YANGON UNIVERSITY OF ECONOMICS

DEPARTMENT OF APPLIED ECONOMICS

MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY ON EFFECT OF ELECTRIFICATION IN RURAL AREA

(CASE STUDY: VILLAGES IN YAEDASHE TOWNSHIP, BAGO REGION)

TUN TUN WIN

EMPA – 40 (18th BATCH)

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A STUDY ON EFFECT OF ELECTRIFICATION IN RURAL AREA

(CASE STUDY: VILLAGES IN YAEDASHE TOWNSHIP, BAGO REGION)

A thesis submitted as the partial fulfillment of the requirements for the degree of Master of Public Administration (MPA)

Supervised by:

Daw Aye Thanda
Lecturer
Department of Applied Economics
Yangon University of Economics

Submitted by:

Tun Tun Win
EMPA - 40
EMPA (18^{th} Batch)

October, 2022

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This is to certify that this thesis entitled "**A Study on Effect of Electrification in Rural Area (Case Study: Villages in Yaedashe Township, Bago Region)**, submitted in partial fulfilment towards the requirements for the degree of Executive Master of Public Administration (EMPA) has been accepted by the Board of Examiners.

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(Supervisor)
Lecturer
Department of Applied Economics
Yangon University of Economics

October, 2022

ABSTRACT

The objective of study is to analyze the social and economic effects of electrification in the rural community of Yaedashe Township, Taung go District, Bago (East) Region. The study was undertaken the rural area of Yaedashe Township. The primary data are collected from the four villages through structure questionnaire. The studies on effects of electrification are analyzed by Likert Scale. The secondary data are collected from the township electricity supply office, Ministry of Electric Power and other relevant departments. The descriptive method is used in this study. The study finds that socio economic development in education, health, public service, social activities, living standard, rural development and agricultural productivity because of it got electricity in their village. Rural electrification is clear on the social benefits of the rural people and the significant of electrification on economic, business and market benefit is still low. The study recommended that government support in technical skill training in rural area which is needed to provide the economic development, market and Information and Communication Technologies (ICT) awareness benefits of the rural community and then medical center and education in the rural area is needed to fulfill the modern medical storage equipment, teaching assistants, computers and electronics device to achieve healthcare and education development in the rural area.

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ABBREVIATIONS

ACSR	Aluminum Conductor Steel Reinforced
AHP	Analytical Hierarchy Process
ASEAN	Association of South East Asia Nations
BMZ	Federal Ministry for Economic Cooperation and Development
CO	Carbon Monoxide
CO_2	Carbon dioxide
DAP	Department of Agricultural Planning, Myanmar
DGIS	daily growth increments
DRD	Department of Rural Development
EPGE	Electric Power Generation Enterprise
ESE	Electric Supply Enterprise
FY	Fiscal Year
GIS	geographic information system
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HFO	Heavy Fuel Oil
IER	Institut für Energiewirtschaft und rationelle Energieanwendung (IER) at the University of Stuttgart;
INGO	International Non-Governmental Organization
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
JV	Joint Venture
kWh	Kilowatt-hours
LED	Light Emitting Diode
LNG	Liquefied natural gas
LPG	Liquefied Petroleum Gas
MESC	Mandalay Electric Supply Cooperation
MGDs	Millennium Development Goals
MJ	Mega Joule
MOEE	Ministry of Electricity and Energy
MOEP	Ministry of Electric Power

MW	Mega-Watt
NEP	National Electrification Plan
NGO	non-governmental organization
NOx	nitric oxide (NO) and nitrogen dioxide (NO_2), the nitrogen oxides
NRECA	National Rural Electric Cooperative Association
NRECA11	Model structure of the NRECA Model [11]
NTU	Nanyang Technological University
PV	Photo-Voltaic
QoL	Quality of Life
RE	Rural Electrification
SAC	Space Aerial Cable
SEIA	Solar Energy Industries Association
SEM	Scanning Electron Microscope
SHS	Solar Home System
TWh	Terawatt-hours
UN	United Nation
UNDP	United Nation Development Programme
Wh	Watt-hour
WHO	World Health Organization
YESC	Yangon Electric Supply Cooperation

WEIGHTS AND MEASURES

A (ampere)	unit of electric current
V (volt)	unit of voltage
kV (kilovolt)	1,000 volts
kWh (kilowatt-hour)	1,000 watt-hours
KVA (kilo volt Ampere)	1,000volt-amperes
GWh (gigawatt-hour)	1,000 megawatt-hours
MW (megawatt)	1,000,000 watts
GW (Gigawatt)	1,000,000,000 watts
MVA (megavolt-ampere)	1,000,000 volt-amperes

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

There are many issues to study the effect of electrification in rural area of Yaedashe Township. Myanmar is low energy consumption and poorest countries in Asia. There has 50% of its population being accessed to power. Connected to energy is one of the key factors for social economic growth and poverty reduction, the Government of Myanmar is giving high priority to the electrification of the country. There have many definitions about the good life such as religious and philosophical norms, satisfaction of preferences and subjective wellbeing (Diener & Suh, 1997). This study has described the third approach subjective well-being which is a study on the effect of electrification in rural area Yaedashe Township, Taung go district, Bago region, Myanmar. Electricity will change the human daily life related with smart housing, upgrade household appliances, raised (employment, education, Small Median Enterprise (SME)) and wider energy services in the household. It is updated the quality of human life in household level and transition socio-economic in high level.

In 2020, approximately 850 million people worldwide are still fighting insufficient access to electricity most of them are living in village of developing countries (WB Sustainable Framework Report, 2020). Traditionally, most of government was trying to extent the national grid for improving access to electricity, it is costly. Rural electrification in developing countries is intended to serve upgrade both economic and social aims. To understand these aims and how they might best be achieved, it is first useful to know something about the extent and growth of village electrification in developing countries and the costs and the uses to which electricity is put. On the other hand, renewable energy (RE), in special, solar and storage technologies, small hydropower, wind power and Distributed Generation (DG) technology is better accessible and has cleared model possibilities to supply electricity via off-grid systems in rural power projects. The implementation of RE projects has gradually increased over the past decades under each country's national energy plans in follow with the 7th objective in the Sustainable Development Goals (SDGs): "Energy for all" [WEO IEA, 2017]. There are four key climate change indicators – greenhouse gas concentrations, sea level rise, and ocean heat and ocean acidification has set new records in 2021 (United Nation Climate report, 2021). Another clear sign for human activities is causing planetary-scale changes on land, in the ocean, and in the atmosphere, with dramatic and long-lasting ramifications. Therefore, every electrification project should consider the investment return rate related with demand and supply, climate change, technology. The Sustainable Development Goals are the world's distributed plan to end-all intense poverty, compensate inequality, and protect the planet by 2030.

The land area occupied by Myanmar is approximately 676, 600 square kilometers, extending about 2050 kilometers (1270miles) from north to south and 930 kilometers (580 miles) from east to west. Per capita GDP of Myanmar was 1,187.24 USD (2021). Bangladesh, India, China, Lao and Thailand are the five neighbor countries which approximately 6500 kilometers (4,000 miles) border length. Myanmar was divided for administrative purposes into 15 States/Region, 74 Districts, 330 Townships and 83 Sub Townships. The total population of the Myanmar is 51,486,253. In Bago division 9.5 percent of populations are live in the land area. The land area of Bago East division was 944.383 square miles. The number of house hold was 636,214. The number of electricity consumer was 389,220. Therefore, fifty percents of population was get electricity in Bago (east) division.

According to the World Bank indicator, Myanmar is lower middle-income countries in East Asia and Pacific, World. The 68 percent of population is access electricity in Cambodia. The 88 percent of population is accessed electricity in India; the 74.4 percent of population is accessed electricity in Bangladesh. The 99.6 percent of population is accessed electricity in Thailand. The 89.7 percent of population is accessed electricity in Lao. The 60.5 percent of population is accessed electricity in Myanmar which generates electricity from the 58.9 percent of hydropower, the 39 percent of Natural gas, the 0.3 percent from oil, the 0 percent from nuclear and the 0.15 percent from renewable energy source (World development indicator, 2022). Therefore, Myanmar is lowest electricity access rate than neighbor five countries.

The main challenges of Myanmar's power sector include limited generation capacity, unreliable services, low electrification, high cost of electric equipment implementation, low electricity consumption, and a large financing gap. There are many problems to implementation of electrification in rural area. Myanmar's rural area demonstrates the big poverty rates than the country's urban regions therefore making rural development is a top priority for the Myanmar's government. Despite its huge energy resources, Myanmar has the lowest electrification rate than the neighbor country. For socio-economic development, many electrification projects are required to implement over the country of Myanmar. Therefore a study on the effect of electrification in rural area is very important for Myanmar socio-economic development in rural area.

1.2 Objectives of the Study

The objectives of the study are:

(i) To study the power generation, transmission, distribution and utilization in Myanmar

(ii) To explore the electrification in Yaedashe Township

(iii) To analyze the effect of electrification in the rural community of Yaedashe Township

1.3 Method of Study

In this study, the investigation on effects of electrification are analyzed by Likert Scale which is designated with five scale design - 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree. The descriptive method is used based on primary data in this study. The primary data are collected from the structured questionnaires by simple random sampling. There are 50 households from each village with a total of 200 households are selected for the survey. The required secondary data for electricity consumption and distribution are collected from Ministry of Electric Power and other reliable sources.

1.4 Scope and Limitations of the Study

In this study, the four villages of the rural area of Yaedashe Township, Bago division are selected because its area's nearness to Nay Pyi Taw also makes the choice for the implementation of the study. The four villages: ChoneInn, Kyaweookauk, Oak pho and Laei Pyin Ma have been electrified since 2017 but there have many un- electrified villages in the rural area of Yaedashe Township. This study is dealt with households and villages that have been electrified for the last five years. The study only focuses on the social and economic effect of electrification on the rural community with the usage of electricity on work, education, health and social life. The data or results of rural electrification of Yaedashe Township, Taunggo district, Bago division cannot be represented the whole rural area of Myanmar.

1.5 Organization of the Study

This thesis is composed of five chapters. The chapter one is introduction including rationale of the study, objectives of the study, method of the study, scope and limitation of the study, and organization of the study. The chapter two presents the literature review with six sub articles. In chapter three, overview of electrification in Myanmar including generation, transmission, distribution and utilization is descripted. The results of the study are covered in chapter four which is organized with profile of study area, survey design, socioeconomic characteristics of respondents, and accessibility to electricity and effects of electrification on rural community of Yaedashe Township. The conclusion with findings and recommendations are presented in chapter five.

CHAPTER II
LITERATURE REVIEW

To investigate the effect is defined as what happened after and as an output of rural electrification. Impact studies are thus meant to verify whether expectations and objectives have in fact been met. We use the term socio-economic impact to refer in particular to the inter-related economic and social consequences of electricity consumption, such as the creation of job and income opportunities and the alleviation of rural poverty, which are commonly quoted in support of the necessary public investments.

2.1 Role of Government in Rural Area Electrification

Although economists have discussed the merits of relating prices to the marginal or incremental costs of supply in electric utilities for many years, the concept has been slow to win acceptance in Myanmar. One reason for this is that other concerns have been felt to be more important. The need to meet revenue requirements is one such concern; another concern is the problem of planning for and financing very high rates of system expansion, generated by demands that have typically doubled every ten years. Another reason, however, is that marginal cost pricing has yet to win the confidence of people responsible for running and regulating the industry. Most of the industry's engineers, accountants, financial, analysts, and administrators do not understand marginal cost pricing and most have concepts about the aims and equity of tariffs that are quite different from those of economists.

Pricing and investment decisions in the electricity industry, as in other industries, have to be made in the context of uncertainty; limited or no information on some matters; distortions in the pricing system; technical feasibility; imperfect institutions; a need, with regard to prices, for simplicity and clarity; and generally a number of restrictions stemming from political, financial, and investments are efficient, no less than the engineers and financial analysts in their work, has to consider these factors if his recommendations are to be useful.

Equity and finance as well as about resource allocation are relevant to tariffs. MOEP's marginal costs comprise four elements; these are the marginal costs of (a) energy; (b) adding to generation capacity; (c) adding to transmission capacity; and (d) maintenance and operation.

Inequality of distribution income caused the market failure which requires government intervene. In a general free market, the charges for the goods and services are decided by the changes of supply and demand, and any wave in one of the changes results in a price high or low and a corresponding wave in the other change. The waves lead to price equilibrium. Market failure appears when it is a condition of disequilibrium in the market due to market distortion. It assigns place when the quantity of goods or services supply is not the same to the quantity of goods or services demanded. Most of the distortions that may support the free market may involve monopoly power, price limits, minimum wage requirements, and government regulations. Market failure that may blow in the market with several reasons, including: externality, public goods, market control and imperfect information in the market that was explain by Arthur C. Pigou, Arthur C. Pigou, Francis Bator, William Baumol, and Paul A. Samuelson 1920 (CFI, 2017).

An externality which can be positive or negative defines a cost or benefit gain from a transaction which affects a user that did not make to be related with the benefit or cost. A positive externality provides a positive effect on consumer and negative externality is a negative effect gain from the consumption of a service and product, and that results in a negative effect on a third party. Public goods are goods that are consumed by a large number of the population, and their cost does not increase with the increase in the number of consumers. Public goods are non-rival and non-excludable. Public goods invite market failures when a section of the population that used the goods fails to pay but continues consuming the good as real payers.

In the fundamentals of deregulation electricity Market, there are tried to transform from vertically integrated to vertically unbundled, from regulated cost based to regulated price based, from monopoly to competition, from service to commodity, from consumer to customer, from privilege to choose, from engineers to lawyers. On the other hand, market failure may also gain from the lack of knowledgeable information between the buyers or sellers. It is that the charge of demand or supply does not relate all the benefits or chance cost of a good and services (CFI, 2017).

When failure happens, less welfare is created than could be created given the available resources. The social task then becomes to correct the failure. The theory of market failure is at the heart of several economic analyses that support government action (intervention) in markets for goods and services. Historically, several services necessary to running a modern economy were considered to have increasing economies of scale. Such services were often thought of as natural monopolies, because free markets would create monopolies from them. They included telephone and other telecommunications services, postal services, railway infrastructure and electrical grid and water utilities (Erik, 2007).

In gas and electricity markets, the infrastructure for generation, transportation and distribution play as an essential role. This infrastructure is characterized by high investment costs, which makes that it is not efficient to have more than one infrastructure. The government has significant capacities that have been applied to counter market failure and to provide these services to the public. As a result, the operators of these networks have a so-called natural monopoly. Natural monopolies can also arise when one firm is much more efficient than multiple firms in providing the good or service to the market. A good example of this is in the business of electricity transmission where once a grid is set up to deliver electric power to all of the homes in a community, putting in a second, redundant grid to compete makes little sense (Machiel, 2021).

2.2 Rural Electrification

Rural electrification, the distribution of electricity to remote and rural areas there are no access to it, is key to implement the socio-economic development of rural area and developed their living conditions.

Really, rural electrification produces the following effects:

(a) Rise in educational success, via allowing young student to study in the morning early or at night late.

(b) Excellent efficiency and productivity, challenge businesses to be open longer hours and farmers to have joined to equipment and techniques which improve their productivity, such as processing, irrigation and food preservation.

(c) Create job like as directly or indirectly.

(d) Improvements healthcare, through developed lighting and cooling of vaccines, possibility for storage blood and medicines; and equipment, such as ultrasound scanners and X rays.

(e) Security and safety Improvement, notably through lighting lit road signs and street.

(f) Isolation and marginalization reduction via television, telephone lines, and radio.

(g) Reduction of the application of kerosene lamps and of indoor open fires purposed for cooking, as well as other polluting equipment.

(h) Gender-based violence reduction occurring during the collection of firewood in village areas.

The vital challenge for rural electrification is the grid electricity extension, which presents constraints such as high costs involved in reaching village areas, expensive of use than in village areas, and power efficiency. Therefore, hybrid system off-grid technologies, and solar mini-grids and generator, offer a promising alternative (NTU, rural electrification, 51).

On a techno-economic basis, the impact of rural electrification can be associated with the scheme adopted. Grid extension is usually considered the best option as it guarantees a continuous supply with high power capability, but numerous studies have also demonstrated the feasibility of rural electrification using individual solar photovoltaic systems (Lemaire, 2018) or centralized systems (Bilich, A.,2017). The bottom line is that the electrification scheme is one important concern to be taken into consideration for these projects.

On the other hand, despite the enormous efforts and knowledge available, the impact of electrification on human well-being and quality of life (QoL) remains vastly unexplored. In general, electrification is considered to bring positive changes to rural communities with improved health, income, education opportunities, and so on, all assumed to improve QoL. However, the existing investigations tend to concentrate on the QoL impact of rural electrification through indirect indicators, such as infant mortality, life expectancy, mean years of schooling, gross domestic product, gross national income, water access, and so on (Zhang, G.,2019). Given that the indirect approaches are generally founded on economic principles, these have several recognized limitations (Kahneman, D, 1999). In contrast, less research exists using measures reflecting the everyday experiences from electrification and its subjective appraisal. Several measurements of subjective human well-being already exist and might be suitable to understand the effects of rural electrification on QoL. For example, the measurement approach provided in (OECD, 2013) distinguishes three domains: life satisfaction, affect, and eudemonic well-being—an Aristotelian concept related to the realisation of the person's mental potential (Ostenfeld, E., 1994). Alternatively, another approach suggests five domains, covering material and physical well-being, relationships, personal development, fulfillment, and recreation (Burckhardt, C.S., 2003). A notable method is the Quality of life Index (Diamond, R., 1999), where perceived importance and satisfaction are given on various QoL domains. Any of the methods mentioned so far seem suitable to inform about the effects of electrification on QoL more directly. On the other hand, the findings of studies on electrification impacts cannot be easily translated to different regions. In general, the investigations have concentrated on case studies from Africa (Batinge, B., 2019) and South Asia, for example, India (Dang, D.A., 2019), Bangladesh (Halder, P.K., 2016), Ghana (Aglina, M.K., 2016), Nepal (Bridge, B.A., 2016) and Rwanda (Bensch, G., 2011), to mention a few. Yet, there is a notable need for electrification in other rural contexts, where it is commonly overshadowed by other problems. Southeast Asia (SEA) is one clear example [40]. Cambodia and Myanmar are two countries having very low electrification rates in rural contexts (see Figure 1, Oxford-Analytica, 2017), and are well under-represented in such literature. Only a few investigations had been conducted on SEA over the years (Ölz, S, 2010).

Globally, access to electricity is attained via the on-grid and off-grid connections, and stand-alone systems. The on-grid system involves connecting to the existing transmission lines, such that extensions are made available to areas with no access. Off-grid systems are mini-grid solutions usually made available where the level of demand and population density is relatively high so as to address the immediate need for power. In the case of stand-alone systems, instances such as a low level of demand, scattered population, distance, terrain and economic profile are justifications for adoption. Myanmar, which is being blessed with varied natural resources that can be utilized to generate electricity such as conventional sources (gas, coal, oil and big hydro) and the renewable sources (solar, wind, tidal, small hydro and geothermal), relied mainly the on-grid system to extend electricity access. But the off-grid, such as stand-alone systems and hybrid system, are mostly used to be provided by communities, private enterprises and government in village area so far from grid extension.

A Geographic information system (GIS) based graphics management system is important for rural electrification planning. The integration of basic information and geographic information enables rural electrification planning easy. Basic information and geographic information are considered in developing a geospatial information system to obtain the best possible electrification planning and strategies. Data like sunshine hour/irradiance, wind speed, slope, land use-land cover, protected areas, water bodies, forest, and towns are collected and analyzed. These data are used to identify the optimal electrification options for particular areas in four districts of the Zone (Fogera, Dera, Farta, and Este). The weighting factors of this criterion are also determined using Analytic Hierarchy Process (AHP) (Alami Merrouni et al., 2018). These weighted and reclassified values are multiplied to produce the final map of electrification options. There is different energy planning system in which geographical information system-related studies in which multi-criteria decision making and geographic information system have been used for different perspectives. Geographic information system has been used for energy planning (Tayel B.Z, 2020).

Rural electrification is a comparatively new field of investment in Myanmar. In common with other initiatives to invest in new areas, particularly area where living standard and productivity are very low, rural electrification raises a number of basic questions for investment analysis.

Electricity can be generated by means of heat engines fueled by combustion or nuclear fission and the kinetic energy of flowing water and wind or other energy sources of solar photovoltaic and geothermal power (Set, 2018). Electricity is the most efficient way of energy consuming. The provision of electricity services can be provided by on grid and off-grid. The former, grid expansion is the widely used method to extend the existing national or regional networks and this type of electrification is an efficient way to support the required electricity demand with respect to the real time. The later method is used in the remote areas where it has very difficult to extend the national grid because of high investment cost and low electricity demand. The diesel generators, solar home system (SHS), and small hydropower are the widely used methods for off-grid electrification which means that it is not connected to the national grid.

Electrification is the process of powering by electricity and it also means the electricity supplying to a region or state. Rural electrification is the process of electricity supplying to the rural and remote areas. In 2018, over 1.4 billion people which are estimated 14% of global population didn't access to electricity (International Energy Outlook, 2018). The electrification process is typically initiated in the urban areas and gradually extended to the rural areas. However, this process is faced many challenges in the developing countries because the expanding of national grid is expensive and countries consistently lack the capital to grow their current infrastructures. In the developing countries, the government can serve the electrification by main grid supply for urban areas yet majority of the rural electrification is off-grid. The main reasons are high investment cost and time consuming. The off-grid is fairly rare in the developed countries but very common in rural areas and peri-urban areas of the developing countries where electricity networks are unable to connect domestic, commercial, industrial and institutional consumers.

In the realm of rural electrification programs, sustainable energy sources such as solar energy, biomass (especially rice husk) are becoming more popular in rural areas of the South Asia and Africa. The sun emits huge amount of energy to the earth. Solar power alone is not the answer to the world's energy challenge due to the technological limitations of solar power technology. But it has been proven to be one of the best solutions for rural areas electrification. A solar cell is a semiconductor, solid-state electronic device that converts radiant energy directly into electrical energy by employing the photovoltaic effect. A solar panel's power output depends on the load resistance, irradiance and temperature. Several techniques can be employed to create a reliable energy output by attempting to control these three parameters (SEIA, 2019).

