

STUDY ON SOLAR ROOF TOP SYSTEM IN BANGLADESH UNDER DHAKA POWER DISTRIBUTION COMPANY LIMITED

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

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December 2018

Declaration

We hereby declare that this thesis paper is based on the results 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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December 2018

Date

Certificate of Approval

This is to certify that this project and thesis entitled “**Study on solar Roof Top System in Bangladesh Under Dhaka Power Distribution Company Ltd**” 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 fulfilment 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**

Countersigned



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Dedicated to

*Our Parents
With Love & Respect*

INDEX

CONTENTS	PAGE NO
DECLARATION	II
CERTIFICATION	III
LIST OF TABLES	VIII
LIST OF FIGURES	IX
ABBREVIATIONS	XI
ACKNOWLEDGEMENT	XIII
ABSTRACT	XIV

CHAPTER 1	INTRODUCTION	(01-04)
1.1	Background of study	01
1.2	Statement of the Problem	02
1.3	Objectives	02
1.4	Significance of the research	03
1.5	Thesis Outline	04

CHAPTER 2	LITURATURE REVIEW	(05-24)
2.1	Introduction	05
2.2	Energy	05
2.3	Classification of Energy	06
2.4	Renewable energy	07
2.4.1	Wind energy	08
2.4.2	Geothermal energy	09
2.4.3	Tidal energy	10
2.4.4	Hydro-power	11
2.4.5	Biomass	11
2.4.6	Solar Energy	12
2.5	Energy Situation	14

2.6	Solar energy as a source of sustainable electrification	15
2.7	Importance of solar energy for rural electrification in Bangladesh	15
2.8	Solar roof-top system (SRS)	15
2.9	Technical background of SRS	16
2.9.1	Solar Photovoltaic PV Panel	17
2.9.2	Combiner Box	19
2.9.3	DC Disconnect	20
2.9.4	DC to AC Inverters	20
2.9.5	AC Disconnect (Utility Accessible)	21
2.9.6	AC Mains Panel and Meter	22
2.10	Progression of World-Wide Solar Roof-Top System Dissemination	22
2.11	Solar Roof-Top System Dissemination in Bangladesh	23
2.12	Summary	24

CHAPTER 3 RESEARCH METHODOLOGY (25-29)

3.1	Introduction	25
3.2	Conceptual Framework	25
3.3	Site Selection	26
3.3.1	Narayanganj District	26
3.3.2	SRS on DPDC south zone Narayanganj circle area map	27
3.4	Household survey	27
3.5	Summary	29

CHAPTER 4 RESULT AND DISCUSSION (30-41)

4.1	Introduction	30
4.2	An Overview of Sample Villages	30
4.3	Demographic Analysis of Households	30
4.4	Information of SRS Installation	32
4.4.1	Types of SRS	33
4.4.2	Reason Behind of SRS Installation	34
4.4.3	Source of Brought SRS	34
4.5	Information of SRS on Operation And Maintenance	35
4.5.1	SRS in Operation	35

4.5.2	System Maintenance	36
4.5.3	Reason Behind of System Disorder	37
4.6	Cost Analysis	38
4.7	Consumers Satisfaction	38
4.7.1	Consumers Opinion	39
4.8	Thesis Finding	39
4.8.1	Lack of knowledge	39
4.8.2	Technical Issues	40
4.8.3	Government Initiative	40
4.8.4	Need to Change Consumer/People Unconscious Mentality About SRS	40
4.9	Recommendation	41
CHAPTER 5 CONCLUSIONS		(42-43)
5.1	Conclusion	42
5.2	Future Work	43
REFERENCES		44

LIST OF TABLE

TABLE	NAME OF THE TABLE	PAGE
Table-1	Energy Situation (Source of Light In Percentage)	14
Table-2	Variable, Indicator, Operational Definition	28
Table-3	Number of Consumer in Different Area	31
Table-4	Information About Household SRS	32
Table-5	Satisfaction with The Use of SRS	38

LIST OF FIGURE

FIGURE	NAME OF THE FIGURE	PAGE
Figure-2.1	Classification of Energy	07
Figure-2.2	Renewable Energy	08
Figure-2.3	Wind Energy	09
Figure-2.4	Geothermal Plant	10
Figure-2.5	Tidal Power	10
Figure-2.6	Hydro-Power	11
Figure-2.7	Biomass Energy System	12
Figure-2.8	The Source of Solar Power	13
Figure-2.9	Bangladesh Electricity Consumption generation	14
Figure-2.10	Solar Home System	16
Figure-2.11	On-grid Solar Power System	17
Figure-2.12	Solar Photo-Voltaic (PV) Panels	17
Figure-2.13	Parallel Connection of Two Solar Panels	18
Figure-2.14	Series Parallel Combination of Solar Panel	19
Figure-2.15	Combiner Box of Solar PV	19
Figure-2.16	DC Disconnect	20
Figure-2.17	DC to AC Inverter	21
Figure-2.18	AC Disconnect (Utility Accessible)	21
Figure-2.19	Net-Meter of Solar PV	22
Figure-2.20	Exponential Growth of Global Solar System	23
Figure-2.21	Show The Cumulative Generation of SRS	24
Figure-3.1	Flow Chart of Our Household Survey	25
Figure-3.2	Narayangonj District (One of Highly Industrialized District)	26
Figure-3.3	DPDC South Zone Narayangonj (Light Green Color) Circle Area Map	37
Figure-4.1	Distribution of Consumer Number	31
Figure-4.2	On-Off Grid SRS Installation Chart (Location Wise)	33

Figure-4.3	Distribution of Consumer by The reason of Installed SRS	34
Figure-4.4	Brought SRS	35
Figure-4.5	Distribution The Percentage of Solar Running or Close	36
Figure-4.6	Maintenance Chart	37
Figure-4.7	Percentage of Reason of System Disorder	37
Figure-4.8	Consumer Opinion	39

LIST OF ABBIBIATION

BBS	: Bangladesh Bureau of Statistics
BCSIR	: Bangladesh Council of Scientific and Industrial Research
BRAC	: Bangladesh Rural Advancement Committee
BPDB	: Bangladesh Power Development Board
BDT	: Bangladesh Taka
CDM	: Clean Development Mechanism
CSD	: Commission on Sustainable Development
DFID	: Department for International Development
EPI	: Expanded Programme on Immunization
FAO	: Food and Agriculture Organization
GEF	: Global Environment Facility
GOB	: Government of Bangladesh
GNESD	: Global Network on Energy for Sustainable Development
GTZ	: German Technical Cooperation
GHG	: Green House Gases
ICT	: Information and Communication Technology
IDCOL	: Infrastructure Development Company Limited
IPCC	: Intergovernmental Panel on Climate Change
JPOI	: Johannesburg Plan of Implementation
LGED	: Local Government Engineering Directorate
LED	: Light Emitting Diode
MDG	: Millennium Development Goal
NGO	: Non-Government Organization
NRECA	: National Rural Electric Cooperation Association
PO	: Partner Organization
REREDP	: Rural Electrification and Renewable Energy Development Project
RSF	: Rural Service Foundation

REB	: Rural Electrification Board
RET	: Renewable Energy Technology
SDG	: Sustainable Development Goal
SRS	: Solar roof-top System
SIS	: Solar Irrigation System
SPSS	: Statistical Package for Social Science
UNFCCC	: United Nations Convention on Climate Change
USAID	: United States Agency for International Development
UNCTAD	: United Nations Conference on Trade and development
UNCED	: United Nations Conference on Environment and Development
UNDP	: United Nations Development Program
WSSD	: World Summit on Sustainable Development

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ABSTRACT

Solar energy is clean, inexhaustible and environment-friendly potential resource among renewable energy options. As a country of acute power crisis Bangladesh is now looking forward to develop its renewable energy sources in addition to its traditional sources of fossil fuel. It has very limited non renewable energy sources of its own but it's endowed with renewable energy sources like biomass, wind, hydro and solar energy.

Therefore, in order to satisfy the load demand, grid connected energy systems are now being implemented that combine solar and conventional conversion units. The following research paper is based on the prospects of solar energy from perspective of Bangladesh. Possible implementations of solar roof top system (SRS). For this purpose we made a survey at different area in Narayanganj district. In our survey we have collected data about SRS basic information, their maintenance and their cost. By analysing this data we found the total cost, consumer satisfaction and some limitation also. The following research paper has written on that collected data.

Chapter 1

Introduction

1.1 Background of study

Electricity is that the world power supply of country's economic activities. These days billions of individuals face lack of access to the foremost basic energy services. As world energy outlook 2016 shows one.2 billion folks square measure while not access to electricity [1]. As January 2017 Bangladesh's total put in electricity production capability was 15,351 MW [2]. 92 urban population and 67 rural population have the access of the electricity for his or her solely supply of sunshine [2]. A complete average of 77.9% population have the access to the electricity in Bangladesh [3]. Moreover, the country's generation plants are incapable to satisfy system demand over the past decade [2]. Non-commercial energy sources, like wood fuel and crop residues are expected to satisfy over 1/2 the country's energy consumption. Providing electricity to all or any is also unacceptable owing to the increasing demand for electricity that is growing by 100 percent yearly in Bangladesh. Our country is found in a section that encompasses a potential to utilize totally different renewable sorts of energy. On the opposite hand, Bangladesh is one in all the countries that are seriously at risk of the results of climate change; thence, the utilization of renewable energy will contribute to say no the results of each temperature change and environmental degradation within the country.

Some distinctive and competitive options create a PV system a lot of valuable energy supply as an example high modularity, non-demand for additional resources like water, fuel and low maintenance price. The world obtains about 3,400,000 EJ radiation annually which may deliver 450EJ energy and this quantity is 7500 times over the energy consumption of the planet [4]. we will discovered a PV system simply on existing building as an example upside or open areas wherever decent daylight are often reached or different localized thanks to manufacture power which will cut back the pressure on our typical national grid.

1.2 Statement of the problem

Power arrangement of Bangladesh relies upon non-renewable energy sources both in private part and state-claimed control plants. About 89% of created control originates from carbon discharging gaseous petrol, fluid fuel, coal and hydropower. The supply of gaseous petrol isn't adequate to take care of the demand. Flow gas creation limit in Bangladesh can't bolster local needs and in addition more extensive power age for the nation. The current hold of oil and gas will be depleted soon. In the meantime worldwide there is an interest for perfect and manageable vitality. The requirement for creating sustainable wellsprings of vitality like sun based, wind, bio-mass, and so on has a more noteworthy feeling of criticalness. As a tropical nation Bangladesh is supplied with sun based vitality. In this setting sun oriented vitality is a dependable, reasonable and secure vitality for the nation. However, the present offer of sustainable power source for power generation is just 0.5% of the aggregate. Real individuals of Bangladesh live in provincial territories. There is solid interest for power accessibility in remote towns. Bangladesh has installed with a lot of sun powered vitality. We can possibly be a sun powered power rich nation. Institutional, money related and innovative abilities go about as critical components for achieving a coveted dimension of sunlight based power creation and usages. In any case, we have absence of data and incorporated research in this field.

