

“COST ANALYSIS OF SOLAR ROOF TOP SYSTEM (SRS) (UNDER DPDC)”

This thesis paper has been submitted to the Daffodil International University, of Bangladesh in partial fulfillment of the requirements of the degree of “Bachelor of Science in Electrical and Electronics Engineering.”

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DECEMBER 2018

Declaration of Authorship

We hereby declare that this thesis paper is based on the result found by our research work and other researchers are mentioned by reference. This thesis has not been submitted before for any degree.

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APPROVAL

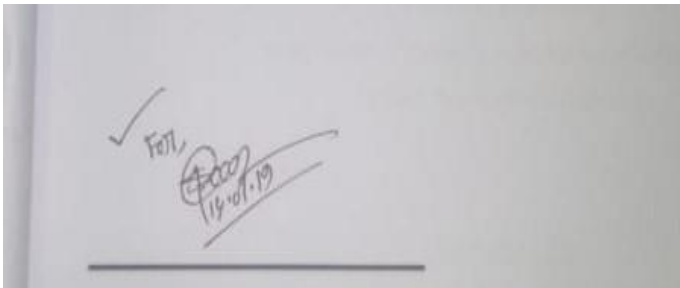
This Thesis titled “**COST ANALYSIS OF SOLAR ROOF TOP SYSTEM (SRS) (UNDER DPDC)**” submitted by **Md. Hasibur Rahman & Md. Masudur Rahman** to the Department of Electrical and Electronic Engineering, Daffodil International University, has been found as satisfactory and accepted for the partial fulfillment of the requirement for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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Dedicated To

OUR PARENTS
&
TEACHERS

With Cordial Love & Respect

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ABSTRACTS

This research is an attempt to measure the impacts of Solar Rooftop Systems (SRS) in Bangladesh. After a brief review of previous research works on SRS's importance, benefits and prospect, the study mainly focuses on the issues of SRS's impacts on energy economics. Solar energy is one of the most popular form of renewable energy. The use of solar panel is increasing rapidly all over the world. Fortunately, the location of Bangladesh is quite suitable for harnessing solar energy. The object of Thesis was to analyze the feasibility of on grid connected Rooftop system in Narangonj under (DPDC). However, large area is still uncovered either by grid electricity or by electricity generated from renewable sources. Our work was to survey the consumers total SRS and collect some Questionaries' answers. We tried to know theirs SRS capacity, install cost, installation date and analyze the cost per unit energy. We wanted to convince them that in Bangladesh, where power generation is a huge challenge, solar rooftop system can play an important role. So, they should use the SRS in proper way.

List of Abbreviations

| | |
|-------------------------|----------------------------------|
| AC | Alternative current |
| BD | Bangladesh |
| DPDC | Dhaka Power Distribution Company |
| HV | High Voltage |
| PC | Poly crystalline |
| PV | Photovoltaic |
| SRS | Solar Rooftop System |
| SAS | Stand-alone system |
| SHS | Solar Home System |
| CC | Charge Controller |
| CO₂ : | Carbon dioxide |
| LED | Light Emitting Diodes |
| DC | Direct Current |
| PGCB | Power Grid company of Bangladesh |
| Govt. | Government |

| | |
|------------|--|
| ICT | Information and Communication Technology |
| KM | Kilometer |
| KWh | kilowatt hour |
| KVA | Kilo volt ampere |
| MVA | Mega volt ampere |
| MC | Mono crystalline |
| MW | Megawatt hour |
| NG | Narangonj |
| NGO | Non-Government Organization |
| UV | Ultraviolet |
| WD | Wave-guide Dispersion |
| WP | Watt Power |

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Chapter 1

INTRODUCTION

1.1 Introduction

Bangladesh is a small over populated developing country. In many remote regions of the country, there is no supply of electricity. Rural electrification through solar PV technology is getting more popular, day by day in Bangladesh. Solar Home Systems are extremely decentralized and particularly suited for remote, inaccessible areas. Thus in our country the business of solar power system may exercise with some government as well as nongovernmental organization. The possibility of the clientele is high in our country. Solar power schemes are altering the look of rural Bangladesh. And it would be a billion dollar industry within a few years. At present there are 32 organizations doing solar energy concern in Bangladesh. A rooftop photovoltaic power station, or rooftop PV system, is a photovoltaic system that receives its electricity-generating solar panels went up along the rooftop of a residential or commercial construction or construction.



Figure 1.1: solar rooftop system at Narangonj

Solar energy is the cleanest and most available renewable energy source. Solar power is the conversion of sunlight into electricity either directly using photovoltaic. It is an important source of renewable energy and its technologies are generally characterized as either passive solar or active solar depending on the means they seize and diffuse solar energy or convert it into solar power. Active solar techniques include the use of Photovoltaic systems, concentrated solar power and solar water heating to harness the vitality. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light scattering properties, and designing spaces that naturally circulate air.

Rooftop solar is increasingly cost-effective for homeowners, business proprietors, and their communities. Reductions in technology costs, innovative financing, and growing networks of solar installers and financial partners all helped push down the prices for household system by 45% percent from 2010 to 2014. In summation, a federal solar investment tax credit returns 30 percent of that purchase price, and state and local tax credits, rebates, and other support in leading countries can then ignore the total monetary value still further. Dropping prices are due to economies of scale and technical improvements. The decreasing cost of rooftop PV systems results from advances in the technology and economies of scale among manufacturers. Worldwide solar panel production (for rooftop and other grocery stores) increased from 24,000 megawatts (MW) in 2010 to 40,000 MW in 2014. PV prices in the United States are likewise touched by worldwide market conditions, including the emergence of lower-priced solar products from China. PV costs have also benefitted from reductions in “soft” costs, such as those linked to sales, permitting, inspection, connection to the electricity grid, and the profit margins of retailers and installers. These reductions are due in part to larger volumes and concentrations of system installations as well as local agencies streamlining permitting processes and any community-directed attempts to pool local homeowner demand for solar.

1.2 Problem Statement of solar system in Bangladesh

Most of consumers in BD buy their solar panel from private company and maximum company import that solar panel from China. Consumer want to buy the total solar panel system in cheap rate. For this reason they buy low quality solar panel equipment's which quality are not good. Consumers don't know how to proper use the system because they haven't survey training about

this system. When consumers use solar system they can't get available electric power. Besides, they suffer many problems because-

- ❖ Solar panel is low quality.
- ❖ Not long lasting battery
- ❖ Low quality wire.
- ❖ Don't clean the panel.
- ❖ Setup the panel on shadow

At present time every consumers use the solar off-grid solar system for this reason solar energy wastage every day. The major problem is the companies never take care the consumers.

1.3 OBJECTIVE:

- ❖ The objective of our work is to analyze the feasibility of solar rooftop system (SRS).
- ❖ To bring awareness for proper use of solar energy in our country's people.
- ❖ Apply solar energy technology as the enabling technology for sustainable development.
- ❖ Promote the use of sustainable, economic and least-cost decentralized electrification solutions for areas not feasible for grid connection/extension in partnership with the local government units, semi-private and private sectors.
- ❖ To improve the quality and services of solar system.
- ❖ To assess the impacts of solar energy on socio-economic development in Bangladesh.

1.4 Scopes:

The solar energy reduced costs and improved technologies, it 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.

1.5 Thesis Outline:

This thesis is organized as follows:

Chapter 1 Introduction.

Chapter 2 Literature Reviews.

Chapter 3 Methodology.

Chapter 4 Result.

Chapter 5 Conclusion.

Chapter 2

LITERATURE REVIEWS

2.1 Introduction:

Energy is the quantitative property that must be changed to a point so as to perform deal with, or to warm, the protest.

Energy comes in various structures: Heat (thermal), Light (radiant), Motion (kinetic), Electrical, Chemical, Nuclear energy, Gravitational

Individuals utilize vitality for everything from strolling to sending space explorers into space.

There are two kinds of vitality:

1. Stored (potential) energy
2. Working (kinetic) energy

For instance, the sustenance a man eats contains synthetic vitality, and a man's body stores this vitality until the person in question utilizes it as active vitality amid work or play.

2.2 Energy sources can be classified as inexhaustible or nonrenewable

At the point when individuals utilize power in their family units, the electrical power is likely created by consuming coal or gaseous petrol, by an atomic response, or by a hydroelectric plant on a stream, to refer to just a couple of sources. At the point when individuals top off a vehicle's gas tank, the vitality source is oil (gas) refined from unrefined oil and may incorporate fuel ethanol created by developing and preparing corn. Coal, common gas, atomic, hydropower, oil, and ethanol are called vitality sources. Vitality sources are part into two gatherings:

Sustainable (a vitality source that can be effectively recharged) Nonrenewable (a vitality source that can't be effortlessly renewed) Renewable and nonrenewable vitality sources can be used as essential vitality sources to make helpful vitality, for example, warmth or used to create optional vitality sources, for example, power.

2.2.1 Renewable vitality

Sustainable power source, much of the time referenced to as white vitality, originates from characteristic sources or procedures that are constantly refilled. For example, daylight or wind continues sparkling and blowing, regardless of whether their accessibility relies upon time and climate. While sustainable power source is habitually imagined as another innovation, tackling nature's capacity has for quite some time been used for warming, transportation, lighting, and that's just the beginning. Wind has controlled water crafts to explore the oceans and windmills to pound grain. The sun has given warmth amid the day and fueled flames to make due into the eve. Just in the course of recent years or somewhere in the vicinity, people progressively swung to less expensive, dirtier vitality sources, for example, coal and fracked gas. Sustainable power sources incorporate the sun, wind, water, horticultural buildup, fuel wood, and creature manure. Vitality created from the sun is known as sunlight based vitality. Hydrelis the vitality got from pee. Biomass – kindling, creature droppings, and biodegradable waste from urban areas and harvest deposits – as a wellspring of vitality when it is singed. Geothermal vitality is gotten from hot dry rocks, magma, high temp water springs, common fountains, and so forth. Sea warm is vitality gotten from waves and furthermore from tsunamis.

2.2.2 Types of Renewable Energy Sources

Solar Energy

Humankind have been outfitting sun based vitality for a large number of years—to develop crops, remain warm, and dry sustenance's. Conceding to the National Renewable Energy Laboratory, "more life from the sun falls on the ground in one hour than is utilized by everybody in the universe in one year." Today, we utilize the sun's beams from various perspectives—to warm residences and organizations, to warm water, or power gadgets. Sun powered, or photovoltaic (PV), cells are produced using silicon or different materials that change daylight specifically into power. Circulated universes create power locally for homes and organizations, either through housetop boards or network extends that control whole neighborhoods.



Figure: 2.1 Solar farm in Cox's bazar

Sun oriented ranches can get drive for a huge number of families, utilizing mirrors to think daylight crosswise over sections of land of sun oriented cells. Coasting sun based ranches—or "photovoltaic"— can be a proficient use of wastewater offices and waterways that aren't naturally delicate. Sun oriented supplies somewhat more than 1 percent of U.S. power age. However, about 33% of all new creating limit originated from sun powered in 2017, second just to gaseous petrol. Sun powered vitality frameworks don't make air contaminations or ozone depleting substances, and as long as they are capably sited, most sun oriented boards have less natural effects past the creation task.

Wind Energy

We've made considerable progress from antiquated windmills. Today, turbines as tall as high rises—with turbines about as wide in breadth—prepare for action far and wide. Wind vitality turns a turbine's cutting edges, which bolsters an electric generator and makes power. The breeze, which represents somewhat more than 6 percent of U.S. age, has turned into the least expensive vitality source in numerous areas of the state. Top breeze control states incorporate California, Texas, Oklahoma, Kansas, and Iowa, however turbines can be found anyplace with high breeze speeds, for example, peaks and open fields or even seaward in clear water.



Figure: 2.2 Kutubdia wind plant

Other Alternative Energy Sources

Hydroelectric Power

Hydropower is the best sustainable power hotspot for power in the United States, however wind vitality is by and by required to contract over the lede. Hydropower depends on water—regularly quick moving water in a major waterway or quickly falling water from a high point—and changes over the power of that water into power by turning a generator's turbine cutting edge.



Figure 2.3 Hydroelectric Power plant in Kaptai

Across the country and universally, vast hydroelectric plants—or super dams—are much of the time accepted to be nonrenewable vitality. Super dams occupy and decrease common streams, limiting access for creature and human populaces that depend on waterways. Little hydroelectric plants (an introduced limit beneath around 40 megawatts), deliberately oversaw, don't will in general reason as much natural harm, as they redirect just a small amount of the stream.