Solar tracking devices can also be used to physically angle of solar panel toward the sun so the maximum amount of irradiance flux shines on the panel. However, solar tracking devices also need power to operate. Since mechanical parts are involved, the equipment requires constant maintenance. For a small solar energy system, it is often time and energy inefficient to implement a tracking system. In contrast, large scale solar array system may be very beneficial. Solar power has advantages of low maintenance requirement, low operational cost, long life expectancy, environmentally friendly, highly portable, and ideal for LED lighting and easy integration with small appliances. However, disadvantages are high initial costs, limited storage of power, heavily needs for energy storage devices, and overdependence on external conditions such as daytime temperature (SEIA, 2019).

Biomass is steadily growing in popularity as a way of reducing CO_2 emissions by noticeably shortening the carbon cycle. It is an organic matter from plants and animals (microorganisms). Animals get this energy through eating the plants. Waste such as crops, manure and garbage are all excellent sources of biomass fuel. Biomass has a wide array of uses such as directly as heat or to generate electricity with a steam turbine. Biomass can also be used to make methane gas, biodiesel and other biofuels. In some villages of Asia, rice husk is used to generate electricity. The characteristics and chemical composition of rice husk has made it easy to use it for electricity generation. Using rice husk for electricity generation depends on the availability of raw material and the technology used for conversion rice husk to energy (C. Bhattacharyya, 2014). Some advantages of the biomass energy sources are renewable, widely available and naturally distributed, low costs, abundant supply, can be domestically produced for energy independence, low carbon, cleaner than fossil fuels and can convert waste into energy through dealing with waste. Disadvantages include expensiveness of processing, seasonal nature, may compete directly with food production, not totally clean when burned (NOx, ash, CO, CO_2) and so on (C. Bhattacharyya, 2014).

The modern diesel generator can provide moderate amounts of electrical generation. The fuel is relatively common and can be stabilized, and has high volumetric and weight energy density. But fuel can be extremely expensive or completely inaccessible and maintenance of these generators is non-trivial, especially where spare parts may be unavailable. From the point of environmental impact assessment, the generators are often noisy, highly polluting and have low overall efficiency. The other various types of electricity sources are different types of batteries (Dry cell battery, Nickel-cadmium rechargeable battery, and Recharged lead-acid battery), Photovoltaic system, Wind generator and Micro-hydroelectric (Odunlade, 2018). The availability and costs of these sources are differed over the world.

2.3 Electrification for Rural Development

In Myanmar, rural regions show far higher poverty rates than the urban region therefore making rural improvement is a top priority for the nation’s government. In spite of its easy energy resources, Myanmar has the lowest electrification rate in the South East Asia region (50% nationwide). Really, its remote societies are permanently unreliable energy supply. More and more rural electrification project is ways to inclusive socio-economic improvement.

In 2015, Myanmar’s Government agreed its National Electrification Plan (NEP) that aspires to get universal electricity by 2030 by the definition of a sector-wide approach including:

(i) Grid extension

(ii) Pre-electrification in remote areas before to the arrival of the national grid

(iii) Permanent mini-grid and off-grid connections in remote areas

On interest of Germany’s Federal Ministry for Economic Cooperation and Development (BMZ), GIZ is aiding Myanmar’s Government to develop NEP’s off-grid component with its specific main focus on mini grids. GIZ has made decision to attribute on renewable energy-based on mini grids for a number of reasons:

(a) The development of local community and business such as mini grids adopt entrepreneurship, advantage international investments allow new jobs and authorize communities on various levels, enhancing the country's overall economic advancement.

(b) Development of sustainable economic such as harnessing Myanmar's galore renewable energy resources to high commercially viable mini-grid electricity business models will upgrade socio-economic and thus rural area development a cleared priority of the present government

(c) Great investment option such as in the most remote region where national grid extension is not possible an economically feasible option, renewable energy and hybrid generation is more low cost than fossil-fuel electric power generation.

(d) Pre-electrification such as temporary mini-grid systems in rural region can be addicted up to the national power grid when it arrives.

Public supplies from the main power system grid comprise of medium voltage such as 11 kV, 33kV, 66kV sub transmission connection point to transmit electricity from the national grid to the bigger demand load centers of an region, plus low voltage distribution in the load demand centers.

Rural electrification investment is mostly in public supplies from the main power grid at a guess which over 80 percent of rural electrification is implemented in this way. For small loads in remote village, utilities often solve that it is more low cost to get electricity requirement by installing small auto generators, wind power, solar home system and mini hydropower.

2.4 Effect of Electricity on Rural Community

Rural electrification is initially an eligible investment in many developing countries (Schramm, 1991) which has been, and still is, considerable give and take about the benefits of socio-economic and the electrification costs of these regions in developing countries. For many rural villagers in the Third World however, electrification of their village areas intends progress and, above all, modernity, light in the darkness (Foley 1990). There is socio-economic effects evaluation in Bangladesh, a villager even understood electricity as "freedom" (Schiller 1996). In the early years 1940s a farmer, who had just been joined to the electric grid, applied witness in a rural area church in the United States of America: "Brothers and sisters, I want to tell you this. The biggest thing on earth is to have the great love of God in your heart, and the next greatest one thing is to get electricity in your house" (NRECA, 1985). Rev. Fr.J.M. Hayes, a non-Christian priest in the community of Bansha in rural area Ireland, talk during a speech on the duration of the closing of the electrification of the rural area in the fifties: "it is better that an amenity, it is a solution that will sweep go away inferiority complexes" (Manning 1978). There is the author loved a dinner with friends in Lesotho in their electricity is not connected home. The food was very excellent and, for someone who gave electricity for granted in here, candlelight can contribute to a comfortable atmosphere. But his friends' every day met discomfort caused by the lack of electrification which is encouragement for my research. The effect on people's lives of a rural area society without electricity is very difficult to imagine. Daily Life without electricity is possible, as has been incontestable in the past and is still showed every day by many villagers all over the world. But in qualitative terms paper, things look wholly different. Anyway, there is electricity which is seen as a "light in the darkness" and a signal of progress, the rural areas electrification can be politically and socially very important.

One user is joined to electricity, this is one clear benefit from electrification is more lighting. Other benefits which motivate children to learn more time studying in the morning, evening and night, allows adults more and more flexibility and time for completing household jobs, and give household-based income-producing activities such as shopping to continue later into the evening and night (Khandker et al. 2014; Khandker, Barnes, and Samad 2012; Barnes, Peskin, and Fitzgerald 2003; Nieuwenhout, van de Rijt, and Wiggelinkhuizen 1998; van der Plas and de Graaff 1988; Filmer and Pritchett 1998). More and more study time for kits can drive to higher school enrollment and excellent grade gain (Khandker and others 2014; Khandker, Barnes, and Samad 2012, 2013). Moreover, electric lighting decrease home electricity user dependence on unfair lighting sources like as kerosene, electric light by reducing indoor air pollution and smoke and then protection from probability of different type's respiratory diseases. After got electricity in rural area, electricity home user adopt the electronics devices such things as television sets, radios, fans, air conditioners, space heaters, and refrigerators increasing exposure to knowledge and information and improving comfort, food storage, and hygiene. Given the sustainable benefits of joined electricity, access to new energy has been known as way to accomplishing the United Nations Millennium Development Goals (UNDP 2005). There are the example of income related benefits brighter lighting will lead shops and other small medium enterprise to operate for more working hours in the night and evening, driving to higher revenue and profit. Machinery and electricity-powered tools also help raise business profits, as they are more generative and cost-efficient than mechanical power ones in the long run. Furthermore, larger exposure to information and knowledge (through television, radio, and the internet) can authorize business owners with up-to-date business technology and knowledge, permitting them to drive their businesses more and more profitably. And the education and health benefits of electrification can drive to bigger long-run income potential.

Fluitman talked that most of the electricity impact studies were of a descriptive characteristic and he summarized "costs it comes out, becomes trivial contrast to the enjoyment of a villager who can access an electric light at the finish of the poverty tunnel".

In the mason 1990, the objective of the rural area electrification project was as follow;

(a) Support industrial, commercial development and agricultural, including irrigation is 80 projects.

(b) Migration reduction from rural to urban areas is 49 projects.
(c) Replacement for more expensive energy sources is 43 projects.
(d) Development of quality of life and time optimizing through such means as improved quality of light and application of domestic electrical devices is 40 projects.
(e) Improvement of security, political stability and correction of regional disparities is 34 projects.
(f) Upgrading in the standard of living of the rural poor is 28 projects.
(g) Alleviation of urban and rural disparities is 6 projects.
(h) Mitigation of deforestation is 6 projects.

2.4.1 Economic Effect

Fundamentally there are three ways that can be apply to assess the economic benefits of electricity accessed for manufacturing purposes (Shamannay 1996). The direct way, the willingness which is ability of the consumer to charge based on the additional income profit through the use of electricity. The indirect way this is the additive output of the manufacturing process as a output of the use of electricity. The intermediate way this is the decision of the charges avoided by the introduction of electricity. Shamannay show that these three ways only measure the static, urgently benefits of electrification such as the emergence of commercial enterprises and small scale industries and then it can define social development of a society. Maillard (1985) talk that it is most difficult to decide the socio-economic effect of rural electrification projects for two essential occasions, it is impossible to open the specific change of electrification within a blossoming process and to clarify a normal relationship within a operation of such complexity. Most usable assessments were drive out by organizations that were stakeholder in the projects and thus it was vital that the end of these assessments project were positive. Abdalla (1994) describe as benefits of rural area electrification, benefits of consumer, benefits of utility and benefits of country. In meaning of the feasibility study of rural area electrification, utilities equivalence their benefits and costs and the results are generally negative. But there have many other benefits, some of that are very hard to quantify. Often one identifies environmental benefits, socio-political benefits and socio-economic benefits.

(a) Electricity’s industrial uses

(i) In motive power such as replacing liquid fuel.

(ii) In Lighting such as replacing gas and liquid fuel.

(iii) Heating and cooling needs and refrigerating such as replacing animal waste, biomass, gas, coal and liquid fuel.

(iv) In processing food such as replacing animal waste, biomass, gas, coal and liquid fuel.

(v) In transport such as replacing liquid fuel.

(b) Electricity’s commercial uses

(i) Air-conditioning and refrigeration.

(ii) Lighting.

(iii) Longer opening times

(iv) Developed video and audio opportunities.

(v) High attractive atmosphere.

(c) Electricity’s Household uses

(i) Lighting-replacing animal waste, biomass, gas, coal and liquid fuel.

(ii) Cooking-replacing animal waste, biomass, gas, coal and liquid fuel.

(iii) Space heating, cooling and refrigeration-replacing animal waste, biomass, gas, coal and liquid fuel.

(iv) Home appliances (fan, iron, radio, TV etc)-replacing coal, batteries and biomass.

(v) Drinking water pumping such as replacing liquid fuel.

(d) Electricity’s Agricultural uses

(i) Pumping of Water such as replacing coal, liquid fuel, muscle power and gas.

(ii) Parboiling, drying and heating such as replacing biomass, liquid fuel and coal.

(iii) Stubble cutting, threshing such as replacing hydro and muscle power, liquid fuel, coal and biomass.

Reported to a listing by NRECA11 (Fluitman 1983), there are numerous opportunities consist in rural region to develop productivity of economic by definition of electricity in rural and to get social benefits. Mason (1990) study some 35

USAID12 and funding of World Bank rural electrification projects in nineteen developing countries. These all projects were elected according to critic group by governments admitting maintaining and attaining regional balances, political reasons and developing the stability of a rural area. The city and villages in the region were selected accordingly to various sets of choosing criteria both social and economic. In this circumstance, Mason right states that "the case with using a group of weighted the factor of socio-economic as a placeholder for a socioeconomic rate of comeback is that the weights applied are usually quite prejudiced as they are never based on any amount unfashionable post estimation of the experience in electrification". It also talks that the output of most affect monitoring studies which is difficult to gain to team conclusions remembering the economic benefits. There have arrived a more insensitive of tentative conclusions. Rural area electrification came out to have had some effect on the development of agricultural in a few countries their irrigation is a distributed activity, but very light in others and then only under clear conditions. The effect on commercial and industrial development, in the feel of the outgrowth of the number of new industrial and businesses, it is typically been modest. Schramm (1991) describe that it is complete evidence to define that rural electrification by itself has not been a catalyst for the development of economic. The paper ended that the effect of rural electrification on agricultural growth out is often over calculated and that there is a few evidences that electricity in rural area by itself outputs in new commercial and agro-industries and small median enterprise industrial activities. In the conclusion of a study, Foley (1990) describe that rural area electrification, on its own idea, does not necessarily cause improvement of rural areas. The paper continues by ending that it can provide a stimulus to economic activity which is in the service sector and where the necessary conditions are present that can have a major effect on the form that improvement takes. Therefore, the economic effect of electrification is very confused to define in clear definition. By the way this thesis paper will propose best way to describe in economic benefit.

2.4.2 Social Effect

Generally, the rural electrification social objectives are directed at betterment in the living status of the rural area population which is the innovation of proper circumstances in health care and education. Electrification of remote and rural areas in developing countries which is simplest form, less or more be seen as a social project, the electricity quantity is enough for a few domestic appliances and lighting but inadequate to supply productive application. Although the aim of such electrification designs is often not damaged, electrification should help relieve the detected problems and encourage the high status of the population, and it should be partial of a rural development strategy. Projects invented only for the interest of politicians to give score points and then for donors to appoint suitable funding opportunities, are not possible to be sustainable. Mason (1990) and Schramm (1991) talk that in typical the rural electrification does not lead to the relief of poverty or to checking migration from rural to urban. It is focusing the benefits of the higher income groups, but in some problem lower income groups have benefited because secondary beneficiaries through the simultaneous introduction of irrigation and other income generating measures.

In formal, the population of rural attaches big importance to the domestic application of electricity. However, without any additional generative use of power, there will be no increased income generation and thus a limit to the ability to pay for the electricity. This could hamper load increment, reduce the beneficial impact, and place sustainability of an electrification scheme at risk. For this argue, some organizations of funding requirements to the hoped-for ratio of consumptive and productive use of rural electrification projects. In spite of the fact that the effect of rural electrification on security, urban/rural bias and political stability is difficult to measure (Mason 1990), experience present that the effect of electric lights on security, educational facilities and civil order is perceived by most rural dwellers as clearly positive. All Mason’s studies showed a gain in reinvented opportunities such as Radio and TV and more time via the use of other electric devices. But the effect of the access of electricity on rural and urban migration, water supply, irrigation and cooking bring to be limited. Foley (1997) show that in Costa Rica after get the electrification in rural areas, vital social improvements get place, the institutions for education with lighting and night classes increased considerably, set up a new hospital and increasing in health centers. Initially most of the primary schools do not use electricity but this situation may change urgently with a more high-speed use of computers. In conclusion electricity is appearing to be most important for secondary schools, and for information and health care. Research also brings out that children living in houses with electricity take advantage and evening and night will do their homework.

2.4.3 Environmental Benefits

The benefit of rural electrification in environment has positive effect on the living statues of the rural population. This relates to the reduction of the negative health effects of conventional lighting (fire-wood, kerosene lamps) such as accidental burns and respiratory diseases. Millington (1994) approved that some 68% (and in some cases even 90%) of the population in rural region used agricultural biomass residues and wood fuel for cooking. Ebohon (1996) resolves "taken the virtual depend on by rural area population on these fuel sources, the combined environmental effect on the single hand, and on the other, supply troubles are having negative effects on growth and output. Thus, the requirement for, and the speed by which solutions must be sought have never been greater". It is often supervised that the rural areas electrification will more or less automatically drive to a shift from wood fuel to electricity in cooking. Research (Mason 1990, Vogel 1993, and others) has talked that rural areas electrification ordinarily does not protect deforestation, truly not during the early years after electrification. It comes out that the awaited switch from wood fuel to electricity for cooking purposes only happens on a very limited scale. In typically the population of rural lacks the resources of financial to buy electric devices. Also, the habits of cooking and the opportunity of purchasing small amount of conventional fuel are referred as reasons. In rural region, land clearing up for agricultural application is often the great cause of degradation in environmental. The demand in energy of the rural population is often the cause of deforestation and then the population has seldom been fortunate in managing the environment. Charcoal and Wood fuel demand by the urban areas but can have a substantial effect on deforestation in the environment of rural areas. In some countries, both rural and urban dwellers have recovered that the forests can be an awesome to generate income with the impact of over-application of resources (DGIS/SEM 1996). Therefore, It is utmost vital that any policy regarding supply of energy and the impacts of associated environmental should cover both the rural areas and the urban.

2.5 Benefit of Electrification of Rural Community

There have many merit and demerit of electrification of rural community, the time-streams of cost and benefits need to be calculated. Calculation of economic rates of return and cost benefit ratios information should be considered as customary practices. Shadow price adjustments are required to obtain for the pricing system distortions. The four most vital adjustments are:

1. Net tax revenues that are part of the profit of government stemming from electrical appliances and equipment sales, and electrical energy if the utility offers taxes on input or sales.
2. Foreign exchange that is the usual shadow price adjustments require be estimated as the payment's balance is in disequilibrium, or there is strong protection, or both.
3. Capital as a specific adjustment may often be to allow required for scarcity of credit. This mainly impacts the sales of equipment and appliance and the connection cost.
4. Labor as the principal element of that is met in the network's construction; there are unskilled labors costs may drive nearly 25 percent of proposed investment costs, based on the difficulty of countryside.

The benefits of time streams, shadow price adjustment and cost are listed individually, therefore the cost benefit tableau contains such as benefit streams, shadow price adjustment streams and cost streams. Benefit streams consists of direct benefits to agro industries, direct benefits to households (revenues), commerce (revenue), and farms, and surplus gain to agro industries, commerce and farms. Shadow price adjustment streams consists net tax revenues (deducted from costs, or added to benefits) such as net foreign exchange penalties, profits from credit rationing, and shadow wage adjustment to labor costs. Cost streams consists of local distribution network (capital cost), transmission and sub transmission (capital cost), generation (capital costs), administration and Maintenance costs and generation (energy cost).

Firstly, if rural electrification is to bring toward the wages and economic output in rural region, it must be built up with product line practical applications in mind. Where it is so built up, the demands from agro-industries, agriculture and commerce will be great, and the surplus benefits and revenues from these should allow a good economic bring back to the investment.

Secondly, and nearly related to this, is that a low **IER** may inform insufficient aid to the growth of agriculture-poor and local infrastructure or no credit, for instance bad roads. Electricity is very important one of various factor inputs required for development.

Thirdly, low economic bring back can also drive to disillusionment between both investors and consumers. One argues for this is that case subsidized electricity and the appliances to join it often cost far greater than consumers anticipate.

Fourthly, where there is a hard demand from businesses and households, a low **IER** probably shows that tariffs are too down case and incorrectly structured. Many of the bigger household consumers in rural often have above level average per capita incomes, while many of the greater farm and business consumers attain quite beneficial profits.

Fifthly, the fundamental reason for a low **IER** is a low level of applies on a big cost project. It is possible in such an event that a least-cost result has not been met. Finally, a low **IER** intends an ineffective investment and wrong priorities.

In conclusion, the economic return calculation supports some effective messages. A high **IER** intends a good investment. Low and very low **IERS** on the other side may signal an inefficient, the possibility of disillusionment and project, wrong priorities.

2.6 Review on Previous Studies

There are many studies long time that emphasized the effects of electrification on rural areas socio-economic development of developing countries. The random relationships between development of poor and electrification in rural communities are very complex and contextual. The most literature main focuses on the effect of rural electrification and electricity access on emphasized area socio-economic development, while the backward feedbacks of various economic and social changes on electricity supply and demand have not been completely characterized. Generally, electricity access effect assessments accept linear, there is one-way effects and growth linearly in electricity demand.

The major part of papers describes that access to electricity guide about a growth in local income generating activities (IGA) which lacks description of the nexus, and they mainly state the spreading of IGAs after electrification in poor communities. Prasad and Dieden (Prasad and Dieden 2007) described in the paper data from South African national surveys recommend that somewhere between 40% and 53% of the growth in small, medium and micro-enterprises development is attributable to the grid throughout. Peters et al. (Peters et al. 2011) said that the implementation of electricity-reliant firms in area with obtain in Rural Benin has been "a deeply positive impact of electrification" ((Peters et al. 2011) p. 781). Jacobson (Jacobson 2007) give information of the 48% of the electricity users interviewed in rural area Kenya talked that the installation of solar electricity holds up some income and work related activities. Adkins et al. (Adkins et al. 2010) inform the 98.1% of developers of solar lanterns in Malawi described that the implementation of solar electricity holds up some work and income related activities. Kooijman-van Dijk and Clancy (Kooijman-van Dijk and Clancy 2010) show the 25% of households obtained electricity run a home business in Philippines, contrast to about 15% of households without electricity.

Employment chance arises from the innovation of new electrical infrastructures required to satisfy local area electricity demand and with the spread out of new devices and appliances. (Kumar et al. 2009) and Somashekhar (Somashekhar et al. 2000) talked the renovated of organizations with manufacture in charge, installation in charge, operation in charge and maintenance in charge of incentive power generation infrastructures in India. Biswas et al. (Biswas et al. 2001) recommend that the administration, operation, and maintenance activities of new renewable energy technologies can carry positive effects on the rural area employment rate in Bangladesh. Others impact of rural area electrification is the working time reduction and produce quality products to the use of electric services and appliances (instead of manual labor), mostly for women who can obtain more time for other home production (Grogan and Sadanand 2013; Khandker et al. 2013) and new market activities (Dinkelman 2011). The save of time allow for the extension and establishment of IGA. Finally, Dinkelman (Dinkelman 2011) presents that South African electrification impacted rural area labor markets also by assisting the new activities for women and men, who started innovation in market services and goods at home via the adoption of new electrical appliances (*e.g.*, food preparation, services requiring electric appliances).

At a deep of analysis, literature investigates in more depth and delves the propensity to build new activities, extend and invest in IGAs, and the feedbacks related on electricity demand. As already highlighted, the possibility to use electrical devices makes new activities possible and for people to invest in: telephone booths, shops that produce and sell yoghurt, fresh drinks (Kirubi et al. 2009; Sovacool et al. 2013), ice-cream (Bastakoti 2006), office support services – e.g. faxing, word processing, photocopying, printing shops, computer centres (Lenz et al. 2017) –

energy stores, laundry services, hair dressers, photo studios (Bastakoti 2006; Shackleton et al. 2009; Peters et al. 2011), saw mills, welders (Peters et al. 2011), village entertainment enterprises such as movie tents and community TVs (Bowonder et al. 1985; Bastakoti 2006), cold stores (Bastakoti 2006; Matinga and Annegarn 2013). Use of new electrical machines and appliances both require and allow the installation of new small business activities that can appear regular maintenance services, as talked for rural Eritrea (Habtetsion and Tsighe 2002), Mali (Sovacool et al. 2013) (Moharil and Kulkarni 2009) (Meadows et al. 2003), and India (Bowonder et al. 1985). Therefore, many literatures are talked deeply about the impact of electrification on rural area for social, economic sustainable and market development.