Sun powered power is progressively being utilized in an extensive variety of off-framework applications. Since the presentation of SRS, Bangladesh has introduced more than 2.2 million units. In this setting estimating the financial effect of SRS would be a representation for planning rustic advancement elective vitality display in the nation. The present investigation is planned to recognize the elements related with the execution of sunlight based vitality and sun powered power framework and how far it has been prevailing with regards to decreasing neediness in rustic region of the nation.

1.3 Objective

Bangladesh is a tropical nation of huge sun based vitality. Be that as it may, a next to no measure of it is utilized. Despite the fact that the origin of SRS in Bangladesh was in 1988 yet it was undiscovered for a significant lot. Solar energy is a standalone solar photovoltaic

system for a wind energy system can provide a continuous supply of energy due to seasonal and periodic variations.

- ❖ To discover the potential outcomes in regards to solar energy systems in our Country as well as the problems regarding the system.
- ❖ To collect data from the consumer at different areas.
- ❖ To analysing data and calculate the total cost
- ❖ To discover the reason behind SRS disorder
- ❖ Verify the consumer satisfaction
- ❖ To compare theoretical Knowledge with the practical work alongside with observing different parts of solar system.

1.4 Significance of the research

Bangladesh is a tropical nation of huge sun based vitality. Be that as it may, a next to no measure of it is utilized. Despite the fact that the origin of SRS in Bangladesh was in 1988 yet it was undiscovered for a significant lot. At this point different uses of sun oriented power is seen all through the world. Presently a-days Solar Panel gives power to sun oriented immunization cooler, sunlight based water sanitization (SODIS), sun oriented nourishment drier and sun powered purification. This aides for decreasing waterborne infections. Sun powered telephone, sun based Wi-Fi, and sun based radio increment country correspondence, and diminishes transport cost and decrease advanced partition.

Next to sun based cooker and sun oriented water warming, dependence on conventional energizes, for example, wood or charcoal, decreases indoor contamination and carbon emanation. This expands the personal satisfaction in provincial territories, enhance wellbeing and training, lessen oil reliance, increment neighbourhood business and decrease deforestation. Sunlight based power exercises lead country advancement. Because of absence of data and study SRS is utilized just for family unit lighting in Bangladesh. Sun oriented water system innovation is likewise getting mainstream in Bangladesh. As agribusiness based nation, utilizing sun oriented power water system framework would be a noteworthy main impetus for provincial improvement.

Government association, Academic establishments, NGOs and privately owned businesses are engaged with sustainable power source area in the nation. Specialist, arrangement producer, advancement accomplice in Bangladesh recognized the colossal prospect of sun powered power for provincial change. Be that as it may, there is no incorporated investigation of the prospect and extent of sun powered power for financial advancement in provincial region of Bangladesh. Starting at now there is exceptionally constrained scholarly investigation on the financial or ecological effect of sun based power in provincial zone. So the examination would help the worry policymakers and implementers to take vital measures for manageable provincial improvement in Bangladesh. Distinguishing the new inventive utilization of sun based power in rustic territories would help the implementers for compelling arranging and undertaking programs. Besides it will likewise help for new innovation move in rustic areas.

1.5 Thesis Outline

The following chapters portrays our thesis, the main points plan and dealing procedure concerning star roof high system, comparative analysis of the appliances and systems, call and future works. The primary chapter offers the general thought concerning our work, background, motivation and objective. The second chapter contain the thought in an elaborate way concerning star roof high system is and their applications. The third chapter contain methodology of our analysis on star roof-top systems. The fourth chapter elaborates and calculate and analysis the information and show the result diagrammatically. The fifth chapter describe conclusion and future work.

Chapter 2

Literature Review

2.1 Introduction

Rural Electrification could also be a serious component of overall rural infrastructure aimed toward quick the pace of socio-economic development of East Pakistan. All the areas of the country, except the municipal areas of Dhaka, Narayanganj, Mymensingh, Gazipur, Narsingdi districts, rajuk areas, industrial areas, divisional cities of town, Rajshahi, Khulna, Sylhet and Barisal with different district cities, cantonments and universities that square measure already electrified by Bangladesh Power Development Board (BPDB) are below the jurisdiction of Johnny. supported the universal principle of cooperative, Palli Biddut Samities (PBS) of Johnny square measure designed as democratic [8], localized and autonomous organisations where the member customers relish equal opportunities and are entitled to exercise equal rights. Continuous support from the govt. And donor agencies and additionally the individuals associated with the programme and comparative clear and accountable system of the PBS has helped to line a high traditional of performance of the organisation. The homeowners of PBSs square measure its consumer members and PBS management is accountable to a regionally elective Board of directors and additionally the performances of the PBSs are controlled by REB.

2.2 Energy

Energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat, the object. Throughout the day, the sun offers out lightweight and warmth energy. At night, street lamps use electricity to lightweight our manner. Once an automotive is driven by, it's being battery-powered by fuel, a sort of keep energy. Therefore "Energy is that the Ability to try and do Work". Energy will be found during a range of various forms. It will be energy, electricity, heat (thermal energy), lightweight (radiant energy), energy, and energy. Energy is taken into account jointly of the foremost vital strategic inputs for development and industrial growth. In context of developing countries like Asian country, energy crisis is taken into account as an excellent downside within the path of future infrastructure development.

At some purpose, fossil fuels area unit progressing to either be gone or they're progressing to become too costly to realistically use. It's an awfully common matter that the presently used typical fossil fuels aren't unlimited in quantity. Fast use of fossil fuels and increased environmental pollution as a result we tend to currently haven't any different decisions however victimisation renewable power sources for wattage generation. Renewable energy technologies area unit clean sources of energy that have a way less environmental impact than typical energy technologies. In developing country like Asian country, it's so necessary to analyse the prospect of renewable energy sources particularly solar power that don't grime atmosphere, keep it clean and safe for our next generation. Victimisation Renewable Energy Technology for finding energy crisis in Asian country has received increasing attention in recent times. several Researchers have devoted themselves for locating Associate in Nursing economic resolution to fight against the depletion of natural resources, to blame for electricity production in Asian country through completely different renewable energy sources like star Photo-Voltaic energy, Wind Energy, Biomass etc.

Conventional energy sources like fossil fuel, coal, oil etc. area unit price ineffective, restricted and not atmosphere friendly. Quite three-quarters of the nation's industrial energy demand is being met by these sources that possible to be depleted by the year 2020 [9]. Among various resolution of renewable energy, solar power is that the most convenient and affordable energy supply to supply electricity. Now-a-days, it's being an awfully common supply of energy attributable to its endless handiness wherever fossil fuel is decreasing day by day. So solar power includes a massive potential to be employed in varied sectors in Asian country to cut back the traditional fuel based mostly power consumption and to make sure an inexperienced atmosphere for the longer term generation.

2.3 Classification of Energy

Energy is exclusively printed in physics as a result of the power to do and work. Sun is that the most provide of energy in our system. Energy is basic wish of living things and life cannot exist whereas not energy. Primitive mam discovered fire and used it for various reason and even in currently world energy is that the fundamental wish of industrialized world. Planets lure the choice energy for his or her natural action. In cyclic manner we have a tendency to tend to induce the indirect energy from the plants. Like this, completely different energy sources unit developed by mortals for his or her wish. Energy resource varieties area unit completely different from sorts of energy.

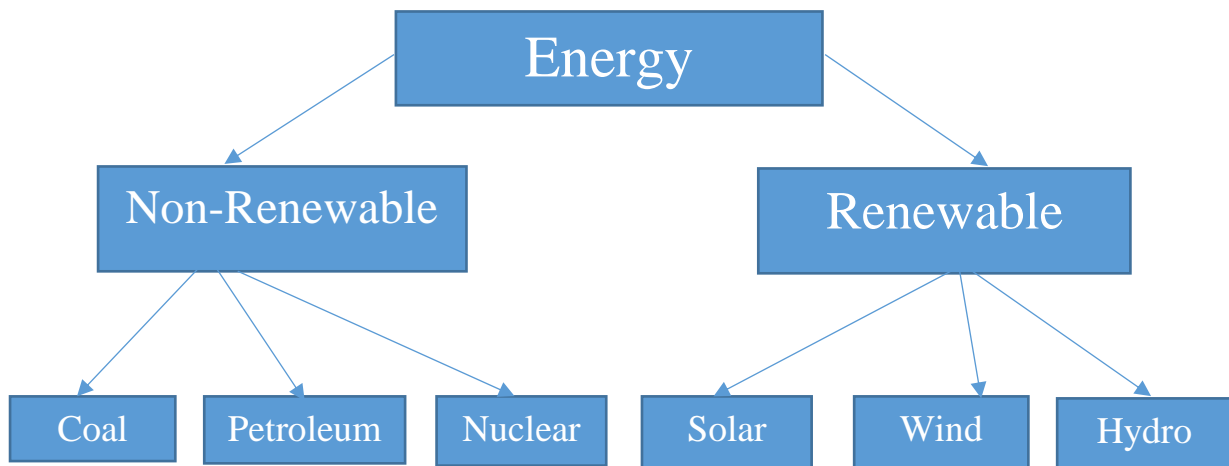


Figure: 2.1: Classification of Energy

2.4 Renewable Energy

Renewable energy is energy that's collected from renewable resources, that area unit naturally replenished on a person's timescale, like daylight, wind, rain, tides, waves, and geothermic heat. Renewable energy usually provides energy in four necessary areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services. Based on REN21's 2017 report, renewables contributed 19.3% to humans' international energy consumption and 24.5% to their generation of electricity in 2015 and 2016, severally. This energy consumption is split as 8.9% returning from ancient biomass, 4.2% as energy (modern biomass, geothermic and star heat), 3.9% hydroelectricity and a couple of.2% is electricity from wind, solar, geothermal, and biomass. Worldwide investments in renewable technologies amounted to over US\$286 billion in 2015, with countries like China and also we heavily finance in wind, hydro, star and biofuels. [9] Globally, there are a unit associate calculable seven.7 million jobs related to the renewable energy industries, with star photovoltaics being the biggest renewable leader. As of 2015 worldwide, over half all new electricity capability put in was renewable. [9]. Figure 2.2 is to show the different kind energy.

