ANALYSIS OF SOLAR ROOF TOP SYSTEM (SRS) UNDER THE DPDC OF BANGLADESH

Supervised By

Professor. Dr. M. Samsul Alam

Dean

Faculty of Engineering

Daffodil International University

Submitted By

Md. Mahbubr Rahman

ID: 152-33-2783

Md. Badujjaman Rabby

ID: 152-33-2790

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF ENGINEERING

DAFFODIL INTERNATIONAL UNIVERSITY

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Certification

This is to certify that this project and thesis entitled **"Analysis of the Solar Roof Top (SRS) under the 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 Electonic Engineering under the Faculty of Engineering of Daffodil International University in partiam fulfillment of the requirments for the degree of Bachelor of Science in Electrical and Electronic Engineering. The Presentation of the work has held on December 2018.

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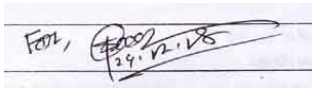

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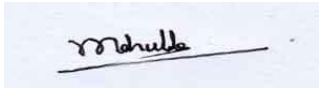
Professor. Dr. M. Shamsul Alam
Dean
Faculty Of Engineering
Daffodil international University

Signature of the candidates



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Md. Mahbubur Rahman
ID No : 152-33-2783

_____

Md. Badujjaman Rabby
ID No : 152-33-2790

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Dedicated to

Our Parents

&

HONOURABLE SUPERVISOR

Professor Dr. M. Shamsul Alam

Dean

ABSTRACT

The daily headline makes aware of the dangerous long-term effects of electricity generation from fossil fuels. It is widely believed that fossil fuel may cause serious environmental problems to generate electricity. Moreover, fossil fuel is limited in quantity and as well as spending a lot of money. Therefore, renewable energy is a possible solution to meet the electricity demand of developing countries like Bangladesh. Among all the renewable technologies, solar photovoltaic (PV) is the most probable, favorable and promising, which converts solar energy into electrical energy, with or without battery backup. Although solar technology has succeeded in rural areas, most of the technology was adopted based on the solar roof top system (SRS), but it still has not been implemented in urban areas to bring 3% of the light fan load Building. We tested the solar roofs installed in Narayanganj's home and industry. Where most homes and industries in the grid use the top roof system grid and close some grids. Some of them are active but not used in the system. Based on this investigation in the study, overall analysis of urban solar potential has been done in three levels. Depending on the amount of load running, the cost efficiency compares to the various solar panels. Efficient batteries are modeled by home and industry in Bangladesh's context to improve PV systems. In addition to this, the reconstructed design of the solar system has been proposed to make the urban rooftop solar system efficient and successful.

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LEST OF ABBREVIATIONS

SRS	Solar Roof Top
CDM	Clean Development Mechanism
BPDP	Bangladesh Power Development Board
REB	Rural Electrification Board
LGED	Local Government Engineering Directorate
IDCOL	Infrastructure Development Company Limited
NGO	Non Government Organizations
MW	Mega Watt
PV	photovoltaic
AGM	Absorbed Glass Mat
DC	Direct-current
DPDC	Dhaka Power Distribution Company
PWM	Pulse-width Modulation
DAQ	Data Acquisition
SODIS	Solar water disinfection

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The concept, solar power has been given more attention and more, it is a clean and renewable energy source. Photovoltaics (PV) cells are obtained from sunlight to convert solar energy directly into electric energy. This power can be used in many applications, like lighting, heating and performing different devices. The sun-powered cells have semiconductor body which uses photovoltaic effects. When PV is reversed from the outer side of the sun-powered board, the higher efficient system can be achieved; Therefore, most potential electrical power can be set up. Most of the tests for solar cell efficiency increased.

Several decades ago, solar cell modules have been made and discovered by arranging series to optimize the output voltage. The solar tracking system is classified as a control system that inserts that the PV panel is not suitable for light source, and a controller that gives signals to one or more activators to change to the maximum targeted panel. Due to the proven efficiency of the PH panel, the dual-axis solar tracker process has gained interest in R & D. Presently the researchers practicing the usage of dc-dc support converter to coordinate the yield voltage as well as boost the lower voltage from system of photovoltaic. The purpose of using dc - dc boost the converter is reduced to low output high voltage output and also avoids the reverse current flow by blocking diode.

Furthermore, the Pulse-width Modulation (PWM) approach is also providing by researchers to regulate the dc-dc support converter. The Extreme Power Point Tracking or MPPT method obtains maximum extreme potential force from sun oriented boards. An intelligent controller is required to support the proficiency of the control framework of PV together with mechanical model of tracking structure. One of the MPPT method is fuzzy logic controller which is very reliable for photovoltaic array because fuzzy logic technique is promoted better and rapid tracking effectiveness for different optimal operating points. It supports to record optimum

power under weather surroundings changing and gain great strength plus feedback amount is big. Progressively, data acquisition (DAQ) is process of recording or storing the data of output voltage from solar panel to compare with different weather conditions [1]

1.2 Statement of the problem

Fossil fuel depends on private sector and state-owned power plants, Bangladesh's power system. About 82% of the production power 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 can not support the domestic demand as well as the generating power for the country. Existing reserves of oil and gas will soon be tired. There is a demand for clean and durable energy worldwide at the same time. The importance of developing renewable sources of energy, such as solar, wind, biomass, etc. have important importance. Bangladesh is involved in solar energy as a tropical country. In this context, solar energy is a reliable, affordable and safe energy for the country. But the current part of renewable energy for power generation is only 0.5%. The main people of Bangladesh live in rural areas. There is strong demand for electricity availability in remote villages. Bangladesh has added a lot of solar energy. We have a lot of potential to be a solar power company. Institutional, financial and technical skills work as an important factor in reaching a preferred level of solar power generation and use. But we have lack of information and integrated research in this field.

In 1988 solar power based rural electrification started in Narsingdi. Bangladesh Power Development Board (BPDB), Grameen Electrification Board (RRB), Local Government Engineering Department (LGED), Infrastructure Development Company Limited (IDCOL) and private sector companies, including non-government organizations (solar power). Development Solar power is increasingly being used in close grid and on-grid applications. Since the introduction of SRS Bangladesh has established 22 million units. In this context, an example of the country's rural development alternative energy model, measuring the socio-economic impact of SRS is an example. In the current study, it is determined to identify the factors involved in the implementation of solar energy and solar power and how far the country has succeeded in reducing poverty in the rural areas.

Usually, a solitary sun based cell can't be connected straightforwardly to the heap on the grounds that it has less output voltage and less energy conversion efficiency. Furthermore, the output voltage covers by solar emission and temperature as well. Many solar cells that build in series to generate the maximum output voltage lead to high expenses to fix the photovoltaic system. In conjunction, large surface area is required for sufficient electricity and competence system. The data of output voltage from solar panel is required to record the different weather conditions.

1.3 Objective of the study

The purpose of the study as follows:

1. Maintain and maintain existing PV systems and keep it for better repair.

Solar energy companies, utilities, and collaborate with attracting research grants from government and federal government agencies.

3. To make data available on solar energy in the college web site for access to the internet through the Internet on the Internet and internationally.

4. Current systems are used by solar energy product suppliers and installers as a demonstration unit for community, industry groups and client viewers.

5. Providing solar power equipment installation, operation and maintenance training.

Play an important role as a partner in Long Island Solar Roof initiative.

7. To determine the role of SRS in socio-economic development in Bangladesh.

To develop some real recommendations to improve SRS access in areas where adequate power supply is limited.

1.4 Scope of the study

There is unhealthy demand for electricity in Bangladesh. Countries generally feel the disadvantage of supply of electricity, especially in the summer. The energy gap in Bangladesh is one of the biggest obstacles to economic growth of Bangladesh. Some estimates of Bangladesh's economic growth have been around 8%, if it was not limited by the energy deficit. Bangladesh government actively engaged in the management of energy crisis to maintain and maintain economic growth. The national energy policy has clear targets for electricity supply throughout

the country by 2021. Bangladesh has adopted the renewable energy policy-2008, of which at least 5% of the power renewable sources and 10% by 2020 are required by 2015. Now, renewable energy-based power is about 90 megawatts (MW) and it originally comes from solar power.

SRS can transform the lives of people in rural areas. Solar power can be a way of providing solar power solutions for customers, agriculture, healthcare, education, telecommunications, rural roads and marketplaces. The government, development partners, research institutions, NGOs and non-government organizations are working to transform Bangladesh into a energy-efficient country using undisclosed solar energy. Solar Power The most probable source of renewable energy resources in Bangladesh. Using solar energy by adopting appropriate policies, rules and regulations, it is possible to reduce the country's growing electricity demand. Therefore, the current research will identify the reasons associated with the use of SRS and the socio-economic impact of rural areas.

1.5 Significance of the study

Bangladesh is a tropical country of huge solar energy. But it is used in a very small amount. Although SRS started in 1988, it was unread for a long time. This time solar applications are seen throughout the world. Nowadays solar panels provide electricity for solar vaccine refrigerators, solar water disinfection (sodis), solar food dry and solar pasitaryization. This helps to reduce waterborne diseases. Solar phones, solar Wi-Fi, solar radiation enhance rural communication, reduce transportation costs and reduce digital divide. Solar cookers and solar water as well as reducing dependence, internal pollution and carbon emissions in traditional fuels such as wood or charcoal. It increases the standard of living in rural areas, improves health and education, reduces oil dependence, increases local employment and reduces forestry. Leadership of Rural Development LeadershipDue to lack of information and research, SRS is used only for consumer discussion in Bangladesh. Solar power technology is becoming popular in Bangladesh. As an agricultural country, using solar power irrigation system will be a major driving force in rural development. Government organizations, academic institutions, NGOs and non-governmental organizations are involved in the renewable energy sector of the country.

Researchers, policymakers, development partners in Bangladesh acknowledge the infinite potential of solar electricity for rural conversion. But there is no integrated study of solar power potential and opportunity for socio-economic development in rural areas in Bangladesh. Currently there is very limited academic research about the socio-economic or environmental impact of solar power in rural areas. So in the study, Bangladesh will help the policy makers and implementers to take necessary steps for sustainable rural development. Identifying the new innovative use of solar power in the rural areas will be helpful in implementing effective planning and initiative programs. Moreover, it will also help in relocation of new technology to rural areas

1.6 Outline of the study

Following the introduction the second chapter of this report will focus on review of selected literature and conceptual overview of SRS in socio-economic development. In third chapter, it will discuss the methodology of the research. The fourth chapter is analysis of the data, results and discussions. The fifth chapter is conclusions and recommendations and of this report.

Chapter 2
LITERATURE REVIEW

2.1 Introduction

Load management for electricity requires a cry to develop sectors in a sustainable manner. Only this can provide more benefits for our citizens and the environment. For our perception of sun energy balance, and developing countries, this is a golden opportunity. Solar energy is an additional market for more developed countries, which can benefit from less electricity costs over time. It is also good for the environment because it replaces conventional, and effectively harmful, energy generation methods. There are sources of renewable energy other than solar, but it is especially useful for sunspots, where there is less air and water resources. Because of the extensive research conducted in this field, solar panels are developing in more efficient models than ever before. The makers allow for higher competition levels as well as cheaper prices. The reasons for choosing solar energy by increasing the number of projects run by different agencies and government are also clearly indicated. Applications for this energy source can be single rooms and large electric grids, which show a versatile fit for the needs of a developing country. Due to population growth, improved standard of living and various factors for general economic and industrial growth, the current energy demand is increasing day by day. The electricity production system is largely dependent on two imported petroleum oils and its own natural gas. On the other hand, as per information about fossil fuel deposits in Bangladesh, if they are consumed at the present rate, then the opposite natural gas and coal will be extracted from 2020 to 2030. Reduce reliance on imported energy and dependence. Natural gas pressure, current power generation should be diversified and simultaneously to discover and improve indigenous energy sources. It can be mentioned that the environmental concerns are now a universal problem and increase greenhouse gases, including conventional energy health and adverse environmental consequences. The development of renewable energies and the relative technology in these perspectives is a very important strategic alternative. Communities in rural areas and mainly in remote areas are likely to have very less possibilities for power supply in Bangladesh. Therefore, and in terms of environmental protection, renewable energy can

contribute substantially to provide users alternative alternatives. Some important things that determine the technological innovation requirements to solve fuel problems in rural areas.

