PERFORMANCE & COST ANALYSIS OF SOLAR ROOFTOP SYSTEM UNDER DHAKA POWER DISTRIBUTION COMPANY (DPDC)

A Thesis submitted in partial fulfillment of the requirements for the Award of Degree of
Bachelor of Science in Electrical and Electronic Engineering

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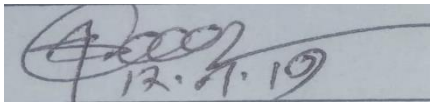
Certification

This is to certify that this project and thesis entitled "**performance and cost analysis of solar rooftop system under Dhaka Power Distribution Company**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on December 2018.

Signature of the supervisor



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Dedicated to

Our Parents

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List of Abbreviations

UNFCC	United Nations Framework Convention on Climate
CDM	Clean Development Mechanism
REB	Rural Electrification Board
BPDB	Bangladesh Power Development Board
LGED	Local Government Engineering Directorate
IDCOL	Infrastructure Development Company Limited
NGO	Non-Government Organizations
BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
BWDB	Bangladesh Water Development Board
SHS	Solar Home Systems
SRS	Solar Rooftop System
DPDC	Dhaka Power Distribution Company

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ABSTRACT

Daily headlines make everyone aware of the dangerous long-term effects of power generation from the fossil fuels. It is widely believed that continuing to depend on fossil fuels to generate electricity can cause serious environmental problems. Moreover, fossil fuels are finite in amount and cost a lot of money as well. Hence, renewable energy is a potential solution to meet up electricity demand for the developing countries like Bangladesh. Among all the renewable technologies, solar photo voltaic (PV) is the most potential, favorable and promising one which converts solar energy into electrical energy, including or excluding battery backup. Although solar technology has nearly been successful in rural areas where most of the technologies are adopted based on Solar Home System (SHS), it has not yet been effective in urban areas after the imposed rule of meeting 3% of light fan load of a building. We have investigated the installed solar rooftop of 86 houses in Narayanganj, where the solar system of most of the houses were found inactive. Among them only 50 systems are active. In this thesis the overall analysis of urban solar prospect has been done in three layers based on this investigation. After all, the effectiveness of the system was discussed in brief to influence them to come to know about the appropriateness of the system and the proper way to maintain the system. It is seen that a few among them find the system useful and want to increase its capacity. The operating condition and maintenance of the SRS was evaluated as well. Most of the interviewed people do not either maintain the system or want to repair it. It is very unfortunate that most of the systems were found inactive or not connected in a proper way. Although urban people are more likely to know the efficient use of solar energy, they still prefer fossil fuels for their power generation. In this manner, they are indirectly contributing to environmental hazards and wasting a lot of money too. From the reading of an installed solar system, the cost per unit is calculated later as an example. However, the appropriateness of the system to the consumer is very limited due to having a lack of knowledge and training to operate the system productively.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

One of the most important fundamental elements required for poverty alleviation and socio-economic development of the country is a power. Fossil fuel, sunlight, air, water source and atomic energy centers all over the world. The main power source is still growing reserve though fossil fuel. Fossil fuel is used when greenhouse gases emanate from industry threats to climate change and sustainable development for global warming. In these circumstances durable and safe energy is usually the main concern of the worldwide. In this situation we are undergoing a transformation in the power sector. This is always happening due to reducing the availability of fossil fuel resources, changes in the situation, and reducing energy emissions worldwide. Due to the durable power in the changing perspective, especially the solar technology benefits are becoming popular for global conditions and the importance of the carbon trading prospect factor. United nation Framework Convention with Climate Change (UNFCC) has had initiative for Fresh Development Mechanism (CDM). In this context, solar energy has become a major source of energy around the world. Transport and the use of households to fulfill the growing requirements of electricity within the industry many developing countries are already using solar biology as a renewable alternative. It not only fills the greater part of the energy needs, but provides additional socio-economic benefits and helps maintain the clean environment. Bangladesh is often the most tropical tropical country where power does not provide power. At present around 91 percent (including renewable energy) of population has access to electricity, the per capita energy consumption is only 335.99 KWh per annum [1]. Bangladesh is very central to the capital city. Many positions away from the capital gain proper attention. Poor people cannot afford the power to live their lives. A large number of remote islands and highlands are generally not connected to domestic grid lines. The expansion of specific national grids inside isolated areas is quite broad and generally not cost-

effective, solar technology can be a powerful alternative to meeting the power requirement within these off-grid locations. Most recently use Solar Home System (SHS) keeps growing fast for electricity, through it consists of high initial amount. As a developing country of Bangladesh, people continue to be in power and energy deficit. But geographical conditions as well as favorable climate problems provide an opportunity for us to use solar energy for almost every aspect of our rural, urban, partly urban livelihood related to the Bangladeshi population.

1.2 Problem Statement

Electric power system of Bangladesh will depend on fossil fuels both equally in private segment and state-owned electric power plants. Approximately 89% of generated power was produced from carbon emitting natural gas, liquid fuel, fossil fuel and hydropower [1]. Availability of natural gas is not enough to meet the demand. In Bangladesh, gas production capacity cannot support domestic electricity as well as domestic demand, as well. The reserve of gas and oil will soon be tired. Worldwide, there is a demand for cleanup and sustainable energy. Renewable causes of energy, such as photo voltaic, air, bio-mass, etc. As an exotic country Bangladesh is actually endowed with solar power. In this context, solar energy is a reliable, safe and secure energy for that country. However, with the renewable energy generation capacity, the current share is just 2.86% [1]. Leading people of Bangladesh live in rural areas. There may be strong demand for electricity available for remote villages. Bangladesh offers embedded with lots of solar energy. Now there are many possibilities as our solar power-rich area. Institutional, financial and technical skills work as an important factor in reaching a higher power generation and utilization. But we have a lack of detailed and integrated research in this field. Solar power based rural electrification begun in the country in 1988 from Norshingdi [2]. Development Board (BPDB), Rural Electrification Board (REB), Local Government Engineering Directorate (LGED), Infrastructure Development Company Limited (IDCOL) and a significant number of private sector agencies including Non-Government Organizations (NGO) are involved in solar electricity development. Solar electricity is increasingly available in a lot of off-grid applications. The Infrastructure Development Company Limited (IDCOL) in Bangladesh cooperated with international and local partners to install solar home systems in remote rural areas, which are not easily accessed by the national electricity grid. The focus was with providing basic electricity coverage to raise the life connected with rural region

in addition to low-income households with Bangladesh. As of May 2017, over 4 million solar home systems had been installed, impacting more than 12 percent of the entire Bangladeshi population [3]. In this context, the realization of the true socio-economic impact of the SHS will be illustrated in the design of rural development alternative energy model of the country. The current study is meant to identify the factors involved in the implementation of solar energy and solar power system and how far it has been successful in reducing poverty in the country's rural areas.

1.3 Objectives of the research

The objectives of the study are as follows:

- To know the present condition of SRS in Bangladesh and the opinion of the consumers about it.
- Calculate per unit cost of solar electricity.
- Find out the problems that consumers are facing when they are using SRS.
- To gather information about the satisfaction of consumer whether they are properly satisfied with their system or not.
- To intend the idea about how much electricity the consumer gets on an average and in which purpose it is being used.

1.4 Scopes

Bangladesh is a large and heavily densely populated country in South Asia, bordering Burma, India, Nepal and Bhutan. Bangladesh has an estimated population of 167.09 million [3]. For poverty alleviation, rapid and sustainable economic growth, technological development energy more explicitly electricity is the most fundamental pre-requisite. The country has been facing severe power shortage for last few decades and it a matter of sorrow in next decades all our natural resources will finish and we fall in a deep ocean of shortage of resources, so now the time has come to think less about the natural resources and more about the renewable energy sources.

