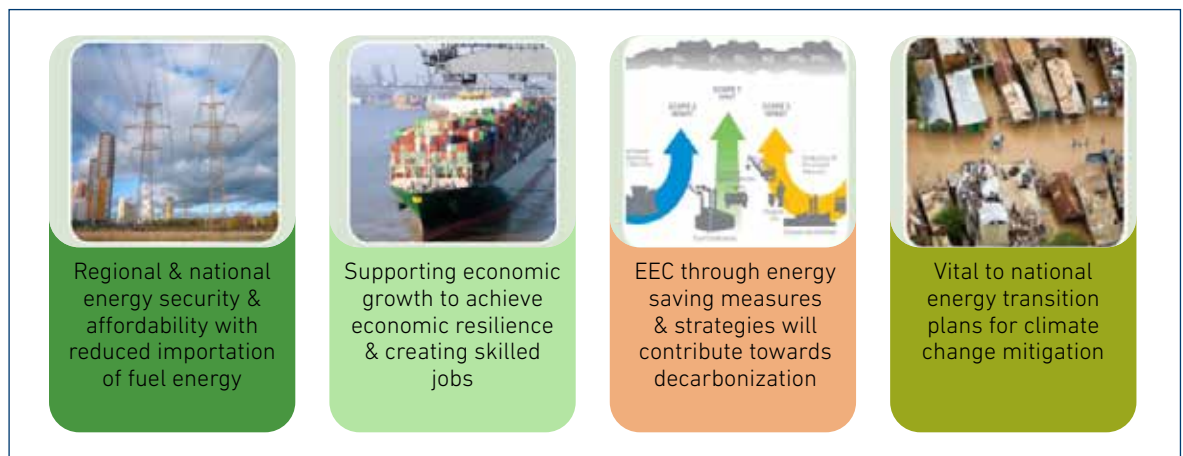
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1. Introduction

The planning for energy security and sustainable development is incomplete without including energy efficiency. Energy efficiency is known as the 'first fuel', as the resulting energy saved becomes an energy source. The International Energy Agency (IEA) reported that energy efficiency plays a critical role in improving living standards around the world; providing reliable, affordable, and universal access; supporting economic growth; and accelerating the clean energy transition towards net-zero emissions by 2050.¹ However, the implementation of energy efficiency and conservation (EEC) initiatives is not straightforward, but energy savings can be achieved through proper and thoughtful planning.

EEC is vital to climate-change mitigation action plans as well as to clean energy transitions for the Association of Southeast Asian Nations (ASEAN) and Lao People's Democratic Republic (Lao PDR). These action plans will contribute significantly to decarbonisation as well as to energy and cost savings while creating skilled jobs. Appropriate and timely government policies on EEC will play an important role in improving energy security, economic resilience, and climate-change mitigation. Figure 6.1 highlights the multiple benefits that can be derived from investments in EEC initiatives.

Figure 6.1. Significance and Impact of Energy Efficiency and Conservation Strategies



EEC = energy efficiency and conservation.

Source: Author.

¹ IEA, Energy Efficiency: The Decade for Action, <https://www.iea.org/reports/energy-efficiency-the-decade-for-action>

It is essential to map out a holistic plan for all end-use sectors in the country to implement best practices and to undertake a holistic approach in regard to EEC. Efficiency improvements will also help reduce the vulnerability of businesses and consumers to potential disruptions to electricity supplies, especially during peak load demands. This chapter provides policy directions for the planning and implementation of EEC strategies and programmes in Lao PDR.

2. Strengths, Weaknesses, Opportunities, and Threats

Having recognised the investments needed to implement EEC programmes and measures, it is important to evaluate the strengths, weaknesses, opportunities, and threats (SWOT) of Lao PDR’s energy scenario before developing policy directions. The SWOT analysis will facilitate the development of a holistic EEC implementation plan.

2.1. Strengths

Lao PDR has a relatively small population of about 7.633 million as of 2023.² It is well-endowed with renewable energy resources, especially hydropower and biomass. The strengths of Lao PDR’s energy security are as follows:

- (i) It possesses abundant hydropower and biomass resources for a small population, resulting in excess capacity to export electricity.
- (ii) It has established infrastructure for power exports to neighbouring countries.
- (iii) Effective energy policies since the establishment of the Ministry of Energy and Mines in 2006 have evolved, which support the development of a sustainable energy sector. As a result, the ministry is knowledgeable about sustainable energy development following various international collaborative programmes.
- (iv) Building on its longstanding history of trading electricity with Thailand, Lao PDR has transformed its landlocked country status into an asset that has facilitated its power integration and electricity exportation to neighbouring countries.
- (v) Power integration across the region enhances Lao PDR’s energy security.
- (vi) Well-planned energy policies have enabled Lao PDR to increase its power supply efficiency and capacity, which can meet domestic demand and export targets, including policies that promote energy savings and conservation by aiming to reduce energy consumption by 10% by 2030.

² World Bank, Lao PDR, Data, <https://data.worldbank.org/country/lao-pdr> [accessed 3 July 2024]

2.2. Weaknesses

For sustainable energy planning, it is also important to examine any shortcomings and/or gaps that may exist in Lao PDR's energy system. The list below summarises these weaknesses.