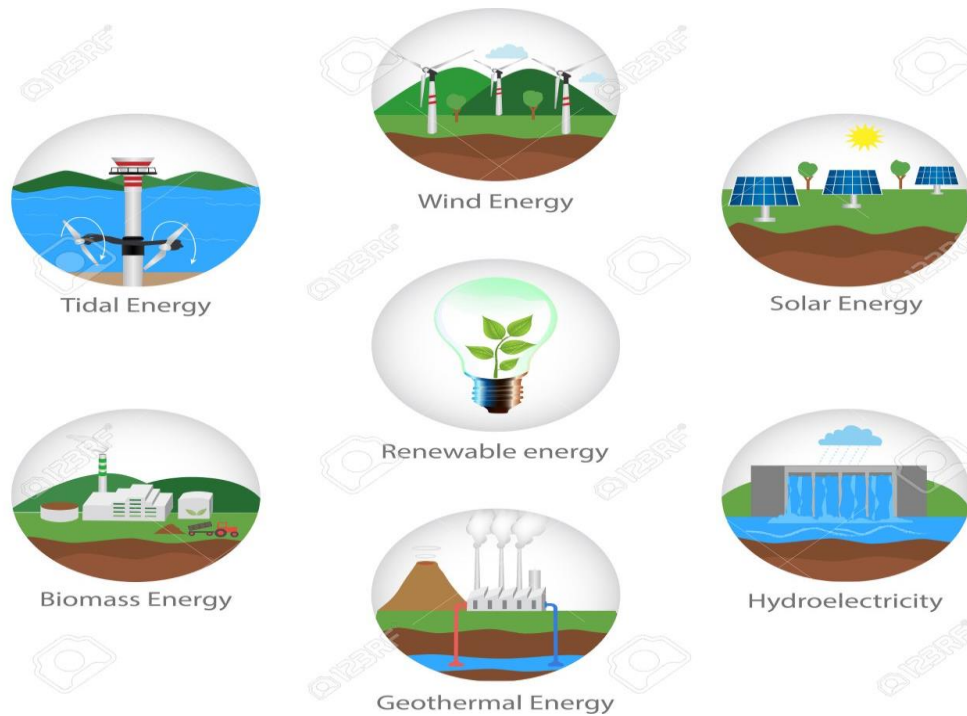


Figure 2.2: Renewable Energy

2.4.1 Wind Energy

Wind power is turning into additional and a lot of common. The new innovations that are permitting wind farms to seem are creating them an additional common sight. By mistreatment giant turbines to require accessible wind because the power to show, the rotary engine will then flip a generator to provide electricity. Whereas this appeared like a perfect resolution to several, the fact of the wind farms is setting out to reveal associate degree unforeseen ecological impact that will not build it a perfect selection. Figure 2.3 will show wind energy.



Figure 2.3: Wind Energy

2.4.2 Geothermal energy

Geothermal energy is that the energy that is made of to a lower place the globe. It's clean, property and surroundings friendly. High temperatures are created ceaselessly among the earth's crust by the slow decay of hot particles. Hot rocks gift below the globe heats up the water that produces steam. The steam is then captured that helps to manoeuvre turbines. The rotating turbines then power the generators.

Geothermal energy are typically utilised by a residential unit or on associate outsized scale by an industrial application. It completely was used throughout past for bathing and space heating. The biggest disadvantage with heat is that it'll only be created at selected sites throughout the earth. Figure 2.4 show the energy plant.



Figure 2.4: Geothermal Plant

2.4.3 Tidal Energy

Tidal energy uses rise and fall of tides to convert K.E. The generation of energy through happening power is sometimes prevailing in coastal areas. Massive investment and restricted convenience of websites are few of the drawbacks of happening energy. Happening energy is one amongst the renewable provide of energy and manufacture big energy even once the tides are at low speed. In figure 2.5 show periodic event power.

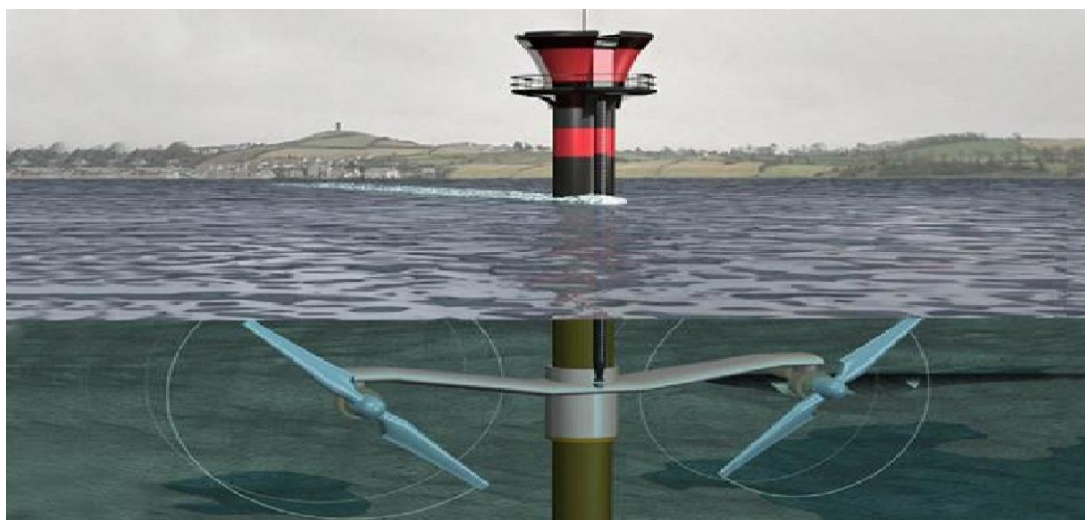


Figure 2.5: Tidal Power

2.4.4 Hydro Power

Water is kept during a reservoir, generating heaps of P.E. Then it's forced through a dam, turning a rotary engine that then turns a generator to provide electricity. Used water is then came back to the stream. Whereas a lot of work has been done to make sure that electricity power has token negative impact on the atmosphere. Their natural home ground extent and may modification the temperature and composition of the stream itself. In figure 2.6 show hydro power.



Figure 2.6: Hydro Power

2.4.5 Biomass

Biomass is additionally a renewable energy supply. It seems from living or recently living plant and animal materials which may be used as fuel. Biomass may be a stuff that produces electricity with steam. A biomass-fired station generates electricity and warmth by burning biomass during a boiler. Show in Fig 2.7 Biomass energy system.

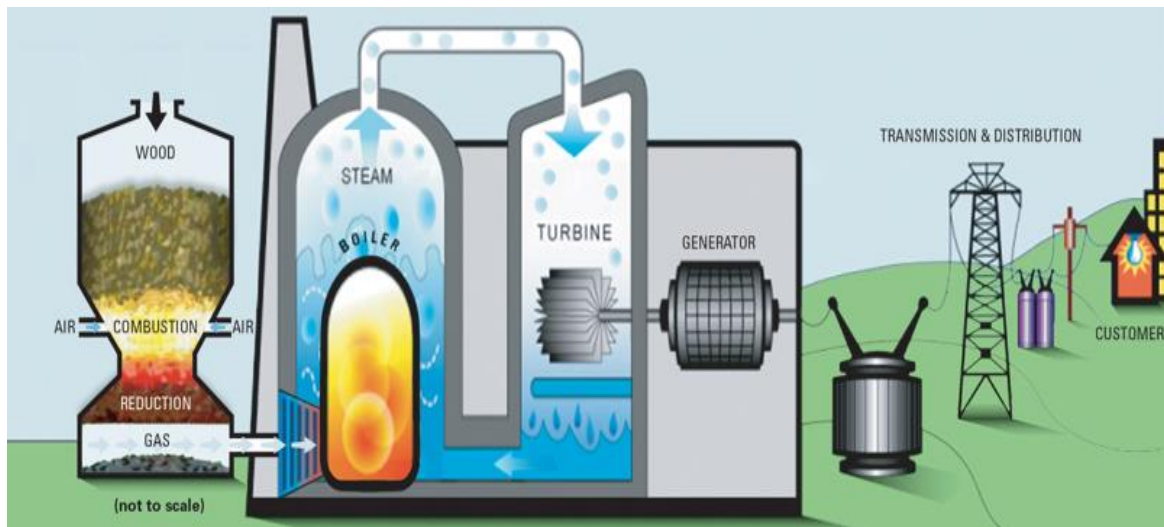


Figure-2.7: Biomass energy system

2.4.6 Solar energy

Solar energy is bright lightweight and warmth from the Sun that's controlled employing a vary of ever-evolving technologies like solar heating, photovoltaics, star thermal energy, star design, liquefied salt power plants and artificial chemical change.

Passive solar techniques embrace homing a building to the Sun, choosing materials with favourable thermal mass or light-dispersing properties, and coming up with areas that naturally flow into air. In figure 2.8 show the solar panel. There are currently two principal types of solar energy technology.

- ❖ **Solar photovoltaic (PV)**
- ❖ **Solar thermal (STE)**

Solar photovoltaic: In this system, sunlight is directly converted into electricity by using photovoltaic (PV) cells. The solar PV cells are linked within panels. These cells are fixed to the surface of a house or tower.

Solar thermal: In this system, the sunlight converts heat energy into heat water. This heat energy is to be used to conduct a refrigeration cycle to provide with solar-based cooling, or to make steam that is got to be used to generate electricity using a steam turbine. Solar thermal energy can also be used in some industrial processes that currently use gas to generate heat. Solar thermal technology uses the heat propagated by the sun to produce efficient and large-scale power generation.



Figure 2.8: The source of solar power

2.5 Energy Situation

In 2010, the Bangladesh Bureau of Statistics mentioned ninetyeth access in urban areas and solely 42nd access in rural areas. The electricity provide isn't reliable; provide doesn't meet the demand. However, as way as doable, load shedding is scheduled.

In 2013 solely associate calculable 59.6 % of the Bangladesh population is connected to the electricity grid. .From 10,213 MW put in electrical generation capability (public, personal and import), the utmost output delivered was 6,675 MW. [11]

In 2016, the entire range of customers connected to the grid is twenty one.8 million. Out of the twenty one.8 million sixteen million square measure domestic connections (households), which might represent roughly five hundredth of all Bangladeshi households (30-40 million). Another 15 August 1945 of the households have access to off-grid electricity. The govt. is estimating that over seventieth of Bangladeshi households currently have access to electricity (76%, June 2016) [11]. The govt. plans to attach ninety eight of households principally through grid extension by 2021. Power cuts and therefore the low responsibility of the ability provide area unit the foremost downside of the grid extension. Even with recently put in capacities (in total eleven, 532 MW; 13, 540 together with captive power generation) and also the import capability of five hundred MW from Bharat. However, the amount of connections is in reality increasing chop-chop with around 250.000 per month. [11]

The supply of population and trade with fashionable energy is extremely low compared to countries with similar economies. The per-capita production of business energy multiplied since 2010 to 371kWh, however continues to be one amongst very cheap within the world.

Bangladesh can most likely have to be compelled to triple that quantity so as to attain its target to become a middle financial gain country by 2021. At an equivalent time avertible energy wastage within the industrial and manage sectors mitigates an outsized share of the profit this energy may wake up the country. [11]. Also new gas connections to manager were suspended for a precise time.