2.2 Renwable Enargy

Energy is one of the main concerns for any nation's growing future. Energy must play an important role in the development and welfare of the people. There is a direct relationship between a country's development and its energy costs. Bangladesh wants to be a middle income country by 2021 As a result, GDP growth will increase by 7.5 to 8 percent every year, based on the rapid growth of exports and remittance. [2] Only 62% of the entire population gets access to electricity and the cost of every capital is only 321 noh [3]. The government has set up 2020 to ensure the supply of electricity and reliable and quality supply of electricity at a reasonable and affordable price. Permanent social and economic development depends on the adequate power generation capacity of a country. There is no other way to accelerate the development of electricity through the energy diversity of electricity generation. Total electricity generation in Bangladesh is largely dependent on natural gas, which in September, 2015 total of 62.59% ofinstalled power generation capacity is 11877 MW [4].
Generating electricity using different energy as shown below:

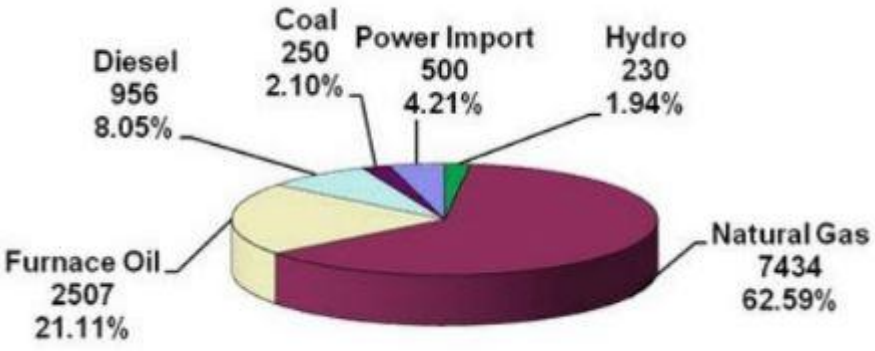

Figure 2.1: Different fuel consumption for energy generation

Renewable energy development is one of the key strategies adopted as part of the energy diversity program. According to the Renewable Energy Policy 2009, the government is committed to facilitate both public and private sector investment in renewable energy projects to enhance the contribution of renewable renewable power supply and renewable energy-based electricity generation. The total energy production that envisions renewable energy policies will be achieved by 2015 and 10% by 2020. To achieve this goal, GOB is looking for several preferred renewable energy resources. Renewable energy is a small proportion of the total generation under the current generation of Bangladesh. Renewable energy share has so far surpassed 1%. The current government is giving priority to the development of renewable energy sources to improve energy security and to establish sustainable energy sources as well as the sources of current energy. [5] In urban area like Dhaka city, the demand of power is increasing gradually. The government starts to take initiatives through installing solar panel at building roof top. Like as all government buildings are to be recommended to use solar energy in Dhaka by 2013 through the Ministry directive [6]. It has been announced by the government that any multi-storied building (futurely built in Dhaka and other major cities) will be planned for solar-based power supply before the approval of the building approved by the building authority. [7]. To get maximum benefit from the solar energy, suitable building location is needed and to introduce high-performing solar installation. In this paper we have focused about the installation of solar PV at roof top to reduce pressure on existing grid network and to mitigate partial demand of energy especially elevator & common load like security light, guard room load, water pump of the building.

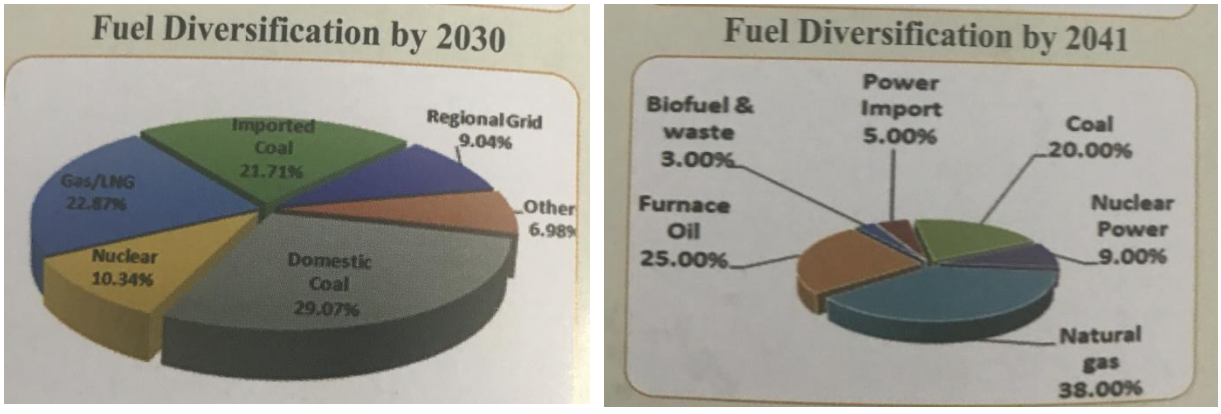

Figure 2.2: Fuel diversification by energy generation

2.3 Why use solar power

The main source of energy generation in the world is fossil fuel (gas, oil, coal) and atomic energy stations. Due to fossil fuel use, greenhouse gases (CFCs, CH 4, and 3, but mainly CO2) emitted in the atmosphere. From the nuclear power plant, the carbon is released in small quantities (90 grams of carbon dioxide per kilowatt hour). [8] But radioactive waste is active for thousands of years, which is possible source of environmental pollution.

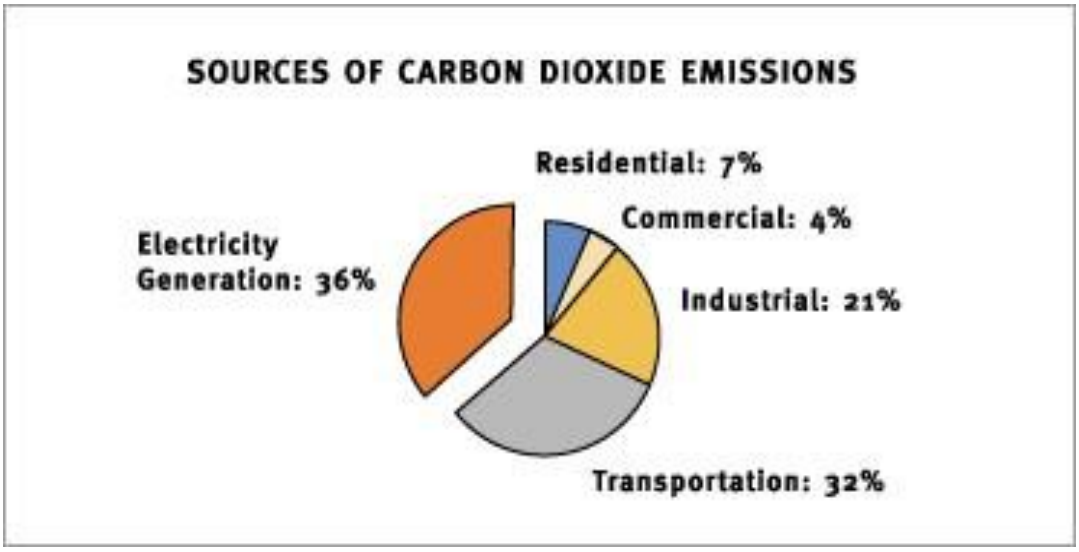

Figure 2.3. Sources of carbon dioxide emissions

Figure 1 shows that the source of the highest emissions of carbon dioxide in electricity production. So, this clean energy production is actually the biggest contribution towards global warming. Global warming as well as environmental pollution in our time, mankind's greatest environmental threat. On the other hand, due to the reduction in the amount of fossil fuel conservation, the global energy crisis is spread around the world and the basic power plants are shutting down in the near future. Scientists and engineers are looking for clean, renewable energy in terms of global warming and natural gas deficiencies. Solar power is one of the best options. Because the Earth holds 3.8 YJ [1YJ = 1024 J] which is 6000 times more than the cost of the world. [9] Bangladesh is experiencing acute shortage of energy. Natural gas is the main source of natural power generation in Bangladesh. But limited gas reservations can not meet the requirements of both domestic requirements and industry and commercial needs, especially for long-term power generation. Our current power generation capacity is about 4,200 MW and the

total power requirement is 6000 MW. [10] So, we are able to generate only 70% of our total electricity demand. Due to this shortage of electricity, we are not only facing load shedding across the country, but the industry is also badly affected. Reduced industry output and low export earnings results.

There is a growing demand for energy sector for rapid industrialization, urbanization, higher population growth, increasing food production, increasing standard of living etc. Solar power can be a major source of power generation in Bangladesh. The government of Bangladesh is planning to make it mandatory to install solar panels on the rooftops of every large and high-rise building. As one of the most clean and simple forms of solar energy we can hope to find out. Solar energy is easily available anywhere and everywhere on earth. It can be used for power generation while using it.

2.4 Works on solar energy technologies around the world

A lot of work on solar technology, research, thesis, implementation, design and improvement in our country as well as in our country. So our more than 35 companies [11] are doing business, implementing and research on solar technology.

University students worldwide work with solar system. A group of students of Science and Technology University of Ahsanullah University have designed a solar system for their university. A group of Pennsylvania State University students have designed and simulated

Their thesis distributed photovoltaic system for their university. Thailand's technology has established PV system for their universities for the development of the Rajmangala University Solar Power Project.

Scientists in Korea and California such as solar panels are working to develop, have created a new way to increase the efficiency of plastic solar panels [12]. By this they make it more competitive in traditional solar panels. Commercial news, houses, offices, companies are installed solar systems for green energy. Like the largest solar power plant in Deoge, in the northwestern China's Sending Province [13]

Figure 2.4. The largest solar power building china

The above image is the largest solar powered building and it will be the location of the fourth world solar city congress. We can see 100% solar powered buildings. Taiwan had 100% solar run like the World Games 2009 stadium.

Figure 2.5: 100% Solar power stadium taiwan

Fig 3 shows that 100% solar-powered buildings in Taiwan. It has 8,840 solar panels on the roof and can produce 1.14 million non-year / year. As a result, it can release 660 tons of carbon

dioxide in the environment [14]. There is a lot of work on solar technology in the world and in our country. Solar energy is based primarily on the basis of some basic factors. Site and load-based: Solar energy site or location based. Solar energy is supplied and supplied from a particular customer / s to a particular location. For example, a house or apartment can use its roof, lawn, garden etc. to get the desired capacity for their solar system. Along with a solar power plant, Canada's Sarania Photovoltaic Power Plant can supply 60 megawatts of electricity, as well as the Olmidila Photovoltaic Park in Spain, as well as a solar power plant that can supply 80 megawatts of electricity. [16]

2.5 Potential of solar energy

Solar energy has a huge potential. It is so huge that the total energy needs of the whole world can be met by solar power. In 2008, the total energy consumption in the whole world was 474 XZUL (1EJ = 1018J) or about 15 watts (1.504 * 1013W). [17] These strengths came from about 80% - 90% of fossil fuels. [18]

The sun gets 3,850,000 ej energy from the earth. Which equals 174 petawattas PW = 1015W). The earth does not contain all the energy, it reflects a part back. After receiving the reflection world 89 PW. This large amount of 0.02% is enough to replace the world's fossil fuel and atomic electricity supply. By this we can easily understand the great potential of solar power. Considering the effect of the green house, other environmental impacts, costs, risks and availability are the greatest potential among all energy sources of solar energy.