CHAPTER III

OVERVIEW OF ELECTRIFICATION IN MYANMAR

3.1 Power Sector in Myanmar

Presently, Myanmar's power sector is fighting to hold foreign power investments and keep up its operating environment. In ASEAN countries, Myanmar has the smallest electrification access rate which has half of its population joined to the Myanmar national grid. In Myanmar Information Management Unit (MIMU) present data, 80 percent of rural are people have no join to national grid electricity. Most of the rural area population depends on candles, kerosene, batteries, home solar and electric power generators in their every day. The inability of electricity is not only threatening the socio-economic development of the Myanmar but also bans the improvement of national infrastructure and industrial business development.

In Myanmar, electricity generates from 52 power plants, including 28 hydropower stations, 21 gas-fired plants, 2 solar power plants and one coal power plant. In 2019, new tariff was calculated by electricity use units and classified by domestic and industrial used, in which the latter more units consuming has been priced for units much higher as increased over 50 percent than the former. To accomplish the National Electrification Plan (NEP), a total investment of $5.4 billion will be required to initiate the electrification rollout, and $40 billion will be required for investment in transmission and distribution.

Generation mix in Myanmar are 54 % (3,262 MW) of hydropower generation, 41% (2,496 MW) of natural gas generation, 4 % (120 MW) of coal power generation, 2% (116 MW) of diesel power generation, 1% (40 MW) of the solar power generation. Total installed capacity by generation is 6,034 MW. Present electricity generation (MW) in Myanmar are 52 % (1,990 MW) of hydropower generation, 45% (1,722 MW) of natural gas generation, 2 % (76 MW) of coal power generation, 1% (40 MW) of the solar power generation. Total electricity generation in Myanmar is 3,828 MW.

In renewable energy law draft, Ministry of Electric Power (MOEP) goal are intending the solar generating which will be 8 percent of the country's electricity at 2021 and 12 percent of all grid electricity generated will be renewable by 2025. Myanmar had a natural resource for renewable energy is 3,300 MW total installed capacity of approximately. Myanmar has a large amount of renewable energy natural resources that, if handled and manage efficiently, could fill its future energy infrastructure requirements for clean and sustainable development. In 2022, electricity grid blackouts have appeared across the country, including in the business cities of Mandalay and Yangon because of the rising global fuel prices. Myanmar had four main rivers for hydropower development such as the Ayeyarwady, Chindwin, Thanlwin, and Sittaung, represent a beneficial natural energy resource. Other rivers are Mekong and Bago. The Asian Development Bank (ADB) presents that Myanmar has more than 100,000 MW of installed capacity of hydropower potential. Myanmar own 7.7 percent of the hydropower natural resources in Asia, and generating electricity from hydropower plants are nearly 62 percent of Myanmar's power.

According to the Ministry of electric Power data, there had planned out potential locations for 41 innovative power projects that will be under implementation from 2016 to 2031. These new power plants are doing built to raise electricity power generation capacity to 29,000 MW by 2031. During the dry season, Myanmar national grid is heavy reliance on hydropower that could lead to shortages in power supply frequently. Most of the projects are facing define challenges construction hydropower projects according to environmental impact issues, extensive project implementation timelines, unseen able weather conditions, insufficient financial support, many defects in aging equipment, and too limited coal production.

For solar plant, Myanmar has many solar natural resource potential, especially in the middle region and in its large dry zones. Hybrid mini-grids and home solar energy systems are clean renewable energy solutions that could break power shortage problems in rural region communities. According to the MIMU, in Myanmar more than 30,000 rural villages are not directly joined to the national grid, the overall potential for solar electric power is nearly 51,973 terawatt-hours per year. Presently, Myanmar has two running solar plant are Minbu 40 MW and thapyawa 30 MW, many utility-scales solar power project, the 160 MW Minbu solar project in Minbu Township, the two solar projects are located in Mandalay division such as

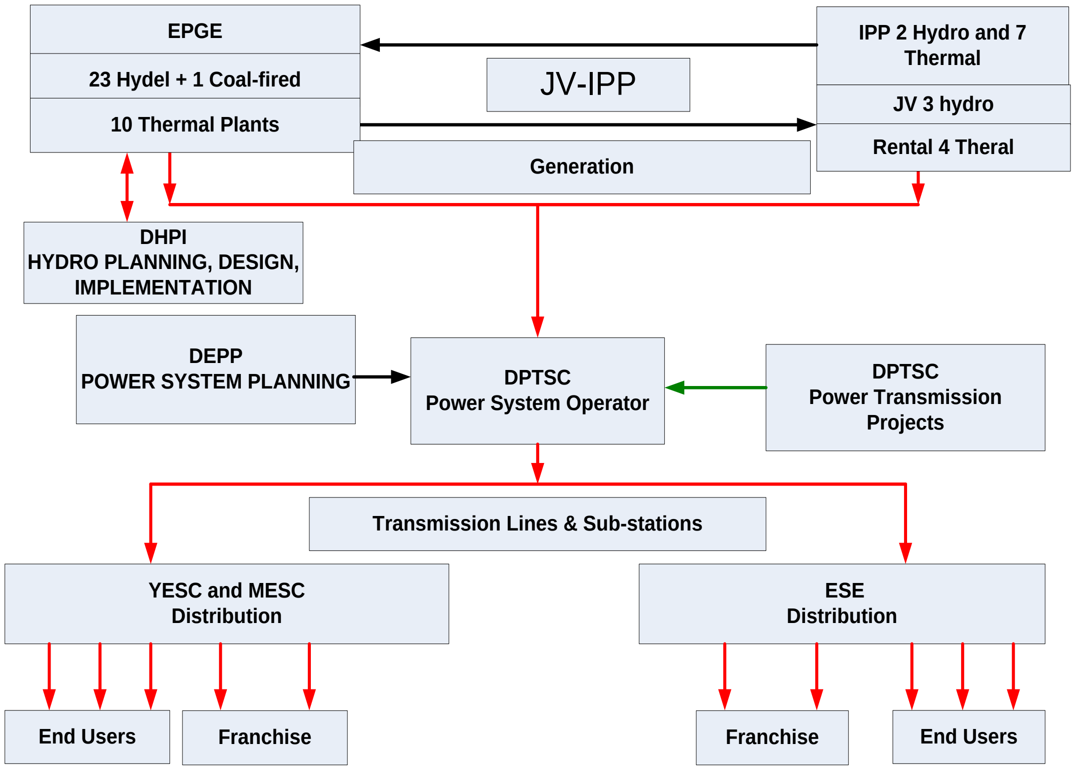
Taungtawkywin 30 MW, Yepaungsone 30MW, Myogyi 30 MW is located in Shan state, Shwe bo 30 MW in Shwebo township located in Sagaing region.

For Wind Power, as the very first project for wind power in Burma, MOEP signed an agreement with China's Three Gorges Corporation to develop a 30MW wind power project in Chaung Thar, Ayeyarwady Region. Myanmar is an agriculture-based economy with large land area, supporting significant resources potential for wind-powered in ADB report 4032 MW from wind energy the places such as Magway division, Chin State, Rakhine State, Ayeyarwady Region, Yangon Region, Shan State, Kayah State, Tanintharyi Region, Mon State, and Kayin State, essentially most parts of the Myanmar.

Mini-grid/Off-grid sector, there are many large amounts of hydro mini grid and hybrid solar diesel mini grid in operation and running. In Myanmar, there are already large number of hydro mini-grids and hybrid solar-diesel mini-grids in running. The potential resources for further mini-grid development in dry zones are very high, normally in the Magway and Sagaing regions. According to the NEP plan, the Department of Rural Development (DRD) was assigned to attempt electricity with off-grid to raise electricity join in rural regions, with the help of costing public funds for system improvement. From 2016 to 2022, solar home system electrification is a total of 434,480 households and mini-grids in 8,568 villages supporting electrical connect to 2.172 million people. There are still left over 19,000 villages to get electrified. As an output of the project, the government is investing large resources to off-grid renewable.

Tigyit coal-fired power plant, the only one coal power plant in Myanmar is producing 120MW and is connected to the national grid. In spite of Myanmar has approximated domestic coal natural resources of 540 million tons, coal extraction has left slowly due to a small amount of investment and the too far location of the country's known coal sites.

Figure (3.1) Power Sector of Ministry of Electric Power



Source: MOEP, 2022

The Figure (3.1) is shown the power sector of Myanmar, which consists of generation, transmission and distribution. As can be seen government owned the 23 hydropower plants, 10 thermal power plants and one coal power. Independent Power Purchase (IPP) plants are 2 hydropower plants and 7 thermal plants, Joint Venture are 3 hydropower and Rentals are 4 thermal power plants in Myanmar national grid. Department of hydropower implementation is responsible for design, budgets and construction plan, implement the hydropower plants. Department of electric power planning are responsible for generation planning and load forecasting and reporting, making and proposing of objective, rule and regulation and standard operating procedure. Generation of the all hydropower, Gas Turbine, Steam Turbine, Coal power plant and solar are managed and operated by the Electric Power Enterprise. Construction of thermal power plant and solar power plants are also managed and controlled by the Electric Power Generation Enterprise. Department of power transmission and system control managed and controlled the power transmission of national grid and implementation of transmission substations and lines. For distribution of electricity and Tariff Metering managed by the Yangon Electric Supply

Cooperation (YESC), Mandalay Electric Supply Cooperation (MESC) and Electric Supply Enterprise (ESE).

3.2 Power Generation in Myanmar

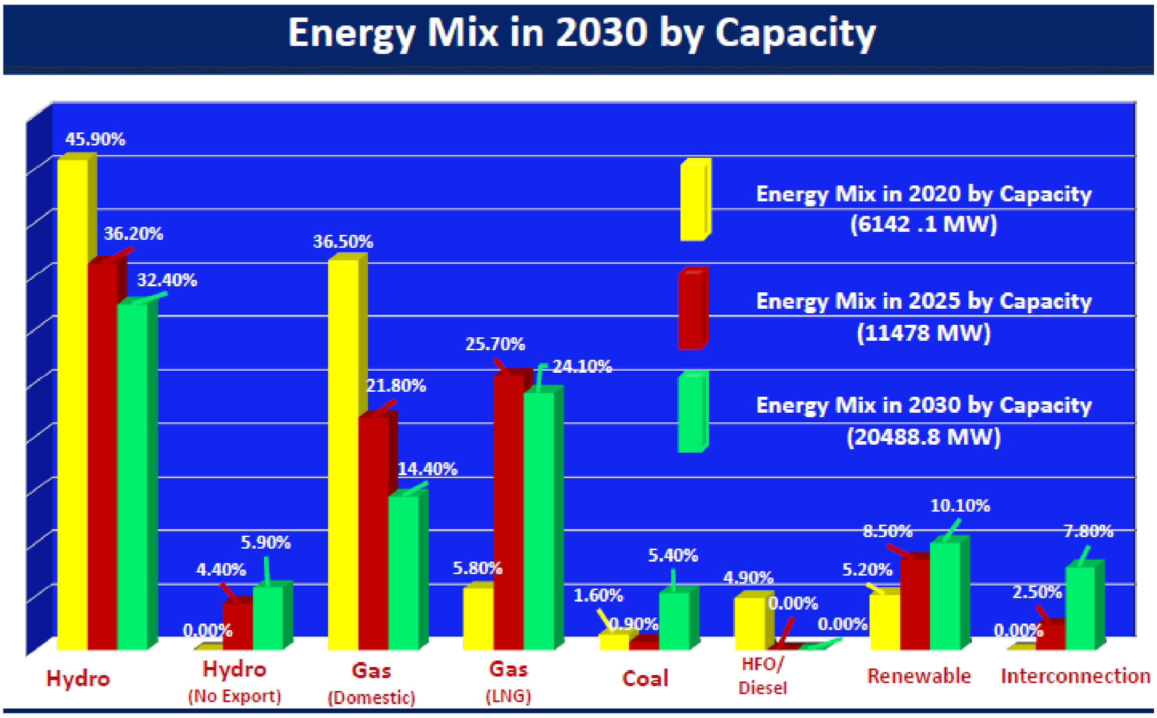
In Myanmar electricity generation, twenty-eight hydropower plants are currently in existence, 23 of them are government own hydropower plant, two of them are Independent Power Producer (IPP) and three of them are Joint Venture (JV). There are fifty big hydropower plants were built before 2000. These are included the Baluchaung-2, built in 1960 and financed by post-war Japanese reparations, which supplies electricity primarily to Loaikaw, Taungo, Naypyitaw, Kalaw, Yangon and Mandalay. Other large hydropower plants are Paung laung, Kinda Multipurpose Dam and Yeywa, supply to the Myanmar national grid. There has survey suggest that it would be reasonable to develop 302 potential hydropower regions plan with a total generation capacity of up to 46.3 GW in Myanmar. The large-scale project of the Myitsone Dam at the confluence of N'Mai Hka and Mali Hka with the Ayeyarwady River was suspended by the Thein Sein government in 2011 due to strong public reservations. Most of other projects are proposed mostly by China, India and Thailand. For instance, Nawchanka and Shweli, Tamanthi, Shwesyay and Mawlight on the Chindwin are largely hydropower resources. All of these hydropower resources are not comprehensive because of assesses ecological, economic, social and political factors. Present condition, there are seven hydropower Plants are situated in Bago division such as Phyu, Thauk Ye Khat, Kun Chaung, Shwegyin, Kabaung, Yenwe and Zaungtu. Generation capacity of Thauk Ye Khat is 120 MW which is Independent Power Producer (IPP) and the biggest one in Bago division. Shwegyin and Kun Chaung are generation capacity 75 MW and 60 MW which is biggest hydropower plants owned by government in Bago division. Other is small hydropower plants in Bago. There have one Gas turbine which name is Pyay gas turbine located in Shwe daung Township. There are twenty-one thermal generating power plants in Myanmar connected to the national grid. Ten of them are state owned, seventh of them are Independent Power Producer (IPP) and four of them are rental. One coal power plant is Tigyit which generating capacity is 120 MW. Two solar power plants are Minbu and Thapyawa solar power plant. Minbu solar power plant is 40 MW and Thapyawa solar is 30 MW.

The hydropower plants location and installed capacity of hydropower in Myanmar are present in Appendix A. This table give information of the largest power generation is Yeywa hydropower plant which is owned by government and Paunglaung is the second largest installed capacity in Myanmar National grid. On the other hand, Baluchaung is the first hydropower plant in Myanmar. Myanmar has rich in natural resources and thus role of gas turbine power in National grid electricity production is become excellent. Presently, Myanmar has 21 gas turbine power plants which installed capacity of 2,306.27 MW account for 38.1% of national grid generation capacity in 2021-2022 FY (Current Situation and Development, MOEP, 2020).

The thermal power plant location and installed capacity in Myanmar are shown in appendix B. Ywama Gas and Steam turbine station owned by government is the highest installed capacity and the second largest generation is the Ahlone and Hlawga stations owned by government. A coal-fired power station or coal power plant is also called as a thermal power station which burns coal to generate electricity which is only one coal power generation plant which is known as Tygyit is located in Shan State. Ywama, Ahlone and Hlawgar plants are located in Yangon division.

The electricity generation form 2010 – 2011 FY to 2020 – 2021 FY is presented in Appendix C. The electricity generation is continuously raising electricity demand with the installed capacity year by year with big rate.

Figure (3.2) Energy Mix in 2030 by Capacity

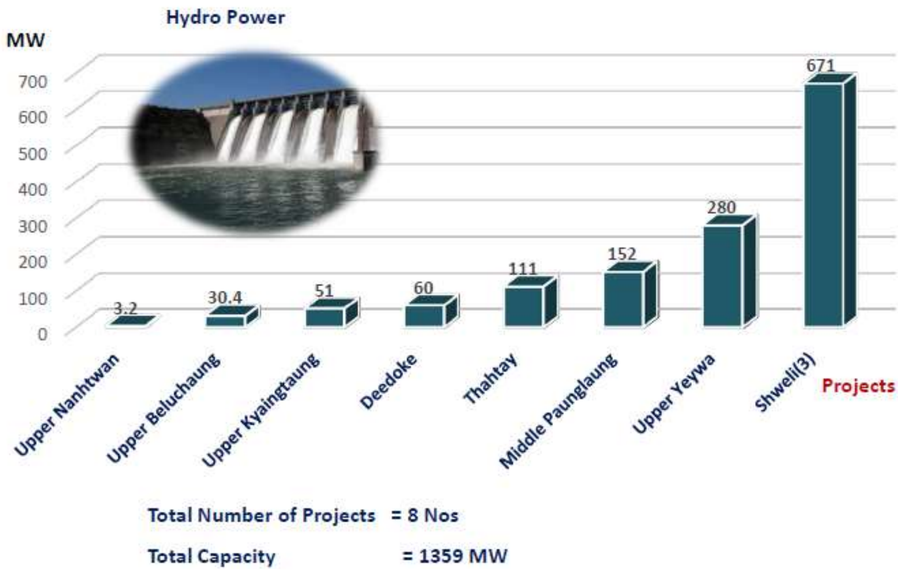


Source: MOEP, 2022

To cover the raising electricity demand, generation mix based on the rich natural resources of the country is very critical path for power sector development. In the generation mix of Myanmar, hydropower is the largest contribution, gas is the second largest, the third is coal and the last is solar power which is commercially operated in 2030. According to Department of electrical power planning data, in 2030 100 percent of household will get electricity in Myanmar.

The given figure (3.2), MOEP energy bar graphs compare the years present and future of energy mix in 2020, 2025 and 2030. As can be seen, the horizontal axis shows the Hydropower, Hydropower (No export), Gas (Domestic), Gas (LNG), Coal, HFO/ Diesel, Renewable and interconnection, the vertical axis presents the generation volume in percentage. In 2020, Hydropower generation is 45.90 percent mix in total generation and in future 2030 will be 32.40 percentage. In 2020 Hydropower export is zero and in future 2030 will be 5.9 percent export to other neighbor countries. For gas turbine, in Gas domestic is 36.5 percent and in future 2030 will be 14.4 percent. For gas (LNG), in 2020 5.8 percent and in future 2030 will be 24.1 percent. For Coal, in 2020 1.6 percent and in future 2030 will be 5.4 percent. For HFO/ diesel, in 2020 409 percent and in future 2030 will be 0 percent. For renewable energy, in 2020 5.2 percent and in future 2030 will be 10.1 percent. For interconnection, in 2020 there have been 0 percent and in future will be 7.8 percent. According to graph, between 2020 and 2030, the Hydropower will be decrease in energy mixed, Hydropower (no export) is increased, Gas domestic used is decreased, Gas LNG used is increase, Coal power used in little down in 2025 and then increased in 2030, HFO/diesel used is decrease, renewable energy used is increased, the interconnection used is increased in 2030. Therefore, Myanmar energy infrastructure future is rich in renewable energy and will increase in using LNG gas generation.

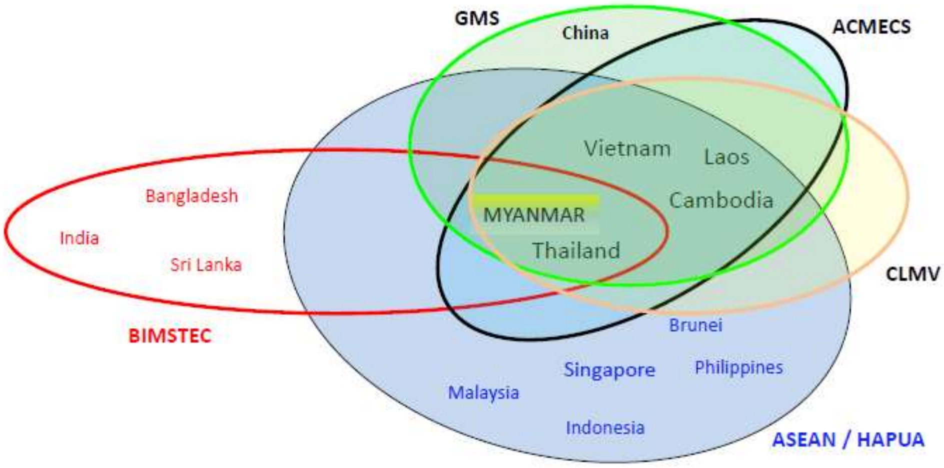
Figure (3.3) Ongoing Generation Projects



Source: MOEP, 2022

Figure (3.3) graph are the ongoing projects of hydropower in Myanmar, the horizontal is project capacity and the vertical is production MW in to the system by hydropower plants. There are eight hydropower projects, Upper Nanhtwan is smallest one in graph, the Shweli (3) is biggest in generation power 671 MW. The total generating MW is 1359 MW. According to graph, near future will be definitely increase 1359 MW Hydropower generation in Myanmar national grid.

Figure (3.4) Organization Related with MOEP for Energy Infrastructure Development



Source: MOEP, 2022

Figure (3.4) is shown the many neighbor countries and organizations are working together with Myanmar for energy infrastructure development such as Bay of Bangal Initiative for Multi Sectorial Technical and Economic Cooperation (BIMSTEC), Greater Mekong Sub-region (GMS)/ Lancang–Mekong Cooperation (LMC), Ayeyarwady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS), Association of South East Asia Nations (ASEAN), Head of ASEAN Power Utilities / Authorities (HAPUA), Cambodia, Laos, Myanmar and Vietnam (CLMV). Therefore, Myanmar is managing and implementing of generation capacities discussing with other neighbor countries for development of energy infrastructure.

3.3 Power Transmission in Myanmar

Big load demand of Myanmar is south central region such as Mandalay, Naypyitaw and Yangon, but power generation is in upper ayeyarwady river north part and Thanlwin river in east part of Myanmar. Grid transmission line facilities are very important infrastructure for proper huge power sending from northern path of Myanmar to southern path of Myanmar. As an overall trend, presents transmission line and flow of power from north to south. At the first glance, it is clear the heavy load Yangon is lower path of Myanmar and huge generation Yeywa and Shweli hydro power is located in Upper path of Myanmar. Upper Paunglaung is located in Middle path of Myanmar but its generation capacities are not enough to transmit electric power to the Yangon load. For future Myanmar grid required 500 kV transmission line from north to south. Therefore, transmission line and their protection infrastructure is vital look like heart of Power system for stability and reliability. Myanmar National Power Grid have (78) numbers of 230kV transmission line, (53) numbers of 132kV transmission line and (149) numbers of 66 kV transmission line.