Table-1: Energy situation (Source of Lights in percentage)

Source	2011	2004	1991
Grid Electricity	53; 56.6	39.77	14.37
Solar energy	6.9; 3.3	-	-
Kerosene	39.5	59.93	84.73
Biogas	0.1	-	-
Others	0.5	0.31	0.89

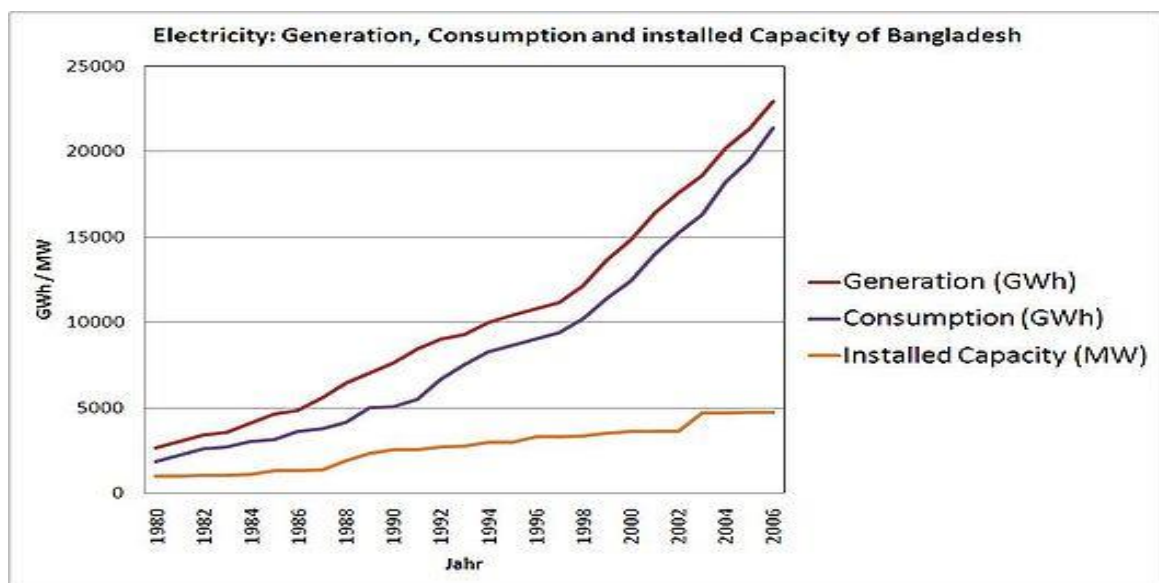


Figure-2.9: Bangladesh electricity consumption generation Capacity

2.6 Solar energy as a source of sustainable electrification

Renewable energy sources like solar energy, wind or hydropower square measure out there on associate indefinitely property basis, whereas fossil resources (oil, coal, gas) are in finite quantities. It concludes that “Energy is that the central in achieving the goal of property development [12]. A study by the world Bank in 2005 reveals that - assumptive convenience of the assorted renewable energy provide – Renewable Energy Technologies (RET) area unit the tiniest quantity worth chance for off-grid complete electrification in rural areas. In step with international Network on Energy for property Development (GNESD, 2007), whereas not adequate provides of affordable energy, it's hard to spice up health, education and reduction of monetary condition.

2.7 Importance of solar energy for rural electrification in Bangladesh

In 1971, the year of independence of Bangladesh, solely 250 out of eighty seven, 928 villages had access to electricity (BARAKAT, 2004).

By Jan 2014, over fifty,194 villages had been electrified through the Reb programme serving over 84, 22, 246 domestic line (REB, website) and 53.34% folks get access to electricity service and therefore the rest forty six.66% depends on hydrocarbon and alternative sources (BBS, 2008) [12] Therefore, solely a tiny low minority (10%) of rural Bangladeshis have access to wattage. what is more, the standard of provide is commonly dissatisfactory thanks to frequent load shedding and voltage variability (MIYAN 2004: 42) [12]. In additional remote areas, distribution line setup is additional pricey thanks to its landscape dominated by intensive areas of water, regular flooding, rough and bound regions of stream islands.

2.8 Solar roof-top System (SRS)

A rooftop photovoltaic power station, or rooftop PV system, is a photovoltaic system that has its electricity-generating solar panels mounted on the rooftop of a residential or commercial building or structure. A vital part of icon Voltaic (PV) system is that the cell, during which the photovoltaic result takes place. Once lightweight falls on the semiconductors of the Cell, it produces a low current. Photovoltaic modules, or panels, include variety of cells connected along to supply voltages and currents high enough for sensible use.. Generally, the system is observed as ‘Solar roof-top System’ (SRS). The SRS providing load is low (below one hundred W). Show in figure-2.10.

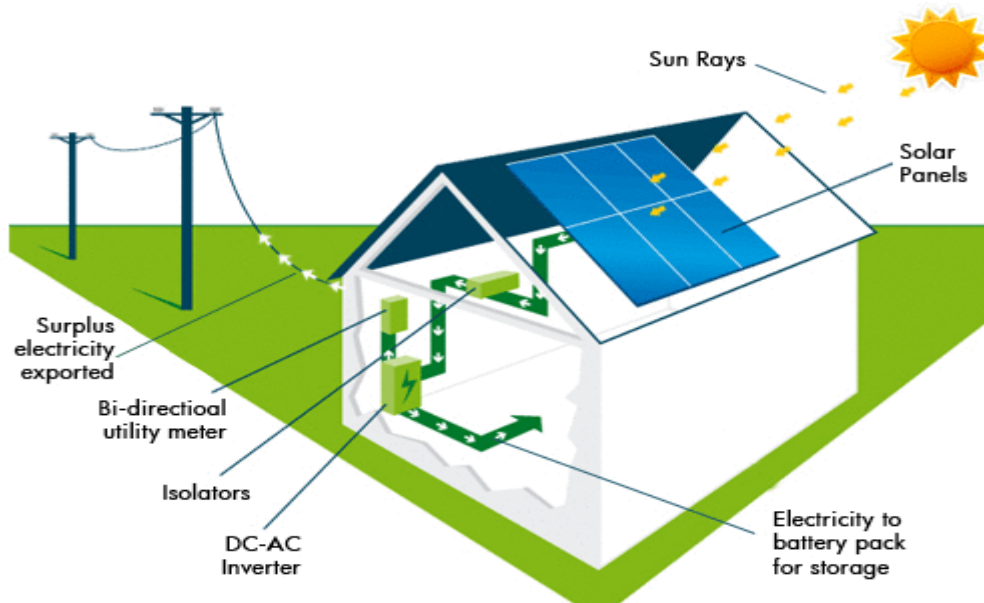


Figure-2.10: Solar Home System

2.9 Technical background of SRS

Solar Energy is that the energy from the Sun. it's usually known as 'alternative energy' to fuel and has been employed by humans for thousands of years. The photovoltaic/solar module (Figure-1) converts the daylight into electricity. It generally includes a capability of between twenty to 100WP. The battery stores the electrical energy for employment in the dark or throughout cloudy weather. In several countries, low-cost automotive batteries are used for this purpose, though they're technically not well matched for PV applications. The charge controller could be a device that manages the electrical flow through the system, and protects the battery from injury. It alerts the user as shortly because the battery desires charge or once the module isn't operating properly. Wires and connected switches distribute the electricity among the system and to the load like lights or electric appliances.

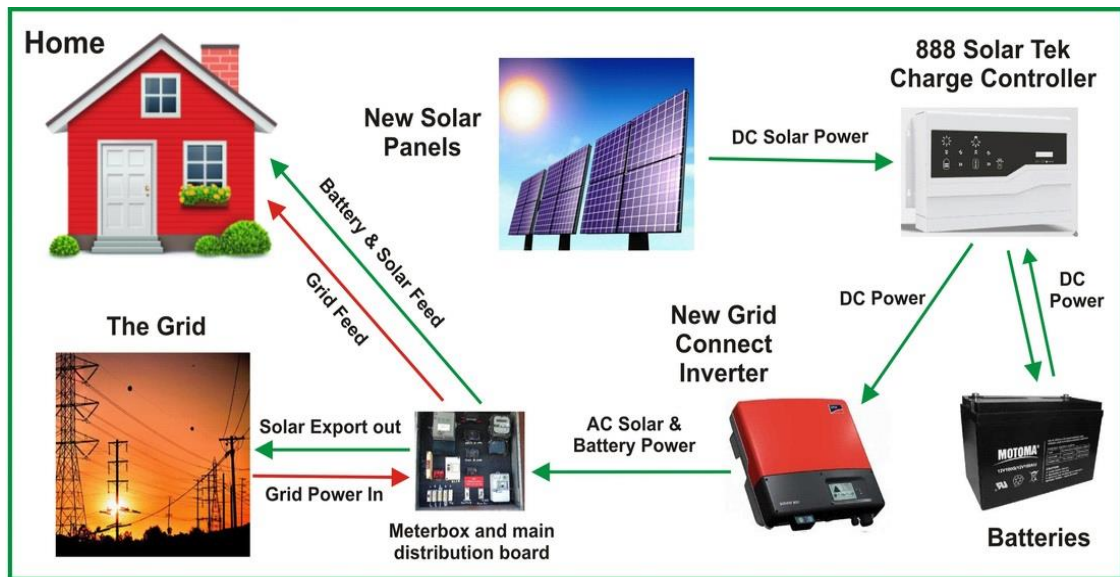


Figure 2.11: On- grid solar power system

2.9.1 Solar Photovoltaic (PV) Panels

These are the most expensive part of the system and will typically make up 60% of the cost of your system. Solar panels are the devices which are used to convert light into electricity. A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to produce electricity through the photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so spacecraft are usually designed with solar panels that can always be pointed at the Sun. There are various types of solar panel connection that are describe in below.



Figure 2.12: Solar Photovoltaic (PV) Panels

1. Parallel connection of two solar panels:

If two solar panels of the identical voltage and power are found, the connection becomes terribly simple. It'll be spare to attach the positive terminal of 1 panel to the positive pole of the opposite and connect the negative terminal of 1 panel to the negative terminal of the opposite. Nonparallel to every panel, a block diode is inserted to guard the whole string from doable faults or short circuits which will occur on the individual panels of the string.

Wiring solar battery in parallel, the amperage (current) is additive, however the voltage remains an equivalent as before. If 2 solar panels in parallel are found and every panel was rated at 12 volts and 10 amps, the whole array would be twelve volts and 20 amps. Show in Figure2.13 Parallel connection of two solar panels of same power.

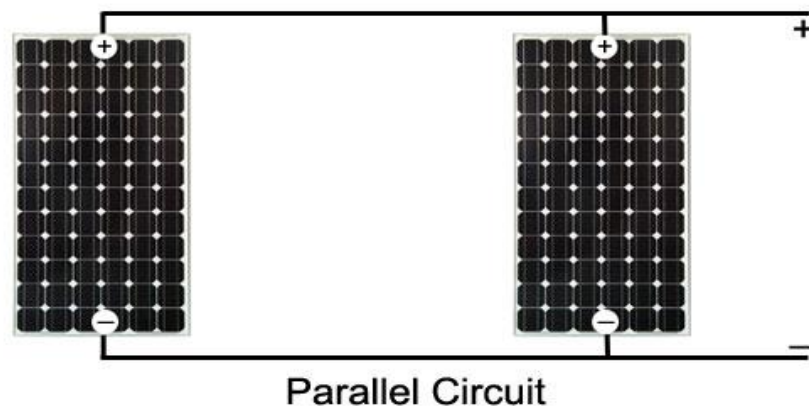


Figure 2.13: Parallel connection of two solar panels

2. Series Parallel combination of solar panels

In an off-grid photovoltaic system, the choice of the total power of the system and the tension of the battery bank must be carefully considered in the design phase. For those who want we have made available a free program to perform a correct design of a photovoltaic system, the calculation of the daily energy requirements, up to the size of the panels according to the area where it will be installed. Show in Figure-2.14: A Series-Parallel combination of solar panels.