- (i) Its landlocked status limits Lao PDR's access to other energy resources such as oil and gas.
- (ii) There is a lack of long-term sustainable energy policies for holistic implementation of EEC to minimise supply interruption.
- (iii) The dry season affects hydropower generation capacity, which can cause supply interruptions.
- (iv) No EEC legislative framework exists.
- (v) There is no funding mechanism for sustainable EEC implementation.
- (vi) There is minimal infrastructure and resources to support EEC targets and management of energy demand and supply.

2.3. Opportunities

Despite the challenges to sustainable energy planning, opportunities do arise if Lao PDR is prepared. Potential opportunities are as follows:

- (i) Improving efficiency in energy use in end-use sectors will increase Lao PDR's capacity to export electricity, and hence, attract foreign revenue.
- (ii) A concerted effort in promoting and adopting EEC measures will improve the energy performance of all end-use sectors; thus, better productivity in domestic production will improve the affordability and competitiveness of domestic goods.
- (iii) The drive towards reduction in energy consumption will contribute towards emissions reduction, and achieving decarbonisation will contribute to achieving net-zero emissions in line with global efforts in climate-change mitigation by 2050.
- (iv) The drive towards achieving net-zero emissions will attract investments in transitional energy developments and EEC facilities.
- (v) Such 'green' or EEC investments will create skilled job opportunities at various skill levels as well as technology transfer to energy management professionals and technical staff in Lao PDR.

2.4. Threats

If no action plans are undertaken for EEC implementation, the threats encountered are summarised as follows:

- (i) End-use sectors in Lao PDR will continue to experience power interruptions during the dry season when hydropower generation capacities fall below peak load demand.
- (ii) End-use (commercial and industrial) sectors in Lao PDR will not be energy-efficient, resulting in higher domestic production costs, which will affect the affordability of goods and services.
- (iii) It will be more difficult to attract foreign investment in transitional energy developments and EEC facilities.

- (iv) There will be no significant increase in ‘green’ skilled jobs. Lao PDR will fall behind in EEC technologies for the commercial and industrial sectors.
- (v) Lao PDR will encounter dumping of energy-inefficient appliances and products by acquiring cheap imports, which will result in a wasteful use of energy and higher running costs.
- (vi) Lao PDR will experience difficulty in curbing emissions due to the increase in demand for use of fuel energy.

3. Key Directions and Implementation Plan

Strategies for implementing EEC plans vary from country to country. The diversity of ASEAN Member States precludes the use of a ‘one-size-fits-all’ approach towards implementing such plans. However, the joint ministerial statement of the 41st ASEAN Ministers on Energy Meeting 2023 acknowledged the importance of accelerating EEC measures, not only for the power sector but also for the larger energy-consuming sectors such as transport, industry, and buildings (ASEAN, 2023). The benefits in accelerating EEC measures are also highlighted by IEA, which noted that more efficient and lower energy demand supports faster, universal access to modern, affordable energy in developing countries (IEA, 2014).

A legislative framework is necessary to accelerate the implementation of EEC measures. Table 6.1 shows the legislative frameworks enacted in some ASEAN Member States.

Table 6.1. Legislative Frameworks across ASEAN

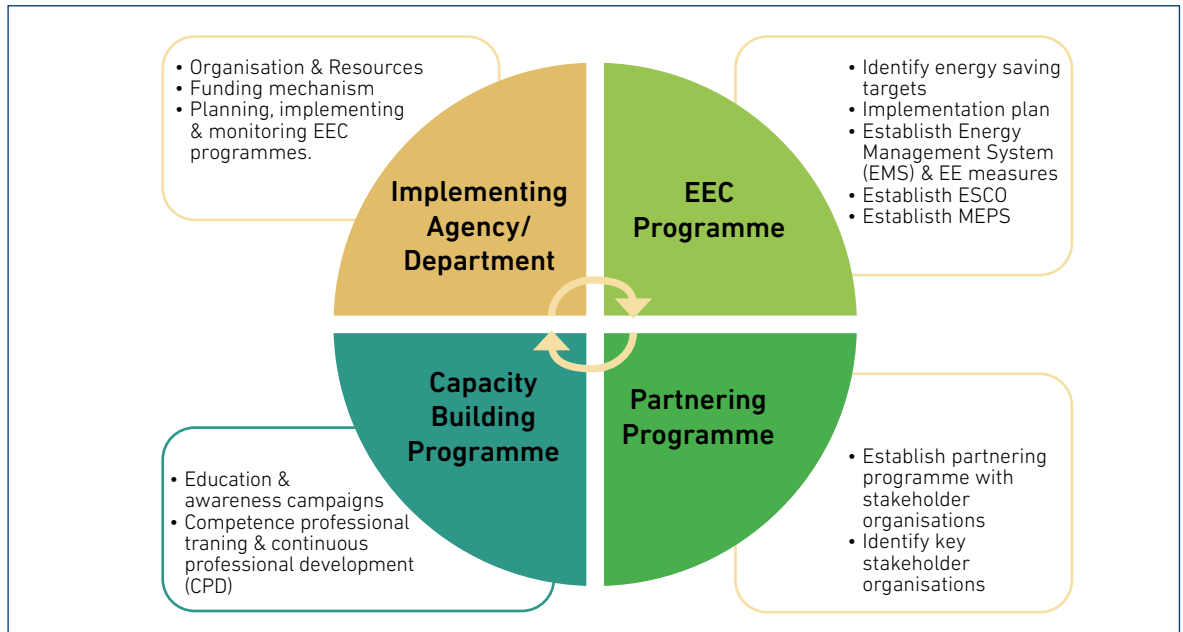
Country	Legislative Framework
Thailand	Energy Conservation Act 1992 Mandatory energy management for companies that consume more than 20,000 GJ/year
Viet Nam	Law on Economical and Efficient Use of Energy, effective 2011 MEPS and labelling for equipment and appliances
Singapore	Energy Conservation Act 2012 Mandatory energy management for companies that have attained the energy use threshold of 54–500 TJ/year in at least 2 out of the 3 preceding calendar years
Philippines	Energy Efficiency and Conservation Act 2019 MEPS for electric motors and similar devices
Malaysia	Efficient Management of Electrical Energy Regulations 2008 Energy Efficiency and Conservation Act, 2023 Mandatory energy management for companies that consume more than 21,600 GJ/year
Indonesia	Law No. 30/2007 on Energy Government Regulation No. 70/2009 on Energy Conservation Mandatory energy management for companies that consume more than 6,000 toe/year (251,200 GJ/year)