2.6 Solar panel

Solar panels generate electricity from sunlight. The first solar panel-powered satellite was launched in 1958 by Hoffman Electronics.

A solar panel series and collagen photovoltaic (PV) in parallel contains the number of solar cells. These cells are composed of at least two layers of semiconductor material (usually shared with pure silicon boron and phosphorus). One level has a positive charge; There is another negative charge. When sunlight attacks solar panels, photons from photons are absorbed by semiconductors atoms, which then release electrons. Electrons, flowing from the negative layer

(n-type) of semiconductors, produce an electric current, the positive level (ptype) flows. Since the current one direction of electricity (such as a battery) flows, the power generates the DC.

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 On - Grid

2 Off-Grid

3 Hybrid

2.7.1 On – Grid System

On-grid or grid-tie solar systems are the most common and widely used by home and business. This system is connected to the public power grid and does not require battery storage. A solar power generated from the on-grid system (which is not used directly in your home) is exported to the electricity grid and you usually pay the feed-in-tariff (FIT) for the export that you export.

In contrast to the hybrid system, the grid-tie solar system is unable to make or operate during blackout or power outage due to security; Blackouts usually occur when the electricity grid is damaged. If the Solar Inverter is still fed electricity to a damaged grid then it will be risky to the safety of people in the error / error repair system. But most of the hybrid solar systems, including battery storage, automatically separate from the grid (known as the islands) and continue during the Blackout period. If needed, the batteries can be added to the on-grid solar system at the next stage. The popular Tesla Power wall 2 is an AC battery which can be added to existing solar systems. On-the-grid system, after reaching the switchboard after power it occurs:

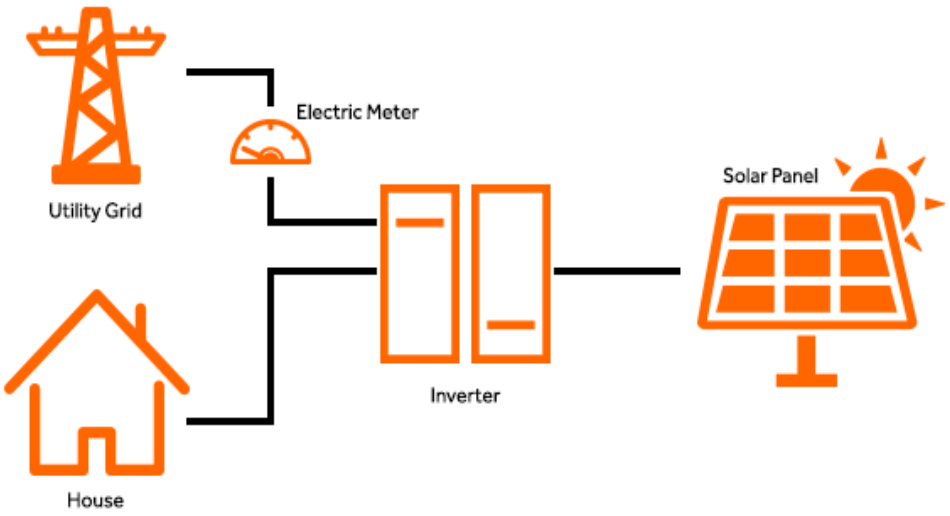

Figure 2.6. On-Grid system

Meter Excess solar energy is run by the meter, how much energy you're exporting or importing (purchase).

Metering system works differently in different countries and countries of the world. In this description I assume that the meter is simply measuring the power exported in the grid, as in most cases of Australia. In some states, the meter measures all the solar power produced by your system, and so it will be run on your meter before reaching your electricity switchboard. In some areas (currently in California), both meter production and export are measured, and customers charge (or credit) for net electricity used for more than one month or more. I'll explain more about metering in the next blog. Power grid the electricity sent from your solar system to the grid can be used by other customers in the grid (your neighbors). When your solar system is not operating, or you are using more power than your system producer, you will start importing or accepting electricity from the grid.

2.7.2 Off – Grid System

An off-grid system is not connected to the electricity grid and therefore requires battery storage. The off-grid solar system should be properly designed so that enough energy is generated throughout the year and if there is less sunlight then there is considerable battery

power to meet the depth of the winter even for home requirements. High-value means of batteries and inverters is off-grid systems much more expensive than on-grid systems and therefore generally only needs far more remote areas than the electricity grid. But battery costs are rapidly decreasing, so cities and cities now have a growing market for off-grid solar battery systems.

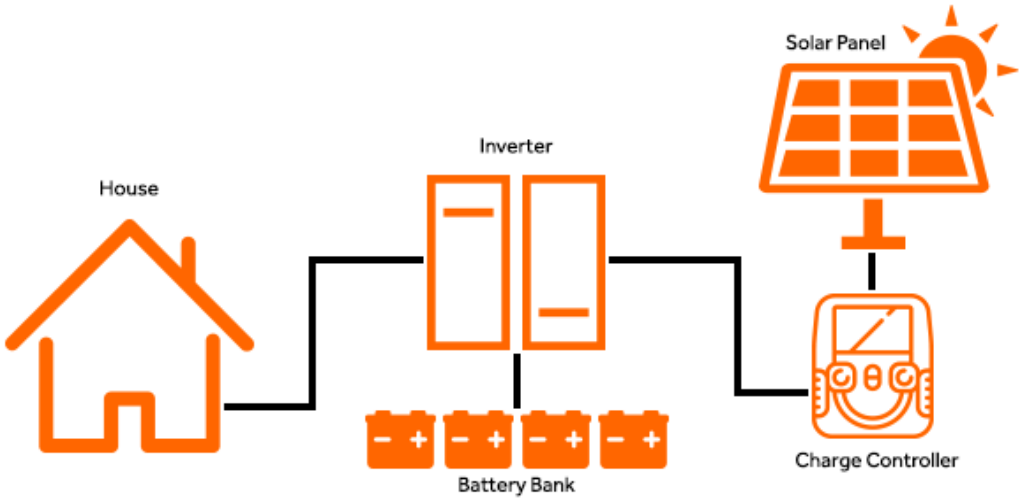

Figure 2.7. Off-Grid system

There are different types of off-grid systems we'll look at later, but I'll keep it simple for now. This description is for an AC coupled system, the DC coupled system is sent to the battery bank, then sent to your devices. To understand more about an efficient off-grid building and set-up, visit our sister's site Off-Grid / Hybrid

Battery bank There is no public power grid in the off-grid system. Once your property equipment uses solar energy, your extra battery will be sent to your battery bank. Once the battery is full, the power off of the solar system will be stopped. When your solar system is not working (night or cloudy day), your device will draw power from the battery.

Backup generator Whenever the battery is low during the year and the weather is very cloudy, you usually need a backup source, such as a backup generator or a zennet. The size of the generator set (Measured at KVA) should be enough to supply your home and at the same time charge the batteries.

.2.7.3 Hybrid System

The modern hybrid system combines solar and battery storage and is now available in different forms and configurations. Due to the reduction in battery storage, the systems connected to the electricity grid can also begin to take advantage of battery storage. This means that it can be used to save solar energy and to day by day. When the stored power is reduced, the grid is backed up, which allows consumers to make the best of the world. The hybrid system is able to charge batteries using cheap off-peak power (usually from midnight to 6pm).

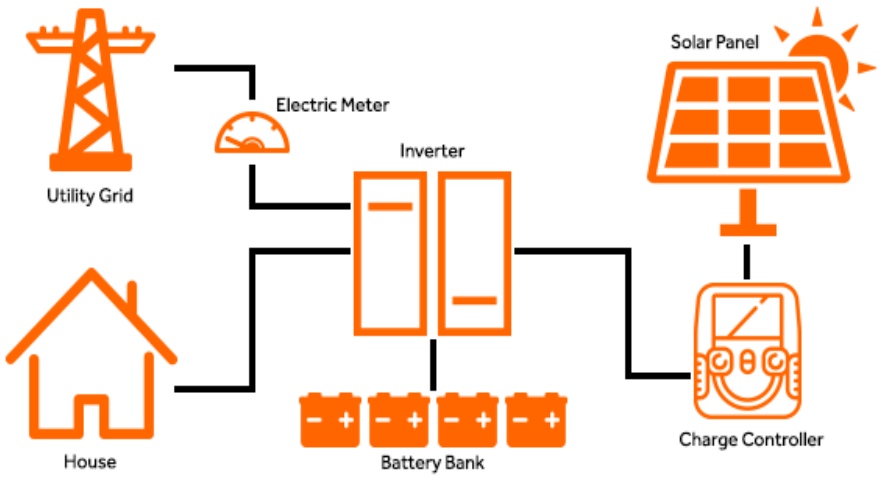

Figure 2.8. Hybrid system

There are several ways to design a hybrid system, but we'll keep it simple now. For more about hybrid and off-grid power systems, refer to our detailed guidelines on hybrid / off-grid solar battery systems.

Battery bank once the hybrid system uses solar power through your property equipment, your extra battery will be sent to your battery bank. Once the battery bank is full, it will stop receiving the power from the solar system.

Meter and power grid. Depending on how your hybrid system is set up and your battery is fully charged, depending on how your device is approved, additional solar power can not be exported to your grid by your device. When your solar system is not used, and if you have used the power to remove the battery, your devices will start drawing power from the grid.

2.8 Solar PV Technologies

New technologies are being introduced with the rising demand of solar power and the development of existing technologies is being developed. There are four types of solar PV cells:

• Single crystal or mono crystal

• Multi- or multi-crystal

• thin film

• Amophos silicon

Single-crystal or mono crystal: It is widely available and among the most efficient cell contents. They produce maximum power per module square feet. Each cell is cut from a single crystal. In order to maximize the number of cells in the solar panel, the wafers cut more in the form of rectangular cells.

Polycrystalline cells: They are made from the same silicon material, instead of being grown in single crystals, they are molten and pour into a mold. It constitutes a square block that can be cut into square wafers with space or material low waste compared to square single-crystal wafers.

Thin Film Panel: It introduces new technology to solar cell technology. Copper Eidium Designline, Cadmium Teluride, and Gallium Arsenide all thin film materials. They are stored directly in glass, stainless steel, or other appropriate level layers. Some of them perform slightly better than crystalline modules under low light conditions. A thin film is very thin - a few micrometres or less.

Amphous Silicon: Amphous Silicon is the newest in thin film technology. The silicon steam stainless steel rolls of these technologies are deposited in a few meters thick film Amar. [19] Compared to crystal silicon, this technology component uses only 1%.

The table below shows the efficiency of different types of solar cells.