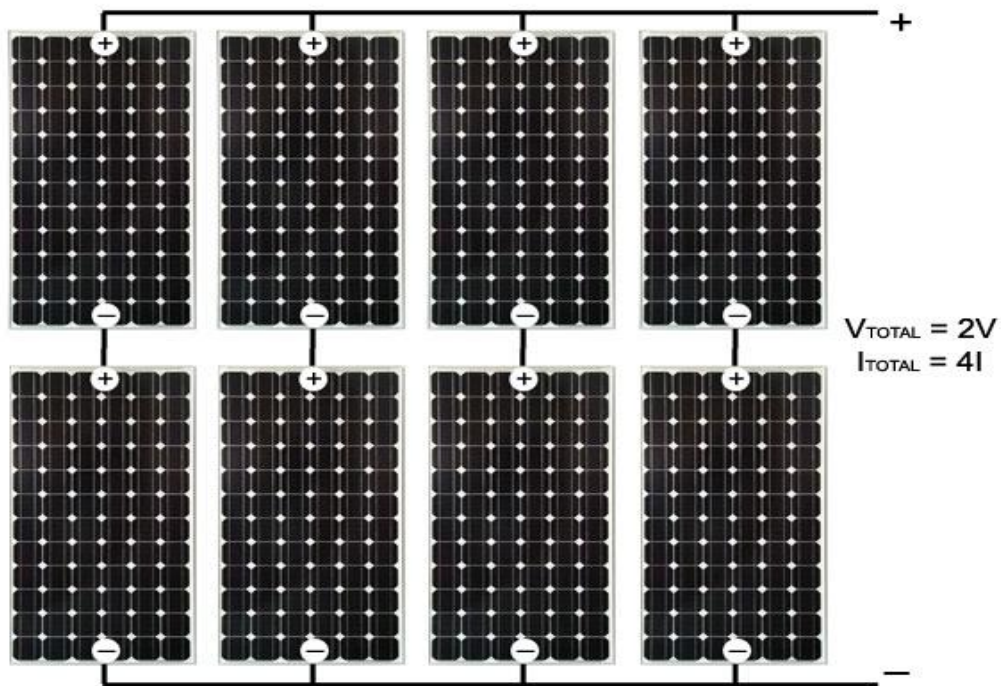


Figure-2.14: Series Parallel combination of solar panels

2.9.2 Combiner box

The solar combiner box is a device that combines the output of multiple strings of Modules for connection to the solar inverter. The PV modules are wire together in a combiner box to output the correct system voltage (VDC).



Figure 2.15: Combiner box of solar PV

2.9.3 DC Disconnect

The PV array electricity flow can be safely interrupted by DC disconnection. During those infrequent occasions when maintenance is performed on the system, this is an essential component. A DC disconnect houses an electrical switch (breaker) rated for DC circuits.

Often, the array DC disconnect is wired into the main DC disconnect (usually mounting on the side) as an additional breaker controlled by the main DC disconnect. This allows the PV array and the remainder of the DC circuitry to be powered off with one switch on the main DC disconnect panel.



Figure 2.16: DC Disconnect

2.9.4 DC to AC Inverters

A power inverter, or inverter, is an electronic device or circuitry that changes direct current to alternating current. The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. Solar inverters are the next most expensive bit of kit and can come with some really nice features.

The process of conversion of the DC current into AC current is based on the phenomenon of electromagnetic induction. Electromagnetic induction is the generation of electric potential difference in a conductor when it is exposed to varying magnetic field. For example, if you place a coil (spool of wire) near a rotating magnet, electric current will be induced in the coil.



Figure 2.17: DC to AC Inverters

2.9.5 AC Disconnect (Utility Accessible)

A Utility External Disconnect Switch (UEDS) is a disconnect device that the utility uses to isolate a PV system to prevent it from accidentally sending power to the utility grid during routine or emergency maintenance. AC output from your inverter and AC power from the grid are combined here with circuit breaker (Figure-2.18).



Figure 2.18: AC Disconnect (Utility Accessible)

2.9.6 AC mains Panel and meter

Net metering allows consumers who generate some or all of their own electricity to use that electricity anytime, instead of when it is generated. Your grid power consumption and the power production from your PV array are metered here. Net metering means you only pay the different between what you used and what you produced.



Figure 2.19: Net meter of solar PV

2.10 Progression of worldwide solar roof-top System dissemination

The use of star electricity increased at the invention of electric cell in 1839 by French man of science Edmond Becquerel. Sequent researchers have developed cells with additional potency. The primary interest in star technologies for rural complete electrification arose within the Nineteen Seventies. AN economic breakthrough occurred once Dr. Elliot Berman was able to style a less costly electric cell conveyance the value down from \$100 per watt to \$20 per watt. This Brobdingnagian price savings spread out an oversized variety of applications that weren't thought-about before attributable to high prices. The 1973 oil embargo and 1979 energy crisis caused a reorganization of energy policies round the world and brought revived attention to developing star technologies.

Since 1997, star electrification has accelerated because of provide problems with oil and gas, heating considerations and therefore the up economic position of PV relative to different energy technologies. By the tip of 2005, 2.4 million SRS had been put in worldwide with a calculable annual installation of over 270000 systems (REN twenty one 2006: 12). Dissemination of SRS

depends on affordability. In keeping with F.D.J. Nieuwenhout adequate service infrastructure is needed to form comes viable. House alternative in system sizes is usually too restricted in donor-funded comes. Smaller systems sold for money are often an honest different to credit systems by providing to exaggerated affordability [14]. Betting on their size, costs of SRS will vary between US\$ one hundred and US\$ 1,100.

Reducing the market costs of SRS by influencing the higher than factors is a crucial strategy of the many SRS dissemination programmes [15]. In recent years most of the worldwide growth in SRS sales has targeting many Asian countries, specifically Asian nation, Sri Lanka, Nepal, Bangladesh, Thailand, and China. In these countries, the matter of affordability has been overcome either with micro-credit or by marketing little systems for money .In figure-2.20 we show the exponential Growth of Global Solar System.

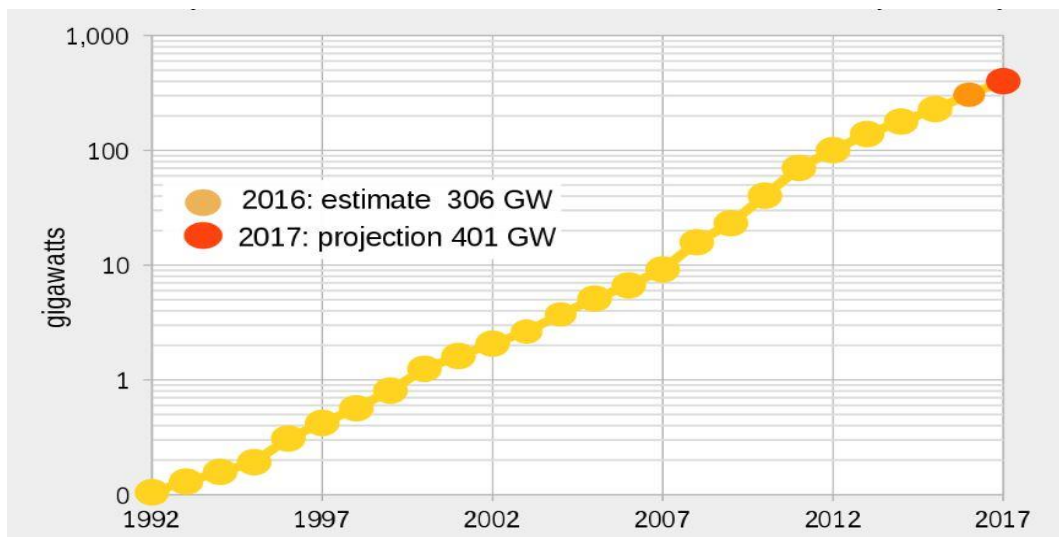


Figure-2.20: Exponential Growth of Global Solar System

2.11 Solar roof-top System dissemination in Bangladesh

The first expertise with SRS in Bangladesh was gained from 1997 forwards once the Rebel enforced a French-funded trial for the electrification of 850 households on a foreign stream island within the district of Narsingdi [16]. This trial was enforced mistreatment the questionable ‘fee for service’ model. The project proved the technical practicableness and socio-economic satisfactoriness of SRS in rural areas of Bangladesh. Expertise from this project clothed to be terribly helpful for the planning of later SRS dissemination programmes [16]. In figure-2.17 show the cumulative generation of SRS in 2005 to 2012.

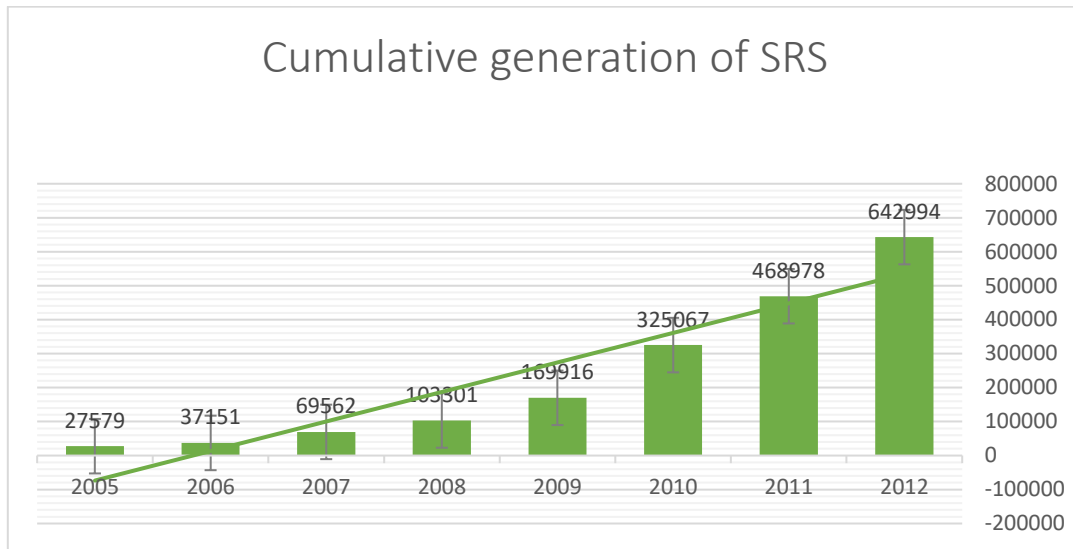


Figure-2.21 show the cumulative generation of SRS

2.12 Summary

Solar energy offers clean power. It doesn't present the risk of a nuclear spill, but it is in fact a release of radiation, only some of which is visible light. It can be scaled to any size or complexity, from warming a room through a window to powering a utility grid. Scientific American estimates the cost of solar power falling below the current average power cost by 2018 or 2020.

Chapter 3

Research Methodology

3.1 Introduction

Both primary and secondary sources are used for collecting information. The basis for primary information was interview of consumer of DPDC south zone narayangonj circle both nocs n.ganj west and n.gonj east. For secondary data Collection different websites, journals, articles and other statistical sources are used. For research on any topic data collection is one of important part .Our research topic is solar roof top system(SRS).for this topic we need to collect information both physically from field survey/field study and some other information from different sources about SRS system.