In Bago Division, there have 230 kV, 66 kV and 33 kV power transmission line. It does not have 132kV transmission line. Seventeen number of 230kV transmission line, thirteen numbers of 66kV transmission line and three number of 33kV transmission line are supporting for Bago region power transmission, distribution and utilization as appendix D.

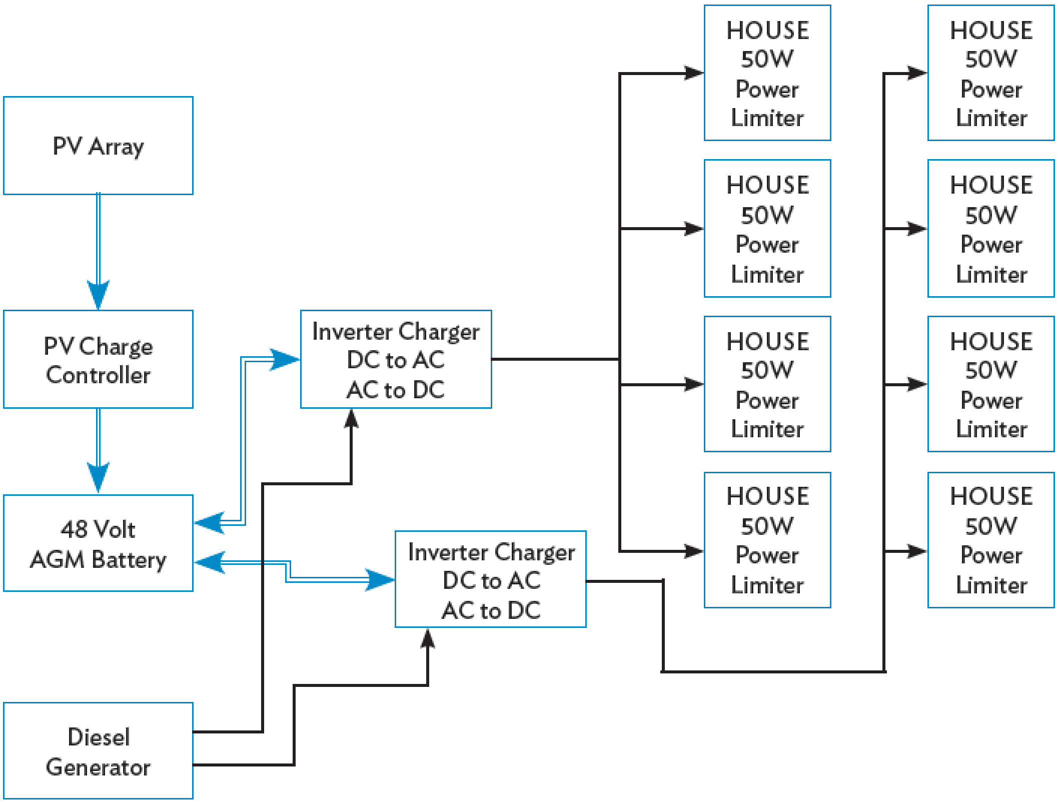
3.4 Electricity Distribution in Myanmar

Myanmar National Grid can be divided in to three regions for power flow and distribution there are northern region which is including Kachin State, Sagaing Division and Chin State. The Eastern region is including Shan State and Kayar State. The Central and Southern region which is including ayeyarwady Division, Bago Division, Magway Division, Mandalay Division, Tanintharyi Division, Yangon Division, Kayin State, Mon State and Rakhine State. For Supply and Demand balance in North and East Myanmar are relatively low load. In grid the central region and the southern region account for nearly 90 percent of national total load but the installed capacities is very limited. Electricity distribution which is supply for used electricity is the last process of Power Generation, Transmission and distribution in the servicing of electricity and it servicing electricity from the transmission line system to the direct connected customer industrial users and household users. In Myanmar, for rural electrification there are two types of distribution system such as on grid and off grid distribution inside. Department of Rural Development under Ministry of Agriculture, Livestock, and Irrigation is implemented the off grid distribution project such as micro hydro, diesel generator, solar power house and small home solar system. Under the control of Ministry of electric Power, Myanmar have three distribution systems which are Gird based electricity distribution process is designed, operated and implemented by Electricity Supply Enterprise (ESE), Yangon Electricity Supply Corporation (YESC) and Mandalay Electricity Supply Corporation (MESC). YESC is responsible for Yangon electricity distribution services with YESC electricity Law. MESC is responsible for Mandalay electricity distribution services. Except Yangon and Mandalay city electricity distribution services, other cities are responsible by ESE. Most of the distribution transformer (11/0.4 kV) are joined to the medium distribution voltage level substations such as 66 kV and 33 kV that are joined to high voltage substations like as 132 kV and 230 kV through grid power transmission lines which is also joined to generation. All of these joined generations to transmission, transmissions to distribution, and distributions to customer have installed energy Meter for tariff purpose electricity market structure. There are two things to consider for implementation distribution facilities such as 66 kV and 33kV substation installation and built distribution transformer (11/0.4kV, 6.6/0.4kV, 22/0.4kV) for distributing electricity to industrial and house hold users.

Distribution lines 66 kV and 33 kV are connected from high voltage substation 230/66/33kV and 132/66/33kV to distribution substation 66/33/11kV and then distribute 11kV voltage to distribution 11/0.4 kV transformers located near the customer industry and home. In Myanmar 400 (three phase)/230(single phase) Voltage (V) is the utilization voltage for home appliances such as air con, washing machine, refrigerator, Television, fan, iron, heater, cooler, lighting, industrial machine. In Median Voltage 66 kV and 33 kV substation transformer are reduced to 11 kV from 66/33kV by using step down transformers. In typically, electricity supply to the big customers (industries) whose demand is 230kV, 132kV, 66kV, 33 kV is connected to the high and medium voltage transmission lines bus near their location. Most of the residential and commercial users are joined to the 400V and 230V lines from 11/0.4 kV step down power distribution transformer located nearby customers. The 33/11 kV Transformer implemented distribution substations are transmitted to the urban and rural areas via 11 kV distribution lines which called on grid distribution.

There are too far to access national grid electricity, hybrid technology such as solar and diesel generator and solar home system are implemented in rural area. It is intended for good citizen and model citizen with electricity. It is reducing electric energy shortage, improving local voltage quality and not causing electric energy quality deterioration. It is used to supply power to remote areas such as rural area, sea and forest. It is used to integrate renewable energies and diesel power generator therefore it is reduced environmental impact of energy power system. It is lower the additional investments due to upgrading the power grid, and lower power transmission and distribution losses. Disadvantage of this system is required skill person for operation and maintenance of hybrid system electricity distribution. It is one the main technologies for realizing reliability, flexibility, self healing and disaster recovering of power grid which system is called off grid electricity distribution system.

Figure (3.5) Off Grid, Hybrid System Design for Electricity Distribution



AC = alternating current, AGM = absorbent glass mat, DC = direct current, PV = photovoltaic, W = watt.
Source: ADB Myanmar Off-Grid Renewable Energy Demonstration Project Team (2017).

Source: MOEP, 2022

Figure (3.5) is shown off grid electricity distribution system for rural area. There are consisting of one diesel generator, one battery bank and PV array. Day time, system generated electricity from solar system. Night time, system requirement electricity can get from diesel generator. Energy Meter reading system is prepaid card system in village. Over the country of Myanmar, there have on grid and off grid electricity distribution system.

Appendix E is shown the urban region on-grid and off-grid electricity distribution of the respective 7 states and 8 divisions in 2020-2021 FY. All of the urban regions are supply electric by on grid and off grid systems. Kayah state, Nay Pyi Taw, Magway and Bago divisions are 100% electricity supply and used by on grid electricity. On the other hand, Tanintharyi division is not reach national grid because it is located far from the power system but MOEP has construction projects to supply the grid electricity in Tanintharyi division. Off-grid electricity supply system of urban areas are 100% in Tanintharyi, 68.42% in Chin state, 53.13% in Kachin state and others are as presented in appendix E. There have too many technologies for off grid distribution system such as diesel generators, micro hydro, solar power house, mini grid systems that are managed and operated by MOEP and DRD.

In rural areas, on grid system, join to electricity is supported by MOEP and for off grid responsible by DRD. Appendix F is shown the condition of on grid and off grid electricity supply and used in rural areas of the state and division up to 2020-2021 FY. As can be seen in table (3.10), (14,570 villages) 23.04 % of rural areas are distributed by on grid system whereas (19790 villages) 31.29% of rural areas are supplied by off grid system and 45.67% of rural area are still needed to electrify. In on grid supply system, rural areas of Kayah state, Mandalay division and Naypyitaw are joined to electricity at 75.82%, 57.45% and 55.53% respectively. Only 2.90% of rural areas of Chin state are joined to on grid supply system, 69.47% of those regions are off grid electrified because its main land is big barrier to receive national grid electricity system. Sagaing division is the second largest point of off grid electricity distribution. In conclusion, total number of 34,360 villages as estimated 54.34% of rural areas is distributed electricity whereas 45.66% of rural areas (28,877 villages) are still needed to be distributed.

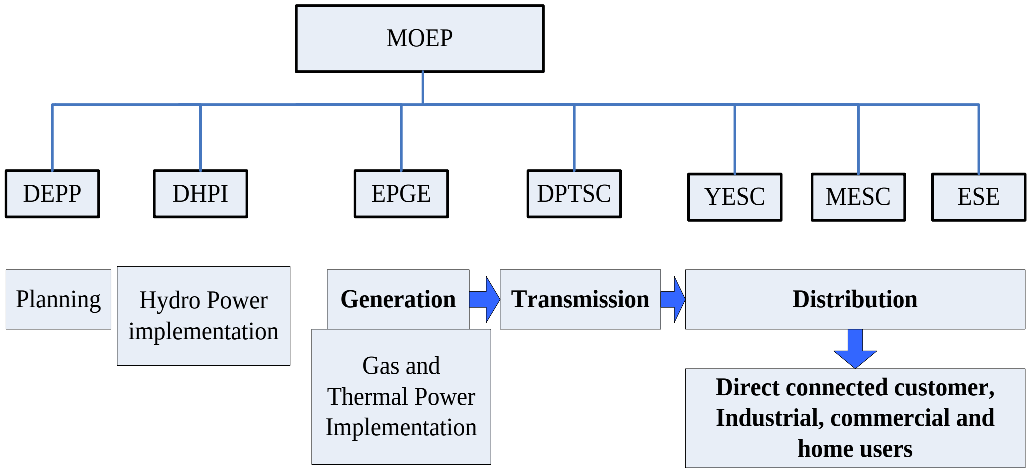
3.5 Power System Organization and Market Structure

In 2006 May, Ministry of Electric Power has been reorganized by the State Peace and Development Council as two ministries, namely Ministry of Electric Power No.1 and Ministry of Electric Power No.2. Implementation of large-scale Hydro Power Projects and generation by Hydro Power and Coal are under responsibilities of Ministry of Electric Power No.1. Thermal and Diesel Power generation, transmission and distribution are under responsibilities of Ministry of Electric Power No.2. In 2012 September, these two Ministries were combined to form the Ministry of Electric Power, Myanmar. On 1st April 2016, the MOEP was composed with the Ministry of Energy to form the Ministry of Electric Power (MOEP). On 2nd May 2022, the MOEE had divided into two Ministry such as Ministry of energy and Ministry of electric power. Under Ministry of Electric Power (MOEP) there have three departments, two enterprises and two corporations (MOEP, 2022).

They are;

1. Department of Electric Power Planning (DEPP)
2. Department of Electric Power Transmission and System Control (DPTSC)
3. Department of Hydropower Implementation (DHPI)
4. Electric Power Generation Enterprise (EPGE)
5. Electricity Supply Enterprise (ESE)
6. Yangon Electricity Supply Corporation (YESC)
7. Mandalay Electricity Supply Corporation (MESC).

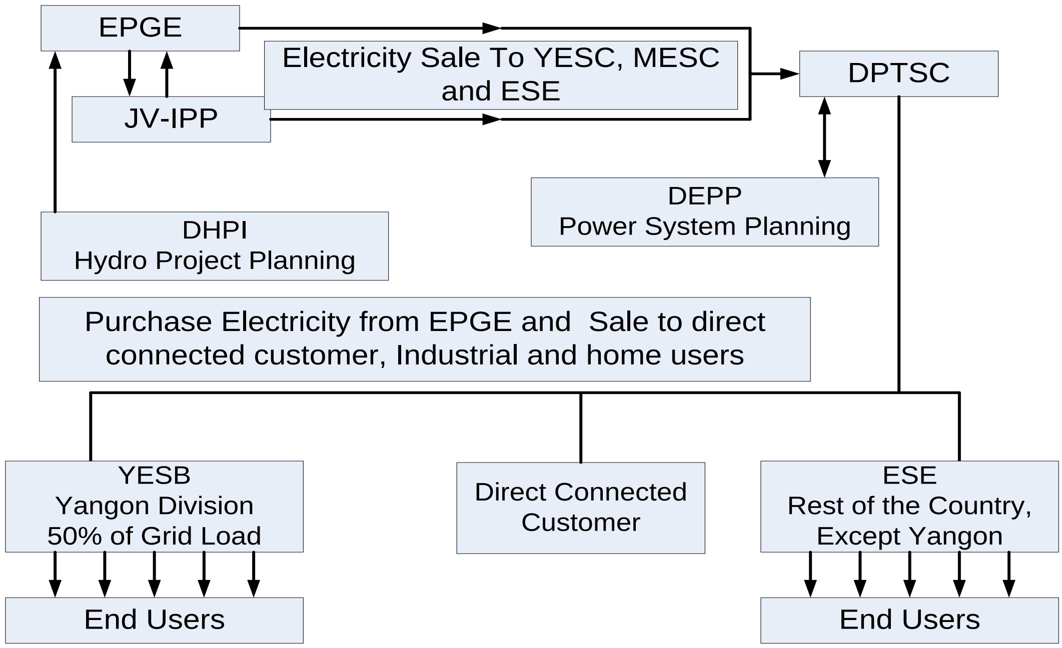
Figure (3.6) Organization Hierarchy of Ministry of Electric Power



Source: MOEP, 2022

In Figure (3.6) shows the organization Hierarchy of Ministry of Electric Power. Department of Electric Power Planning (DEPP) is responsible for planning, coordination, international relations, to formulate the long-term and short-term planning of the renewable, Gas and thermal power and hydropower projects, to forecast the load demand for future, to analyze and recommend for expanding of power plants to meet the demand requirement. Department of Power Transmission and system control (DPTSC) develops and implements the transmission substation, transmission line, transmission network and Supervisory Control and Data Acquisition system, including operation and maintenance national grid which control the processes of electricity generation, transmission, and distribution which are connected with the national grid, High Voltage and medium voltage distribution system and to report the financial statement to MOEP. Their responsibility transmission network voltage level is existing 66 kilovolt (kV), 132 kV, and 230 kV; and the planned under construction 500 kV. The distribution systems voltage level consists of median voltage levels namely as 33 kV, low Voltage level namely as 11 kV, 6.6 kV, and 0.4 kV and 230 Voltage. The Department of Hydropower Implementation(DHPI) has four sections responsible for planning, design, investigation civil, electrical works, and mechanical works; and seven hydropower construction engineering companies competent of construction and installation of big dam and hydropower projects. The department of hydropower implementation is to present the hydropower resources and then project report the possibility of these resources, implement of the new projects which are assigned from the ministry, and monitoring and reporting the progress of the projects. Electric Power Generation Enterprise(EPGE) operates, maintains and implementation of all the MOEP's gas turbines, combined-cycle gas turbines and power plants under Independent Power Producer (IPP) and joint venture (JV) arrangements with the private sector such as Joint Venture (JV), Build-Operate-Transfer (BOT), an Independent Power Producer (IPP) by mean of the system of Power Purchase Agreement (PPA). It also operates the countries only coal fired power plant, with a capacity of 120 MWs. Yangon City Electricity Supply Board (YESB) manage and control the supply of electricity to industrial, commercial and household consumers in Yangon division. On 1 April 2015, the YESB has been corporatized into state-owned Yangon City Electricity Supply Corporation, financially independent from MOEP. Full privatization is planned within the next 3 to 4 years. The Mandalay Electricity Supply Board has also been transformed into an independent publicly owned firm, Mandalay Electric Corporation, to cut down running costs and national budget deficit. MESC also have on grid and off grid distribution. Electric Supply Enterprise manages and controls the supply of power to the whole of the country except Yangon and Mandalay division, which comprises 17 states and regions, including grid and off-grid generation and distribution. It is also responsible for planning, implementation, and operation of off-grid mini hydropower and diesel, solar hybrid system. Yangon City Electricity Supply Corporation, Mandalay City Electricity Supply Corporation and Electric Supply Enterprise also plan, propose budget, design, implement system improvement and expansion of distribution systems.

Figure (3.7) Power Market Structure of Ministry of Electric Power



Source: MOEP, 2022

The Figure (3.7) presents the power market structure of Ministry of Electric Power. Electric Power Generation Enterprise (EPGE) generates electricity and sells to Electric Supply Enterprise (ESE), Yangon Electric Supply Cooperation (YESC) and Mandalay Electric Supply Cooperation (MESC).

3.6 Electrification Policies and Plans in Myanmar

After restructuring the Ministry of Electric Power into the Ministry of Electricity and Energy in 2016, the MOEE sets the ambitious goals for the development of the energy sector. To achieve the 100% electrification rate by 2030, the government enhances the involvement of the private sector. There are five main policies for electric power sector which include -

(1) for sufficient electricity supply throughout the country, to expand the national power grid for effective utilization of generated power from the available energy resources such as hydro, wind, solar, thermal and other alternative ones,

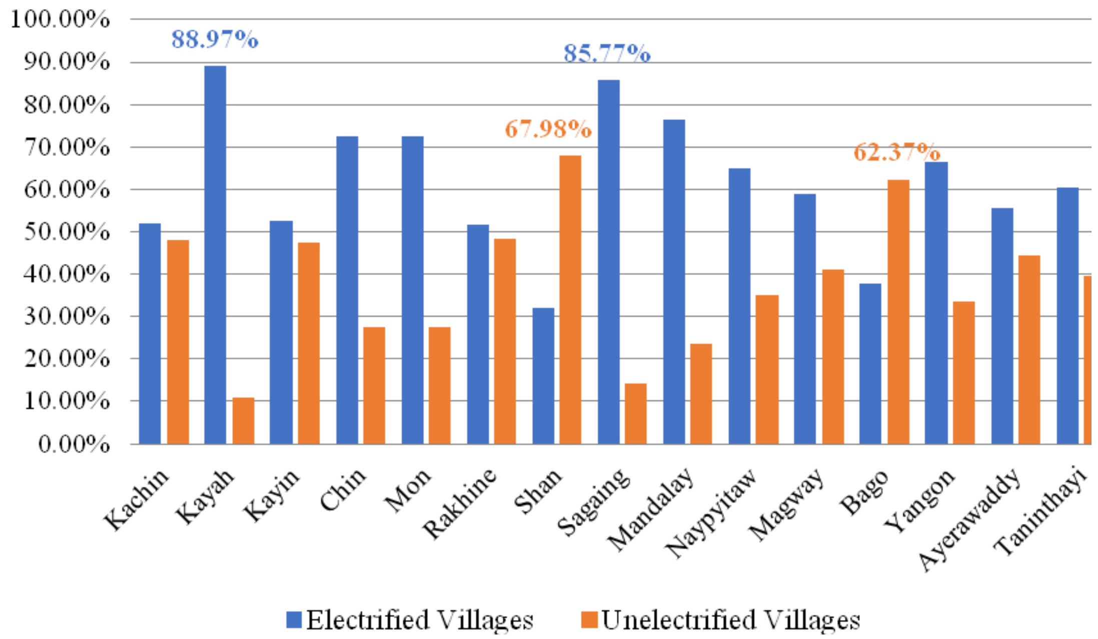
(2) to conduct the electricity generation and distribution in accordance with the advanced technologies and to uplift and enhance private participation in regional distribution activities,

(3) to conduct Environmental and Social Impact Assessments for power generation and transmission in order to minimize these impacts,
(4) to restructure the power sector with cooperation, boards, private companies, and regional organizations for more participation of local and foreign investments and formation of competitive power utilities, and
(5) to formulate the electricity acts and regulations with the assistance of the local and international experts in order to align with the open economic era (MOEE, 2016).

The Myanmar National Electrification Plan (NEP) aims to electrify 100% of Myanmar's households by 2030. The National Electrification Plan (NEP) is funded by the World Bank through a loan of US$ 400 million and implemented by the Ministry of Electricity and Energy and the Department of Rural Development under the Ministry of Agriculture, Livestock, and Irrigation (Department of Rural Development, 2014). The ultimate goal of the National Electrification Plan (NEP) is to achieve electricity in all regions in Myanmar by 2030. This plan will help to new households' connections in urban and rural areas across the country. And, the plan will assist in establishing and supporting a coordinated sector-wide institutional framework for the implementation of national electrification program, and strengthen the institutional capacity of implementing agencies, including both public and private sector active in the grid rollout and off-grid pre-electrification. The plan will also include an off-grid pre-electrification program as this can get directly benefit the poor and vulnerable households by targeting those who reside outside the realm of the power grid and are expected to receive grid-based electricity services more than 10 years after the first phase of NEP. There are four components in the National Electrification Plan which are - (1) grid extension, (2) off-grid electrification, (3) technical assistance and project management, and (4) contingent emergency response.

Currently, MOEE has implemented grid-based electrification plans through phase (1) and (2) of National Electrification Plan (NEP). According to phase (1), 14,570 villages and 343 towns had accessed to grid electricity in October, 2019 as part of the National Electrification Plan (NEP).

Figure (3.8) Percentages of Electrified and Un-electrified Villages of Rural Area in State and Region (Up to 2021-2022 FY)



Source: MOEP, 2022

Figure (3.8) shows electrified and un-electrified percentage of the rural areas of state and region in 2018-2019 FY. From this figure, the rural areas in Kayah state and Sagaing region have the higher electrification rate than other states and regions. The electrified percentage of rural area in Kayah state was 88.97% (460 villages) and 11.03% (57 villages) were left to access electricity. In Sagaing region, 85.77% (5137 villages) of rural areas were electrified whereas 852 villages were left. In Mandalay, implemented villages for electrification include 3671 villages (76.50%) out of 4799 villages. In Yangon, 1423 villages (66.40%) were implemented and 720 villages were un-electrified. On the other hand, the two highest un-electrified villages are in Shan state (67.98%) and in Bago region (62.37%).