GJ = gigajoule, MEPS = minimum energy performance standards, TJ = terajoule, toe = tonnes of oil equivalent.

Source: Kim and Yang (2020) and author.

Developing an EEC act in Lao PDR will take time. It is advisable to take small steps, such as first empowering an existing agency or department to be dedicated to driving the EEC agenda through government directives or statutory regulations (Figure 6.2). The expertise and resources available within ASEAN may also be tapped to help expedite these programmes, which can be implemented simultaneously or under a staggered timeline subject to the availability of financial and human resources.

Figure 6.2. Key Directions to Kickstart EEC Implementation



EE = energy efficiency, EEC = energy efficiency and conservation, ESCO = energy service company, MEPS = minimum energy performance standards.

Source: Author.

The suggested programmes depicted in Figure 6.2 are discussed below.

3.1. Implementing Agency

To kick-off EEC implementation, it is necessary to identify an agency or department that is empowered to implement programmes, collect energy data, monitor and analyse energy performance, disseminate information, and provide guidance to end-use sectors. The implementing agency/department should be staffed with qualified, well-trained, and knowledgeable personnel. For sustainable EEC implementation, a mechanism must be determined to fund the operation of this implementing agency/department as well as an in-depth study and planning. The funding mechanism may be established through government budgets, levies on electricity and/or fuel energy usage, or levies on independent power producer power generation.

3.2. Energy Efficiency and Conservation Programme

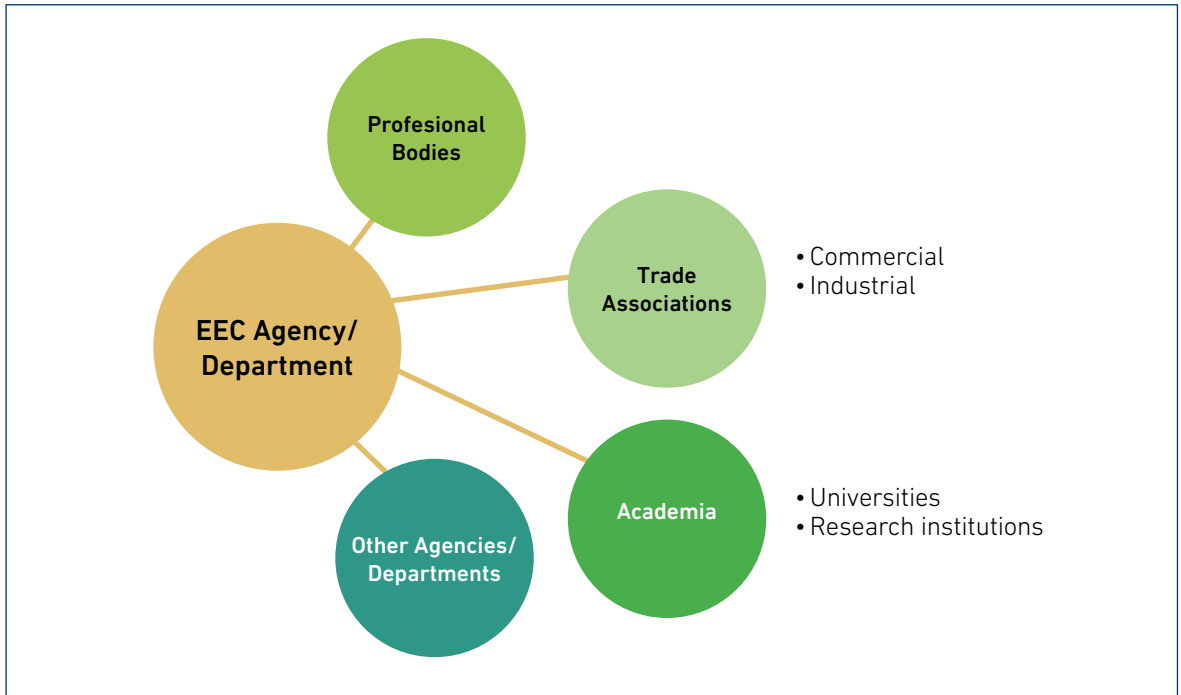
Energy-saving targets should also be set. Subject to the intensity of such targets, the implementing agency/department should develop an EEC programme comprising:

- (i) EEC guidelines, composed of best practices for the commercial and industrial sectors;
- (ii) an energy management system (EMS) with regimented maintenance practices to achieve energy efficiency;
- (iii) energy-efficiency indicators (EEIs), such as building energy intensity for the commercial buildings sector, and energy use intensity for the industrial sector with statistical benchmarking values;
- (iv) implementation of energy-saving measures in the industrial and commercial buildings sectors with the establishment and participation of energy service companies (ESCOs); and
- (v) minimum energy performance standards (MEPS) for energy-efficient electrical appliances and equipment, which are primarily used in the residential sector.

3.3. Partnering Programme

A partnering programme is a consultative programme designed to involve pre-identified stakeholder organisations, such as industrial and commercial sub-sector associations, professional bodies, academia, and other governmental departments (Figure 6.3). This programme should be led by the implementing agency/department. The objectives of the partnering programme are to (i) obtain stakeholders' input for greater effectiveness and coverage of EEC programmes, (ii) facilitate the dissemination of information pertaining to EEC programmes, and (iii) improve stakeholders' buy-in process and gain immediate nationwide acceptance and participation of EEC programmes.

Figure 6.3. Suggested Stakeholders in Partnering Programme



EEC = energy efficiency and conservation.

Source: Author.

3.4. Capacity-Building Programme

Capacity building is an essential part of EEC implementation. Greater public awareness will improve the uptake of EEC strategies and measures, which will, in turn, result in significant energy savings and improved energy performance in each end-use sector.

As an immediate measure, capacity-building programmes – including continuous professional development – should be developed to target training energy managers and professionals for energy management in the industrial and commercial buildings sectors. Establishment of ESCOs in the longer term will provide much-needed resources for sustainable development. Meanwhile, awareness of EEC in the selection and use of efficient electrical appliances and energy conservation in daily energy use should be promoted to consumers in the residential sector through MEPS with energy performance labelling. Publicity is also required to promote awareness of the benefits of energy-efficient appliances.

4. Energy Efficiency and Conservation Guidelines

After establishing an implementing agency/department, priority should be given to developing and publishing guidelines to advise end-use sectors on EEC strategies and measures. Guidelines for the industrial and commercial sectors should focus on the following topics with case studies, which are subjected to finalisation by a taskforce: (i) procedural guidelines to establish an EMS; (ii) decarbonisation strategies; (iii) computation of EEIs and benchmarking values for respective sub-sectors; (iv) plans for digitalisation; (v) categories of EEC measures (low, medium, and high investment initiatives); (vi) passive and active design measures for the commercial buildings sector; and (viii) significant energy users (with specific energy consumption and guides on best practices in selection, optimisation, design, installation, operation, and maintenance).

For the residential sector, information on MEPS with energy performance or 'energy star' labelling and efficient home energy use guides should be developed, published, and made easily accessible. The EEC guidelines for industrial and commercial buildings sectors may be used as a syllabus and reference book for professional training courses as well.

4.1. Energy Management System

Based on the ISO 50001 Energy Management System standard, the EEC guidelines should provide a framework for establishing energy management best practices to help organisations establish systematic procedures to improve their energy efficiency based on the concept of plan–do–check–act.

