

PERFORMANCE ANALYSIS OF SOLAR ROOF TOP SYSTEM UNDER 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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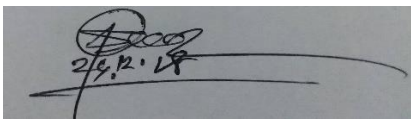
DAFFODIL INTERNATIONAL UNIVERSITY

December 2018

Certification

This is to certify that this thesis entitled “**performance analysis of solar roof top system under DPDC**” 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.

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List of Abbreviations

SHS	Solar home system
PV	Photovoltaic
BRAC	Bangladesh Rural Progression Committee
REB	Rural Electrification Board
IDCOL	Infrastructure Development Company limited
GEF	Global Environment Facility
PCI	Participating Credit Institution
BPDB	Bangladesh Power Development Board
GDP	Gross Domestic Product
LED	Light Emitting Diode
RE	Renewable Energy
DC	Direct Current
AC	Alternating Current
AGM	Absorbed Glass Mat
DPDC	Dhaka Power Distribution Company

ACKNOWLEDGEMENT

First of all, we give thanks to God. Then we would like to take this opportunity to express our appreciation and gratitude to our thesis supervisor **Prof. dr. M. Shamsul Alam, dean, Faculty of engineering, Department of EEE** for being dedicated in supporting, motivating and guiding us through this thesis. This thesis can't be done without his useful advice and helps. Also thank you very much for giving us opportunity to choose this thesis.

Apart from that, we would like to thank our entire friends for sharing knowledge; information and helping us in making this thesis a success. Also thanks for lending us some tools and equipment.

To our beloved family, we want to give them our deepest love and gratitude for being very supportive and also for their inspiration and encouragement during our studies in this University.

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-1

INTRODUCTION

1.1 Introduction:

Bangladesh is an over populated 1015 km² [1] creating nation having no supply of the nation. Rural electrification through solar photovoltaic (PV) technology is promising and becoming more than popular. Solar home systems SHSs are extremely decentralized and particularly suitable for remote inaccessible regions therefore the business of solar power system was introduced by both governmental and non-governmental organizations. Solar home system are contributing a colossal measure of vitality and changing the present vitality prerequisites, particularly in rustic territories of Bangladesh. At present there are 30 associations leading sun oriented vitality organizations in Bangladesh [2]. Grameen Shakti initially familiar insignificant exertion glorious bodies with the nation community in 1996 and in 1997 [3], Bangladesh Rural progression committee, BRAC, a NGO, propelled sun energy program for reasonable improvement [4, 5]. Electricity play very important role in creating nations the economy and the value of living of a country. To improve business advantage, approaches and motivating forces are there to encourage the development of both the horticultural and the mechanical segment which are absolutely relies upon power. Nonetheless age and supply of electrical power in the nation is falling much behind the developing interest restricting supportable development of the economy. Bangladesh as it were depends upon oil gas and hydro control stations to deliver critical piece of power. In any case our advantage rises well ordered and control crisis transforms into a significant issue for our country nowadays. Despite the way that many electricity age units had been added to the national lattice to comprehend the electricity crisis issue anyway it is not adequate.

Popularity and expanding need of intensity have made test for the power plants to take care of the demand. In Bangladesh a substantial segment of aggregate masses still doesn't have the entrance to electricity. At present fuels account for 99% of energy carious in rural households. Just about 60% of aggregate demography in Bangladesh approach power and it would take around 15 years to give power to all [6]. To fathom this vitality emergency we can utilize distinctive type of sustainable power source to produce control. Sustainable electricity source originates from various kinds of regular assets essentially from daylight, wind, tides, geo-thermal, hydro, bio-gas, bio-diesel, bio-fuel, and solar. Numerous Government and non-government associations are working with various sorts of sustainable power source to give power to the normal masses. To satisfy our power request sun based vitality through sun powered home framework solar home system SHS program was helped thorough two diverse conveyance models. The 1st model is apply by the rural Electrification Board (REB) the site owned utility responsible for grid electrification in Infrastructure Development Company (IDCOL), which sold the frameworks to family units utilizing a small scale fund conspire executed by different private organizations, for example Grameen Shakti. Specifically Grameen Shakti has assumed a vital job in the spread of solar home system SHS in country Bangladesh and its credit program has achieved some low-pay families [7].

1.1.1 Potential of solar energy:

There is a huge potential of solar energy. It is huge to the point that the aggregate vitality needs of the entire world can be finished by the sunlight based vitality. The total energy consumption of the whole world in the year 2008 was 474 EJ (1exajoule =1018J) or approximately 15 TW (1.504*1013W). From the sun earth receives 3,850,000 EJ of energy. [8] Almost 80%-90% of this energy came from fossil fuel. [9] Which is equivalent to 174 PW (1petawattas=1015W). The earth does not hold all the vitality a piece of it reflects back. After refection earth gets 89 petawatts of vitality. Of this immense sum just under 0.02% is sufficient to supplant the nonrenewable energy source and atomic energy supply in the entire world at present. By this we can without of a stretch comprehend the extra ordinary of sun powered vitality. Considering about nursery impact natural effect, cost, Chance.

1.1.2 Solar home system program throughout the world:

Solar Home System (SHS) has for some time been pondered as a feasible alternative to determine the vitality emergency for the country individuals in socially and monetarily underprivileged social orders everywhere throughout the world. Be that as it may, an appropriate money related structure has dependably been looked to convey the extraordinary effects of this innovation to the provincial poor. Understanding the possibility of Solar Photovoltaic PV innovation, since the mid1990s the World Bank, the Global Environment Facility (GEF) and some other worldwide contributor organizations have started and financed sun powered home framework extends in creating nations like Argentina, Bangladesh, Benin, China, India, Srilanka, Togo, Vietnam and so forth. With the worldwide financing Grameen Shakti effectively executed the Consumer Credit Model through its Microfinance Policy in Bangladesh [10]. Following this model Srilanka's driving Participating Credit Institution (PCI) Sarvodaya Economic Enterprises Development Services (SEEDS) financed in excess of 60,000 frameworks amid 2002-06 [11]. SEWA Bank in India, FAULU and KUSCCO in Kenya, FADES in Bolivia and so on are some different associations giving SHS to country individuals utilizing Microfinance arrangement [12].

1.1.3 Solar energy source of Bangladesh:

First solar PV was scattered by Rural Electrification Board in 1993 then Local Government Engineering Department, and after that Infrastructure Development Company Limited began their sun based vitality program. Right now, a various Government Organizations and Non-Government Organizations are spreading SHSs all through the nation under different sustainable power source program financed by IDA, GTZ, KFW, GEF, ADB and IDB. IDCOL is the pioneer association supporting its 47 Partner Organization to spread SHSs So far, up to November 2013, a sum of 2,677,896 solar home frameworks SHSs have just been introduced under the program.

1.1.4 Solar energy home system situation in Bangladesh:

Solar Energy is an extraordinary hotspot for comprehending power emergency in Bangladesh. Bangladesh is arranged somewhere in the range of 20.30 and 26.38 degrees north scope and 88.04 and 92.44 degrees east which is a perfect area for sun powered vitality use [12]. At this location the measure of long periods of day light every day consistently and the most elevated and the least power of straight radiation in W/m² are likewise appeared in the Figure 1.1 [13]

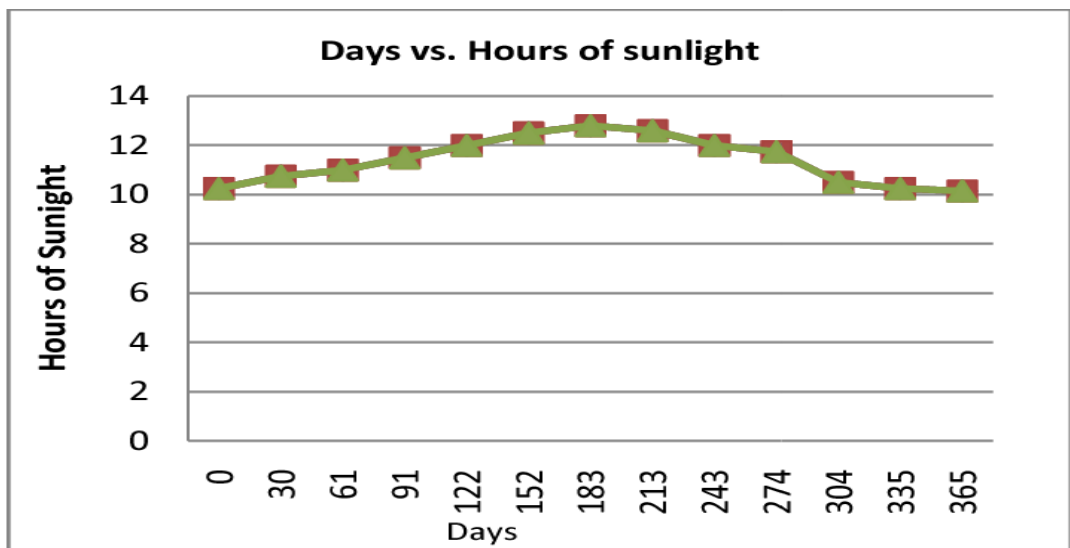


Figure 1.1: The amount of hours of sunlight in Bangladesh

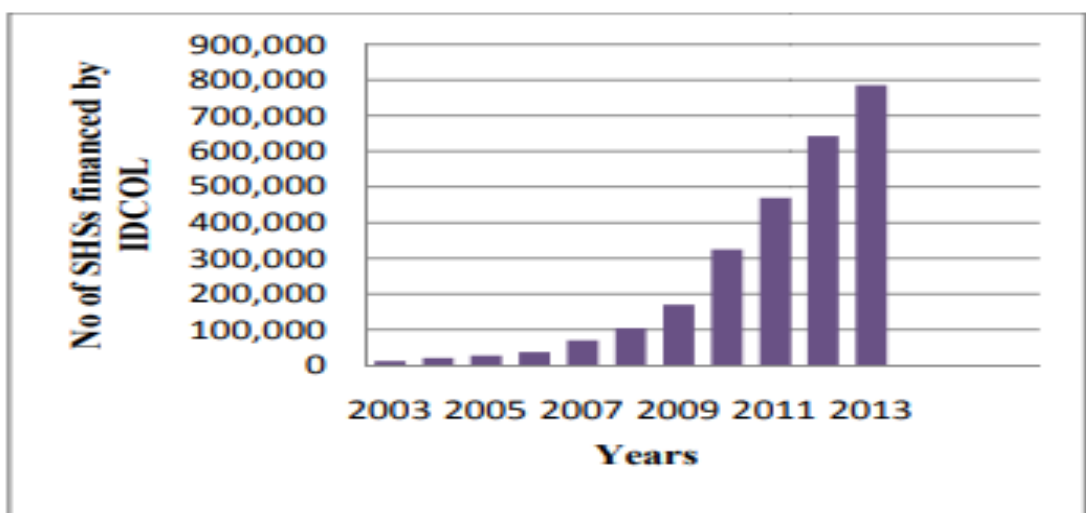


Figure 1.2: Year wise installation of solar home systems in Bangladesh by IDCOL.

