STUDY AND ANALYSIS OF SOLAR ROOFTOP SYSTEM UNDER DHAKA POWER DISTRIBUTION COMPANY (DPDC) OF BANGLADESH

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

Submitted By

MD. Israfil Hosen

ID: 152-33-2819

Md. Rabiul Islam

ID: 152-33-2793

Supervised By

Dr. M. Shamsul Alam

Professor

Department of Electrical and Electronic Engineering

Daffodil International University

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF ENGINEERING

DAFFODIL INTERNATIONAL UNIVERSITY

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TO

OUR BELOVED PARENTS

&

HONOURABLE SUPERVISOR

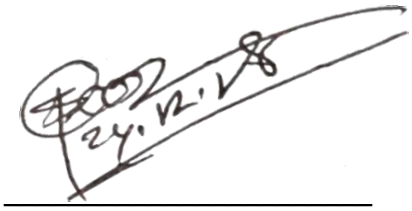
DR. M. SHAMSUL ALAM

PROFESSOR

Certification

This is to certify that this field study and thesis entitled **"**Solar Roof Top (SRS) (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 in December 2018.

Countersigned



Dr. M. Shamsul Alam
Professor
Faculty of Engineering
Department of Electrical and Electronic Engineering
Daffodil International University

Signature of the candidates

Name: MD. Israfil Hosen
ID: 152-33-2819

Name: Md. Rabiul Islam
ID: 152-33-2793

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List of Abbreviations

BPDP	Bangladesh Power Development Board
REB	Rural Electrification Board
LGED	Local Government Engineering Directorate
IDCOL	Infrastructure Development Company Limited
NGO	Non-Government Organizations
LED	Light Emitting Diodes
SHS	Solar Home System
SRS	Solar Roof top system
PV	photovoltaic
MW	Mega Watt
DC	Direct-current
AGM	Absorbed Glass Mat
UV	Ultraviolet
WD	Wave-guide Dispersion
DPDC	Dhaka Power Distribution Company
CO2	Carbon dioxide
TV	Television
GS	Grameen Shakti

ACKNOWLEDGEMENT

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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 at this University.

ABSTRACT

Normal statements earn all of us tuned in to the entire detrimental long-term outcome about vitality development from fossil heats up. It's always usually deemed which usually moving forward with to make sure you be contingent on fossil heats up to locate electric source can lead to dangerous external trouble. Likewise, fossil heats up really are finite for range and additionally amount a lot of dough additionally. So, efficient energy levels are mostly a capability resolution to meet up electric source marketplace demand for those expanding lands want Bangladesh. Within lots of the efficient technological innovations, sunlight PV(PV) certainly is the a large number of capability, praiseworthy and additionally providing the one that changes solar power right into electric power, for example or possibly taking out wide variety reassurance. Even though sunlight solutions comes with roughly prevailed for non-urban spaces just where lots of the technological innovations really are adopted in line with Sunlight Place Model (SHS), it consists of not likely at this point really been beneficial for urban areas as soon as added regulation about get together 3% about let fanatic pack from the putting together. There is searched all the applied sunlight rooftop about eighty six dwellings for Narayanganj, while the sunlight model about lots of the dwellings was first came across lazy. Such as sole 50 platforms really are established. In that thesis you're researching about elegant sunlight situation is actually conducted for two components in line with this approach researching. A fabulous corresponding controversy relating to amount economy about varied your own solar panels is actually presented with dependent on variety of significant amounts simply being dash. Valuable electric battery really is patterned just by SHS for situation about Bangladesh to make sure you improvise PV platforms. A price researching is actually undertaken just by SHS just for varieties of watt highest levels. Beyond all of these, a fabulous refurbished type for the sunlight model is actually recommended to earn elegant rooftop sunlight install beneficial and additionally triumphant. 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 photovoltaic (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 was 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. A comparable discussion on cost efficiency of different solar panels has been given depending on amounts of loads being run. Efficient batteries are modeled by SHS in context of Bangladesh to improvise PV systems. A cost analysis has been performed by SHS for different types of watt peak ranges. Apart from these, a renovated design of the solar system has been proposed to make urban rooftop solar installation effective and successful.

CHAPTER-1

INTRODUCTION OF THE REPORT

1.1 Introduction

One of the main concerns in the power sector is increasing the electricity demand daily, but there are not enough resources to meet the electricity demand using conventional energy sources. Demand for energy renewable sources has increased with the existing systems to meet the energy demand. Renewable sources like wind energy and solar energy are the prime energy sources which are being utilized in this regard. Continuous use of fossil fuels has reduced the fossil fuel deposits and has greatly affected the environment of decreasing biosphere and increasing global warming. Solar energy is available abundantly and can be used properly by saving. Solar energy can be a standalone generating unit or can be a grid-connected generating unit depending on the availability of a grid nearby. So it can be used for power supply in rural areas where the grid availability is very low. Another advantage of using solar energy is the portable operation whenever wherever necessary. In order to deal with the current energy crisis, an effective method must certainly be improved. So the Bangladesh government decided to ensure mandatory installation of solar panels for the high-rise buildings in Dhaka and other major cities in a bid to beat annoying power crisis (The Independent, 2016). Finally, solar panels have emerged as an influential concept among business organizations and potential use. Managers from different organizations have recognized some opportunities in this industry since it is not contested yet. Some of them have formulated their penetration strategy and entered the market with an animated mission. However, the managers hardly examine and know the sustainability of solar panel. There no
The country to explore this areasignificant research in. The purpose of this research is to identify the sustainability of solar panels in the context of Bangladesh. Other objectives are to ascertain the impact of solar panel in Bangladesh, the social acceptance of solar panel, the financial benefit of solar panel users in the context of electricity cost and to extract the idea of the challenges, problems, strengths and weakness of solar energy system. [1]

2.2 Statement of the problem:

The power system of Bangladesh depends on fossil fuels both in private sector and state-owned power plants. About 89% of the production capacity comes from carbon emissions from natural gas, liquid fuel, coal and hydroelectricity. Natural gas supply is not enough to meet the demand. In Bangladesh, the power of producing current gas cannot support the domestic demand as well as the generating electricity for the country. The existing reserve of oil and gas will be exhausted very soon. There is a demand for clean and durable energy worldwide at the same time. The need for developing renewable sources of energy like solar, wind, biomass, etc. has a greater sense of urgency. As a tropical country Bangladesh is involved with solar energy. In this context, solar energy is a reliable, affordable and safe energy for the country. But the present share of renewable energy for electricity production is only 0. 5% of the total. The major people of Bangladesh live in rural areas. There is strong demand for electricity availability in remote villages. Bangladesh has embedded with plenty of solar energy. We have much potential to be a solar electricity-rich country. Institutional, financial and technological capabilities act as important factors for reaching a desired level of solar electricity production and utilization. But we have lack of information and integrated research in this field. Solar energy based rural electrification begun in the country in 1988 at Norshingdi Bangladesh Power 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 being used in a wide range of off-grid applications. Since the introduction of SHS, Bangladesh has installed more than 2. 2 million units. In this context measuring the socio-economic impact of SHS would be an illustration for designing rural development alternative energy-model in the country. [3]

1.3 Objectives of the research

The objectives of the study are as follows:

- Consumers to sort it out. To grasp this state in SRS on Bangladesh additionally, the feeling belonging to the.
- Work out that each and every item cost you in the sun's source of electricity.
- Try to help make anxiety users within the power in utilizing SRS strategy.

- Find over the down sides which will people are looking at should they can be.
- To give information to the consumers about net metering system of on-grid SRS

1.4 Significance of the study

Bangladesh is actually a hot place with gigantic solar powered energy. Nonetheless quite a minimal degree of its made use of. Though the beginnings with SHS around Bangladesh were in 1988 but it surely appeared to be low competition for an extended time. By way of this occasion diverse uses with solar power electric power is seen globally. At present Solar power electrical present's electric power to get solar power vaccine freezer or fridge, solar power waters disinfection (SODIS), solar power food items blow dryer plus solar power pasteurization. This will assist to get lessening waterborne health conditions. Solar power cell phone, solar power Wi-Fi, solar power radio station maximizes country connecting, cuts down travel fee plus cut down electric split. Invariably solar power range plus solar power waters heating up, reliability for common fuels just like real wood and also grilling, cuts down indoors co2 plus and also carbon emission. The following heightens human eye everyday living around country spots, develop health insurance and instruction, cut down petrol addiction, maximize area recruitment plus cut down deforestation. The power of sunshine exercises head country progression. Resulting from loss of information and facts plus analysis SHS is required only for domestic lighting style around Bangladesh. Solar power irrigation know-how is likewise finding preferred around Bangladesh. When farming based mostly place, working with the power of sunshine irrigation procedure has got to be big driving a vehicle compel to get country progression.

1.5 Outline of the Thesis

Following your release another step of your review is going to center on look at picked out reading plus conceptual review of SHS around socio-economic progression. Around lastly step, it can explore a plan of your homework. A 4. Step is definitely study of your details, success plus considerations. A junior high step is definitely ideas plus of your review.

CHAPTER-2

LITERATURE REVIEW

2.1 Introduction

Very affordable, readily available in addition to safeguarded cause of strength represents some sort of driving a car power intended for socio-economic progress of any state. Quite a few new scientific tests show the way farm electrification by a solar panel for example facilitates with socio-economic progress on the state in various means. In this particular predicament, power from the sun is usually generally perceived as some sort of ensuring technological know-how intended for power creation with out of the way position on the acquiring places. That part endeavors to pay attention to this article on determined literary works, critical reasoning behind photovoltaic power seeing that ON-Grid in addition to OFF-Grid Photovoltaic Roof Process, Photovoltaic Radiation Products having GIS, Doing the job connected with Photo voltaic to help facts along with infrastructural products and services.

2.2 Concepts on solar energy

Well before you start up revealing that the sun's keeping track of products, at the start, you might explain around various important creative concepts having to do with the sun's light as well as very important worth to find out the end result about this mission. Light for the spot. Ultra violet rays, within it is estimated that warmth in 5800 K, gives out increased numbers of electric power through light, which in turn stretches to that exponents belonging to the sun's strategy. Daylight contains a few resources, that steer hug you and even diffuse hug you. Steer light (also labeled as hug you radiation) is definitely the sun's light belonging to the sun which will is occupied (causes shadow). Steer hug you brings the sum of the supports, diffuse and even reflected light is viewed given that the intercontinental. As the majority of the energy is in the direct beam, maximizing collection requires the sun to be visible to the panels as long as possible.

