SOLAR Electricity As Renewable Energy In Bangladesh For Home Systems

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

by

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Certification

This is to certify that this project and thesis entitled "**SOLAR Electricity As Renewable Energy In Bangladesh For Home Systems**" is done by me and this work has been carried out by me in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

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The project and thesis entitled **"SOLAR Electricity As Renewable Energy In Bangladesh For Home Systems,"** submitted by **Md. Habibur Rahman**, ID No: **131-33-1305** has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering** on 18th October 2020.

Declaration

I hereby announce that, in partial fulfillment of the Bachelor of Science in Electrical & Electronic Engineering, the thesis entitled “SOLAR Electricity As Renewable Energy

In Bangladesh For Home Systems” is proposed to the Department of Electrical & Electronic Engineering of Daffodil International University. This is my original thesis and has not been published elsewhere for any such degree or publishing recognition.

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Acknowledgement

Thanks to the Almighty, the Founder and Sustainer, who gave me the strength and opportunity to complete the " SOLAR Electricity as Renewable Energy in Bangladesh for Home Systems " study.

I take this opportunity to recognize the tremendous support of those individuals who have helped me conclude this study successfully and also extend me special gratitude to

Md. Mahbub-Ud-Jaman and **Md. Ramjan Ali** Sir, who gave me an opportunity to make this study report with several helpful recommendations and style.

Last but not least, I extend my gratitude to all individuals and associates who always inspire me and support me at all times.

Md. Habibur Rahman

Abstract

Connection to power is one of the key factors affecting a country's socio-economic stability. Bangladesh is currently distressed by an acute electricity crisis. Around 65% of individuals lack access to electricity and most of them live in villages. The power produced was insufficient to satisfy the demand, resulting in a load shedding of up to a limit of 1500 MW. In this scenario, "Solar Home Systems" technology may be a wise move by harnessing the country's free-flowing natural source of energy such as sunlight to solve this issue. Installation of Solar Home Systems has grown enormously in the last 20 years and now its installations are growing day by day. So it's high time to assess the effects of SHS in our region. This outcome will help us to more successfully tackle our energy crisis.

SOLAR Electricity As Renewable Energy

In Bangladesh For Home Systems

Chapter-1
Introduction

1.1 Introduction

Electricity load control is a pressing need to improve the industry in a sustainable way. Only this will provide our people and the world with greater value. It is beyond our reach to tap the sun 's resources, and for developing nations, this is a golden chance. For more developing countries, solar power is an growing sector that will benefit from lower energy prices over time. It is also beneficial for the atmosphere because it substitutes conventional energy generation practices and, in addition, unhealthy ones. In addition to solar, there are other renewable energy methods, although it is particularly feasible for sunny areas that have less wind and water supplies. Solar panels are turning into more effective models than ever because of the extensive research being carried out in this area. The higher level of competition between producers often permits cheaper prices.

The motives for preferring solar energy are also clearly demonstrated by the-number of initiatives initiated by different organisations and governments. Applications for this energy supply can range from single houses to wide power grids to vehicles, providing the right flexibility for a developing country's needs.

Due to numerous factors, such as growing population, hopes for better living standards and general economic and industrial development, existing energy demand is rising day by day in Bangladesh. The main dependency of the power generation system is on imported petroleum oil and own natural gas. On the other hand, as the details on the fossil fuel resources in Bangladesh, if they are, Reversed natural gas and coal are absorbed at the current rate and will be gone by 2020 to 2030. The new power generation infrastructure must be diversified and, at the same time, renewable energy resources must be exploited and established in order to reduce the reliance on imported fuel and the burden on natural gas. It should be noticed that environmental issues are now a common problem and that fossil technology generates greenhouse gases with detrimental effects on health and the atmosphere. The production of renewable energy and the advancement of relative technology is a highly significant strategic choice in these viewpoints. Communities in rural areas, and especially in remote areas of Bangladesh, have very little ability to take part in the national supply of electricity. Therefore, and in the light of the conservation of the atmosphere, renewable energy resources will Some of the main challenges assessing the need for technical inventions to address energy challenges in rural areas are adding greatly to the supply of renewable resources to consumers, etc.

1.2 ELECTRICITY DEMAND Expected

1.2.1 Master Plan Power Structure, 2005

The forecast of the market for energy should best be made in terms of the development of the individual end-user industries. The demand prediction is based on an exceptional historical association between energy demand and GDP and three GDP growth projections up to 2025. GDP statistics whose weighted average annual growth rate is 5.2 percent are included in the Base case. The average annual pace of low-case GDP numbers is 4.5%. The high case is based on a GOB prediction for an estimated annual pace of 8.0%. These GDP growth rates yield growth rates of net energy consumption of 7.9 percent for the base case, 6.7 percent for the low case, and 12.0 percent for the high case, to 2025. In all three cases, transmission and delivery losses are therefore projected to continue to decline. They will decline to 3.0 percent for transmission by 2018. By 2019, delivery losses will decrease to 10 percent.