IDCOL has upheld NGOs in establishment of solar home system (SHS) and a sum of 1,320,965 solar home systems having limit of about more than 36.5 MW have been introduced up to February 2013.[14] IDCOL now has an overhauled focus of financing 4 million solar home systems by 2015. In 2012 alone, IDCOL has figured out how to fund 642,994 SHS through its accomplice associations. At this pace, in three years from 2013 to 2015, add up to establishments in the following three years will be around 1,928,982. The total aggregate will be 3,882,868. This exhibition that with an extra push IDCOL can achieve its target of 4000000 installations by 2015. Figure 1.2 [15, 17]

Figure 1.3 show the approximate division wise solar home system installation. The figure illuminates that the distribution of solar home system (SHS) is highest in the Dhaka district whereas lowest sylhet. [16, 17]

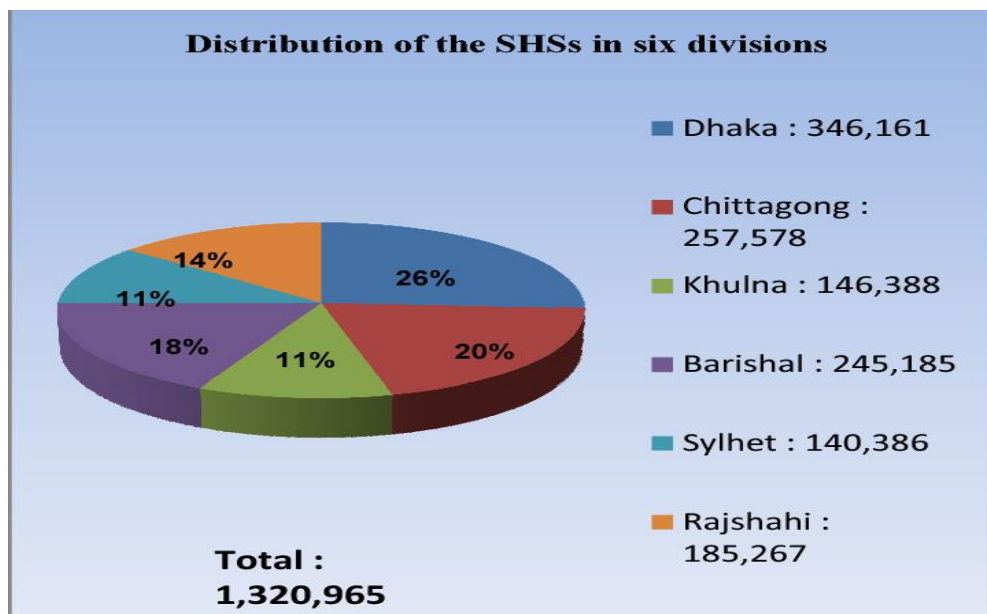


Figure 1.3 Distribution of the SHS in six divisions in Bangladesh up to February 2013.

Presently a-days, around 2 million solar home system (SHS) as of now introduced under IDCOL's financing with normal capacity 50 W, add up to generation capacity in December 2012 is roughly 94 MW. At present around 60,000 SHS are being introduced each month under IDCOL's SHS program. In light of current circumstances, by December 2015, add up to generation capacity from this solar home system program should reach around 200 MW. Presentation of solar home system photovoltaic PV frameworks has been in advancement since 1980 however the aggregate wattage up to December 2002 was only 1,000 kW [18]. As of late, aside from sun oriented home framework, different other sustainable power source undertakings, for example, biomass (rice-husk) gasification based power plants, biogas (from poultry litter and dairy animal compost) based power plants; metropolitan waste based power plants are being completed in Bangladesh. As per new controls, each recently manufactured tall structure must introduce sunlight based photovoltaic PV boards at the rooftop top before they get association with electrical dispersion lines. All these sustainable power source (RE) ventures are contributing in accomplishing the administration's objective of directing 5% control from inexhaustible sources by 2015 and 10% by 2020 as announced in the Renewable Energy Policy of Bangladesh [19].

1.2 Problem Statement:

Electrical power access plays the vital role in accelerating economic development by improvement health and life standards. Important investments have been made in energy sector to improvement electricity access in household and more than efforts need to be made by Rawandan government in collaboration with private sectors to meet he sets target of electrifying 70% of households by 2017/2018 and 100% by 2020.[20] For the above focuses to be cultivated, a mix of different arrangements that emphasis on the land area, pay and utilization level is required as opposed to utilizing the conventional association with the framework that may not be reasonable for every rustic family unit. Off grid photovoltaic frameworks can be proposed as a feasible answer for be actualized with an extensive variety of advancements from a fundamental solar home

system that can deliver power for the single house with a radio, cell phone and four lights to remain solitary frameworks that can produce abnormal amounts of electrical power that can be utilized by both the family units and different business focuses. This methodology can fill in as a temperate and dependable answer for expanding the rate of electricity access by the whole rustic network and in addition for the nation all in all. [20] In acknowledgment of the above proposed arrangements the exploration had likewise demonstrated that the long haul yearly normal worldwide light in various regions is over 1700 Kwh/m². This shows what number of areas of Rwanda are positive possibility for use of photovoltaic PV heavenly bodies. [21]. In this manner since the chosen put is dry with high force of sun divergence this makes the site more alluring for the utilization of photovoltaic frame works for power age and capacity.

1.3 Specific objectives of this research:

To find the potential results in respects to solar energy frameworks in our nation and also the issue's in regards to the business. A cautious audit prompts the improvement of the accompanying explicit research goals:

- To know the present condition of SRS in Bangladesh and the opinion of the consumers about it.
- Calculate the 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:

The energy sector in Bangladesh faces significant challenges which include among others limited availability of indigenous hydro-carbon resources limited access to the electricity network and climate change. Government has been attempting to alleviate these difficulties by duty designs and projects to guarantee supply of power as indicated by interest and to keep up an enduring GDP development rate of more than six percent for the following quite a long while. The Power System Master Plan 2010 set objectives for fuel variegation with an accentuation on expanding the job of sustainable power source in the power age blend. Solar home system were considered monetarily useful by 71 percentage of the households. Then solar home system establishment upkeep costs are anticipated to be insignificant more than 25years. Solar home system households who utilized sun based controlled LED lights abstained from purchasing lamp fuel each month for lamp oil lights. As a rule, if the lamp oil cost expanded, it brought about diminished utilization to stay away from an expansion in month to month lamp fuel consumption. A solar home system additionally spares its clients time, cash, and vitality for buying and transporting lamp fuel from business sectors. Besides, because of effective lighting, householders could seek after business exercises like sewing and crafted works. Four sewing machines were as of late purchased by four ladies with the assistance of credit by a NGO which together with a solar home system will enable them to acquire additional cash by sewing at night hour is utilizing sun light based light. Proprietors of tea slows down and neighborhood shops revealed longer night business hours and expanded benefits since the establishment of solar home system. This benefit cash could be additionally given for business extension. Basic supply shop proprietors who were utilizing lamp fuel lights for their business broadened their working exercises by around 2 hours because of presentation of the solar home system.

1.5 This thesis is organized as follows:

Chapter 1 Introduction.

Chapter 2 literature review.

Chapter 3 Methodology.

Chapter 4 Result.

Chapter 5 Conclusion.

CHAPTER-2

LITERATURE REVIEW

2.1 Introduction:

Energy is the power to do work where work is done when a strength move is an object. We need and we utilize energy consistently, and energy is accessible in every single different frame. Electrical energy is energy that is put away in charged particles inside an electric field. Electric fields are basically zones neighboring a charged molecule. As it were, charged particles make electric fields that apply quality on other charged particles inside the field. The electric field applies the solidarity to the charged molecule, making it move at the end of the day, to do work.

2.2 Energy:

In socio-economic development, energy sources are the vital that can be renewable (solar, wind, biomass, hydro, geothermal and soon) or nonrenewable (oil, coal and natural gas) energies especially to produce electricity where the infrastructure is quite small as well as insufficient [22]. Additionally, the expansion underway and add up to request is completely related with the expansion in vitality utilization. Then again, the expansion in vitality utilization is not the related of the financial development and aggregate interest. Hence, the current production and total demand fully depend on energy consumption [23]. Global electricity production is nearly 60 percent in between 2011 and 2017 through from renewable sources plus hydro power according to the report from the OECD and the International Energy Agency in Figure 2.1 [24].

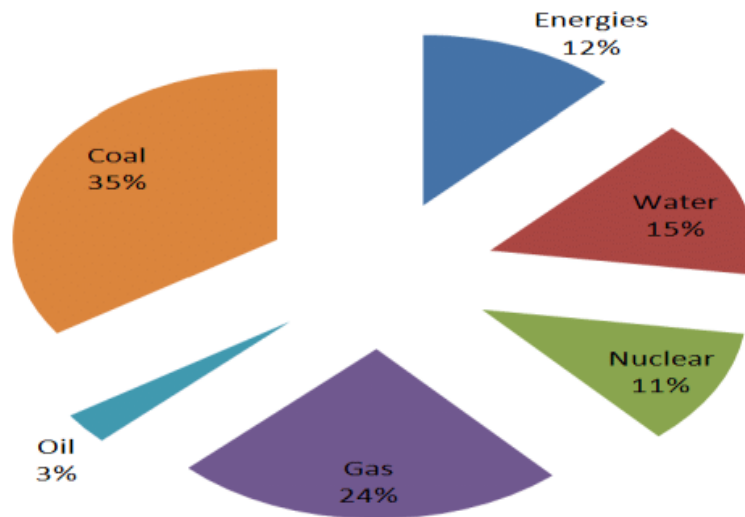


Figure 2.1: Electricity generation mix worldwide (in kwh)

The per capita power consumption in Bangladesh is one of the lowest 321 kwh in the world [25, 26]. The energy rate is very low compared with population growth in Bangladesh. . Hence, electricity production is less satisfactory whereas demand for electricity is going to peak. On the other hand, today the number has increased to around more than 50% of the population where that percentage was just 3% in 1971. However, still one of the lowest in the world-but access often amounts to just a few hours each day [27]. According to the energy system master plan Bangladesh electricity demand was made based on 7 percentage GDP growth rate in 2010 and this GDP growth rate requires investment 38 percentage GDP by 2021[29]. After the increasing access and attain economic development, its rate has been increased. Based on this study the peak demand would be about 17304 MW in FY 2020 and 25199 MW in 2025[27-31] that has been given through Figure 2.2.