Our country is blessed with number of potential and renewable sources. Energy sources which are regenerated after a certain period of time cycle are generally known as renewable sources of energy. Commonly used renewable energy sources are Solar, Wind, Hydro, Biomass, and Biogas. In Bangladesh, solar energy, biomass, bio gas is being used since the time immemorial. Especially areas which are out of grid connection and gas coverage, use of bio gas for cooking, harnessing wind power and solar energy for drying of different grains and clothes is known to all. However for lack of proper technological advancement, policy enforcement and implementation, we are still lagging behind in promotion and mass use of renewable sources compared to other developed and developing countries in the world. Renewable energy is clean, sound and environment friendly. A brief over view of all the available renewable energy sources that are found in this country territory is provided in the section

1.5 Thesis Outline

This thesis is organized as follows:

Chapter 1 Introduction

Chapter 2 Reviews the literature

Chapter 3 Methodology

Chapter 4 Result & data analysis

Chapter 5 Conclusion

CHAPTER TWO

LITERATURE REVIEWS

2.1. Introduction

Effective, available and protected methods for getting vivacious in any travel related to the socio-economic progress of your region. Most current studies show how non-urban electrification through solar power helps in the socio-economic development of the country in a variety of ways. In this situation, solar power is widely considered to be a promising technology for remote power generation in developing countries. The chapter tries to focus on the main ideas of the selected literature, thereby giving the main idea of solar power mainly due to the power, complexity and effects of energy meant for socioeconomic development, socio-economic growth such as money, health, education, lawn production and access.

2.2 Energy

Energy can be the driving force behind all economic activities and many important economies that are visible as a system of flow, such as in the order of transition, the product and service end in production .So the economic growth of the country is directly related to the strength of the country. Energy demand in Bangladesh is increasing day by day now one day Bangladesh is facing the energy crisis. About 24.04% of the population in Bangladesh lack access to electricity and many of them live in villages [5]. About 9% of them are located below the poverty line [6]. Both sectors increased by 15.96 percent and 6.25 percent respectively in the year 2011-12. Within the overall demand of electricity, the government has given priority to the development of the power and power sector. There are innumerable natural resources in Bangladesh like coal, gas, gasoline etc.

There is a huge potential for renewable energy, the natural availability of alternative energy in Bangladesh creates opportunities for energy sector development. We will use different methods of renewable energy to generate strength to solve the energy crisis. Renewable energy can be the power that comes from various types of natural resources such as air, precipitation, tides and geothermal heat, biodiesel, biomass sunlight etc. In this paper we have now discussed the possibility of renewable energy sources to remove the power of Bangladesh.

2.3 Renewable Energy

Renewable energy tide together with all the electrical energy produced from natural resources - such as sun energy, wind, rain, and microbial heat which can be renewable (naturally replenished). Renewable energy technologies are priced between solar powers a blowing wind power, hydroelectricity/micro hydro, biomass together with biofuels for transfer [9]. It comes from natural processes which can be met continuously. In its various forms, it is produced directly from the sun, or from the heat generated from the earth. Major renewable energy resources in Bangladesh, solar, wind, small hydropower, biogas and biomass.

2.3.1 Hydro Energy

A generating station using the potential energy of high level water for the generation of electricity. Hydro-electric power stations are generally located in mountainous areas, where dams can be made conveniently and large reservoirs can be obtained. A hydro-electric power station, a dam or a lake is built by creating a water tank. From the dam, water is led to a water turbine. The water turbine captures the energy in the falling water and changes the hydraulic energy (i.e. product of head and flow of water) into mechanical energy at the turbine shaft. Turbine runs the rotator which transforms the mechanical energy into electrical energy.

2.3.2 Wind Energy

Air is another renewable energy source which can be used to overcome the power crisis of Bangladesh. There is no suitable air info available in our country. As a result, the exact interpretation of the specific options linking the air flow cannot be taken. There are 724 km wide coastline lines in Bangladesh and the smallest islands of the Bay of Bengal, where in the summer months the wind and sea winds are thunderstorm and in the cooler months you can find good air ventilation and air ventilation in the northern region. [11]. In addition to the expensive cost associated with Bangladesh, from the height of 30 meters altitude, the annual wind speed is more than 5 million [12]. The velocity of the wind in the northeast of Bangladesh is actually above 4. 5m / She In another area, the speed of the wind is about 3.5m / s [12, 13]. The coastal locations of Bangladesh like Chittagong, Kutubdia and Cox's Bazar have the infinite potential of generating electricity from wind power. Using data from the one year of the Bangladesh Center for Advanced Research, it has already been found that the wind speed at 50 meters from this place varies from four to four. 1 to 5. 8 meter/second having a power density associated with 100-250 w/m2 [13].

Table 2.3: Wind conditions at different places in Bangladesh

Site	Reference height (m)	Annual average wind speed (m/s)
Teknaf	5	2.16
Cox's bazaar	10	2.42
Patenga airport	5	2.45
Kutubdia Island	6	2.09
Sandip Island	5	2.16
Hatia Island	6	2.08
Bhola Island	7	2.44
Khepupara	10	2.36

2.3.3 Bio Energy

Biomass may be considered as the biggest energy source in Bangladesh. About 70% of its total production is being supplied by the basic energy for the energy consumption of cookery and veterinary family warming [14]. Biomass contains various types of natural and organic materials from organic materials to organic materials. There are many existing technologies available to

translate the energy of biomass in power and heat energy. There are two types of broad technology, which are directly ignited and gaugification. The direct ignition process keeps additional biomass corrosion, produces warm chimney gas, which causes vapor, which is eventually applied for power generation. On the contrary, gifting reaves reduce the conversion of biomass and produces lower secondary calorific gases and then the received gas uses joint cycle energy for the production of the plant. It is acknowledged from literature that up to 40% of electrical translation skills are achieved within a short period of 30 megawatt. Generally, organic gas refers to the gas produced by the biological breakdown of various organic matter in the absence of oxygen. Country like Bangladesh, where the major portion of economy relies largely on the agro-based production, there exists a huge potential for utilizing biogas technology. Raw materials for biogas production are easily and cheaply available everywhere. Different NGOs along with government are working together for power production from biogas recently. Among them, Grameen Shakti can be mention in this field. They have settled 13,500 biogas plants across the country. Besides this, a government owned Infrastructure Company named IDCOL along with other organizations installed 18,713 biogas plants since May, 2011 [15]. Cost is the most dominant factor limiting the wide application of biogas based energy production. Proper planning, technology and economic assistance is needed to make this technology a more fruitful and popular mean of getting electricity among the people. Various feed stocks such as organic domestic waste, manufacturing waste, fertilizer, sludge, and others have been demonstrated and pertained commercially by the anaerobic digestion of biomass.

2.3.4 Geothermal Energy

The word geothermal comes from the Greek words geo (earth) and therme(heat). Geothermal energy is heat in the earth. People can use these heat as a steam or hot water for the production of heat or electricity. Geothermal power is a renewable energy source because heat is produced continuously inside the Earth. Slow reduction of radioactive particles in the main regions of the earth, such a process occurs in all the rocks that generate geological power. The Earth's center is hotter than the Sun's surface. The world's crust is divided into pieces known as tectonic plates. The magma comes near the surface of the planet near the plate, where many volcanoes occur. Lava arising from the volcano partly partially magma. Heat absorption from stone and water deep underground magma.

2.3.5 Solar Energy

Of the different forms of renewable energies in Bangladesh, solar energy is the most popular and the effective one and compared to any other form of renewable sources solar energy has brighter prospect from application point of view. The Sun is known as the solar energy by forming the sun as the power radiation obtained by the Earth's surface. Bangladesh is located in 24o0'0 "N latitudes and 90o0'0" EE line which is ideal for conservation of solar energy. For years, the cost of PV, production and installation has decreased, and it is an opportunity to invest as an economic scale for a developing country like Bangladesh. Recent literature of solar photovolytique (PV) indicates that the average daily diversity of solar discharge is between the dry and wet season pattern of 4 to 6.5 kilowatts of the soil [11]. The maximum level of radiation from March to April is accessible, from December to January, and the average sunlight hours respectively in summer, summer and season seasons are 6.69 / 7.6 s, 6.16 and 4.81 respectively. The projected value of solar radiation is the highest in the month of March–May, where 1 (one) square meter area occupies the potential of producing 4–5 kWh/m2/day. In our thesis, we actually worked on the problems of solar system installations in the urban area and offered some effective, renewed, economically feasible designs so that customers can have a positive impact from these new systems except for grief.

Along with the family's electricalization, solar-based recharging stations can be used in solar-based recharge stations at solar-based recharge stations, which are the top of the rooftops of filling stations where most of the cases are on top of the roof and the PV system can be installed to track the maximum power by adjusting the weighing angle of the module. Using the potential of technology with the economic power of the country, it is best to use only the right planning, public awareness, and the best use of solar energy. Figure-2.1 shows off the grid solar system.

