

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

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

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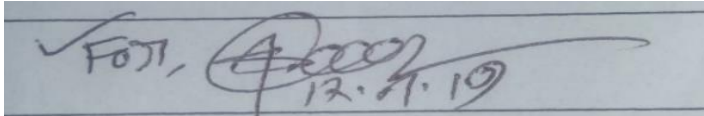
**DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING  
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# Certification

This is to certify that this thesis entitled “**Performance & cost analysis of solar rooftop system under Dhaka Power Distribution Company (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 & 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 & Electronic Engineering. The presentation of the work was held on December 2018.

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**Dedicated to**  
**OUR PARENTS**  
**With Love & Respect**

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## List of principal Symbols Abbreviations

AC	Alternating Current
DC	Direct Current
PV	Photovoltaic
SRS	Solar Rooftop system
V	Voltage
W	Watt
Amp	Amperes
W/M <sup>2</sup>	Watt per Square Meter
EJ	Exa joule
PW	Pet watt
cm	Centimeter
kWh	Kilowatt hour
DPDC	Dhaka Power Distribution Company
WP	Watt peak
Sreda	Sustainable and Renewable Energy Development Authority
DA	Distributed Generator



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First of all, we give thanks to Allah. Then we would like to take this opportunity to express our appreciation and gratitude to our thesis supervisor **Prof. Dr. M. Shamsul Alam, Dean, Faculty of Engineering, EEE Department, and Daffodil International University** for being dedicated in supporting, motivating and guiding us through this thesis.

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

# ABSTRACT

Daily headlines make everyone alert to the dangerous long-term outcomes of power generation from your fossil fuels. It really is widely believed in which continuing to be determined by fossil fuels to build electricity can result in serious environmental issues. Moreover, fossil fuels are usually finite in sum and cost big money as well. Consequently, renewable energy can be a potential solution to fulfill up electricity demand for your developing countries for instance Bangladesh. Among every one of the renewable technologies, solar sun (PV) is one of the most potential, favorable and promising the one which converts solar energy into electricity, including or taking out battery backup. Although solar engineering has nearly succeeded in rural areas where a lot of the technologies are adopted according to Solar Home Method (SHS), it have not yet been effective in towns after the added rule of achieving 3% of mild fan load of your building. We have got investigated the put in solar rooftop regarding 86 houses inside Narayanganj, where the pv system of a lot of the houses were identified inactive. Among these only 50 methods are active. On this thesis the total analysis of metropolitan solar prospect continues to be done in three layers according to this investigation. After all, the effectiveness of the system was discussed in brief to influence them to come to know about the appropriateness of the system and the proper way to maintain the system. It is seen that a few among them find the system useful and want to increase its capacity. The operating condition and maintenance of the SRS was evaluated as well. Most of the interviewed people do not either maintain the system or want to repair it. It is very unfortunate that most of the systems were found inactive or not connected in a proper way. Although urban people are more likely to know the efficient use of solar energy, they still prefer fossil fuels for their power generation. In this manner, they are indirectly contributing to environmental hazards and wasting a lot of money too. From the reading of an installed solar system, the cost per unit is calculated later as an example. However, the appropriateness of the system to the consumer is very limited due to having a lack of knowledge and training to operate the system productively.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

The world is growing at a wonderful rate .Currently the Earth's population is growing by 60000 people every 8 hours. Experts believe if we continue to grow the space, we'll need 50% more energy to sustain humanity by 2050. And that's all, more people mean's we'll need more foods, water, and shelter, putting a strain on our renewable resources as well. There are various energy in the world. Example: Coal, oil, Electricity, solar energy etc. So we'll discuss about the solar energy. Presently Global warming up and climate changed effect is the burning issue all over the world. Bangladesh will function as most effected country in the climate changes effect round the world. There are so many causes of global warming. Among them power generation is the most remarkable one. We can't think about any development without power (Electricity). Finally, sources of conventional energy likes Fossil fuel, Natural gas and Coal are limited. If we used them in the present rate it will be finished within the short time. So, there is no other way to think about environmental friendly renewable energy production sources. In Bangladesh context solar energy is the most affective source for renewable energy production. Regardless if fuel is an available while in the country transporting that your fuel to remote computer repair, rural village are usually difficult. There are hardly any loads or supporting infrastructure in a good many remote villages the place transportation by animals stands out as the still common. Transportation by critters limits loads capacities but some loads, diesel power generators, for example may very well be impossible to bring to including locations. The uses for renewable energy is attractive for the solar technology advantages application in countless developing countries.

The solar radiation energy is converted into DC power and requires an inverter into AC power. But still some problems have that make it uncomfortable to us. Its efficiency is so much low and the prices of its energy is so high. So in this paper we try to find way to make it comfortable.

### **1.3 Problem Statement**

Bangladesh is mostly a little and over filled developed country. In many remotes areas in the area there is no way to obtain electricity. Rural electrification on the solar PV (Photovoltaic) technology is become the more popular, day just by day in Bangladesh. Solar power Systems are highly decentralized and particularly to suit remote, inaccessible areas. Our country in the flooring business of solar power system could very well be some government combined with nongovernmental organizations. Solar power systems are changing the eye of rural Bangladesh. And it a billion dollar industry within a couple of years. At present, there are 32 organizations doing solar power business in Bangladesh.

In several rural areas, people live to the not even close to the main electrical grids to connections reliable or inexpensive. Without entry, these families are forced to depend on more expensive and nonrenewable energy options for example kerosene's or batteries. Even with 400000 new households gaining use of electricity every year, it could be take another 40 years for all the people of Bangladesh to have energy. The renewable energy project is assisting the private, industry, NGOs, and microfinance institutions expands the solar panel technology program and establish it with a commercial and sustainable time frame. Recognizing the importance associated with an informed public.[2]

These efforts will be critical to providing in Bangladesh with the diversity of clean power sources it needs to bring to the benefits of electricity to all of its 140 million citizens. In Bangladesh there is a hugest possibility of solar energy. Our entire reports is about the problems and possibilities of solar business in our country.

### **1.4 Objective of Thesis**

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

- Calculate the per unit cost of solar electricity.
- Find out the problems that consumers are facing when they are using SRS.
- To gather information about the satisfaction of consumer whether they are properly satisfied with their system or not.

- To intend the idea about how much electricity the consumer gets on an average and in which purpose it is being used.

## 1.5 Scope of the Research

Properties with better physical and educational endowments have a propensity to adopted solar rooftop solutions than poor households. Immediately the system matters in household decision coming up with a 10% decline in immediately the system increases complete demand for a solar array electrical by 2%. As to your benefits, adoption of a good solar rooftop system advances children’s evening study point in time, lowers kerosene consumption, and health benefits for household members, in particular for most women. It’s also found to add to women's decision-making ability in certain household affairs. Finally, it is actually found to increase family member’s consumption expenditure, although on a small scale.

Energy Construction and Transportation, Renewable Electrical power, Climate Changes Mitigation and Greenhouse Gases, Climate Change Economics, Market Theory & Research.