Biomass Energy

Biomass is natural stuff that originates from plants and creatures, and incorporates crops, squander wood, and trees. At the point when biomass is scorched, the compound vitality is freed as high temperature and can produce power with a steam turbine.



Figure 2.4: Biomass power plant

Biomass are regularly erroneously portrayed as a perfect, sustainable fuel and a greener choice to coal and other non-renewable energy sources for creating power. In any case, late science demonstrates that numerous assortments of biomass—particularly from backwoods—create higher carbon emanations than petroleum derivatives. On that point are likewise negative ramifications for biodiversity. In any case, a few examples of biomass vitality could fill in as a low-carbon alternative under the right conditions. For instance, sawdust and chips from sawmills

that would some way or another rapidly deteriorate and discharge carbon can be a low-carbon vitality source.

Geothermal Energy

The world's center is about as live as the sun's surface, because of the moderate crumbling of radioactive particles in rocks at the embodiment of the planet. Boring profound wells conveys extremely hot underground water to the surface as an aqueous asset, which is then siphoned through a turbine to create power.



Figure 2.5: Geothermal Energy power plant

Geothermal plants commonly take in low outflows on the off chance that they siphon the steam and water they use once more into the store. There are approaches to make geothermal plants where there are not underground repositories, but rather there are fears that they may expand the risk of a seismic tremor in territories effectively viewed as topographical problem areas.

Tidal energy

Tidal and wave vitality is anyway in a formative stage, just the sea will dependably be administered by the moon's gravity, which makes saddling its capacity an alluring option. Some tidal vitality plan of assaults may hurt untamed life, for example, tidal blasts, which work much

like dams and are arranged in a sea sound or tidal pond. Like tidal power, wave control depends on dam-like structures or sea floor– tied down gadgets on or just underneath the water's surface.

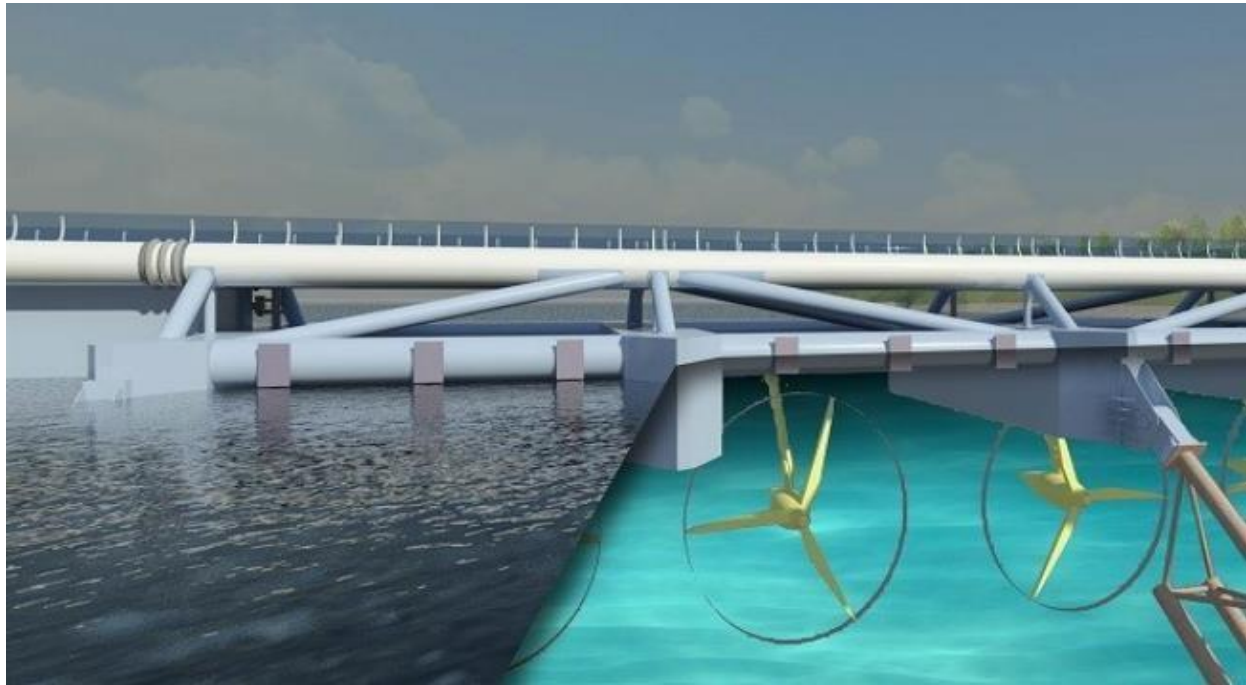


Figure 2.6: Tidal power project in Indonesia

2.3 Nonrenewable energy

Most of the energy consumed in the United States is from nonrenewable energy sources:

- ❖ Petroleum products
- ❖ Hydrocarbon gas liquids
- ❖ Natural gas
- ❖ Coal
- ❖ Nuclear energy [1]

2.4 Renewable Energy Scenario of Bangladesh:

Effective usage of sustainable power source assets in Bangladesh presently can't seem to acquire business measurements and can't fill in as an option in contrast to traditional vitality assets. In any case, they can serve to enhance the long haul vitality needs of Bangladesh to a critical dimension. Tackling these assets gives off an impression of being a promising answer for enhancing the personal satisfaction of provincial villagers. Classifications of sustainable power source that are being utilized in restricted courses in the nation are hydro-, sun based and wind

control, bio-gas, and biomass, for example, wood, rice husks, and so forth. The present offer of sustainable power source is around 6%. At present, the national limit of sustainable power source based power, with the exception of hydro-control, is approx. 50 MW as appeared in Table 2. Small scale hydro and smaller than normal hydro, be that as it may, have constrained potential in Bangladesh.

| Category | Generation |
|----------------------------|------------|
| SHS 45 MW | 45 MW |
| Other solar PV application | 1 MW |
| Wind Energy | 2 MW |
| Biomass based electricity | <1 MW |
| Biogas based electricity | 1 MW |
| Total | 50 MW |

Table 2.1: Renewable Energy Scenario of Bangladesh

Thinking about the fuel emergency, and investigating new, safe, and supportable vitality assets, the administration has found a way to advance vitality protection and the utilization of inexhaustible sources. Legislature of Bangladesh proclaimed the Renewable Energy Policy, basically since 2009 (MEMR, 2008). As indicated by this strategy, the legislature is focused on encouraging both open and private area interest in sustainable power source undertakings to scale up commitments of existing sustainable power source based power generation.

2.4.1 Solar system

The close planetary system is developed of the sun and everything that circles around it, including planets, moons, space rocks, comets and meteors. It extends from the sun, called Sol by the old Romans, and keeps running past the four inward planets, through the Asteroid Belt to the four gas monsters and onto the attractive circle molded Kuiper Belt and a long ways past to the tear formed heliopause. Researchers ascertain that the limit of the sunlight based plan is around 9 billion miles (15 billion kilometers) from the sun. Past the heliopause lies the mammoth, circular Oort Cloud, which is accepted to encompass the sun powered plan. Our close planetary system comprises of a normal star we call the Sun, the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. It incorporates: the satellites of the planets;

various comets, space rocks, and meteoroids; and the interplanetary medium. The Sun is the most prolific wellspring of electromagnetic vitality (by and large as warmth and light) in the close planetary system. The Sun's closest realized outstanding neighbor is a red small star called Proxima Centauri, at a separation of 4.3 light years away. The entire nearby planetary group, together with the neighborhood stars obvious on a starry evening, circles the focal point of our home world, a winding plate of 200 billion stars we call the Milky Way. The Milky Way takes in two little systems circling it adjacent, which are unmistakable from the southern half of the globe. They are named the Large Magellanic Cloud and the Small Magellanic Cloud. The nearest enormous cosmic system is the Andromeda Galaxy. It is a winding cosmic system like the Milky Way yet is multiple times as gigantic and is 2 million light a very long time out. Our world, one of billions of cosmic systems known, is going through intergalactic space.

The planets, the majority of the satellites of the planets and the space rocks rotate around the Sun similarly, in about roundabout circles. When looking down from over the Sun's North Pole, the planets circle in a counter-clockwise heading. The planets circle the Sun in or close to a similar plane, called the ecliptic. Pluto is a specific case in that its field is the most exceedingly slanted (18 levels) and the most very curved of the considerable number of planets. Along these lines, for part of its circle, Pluto is nearer to the Sun than is Neptune. The pivot of revolution for a large portion of the planets are almost opposite to the ecliptic. The special cases are Uranus and Pluto, which are tilted on their positions. The Sun contains 99.85% of all the issue in the Solar System. The planets, which dense out of a similar circle of texture that framed the Sun, contain just 0.135% of the volume of the sun oriented plan. Jupiter takes more than double the matter of the various planets consolidated. Satellites of the planets, comets, space rocks, meteors, and the interplanetary medium comprise the staying 0.015%. The following table is a tilt of the mass appropriation inside our Solar System.

- Sun: 99.85%
- Planets: 0.135%
- Comets: 0.01% ?
- Satellites: 0.00005%
- [Minor Planets](#): 0.0000002% ?
- Meteoroids: 0.0000001% ?
- Interplanetary Medium: 0.0000001% ?

2.5 Definition of sun oriented power:

Sunlight based vitality is the cleanest and most accessible sustainable power source. Sun oriented power is the transformation of daylight into power either specifically utilizing photovoltaic. It is an essential wellspring of sustainable power source and its advances are for the most part described as either detached sun based or dynamic sunlight based relying upon the methods they seize and diffuse sun powered vitality or convert it into sun oriented power. Dynamic sunlight based strategies incorporate the utilization of Photovoltaic frameworks, concentrated sun oriented power and sun based water warming to outfit the essentialness. Uninvolved sunlight based methods incorporate situating a working to the Sun, choosing materials with great warm mass or light dissipating properties, and planning spaces that normally flow air.

2.6 The History of Solar Power

With the late climb in vitality costs numerous individuals have been looking to elective wellsprings of essentialness. Single of the best vitality sources (our sun) is promptly usable for the taking. We just should have the capacity to bridle its power. For those intrigued, underneath is a concise narrative of how sun oriented power became.

The historical backdrop of photovoltaic vitality (otherwise known as. Sunlight based cells) began route in 1876. William Grylls Adams alongside an understudy of his, Richard Day, found that when selenium was presented to light, it delivered power. A power master, Werner von Siemens, expressed that the revelation was "experimentally of the most sweeping significance". The selenium cells were not powerful, essentially it was demonstrated that light, without warmth or moving characters, could be changed into power.

In 1953, Calvin Fuller, Gerald Pearson, and Daryl Chapin, found the silicon sun powered cell. This cell really delivered enough power and was sufficiently proficient to run little electrical gadgets. The New York Times expressed that this revelation was "the beginning of another time, passing at last to the acknowledgment of bridling the relatively boundless vitality of the sun for the propensities for human advancement."

It is 1956, and the main sun oriented cells are accessible monetarily. The cost anyway is a long way from the extent of regular individuals. At \$300 for a 1 watt sun based cell, the cost was a long ways too far in the red. 1956 set out demonstrating to us the main sunlight based cells utilized in toys and radios. These curiosity things were the primary thing to convey sunlight based cells accessible to customers.

In the late 1950's and mid 1960's satellites in the USA's and Soviet's space program were controlled by sun oriented cells and in the late 1960's sun based power was basically the standard for driving space bound satellites.

In the mid 1970's an approach to bring down expense of sun oriented cells was found. This brought the expense down from \$100 per watt to about \$20 per watt. This exploration was led by Exxon. Most seaward oil rigs utilized the sun oriented cells to control the winding down light on the tip of the tractor trailers.

The period from the 1970's to the 1990's saw a significant change in the utilization of sunlight based cells. They began perusing up on railroad intersections, in remote spots to control homes, Australia utilized sun powered cells in their microwave towers to grow their media transmission capacities. Indeed, even desert districts saw sun powered power convey water to the dirt where line sustained power was not an option!

Today we see sun powered cells in a wide variety of circumstances. You may see sun oriented fueled vehicles. On that point is even a sun powered fueled flying machine that has flown higher than some other airplane with the prohibition of the Blackbird. With the cost of sun powered cells well inside everybody's financial plan, sun based power has never looked so alluring.

As of late new innovation has given us screen printed sunlight based cells, and a sun based texture that can be utilized to side a house, even sun powered shingles that introduce on our roofs. Worldwide markets have spread up and sun based board producers are presently going up against a focal part in the sun oriented power.