1.2.2 The Market for Electricity Expected (Base Case)

	2005	**2010**	**2015**	**2020**	**2025**
GDP (million Taka)	2,634,409	3,525,434	4,607,601	5,880,596	7,328,292
Growth Rate (%)	5.3	6.0	5.5	5.0	4.5
Total GWh	21,964	33,828	50,306	72,222	100,083

Net Peak Load (MW)	4,308	6,608	9,786	13,993	19,312
Load Factor	58.2	58.4	58.7	58.9	59.2

1.2.3 The Market for Electricity Expected (High Case)

	2005	**2010**	**2015**	**2020**	**2025**
GDP (million Taka)	2,664,431	3,525,434	4,607,601	5,880,596	7,328,292
Growth Rate (%)	6.5	6.0	5.5	5.0	4.5
Total GWh	22,336	37,652	68,924	126,172	217,137
Net Peak Load (MW)	4,381	7,355	13,408	24,445	41,899
Load Factor	58.2	58.4	58.7	58.9	59.2

1.2.4 The Energy Demand Expected (Low Case)

	2005	**2010**	**2015**	**2020**	**2025**
GDP (million Taka)	2,634,409	3,362,248	4,189,972	5,221,468	6,352,714
Growth Rate (%)	5.3	5.0	4.5	4.5	4.0
Total GWh	21,964	31,533	43,697	60,553	80,982
Net Peak Load (MW)	4,308	6,160	8,501	11,732	15,626
Load Factor	58.2	58.4	58.7	58.9	59.2

1.2.5 Electricity Analysis Programme of the new Government

For the period 2010-2021, the Perspective Proposal of the Planning Commission of the Government of Bangladesh has proposed an energy mix to produce 20,000 MW of generation by 2021. Electricity output goals are 7,000 MW and 8000 MW , respectively, by 2013 and 2015. The energy balance for power output is as follows, according to the Perspective Model. Energy balance for power generation from the 2010-2025 Outlook Strategy.

Energy Sources	Target Period		
	Current	2021	2030
Gas	88%	30%	28%
Coal	3.7%	53%	38%
Oil	6%	3%	5%
Hydro	2.7%	1%	4%
Nuclear	0%	10%	19%
Renewable	0%	3%	6%

Source: The 2010-2021 Bangladesh Perspective Programme

1.3 The Energy Concept

The capacity to do work is the theoretical concept of electricity. It can also be characterized as force that can be turned into motion or that can lead to resistance being overcome. Kinetics and potential are the two primary sources of electricity.

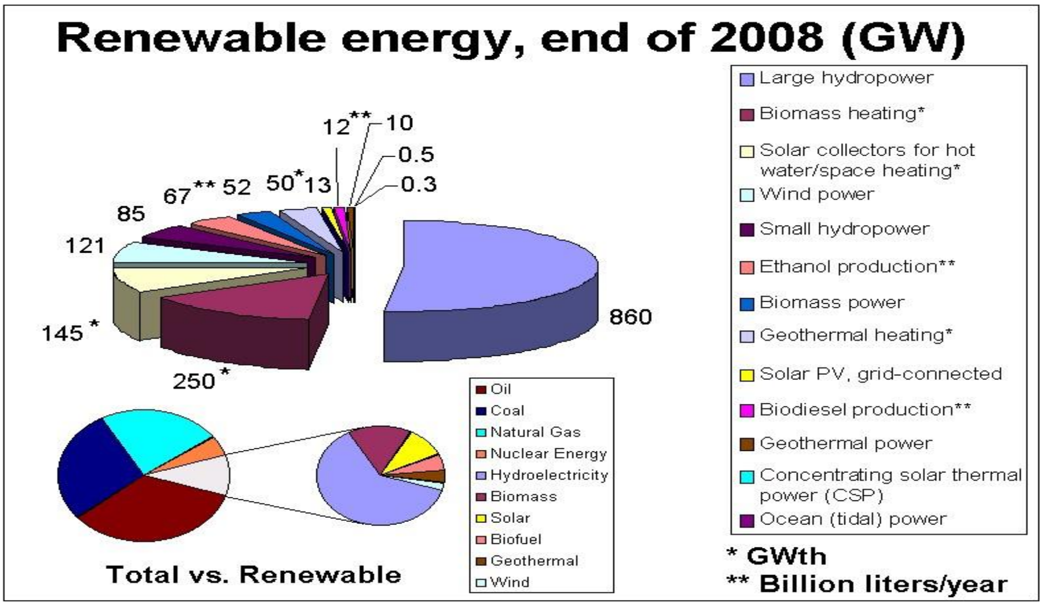
1.4 Electricity from renewable sources

Any energy resource obtained directly from the sun (such as thermal, photochemical, and photoelectric), indirectly from the sun (such as wind , hydropower, and photosynthetic energy contained in biomass), or from other natural motions and processes of the environment (such as geothermal and tidal energy) that is naturally regenerated over a short time scale. Renewable energy does not include fossil fuel-derived energy supplies, fossil fuel waste products, or inorganic waste products.

1.4.1 Green energy forms.

- Biomass
- Geothermal Resources
- Wind Energy
- Cells of Photovoltaic (PV)
- Hydroelectricity

1.4.2 Main Green Energy Forms / Sources



1.5 Benefits of Green Energies

- It is highly renewable since it is extracted from inexhaustible sources.
- No greenhouse gases or hazardous waste are released, making the planet a healthier and safer environment.
- It is extremely cost effective since the power plant would not need to be supplied with diesel.
- It is also cost efficient because the operation of a renewable energy station needs less manpower and needs less upkeep.
- Since many renewable energy projects are located further from major cities, they will offer economic benefits to rural areas.
- For existing buildings, sustainable energy sources such as solar power may be implemented to make them more environmentally sustainable and energy efficient.
- Some sources of renewable energy, such as geothermal steam plants, take up less land and can work day and night than larger traditional power plants.