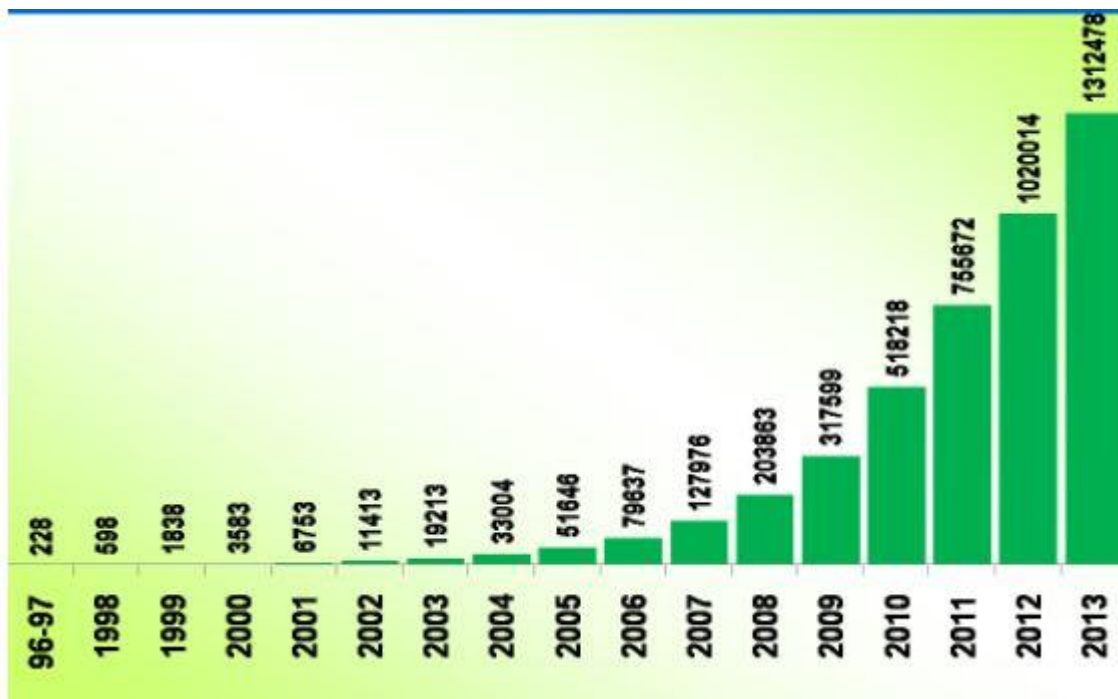


Figure: 1.1 Bangladesh Solar Energy Revolution

Day by day increase the solar energy revolution in the Bangladesh. The power of sunshine is helped to your green Bangladesh's vigor mix. Renewable energy accounts intended for 1 percent of your country's energy generating, but the government aims to acquire 10 percent with its national grid derived by renewable vigor by 2020. Adding the solar energy panels to rural homes is undoubtedly an important an area of the country's sustainable progression strategy.

## **1.6 This thesis is organized the following**

Chapter 1 Introduction

Chapter 2 Literature Review

Chapter 3 Methodology

Chapter 4 Results

Chapter 5 Conclusion

# **CHAPTER 2**

## **LITERATURE REVIEWS AND INTRODUCTION OF SOLAR ROOFTOP SYSTEM TECHNOLOGY**

### **2.1 Introduction**

Since the start of time, the people have been completely fascinated by the sun. Ancient courtesy personified ultra violet rays, worshipping it as an important God or Goddess. Across history, farming and agriculture hard work have relied upon ultra violet rays to grow factories and sustains population.

Primarily recently, however, we have developing the capability to harness the sun's remarkable power. The resulting technologies have promising implications money for hard times of renewable energy and even sustainability. [3]

### **2.2 Renewable Energy**

Renewable energy is a produced using natural resources that happen to be constantly replaced and never expired. There are many natural sources of energy and there are plenty of renewable energy technologies.

Solar has become the most well-known, wind power has become the most widespread, and hydro power has become the oldest. Other renewable modern advances harness geothermal energy, bio energy or ocean energy to form heat or electricity. [4]

Expanding capacity in the electricity sector can be carried out by cost effectively by clean energy options (renewables and also energy efficiency), which but not only reduce greenhouse gas emissions, and increase the jobs plus improve human health by reducing polluting of the environment.

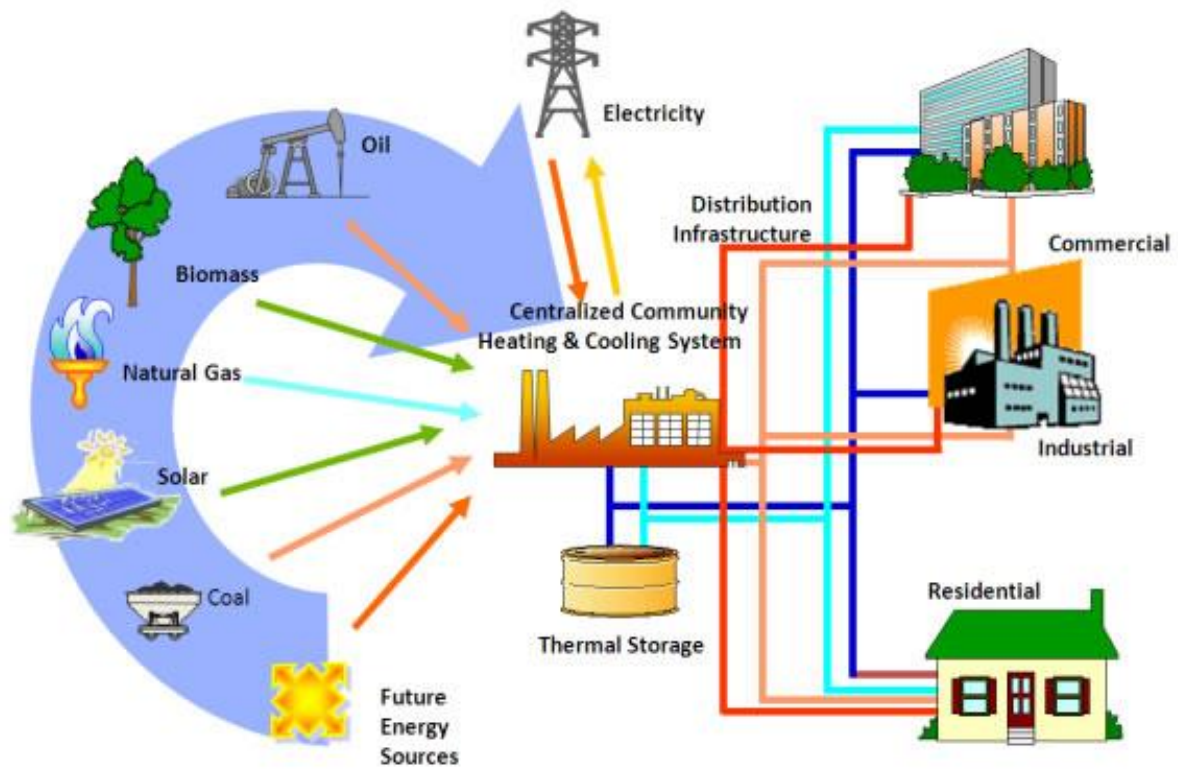


Figure: 2.1 Renewable Energy Chart

### 2.2.1 Solar Energy

Solar panel technology is energy generated in the sun's heat and sunshine. Solar power is an electricity captured from the sun that is converted into electricity, or accustomed to heat air, water, or even other fluids.



## 2.2.2 Hydropower

Hydropower belongs to the oldest sources of electric power for producing mechanical & electric power. Hydropower was used tens of thousands of the years ago to show paddle wheels to allow grind grain. Before the steam potential and electricity were available in North America, grain and lumber generators were powered directly through hydropower. The first industrial consumption of hydropower to generate electricity in North America occurred in 1880. Hydropower would once the force or electric power of moving water to earn the power. This power is addressed as hydroelectricity. Solar energy system heats water at first glance of rivers, lakes, and even oceans, which causes you to evaporate. Water vapor condenses into clouds & occurs as precipitation-rain and excellent skiing conditions.