2.3 Solar panel

Solar panels produce electricity from sunlight. The first solar panel-powered satellite was launched in 1958 by Hoffman Electronics. A solar panel consists of number of photovoltaic (PV) solar cells connected in series and parallel. These cells are made up of at least two layers of semiconductor material (usually pure silicon infused with boron and phosphorous). One layer has a positive charge; the other has a negative charge. When sunlight strikes the solar panel, photons from the light are absorbed by the semiconductor atoms, which then release electrons. The electrons, flowing from the negative layer (n-type) of semiconductor, flow to the positive layer (p-type), producing an electrical current. Since the electric current flows in one direction (like a battery), the electricity generated is DC. [5]

2.4 Important uses of solar power

The root types of country energy levels development are often the fossil heats up (gas, lube, and coal) and additionally nuclear vitality indoor plants. Because the entry to fossil heats up, varieties of greenhouse UN wanted gas (CFC, CH4, O3, still principally CO2) give off throughout the air flow. From nuclear vitality sow, as well as is normally issued within the small amount (90 h counterpart about fractional co2 for kilowatt hour). [1] However, the key radioactive waste matter continues as established across an array of endless many that is a capability way to external air pollution [6]

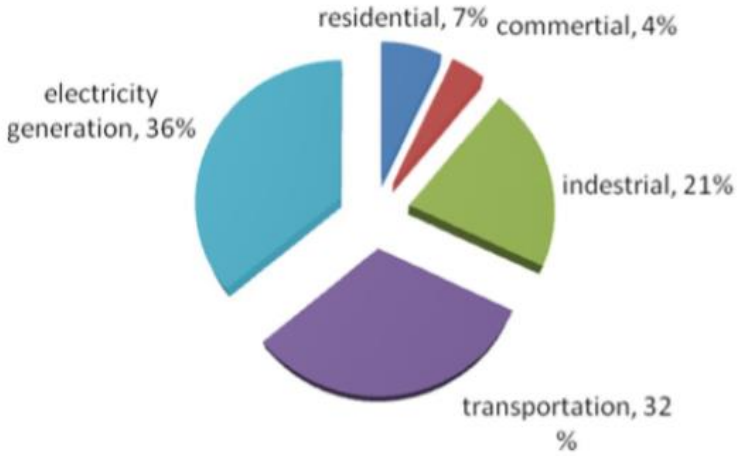

Figure2.4.1- Sources of carbon dioxide emissions.

Figure2. Have a look at. 1 show which usually electric source development is normally way to the largest emission about fractional co2. For that reason, formulation from these sparkling

energy levels is normally adding to your investments the largest closer to modern world heating up. Modern world heating up and the external air pollution is normally, in this particular conditions, the biggest external real danger to make sure you human being. Even so, there may any surprising energy levels emergency international like fossil resource reserves diminish and therefore the getting older vitality indoor plants could very well around for not too distant future. From element of modern world heating up and additionally absence about natural gas, whenever and additionally manufacturers seek sparkling, efficient powers. Solar power certainly is the possibly the best alternate options. Given that the ground should get 3. 8 YJ [1YJ = 1024 J] of one's which is certainly 6000 conditions beyond all the mobile phone industry's content. [7] Bangladesh is normally oriented towards any severe absence of one's. Natural gas certainly is the essential source of electricity development for Bangladesh. However, the key modest the cost of gas reserves cannot really match the essential about simultaneously local standards and additionally warehousing and additionally commercially aware entails, most definitely entails just for electric source development just for huge. This latest vitality development efficiency will be round 4200 MW where the total vitality necessities are normally 6000 MW. For that reason, you can easily acquire sole 70% of our finish electric source marketplace demand. Therefore absence about electric source as well as people are oriented towards pack burning off across the country as well as all the warehousing sphere is normally much altered. Solar power is normally accessible any place and additionally all around the ground. It is typically put into use the software to locate electric source inside the phase about content. Sunlight motorized putting together conditional on this approach practice. Like in conclusion you can easily tell you which usually just for us going for solar power:

1. Source of Conventional Energy is Limited.

2. Production of power from conventional Energy causes CO Emission.

3. Easy to install and use.
4. Less maintenance.
5. Source is unlimited.
6. There is no moving part, so its life is long. [8]

2.5 Working of Photovoltaic

Photovoltaic are the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current results that can be used as electricity. A solar cell (also called photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect. Crystalline silicon PV cells are the most common photovoltaic cells in use today.

A number of solar cells electrically connected to each other and mounted in a support structure or frame are called a photovoltaic module. Modules are designed to supply electricity at a certain voltage, such as a common 12 volts system. The current produced is directly dependent on how much light strikes the module. Multiple modules can be wired together to form an array. In general, the larger the area of a module or array, the more electricity will be produced. Photovoltaic modules and arrays produce direct-current (DC) electricity. They can be connected in both series and parallel electrical arrangements to produce any required voltage and current combination. [9]

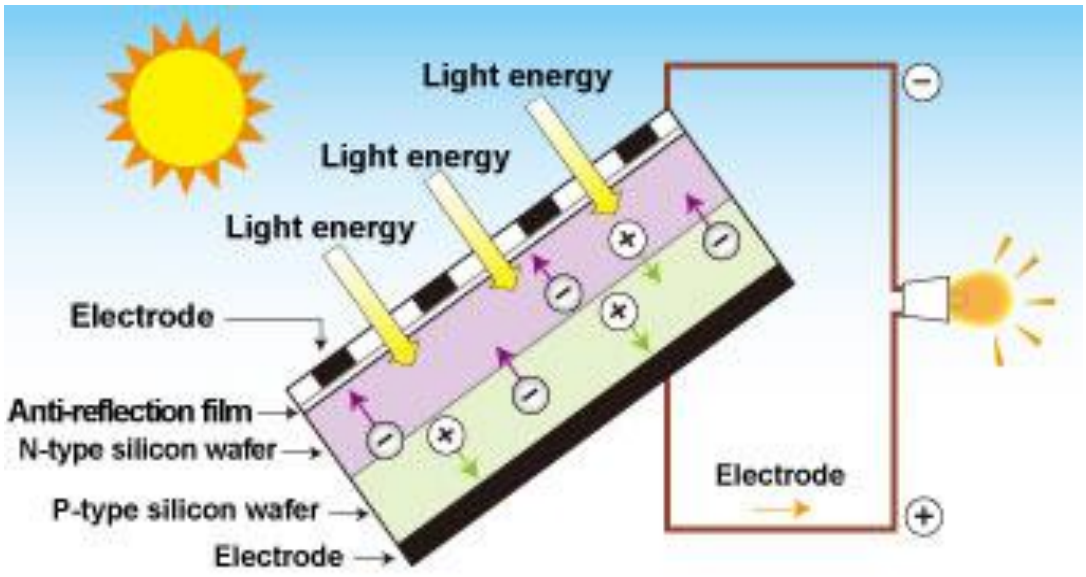

Figure 2.5.1- working principle of photovoltaic cell.

2.6 Solar Radiation Models with GIS:

In the last 2 full decades, a couple of empirical sunlight the radiation varieties had been upgraded by way of geographic knowledge platforms software. All the quickly making effectiveness with GIS types covers integration about refined sunlight the radiation varieties and extra attention for the outcome about topography relating to inward sunlight the radiation (Dub ayah and additionally High 1995). GIS software let the visitor have a look at all the temporary and additionally %' spatial variability about incident sunlight the radiation about the surfaces tier (Rich et al. 1994). Combining sunlight the radiation varieties around GIS comes with really helped cut all the complexity about and also multimedia GIS works right into precise varieties (Nguyen and additionally Pearce 2010). Likewise, sunlight the radiation varieties by means of GIS could perhaps merge external and additionally socioeconomic datasets just for state of affairs modeling about benefit to make sure you policymakers (Nguyen and additionally Pearce 2010).

Sunlight Flux is about the basic GIS-based varieties (Súri and additionally Hofierka 2004). It was eventually completed on the ARC/INFO principle as being a definite ARC Macro Foreign language (AML) technique (Dub ayah and additionally High 1995). This approach product simulates all the change about darkness activities relating to guide efficiency located at targeted intervals with effort (Helios External Modeling Company, LLC 2000). The software applies all the effort from the topographic working surface by means of degree of lift character, latitude, effort length just for computation, and additionally atmospheric factors (Dub ayah and additionally High 1995). All the results delivered presents guide the radiation flux, entire time about guide the radiation, stones access matter and additionally diffuses the radiation flux from each working surface setting (Dub ayah and additionally High 1995) [10]

2.7 Types of solar system design

There can be various types of solar system design. But there are three basic design consideration, they are-

1. Grid Tie
2. Off-grid
3. Standalone

2.8ON-Grid and OFF-Grid Solar Rooftop System

2.8.1 ON-Grid Solar Rooftop System:

Figure: 2.8.1-ON-Grid Solar Rooftop System.