- In order to generate more electricity at peak periods and be idle during lulls in electricity use, hydroelectric power stations can be regulated.
- Biomass energy aims to reduce the volume of rubbish taken to landfills.

- In most cases, if a person has a source of renewable energy , such as solar power, added to their home or company, they may sell some surplus electricity back to the grid, minimizing the total number of fossil-fuel powered homes or companies.

1.6 Ongoing Renewable Energy Technology (RET)

Bangladesh Schemes

- Strategy for the production of green energies- REB / IDCON.
- LGED-Sustainable Rural Electricity
- Project for Solar & Wind resource evaluation- RERC, DU-SHS project- Grameen Sakti.
- PREGA- REB / BPDB• GTZ-REB funded initiative.
- Pilot project for biogas- LGED.
- Project SHS- BRAC.
- Project CHT SHS- BPDB.
- Analysis of RET viability- BCSIR.
- Project-TMSS SHS.
- Solar home lighting system-Centre for Science Mass Education (CMES)
- Integrated Production Foundation (IDF) • Solar home system-
- Generation of wind power- BPDBB
- Grameen Sakti, BRAC. • Mixed device.
- LGED-Wind Mill Water Pumping.
- Micro hydroelectric power plant- LGED.
- Biogas-BCSIR, BRAC trees.

Chapter-2
Sun and Energy

2.1 The Sun

A star is the sun. Of our solar system, which is the largest entity and one of the bigger stars of our galaxies. In its heart, the source of energy in the Sun is where hydrogen in a thermonuclear reaction is converted to helium. This energy travels from the heart to the Sun's surface and is mainly emitted as light into space. In our solar system, the Sun is the most prominent element. It is the largest entity that comprises about 98 % of the total mass of the solar system. 4.6 billion years old is the sun. It consists of hydrogen and helium to a great degree. The sun is about 110 times heavier than the earth. It would be necessary for one hundred and nine Earths to fit across the disk of the Sun, and its interior could contain over 1.3 million Earths. The outer visible layer of the Sun is called the photosphere and has a 6,000 ° C (11,000 ° F) temperature.

2.2 Temperature on the Sun's surface

Its mass is as thick as water, from one millionth to one millionth. The photosphere, in the form of heat and light, releases the energy of the sun. The sunshine we see is mainly from its pebbly surface. The photosphere is 340 miles deep and ranges from 5,500 ° C to 6,000 ° C in temperature. It has dark spots or sunspots, the only solar movement that the naked eye can detect.

The temperature above the photosphere is around 4,000 ° C above that, and the temperature increases to 27,800 ° C. The environment consists of hot gases, called chromospheres, in violent motion. Fountains of burning gases are seen. The convection zone is the next layer below the photosphere. It is 60,000 miles deep and can exceed a temperature of 2 million ° C. Directly below the convection zone is the radiation zone. Power from the center recovers before surfacing for decades, And with a temperature of up to 6.5 million ° C, it is 300,000 miles deep. The sun's heart is under 200 billion times the strain of the surface of the earth. It has a thickness of 60,000 miles and a temperature that does not exceed 15 million ° C. It is so hot that it fuses hydrogen into helium.

2.3 The Radiation of the Extraterrestrial

The spectral spectrum of extraterrestrial radiation, i.e. the radiation that can be collected in the absence of an atmosphere, is also important to know. At mean earth solar wavelength, the extraterrestrial solar spectrum can be separated into three major regions, typically separated into wave bands (1 micron = 1 m = 10-6, mm = 10-6 meter).

• UV area (l < 0.38 mm). 7 per cent solar radiation percentage.

• Visible area (0.38 < l < 0.78 mm) 47.3% radiation percentage.

Infrared area (l > 0.78 mm) 45.7% percentage ration

At any time of the year, extraterrestrial radiation is produced by

$$I_{on} = I_{sc}(1 + \frac{360n}{0.033cos})$$

Where the solar constant is Isc and Ion is the extraterrestrial radiation measured as n=1 on a plane common to the radiation on the day of the year counted from January 1st.