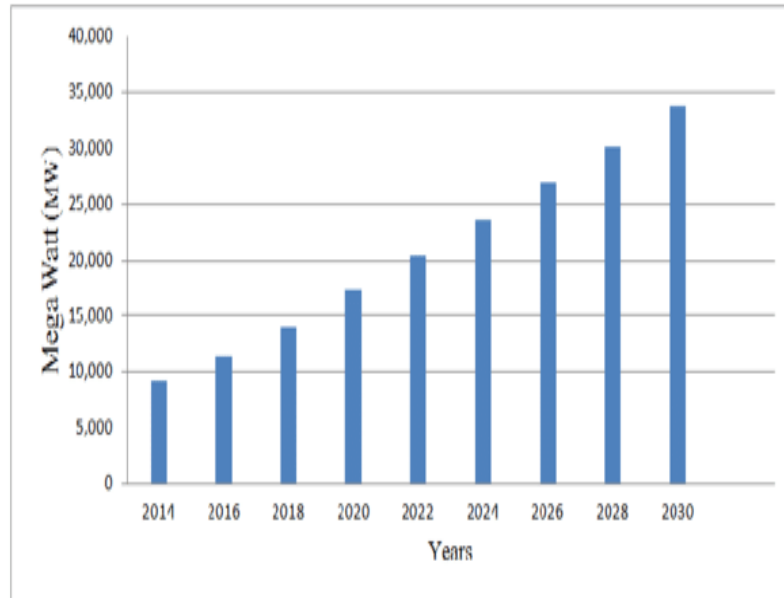


Figure 2.2: Electricity forecasted demand in Bangladesh

2.3 Renewable Energy in Bangladesh:

Bangladesh has extensive renewable energy potential, and noteworthy past involvement in creating renewable energy projects. The vast majority of the current sustainable RE venture has been in off-grid advances, for example, solar home system (SHS), solar micro grids, and solar irrigation pumps. The GOB has set a few venture focuses for framework associated innovations including utility-scale sunlight based, wind, and waste-to-vitality. In spite of noteworthy potential the improvement of these renewable energy (RE) advancements, in any case, has been ease back to appear. There are different managerial budgetary and particular blocks that, at whatever point tended to, could animate supportable power source enthusiasm for Bangladesh. Improved headings, for instance, foundation of a formal feed-in collect and game plants for compensating smaller than normal matrix examiners after transmission augmentation, would diminish shot and send strong signs to budgetary authorities. Concede subsidizing and low enthusiasm financing can help address worries about moderateness for both lattice associated and off-matrix ventures.

Lessened financing expenses can likewise balance the mind-boggling expense of acquiring land for activities arrive short age being one of the key obstructions to venture. Generally speaking the conundrum of the speculation circumstance is that elaborate involvement with sustainable power source undertakings will prompt expanded venture. Effective inexhaustible tasks will give better access to information on sustainable power source; show fruitful plans of action that can be imitated by nearby banks; and permit neighborhood specialists the chance to take in the fundamental specialized aptitudes. The GOB has two arrangements of mandates for sustainable power source venture. The first is the 500 MW Solar Program, advance in 2012. The goal of the program is to include 500 MW of sun based age limit by 2016 through financing and executing sun based controlled undertakings in both the general population and private areas. The GOB have been also set renewable energy (RE) improvement targets for several technologies for each year from 2015 to 2021 “RE development Targets”. The renewable energy Development targets require a extra 3100 MW of RE of renewable energy ability to be introduced by 2021. The greater part of the new limit will be given by sunlight based (1676 MW or 54 percent) and wind (1370 MW or 44 percentage). There are additionally focuses for waste to energy 40 MW, bio-mass 7 MW, bio-gas 7MW, and hydro power 4 MW. SREP could assume a noteworthy job in tending to a portion of the speculation obstructions and bolster the GOB's sustainable power source objectives. SREP assets would be utilized to kick-begin interest in the administration need regions of utility-scale extends and off-matrix sun oriented. Gives and minimal effort financing can be utilized to draw in early speculators into a doubtful market and keep the expense of vitality more moderate for clients. The effective undertakings created utilizing SREP assets will at that point exhibit the potential for scaling up activities and pull in different speculators into the market.

2.4 Non-renewable Energy:

Non-renewable energy such as natural gas Oil from minerals and other sources, coal and coal like substance and soon [32]. Oil is one of the major sources of non-renewable energy in the world and it seems to be a positive for reserving high amount of proven oil globally.

Around 1200 to 1266 billion barrels of oil has reserved at British where this information has been collected from IEA [33]. In additionally the reservation of global oil reserves is almost 60 percentage larger today compared to 20 years ago and production of oil has gone up by 25 percentage. If the alternative oil resources including oil sands oil shale natural bitumen and extra heavy oil are taken into account the global oil stockpile will be around four times larger compared to the current conventional reserves. Oil yet relics the leading energy resource with a wide range of possible applications. From 2000 to 2009 the oil resource assessments have grown which is very low and about a half of this incline is due to the reclassification of the Canadian oil sands and the revisions undertaken in major OPEC countries- Venezuela, Iran and Qatar. Compared to the 2010 survey the proved oil reserves increased by 37 percentage and production by 1 percentage [35]. Natural gas is another fossil fuel resource which is highly contribution to the world energy economy. The cleanest of all fossil based natural gas, fuels is overflowing and flexible. It is progressively utilized in the most effective power age advances, for example, Combined Cycle Gas Turbine with change efficiencies of about 60%. The stores of customary oil gas have created by 36% over the span of late decades and its age by 61%. Contrasted with the 2010 study, the demonstrated gaseous petrol holds have developed by 3% and generation by 15% [34]. The world petroleum gas holds toward the finish of 2004 were 179.5 trillion m³. Moreover, generation of gaseous petrol has been ascending at a normal rate of 2.5% in the course of recent years. If age continues ascending because of additional usage of gas for transportation and extended power creation, the stores would prop up for less years. Clearly, there could be additional new disclosures. In any case, even with extra revelations, it is sensible to expect that all the accessible flammable gas assets may last around 50 years with a top underway happening a lot prior [33]. Coal is the most far reaching non-renewable energy source far and wide, and in excess of 75 nations have coal stores. The current offer of coal in worldwide power age is over 40%, yet it is imminent to diminish in the coming years, while the real coal utilization in supreme terms will develop. Notwithstanding the way that countries in Europe, and somewhat North America, are attempting to move their usage to elective wellsprings of imperativeness, any declines are more than offset the broad making economies, fundamentally in Asia, which are powered by coal and have basic coal holds.

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2.5 Impacts of SHS:

A solar home system (SHS) has both immediate and backhanded effects on clients, with a few effects changeless in nature. Access to solar home system power improves the general increase of life of its clients. Exercises of day by day living like contemplating and working under light, sitting in front of the TV programs, charging electronic gadgets are every now and again attempted by individuals who have a sun oriented home framework unit in their family unit, along these lines advancing family welfare by giving a superior personal satisfaction or greater profitability.

2.5.1 Lighting Facilities:

Lighting is the most widely recognized solar home system (SHS) application, and most solar home system (SHS) bundles incorporate LED lights. Driven lighting gives a stage forward in standard and comfort. Sunlight based lighting enables provincial families to expand their work day into the sunset hours. Because of broadened study and family unit work hours, comfort, security, cleanness, and brilliance, lighting is viewed as the most vital advantage of solar home systems (SHSs). Around 64% (n = 77) of householders reacted that lighting was the primary reason they introduced a solar home system (SHS). Poisonings, flames, and blasts are all around recorded lamp oil dangers [36]. Rather than lamp oil lights, sun based lights are free of dangerous emanations. In addition, utilization of a SHS decreases the time spent keeping up and refueling lamp oil lights. In provincial regions, obtaining and transporting lamp fuel is regularly both troublesome and costly. More brilliant solar home system (SHS) lights are additionally a tremendous enhancement for the poorer light given by lamp oil lights. Because of lighting offices, understudies had more opportunity to study, and ladies never again depended exclusively on daylight to finish their family unit errands. Lighting also benefit from other household activities for example sewing by women small shops and village markets to manage during the evening and relieved their reliance on grid supply which is more unreliable especially in rural areas of Bangladesh.

2.5.2 Information Facilities:

Despite the fact that lighting was the most prevalent application, access to different excitement and correspondence offices gave a solid solar home system motivation. Solar home system (SHS) expanded the chance to get to data through sitting in front of the TV or potentially tuning in to radio communicate data, and gave better correspondence openings by means of cell phones and additionally the Internet. Because of the abnormal state of ignorance pervasive in provincial zones, radio and TV are the best methods for achieving country occupants, and in this manner assume an imperative job in financial improvement [36].

The Internet has now influenced it conceivable to procure and share data, e.g., on instruction and medical problems with nearby and global associations, for example, NGOs, agriculturists' associations, and ladies associations. Universal improvement offices and national advancement accomplices are as of now trying different things with new data innovations and electronic correspondence systems for country improvement. Such data devices can be extremely puissant at spreading essential messages about new farming creation thoughts and systems and in addition wellbeing, sustenance, family arranging, and other social and social issues. Other than close to home correspondence, portable correspondence has a few financial and social advantages; it can improve business, diminish data asymmetries and market wasteful aspects, and encourage better transport. Access to such as offices can realize changes in the way of life of life of provincial individuals. As opposed to investing energy conversing with one another (mingling), the members of our examination liked to sit in front of the TV shows to be a la mode on current national and worldwide issues. Rustic individuals accumulated in tea slows down or shops in the commercial center to watch a unique program, film, or match together. Getting a charge out of TV amusement indicates helped them to unwind following multi day's cultivating and different exercises. Battery-powered lead-corrosive batteries normally used to control TV sets should be transported more than a few kilometers for energizing by and large. A SHS requires just daylight and will last up to 20 years with negligible overhauling.

2.5.3 Health and Environment:

Solar home system can have noteworthy wellbeing and natural advantages in rustic regions. Since a solar home system has a negligible introduced carbon impression and sunlight based vitality is in relatively limitless supply within a reasonable time-frame, solar home systems (SHSs) are probably going to have more positive natural effects than fossil and biomass energizes. A solar home system can supplant lamp oil lights, which transmit considerable measures of fine particulates, carbon monoxide (CO), nitric oxides (NO_x), and sulfur dioxide (SO₂), all of which unfavorably impacts indoor air quality [39].