Appendix G is presented the number of electrified households of the respective state and region from 2018-2019 FY to 2020-2021 FY. As can be seen, the highest percentage of electrified households is 99 in the Kayah state because of its land is small and the state government's budget allocation for electrification is excellent. In contrast, Taninthayi region which is only joined by off-grid electric distribution system is 37% in 2020-2021 FY because it is too far from the national grid but the government arranges new transmission line for grid extension. The percentages of electrified households in the 2020-2021 fiscal year were at 94% in

Yangon region, 75% in Mandalay region and 64% in Nay Pyi Taw. Other states and regions that are already electrified in 2020-2021 FY as presented in Appendix F. According to Electrification Master Plan, 2020 is regarded as a mid-point to reach its target of 100% electrification by 2030.

Vision of the rural area electrification is built up in line with MDG to develop rural area to improve socioeconomic life of villager and to eliminate the development gap between rural and urban areas. The primary policies of the rural electrification are to get real sustainable rural improvement. In Myanmar, present policies and institutional structure for electricity supplying is to increase off-grid system rural electrification through

1. Forming Village Electrification Committee(VEC)
2. Leading rural development committee in village & town,
3. Collect and surveying the community electricity user requirement, joining forces between government and citizen as forming the committee from the village community.
4. Assigning the budget with the parliament's decision, and
5. Joining forces with private sectors - UN agencies, INGO, NGO - to achieve the rural electrification target.

Off- grid electrification have innovative technologies for the generation of electricity from diesel generator, hybrid system, solar plant, mini- hydropower and biogas or biomass. The off – grid rural electrification system supported by Department of Rural Development includes

1. The government budget annual allotment;
2. Local or villages themselves constructed by Rural Development Bank's Loans
3. Private sector Hire Purchase system
4. Getting the international investment loan and grant;
5. Joining forces with NGO, INGOs, Donors, Private and Public Partnership and
6. Construction for Rural Electrification.

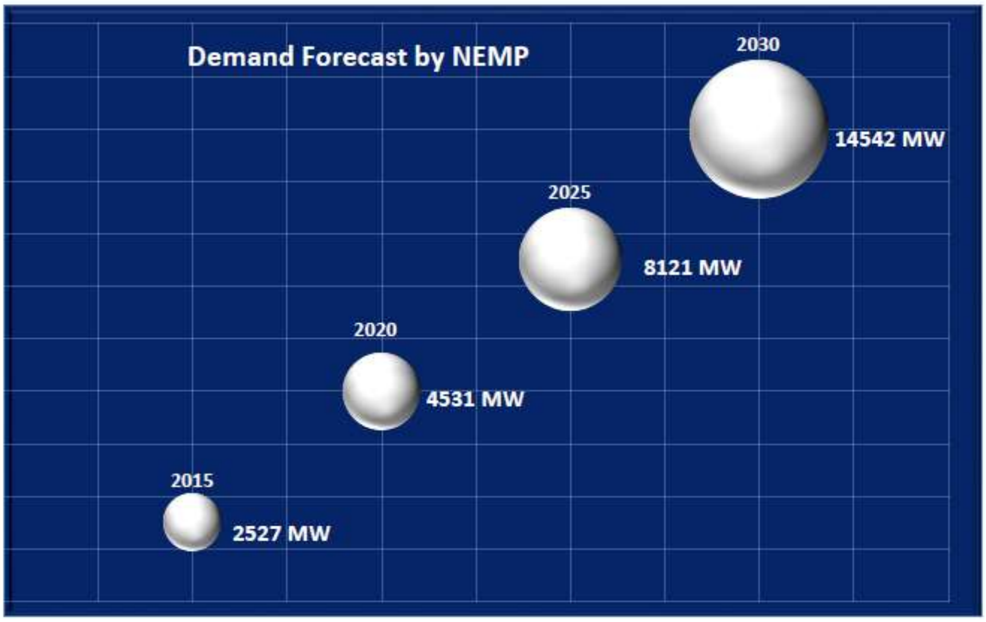
3.7 Utilization of Electricity in Myanmar

According to MOEE's statistic data, 50 % of total household have been accessed grid electricity in 2019. Rural people mainly rely on alternatives sources, often powered by diesel-powered mini-girds. In electricity utilization in Myanmar, there are four sectors: residential for household use, industrial for powering to industries, commercial for business or bulk use and others for street lighting, public use. The proportion of these contribution sectors are residential 31.50%, industrial 21.50%, commercial 12.99% and others 34.02% generally according to the nine year released information of MOEE from 2010-2011 FY to 2018-2019 FY.

In appendix H is presented the electricity utilization by each sector in the respective year. According to this table, the residential utilization was gradually increased from 2653.33 million kWh in 2010-2011 FY to 3655.18 million kWh in 2012-2013 FY. Increase in domestic consumption of electricity is due to increase in living standard of people, increase in utilization of modern electronic gadgets such as computer, refrigerators, and satellites receiver, washing machines etc., in the today modern world. But the residential usage was slightly increased from 2012-2013 FY to 2013-2014 FY. The reason is load shed which means the deliberate shutdown of electric power in a part or parts of a power-distribution system, generally to prevent the failure of the entire system when the demand strains the capacity of the system. Its volume is decreased from 4112.83 million kWh in 2014-2015 FY to 3567.15 million kWh in 2015-2016 FY. The reason is volume of sales to YESC and MESC are excluded from residential and included under others. But the residential utilization was still increased in 2019-2020 FY because of the number of electrified towns and villages by NEP.

Electricity utilization of industrial sector was not dramatic change form 2010-2011 FY to 2019-2020 FY. Although the government has implemented several industrial zones throughout the country, there is insufficient and unreliable electricity supply was one of the reasons why the industrial utilization is not too much difference. Meanwhile, commercial usage is slightly increased but it is decreased in 2015-2016 and 2016-2017 FYs because the reason is similar to described in residential usage. Other usage which means public space lighting, street lighting, utilizations of public schools, public hospitals, religious building and separate corporation was increased dramatically as shown in appendix H. The per capita consumptions (kWh) are 186.796 in 2013-2014, 218.711 in 2014-2015, 260.318 in 2015-2016 and 332.594 in 2017-2018 respectively (MOEE).

Figure (3.9) Forecasting Increased Consumption Rate by 2030



Source: MOEP, 2022

The presented Figure (3.9) shows the demand forecast by NEMP, the horizontal is Requirement quantity (MW) and Vertical is years. As a general trend, in 2015 has been 2527 MW, in 2020 has been 4531 MW therefore figure forecasted in 2025 will be 8121 MW and 2030 will be 14542 MW. According to figure the electricity demand of Myanmar is sharply increase year by year to reach 2030.

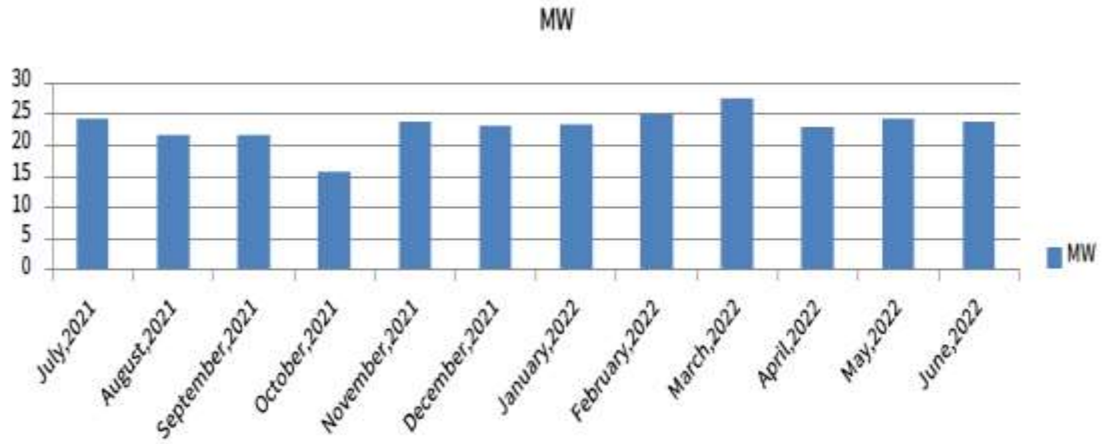
3.8 Electricity Distribution in Bago Division

Bogo division has four districts with electricity engineer office, 28 townships with 27 electricity engineer office and 24 towns with engineer office. There are total 73 transmission and distribution substations in Myanmar. Six of them are located in Bago division such as 230 kV Kamarnat, 230kV Taungoo, 230kV Tharyargone, 230kV Thaephyu, 230kV Oakshinpin and 230kV Minhla Substation. Substation Capacity and Voltage level is shown in Appendix I. Among them, Thaephyu substation is the one transmission substation to distribute electricity for Yaedashe township, Myohla, Thaephyu village.

In appendix I is shown the six substations in Bago region which capacities, voltage level and location are also included. As can be seen, except Oakshinpin substation, the voltage level of all substation in Bago region is 230/33/11 kV and Oakshinpin is 230/66/11kV voltage level. According to Capacities, Kamarnet

Substation is biggest one in Bago region, 160 MVA capacities. Tharyargone is smallest one capacity in Bago region, 30 MVA capacities Substation. Thaephyu, Oakshinpin and Minhla are 100 MVA capacities substation in Bago region. Taungoo substation is 60 MVA capacities. There have 100 MVA transformers future extension implementation in Taungoo, Tharyargone and Kamarnet. All of these 6 substations are installed capacities of Bago MVA for distribution grid.

Figure (3.10) Maximum Load of 230 kV Thaephyu Substation



Source: MOEP, 2022

As can be seen, Figure (3.10) presents the maximum load (MW) in month for a year of 230 kV Thaephyu Substation which distributed electricity to Yaedashe Township. In October, 16 MW load is minimum for 2021-2022 FY but 28 MW in March is maximum Mega Watt for 2021-2022 FY. According to the graph, Yaedashe Township demand is high in March and low in October.

Table (3.1) Electrified Town/ Village in Bago (East) Region

Sr. No.	Name of District	List	No. of Town			Un Electrified	List	No. of Village			Un Electrified	Un Electrified
			On grid	Off grid	Total			On grid	Off gird	Total		
1	Bogo	16	16	-	16	-	1454	694	173	867	587	40.37%
2	Taungoo	13	13	-	13	-	1430	838	88	926	504	35.24%
Total		**29**	**29**	**-**	**29**	**-**	**2884**	**1532**	**261**	**1793**	**1091**	**37.83%**

Source: MOEP, 2022

Table (3.1) present condition of electrification in the rural and urban areas of Bago (East) Region up to 2020-2021 FY. As is presented, the urban areas of Bago East division twenty nine towns are directly distributed by national grid based electricity. The rural areas of Bago (East) region are distributed not only on-grid but also off-grid electricity. There are 1793 villages within two districts (62.17%) are already electrified but 1091 villages (37.83%) are still needed to access electricity. Among electrified villages, 1532 villages (85.44%) are distributed by national grid, 261 villages (14.56%) are distributed from hybrid electric system such as diesel generator and solar.

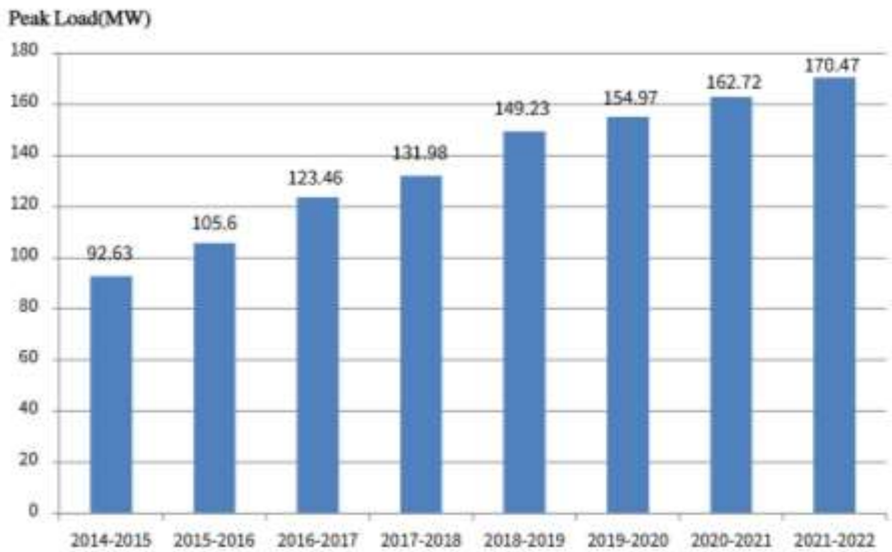
Table (3.2) List of Electrified Households in Bago (East) Region

Sr. No.	Name of District	No. of Household	Electrified Household	Unelectrified Household	Electrified Household (%)
1	Bago	425774	234159	191615	55.00%
2	Taungoo	270235	165844	104391	61.37%
Total		**696009**	**400003**	**296006**	**57.47%**

Source: MOEP, 2022

Table (3.2) shows the condition of electrified and un-electrified households in two districts such as Bogo and Taungoo. It is obvious that 696009 households within two districts but 400003 households (57.47%) are already electrified and 296006 households (42.53%) are un-electrified up to 2020-2021 FY. Taungoo district have 270235 households, 165844 households (61.37%) are electrified and others 38.63 % 104391 are not get electricity to use households.

Figure (3.11) Annually Increased Peak Load Condition in Bago (East) Region



Source: MOEP, 2022

The given Figure (3.11) presents the annually increased peak load condition in Bago (Ease) region from 2014-2015 to 2021-2022. The vertical line is shown for peak load (MW). It is clear from the graph that load is increase from 2014-2015 to 2021-2022 modestly changed 77.84 MW rose, 84 % went up. There is 14 % increased in 2014-2015 and 2015-2016, 17% increased in 2015- 2016 and 2016-2017, 7% increased in 2016-2017 and 2017-2018, 13% increased in 2017-2018 and 2018-2019, 4% increased in 2018-2019 and 2019-2020, 5% increased in 2019-2020 and 2020-2021, 5% increased in 2020-2021 and 2021-2022.

Table (3.3) Electrification Condition of Town/Villages in Bago (East) Region in the end of Financial Year 2021-2022

Sr. No.	Name of District	List	No. of Town			Un Elect rified	List	No. of Village			Un Elect rified	Un Electrified (%)
			On grid	Off grid	Total			On grid	Off grid	Total		
1	Bago	16	16	-	16	-	1454	736	173	909	545	37.48
2	Taungoo	13	13	-	13	-	1430	856	88	944	486	33.99
Total		**29**	**29**	**-**	**29**	**-**	**2884**	**1592**	**261**	**1853**	**1031**	**35.75**

Source: MOEP, 2022

The given Table (3.3), electrification condition of Town/Villages in Bago (East) Region in end of Financial Year 2021-2022 shows percentage electrification increase in the end of financial years. It is compared with table (3.1), unelectrified rate decrease to 35.75 % from present rate 37.83%. On the other hand electrified rate increased from present status 62.17 % to 64.25%.

Table (3.4) Electrified Household in Bago (East) Region in the end of Financial Year 2021-2022

Sr. No.	Name of District	No. of Household	Electrified Household	2021-2022 Electrified Household	2021-2022 Unelectrified Household	Electrified Household (%)
1	Bago	425774	234159	240785	184,989	56.55%
2	Taungoo	270235	165844	167399	102836	61.95%
Total		**696009**	**400003**	**408184**	**287825**	**58.65%**

Source: MOEP, 2022

The given Table (3.4) electrified household in Bago (East) Region in the end of financial year 2021-2022 shows electrified and unelectrified household detail. It is compared with table (3.2), unelectrified household rate came down to 41.35 % from present rate 42.53%. On the other hand electrified household rate climbed from present status 57.47 % to 58.65%.

Table (3.5) Electrification Condition for Towns/ Villages in Bago (East) Region After NEP Projects Plan Completion

Sr. No.	Name of District	List	No. of Town			Un Elect rified	List	No.of Village			Un Elect rified	Un Elect rified
			On grid	Off grid	Total			On grid	Off grid	Total		
1	Bogo	16	16	-	16	-	1454	1006	173	1179	275	18.91%
2	Taungoo	13	13	-	13	-	1430	1177	88	1265	165	11.54%
Total		**29**	**29**	**-**	**29**	**-**	**2884**	**2183**	**261**	**2444**	**440**	**15.26%**

Source: MOEP, 2022

Given Table (3.5) shows electrification status of Towns/Villages in Bago (East) region after NEP plan is completed. It is compare with table (3.3), unelectrified rate is fallen to 15.26% from 2021-2022 completion rate 37.83 %. On the other hand electrified rate is dramatically grown from 2021-2022 completion rate 64.25% to 84.74%.

Table (3.6) Households to be Electrified in Bago (East) Region After NEP Projects Plan Completion

Sr. No	Name of District	No. of Household	Electrified Household	Unelectrified Household	Electrified Household (%)
1	Bago	425774	284092	141682	66.72%
2	Taungoo	270235	208022	62213	76.98%
Total		**696009**	**492114**	**203895**	**70.71%**

Source: MOEP, 2022

The given Table (3.6) shows electrified household in Bago (East) Region after NEP projects plan completion. It is compared with table (3.4), unelectrified household rate is rapidly dropped to 29.29% from 2021-2022 completed rate 41.35%. On the other hand, electrified household rate is sharply gone up from 2021-2022 completed status 58.65% to 70.71 %.

Table (3.7) Annually Increased Peak Load Condition of Four Years in Bago (East) Region

Sr. No.	District	Annually Increased Peak Load Condition									
		2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	
		Max;	Min;	Max;	Min;	Max;	Min;	Max;	Min;	Max;	Min;
1	Bago	89.54	62.68	94.82	66.38	99.57	69.70	104.16	72.91	109.37	76.56
2	Taungoo	59.69	41.78	60.15	42.10	63.15	44.21	66.31	46.42	69.62	48.74
Total		**149.23**	**104.46**	**154.97**	**108.48**	**162.72**	**113.91**	**170.47**	**119.33**	**178.99**	**125.29**

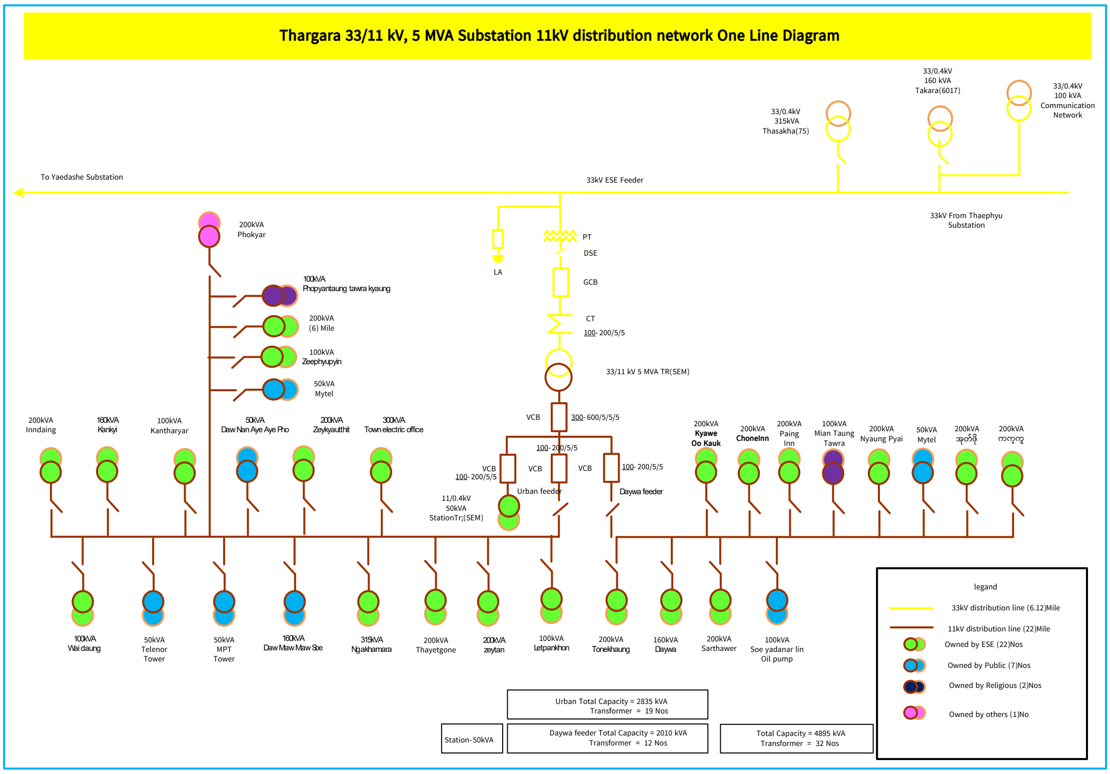
Source: MOEP, 2022

Table (3.7) is shown the maximum and minimum load condition four years of Bago (East) region. It is clear that maximum load in 2018-2019 was 149.23 MW which will be increased to future in 2022-2023, 178.99 MW. It is also increase minimum load in 2018-2019 was 104.46 MW which will be increased to future in 2022-2023, 125.29 MW.

3.9 Supply and Used of Electricity in YAEDASHE Township

The electricity that distributes to the end users in Yaedashe Township, Thargara town is received from main primary substations 230kV thaephyu. These primary substations are received the electricity from pyinmana through 230 kV Pyinmana – Thaephyu and 230 kV Taungoo – Thephyu transmission lines and then it reduced the distribution voltage level 33kV by using 230/33/11 kV step down transformers. 230 kV Thaephyu substation has ten number of main power distribution lines such as 33 kV Max Myanmar, 33 kV Thargaya (1) and (2), 33 kV Sukkudatu (1) and (2), 33 kV ESE, 33 kV Taungphila, 33 kV Pantin, 33 kV Laewai, Myit yaetin and 33 kV Air defense. These eight distribution line are redistributed with substation 33/11kV to the rural and urban areas via 11 kV power distribution lines. 33 kV Thargara (1) feeder distribution line is going to Thargara Substation 33/11kV, 5MVA. The rural areas of Yaedashe township, Thargara town are distributed from 33/11kV, 5MVA transformer by two 11 kV power distribution lines with the total distance of 22 miles while the urban areas of that are distributed from 11kV urban feeder to nineteen 11 kV power distribution transformer its total capacities is 2835 KVA. 11kV Daywa feeder is distributed to twelve 11kV distribution transformer its total capacities is 2010 KVA.