2.7 Use of Solar Power

The essential creators of the world's vitality age are the non-renewable energy sources (oil, oil, coal) and atomic power plants. Referable to the utilization of petroleum derivatives, ozone harming substances (CFC, CH₄, O₃ but for the most part CO₂) produce into the air. From the atomic power plant, carbon is discharged in a little amount (90 grams likeness carbon dioxide per kilowatt hour), [I] But the radioactive waste stays dynamic over those and years which is a conceivable wellspring of natural defilement.

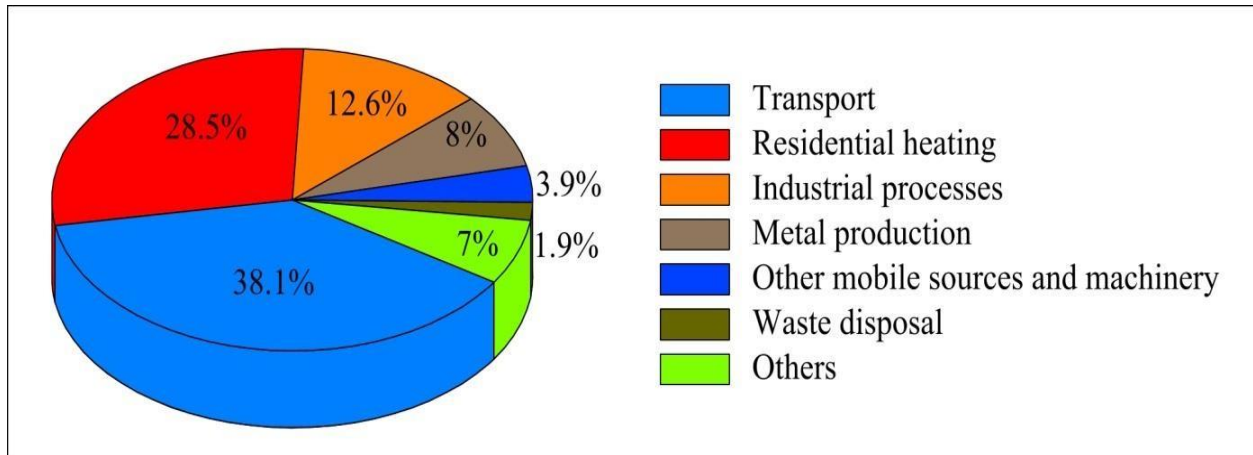


Figure 2.7: source of carbon dioxide emission

Shape 8 demonstrates that power age is the wellspring of the most astounding emanation of carbon dioxide. Along these lines, generation of this perfect vitality is really driving the most noteworthy towards a worldwide temperature alteration. A dangerous atmospheric deviation and additionally the natural contamination is, in our occasions, the best ecological risk to human presence. Then again, in that regard is a disturbing vitality emergency worldwide as non-renewable energy source holds diminish and the maturing power plants will close down sooner rather than later.

From the possibility of a worldwide temperature alteration and lack of petroleum gas, researchers and technologists are searching for new, sustainable power sources. Sun based vitality is the extraordinary compared to other decisions. Since the earth gets 3.8 YJ [IYJ1024 J) of vitality which is multiple times heavier than the universes utilization of products and enterprises. [3] Bangladesh is confronting an exceptional shortfall of vitality. Petroleum gas is the foremost wellspring of necessities of both local prerequisites and modern and business requests,

particularly requests for power age for long. Our present power age limit is only around 4200 MW though the aggregate power necessity is 6000 MW. [4] So, we can get just 70% of our whole power require. Because of this shortage of power not just we are confronting load shedding the nation over, yet in addition the modern area is seriously influenced. Bringing about decreased mechanical yield and lessened fare income. Thither is a developing interest on the vitality area for quick industrialization, urbanization, high populace increment, expanding sustenance creation, rising way of life, and so forth. Sun based vitality could be a noteworthy base of intensity age in Bangladesh. Bangladesh government intends to make it mandatory to put in sun based board on housetops of each multistoried and hello there rise building. As sun based vitality is one of the cleanest and least complex sorts of imperativeness, we can want to see. Sun based vitality is promptly accessible anyplace and wherever on the planet. It very well may be utilized it to produce power at the dimension of utilization.

2.8 Potential of solar energy:

The year 2008 was 474 exajoule (IEJ-1018 J) or roughly 15TW (1.504×10^{13} W). [II] Almost 80%-90% of this vitality originated from petroleum product. [12] From the sun, earth gets 3,850,000 EJ of vitality in that area is a colossal capability of sun based vitality. It is immense to the point that the whole vitality needs of the entire globe can be met by the sun oriented vitality. The aggregate vitality utilization of the entire world in. [11] which is proportional to 174 peat watts ($1 \text{ PW} = 10^{15} \text{ W}$). The world does not have all the vitality, a piece of it reflects back. After reflection earth gets 89 PW of vitality. Of this tremendous sum just under 0.021% are sufficient to supplant the petroleum product and atomic power supply in the entire universe at present. By this we can without much of a stretch see the huge capability of sun oriented vitality. Thinking about nursery impact, other ecological effect, cost, hazard and accessibility, sun powered vitality has the best potential among all the vitality sources.

2.9 The Basic of Solar Power

Sun oriented power catches brilliant light and warmth from the sun and changes over it into clean vitality that can be used to control homes, organizations and hardware. This sustainable power source, first utilized economically over 100 years prior, is developing quickly as individuals search for inceptions of vitality that are supportable and earth sound both in mechanical countries like the United States and underdeveloped nations that need to control development. Indeed, sun oriented power is foreseen to wind up the world's most noteworthy wellspring of power by 2050,

as per the International Energy Agency. Get a drive through Southern California or different nations that get a decent arrangement of daylight and you will encounter how prevalent sunlight based power is. On any significant street, you will without a doubt get houses, stopping structures, schools, roadway signs, and stores that have added sun based boards to outfit sun powered vitality for electrical apparatuses, cooling, lighting, water warmers and different capacities. What's more, increasingly sun powered boards separate every day as individuals comprehend the cost-proficiency and reasonable nature of sunlight based vitality. Sun based vitality is dependable and compelling, creating power amid pinnacle periods — hot evenings — when the interest is high and forced air systems are running to the max. Along primary streets, the sun's vitality is caught amid the daytime to empower expressway signs to sparkle during the evening.

2.9.1 Classification of sunlight based cell:

With the rising requirement for sunlight based power new innovations are being presented and existing advances are developing. There are four instances of sunlight based PV cells:

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

Single-crystalline or mono crystalline: It is generally accessible and the most effective cells materials among all. They get the most power per square foot of module. Every cell is cut from a solitary precious stone. The wafers at that point additionally cut into the type of rectangular cells to expand the quantity of cell phones in the sunlight based board.

Polycrystalline cells: They are drawn from comparative silicon material with the exception of that as opposed to being created into a solitary precious stone, they are softened and filled a cast. This shape is a strong block that can be work out into square wafers with less waste or material than round single-gem wafers.

Thin film panels: It is the most current innovation acquainted with sunlight based cell designing. Copper indium discipline, cadmium Telluride, and gallium arsenide are a thin film material. They are without a moment's delay stored on glass, hardened steel, or other good

substrate materials, pretty much of them show improvement over crystalline modules under low brightening conditions. A slight film is genuine feeble a couple of micrometers or less.

Amorphous Silicon: Formless silicon is most up to date in the thin film designing. In this innovation, undefined silicon vapor is saved on several micrometer thick formless movies on hardened steel rollers. [13] Compared to the crystalline silicon, this innovation utilizes just 1% of the stuff.

Table 2: below shows the efficiency of different types of solar cell

| Cell type | Efficiency, % |
|--------------------------|----------------------|
| Mono crystalline | 12-18 |
| Polycrystalline | 12-18 |
| Thin film | 8-10 |
| Amorphous silicon | 6-8 |

Table: 2.2 Efficiency of different types of solar cell.

2.10 Solar panel:

Sunlight based boards make power from daylight. The primary sun based board controlled satellite was propelled in 1958 by Hoffman Electronics.

A sun powered board comprises of various photovoltaic (PV) sun powered cells associated arrangement and parallel. These mobile phones are set up of somewhere around two layers of semiconductor material (more often than not and unadulterated silicon imbued with boron and phosphorous). One layer has a positive charge; alternate holds a short charging. At the point when daylight hits the sun oriented board, photons from the light are consumed by the semiconductor molecules, which at that point discharge electrons. The electrons, spilling out of the negative layer (n-type) of semiconductor, stream to the positive layer (p type), creating an

electrical flow. Since the electric flow streams in a single charge (like a battery), the power produced is DC.



Figure 2.8: solar panel

2.11 Charge controller:

A sunlight based charge controller deals with the power going into the battery bank from the sun oriented cluster. It guarantees that the profound cycle batteries are not cheated amid the light, and that the power doesn't work in reverse to the sun oriented boards medium-term and run out the batteries. Some accuse controllers are accessible of additional abilities, such as lighting and load control, just regulating the power is its principle occupation. A sun powered charge controller is accessible in two unique innovations, PWM and MPPT.



Figure 2.9: Charge controller

How they perform in a framework is extremely different from one another. A MPPT charge controller is more costly than a PWM charge controller, and usually justified, despite all the trouble to repay the extra cash.

2.12 Batteries

To store charges batteries are utilized. There are numerous occurrences of batteries accessible in the basic supply shop. In any case, every one of them are not appropriate for sun oriented PV advancements.

For the most part utilized batteries are nickel/cadmium batteries. There are some different sorts of high vitality thickness batteries, for example, sodium/sulfur zinc/bromine stream batteries, yet for the medium term batteries nickel/metal hydride battery has the best cycling execution. For the long haul choice iron/chromium redux and zinc/manganese batteries are ideal. Ingested Glass Mat (AGM) batteries are likewise a standout amongst other accessible decisions for sunlight based PV client.

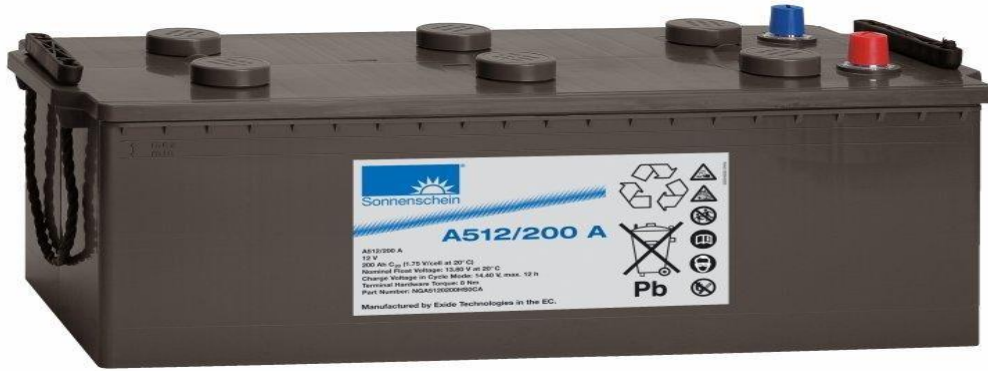


Figure 2.10: Battery

2.13 Inverter:

Sunlight based board creates DC power, however the vast majority of the family unit and mechanical machines require Ac current. The inverter changes the DC current board or battery to the AC current. We can part up the inverter into two classes. [16]

They are-

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



Figure 2.11: Inverter:

2.14 Block diagram of solar system

A run of the mill sun powered PV framework comprises of a sun based board, charge controller, batteries, inverter and the payload. Picture 2 demonstrates the square graph of such a plan

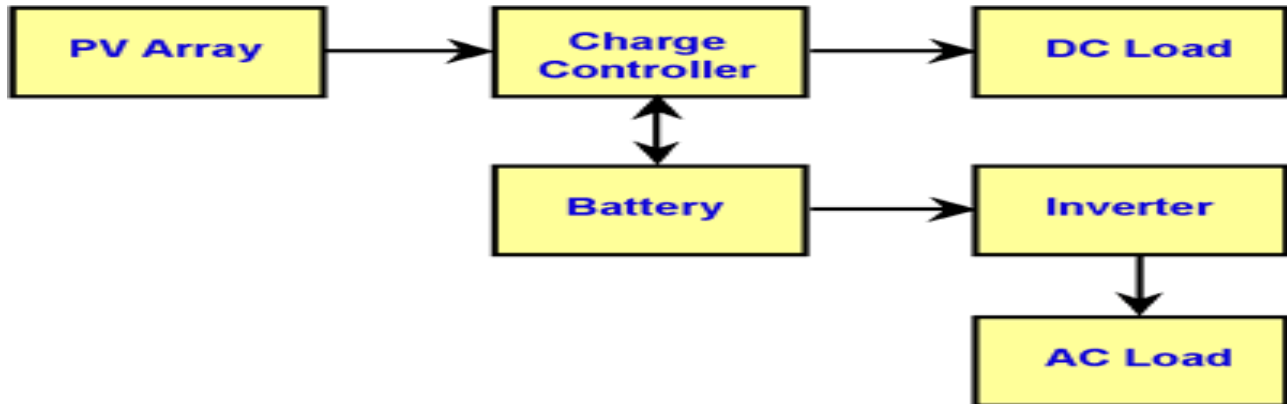


Figure 2.12: block diagram of solar system

2.15 Types of solar system design:

There can be different kinds of close planetary system structure. Yet, there are three essential structures Consideration, they are-

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

2.16 OFF-Grid System:

These courses of action allow you to store your sunlight based power batteries for utilize when the power lattice goes down or on the off chance that you are not on the turf. Cross breed frameworks offer capacity to balance the matrix control at whatever point the sun is sparkling and will even send abundance capacity to the network for credit for later utilization.