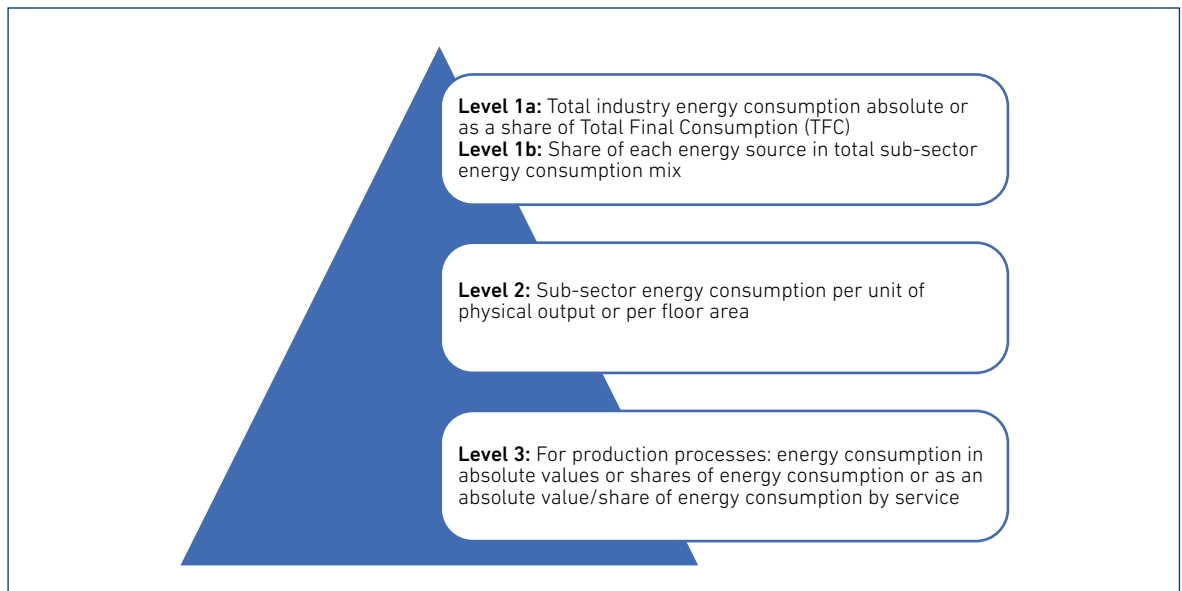
4.2. Decarbonisation

Achieving significant emissions reduction requires a broad range of policy approaches and technologies. EEC measures – together with renewables – are the key pillars of decarbonisation. In general, buildings are responsible for roughly 40% of energy-related emissions in the world. Priority should be given to the efficient design of new buildings; efficient operation of existing buildings will be challenging. Rationalisation of fuel energy use will be an effective measure to achieve decarbonisation as well. EEC guidelines will be a useful guide to achieving decarbonisation.

4.3. Energy-Efficiency Indicator Benchmarking

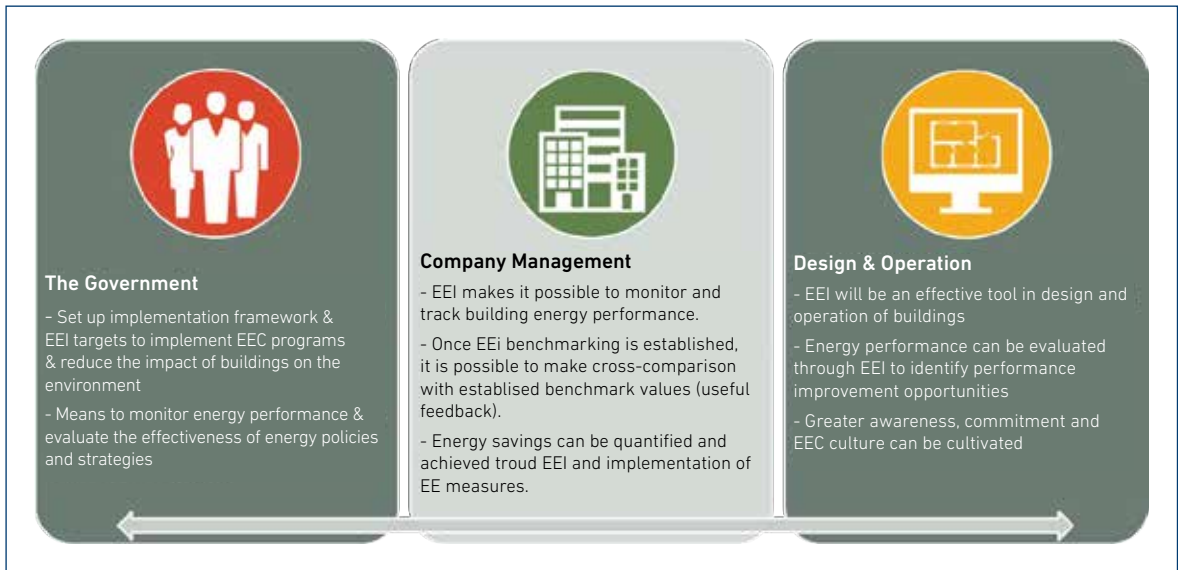
EEl benchmarking can be established after collecting sufficient data. However, as an interim measure, it may be possible to establish an initial set of EEIs, especially for the commercial buildings sector through surveys and consensus in the consultative partnering programme as well as through resources available within ASEAN. An initial set of EEIs may be referred to from neighbouring countries. Energy-saving targets can then be set for the commercial buildings sector once there are EEIs or building energy intensity benchmarking values under various building categories (Figure 6.4).

Figure 6.4. Generic Pyramid of Energy-Efficiency Indicators for the Industrial and Commercial Buildings Sectors



Source: IEA (2014).

Level 3 EEIs are useful for comparing absolute values or shares of energy consumption by services (buildings) or processes (industries). EEIs are valuable for policymakers to set energy-efficiency targets, monitor energy performance, and evaluate the effectiveness of energy policies and strategies (Figure 6.5). Company management many find EEl benchmarking useful for evaluating energy performance of their premises or plant operations. Designers can make use of EEIs to help produce energy-efficient designs.

Figure 6.5. Significance and Benefits of Energy-Efficiency Indicator Benchmarking

EEC = energy efficiency and conservation, EEI = energy efficiency indicator.

Source: Author.