Cell type	Efficiency, %
Mono Crystalline	12 – 18
Polycrystalline	12 -18
Thin Film	8 – 10
Amorphous Silicon	6 - 8

Table 2.1. Different types of solar cells

2.9 Components of a solar Photovoltaics system

An ideal solar PV system consists of solar panel, charge controller, battery, inverter and load. Figure 2 shows a block diagram of such a system

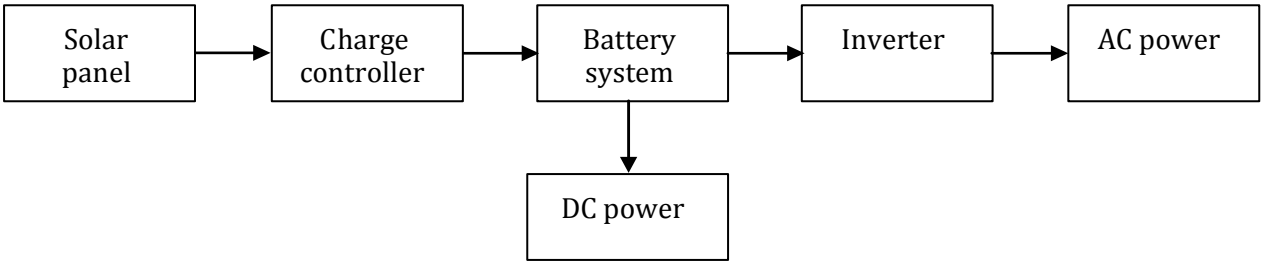

Figure 2.9. Drawing blocks of a standard solar PV system

2.10 Charge controller

Limit the rate of a charge controller, charge regulator or battery regulator connected to the electric battery or the rate at which the electric battery is added. It can prevent extra charging and protect against overvoltage, which can reduce battery performance or lifespan and it can cause a

security risk. For the protection of battery usage, it can fully eliminate the drainage ("deep drainage") battery or controlled exhaust, depending on the battery's technology. The terms "charge controller" or "charge regulator" can control the integrated circuit between a stand-alone device, or a battery pack, battery powered device, or battery charger. [20]

2.11 Batteries

Charge batteries are used. A lot of batteries are available in the market. But not all of them are suitable for solar PV technology. The most used batteries are nickel / cadmium batteries. High energy density of other energy includes batteries such as sodium / sulfur, zinc / bromine flow batteries. But for the medium-term batteries, the performance of optimal cycling of nickel / metal hydride batteries. Iron / chromium redox and zinc / manganese batteries are the best for long-term alternatives. Asbestos Glass Matt (AGM) is one of the best available pots for solar PV use.

2.12 Inverter

A Power Inverter, or Inverter, is an electronic device or circuit that changes the current (DC) replacement (AC) option. Input voltage, output voltage and frequency, and overall capacity handling depends on specific device or circuitry design. The inverter does not produce any power; The power is supplied by DC sources. A power inverter can be completely electronically or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuits. Static inverters do not use the moving parts of the conversion process. [21]

The solar panel produces DC electricity but most of the consumers and industrial appliances require AC. The current of the inverter AC current panel or battery DC is changed. We can inverter the two categories. They are-

• Stand alone and

• Line-tied or utility-interactive

2.13 Working Of Photovoltaics

Photo voltacts convert directly to the light of atomic energy. Some materials display a protein that is known as the electronic effect of the photo, which causes their illumination and releasing electrons. These free electrons are captured, an electrical current results that can be used as electricity. A solar cell (also called photovoltaic cell or photoelectral cell) is a solid state electric device that transforms electricity directly into photovoltaic effects. Crystalline silicon PV cells are currently the most common photovoltaic cells in use.

Multiple solar cells are electrically connected to each other and mounted on a support frame or frame is called a photovoltaic module. Modules are designed to provide electricity at a specific voltage, such as a normal 12-volt system. Presently produced modules depend directly on how light strikes. Multiple modules can be wired together to form an array. Generally, a larger area of a module or array, more electricity will be produced. Photovoltaic modules and arrays produce direct-current (DC) power. They can be connected to both series and parallel electrical systems of producing any necessary voltage and current coordination.

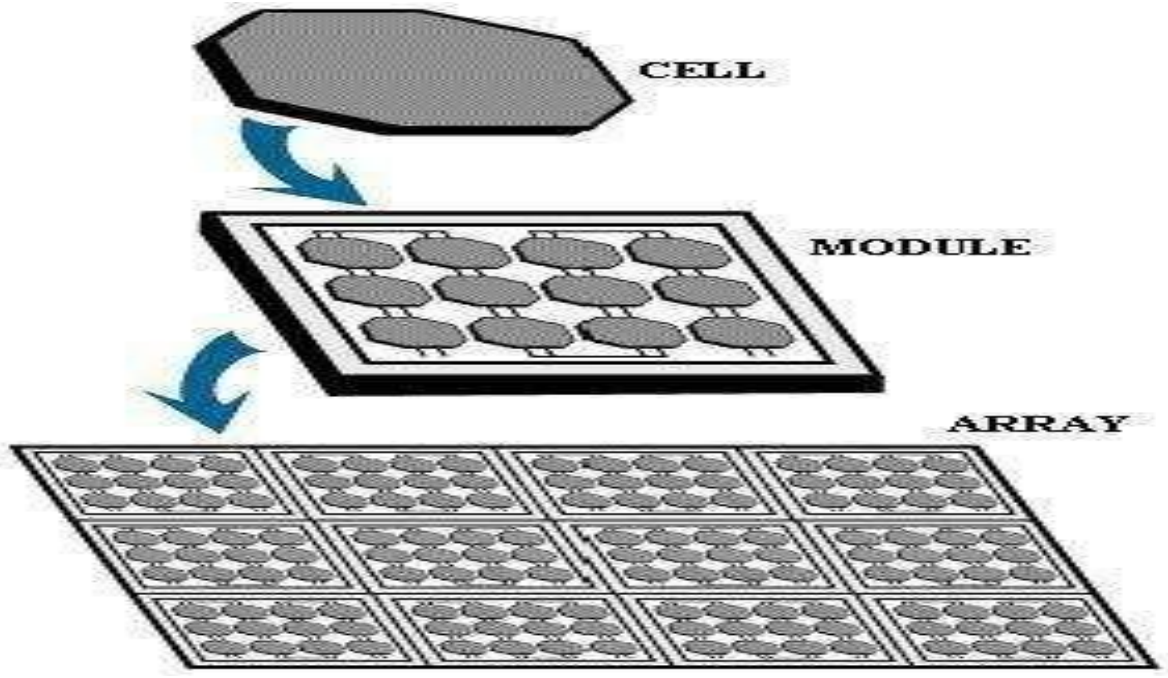

Figure 2.10: Photovoltaic panel or arrays

2.14 Types Of Solar Trackers

There are two types of tracking systems they are

- Passive Tracking.
- Active Tracking.

2.14.1 Passive Tracking System

Passive tracking system can understand the movement of the system using a low warm point fluid. This fluid is evaporated by the added heat of the sun and the mass center finds a new balanced position, leading to the transition.

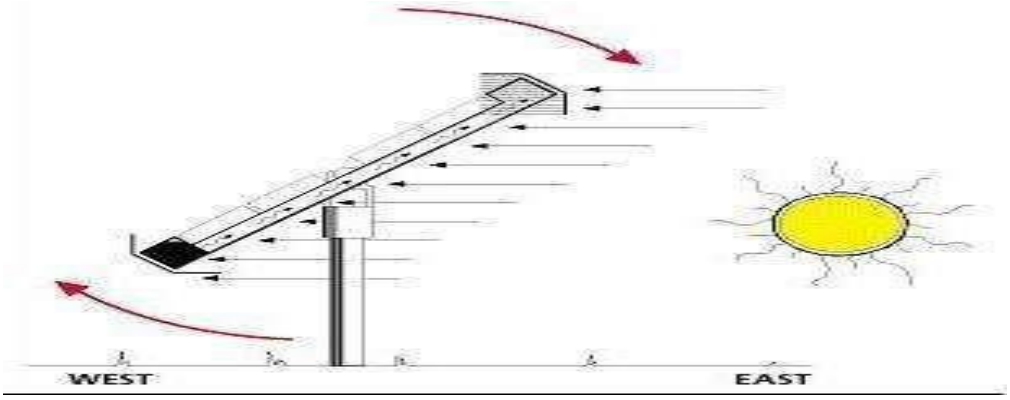

Figure 2.11: Passive tracking system

2.14.2 Active Tracking System

Activated Solar Tracer is one of two basic types of single axis and double axis.

(A) single character tracker

The unit axis tracking system realizes elevation or azimuth movement for a solar power system. Which of these movements is desired, depending on the tracker as well as the place it has been mounted. For example, when using PABBILIC TRACKING through the system, PV-system uses height tracking due to lack of space in many roofs. A single-axis tracker can only pivot on a plane - both horizontally or vertically. It is less complex and generally cheaper than two axis trackers, but it is less effective in collecting total solar energy available on a site. Trackers point to the tracker motor and gear trains so that the solar reaction is indicated by the controller. Since

the motor uses energy, it only wants to use them as necessary. The unit type of axis and double axis

Figure 2.12: Single axis solar tracker

A horizontal axis is a long horizontal tube in which the solar module is connected. The tube is attached to a north-south side, it is supported in billets mounted in pylons or frames and gradually rotates its axis to follow the speed of the sun across the sky. This type of tracker is most effective in toxic latitudes where the sun is less or less overhead at noon. In general, for significant parts of the year, the sky is high in the solar system, but for this reason, it does not perform well in high latitudes. For a high latitude, a vertical-axis tracker is more suitable. This sun usually works well in the sky and at least in the summer, days are long.

(B) Dual Execular Tracker

Dual-axis trackers shown in Figure 10 have two degrees of freedom, which act as rotation axis. Double-axis solar trackers can rotate horizontally and vertically in the same sense, and they are able to accurately point to the Sun in some places.

Dual axis tracking system elevation- and azimuthally understand movements along the axes. These tracking systems naturally provide better performance, since there is substantial merit in addition to the components.

Figure 2.13: Dual-axis solar tracking

2.15 Working Principle Of The Tracker

Tracking device in the image prototype shown here. It follows the movement of the sun day after day and provides continuous reflections on the panel of Thosla. The solar panels will fall in two ways by the sun's rays, which they will fall directly into the solar panel and reflect the reflective phenomena in the sun panel. When the sun rises, when the sun rises, the sun will appear in the east. The reflector will reflect itself in some positions that occur in the solar panel. Now when the earth turns around and the sun is transferred, its previous position will also change the reflection of the rays. As a result, light will be lit on each side of the solar panel. The tracking circuit is designed in such a way that when reflection takes place when the sensor is connected to the right of the panel, the tracker will move to the left and vice versa. In the same case when the reflection of the connected sensor at the top of the panel falls, the circuit tracker will move downwards. We have tried to combine two common principles here. One is the general principle of events and reflections which works in our tracker. And the other is the principle which works solar panel, which is the events of the solar ray panel tracking system. Solar tracking enables more power generation because the solar panel can maintain a long profile in the sunlight. The development of the solar panel tracking system has been running for many years now. The sun goes through the sky day by day, the sun's panels are convenient to track the position of the sun, as the panels always extend the solar energy disturbed by the sun. These tend to tend to maximize the energy amount absorbed by PV system. It is estimated that using a tracking system on an estimated system, could increase power output by 30% - 60%. Despite the increase in

system costs, enough potential tracking of a potential increase is enough. Using the electronic control by a micro controller, the sun tracking heliostat can be naturally arranged.