3.2 Conceptual framework

In figure 3.1 show the flow chart of our household survey.

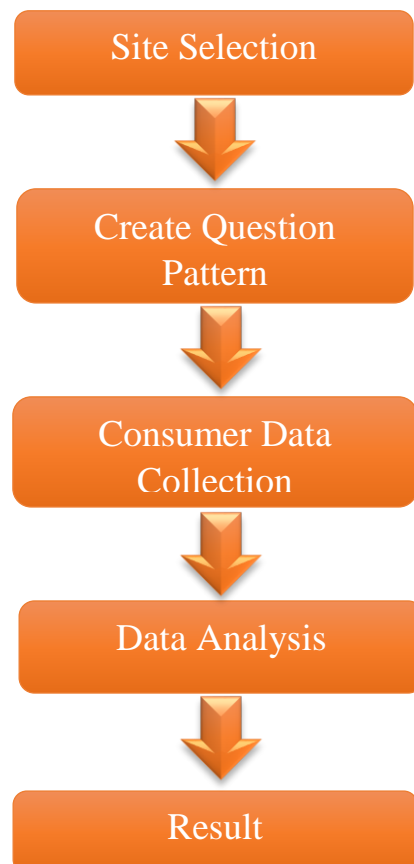


Figure-3.1: Flow chart of our household survey

3.3 Site Selection



Figure 3.2: Narayanganj District (one of highly industrialized district)

3.3.1 Narayanganj District

Narayanganj could be a district in central Bangladesh, a part of the national capital Division. The traditional town of Sonargaon is in Narayanganj. It's situated within the bank of Meghna and Shytolkha watercourse. The most center of the district is Narayanganj town. Its adjuncts with is capital town of national capital. Narayanganj is one among the oldest industrial District of Bangladesh. It's additionally a middle of business and trade, particularly the jute trade and process plants, and also the textile sector of the country.

3.3.2 SRS on DPDC South zone Narayangonj circle area map

This map is to show the south zone of Narayangonj district under Dhaka power development company (DPDC).

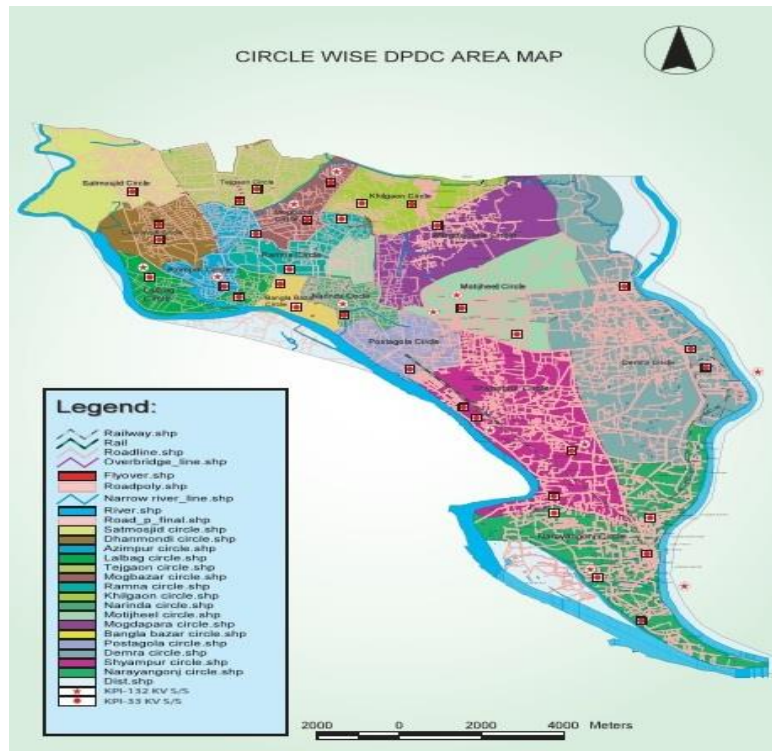


Figure 3.3: DPDC south zone Narayangonj (light green color) circle area map

3.4 Household survey:

To reveal quantitative as well as qualitative information from users of SRS, empirical household level data are collected through a household survey conducted in three villages shown by the following table-2

Table-2: Variables, Indicators, Operational definition

SL	Indicator	Question	Description
1	Consumer information and Demo graphic analysis	1.Consumer Name 2.Consumer No 3.Consumer Address 4.Consumer Contact 5.Zone	For SRS data analysis the consumer information collection is 1st step.
2	Information of SRS installation	1.Why install SRS 2. Where they buy 3. What are the types of SRS 4. What is panel capacity 5. What is the date of installation 6. How much cost of installation SRS	The 2 nd step is to collect information about SRS installation
3	Information of SRS on Operation and Maintenance	1.Is it running 2.Do they test it regular basis 3.How many days ago 4.Do they use electricity from SRS 5.In which purpose they installed SRS 6.Do they have maintenance training 7. What is the main reason for system disorder 8.Do they feed SRS power on grid 9.Do they want to repair and clean it	The 3 rd step is to collect SRS data on operational information and maintenance
4	Information of SRS on Cost Analysis	1. What is the total cost of SRS installation(Initial) 2. What is total cost of SRS maintenance(yearly) 3.Do they feed SRS power on grid	This part, we collect data of their total cost of installation and maintenance. This is the most important

		4. Do you get any support from govt.	part of SRS Data Analysis
5	Consumer Satisfaction	1.Do they face any survey 2.Do they think SRS is useful 3.Do they think ,is it waste of money 4.Do they want increase the SRS capacity	This is another important information of consumer satisfaction SRS

3.5 Summary

The following chapters portrays to our field study work, the details idea about our survey on solar roof top system. This chapter we show overall concept to our survey and also show the question pattern in section wise to our survey.

Chapter 4

Result and Discussion

4.1 Introduction

Background, concept, policy and gift scenario of solar electrification dissemination for rural areas are mentioned. It's ascertained from the previous discussion that energy plays the key role for development. Thanks to rise of fuel value and increasing carbon emission worldwide, there's a world shift towards renewable energy like star, wind etc. Being in tropical region, People's Republic of Bangladesh may be a solar power made country. Solar power will play an important and secure energy supply for property development. The most objective of this study is to assess the impacts of solar power in rural areas of Bangladesh. To verify the target through empirical observation, a cross-sectional of thirty arbitrarily designated households in 3 villages are surveyed with a structured form. The survey results ar analyzed as follows within the following sections.

4.2 An overview of sample villages

As mention in methodology the survey is conducted in five villages. New chashara, Bscic narayanganj, Fatulla, Siddhirganj and Rupganj. For (Area A) is the biggest of the surveyed area with an estimated 1,500 households. The next electric grid line is about 10km away from the village. SRS dissemination was started around six years ago.

Bscic industrial area narayanganj (Area B) is slightly smaller with about 3,416 inhabitants. The village constitutes approximately 700 households. More than 300% of Households are equipped with SRS and it dissemination was started more than five years ago. We was taken approximately 50% data at this two area.

4.3 Demographic analysis of households

A total of 28 respondents are interviewed for primary data collection in the survey. 3 household are in new Chashara, 8 household are in Bscic industrial area, 4 household are in Fatulla. And

rest of the household are in Ikbal Road, Masdia, Sasuja Road. Table-3 present the number of household.

Table-3: Number of consumer in different area

Area	Number
Chashara	3
Bscic	8
Fatulla	4
Masdiyer	5
B.B Road	4
Ikbal Road	2
Sasuja Road	2

In figure 4.1 show present the percentage of distribution of consumer. In our survey we collected maximum data up to 30% in the area of new Bscic. Up to 20% data from Masdiya, 15% from Ikbal road and BB road show in figure.

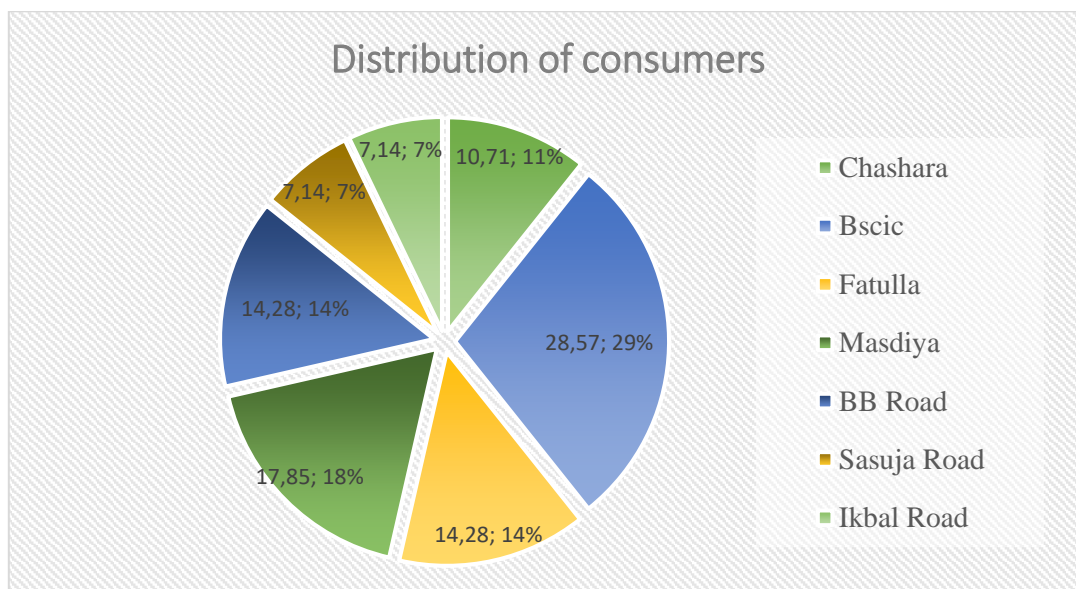


Figure-4.1: Distribution of consumer number

4.4 Information of SRS installation

In table-4: Show total 28 household SRS capacity, Installation cost, Installation date and Generation.

