Recent Trends and Pathways in the UN Sustainable Development Goal 7 in Thailand

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ABSTRACT

Sustainable energy is a global issue with significant sustainable development implications. The UN Sustainable Development Goals (SDGs) has specific goal to the energy sector so-called SDG 7. The SDG 7 focuses on accessing to affordable, reliable, sustainable, and modern energy services. It has three main targets and involves international cooperative actions. This paper examines the trends and analyzes the profiles of the SDG 7 in Thailand. It estimates SDG 7 indicators in the future under different energy scenarios. This paper contributes to energy studies by analyzing recent trends in SDG 7 and pathways to achieving the goal. The paper presents energy policies and measures related to SDG 7 in Thailand and other South-East Asian nations. It is found that under the three targets of SDG 7, namely energy access, renewable energy, and energy efficiency, Thailand has performed better than the global average. The paper calculates the indicators using findings from existing modeling studies to analyze the pathways for achieving SDG 7. The findings highlight an opportunity for Thailand to achieve SDG 7 by 2030.

1. Introduction

The UN (United Nations) adopted the 17 Sustainable Development Goals (SDGs) with 169 associated targets in 2016. Many countries began reviewing and upgrading their own processes for implementing the 17 goals by 2030. The SDGs have a broader focus on development in both developed and developing nations. The energy issue was not directly included in the previous international development goals, such as the Millennium Development Goals (MDGs). The MDGs required action with more focus on poverty in developing countries. The role of high-income countries was primarily to provide funding and support. The energy sector is essential for national economic development and human wellbeing, as well as improving the quality of life. Energy development faces challenges with respect to environmental, economic, and social dimensions.

Under the SDGs, energy is recognized as a key enabler of sustainable development by setting the SDG 7, which is focused on accessing affordable, reliable, sustainable, and modern energy services. It has three main targets, namely ensuring universal access to energy services (SDG 7.1), increasing the share of renewable energy in the energy mix (SDG 7.2), and improving energy efficiency (SDG 7.3). In addition, the SDG 7 also involves international cooperative actions through facilitating access to clean energy research (SDG 7.a) and expanding supply sustainable energy services in developing countries (SDG 7.b) [1]. However, moving towards SDG 7 relies on each country envisioning its future society. Each country needs to form policies and measures which are based on its own development context.

In recent years, the literature related to SDG 7 in Thailand are decarbonization of energy systems [2,3,4] and the assessment of energy security [5,6,7,8]. Some studies have put attempts to combine energy modeling and scenario analysis at the sectoral level [9,10,11]. Little work has been conducted on the SDG 7 because of the relatively new issue. This paper contributes to filling this gap by analyzing trends and pathways for achieving the SDG 7 in Thailand. The aim of this paper is to examine the trends and analyze profiles of SDG 7. The paper adds some new insights to energy studies by calculating SDG 7 indicators in the future under different energy development pathways.

2. Methodology

2.1 Literature Selection and SDG 7 Indicators

The first step of the research was an intensive literature review to identify the body of literature and highlight the trend and progress towards SDG 7. Because of the relatively young history of SDG 7 and its evaluation, the review did not include search of scientific databases. The review relied on national and international reports related to the energy issue and the SDG 7. Table 1 presents the SDG 7 targets and indicators.

Data used in this paper come from a variety of sources. All calculations are based on data from international organizations, such as the International Energy Agency (IEA), the United Nations Department of Economics and Social Affairs, the United Nations Economic and Social Commission for Asia and the Pacific, the World Bank, the International Renewable Energy Agency, Asia Pacific Energy Research Centre, and official government data.

