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PARLIAMENTARY INSTITUTE OF CAMBODIA
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Briefing Note

Regional Fellowship Program

Overview of Renewable Energy Supply in Myanmar

Author: Ms. Zin Wai Phyo, Fellow from Myanmar
Direct Supervisor: Ms. Bandeth Ros, Senior Instructor
Editor: Mr John Christopher, Institutional Development Director

September, 2019

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List of Acronyms

MOEE	:	Ministry of Electricity and Energy
MOALI	:	Ministry of Agricultural, Livestock and Irrigation
MoST	:	Ministry of Science and Technology
MOECAF	:	Ministry of Environmental Conservation and Forestry
WB	:	World Bank
NEMC	:	National Energy Management Committee
UNDP	:	United Nations Development Programme
ADB	:	Asia Development Bank
IEA	:	International Energy Agency
ERIA	:	Economic Research Institute for ASEAN and East Asia
UNESCAP	:	United Nations Economic and Social Commission for Asia and the Pacific
WWF	:	World Wildlife Fund
REAM	:	Renewable Energy Association of Myanmar
MERRA	:	Modern Era Retrospective-analysis for Research and Applications
NEP	:	National Electrification Plan

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Problem

Renewable energy refers to clean energy, coming from natural sources or processes that are constantly replenished[1]. Renewable energy includes solar, wind, hydro, ocean thermal, geothermal, biomass, biogas, bio-fuels and tidal[2]. In 2017, renewable energy accounted for 24 percent of electricity power supply in the world in which bioenergy is the most predominant source (50 percent) with hydropower second (31 percent) [3]. Renewable energy is essential for human beings because it addresses energy needs and helps promote a clean environment. Renewable energy is targeted to help ensure affordable energy for all by achieving the Sustainable Development Goal (SDG 7) by the year 2030[4].

In Myanmar, the country could generate a high amount of energy, but the distribution of energy to the people, especially those in rural areas is still limited. For example, 70 percent of Myanmar's population live in rural areas, but only 54 percent of villages were electrified in 2018 [5, 6, 7]. In this regard, solar, wind, hydro and bio-mass energy are the main alternative sources for power supply to rural people. Even so, the implementation of renewable energy still faces challenges to respond to the needs of the people in Myanmar. Therefore, the aim of this briefing note is to identify challenges in implementing current renewable energy in Myanmar.

1.2 Research Questions

- What is the situation regarding renewable energy supply in Myanmar?
- What are the current challenges of implementing renewable energy in Myanmar?
- What are the current government legal frameworks, policies and action plans for supporting the implementation of renewable energy for all in Myanmar?

1.3. Research Methodology

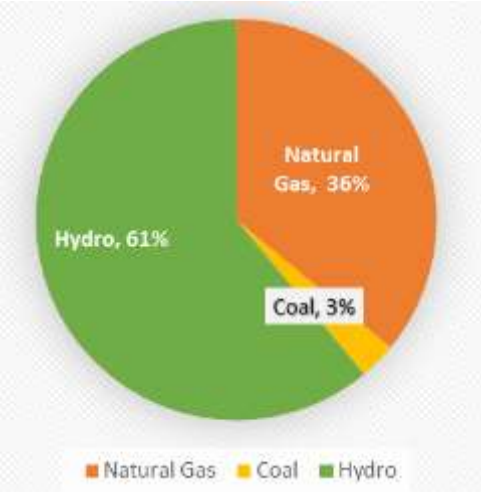
This briefing note reviewed secondary data and existing reports from the Ministry of Electricity and Energy, NEMC (National Energy Management Committee), UNDP (United Nations Development Programme), ADB (Asia Development Bank), IEA (International Energy Agency), World Bank, ERIA (Economic Research Institute for ASEAN and East Asia), UNESCAP (United Nations ESCAP) and other related academic articles.

