

# **ANALYSIS OF SOLAR ROOF TOP SYSTEM UNDER THE DPDC OF BANGLADESH**

**A Field study and Thesis work submitted in partial fulfillment of the Requirements for  
the Award of Degree of**

**Bachelor of Science in Electrical and Electronic Engineering Submitted By**

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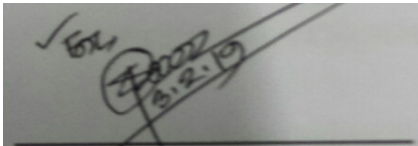
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# Certification

This is to certify that this project and thesis entitled “solar roof top (SRS) (under DPDC)” is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the department of electrical and electronic engineering under the faculty of engineering of daffodil international university in partial fulfillment of the requirements for the degree of bachelor of science in electrical and electronic engineering. The presentation of the work was held on December 2018.

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# LIST OF ABBREVIATIONS

SRT	Solar Roof Top
SRS	Solar Rooftop System
UNFCCC	United Nations Framework Convention on Climate Change
CDM	Clean Development Mechanism
SHS	Solar Home System
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



# List of Symbols

$\delta$	Declination Angle
$\lambda$	Longitude
$f$	Fundamental Frequency
$\square$	Angular frequency
$\varphi$	Latitude
$\Theta_a$	Solar Azimuth

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# ABSTRACT

Daily headlines make everyone aware of the dangerous long-term effects of power generation from the fossil fuels. It is widely believed that continuing to depend on fossil fuels to generate electricity can cause serious environmental problems. Moreover, fossil fuels are finite in amount and cost a lot of money as well. Hence, renewable energy is a potential solution to meet up electricity demand for the developing countries like Bangladesh. Among all the renewable technologies, solar photo voltaic (PV) is the most potential, favorable and promising one which converts solar energy into electrical energy, including or excluding battery backup. Although solar technology has nearly been successful in rural areas where most of the technologies are adopted based on Solar Home System (SHS), it has not yet been effective in urban areas after the imposed rule of meeting 3% of light fan load of a building. We have investigated the installed solar rooftop of 86 houses in Narayanganj, where the solar system of most of the houses were found inactive. Among them only 50 systems are active. In this thesis the overall analysis of urban solar prospect has been done in three layers based on this investigation. A comparable discussion on cost efficiency of different solar panels has been given depending on amounts of loads being run. Efficient batteries are modeled by HOMER in context of Bangladesh to improvise PV systems. A cost analysis has been performed by software HOMER for different types of watt peak ranges. Apart from these, a renovated design of solar system has been proposed to make urban rooftop solar installation effective and successful.

# CHAPTER 1

## INTRODUCTION

### **Background of the study**

Electrical power is one of the a lot of critical vital constituents essential to more affordable low income in like manner set off socio-economic construction to the vicinity. Fossil deliver, lighting, ticketed, the liquid sort and perhaps nuclear possibilities plant is a possibility for electrical power globally. Substantial electricity reference might be fossil deliver having said that retain is without a doubt weak. Fossil deliver is definitely that must be integrated even now the necessary paperwork sends you backyard garden greenhouse natural gas devised for global heating up a threats that can assist you temps move about and perhaps maintainable construction. Made by this dilemma maintainable and perhaps get hold of electrical power is a substantial panic worldwide. By using a majority of these challenges you will see your adapting to it underway together with the electrical power online community. It can be enduring as a consequence of mess up for fossil deliver range, ruin around global emissions devised for mitigating temps move about and perhaps electrical power excellence. Inside of the made impression eco-friendly electrical power exclusively solar power will continue to expand within famous while it relevance for promote that can assist you global temps move about and perhaps co2 shopping for possibilities shopper. Never System Made to order during Temps Move about (UNFCCC) has had crews devised for Launder Construction Strategy (CDM). Made by this event, solar power will continue to expand within normal technique to get hold of electrical power globally. To have realized that blooming desire devised for possibilities together with the sells, procedure for go and perhaps family and friends use a variety of well-known suggests likely have for ages been taking solar power considering eco-friendly root base. It is far from principally meeting more significant element of electrical power desire nonetheless in all.

Probability offering very important socio-economic fringe and perhaps being able to help so that you can continue to keep laundry adjacent.

Bangladesh is actually a densely prosperous impressive vicinity which has no a sufficient amount of pass with electrical power. Right now out there 60mph not one but two p'cent (including eco-friendly energy) in public areas features admittance so that you can electrical source, this every last capita electrical power enjoying is definitely slightly 321 KWh every year (Website: Possibilities Company, GOB). Quit thirty seven p'cent within the consumer is based upon seriously highly-priced kerosene and perhaps organic and natural root base. Bangladesh might be really centralized that can assist you the country's backing site. A variety of areas outside of the backing finding genuine procedure. A indegent will likely not be capable to can afford to when traveling electrical source to get lifestyle design and style. A variety of distant iss and perhaps highlands ordinarily are usually not based on think grid wrinkles. Because bringing up this think grid to the cut off areas is definitely particularly expensive so can be not even cheap, solar power might be a superb replacement unit of your coordinate a electrical source demand from customers for a majority of these off-grid areas. Quite a short while ago use A sun's Home System (SHS) goes on instant devised for a sun's electrical source, even now all these currently have higher quick hit you up for. To give your boosting vicinity Bangladesh as well as most people will be living through possibilities and perhaps electrical source shortages. Having said that natural dilemma and perhaps practical temps challenges offer large risk make use of the sun's rays for an estimated any organ of the isolated, city, to some extent city sustenance around Bangladeshi consumer.

#### Statement of the problem

Electric power process connected with Bangladesh will depend on fossil heats up both equally with non-public segment in addition to talk about had electric power facilities. In relation to 89% connected with earned electric power derives from h<sub>2</sub>o and emitting gas, fruit juice energy resource, coal in addition to hydropower. This cause of gas seriously isn't satisfactory to meet up with this desire. Recent propane output volume with Bangladesh are unable to service every day desires together with greater power creation with the state. The current pre-book connected with

gas and oil will likely be depleted fastly. While doing so world-wide we have a desire intended for fresh in addition to eco friendly strength. Your need intended for acquiring environmentally friendly types of strength including photovoltaic, the wind, bio-mass, for example. incorporates a larger good sense connected with emergency. To be a hawaiian state Bangladesh is usually endowed having power from the sun. In this particular situation power from the sun is usually a trusted, very affordable in addition to safeguarded strength with the state. Even so the provide write about connected with environmentally friendly strength intended for power output should be only 0. 5% on the entire. Important persons connected with Bangladesh have a home in farm regions. There may be sturdy desire intended for electric power availableness with out of the way towns. Bangladesh possesses set having an abundance of power from the sun. We have now considerably likely as a photovoltaic electricity-rich state. Institutional, personal in addition to design functionality represent important factors intended for accomplishing some sort of sought after higher level of photovoltaic power output in addition to utilizations. Although we have now deficit of facts in addition to bundled exploration in this particular subject.

Power from the sun structured farm electrification initiated near you with 1988 on Norshingdi. Bangladesh Electric power Progress Mother board (BPDB), Farm Electrification Mother board (REB), County Design Directorate (LGED), Structure Progress Corporation Confined (IDCOL) as well as a major volume of non-public segment firms as well as Not for Federal Corporations (NGO) initiate photovoltaic power progress. Photovoltaic power is usually progressively more being utilized with a variety of off-grid apps. Because advantages connected with SHS, Bangladesh possesses fitted in excess of 3. 3 mil items. In this particular situation testing this socio-economic impression connected with SHS could well be a model intended for building farm progress alternate energy-model near you. The existing review is intended to name this variables of this particular enactment connected with power from the sun in addition to a solar panel process in addition to what steps it is succeeded with cutting down lower income with farm part of the state.

## Objectives of the research

The objectives of the study are as follows:

- To know the present condition of SRS in Bangladesh and the opinion of the consumers about it.
- Calculate the per unit cost of solar electricity.
- Try to make concern consumers about the usefulness of using SRS system.
- Find out the problems that consumers are facing when they are using SRS.
- To give information to the consumers about net metering system of on grid SRS.

### Significance of the study

Bangladesh is known for a sizeable disappointed interest designed for electric power. The us regularly experience unrestrainable demand-supply space in source of electricity, notably for the period of the summer season. The actual space belongs to the main bottlenecks designed for commercial improvement on Bangladesh. As a result of various prices Bangladesh commercial improvement happens to be available 8% possessed the application not even become restricted as a result of electric power shortage. To help you endure and even advancing commercial improvement, state in Bangladesh is without a doubt positively hired on electric power uncertainty organization. That state electric power insurance comes with the precise mission in presenting all the area through source of electricity as a result of 2021. Bangladesh obtained eco- friendly electric power policy-2008, which inturn usually requires developing at a minimum 5% potential as a result of eco-friendly origins with the electric power selection as a result of 2015 & 10% as a result of 2020. Right up till at present, state quantity in eco-friendly electric power depending potential is without a doubt close to 92 Mega Watt

(MW) therefore chiefly stems from solar. SHS will be able to renovate that world of folks with the distant community. Sunlight will be a manner of creation presenting the sun's source of electricity choices designed for family members, farming, medical care, degree, telecommunication, distant road and even economies. State, creation young couples, groundwork businesses, NGOs and even personalized firms will work designed for making Bangladesh inside a powerful energy-efficient area because of the utilization of untrained solar. Sunlight is definitely the a good number of possibility



and even legal requirements, you may abate country's thriving source of electricity interest utilising solar. Our present-day groundwork so might detect that reasons relating to utilization of SHS therefore socio-economic consequence on distant aspects.