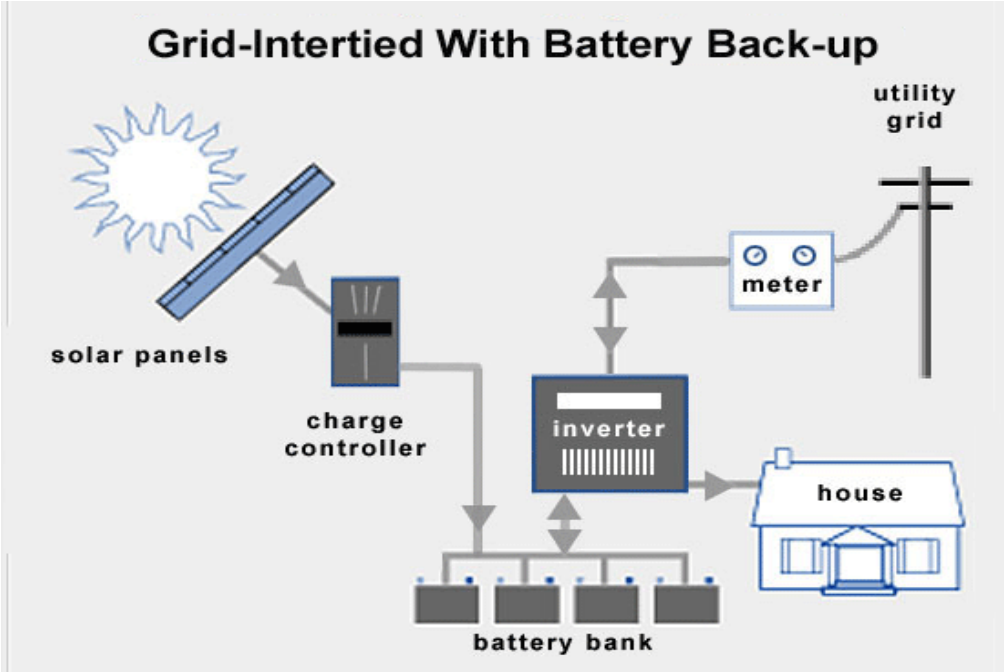

Figure: 2.8.2-Grid-Intertied with Battery Back-up.

We know that if we store energy in batteries so it will result in 30% loss of energy while storing it. So there is one more option to increase the efficiency of our system that is an ON-Grid system.

In On-Grid system solar panels are placed on the rooftop, the electricity generated by the solar panel is direct current and the electricity we use in our houses is alternate current so to convert DC to AC we need an inverter to convert it.

But as the system have to connect with the grid so we require Grid Tie inverter which will convert the DC to AC in the same frequency as we are getting it from our energy provider company.

The Grid tie inverter is connected to our mains through a solar meter which will just calculate the solar unit generated, and then the connections are made with the NET METER, which calculate the units consumed from the electrical company and also have the data about the solar unit generated.

The net meter gives the net unit consumed.

NET UNIT = (UNIT CONSUMED FROM ENERGY COMPANY ---- SOLAR UNIT)

On-Grid system can be understood more easily from an example:

Suppose we have placed a solar Grid tie system of 3000 W, and in the morning around 11 Am, The system is producing 2700 W.

The consumption in our house is 1500 w (consumed by fan, LED TV etc.) so the 1500 W will be supplied directly from the solar system and remaining Wattage will be feedback to the grid. (2700-1500=1200 W)

And suppose if we have a party @ our place in morning and our consumption reaches to 4000 W so our solar system will provide us with 2700 W and the remaining 1300 W will be supplied by the electrical energy company.

In ON-GRID system suppose we are out for the day and our system generates 12 units and in the evening when we reach home and switch on the Air condition and light so we can use the same amount of unit at night,[11] [12]

Solar Panels:

The solar panels are made up of photovoltaic (PV) cells, which convert sunlight into direct current (DC) electricity throughout the day. [13]

Inverter:

This device converts the DC electricity generated by the solar panels into the alternating current (AC) electricity. [14]

Electrical Panel:

The AC electricity is sent from the inverter to your electrical panel to power your lights and appliances with solar energy. The electrical panel is often called a “breaker box.” [15]

Utility Meter:

The utility meter measures your energy use. It actually goes backward when your system generates more power than you immediately need. This excess solar energy offsets the energy you use at night. [16]

Utility Grid:

Your business is still connected to the grid. You’ll need that power from the utility company at night, but don’t worry. The cost is offset by any excess solar energy you put into the grid during the day. [17]

2.8.2OFF-Grid Solar Rooftop System:

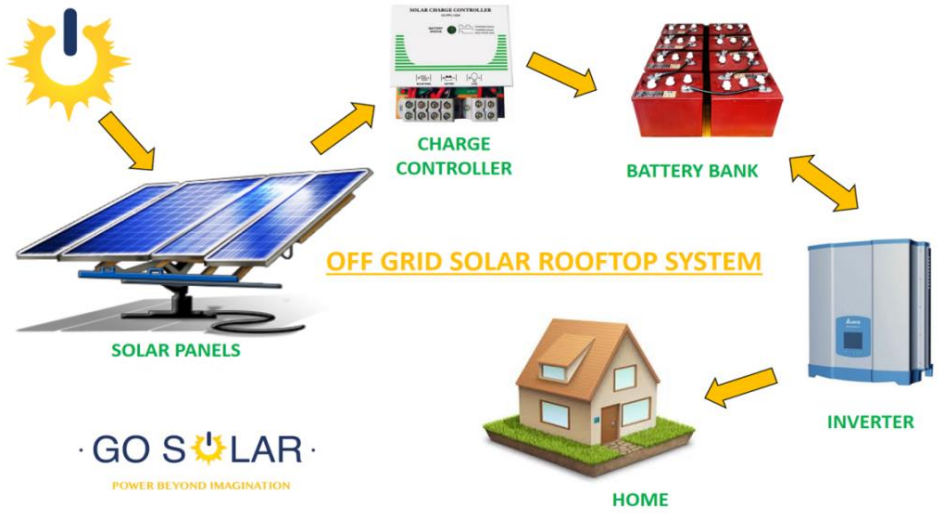

Figure: 2.8.3- Off-Grid Solar Rooftop System.

Off-grid system is feasible for the villages where there is no electricity or the power cuts are high.

In this system the electricity produced by solar panels are stored in battery's which stores the charge and provide backup when required. We can understand this with an example.

Suppose I bought a hut in the village where the electricity is not provided by any company and people living there uses kerosene oils to illuminate their house, so I decided to place solar panel on my roof and store the electricity in my battery which I can use in the evening to power my appliances and lights. This system is an independent system.

As I am living in the city and power cuts are really rare, so I am installing a hybrid solar interface system.

In morning it charges the battery from solar energy and in the evening it will automatically cut the supply of grid electricity to the power points which run on inverter and supply them with battery power. This system suits me because in the morning my house will run on green energy from the On-Grid system and in the evening the load will shift to OFF-Grid system.

Isn't amazing?

Solar Panels:

The solar panels are made up of photovoltaic (PV) cells, which convert sunlight into direct current (DC) electricity throughout the day.

Off-Grid interface

It has various functions,

It acts as a charge controller; the solar energy generated flows through it and goes to battery once the battery is fully charged it cut off the supply of DC charge going towards battery.

This system is connected to (Battery, Home inverter, solar panels, Main supply)

It has a deep switch which even controls the discharge of battery according to our power cuts, if we have high power cuts that we can feed the code accordingly to maintain the battery charged %.

If we have less power cut than we can use the battery just by leaving it 20% charge for emergency once the energy of the battery is utilized than the lights connected to the inverter shifts to mains automatically.

Battery:

It is used to store the electricity in DC form and manages to provide the backup when needed

Voltage =12 V Amp/ Hr = 150 Amp/Hr

We are using solar battery having c10 plate which charges fast as compare to normal c20 battery.

We can also use the lithium-ion battery like power wall I am making one will share soon. [18]

Inverter:

This device converts the DC electricity generated by the solar panels into the alternating current (AC) electricity.

Electrical Panel:

The AC electricity is sent from the inverter to your electrical panel to power your lights and appliances with solar energy. The electrical panel is often called a “breaker box.”

2.9Solar energy attractive in Bangladesh

Bangladesh is a south Asian country located in between latitudes 20°34’ and 26°39’ north and longitudes 80°00’ and 90°41’ east. Therefore, it is an ideal location for solar energy utilization. Also, as it is a subtropical country, 70% of the year sunlight is plentiful. This makes the use of solar panels very effective in Bangladesh. Daily solar radiation is 4-6.5 kWh/m² and maximum radiation is generally received in the months of March-April and minimum in December-January. Hence, solar energy can be a viable solution for the power crisis in Bangladesh. [19]

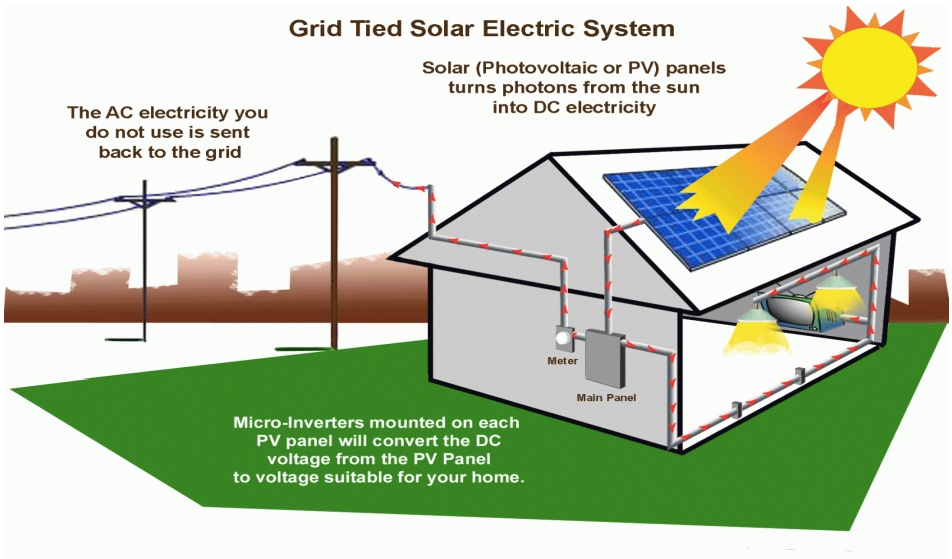

Figure: 2.9.1- Future Prospect of solar energy.

2.10 Top ten countries using solar power:

Table: 2.10.1-Table for Top ten countries using solar power.

Rank	Country	Using Total capacity
1	China	78.7%
2	Japan	42.75%
3	Germany	41.22%
4	United States	40.3%
5	Italy	11.28%
6	United Kingdoms	1163%
7	India	9.01%
8	France	7.13%
9	Australia	5.9%
10	Span	5.49%

CHAPTER-3

METHODOLOGY

3.1 Introduction

This study is designed to explore the socio-economic impacts of SHS in remote rural areas of Bangladesh. The study is based on primary data. Secondary sources are also used. Due to technology-based social research a mixture of qualitative and quantitative methodological approaches are applied. General information regarding the SHS dissemination programmers and socio-economic impacts of solar electricity are collected from secondary source and interviews with local experts. Primary data of the study are collected through an extensive household survey method using questionnaire. Secondary sources are also used to support the survey data. Questionnaire is designed as present and before SHS installation to measure role of SHS in socio-economic development of rural area.