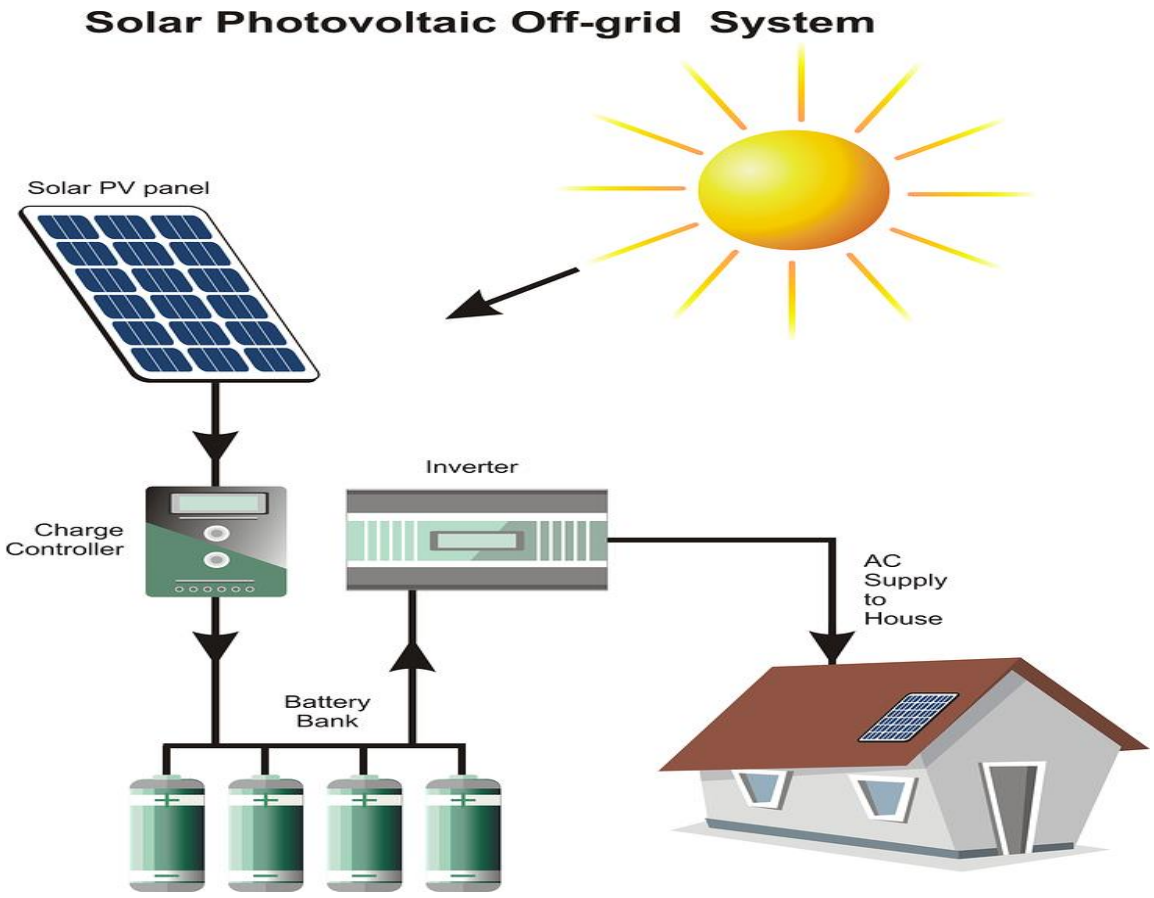


Figure-2.1: Solar AC System (Off Grid)

2.4 Solar Rooftop System

Every building whether home, industry, institution or commercial establishment can generate some solar power by installing PV panels on the rooftop shown in figure-2.2. Based on available roof area solar PV panels will be installed on the roof of the building. The panel (DC power) connects the output power conditioning unit / inverter which converts DC to AC. If the solar power load is higher than the requirement, the excess energy is fed automatically to the grid. For larger capacity systems connection through step up transformer and switch yard may be required to feed the power to grid.

Figure-2.2: On grid solar rooftop system

2.5 Technical Background

"Photovolite" refers to the formation of voltage from the lite and is often summarized as "PV". A common term for photovoltaic cells is "solar cells", although cells work with any type of light and not sunlight. A solar cell is a converter. It changes the power of light into the electric power. A cell does not store any energy, so when the light source (usually the sun) is removed, there is no electrical power from the cell. Power should be included in some form of power saving (usually battery) circuits if the power is required at night.

2.5.1 Solar Cells

A solar cell is simply an electrical device which, otherwise, converts light energy into electrical energy through photovoltaic effects. Basically this solar cell element is silicon. There are three general panels available in the market and they are:

1. Monocrystalline Panels

2. Polycrystalline Panels

3. Thin Film Panels (Amorphous Silicon)

The efficiency of a solar panel affects the whole solar home system, so it is very important to buy a proper solar panel for a proper solar home system. For example: if a customer has a low budget the panel should be a low cost one on the other hand if there is a huge budget or the system is for a grid, it should be a high efficiency solar panel regardless of cost.

In our survey we found that all of the cases clients used only Monocrystalline and Polycrystalline Panels. In some of the cases, we found that clients used Monocrystalline solar panels for huge size of solar panels array as a high efficient conversion of energy. We also found that people used Polycrystalline Panels because of its low cost, regardless of efficiency calculation for a huge size of solar panels array. In most of the overall efficient solar home system we found that only Monocrystalline solar panels are used for high end performance.

2.5.2 Monocrystalline Panels

The dark black color solar panels are known as Monocrystalline solar panels shown in figure-2.3. Monocrystalline panels get their names as silicon wafers are used to spend their single crystals or silicon 'bowls'. Silicon is raised in a laboratory to achieve high degree of purity and then it is very thinly cut to make wafer. So far, 21.5% of the best solar energy companies have been able to achieve the best efficiency [16].

Advantages:

1. Have the highest efficiency of all solar panels available in the market.

2. Space-efficient.

3. Longer lifetime, usually come with a 25yr warranty.

4. Performs better than any other solar panel in low light condition.

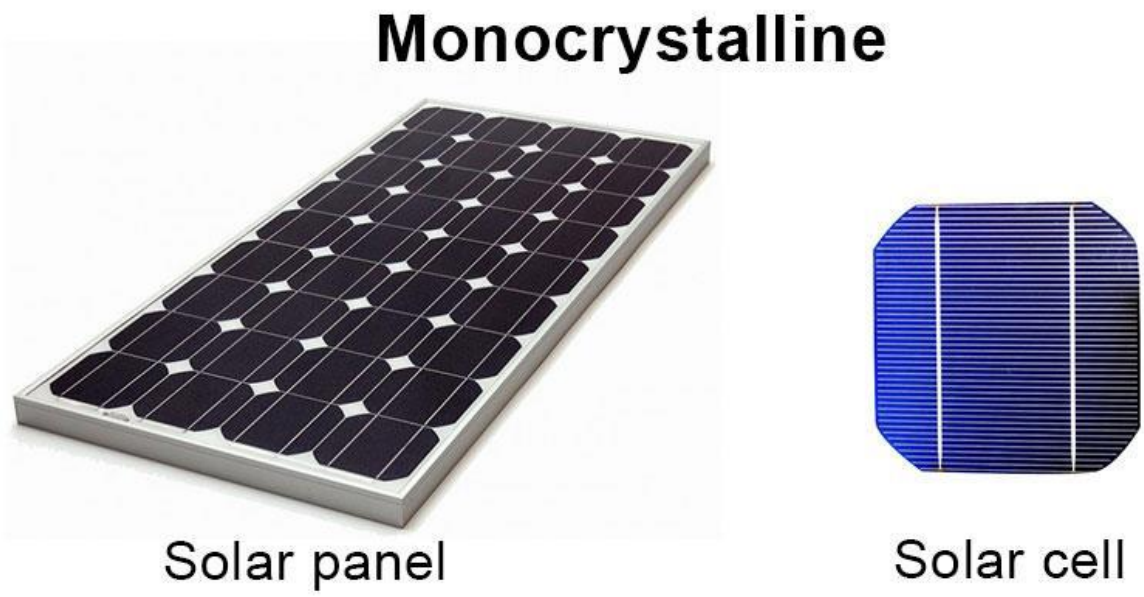


Figure-2.3: Monocrystalline solar panel

Drawbacks:

1. Most Expensive.

2. A significant amount of silicon ends up as waste.

3. Performance suffers under high temperature.

2.5.3 Polycrystalline Panels

The light or dark blue color solar panels are known as Polycrystalline Panels. It is also known as poly silicon (p-Si) and multi-crystalline silicon (mc-Si) shown in figure-2.4. These cells are cut from an ingot of melted and re-crystallized silicon. Raw silicon is melted and poured into a square mold, which is cooled and cut into perfectly square wafers [16]. The efficiency of polycrystalline solar panels is usually 13-17%.