Table-4: Information About household SRS

SL No	Capacity (kW)	Installation cost (BDT)	Installation Date	Generation (kWh)
1	1.92	200000	2016	519
2	1	120000	2016	1301.63
3	8.4	670000	2017	3131
4	2	210000	2016	1512
5	5	450000	2018	260
6	3	1100000	2018	1.5
7	1	85000	2017	Disorder
8	6	600000	2017	108.42
9	7.5	620000	2016	156.42
10	2.4	210000	2015	612
11	5	480000	2016	3602.02
12	9.4	840000	2015	5268.02
13	2.8	250000	2016	1206.84
14	7	540000	2015	3842.12
15	4	311000	2014	Disorder
16	2.8	250000	2016	1011.56
17	1	800000	2015	Disorder
18	1.9	200000	2017	Disorder
19	5	450000	2016	1990
20	2.4	220000	2016	635
21	2	211000	2017	Disorder
22	1.5	180000	2015	465.26
23	1	75000	2017	Disorder
24	3	300000	2016	500
25	2.9	300000	2015	Disorder

26	5	450000	2017	Disorder
27	4.5	400000	2016	756.23
28	2	150000	2017	526

4.4.1 Type of SRS

In our survey we found maximum number of on-grid connection, but some case we found off-grid connection. We get total 19 on-grid and 9 off-grid connection. Figure-4.2 show ON-Off grid SRS installation Chart location wise

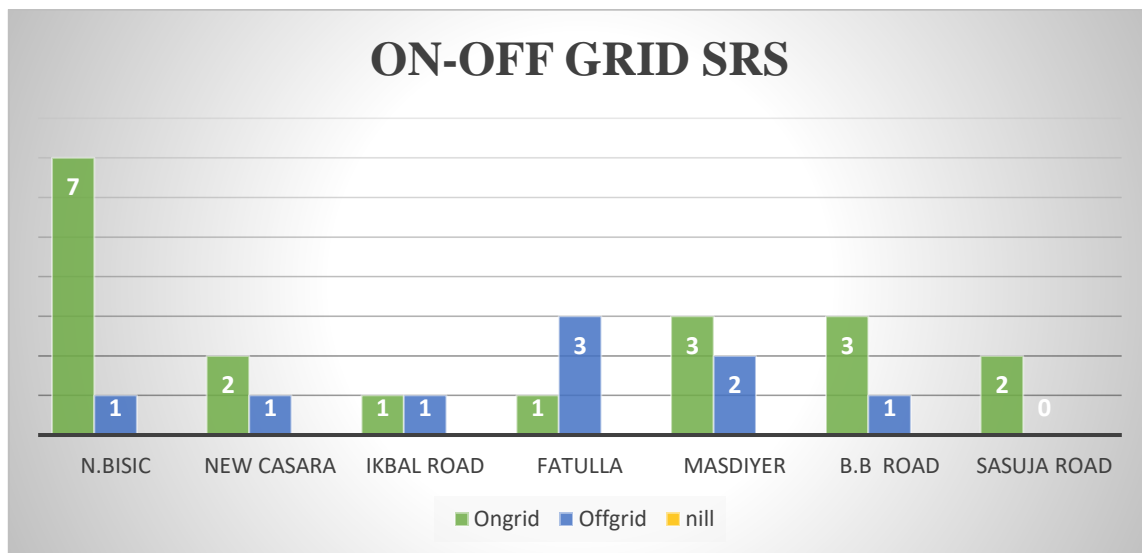


Figure-4.2: ON-Off grid SRS installation Chart (location wise)

The area of Narayanganj new basic we get maximum number of on-grid connection and only one number of off-grid connection. In Ikbal-road (Narayanganj) we get equal number of on-grid and off-grid. In Fatulla (Narayanganj) we get maximum number of off-grid connection and Sasuja-road we get all number of on-grid connection.

4.4.2 Reason Behind SRS Installation

In our survey we found, most of the people installed Solar roof-top System by maintain policy. But some of the household was installed Solar roof-top System by their own wishes. Figure-4.3 present the distribution of household by the reason of installed SRS.

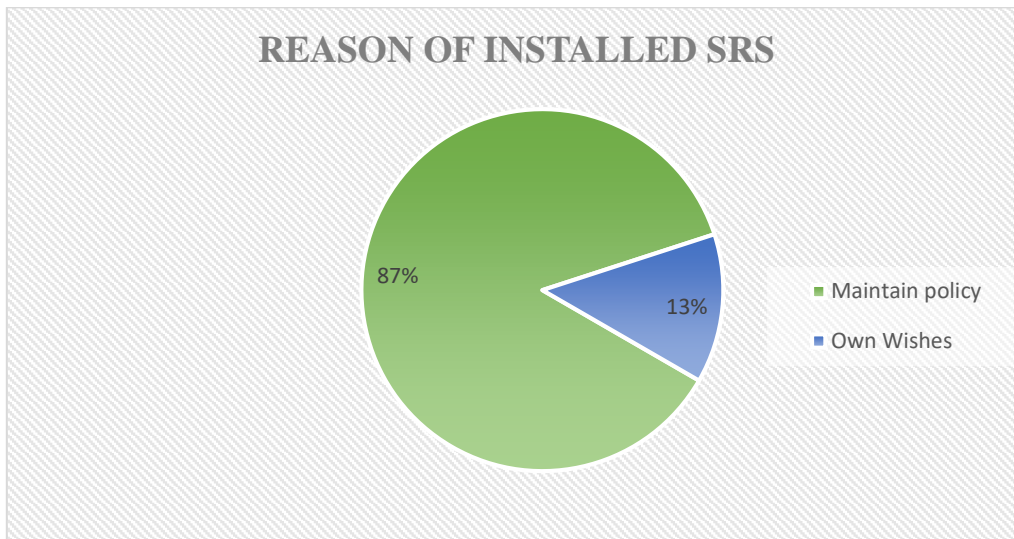


Figure-4.3: Distribution of consumer by the reason of installed SRS

In our survey we get maximum number of consumers installed SRS by maintaining policy. Only 13% consumers installed SRS for their own wishes. This analysis get us the clear idea about consumers that they have no own wishes to install SRS. Maximum consumers thought that it's totally waste of money because they are not too much conscious about electricity generation in Bangladesh.

4.4.3 Source of Brought of SRS

In this chart shows the comparison between the market and Agency. Around 36% of the consumer brought the SRS from an agency and opposite 64% of the consumer brought the SRS from the market.

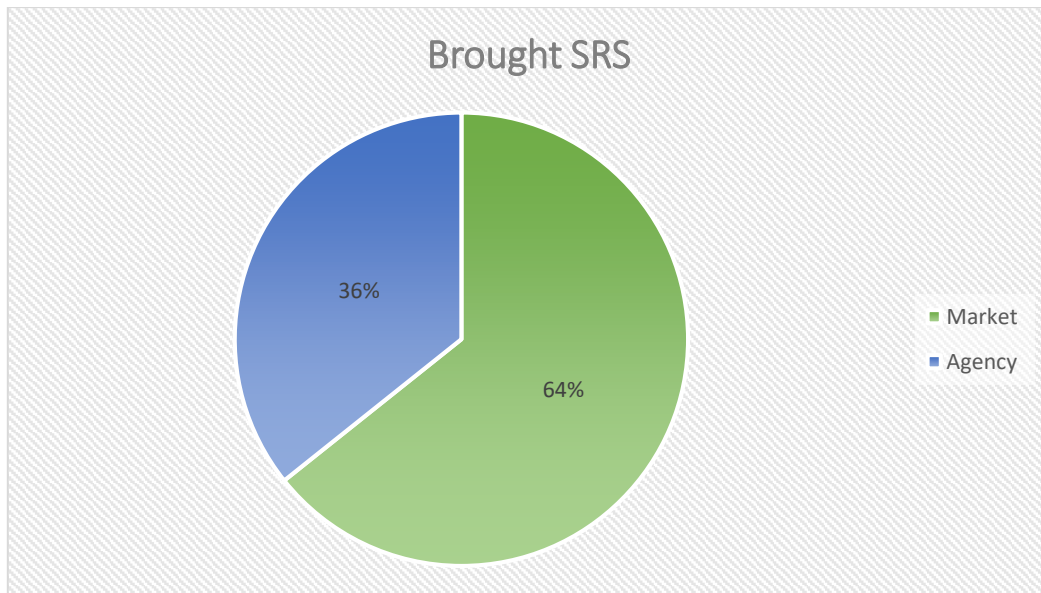


Figure-4.4: Brought SRS

We see that maximum number consumers brought SRS from local market. It might be reason of system disorder. Because the product of local market not be always good. But 36% consumers brought from agency under DPDC.

4.5 Information of SRS on Operation and Maintenance

In our survey we collect data about the information of SRS operation and maintenance. We collect data on the number of SRS connection is running or close.

4.5.1 SRS in Operation

In our survey we found that large number of solar panel was shut-down because of lack of knowledge about solar system and their maintenance. In some case we observed that panel not found. In figure-4.5 show the percentage of solar panel is running or shut-down.

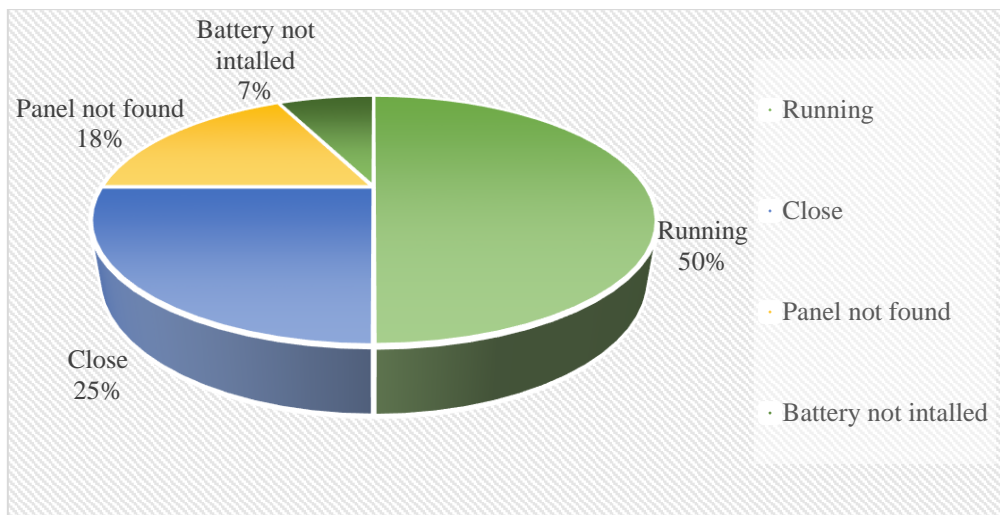


Figure-4.5: Distribution the percentage of solar running or close

In our survey we get 50% panel are running. But rest of other 50% remain closed for different reasons. 25% panel totally close because of they have no idea about solar operation and maintenance. In some case we found that there was no panel, that's means they sold it because they lost their interest about using solar.

4.5.2 System Maintenance

Most of the consumer does not test their system on a regular basis. Even if the system is found disorder, they don't either want to repair it. Majority of the consumers do not have the record of the solar electricity. A minor number of consumers have kept the record of the reading of solar electricity. They neither associate any trainer for the SRS operation. Nor clean their panel. So, the number of people who clean their panel is very limited. A chart about the maintenance system is given here. In this chart, it is seen that among 28 consumers, only 8 consumers have been testing the system on a regular basis. Only 10 consumers have got the record of the electricity from SRS, and 16 consumers haven't got the record right. Only 12 consumes clean the panel where 16 consumers do not either feel the necessity to clean the panel at all. In addition, only 6 consumers are interested to repair their system if it disordered and the rest 22 consumers are not interested at all to repair the system show in figure-4.6.