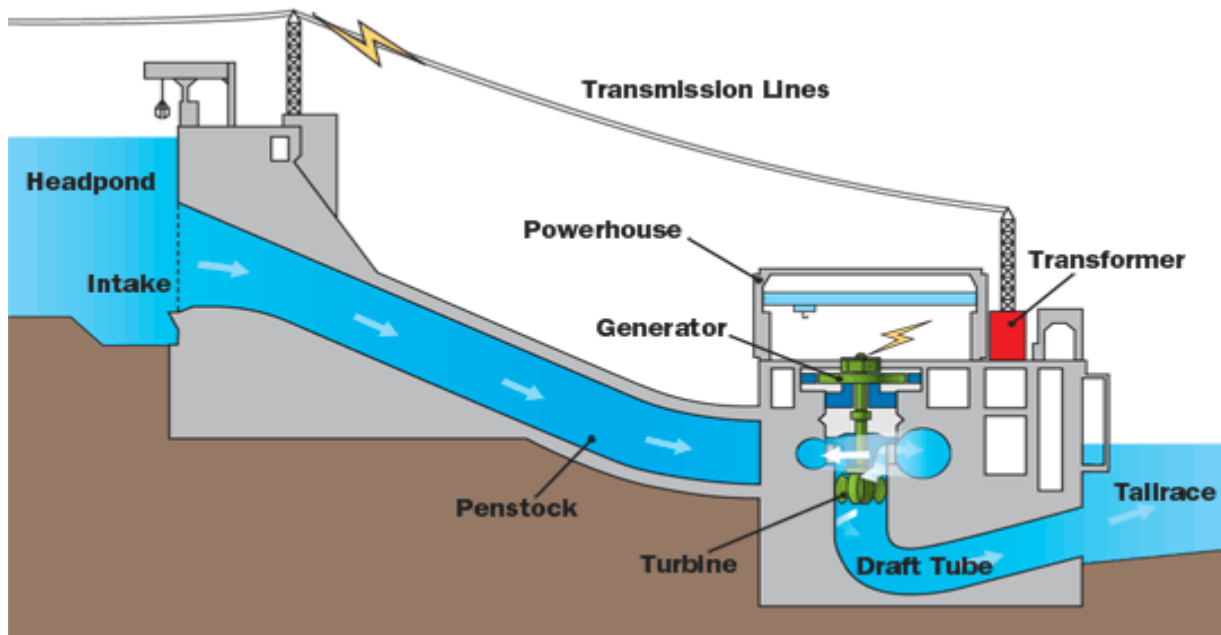


Figure: 2.2 Hydropower plant

## 2.2.3 Bioenergy

Bio energy is derived from the biomass to acquire the electricity and heat or to produce the liquid heats up for transport. Biomass is normally any organic matter about recently living plant or possibly animal origin, such as being a definite agricultural products, forestry supplements, municipal and other waste matter. Solid biomass, such as wood and garbage, can be burned directly to produce the heat. Biomass can also be converted into a gas

called biogas or into liquid bio fuels such as ethanol and biodiesel. These fuels can then be burned for energy.

Biogas forms when paper, food scraps, and yard waste decompose in landfills, and it can be produced by the processing sewage and animal manure in special vessels called digesters.



Figure: 2.3 Bioenergy and Energy Future

## 2.2.4 Geothermal

Geothermal energy is the stored of the heat in the earth. The heat is generated by the natural decay over the millions of years of radiogenic elements including uranium, thorium and potassium. [5]. Heat from the Earth's interior generates surface phenomena such as lava flows, geysers, fumaroles, hot springs, and mud pots.

In contrast, incoming solar radiation striking Earth's surface provides 342 watts per square metric annually. Geothermal heat energy can be recovered and exploited for human use, and it is available anywhere on the Earth's surface. [6]

Thermal energy is energy the fact that determines the temperature for matter. Geothermal power is inexpensive, reliable, sustainable and good for the environment but has historically been limited by areas tectonic plate bounds. Geothermal energy originates within the heat

retain within the globe since the original formation within the planet, from radioactive rot of minerals, and from solar technology advantages absorbed at the outside.



Figure: 2.4 Geothermal Energy

## 2.3 Solar Rooftop System

Solar energy, radiant light and heat out of your sun is harnessed using all sorts of ever evolving technologies along the lines of solar heating, solar photovoltaic or pv, solar thermal electricity, energy architectures and artificial photo synthesis. Either passive solar and active solar depending on the way they capture, convert and distribute the solar energy. Passive solar system techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Industries Entrepreneurs are making the best of the rooftops at their industrial units by installing solar panels to meet part of their energy demand and cut reliance on the national power grid.

In the last 3 months, 30 companies showed interest in setting up solar panels on their factory rooftops, said a senior official of Infrastructure Development Company Ltd (IDCOL).

“We are planning to the finance these projects, considering the potential. There are many factories where more than 2MW of electricity can be produced by utilizing the rooftop

space,” said Md Enamul Karim Pavel, head of renewable energy of the nonbank financial institutions that bankrolls renewable energy projects in Bangladesh.

Designer Fashion Ltd, a unit of Bengal Group of Industries, has already started installing a 300 kWp solar panel system at its woven garment factory in Savar, said Md Raziur Rahman, who is the charge of activity coordination at the factory.

“We have to suffer from load shedding on a regular basis. The solar power will be provided partial back up when there is a power cut,” he said.

“We will use the solar electricity for the emergency lights at the fire exits, staircases and street lights, to ensure workers' safety and security.”

Rahman said the company wants to meet 14 percent of its electricity demand through rooftop solar energy.

Industrialists eye green energy at a time when the demand for electricity is growing to meet the requirements of Bangladesh's \$220 billion economy, expanding by more than 6 percent a year.

The country witnessed a rise in peak electricity demand by 8-9 percent from fiscal 2009-2010 to 2014-15 due to an increase in population, urbanization and expansion of economic activities, according to the draft of Energy Security Study by the power division.

The power generation capacity also grew fast in recent years, hitting 15,351MW. But industrialists demand an uninterrupted supply of electricity to run production smoothly and protect the machines from damages caused by sudden power outages.



Figure: 2.5 Solar Rooftop Energy

## 2.4 Solar Energy Parameters

### 2.4.1 Solar Module Parameters

Modeling a Solar Cell while using Voltage or Current quality. This model is more detailed than the solar cell module and can be employed for maximum power position tracking. Although the model requires is more complicated than the solar cell phone model, it gives far more accurate results. Modeling a Solar Cell while using Voltage or Current quality. This model is more detailed than the solar cell model and can be employed for maximum power position tracking. Although the model requires is more complicated than the solar cell phone model, it gives far more accurate results.

The open-circuit voltage heat range coefficient  $\alpha U$  specifies this temperature dependence. For the voltage on the characteristic. The short- world current temperature coefficient  $\alpha I$  specifies this temperature dependence. For the latest of the characteristic.

Default values are given below for a 150Watt solar module

- Nominal Voltage 24 [V]
- Maximum Power Point MPP 150[W]
- Rated current  $I_{MPP}$  4.4 [A]
- Rated voltage  $V_{MPP}$  34.0 [V]
- Short circuit current  $I_{SC}$  4.8 [A]
- Open circuit voltage  $V_{OC}$  43.4 [V]

### 2.4.2 Solar Panel

The amount of electricity a solar panel produces depend on three important factors: the size of the panel, the efficiency of the solar cells inside, and the amount of the sunlight the panel gets.

Greater solar cells working throughout tandem, the more power they may create. That is why the dimensions of the panel matters if you're looking to calculate how much energy a panel makes. Solar power systems have been about this size for many years, but modern panels create more the electricity than previously. That's because panel manufacturers have realized ways to improve the cell efficiency after a while.

Solar efficiency related to the amount of available energy from the sun that gets converted into electricity.

Back in the 1950s, the first solar cells were capable of the taking 6% of the energy from the sun and converting it into electricity.

If they were configured to be the same array of 60 cells, that would have created a current of about 20 watts electricity, about a third of what would be needed to the light up a 60 watt incandescent bulb.

### **2.4.3 Solar Inverter**

A solar inverter is one of the most important elements of solar electric power system. It converted into the variable direct current output of a photovoltaic solar panel into alternating 240V current. This AC electricity then can be fed into the home to operate your appliances.



Figure: 2.6 Solar Inverter

The electricity that is not the used in your home is then either fed into the grid (electrical power lines) or into home battery storage. New hybrid inverters added an integrated battery management system.

#### **2.4.4 Solar Energy Meter**

Solar meters often come with a monitoring function to alert plant owners of issues with PV plant performance, letting them quickly resolve issues and maximize return on the investment. Plant data is transferred to a monitoring platform that provides a concise presentation of PV yields, monetary saving and plant performance.