Advantages:

1. Low cost.

2. Waste of silicon is much lower than Monocrystalline for the manufacture.

3. Performance gets higher in the higher temperature.

4. Excellent life span, usually come with a 25yr warranty.

Figure-2.4: Polycrystalline solar panel

Drawbacks:

1. Slightly less efficient than Monocrystalline..

2. Need more space than Monocrystalline to produce the same amount of electricity.

2.5.4 Amorphous Thin Film

Thin film, or vertex, silicon cells make silicon atoms in thin layers instead of a crystal structure. Amorphous silicon can absorb light more readily than crystalline silicon, so the cells can be thinner shown in figure-2.5. For this reason, amorphous silicon is also known as 'thin film' photovoltaic (PV) technology. The efficiency of Thin Film is very low, usually around 7-13% [16].

Advantages:

1. Mass-Production is very simple.

2. High temperatures and shading have less impact on the performance.

3. It could be flexible, which opens the doors of a new potential of solar panels

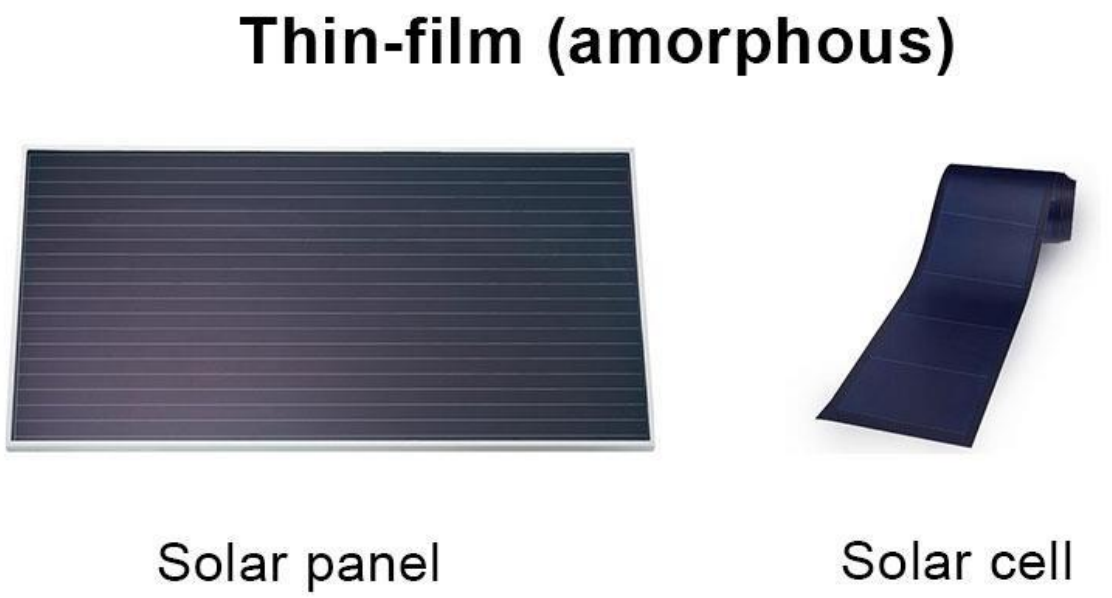


Figure-2.5: Amorphous Thin Film solar panel

Drawbacks:

1. Has the lowest conversion efficiency among the all other solar panels.

2. Need a huge space to produce the same amount of electricity as crystalline based panels.

3. Life span is much lower than the crystalline based panels.

4. Efficiency decrease in the cold weather.

2.6 Present performance of solar System

Table 2.1 Performance of solar in the world

No	Country Name	Capacity(MW)	Share of RE
1	China	78100	25.8%
2	Japan	42800	14.1%

3	Germany	41200	13.6%
4	United States	40300	13.3%
5	Italy	19300	6.4%
6	United Kingdom	11600	3.8%
7	India	9000	3.0%
8	France	7100	2.3%
9	Australia	5900	1.9%
10	Spain	5500	1..8%

2.7 Summary of the chapter

Now a day depends on the real speed, the mobility of civilization and the durability of civilization. Therefore, a country can be seen as civilized if adequate access to the energy required for industrial, agricultural and economic development. There are many sectors to use solar power in rural and urban divisions in Bangladesh. Internal solar power utilization in residential areas of household, generational function, community health treatment center, school union-information as well as remote and hard-to-reach between flood / cyclone centers. In rural areas only the quality of living and productivity will not improve, but the environmentally friendly development goals will contribute rapidly.

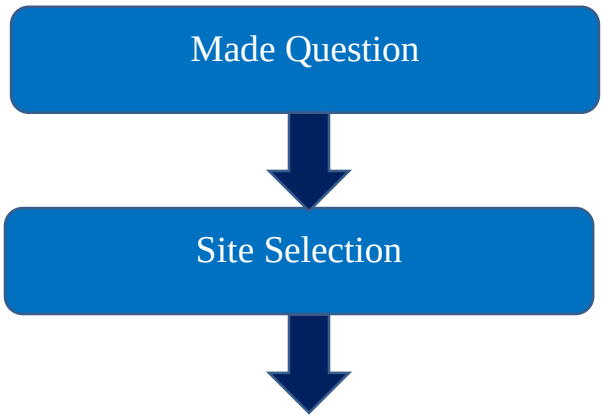
CHAPTER THREE

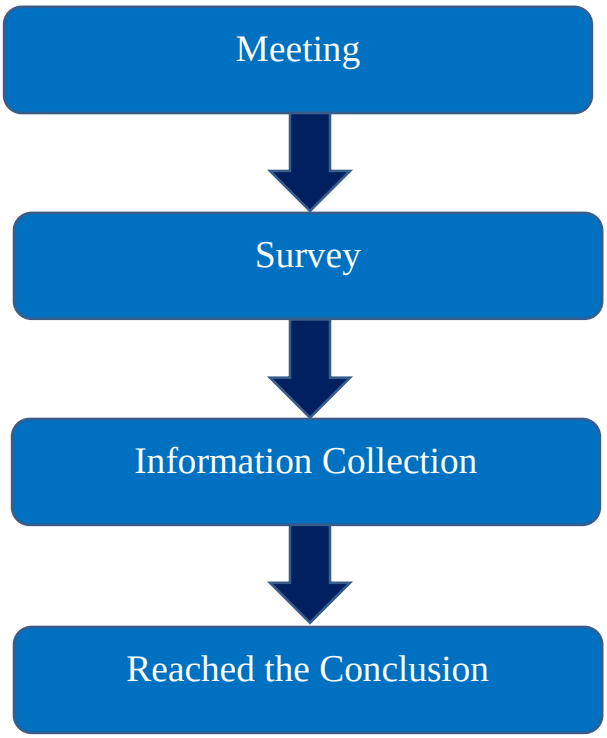
METHODOLOGY

3.1 Introduction

The Green House Effect is a big problem in the twenty century. The main cause of this is that the extra carbon emissions in the atmosphere. There is a lot of carbon emitted from fossil fuel. Which is very bad for the environment Especially for Bangladesh. Bangladesh's natural gas reserves are running out. So, we have to move towards renewable energy. Government of Bangladesh passed the Renewable Energy policy 2008. Where it is said that 3 percent of the solar power installed for the new electricity connection for residential home and 10 percent for industrial of total demand. As a result of this law, many solar power systems have been introduced in the city. We are going to both residential and industrial are under DPDC coverage are for collected our survey information.

3.2 Working Strategies





3.3 Site selection

As per the instructions of the Ministry of Utility, according to the renewable energy policy, all new connections with demand above 2KW now require solar panels installation. For domestic purposes, solar energy should be met for at least 2% demand, 7% for commercial and 10% for the industry. But it should be checked to see how the installed systems are running and benefited by the installed solar system. An official survey recently stated that the installation of solar panels on roofs in urban areas will not add extra strength to the system, rather it will cause serious degradation of system management and huge financial losses to consumers. The survey also noted that solar panels failed to track the public interest because distribution companies did not take any awareness program for consumers and severely prevented service from agencies. Considering the results from the survey, a detailed survey was conducted in Narayanganj area to inspect the working condition of the installed solar system. Some homes were listed on DPDC and others were

not. User feedback is also collected from each potential person. The data collected was used to calculate the effective and ineffective systems. In figure-3.1 shown survey area map.