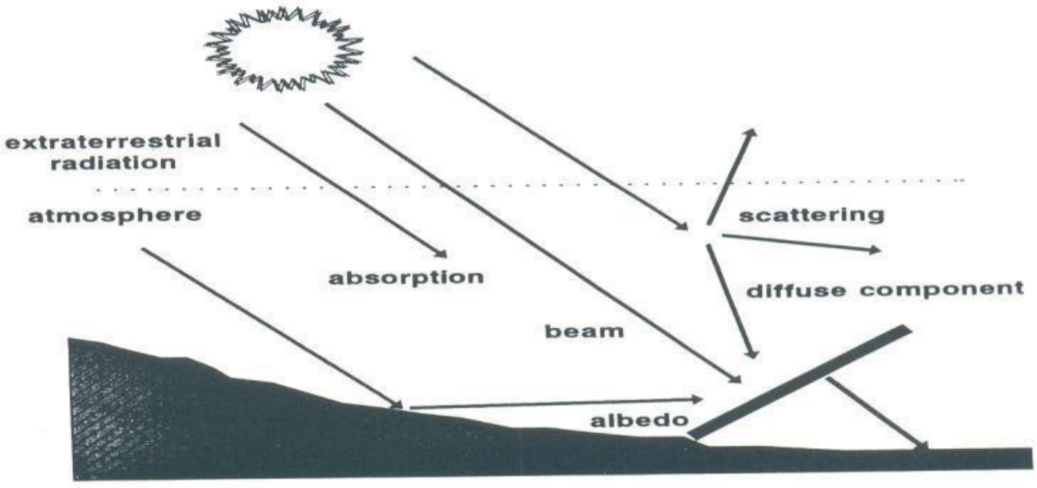


Figure 2-1: Radiation from the Extraterrestrial

2.4 Time equation

E= 229.2(0.000075 + 0.001868 B-0.032077 sin B -0.014615 cos 2B- 0.032077 sin B-0.014615 cos 2B- 0.04089sin2B) (i.e. Where the date of the year is B = (n-1)360/365 and n.

Average normal global radiation per month (kWh / m2 / day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
4.02	4.64	5.01	5.37	4.83	4.22	4.00	4.13	4.15	4.23	4.04	3.80	4.37

2.5 Solar conversion into electricity

Electrons are induced to flow by light hitting a silicon semiconductor, generating electricity. To transform sunlight directly into electrical energy, solar power generation systems take advantage of this property. Solar panels (also called direct current (DC) generated by solar modules E, which goes through a power inverter to become alternating current (AC), electricity that we can use in the home or office, such as that provided by a utility power provider. Two types of solar power generation systems exist: grid-based systems attached to a commercial power infrastructure; and stand-alone systems that provide energy to an installation for immediate use, or to an installation for immediate use.

Battery for warehousing. For houses, public institutions such as universities and hospitals, and industrial facilities such as offices and shopping malls, grid-connected networks are used.

Power produced during the day can be used instantly, and excess electricity can be leased to a utility provider in some situations. If the machine does not produce enough energy or does not produce any energy at all (for example, on a snowy or rainy day, or at night), the power provider can buy electricity. Power usage levels and surplus purchases can be reviewed on a dashboard in real time, which is an easy way to calculate everyday energy usage. In a range of uses, stand alone devices are used, including emergency power supply and remote support where conventional infrastructure is inaccessible.

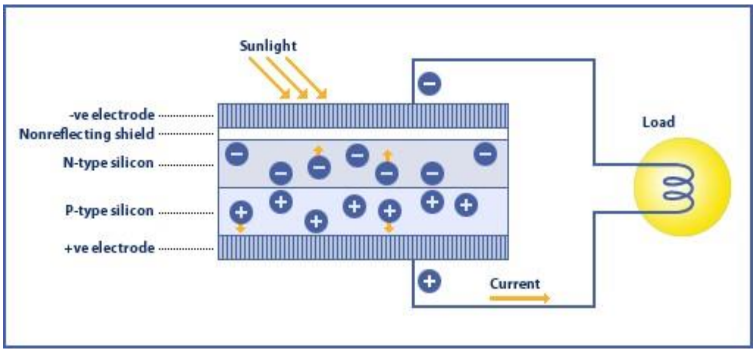


Figure 2-2: Sunshine conversion into electricity

An electron rises up and is drawn to the n-type semiconductor in Figure 2-2 as sunlight reaches the semiconductor. In the n-type semiconductor, this induces more negative electrons and in the p-type, more positive electrons, thereby producing a wave of electricity in a mechanism known as the photovoltaic effect.