Table 1. UN SDG 7 targets and indicators

SDG 7: Ensure access to affordable, reliable, sustainable, and modern energy for all Target	
7.1 By 2030, ensure universal access to affordable, reliable, and modern energy services	Indicator 7.1.1 Proportion of population with electricity access (percentage of population) 7.1.2 Proportion of population with primary reliance on non-solid fuels (percentage of population)
7.2 By 2030, increase substantially the share of renewable energy in the global energy mix	7.2.1 Renewable energy share in total final energy consumption (percentage of total final consumption)
7.3 By 2030, double the global rate of energy efficiency	7.3.1 Energy intensity in terms of total primary energy per GDP (ktoe per GDP)
7.a By 2030, enhance international cooperation to facilitate access to clean energy research and technology, and promote investment in energy infrastructure and clean energy technology	7.a.1 Mobilized amount of US\$ per year starting in 2020
7.b By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in development countries	7.b.1 Investments in energy efficiency (including technology) as a percentage of GDP and the amount of foreign direct investment

Source: [1]

2.2 National Pathways to the SDG 7

The second step was to review and evaluate energy models and their relevance for national SDG 7 planning. It was not considered to run detailed model simulations, but using findings from the modeling exercise to calculate the SDG 7 indicators. To select modeling results from existing studies for evaluation, an analysis of the energy modeling studies was done using databases of ScienceDirect and Mendeley. Different keywords were used to identify the relevant articles. The final selection of energy systems modeling was [4]. This publication meets the following criteria:

- Modeling technique and assumptions published in detail;
- Recent Thailand's study regarding energy systems analysis of demand and supply;
- Covers the timeframe of SDGs and enough data for calculating SDG 7 indicators; and
- Publish in peer-reviewed journals.

According to [4], the modeling tool used in the study was developed by the Asia Pacific Energy Research Center (APERC) [12]. The APERC model consists of seven sub-models, namely macroeconomic, industry, transport, buildings, renewables, electricity, and investment. The projection period is 2013–2040, excluding the investment model which is from 2015–2040. On the energy supply side, the modeling results come from electricity model, renewable model, and supply

assumptions. On the energy demand side, the modeling results come from macroeconomic model, transport model, industry model, and building model. The investment model calculates the investment to realize the energy infrastructure requirements.

Regarding energy scenarios, the APERC model involves a Business-as-Usual (BAU) Scenario and three alternative pathways: the Improved Efficiency Scenario (IES); the High Renewables Scenario (HRS); and the Alternative Power Mix Scenario (APS). The BAU scenario reflects current policies and trends and the projections extend the past into the future. The IES scenario supports the APEC (Asia-Pacific Economic Cooperation) energy intensity goal to reduce the energy intensity by 45% between 2005 and 2035. The HRS supports the APEC's goal to double the use of renewable energy sources in the region between 2010 and 2030. The APS scenario assesses the trade-offs among the use of clean coal, gas, and nuclear in the power sector [4,12].

3. Findings

3.1 Recent Trends in Thailand's SDG 7

The SDG 7 has fewer number of indicators when compared with other goals, but it is no less important in sustainable development strategies. Energy services are fundamental to economic development and the quality of life. The implementation for achieving the SDG 7 will definitely impact and be impacted along with other goals. Figure 1 presents regional trends and progresses under three targets of SDG 7, namely energy access, renewable energy, and energy efficiency.

a. SDG 7.1.1

b. SDG 7.1.2

c. SDG 7.2.1

c. SDG 7.3.1

Figure 1. Comparison of Thailand's SDG 7 indicators with other regions [13].

According to the SDG 7 indicators (Table 1) in Thailand, the SDG 7.1.1 is the greatest coverage in terms of proportion of population with access to electricity (Figure 1a). The proportion of access to electricity increased from 80% in 1990 to almost 100% in 2010, and 100% in 2012. The primary access to non-solid fuels (Figure 1b) rose from 66% in 2005 to 76% in 2014. Overall, the global access deficit concentrated in rural areas in Asia and Africa for clean fuels and technologies for

cooking. The share of renewable energy in total final energy consumption (TFEC) or SDG 7.2.1 (Figure 1c) was from 22% in 2000 and 23% in 2012. This represents the use of renewable energy from 15,127 ktoe to 23,557 ktoe.