“Solar meters record the electricity readings using integrated current transformers (CTs),” said Anne Nelson, marketing manager at Solar-Log. “Solar Meters can be cellular enabled, which allows for the dependable communication from the plant to the monitoring platform, where the installer and customer can view performance remotely via the web.”

### **2.5 Potential of Solar Energy**

There's an easy huge potential of solar technology advantages. It's so huge that your total energy needs of the whole world can be fulfilled by way of the solar energy. The total electrical power consumption of the whole world in the year or so 2008 was 474 exajoule ( $1\text{EJ}=1*10^{18}\text{ J}$ ) or simply approximately 15 TW ( $1.504*10^{13}\text{ W}$ ). [7]Almost 80%-90% for this energy came with fossil fuel. [8] Within the sun earth attracts 3, 850, 000 EJ of energy. [9] Which is equivalent to 174 pet watt ( $1\text{PW}=1*10^{15}\text{ W}$ ). The globe don't hold most of the energy, a a natural part of it reflects to come back. After reflection the earth receives 89 PW of energy. Of the large number only less compared with 0. 02% will do to replace any fossil gasoline or diesel and nuclear power supply in depends upon at present. From this, we in many cases can understood the amazing potential of solar energy. Considering about techniques effect environmental have an impact on, cost, and financial risk.

### **2 .6 Photovoltaic Cell**

A typical PV cell made of crystalline silicon is 12 centimeter (cm) in a diameter and 0.25 millimeter thick. In full sunlight, it generates 4 Ampere (Amp) of direct current at 0.5 volts or 2 watts of electrical power.



Figure: 2.7 Photovoltaic cell

## 2.7 Series and parallel connection of PV cells

- Solar cells can be thought out as a solar batteries. If solar cells are connected in series, then the currents stay the similarly and the voltage increases [10].
- Connected to the positive terminal of the first solar panel to the negative terminal of the next one.



Figure: 2.8 Series connection of cells

- If solar cells are connected in parallel, the voltages stay the same, but the current increases.
- If you had 4 solar panels in parallel and each was rated at 12 volts and 5 Amps, the entire arrays would be 12 volts at 20 Amps.





Figure: 2.9 Parallel connections of cells

- As we know those Solar cells are combined to form a ‘module’ to obtain the voltages and currents (and therefore power) desired.

## 2.8 Types of Solar

**Single-crystal cells:** This types of solar cells are made in long cylinders and are cut into hexagonal or round wafers. This types of solar cell produces high efficiency cells, making them more expensive than the other types of photovoltaic cells. Installing them can increase the efficiency of every homes for as much as 30%. This types of solar cell comprises 29% of the global market.. These solar cells use very pure silicon and involved a complicated crystal growth process. Long silicon rods are produced which are cut into the slices of 0.2 to 0.4 mm thick discs or wafers which are then processed into individual cells that are wired together in the solar panel.

**Polycrystalline cells:** These are made from molten silicon which were casted into ingots then sliced towards the small squares. The money necessary producing the solar cell is leaner, but the efficiency is furthermore lower than single-crystal cells by to the extent that 15%. Since typically the squares are smallish, they can turn out to be packed closely together with ease to increases the energy production. This might be what gives these products that striking destroyed glass appearance. Prefer Mono crystalline units, they are even then sliced towards the wafers to produce individual cells define the solar aboard.

**Amorphous silicon:** With this type of solar cell, silicon is sprayed on the glass or metal surface in thin films, thus the productions of such solar cells are the least expensive of all three. Then again, it is the results to a very low efficiency of about 5%. Amorphous solar

panels can even be made into the long sheets of roofing material to cover large areas of a south facing roof surface.

## 2.9 On grid of Solar Rooftop System

When the steady advancement of technology in the rapidly expanding field of solar energy , more and more individuals have started installing solar systems .Of the different types of solar PGS being installed across in the world today, the on grid or the grid system is the most widely chosen.



Figure: 2.10 On-Grid Solar Roof Top System

Solar Rooftop PV system using On-grid is also termed as a Grid-tied system & Utility interactive or Grid back feeding or Grid intertie system. In this kind of system, the Solar is connected with the utility grid (typically the power lines) along with the loads and batteries if any are present. In pure on-grid solar PV systems, batteries are not connected.

### 2.9.1 ON Grid Solar Rooftop PV System

In pure on grid solar PV system batteries are don't present. Once the Solar generation starts all the built energy tries to compensated the previous loads. Once lots of the loads are completely satisfied excess generates would be going to all the grid. By end of the every month based on total export and import billing will be done. This net will be calculated by the help of a Bi-directional meter.



**Figure 2.11 On-Grid Solar PV Systems & Bi-directional meter**

Difference between your traditional unidirectional meter and also the Bi-directional meter is really a unidirectional meter only displays the whole energy imported in the grid. While Bi-directional meter scans three readings. The content of energy exported (in kWh), total content of energy imported, and also the net energy difference from the export and signify.

## 2.9.2 On-Grid Solar PV System using

- String Inverter
- Micro Inverter
- Power Optimizers

String inverters are connected to series of individual panels. These inverters pick up the accumulated DC Voltages not to mention convert the Direct Currents of this installed solar array towards the grid supportive AC Power. Even though such inverters don't have plenty of components for breakdown, generation depends on around generating module in your series. Due to shadow issues or affordable performing module of this whole series age bracket gets effected. This technique best suits at the roofs where there can be no shading issues owing to trees, adjacent architecture etc. [19]

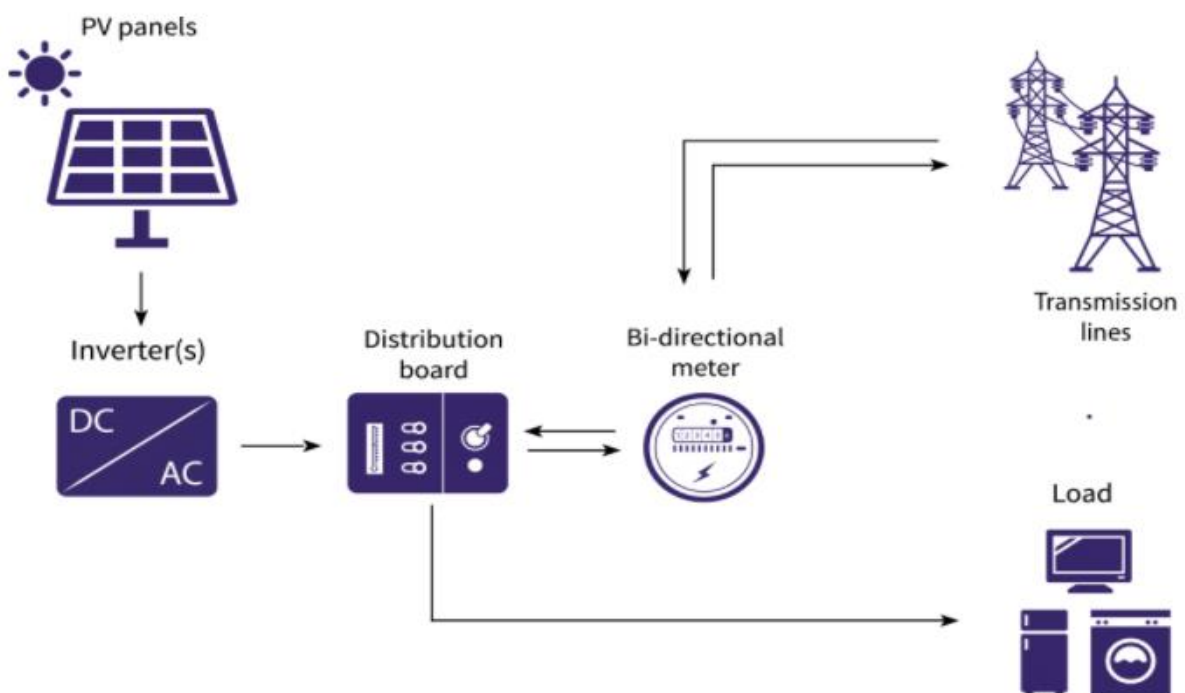


Figure: 2.12 On-Grid Solar PV System using

## 2.10 Off Grid of Solar Rooftop System

An off-grid solar system (off-the-grid, standalone) is the obviously alternative to one that is grid-tied. For homeowners that have access to the grid, off-grid solar systems are usually out of the question.

