Chapter 5

Policy Measures for Promoting the Deployment of Energy Management System

February 2017

This chapter should be cited as

ERIA (2016), 'Policy Measures for Promoting the Deployment of Energy Management System', in Iida, Y., S. Inoue, and Y. Li (eds.), *Study on the Advancement of the Energy Management System in the East Asia Summit Region*. ERIA Research Project Report 2015-17, Available at: http://www.eria.org/RPR_FY2015_No.17_Chapter_5.pdf , pp.76-102.

Chapter 5

Policy Measures to Promote EMS Deployment

Following the first-year report of this study, this second-year report reviewed the possibility of EMS deployment in Southeast Asian region from technical aspect, including the results of the case studies at five sites. As discussed in Chapters 0 and 4, this study observed that there is a good space for energy efficiency by improving and advancing the operational practices of facilities at factories and office buildings.

These recommended energy-efficiency measures can be managed to some extent only with human efforts. However, as also discussed in the previous chapters, to identify and apply an optimised configuration of these facilities, a support from data analysis tool, in combination with meticulous data measurement, is indispensable. Especially for large factories that have a huge energy demand and a complicated structure of energy-consuming facilities, support from advanced technologies for managing these energy-related data is indispensable. EMS is expected to play an important role. The function of energy monitoring and analysis underlines the advanced stage of EMS, i.e. automated energy control.

However, despite these benefits of implementing EMS for promoting energy efficiency, the pace of its dissemination is very slow in many Southeast Asian countries. In some countries, the energy prices are very low and this hampers the investment for energy efficiency in general. However, this study also considers that there are some other reasons to discourage the investment on EMS even in the case where the benefit of energy efficiency will possibly recover the initial cost in the long run. Hence, there is a necessity for policy intervention to mitigate the factors that discourage the investment and to bridge between the current situation and the future dissemination.

As a conclusion, this study proposes a set of policy recommendations especially for Southeast Asian countries to facilitate the promotion and deployment of EMS. This chapter reviews the policies related to energy efficiency in Southeast Asian countries to identify the characteristics commonly observed in this region and tries a rough estimation of the potential of EMS deployment. Thereafter, it discusses the challenges for the deployment of EMS technologies.

1. Current Status of Energy-Efficiency Policy in Southeast Asia

Policies relating to energy efficiency include laws on energy conservation, energy- efficiency targets, requirements for appointment of energy managers, labelling or certification scheme, and financial incentives. It is also important to note that policy for electricity tariff is a key for promoting energy-efficiency measures.

In the following subsections, the current status of policies for energy efficiency in Southeast Asian region is described, especially focusing on Indonesia, Malaysia, Singapore, Thailand, and Viet Nam, the WG members.

1.1. Basic laws for energy efficiency and conservation

It is important for energy-efficiency and conservation laws to both set the requirements for energy efficiency and prepare the necessary incentives for achievement of these goals. Many of these laws mandate the energy management of large energy consumers, while at the same time preparing financial incentives for promotion and utilisation of energy-efficiency measures. Such requirements will raise the need for energy-efficiency measures, while preparation of financial incentives will increase accessibility to such technologies, including xEMS.

In many countries, laws for energy efficiency and conservation are usually established at the national parliament level. Many of these laws determine the responsible entities for energy efficiency and their obligations, including requirements and schemes for energy management. These laws often state the necessity of setting targets for energy efficiency and conservation, placement of energy managers, schemes for standard and labelling, and incentives for deploying energy-efficiency measures.

Thailand, for example, was one of the first countries in the ASEAN to establish a law for energy conservation (Energy Conservation Promotion Act B.E. 2535, revision B.E.2550) in 1992. The law was established to better manage energy-consuming sectors for energy conservation and to promote utilisation of energy-efficiency measures. It also provides for the necessity of providing financial incentives for deployment of such measures.

Singapore has different energy conservation laws for different sectors. Its Energy Conservation Act was established in 2012 to require energy management for large energy consumers in the industrial and transport sectors, and regulations for energy consumptions were added to the Building Control Act in 2012, targeting the building sector.

Indonesia, similarly, established its Government Regulation on Energy Conservation in 2009; Malaysia established its Efficient Management of Electrical Energy Regulations in 2009; and Viet Nam issued its Decree on Energy Efficiency and Conservation in 2003 (renewed by Law on Energy Efficiency and Conservation in 2011).

Detailed provisions of each policy measure related to energy efficiency based on these basic laws are described in the following subsections.

1.2. Energy-efficiency targets

(1) Current status in ASEAN countries

Based on laws for energy efficiency and conservation, energy-efficiency targets are established. Some targets include sector-wise goals for achieving the overall target. These targets may be in the form of energy intensity or, in other cases, in the form of energy consumption.

In Indonesia’s National Energy Conservation Master Plan, for example, energy-efficiency targets are established both as energy intensity and energy savings with a target reduction of 1 percent per annum in energy intensity up to 2025 and of 17 percent in energy consumption in the industrial, transport, commercial, and household sectors. The target further establishes energy saving goals for each sector: 17 percent for the industrial sector, 20 percent for the transport sector, and 15 percent for the commercial and household sectors.

Viet Nam’s energy-efficiency targets are defined in its Master Plan for Power Development 2011−2020, which establishes electricity savings target of 8–10 percent by 2020 (compared with BAU). The master plan notes that deployment of equipment with high-energy efficiency and advanced standards will be needed to accomplish the 10 percent target.

Energy-efficiency targets are determined in other ASEAN countries as well: For example, Malaysia in its National Energy Efficiency Action Plan 2016−2025, with the goal of reducing electricity consumption by 8 percent by 2025 (compared with BAU); Singapore in its Sustainable Singapore Blueprint 2009, with the goal of reducing its energy intensity by 35 percent from 2005 levels by 2030; and Thailand in its Energy Efficiency Plan 2015 (EEP2015), with the goal of reducing its energy intensity by 30 percent by 2036 (compared with that in 2010).

(2) General observations

These energy-efficiency targets serve as an important basis in determining target sectors for promoting energy efficiency and implementing appropriate programs for promotion of energy efficiency. As was the case in Viet Nam, it may be effective to consider energy-efficiency targets comprehensively with power development plans. Outlook for power demand should incorporate such energy-efficiency targets, and power development plans should be formulated with consideration to such power-demand outlook.

1.3. Nomination of energy managers and reporting

(1) Current status in ASEAN countries

Energy conservation regulations mandate the appointment of energy managers for facilities with more than certain amount of energy consumption.

Malaysia, for example, mandates the placement of energy managers for energy consumers of 3 million kWh or more for six consecutive months. The standard may be set as energy consumption in tonne of oil equivalent (toe) unit, as is the case in Indonesia of 6 kilotonne (ktoe) per year and Viet Nam 1 ktoe for agriculture and transport sectors and 500 toe for facilities). The standard in Singapore is either 15 GWh/year or 1.29 ktoe/year. Thailand's minimum standard for appointment of energy managers is set in terms of peak demand, for consumers with peak demand of 1 megawatt (MG) or higher.

In general, energy managers are required to monitor and report the use of energy, give advice for improving energy efficiency, and develop a plan for energy conservation. Energy managers must be certified by competent authorities. For certification, they need to satisfy various qualifications usually consisting of academic degree and work experiences in the energy-efficiency field, attend necessary training programs, and pass examinations. Viet Nam, for example, prepares different standards for certification of energy managers according to the sector they work in. To be appointed as energy manager in the field of industrial production, construction works and business services, college degree on energy specialty, and completion of energy management training course with a certificate are necessary. In the field of transportation and agriculture, intermediate level technical certificate or higher and the completion of energy management training course with a certificate are necessary.

The roles of energy managers include developing an energy-conservation plan; monitoring, evaluating, and reporting energy consumption data; and giving recommendations for improvements in energy consumption. The required frequency for reporting of energy-consumption data varies among countries: Singapore requires annual reporting of such data, while Viet Nam requires energy audit once in every three years.

(2) General observations

While the standards for appointment of energy managers vary among countries, it is important to set a standard for all so that energy managers can be appointed for the building and the industrial sectors. The energy consumers have relatively high potential for improved energy efficiency, but to recognize such benefits periodical collection of energy-consumption data is necessary so that quantified assessment of the benefits of xEMS technologies can be conducted to ratify the capital expenditures associated with their deployment.

Furthermore, scheme for training and recertifying existing energy managers will be effective in promoting energy-efficiency measures. Such training program should provide energy managers with new trends in energy-efficiency measures so that they would be able to incorporate them in their energy-conservation plan.