Global renewable energy use grew at a CAGR (Compound Annual Growth Rate) of 2.4% over the period 2010–2012. Fig. 1d reports progress on SDG 7.3.1 over the period 2000–2012. The primary energy intensity increased from 5.43 to 5.78 MJ per US dollars. Energy intensity is often used as a proxy to represent the energy efficiency of an economy. Thailand has large opportunities to accelerate the use of high-efficiency equipment and efficient use of energy resources.

Implementing SDG 7 will impact on other SDGs as well. Thus, the analysis of the interlinkages between SDG 7 and other key areas of resource systems, such as water, food, and climate change, would provide wider cross-sector perspectives. This will have more holistic energy decisions. Access to modern energy services (SDG 7.1) can reduce the poor and improve the quality of life. Renewable energy (SDG 7.2) can affect water and climate systems. Solar electricity requires less water and more water-efficient than thermal power plants. Hydroelectricity depends on water and has a high impact on climate change. Improving energy efficiency (SDG 7.3) has impacts on other resources. For example, an efficient use of energy reduces the need for electricity generation, and thus cooling water.

3.2 Policies and Measures Relevant to SDG 7

This paper examines the technology and policy opportunities available for achieving SDG 7. Such potential could be the key to successfully driving the energy transition. Existing energy policies and measures would help Thailand to reduce energy demand, as well as imported energy. However, more innovative policy packages would deliver higher potential to achieve SDG 7. The recent energy planning and policy in Thailand (as of May 2017) is Thailand Integrated Energy Blueprint (TIEB), which consisted of five energy plans, namely (1) the Power Development Plan (PDP 2015), (2) the Energy Efficiency Plan (EEP 2015), (3) the Alternative Energy Development Plan (AEDP 2015), (4) the Oil Plan 2015, and (5) the Gas Plan 2015. All plans cover the period from 2015 to 2036 [14].

According to the above-mentioned energy policies, the EEP 2015 has set the target of a 30% energy intensity reduction by 2036 from the 2010 level. However, it should be noted that the calculation of energy intensity in this plan is based on the consumption intensity, whereas the SDG

7.3.1 is calculated on the primary intensity. Table 2 presents a summary of major energy policies and measures relevant to SDG 7 in Thailand and other ASEAN nations.

Table 2. Summary of major energy policies and measures related to SDG 7.

Energy policies and measures	
Brunei	The Energy White Paper promulgated in 2014 set target for 10% renewable electricity by 2035. Reduction of 25% energy intensity by 2030 from the base year of 2005. Measures include a 30-year energy efficiency and conservation roadmap.
Cambodia	By 2020, all villages in the country should have access to electricity and a target of 2,241 MW supplied by hydro power. At least 70% of the total households should have access to quality grid electricity by 2030.
Indonesia	By 2025, the energy mix of at least 23% from renewable energy, oil less than 25%, coal at 30%, and gas at 22%. Target of 1% annually reduction in final energy intensity up to 2025. The energy elasticity target will be less than 1 in 2025. The electrification rate will be nearly 100% in 2020. Energy efficiency and conservation programs across all sectors.
Lao PDR	Increasing the share of renewable energy to 30% of the total energy consumption in 2025, small hydro power accounts for 55%. Increasing biofuel consumption in the transport sector by 10%.