To ensure access to electricity at all times, off-grid solar systems requires battery storage and a backup generator (if you live off-the-grid). On the top of this, a battery bank typically needs to be replaced after 10 years. Batteries are complicated, expensive and decrease the overall system efficiency.

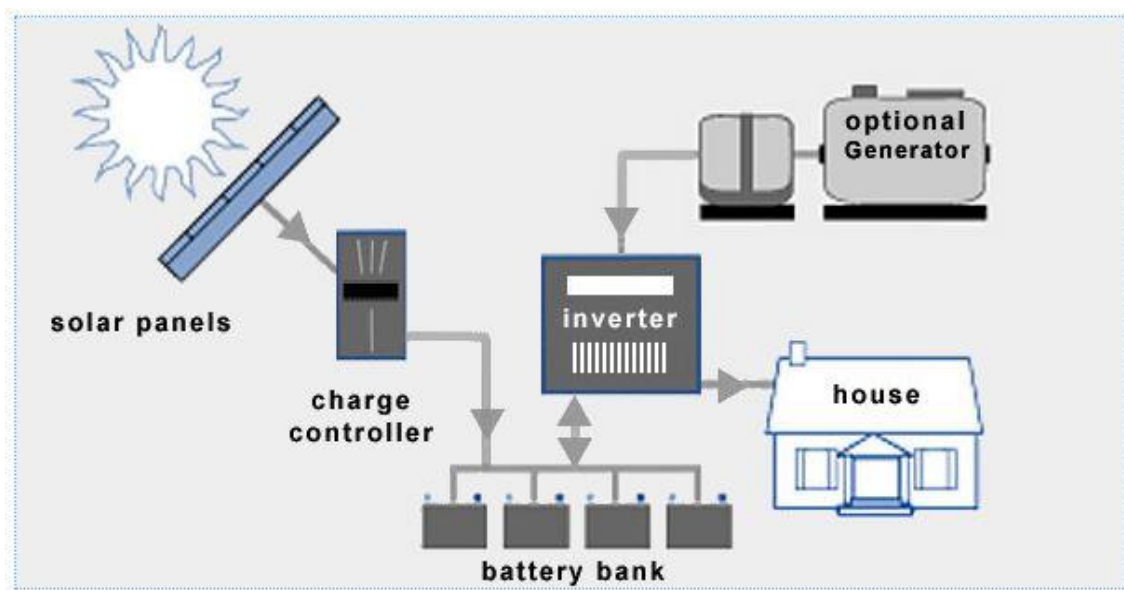


Figure: 2.13 Off-Grid of Solar Rooftop System

## 2.11 Roof Top Technology



Figure: 2.14 Roof Top Technology

Ecological building rooftop technique technologies, such because white roofs, natural roofs, and your photovoltaic panels, are becoming increasingly implemented caused by their associated ecological benefits. Studies of such rooftop technologies will often be located in scorching climates & don't determine their full ecological consequences. Further, current studies tend to pay attention to one technology & often don't assess the full range involving technology options by using a systematic framework using common assumptions along with boundaries. This article evaluates the environmental performance on a life cycle basis of white roofs, green roofs, and the roof-mounted PV in the cold climates. Solar PV demonstrates in the highest environmental performance in all impact categories considered and is the preferred option from an environmental perspective. Green roofs result in beneficial environmental impacts, although much less significant than those obtained with PV, and are the only rooftop technology that reduces both heating and cooling energy uses.

### **2.11.1 Solar Grid-Tied System**

- The whole systems Tied/synchronized with existing utility grid.
- It's a best system in which not only we feeds the excess generated power into the grid but also received the power in case of high demand from the grid via bi-directional meter.
- In this technology we avoid use the battery bank.
- A grid-tied solar system is dependent upon on your municipality's electrical grid

### **2.11.2 Solar Hybrid Systems**

- Solar Hybrid energy together with a secondary source of power to turn the loads.
- The secondary source can be diesel
- Reduction in utility bills and fuel expenses
- Battery backup for the night time /cloudy day usage.

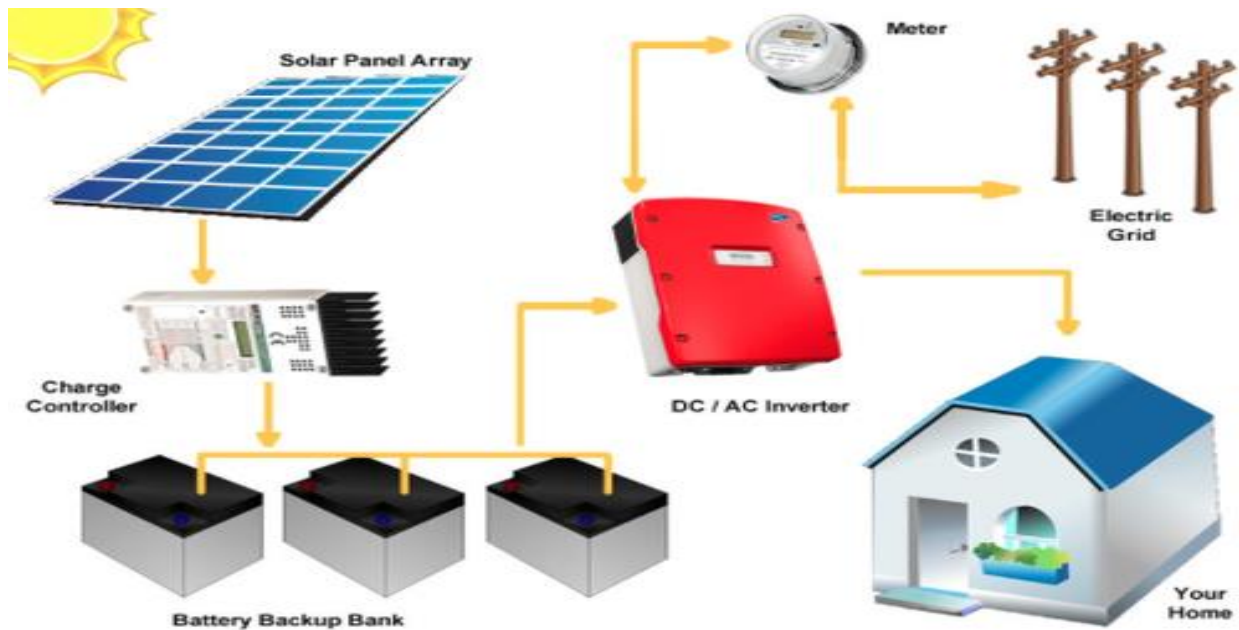


Figure: 2.15 Solar Hybrid Systems

## 2.12 Solar energy attractive in Bangladesh

1. Bangladesh is situated between 20.30 – 26.38 degrees north latitude and 88.04 - 92.44 degrees east longitude.
2. Daily average solar insolation rate is 4 to 6.5 KWh per square meter.
3. Maximum amount of radiation is available on the month of March- April (6.5h) and minimum on December- January (4h).

## 2.13 Advantage of Solar Energy

- Rooftop solar is the great step toward combatting climate change.
- Solar panels contributes to the “green economy”
- Solar power is the incredibly efficient.
- It can be installed quickly.
- Solar energy requires minimal maintenance
- Solar panels have zero emissions.