These poisons may cause disable lung capacity and increment irresistible sickness, asthma, and malignancy dangers [37]. Solar home systems have been found to result in less contamination and diminish the burden related with utilization of lamp fuel lights. Among respondents, just 10% every so often still utilized lamp oil lights for lighting at whatever point required. Utilization of SHS additionally diminishes nearby air contamination. There was an abatement in neighborhood contamination levels coming about because of the lessened utilization of lamp oil lights and little diesel generators [38]. Furthermore sunlight based home framework produces power with no immediate carbon dioxide (CO₂) discharges. The net carbon emanation balance is assessed to be roughly 6 tons of CO₂ over the 20-year life of one PV framework [39]. Lamp fuel, diesel fuel, or gas set away for lights and little generators are potential security perils, and basic amounts of expend wounds caused by light oil lights are represented far and wide. In the Philippines, there have been various reports of flame passing caused by lamp fuel lights [40].

2.6 Connection of solar PV system:

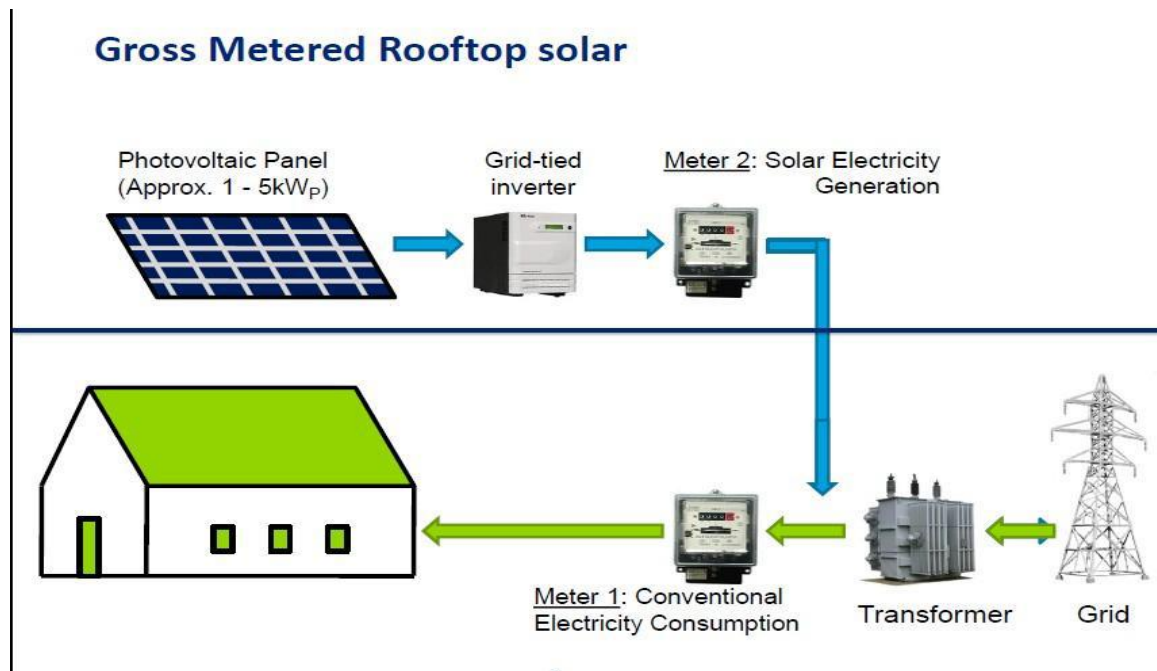


Figure 2.3: Connection of solar PV system.

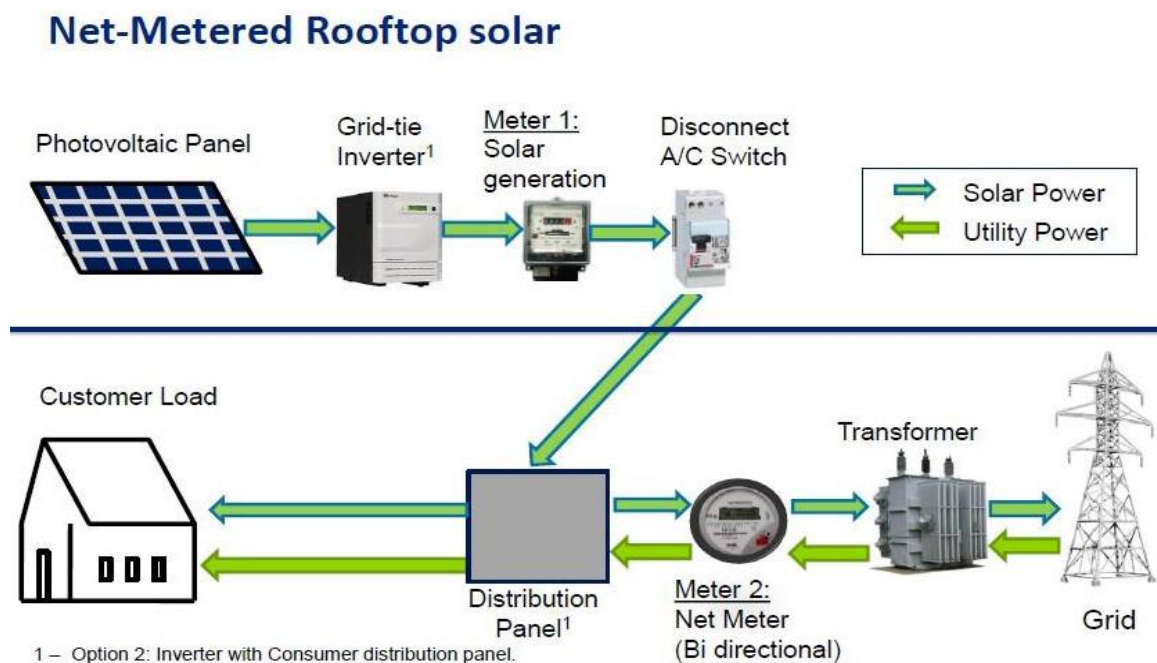


Figure 2.4: Net-Metered Rooftop solar

2.6.1 Components of a solar photovoltaic system:

A typical solar PV system consists of solar panel charge, batteries, charge controller, inverter and the load.

➤ **Solar panel:**

When all is said in done, a solar cell or photovoltaic (PV) cell is a hard state electrical gadget that changes over light into electric flow utilizing the photoelectric impact. Each board is evaluated as per its DC yield control under standard conditions, and commonplace determination ranges from 100 to 320 watts. We uphold a gathering of 200 watt boards to shape 1000 watts. The guessed proficiency of these boards is 80% and therefore we could hypothesize that a figure of 1870 watts might be gathered from this area. A photovoltaic system conventionally understand an array of solar panels, an inverter, and an optional battery.



Figure 2.5: Solar panel.

➤ **Charge controller**

At the point when battery is involved in a framework, the need of charge controller approaches. A charge controller controls the indeterminate voltage develop. In a splendid radiant day the sunlight based cells create more voltage that can prompt battery harm. A charge controller help to keep up the equalization in charging the battery.

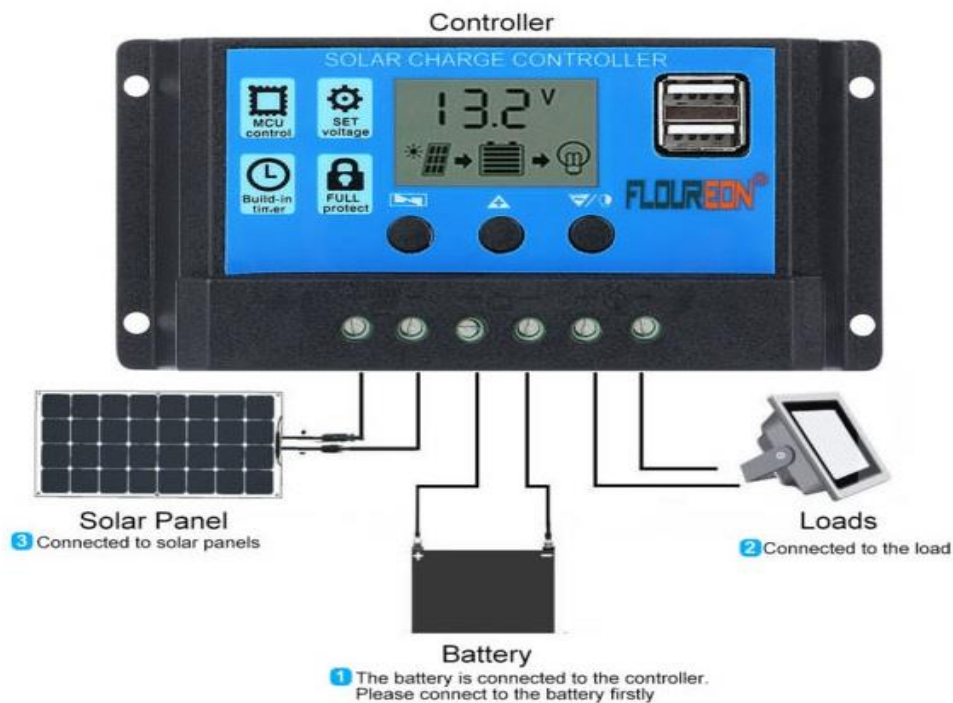


Figure 2.6: Charge Controller

➤ **Batteries:**

To storage charges batteries are used. There's numerous kinds of batteries accessible in the market. Be that as if may, every one of them are not reasonable for sun oriented PV advances. Generally utilized batteries are nickel / cadmium batteries. There's some different kinds of highly vitality thickness batteries, for example sodium / sulfur, zinc / bromine stream batteries. In any case for the medium term batteries nickel / metal hydride battery has the best cycling execution. For the long haul alternative iron/chromium red bull and zinc or manganese batteries are ideal. Consumed Glass Mat

(AGM) batteries are additionally a standout amongst other accessible elixirs for sun powered PV utilize.

➤ **Inverter:**

An inverter is an electrical gadget that changes over direct flow DC to rotating flow AC , the subsequent AC can be at any required voltage recurrence with the utilization of suitable transformers, control circuits and exchanging or batteries. The electrical inverter is a high power electronic oscillator. It is so named because of quickly mechanical AC to DC converters was made to work in reverse and thus was “inverted” to convert DC to AC.