1.4. Labelling and certification schemes and minimum energy performance standard

(1) Current status in ASEAN countries

Most target countries have a certification or a rating scheme or both for energy-efficiency performance. To maintain the minimum standard of energy efficiency in the market, many countries have implemented a mandatory MEPS for certain designated appliances. Voluntary labelling schemes for high energy-efficiency appliances are implemented with an intention of promoting their purchase and utilisation in the application for various government incentives.

The labelling scheme in most countries takes the form of a star-rating scheme. Other than the rating mark, these labels often show information on energy consumption in kWh per year. Energy-efficiency label in Malaysia also shows the amount of energy saving in percent compared with an average appliance. In most cases, for appliances to which MEPS is applied, at least one-star rating must be acquired for them to be able to enter the market. (In Malaysia, two-star rating is the minimum standard.) Appliances with higher energy efficiency can acquire a higher star rating.

In many countries, MEPS have been established in the domestic sector mainly for air-conditioning units, refrigerators, and lightings. In Singapore, for example, manufacturers supplying air conditioner, refrigerator, clothes dryer, television, and lamp (incandescent, compact fluorescent lamp, and LED) must receive the certificate of registration for the model to enter the market.

(2) General observations

While some countries have already established mandatory MEPS in the household sector, other countries are still on their way. MEPS for building and industrial sectors are more underdeveloped than that for household sector. To be able to certify large appliances, testing laboratory capable of testing such certification criteria is necessary, and capacity building for the institutions and workers is also important.

In addition, comprehensive certification scheme, such as the building certification scheme in Singapore, will be effective in the promotion of xEMS technologies. The buildings are given a 'Green Mark' if they satisfy certain criteria for certification, including standards for energy efficiency, water efficiency, environment conservation, internal environment quality, and green innovation. The government is aiming to achieve 80-percent certification in all of the buildings by 2020. Such comprehensive certification will promote the deployment of xEMS technologies since these technologies contribute to the overall management of energy consumers.

1.5. Financial incentives for energy-efficiency measures

(1) Current status in ASEAN countries

Financial incentives are provided by the government for energy-efficiency measures. Some major schemes include tax reduction, low-interest loan, and subsidies.

In Singapore, for example, various tax incentives and subsidy programs are provided for energy-efficiency measures. Tax schemes include investment allowance, which provides additional 30 percent of investment allowance to encourage investment in energy-efficiency equipment.

In Malaysia, similarly, green investment tax allowance is provided for capital expenditures for energy-efficiency improvement in companies. It provides a 100-percent tax allowance for capital expenditure for five years. Also, it provides a 100-percent income tax exemption of 10 years for companies providing energy-efficiency improvement services.

Low-interest loan programs are provided by the government to promote investment in energy-efficiency projects. Malaysia, for example, offers green technology financing scheme, which is a low-interest loan program for companies that are supplying or utilising green technologies. The government bears 2 percent of the total interest or profit rate in the financing, so that a guarantee of 60 percent can be provided to the companies.

Thailand, similarly, provides a low-interest loan programs for local banks for them to be able to lend money for energy-efficiency or renewable-energy projects at a maximum interest rate of 4 percent.

The government can provide subsidies for various energy-efficiency measures. It can provide direct subsidy for implementation of energy-efficiency equipment. In Thailand, for example, a 20–30 percent direct subsidy is provided for the replacement of equipment with an energy-efficient one. In other cases, subsidies are provided for conducting energy audits, as is done in the Partnership Program on Energy Conservation in Indonesia, where buildings and industries can receive energy audits funded by the government if they introduce energy-saving measures as described in the audit.

Such financial incentives, focusing on the five ASEAN countries − Indonesia, Malaysia, Singapore, Thailand, and Viet Nam – are summarised in the table below.

Table 5.1: Summary of Financial Incentives in Some ASEAN Countries

Tax Incentives	• Investment tax allowance scheme (e.g. green investment tax allowance in Malaysia, Thailand, Singapore) • Income tax exemption (Malaysia, Thailand) • Depreciation allowance scheme (Singapore) • Waiver of import taxes (Thailand)
Subsidy	• Partnership Program on Energy Conservation (Indonesia) • Direct subsidy (Thailand) • Bidding mechanism subsidy (Thailand) • Energy-efficiency improvement assistance (Singapore) • Design for efficiency scheme (Singapore) • Grant for energy-efficiency technologies (Singapore)
Low-interest loan	• Green technology financing scheme (Malaysia) • Interest-rate cap for EE or RE projects (Thailand)
Others	• Co-investment scheme (Thailand) • Training for energy efficiency audit, project, and financial products (Viet Nam)

ASEAN = Association of Southeast Asian Nations, EE = energy efficiency, RE = renewable energy.

Source: Study Team.

(2) General observations

It is often the case for xEMS technologies that the initial investment cost and feeling of uncertainty for their benefits serve as barrier for deployment. ESCO business would lower such barriers; ESCO provides energy-management service to energy consumers by guaranteeing a certain amount of energy savings. It is important to provide incentives for financial institutions to grant loans to ESCO businesses. Thailand offers a co-investment program called ESCO fund, which is funded by the Department of Alternative Energy Development and Efficiency. The purpose of the fund is to promote investments in energy efficiency (EE) or renewable energy (RE) projects by sharing their risks among public and private entities. The budget is allocated to the non-profit organisation responsible for managing and co-investing a maximum of 50 million Thai baht per project in such EE or RE projects. Such scheme will promote the understanding of financial institutions towards EE or RE projects and is extremely important in accelerating investment for energy-efficiency measures.

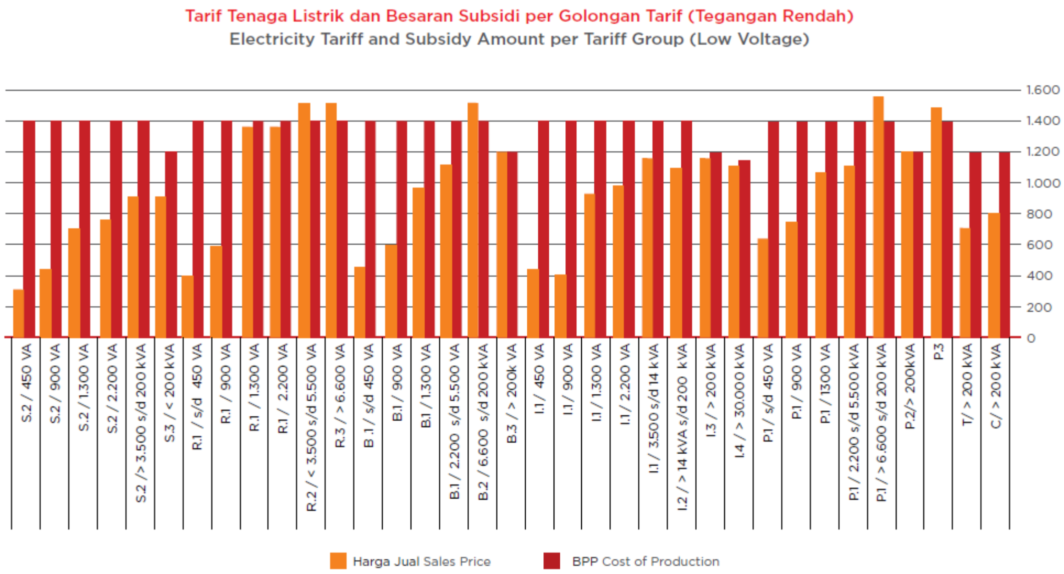
1.6. Electricity price

(1) Current status in ASEAN countries

In some countries, subsidies are applied to electricity prices to cover for the low domestic electricity tariff. In other words, it is difficult in such cases to recover the capital investment of energy-efficiency measures.

There are two types of subsidies pertaining to electricity tariff. The first type is a subsidy in tariff rates, given from the government to utilities to attain profitability. Perusahaan Listrik Negara, for example, provides data for such subsidy as shown in its annual report (Figure 5.1). This type of subsidy has been seen in many countries in Southeast Asia, but its amount is in a decreasing trend.