Figure (3.12) Thagaya Town Distribution Network



Source: MOEP, 2022

Table (3.8) Number of Electrified Household of Urban and Rural Areas in Yaedashe Township (From 2015 – 2016 FY to 2021 – 2022 FY)

No.	Fiscal Year	Electrified Household			
		Urban Area		Rural Area	
		Quantity	(%)	Quantity	(%)
1	2015-2016	27,678	90.87	856	44.51
2	2016-2017	1,298	4.26	197	15.31
3	2017-2018	981	3.22	70	5.44
4	2018-2019	400	1.31	50	3.88
5	2019-2020	106	0.34	30	2.33
	2021-2022		-	20	1.5
Total		**30,463**	**100**	**1,223**	**72.97**

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2022

Table (3.8) shows the numbers of electrified household in the rural areas and urban areas of Yaedashe Township from 2015 – 2016 FY to 2021 – 2022 FY. According to this table, the majority of the households (90.87%) had been electrified since 2015 – 2016 FY and all households of urban area have been electrified in 2018 – 2019 FY. In rural area, the total number of household is 1923 households by 2014 Census. Among them, 44.51% of the households had been electrified since 2015 – 2016 FY and 72.97% (1223 households) are already electrified in 2018 – 2019 FY. But 27% of the total households of the rural area (519 households) are still needed to electrify.

Table (3.9) Number of Electrified Household of Villages in Yaedashe Township (From 2017-2018 FY to 2020-2021 FY)

Name of Village	Total Number of Household	Number of Electrified Household					Electri-fication (%)
		2017-2018	2018-2019	2019-2020	2020-2021	Total	
Shone Inn	186	78	30	24	-	132	71
Kyawe Oo Kauk	255	147	59	18	3	227	89
Oak Pho	590	369	127	15	3	514	87.12
Laepyinma	256	175	43	38	-	256	100
Total	**1,287**	**769**	**259**	**95**	**6**	**1,129**	**87.72**

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2022

There are four villages in Yaedashe Township, Thargara Town are Shone Inn, Kyawe Oo Kauk, Oak Pho and Laepyinma. These villages are distributed electricity by 33 kV Thargara substation. Table (3.9) shows number of electrified household of rural area in Thargara Town, Yaedashe Township up to 2021-2022 FY. From this table, most of the household have been electrified since 2017 – 2018 FY. The number of electrified household was gradually increased. In 2020 – 2021 FY, all of the total households in Laepyinma village are already electrified. In sum up, 87.72% of total household in the rural areas (1,129 households) are accessed to electricity and only 12.28% of that (158 households) are not accessed to electricity. Among four villages, Lae Pyin Ma villages has 100% electrification, second largest electrification rate was 89% in Kyawe Oo Kauk. ShoneInn village has total number of household of 186 which is lowest population in four villages but its electrification rate was 71% and un-electrified rate was 29%. The last village, Oakpho, has electrification rate of 87.12% and un-electrified rate of 12.88%.

Table (3.10) Yearly Electricity Utilization of Urban and Rural Areas of Yaedashe Township (From 2015 to 2020)

No.	Year	Electricity Utilization in Volume (kWh)		
		Urban Areas	Rural Areas	Total
1	2015	131998	101201	233199
2	2016	136081	103267	239348
3	2017	140290	105375	245665
4	2018	144629	107526	252155
5	2019	149102	109721	258823
6	2020	153713	111961	265674
7	2021	158,467	114,246	272713

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2022

Table (3.10) presents the yearly electricity utilization of urban and rural areas in Yaedashe Township from 2015 – 2016 FY to 2020 – 2021 FY. From this table, the utilization of urban areas is dramatically higher than that of the rural areas because the rural people did not use the heavy electrical appliances and commercial usage. Both of utilization is slightly increased year by year. It can be seen that there is no dramatic change in utilization of electricity and it can be pointed out that there is no heavy industrial usage or commercial usage in urban areas. The total utilization of electricity of Yaedashe Township was 272713 kWh in 2021.

Table (3.11) Monthly Electricity Utilization of Urban and Rural Areas of Yaedashe Township in 2021

No	Month, 2021	Electricity Utilization in Volume (kWh)		
		Urban Areas	**Rural Areas**	**Total**
1	January	13,199	9,519	22,718
2	February	13,154	9,400	22,554
3	March	13,206	9,512	22,718
4	April	13,231	9,429	22,660
5	May	13,201	9,509	22,710
6	June	13,309	9,523	22,832
7	July	13,226	9,591	22,817
8	August	13,157	9,468	22,625
9	September	13,086	9,589	22,675
10	October	13,147	9,606	22,753
11	November	13,304	9,510	22,814
12	December	13,247	9,590	22,837
Total		**158,467**	**114,246**	**272,713**

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2022

Table (3.11) shows monthly electricity utilization of urban and rural areas of Yaedashe Township in 2021. Both of utilizations were generally higher in March, April, May and June than other months because these three months are hot season in Myanmar. Therefore, all of electricity users used cooling electrical appliances. But the utilization of rural areas did not gradually change and its average usage was 272,713 kWh in 2021. This was shown that the rural people did not use the heavy load electrical appliances and there was very few commercial or bulk usage of electricity in rural areas. The utilization of rural area was 22,718 kWh in March and it was slightly decreased in May (22,710 kWh) which may be higher than April. The reason is that the rural areas are occurred by load shed. Thus, its utilization volume is lower than the actual demand and it turns increased in June (22,832 kWh). Furthermore, the monthly utilization was not stable and it can be seen that the rural utilizations were 22,817 kWh in July, 22,675 kWh in September and 22,814 in November. It is meant that rural utilization was not decreased because its un-electrified households were accessed to electricity slightly. In Urbana's utilization, May was the highest utilization of electricity with the total of 13,247 kWh which was nearly doubled its least utilization in December. Its average usage was 12,448,829 kWh that can be showed that a lot of commercial and bulk utilizations are not developed in Yaedashe Township because there are residential areas in Bago. Therefore, its utilization volume is stable and varied with respect to season.

Table (3.12) Yearly Utilization of Electricity of Villages of Yaedashe Township (From 2019 to 2021)

No.	Year	Electricity Utilization in Volume (kWh)				
		ChoneInn	Kyaweookauk	Oak Pho	LaePyinma	Total
3	2019	46,700	107,358	46,742	63,058	263,858
4	2020	47,805	108,416	47,800	64,116	268,137
5	2021	48,926	109,541	48,825	65,421	272,713

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2020

The yearly utilization of electricity of each village in Yaedashe Township is shown in Table (3.12). The volume of electricity utilization of Kyaweookauk village is the highest with its total number of household of 255 which is more than the other villages ChoneInn. With the 80% electrification rate, the LaePyinma village was the second largest volume in electricity utilization from 2019 to 2021. Oak Pho village was the lowest volume of electricity utilization in accordance with the lowest electrification rate because technical problems have in generator of Oakpho village. The utilization of the villages in Yaedashe Township was not dramatic change and stable for the above mentioned five years. Thus, it can be shown that the rural people did not use the heavy commercial usage and electrical appliances.

Table (3.13) Monthly Electricity Utilization of Villages of Yaedashe Township in 2021

No	Month	Electricity Utilization in Volume (kWh)				
		ChoneInn	**Kyaweookauk**	**Oak Pho**	**LaePyinma**	**Total**
1	January	4,071	9,128	4,068	22,718	22,718
2	February	4,052	9,102	4,011	22,554	22,554
3	March	4,108	9,098	4,091	22,718	22,718
4	April	4,121	9,110	4,021	22,660	22,660
5	May	4,102	9,099	4,010	22,710	22,710
6	June	4,201	9,108	4,025	22,832	22,832
7	July	4,015	9,211	4,101	22,817	22,817
8	August	4,021	9,136	4,058	22,625	22,625
9	September	4,001	9,085	4,110	22,675	22,675
10	October	4,031	9,116	4,108	22,753	22,753
11	November	4,106	9,198	4,101	22,814	22,814
12	December	4,097	9,150	4,121	22,837	22,837
Total		**48,926**	**109,541**	**48,825**	**65,421**	**272,713**

Source: Yaedashe Township Office, Electricity Supply Enterprise, MOEP, 2022

The monthly utilization of electricity of each villages of Thargara Town, Yaedashe Township in 2021 is shown in Table (3.13). As the highest number of total household of village on grid, the utilization of electricity of Kyaweookauk was 109541 kWh which was the highest utilization of electricity in 2021 with the electrification rate of 87%. The LaePyinma was the second highest utilization of electricity in 2021 with 100% electrification rate in off grid. ChoneInn village (on grid) was the third highest utilization of electricity with the estimate of 48,926 kWh. In accordance with the lowest electrification rate, the electricity utilization of Oak Pho village was 48,825 kWh which was the lowest volume in 2021.

CHAPTER IV

ANALYSIS OF ELECTRIFICATION IN RURAL AREA

4.1 Survey Profile

In this study, the four villages in Yaedashe Township of Bago region are selected to investigate on effect of electrification in rural area. Bago region is located in the southern central part of the country. It is bordered by Magway Region to the north; Kayin State, Mon State and the Gulf of Martaban to the east; Yangon Region to the south and Ayeyarwady Region and Rakhine State to the west. It is located between 46°45'N and 19°20'N and 94°35'E and 97°10'E. It has a population of 4,867,373 (2014). According to the 2014 Myanmar Census, Buddhists make up 93.5% of Bago Region’s population, forming the largest religious community there. Minority religious communities include Christians (2.9%), Muslims (1.2%), Hindus (2.1%), and animists (0.1%) who collectively comprise the remainder of Bago Region’s population. There are 0.3% of the population listed no religion, other religions, or were otherwise not enumerated. It is composed of four districts such as Pyay, Tharyarwaddy, Bago and Taungoo.

The study was performed in the Thagaya Town, Yaedashe Township, which is located on the northern edge of the Bago region. The Bago region is the second most important production area of rice after the delta region and it is a lowland irrigated rice production region in the south- central part of Myanmar. The annual rainfall in this region is about 2513 mm with 78.5% of mean relative humidity (DAP, 2013). The Yaedashe Township is located between 95°50‘‘ to 96°30‘‘ East longitude and 19°5‘‘ to 19°30‘‘ North latitude. This region is part of the central plains ranging from South to North, and is bounded in the West by the Yoma mountain range and in the East by the Shan mountain range.

Table (4.1) Site and Survey Summary

Electricity Scheme	Village	Demographics (households)	Electrification Date	Surveys
Grid Extension	ChoneInn	186	2019	50
	Kyawe oo Kauk	255	2019	50
Off Grid (Hybrid System)	Oak Pho	590	July, 2017	50
	Lae Pyin Ma	256	July, 2017	50

Source: Survey Data, 2022

Four village tracts namely Kyawe Oo Kauk, ChoneInn, Oak Pho and Lae Pyin Ma were selected and the basic statistics of the selected village are presented in Table (4.1). Grid extension villages are Kyawe Oo Kauk and ChoneInn. Off grid (Hybrid system) villages are Oak Pho and Lae Pyin Ma. Oak Pho village got electricity in 2017 and have 590 households. Kyawe Oo Kauk village got electricity in 2019 and have 255 households.

4.1.1 Socioeconomic Characteristics of the Respondents

Socioeconomic characteristics of the respondents are social and demographic factors which include gender, age, education level, occupation, monthly income level and number of family members in each household. The socioeconomic characteristics of the respondents can be seen in Table (4.2). The thesis question was “What are the socio economics effect of electrification in rural area?”. To get the objective of the study “to analyze the effect of electrification on rural area”, by choosing the respondents with education level are minimum primary education level. In this study area, some houses have their own solar system with battery for backup electric system.

Table (4.2) Socioeconomic Characteristics of the Respondents

No.	Factors	Number of Respondents	Percentage
1	**Gender**		
	Male	154	77
	Female	46	23
	Total	**200**	**100**

Table (4.2) Socioeconomic Characteristics of the Respondents (Continued)

No.	Factors	Number of Respondents	Percentage
2	**Marital Status**		
	Single	7	3.5
	Married	193	96.5
	Total	**200**	**100**
2	**Age Distribution**		
	20 – 40	102	51.0
	41 – 60	65	32.5
	Above 61	33	16.5
	Total	**200**	**100**
3	**Education Level**		
	Primary School	64	32
	Middle School	92	46
	High School	17	8.5
	Undergraduate	0	0
	Bachelor	26	13
	Master	1	0.5
	Others	0	0
	Total	**200**	**100**
4	**Occupation**		
	Dependent	0	0
	Student	0	0
	Government Staff	9	4.5
	Company Staff	0	0
	Self – Employment	32	16
	Agriculture and livestock	157	78.5
	Fisherman	2	1
	Total	**200**	**100**

Table (4.2) Socioeconomic Characteristics of the Respondents

No.	Factors	Number of Respondents	Percentage
5	**Monthly Income**		
	≤ 100,000	42	21.0
	100,001 – 200,000	93	46.5
	200,001 – 300,000	38	19.0
	300,001 – 400,000	15	7.5
	Above 400,001	12	6.0
	Total	**200**	**100**
6	**Number of Household**		
	1 – 3	50	25
	4 – 6	120	60
	Above 6	30	15
	Total	**200**	**100**

Source: Survey Data, 2022

The given Table (4.2), it is observed that 154 of the total respondents (77%) are males and 46 of the total respondents (23%) are females. A very large majority of the respondents are the male who is more accessible to ask the survey questions because they are leader of every home in village. The age statistical distribution of primary of the respondents is between 41 and 60 which are estimated as 32.5% or 65 respondents. Combining with the number of respondents, 102 or 51% from the age group of 20 to 40 years, it can be seen as the highest number of respondents, 168 or 83.5% are less than the age of 60. It is pointed out they are able to read and respond the questionnaire and have full experiences which can be impacted on the survey results. The only 33 respondents or 16.5% are above 61 years old. The education level of the majority of the respondents is middle school level (92 respondents or 46%), followed by high school level (8.5% or 17 respondents), primary school (32% or 64 respondents), bachelor degree level (13% or 26 respondents). The only 1 respondent (0.5%) is master and there are no undergraduate and other education levels among respondents.

The most of the respondents are engaged in agriculture and livestock and this account for 157 respondents (78.5%) of the total respondents. The second largest group of respondents (32 respondents or 16%) is self-employment in other sectors which mean informal sector labor, daily workers and seasonal employment type. Each 4.5% of the respondents are working in government staff, followed by 1% of fishermen. It was found that most of the respondents in the study area relied on the agriculture and livestock sector. The monthly income of the household of the survey villages mainly comes from agriculture, agriculture related works and small family business. It is found that most of the respondents (19%) earn between kyat 200,001 and kyat 300,000 per month. Another 46% earns between kyat 100,001 and kyat 200,000 and 21% has a monthly income of less than kyat 100,000. Moreover, the 6% of the total respondents earns above kyat 400,001 and the only 7.5% earns between kyat 300,001 and kyat 400,000. For the number of household members, 120 respondents have between four and six family members which are 60% of the total respondents, 50 respondents (25%) have between one and three family members and only 30 respondents (15%) have above six family members.

4.2 Survey Design

This survey is conducted to explore the investigation on effect of electricity in the rural area of Thagaya Town, Yaedashe Township, Bago Region. There are 50 households from each village that are selected by using random sampling and the 200 respondents are collected in total. The survey is carried out in June of the year 2022 by using a survey questionnaire and face to face interview. The questionnaire includes three main parts: socioeconomic characteristics of the respondents, accessibility to electricity and utilization of electrical appliances, the effects of electrification on the agriculture sector, SMEs and job opportunities, monthly income and additional income, education, health, information and telecommunication, public services, social activities, the environment conservation and willingness to pay. The investigation on effects of electricity are analyzed by Likert Scale which is designated with 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree.

The Yaedashe Township has a tropical monsoon climate. There are three distinct seasons in Myanmar, summer season (March to April), rainy season (May to October) and the cold and dry winter season (November to February). The Yaedashe Township has an average elevation of 12 meter above sea level. In the summer period, the average temperature is 38°C at noon, but in the winter season, the average night temperature is about 15°C. The 20 years rainfall data showed a mean precipitation of

2038 mm (±395 mm), and the mean number of days with precipitation was observed to be 97 days (±11 days) in the study area. In the wet season, the highest rainfall peak can be observed in July.

The two villages of Yaedashe Township have been accessed electricity from the national grid since 2019. Electricity was distributed from 33 kV, 5MVA Thagaya substation via the two 11 kV distribution lines of 11.1 miles. The 87.72% of the total households in the rural area have accessed electricity. The utilization of electricity in rural area was slightly higher in April, May and June than other months. The rural area did not use the heavy load electrical appliance and business usage. Therefore, its utilization was not dramatically changed. Moreover, the monthly utilization volume of electricity was not stable because un-electrified households are joined electricity. And then others two villages got electricity from hybrid system electricity distribution in 2017. Therefore, the monthly utilization volume of electricity was not stable because June and July are working agriculture field for growing paddy and vegetables.

4.2.1 Sampling and Data Collection

The study was conducted with effect of electrification rural areas in Yaedashe Township. Four villages out of the many villages were purposively elected because these villages are strategically located. Based on their location, the two villages are grid connected and other two are off grid. During the selection of the four villages, the suggestions of the Township electricity distribution overall in charge, and electric field technician team leaders were acquired, but in the end data was sourced from a random survey. The two village Kyawe Oo Kauk and ChoneInn have socioeconomics improvement and raise the quality of living style in daily after they got electricity in 2019. The two villages Oak Pho and Lae Pyin Ma have developed socio economics and quality of living style in their daily life since the electric project finished in 2017. The fieldwork was conducted from June to September 2022. The Kyawe Oo Kauk village was located close to Thagaya city is regarded as head-end electricity users. The ChoneInn village was located half mine far from Kyawe Oo Kauk village therefore recorded as the middle reach Electricity users. Oak Pho and Lae Pyin Ma were situated the furthest from the Thagaya city therefore those two villages are implemented off grid such as hybrid system, solar and generator. These two villages are not possible to access national grid until 10 years later. These places are too far from Yaedashe township electric grid distribution network. Oak Pho village off grid is

20 kW (solar) + 30 kW (Diesel) (Backup System). Lae Pyin Ma village off grid is also 20 kW (solar) + 30 kW (Diesel) (Backup System).

4.2.2 Connection Status of Electricity and Utilization of Electrical Appliances

According to the survey data, access to electricity in the four village, frequency of power breakdown, application of electricity, utilization of other energy sources for lighting, household works and business prior to electrification, properties of electrical devices and their averaged running and consuming hours per day are explored.

Table (4.3) Accessibility to Electricity of the Respondents

No	Year of Electrification	Number of Respondent	Percentage
1	2017	100	50.0
2	2019	50	25.0
3	2021	48	24.0
4	2022	1	0.5
5	Not access electricity	1	0.5
Total		**200**	**100**

Source: Survey Data, 2022

The two villages have been accessed electricity since 2017 and other two are accessed electricity in 2019. Table (4.3) shows condition of join to electricity of the respondents. As can be seen, the respondents of 100 had accessed to electricity in 2017, followed by 50 respondents in 2019, 48 respondents in 2021, 1 respondents in 2022 and only 1 respondents are not used in these four villages. Off grid village is 35 miles far from Thar Ga Ya Town, it got electricity from 2017 with solar and generator system called hybrid system. One respondent is not connected to the electricity because his income very low and large family number but he have interested to connected electricity. I find that most of the respondents are happy in face and want to learn how to do business with electricity.

Table (4.4) Frequency of Electricity Blackout per Month

No	Black Out Condition	Number of Respondent	Percentage
1	Never	101	50.5
2	4 times	50	25.0
3	30 times	49	24.5
Total		**200**	**100**

Source: Survey Data, 2022

Table (4.4) shows the frequency of electricity breakdown per month in study area. As is presented, 50.5% of total respondents faced electricity never blackout per month because they got electricity from their village Solar and generator system and 25% responded that the electricity breakdown is occurred 4 times per month because they count actual distribution line fault break down times. The 24.5% of total respondents answer 30 times electricity blackout per month in the study area because it is counted the load shed times form the system operators. Load shed times is not black out condition which is off by the system operator from the grid to balance supply and demand of electricity.

Table (4.5) Monthly Electricity Bill of the Respondents

No	Monthly Bill (Kyat)	Number of Respondent	Percentage
1	< 5,000	70	35
2	5,001 – 10,000	69	34.5
3	10,001 – 15,000	14	7
4	15,001 – 20,000	23	11.5
5	> 20,001	24	12
Total		**200**	**100**

Source: Survey Data, 2022

Most of the villager used electricity for cooking and lighting. They used electricity cleverly in house therefore bill of electricity is not too much look like city customer. Table (4.5) shows the respondents' monthly expenditure on electricity. It was shown that 11.5% of the total respondents are spending between kyat 15,001 and kyat 20,000 per month on electricity. The 7% of the total respondents are spending between kyat 10,001 and kyat 15,000 and 34.5% of the total respondents are spending between kyat 5,001 and kyat 10,000 respectively. The expenditure of the 35% of respondents is below kyat 5,000 for electricity and only 12% cost above kyat 20,001. There are only 23.5 % of respondents are spend above kyat 15,000 per month for electricity because there are too little commercial usage of electricity such as welding, printing, copier, wood machine, rice and oil mill and they use electricity for lighting and entertainment. Moreover, they don't have too many electrical appliances in the study area.

4.3 Survey Results

In this section, the effects of electrification on rural community of Yaedashe Township are examined by the factors of agriculture sector, micro, small and medium enterprise and job opportunity, monthly income, education, health, information and telecommunication, public service, social activities, safety and convenience, and living standard. A study finds that socio economic development in education, health, public service, social activities, living standard, rural development and agricultural productivity because of it got electricity in their village. Most of the respondents are very interesting in new vocational training, technology and high education. The trustees of respondents are electricity will drive the opportunity of their new generation with new technologies.

4.3.1 Economic Effects of Electrification

The economic effects of electrification on agriculture sector such as product increasing, industrial development in farming, motor application in pumping water in paddy field and micro, small and medium enterprises (MSMEs) such as welding, rice machine, wood mill, sewing, peace oil mill, monthly income with new job and cost saving of using electricity are presented in this section.

4.3.1.1 Effects of Electrification on Agriculture Sector

Myanmar's economy is based on agriculture therefore agriculture development is very important for Myanmar economy development. The effects of electrification on agriculture sector are seen in Table (4.6). There are three sub question asked for study with agriculture. The occupations of the respondent are Agriculture and Livestock so the agriculture development with electrification is very important. A study asked the questing one by one deeply the question with research assistant.