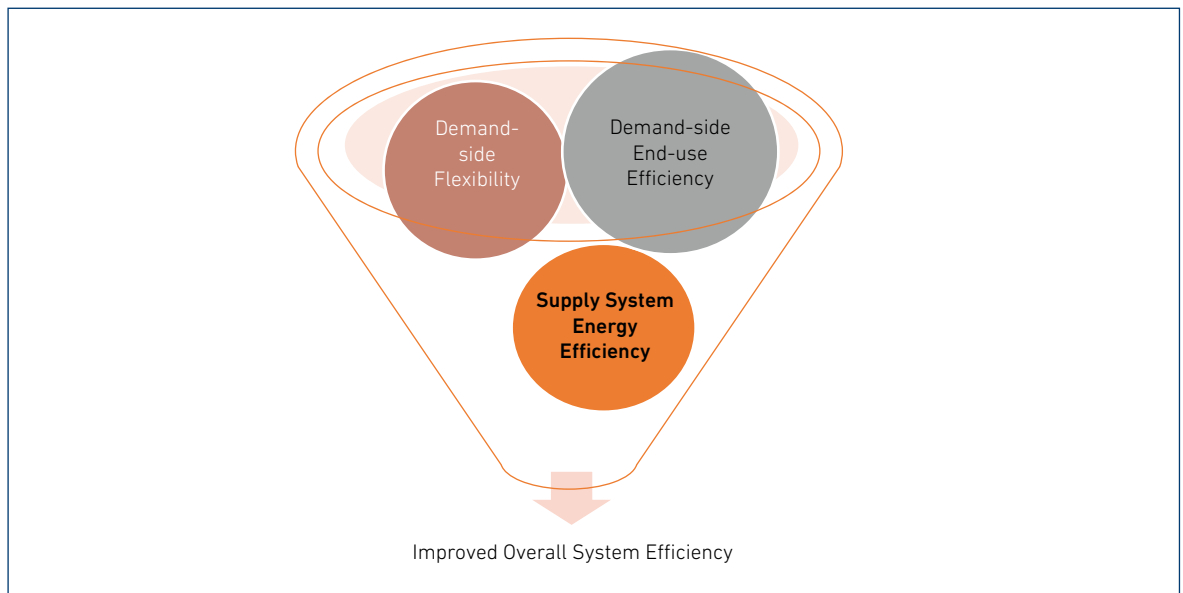
4.4. Digitalisation

Achievement of EEC is changing with the application of state-of-the-art digital technologies, which enable greater control, flexibility, optimisation, and savings in equipment investments. Digitalisation offers opportunities to increase EEC through technologies for the industrial and commercial buildings sectors, in addition to other well-established EEC initiatives. Digitalisation is useful in the following areas:

- (i) **Energy-efficient design.** Optimisation in design – with optimal selection/sizing of equipment through simulation of various usage scenarios – can be achieved and is cost-effective. Such design will also save equipment and ancillary capital costs due to reduced equipment and ancillary infrastructure sizing.
- (ii) **Energy-efficient operation.** Through data-gathering technologies via sensors and smart meters, data are processed into useful information through real-time data analysis technologies such as artificial intelligence (AI) algorithms and internet-of-things (IoT). Processed information is sent to devices that can effect physical changes to optimise energy use. Seamless integration and connectivity for an IoT ecosystem consisting of web-enabled smart devices and control instrumentation will enable real-time and AI-assisted optimisation for a higher level of energy-efficient operation.

Digitalisation will also enable smart buildings and industrial facilities to provide flexible load demands to facilitate better management of the supply system (IEA, 2019). The power of digital technologies to both improve end-use efficiency and to supply system efficiency ultimately benefits overall energy system efficiency by managing demand and supply, improving energy resiliency, minimising supply disruption, as well as reducing financial burdens through avoided capital investments in energy infrastructure (e.g. peaking plants and improved integration of renewable energy for greater flexibility and options) (Figure 6.6). However, the challenge is the timing of investing in digital technologies due to continual improvement and rapid advancement in technologies.

Figure 6.6. Overall Demand- and Supply-side System Efficiency Improvement by Digitalisation