Figure 5.1: Example of Subsidy in Tariff Rates



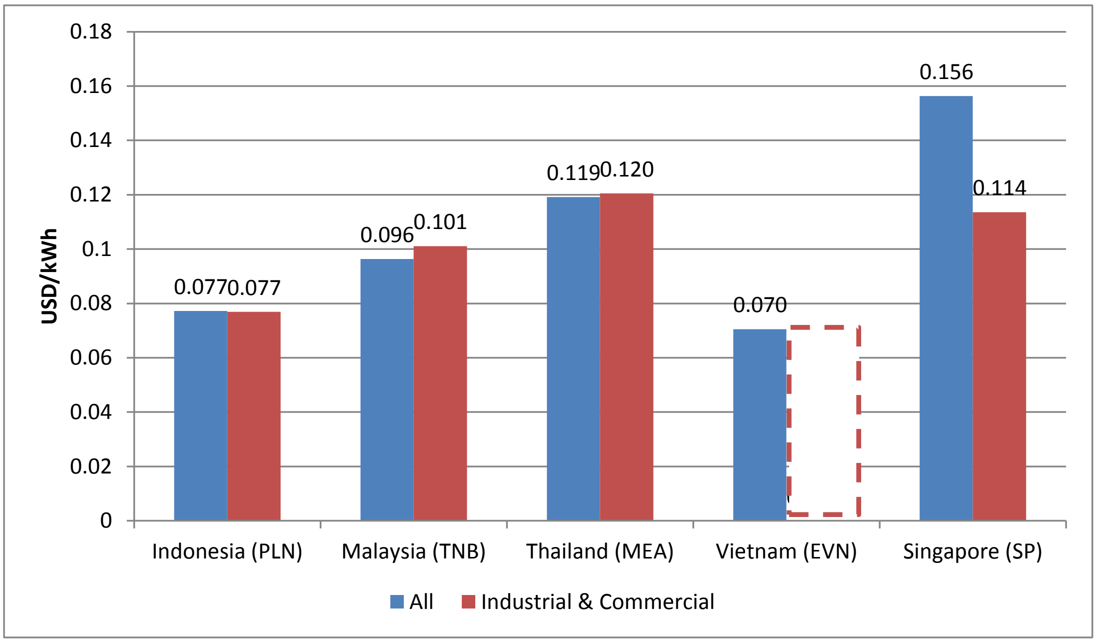
Source: Perusahaan Listrik Negara (PLN) Annual Report 2015.

The second type is the gap between the international fuel price and the domestic fuel price for power generation. This type of subsidy is often seen in countries that can produce fuels domestically. It would gradually be driven away as well. Malaysia, for example, has started implementing imbalance cost pass-through as part of its incentive-based regulation starting from 2015. The purpose of this regulation is to establish competitive electricity tariff, which can cover for the electricity supply cost incurred in utilities. The pass-through mechanism allows Tenaga Nasional Berhad to reflect fluctuations in fuel and generation costs in electricity tariff every six months. Under this mechanism, if there is a net savings in fuel and generation costs, rebate is given to customers; if there is a net increase in fuel and generation costs, Tenaga is allowed to raise its electricity tariff for the following period. In this way, fuel price will be properly reflected in the electricity tariff.

(2) General observations

A comparison of an average electricity selling price for ASEAN countries, focusing on Indonesia, Malaysia, Singapore, Thailand, and Viet Nam, is shown below. The average electricity selling price was estimated for the overall sector, particularly for the industrial and commercial sectors.

Figure 5.2: Average Electricity Selling Price (USD/kWh)



EVN = Vietnam Electricity, MEA = Metropolitan Electricity Authority, PLN = Perusahaan Listrik Negara, SP = Set Point, TNB = Tenaga Nasional Berhad, USD/kWh = United States dollar per kilowatt-hour.

Notes:

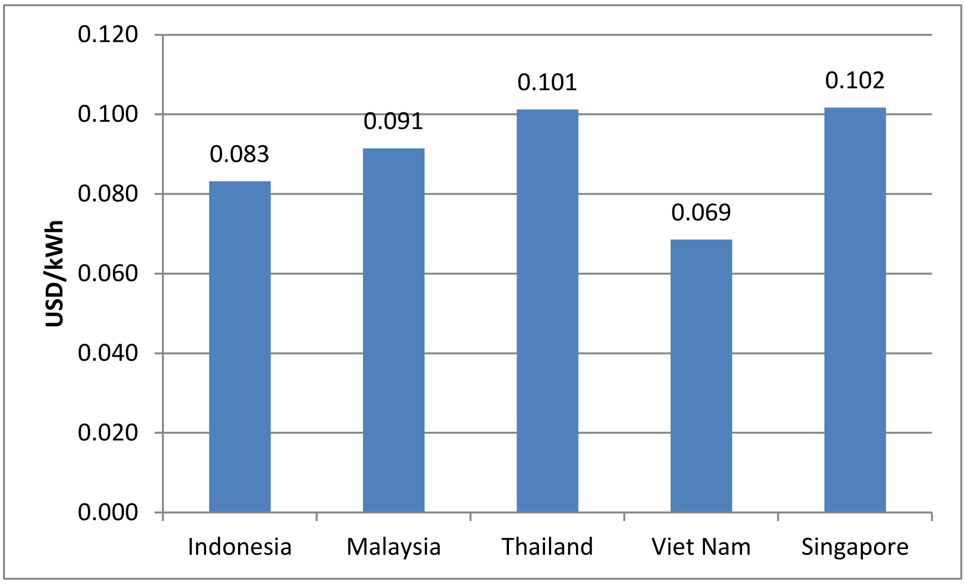
1. The figure was prepared by the study team using the following sources. Indonesia: PLN 2015 Annual Report; Malaysia: TNB 2015 Annual Report and Energy Commission Data; Thailand: MEA 2015 Annual Report; Viet Nam: EVN 2015 Annual Report; Singapore: EMA 2016 Annual Report.
2. Currency exchange rate: International Monetary Fund (IMF) and World Bank (WB) (Viet Nam) data for 2015.
3. Electricity selling price for the industrial sector in Viet Nam was not provided, therefore, its industrial and commercial average selling price is shown as almost equal to its overall average selling price, following the trends of other countries.

Source: Study Team.

The average selling price of electricity in Singapore, which mainly relies on imported fuel for electricity generation, is higher than that in Indonesia and Malaysia, which are able to procure some of its fuel domestically. From the figure, it can also be observed that Viet Nam has a significantly lower electricity selling price compared with other countries.

Furthermore, the average electricity price for a model factory was estimated for each country. The model factory was assumed to have a peak demand of 2,000 kW, an annual consumption of 15 million kWh, and a voltage of 22 kilovolts. The factory was assumed to maintain its full load during its operating hours.

Figure 5.3: Electricity Price for a Model Factory (USD/kWh)



USD/kWh = United States dollar per kilowatt-hour.
Note: Currency exchange rate: International Monetary Fund (IMF) and World Bank (WB) (Viet Nam) data for 2015.
Source: Study Team (prepared based on electricity tariff of major utilities of each country).

While the average electricity selling price of Singapore was significantly higher than that of other countries, the average electricity price for a model factory in Singapore is more comparable with that in other countries. The reason is that Singapore provides much lower electricity tariff for the industrial and commercial sectors. It can also be pointed out that the electricity price for a model factory in Viet Nam is much lower than that in other countries, which follows the trend seen for the average electricity selling price.

It should be noted that when electricity tariff is set at a low level, it disincentivises the electricity consumer to implement energy-efficiency technologies, since low electricity prices would provide only limited benefit for electricity savings.

2. Estimated Potential of Energy Efficiency through EMS Deployment

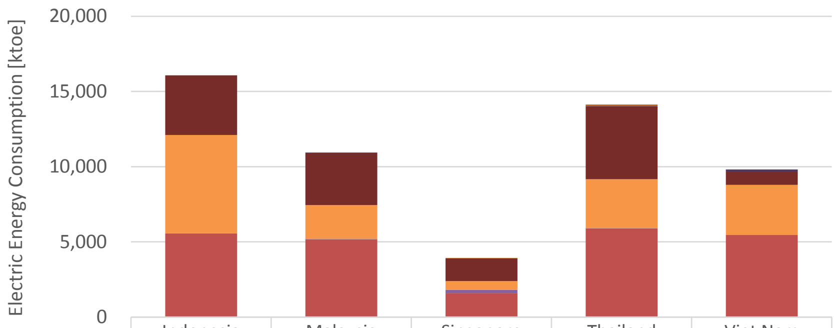
The statistical overviews of related energy macro data in five target countries − Indonesia, Malaysia, Singapore, Thailand, and Viet Nam − were conducted in last year's study. Based on these studies, the potential of energy efficiency through the deployment of EMS is estimated in this fiscal year.

2.1. Background

The current electric energy consumption by each sector in the five target countries is shown in Figure 5.4. EMS technologies contribute for energy saving, especially reducing electricity consumption by introducing BEMS in the building sector and FEMS in the industry sector. In the five target countries, the most electricity is consumed in those introduced potential sectors, such as industry, residential, and commercial or public services sectors.