Table (4.6) Economic Effect on Agriculture Sector

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Productivity per acre is raised by using electricity.	1	0.5	10	41.5	47
Farming modifies – Industrial development in farming is increased after village has been connected with electricity.	0	0	2	28.5	69.5
Motor are more used for mill and water pumping after village has been connected with electricity.	0	0	3	21.5	75.5

Source: Survey Data, 2022

Table (4.6) presents the survey data effects of electrification on agriculture sector of the study area. There are 47% of the respondents strongly agreed increased productivity per acre while 41.5% of the respondents agreed increased in their production after electrification. The respondents are answer the question strongly agreed and agreed in agriculture production increased because the modern firming instrument and effective growing technology are used after they got electricity in village. And then, 10% of the respondents neither agreed nor disagreed because they didn’t work in the agriculture sector, on the other hand, only 0.5% of the respondent is disagreed and 1 % of respondents are strongly disagreed in this proposed statement. Among the respondents, 69.5% is strongly agreed that modern farm machines such as electric planting machine, electric blower and dryer can be used and it results time and labor saving due to electrification. Moreover, 28.5% of the respondents agreed this statement. It was found that 75.5% of the respondents are strongly agreed that electric irrigation pump is used for water supply through irrigation or pumping underground water. In contrast, 21.5 % of the respondents agree that they use electric irrigation pump to get water from the underground well for their plantation usage. Therefore, it can be concluded that access to electricity in the study area supports farm mechanization. Consequently, it results time and labor saving, and increases productivity per acre. The farmers use electric harvest dryer and blower machine that save time, manpower and increase productivity. If the farmers use the manpower to dry the fish, paddy bean and crops, it will take two or three days with respect to the weather condition. But if the electric harvest dryer machine and blower is used, it will take one day and save time and labor charges. Thus, electrification increases the productivity per acre. The rural people access the water for plantation usage via electric motor and the agricultural usage is accessed by irrigation system of the dam. Electric blower is also remove dust from paddy, pea, peanut and crops.

4.3.1.2 Effects of Electrification on Micro, Small and Medium Enterprises (MSMEs) and Job Opportunity

The effects of electrification on Micro, Small and Medium Enterprises (MSMEs) and job Opportunity can be seen in Table (4.7). Producing import substitute goods at home will improve businesses at home and abroad. Agriculture and livestock products and raw natural resources must be efficiently utilized Local raw materials must be utilized in the manufacturing process. As the strength of the nation lies within, encouragement must be given to local manufacturing based on agriculture and livestock farms to develop socio-economic life.

Table (4.7) Economic Effect on SMEs and Job Opportunities

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Developed of Small industry in the village is occurred after village has been connected with electricity.	0	0	3.5	22	74.5
Productivity of industry is raised by electricity application.	0	0	2	28	69
Electrification is created job in village.	0	0.5	1	30	68.5

Source: Survey Data, 2022

Table (4.7) explores the effects of electrification on micro, small and medium enterprises (MSMEs) and job opportunity in the selective four villages. It was shown that 7% of the respondents are neutral and 74.50% of the respondents strongly agreed, the extension of MSMEs such as shop, rice mill, peanut, sunflower and sesame oil mill in the villages after electrification. The productivity of the MSMEs is increased by 69% answer strongly agreed after electrification because there is used new technique for agriculture firming. The 4% are not agree or not disagree that electrification is increased the productivity of home business and there is a little respondents with the estimate of 28% who agreed the increased productivity because the shops and sewing can be extended the operating hours at night. Meanwhile, 68% of the respondents strongly agreed that electrification can be created new job opportunities in the villages and followed by 1% of neutral and 1% of disagreed. There are 30 % of respondent got opportunities from electricity directly investment in mill, ice creams maker, noodle maker and others machine. On the other hand, 70 percent of respondent was found their environment development MSME with electricity.

Therefore, it can be concluded that electrification can enhanced SME such as small medium enterprises in the villages except the micro enterprises. It helps to grow home business which mostly employs family labors and extends working hours. Consequently, the productivity of home business is increased due to the extended working hours at night. And it can be generated new job opportunities in the villages. The barriers for SME are poor management, corruption, regulation, security risks, lack of skilled workers, and lack of reliable infrastructure. These barriers can be passed with localized to specific geographies or crop value chains in village with electricity.

4.3.1.3 Effects of Electrification on Monthly Incomes and Additional Incomes

The effects of electrification on monthly incomes and additional incomes can be seen in Table (4.8). There have many activities in rural area for income increasing such as food drying, agriculture production, animal production, welding, sewing, printing and copying the inviting letter.

Table (4.8) Effects of Electrification on Monthly Incomes and Additional Incomes

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Daily income is increased by electricity application.	0	0.5	2	34.5	63
Huge income is gained by electrification.	0	0	1	42	57

Source: Survey Data, 2022

As shown in Table (4.8), most of the respondent (4%) answered neutral on increment in monthly income after electrification. The 63% of the respondents strongly agreed that access to electricity increased their monthly income. It is followed by 0.5% of disagree, 34.5% of agree and no one answer of strongly disagree. Moreover, access to electricity can support huge income of the rural people which is estimated of 57% of the respondents is strongly agreed. The 1% of the respondents is neutral on it. There are 42% respondents that agreed on the increased additional income due to electrification because sewing, selling soft drinks and ice – cream, and retailed business are operated after dark. Villages have more job opportunities therefore they got more income before they got electricity. Thus, it can be concluded that getting electricity in the study area is not changed the monthly and additional income of the rural people because most of them work in the agricultural sector, informal sector and some are government and company staffs.

4.3.1.4 Effects of Electrification on Cost Saving of Using Electricity

The effects of electrification on cost saving of using energy can be seen in Table (4.9). Electric power energy is more efficient than other energy such as wood for heating, candle for lighting, diesel generator for generating electricity. Therefore, electricity energy is more efficient energy.

Table (4.9) Effects of Electrification on Cost of Using Energy

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Electricity energy is more efficient and cost effective than other energy in housing and business activities.	0	0	2.5	17	80.5

Source: Survey data, 2022

According to the Table (4.9), 80.5% of the respondents strongly agreed on cost saving of using electricity rather than using of other energy sources. The 17% of the respondents also agreed on it and 5% are neutral it because rate of unit price is higher than the previous. There are no respondents who is strongly disagreed this proposed statement. It can be proved that a 4" lighting lamp with 40 Watt is operated for lighting with 6 hours per day. Its daily operating unit is 240 Watt hour (Wh) and its monthly operating unit is 7,200 Watt hour (Wh) (7.2 kWh). It is charged only kyat 252 per month for a 4" lighting lamp. A candle is burned 2.5 hours at the atmospheric static condition. Its price is kyat 200 and its monthly cost is kyat 6,000. For industrial business activities, the generator produces 35.8 MJ per liter of diesel (Martein, 2017). Energy is measured in joules (J) and one watt is equal to one joule per second. Therefore, 1kWh is the same as 1,000W x 3,600s = 3,600,000J. In other words, there are 3.6 mega-joules per kWh, or 3.6MJ/kWh. A liter of diesel which is charged kyat two thousand seven hundred, can be produced 9.9 kWh because 3.6 MJ is equal to 1kwh. Therefore, electricity which is used for household works or industrial business is more cost saving than other sources of energy such as diesel generator, natural gas, biomass and charcoal. Furthermore, generator or other machines which are used other energy sources are more charged in operation and maintenance cost.

4.3.2 Social Effects of Electrification

The social effects of electrification on education, health, information and telecommunication, living standard and environmental conservation are included in this section. To study the effect of electricity in social I asked question to respondents with research assistant one by one. All respondent promised me to answer my question as they field with getting electricity in their village.

4.3.2.1 Effects of Electrification on Education

The effects of electrification on education are shown in Table (4.10). The educational system of Myanmar is operated by the government Ministry of Education. Oak Pho village have one basic education high school.

Table (4.10) Social Effect on Education

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
After village has been connected with electricity, the students receive educational improvement by online learning.	0	0	0.5	44	55.5
After village has been connected with electricity, the students receive more knowledge and information by reading electronics book or watching TV.	0	0	0.50	40.5	59
After village has been connected with electricity, the educational quality of school is improved by using computer.	0	64	0	8.5	27.5
After village has been connected with electricity, the students of distance university receive educational achievement by learning via TV or internet.	5.5	36	12.5	22.5	23.5
Electrification leads the knowledge improvement of teachers in school of village.	0	12.5	38	17.5	32.0

Source: Survey Data, 2022

According to the Table (4.10), there are 55.5% of the respondents strongly agreed that the students in the villages have been achieved educational improvement after electrification and 44% also agreed that statement because the students extend the studying time after dark. Moreover, most of the respondents with the estimate of 99.5% believed the young people get more general knowledge by reading newspaper, magazines and journals and watching TV after electrification. In addition, 27.5% of the respondents agreed and 64% of the respondents disagreed on improvement of educational quality by using electrical teaching equipment whereas only 8.5% agreed there is an improvement in school's facilities such as the installation of fluorescent in the classrooms.

For distance students in the villages, educational achievement is received by learning via TV or internet. It is shown that 22.5% of the respondents agreed, 12.50% are neutral on it and 23.5% is strongly agreed among them who are master of 1 and bachelor degree holder of 26 strongly agreed on the educational achievement of the students of Distance University after electrification. There are 36% respondents who somewhat disagree and 5.5 % is strongly disagreed. Furthermore, 32% of the respondents agreed that access to electricity leads to the attraction and retention of teachers at the school. The 17.5% also strongly agreed on it but only 12.5% of the respondents disagreed it because the teachers live not far from the study area. It can be concluded that electrification is not only improved education quality of the basic students and distance students but also getting more general knowledge by reading book or Watching TV at night. But it cannot be supported the improvement of quality of school because there is only one primary school in the study area and there has no teaching assistance equipment like TV, media room and computer in the school.

4.3.2.2 Effects of Electrification on Health

The effects of electrification on health in the study area are shown in Table (4.11).

Table (4.11) Social Effect on Health

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
After village has been connected with electricity, health care awareness service is more developed.	0	0	1	46	53
After village has been connected with electricity, the rural people receive health knowledge through internet or social media.	0	0	0.5	35.5	64
After village has been connected with electricity, health electrical equipment is more used in clinics.	0	41	10	22	27
After village has been connected with electricity, disease which is caused by indoor air pollution is reduced.	0	2.5	1.5	36	60
After village has been connected with electricity, disease like diarrhea is reduced by access to clean water.	0	0	11	43	46

Source: Survey Data, 2022

From the above Table (4.11), the majority of the respondents experience improvement of health care service in the villages after electrification because they can go to the clinic and receive the medical treatment any time. In detail, there are 64% of the respondents who have the perception of agree in the improvement of health care service of rural clinic. There are no respondents for strongly disagree and somewhat disagree of that statement. Moreover, 86% of the respondents get health related knowledge via TV or social media after electrification. Most of the respondents with 41% is disagreed the health related electrical equipment is more used in rural clinic after electrification and 20% who have the perception of neutral. And also, 1.5% of the respondents are neutral on reduction of respiratory disease by indoor air pollution. However, 36% agreed on it because most of rural people use electric stove rather than traditional biomass which causes indoor air pollution. The 46% of the respondents strongly agreed that disease like diarrhea is reduced by access to clean water after electrification and 43% is also agreed it. Therefore, it can be concluded that electrification affects the improvement of health care service of village's clinic. As the high level of ownership of TV and its average operating time of 5.8 hours per day, it helps to receive health knowledge and improve their health indirectly. And access to clean water supports the health improvement of the rural people. However, the clinic in the village is still needed the health related electrical equipment for advanced services.

4.3.2.3 Effects of Electrification on Information and Telecommunication

The effects of electrification on getting informative news and improvement of telecommunication on the rural community can be seen in Table (4.12)

Table (4.12) Social Effect on Information and Telecommunication

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	**Disagree (%)**	**Neutral (%)**	**Agree (%)**	**Strongly Agree (%)**
After village has been connected with electricity, the informative news is received through internet or social media in time.	0	0	0	43.5	56.5
After village has been connected with electricity, the information and telecommunication technology is more developed.	0	0	0	43	57

Source: Survey data, 2022

From the Table (4.12), 56.5% of the respondents strongly agreed that the informative news can be received through TV, radio and social media with respect to time after electrification. And then, 57% of the respondents strongly agreed that telecommunication systems in the villages are improved after electrification. Thus, the electrification supports indirectly the improvement of getting informative news with respect to time and telecommunication sector in the rural area.

4.3.2.4 Effects of Electrification on Public Service, Social Activities, Safety and Convenience, and Living Standard

The effects of electrification on public services, social activities, safety and convenience, and living standard of the rural area can be seen in Table (4.13). The public services include health care, evening or night classes (education), public transportation, postal service, public administration and emergency services are operated after dark by electricity.

Table (4.13) Social Effect on Public Services, Social Activities, Safety and Convenience, Rural Development

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
After village has been connected with electricity, public services in the village are more developed.	0	0	1	45.5	53.5
After village has been connected with electricity, social activities are more performed any time.	0	0	0.5	45	54.5
After village has been connected with electricity, the rural people feel more safety and clean air.	0	0	0.5	33	66.5
After village has been connected with electricity, the village is not much different from urban.	0	0	0.5	43	56.5
After village has been connected with electricity, the living standard of village is high.	0	0	0.5	39	60.5

Source: Survey Data, 2022

According to the Table (4.13), each 53.5% of the total respondents strongly agreed and 45.5% is agreed that the public services in the villages are improved after electrification respectively. Similarly, all of the respondents feel that they can be more cooperated and included in the social activities such as the activities of the sake of the others, leisure and entertainment activities in day time and after dark. Also, they can motivate other people to participate the activities by microphone and loud speaker. Moreover, 66.5% of the respondents feel that they are more safe and convenience after electrification because street lighting is opened after dark. Thus, they can go somewhere in the village any time. After electrification, 56.5% of the respondents strongly agreed that the villages are more developed than the previous while 43% agreed that statement. Consequently, all of the respondents express that the living standard of the rural people is higher than the previous. Although the electrification cannot be created the job opportunities in the villages, rural to urban migration is reduced because the villages have the advantages of proximity to Yaedashe Township. Most of the rural people are worked in agricultural sector and informal sector. For this statement, 2.5% of the respondents agreed on it and 88% are neutral about it. Therefore, it can be observed that electrification supports the social welfare, living standard of the rural people, quality of life but has not changed on rural – urban migration.

4.3.2.5 Effect of Electrification on Environmental Conservation

The effect of electrification on environmental conservation can be seen in Table (4.14).

Table (4.14) Social Effect on Environmental Conservation

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Electricity reduces the environmental degradation by without using traditional energy sources.	0	0	0	14.5	85.5

Source: Survey data, 2022

According to the Table (4.14), 85.5% of the respondents strongly agreed that environmental degradation is reduced by electrification because the majority of rural people used wood as the main source of energy for their daily routine process before electrification. But no one is neutral disagreed about it. There are 14.5% is agreed on it.

4.3.2.6 Willingness to Pay for Using Electricity

Electricity service means the service by MOEP for bill collecting, maintenance, getting and controlling distribution grid. Myanmar is low income therefore electricity billing is also need to balance with income rate. For industrial growth, it is required to increase industrial using electricity in rural area.

Table (4.15) Willingness to Pay for Using Electricity

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Satisfied on bill charges.	0	0	0	46	54
Satisfied on electricity Services.	0	0	3.5	43.5	53

Source: Survey Data, 2022

According to the Table (4.15), 54% of respondents are strongly agreed and 46% of respondents are agreed on bill charges for using electricity. The electric bill is not too much if they compared with their monthly income. They want to pay bill to government for using electricity with efficient energy. There are 53% of respondents are strongly agreed and 43.5 % of respondents are agreed on electricity services. Electric technician form MOEP come urgently when they called for service of their home electric appliances. Maintenance time is also not too much long hours.

4.3.2.7 Comparing the On Grid and Off Grid Electricity Supply System

On grid is grid extension power and off grid is hybrid or solar home system for electric distribution. On grid is implemented by MOEP and off grid is implemented by DRD.

Table (4.16) Comparing the Electrification On Grid and Off Grid

Statement	Number of Respondent in Percentage				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
On grid is better than off grid.	0	0	1.5	11.5	87

Source: Survey Data, 2022

According to the Table (4.16), 87% of respondents are strongly agreed and 11.5% of respondents are agreed on grid is better than off grid. In Off grid system, generation is limited with capacities therefore it is not possible to use large load such as rice, paddy and wood mill. On grid is extension from grid, this is connected to many generator such as hydro, gas turbine, thermal and others therefore it can be used peanut, paddy, wood and rice mills in village.

4.3.3 Summary of Effects of Electrification on Rural Community

In order to explore which factors or sectors can be more impacted on rural community by rural electrification, the summary of effects of electrification on rural community is presented in Table (4.17).

Table (4.17) Summary of Effects of Electrification on Rural Community

No	Effect	Mean	Standard Deviation
1	Economic Effect on Agriculture Sector	4.58	0.59
2	Economic Effect on SMEs	4.68	0.52
3	Effect of electrification on monthly and additional income	4.58	0.54
4	Effect of electrification on cost saving	4.78	0.47
5	Social Effect on Education	3.81	0.945
6	Social Effect on Health	4.28	0.7208
7	Social Effect on Information and Telecommunication	4.65	0.46
8	Social Effect on Public Services, Social Activities, Safety and Convenience, Rural Development	4.576	0.5048
9	Social Effect on Environmental Conservation	4.85	0.353
10	Willingness to pay in electricity	4.52	0.5335

Source: Survey Data, 2022

As shown in Table (4.17), the rural electrification is more supported in the development of getting information and telecommunication in the rural area with mean value of 4.65. With the mean value of 4.85, the electrification causes the environmental conservation rather than using other energy sources such as wood and charcoal for daily routine process. The public service, social activities, living standard and development of the rural area are more improved after electrification because its mean value is 4.576. Moreover, the electrification is more cost saving for rural people rather than other energy. The educational achievement and health care services in the rural area are more improved by electrification with the mean value of 3.81 and 4.28 respectively. In the economic effects of electrification, only agriculture sector is improved by electrification as the mean value of 4.58 while MSMEs and job opportunities, monthly and additional income are not obvious with electrification because their mean values are 4.68 and 4.68 respectively. Therefore, it can be concluded that the electrification is more obvious on the social benefits of the rural community but it is not obvious on economic benefit except the agriculture sector.

In conclusion, these study areas have improvement with electricity application. Wisconsin Quality of Life Index (W-QLI) model have 9 dimensions for measurement of Quality of Life. There are life satisfaction, occupational activities, psychological well-being, physical health, social relations, economics, and activities of daily living, symptoms and patient's own goals. Therefore, the quality of life in this study area improves after getting electricity.

CHAPTER V
CONCLUSION

5.1 Findings

The survey area is conducted on 200 households in four villages of Yaedashe Township. According to the survey results, the age of 102 or 51% of the total respondents are between 20 and 40 years. Most of the respondents are middle school in education level and second is primary school. It can be found out that most of respondents are able to read and answer the survey. And then, 78% of the total respondents are working in agriculture and livestock sector and the second largest group (16%) is self employment, including daily workers and seasonal employment.

There are 88.5% of the respondents agreed that the agricultural productivity per acre is increased by electrification and 69.50% of the respondents strongly agreed that the modernized farm machines are used in agriculture field. Among them, 78.5% are worked in agriculture sector. On other hand, off grid electricity distribution system is intended for the lighting and other small electric appliances use therefore electrification is also improvement their living style than before they joined electricity, development is limited by electricity generation. But the electricity generation is clean and sustainable for their village mostly depend on solar system.

In the effects of electrification on Small Medium Enterprise, electrification can be enhanced SME in the villages more than the home business shops. Electrification supports to develop from home business to industrial improvement of country which mostly employs villager and family members and extends working hours. Consequently, it increased the manufacturing of home industrial business. In contrast, 68.5% strongly agree, it can be created job opportunities in the villages after electrification. In addition, 97.5% of the respondents believed that access to electricity can be increased their daily income. Similarly, 99% of the respondents also believed that it can be supported additional income for the rural people. Thus, it can be concluded that getting electricity in the study region is not changed the improvement health related electrical equipments is more used in village because most of the rural clinic is not used modern medical equipments.

From the survey results, the students in the villages achieve educational improvement and the young people get more knowledge and information by using online learning. On the other hand, 64% of the respondents disagreed that there is improvement in educational quality of school by using electrical teaching assistance appliances such as computer and notepad. The education levels of the 21.5% (43 respondents) of them are bachelor degree holders, undergraduate and high school. There is an improvement in school's facilities such as the fan and installation of fluorescent in the classrooms. The most of the respondents believed that the educational improvement of the distance students in the villages is disagree 36%, whereas 46% of the respondents think the students are easy to access education through internet, Online TV, internet social media after electrification. The 49.5% of the respondents agreed and strongly agreed that electrification can improve the quality and knowledge of the teaching.

Electrification in the rural area results both directly and indirectly on socio economic benefits after they joined electricity. According to the analysis results, the overall mean values of economic effect on agriculture, economics effect on SME, cost saving, willingness to pay, improvement of information and telecommunication sector, public service, social welfare and rural development, and environmental conservation are more than 4.4. Other is larger than 3.6; in contrast, social effect on health is larger than social effect on education, and the overall mean value of social effect on education is 3.81. Therefore, the result showed that the rural area has still limitations to access the education benefit after electrification although social and economic benefits are gained.

5.2 Recommendations

For economic development of Myanmar with all comprehensive development, rural development is critical point as a vital role and the living standard of the citizen is also needed to be high. For the sustainable development in the rural area, utilization of modern energy is very important. Therefore, the government should motivate the rural citizen to use electricity for upgrading their living style, economic and social development. Moreover, the governments also need to change the organization structuring of electricity distribution office for easy to get energy meter of citizen little functional process.

Government through relevant organization should arrange the vocational training center at the rural region for primary and secondary education level villager. Most of the villagers are very intelligence and active for studying new technology for their development of life. Government should make policies for upgrading the development of human resources development of rural region. Therefore, the successful innovative economy development in the rural area will be changed with respect to the aim of NEP project. And then, the union government should initiate the strategies for development of SME with loan for the rural people with the help of technologies and skill training with the relevant departments or non government organizations. For industrial development over the country, the government through the relevant departments should call for the investment in small industry based on the local rural region opportunities to innovate the job capabilities after electrification.

In conclusion, the electrification in rural area creates more in economic and social growth in the local region by the study. Technology capability, business process capability, information and knowledge capability and organization capability are improvement in rural region. Human resource development is very important for the sustainable regional development such human skills, technical skills, conceptual skills in twenty first century. The students and teacher in the rural region are needed to supply more modern teaching methods and teaching assistance equipment such as computer and notepad. The government should arrange to support the new technology teaching equipment like projector, computer, notepad, multi-media room, and television and internet access to get the educational development in the rural area in accordance with electrification programs. Similarly, the electronics medical instrument for health care services in the villages is still needed to support. Therefore, the rural infrastructure development with electricity is very important for the government because they need to fulfill the tangible accessories and intangible infrastructures improvement in the rural region to get the sustainable development.