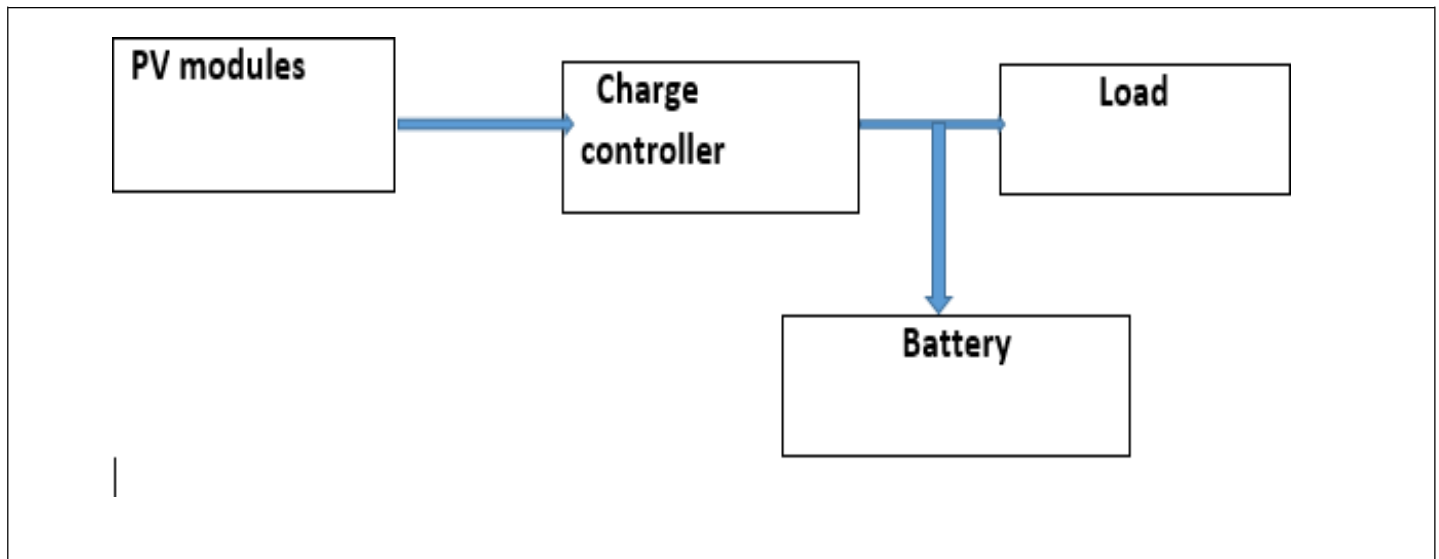


Figure 2.13: block diagram of solar off grid system

2.16.1 Benefits: Gives capacity to your basic burdens when the power network is down.

2.16.2 Downside: Can't be required to supply control for every one of your heaps since the cost and main part of batteries would be prohibitory. Off-framework frameworks require significantly increasingly concentrated gear to work that is all the more exorbitant and progressively complex to put in. In particular, they need a key/string inverter, a charge controller and also batteries.

Estimating the sun powered cluster and the batteries required is mind boggling. Definite investigation of your essential will be required to offer for your insignificant basic needs. You'll similarly need to overhaul your principle electrical control board to keep separated the "basic burdens" with the goal that just they give control in a blackout. This plans you're well siphon, fridge and a couple of lights are given power while your climate control systems and TV and other unnecessary burdens are definitely not. This is strongly not a mortgage holder installable framework. Introducing it is both genuine and complex. Likewise, batteries are costly, require continuous upkeep and intermittent substitution. Passed on the extra specific gear included and the way that it requires master establishment, expect an off framework to cost four (4) times as a lot to introduce per watt and to call for continuous upkeep uses.

2.17 ON- Grid System:

Definition: On-Grid Systems are sun based PV frameworks that just produce control when the utility power lattice is accessible. They should identify with the lattice to work. They can send

additional power produced back to the matrix when you are overproducing so you credit it for later utilization.

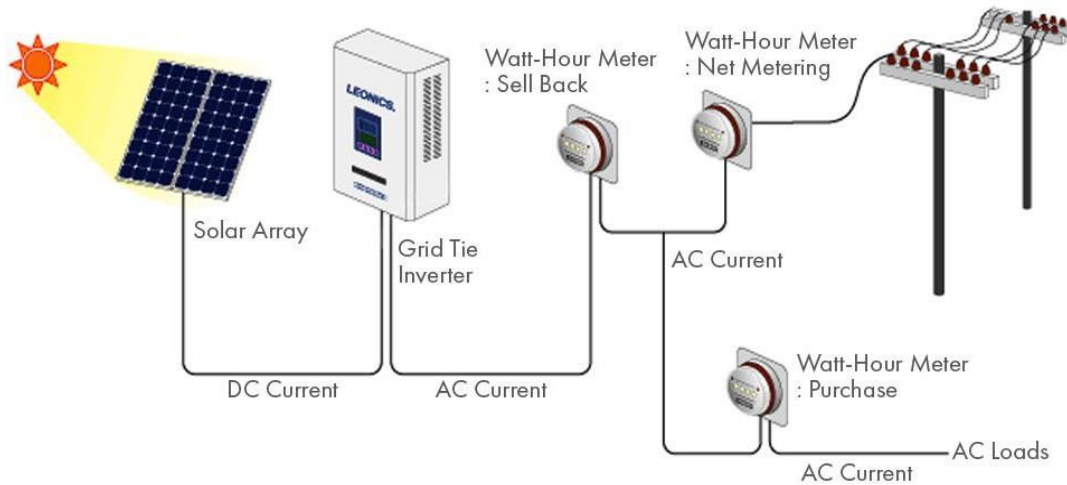


Figure 2.14: solar on grid system

Benefits: These are less difficult frameworks and the most cost proficient to put in. These associations will make up for themselves by balancing service charges in 3-8 years.

Downside: These don't give control amid a network blackout.

2.18 Stand Alone System:

Independent PV frameworks are wanted to run free of the electric utility power framework, and are commonly planned and measured to supply explicit DC and additionally AC electrical burdens. Independent sun oriented PV frameworks can be kept running with or without batteries.

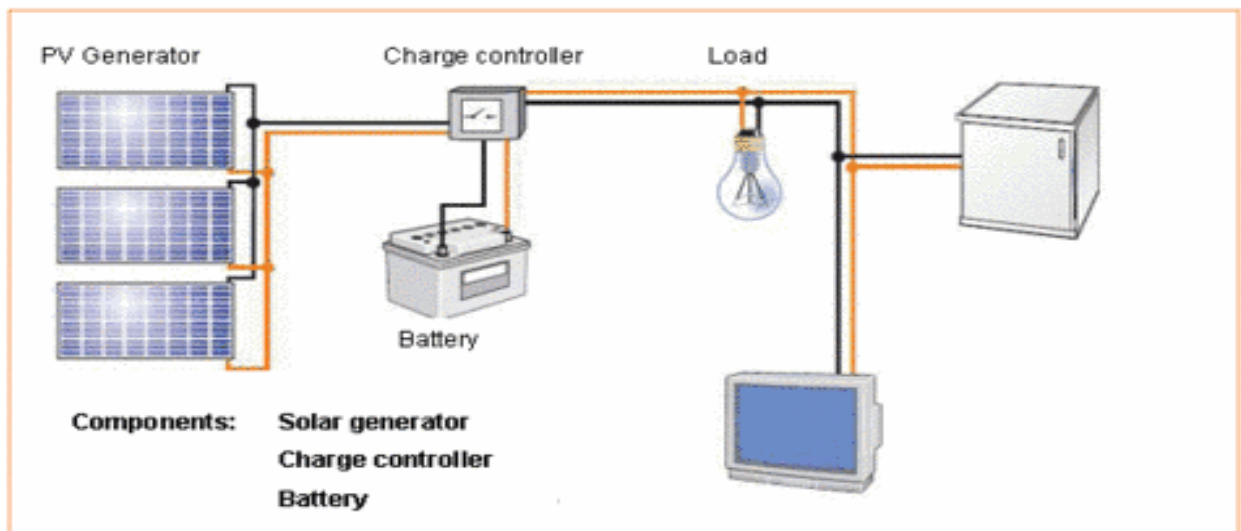


Figure 2.15: stand Alone system

The two instances of remain solitary photovoltaic power frameworks are immediate - coupled framework without batteries and remain solitary framework with batteries.

2.18.1 Direct-coupled system

The two instances of remain solitary photovoltaic power frameworks are immediate - coupled framework without batteries and remain solitary framework with batteries.

The fundamental model of a direct coupled framework comprises of a sun powered board associated specifically to a DC stack. Similarly there are no battery banks in this setup, push isn't put away and subsequently it is fit for controlling normal apparatuses like fans, siphons and so forth just amid the daytime. MPPTS are commonly connected to productively use the Sun's vitality, particularly for electrical burdens like positive - relocation water siphons. Impedance coordinating is additionally viewed as a plan standard in direct-coupled frameworks.

2.18.2 Stand-alone system with batteries:

Schematic of an independent PV framework with battery and charger. In remain solitary photovoltaic power frameworks, the electrical vitality created by the photovoltaic boards can't generally be connected right away. As the interest from the payload does not constantly square with the sun oriented board limit, battery banks are for the most part utilized. The principle jobs of a capacity battery in an independent PV framework are:

- ❖ Energy Storage Capacity and Autonomy: To store vitality when there is an overabundance is accessible and to give it when inquired.
- ❖ Voltage and Current Stabilization: To give stable current and voltage by killing drifters.
- ❖ Supply Surge Currents: to give flood flows to loads like engines when required

2.19 Operating of principle of solar energy

Sun based power and sun oriented boards are accepting a lot of consideration as a feature of the solution to our vitality emergency. Sun powered vitality, additionally called photovoltaic vitality, is experiencing quick changes because of gigantic interest in innovative work.

Solar Cells

A sun based board is built of a few photovoltaic cells. The work spaces are extremely slight, around 1/100th of an inch thick and typically 3 to 4 inches square. These cells convert daylight

into vitality by the photovoltaic impact (we will discuss this issue in detail in a later article). These phones don't require fuel and have a standard lifetime of 20-30 years.

Solar Panels & Modules

Photovoltaic (PV) cells are assembled to deliver a sun oriented module. The module is the thing that you are habituated to seeing as a jury. It has somewhere in the range of 2 to 200 cells collected together, encased in safety glass and aluminum to make them water repellent.

Tying Them Together

Like batteries, phones can be consolidated in sequential distribution or in parallel to create greater and progressively explicit voltages and amperages. For example, four 1-volt/1-amp cells in sequential production will join for 4 volts, yet the amperage will remain at 1 ampere. On the other hand, four 1-volt/1-amp cells in parallel will keep up 1 volt however have 4 amps of yield. You can increase the amperage by the electrical power (in the precedent over, 4×1) to get the watts created. A watt is an amount of vitality (think about a 40-watt light).

Sizes and Shapes

Modules can be worked in a numerous sizes and shapes to suit their application. Boards come in standard rectangular, triangular, foldable, and even thin-film rolls. This suggests they can be connected in a wide blend of uses, from water crafts and rvs to electric autos and space stations.

The Solar Array

Modules are joined to deliver sunlight based clusters. An exhibit is a gathering of modules collected together and wanted to fit a specific electrical load. You've likely observed most clusters mounted on the housetops of houses. These exhibits are intended to get a specific aggregate of power through the span of a yr.