The countries' electricity consumptions in the industry sector, excluding Singapore's, are almost the same level, around 5 million toe, while the tendency in building sector is different by countries. Indonesia, for example, has the highest electricity consumption in the residential sector because of its big population in the city. In contrast, in Thailand, electricity consumption in commercial and public services sector is higher than that in the residential sector because of its more-developed commercial and urban areas.

Figure 5.4: Electric Energy Consumption by Sector, 2013 (ktoe)



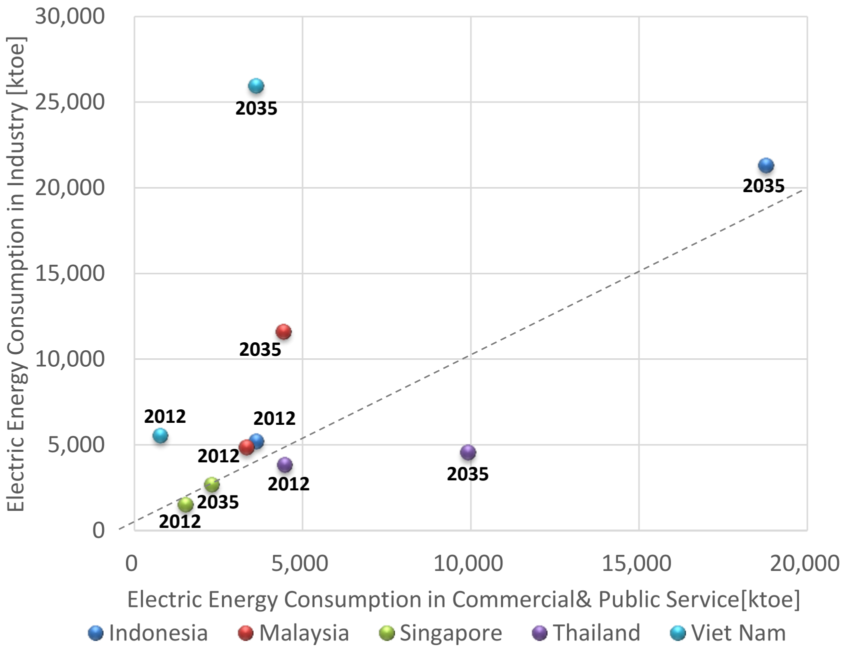
	Indonesia	Malaysia	Singapore	Thailand	Viet Nam
Non-specified	0	0	30	85	0
Agriculture/forestry	0	32	0	30	135
Commercial and public servises	3,970	3,467	1,520	4,853	887
Residential	6,539	2,262	582	3,250	3,336
Transport	0	21	204	14	0
Industry	5,562	5,171	1,603	5,900	5,454

ktoe = kilotonne of oil equivalent.
Source: International Energy Agency (IEA) (2015), 'Energy Balances of Non-OECD Countries, 2015'.

The publication by the Economic Research Institute for ASEAN and East Asia (ERIA), 'Energy Outlook and Energy Saving Potential in East Asia', summarises the current and future electricity consumption in the target sector of introducing EMS. Based on the above-mentioned International Energy Agency data (Figure 5.4), there is little electricity consumption in the agriculture sector, therefore, these data are treated and regarded as negligible. The following is the trend in each country.

- Indonesia: One of the highest growth rates of electric energy consumption, and most consumption in the industry and commercial and public service sectors.
- Malaysia: The middle growth rate of electric energy consumption, and larger consumptions in the industry sector.
- Singapore: Lower electric energy consumption compared with other countries.
- Thailand: Similar growth of electric energy consumption as Malaysia, however, larger consumption in the commercial and public service sector.
- Viet Nam: The same level of growth rate of electric energy consumption as Indonesia, however, larger consumption in the industry sector compared with Indonesia.

Figure 5.5: Electric Energy Consumption in Industry and Building and Agriculture Sectors, 2013, and 2035 as BAU Scenario (million toe)



BAU = business as usual, ktoe = kilotonne of oil equivalent.
Source: Economic Research Institute for ASEAN and East Asia (ERIA) (2015), 'Energy Outlook and Energy Saving Potential in East Asia'.

The 'Energy Outlook and Energy Saving Potential in East Asia' examines the BAU scenario and against alternatives called Alternative Policy Scenario (APS). The following scenarios are used for estimation (Figure 5.2). The difference between the BAU scenario and the APS in both final and primary energy consumption represents potential energy savings.

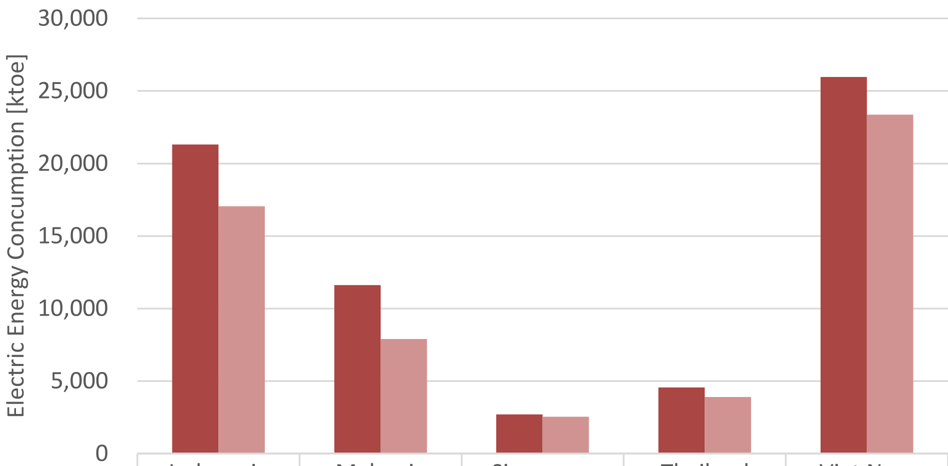
Table 5.2: Assumptions of Alternative Policy Scenario

	Improved Efficiency Scenario
APS1	More efficient final energy demand
APS2	More efficient thermal power generation
APS3	Higher consumption of new and renewable energy (NRE) and biofuels
APS4	Introduction or higher utilisation of nuclear energy
APS5	Included all APS

APS = alternative policy scenario.
Source: Economic Research Institute for ASEAN and East Asia (ERIA) (2015), 'Energy Outlook and Energy Saving Potential in East Asia'.

Electric energy consumption by the industry and commercial and public service sectors in 2035, each scenario compared, is shown in Figure 5.6.

Figure 5.6: Electric Energy Consumption in Industry Sector, 2035 (BAU Scenario vs APS)

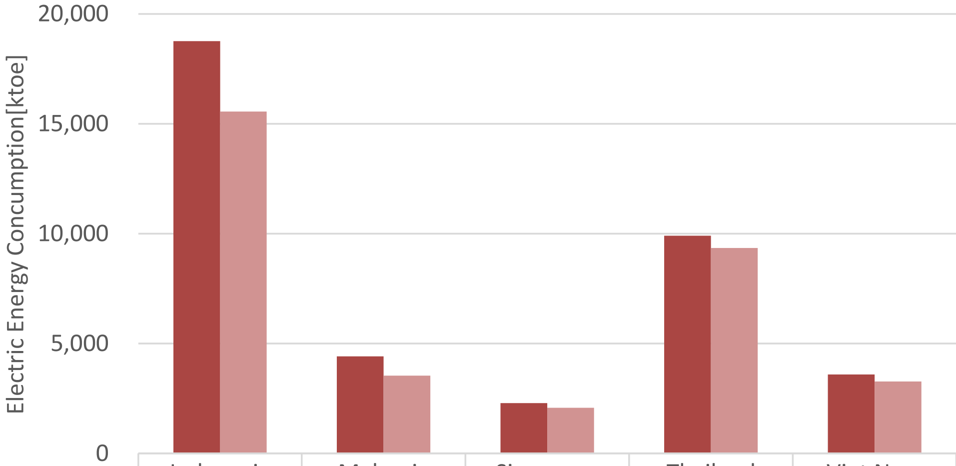


	Indonesia	Malaysia	Singapore	Thailand	Viet Nam
BAU	21,311	11,612	2,689	4,564	25,970
APS	17,049	7,896	2,547	3,904	23,370

APS = alternative policy scenario, BAU = business as usual, ktoe = kilotonne of oil equivalent

Source: Economic Research Institute for ASEAN and East Asia (ERIA) (2015), 'Energy Outlook and Energy Saving Potential in East Asia'.