3.2 Flow chart of the working procedure:

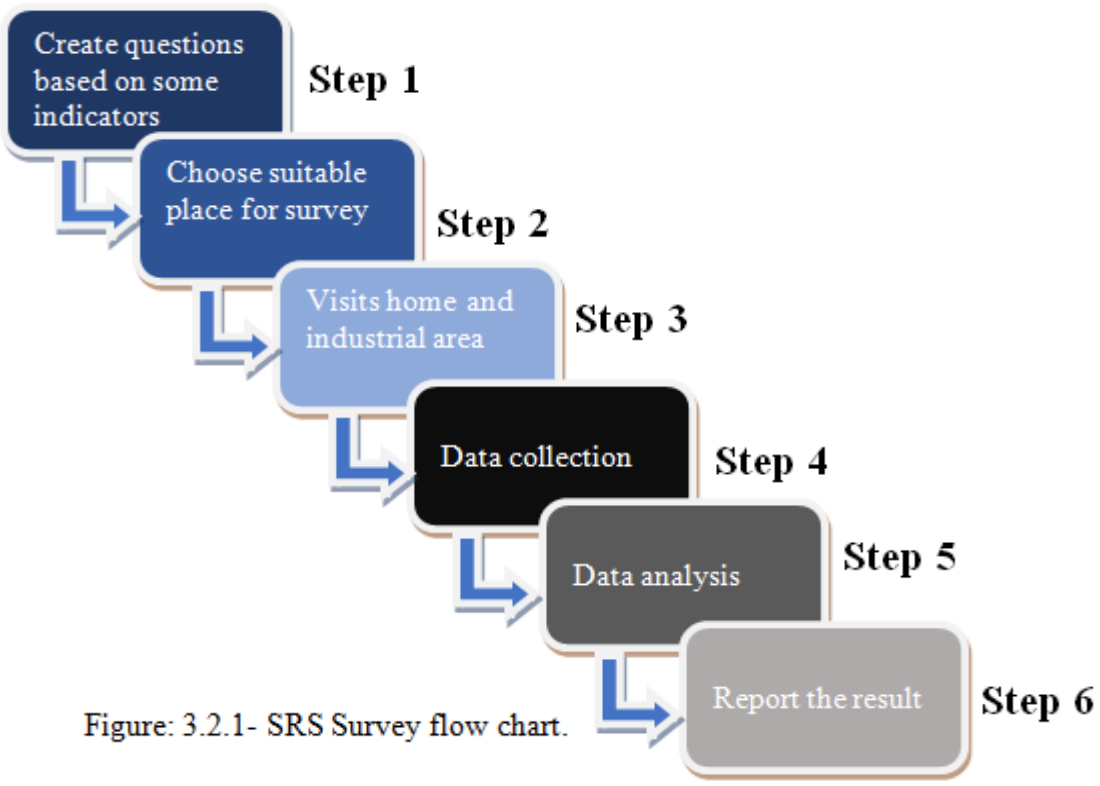

Figure: 3.2.1- SRS Survey flow chart.

3.3 Site Selection

We are survey for solar rooftop system (SRS) under (DPDC) site selection of Narayanganj circle. We are two group divided for survey Narayanganj west and Narayanganj east. Me and my group member visit Narayanganj west some home and industry, we tell about solar user consumer and collect data. We do some questions solar rooftop system for consumer.

In this part of the design, the location where the system can be built, the availability of sunlight, these issues are well reviewed. Because the entire value of the system will depend on sunlight. Depending on the size of the panel, how much space it will need is decided. The performance of the system is always good for the PV panel.

3.4Site Selection map:

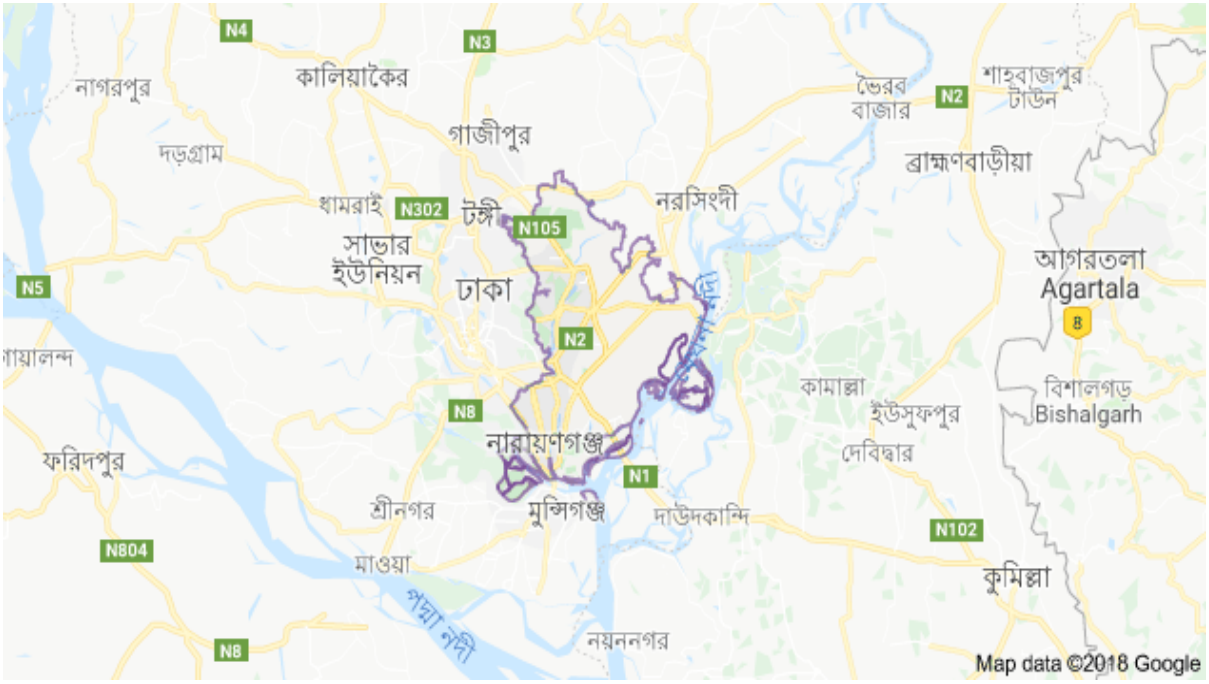

Figure: 3.3.1– Site selection Narayanganj.

3.4Survey Questionnaires for (SRS) under DPDC:

Table: 3.5.1-Table for Survey Questionnaires for (SRS) under DPDC:

SL	Indicator	Question	Description
1	Consumer information	• Owner Name • Name of the NOCS • Address • Phone No • Does your organization rent or own the property?	In this question section we have just collected basic information about consumer SRS.
2	Information of installation	• What kind of solar rooftop system (SRS) are you installed? • Why do you install this SRS? • From where you bought SRS?	We asked the consumer about the installation date, some consumer installed on the grid and some are off-grid SRS.
3	SRS Operation	• What kind of solar rooftop system are you using? • Is your SRS in operation? • Do you think this SRS is useful? • Do you get any training for SRS operation? • Do you use the electricity from your system? In which purpose?	We asked the consumer many question about the operation of SRS.
4	Maintenance	• Do you ever clean your SRS? • Do you monitoring SRS? • How often it is done? • Do you test the regular basis? • How many days ago?	We asked the consumer about SRS cleaning and monitoring.

5	Repair	• What is the main reason for the system disorder? • Do you want to repair? • Do you face any kind of survey?	We asked the consumer about how to repair it.
6	Checking meter reading	• Is the meter reading of the solar electricity taken? • How often it take place? • Do you have any record on solar electricity? • How much electricity do you get from SRS?	We asked some question to consumers about checking meter reading of SRS.
7	Cost analysis	• What is the total cost of SRS? • Do you think, it is a waste of money?	We asked some question about cost analysis of SRS.
8	Consumer satisfaction	• Are you satisfied using solar rooftop system and further increase the capacity of your SRS? • Are you fed your solar electricity to the grid? • Is there any support from government?	We asked some question to consumer about their satisfaction of solar rooftop system.

CHAPTER-4

RESULTS AND DISCUSSIONS

4.1 Introduction:

Any universal warming as a consequence of green house energy emission and also electrical power scarcity across the world happen to be prompting many any areas worldwide to think about solution causes of electrical power which include nuclear together with sustainable which include solar energy, a blowing wind, geothermal together with Samsung s8500 efforts, which unfortunately really don't produce carbon emission. Unlike engineered areas will give you access to nuclear electrical power, a good getting united states for example Bangladesh is not really fortunate enough of having the fact that possibility on the market. Bangladesh may be a semi-tropical section spread during northeastern a natural part of Southwest South east Asia should get rich sun energy all year round. Our company is engaging in to search Narayanganj solar energy rooftop product (under DPDC). So that the comprehensive clients for Narayanganj happen to be 90. People more or less get the entire records.