Figure 2.7: Inverter planned to provide 115 VAC from the 12 VDC starting point provided in an automobile. The unit shown provides up to 1.2 Ampere’s of AC or just enough to electricity two sixty watts light bulb.



Figure 2.7: Inverter

➤ **String Inverter:**

Good look.

Accessible in little and medium estimated PV power station.

User friendly interface.

Power level 1.5kw to 6kw.



Figure 2.8: String inverter

➤ **Power plant inverter:**



Figure 2.9: Power Plant Inverter

Proficient plan for substantial measured PV power station transformer type and transformer less sort Satisfy diverse necessity, predigest structure of intensity station. A grid tie inverter Or (GTI) is a specific kind of Inverter (electrical) that is utilized to a sustainable power source control framework to change over direct flow into rotating flow and feed it into the utility grid. The specialized name for a framework tie inverter is matrix intelligent inverter. They may likewise be called synchronous inverters. Framework intuitive inverter ordinarily can't be utilized in independent applications where utility electricity is not accessible.



Figure 2.10: Inverter for grid connected PV

➤ **Load:**

In this system our main purposes to supply electricity from solar panel to elevator & common load like security light, guard room load, water pump of the building.

2.8 Summary:

The target of this examination is to add to the comprehension of consumer loyalty SHS benefit in Bangladesh. Individuals discover it's critical to fathom the elements of this industry from the point of view of the client who is the last referee of how to buy and utilize the framework. Hence, a comprehension of the elements that impact consumer loyalty should be helpful in directing the Solar Home System industry to structure and convey the correct advertising.

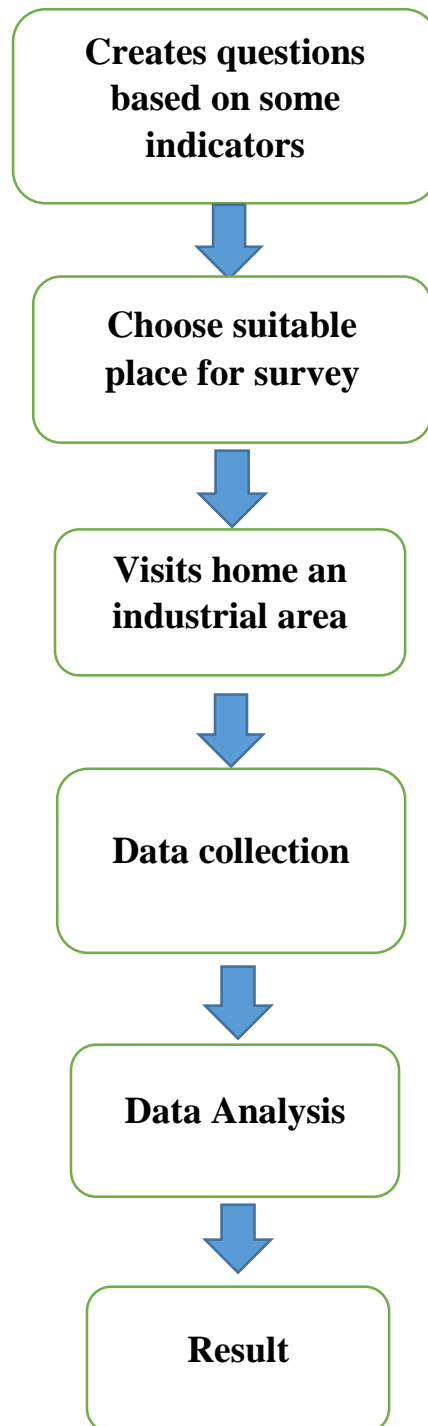
CHAPTER-03

METHEDODOLOGY

3.1 Introduction:

Energy is one of the main concerns for the rising future of any country. Energy absolutely assumes an indispensable job being developed and welfare of individual. There exists an immediate connection between is the enhancement of a nation and its utilization of vitality. Bangladesh tries to be a medium-pay nation by 2021. This will require increasing GDP growth to 7.5 to 8% per year based on quicker export and remittance growth. Only 62 percentage of the entre of demography have access to power supply and the per capita power consumption is only 321kwh. Government have define up the objective of giving power to all by 2020 and to guarantee solid and quality supply of power at a sensible and reasonable cost. Manageable social and financial advancement relies upon sufficient power age limit of a nation. There is no other route for quickening enhancement but to expand the power age by fuel expansion The aggregate power age in Bangladesh is as a rule reliant on gaseous petrol, which represents about 62.59% of the power fabricate of the aggregate introduced limit as on September, 2015 is 11877 MW.

3.2 Flow chart of the research:



3.3 Site Selection:

Google map :



Figure 3.1: Narayanganj Chashara google map location

Dhaka Power Distribution Company's (DPDC) plan to set up 1 MW rooftop solar system on different government buildings and their own structures in the city is getting delayed for lack of provision to offset a possible loss. As per the plan, private investors are supposed to set up the rooftop plants from where DPDC will buy electricity, official sources said. IDCOL consented to a financing arrangement with Baraka renewable energy Ltd. For a 168kwp sun oriented scaled down matrix to be situated at Nooner Tek Island in Sonargaon of Narayanganj region. Add up to cost of the undertaking is 7.14Tk crore of which IDCOL will give 30 percentage as delicate credit and half as allow.

First of its sort in the historical backdrop of nation's capacity age. A Memorandum of Understanding (MoU) was marked between Dhaka division at Narayanganj City Corporation and the Power Development Board on Wednesday at Bidyut Bhaban in the capital on Wednesday. State Minister for Power, Imperativeness and Mineral Resources Nasrul Hamid and Mayor of Narayanganj City Corporation Salina Haiat Ivy were accessible at the stamping administration. The waste based power plant which will be based on around 10 to 12 sections of land of land will deliver power on Build Own and Operate premise. "City corporations of Narayanganj, Gazipur and Savar, Kaliakoir municipalities will be incorporated in Dhaka South and North City Corporations," Nasrul Hamid said. "Dhaka is a neoteric city now. Waste does not suit it" he added. "Several power plants will be constructed under the Power Development Board (BPDB) in different part of the country. Construction work of Keraniganj power plant is going on," the state minister said. Narayanganj mayor Ivy Rahman said the occupant government have taken up different activities to produce power from sustainable sources. She said Narayanganj City Corporation is prepared to finish every vital work to deliver control from waste in the following 1 year. "Such initiative is most important for keeping the city clean. We will get electricity from waste even if the price will be a bit high,"

3.4 Survey Question:

Table-3.1: The questionnaire has been made to settle the survey index permanently.

Serial No.	Items	Questions	Description
01	Consumer information	i) Name of the owner ii) Name of the NOCS iii) Mobile No., Address. iv) Consumer No.	In this method we just collected consumer information.
02	Installment Information	i) Date of installment ii) Total capacity iii) Bought SRS from where.	In this part we asked and tried to find out the information of installment.
03	Operation	i) SRS are in operation or not ii) Is consumer use it iii) In which purpose they use it. iv) Electricity generation	In this part we checked the present situation of SRS and taken reading from the meter.
04	Maintenances	i) Do the clean the panel ii) How often it is done iii) Do they get any training about SRS	In this part we wanted to know about maintenance and training.
05	Consumer satisfaction	i) Do they want to increase SRS capacity ii) SRS is useful or not iii) Is it the waste of money	The part we tried to know that consumers are satisfied or not.
06	Cost analysis	i) Total cost for SRS ii) How much electricity generated.	In this section we calculated the electricity generation from a solar system and per unit cost of solar power.

3.5 Summary:

A housetop photovoltaic power station or housetop photovoltaic framework is a photovoltaic framework that has its power producing sunlight based boards mounted on the housetop of a private or business building or structure. The different material of such a framework incorporate photovoltaic mounting frameworks, modules, links, sun oriented inverters and other electrical adornments. Housetop mounted frameworks are little contrasted with ground mounted photovoltaic power stations with limits in the megawatt go. Housetop PV frameworks on private structures ordinarily include a limit of around 5 to 20 kilowatts while thowse mounted on exchange structures regularly achieve 100kw or more.

CHAPTER-4

RESULT

4.1 Introduction:

Background, concept, and given scenario of solar electrification dissemination for transfer socioeconomic development in numerous areas are mentioned. It is observed from the previous discussion that energy plays the key role for development. Due to rise of fuel value and increasing carbon emission worldwide, there's a worldwide shift towards renewable energy like solar, wind etc. Being in tropical region, Bangladesh could be an alternative energy wealthy country. Alternative energy will play a significant and secure energy supply for property development. The most objective of this study is to assess the impacts of alternative energy on socio-economic development in rural areas of Bangladesh. To verify the target through empirical observation, a cross-sectional of twenty-five haphazardly elect households and industries in Narayanganj space are surveyed with a structured form. The survey results are analyzed as follows within the following sections.

4.2 Data Analysis:

In data analysis part we showing the results through the questionnaire segment part. In these part we tried to show the results of the each items of the questionnaire segment. We also tried to find out the solution from bellow results.

4.2.1 Consumer Information:

In this section we showing one chart. The chart indicates the total number of consumers.

- **Number of consumers:**

Figure 4.1 indicates the survey area divided into four different region. These four regions are Killarpul, Fatulla, Nitaiganj and Chasara. From the pie chart, we see that 23 consumers are New Chasara, 4 North Chashara, 5 consumers are Killarpul, 6 consumers are in Fotulla and 8 consumers are in Narayanganj Area.