Figure 5.7: Electric Energy Consumption in Commercial and Public Service Sector 2035 (BAU Scenario vs APS)



	Indonesia	Malaysia	Singapore	Thailand	Viet Nam
BAU	18,767	4,425	2,294	9,911	3,601
APS	15,557	3,540	2,080	9,358	3,272

APS = alternative policy scenario, BAU = business as usual, ktoe = kilotonne of oil equivalent.
Source: Economic Research Institute for ASEAN and East Asia (ERIA) (2015), 'Energy Outlook and Energy Saving Potential in East Asia'.

2.2. Results of estimation

The potential of energy savings through the deployment of EMS in the industry and commercial and public service sectors was estimated against electrical energy consumption forecast in 2035 based on the BAU scenario.

Assumptions:

(1) Potential of energy savings by EMS per unit set at 10 percent based on the case study.

(2) Potential of energy savings through the deployment of EMS is estimated using the following equation: electric energy consumption × potential energy savings by EMS per unit × market penetration rate of EMS.

Table 5.3 Estimated Potential of Energy Saving through the Deployment of Energy Management System (Mtoe/year)

Country	Sector	Market Penetration Rate of EMS				(c.f.) Energy saving potential *1
		10%	30%	50%	70%	
		Estimated potential of energy efficiency through EMS				
Indonesia	Industry	0.2	0.6	1.1	1.5	4.3
	Building	0.2	0.6	0.9	1.3	3.2
Malaysia	Industry	0.1	0.3	0.6	0.8	3.7
	Building	0.0	0.1	0.2	0.3	0.9
Singapore	Industry	0.0	0.1	0.1	0.2	0.1
	Building	0.0	0.1	0.1	0.2	0.2
Thailand	Industry	0.0	0.1	0.2	0.3	0.7
	Building	0.1	0.3	0.5	0.7	0.6
Viet Nam	Industry	0.3	0.8	1.3	1.8	2.6
	Building	0.0	0.1	0.2	0.3	0.3

*1: Energy saving potential is calculated as 'BAU scenario' minus 'Improved Efficiency scenario'
Source: Author.

3. Promoting the Deployment of EMS in ASEAN Countries

3.1. Challenges for the EMS deployment

Despite the benefits of implementing EMS for promoting energy efficiency, the pace of its dissemination is very slow in many of the Southeast Asian countries. Installation of EMS requires certain costs for investment, and the user's little confidence on the economic benefit of investing in EMS may discourage the investment in EMS and the promotion of its deployment.

Hence, this study identifies the challenges for the deployment of EMS, i.e. main factors that may hamper the investment in EMS, for discussing the solutions to deal with these challenges.

(1) Identifying the benefit of EMS implementation

(a) Role of EMS in energy efficiency

First, it has to be pointed out that the role of EMS is to provide data of energy consumption of the installed appliances for monitoring and analysis to determine their optimised operation. In other words, EMS itself does not contribute to energy saving, but provides tools for energy saving of energy-consuming appliances (e.g. turbo chillers and air compressors). This indirect role of EMS for energy efficiency, compared with the direct investment to replace these energy-consuming appliances with more energy-efficient ones, makes the economic benefit of investment less clear.

Certain efforts for enhancing the awareness of the role of EMS may be needed to promote its deployment.

(b) Methodology to measure the energy-saving effect

In relation to the indirect role of EMS as aforementioned, the economic benefit of installing EMS may not be easily determined without establishing a methodology to measure its effect.

Usually, the effect of energy efficiency by optimising the operation referring to the data analysis from EMS is measured by comparing the actual performance of energy consumption with that in the past when the basic conditions are similar (e.g. the same period in the previous years) or with the estimated energy consumption of the without-EMS scenario considering the difference in operational parameters.

However, since the energy consumption of an appliance is affected by various factors, such as weather conditions, operational hours, number of people working in the building, and production volume, comparison with the historical record or the without-EMS scenario may sometimes be difficult because of the differences in various factors that can affect the energy consumption although these differences are not related to the installation of EMS.

A sophisticated methodology to evaluate the energy-saving effect by using EMS, which is clearly formulated and quantitatively cogent, should be prepared for its diffusion.

(2) Financial support and incentive for EMS installation

Since the installation of EMS requires initial cost for investment, financial support and incentives to this investment cost will facilitate EMS deployment. However, although some countries in the Southeast Asian region have established institutional schemes of providing financial support and incentive to the investment in implementing technologies related to energy efficiency, such as tax reduction, low-interest loan, and subsidies, these schemes usually do not cover the installation of EMS.

There may be some reasons for this. As previously explained, the effect of energy efficiency by installing EMS may not be estimated easily compared with the case of direct investment in energy-consuming appliances, i.e. the baseline of financial support and incentive for the expected effect of energy efficiency may not be easily determined. Further, installation of EMS is supposed to be a relatively advanced step towards energy efficiency, thus, the policymakers are apt to consider that this should be disseminated totally in a commercial manner without policy intervention from the government.

However, the installation of EMS, as well as the replacement of energy-consuming appliances with more energy-efficient ones, can explore potential of energy saving but necessitates certain initial costs for implementation. Hence, it is worth considering the provision of financial support and incentive to any kind of investment that serves for energy efficiency and certain financial support helps, improving the cost-benefit balance and facilitating the owner’s decision on investment.

In fact, the investment in EMS is not a separate activity from the investment in energy-efficient appliances in actual practices, and they are often implemented in combination because EMS also provides tools for measuring the effect of investing in energy-efficient appliances.

(3) Private sector's involvement in energy-efficiency businesses

Although the utilisation of public fund is effective for promoting energy-efficiency technologies, direct policy intervention in the market should be eradicated gradually and be taken over by commercial-based businesses in the long run. Hence, even in the stage where policy support for promoting energy-efficiency technologies is still needed, the support should be gradually shifted from directly providing subsidies to capital investment to a more indirect approach, such as establishing institutional framework for supporting private sector's businesses to promote energy efficiency.

(4) Economically irrational energy prices

The promotion of energy-efficiency technologies is also affected by energy prices because the benefit of energy-efficiency technologies, i.e. the return on investment, is determined by the saved energy cost, which is the product of energy-saving volume and unit price of energy.

In some countries that are abundant in domestic production of energy sources, domestic energy prices are, in general, lower than those in countries that rely on imported energy sources. Also, if a country's value chain of energy supply from upstream (i.e. primary energy production) to downstream (i.e. end-consumption) is closed domestically, the domestic energy prices are less volatile to international energy prices. This little volatility often results in government subsidies to maintain the prices at low level if the prices have upward rigidity for some reasons.

In ASEAN countries that have abundant domestic production of energy sources, such as Indonesia and Malaysia, domestic energy prices have been set at lower than international prices and like the case of Perusahaan Listrik Negara in Indonesia, government subsidies are also provided directly.

There are several problems about uneconomically low energy prices.

(1) The loss of price elasticity of energy demand that leads to the waste of energy consumption and the depletion of domestic reserve of energy sources.

(2) The loss of wealth that would be gained if energy sources were sold at higher prices, not only for the energy suppliers directly but also for the entire national economy indirectly.

(3) The waste of subsidies to energy prices that would have been used for other purposes for sustaining the national economy.

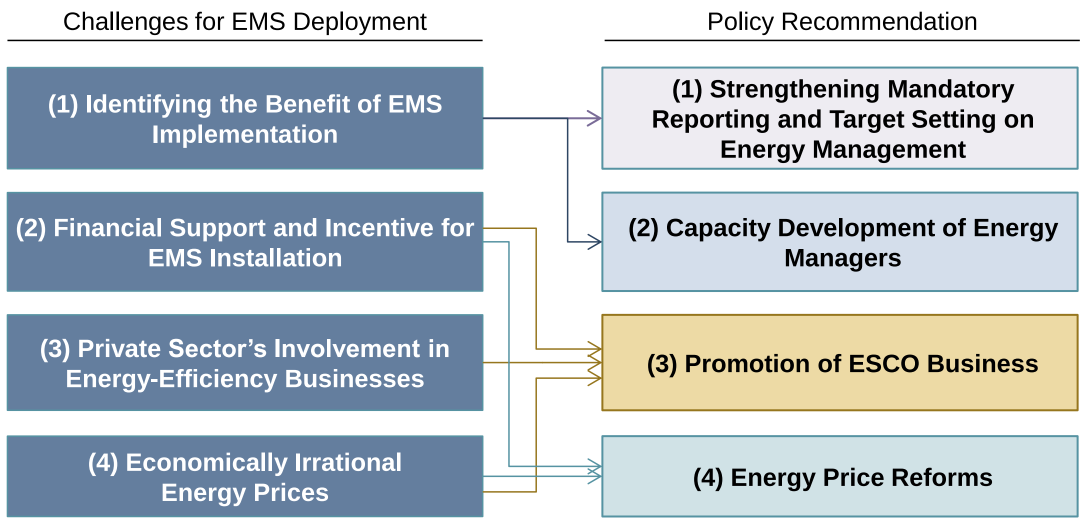
Recently, the importance of adjusting the domestic energy prices to the international prices has been accepted by many countries, and policy measures have been taken for mitigating the gap between domestic and international prices.