## 2.14 Disadvantage of solar Rooftop system

- Reduces our dependence on the fossil fuels for electricity production
- Solar power is one of the most widely accepted power in the technologies available
- Solar energy arriving from a limitless source to produce the electricity while sunlight is available
- Energy from the sun is the totally free and widely available.
- Generation electricity from renewable solar energy sources leaves no carbon footprint.
- Generating electricity from the renewable solar energy sources leaves no carbon footprint.

To help keep the pace of development in conjunction with environmental and fuel consideration, America is desperate to explore in addition to implement various emerging features including smart grids, renewable technologies, while using the policy of “go green”, several initiatives will be taken by Goal and echoed by means of respective authorities. Rooftop solar PV system has become used as the renewable sources in this particular Smart Grid. This paper presents an analysis of rooftop solar PV system implementation barrier in clever grid pilot project. A survey has become performed with the electricity people, considering questions regarding consumption over in a variety of period, space availability for roof major PV system and users experience on this technology.



# CHAPTER 3

## METHODOLOGY

### 3.1 Introduction

The actual methodology, known because Value of Photo voltaic system Methodology, takes into account the unique nature of photovoltaic generation in that systems produce electrical power on peak, produce power in the location of make use of, do not need continuous fuel buys, and have substantial security and environmental advantages within the fossil fuels. These characteristics is usually increase the worth of solar electricity because they allow utilities to prevent the costs associated with fuel, plant O&M, era, reserve capacity, tranny, and distribution within their centralized assets.

### 3.2 Site selection /Research Area:

A rapid rise of affinity for solar development around Narayanganj has meant it was imperative that a technological, social, politics, and environmental costs and benefits associated with solar development often be analyzed. The goal of your report is to present a series of qualitative and quantitative analyses that together produce a framework for a strong evaluating proposed utility-scale solar study field around Narayanganj. We are usually present recommendations and guidelines that should enable stakeholders to gauge potential impacts of utility-scale solar enhancements. The analysis plus recommendations ultimately provides guidance for any selection site of the most useful proposals for utility-scale solar power facilities in desert locations that provide both solar vigor generation and resource efficiency of ecosystems. To obtain the electricity, solar modules are placed directly among the bushes and aligned so that you can catch sunlight. In combination with land requirements, proposed solar systems facilities need infrastructure to hurl to the electrical grid. While we recognized a critical role transmission plays in siting conclusions, an analysis with transmission was above the scope of your study. [11]



Figure: 3.1 Location of Narayanganj.

The actual processes, regulatory companies, and decision-making structures are very different from facility siting, plus they represent added the actual layers of complexity within the larger issue associated with utility-scale renewable power generation. In add-on, relevant transmission information were unavailable for a number of reasons, including those associated with concerns over the actual national security. Additionally, transmission is the actual being adequately investigated by other organizations.

### 3.3 Analyze Survey Question

Table: 3.1 Survey Question

Serial No.	Indicator	Question	Description
01.	Consumer Information	1. Name 2. ID 3. Address 4. Mobile No. 5. Zone	Through this question, we can know basic information of the consumers.

02.	Information of installation	<ul style="list-style-type: none"> <li>1)Date of installment</li> <li>2)Total capacity</li> <li>3) Bought SRS from where.</li> </ul>	In this part we asked and tried to find out the information of installment.
03.	Operation	<ul style="list-style-type: none"> <li>i)SRS are in operation or not</li> <li>ii)Is consumer use it</li> <li>iii) In which purpose they use it.</li> <li>iv) Electricity generation</li> </ul>	In this part we checked the present situation of SRS and taken reading from the meter.
4.	Consumer satisfaction	<ul style="list-style-type: none"> <li>i) Do they want to increase SRS capacity?</li> <li>ii) SRS is useful or not?</li> <li>iii) Is it the waste of money?</li> </ul>	The part we tried to know that consumers are satisfied or not.

5.	Maintenances	i) Do they clean the panel  ii) How often it is done?  Iii) Do they get any training about SRS?	In this part we wanted to know about maintenance and training.
6.	Cost analysis	i) Total cost for SRS  ii) How much electricity generated.	In this section we calculated the electricity generation from a solar system and per unit cost of solar power.

Analyzes the results of a survey Question in three Narayananj with close proximity to utility-scale solar facilities. Differences in an attitude were explored between those who support and oppose solar. Respondents were asked about the likelihood of possible outcomes, concern for negative consequences, value they place on potential positive impacts, and use of a variety of information sources.

# CHAPTER 4

## DATA ANALYSIS, RESULTS AND DISCUSSION

### 4.1 Introduction

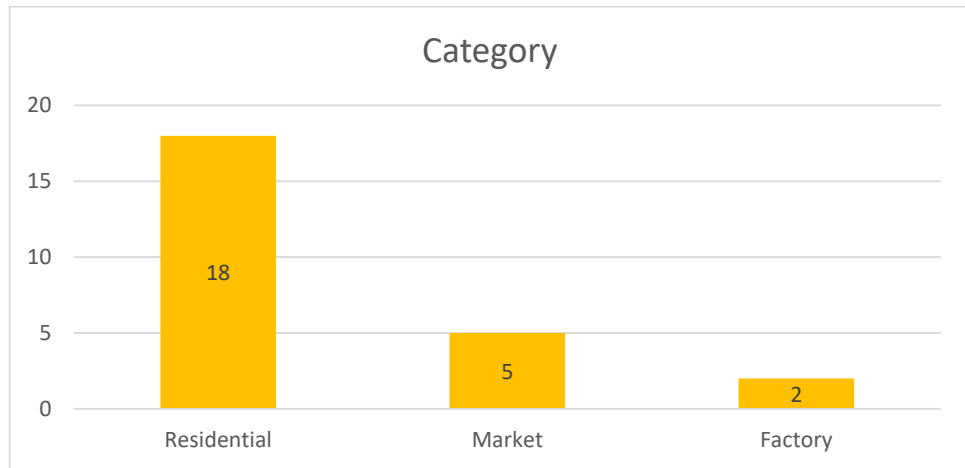
Dhaka Electrical power Distribution Company Limited (DPDC) has taken a 'Rooftop In Grid Solar System in addition to a 'smart complaint management system' and a few other new technologies that will aid to the improved products you can the services greatly in the utilities service vendors. Power distribution utilities have to start buying solar electricity from consumer's rooftop plants under the newly introduced 'Net Metering' system. According to five out of six power distribution companies have signed contracts with a total of 25 consumers to follow solar electricity from their respective rooftop solar panels. [12] The good news is necessity to speed the development of clean the power technologies to address the global challenges of one's security and advantageous development. Solar PV cell technology certainly is the easiest option to relief the excessive uses of non-renewable power source. As Bangladesh operating out of the equatorial sunbed for the earth, the territory should get plenty radiant energy from sun. Most area of Bangladesh is feeling over 250-300 days one year of clear warm day.

### 4.2 Category

There are three category use to the SRS. There are residential, shopping mall, factory. The bar chart show the category of SRS in Narayanganj. Summaries the information in the chart by selecting and reporting the main features. Make comparisons where relevant. The chart gives information about how much used the SRS survey on Residential, Factory and Market.

Residential uses in 72%, Market uses in 20%, and Factory uses in 8%. Although Residential are still more than uses of Market but also Market greater than uses Factory.