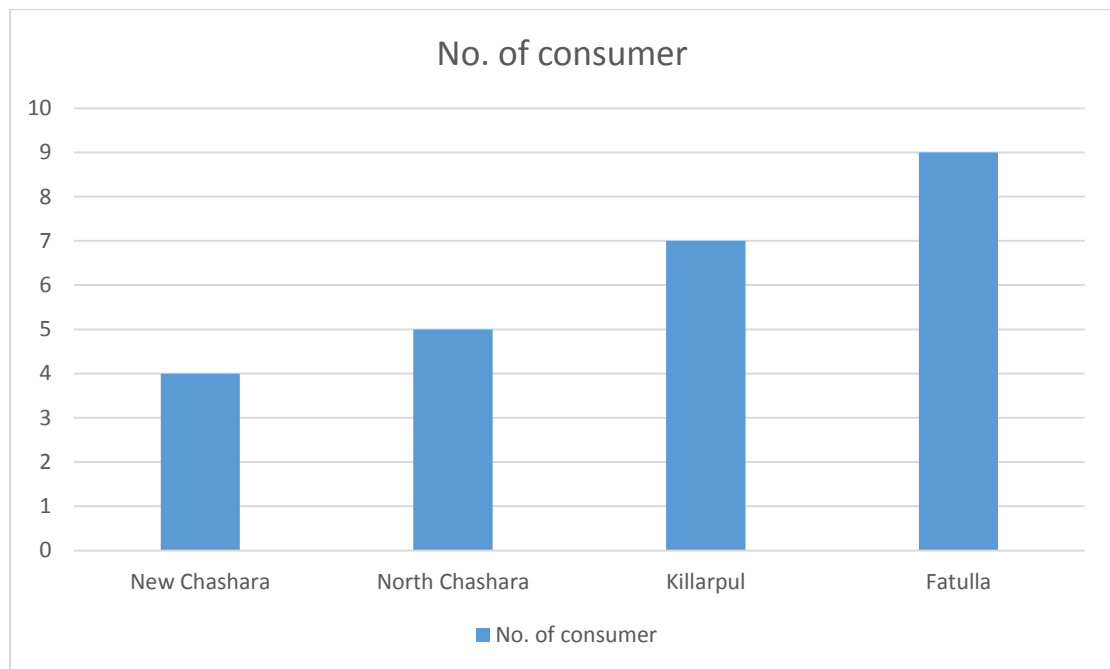


Figure 4.1: Number of Consumer

4.2.2 Installment Condition:

In installment condition part, we are showing three different sections of installation system. After completing the survey we found the total capacity of the SRS of 25 consumers has 20KW. Figure 4.2 shows that, the 20KW electricity divided into basic two areas of Narayanganj. We see here west zone of Narayanganj area has 40% of the total capacity and the rest of 60% is in east zone of Narayanganj. These three are using of solar energy, installment condition and brought the solar system.

- **Using of solar energy:**

50% answer are using of solar energy from 2year, 20% answer are using of solar energy less than 1year and 3year , 10% are using solar energy more than 4year .

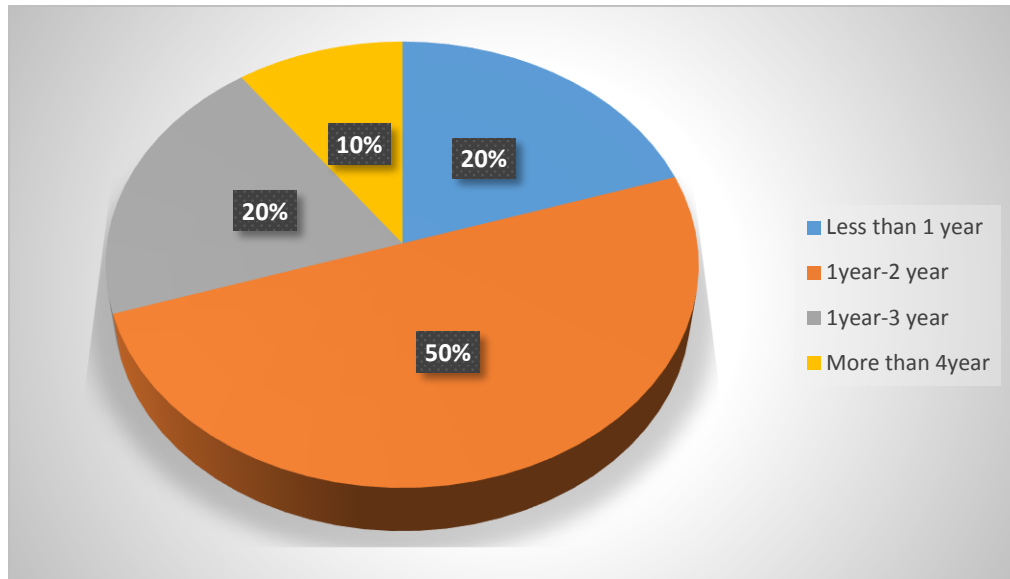


Figure 4.2: Answer of using solar energy system

- **Solar system provider:**

Under Narayanganj NOCS, we collected 25 consumers data samples. Figure 4.3 indicates that, between those consumers, 18 consumers are brought SRS from market for installation of solar system, 5 consumers are brought SRS from DPDC and other agency and rest 2 users are not wants to say anything about it. But the consumers those are brought SRS from the market cannot get much electricity according to their capacity.

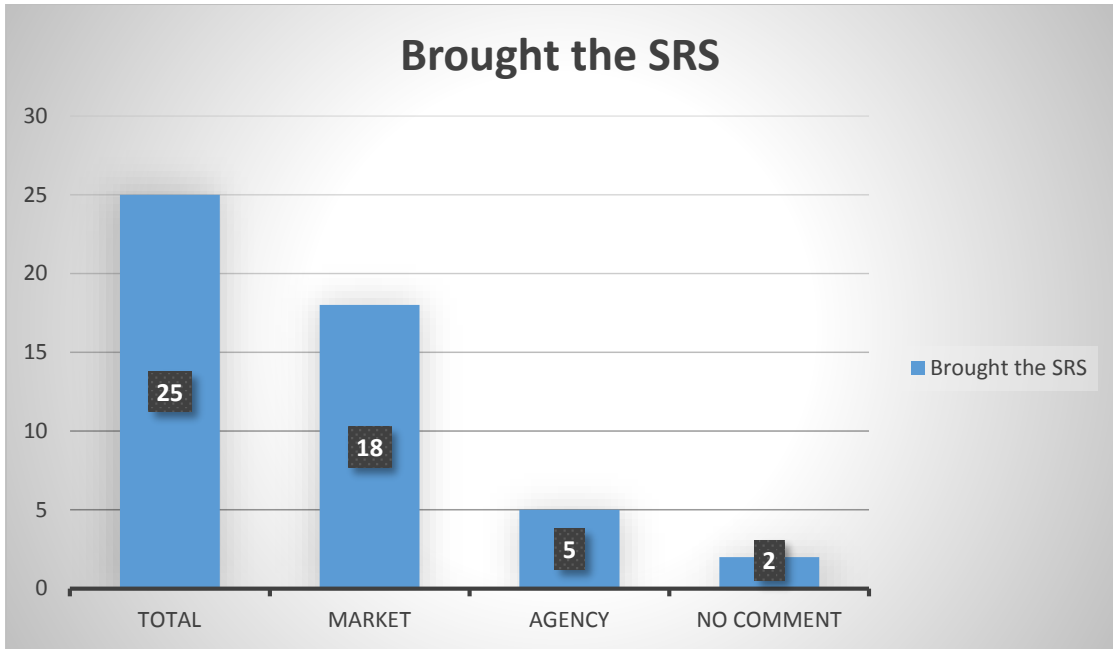


Figure 4.3: Brought the SRS

- **Installation process:**

Figure 4.4 provides information that 21 consumers are installed SRS for the policy obligation. That means they have no interest to install the solar system. Other 4 consumers are interested to install the SRS system. That's why they intalled SRS for their own choice.

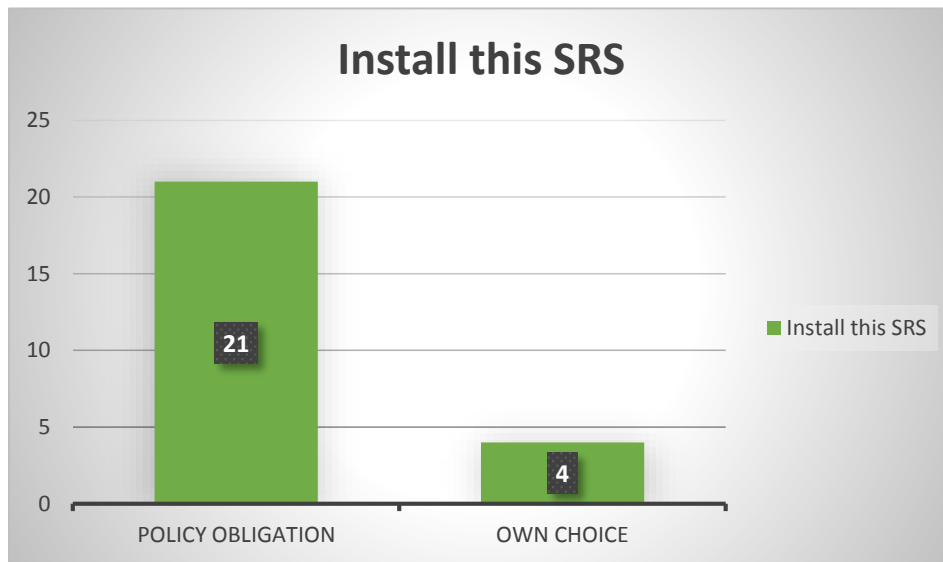


Figure 4.4: Installment condition

4.2.3 Operation:

In operation part we are showing one chart, which is solar systems are in operation or not.

- **Operating status:**

In figure 4.5 we used bar type chart. This bar shows that, in home unit 3 SRS systems are in operation among 5 consumers, and in industrial sector, among 11 consumers, only 2 consumers are in operating modes and 9 consumers are not in operating modes. Its a very low numbers of SRS are in operating modes in industrial sector. Though there is highest numbers of SRS intalled in industrial sector. In commercial building, only 2 SRS is in operating modes among 6 consumers. At last we see in hospital there is 100% SRS system are in operation. That's are 3 of 3 in opeation.

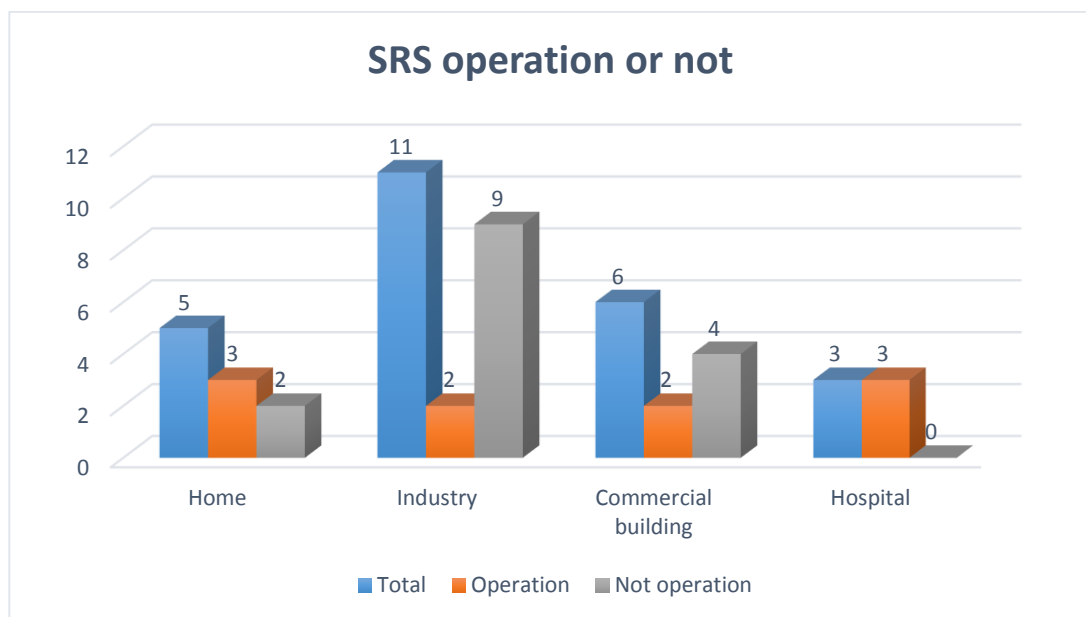


Figure 4.5: Operating condition

4.2.4 Maintenance of solar home system:

When we went to surveys in Narayanganj, we learned a lot and learned. We have surveys in different areas of Narayanganj and found their views about the consumer one and Solar Home System. 5 consumer are cleaning the solar panel and next 20 consumer are not cleaning the solar panel. Solar panels are becoming sterile due to not being clean, which means the solar panel's life time is decreasing. In figure 4.6 there showing vertical line type chart with percentage condition. From chart, we can say that, between 100 percent consumers are not interested to taking any kinds of traning for SRS operating. They are not interested to use solar energy and for this they don't agree to take any kind of training about it.