Fig-3.1: Survey area

3.4 Survey questionnaire

To publish quantitative and qualitative information to SHS users, the experimental survey is collected through civil war. Overall 25 interviews of urban families were conducted by the questionnaire designed. The questionnaire is designed based on indicator of the study. Shown by the following table-1 .Table 3.1: Survey questionnaires

SL	Indicator	Question	Description
1	Consumer Information	i. Owner Name ii. Consumer No iii. Address	In this method we just collected consumer information.
2	Information of installation	i. What kind of solar rooftop system are you using? ii. Why do you install this SRS? iii. From where you brought SRS?	In this part we asked and tried to find out the information of installment.
3	Maintenance	i. Do you test it regular basis, how many days ago? ii. What is the main reason for the system disorder? iii. Do you want to repair it? iv. Do you get any training for SRS operation? v. Do you ever clean your SRS? vi. How often it done?	In this part we wanted to know about maintenance and training.
4	Cost analysis	i. What is the total cost of SRS? ii. How much electricity do you get from SRS? iii. Do you have any record on solar electricity?	In this section we calculated the electricity generation from a solar system and per unit cost of solar power.
5	Operation	i. Is your SRS in operation? ii. Do you use electricity from your system? iii. In which purpose they use it. iv. Are you fed your electricity to the grid?	In this part we checked the present situation of SRS and taken reading from the meter.

6	Consumer satisfaction	i. Do you think this SRS is useful? ii. Do you think, it is a waste of money? iii. Is there any support from govt? iv. Do you want to increase the capacity of your SRS?	The part we tried to know that consumers are satisfied or not.

Questionnaire is the principal tool for data collection. The questionnaire is characterized by the mixture of closed and open questions, allowing the collection of quantitative as well as information on before and after using SRS in the household.

First of all, the study area is selected. It is located at Sonargaon upazila is located 25 km south-southeast of Dhaka city and Narayanganj Sadar Upazila is located just 15 kilometers south of Dhaka city on the outskirts of Dhaka city in Narayanganj District. With the help of DPDCs administration and staff engaged for Solar Rooftop System dissemination two division are identified under DPDC for the survey, namely Narayanganj East, Narayanganj West. Total 25 SRS owned household data are collected from the city. Households are selected randomly as there are many SRS-owned household in each of the city. For secondary sources of data journal, reports, working paper and documents regarding solar energy in Bangladesh have been consulted. Moreover, personal experiences and informal interview method are also used to have some more information about the issue. Data collection is conducted by author. Due to extensive questionnaire, the average duration of interviews was about 20 minutes and it is found interviewed household members showed keen interest in the survey activities. As people are lack of knowledge in English, the questions have been translated into Bengali for well understanding.

CHAPTER FOUR

DATA ANALYSIS & RESULTS

4.1 Introduction

We will try to find out from the survey data analysis solar rooftop system is beneficial for increasing renewable energy, consumer are satisfied for this system. They are any support from government. Per unit cost analysis of solar rooftop system and compare the grid electricity per unit cost. To verify the objective empirically, a survey of 25 randomly selected households in two division have been surveyed with a structured questionnaire. The survey results are analyzed as follows in the following sections.

4.2 Category

We are collected data from 25 of different consumer of DPDC. The category of consumers are 56% Residential 24% Shopping mall 12% factory 8% hospital. During survey we are not found owner of the house. So we are collected our information from there caretaker. Figure 4.1 illustrates the consumer category.

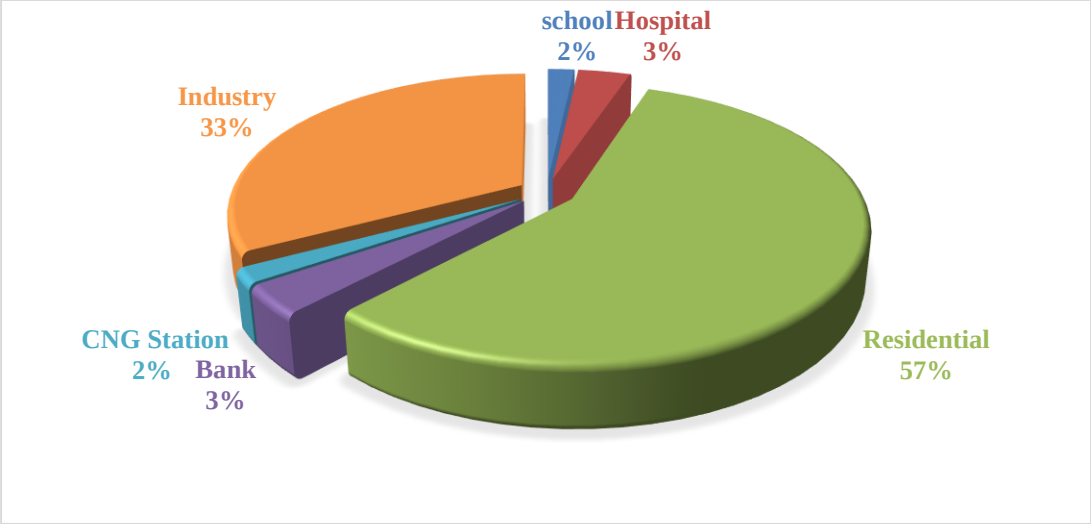


Figure 4.1: Consumer category

4.3 Statement of Consumer

4.3.1 Types of SRS

We're working on an on-grid solar system. But there are some Off-Grid systems along with On-Grid system in the field. Among them, 19 are on-grid and 6 off-grid system. Figure 4.2 shows the percentage of on-grid and off-grid solar system.

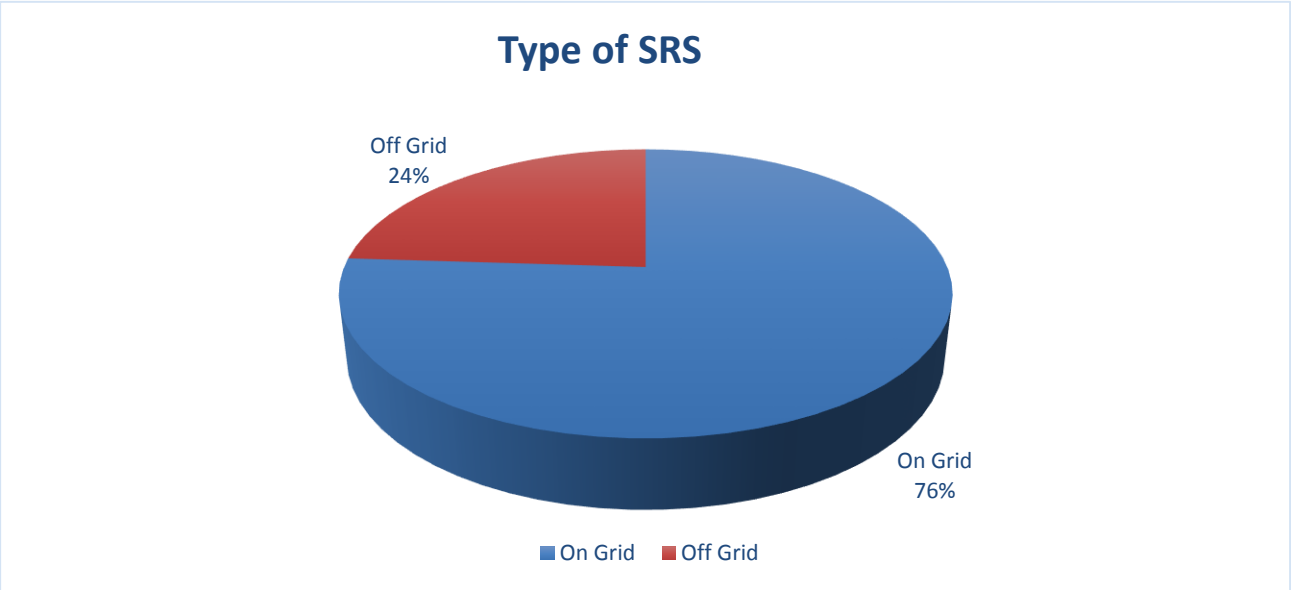


Figure 4.2: Type of SRS

4.3.2 Install Status

Urban people are very unwilling to use solar power. Most of the houses in which solar power is used under pressure of the authority. We got 23 homes in our 25 house surveys they install solar system as per policy obligation this illustrate in figure 4.3.