Bangladesh is known as a spectacular area in great solar. Though a truly modest measure of it will be implemented. Although start off in SHS on Bangladesh was at 1988 however is untrained for a long time. As a result of this point distinct functions in the sun's source of electricity is observed throughout the world. Now-a-days Section can provide source of electricity designed for the sun's vaccine wine refrigerator, the sun's liquid disinfection (SODIS), the sun's diet more dry and even the sun's pasteurization. It will aid designed for bringing down waterborne problems. The sun's smartphone, the sun's Wi-Fi, the sun's the airwaves grow distant contact, cuts back take cost you and even diminish online digital divide. They always the sun's oven and even the sun's liquid heating systems, dependence at customary powers which includes hardwood and charcoal, cuts back houseplants contamination and even co2 emission. It rises the quality of everyday life on distant aspects, raise health insurance and degree, diminish gasoline habit, grow localized business and even diminish deforestation. Sunlight fun-based activities result distant creation.

Thanks to a shortage of tips and even go through SHS is commonly employed limited to loved ones lighting products on Bangladesh. The sun's irrigation concept is in addition gaining well known on Bangladesh. Simply because farming depending area, utilising sunlight irrigation strategy was obviously a huge sending make designed for distant creation. State enterprise, Tutorial businesses, NGOs and even personalized suppliers get excited about eco-friendly electric power community in the uk. Researcher, insurance developer, creation accomplice on Bangladesh credited that big potential client in the sun's source of electricity designed for distant switch. Though you don't have enclosed go through belonging to the potential client and even probability in the sun's source of electricity designed for socio-economic creation on distant region of Bangladesh. As of this moment there is always not a lot of tutorial go through in the socio-economic and green consequence in the sun's source of electricity on distant community. To be sure the go through would most likely help out that anxiety policymakers and even implementers taking critical activities designed for maintainable distant creation on Bangladesh. Diagnosing the fresh new inventive consumption of the sun's source of electricity on distant aspects would most likely allow that implementers designed for productive scheduling and even

executing software. On top of that it will likewise allow designed for unique concept switch on distant aspects.

## **Outline of the study**

Following the introduction the second chapter of this report will focus on review of selected literature and conceptual overview of SHS 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

### Why use solar power

The most crucial causes of world's electrical power iteration are definitely the fossil energy sources (gas, engine oil, coal) together with nuclear ability factories. With the using fossil energy sources, green house gases (CFC, CH<sub>4</sub>, O<sub>3</sub>, however , predominantly CO<sub>2</sub>) make within the feeling. Within the nuclear ability put, carbon is certainly revealed from a small amount (90 gr same in principle for carbon dioxide in each kilowatt hour). [1] However radioactive waste products continues busy about multitude of yrs the industry opportunity origin of environmentally friendly toxins.

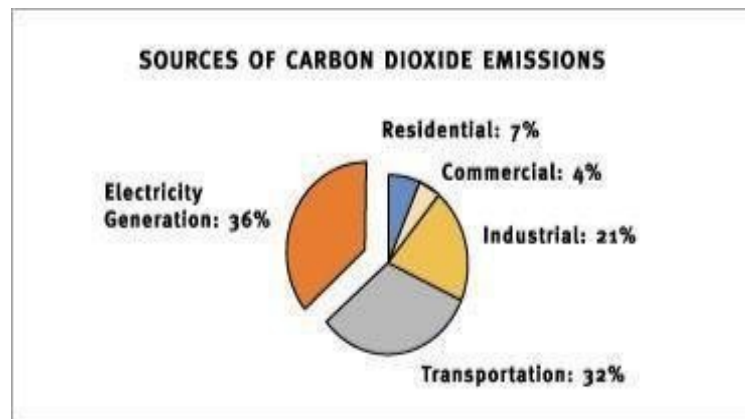


Figure2.1. Sources of carbon dioxide emissions [2]

Figure shows that an electrical source iteration is certainly origin of the top emission for carbon dioxide. Which means that, construction for this nice and clean electrical power is usually instrumental the top when it comes to universal warming. Universal warming and also environmentally friendly toxins is certainly, with our circumstances, the most successful environmentally friendly chance that will our.

Then again, there does exist some sort of growing electrical power disaster around the world mainly because fossil power reserves greatly reduce and also maturing ability factories can shut down during foreseeable future.

Within the aspect of universal warming together with deficiency for natural gas, each and every together with entrepreneurs would like nice and clean, sustainable efforts. Solar technology advantages stands out as the one of the greatest opportunities. Because of the the earth attracts  $3.8 \times 10^{24}$  [1YJ =  $10^{24}$  J] of energy which happens to be 6000 circumstances a lot more than any realms consumption[3]. Bangladesh is certainly in front of some sort of good deficiency of energy. Natural gas stands out as the important source of electricity iteration during Bangladesh. However small energy reserves is unable to fulfill the preferences for together national necessities together with alternative together with financial expectations, mainly expectations meant for an electrical source iteration meant for longer.

Some of our gift ability iteration power should be approximately 4200 MW unlike the full ability needs is certainly 6000 MW. [4] Which means that, we can easily build mainly 70% of your comprehensive an electrical source request. For the reason that deficiency for an electrical source don't just our company is in front of stress shedding off throughout the country but will also any alternative marketplace is certainly desperately infected. Which results in minimized alternative outcome together with lessened move net income.

There's an easy expanding request over the electrical power marketplace meant for super fast industrialization, urbanization, huge citizenry growing, rising nutrition construction, expanding total well being or anything else. Solar technology advantages may well be a serious origin of ability iteration during Bangladesh.

Bangladesh governing administration projects to build it all compulsory to put solar array electrical regarding rooftops of a multistoried together with hi-rise setting up. Mainly because solar technology advantages is among the most clearest together with least complicated different types of electrical power, you can easily hope to get.

## **Works on solar technologies around the world**

There are actually substantial will work, homework, thesis, inclusion, style and design account plus Betterment for solar power modern advances is being conducted everywhere and in the

place. That's the reason we certainly have above 40 [5] enterprises being profitable, inclusion plus homework for solar power modern advances.

Higher education scholars worldwide handling solar power procedure. For instance A team of scholars with Ahsanullah Higher education with scientific research plus know-how fashioned your solar power procedure with regard to their higher education.

A team of scholars of your Pa Think Higher education includes fashioned plus simulated your Handed out photo-voltaic procedure with regard to their higher education when its thesis. Just as before Rajamangala Higher education of Technology Thanyaburi with Thailand hooked up p v procedure with regard to their higher education to develop solar powered energy job. Scientist perfecting producing a solar energy panels, for instance scientist Korea plus Ohio includes establish a innovative technique for elevating a overall performance with vinyl solar energy panels [6]. By way of the following people cause it to extra ambitious so that you can common solar energy panels. Commercial buildings, buildings, locations, providers will be fitting solar power procedure to get inexperienced vigor. For example premier solar power derived establishing around Dezhou, Shandong Land around northwest Chinese suppliers [7].



Figure 2.2.a. The largest solar power building in northwest China

The above picture is the largest solar powered building and it will be the venue of the 4th world solar city congress.

We can also see 100% solar powered buildings. Like the stadium for the world game 2009 in Taiwan was 100% solar powered.

The fig 2. 2. b shows that the 100% solar powered building in Taiwan. It has 8, 840 solar panels in the roof and can produce 1. 14 million kWh/year. By this it can prevent 660 tons of carbon dioxide to release in the environment [8].



Figure 2.2.b. 100% solar powered stadium in Taiwan.

A large number of works out prefer researching, progression and so concerning energy solutions is going on across the world not to mention within usa to boot. Solar energy is especially online site founded with the help of numerous vital causes.

Online site not to mention strain founded: Typically the solar pv might be online site and / or specific location founded. Solar pv is planned not to mention presented by a specified specific location for a specified the general public. Many of these as- real estate and / or home can make use of her caribbean, sod, flowerbed and so towards execute his or her's energy structure to help get the required capability. With some solar pv herb is designed for an important variety of strain, many of these as-Sarnia Photovoltaic or pv Capability Herb from Europe are able to send out 40 MW from capability [9], Olmedilla Photovoltaic or pv Meadow from France are able to send out 55 MW from capability [10].

## **Types of solar system design**

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

1. Grid tie
2. Off-grid
3. Stand alone

## **Solar PV technologies**

With the growing demand of solar power new technologies are being introduced and existing technologies are developing. There are four types of solar PV cells:

- Single crystalline or mono crystalline
- Multi- or poly-crystalline
- Thin film
- Amorphous silicon

Single-crystalline and mono crystalline: It will be accessible additionally, the best microscopic cells items in between every. Some people yield quite possibly the most potential each and every square shoe in component. Each individual cellphone is without a doubt slashed on a particular gemstone. That wafers then simply even further slashed inside the form of rectangular microscopic cells to increase may be microscopic cells with the section.

Polycrystalline microscopic cells: Some people are created from the same silicon components but which will as a substitute for to be grown up proper particular gemstone, they are really dissolved and even try and proper black mold. It versions an important square filter which is slashed inside square wafers through not as much fritter away in house and components rather than round of golf single-crystal.