In maintances part we showing different types of conditional chart which are important for maintances. These are cleaning the solar, getting any kinds of traning, and test it regular basis.

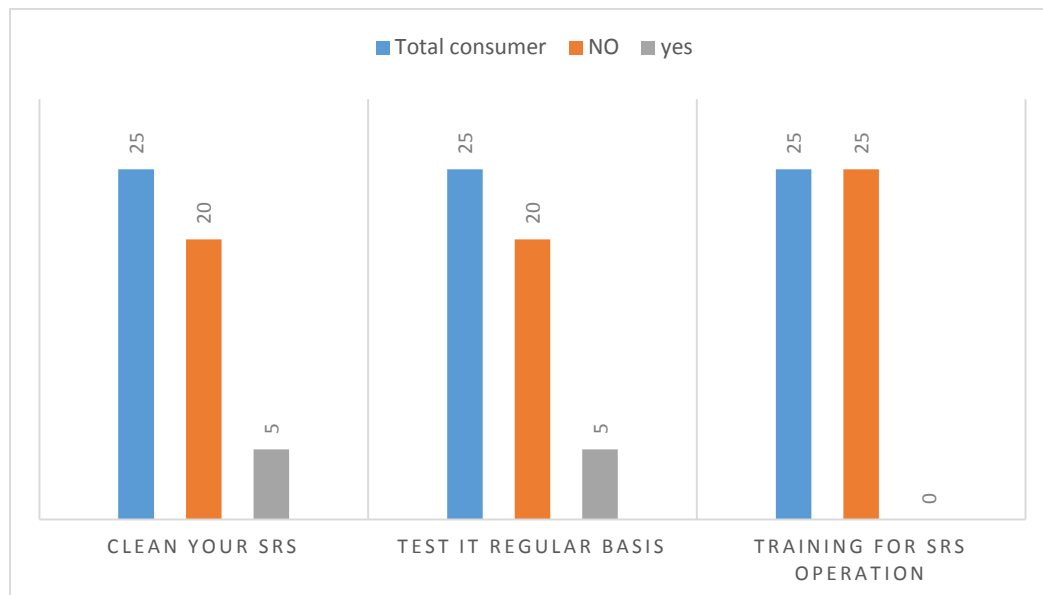


Figure 4.6: Maintenance of solar home system.

- **Facing any kinds of survey:**

Figure 4.8 showing the pie chart with percentage value of facing any kind of survey. The pie chart indicates that 16 percent users are facing survey one or more time. And 84% users are not facing any kinds of survey. Some of them realise that there need to held such kind of survey.

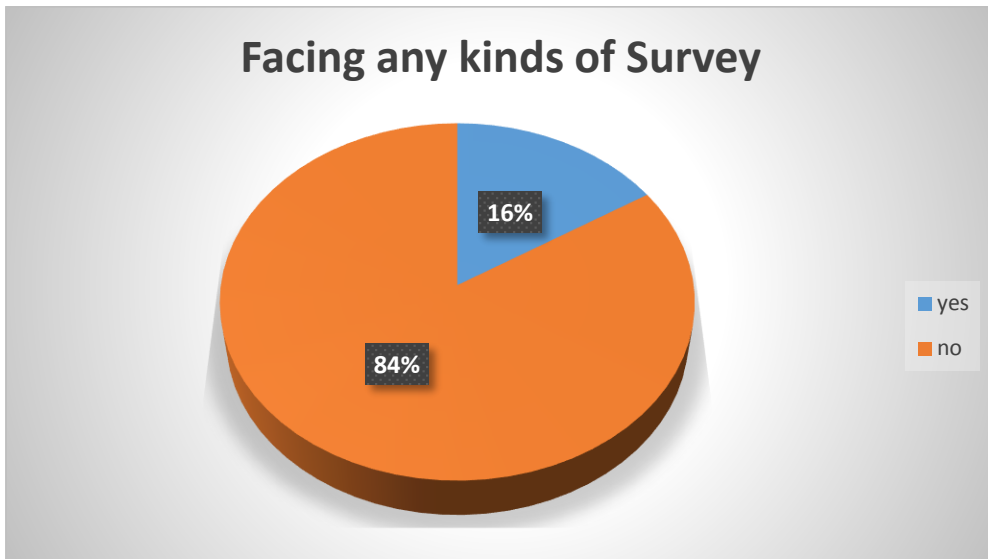


Figure 4.7: Facing any kinds of survey

4.2.5 Service of solar panel:

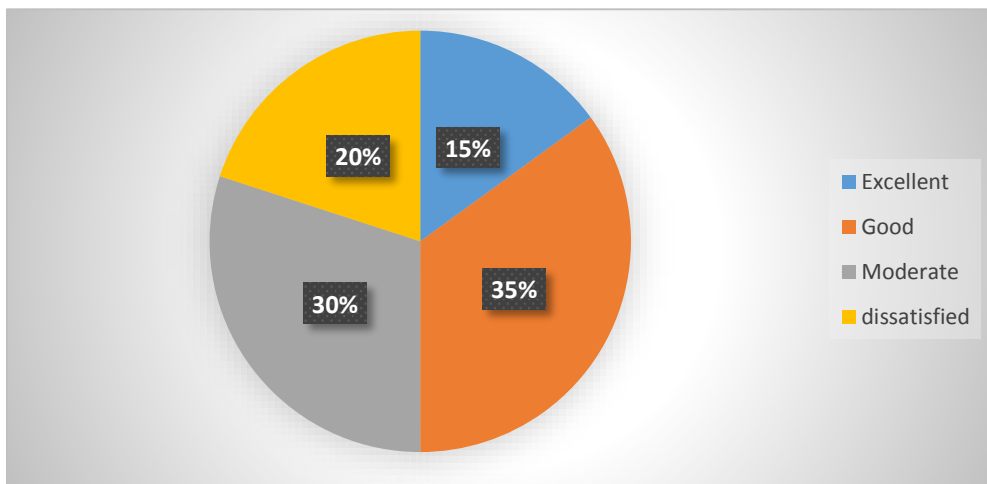


Figure 4.8: Answer about service of solar energy systems.

15% of the reacted said fantastic with respect to the administration of sunlight based vitality frameworks, while 35%, 30% and 20% said great, moderate and disappointed, individually Figure 4.8. A large portion of the general population are happy. The administration of solar energy panel. Be that as it may, they should enhancement their administration to build their client. Every one of the respondents tell the organizations are giving guarantee to the sunlight based vitality frameworks. Every one of the respondents are cheerful because of longer time of sun oriented board guarantee.

4.2.6 Consumer Satisfaction:

In consumer satisfaction part, we get various types of questions or comments which is useful for making this report. solar is useful. 50% consumers are satisfied between them 15% are very satisfied while 35% are not

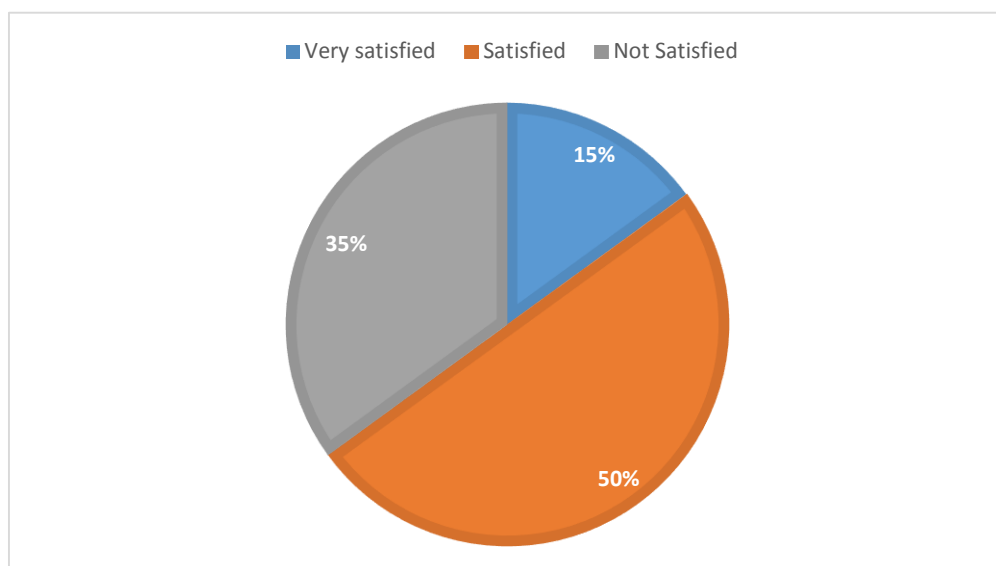


Figure-4.9: Satisfied with the solar home system services.

- **Increasing the capacity of the solar:**

These questions or comments are showing through charts. These charts are increasing the capacity of the solar, Figure 4.10 gives us consumers interest about increasing the capacity of the solar system. It shows the information that all 25 users didn't want to increasing the capacity of the solar system. They thinks that the solar system is not useful.