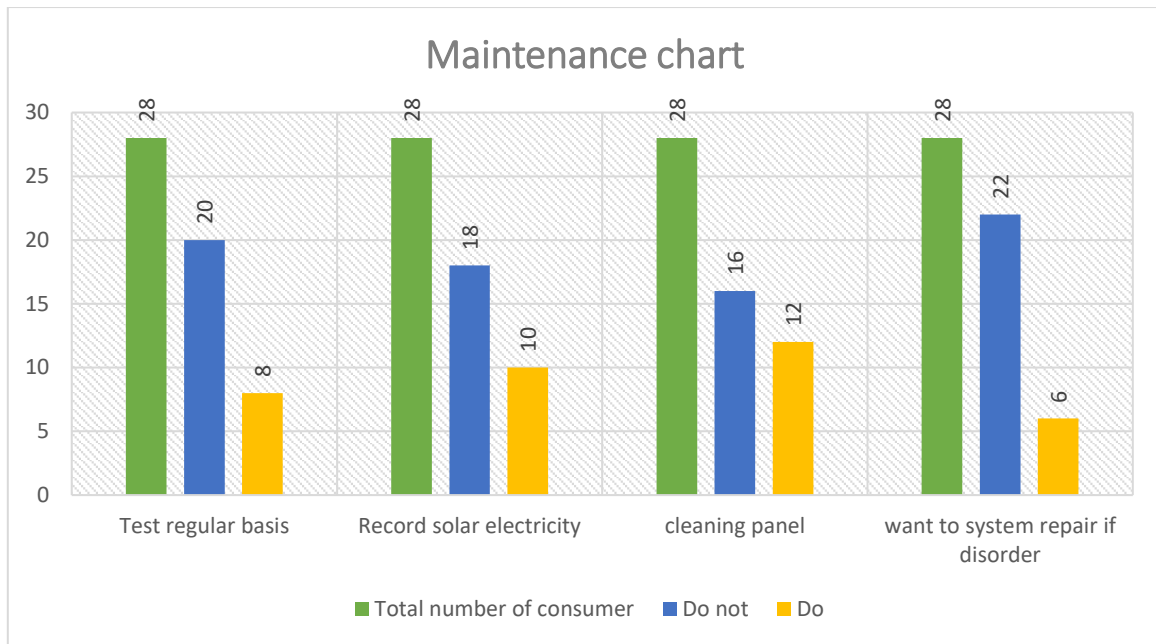


Figure-4.6: Maintenance chart

4.5.3 Reason Behind of system disorder

The main Reason of System Disorder is technical issues. But large number of solar system was disorder due to maintenance. The household haven't knowledge about solar repair and maintenance for these reason it is shut-down. Figure-4.7 present the percentage of reason of system disorder.

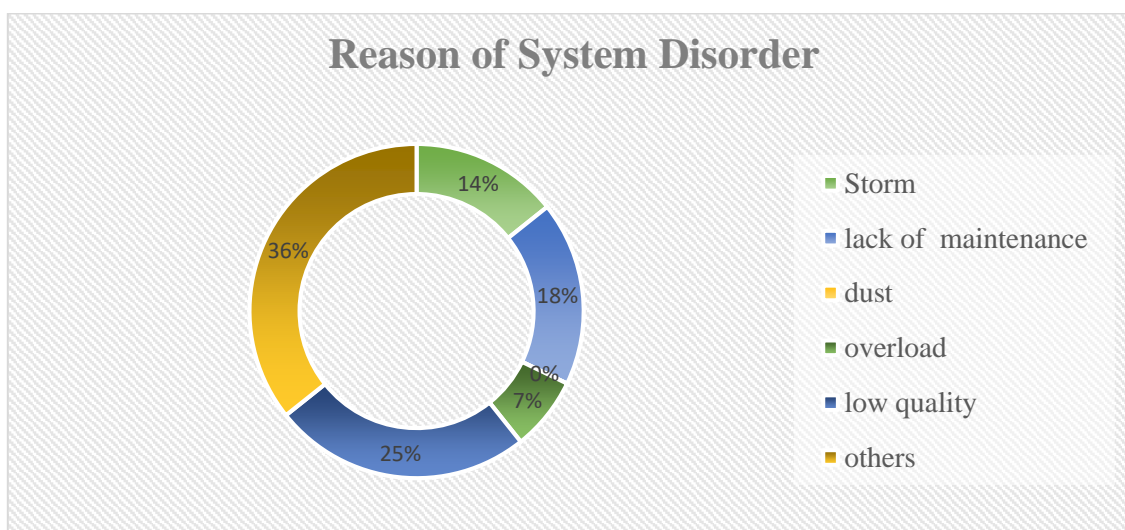


Figure-4.7: Percentage of reason of system disorder

In our survey we discovered reason behind of system disorder. Maximum number of system are disorder for their low quality. Lack of maintenance are the major cause of system disorder. Besides overload, storm, dust might be the reason of system disorder.

4.6 Cost analysis

Consumer name: Anwar Hossain

Address : Bscic industrial area, Narayangonj

Installed by : Grameen Shakti.

Installation date: 30.07.16

Survey Date : 20.11.2018

Capacity : 1 kW

Price : 120000 BDT

Energy generated: 1301.63 kWh

Total energy generated per month = $1301.63/28 = 46.48$ kWh

Energy generated per year = $46.48*12 = 557.84$ kWh

Life time energy generated = $557.84*20 = 11156.82$ kWh

Cost per unit = $120000/11156.82 = 10.75$ taka/kWh

4.7 Consumers Satisfaction

Every households desires electricity as it facilitates quality life in survey area. Due to unavailable of lots of grid line electricity as their expectation and due to high cost of electricity SRS users are satisfied with the system. Nearly 80% household member expresses their satisfaction and 20% household member expresses their dissatisfaction with the present system.

Table-5 illustrates the survey result.

Table-5: Satisfaction with the use of SRS

Attitude of households	Percentage
Highly dissatisfied	8.9
Dissatisfied	11.1
Satisfied	16.7
Moderately satisfied	26.7
Highly Satisfied	36.7

4.7.1 Consumers Opinion

In the following chart, the comparison of how many consumers accepts the system as a waste of money and how many of them find it useful. The comparison shows that 28 consumers are judged totally. According to the result, 13 consumers think that the installed system has just been a waste of their money, 5 consumers found the system useful, 2 consumers did not either make any comments on this question and 8 consumers are interested and want to increase the capacity of the SRS show in figure-4.8.

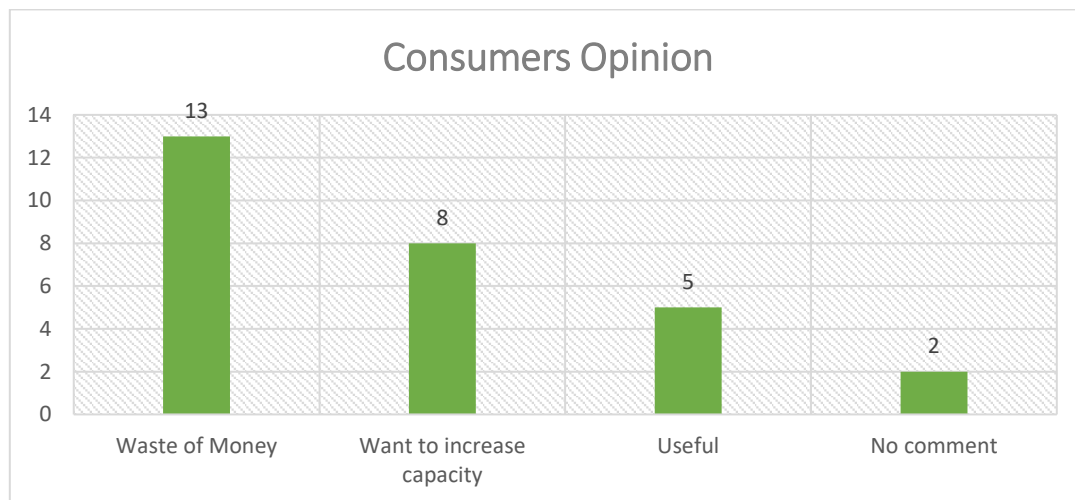


Figure-4.8: Consumer opinion

4.8 Thesis finding

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

4.8.1 Lack of Knowledge

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

4.8.2 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.

4.8.3 Government Initiative

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

4.8.4 Need to change Consumer/People unconscious mentality about SRS

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

4.9 Recommendation

In survey, it's found that, there's a substantial chance of Bangladesh to fulfill its future power demand and so economic process through renewable resources. Solar power sources mentioned on top of will facilitate East Pakistan to provide additional power so as to cut back limitation downside. Time has come back to appear forward and work with these renewable energy fields to provide electricity instead of relying totally on standard technique. Already SRS established in our country.

In survey, it's found that the quantity of SRS will increase the affordability by getting scheme in rural areas. The role of SRS on unit financial gain is discovered to be quite restricted, as SRS electricity is not often used fruitfully. Lack of information on productive use of SRS and also the non-availability of star electrical appliances are found to be the most reasons for this case. In order to get rid of the impediments and increase effectiveness the SRS in geographical area following necessary actions is taken.

- Government should foster research programs for harnessing, conversion and consumption solar energy technologies.
- 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

Conclusions

5.1 Conclusion

Now-a-days the momentum, dynamics and property of a civilization depend upon energy. Hence, a country may be thought-about as civilized one if its comfortable access to energy as needed for the commercial, agricultural and economic process. We figure out that total 80% consumer are satisfied and rest of the 20% consumer is not satisfied on their SRS. From this 80% satisfied consumer maximum 50% are commercial consumer and rest of the 30% is noncommercial consumer on SRS. Now we have to focus on the rest of the 20% unsatisfied consumer because from all type of renewable energy solar is much cheaper but its initial cost is very high. If we are bound to in policy obligation then we need use this SRS with proper operational and maintenance knowledge because we are investing our valuable asset on it, not only this for getting maximum output from this SRS we need to clean it regular basis and take meter reading regularly

Reduction of greenhouse gas (CO₂) emissions is discovered compared to former employment of lamp oil for lighting functions. However disposal of previous batteries constitutes the sole potential negative impact of SRS that may represent a heavy threat to natural resources. Accenting previous batteries assortment and introduction of reliable battery employment system will scale back the threat.

Human life directly depends on electricity. In Bangladesh, the generation of electricity is generally addicted to gas and fuel. Since these resources are restricted, solar power are going to be the most supply of electricity. Researcher, influential person, development partner acknowledged the large prospect of star electricity in country of Bangladesh. Despite the potential of star electricity to change state rural development, access to the current technology has not been translated into widespread adoption in country. Right incentives, policy alignment, development of native technological capabilities, political and institutional support is incredibly abundant essential for property and effective use of SRS. Currently it's time to integrate structural got wind of for exploitation this untapped resource.

5.2 Future Work

This survey was taken place in various areas of Narayanganj throughout an inquiry form. It is found that 90 percent of the interviewed people are not satisfied with the system and its actualization. A hypothetical discussion has been going on that another survey will be covered within Dhaka city under DPDC as well. The principal of this objective will be to circulate the usefulness and its effectiveness to more people who keep a limited knowledge about solar rooftop system. Among the circulation, an inquiry form will be also provided to the interviewed crew. It is hypothesized that a stimulation lesson will be discussed with the people, not going with the system due to having a minor knowledge about it.

From all renewable energy power source in our country as well as the globally solar roof top system is perfect for our energy generation. If government and businessman seat together and discuss about the current solar energy price (still now per watt solar energy production cost near about 70-90BDT) to make all this solar system equipment at reasonable price then general people can able to buy and use this renewable energy, make our country environmental friendly. We hope within few years' government and businessman will take necessary steps to build solar power base national grid.

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