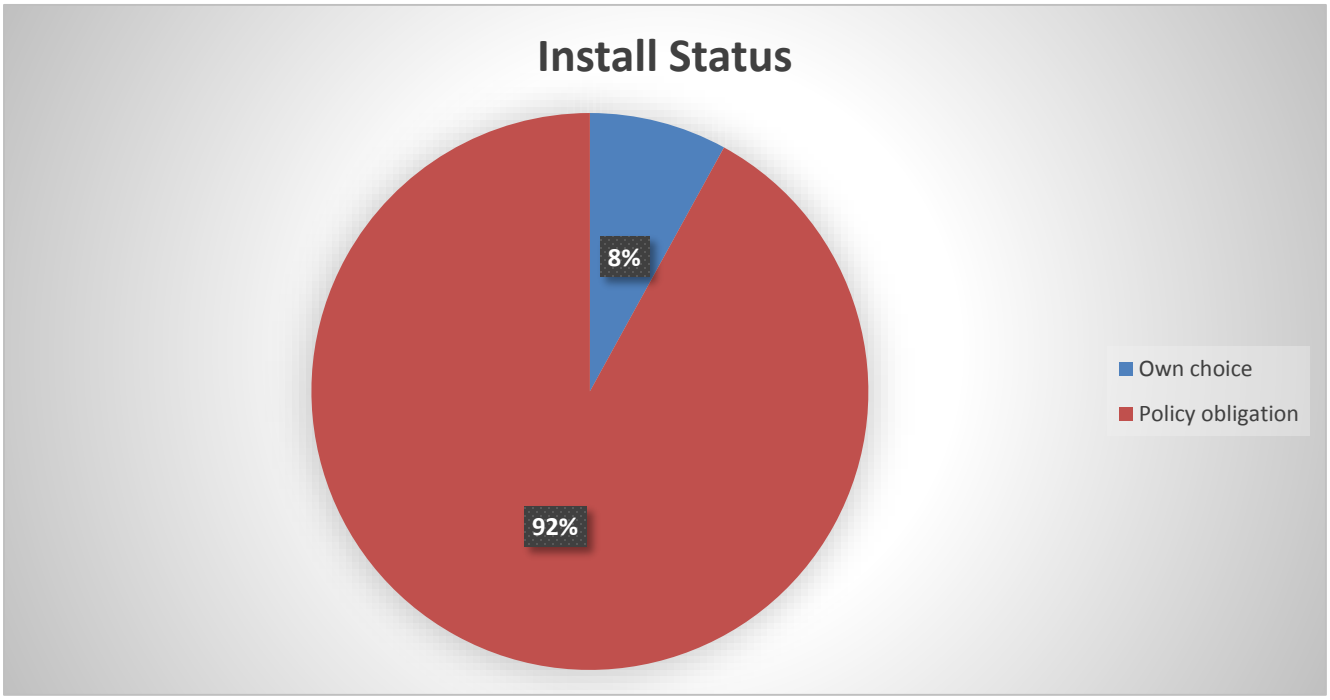


Figure 4.3: Install Status of SRS

4.3.3 Record of Energy

In our survey we found that most of the consumer are not record of energy which has 95%. If they keep energy record, Then they could understand how much energy is generated, how much to spend their house and how much supply to the grid.

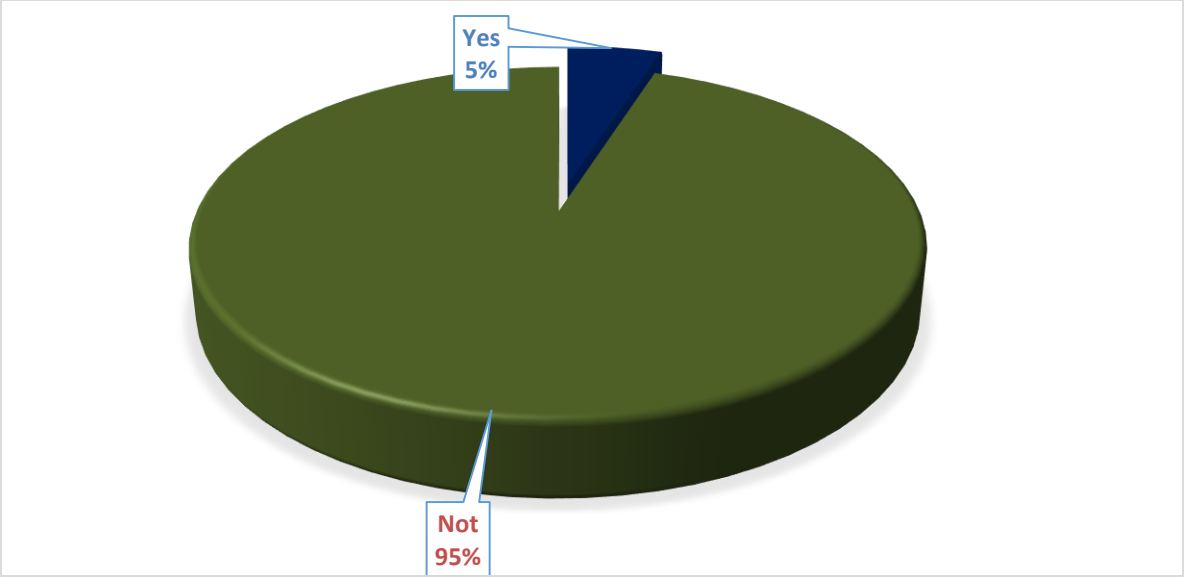


Figure 4.4: Record of energy

4.3.4 Consumer Realization

There were some questions in the survey that showed consumer's personal opinion.88% of consumer's surveyed think the solar rooftop system is useful for them. The remaining 22 percent of consumers think that this system is not beneficial for them. The people who think that this system is not beneficial for them, we have found them in search of their home well and seen that the system is defective or the solar panel is not cleaned properly As a result, the generation of power has decreased in the system. Even if the system is damaged, they do not repair properly. 84 percent of the surveyed consumers thought that they did not waste money because they use their power from this. The remaining 16% of consumers think their money is wasted Because of this we know that they just install this system to get a new connection**.**Where solar panels are visible only on the roof of the house. We asked the consumers did you want to increase the capacity of your solar system. Everyone replied that they do not want to increase the capacity in future. Figure 4.4 shows consumer realization scenario.