Table 2. (Continued)

Energy policies and measures	
Malaysia	Target of renewable energy capacity of 2.1 GW or 11% of overall electricity generation by 2020. Continued implementing market-based energy pricing, energy efficiency improvements, and demand-side management master plan.
Myanmar	The electrification plan is to electrify the whole country in 2030. Currently, no official established renewable energy target.
Philippines	Maintaining the share of renewables in power generation at 30%. The total target installed capacity is 9,931 MW by 2030. Increasing the rate of electrification to 90% by 2017. Measures include national energy efficiency and conservation program, and the green energy roadmap.
Singapore	Reduction of emission intensity by 35% in 2030 with 2005 base year. Solar and waste-to-energy (WTE) are the main renewable energy sources. PV target of 350 MW by 2020 and the total capacity of WTE plants will be increased to 10,140 tons per day by 2018.
Thailand	Energy intensity reduction of 30% by 2036 with 2010 base year. Target of renewable energy at 30% by 2036 in total final energy consumption. Integration of major energy plans into TIEB.
Viet Nam	Reduction of energy intensity by 1% to 1.5% annually and increasing rural electrification rate to 100% by 2020. Target of renewable energy sources for power generation at 23% by 2030 and hydro power will be accounted for 15.5%. Target of 21.9% by 2030 in total final energy demand for heat and biofuel production from renewable energy sources.

Source: [12,15,16]

3.2 Thailand's Pathways for Achieving SDG 7

In the context of planning for achieving SDG 7, energy systems modeling play an important role to assist policy making. According to the APERC projections (see Figure 2), total primary energy supply (TPES) in Thailand under the BAU scenario is expected to increase from 134 Mtoe in 2013 to 211 Mtoe in 2030, and to 248 Mtoe in 2040. Oil and natural gas still dominate energy supply, and the shares in TPES remain almost unchanged. In 2030, oil represents 40.9% of TPES, followed by gas (27.9%), coal (14.4%), and renewables (16.8%). It can be seen that Thailand will rely heavily on fossil fuels in the BAU scenario. It should be noted that the APS scenario is not taken into account for the analysis in this paper due to being limited to the power sector. It aims to evaluate trade-offs among different fuel use in the electricity sector, while energy efficiency and renewable energy sources maintained at the BAU level.

The alternative scenarios (IES and HRS) evaluate the reducing energy intensity and increasing the share of renewables. These scenarios include the government's targets for higher penetration of energy-efficient equipment (EEP 2015) and renewable energy sources (AEDP 2015). These are essential for Thailand to archive SDG 7, as well as to meet Thailand's INDC (Intended Nationally Determined Contribution) targets [4]. The IES scenario assumes new policies of the Thai government in the EEP 2015. The IES illustrates large potential to reduce TPES through various measures in different sectors. This scenario could result in reduction of

TPES up to 5 Mtoe, 22 Mtoe, and 41 Mtoe in 2020, 2030, and 2040, respectively. The HRS scenario improves the fuel mix diversity, but an increase of TPES. This is due to the heat content and inefficient energy conversion of renewable energy, in particular, biomass. The HRS scenario considers the increased shares of renewable energy in the power and transport sectors, as presented in the AEDP 2015 targets, and then further increased based on a least cost planning approach.

Figure 2. Projections of TPES in the BAU and alternative scenarios [12].

Table 3 presents Thailand's macroeconomic drivers and projections of SDG 7 indicator under three scenarios, namely BAU, IES, and HRS. The projections account for SDG 7.2.1 and 7.3.1 because it is assumed that SDG 7.1.1 has already reached 100% since 2012 (Figure 1a), and the SDG

7.1.2 (Figure 1b) has high coverage, almost 80%. Demand for solid fuels or traditional biomass in the residential sector has been gradually falling as an increase in household income leads to a switch to modern energy sources for energy services, such as LPG and electricity for cooking and lighting.

Table 3. Projections of Thailand's SDG 7 indicators, 2013–2040.