2.5.1 Sun-Relationship to Earth-1

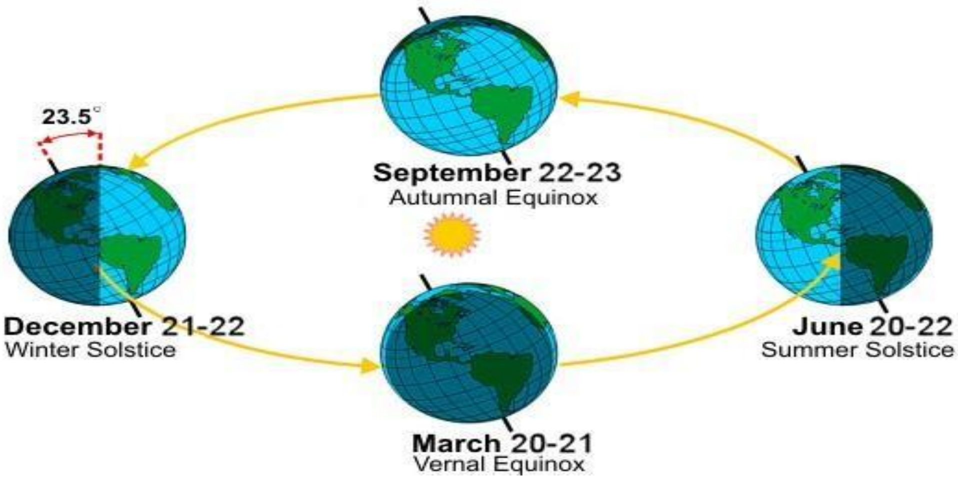


Figure 2-3: Sun-Relationship to Earth-1

2.5.2 Sun-Relationship to Earth-2

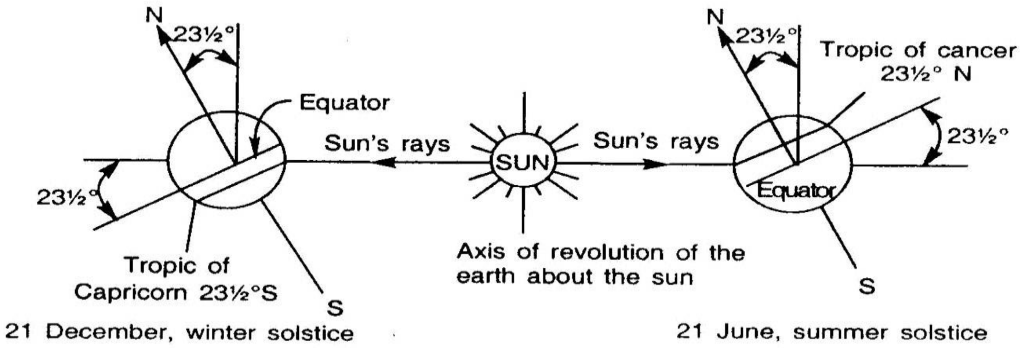


Figure 2-3: Sun-Relationship to Earth-1

2.6 Energy

There are 2 primary forms, heat and light, of the energy that comes to the Planet. Enough solar energy hits the Planet every hour to satisfy the world's demand for electricity for an entire year. 4 x 1018 Joules is the amount of energy from the Sun that hits the Planet yearly. Four x 1018

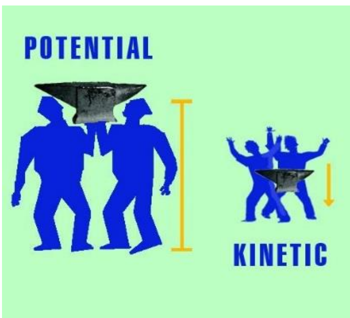
Joules per year ÷ 365 days each year = 1 x 1016 joules per day. 1 x 1016 Joules a Day ÷ 24 Hours per Day = 4 x 1014 Joules per Hour. The amount of energy that the world's population absorbs annually is around 3 x 1014 joules.

2.7 Energy Sources

Energy falls in two fundamental forms:

1. Potential Control

2. Kinetic Energy



Potential Energy: It is accumulated energy of any kind; it is not seen by motion. Potential control could be:

(a) Chemistry

(b) Nuclear-based

(c) Kinetic or Gravitational

Kinetic energy: energy of movements: energy of movements:

(a) Motion

(b) Temperature and Thermal Energy

(c) Tone

Electromagnetic Radiation (d)

(e) Electric power

2.7.1 The Potential Energy Types
Chemical

In the bonds of atoms, chemical energy is retained. This accumulated energy is released and consumed as bonds are broken and chemical reactions create new bonds. The way atoms are organized is modified by chemical reactions. Atoms go through chemical processes to be reorganized to create new substances with drastically different characteristics, including letters in the alphabet that can be rearranged to form new terms with quite different meanings. Each compound has its own chemical energy due to the bonds it produces between the atoms. Its components are reorganized into water (H2O) and carbon dioxide (CO2) as we consume sugar (a composite consisting of hydrogen , oxygen, and carbon) during exercise. Such reactions both consume and release electricity, but energy is released by the net reaction.

Nuclear

The accumulated potential of an actual atom's nucleus, or core, is nuclear energy. Most atoms remain stable on Earth; as defined in the Periodic Table of Elements, they maintain their identity as basic elements, such as hydrogen , helium, iron, and carbon. The basic identity of elements is modified by nuclear reactions. Atoms break apart or come together in nuclear reactions to form different kinds of atoms, called fission and fusion, respectively.

Gravitational

As mass travels away from the core of the Earth or other structures that are massive enough to produce substantial gravity (the sun, other planets and stars), devices will gain gravitational energy. The further you lift an anvil up from the ground, for instance, the more possible energy it gains.

2.7.2 Kinetic Energy Sources

Motion

A fluid object possesses kinetic energy. In the movement that brings the ball from player A to player B, a basketball moved between players displays translational energy. The kinetic energy is proportional to the mass of the ball and its velocity 's square. A athlete needs four times as much energy to toss the same ball just as easily.

If a player shots a basketball with a backspin or topspin, as it flips through the air, the basketball may still have rotational energy. Rotational energy, as well as the density of the ball and the size and form of the ball, is proportional to how fast the ball revolves. To rotate at the same rate, a hollow ball requires more energy than a solid ball of equal density. More energy is needed for the hollow ball since its mass is further away from its core.

Temperatures and Thermal Energy

Thermal energy and heat are strongly related to temperature. We can't see actual atoms vibrating, so we can detect the temperature of their kinetic energies, which is a measure of the force that atoms vibrate with. When there is a disparity between the environmental temperature and a device inside it, thermal energy is transmitted as heat between them.