2. The Situation Regarding Renewable Energy Supply in Myanmar

2.1 Overall Data on Renewable and Non-Renewable Energy Supply by Sources

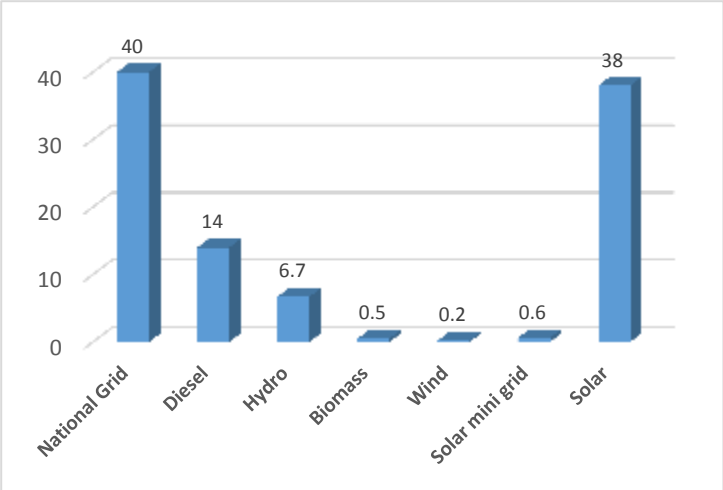
Myanmar relies on both renewable and non-renewable energy to supply electricity to its people and to develop the economy. Among the three major sources of energy, hydro power was produced with the largest amount at 3,221 Megawatt (61 percent), followed by natural gas and coal at 1,919 MW (36 percent) and 120 MW (3 percent) respectively in 2017 (See Figure 1)[7]. Related to rural energy, in 2016, rural areas mainly received electricity from the national grid at 40 percent, followed by solar 38 percent, diesel 14 percent, local hydropower 6.7 percent, biomass 0.5 percent and wind 0.2 percent (See figure 2)[8].

Figure 1: Energy Production from Hydro, Coal and Natural Gas in 2017 (%)



Source: Ministry of Electricity and Energy (2017)

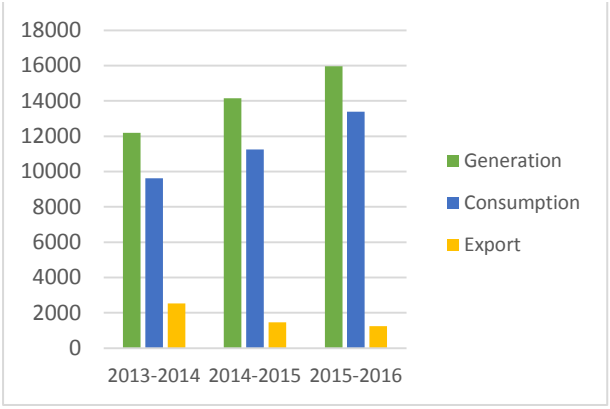
Figure 2: Rural Electrification in 2016 (%)



Source: Ministry of Agriculture, Livestock and Irrigation (2016)

In comparing Myanmar electricity generation and consumption, electricity consumption has been lower than its electricity generation in every year from 2013 to 2016, leaving the country to export its surplus to other countries (See Figure 3)[9]

Figure 3: Myanmar Electricity Generation, Consumption and Export, 2013-2016 (GWh)



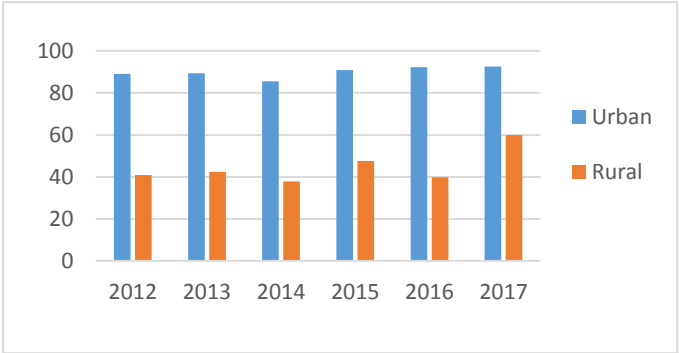
Source: Ministry of Electricity and Energy (2017)

Figure 4: Electricity Consumption Shares by Sector in 2014 (%)

Source: WWF, REAM, Spectrum, IES and MKE (2016)

As for the distribution of the electricity consumed, the domestic sector consumes the highest (30.8 percent), followed by the industrial sector (22.1 percent), commercial sector and others in 2014 (See Figure 4)[10] .

Figure 5: Access to electricity in Rural and Urban, 2012-2017 (% of Population)



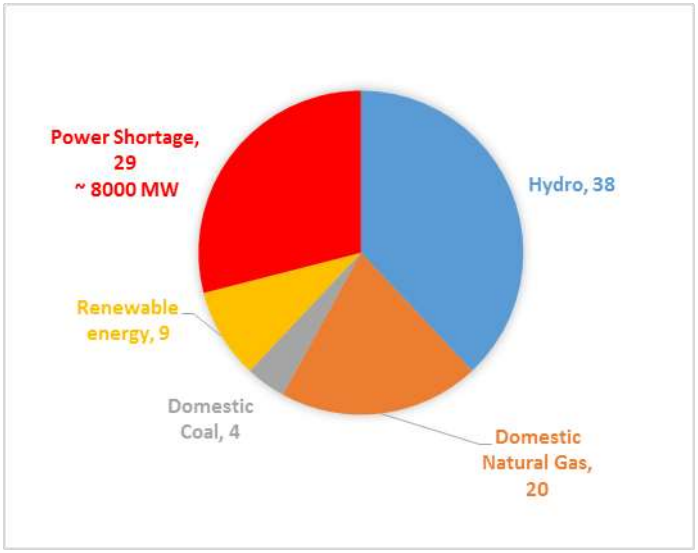
Source: World Bank (2019)

Despite the surplus, distribution of electricity to the domestic market was still not enough. People's access to electricity was unequal between the urban and rural areas (See Figure 5)[11].