2.16 Circuit Operation

In our project, we can use the solar panel to convert light energy into electricity. The sun changes its position throughout the day, so we will not be able to use full light energy, so we have created a tracking system that can change the sun panel like sun so that it changes its position. We used four LDR sensors to understand the light and if the sun changes its position, it understands the corresponding LDR sensor light and creates maximum voltage signals, and this maximum voltage signal supplied to the comparative IC and the remaining sensors also make it comparable to the IC voltage level. All voltage signals of each LDR sensor compared to LM324 are supplied to the microcontroller. Receive voltage signals from the microcontroller controllers' I / O pin and compare each LDR output signal to each LDR sensor output. When detecting the highest voltage level of an LDR sensor, the motor driver gives maximum direction to move the solar panel in the direction of the LDR sensor in the circuit panel, which produces the highest voltage output. So the battery can recharge properly through the solar panel and we can run any electronic device here, we rotate the regular 12V DC fan. By using the external two motors and creating a parallel connection, we can move the solar rays from any direction. As the solar panel rolling from the sun's side we use the maximum power of the sun.

2.17 Selecting the Photovoltaic module

We need huge power supplies and we do not have huge areas. So, we've selected Mono Cristaline Silicon Module. Our modules depend on the cost and efficiency of selection.

The investment of solar PV panels is very high. Approximately, the total system installation costs 60% of the cost of the module. To get the best output of the spent money we should consider the cost. The cost panel efficiency is changed and the material was used to create PV panels. The cost of silicon solar cells is very high. In our design we used mono crystalline silicon cell.

Depending on the technology used in solar cell efficiency. Silicon solar cells have the highest efficiency. Thin film has low efficiency, but they can be ideal for some applications. Another

important consideration is temperature. Increase the temperature of the module as the module decreases efficiency. When the operating module on the roof, it heats significantly. Cell internal temperature reaches 50-70 degrees Celsius. In high temperature areas, it is best to choose a panel with low temperature co-efficientness.

Considering the above factors, we have selected a Samsung brand module.

Figure 2.14. Samsung LPC250S solar module

Figure 14 shows Samsung solar modules and models are LPC250S. Its maximum output power is 250 watt. If the immunity is 1000 meters per square meter, the nominal power output of the module is 200 watts, if the immunity is 800 meters per square meter. 694.04 square meter square against the City of Dhaka. So we will get less than 200 watts of electricity, about 173.51 watts. 25 years Power Output Warranty 80% Panel efficiency 15.62%. The panel's short circuit is 8.66A on current standard test conditions and 6.90A in the nominal position.

2.18 Inverter selection

Figure 2.15. ZONZEN ZZ-ZB 10kW grid tie inverter

We select a pv-binding binding inverter. The model is ZZ-ZB10kW. It is a product of China's Zonjane [22].

• MPPP voltage range: 100-150V

• Output power: 10kW

• Connection: 50Hz grid frequency and 3 phase 4 wire connection

• This electronic signaling efficiency: 97%. • AC voltage: 230 volts.

2.19 Combiner box selection

Figure 2.16. The SMA SCCB-10 combiner box

The model of selected combiner box is SMA SCCB-10 [23]

- The no of input circuit: 12
- Maximum input fuse rating: 20 A, 600V DC
- Maximum output current: 240 A DC

2.20 Mounting

The solar panels can be mounted in different types of mounting. Depending on the location and the system, different types are mounted. They are described in the bellow

Pole mounting

3 types of pole are mounted [24]

1. Pole top: mounted with a pole and metal rack Such PV modules are installed. The pole base is usually concrete

2. Pole Side: Usually small PV modules are passed on to the electricity or telephone poles

3. Tracking Pole Mount: It is special kind of mounting. This is maximize the PV module output by tracking the path of the sun.

Ground mounting

Solar modules can be mounted on the ground. PV panels can be mounted on the ground in case of excess electricity demand or insufficient space on the roof.

Building Integrated Photovoltaic (BPV)

This is a unique type of mount system; PV modules are placed in building surface, vertical walls and atrium. It has lots of benefits [25], star-

• Mounting can be done in such a way that the building mixes with the architecture to make it more beautiful

• It is unique and versatile

• Many advantages of shedding, protection, cooling etc..

Roof mounting

Roof mount mounted two types of molding roof mounting and flat roof

Rotten roof mount

The mounting of the roof is difficult because the adaptation and angle depends, right mounted. Need to fix the welding angle for optimum output.

We can not expect that all these sections can match a roof. That is why the roof is of 3 types of mount. They-

Figure 2.17. Flush Mounting on roof

This roof facing the south is good for this mounting. No shield fit but a steep slope is good. Fig17 shows a flush mount PV system.

1.Angle mount:

Figure 2.18. Angle Mounting on roof

For the roof that has low pitch - this system is most suitable. Fig18 is an angle mount PV system show.

2. Fin Mount:

Figure 2.19. Fin mounting on roof

Flat roof mounting: There are three steps to mount in this section,

1. Attached: This section requires fring penetration and connection

2. Ballasted: It does not need to penetrate into this section, except it can resist 90 miles of wind [26].

Hybrid: It combines zinc and structural systems. Hybrid system concept is less penetration and more ballast or reverse.

2.21 System Sizing

In this section we will choose to install PV module in the selected area. We will also find the number of additions to the number of numbers of inverters.

CHAPTER 3

METHODOLOGY & SYSTEM DESIGN

3.1 INTRODUCTION

The performance of a photovoltaic array can be improved in many ways. One alternate condensed optics is employed, which holds sunlight with lenses and focuses on it and in turn causes photovoltaics to hit the cell to increase the intensity of the sunlight. The primary reason for using density is to reduce the area of solar cells. Using a cube relatively expensive materials to focus on a small area where solar energy is to capture a larger area and the solar cells are fixed. In addition to reducing the number of shapes or numbers used to increase strength, there is also additional advantage of increasing the room efficiency in the light of the sun. Increasing the effectiveness depends largely on cell design and used cell components. Another advantage in the center is that it is much easier to produce small cells, which can use high efficiency and produce similar skills in a larger cell area. There are many difficulties in using attentive behavior. Contrasting optics are significantly more expensive than general covers needed for flat-plate modules, and most of the attention will be implemented throughout the day and year. Thus the high density ratio requires only the costly tracking process but requires precise control over the flat plate system with static structure. High density ratio is a special problem because when the extra radiation is condensed, the operating temperature of the cells increases and it produces heat. The temperature of heat efficiency decreases as the temperature increases, and high temperature PV cells threaten long-term stability. Therefore, PV cells must be cold. Thermal management of the PV cells plays a part in maintaining the overall efficiency of a system. The reduction in the requirement of available roof area is a major advantage by using concentrating PV system especially in a densely populated area country like Bangladesh. The aim henceforth is to analyze the energy situation in the District of Narayanganj to find the permissible limits of the installable photovoltaic systems in the domestic side based on optimization methodology under various constraints. The methodology helps to identify the levels up to which PV power is

installable in the overall energy mix of the district. The modeling is done based on a regional energy planning model based on optimization technique. In this study the Photovoltaic system is assumed to be tied to the grid in the low voltage side for the reason that a representation of the electricity grid considering the demand side management and resource availability portrays a close to real situation by which the maximum permissible PV systems could fulfill the growing electricity demands. An optimization procedure by considering all these factors based on the Energy Flow Optimization Model (EFOM) bottom up model is thus helpful in estimating the limits till which PV systems can be a part of the energy system. Having known the installable limits, a reference Combined Heat and Power Systems (CHAPS) unit based on the Solar Photovoltaic Linear Concentrators (SPVLC) also referred as Concentrating Photovoltaic systems (CPV) is considered for the techno economic study.