As heat flows from the tea to the room, a hot cup of tea in a cold room loses some of its thermal energy. If the tea loses heat, the atoms in the hot tea slow their movements, and the tea cools to the same temperature as the room within a few hours. The room gains the thermal energy expended from the tea at the same time, but since the room is The temperature of the room increases by so little that a person would not notice it, much more than the tea.

Sound Audio

The emitted vibration of atoms in bulk creates sound waves, while atoms can also vibrate by heat, and sound can propagate through the movement of atoms, irrespective of whether they are in liquid , solid or gaseous states. In a vacuum, sound does not move and a vacuum has no atoms to express the vibration.

Sounds are emitted as waves through solids, liquids , and gases, but the atoms that pass through the signal do not move (unlike photons of light). The sound wave passes through atoms, like spectators in a sports stadium traveling around a 'shock.' Sounds have different frequencies (related to pitch) and wavelengths and different magnitudes (related to how loud they are). Although radio waves can relay sound details, they are an entirely different kind of energy, called electromagnetic energy.

Electromagnetic Radiation Inside

Like radiation or light energy, electromagnetic energy is the same. This type of kinetic energy can take the form of visible waves of light, such as light from a candle or a light bulb, or intangible waves, such as electromagnetic waves, microwaves, gamma rays and x-rays. Radiation will fly in a vacuum, whether it arrives from a candle or nuclear uranium fission, and scientists tend to think of electromagnetic radiation as separated into tiny packets of energy called photons. The frequency, wavelength, and energy of each photon are characteristic, but all photons travel at the same speed, the speed of light, or approximately 1 billion feet per second.

Electric Power

The kinetic energy of traveling electrons, the negative-charged particles of atoms, is electric energy. See The Fundamentals of Electricity for more detail on electricity.

Chapter-3
Solar Power System

3.1 A solar system

The Solar System consists of eight planets, their moons, and other non-stellar artifacts of the Sun and its celestial system. It evolved from the gravitational collapse of a massive molecular cloud 4.6 billion years ago. The vast bulk of the mass of the system is in the Sun, with Jupiter holding much of the remaining mass. Mercury, Venus, Earth and Mars, the four smaller inner planets, sometimes referred to as the terrestrial planets, are mainly composed of rock and metal. The four outer planets, called the gas giants, are much heavier than the terrestrial ones. The two largest planets, Jupiter and Saturn, are primarily composed of hydrogen and helium; the two outermost planets, Uranus and Neptune, are primarily composed of extremely high melting point substances (compared to hydrogen and helium), known as ice, such as water, ammonia and methane, which are also collectively referred to as 'ice giants.' The almost circular orbits of all planets lie inside an almost flat disk called the ecliptic plane.

A variety of areas inhabited by smaller particles are also found in the Solar System. The asteroid belt between Mars and Jupiter, since it mainly includes objects made of rock and metal, is close to the terrestrial planets. The Kuiper belt and dispersed disk lie outside Neptune's orbit, entangled clusters of trans-Neptunian objects made entirely of ice. There are some hundred to more than ten thousand artifacts within these communities that could be massive enough to have been gathered up by their own gravity. Objects such as these are referred to as dwarf planets. The asteroid Ceres and the trans-Neptunian objects Pluto, Eris, Haumea, and Make Make contain named dwarf planets. In addition to these two regions, numerous other small-body populations openly migrate between regions, including comets, centaurs, and interplanetary ice. "Six of the planets, at least three of the dwarf planets, and two of the smaller bodies are orbited after the Earth's Moon by celestial satellites, commonly referred to as" moons. Planetary circles of dust and other minor objects encircle each of the outer planets.

3.2 Framework for Solar Power

The conversion of sunlight into electricity is solar power. It consists of eight planets, their moons, and other non-stellar objects from the Sun and its solar system. In order to direct a wide area of sunlight through a narrow beam, focused solar power systems use lenses or mirrors and monitoring systems. In the 1980s, industrial, concentrated solar power plants were first built.

3.2.1 Solar Power System Implementations

The conversion of sunlight into electricity is solar power. Using photovoltaic (PV), or indirectly with concentrated solar power (CSP), sunlight can be transformed directly into electricity, which usually utilizes the energy of the sun to heat water, which is then used to provide power. Other innovations, such as Stirling engine plates that use a Stirling cycle engine to control a generator, still exist. Originally, and still are, photovoltaics is used to control small and medium-sized

Apps, from a single solar cell powered calculator to offgrid homes powered by a photovoltaic generator. They are an important and comparatively inexpensive source of electrical energy where linking grid electricity is unpleasant, unreasonably costly, or completely inaccessible.