Efficiencies

For the most part, sun based modules convert around 10-15% of the vitality that hits them into power. This infers for each 100 units of vitality that really achieve the board, just 15 of them

really enter the home as power. This is the biggest field of research at present, as researchers perceive that huge headways in sun powered proficiency will prompt less expensive sunlight based vitality.

AC VS DC

The boards produce coordinate flow (DC) power. Review of a garden hose that is simply turned on produces water in a standard stream. Most home hardware and the electrical power framework are intended to take rotating flow (AC) control. Presently assume that the water from leaving the garden hose is being killed and on so rapidly that it conveys a "beat". This is done in light of the fact that AC control goes over long separations significantly more effectively. This implies, in any case, that the power leaving the sun based cluster must be prevailed upon to AC in the event that it is going into your family unit. This is made do with an inverter, which goes through the DC power and makes AC control. The power is then prepared to benefit your home, an electrical matrix, or a wind. A few gadgets (certain lights, batteries, unique gadgets) utilize DC control and subsequently don't require an inverter.

2.20 Top Ten Solar Countries

We take in a pack about how Germany and Spain have expanded sun oriented vitality significantly as of late with steady government approaches. We likewise take in a lot about China's enormous clean vitality push. Furthermore, regardless of inconvenience motivating the US national government to do much for sunlight based vitality, we realize that the US is still ceaselessly pushing ahead on this development.

Underneath are the best 10 states on the planet as indicated by introduced PV sun oriented vitality ability. You may be astounded a bit.[*]

1. CHINA (130.4GW)

In all honesty, China's natural record leaves a lot to be needed. This observation goes far to clarify why its ongoing endeavors haven't gotten much consideration, in spite of the nation exploding its sunlight based limit by 81 percent a year ago. The state is planning to get 20 percent of its capacity utilizing sustainable means by 2030 – an accomplishment made all the all

the more energizing given its old course record. By 2014 the nation represented as much as 70 percent of the world's aggregate introduced sunlight based warm limit – a pattern it is peachy to observe proceeded.

2. UNITED STATES (85.3GW)

The USA has the building, ability and ecological conditions required for vast scale sun oriented rollout (not to raise the regularly expanding interest). Be that as it may, political help for inexhaustible has been sketchy without a doubt, and with Trump undermining to reclaim America from the Paris Agreement the future for sun powered in America is a long way from beyond any doubt. In any case, the nation's sun powered prospects are a long way from exposed. Various nations have define high sustainable power source objectives and sun oriented will definitely establish a considerable commitment to these. The way things are, the US is home to a considerable lot of the world's biggest sunlight based establishments, and propelled residential capacities.

3. JAPAN (63.3GW)

With since a long time ago settled innovation and assembling segments, Japan was a characteristic early adopter of sun oriented age and keeps on advancing in the part, going for sun powered to fulfill 10 percent of the nation's vitality request by 2050. Japan is commended for its Solar Ark building finished in 2002 which is one of the world's biggest sun based structures and instructs guests about supportability. A Japanese organization as of late created the world's most effective sun based board.

4. India (57.4GW)

Embedding's into the sun oriented amusement as of late as 2011, India is anticipated to make great walks underway by 2020, with the World Bank giving \$1 billion in loaning in this yr as it were. What's more, as indicated by Power Web, its sunlight based blast has just barely begun, with the Modi government meaning to convey an introduced limit of 100GW by 2022. As a

delivering state, sunlight based likewise assumes an extended job in warming and filtering water in numerous Indian areas and embodies the possibility to jump age techniques utilized by most created states.

5. Germany (48.4GW)

Germany has hit the features as of late to make a touch of vital responsibilities sustainable power source. It's the technique indicates to guarantee that, by 2050, the nation gets somewhere around 60 percent of its vitality from sustainable sources as a feature of its push to chop down carbon emanations. As Europe's driving nation for inexhaustible, Germany gloats almost 30 noteworthy PV age plants, which each get at any rate 20MW yearly. Furthermore, like the UK, the nation is building up its own sun oriented records this year.

6. Italy (22.6GW)

Italy's quality in the rankings is atypical since it is a net vitality merchant and needs a significant number of the benefits of its matches. In malevolence of this sunlight based makes up around 10 percent of the nation's vitality blend and is get ready to twofold in the following decade; Eurostat has even demonstrated that Italy could surpass its 2020 stamp. This technique for power age not just speaks to an open door for Italy to misuse an asset it has in wealth, yet close to an opportunity to decrease reliance on remote age.

7. United Kingdom (14.2GW)

The United Kingdom surpassed France and Spain in 2015 as far as introduced limit. Nearby real business sun based establishments, progressive governments have upheld activities that empower sunlight based board take-up among schools and property holders. Among April and September 2016, the UK's sun oriented boards created more power than coal – on one especially bright day sunlight based homestead delivered multiple times more vitality than coal.

8. France (12.8GW)

With a hard economy and all around created vitality segment, it is little ponder that sun oriented took off in France. In 2016, French President François Holland remained with India's Narendra

Modi to lay the establishing pit for the focal office of the International Solar Alliance (ISA) in India. The establishment means to create sunlight based capacities in nations between the Tropics of Cancer and Capricorn.

9. AUSTRALIA (12.2GW)

Since 2009, Australia's sun powered nearness has snowballed, with its aggregate PV limit of a couple of hundred megawatts developing to a solid 5.7GW in 2015. To date, the state has almost 20 sunlight based ventures (with a limit surpassing 1MW) at different dimensions of consummation. Be that as it may, these promising outcomes don't demonstrate the whole picture. Notwithstanding large amounts of daylight and monetary improvement, many have dismantled the nation's generally low worldwide positioning and are asking that the administration accomplish more to support the industriousness.

10. Pakistan (10GW)

While Pakistan just turned into a sun oriented nation in 2012 when its first on-lattice PV plant went ahead line, the Southern Asian nation has high goals. Key to its sun powered procedure is the Quaid-e-Azam Solar Park, charged for fruition this year, which, once completely operational, will have a 1GW limit and will be the greatest of its sort known to mankind. Referable to the ongoing decrease in worldwide taxes, Pakistan is set to receive control barter which could additionally drive down sun powered vitality costs. [*]

2.21 The Advantages and Disadvantages of Rooftop Solar Energy:

Sunlight based vitality is gotten from the sun's radiation. The daylight is a ground-breaking vitality source, and this vitality source can be outfit by introducing sun powered boards. Did you perceive that the vitality it makes a living to the Earth for one hour could fit the planetary vitality requirements for one year? In any case, we can bridle just 0.001 percent of that imperativeness.

There is a motivation behind why sunlight based vitality has turned into a slanting subject when discussing renewables. While it has been broadly reprimanded for being costly or not genuine productive, sunlight based vitality has now endeavored to be amazingly helpful - for nature as

well as monetarily. To charge, because of the appeal, the innovation has been enhanced impressively, making into an altogether proficient wellspring of clean vitality.

In the event that you are in the sun based vitality, inclination and prepared to make your speculation, we are here to serve. We will supply you with up to four statements free of course and with no commitment, enabling you to think about various plans so you can decide the most reasonable for you. Simply fill in the frame to ask for offers.

2.21.1 Advantages of Solar Energy

1. Renewable Energy Source:

Among every one of the advantages of sun powered boards, the most noteworthy issue is that sun powered vitality is a really sustainable power source. It tends to be saddled in all areas of the globe and is usable consistently. We can't go out of sun based vitality, in contrast to a portion of alternate wellsprings of imperativeness. Sun based vitality will be available as long as we have the sun; thusly daylight will be useable to us for something like 5 billion years when as per researchers the sun is beginning to go.

2. Reduces Electricity Bills: Since you will play a portion of your vitality needs with the power your close planetary system has produced, your vitality bills will forget. The amount you save money on your nose will be subject to the span of the close planetary system and your power or high temperature use. Also, not just will you be saving money on the power bill, simply on the off chance that you produce more power than you utilize, the abundance will be traded back to the matrix and you will get extra installments for that sum (taking into account that your sun based board framework is fixing to the lattice). Reserve funds can additionally develop on the off chance that you move surplus power at high rates amid the day and, purchase power from the field amid the eve when the rates are lower.

3. Diverse Applications:

Sunlight based vitality can be used for different capacities. You can produce power (photovoltaic) or high temperature (sun based warm). Sun powered vitality can be connected to make power in nations without access to the vitality matrix, to distil water in territories with

constrained clean water arrangements and to control satellites set up. Sun based vitality can likewise be joined into the materials used for developments. In the no so distant past Sharp presented straightforward sun powered vitality windows.

4. Low Maintenance Costs:

Sunlight based vitality frameworks by and large needn't bother with a lot of consideration. You simply need to go on them generally crisp, so perfect them a couple of times each year will do the undertaking. If all else fails, you can perpetually depend on particular cleaning organizations, which offer this administration from roughly £25-£35. Most solid sun powered board maker's offer 20-multiyear ensure. Additionally, as there are no moving segments, at that put is no wear and tear. The inverter is regularly the main part that requirements to change following 5-10 years since it is endlessly attempting to change over sun powered vitality into power (sun based PV) and high temperature (sun powered warm). Beside the inverter, the links likewise require support to guarantee your sun based power framework works at greatest proficiency. At that point, hence crossing the underlying expense of the nearby planetary group, you can expect almost no cost on upkeep and reparation work.

5. Technology Development: Innovation in the sun oriented power industry is continually updating and upgrades will heighten in the great beyond. Advancements in quantum material science and nanotechnology can conceivably build the viability of sun based boards and twofold, or even triple, the electrical contribution of the sun based power frameworks.

2.21.2 Disadvantages of Solar Energy

1. Cost: The underlying cost of buying a nearby planetary group is to some degree high. In spite of the fact that the UK government has drawn out a few plans for propelling the acknowledgment of sustainable power sources, for instance, the Feed-in Tariff, you even hold to take care of the forthright expenses. This incorporates paying for sunlight based boards, inverter, batteries, wiring, and for the establishment. In any case, sun powered advances are continually developing, consequently it is protected to accept that costs will move descending later on.

2. Weather Dependent: Albeit sun based vitality can at present be gathered amid overcast and stormy days, the proficiency of the nearby planetary group drops. Sun powered boards are subject to daylight to adequately assemble sun oriented vitality. Along these lines, a couple of shady, stormy days can cause a perceptible impact on the essentialness framework. You ought to too consider that sun oriented vitality can't be amassed amid the evening. Then again, in the event that you additionally require your water warming answer for keep running at evening or amid wintertime, thermodynamic boards are a choice to consider.

3. Solar Energy Storage Is Expensive: Sun powered vitality holds to be utilized immediately, or it very well may be put away in expansive batteries. These batteries, utilized in off-the-framework universes, can be turned on amid the day with the goal that the imperativeness is utilized at evening. This is a sheltered goals for using sun powered vitality throughout the day, however it is likewise rather costly. In many examples, it is more brilliant to simply utilize sun powered vitality amid the light and take vitality from the field amid the dull (you can only answer this if your framework is connected up to the network). Fortunately, your vitality request is ordinarily higher amid the day and after that you can see a large portion of it with sunlight based vitality.

4. Uses a Lot of Space: The greater power you need to develop, the more sun based boards you will require, as you want to take in however much sun as could reasonably be expected. Sun based boards require a lot of room and a few roofs are not sufficiently huge to suit the quantity of sun based boards that you would wish to get. An option is to set up a portion of the boards in your yard, however they request to approach daylight. On the off chance that you don't claim the space for every one of the boards that you needed, you can choose introducing less to at present fulfill a portion of your imperativeness needs.

5. Associated with Pollution: Despite the fact that contamination identified with sun powered vitality frameworks is far less contrasted with different wellsprings of vitality, sunlight based vitality can be related with tainting. Transportation and establishment of heavenly bodies have been associated with the release of ozone harming substances. There are likewise pretty much harmful materials and risky items utilized amid the creation task of sun oriented photovoltaic, which can by implication include the environment. Be that as it may, sun oriented vitality dirties far not exactly other elective vitality sources.

2.22 Summary:

Energy from sun can be viewed as the principle wellspring of a wide range of energies. It very well may be utilized by different systems, for example, making full utilization of daylight to specifically produce power or by utilizing heat from the sun as a warm vitality. Utilizing Photovoltaic (PV) cells is normal in sun oriented vitality field. The significant target of this audit ponder is to help anybody traversing sun oriented vitality field by acquainting improvements up with date in the field. One can be helped and will spare time of building a writing audit about PV by this survey is viewed as a major aspect of an arrangement looks at the execution of PV innovations. In this paper, an examination overview is incorporated which explores the three ages of PV cells with the most recent attributes.