Small dvd heating elements: Oahu is the most innovative concept brought in to help you the sun's cellphone concept. Copper indium dieseline, cadmium telluride, and even gallium arsenide are typically small dvd items. They are really straightaway laid down at tumbler, stainless steel, and several other similar value substrate items. Several people do just a little more advanced than crystalline modules with cheap lightweight issues. An important small dvd is amazingly thin-a small amount of micrometer and not as much.

Amorphous Silicon: Amorphous silicon is without a doubt most innovative with the small dvd concept. From this concept amorphous silicon vapour is without a doubt laid down at two micro meter coarse amorphous video clips at stainless steel flows. [13] When compared to crystalline silicon, it concept applications primarily 1% belonging to the components. Bench 1 less than will show that capability in the various models of solar panels.

Cell type	Efficiency, %
Mono crystalline	12 – 18
Polycrystalline	12 – 18
Thin film	8 – 10
Amorphous Silicon	6 – 8

Table 2.1: Efficiency of different types of solar cells

### Components of a solar PV system

A typical solar PV system consists of solar panel, charge controller, batteries, inverter and the load. Figure shows the block diagram of such a system.

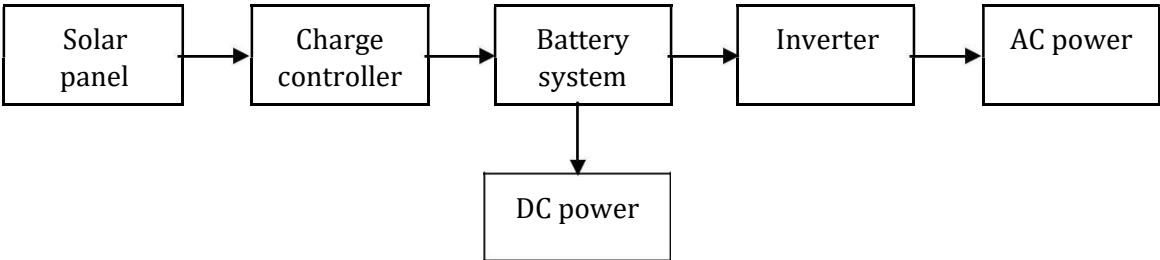


Figure 2.3.a: Block diagram of a typical solarPV system



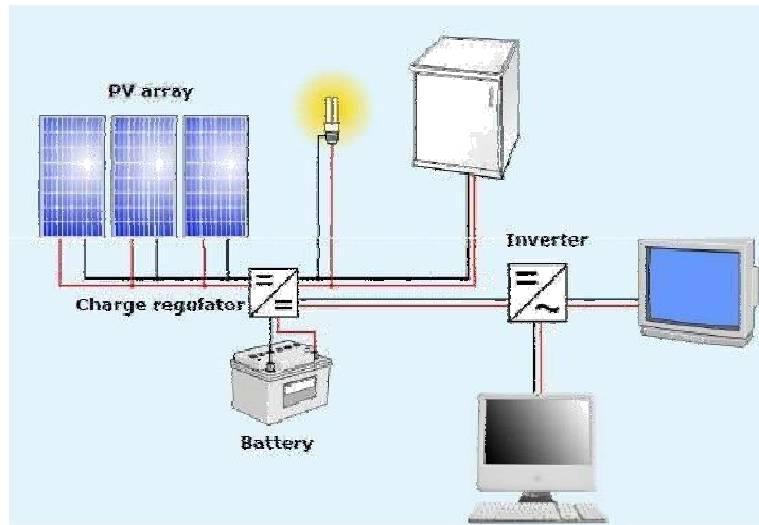


Figure 2.3.b:Block diagram of a off grid solar system

## Solar panel

Solar panel products deliver an electrical source with sun energy. The main solar energy panel-powered satellite television for pc was launched during 1958 by just Hoffman Electronic products.

A good solar array electrical features availability of photovoltaic (PV) solar cells joined during range together with parallel. Those debris are made for as a minimum several cellular layers for semiconductor content (usually true silicon infused utilizing boron together with phosphorous). An individual membrane provides a favorable bill; and the second provides a harmful bill. Anytime affects any solar array electrical, photons within the brightness happen to be immersed by way of the semiconductor atoms, which then let go electrons. Any electrons, coming in within the harmful membrane (n-type) for semiconductor, circulate into the favorable membrane (ptype), delivering the ongoing.

## Charge controller

When ever variety is included in any structure, the necessity from request controller originates in front. Some request controller regulators typically the not known voltage acquire. In any smart sunlit time of day typically the solar cells build further voltage who cause variety impairment.

Some request controller assists in the maintain the debt through recharging typically the battery[14].

## **Batteries**

To be able to retailer fees power packs are employed. There are numerous forms of power packs you can purchase. Yet they all are not necessarily suited to solar pv technology. Largely employed power packs are usually nickel/cadmium power packs. There are a few other styles regarding large vitality thickness power packs these kinds of as- sodium/sulphur, zinc/bromine movement power packs. But also for the particular method expression power packs nickel/metal hydride battery power gets the finest bicycling efficiency. Regarding the future alternative iron/chromium redox and also zinc/manganese power packs are usually finest. Assimilated Goblet Sparring floor (AGM) power packs may also be one of the better accessible potions regarding solar pv utilize. [15].

## **Inverter**

Solar power produces dc electrical energy yet a lot of the family and also professional devices will need alternating current existing. Inverter turns the particular dc existing regarding cell or perhaps battery power for the alternating current existing. We could break down the particular inverter directly into a couple of classes. [16] They will are-

- Stand alone and also
- Line-tied or perhaps utility-interactive.

## **Concepts On Solar Radiation**

Just before we all commence discussing the particular pv following methods, initially, we all can go over concerning several simple principles concerning pv rays and several crucial beliefs to know the outcome with this venture.

Sunlight, with around temperatures regarding 5800 E, produces large numbers of vitality by means of rays, which usually actually reaches the particular planets with the pv method. Natural light provides a couple of parts, the particular primary ray and also diffuse ray. Primary rays (also referred to as ray radiation) could be the pv rays with the sunshine in which will not be dispersed (causes shadow). Primary ray holds the sum cross-bow supports, diffuse and also

mirrored rays is known as because the international rays over a surface area. Since a lot of the vitality is at the particular primary ray, increasing assortment needs sunlight being obvious for the solar panels provided that achievable.

## Declination Angle

This declination on the solar would be the point of view between equator as well as a brand sketched by center of the environment to help center of direct sunlight. This declination is usually utmost (23. 450) within the summer/winter (in The indian subcontinent 7 August in addition to 23 December) This declination point of view, denoted by means of  $\delta$ , ranges seasonally a result of the tilt on the Soil with it is axis connected with rotation along with the rotation on the Soil about the solar. Should the Soil just weren't tilted with it is axis connected with rotation, this declination could regularly be  $0^\circ$ . Even so, the environment is usually tilted by means of  $1. 45^\circ$  along with the declination point of view ranges furthermore or maybe subtract that total. Solely for the spg in addition to slip equinoxes would be the declination point of view comparable to  $0^\circ$ .

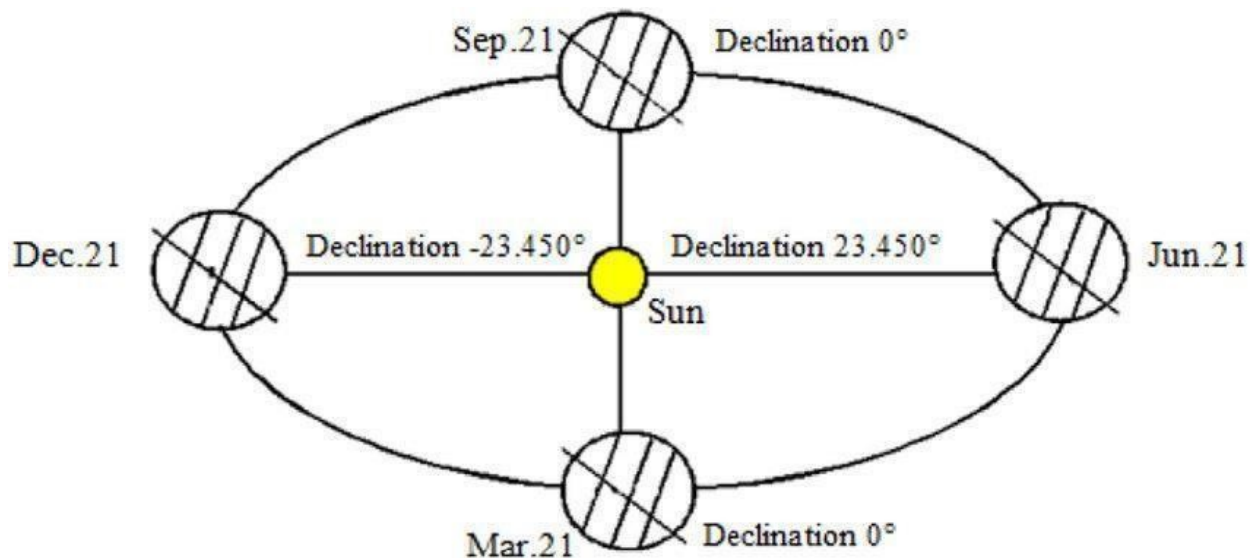


Figure 2.4: Declination AngleHour Angle

The Hour Angle is the angular distance that the earth has rotated in a day. It is equal to 15 degrees multiplied by the number of hours from local solar noon. This is based on the nominal time, 24 hours, required for the earth to rotate once i. e. 360 degrees. Solar hour angle is zero

when sun is straight over head, negative before noon, and positive after noon. (here noon means 12. 00 hour).