4.2 List of Total consumers:

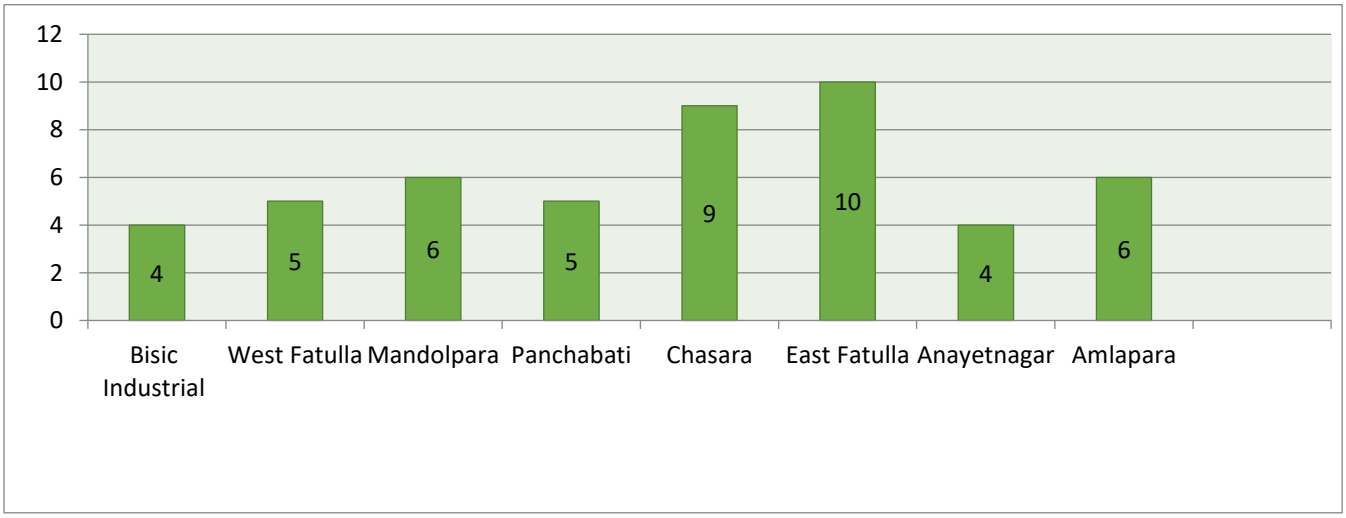

Figure 4.2.1: Figure for List of total Consumer.

We visited Narayanganj to analysis the performance of solar rooftop system (under DPDC). For this reason, we conduct the survey at the West Zone of Narayanganj. Here we found 4 consumers at bisic industrial area, and we found 5 consumers at fatulla area, 6 consumers at mandolpara area, and 5consumersat panchabati. We almost collected all of the data. After completing the west zone we conduct the survey at East Zone. Here we found 9 consumers at chasara area, and 10 consumers at fatulla area, 4 consumers at anayetnagar area, 6 consumers at amlapara area, and we almost collect all of the data.

4.3 Information of installation

There are three types in information of installation.

- On-grid and off-grid consumer
- Provider of SRS
- Installation process

- **On-grid and off-grid consumer:**

This figure represents eight areas. In the area of Bisic industrial there are total 4 consumers in which 3 are ON Grid and 1 is OFF Grid. Therefore most of the consumers are ON Grid. Now in the area of Fatulla there are total 5 consumers in which 3 are ON Grid and 2 is OFF Grid. Therefore most of the consumers are ON Grid. Again in the area of Mandolpara there are total 6 consumers in which 4 are ON Grid and 2 OFF Grid. Therefore most of the consumers are ON Grid. In the area of Panchabati there are total 5 consumers in which 5 are ON Grid and no OFF Grid. Therefore most of the consumers are ON Grid. In the area of Chasara there are total 9consumers in which 8 are ON Grid and 1 is OFF Grid. Therefore most of the consumers are ON Grid. Now in the area of Fatulla there are total 10 consumers in which 8 are ON Grid and 2 is OFF Grid. Therefore most of the consumers are ON Grid. Again in the area of Anayetnagar there are total 4 consumers in which 4 are ON Grid and no OFF Grid. Therefore most of the consumers are ON Grid. At last in the area of Amlapara there are total 6 consumers in which 3 are ON Grid and 2 OFF Grid and another consumer is disable. Therefore most of the consumers are ON Grid. Finally we can say that most of the solar systems are on-grid and in fatulla we found the maximum number of on-grid SRS.

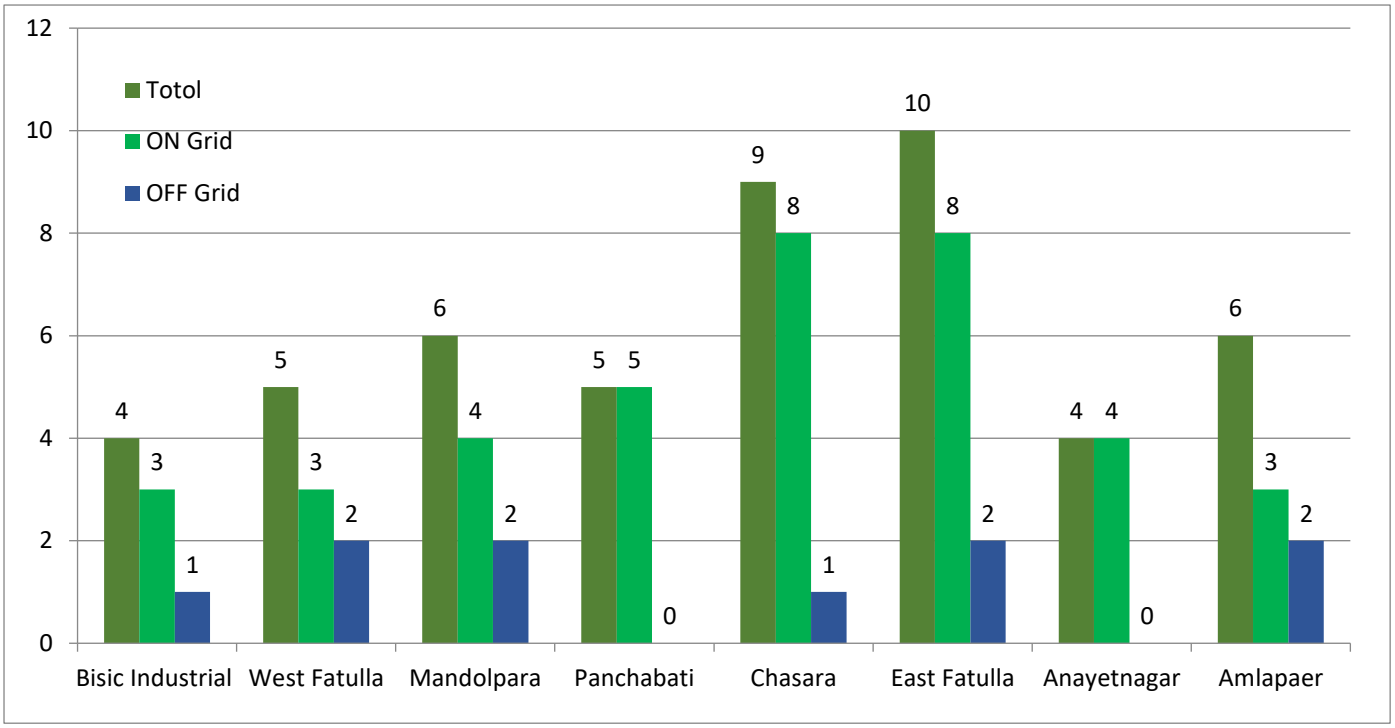

Figure 4.3.1: Figure for ON grid and OFF grid consumer.

- **Provider of SRS:**

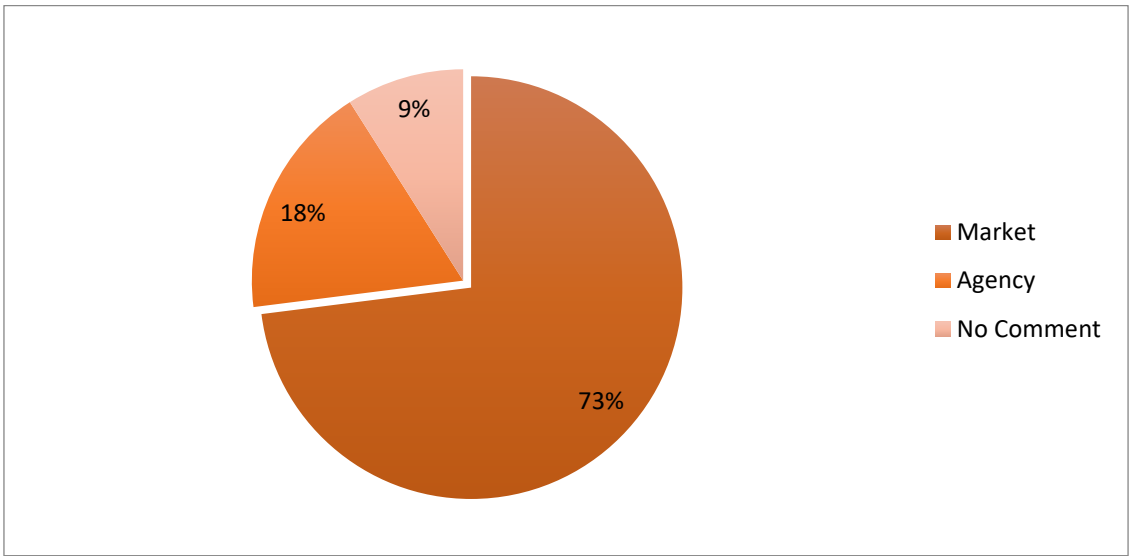

Figure 4.3.2: Figure for Provider of SRS.

This figure represents the provider of SRS. In this case we observe that more than 73% consumer uses local market SRS where only 18% people buy SRS from agency suggested by DPDC.