Projections show that Myanmar will face a shortage of electricity supply in the future. According to the Ministry of Electricity and Energy, by 2030 hydropower will be able to

respond to 38 percent of the total energy demand, domestic natural gas 20 percent, domestic coal four percent and other renewable energy sources nine percent. Therefore, Myanmar still needs 29 percent of total electricity supply for the whole country (See Figure 6)[7] .

Figure 6: Future Power Demand in Myanmar in 2030 (%)



Source: Ministry of Electricity and Energy (2017)

Hydropower

Myanmar's hydropower sector has been developed since the 1990s and it became the main source of the country's electricity supply. The country has several hydropower resources because it has four main large rivers flowing across the country [12]. The largest potential areas for hydropower are found in the Shan state (See Table 1). Currently, hydropower is used for two-thirds of the country's energy. 5.52 Terawatt hour electricity were produced in 2014 by hydropower [13]. According to Kyi Thin Aye (2018), by 2015 seven major hydropower projects with a capacity of 1,661.2 Megawatt were managed by the Ministry of Electricity and Energy and one project with a capacity of 30.4 Megawatt was managed by a local private entrepreneur [12].

Table 1: Myanmar's implemented Hydropower Projects

No	Project Name	Start Year	States /Regions	Capacity (MW)
1	Thahtay	2008	Rakhing State	111
2	Upper Kengtawn	2008	Shan State(S)	51
3	Shweli-3	2010	Shan State(N)	1,050
4	Upper Yeywa	2010	Shan State(N)	280
5	Upper Baluchaung	2010	Shan State(S)	30.4
6	Middle Paunglaung	2014	Naypyitaw (Union Region)	100
7	Upper Nattrum	2014	Kachin State	3.2
8	Deedoke	2015	Mandalay Region	66
			Total	1,691.6

Source: Ministry of Electricity and Energy (2018)

Solar Energy

Myanmar has plenty of sunshine and therefore, solar energy can be available throughout the country, especially in the central dry zone areas. The feasibility of developing solar energy was first looked at by the Ministry of Electricity and Energy in 2000 [14]. Solar energy can be produced in maximum amounts in April and minimum amounts in August. The potential of solar energy in central areas of Myanmar is about 5.56 kilowatt-hours per square meter per day. In remote areas, solar energy is essential for everyday living of people, supports the education sector and allows local people to engage in economic activities [15].

Wind Energy

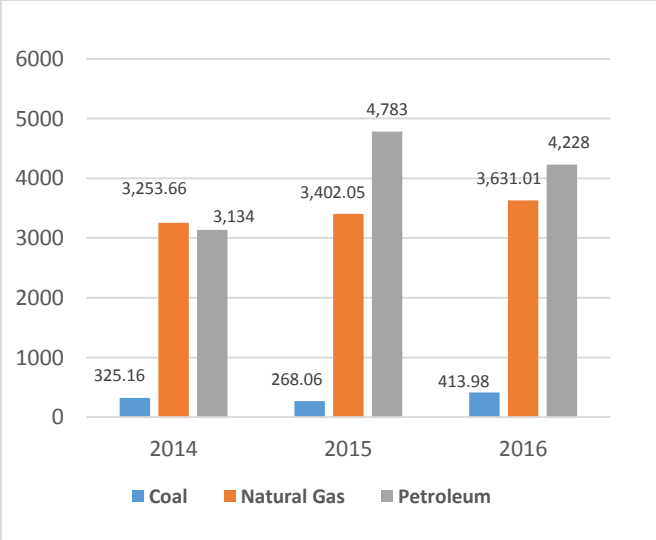
In Myanmar, hilly and , coastal regions in the south, western and the central regions can only use wind energy - mostly in Shan, Chin States and the Rakhine Coast[8]. Japan's New Energy and Industrial Technology Development Organization performed a study on renewable energy potential of Myanmar in 1997. In 2003, wind energy developed and installed 40 Kilowatt in Chaung Thar with the help of Fuji Heavy Industries Ltd. of Japan. In 2014, Ministry of Electricity and Energy concluded an MOU concerning a large-scale wind power project with Gunkul Engineering Public Co., Ltd. of Thailand and China Three Gorges

Corporation of China to produce 4,032 MW of electricity in Mon, Kayin, Shan, Chin, Rakhine States, and Ayeyarwady, Yangon and Tanitharyi Regions [16].