However, raising energy prices often stirs up national discontent and can be a politically sensitive issue. Hence, a cautious and gradual approach to deal with this should be taken.

3.2. Policy recommendation for promoting EMS deployment

To deal with the aforementioned challenges, this study proposes the following policy recommendations that will facilitate the deployment of EMS and energy-efficiency technologies.

Figure 5.8: Challenges for EMS Deployment and Policy Recommendation



Source: Author.

(1) Strengthening mandatory reporting and target setting on energy management

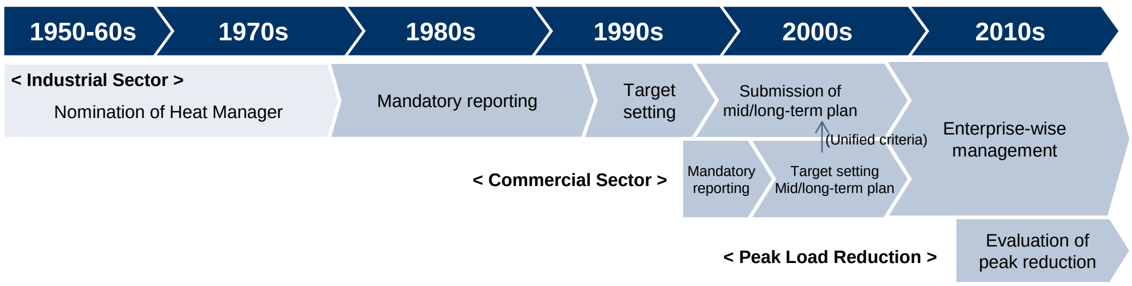
As the prerequisite for promoting the deployment of EMS, large energy consumers, such as factories and buildings, should be motivated to monitor the status of their energy consumption. Consumers with large consumption of energy who are conscious about cost management may voluntarily monitor their energy use. However, policy intervention to oblige consumers, who utilise a certain volume of energy or more in a year, to report on their status of energy management periodically is recommended, extending this practice to a larger number of consumers. Introduction of mandatory reporting is expected to enhance the consumers' awareness to monitor the status of their energy use and to reduce their consumption as needed.

Mandatory reporting of large energy consumption to a government agency also helps the government to grasp the status and the historical trend of energy consumption of a country as a whole.

The next step is the mandatory target setting, i.e. obliging these large energy consumers to develop a short-, mid-, and long-term plan of energy efficiency with quantitative target. Japan's Energy Saving Act mandates the designated business organisations to define a benchmark index for comparison with the standard of the same or similar industrial sector and to set mid- and long-term targets for improving their energy intensity (more than 1 percent per annum). In this stage, large energy consumers need not only to fill the data in the designated reporting format but also to conduct more detailed works of data recording and analysis. This is expected to help promote the utilisation of advanced energy management technologies.

As discussed in Section 1.3, mandatory reporting for large energy consumers has become a common practice in the ASEAN countries, more or less, hence, these countries should consider strengthening mandatory reporting and mandatory target setting. It has to be noted that an all-out implementation is not realistic, and moving to this direction may take time considering human limitation. In fact, Japan has taken a long history of developing mandatory reporting and target setting (Figure 5.9). Governments in the ASEAN region are also suggested to prepare a long-term plan of evolving the mandatory reporting for advancing energy management.

Figure 5.9: History of Mandatory Reporting on Energy Management in Japan



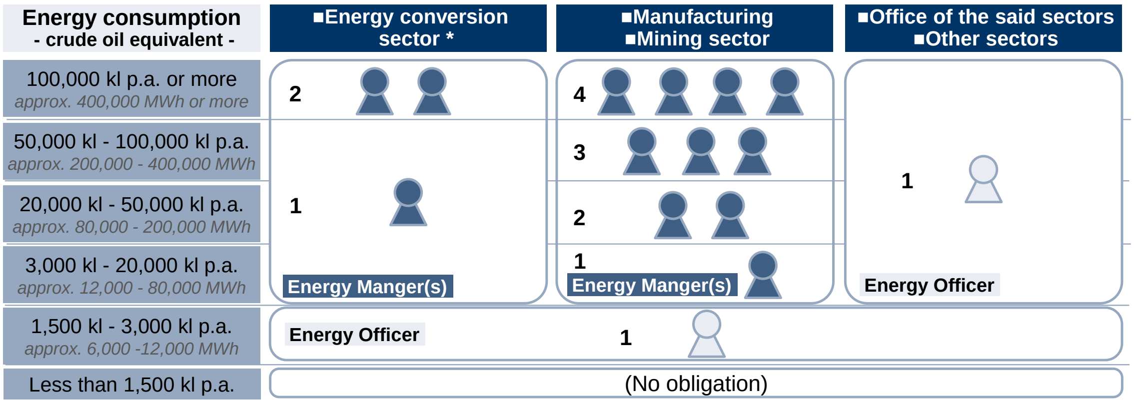
Source: Author (referring to various sources).

(2) Capacity development of energy managers

As discussed above, developing the capacity of human resources is a key for advancing energy management, especially those who assume the responsibilities of energy manager on behalf of large energy consumers.

Along with mandatory reporting, nomination of qualified energy managers has been mandated to large energy consumers not only in Japan but also in other ASEAN countries. In Japan, the requirements for nominating energy managers and energy officer vary depending on the type of business and the volume of energy consumption (Figure 5.10).

Figure 5.10: Requirements for Nominating Energy Manager(s) and Energy Officer



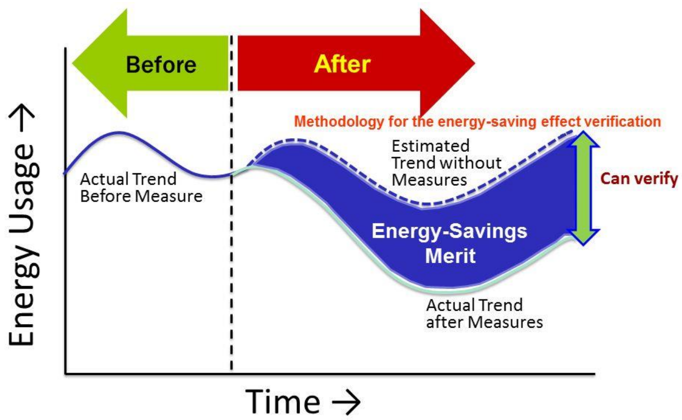
Note: *Energy conversion sector includes coke production, electricity supply, gas supply, and heat supply.
The main difference between energy manager and energy officer is the ease of acquiring the qualification.

Source: Author (referring to various sources).

These energy managers and energy officer are requested to be versed not only in technical matters of energy efficiency but also in developing plans of energy efficiency so that they can apply appropriate performance indicators to measure the effect of energy efficiency.

Developing the capacity of energy managers so that they can devise meticulous methodologies of evaluating the effect of energy efficiency helps verify the benefit of implementing EMS. Advancing capacity development of energy managers is especially essential for large-scale manufacturers that have a complicated internal structure of energy supply and demand, thus needing a sophisticated approach for identifying the benefit of EMS quantitatively and accurately.

Figure 5.11: Methodology of Verifying Energy-Saving Effect



Source: Azbil Corporation (2016), 'Abu Dhabi Energy Efficiency Improvement Forum, 2016'.