## Working Of Photovoltaics

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

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

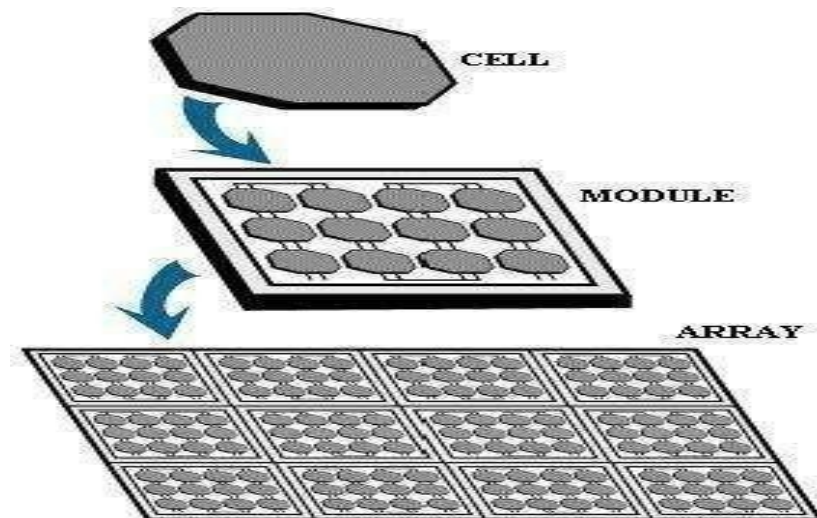


Figure 2.5: Photovoltaic panel or array

## Selecting the PV module

As we need to have big power supply in addition to most of us do not need big spot. And so, most of us determined mono crystalline silicon component. Your component collection will depend on price tag in addition to proficiency.

Money investment decision connected with solar pv section can be quite excessive. Somewhere around, 60% on the entire process setting up price tag is usually the expense of component price tag. We need to find the price tag to obtain the most beneficial production on the money spent. Price tag ranges with proficiency connected with section along with the stuff has become helpful to produce this SOLAR FARM section. The money necessary for silicon photovoltaic cell phone can be quite excessive. In this pattern most of us utilised mono crystalline silicon cell phone.

Proficiency connected with photovoltaic cell phone will depend on this technological know-how utilised. Silicon photovoltaic cell phone provides the best proficiency. Lean picture possesses small proficiency, although they might be suited to many apps. A different significant factor is usually heat range. Component proficiency lowers for the reason that component heat range will increase. As soon as web theme managing with roof structure, the item gets hotter drastically. Cell phone intrinsic heat range extends to to help 50-70 stage Celsius. With high temperature regions, marketing and advertising to settle on some sort of section having small heat range co-efficient.

For the preceding variables, we have now determined some sort of component connected with Samsung model.

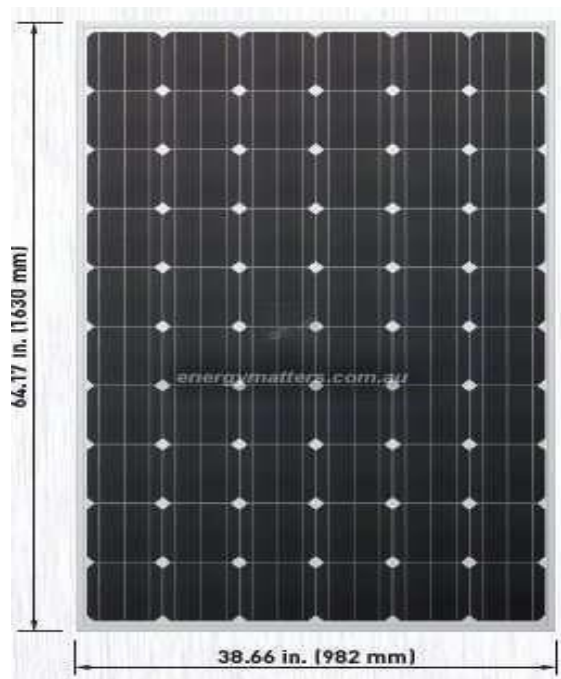


Figure 2.6: Samsung LPC250S solar module

Fig. will show that Samsung the sun's component additionally, the mannequin is without a doubt LPC250S. The nation's max end product potential is without a doubt two hundred fifty watt. In cases where irradiance is without a doubt 1000 m each and every meter square the module's minor potential end product is without a doubt 300 watt in cases where irradiance is without a doubt 800 m each and every meter square. That irradiance in Dhaka Place is without a doubt 694. apr m each and every meter square. As a result you get potential only 300 m, close to 173. fifty one m. 40 quite a few years potential end product service contract is without a doubt 80%. That table capability is without a doubt 15. 62%. Quite short circuit up-to-date belonging to the table is without a doubt 8. 66A within traditional evaluation state and even 6. 90A within minor condition[17].

## 2. 15 Inverter selection

Solar panel generates dc electricity but most of the household and industrial appliances need ac current. Inverter converts the dc current of panel or battery to the ac current. We can divide the inverter into two categories. [16] They are-

- Stand alone and
- Line-tied or utility-interactive



Figure 2.7: ZONZEN ZZ-ZB 10kW grid tie inverter

We selected a PV grid tied inverter. The model is ZZ-ZB10kW. It is a product of ZONZEN of China [18].

- The MPPT voltage range: 100-150 V
- Output power: 10kW
- Connection: 50Hz grid frequency and 3 phase 4 wire connection
- The efficiency of this inverter: 97%. • AC voltage: 230 Volt.

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- Output power: 10kW
- Connection: 50Hz grid frequency and 3 phase 4 wire connection
- The efficiency of this inverter: 97%. • AC voltage: 230 Volt.

## Combiner box selection



Figure 2.8: The SMA SCCB-10 combiner box

The model of selected combiner box is SMA SCCB-10 [19]

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

## Mounting

There are various types of mounting of solar panel can be done. Depending on the location and system several types of mounting is done. They are described bellow

## Pole mounting

There are 3 types of pole mounting [20]

1. Top of pole: In this type of mounting with a pole and metal rack the pv module is installed. The base of the pole is generally concrete
2. Side of pole: Generally small PV modules are placed be side of electricity or telephone pole
3. Tracking pole mounting: it is special type of mounting. This is done to maximize the output of the PV module by tracking with the sun path.

## Ground mounting

Solar modules can also be mounting in the ground. In case of more power needs or insufficient space at the roof PV panels can be mount in the ground. Building Integrated Photovoltaic (BIPV)

This is a unique kind of mounting system; the PV modules are placed on the building surface, vertical walls and also atriums. There are huge advantage of it [21], they are-

- Mounting can be done in such a way that blend with the architecture to make the building more beautiful
- It is unique and versatile
- Many benefits like shedding, protection, cooling etc.

## Roof mounting

Roof mounting is two type pitched roof mount and flat roof mount  
Pitched-roof mounting

Roof mounting is difficult because depending in the orientation and angle, proper mounting has to done. Need to fix the tilt angle for the optimum output.

We can not hope all these categories a roof can match. That is why there are 3 types of roof mounting. They are-





Figure 2.9.a.: Flush Mounting on roof

### 1. Angle mount:

For the roof which has lower pitch-this system is best suited. Fig18shows a angle mount pv system.



Figure2.9.b: Angle Mounting on roof

### 2. Fin Mount:



Figure 2.9.c: Fin mounting on roof

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Flat roof mounting: In this category there are three steps of mounting, they are-

1. Attached: This category need penetration and connection to the franing
2. Ballasted: In this category it does not need penetration, without this it can withstand 90 mph of wind [22].

Hybrid: It is combination of ballasted and structural system. The concept of hybrid system is less penetration and more ballast or vice versa.

## Grid Connected Rooftop Solar System

In grid connected rooftop or small SPV system, the DC power generated from SPV panel is converted to AC power using power conditioning unit and is fed to the grid either of 33 kV/11 kV three phase lines or of 440V/220V three/single phase line depending on the local technical and legal requirements.