Biomass energy

Biomass is a renewable energy source that reduces carbon emissions and is good for the environment. The sources of biomass in Myanmar are mainly from the forest and agricultural sectors which include rice husks and stalks, sugarcane bagasse (the remaining part of sugarcane after being used), maize , cassava and oil palm stalks, sawdust, and other forest product and agricultural wastes[17] and annually, 21.6 million tons of rice husks are collected from milling and converted at biomass power plants [18]. Biomass consumption increased between 2000 and 2016 at an average rate of 1.6 percent per year [19].

Figure 7: Energy Supply for Non-renewable Energy in Myanmar, 2014-2016 (Ktoe)



Source: Ministry of Electricity and Energy, ERIA (2019)

Non-renewable energy

Non-renewable energy which includes coal, natural gas and petroleum are the key sources for energy in Myanmar. Energy from non-renewable energy had increased relatively from 2014 to 2016. For example, energy supply from natural gas has increased from 3,253.66 Kiloton in 2014 to 3,631.01 Kiloton in 2016 (See Figure 7) [19] and is exported to other countries such as China and Thailand[20].

2.2 Cooperation between Development Partners, and the Private and Public Sectors

Renewable energy in Myanmar is managed by the Ministry of Electricity and Energy and Ministry of Science and Technology. The Ministry of Environmental Conservation and Forestry and the Ministry of Agriculture, Livestock and Irrigation have responsibilities for generating electricity from non-renewable energy sources. Besides these ministries, cooperation between development partners and the private sector also plays a vital role in

improving renewable energy supply in Myanmar. For example, to supply electricity in urban and rural areas, the World Bank provided a loan of up to 400 million USD in 2016 to the Ministry of Electricity and Energy and Ministry of Agriculture, Livestock and Irrigation to implement the Myanmar National Electrification Project which aims to increase the access to electricity [21]. In 2017, an ADB project funded 80 percent with the villagers contributing the remaining 20 percent of the installation cost to install a solar system in the Dry Zone [22]. Additionally, the first solar power plant was built in February 2018 in Minbu with the help of Green Earth Power (Myanmar) Co. Ltd (BOT system) and it has been generating 20 MW of electricity on May 2019 [23] .

3. Challenges of Implementing Renewable Energy in Myanmar

Implementing renewable energy in Myanmar still faces several challenges. As for hydropower, electricity cannot be produced in the dry season due to the lack of water especially in the dry zones. Moreover, Myanmar faces challenges with the low quality of solar equipment, affordability, technological needs for wind energy and lack of domestic peace in the country.

3.1 Low Quality of Solar Equipment

In remote areas, Solar Home System (SHS) were used and provided by the Department of Rural Development, and Ministry of Agriculture, Livestock and Irrigation of Myanmar. Myanmar's SHS are built with low-quality substandard material and they cannot work for longer periods of time. Solar panels, batteries, inverters and charge controllers are solar equipment and are available in the market towns. Most of this equipment is inexpensive and of low quality imported from China and India, and with little guidance on how to install. For example: solar batteries are weak, drop voltage immediately from 12.9 volts to 11.3 volts when they are used and can only last for one or two years. As for the inverters, according to a survey by the World Bank in Taung Pa Le Village with 60 households who used invertors to power televisions, 90 percent reported that they did not work [24].

3.2 Affordability

In rural areas, people use solar energy, but their incomes which are mainly from farming cannot afford high quality solar equipment. The average income of individual rural household

was from USD76 to USD330 per month in 2015 while good quality solar panels cost 400,000 Kyats (USD266). Therefore, people can only use the low quality costing 200,000 Kyats (USD133)[24].

3.3 Technological Needs for Wind Energy

Wind patterns in Myanmar are irregular and good statistical data on wind speeds to produce electricity is essential. Myanmar has a poor wind database because of limited experience in wind energy development, lack of wind measurement tools and little study of wind data. So far, Myanmar has taken wind data for the first overview of statistic data from Modern Era Retrospective-analysis for Research and Applications (MERRA) which was undertaken by NASA's Global Modeling and Assimilation Office. The data form the MERRA has been used for the preliminary wind potential assessment of the country [25].