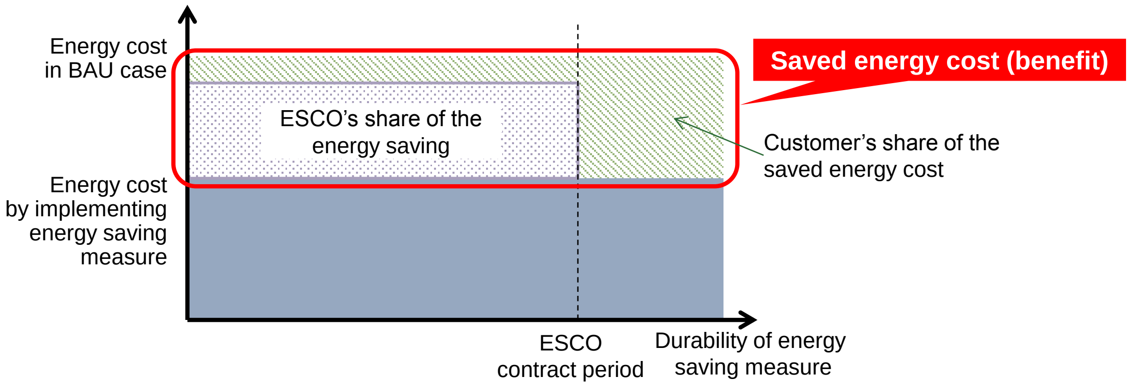
(3) Promotion of energy service company business

It may be ideal if all the large energy consumers have their internal energy manager who is versatile in energy-efficiency technologies and can provide the best-ever solutions for energy efficiency for the employer.

However, all the internal energy managers may not have such highest-end skills, hence, it is better, especially for medium and small enterprises, to ask for the expertise of external energy managers in making a decision on implementing energy-efficiency measures that require certain initial cost for investment. Also, there is a potential for promoting the ESCO business.

In an ESCO business, ESCO and the customer go into energy-saving performance contract under which ESCO provides energy saving measures and receives from the customer a portion of the benefit that derives from saved energy cost. The basic concept of the ESCO business is illustrated in Figure 5.12.

Figure 5.12: Basic Concept of Energy Service Company Business



BAU = business as usual, ESCO = energy service company.
Source: Author.

Implementing energy saving measures requires certain costs, such as the initial investment cost for installing devices and operation, whereas it is not certain how much benefit, i.e. saved energy cost, will be brought to the customer until actual implementation. Therefore, the key point of ESCO business is that ESCO takes the risk of this uncertainty so that the customer is motivated to take energy-efficiency measures without the risk.

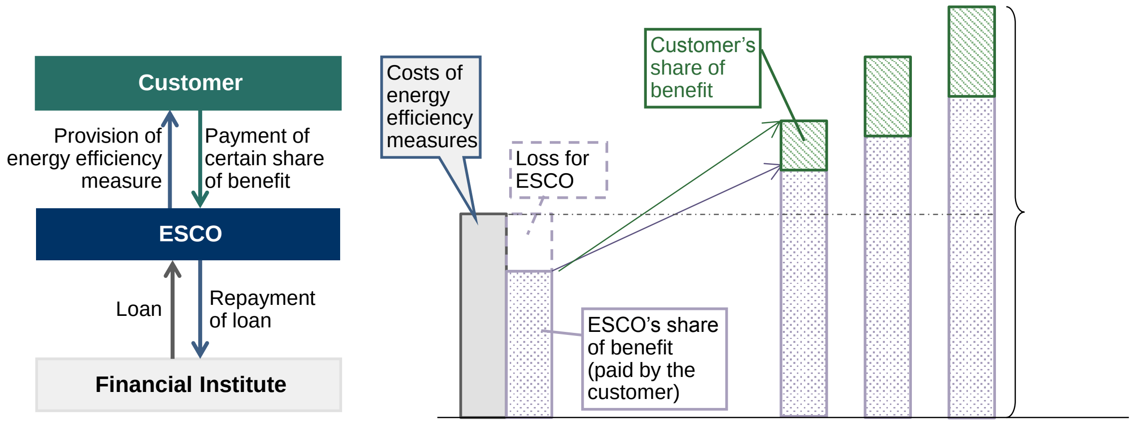
ESCO's business model can be roughly classified into two types: (i) shared saving model and (ii) guaranteed saving model, depending on who bears the costs of energy-saving measures.

In the shared saving model, ESCO bears the costs of energy-efficiency measures, including the initial investment and depending on the actual performance of energy saving (i.e. benefit) by implementing the measures, and the customer pays ESCO a certain share of the benefit. If the benefit fails to cover the costs of energy-efficiency measures, the customer does not have to pay ESCO the amount exceeding the benefit.

In the guaranteed saving model, the customer bears the costs of energy-saving measures, and ESCO usually assists the customer in arranging the loan for the initial investment. ESCO assures the customer of the guarantee of energy-saving performance. If the actual performance of energy saving (i.e. benefit) fails to cover the costs, ESCO compensates for the loss. When the benefit outperforms the costs, the customer pays ESCO a certain share of the excess benefit.

Images of the shared saving model and the guaranteed saving model are illustrated in Figure 5.13 and Figure 5.14 respectively.

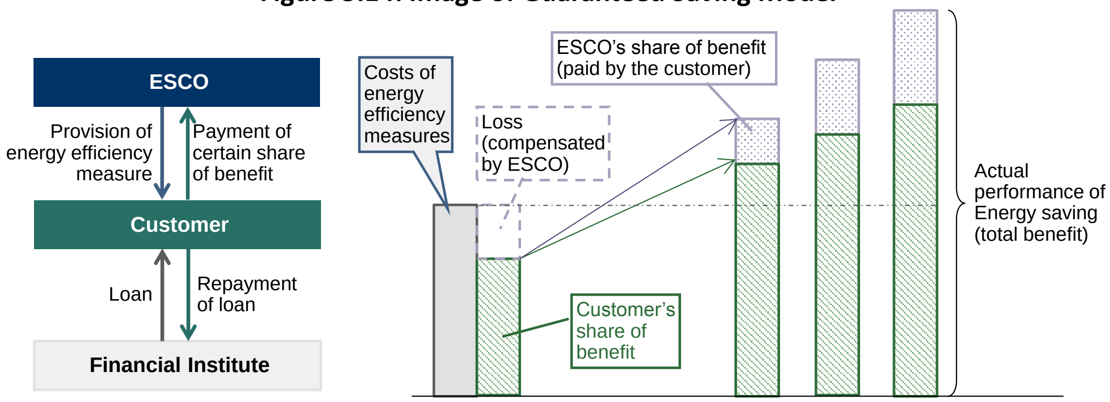
Figure 5.13: Image of Shared Saving Model



ESCO = energy service company.

Source: Author.

Figure 5.14: Image of Guaranteed Saving Model



ESCO = energy service company.

Source: Author.

Promoting ESCO business is expected to boost the deployment of EMS because, to confirm the benefit of energy-efficiency measures agreeable between the customer and the ESCO, sophisticated tools for measuring and monitoring the customer's energy consumption are needed. In fact, ESCO proposes that the customer install EMS as part of energy-efficiency measures, along with the investment in the energy-efficient appliances.

From the viewpoint of EMS suppliers, ESCO business is an opportunity for developing their business from simply selling the EMS system alone to providing the customer with various kinds of services. The four stages summarise the evolution of EMS-related business model.

Stage 1: Sales model

Simply selling EMS together as the tool for measuring energy efficiency.

Stage 2: Solution model

Providing customers advices on energy efficiency and proposing to install appliances that serve for energy efficiency in relation with EMS.

Stage 3: Life-cycle solution model

Assisting the customers with analysing the operational data and providing advices for improving the performance of operation on a long-term basis (as a kind of operation and maintenance contract).