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APPENDIX - I

Questionnaires for Respondents

Effect of Electrification in Rural Area

This survey questionnaire which is part of the research for the Master of Public Administration is designed for effect of electrification in Rural Area (Case Study: Villages in Yaedashe Township, Bago Region). You are kindly requested to spare a few minutes and fill these questions. Your feedback is very important for the survey. Thank you very much for your cooperation.

Section (A)

Demographic Characteristics

Please fill the space provided and tick (✓) the relevant box.

1. Gender ☐ Male ☐ Female
2. Age -------------------
3. Marriage Status
   - ☐ Married
   - ☐ Single
4. Education Level
   - ☐ Primary School
   - ☐ Middle School
   - ☐ High School
   - ☐ Undergraduate
   - ☐ Bachelor Degree
   - ☐ Master Degree
   - ☐ Others
5. Occupation
   - ☐ Dependent
   - ☐ Student
   - ☐ Government Staff
   - ☐ Company Staff
   - ☐ Self-Employment
   - ☐ Agriculture and Livestock
6. Monthly Income ------------------------
7. Number of Household ------------------------

Section (B)

Accessibility to Electricity, Utilization of Electricity and Electrical Appliances

1. Does your house access to electricity?

☐ Yes ☐ No

2. When was your house accessed to electricity?

----

3. Frequency of electricity blackout per month

☐ Never ☐ Once

☐ Rarely ☐ Frequently

3. Monthly Electricity Bill ------------------------

4. Sources of Energy for Lighting before electrification

☐ Candle ☐ Generator

☐ Battery ☐ Biomass

☐ Solar Home System ☐ Others

5. Sources of Energy for Household Works/ Business before electrification

☐ Generator ☐ Biomass

☐ Battery ☐ Charcoal/Wood

☐ Solar ☐ Others

Do you have the following electrical devices in your house, please tick (✓) in the column before, after and fill its average daily usage time.

No	Type of Electrical Appliance	Possess		Average daily usage time
		Before	After	
1	Television			
2	Rice Cooker			
3	Induction Cooker/ Electric Stove			
4	Refrigerator			
5	Fan/Air cooler			
6	Air conditioner			

No	Type of Electrical Appliance	Possess		Average daily usage time
		Before	After	
7	Washing Machine			
8	Iron			
9	Water Pump/ Motor			
10	Others			

Section (C)

Please tick (√) the one that matches with your situation.

(1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)

No	Description	1	2	3	4	5
Economic Effect on Agriculture Sector						
1	Productivity per acre is raised by using electricity.					
2	Farming modifies – Industrial development in farming is increased after village has been connected with electricity.					
3	Motor are more used for mill and water pumping after village has been connected with electricity.					
Economic Effect on SMEs and Job Opportunities						
4	Developed of Small industry in the village is occurred after village has been connected with electricity.					
5	Productivity of industry is raised by electricity application.					
6	Electrification is created job in village.					
7	Daily income is increased by electricity application.					
8	Huge income is gained by electrification.					
9	Electricity energy is more efficient and cost effective than other energy in housing and business activities.					

No	Description	1	2	3	4	5
Social Effect on Education						
10	After village has been connected with electricity, the students receive educational improvement by online learning.					
11	After village has been connected with electricity, the students receive more knowledge and information by reading electronics book or watching TV.					
12	After village has been connected with electricity, the educational quality of school is improved by using computer.					
13	After village has been connected with electricity, the students of distance university receive educational achievement by learning via TV or internet.					
14	Electrification leads the knowledge improvement of teachers in school of village.					
Social Effect on Health						
15	After village has been connected with electricity, health care awareness service is more developed.					
16	After village has been connected with electricity, the rural people receive health knowledge through internet or social media.					
17	After village has been connected with electricity, health electrical equipment is more used in clinics.					
18	After village has been connected with electricity, disease which is caused by indoor air pollution is reduced.					
19	After village has been connected with electricity, disease like diarrhea is reduced by access to clean water.					

No	Description	1	2	3	4	5
Social Effect on Information and Telecommunication						
20	After village has been connected with electricity, the informative news is received through internet or social media in time.					
21	After village has been connected with electricity, the information and telecommunication technology is more developed.					
Social Effect on Public Services, Social Activities, Safety and Convenience, Rural Development						
22	After village has been connected with electricity, public services in the village are more developed.					
23	After village has been connected with electricity, social activities are more performed any time.					
24	After village has been connected with electricity, the rural people feel more safety and clean air.					
25	After village has been connected with electricity, the village is not much different from urban.					
26	After village has been connected with electricity, the living standard of village is high.					
27	After village has been connected with electricity, migration is decreased.					
Social Effect on Environmental Conservation						
28	Electricity reduces the environmental degradation by without using traditional energy sources.					
Willingness to pay for using electricity						
29	Satisfied on bill charges.					
30	Satisfied on electricity Services.					
Compare electricity on grid and off grid						
31	On grid is better than off grid.					
32	Off grid is better than off grid					

Thank You for Your Participation!

APPENDIX – II

Survey Data Collection in Oak Pho Village

Appendix A

Hydropower Plants' Location and Installed Capacity (MW) in 2022

Sr. No.	Hydropower Plants	Location	Installed Capacity (MW)
Government			
1	Baluchaung (2)	Kayar	168
2	Kinda	Mandalay	56
3	Sedawgyi	Mandalay	25
4	Baluchaung (1)	Kayar	28
5	Zawgyi (1)	Shan	18
6	Zawgyi (2)	Shan	12
7	Zaungtu	Bago	20
8	Thapanzeik	Sagiang	30
9	Mone Chaung	Magway	75
10	Paunglaung	Naypyitaw	280
11	Yenwe	Bago	25
12	Kabaung	Bago	30
13	Kengtawng	Shan	54
14	Shwegyin	Bago	75
15	Yeywa	Mandalay	790
16	Kyeeon Kyeewa	Magway	74
17	Kun Chaung	Bago	60
18	Nancho	Naypyitaw	40
19	Phyu Chaung	Bago	40
20	Upper Paunglaung	Naypyitaw	140
21	Myogyi	Shan	30
22	Mitthar	Magway	40
23	Yazajo	Sagaing	4
IPP			
24	Thauk Ye Khat (2)	Bago	120
25	Baluchaung (3)	Kayar	52
JV			
26	Shweli (1)	Shan	600
27	Dapein (1)	Kachin	240
28	Chipwinge	Kachin	99
Total Installed Capacity			**3225**

Source: Current Situation and Development 2022, MOEP

Appendix B

Thermal Power Plants' Location and Installed Capacity (MW) (2022)

Sr. No.	Power Plant Name	Location	Installed Capacity (MW)
Government			
1	Kyunchaung GT	Magway	54.3
2	Myanaung GT	Ayarwaddy	34.7
3	Mann GT	Magway	36.9
4	Shwetaung GT	Bago	55.35
5	Tharkayta GTCC	Yangon	92.0
6	Ahlone GTCC	Yangon	154.2
7	Hlawga GTCC	Yangon	154
8	Thaton GT	Mon	50.95
9	Ywama GT	Yangon	36.9
	Ywama NEDO		33.4
	EGAT GT		240
10	Thilawa	Yangon	50
IPP			
11	Ahlone Toyo Thai GTCC	Yangon	121
12	Hlawga Zeya (MCP)	Yangon	54.25
13	UPP (Ywama)	Yangon	52
14	Tharkayta Max Power	Yangon	53.584
15	Myanmar Lightning GTCC	Mon	230
16	Myingyan (Sembcorp)	Mandalay	225
17	Tharkayta UREC	Yangon	106
Rental			
18	Kyaukphyu (V Power)	Rakhaine	99.84
19	Myingyan (Aggreko)	Mandalay	103.04
20	Myingyan (V Power)	Mandalay	149.76
21	Thahton	Mon	118.9
Total Installed Capacity			**2,306.27**

Source: Current Situation and Development 2022, MOEP

Appendix C

Table (3.5) Electricity Generations from 2010-2011 FY to 2020 – 2021 FY

Sr. No.	Fiscal Year	Installed Capacity (MW)	% Change In Installed Capacity	Generation (Million kWh)
1	2010 – 2011	3413	0	8,625.11
2	2011 – 2012	3588	5.10	10,425.03
3	2012 – 2013	3726	3.80	10,964.90
4	2013 – 2014	4146	11.30	12,247.12
5	2014 – 2015	4805	15.90	14,156.30
6	2015 – 2016	5125	6.70	15,964.75
7	2016 – 2017	5390	5.20	17,866.99
8	2017 – 2018	5642	4.70	20,055.32
9	2018 (April – Sept)	5651	0.20	11,129.23
10	2018 - 2019	5838	3.31	22,882.85
11	2019 – 2020	5856	0.3	18,761.34
12	2020 – 2021	5868	0.2	17,331.48

Source: Statistics Report from 2010-2011 to 2022, Department of Electric Power and Planning, MOEP

Appendix D

230 kV Transmission Line in Bago Division

Sr. No.	Name of Transmission Line	Conductor Size	Distance (Mile)	Number of Tower
1	230 kV Taungoo- Phyu-Kun-Tharyargone(1)	795 MCM	60.55	307
2	230 kV Phyu Plant In/Out	795 MCM	5.00	26
3	230 kV Kun Plant In/Out	795 MCM	3.61	20
4	230 kVBa Lu Chaung (2) – Taungoo	795 MCM	95.52	383
5	230 kV Shwetaung – Minhla	605 MCM	65.39	270
6	230 kV Minhla - Myaungtagar	605 MCM	62.96	252
7	230 kV Shwetaung - Taungdwingyi	605 MCM	98.12	384
8	230 kV Shwetaung(Myaungtagar)-Hlawgar (Single Circuit)	605 MCM	19.14	84
9	230 kV Thaephyu – Taungoo	265/35 sqmm	40.28	209
10	230 kV Kamarnat – Sittaung	605 MCM	36.60	136
11	230 kVTaungoo – Tharyargone (2)	605 MCM	60.10	266
12	230 kVTharyargone – Kamarnat (1)+(2)	605 MCM	58.80	260
13	230 kVShwekyin - Tharyargone	605 MCM	25.62	106
14	230 kVShwetaung- Oakshinpin	605 MCM	25.60	111
15	230 kVShwetaung - Myaungtagar (Double Circuit)	605 MCM	131.61	554
16	230 kV Oakshinpin – Toungup	795 MCM	54.41	206
17	230 kV Taungdwingyi – Shwetaung (D/C)	605 MCM	104.00	429

Source: MOEP, 2022

66 kV Transmission Line Bago Division

Sr. No.	Name of Transmission Line	Conductor Size	Distance (Mile)	Number of Tower
1	66 kV Shwetaung – Pyi	336.4 MCM	9.64	55
2	66 kV Shwetaung-Textile industry	100 sqmm	1.00	12
3	66 kV Shwetaung- Nuthmaw	266.8 MCM	4.00	46
4	66 kV Zaungtoo – Kamarnat	185 sqmm	45.25	646
5	66 kV Shwetaung – Hsintae	397.5 MCM	11.50	133
6	66 kV Hsintae – Nyaungchayhtauk	397.5 MCM	20.00	259
7	66 kV Oakshinpin-(Kapasa-6)	336.4MCM	4.40	32
8	66 kV Hsintae – Oakshinpin	397.5 MCM	17.30	282
9	66 kV Oakshinpin – Mathone	397.5 MCM	12.20	188
10	66 kV Kasala (5) – Kwinhla	266.8 MCM	0.94	13
11	66 kV Kamyaing – kapasa (5)	336.4 MCM	2.50	33
12	66 kV Shwetaung-Kyaukswyalkyoe	397.5 MCM	32.00	448
13	66 kV Shwetaung-Paukkhaung	795 MCM	44.00	677

Source: MOEP, 2022

33 kV Transmission Line Bago Division

Sr. No.	Name of Transmission Line	Conductor Size	Distance (Mile)	Number of Tower
1	33 kV Yenwe – Tharyargone	397.5MCM	17	336
2	33 kV Khapaung – Taungoo (1)	95sqmm	15.57	300
3	33 kV Khapaung – Taungoo (2)	400/35sqmm	15.57	286

Source: MOEP, 2022

Appendix E

On-Grid and Off-Grid Electricity Distribution in Urban Areas

(Up to 2020-2021 FY)

Sr. No.	State / Region	Electricity Distribution in Urban Area				
		On Grid Distribution		Off Grid Distribution		Total Number of Towns
		Number of Towns	(%)	Number of Towns	(%)	
1	Kachin	15	46.88	17	53.13	32
2	Kayah	10	100	-	-	10
3	Kayin	9	50	9	50	18
4	Chin	6	31.58	13	68.42	19
5	Mon	14	82.35	3	17.65	17
6	Rakhine	22	84.62	4	15.38	26
7	Shan	50	58.14	36	41.86	86
8	Sagaing	34	68	16	32	50
9	Mandalay	20	95.24	1	4.76	21
10	Naypyitaw	8	100	-	-	8
11	Magway	32	100	-	-	32
12	Bago	52	100	-	-	52
13	Yangon	20	95.24	1	4.76	21
14	Ayerawaddy	41	91.11	4	8.89	45
15	Tanintharyi	-	-	18	100	18
Total		**333**	**73.19**	**122**	**26.81**	**455**

Source: MOEP, 2022

Appendix F

On-Grid and Off-Grid Electricity Distribution in Rural Areas

(Up to 2021-2021 FY)

Sr. No.	State / Region	Total Village	Electricity Distribution in Rural Area					No of Unelec-trified Village
			On Grid Distribution		Off Grid Distribution		Total No of Village	
			No of Village	(%)	No of Village	(%)		
1	Kachin	2547	543	21.3	778	30.55	1321	1226
2	Kayah	517	392	75.82	68	13.15	460	57
3	Kayin	2097	459	21.89	644	30.71	1103	994
4	Chin	1343	39	2.90	933	69.47	972	371
5	Mon	1143	550	48.12	279	24.41	829	314
6	Rakhine	3741	431	11.52	1499	40.07	1930	1811
7	Shan	13773	1831	13.29	2579	18.73	4410	9363
8	Sagaing	5989	1959	32.71	3178	53.06	5137	852
9	Mandalay	4799	2757	57.45	914	19.05	3671	1128
10	Naypyitaw	796	442	55.53	74	9.30	516	280
11	Magway	4761	1000	21	1803	37.87	2803	1958
12	Bago	6487	1964	30.28	477	7.35	2441	4046
13	Yangon	2143	1143	53.34	280	13.07	1423	720
14	Ayera-waddy	11864	1060	8.93	5536	46.66	6596	5268
15	Taninthayi	1237	-	-	748	60.47	748	489
Total		**63237**	**14570**	**23.04**	**19790**	**31.29**	**34360**	**28877**

Source: MOEP, 2022

Appendix G

Condition of Electrified Households of the State and Region

From 2018-2019 FY to 2020-2021 FY

Sr. No.	State / Region	Total No of Household	Electrified Household in 2018-2019 FY		Electrified Household in 2019-2020 FY		Electrified Household in 2020-2021 FY	
			Quantity	%	Quantity	%	Quantity	%
1	Kachin	269365	162043	60.16	172394	64	183168	68
2	Kayah	57274	54269	94.75	56129	98	56701	99
3	Kayin	308041	100712	32.69	107814	35	123216	40
4	Chin	91121	24194	26.55	27336	30	36448	40
5	Mon	422612	233882	55.34	253567	60	266246	63
6	Rakhine	459722	115706	25.17	137917	30	160903	35
7	Shan	1169569	413244	35.33	467828	40	502915	43
8	Sagaing	1096857	458083	41.76	493586	45	515523	47
9	Mandalay	1323191	840505	63.52	926234	70	992393	75
10	Naypyitaw	262253	152313	58.08	157352	60	167842	64
11	Magway	919777	297776	32.37	321922	35	367911	40
12	Bago	1142974	489305	42.81	514338	45	560057	49
13	Yangon	1582944	1389220	87.76	1408820	89	1487967	94
14	Ayerawaddy	1488983	283019	19.01	446695	30	595593	40
15	Taninthayi	283099	52571	18.57	84930	30	104747	37
Total		10877782	5066842	46.58	5576860	50.7333	6121630	55.6

Source: MOEP, 2022

Appendix H

Electricity Utilization in Each Sector

Sr. No.	Fiscal Year	Electricity Utilization in Volume (Million kWh)				Total (Million kWh)
		Residential	Industrial	Commercial	Others*	
1	2010 – 2011	2653.33	2727.37	1306.38	65.60	6752.68
2	2011 – 2012	3380.97	2676.57	1531.71	76.81	7666.06
3	2012 – 2013	3655.18	2699.00	1642.81	280.63	8277.62
4	2013 – 2014	3764.00	2984.60	1692.12	1457.52	9898.24
5	2014 – 2015	4112.83	2144.85	1754.58	2402.94	10415.2
6	2015 – 2016	3567.15	2119.75	1463.75	6220.80	13371.45
7	2016 – 2017	3451.07	2772.87	1377.92	8406.35	16008.21
8	2017 – 2018	4509.82	2752.78	1703.04	8129.74	17095.38
9	2018-2019	5128.10	2602.71	1803.91	8860.48	18395.20
10	2019-2020	6,728.60	4,581.41	2,075.12	5,909.37	19,294.50
11	2020-2021	8,075.79	5,553.48	2,197.74	4,012.54	19,839.55

Source: Statistics, DEPP, MOEP, 2022.

* Others include public space lighting, street lighting, and utilizations of public schools, public hospitals, religious building and Separate Corporation.

Appendix I

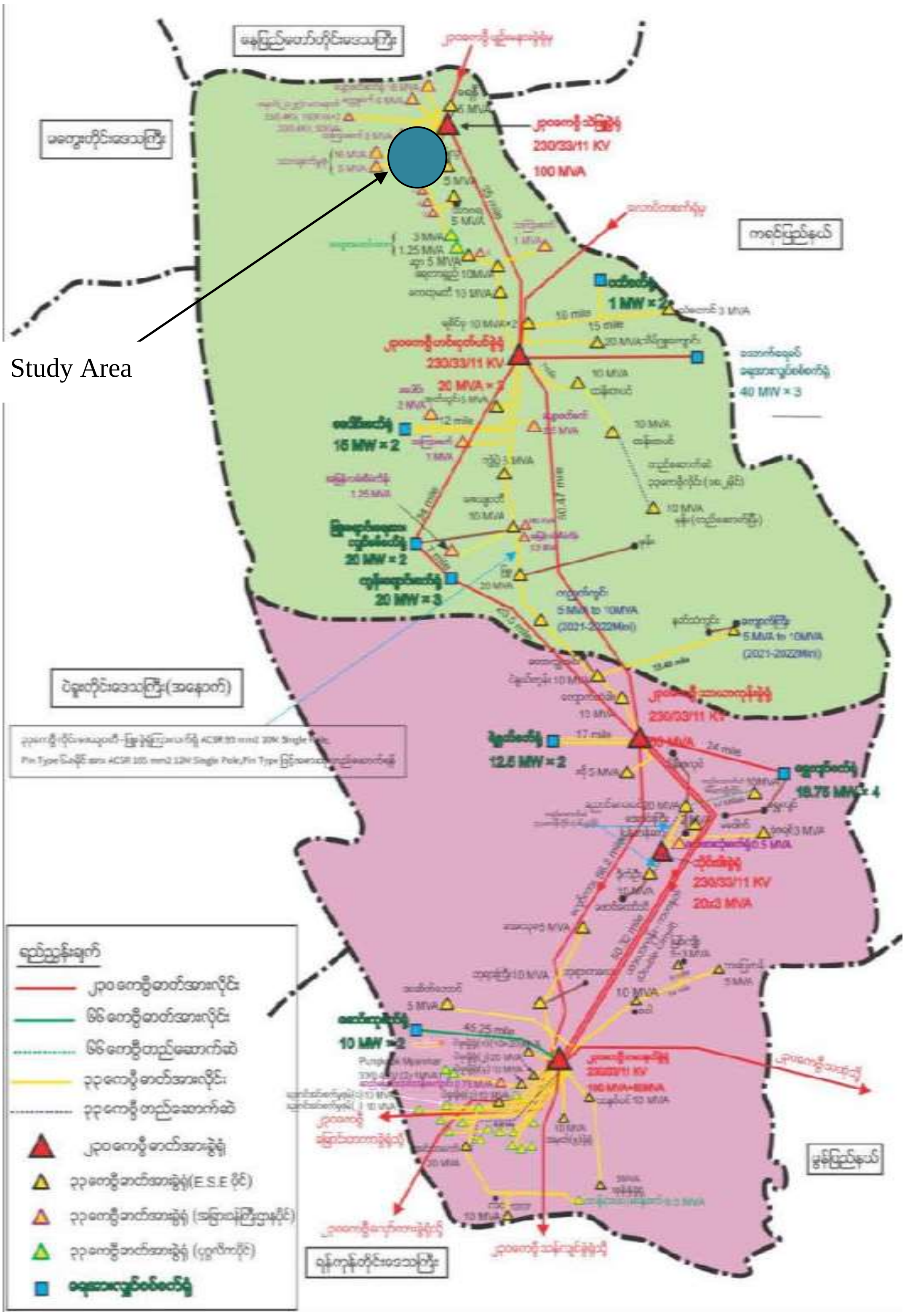
230 kV Primary Substation (Bago Division)

Sr. No.	Substation	Voltage ratio (kV)	Capacity (MVA)	Location
1	Kamarnat	230/33/11	100	Kamarnat village,Bago
		230/33/11	60	
2	Taungoo	230/33/11	60	Oaktwin Township
3	Tharyargone	230/33/11	30	Kyauktagar township, Tharyargone village
4	Thaephyu	230/33/11	100	Yaetarshae township, Myohla, Thaephyu village
5	Oakshinpin	230/66/11	100	Pyi district, Pantaung township, Oakshinpin
6	Minhla	230/33/11	100	Tharyarwady district, Minhla Township Oakshinpin

Source: MOEP, 2022

Appendix J

Map of Study area in Yaedashe Township, Thargaya Twon, Bago Division



Source: MOEP, 2022

Appendix K

Oak Pho Village Mini- Grid Power House Location Map

Appendix L

Lae Pyin Ma Village Mini- Grid Power house Location Map