3.4 Lack of Domestic Peace in Some Regions

Myanmar has seven states and seven regions, and among them Shan, Kachin and Rakhine States are still facing conflicts between the military and armed ethnic groups. Two-thirds of hydro electricity generation resources are located in ethnic minority areas, especially in Kachin and Shan states where conflict still occurs[26]. Also, many hydropower projects in southeastern Myanmar are financed by private companies, but they are often affected by the conflict. For example, along the Salween River (Thanlwin), there is a plan to build six dam sites with investment from China, Myanmar and Thailand [27, 28]. In 2013, the Myanmar government announced that the six hydropower dams were approved, but later, in 2015, they were stopped due to heavy fighting between military and ethnic armed groups. At present, the dam sites are still suspended and abandoned due to the ongoing-armed conflict [29, 30].

4. The Current Government Legal Frameworks, Policies and Action Plans

There are a number of legal frameworks, policies and actions plans developed by Myanmar to address the challenges of implementing renewable energy in the country. First, the Myanmar Electricity Law was approved in 2014. This law partly seeks to improve the voltage quality of solar electricity equipment to meet the electricity needs of users and attract

foreign and local investors to invest in the electricity sectors. The exporters need to obey this law which is to import proper quality electrical products[31].

Second, Myanmar also developed the Myanmar Sustainable Development Plan (2018-2030). This plan seeks to build peace and national reconciliation, establish a United National Federal Union, achieve balanced economic development for states and regions and establish an economic system that can achieve and maintain positive development outcomes through the participation, innovation and efforts of all citizens. This plan includes 5 goals and 3 pillars. Renewable energy was stated in goal 5 (Natural Resources & the Environment for Posterity of the Nation) and one of the specific objectives is to ensure access to affordable, sustainable energy for the rural populations[32].

Third, the Myanmar Energy Master Plan 2015 aims to achieve a long-term optimal fuel supply mix taking into account the country's primary resource endowments. The Energy Master Plan is guided by the principles of long-term cost effectiveness, environmental responsibility and security of energy supply. Also, there are technological choices and resource constraints to decide the best use of energy in support of national development goals in Myanmar [33].
Fourth, National Energy Policy (2014) aims to explore the available energy resources of the country systematically in order to supply the demand of the country and to export surplus energy to improve the living standard of the people and sustainability of resources. Chapter 7 of this policy aims to implement programs on a wider scale, utilizing renewable energy sources such as wind, solar, hydro, geothermal and bioenergy for sustainable energy development in Myanmar[34].

Fifth, the draft Renewable Energy Policy of 2014 aims to address technological needs for energy services in Myanmar by introducing renewable energy technology. It seeks to convert natural and renewable resources such as water, wind, solar and biomass to productive energy for citizens, private enterprises and the other national and international stakeholders. In order to develop wind energy technology, the government has to provide training on how to measure the speed, strength, weakness and wind potential with theoretical and practical exercises. As for priority actions, the following are the expected outcomes and targeted dates of this Renewable Energy Policy [35].

- Renewable energy training, certification and information in 2014 targeted in 2015.
- At least 40 renewable energy advisers for solar, wind, biomass and hydro power trained within 2015 targeted in 2016.
- Use of firewood reduced to 50% by 2020 and to 20% by 2030 targeted from 2020 to 2030 [35].

As for the renewable energy training, the practical training for solar, wind, hydro and biomass was started in November 2014 and the 19th training module was given in 2019 with the help of Japan and China.[36]

In addition, Myanmar's National Electrification Plan Phase 1 (2016-2030) aims to achieve universal access to electricity in 2030. This policy is led by the Ministry of Electricity and Energy and Ministry of Agriculture, Livestock and Irrigation. Due to concerns over the affordability for the people, the government will implement off-grid programs to support electricity services to a maximum number of households which are not receiving the electricity. This plan has 4 components which are; to extend the grid, to achieve off-grid electrification, to provide technical assistance and project management and to support finance for specific emergency works, goods and services with the help of the World Bank. According to the National Electrification Plan, 7.2 million households will have grid connections by 2030 [37].

5. Conclusion

The Myanmar government has implemented an energy mix that includes hydro, solar, wind, biomass and non-renewable energy to distribute electricity to its people. As this briefing note found, implementing renewable energy in Myanmar still faces challenges which include low quality of solar equipment, affordability, technological needs for wind energy and lack of domestic peace in some areas of the country to implement hydropower projects. Myanmar has developed a number of legal frameworks and policies to help address these challenges

and in support for further expansion and development of renewable energy. As a further step, the government could ensure that all the policies are implemented effectively and cooperation between private and public sectors is essential for addressing the challenges and improving the supply of renewable energy in the country.

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