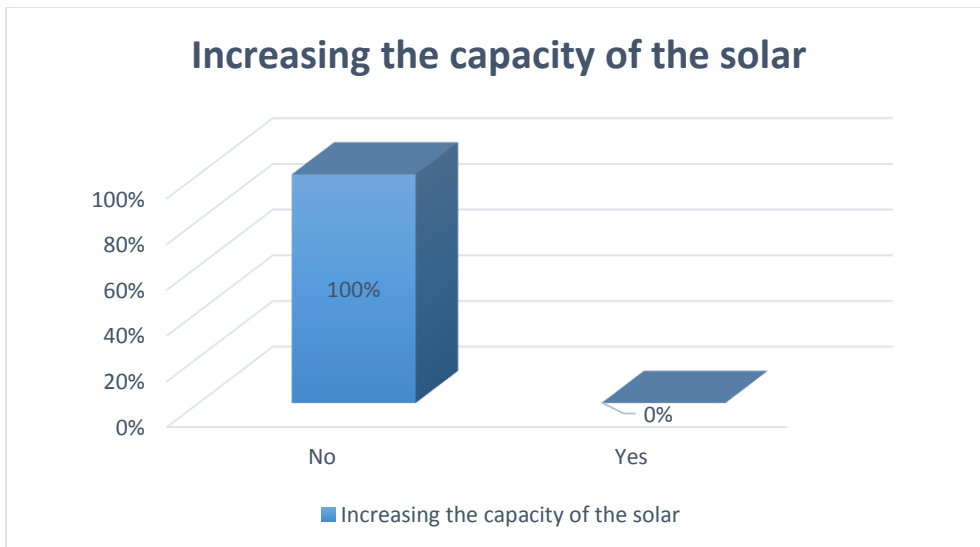


Figure 4.10: Increasing the capacity of the solar

4.2.7 SRS in operation:

Most systems are system driven. 5 consumer system disorder some system maintenance is broken due to lack of system for which the system is not working. The industry has 4 consumer system disorder.

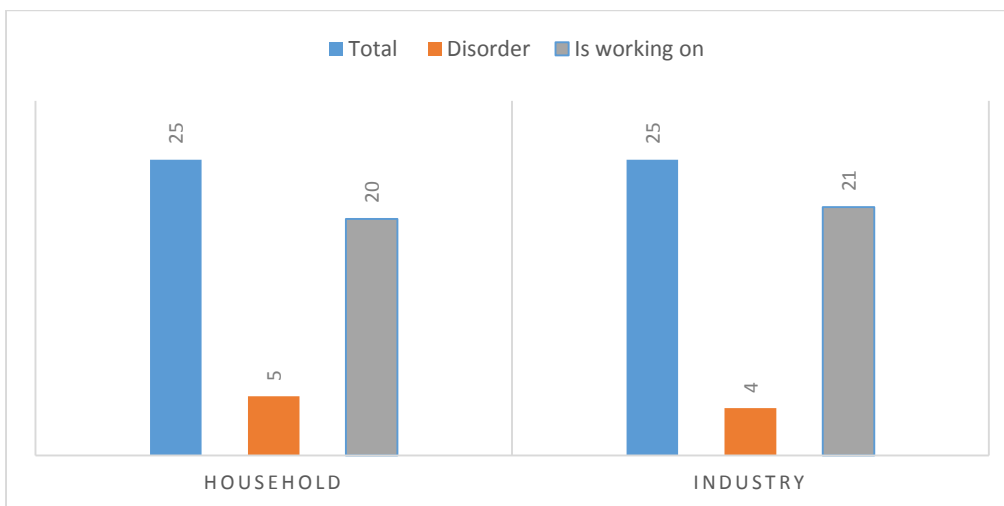


Figure 4.11: solar rooftop system in operation

4.2.8 Response of solar energy:

90% reacted "No" in regards to the cost adequacy of sun powered vitality frameworks, while 10% gave a positive reaction. The majority of the general population said it's still exorbitant because of its underlying set-up expense. To get more client they ought to diminish their expense and cost of the sun powered vitality board. Consumer's system does not want to repair. The customer said this system has been installed for policy obligations. This system just does not seem to be beneficial to everyone. Most of the consumers think SRS is waste of money.

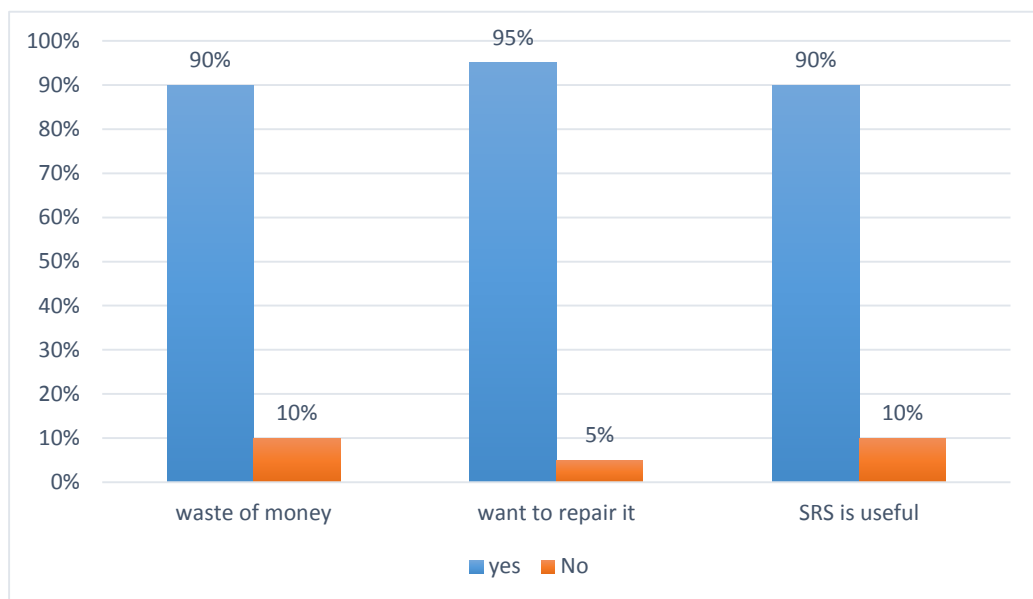


Figure 4.12: Response of solar energy

4.3 Calculation: Sample calculation:

Installed Cost: 3,93,333 Tk

Capacity: 6kw

Electricity produce 1year: 8035.92kwh

Life time: 15 years

Electricity produce 15years: $8035.92 \times 15 = 120538.8$ kwh

Per unit cost: $393333 / 120538.8 = 3.26$ Tk

- In below we added a table, which is indicating the previous one-cost calculation and more:

Consumer number	Installed Cost(TK)	Capacity (KW)	Electricity produce(KWh)	Life time	Electricity produce(kwh)	Per unit cost(TK)
1.	229444.25	3.5	1.5year=7080.8	15	105462	2.17
2.	262222	4	1year=5356.8	12	64281.6	4.1
3.	393333	6	1year=8035.92	15	120538.8	3.26
4.	491666.25	7.5	1year=10044	20	200880	2.45

4.4 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 98% 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.

4.5 Summary:

The rooftop must be reachable to do establishment and upkeep. It must be conceivable to lift the nearby planetary group parts onto the rooftop and for work force to physically get to the site to introduce and keep up the framework. For the most part a level solid pores rooftop will typically have the solidarity to suit the extra weight of the boards and supporting structures. Slanted tops of capacity sheds and private structures might be made of metal tiles, sheet or comparative materials, in which case it is important to look at whether the brackets can bolster extra weight. If the rooftop can't bolster the heap of a crystalline photovoltaic framework. Lighter thin film modules could be a choice. At last if the material establishment of a housetop nearby planetary group could void the guarantee.

CHAPTER-5

CONCLUSION

Global demand for energy will be more double by middle century and more than triple by the century is end. Taking care of this demand is society's first test. Renewable energy advancement in existing energy technologies can bridge the gap between today is production and tomorrow is needs. The enormous untapped potential of the solar energy is a friendly opportunity to meet our future energy needs. Considering the fact we started our thesis project to analysis current urban solar home system efficiency. Country jolt through the Solar home System is winding up more prevalent, step by step in Bangladesh especially for remote, difficult to reach territories. Be that as it may, the increased rivalry challenges do the clients fulfillment a basic essential for the accomplishing a reasonable upper hand and, thus, the Solar Home Systems industry's general achievement. As in the present focused condition benefit advertisers put extraordinary exertion on creating consumer loyalty with the end goal to keep up aggressive edge research can be attempted for sketching out of what should be done to enhance the administration of the solar home systems in Bangladesh. For that reason the analyst attempted to pass judgment on its consumer loyalty with this exploration. From the exploration it might be inferred that solar home system befit have been significant and expansive socio-social, financial and Statistic influence on life and living of the provincial individuals in Bangladesh. It have been noteworthy and supported effect upon family and business exercises. Furthermore by sitting in front of the TV individuals are presently keeping educated about the most recent condition of games culture and political advancements. A large portion of respondents are discovered simply happy with the SHS in Bangladesh.

They is discovered disappointed with some administration quality factors like helpful utilization of the frame work life span of the solar home system supportability of the solar home system accessibility of advance from the framework Suppliers upkeep cost of the framework guarantee support of the solar home system. Believability of the suppliers benevolent conduct of the work force the pamphlet inventory and so on. Given the framework and accessibility of the parts of the framework in the nearby market. So the specialist co-ops should take legitimate consideration of these factors to enhance the general administration nature of SHS benefit in Bangladesh. The specialist co-ops should offer a decent quality framework at a sensible cost with sufficient limit and life span to get together the prerequisites of the clients. Besides they ought to keep up a superior after deal benefit at sensible expense for the clients for advantageous utilization of the frameworks and furthermore orchestrate preparing on innovative and better administration conveyance to their staff. The discoveries of this investigation might be summed up subsequent to mulling over specific constraints. This investigation considers just the clients of Solar Home Systems in a few regions of the Dhaka Division. To the best of the learning this investigation is the first of its thoughtful dependent on the client's viewpoint. At the point when such examinations affirm, support, and power the discoveries of this exploration and offer extra vital direction, the Solar Home System benefit in our nation could be fundamentally moved forward. We observed that in west zone of Narayanganj area has 40% of the total capacity and the rest of 60% is in east zone of Narayanganj. 18 consumers are brought SRS from market for installation of solar system, 5 consumers are brought SRS from DPDC and other agency and rest 2 users are not wants to say anything about it. 50% consumers are satisfied between them 15% are very satisfied while 35% are not satisfied .Finally we saw that in hospital, there is 100% SRS system are in operation. 10% users are cleaning the solar panel and the rest of the portion that is 90% users are not cleaning the solar panel.

Future Work:

We surveyed in some places in Narayanganj. In future, We will survey the entire Bangladesh to analyze the condition of Solar Rooftop System.

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