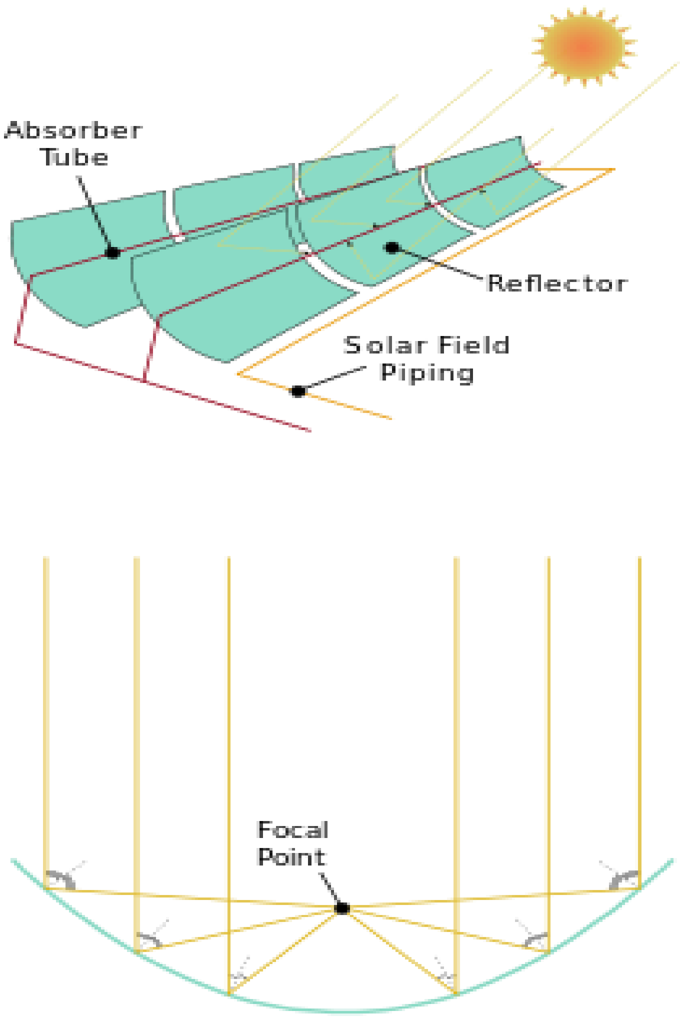


Figure 3-1: Applications of Solar Power System

3.3 Method of photovoltaics

To transform sunlight into electricity, photovoltaic (PV) systems use solar panels. A structure consists of one or more photovoltaic (PV) systems.

Panels, a DC / AC power converter (also known as an inverter), a solar panel monitoring system, electrical interconnections, and other component mountings. The word "photovoltaic" derives from the Greek meaning "light" and from "volt," the electro-motive force device, the volt, which in turn comes from the last name of the battery (electrochemical cell) founder, Alessandro Volta, an Italian physicist. Solar or photovoltaic (PV) cells are constructed of semiconducting materials and can directly transform electricity into sunlight. It dislodges and releases electrons inside the substance as sunlight hits the batteries, which then travel to create a direct electrical current (DC). Optionally, a maximum power point tracker

(MPPT), battery system and charger, solar sensor, applications for energy conservation, solar concentrators or other equipment can be included. A small PV system may provide a single user with electricity, or an isolated unit such as a lamp or a weather instrument. Large-Sized The electricity required by many clients can be generated by grid-connected PV systems.

Figure 3-2: PV farm or solar park

3.3.1 Photovoltaic System Advantage

Over traditional power sources, photovoltaic systems deliver major advantages:

- **Durability.** Photovoltaic devices have proved their durability, even under extreme environments. In conditions where continuous operation is crucial, PV arrays avoid expensive power failures.
- **Longevity**. After ten years of use, most PV modules available today display no deterioration. Future modules are projected to deliver electricity for 25 years or more.
- **Low cost of maintenance.** It is difficult to ship supplies and workers to remote locations for infrastructure repair or service work. Because only routine inspections and occasional repairs are expected for PV systems, these costs are typically lower than for conventionally fuelled systems.
- **No Fuel Bill.** There are no costs associated with buying, storing, or shipping fuel because no fuel supply is needed.
- **Reduced Pollution of Sound.** Photovoltaic devices work with limited activity and quietly.

- **Modularity Photovoltaics.** PV systems are more cost-effective than traditional systems that are bulky. To maximize usable electricity, modules can be connected incrementally to a photovoltaic device.
- **Security.** When correctly built and mounted, PV systems do not require the use of combustible fuels and are very clean.
- **Freedom.** As their key reason for embracing the new technologies, many residential PV consumers claim energy freedom from utilities.
- **Decentralization of power grids.** The risk of outages on the electric grid is minimized by small-scale decentralized power stations.
- **Output at High Altitude.** Increased insulation at high altitudes, when power output is optimized, makes the use of photovoltaic beneficial. In comparison, because of reductions in performance and power output, a diesel generator at higher altitudes must be de-rated.

3.4 Module for Photovoltaics

Owing to the low voltage of an individual solar cell (typically approx. 0.5V), multiple cells (see: copper in photovoltaic power systems) are wired in series for 'laminate' output. The laminate is mounted into a weatherproof shielding enclosure, thereby forming a solar panel or photovoltaic module. In a photovoltaic array, modules can then be strung together.

3.5 Photovoltaic Array

A related set of solar panels is a photovoltaic array (or solar array). The power one module will generate is rarely adequate to fulfill a home or company 's requirements, so the modules are joined together to form an array. Using an inverter, most PV arrays transform the DC power produced by the modules into alternating current that can power lamps, engines, and other loads. In order to achieve the desired voltage, the modules in a PV array are normally first connected in series; the individual strings are then connected in parallel to allow more current to be generated by the system. Usually, solar panels are measured in watts, under STC (standard test conditions) or PTC (PVUSA test conditions). Typical panel ratings vary from over 400 watts to less than 100 watts. A list of the panel ratings, in watts, kilowatts, or megawatts, is the array ranking.