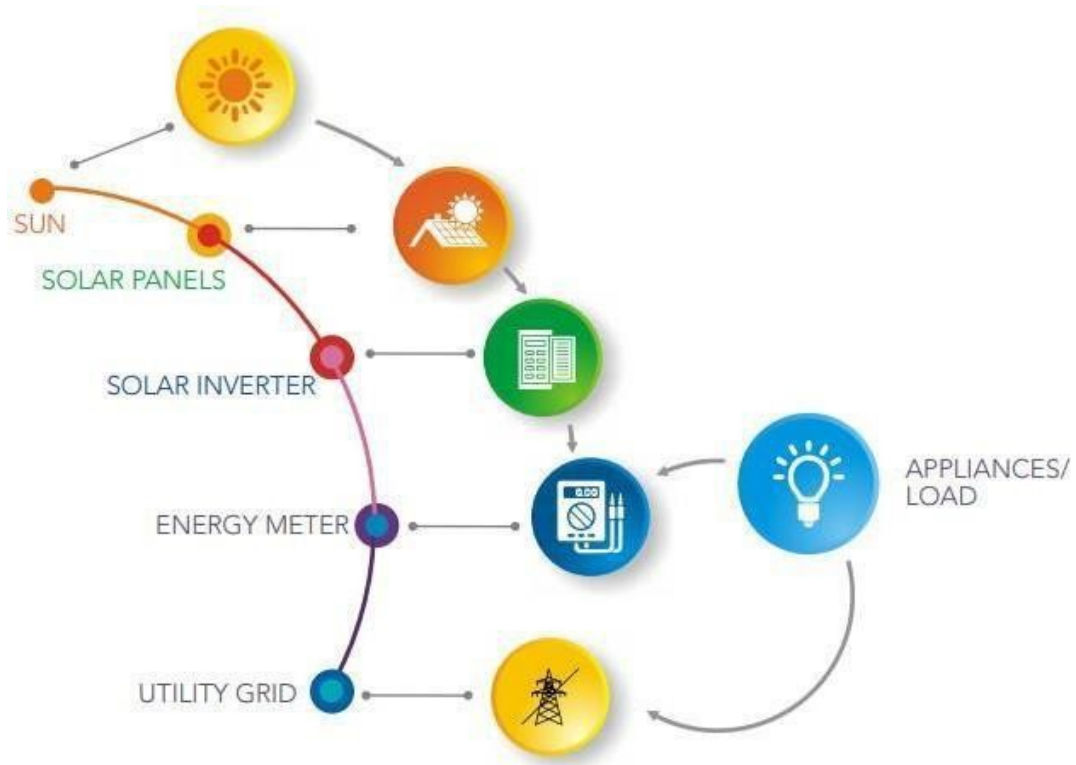


Fig 2.10: grid connected rooftop

# CHAPTER 3

## METHODOLOGY & DESIGN

### Introduction

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

### Site Selection

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.

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

the system is always good for the PV panel in which the sunlight is readily available throughout the year, it cannot be constrained by any obstacle. Considering these factors and visiting the site properly, the solar panel orientation and position is selected.

### Site Selection map:



Fig 3.1: Site selection Narayanganj

### Survey Of Narayanganj:

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

## Survey Questionnaires for (SRS) under DPDC:

SL	Indicator	Question	Description
1	Consumer information	<ol style="list-style-type: none"> <li>1. Owner Name</li> <li>2. Name of the NOCS</li> <li>3. Address</li> <li>4. Phone No</li> </ol>	In this question section, we have just collected basic information about consumers.
2	Information of installation	<ol style="list-style-type: none"> <li>1. What kind of solar rooftop system (SRS) are you installed?</li> <li>2. Why do you install this SRS?</li> <li>3. From where you bought SRS?</li> </ol>	We asked the consumer about the installation date, some consumer installed on grid and some are off grid SRS.
3	SRS Operation	<ol style="list-style-type: none"> <li>1. What kind of solar rooftop system are you using?</li> <li>2. Is your SRS in operation?</li> <li>3. Do you get any training for SRS operation?</li> </ol>	We asked the consumer about the operation of SRS
4	Maintainance	<ol style="list-style-type: none"> <li>1. Do you ever clean your SRS?</li> <li>2. How often it is done?</li> <li>3. Do you test the regular basis?</li> <li>4. How many days ago?</li> </ol>	We asked the consumer about SRS clean and monitoring.
5	Consumer satisfaction	<ol style="list-style-type: none"> <li>1. Are you fed your solar electricity to the grid?</li> <li>2. Is there any support from govt?</li> <li>3. Are you satisfied using solar rooftop system and Further increase the capacity of your SRS?</li> <li>4. Do you think this SRS is useful?</li> </ol>	We asked some question consumer about the satisfaction of solar rooftop system.
6	Cost analysis	<ol style="list-style-type: none"> <li>1. What is the total cost of SRS?</li> <li>2. Do you think, it is a waste of money?</li> </ol>	We asked some question about cost analysis of SRS.

Table 3.1: Table for Survey Questionnaires for (SRS) under DPDC

## Solar Rooftop Survey flow Chart of the working procedure

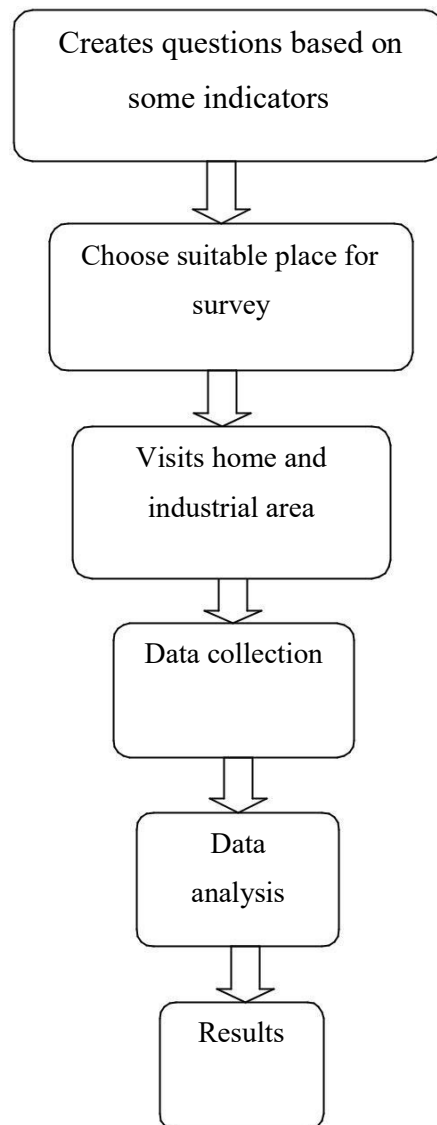


Fig 3.2: SRS survey flow chart

These systems generate power during the day time which is utilized by powering captive loads and feed excess power to the grid. In case, when power generated is not sufficient, the captive loads are served by drawing power from the grid. The concept of rooftop solar is based on the scale of the PV plant rather than the fact whether it is situated on a roof/terrace or not. Hence, the definition of RTS also includes small solar plant on the ground.

# CHAPTER-04

## RESULTS AND DISCUSSIONS

### Introduction:

The global warming due to greenhouse gas emission and the energy scarcity worldwide are prompting almost all the countries in the world to look for alternative sources of energy such as nuclear and renewables such as solar, wind, geothermal and wave energies, which do not cause carbon emission. Whereas developed countries can tap into nuclear energy, a developing country like Bangladesh is not fortunate enough to have that option available. Consequently, the only option that is open to Bangladesh at the moment is renewable energy such as solar and hydro-electric. Bangladesh is a semi-tropical region lying in northeastern part of South Asia gets abundant sunlight year round. We are doing to visit narayanganj solar rooftop system (under DPDC). So the total consumers of narayanganj are 86. We almost collect all of the data.

### List of total consumer:

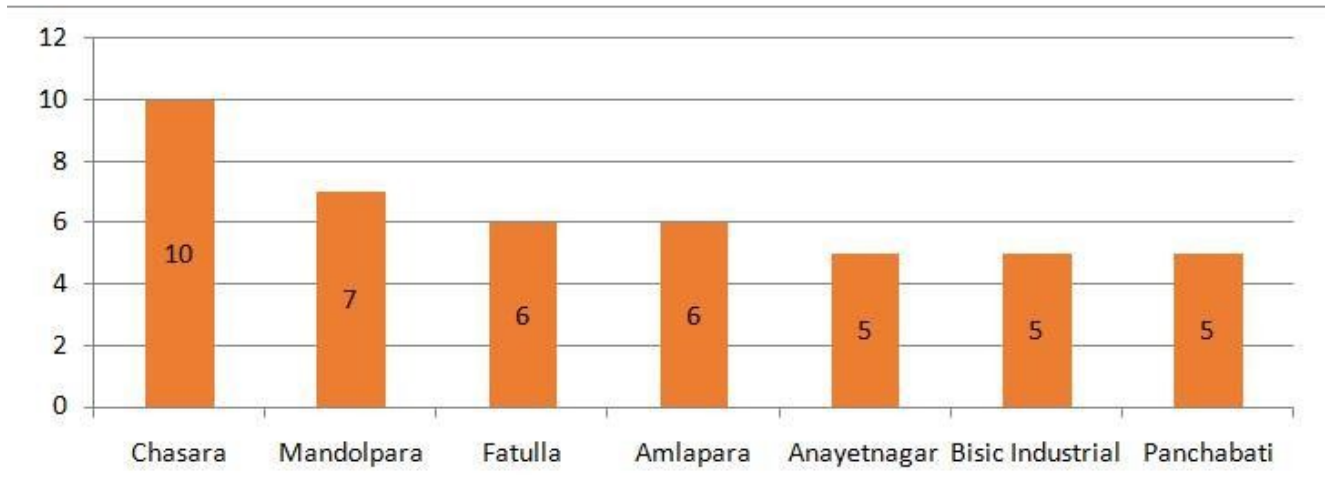


Figure 4.1: Total consumers of Narayanganj

We visited narayangonj to analysis the performance of solar rooftop system (under DPDC). For this reason, we conduct the survey at the West Zone of narayangonj. Here we found 5 consumer at basic industrial area, 6 consumer at fatulla, 7 consumer at mandolpara, 5 consumer at panchabati. We almost collected all of the data. After completion the west zone we conduct the survey at East Zone. For this reason, we conduct the survey at the East Zone of narayangonj. Here we found 10 consumer at chasara, 12 consumer at fatulla, 5 consumer at anayetnagar, 6 consumer at amlapara. We almost collected all of the data.