Graph: 4.1 SRS Category



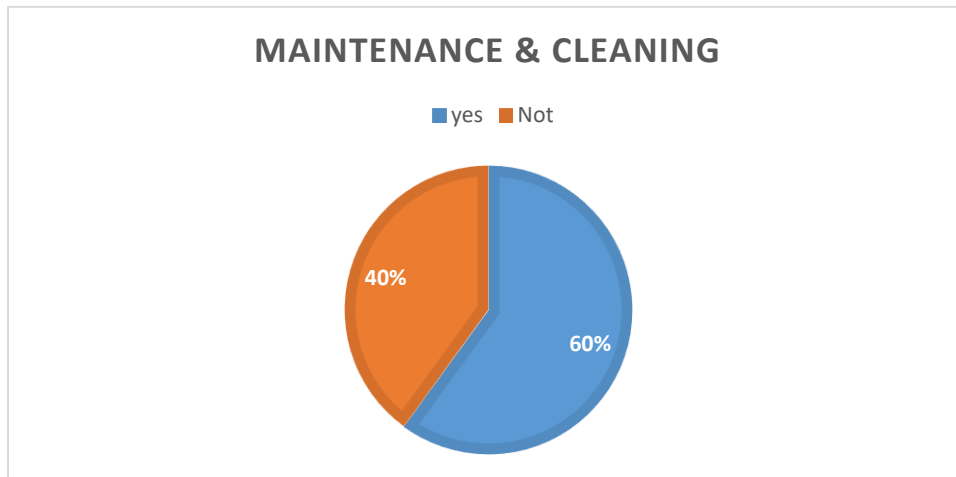
## 4.2 Statement of Consumers

These consumers are supplying 3.066 MW of electricity in the national grid of the distribution companies. We hope the number of consumers will rise soon as well as further increase in the volume,” Mohammad Alauddin, joint secretary at the Power Division who is in-charge of renewable energy-related issue, told UNB.[13] In addition to financial benefits, you do improve your carbon emissions, which your clients might appreciate and give you a preference over your competitor.[14]

### 4.3.1 Maintenance and Cleaning

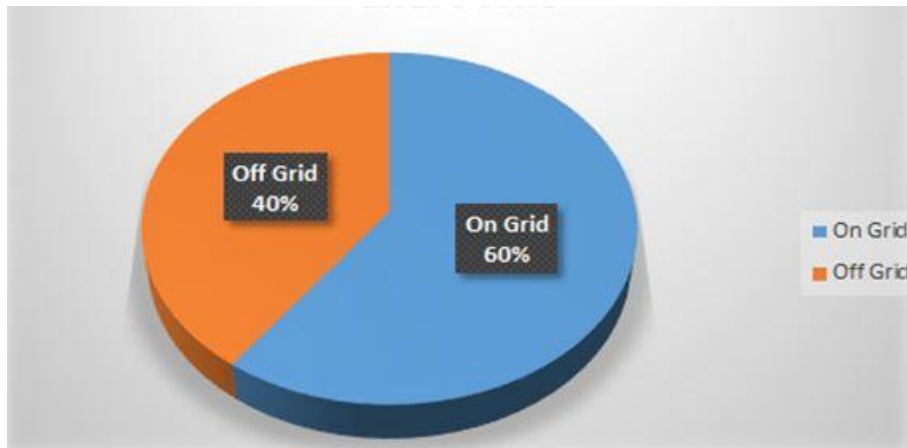
A pie chart is a type of graph in which a circle is divided into sectors that each represents a proportion of the whole. The consumers clean and not cleaning in the SRS. It is meant to be cleaned the SRS by the subscriber regularly or not by cleaning the pie charts. We can show this chart, there are 40% consumers are not cleaning the SRS and but also 60% consumers are cleaning the SRS is regularly. The entire circle maintenance & cleaning all of the SRS, and the sectors represent specific products that use a percentage of that SRS. For example, 40%are not maintenance & cleaning and 60% consumers are maintenance.

Graph 4.2: Maintenance & Cleaning



### 4.3.2 Types of Solar

There are two types of SRS off grid and on grid. We are analyze, Most of the consumer are connected with the connection on grid, but some consumer are not connected grid of the SRS it's also called off grid. Customers who have off-grid they are used the electricity of light, fan and motor. A pie chart showing the off grid and on grid in the SRS, may have 2 segments, showing on grid 60%, off grid as 40%.The percentage of this SRS in increase on grid and decrease the off grid. So we know this graph, the consumer more than use the on grid. Bangladesh is one of the leading importer of Solar Panel. Consumer Electronics, CPVC Pipe & Fittings, Solar Charge Controller, and Battery, On Grid & off Grid Inverter, Solar Street Light & Solar related all products. LED Bulb & Tube, Energy Saving FAN, Prepaid Meter etc.



Graph 4.3: On Grid and off Grid

### 4.3.3 Consumer Realization

We are visited the SRS in Narayananj. We ask them whether they get any advantage from the SRS or not. Then some people say that it is good, some people say that money is lost in it, someone says they want to increase its holding capacity. We can go to 25 customers and know, they think that it comes in profit 92%, and does not come in 8%. And 8% consumer, they are think, they waste of money. Again, little number of consumers wants increase the capacity of SRS. 25% of the 88% of people who did not know how much money has been received from 12% consumer think there are not waste money. Only one consumers, they are increase the capacity of SRS.

Graph: 4.4 Consumer Realization

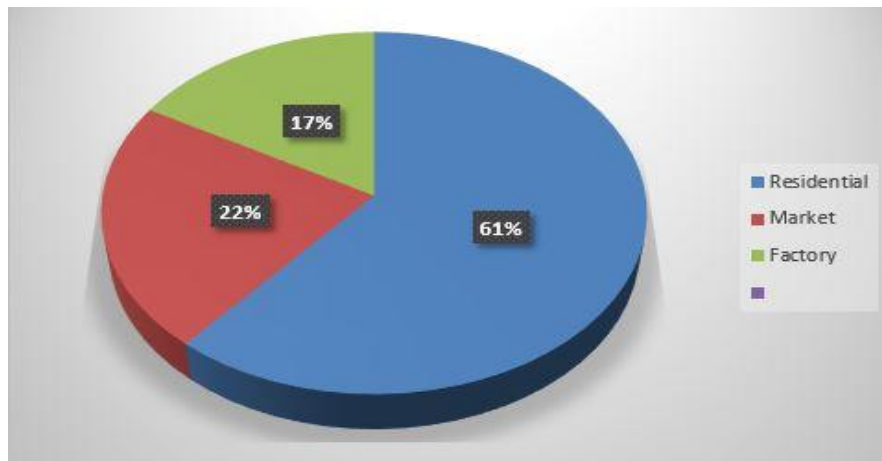




### 4.3.4 Present Condition

Under the present condition, if any new consumer wants to take electricity connection, he has to mandatorily install rooftop solar panel to generate a certain small portion of the power from the rooftop plant. But due to absent of any Net Metering System or policy, many of the consumers allegedly install fake solar panels only to get. We know that, there are many 20% SRS is an inactive, but also 80% are SRS is an active. All of those consumers were SRS is off asking them this, they would repair it. They some people will say no, no one will say anything.

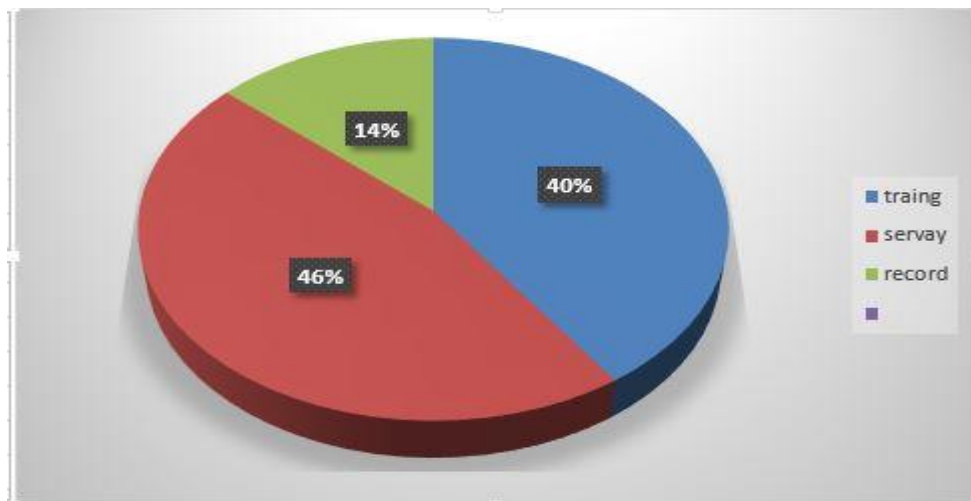
Graph: 4.5 Present Condition



### 4.3.5 Consumer Provided

The graph shows the results of survey 14% consumer recorded the data of SRS and 86% consumer are not recorded in data. And 40% consumer are taken training and 60% consumer are not found any kind of training. And we also know in this graph 46% consumer facing survey. In this graph we saw that a lot of consumer are not taken data record and not found training. So government should be awareness in this step, then its developed and benefited consumer.