3.2 Flow chart

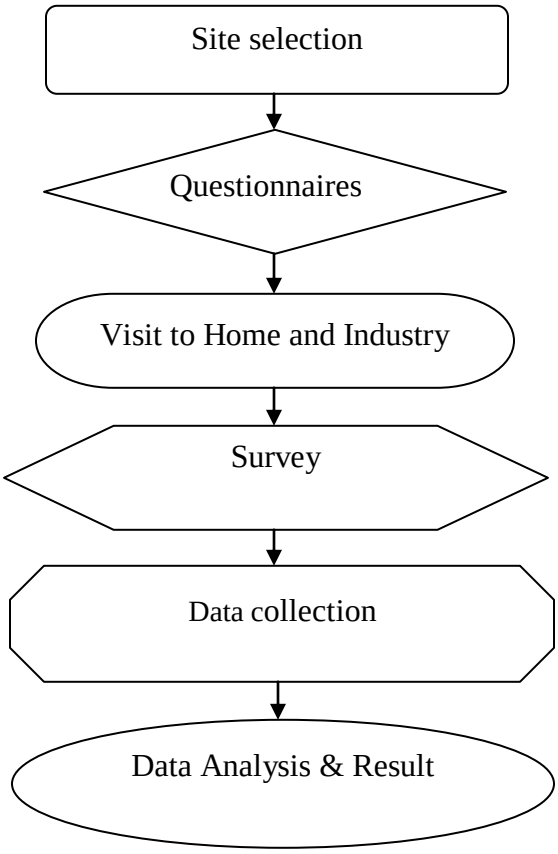

Figure 3.1: Flow chart of the working procedure

3.3 Site Selection map

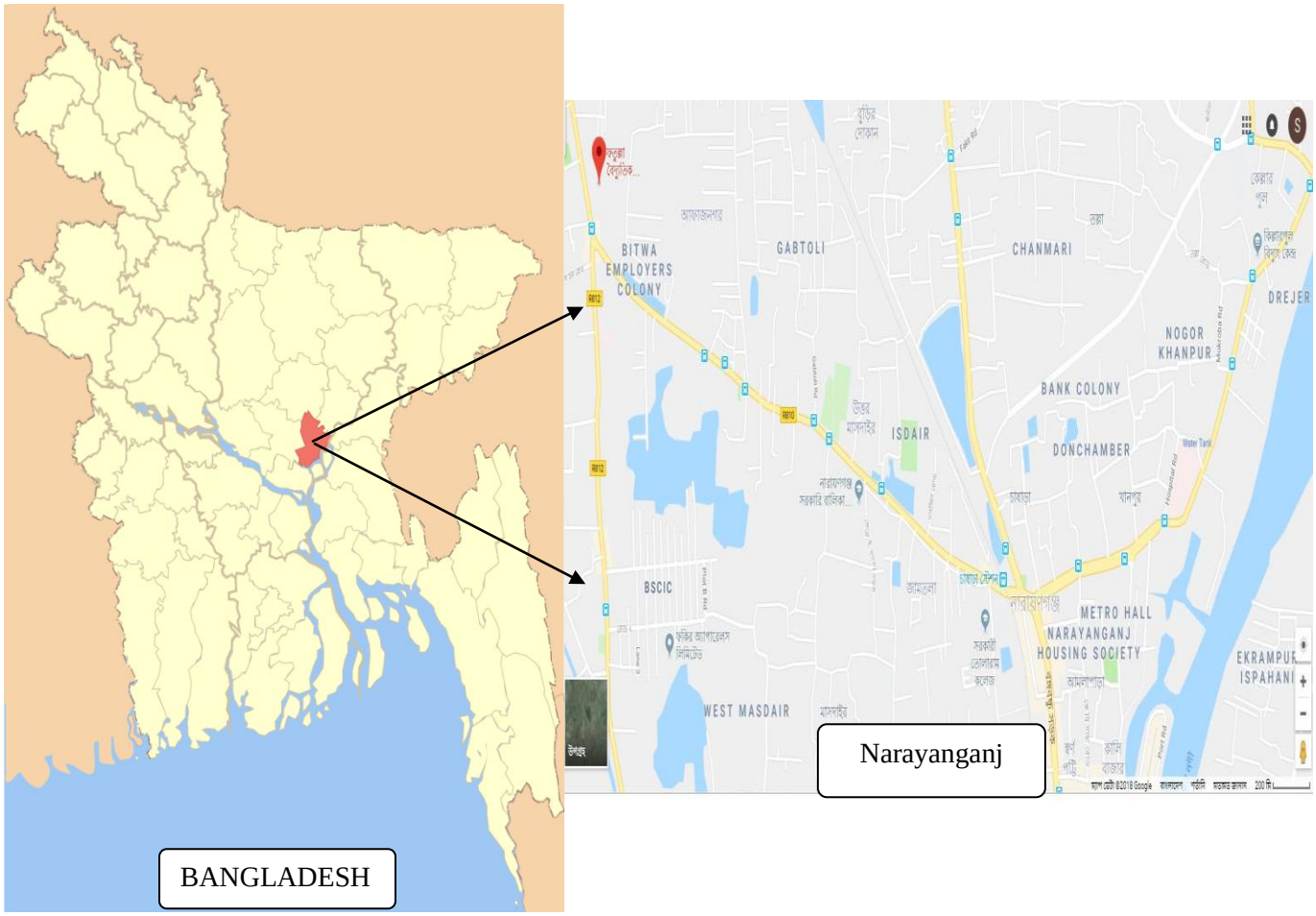

Fig 3.2– Site selection Narayanganj

3.4 Survey of narayanganj

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

3.5 Survey Questionnaires for (SRS) under DPDC

SL	Indicator	Question	Description
1	Consumer information	1. Owner Name 2. Name of the NOCS 3. Address 4. Phone No	In this question section, we have just collected basic information about consumers.
2	Information of installation	1. What kind of solar rooftop system (SRS) are you installed? 2. Why do you install this SRS? 3. From where you bought SRS?	We asked the consumer about the installation date, some consumer installed on grid and some are off grid SRS.
3	SRS Operation	1. What kind of solar rooftop system are you using? 2. Is your SRS in operation? 3. Do you get any training for SRS operation?	We asked the consumer about the operation of SRS
4	Maintainance	1. Do you ever clean your SRS**?** 2. How often it is done? 3. Do you test the regular basis? 4. How many days ago?	We asked the consumer about SRS clean and monitoring.
5	Consumer satisfaction	1. Are you fed your solar electricity to the grid? 2. Is there any support from govt? 3. Are you satisfied using solar rooftop system and Further increase the capacity of your SRS? 4. Do you think this SRS is useful?	We asked some question consumer about the satisfaction of solar rooftop system.

6	Cost analysis	1. What is the total cost of SRS? 2. Do you think, it is a waste of money?	We asked some question about cost analysis of SRS.

Table 3.1. Survey Questionnaires for SRS

3.6 Summery

A roof photovoltaic power station, or a roof path PV system, is a photovoltaic system, which has a solar power generating solar panel that is mounted on the roof of a residential or commercial building or structure. Different elements of such a system include photovoltaic modules, mounting systems, cables, solar inverter and other electrical accessories. Rooftops mount system smaller than ground mounted photovoltaic power stations, with a capacity of megawatt range, small. Rooftop systems in residential buildings hold about 50 kilowatt (KWT) capacity and often mounted in commercial buildings reach 100 kilowatt or more.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

Due to the greenhouse gas emissions and lack of global power, global warming is encouraging almost all countries in the world to find alternate sources of solar, wind, geological and wind power such as nuclear and renewable energy, which is not carbon reason. Emission The developed country can tap into nuclear power, but a developing country like Bangladesh is not lucky to get that option. As a result, renewable energy like the only alternative solar and hydro power open in Bangladesh at this time. Bangladesh is a semi-tropical zone located in the northeast of South Asia and receives abundant sunlight throughout the year. We are going to visit Narayanganj solar rooftop system (under DPDC). So 86 of the total consumers of Narayanganj. We collect almost all information.

4.2 List of total Consumer

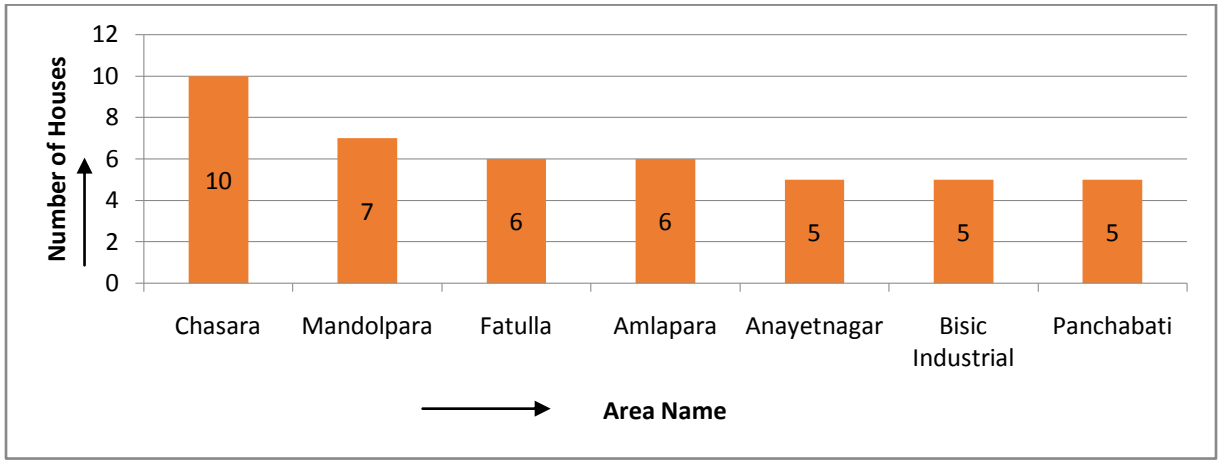

Figure 4.1: Figure forList of total Consumer

We visited narayangonj to analysis the performance of solar rooftop system (under DPDC). For this reason, we conduct the survey at the est Zone of narayangonj. Here we found 10 concumer at chasara, 6 concumer at amlapara, 5 concumer at anayetnagar. We almost collected all of the

data. After completion the East zone we conduct the survey at West Zone. For this reason, we conduct the survey at the West Zone of narayangonj. Here we found 5 concumer at basic industrial area, 6 concumer at fatulla, 7 concumer at mandolpara, 5 concumer at panchabati. We almost collected all of the data.

4.3 Information of installation

For knowing the installation information mainly we focused on the following indicators.

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

➢ **On-grid and off –grid consumer**

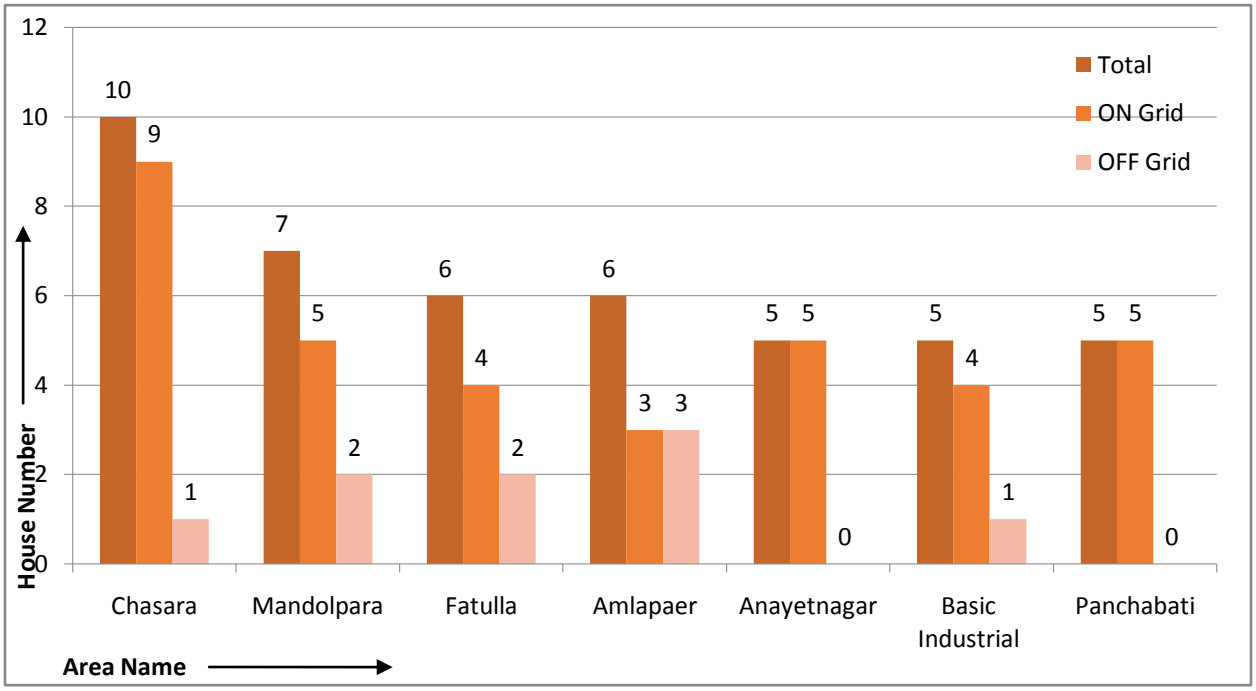

Figure 4.2: Figure for Using of on grid and off grid

In This figure represents eight areas. This area of Chasara, there are total 10 consumers in which 9 are ON Grid and 1 is OFF Grid. Therefore most of the consumers are ON Grid. Again in Mandolpara, there are total 7 consumers in which 5 are ON Grid and 2 OFF Grid. Therefore most of the consumers are ON Grid. In the area of Fatulla, 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 Amlapare, there are total 6 consumers in which 3 are ON Grid and 3 is OFF Grid. Therefore the consumers of ON Grid and OFF Grid are same. Now in Anayetnagar, there are total 5 consumers in which 5 are ON Grid and no OFF Grid. Therefore most of the consumers are ON Grid. Again in Basic Industrial, there are total 5 consumers in which 4 are ON Grid and 1 OFF Grid. Therefore most of the consumers are ON Grid. At last in Panchabati there are total 5 consumers in which 5 are ON Grid and no OFF Grid and another consumer is disabled. 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.