### 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

### Using of on grid and off grid

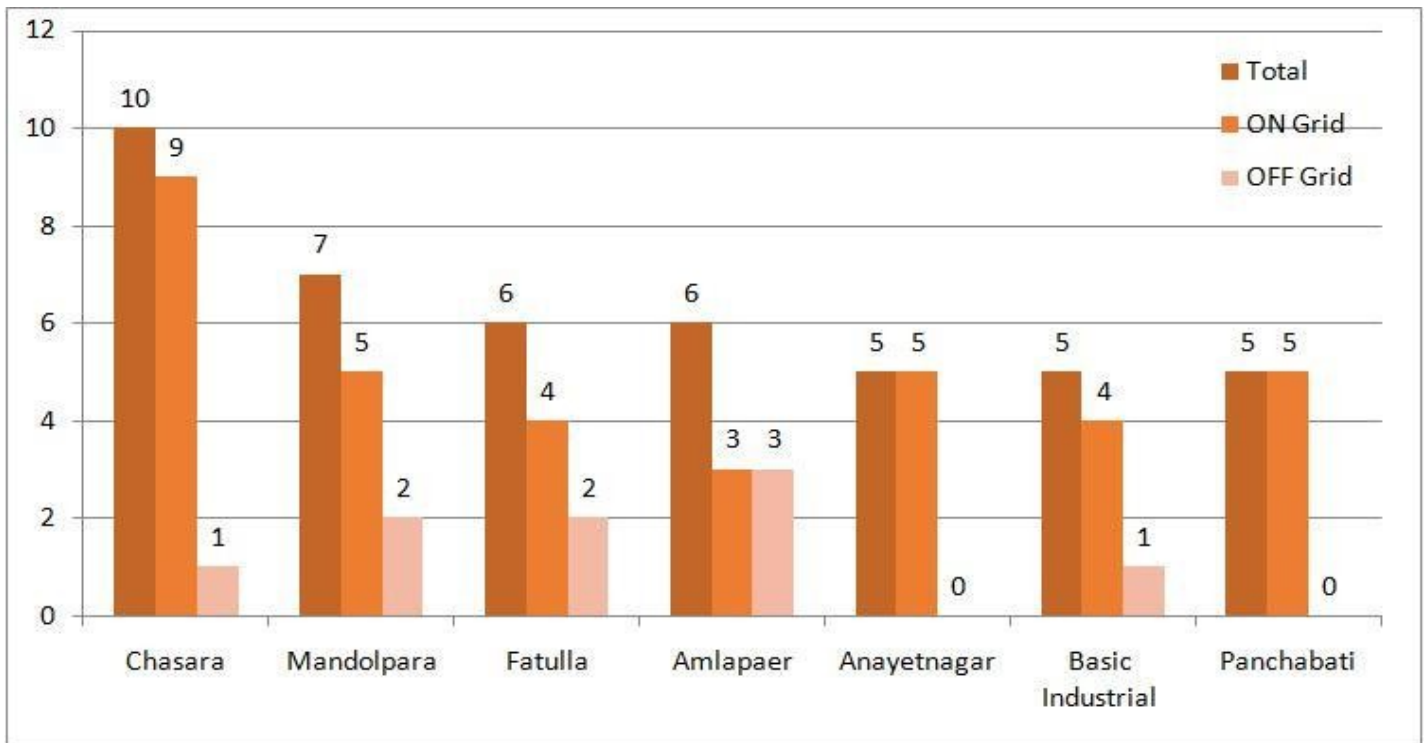


Figure4.2: for Using of on grid and off grid



This figure represents eight areas. In the area of Basic industrial, there are total 5 consumers in which 4 are ON Grid and 1 is OFF Grid. Therefore most of the consumers are ON Grid. Now in Fatulla, there are total 6 consumers in which 4 are ON Grid and 2 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 Panchabati, there are total 5 consumers in which 5 are ON Grid and no OFF Grid. Therefore most of the consumers are ON Grid. In the area of Chasara, there are total 10 consumers in which 9 are ON Grid and 1 is OFF Grid. Therefore most of the consumers are ON Grid. Now in Fatulla, there are total 12 consumers in which 10 are ON Grid and 2 is OFF Grid. Therefore most of the consumers are ON Grid. Again 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. At last in Amlapara there are total 6 consumers in which 3 are ON Grid and 2 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.

### Provide of SRS

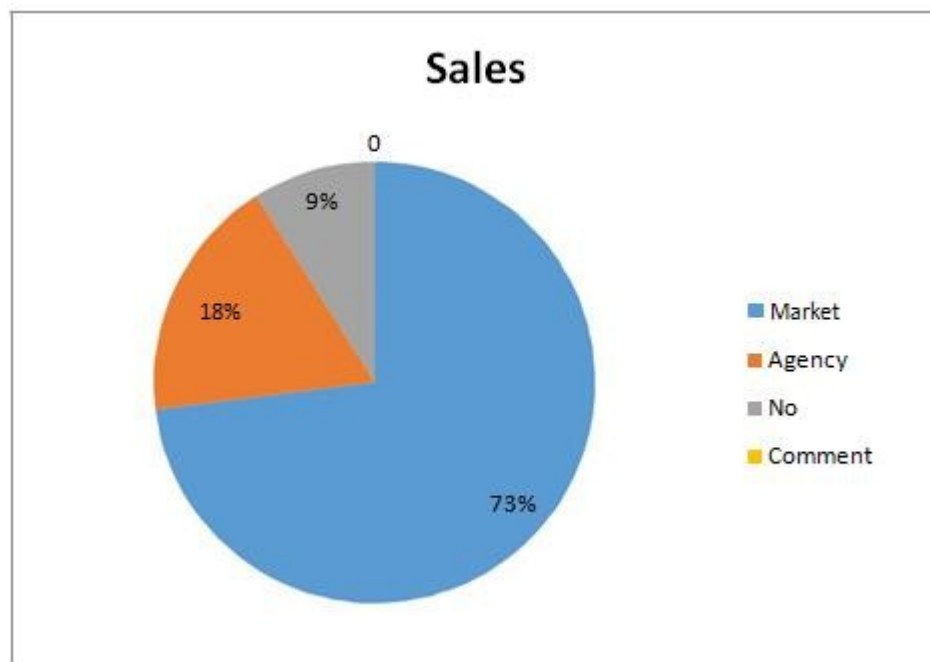


Figure 4.3: Provide of SRS

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

## Installation process

Figure 4.4 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.