Stage 4: ESCO model

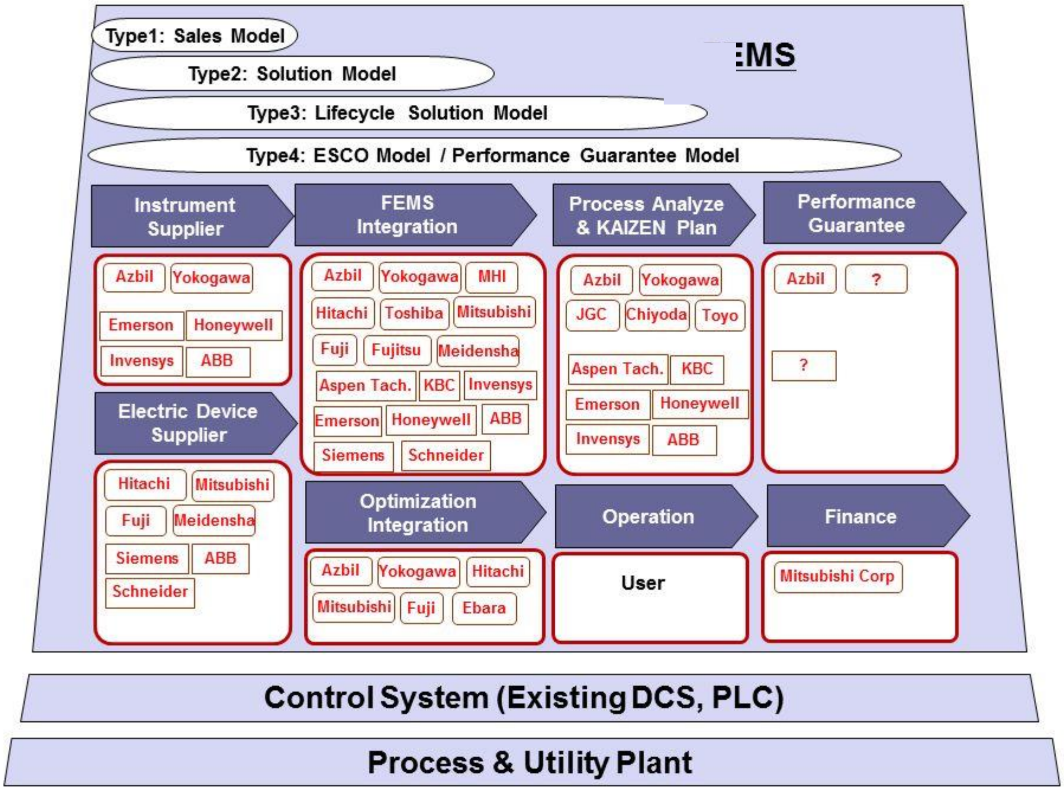
Besides the aforementioned services, providing also the customers with guarantee to mitigate their financial risk.

Figure 5.15 illustrates the stages of evolution of EMS-related business models with main players in each stage.

In terms of policy support, regulations, like mandatory reporting and target setting, are expected to motivate the consumers to be aware of solution services, like ESCO, that help them to comply with these regulations, even disregarding the evaluation of cost-and-benefit balance of these services.

In a more advanced stage, policy support should be advanced, not only imposing legal obligations but also providing incentives for facilitating the energy-efficiency-related businesses to be commercially sustainable. Also, the financial incentives should be sophisticated with stages, e.g. shifting from directly providing subsidies to investment to indirectly supporting the investment, such as low-interest loan and tax reduction.

Figure 5.15: Development of EMS-Related Business Model



DCS = distributed control system, ESCO = energy service company, EMS = energy management system, FEMS = factory energy management system, PLC = programmable logic controller.

Source: Azbil Corporation (2016), 'Abu Dhabi Energy Efficiency Improvement Forum, 2016'.

(4) Energy price reforms

(a) Shift from energy-price subsidies to energy-efficiency subsidies

The last, but not the least, to be pointed out is the importance of energy price reforms since the financial feasibility of implementing EMS, as well as any other kinds of energy-efficiency technologies, depends on how the costs for implementing these technologies are recovered by the saved costs of energy. Thus, if the energy prices are low, the payback period for implementing EMS becomes longer.

As discussed in Section 3.1, energy prices are apt to be low in countries that domestically produce fossil fuel, because the energy price are set based not on the international market price but on the conventionally determined rules that may not be supported by economically reasonable formula. The gap between the domestic energy price and the international market price is regarded as subsidies borne by the national economy. Although these kinds of subsidies may be justified to some extent in terms of social consideration, modifying the prices from actual costs of supply by subsidisation may deteriorate the price signal that may control the demand in an economically rational way.

Ideally, the energy prices in these countries should also be adjusted to meet the market price that reflects the supply and demand of energy in the market. As a general trend, even in the countries where the domestic energy prices are still low, the governments recently have been trying to raise the prices to mitigate the gap from international market price. However, adjusting the prices is made gradually and completely eradicating may take certain period since energy price is a politically sensitive issue.

For the countries where the domestic energy prices are set lower than the international prices − and it is not easy to adjust the prices in a short term − this study recommends to provide subsidies for implementing energy-efficiency technologies as the compensation for reducing the subsidies to prices of energy consumption. The maximum amount of subsidies to implementing energy-efficiency technologies thus can be formulated as follows.

Subsidies to implementing energy-efficiency technologies = Σ(volume saved energy) x (international market price – domestic energy price), where ⍰ stands for the duration of cost recovery (e.g. 15 years).

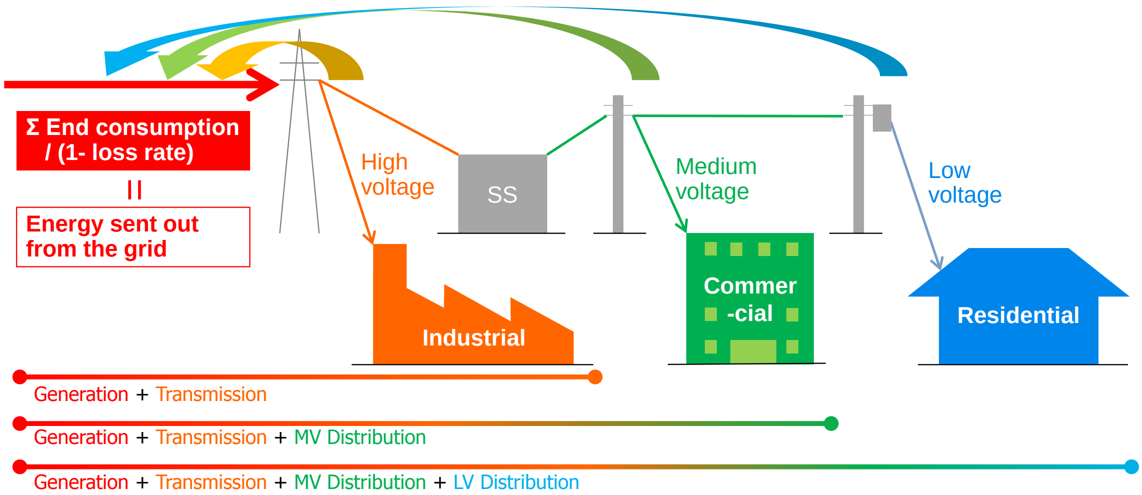
Reduced carbon costs deriving from reduced energy consumption can also be added to the formula if the country's energy supply relies on fossil fuel combustion.

(b) Designing economically rational energy prices

The ultimate stage of price reforms is total liberalisation where government regulation on prices is removed and every transaction between supplier and consumer is traded at a market price. However, the volatility of market price may impair the stability of national economy and hence, maintaining price regulation may be justified, especially when the market is still immature and is vulnerable to price fluctuation. Even in this situation, price regulation should be designed so that the pricing is made in accordance with the actual cost of supply not only entirely (matching the total revenue with the total cost) but also sector-wise and time-wise.

Sector-wise pricing means that the cost is allocated to different sectors, e.g. residential, industrial, and commercial, appropriately to determine which customers need more or who needs less cost for energy supply, e.g. low-voltage consumers.

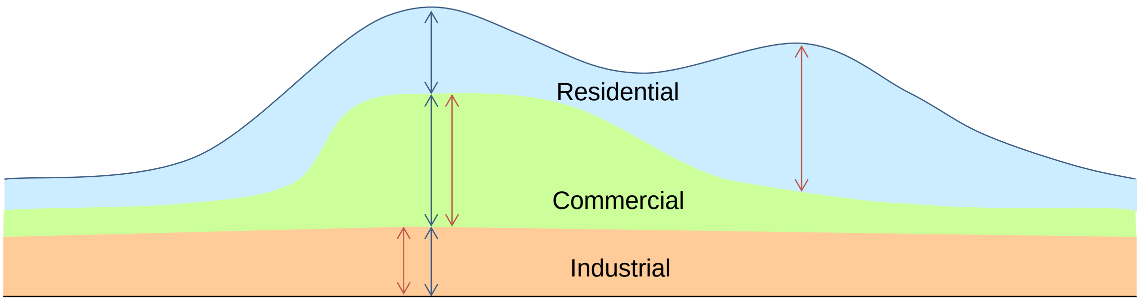
Figure 5.16 Sector-Wise Pricing



Source: Author.

Time-wise pricing means that the prices vary depending on the load level in each time zone considering that energy supply infrastructure should be prepared to meet the peak demand, hence, the costs of infrastructure that is used only in peak hours should be borne only by those who use the energy in peak hours. In the case of the following figure, the commercial sector should take the largest responsibility for the costs of energy supply in peak hours.

Figure 5.17: Time-Wise Pricing



Source: Author.

Designing energy prices based on these concepts will motivate the customers to control their energy demand in an economically rational way, and helps the deployment of EMS-related investment that assists in identifying the solution for lowering energy costs.

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