- **Provider of SRS**

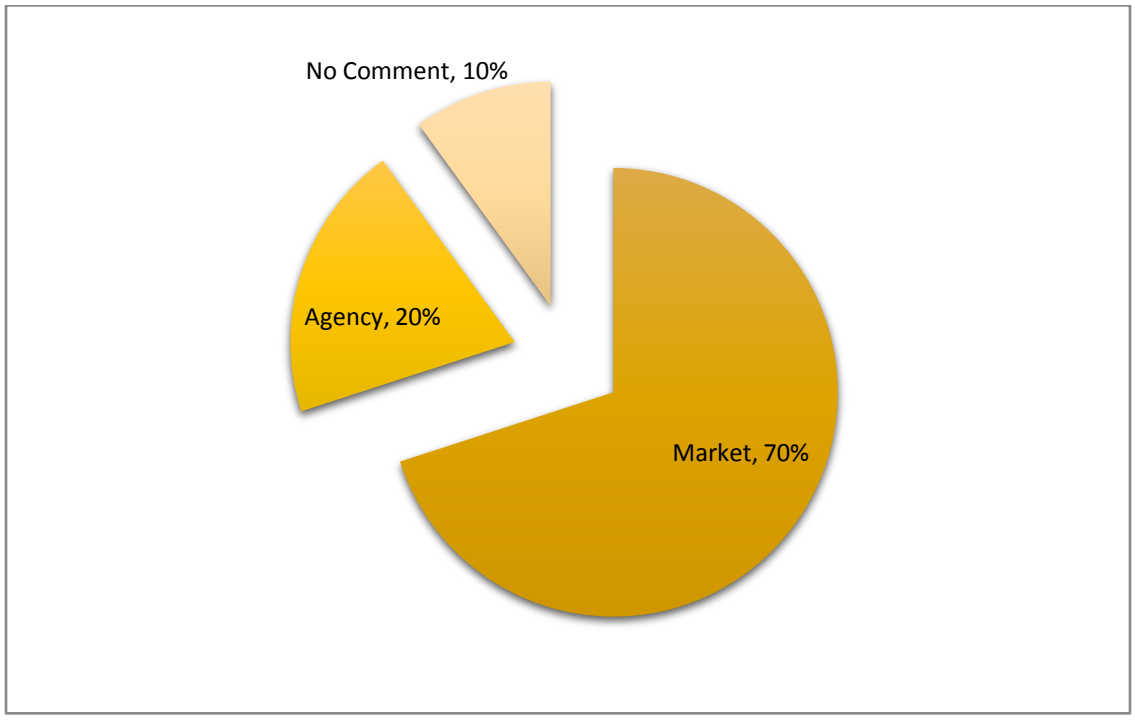

Figure 4.3: Figure for Provide of SRS

This figure represents the provider of SRS. In this case we observe that more than 70% consumer uses are local market SRS where only 20% people buy SRS from agency suggested by DPDC.

- **Installation process**

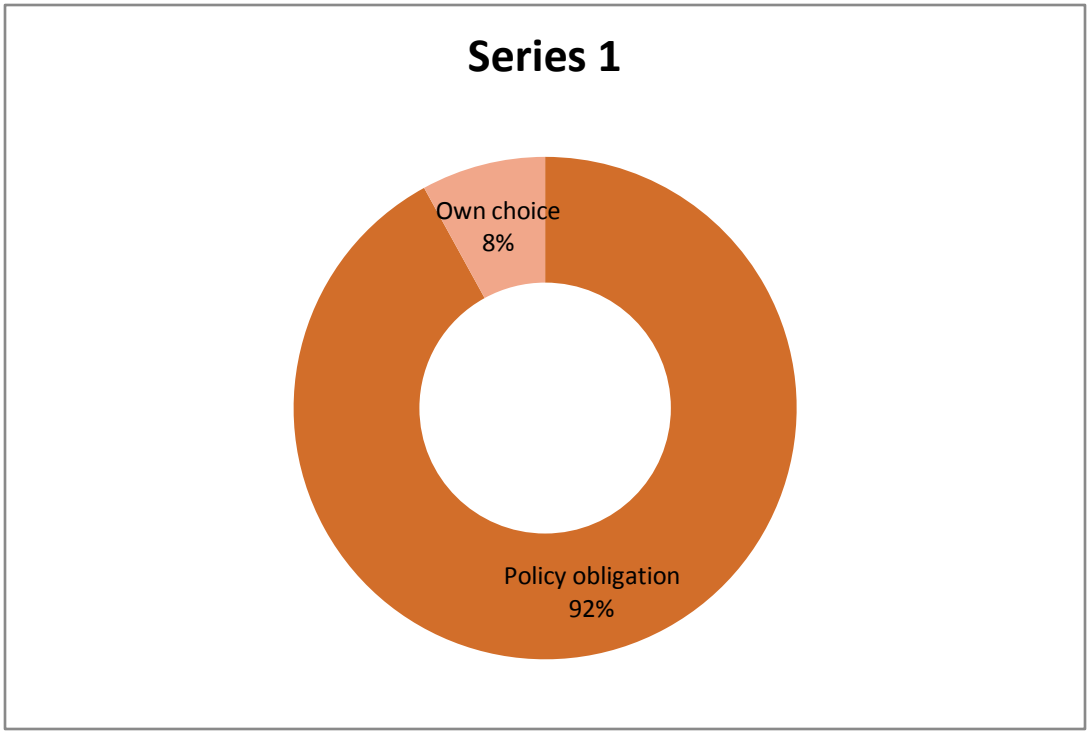

Figure 4.4: Figure for Installation process

Figure 4.4 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

From figure 4.5 we can observe that, in house, there are total 12 consumers in which 10 are on and 2 are damage. Therefore most of the SRS are in Operating condution. We can observe that, in Academy, there are total 3 consumers in which 2 are on and 1 are damage. Therefore most SRS are in Operating condution. We can observe that, in industry, there are total 5 consumers in which 3 are on and 2 are damage. Therefore most of the SRS are in Operating condution. 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 condution.we can observe that, in Shoping mall, there are total 4

consumers in which 3 are on and 1 are damage. Therefore most SRS are in Operating condution.From this analysis we can say that, in industry and market 25% SRS are damaged.

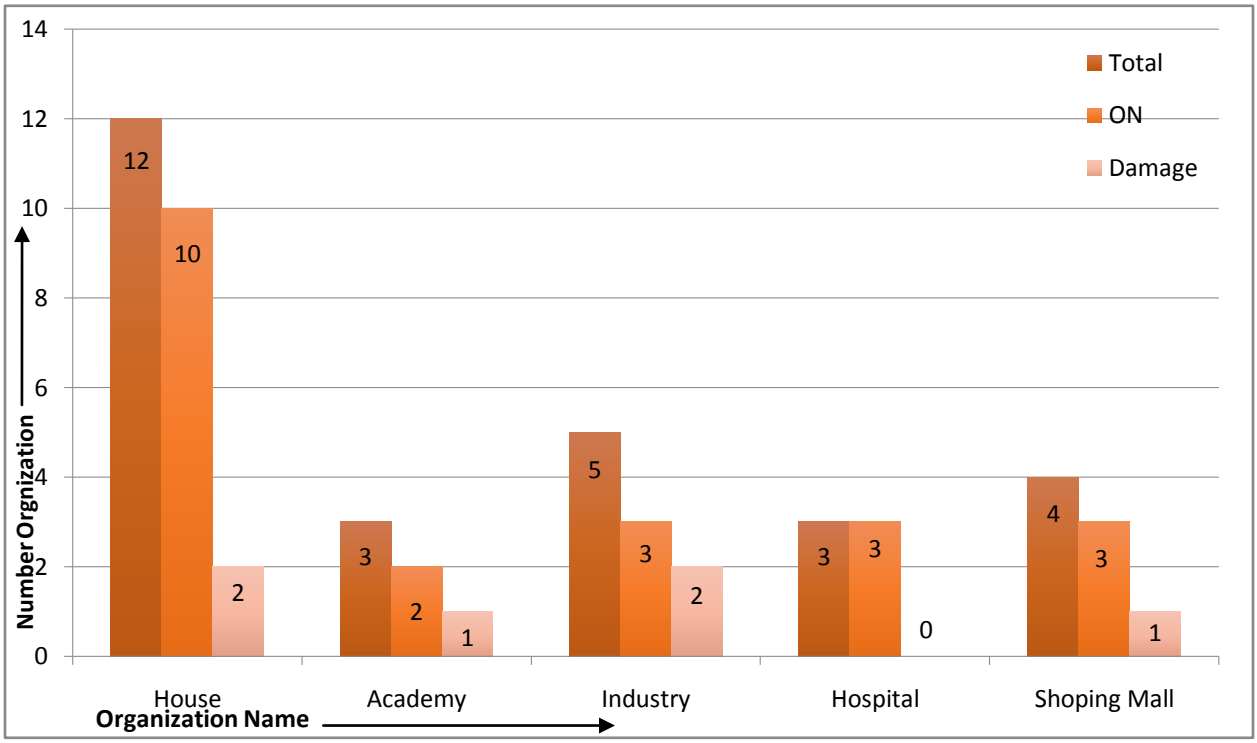

Figure 4.5: Figure for Operation of SRS

4.5 Maintainance 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.

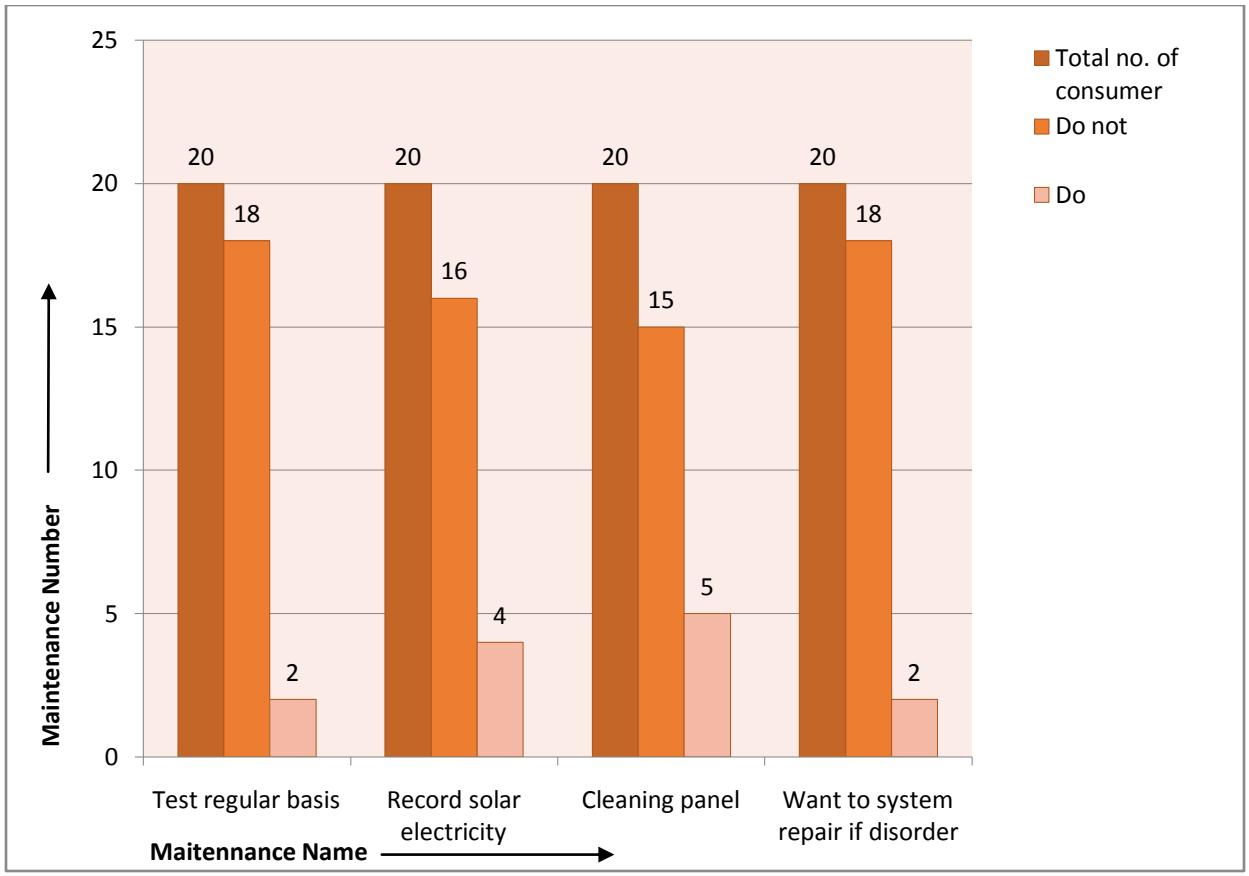

Figure 4.6: Figure forMaintainance of SRS

4.6 Checking meter reading of SRS

From figure 4.6 we can observe that, in house, there are total 41% consumers in which Checking meter reading of SRS. We can observe that, in Academy, there are total 14% consumers in which Checking meter reading of SRS. We can observe that, in industry, there are total 11% consumers in which Checking meter reading of SRS. We can observe that, in hospital, there are total 16% consumers in which Checking meter reading of SRS.We can observe that, in Shoping Mall, there are total 18% consumers in which Checking meter reading of SRS.Therefore most of the consumers are industry no record of the meter reading of SRS.