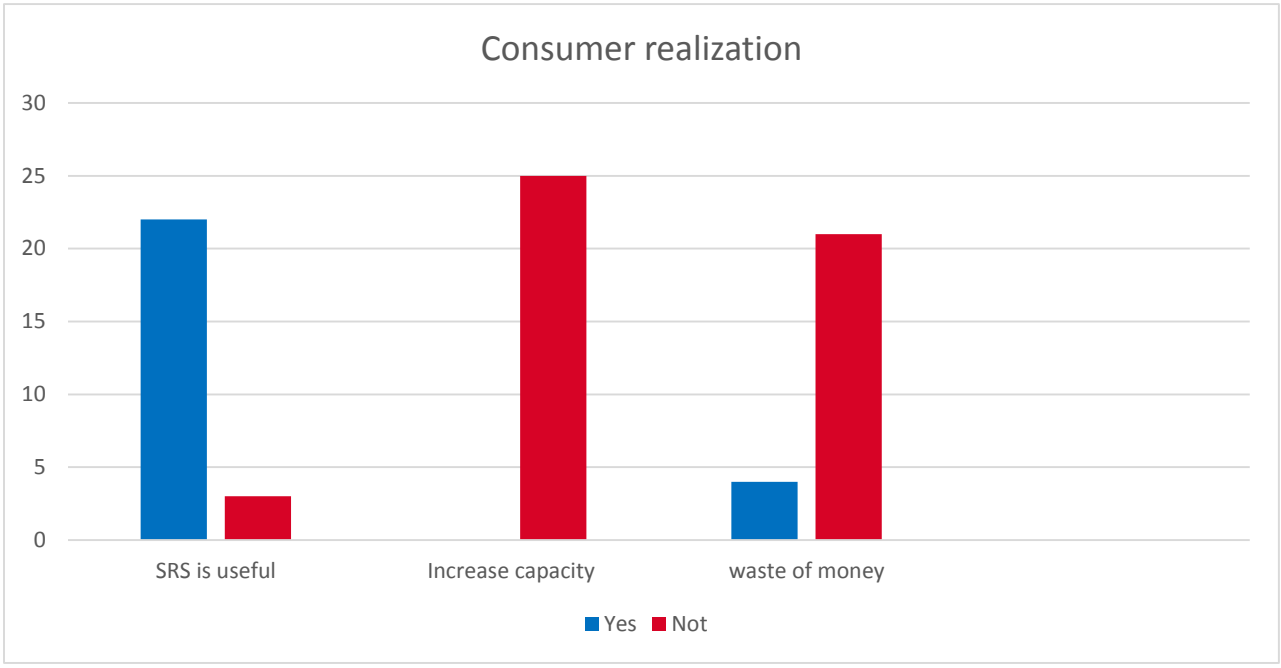


Figure 4.4: Consumer realization

4.4. Present Condition of SRS

The survey found that 64 percent SRS were active and 36 percent were inactive. We know that as the reason for being inactive, if the system disorder they do not repair it or the system was not already in operation. Because they have no training for SRS operation. Figure 4.5 represent the operational status of SRS.96 percent people have no training for SRS operation.

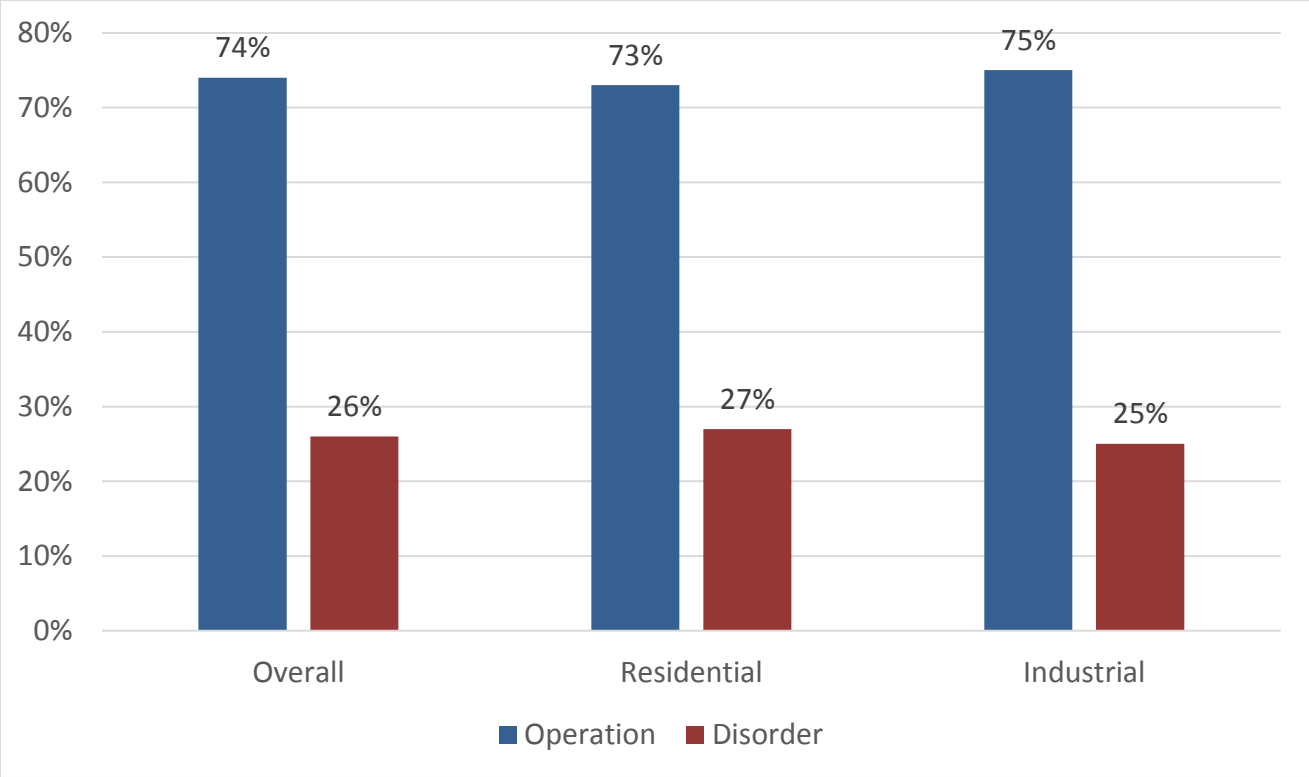


Figure 4.5: SRS Operation status

4.5 Cleaning Status of SRS

The people are not aware of the use of solar energy and they properly monitor and clean the solar system. As a result, the target of the country's renewable energy generation is being interrupted. Many people do not clean the solar panels months after month. As a result, the power generation capacity of solar panels its 50 percent is not generation in a long time. If any parts are damaged, repair them at the right time. We have made a list of maintenance and cleaning status in different homes, given at Table-02. Most of which are clear after one year later and 14 percent of the people never clean since the system install.

Table 4.1: Cleaning status

Duration Of Month	Percentage
One month	4

Two month	8
Six month	25
Twelve month	40
Not clean	23

4.6 Maintenance Status of SRS

Most people do not have any ideas about solar systems so they are not check the system regularly. Our survey shows that 92 percent people check the system regularly rest of the 8 percent check regularly with their kin interest which illustrate in figure 4.6.

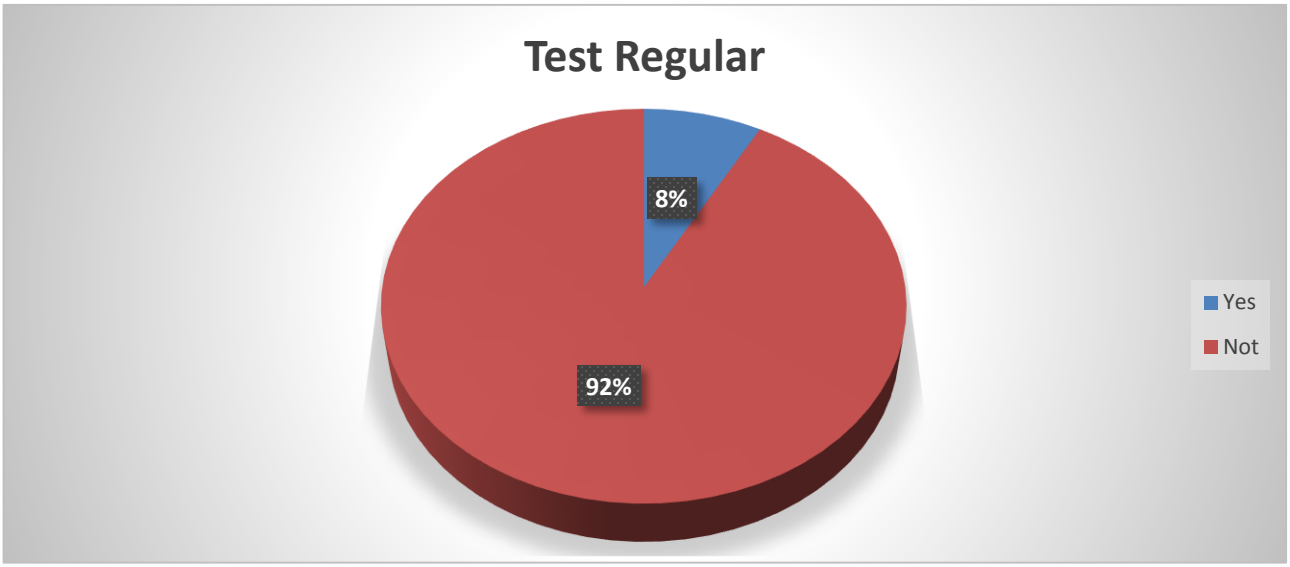


Figure 4.6: Maintenance Status

5.7 Energy Record of SRS

The urban people are less interested in solar electricity. They do not have any record of solar electricity. As a result, they do not know how much electricity is being generated from their solar system? If they kept the energy records, they would have understood how much power system was

used and how much generation. 96 percent of consumer fed solar energy to grid rest of the 4 percent are off grid system. Figure 4.7 illustrate the record of solar energy.