Graph: 4.6 Consumer Provided



### 4.3.6 SRS Bought

In this graph we see that 88% consumer bought SRS in agency medium and 12% consumer bought SRS in market.

Graph: 4.7 SRS Bought



### 4.3.7 Choice of SRS install

When we survey and asked the consumer “why do you install this SRS?” then maximum consumer answer its policy obligation. In this graph we saw 86% consumer install SRS policy

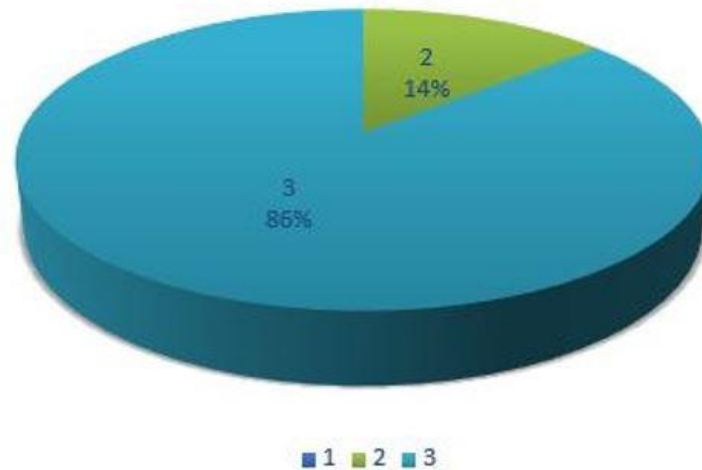
Obligation and 14% consumer install own choice.

Let,

Policy Obligation = 86%

Own Choice = 14%

Graph: 4.8 Choice of SRS install



#### 4.4 Cost Analysis:

Let, Capacity = 2340 Wp, Installation date = 13/11/2016

Life time = 15 Years

Capacity = 2.34 kW

Total install cost = 108600 TK

Electricity generation = 1502 kWh (month-13)

Per month generation = 116 kWh

Yearly generation = 1392 kWh

Lifetime generation = 20880 kWh

Per unit cost (without of maintenance) = 5.20 TK

We can saw, this calculation find the per unit cost = 5.20 TK. Below the per unit cost in different SRS.

Table: 4.1 Cost Analysis

SI No.	Capacity (Wp)	Installment of date	Life time total Gen.	Total cost of SRS (TK)	Per unit cost(TK)
01.	2340	13/11/15	20880	108600	5.20
02.	3600	21/08/17	33571.43	141000	4.20
03.	5000	04/04/15	67771.08	225000	3.32
04.	1570	28/06/15	14989	80940	5.40
05.	17400	14/07/15	228000	798000	3.50
06.	1000	06/09/16	18125	58000	3.20
07.	12000	17/07/17	163385	531000	3.25
08.	18000	24/07/16	209749	753000	3.59
09.	880	18/07/16	10744	53720	5
10.	3360	17/11/16	31378.37	139320	4.44
11.	6000	12/08/16	60667	273000	4.50
12.	4800	01/11/17	36764	202200	5.50
13.	15120	04/09/15	199936	619800	3.10

We have collected data in various places of Narayanganj and have collected data find the per unit cost. We have collected the consumers name, mobile No. address, capacity, date of installation etc. From this Results, we know that the electricity cost more, but SRS cost is less. This data analysis average cost per unit 4.17TK.

### 4.3 Thesis finding and suggestion

After completing the survey according to the indicators and analyzing the result we

Pointing out some important things,

- The main thing is there consumers are not concern about the SRS properly. So, here need to counsel consumer when provide the SRS.
- Consumers do not have enough knowledge about how to clean it and the usefulness SRS system.

There should need to train the consumer so that they can clean it properly and should Inform about the usefulness of the SRS system.

- Majority of the consumer do not know about the net metering system.

Government organization should inform the consumer how they will get profit by net Metering system.

- About 98% consumer think that SRS system is waste money, they do not get Much energy from SRS but its initial cost is very high.

Government should reduce the market price of instrument for the SRS system.

- From above analysis it can be roughly estimated the data in the respective areas.

To find out actual data we need time series data. Further studies are required in this line For better understanding of SRS in various area of Bangladesh.

The idea is that consumers will use their own the solar power alongside the grid. But on the holidays when solar power is not used, the consumers can sell it to the national grid. Power Cell officials believe the government will be able to buy about 10-12 MW power from rooftop consumers as many large client like industries, apartment complexes, shopping malls and hotels have already set up rooftop solar power plants for their own consumption as part of the govt. policy. There is a target to generate 3,168 MW of electricity from the renewable energy sources by 2021 in compliance with the Sustainable Development Goals (SDGs) as well, said an official of the Sustainable and Renewable Energy Development Authority (Sreda). The Power Division has opted for Net-metering. As it offers option for producing electricity from renewables and also to get connected to the grid. The prime advantage of net metering is its simplicity between concept and operation. A draft guideline has already been prepared.

# CHAPTER 5

## CONCLUSION

### 5.1 Conclusion:

Electricity is the basic requirement for the economics of a country. The industrial development and the increase of living standard of people are directly related to the more uses of electricity. Solar power is connected to the National grid then increase the total generation power. So, we study how to connect solar roof top system energy to the national grid. This system is very complex but solar source free from cost also, there has no environment effect and reliable. Solar Rooftop Systems have a great potential, however, there is need for awareness creation both about the Rooftop Solar System and technology packages as well as about the financing avenues available.

In the present years increase for power demands from local costumer has experience by the energy distribution in mobile phone network. Recently power platforms are giant and additionally complicated, with the way to acquire and distribute electricity to customers. Distribution about electricity through time consuming and overburden sign lines causes excessive low voltage trouble. Therefore, the system problems may be solved either just by overdesigning and under-utilizing all the transmission systems or possibly by introducing the tiny generators to all the distribution network. Hence the concept distributed generator (DG) was first introduced. [15] Distributed generator technologies feature photovoltaic systems, wind generators, fuel cells, small to medium sized micro-sized turbines, and additionally internal combustion engine-generators. Deregulation for the electricity supply system results from addition of DG becomes a very important issue in various countries. Grid connected PV system famously used as the power market becomes beyond competitive. This system doesn't necessarily require bulk and additionally loss battery and additionally reduces transmission financial obligations. Therefore, PV grid-connected platforms have become about the most important applications of solar power. The performance for the distribution system combined with grid is effected by installing Photovoltaic system. This is why, the impact about DG on

distribution system combined with grid needs that should be evaluated in classified of steady assert normal and transient factors before implementation. [18]

Currently the Markets there are been found that 82% of which are also enthusiastic about marketing SRS inside surrounding areas if some kinds of favorable financing arrangements can be obtained. [19] We are usually visited the SRS inside Narayanganj. We inquire further whether they acquire any advantage from your SRS or not necessarily. Then some people say it is good, some people point out that money is lost inside, someone says they wish to increase its having capacity. We can head to 25 customers and also know, they believe it comes inside profit 92%, and will not come in 8%. And also 8% consumer, they may be think, they spend of money. Again, little number of consumer's national grid is serving only 50 percent of the nearly 10,000 rural markets and commercial centers in the country which are excellent market for the centralized solar PV plants. Currently, the private diesel genet operators are serving in most of the off-grid rural wants increase the capacity of SRS.

## **Future work**

We are collected huge amount of data and analysis these data and calculate the cost per unit. After calculation we see that if increase the efficiency then decrease the cost per unit. In future using net meter extra energy are going to the on grid and consumer will be satisfied.

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