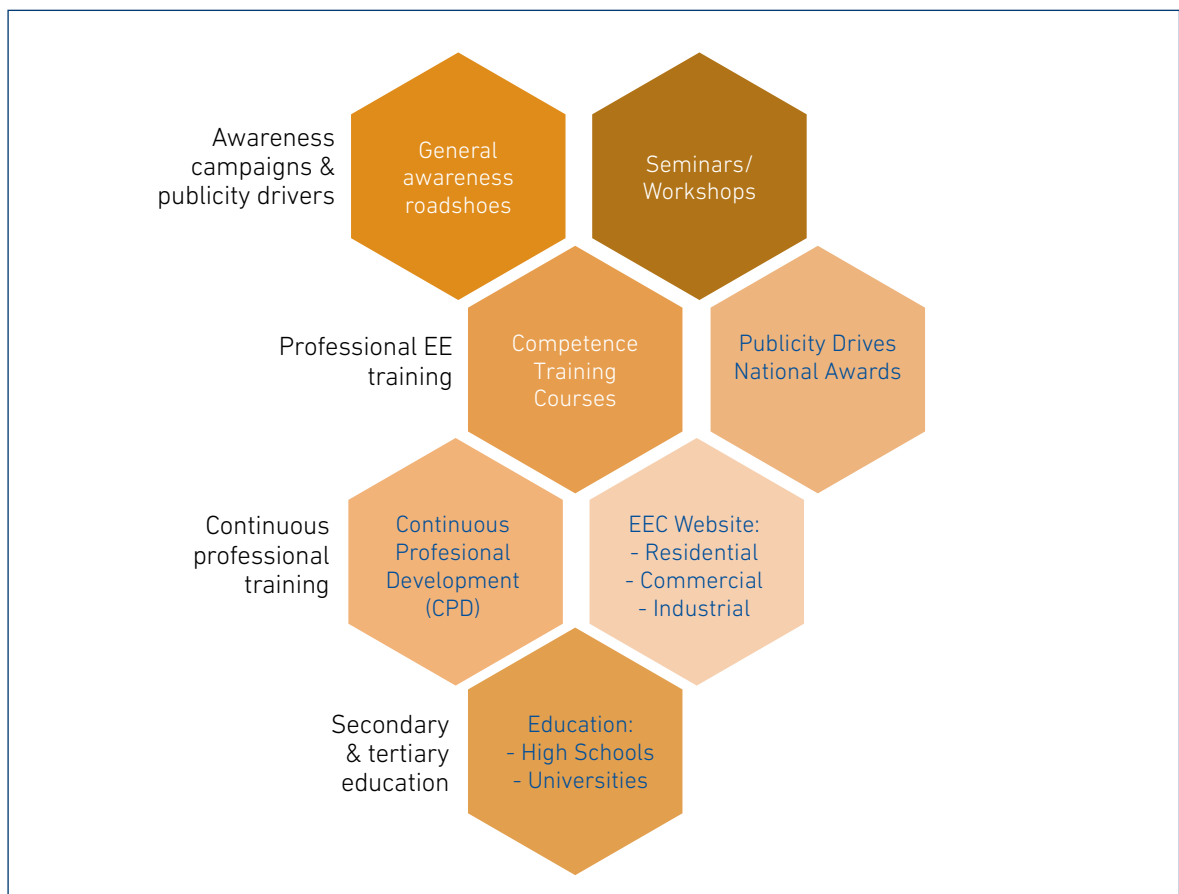
Source: IEA (2019).

5. Capacity Building through Continuous Education and Awareness Campaigns

As previously noted, capacity building is an important part of EEC implementation. To expedite such programmes, the expertise and resources within ASEAN may be sourced. Capacity building should cover the following areas:

- (i) **Immediate measures.** Competency professional training courses for the development of expertise and skills in energy-efficient design, system operation and energy management, and energy audits, which may be classified into elementary, intermediate, and advanced levels; continuous professional development programmes; and awareness campaigns via roadshows, seminars, workshops, social media, and other publicity drives.
- (ii) **Long-term measures.** EEC school curriculum for secondary schools and universities (Figure 6.7).

Figure 6.7. Capacity-Building Programmes and Awareness Campaigns



EE = energy efficiency, EEC = energy efficiency and conservation.

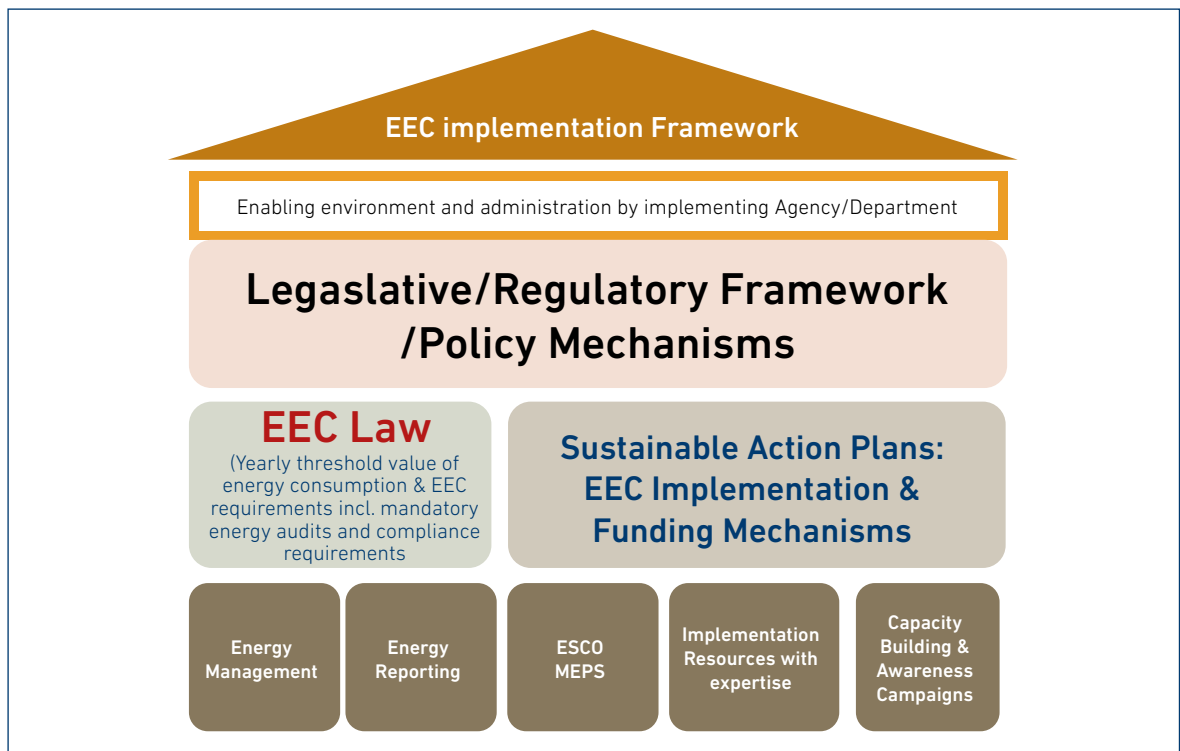
Source: Author.