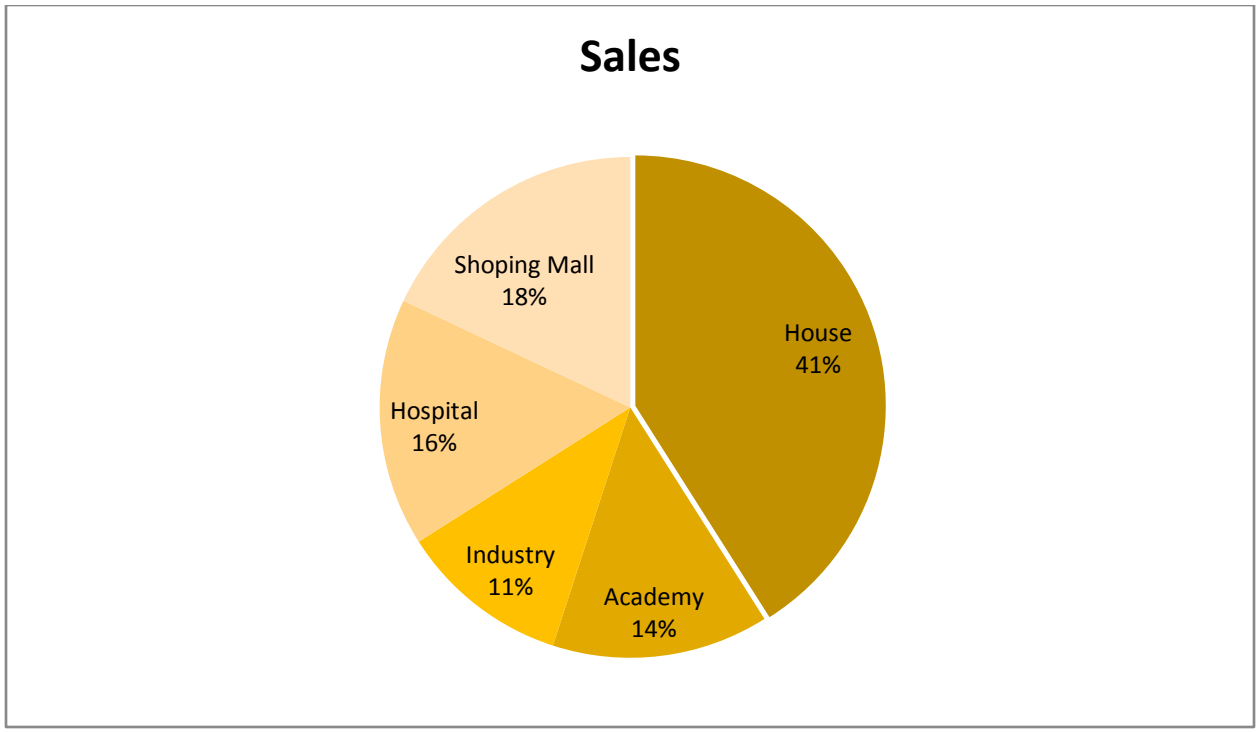

Figure 4.7: Figure for Checking meter reading of SRS

4.7 Cost analysis of SRS

In this part we canculate the per unit cost of solar electricity which is very important for thr promotion od solar power.

Consumer name : Md. Jahangir Hosain Molla

Address : Tokyo Plaza 1, DIT

Installed by : 46/27 – A, New Chasara

Installation date : 01-05-2016

Capacity : 1.92 KW

Price : 90,000 BDT

Energy generated = 1800 KWh (01-05-2016 to 10-11-2018)

Total energy generated per month = 1800/30 = 60 KWh

Energy generated per year = 60*12 = 720 KWh

Life time energy generated = 720*20 = 14,400 KWh

Cost per unit = 90,000/14,400 = 6.25 BDT

4.8 Consumer satisfaction

In the following chart, the comparison of how many consumers accept 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 amoung 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 loadshedding.Here we find that some consumers donot want to comment anything about their SRS.

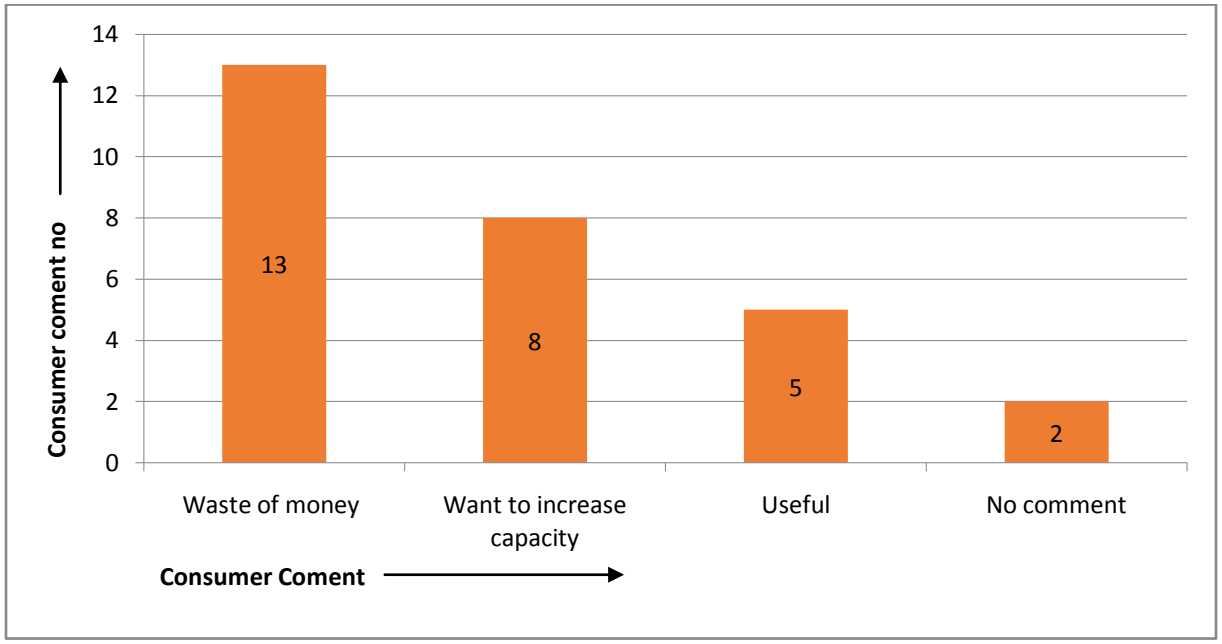

Figure 4.8: Figure for Consumer satisfaction

4.9 Thesis Finding

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

4.9.1 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 consumers reply 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.

4.9.2 Technical Issues

After few days later they are facing many technical problems. In that process they are losing their interest in using solar energy. More over information regarding use of solar energy not readily available in the market. Bangladesh government should take necessary steps to motivate the business persons as well as the rural people.

4.9.3 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 Roof top System'' at their local office/community.

4.9.4 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 council 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 all this 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.

4.10 Recommendation

Power supply to meet the needs of consumers and the rural market can have various positive effects, including improved living standards and opportunities for income and employment. Therefore, a model for solar power users is a model that they are free from maintaining the system. With the involvement of managed local communities, the risk of the whole system is avoided. Solar energy exhibition has been successful in creating interest among rural people and meeting other needs. Proposed recommendations for smooth growth of rural electrification through solar energy are being followed:

• Permanent and renewable energy development authorities have to be more active to popularize solar power in the rural areas of Bangladesh.

• Sufficient financial systems, payment fees, subscriptions, technical and legal support, including payment installments for organizations established in the solar sector

• The government will encourage research activities to combine, convert and spend solar energy technologies. Protests program should increase the use of solar energy technology.

• Rural people in Bangladesh are not aware of solar energy technology. Therefore, there is a need for protests to reach this group's information.

Proper financial system is essential for taking measures for rural people. It may include payment in installments, fees for fees and other appropriate modes.

User training has a great effect because users can shoot minor problems such as replacing fuse, distorted water, adding bulb replacement. It can avoid technicians call and increase system reliability.

• Solar systems should be available to customers with different options so they can choose themselves according to their needs.

Technician training is essential to sustain the project as well as to ensure local technical support.

• Women should be invited to train, because they are the main user of the system.

• They can pay attention to maintenance.

• They can pay attention to maintenance.

• Solar system components / accessories should be available locally so that users can easily buy them when needed. These users can increase the acceptability of the technology.

CHAPTER 5

CONCLUSION AND RECOMENDATIONS

5.1 Conclusion

Now depends on the speed of a day, the mobility of civilization and the durability of civilization. Therefore, a country can be considered civilized if adequate access to the energy required for industrial, agricultural and economic growth. There are many sectors for using solar power in rural areas in Bangladesh. To access consumer productive work, community health clinic, school, union information center and solar / cyclone centers to reach remote and difficult areas will not only increase the quality of life and productivity in rural areas but will also contribute to achieving faster development targets (SDGs).

It has been found in the survey that the mini-financing system increases the purchasing capacity of the solar system in rural areas. Because the SRS power is used at least productively, consumers' revenue is considered to be quite limited in the role of SRS. The lack of knowledge and training of SRS productive use and non-availability of solar electrical equipment is considered to be the main reason for this situation.

The role of SRS on social development is more dramatic than the advantages of economic development. Facilitate the increase of understanding on clean customer lighting and fresh air education, health improvement, access to information, communication, entertainment, and security. These factors can bring fundamental changes in the rural social life's traditional social life. Although the use of SRS electrical equipment is limited, lifestyle has significantly improved due to solar power availability. Solar electric lighting hconsumer activity stretches evening hours. Television, production activities and school education for children are benefited from evening activities in the evening. SRS electricity also improves the condition of consumers for education because it provides clean, light and fresh air as well as long-term education for children. In case of health facilities, better internal air pollution of SRS-owned consumers, availability of health related information and accidents related to kerosene use are also available.

Increasing access to economic growth, quality education, health facilities and information can significantly improve the productivity, efficiency and livelihood of rural people. SRS will ensure sustainable socio-economic development for a long time, in coordination with other comprehensive rural development programs.

Human life depends directly on the electricity. Power generation in Bangladesh is mostly dependent on gas and diesel fuel. Since these resources are limited, solar power will be the main source of electricity. Researchers, policymakers, development partners, Bangladesh acknowledged the huge potential for solar power in the rural areas. In spite of the possibility of solar power to estimate rural development, access to this technology was not widely accepted in rural areas. Proper stimulation, coordination of policies, development of local technical skills, political and institutional support are extremely essential for the sustainable and effective use of SRS. Now high time to integrate the structural set up to use this resource.

5.2 The Future Scopes of the work For Bangladesh

With reduced costs and improved technologies, the solar energy ensures the reduced electricity bills, increases countries' energy security through reliance on an indigenous, inexhaustible resource, enhanced sustainability, reduced pollution, lower the costs of mitigating global warming, and keeps fossil fuel prices lower than otherwise. It is environment-friendly and anyone can use it. The advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

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