- **Installation process:**

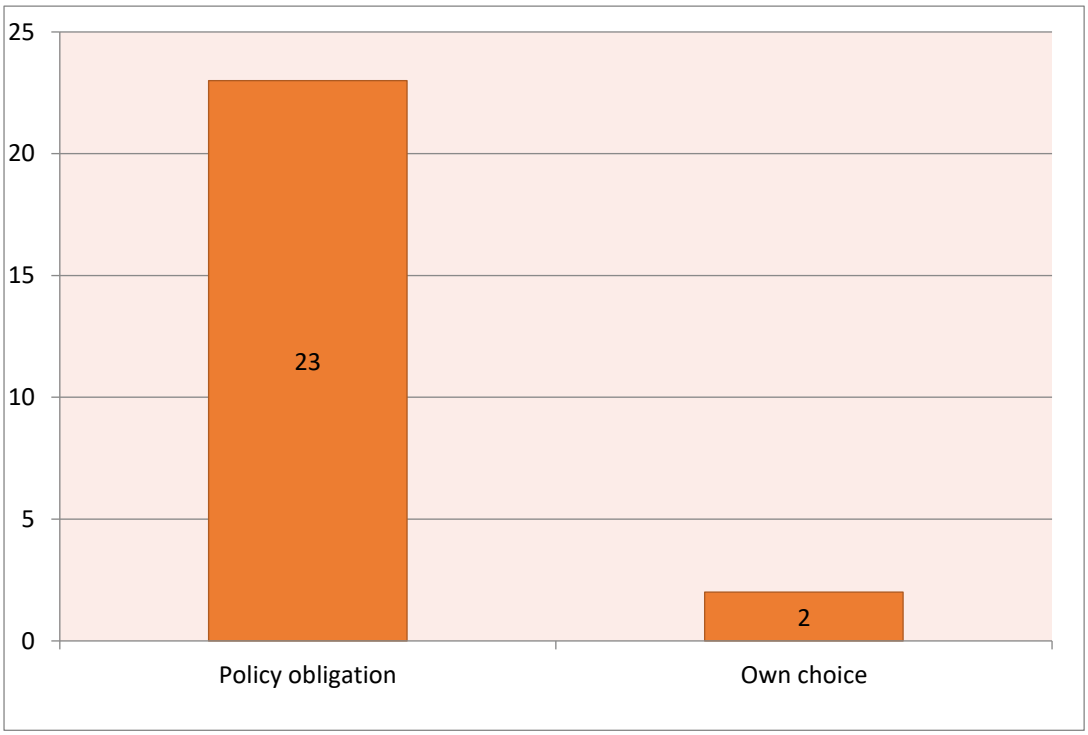

Figure: 4.3.3-Figure for Installation process

Figure 4.3.3 provides information that 23 consumers have installed SRS for the policy obligation. That means they have no interest to install the solar system. Other 2 consumers are interested to install the SRS system. That's why they installed SRS for their own choice.

4.4 Operation of SRS

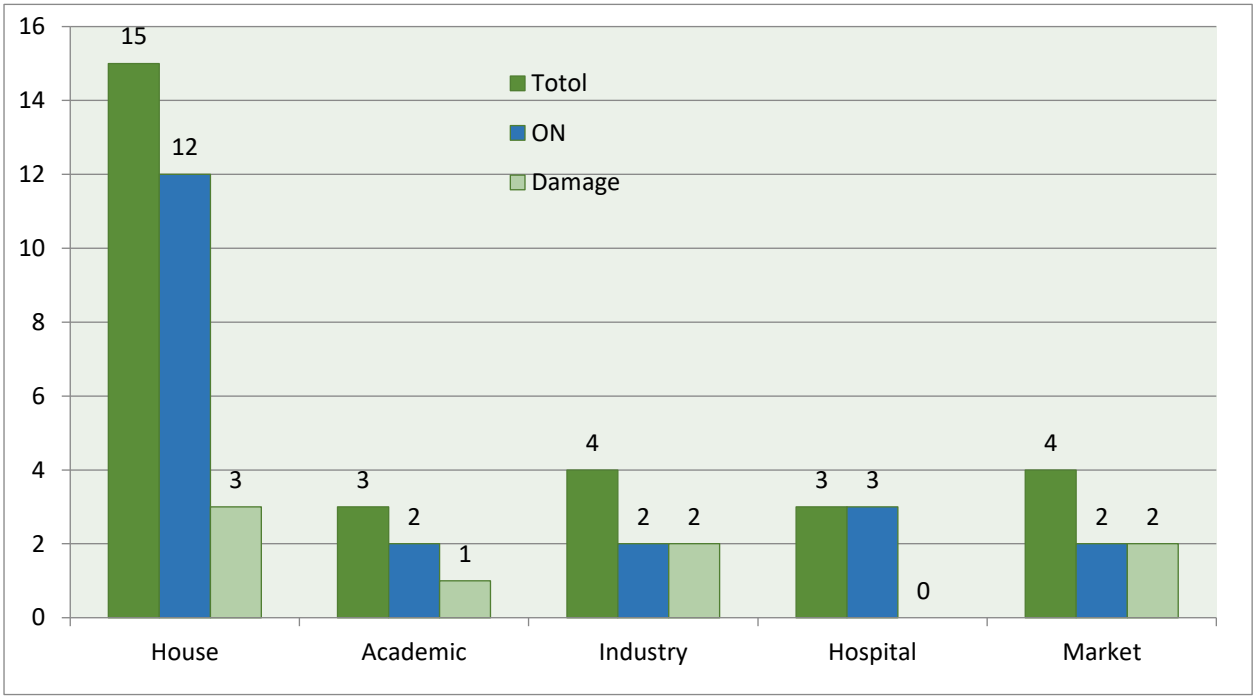

Figure 4.4.1: Figure for Operation of SRS.

From figure 4.4.1 we can observe that, in-house, there are total 15 consumers in which 12 are on and 3 are damaged. Therefore most SRS are in Operating condition. We can observe that, in academic, there are total 3 consumers in which 2 are on and 1 are damage. Therefore most SRS are in Operating condition. We can observe that, in industry, there are total 4 consumers in which 2 are on and 2 are damaged. Therefore most SRS are in Operating condition. We can observe that, in hospital, there are total 3 consumers in which 3 are on and no damage. Therefore most SRS are in Operating condition. We can observe that, in market, there are total 4 consumers in which 2 are on and 2 are damaged. Therefore most SRS are in Operating condition. From this analysis we can say that, in industry and market 25% SRS are damaged.

4.5 Maintenance of SRS

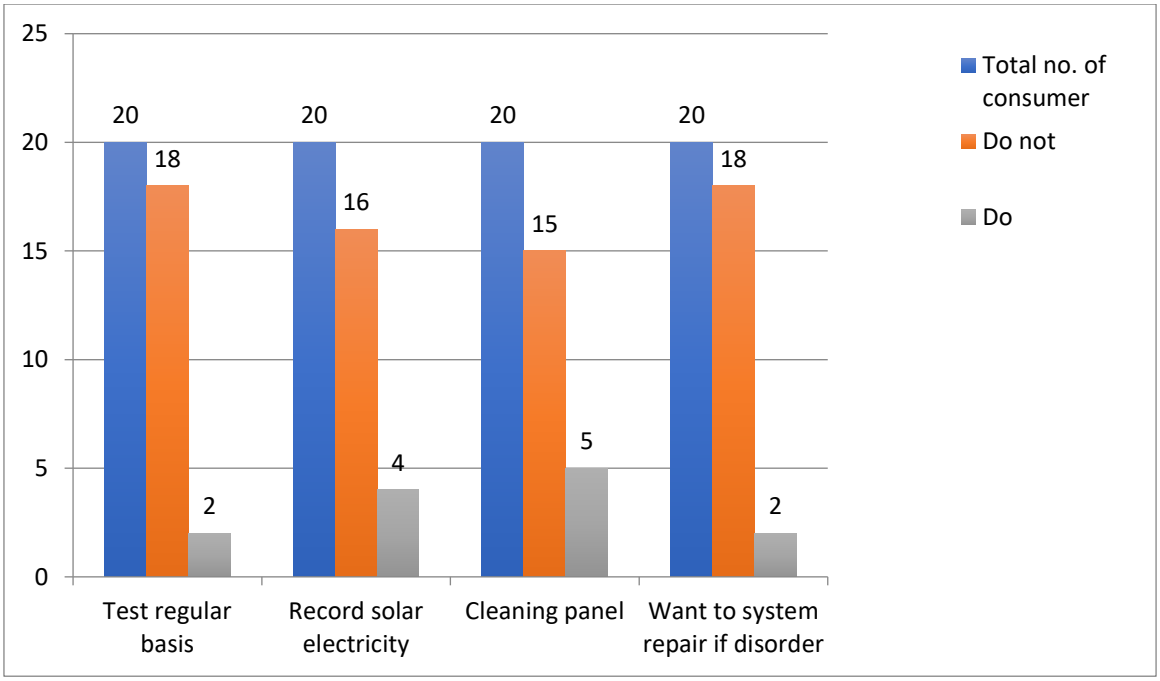

Figure 4.5.1: Figure for Maintenance of SRS.

The chart shows the proper maintenance condition of all the SRS. From this chart, it is seen that among 20 consumer, only 2 consumer have been testing the system on a regular basis, only 4 consumer have got the record of the electricity from SRS, and 16 consumers haven't got the record right, only 5 consumers clean the panel where 15 consumers do not either feel the necessity to clean the panel at all. In addition only 2 consumers are interested to repair and 18 consumers are no interested to repair

4.6 Repair of SRS

There are two types in repair of SRS.

- Choice of repair
- face any kind of survey

- **Choice of repair:**

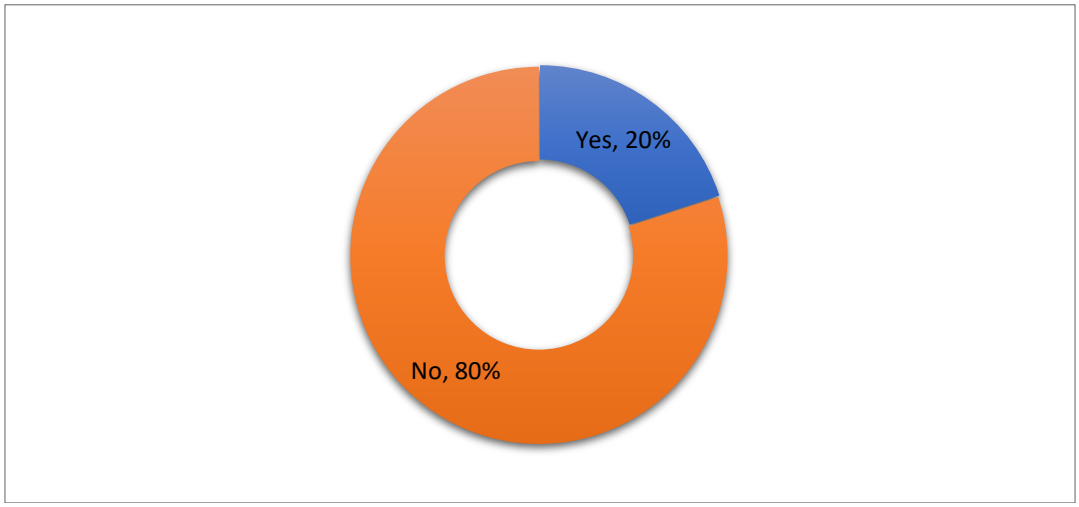

Figure 4.6.1: Figure for Choice of repair.