	2013	2020	2030	2035	2040
GDP (2012 USD billion PPP)	668	854	1,221	1,440	1,686
Population (million)	67	71	73	73	73
BAU Scenario					
TPES (Mtoe)	134	167	211	231	248
TFEC (Mtoe)	96	122	154	167	178
SDG 7.2.1: Renewable energy share (%)	26.00	25.41	22.72	22.15	21.35
SDG 7.3.1: Energy intensity (Mtoe per 2012 USD billion PPP)	0.200	0.195	0.173	0.160	0.147
IES Scenario					
TPES (Mtoe)	134	162	189	199	207
TFEC (Mtoe)	96	119	139	145	150
SDG 7.2.1: Renewable energy share (%)	26.00	25.21	23.74	22.76	22.67
SDG 7.3.1: Energy intensity (Mtoe per 2012 USD billion PPP)	0.200	0.189	0.155	0.138	0.123
HRS Scenario					
TPES (Mtoe)	134	169	217	236	253
TFEC (Mtoe)	96	122	154	167	178
SDG 7.2.1: Renewable energy share (%)	26.00	28.69	32.47	31.74	30.34
SDG 7.3.1: Energy intensity (Mtoe per 2012 USD billion PPP)	0.200	0.198	0.177	0.164	0.150

In the BAU scenario (see Table 3), Thailand's TPES is projected to increase by 85%. In terms of TPES per capita, it will increase from 2.09 toe per capita in 2013 to 2.89 and 3.39 toe per capita in

2030 and 2040 or about 72%. The share of renewable energy (SDG 7.2.1) will reduce to 22.72% in 2030 from 26% in the base year (2013). The energy intensity is showing some improvement. Under two alternative scenarios, the IES scenario shows substantial potential to reduce TPES and TFEC, as compared to the BAU scenario. SDG 7.2.1 will decline from 26% in 2013 to 25.21% in 2020, 23.74%

and 22.67% in 2030 and 2040, respectively.

However, the SDG 7.3.1 presents higher energy efficiency improvements than the BAU scenario. The HRS scenario is an expansion share of renewable energy in the energy system. This scenario may not progress in the improvement of SDG 7.3.1, compared with the BAU case. However, it will increase the share of renewable energy in TFEC from 26% in 2013 to 32.47% in 2030. This finding is in line with AEDP 2015, which has a target of 30% renewable energy in TFEC. The HRS scenario presents higher progress than the global average, which is expected that the world will likely reach a renewable energy share of about 21% by 2030 [17].

4. Conclusions

The 2030 Agenda for Sustainable Development presents a holistic set of goals and targets that will shape a new way of development. It will have significant implications for national development planning. This paper examines the trends on the SDG 7 in Thailand. It estimates the SDG 7 indicators in the future under different energy scenarios. The paper addresses a gap in the literature by analyzing trends and pathways for achieving the SDG 7. Although Thailand has already set targets for energy efficiency improvements and renewable energy utilization, with regard to SDG 7 the country will need to revise the targets and timeframe, as well as accelerating the implementation of policy measures.

Thailand has performed better than the global average for all SDG 7 indicators. Results of recent APEC energy modeling confirm the view that under the BAU scenario Thailand will not reach the targets 7.2 and 7.3 by 2030. This coincides with results of global energy modeling by the IEA, which is confirmed that the world will not reach the targets for 2030 with the current efforts. The HRS scenario is shown that the share of renewable energy in TFEC will reach 32.47% in 2030. This scenario presents higher progress than the global average, which is expected that the world will likely reach a renewable energy share of about 21% by 2030. The IES scenario shows that Thailand will need substantial efforts to improve energy efficiency for achieving target 7.3 by 2030.

Moving towards SDG 7 can be seen as an agenda for action, and not just a reporting exercise to the international community. Thailand has an opportunity to achieve the SDG 7. Actions to achieving the SDG 7 will need to involve non-state actions, such as cities, businesses, financial organizations, and civil societies, to play the roles in the transition. They can be both drivers of the actions and being themselves as part of the solution. This step forward needs to be accompanied by the development of measurement, monitoring, and evaluation for related policies and measures. In addition, the setting of national SDG 7 planning will need to consider interactions with other goals, such as water and climate change (SDG 6 and 13). This would minimize the conflict and optimize investment in infrastructure.

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