Chapter 3

METHODOLOGY

3.1 Introduction:

This study is designed to explore the socio-economic impacts of SRS in remote urban areas of Bangladesh. The study is based on fundamental data, minor sources are also used. Due to technology based social research a mixture of characteristic and quantitative methodological approaches are applied. General information on the SRS dissemination programmed and socio-economic impacts of solar electricity are collected from minor source and interviews with local experts. Fundamental data of the study are collected through an extensive household survey method using questionnaire. Minor sources are also used to support the survey data. Questionnaire is designed as present and before SRS installation to measure role of SRS in socio-economic development of urban area.

3.2 Steps of working procedure:

Our work was about SRS under DPDC. At first we create some questions based on our indicators. We selected some areas, and they are S.M. Maleh Road, Khanpur, Fatullah, Chasara. Then we visited their homes industry, hospital and residential house. We collect data from the consumers and the meter and analyze the data. Then we create the result.

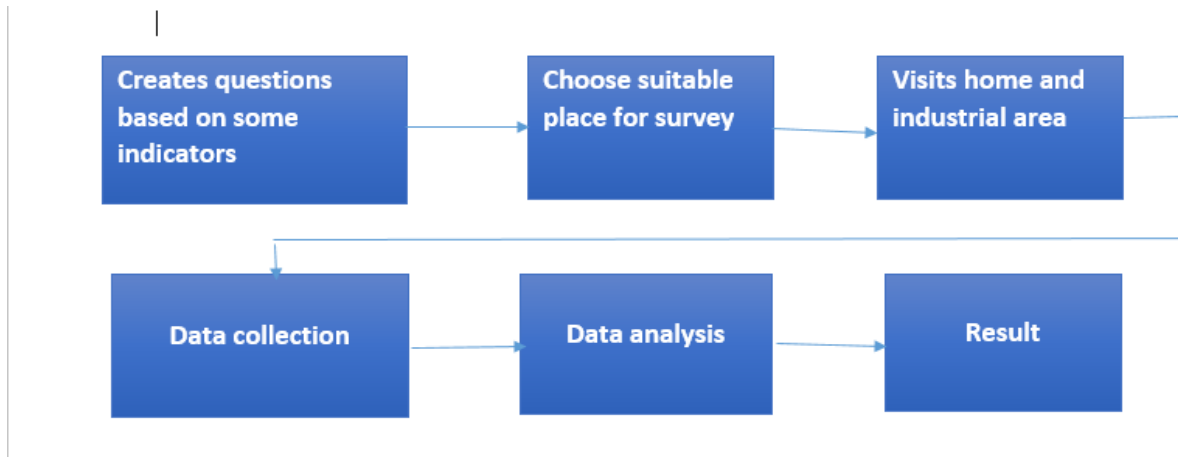


Figure 3.1: Flow chart of our working procedure

3.3 Survey Area:

Our survey topic is Solar Rooftop system (SRS) under DPDC, Khānpur in Narayanganj District (Dhaka Division) it's located in Bangladesh a little south-east of Dhaka, the country's capital place. Its geographical coordinates are 23° 37' 0" North, 90° 30' 0" East and its original name (with diacritics) is Khānpur. See Khanpur photos from satellite below, explore the aerial photographs of Khanpur in Bangladesh.

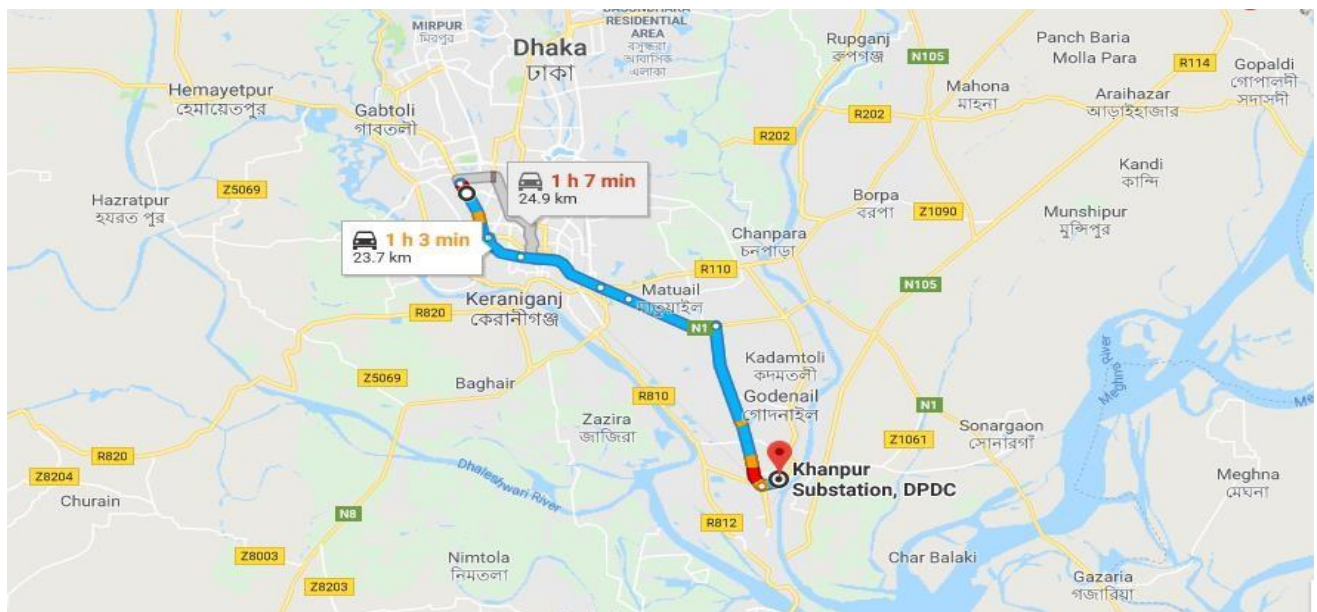


Figure 3.2: DPDC area of Khānpur in Narayanganj

3.4 Survey Questions for SRS under DPDC:

| SL No | Indicator | Questions | Description |
|-------|-----------------------------|--|--|
| 1 | Consumer information | Owner Name Consumer NO Mobile number Name of NOCS Consumer Address | In this question section we have just collect basic information of the consumers |
| 2 | Information of installation | Installation date Total Capacity What is the total cost of SRS? From where you bought SRS? | We ask the consumers about the installation date, capacity, installation cost, install date, etc. Some consumers use on-grid solar system and some of consumers use Off-grid solar rooftop system. |
| 3 | Maintenance | Have you ever mentions your SRS system? What is the total maintenance cost of SRS? How often it was done? | In this question section we ask the consumers about their SRS maintenance. We take information of their total Solar Rooftop System. |
| 4 | Operation | Is your SRS in operation? Do you test it regular basis? Do you ever clean your SRS? How often it was done? In which purpose you use the SRS? | In this part we checked the present situation of SRS and taken reading from meter. |
| 5 | Consumers opinion | Why do you install are SRS Do you think is it waste of money Are you satisfy Do you want to increase SRS capacity | In this section we tried to know about the consumer's opinion. |
| 6 | Cost analysis | Capacity Total consumption of electricity Installation cost | In this question we try to know about how much amount they paid for this purpose. |

Table 3.1 Survey Questions for SRS under DPDC

3.5 Summery:

Most of the SRS were found on grid and in operation. Solar rooftop system is very important technology for our country. Narangonj is an industrial area and DPDC is the main power distribution company for NG. We worked under DPDC and it was survey in SRS holders home/company. We visited there and collect some data which was given by DPDC. We try to aware them about their system and try to understand about the total benefits of the system.

Chapter 4

RESULT

4.1 Introduction:

Conditions, opinion, policy and present situation of solar rooftop system for bringing socio-economic development in BD have been discussed. It is audited from the previous discussion that energy plays the main role for development. Due to increment of fuel price and increasing carbon emission, there is a global change towards renewable energy like solar, wind etc. Being in torrid, Bangladesh is a solar energy fruitful country. Solar energy can play a vital and secure energy source for sustainable improvement. The main objective of this study is to assess the impacts of solar energy on socio-economic promotion in Bangladesh. To verify the objective empirically, we went to NG to survey under DPDC. The survey results are analyzed as follows in the following sections.

4.2 Consumers in different areas and SRS capacity:

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

Figure 4.1 indicates that we used 5 survey sampled information for creating the results. Between 5 survey information 15 data samples are situated in East zone and 10 data samples are situated in west zone of DPDC under Narayanganj NOCS. There are 8 consumers house in Chasara area and their SRS capacity 40% , 7 consumers in Fatullah and their SRS capacity is 31%, 6 consumers in Khanpur and their SRS Capacity is 20%. 4 consumers in S.M Maleh road and their SRS capacity is 9%



Figure 4.1: Total consumers

4.3 Data Analysis basis on number of installation:

In this part we wanted to know about their installation date. There were 25 total subscribers in our group, among them 11 consumers has installed their SRS in 2018, 7 consumers installed their SRS in 2017, 4 consumers installed their SRS in 2016 and only 2 consumers installed their SRS in 2015. So we can say number of installment are increasing day by day. And capacity are increasing very largely.

Figure 4.2 indicates the increasing rate of SRS.

NUMBER OF INSTALLTION IN DIFFERENT YEARS

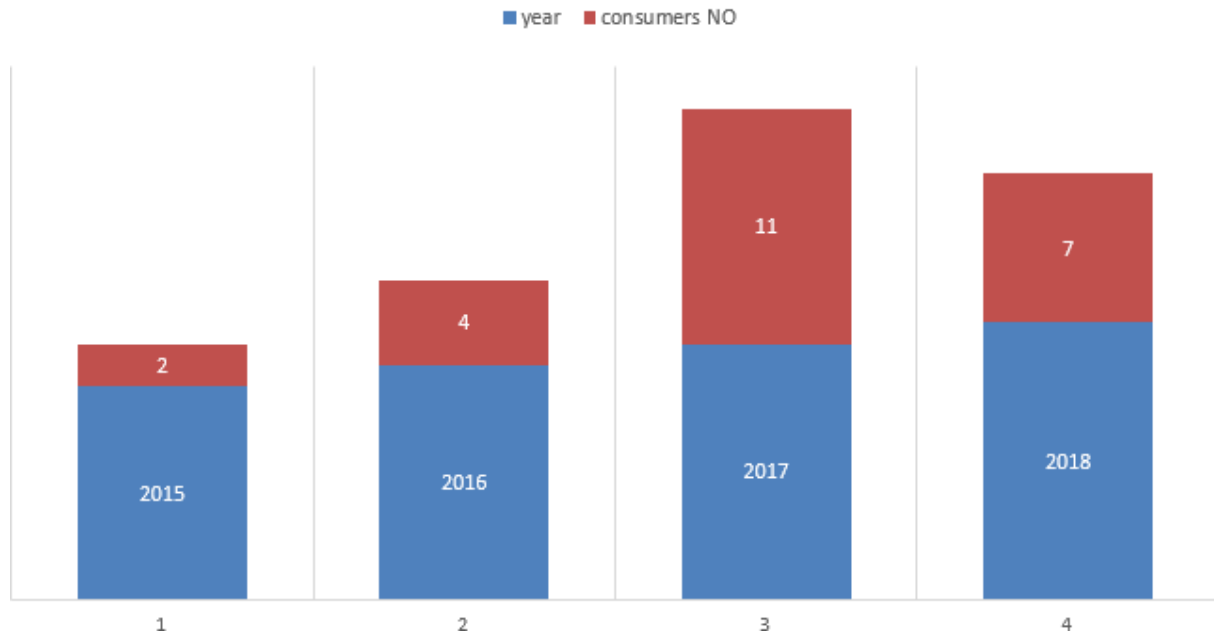


Figure 4.2: Chart of information of installation in different years

4.4 Brought the SRS:

Figure 4.3 indicates that, in Narayanganj NOCS, between all consumers data samples we selected 25 consumer survey data samples. In between these, 18 consumer are brought from market for install the solar system. And 7 consumers are brought agency for install the solar system. For getting electricity connection of high range building I mentatory to install the solar