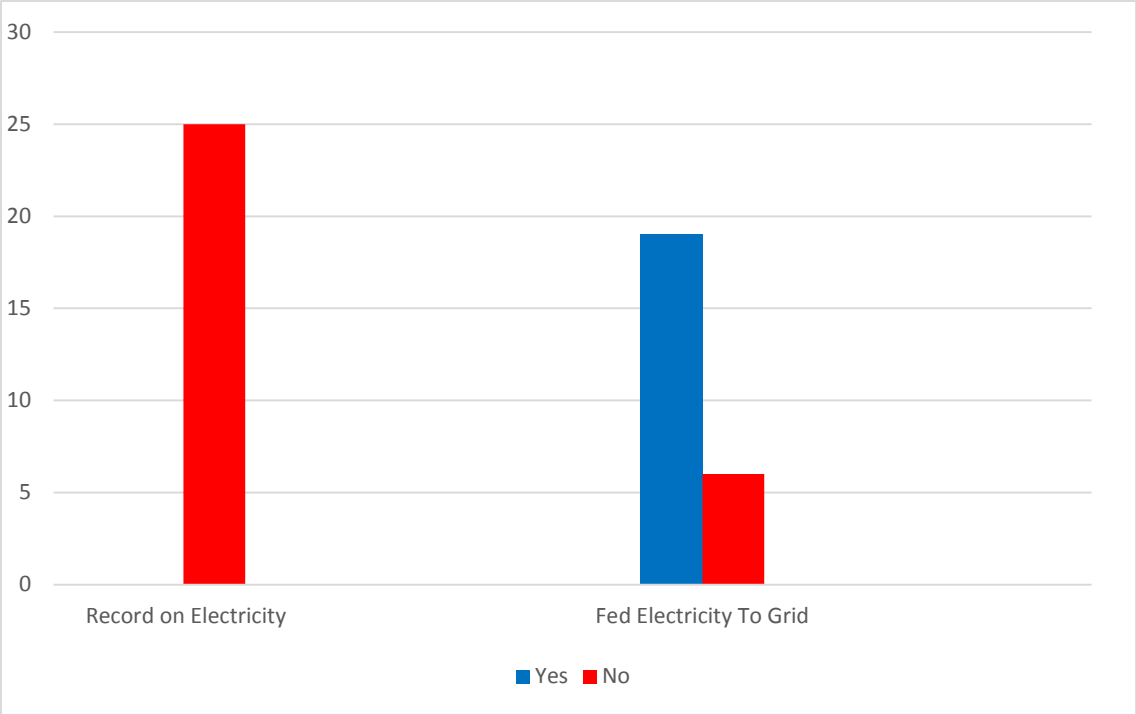


Figure 4.7: Record of solar energy

4.8 Cost Analysis of SRS

We are data collected from different 25 house. In this section we are showing cost analysis of some system.

Here we analyze the per unit cost of 3600 WP PV solar system “HDL Jamila’s Dokkhina.” 14, Allama Ikbal Road, Narayangonj.

Life time = 20 years

Capacity = 3.6 kW

Total install cost = 288000 TK

Electricity generation = 5736.96 kWh (month-16)

∴ Per month generation = 5736.96/16 = 358.56 kWh

∴ Yearly generation = 358 × 12 = 4296 kWh.

And life time generation = 4296 × 20 = 85920 kWh.

Power degradation factor = 0.5%

P Lifetime = Prated*e (rated of decay)*(time period)

P Lifetime = 85920*e (-0.005)*(20)

= 77743.63 kWh

Per unit cost (without maintenance cost) = 288000/77743.63 TK

= 3.70 TK

Here we analyze the per unit cost of 1000WP PV solar system "Life View Developers Ltd." 74, B.B Road Ukilpara, Narayangonj.

Life time = 20 years

Capacity = 1 kW

Total install cost =80000 TK

Electricity generation = 897 kWh (month-13)

∴ Per month generation = 897/13 = 69 kWh

∴ Yearly generation = 69 × 12 = 828 kWh.

And life time generation = 828 × 20 = 16560 kWh.

Power degradation factor = 0.5%

P Lifetime = Prated*e (rated of decay)*(time period)

P Lifetime = 16560*e (-0.005)*(20)

= 14984.10 kWh

Per unit cost (without maintenance cost) = 80000/14984.10 TK

= 5.33 TK

Here we analyze the per unit cost of 3300 WP PV solar system “Croni tex sweater Ltd” 193, Becik shilpo Nogori , Fotulla, Narayangonj.

Life time = 20 years

Capacity = 3.3 kW

Total install cost = 257400 TK

Electricity generation = 475 kWh (month-2)

∴ Per month generation = 475/2 = 237.5 kWh

∴ Yearly generation = 237.5 × 12 = 2850 kWh.

And life time generation = 2850 × 20 = 57000 kWh.

Power degradation factor = 0.5%

P Lifetime = Prated*e (rated of decay)*(time period)

P Lifetime = 57000.6*e (-0.005)*(20)

= 51575.73 kWh

Per unit cost (without maintenance cost) = 257400/51575.73 TK

= 4.99 TK

4.9 Thesis finding and suggestion

After completing the survey according to the indicators and analyzing the result we pointing out some important things.

- The main thing is there consumers are not concern about the SRS properly. So, here need to counsel consumer when provide the SRS.
- Consumers do not have enough knowledge about how to clean it and the usefulness SRS system. There should need to train the consumer so that they can clean it properly and should inform about the usefulness of the SRS system.
- Majority of the consumer do not know about the net metering system. Government organization should inform the consumer how they will get profit by net metering system.
- About 88% consumer think that SRS system is waste money, they do not get much energy from SRS but its initial cost is very high. Government should reduce the market price of instrument for the SRS system.
- From above analysis it can be roughly estimated the data in the respective areas. To find out actual data we need time series data. Further studies are required in this line for better understanding of SRS in various area of Bangladesh.

4.10 Conclusion

From our collected data analysis we can see that most the consumers have installed the SRS system to get a new grid connection. They does not want to extend the capacity of the system because the initial cost of the system is very high. But from coast analyses, we can see that solar power per unit cost is less than the grid power cost. If the government should take some initiative such as aware people to use solar power, subsidy for installing solar system, free maintenance training. So hopefully the use of solar power will increase.

CHAPTER FIVE

CONCLUSIONS

6.1 Conclusions

We have inspected 25 solar Rooftop systems in Narayanganj area. It is very unfortunate that most of the systems were inactive or not connected in proper way. The survey found that 92 percent of the people installed solar rooftop system for got a new grid connection. They are not prefer SRS because initial cost of SRS install is very high. Although urban people are more likely to know the efficient usage of solar energy, they still prefer fossil fuels for their power generation. In this manner, they are indirectly contributing to environmental hazards and wasting lots of money too. The main aim of our thesis is to analysis the existing solar systems' efficiency regarding the power supply and cost consuming. we are analyze the per unit cost of SRS and seen that it's range around 3.92 to 5.6 Taka .Moreover, we also have proposed some initiatives those should be taken by Bangladesh Govt. to increase the power generation from solar energy and solar energy user as well. Thus a developing country like Bangladesh can be self-dependent in power generation, can keep the environment green and save money by using solar energy.

6.2 Future Scopes

In urban areas effectiveness of solar system is a huge issue. In our survey of urban solar systems we have found that the major part of the installed solar system is not operational or not effective. City dwellers are not that much interested in the effectiveness of renewable energy sources. The main reasons behind this situation are high installment cost, technical problems during installing, specialized disadvantage and absence of strict policy enforcement by the government. Government cannot diminish this crisis alone. We all have to work together. Other private organizations e.g.

NGOs, distinctive solar manufacturer organizations, contributor offices approach readily and work as an inseparable unit. The government needs to take logical, realistic steps other than the already taken initiatives. If government comes forward in favor of promoting the solar home systems in urban areas other organizations and institutions will regain courage to lessen the crisis. Steps government can take are listed below:

1. Government can initiate a subsidy scheme to help individuals (both in rural and urban area) and organizations to buy solar technologies at reduced capital cost. Then people will be more interested in solar energy.
2. Govt. should reduce VAT/taxes on solar accessories & increase our own production of solar.
3. Govt. should onset net metering system.
4. Increase consumer awareness.
5. Govt. should provide loan for install SRS.
6. Insure the quality of the SRS.
7. IPS system from their SRS during peak demand hour.

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