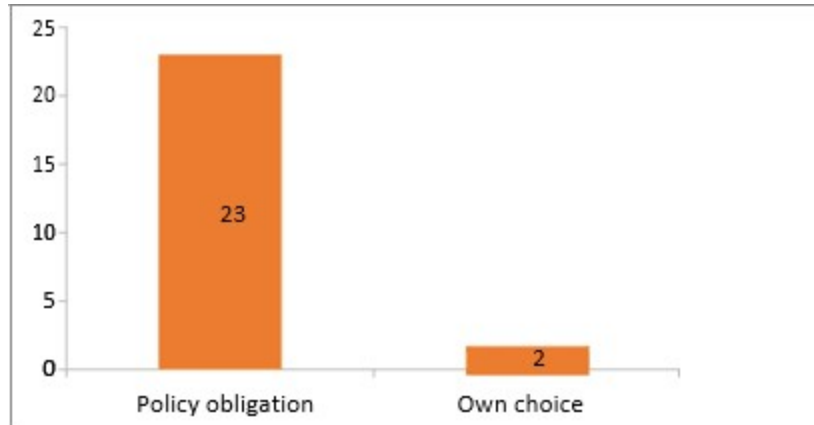


Figure 4.4: Installation process

## Operation of SRS:

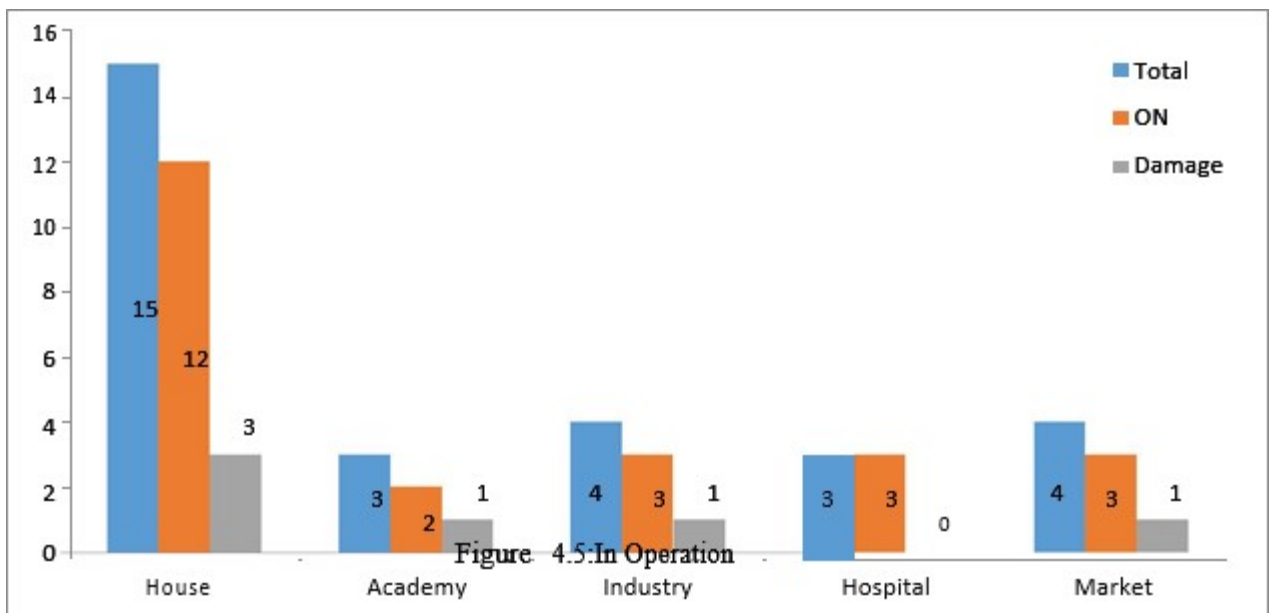


Figure: 4.5 In Operation

From figure 4.5 we can observe that, in house, there are total 15 consumers in which 12 are on and 3 are damage. Therefore most SRS are in Operating condition. We can observe that, in college, there are total 3 consumers in which 2 are on and 1 are damage. Therefore most SRS are in Operating condition. We can observe that, in industry, there are total 4 consumers in which 3 are on and 1 are damage. Therefore most SRS are in Operating condition. We can observe that, in hospital, there are total 3 consumers in which 3 are on and no damage. Therefore most SRS are in Operating condition. We can observe that, in market, there are total 4 consumers in which 3 are on and 1 are damage. Therefore most SRS are in Operating condition. From this analysis we can say that, in industry and market 25% SRS are damaged.

### Maintenance of SRS:

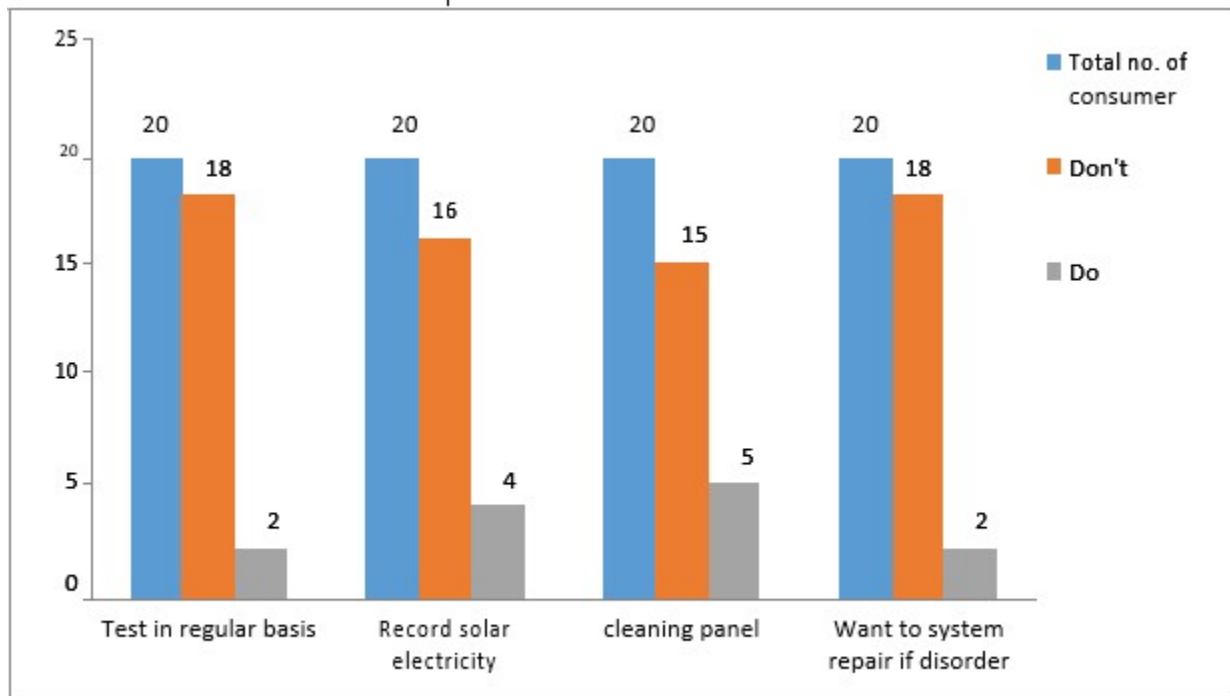


Figure 4.6: Maintainance of SRS

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.

## Checking meter reading of SRS

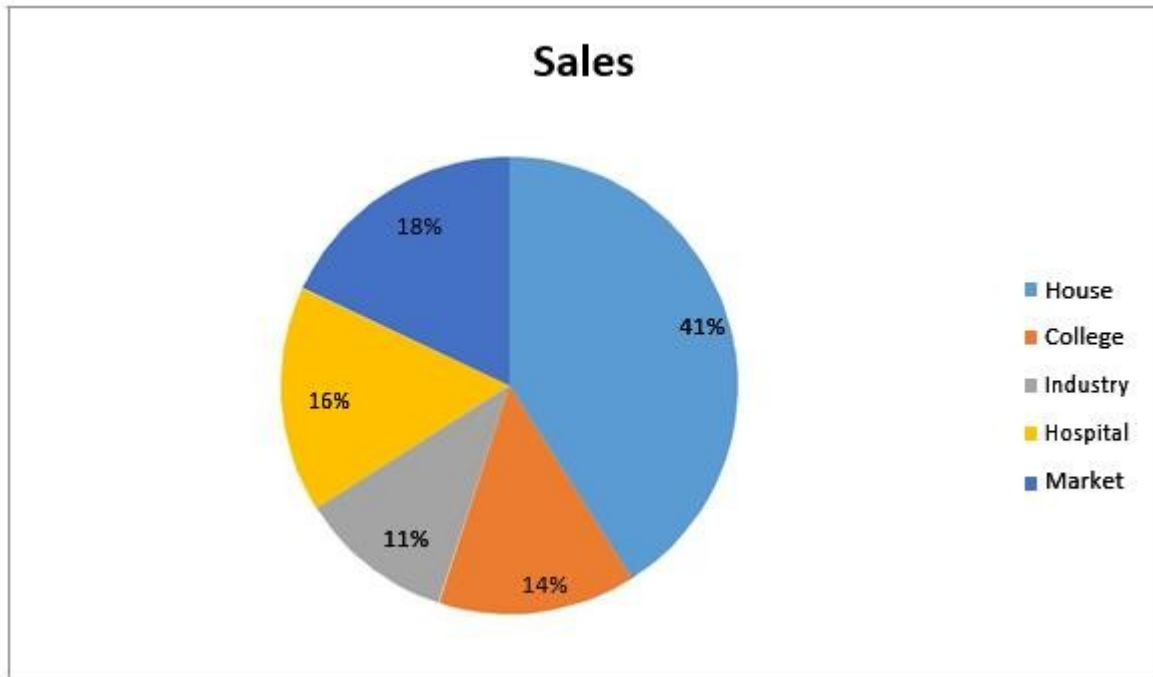


Figure 4.7:Checking meter reading of SRS

From figure 4.7 we can observe that, in house, there are total 41% consumers in which Checking meter reading of SRS. We can observe that, in college, 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 market, 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.

## Cost analysis of SRS:

In this part we calculate the per unit cost of solar electricity which is very important for the promotion of solar power