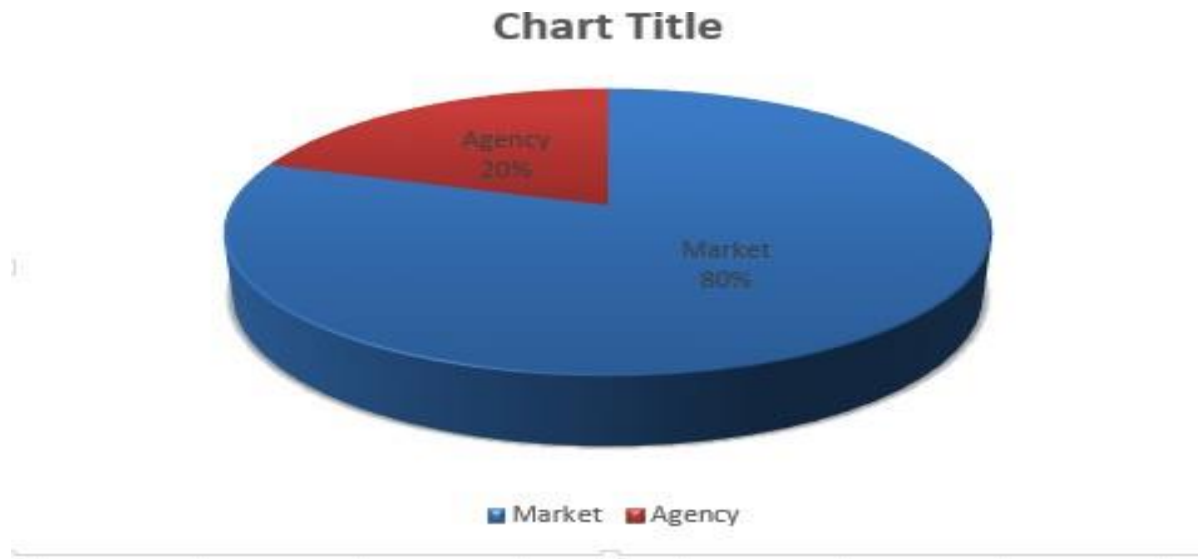


Figure 4.3: Brought the SRS

4.5 Installment condition:

Figure 4.4 provides information that 22 consumer or 88% peoples are installed the solar cause of policy obligation. That means they have no interest to install the solar system. Only 8% proples or 3 consumers are interested to install the solar system. They are ell known about the future of the electricity in Bangladesh.

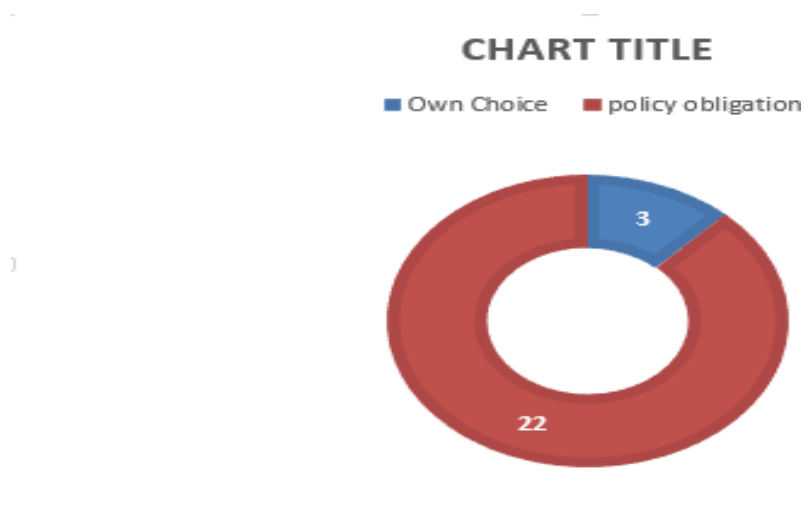


Figure 4.4: Installment condition

4.6 Operating condition:

Figure 4.5 indicates that, most of user are installed the solar for getting the electricity connection of buliding. These statement proves through the circle-type chart. In circle-type chart, the chart provides that 18 consumers are in now not-operating condition. That means they provide the previous statement. And 7 consumers are in operating mode. They feel that they getting some benefits from solar.

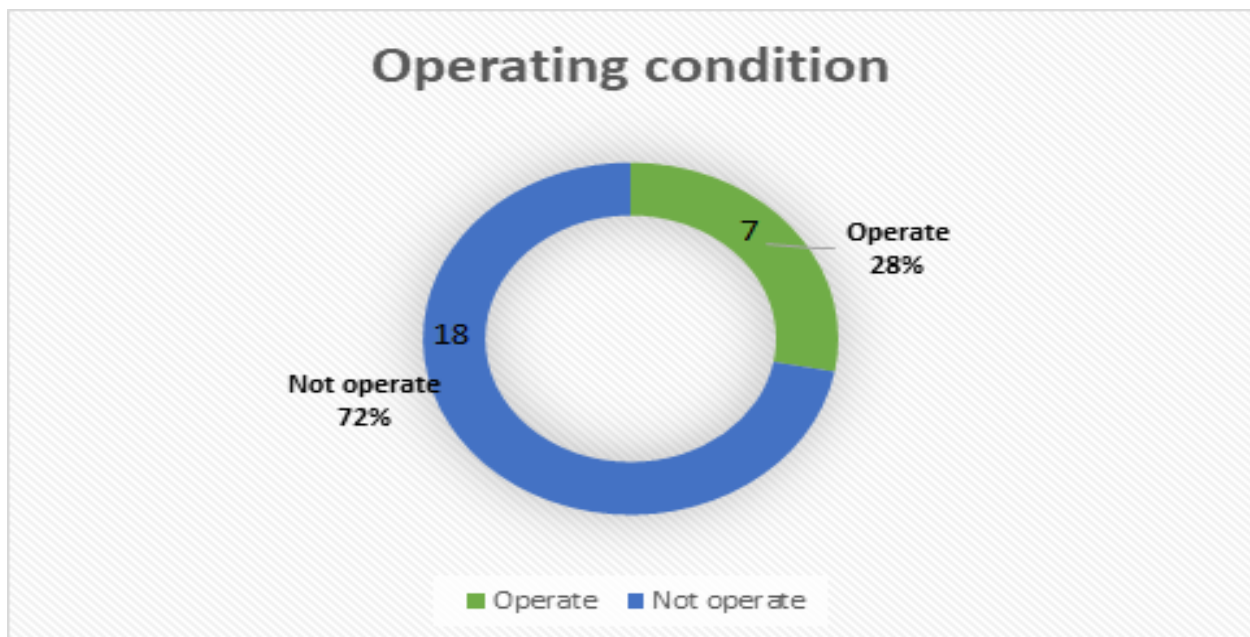


Figure 4.5: Operating condition

4.7 Maintenance:

4.7.1 Clean the solar panel

Figure 4.6 gives us information that at least five of the consumers of 9 households cleaned the solar system and the remaining 4 consumers did not clean the solar system. The table has the second industry. In the industry sector, a total of 6 consumers do not clean the solar cell.

Residential House comes to the third in the table. Residents can see the total consumer 7. Three of them clean the solar cells and the remaining four consumers do not clean the solar system. See table 4 at Hospital. The total number of three consumers in the Hospital. One of them cleaned the solar. The remaining two do not clean the solar.



Figure 4.6: Cleaning the solar panel

4.7.2 Training and Facing any kinds of survey

In figure 4.7 we use vertically bar types chart ith percentage condition. From chart, we can say that, between 100 percent users are not interested to taking any kinds of traning for SRS operating. They don't think that they are not thinking about solar uses.

And Figure 4.7 also shoing ith pie chart ith percentage abd value of the surve. The pie chart indicates that 16 percent users are facing any kinds of survey one or more time. And 84% users are not facing any kinds of survey.

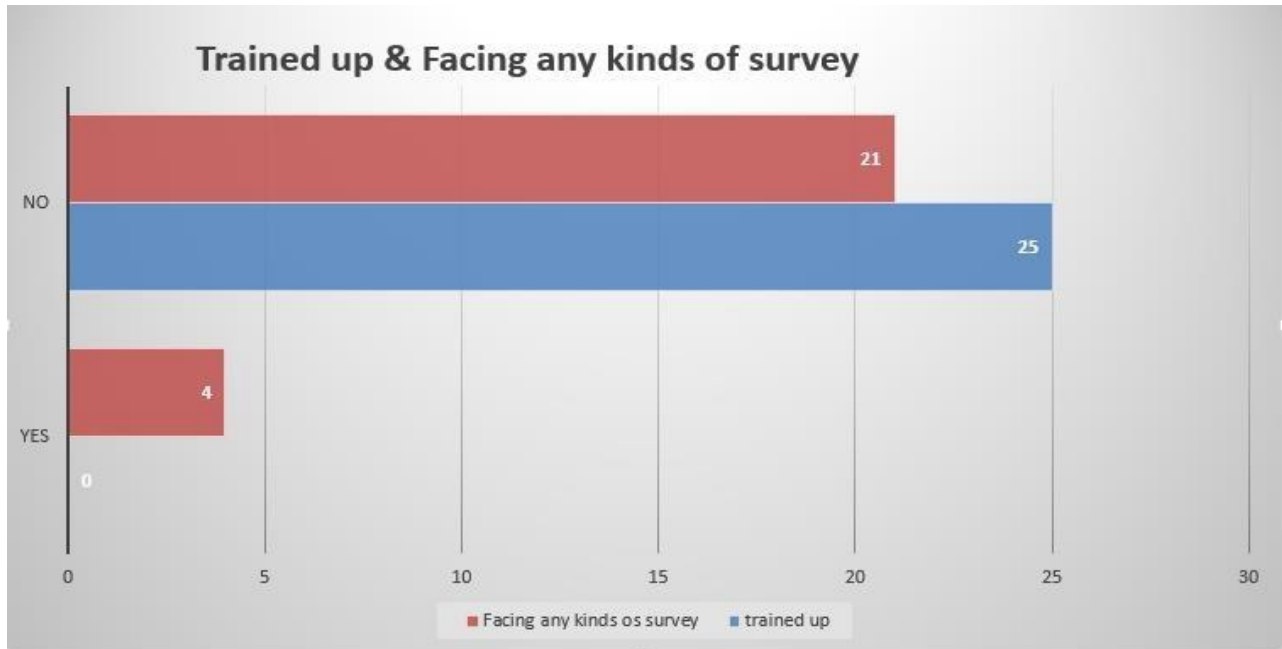


Figure 4.7: Training for SRS operation and facing any kinds of survey

4.7.3 Records of solar electricity

Figure 4.8 showing with pie chart with number of the survey. The chart shows that 3 users are recorded the solar electricity. And 22 users are not recorded the solar electricity. These information indicates that they do not check the meter whether is operated or not operated

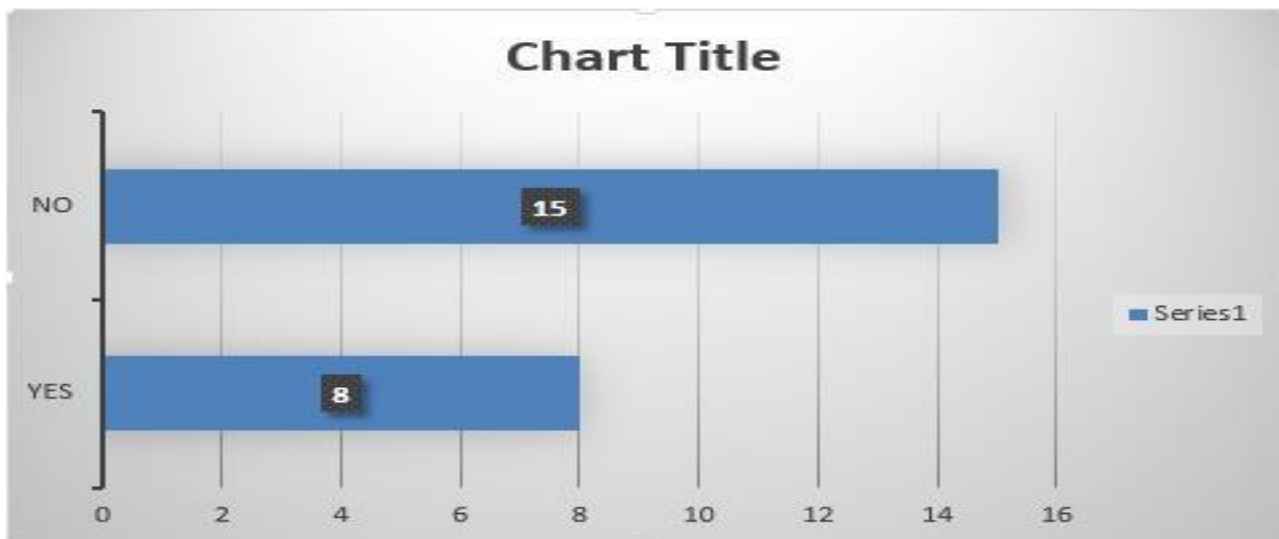


Figure 4.8 Records of solar electricity

4.8 Interested to increase capacity of the SRS

Figure 4.9 indicates the survey of increasing the capacity of the solar system. The chart type is Column type with x-axis and y-axis. It provides the information that 80% users didn't want to increasing the capacity of the solar system and only 20% want to increase. They thinks that the solar system is not useful.