6. Legislative Framework

Lao PDR's total final energy consumption grew by 2.1% from 2010 to 2019. Electricity consumption grew the fastest at 11.7%, followed by petroleum products at 3.8%. Biomass – although having the highest share of total final energy consumption – decreased at an average rate of 0.7% per year (Kim and Yang, 2020). Comparing the growth rates of final energy consumption by sector during 2000–2019, the industrial sector grew the fastest at 10.0% per year, followed by the transport sector at 6.2% per year, and the 'others' sector (including residential, commercial, services, and agriculture) at 1.9% per year. Industry's high growth rate in energy consumption is expected to continue during 2019–2050 at 5.4% per year (Kim and Yang, 2020).

In view of the expected increase in energy demand – especially in the industrial sector – EEC measures are key to curbing demand growth whilst maintaining economic growth. Adopting the recommended EEC programmes without a legislative framework will make them voluntary; thus, uptake rates are not expected to be strong. The development and enactment of a legislative framework will enable Lao PDR to accelerate the EEC programmes as part of the country's sustainable development policy. An EEC law will provide the necessary enabling environment for EEC implementation (Figure 6.8).

Figure 6.8. Overview of Energy Efficiency and Conservation Implementation and Legislative Framework



EEC = energy efficiency and conservation, ESCO = energy service company, MEPS = minimum energy performance standards.

Source: Author.

The EEC programmes outlined in this chapter should thus be made mandatory for large energy consumers that exceed a pre-determined yearly threshold value of energy consumption in the industrial and commercial buildings sectors. This threshold value of yearly energy consumption will be defined in the EEC law. Compliance requirements and penalties due to repeated non-compliance will also be stipulated in the EEC law.

7. Policy Recommendations

EEC implementation will bring multiple benefits to Lao PDR such as enhancing energy security, improving the affordability and access of energy supply, supporting economic growth, and contributing to decarbonisation and climate-change mitigation measures. EEC implementation must start with a government directive – a top-down approach – while the EEC programmes listed below will constitute a bottom-up approach. In summary, it is recommended that these EEC programmes in Lao PDR be executed in three stages.

Immediately:

- (i) **Create competency professional training courses for the development of expertise and skills in energy-efficient design, system operation and energy management, and energy audits.** These may be classified into elementary, intermediate, and advanced levels.
- (ii) **Foster continuous professional development.**
- (iii) **Begin EEC awareness campaigns through roadshows, seminars, workshops, social media, and other publicity drives.**

For the short term (i.e. within 2–3 years from the start of EEC implementation):

- (i) **Establish an implementing agency/department to spearhead the execution of EEC implementation.** This agency/department is empowered with the authority and human and financial resources to implement programmes, collect energy data, monitor and analyse energy performance, disseminate information, promote EEC activities, and provide guidance to end-use sectors.
- (ii) **Execute EEC programmes.** Develop and publish EEC guidelines for an EMS, decarbonisation, EEs and associated benchmarking for respective commercial and industrial sub-sectors, digitalisation, categories of EEC measures, passive and active design measures for the commercial buildings sector as well as significant energy users with specific energy consumption.
- (iii) **Establish EEs.** These should include building energy intensity for the commercial buildings sector, and energy use intensity for the industrial sector with statistical benchmarking values.
- (iv) **Implement energy-saving measures for the industrial and commercial buildings sectors with the establishment and participation of ESCOs.**
- (v) **Establish MEPS for energy-efficient electrical appliances and equipment.** These are primarily used in the residential sector.
- (vi) **Develop and implement an EEC partnering programme.** The objectives are to obtain stakeholders’ input for greater effectiveness and coverage of EEC programmes, facilitate the dissemination of information, and improve stakeholders’ buy-in process.

(vii) **Develop and implement capacity-building programmes.** The expertise and resources within ASEAN may be sourced.

In the long-term (i.e. within 4-5 years from commencement of EEC implementation):

- (i) **Develop an EEC school curricula for secondary schools and universities.**
- (ii) **Develop and establish an EEC legislative framework.** Once this is established, human resources for the enforcement of EEC legislative requirements should be increased. A policy direction to implement EEC plans as early as possible will complement the development and establishment of an EEC legislative framework for Lao PDR's long-term sustainable energy plan.

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