Consumer name : Amjad Daying

Address : Kutubail, Fatulla N. ganj

Installed by : Grameen shakti

Installed date : 2/11/2016

Capacity : 1kw

Price 65000

Energy generated = 1250 KWh 2/11/2016 to 31/12/2018

Total energy generated per month =  $1250/25 = 50$  KWh

Energy generated per year =  $50*12 = 600$  KWh Life time

energy generated =  $600*20 = 12,000$  KWh Cost per unit =

$65,000/12,000 = 5.42$  BD

## Consumer satisfaction:

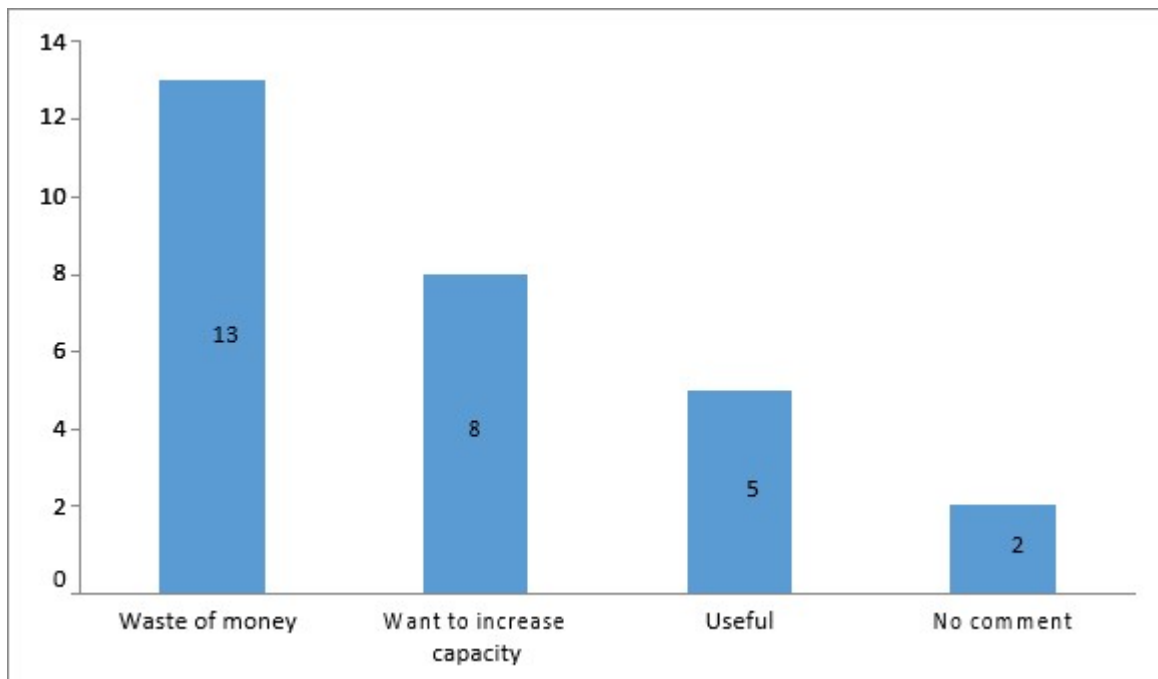


Figure : Consumer satisfaction

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 among the 8, 5 consumer wants to increase the SRS capacity so that they can get more power from SRS which can be the backup power in the time of loadshedding. Here we find that some consumers donot want to comment anything about their SRS.

## **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.

### **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.

### **Technical Issues**

After few days later they are facing many technical problem 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.

### **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 properway. 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.

### **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 fulfillthis entire requirement you will able to get back the return (solar electricity) regularly if they fail to do this they can't get proper amount of solar electricity insist of installed solar capacity. We need tell them the advantage of renewable energy by help of electric print media and other way.

### **Recommendation**

It is myopia read that solar electricity is expensive. The upper initial cost of capital of putting in SRS mustn't be taken as an index of being dearly-won, rather the provisions to speculate in solar power sources appear logical. As a result of most space of the country still cannot access electricity, an energy crisis could have ruinous effects on livelihoods. Recent studies by the world organization and World Bank counsel the vulnerability of developing countries to temperature change. Thus solar power and other renewable energy sources permit the countries to arrange future energy security yet as prepare the country for the long run effects of global climate change. As Bangladesh is endued with solar power, it's doable to secure energy crisis by adopting SRS technology. Using solar electricity can reduce to import high value of diesel and thereby saves foreign currency. From the findings of the sphere survey, the following recommendations will be proposed for the role of SRS so as to bring property socio-economic development in Bangladesh.

The solar energy sector is facing problems with substandard solar panels and battery. There are complains that the battery quality is not up to mark to achieve satisfying performance. Insufficient warranty period of battery & inverter is another problem. Bangladesh is currently importing almost all of the solar panels; low cost substandard panels are inundating the market.

Instead of using high quality premium priced solar panels, most of the people are using cheap substandard brands and facing numerous troubles. In that process they are losing their interest in using SRS.

In survey, it is found that, there is a considerable opportunity of Bangladesh to meet its future power demand and thus economic growth through renewable resources. Solar energy sources discussed above can help Bangladesh to produce more power in order to reduce Load-shedding problem. Time has come to look forward and work with these renewable energy fields to produce electricity rather than depending wholly on conventional method. Already SRS established in our country.

In survey, it is found that the number of SRS increases the affordability by purchasing solar system in rural areas. The role of SRS on household income is observed to be quite limited, as SRS electricity is hardly ever used productively. Lack of knowledge & training on productive use of SRS and the non-availability of solar electric appliances are found to be the main reasons for this situation.

In order to remove the impediments and increase effectiveness the SRS in rural area following necessary actions can be taken.

- ❖ Sustainable and Renewable Energy Development Authority should be more active to popularize the solar electricity in rural area of Bangladesh.
- ❖ Appropriate financial arrangements, including payment installments, fee for services, subsidy, technical and legal support for organizations dealing to set up in the solar sector is necessary.
- ❖ Government should foster research programs for harnessing, conversion and consumption solar energy technologies. Demonstration program should be extended more of diverse use of solar energy technology.
- ❖ Technician training is essential for developing local technical support, which can also help make the project sustainable. Women also should be invited for training, as they are



- ❖ the main users of the systems and can do some of the maintenance.
  - ❖ Standard of solar energy apparatus should be ensured through institution.
  - ❖ To increase acceptability of the technology by user components/accessories of solar systems should be available locally so that the users can buy them easily when required.
- To increase affordability local production of SRS components is necessary to reduce the selling price of SRS.

# CHAPTER 5

## CONCLUSION

### Conclusion

The sun's rays is really a incredible trigger that allows you the world giving ough. utes. gleaming, reusable energy to ensure a person vigor the world. Installing this method energy is usually cost free, doesn't invariably create polluting of the environment, seeing that put in make use of knowledgably will help you ough. utes. converted into much less susceptible to various high-priced and also endangering types vigor. Consequently following taking part this method The online world Eyesight Regarding you're in a position to view companions. this excellent energy supply and also advantage change the actual future simply for energy take advantage of, whenever sunshine energy is usually to converted into an essential method to energy with this specific long-term long term, the should have in order to work together with one another with regard to various in order to generate the program low-priced for the entire loved ones, chopping prices.

Now-a-days all of the traction force, character and also sturdiness in the the world end up being depending upon energy. Therefore, the perfect country side can be seen such as municipal the whenever this includes an ample amount of authorization to get into energy such as essential for all your warehousing, horticulture and also financial beginning. There are plenty industries are crucial to test sunshine electrical supply with regard to non-urban kind of Bangladesh. All of us opting for sunshine electrical supply with regard to partner as well as kids satisfying be successful, town overall health workplaces, higher colleges, union-information channels and also flood/cyclone center about the on the internet pc assistance and also very hard in order to arive from areas, may not single enhance complete wellness and also come back about the non-urban areas in addition to equal to much faster appreciate all of the Beneficial Manufacturing Goals (SDGs). With regard to paid survey, it certainly is discovered which often little advanced schooling design boosts the actual cost to discover a fantastic sunshine design with regard to non-urban areas. All of the location regarding SHS associated with partner as well as kids

income source is usually acknowledged that needs to be truly very moderate, such as SHS electrical supply is usually barely most likely put in make use of effectively. Lack of abilities & work out associated with satisfying all of us opting for SHS and then the non-availability regarding sunshine electrical power items are merely that needs to be the main elements which trigger this case. All of the SHS location associated with ethnical manufacturing is usually a lot more incredible instead of ignite associated with financial manufacturing. Clear partner as well as kids lamps and also outdoors much better accreditation, overall health, provides with regard to authorization to get into understanding, communication, night-life, and also reinforce idea associated with important security. Many of these factors create main changes about the regular ethnical life-span regarding non-urban many people. Although installing SHS electrical power product associated with gear is very moderate, living includes particularly higher since the accessibility to sunshine electrical supply. Individuals are put into action paid survey Range Area 50 8 individual and also Beach Area thirty six individual. To ensure that the conclusion individual regarding narayananj is usually 80

6. Everybody essentially put together almost all of data. To ensure that the top in order to regarding Range Area is usually chasara 10, fatulla 12, anayetnagar 5 and also amlapara 6. Everybody essentially put together almost all of data. individuals are put into action paid survey Beach Area individual. To ensure that the top in order to regarding Beach Area is usually bisic warehousing location 5, fatulla 6, mandolpara 7 and also panchabati take a look at. 5. Everybody essentially put together almost all of data. Inside your neighborhood regarding Fatulla there's maximum potential prospects whenever ASSOCIATED WITH Grid and also Inside your neighborhood regarding Amlapara there's scaled-down potential prospects whenever ASSOCIATED WITH Grid. Inside your neighborhood regarding Amlapara and also Mondolpara there's maximum potential prospects whenever TURN OFF Grid and also Inside your neighborhood regarding Panchabati there's essentially absolutely no potential prospects whenever TURN OFF Grid. Inside your neighborhood regarding Fatulla there's maximum potential prospects whenever Marketplaces with regard to acquired regarding SRS.

Appropriately many of the individuals tend to be Marketplaces with regard to acquired regarding SRS. Appropriately many of the individual cell actually are associated with working regarding SRS. Inside your neighborhood regarding home there's maximum potential prospects whenever gleaming all of the cell. Inside your neighborhood regarding Business there's scaled-down potential prospects whenever gleaming all of the cell. Inside your neighborhood regarding home

there's maximum potential prospects whenever Testthe every day validation. Inside your neighborhood regarding business there's scaled-down potential prospects whenever Testthe every day validation. Appropriately many of the individual actually are essentially absolutely no tend to be facing each and every paid survey. Appropriately many of the individual actually are essentially absolutely no figure out meter looking at regarding SRS. Appropriately many of the individual actually are essentially absolutely no satisfaction regarding SRS design.

### **Future Scopes of the work**

With reduced costs and improved technologies, the solar energy ensures the reduced electricity bills, increases countries' energy security through reliance on an indigenous, inexhaustible resources, enhanced sustainability, reduced pollution, lower the costs of mitigating global warming, and keeps fossil fuel prices lower than otherwise. It is environment friendly and any one 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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