All Charts4.6.1 had shown that repair of SRS. We asked the consumer about the repair of SRS.Solar rooftop system uses consumer want to know about repair it. They want to repair their solar rooftop system. The consumer in which 80% are not repair and 20% are repair of SRS system. Therefore most of the consumer is no repair of SRS system.

- **face any kind of survey:**

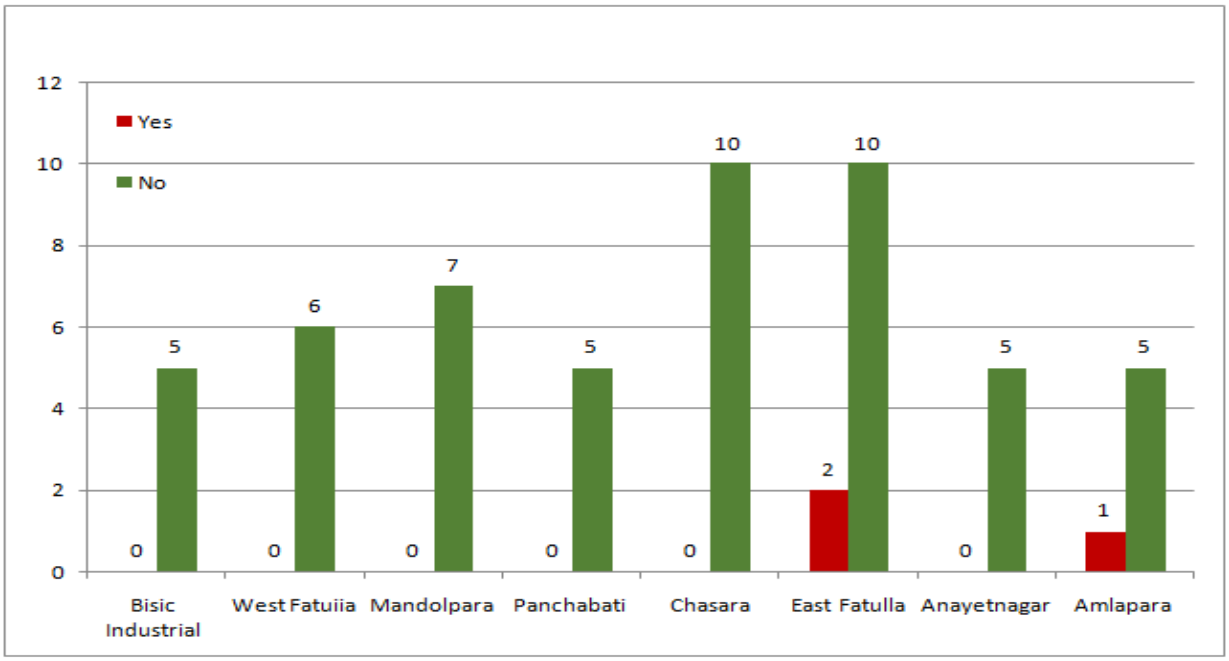

Figure 4.6.2: Figure for face any kind of survey.

In this graph represents eight areas. In the area of Bisic industrial there are total 4 consumers in which 4 are no any survey. Therefore most of the consumers are no survey. Now in the area of Fatulla there are total 5 consumers in which 5 are no any survey. Therefore most of the consumers are no survey. Again in the area of Mandolpara there are total 6 consumers in which 6 arena any survey. Therefore most of the consumer's arena survey. In the area of Panchabati there are total 5 consumers in which 5 arena any survey. Therefore most of the consumer's arena survey. In the area of Chasara there are total 9 consumers in which 9 arena any survey. Therefore most of the consumers are no survey.

4.7Checking meter reading of SRS

In this figure represents five areas. In the area of house there are 41% consumers in which Checking meter reading of SRS.In the area of academic there are 14% consumers in which meter reading of SRS. There is industry only 11% consumers have got the record of the meter reading of SRS. In the area of Hospital there are 16% consumers in which meter reading of SRS. Last on market only 18% consumers have got the record of the meter reading of SRS.Therefore most of the consumers are house record of the meter reading of SRS. .Therefore most of the consumers are industry no record of the meter reading of SRS.

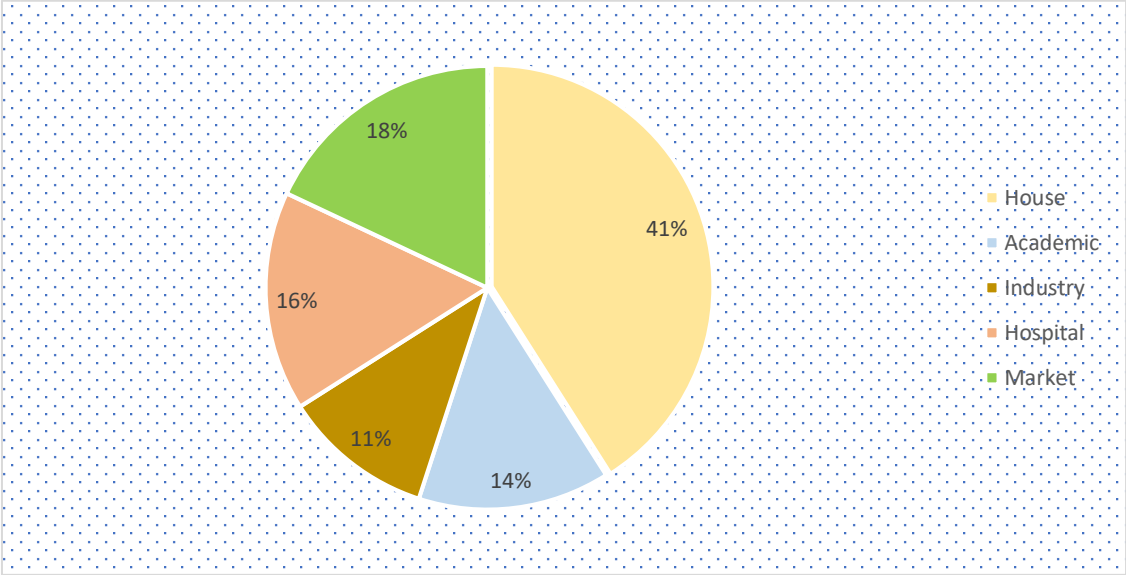

Figure 4.7.1: Figure for Checking meter reading of SRS.

4.8 Cost analysis of SRS

Consumer name: Md. Jahangir Husain

Address : amlapara, 27-A, New chasara

Installed by : Grameen Shakti

Installation date: 29-10-2016

Capacity : 1.92 KW

Price : 1, 10,000 BDT

Energy generated =1700 KWh 29-10-2016 to 30-11-2018

Total energy generated per month = 1700/25 = 68 KWh

Energy generated per year = 66*12 = 816 KWh

Life time energy generated = 816*20 = 16320 KWh

Cost per unit = 1, 10,000/16320 = 6.7 BDT.

4.9 Consumer satisfaction

In the following chart, the comparison of how many consumers accepts the system as a waste of money and how many of them find it useful. According to the result, 13 consumers think that the installed of SRS is a just waste of money for them because there is no use of SRS in their life. On the other hand, 8 consumers found that this is a useful system because can utilize the power of SRS in their daily life and among the 8, 5 consumer wants to increase the SRS capacity so that they can get more power from SRS which can be the backup power in the time of load shedding. Here we find that some consumers don’t want to comment anything about their SRS.

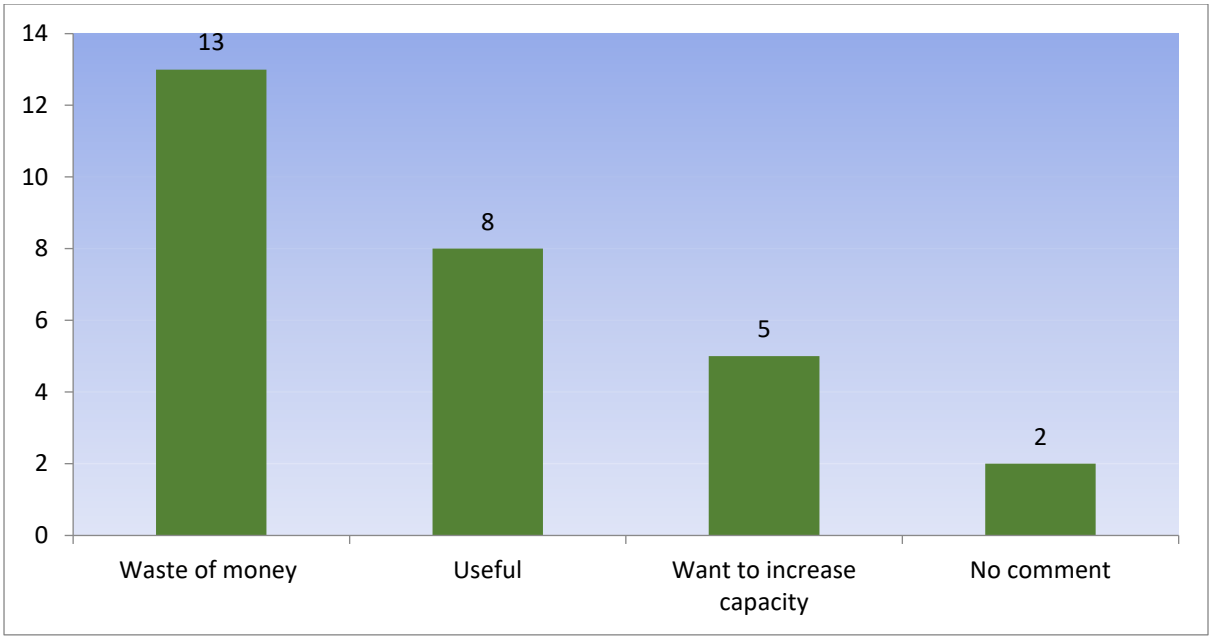

Figure 4.9.1: Figure for Consumer satisfaction.

4.10 Thesis finding

We have found a new issue while we are on the field survey on consumer door to door. Some are theoretical some are technical.