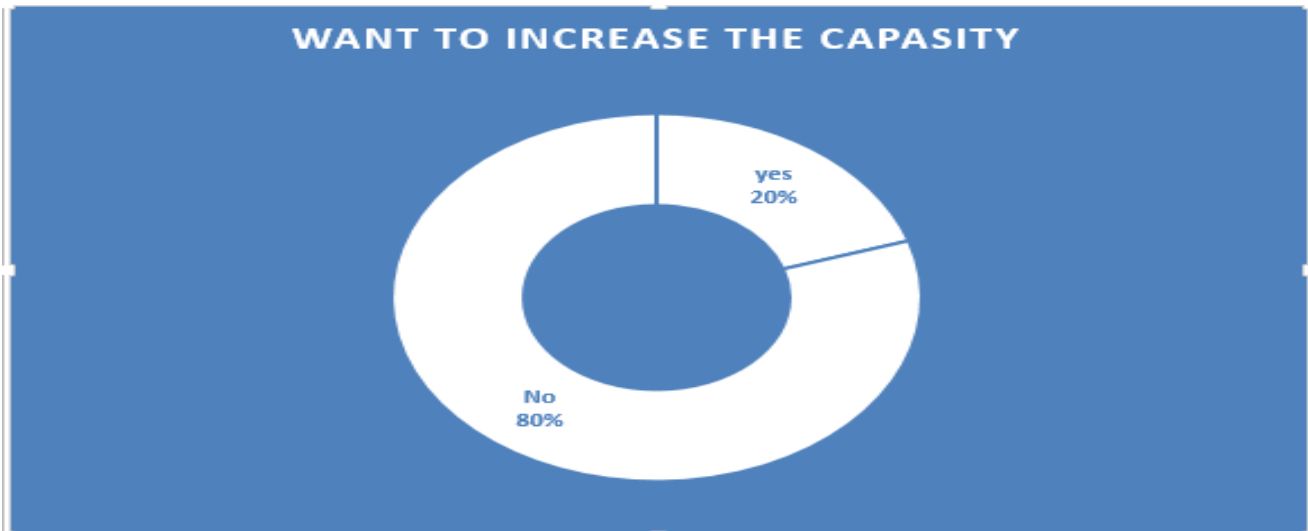


Figure 4.9: Interested to increase capacity of the SRS

4.9 Consumers feedback

Figure 4.10 provides the pie chart with description in percentages and number. The chart gives information that is only 4 users think that solar is useful. And 21 are thinking that solar is not useful. They didn't think about the condition of future electricity.

Figure showing also the result of the survey that is total 18 users are thinking that this is waste of money and only 7 consumers are thinking it's useful. That is indicated that we are not adopted the using of our renewable source like sun ray.

SOLAR IS USEFUL AND WASTE OF MONEY

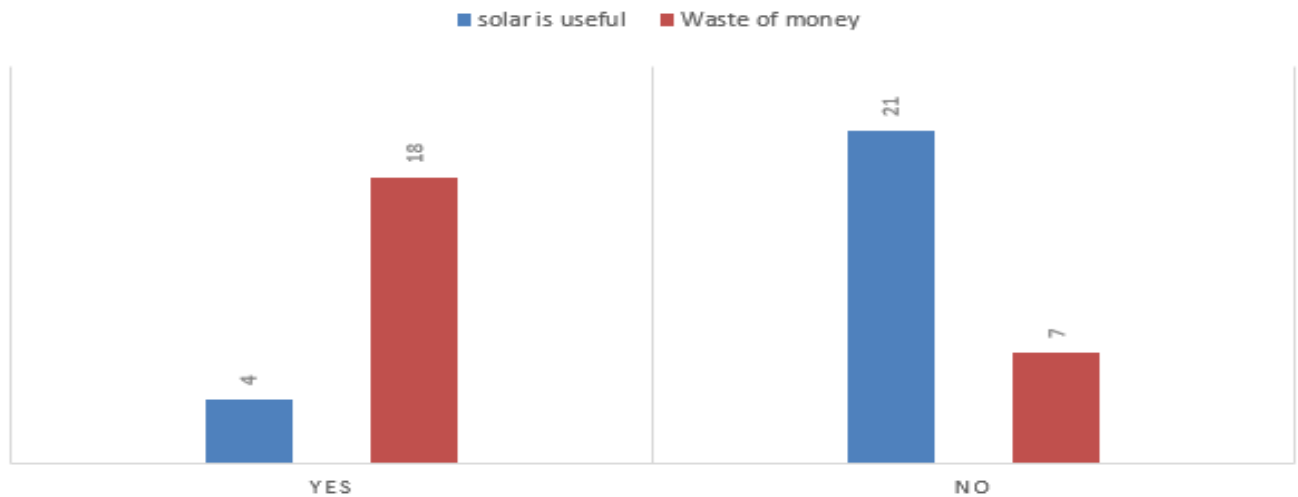


Figure 4.10: Solar is useful and waste of money

4.10 per unit energy cost:

First Calculation:

We consider our proposed SRS system life time is 20 years. So, the cost per unit of energy by the SRS will be:-

Meter reading = 3978.9 Kwh.

Total cost of the system = 180000 TK

Date of installment, 2016/06

Date of survey, 2018/11/20

Time duration = 2 years 5 months

= 2.417 years

So, yearly generated = $(3978.9 \div 2.417)$ Kwh/year

= 1646.21 Kwh/year

Total generation of energy will be after 20 years = 1646.21×20

= 32924.2 Kwh

Cost of per Kwh of electricity = $(180000 \div 32924.2)$ Taka/Kwh

= 5.46 Taka/Kwh

Second Calculation:-

We consider our proposed SRS system life time is 20 years. So, the cost per unit of energy by the SRS will be:-

Meter reading = 7865.68 Kwh.

Total cost of the system = 350000 TK

Date of installment, 2016/02

Date of survey, 2018/11/20

Time duration = 2 years 5 months
= 2.75 years

So, yearly generated = $(7865.68 \div 2.75)$ Kwh/year
= 2860.247 Kwh/year

Total generation of energy will be after 20 years = 2860.247×20
= 57204.94 Kwh

Cost per unit of energy in taka = $(350000 \div 57204.94)$ Taka/Kwh
= 6.11 Taka/Kwh

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

| SL NO | Total Cost | Capacity(Kw) | Lifetime(year) | cost of per Kwh (Taka/Kwh) |
|-------|------------|--------------|----------------|----------------------------|
| 1 | 120000 | 1 | 20 | 5.72 |
| 2 | 200000 | 1.92 | 20 | 5.1 |
| 3 | 90000 | 0.88 | 20 | 8.43 |
| 4 | 640000 | 10 | 20 | 4.65 |
| 5 | 150000 | 1.2 | 20 | 6.48 |
| 6 | 450000 | 5 | 20 | 4.97 |
| 7 | 100000 | 0.9 | 20 | 5.23 |
| 8 | 260000 | 2.3 | 20 | 6.5 |
| 9 | 570000 | 8 | 20 | 4.45 |
| 10 | 350000 | 6 | 20 | 5.28 |

Table 4.1 cost calculation

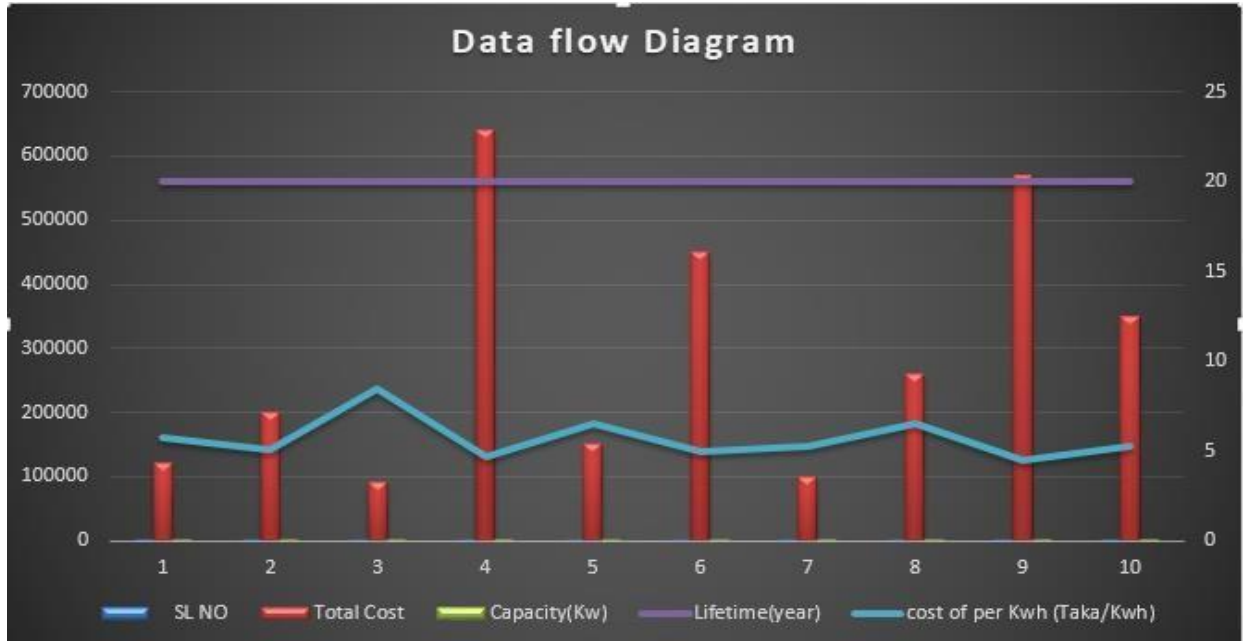


Figure 4.11 Data flow diagram

Average Cost per unit of energy is 5.6 Taka/Kwh

4.11 Summery:

After completing the survey to the indicators and analyzing the result we find out some problems Consumers don't have enough knowledge about the SRS and they are not concern. So, here need to counsel with them. Maximum consumers never clean the panel because they don't know about it. The authority should train them about SRS and inform about usefulness.

Majority of the consumers don't know about net-metering system. So, I think organization should inform them and inform the consumer how they can use it properly. The main problem is the cost of SRS is very high. So, Govt. should minimize the cost.

Chapter 5

CONCLUSION

5.1 : Overall Discussion:

The objective of this thesis is to analyze the feasibility of solar rooftop system (SRS). Technology was extensively reviewed. This study demonstrates the significant potential that exists for harnessing solar energy and producing electricity from the building rooftops. By executing this survey under DPDC in the City of NG will set an example to cities across the country as to the environmental and financial benefits of solar energy and how to tap solar energy utilizing building rooftops that are otherwise idle. The initial assessments were based on a site review and preliminary calculations. A more detailed analysis of the structures and electrical system is needed prior to installation. The methodology outlined above can be applied to any large scale rooftop solar applications such as those owned by cities or clients with a large number of buildings.

The use of solar panel is increasing rapidly all over the world. Fortunately, the location of Bangladesh is quite suitable for harnessing solar energy. The object of Thesis was to analyze the feasibility of on grid connected Rooftop system in NG under (DPDC). However, large area is still uncovered either by grid electricity or by electricity generated from renewable sources. In the on grid areas of Bangladesh, solar rooftop system (SRS) is getting popular day by day. Solar PV system has emerged as an alternative renewable energy technology all over the world. It has numerous benefits in comparison to the traditional electricity generation systems, primarily pollution freeness and cost effectiveness. In Bangladesh, where power generation is a huge challenge, solar rooftop system can play an important role.

5.2: Future Scopes of the Work

Our climate condition and geographical position are very favorable for solar rooftop system. We can't use it properly. Present time there is deficit of electricity in Bangladesh. The present government has taken a proper initiative that if a person wants to build a new building, then he must use the solar rooftop system which should be on grid. . DPDC wants to make the consumers aware about this system. Maximum solar system is off grid but government trying to turn them in on grid system. In future by using solar system generation of electricity will increase and it will help to reduce environmental pollution.

This review is taken by means of a demand in different areas of NG. The proposed trade is underway for another investigation under Dhaka City Corporation. Subsequent to finishing this study both Dhaka and NG city we make a give an account of SRS framework for DPDC which is assist them with making choice about nearby planetary group. Next, we need to make a study give an account of the entire nation where SRS framework are introduced.

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