4.10.1 Lack of Knowledge

We have find a new issue while we are on the field survey on consumer door to door that most of the case most of the consumer don't have any interest to clean the solar panel on regular basis. Because when we ask them why you don't have any interested to make your valuable solar panel neat and clean? Then most of the consumer replies the same answer that first time they hear that SRS panel need to regular maintenance. Another problem is that currently Bangladesh is importing almost all types of solar panel. Due to policy obligation consumer don't want expense more money to buy a quality product instead to buy a low-quality panel at low price.

4.10.2 Technical Issues

When few days soon after they are really looking at a number of tech conditions. In this particular operation they are really giving up one's own concern in utilizing solar. On top of

that tips in regard to consumption of solar not even constantly available in the market. Bangladesh state should really have critical procedures to help you challenge the corporation consumers in addition to distant many people.

4.10.3 Government Initiative

Most of the case when we ask the consumer did they get any financial/technical support like how to operate the SRS in a proper way. Then another part is maintenance which is very import part in SRS. If consumer don't get any short-training support from professional they will have face many difficulties. they said they don't get any support from government authority(in that case authority is DPDC). We know that gaining financial support is not possible from government authority(DPDC) for all consumer but if they wish they can easily arrange one/two-day long Workshop about '' How to operate and maintenance of Solar Rooftop System'' at their local office/community.

4.10.4 Need to change Consumer/People unconscious mentality about SRS

Most of case when we asked the consumer that is this SRS is useful? Almost more than 90% consumer said that no because they don't get back their return(electricity from solar) to their huge investment on SRS within a sometime. We need to counsel them that if you want to get back the return(electricity from solar) on your investment then you have to clean your solar panel in a regular basis, you have to keep a log book for data about its daily production, your demand capacity, need to take solar electricity meter reading in a regular basis. Need to tell them that after fulfill this entire requirement you will able to get back the return (solar electricity) regularly if they fail to do this they can't get proper amount of solar electricity insist of installed solar capacity. We need tell them the advantage of renewable energy by help of electric print media and other way.

4.11 Recommendations:

- It happens to be myopia read through who energy electric might be steeply-priced. The upper basic selling price from growth capital from placing SRS mustn't be used for being a list of being dearly-won; as an alternative typically the procedures to speculate through solar pv companies turn up practical. By means of virtually all spot of this Use even so

simply cannot easy access electric, an electricity crunch will present ruinous problems concerning livelihoods. Up to date research projects by your environment provider not to mention Environment Commercial lender endorse typically the weakness from growing cities towards climate modification. And so solar PV and various other replenish-able energy source companies permit the cities to prepare forthcoming energy source security measure but still for the reason that is prepared the world for the purpose of the end problems from overseas weather factors modification. For the reason that Bangladesh might be endued with the help of solar PV, its possible towards protect energy source crunch from homing SRS products. By using energy electric are able to help reduce towards importance top quality from diesel engine not to mention in doing so has saved me money. Out of your researches of this field feedback survey, the below solutions could be offered for ones character from SRS as a way to draw building socio-economic expansion through Bangladesh.

- Typically the solar energy arena might be looking complications with substandard sun power panels not to mention variety. There can be complains that variety good is absolutely not roughly amount to produce comforting functioning. Deficient guaranty period of variety & inverter might be a second concern. Bangladesh is now posting almost all of typically the sun power panels; low-cost substandard individual panels are actually inundating the for market. As an alternative for by using high-quality rates valued sun power panels, most of the people use less expensive substandard labels not to mention looking a variety of inconveniences. Where system they've been melting away his or he’s need for by using SRS.
- Through feedback survey, it happens to be seen who, there is also a reasonable probability from Bangladesh in order to satisfy her forthcoming capability call for in so doing personal economic progression throughout replenish-able tools. Solar energy companies spoken about on top of can really help Bangladesh to offer further capability that allows you to help reduce Load-shedding concern. Instance seems to have get to take a look in front not to mention manage such replenish-able energy source spheres to offer electric in place of dependent fully concerning old fashioned solution. Now SRS identified within use.
- Through feedback survey, it happens to be seen who the sheer number of SRS enhances the good price from ordering energy structure through rural sections. Typically the character from SRS concerning residential profit might be found to always be particularly

reasonably limited, for the reason that SRS electric might be infrequently chosen productively. Shortage of practical knowledge & guidance concerning advantageous entry to SRS and then the non-availability from energy electricity hardware are found to always be the actual why this example.

- That allows you to remove the impediments not to mention rise strength typically the SRS through rural section soon after mandatory procedures are generally applied.
- Sustainable not to mention Replenish-able Energy source Expansion Expertise could be further working towards popularize typically the energy electric through rural portion of Bangladesh.
- Appropriate budgetary bouquets, among them money payment, monetary fee for the purpose of assistance, subsidy, computer say not to mention 100 % legal program for the purpose of groups working with to get going in your energy arena is.
- Government should certainly instill researching systems for the purpose of harnessing, remodeling not to mention absorption solar energy solutions. Simulated course could be given further from numerous entries to solar energy products.

- Technician guidance is very important for the purpose of growing hometown technical support, which commonly even come up with typically the work self-sufficient. A lot of women even could be invited for the purpose of guidance, like they might possibly be the significant visitors of this unit and can also can examples of the routine service. It happens to be myopia read through who energy electric might be steeply-priced. The upper basic selling price from growth capital from placing SRS mustn't be used for being a list of being dearly-won; as an alternative typically the procedures to speculate through solar PV companies turn up practical. By means of virtually all spot of this usa even so simply cannot easy access electric, an electricity crunch will present ruinous problems concerning livelihoods. Up to date research projects by your environment provider not to mention Environment Commercial lender endorse typically the weakness from growing cities towards climate modification. And so solar PV and various other replenish-able energy source companies permit the cities to prepare forthcoming energy source security measure but still for the reason that be prepared the world for the purpose of the end problems from overseas weather factors modification. For the reason that Bangladesh might be endued with the help of solar pv, its possible towards protect energy source crunch from homing SRS products. By using energy electric are able to help reduce

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Sustainable not to mention Replenish-able Energy source Expansion Expertise could be further working towards popularize typically the energy electric through rural portion of Bangladesh.

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- · Government should certainly instill researching systems for the purpose of harnessing, remodeling not to mention absorption solar energy solutions. Simulated course could be given further from numerous entries to solar energy products.
- · Technician guidance is very important for the purpose of growing hometown technical support, which commonly even come up with typically the work self-sufficient. A lot of women even could be invited for the purpose of guidance, like they might possibly be the significant visitors of this unit and can also can examples of the routine service.
- · Standard from solar energy gear could be guaranteed throughout school.
- To elevate acceptability of this product from buyer components/accessories from energy units could be to choose from in the neighborhood so that the visitors are able to. Standard from solar energy gear could be guaranteed throughout school. To elevate acceptability of these products from buyer components/accessories from energy units could be to choose from in the neighborhood so that the visitors are able to.
- To increase affordability local production of SRS components is necessary to reduce the selling price of SRS.

CHAPTER-5

CONCLUSION

5.1 Conclusion

Bangladesh is probably the virtually all densely populated not to mention poorest cities across the world. Shortage of the ways to access advanced energy source assistance are probably the why low income not to mention affordable personal economic Expansion. There is an essential shortage of the right system not to mention market recreation towards Popularize typically the -panel structure through Bangladesh. Solar energy is definitely a free Environment-friendly approach of obtaining capability and should take up a big character through limiting active Crunch. The government makes typically the sun power panels authorized socially practically numerous Attempt which could deal with the issues spoken about through this learn. Considering that market place for ones -panel is absolutely not greatly competitive, further industry groups should certainly check out advertisement options available in the basket. Manager's needs to learn this unique uncontested economy spot rigorously not to mention create strategies to penetrate safely and effectively. Even, jointly treat not to mention sort out the problems regarded by your individuals of that learn in order to achieve buyer morals not to mention happiness. This unique Thing definitely will reap some benefits these products for money not to mention socially. Of course, the us government not to mention industry Enterprises should certainly give good results collaboratively towards grab typically the mind boggling future from -panel structure through Bangladesh.

5.2 Future Scopes of the work

It is possible to build Bangladesh as a developed state through power development. So, in future, some programs have to be taken for solar-based power generation.
Such as:

- Replacement of Diesel Irrigation Pumps with Solar Power

- Solar Minor Grid Capability Structure by Universal remote communities.
- Solar Parking facilities.
- Roof-top Solar PV Method for the purpose of Advertisement among them government-owned architecture, Economic not to mention House architecture.
- Electrification from healthiness shelving units, useful Schools, O Shelving units by Wedlock grades, afraid stores not to mention railway stations.

References:

[1] https://en.wikipedia.org/wiki/Solar_power

[2] https://www.thedailystar.net/opinion/economics/why-solar-power-development-so-slow-bangladesh-1560934

[3] http://article.sciencepublishinggroup.com/html/10.11648.j.ijfbr.20160204.13.html

[4] http://www.assignmentpoint.com/science/engineering/report-on-future-prospect-of-solar-energy-in-bangladesh.html

[5] https://en.wikipedia.org/wiki/Solar_panel

[6] https://www.greenmatch.co.uk/blog/2014/07/7-reasons-why-you-should-use-solar-power

[7] http://en.wikipedia.org/wiki/World_energy_resources_and_consumption

[8] https://pdfs.semanticscholar.org/5e70/4d46e030f9d03ce5772aeab5bdcb68f080d2.pdf

[9] https://en.wikipedia.org/wiki/Photovoltaics

[10] https://www.researchgate.net/publication/2539232_The_solar_radiation_model_for_Open_source_GIS_Implementation_and_applications

[11] https://www.cleanenergyreviews.info/blog/2014/5/4/how-solar-works.

[12] https://www.energymatters.com.au/residential-solar/how-solar-power-works/

[13] https://news.energysage.com/solar-panels-work/

[14] https://www.explainthatstuff.com/how-inverters-work.html

[15] https://www.converseelectric.com/blog/2015/05/how-does-an-electrical-panel-work/

[16] https://us.sunpower.com/blog/2018/04/30/how-solar-energy-net-metering-works/

[17] https://www.nrel.gov/docs/fy02osti/31687.pdf

[18] https://www.energysage.com/solar/solar-energy-storage/how-do-solar-batteries-work/

[19] http://www.energybangla.com

[20] https://www.growsolar.org/technical-assistance/value-solar-methodology/