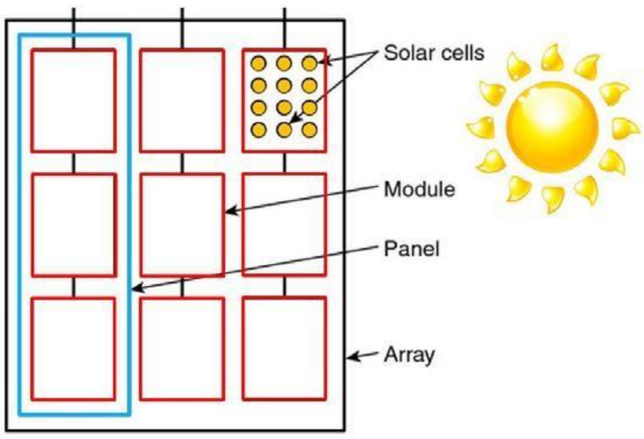


Figure 3-3: Fundamental components of photovoltaics used to absorb solar energy

3.6 Circuit Architecture module

- A PV module's voltage is typically selected to be consistent with a 12V battery.
- There is a voltage of just under 0.6V under 25 ° C and AM1.5 illumination for an individual silicon solar cell. Most modules include 36 solar cells in sequence, taking into account the anticipated decrease in PV module voltage due to temperature and the fact that a battery can require voltages of 15V or more to charge.
- This provides an open-circuit voltage of approximately 21V under normal test conditions and a working voltage of approximately 17 or 18V at optimum power and ambient temperature.

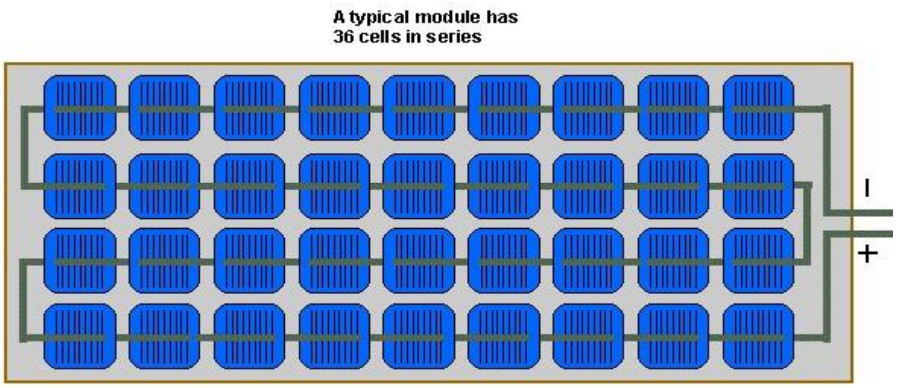


Figure 3-4: 36 cells are bound in series in a standard module to generate a

Enough voltage to charge a 12V battery.

- While the voltage from the PV module is determined by the number of solar cells, the module current depends mainly on the size and performance of the solar cells.

- Single crystal solar cells provide a total current of approximately 3.5 A from a panel at AM1.5 and under maximum tilt conditions. Multicrystalline modules have bigger individual solar cells, but a lower density of current and thus the short-circuit current is mostly around 4A from these modules.

- If all solar cells have similar electrical characteristics in a module, and all of them undergo the same polarization and separation.

  Then all the cells run at precisely the same current and voltage, at the same temperature.

- The PV module's I-V curve has the same structure as that of the individual cells in this situation, except that the voltage and current are raised.

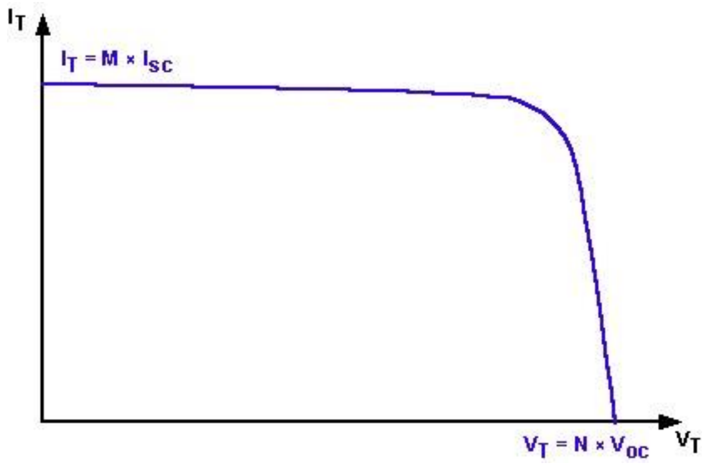


Figure 3-5: The average IV curve of a group of similar solar cells linked to each other.

3.7 Mismatch between PV cells

- Mismatch-PV cells or modules do not have similar properties or have different situations.
- If one solar cell is shaded while the remainder in the module is not, instead of powering the load, the power produced by the "strong" solar cells can be dissipated by the lower output cell.
- Mismatch can lead to extremely localized dissipation of power (hot spot) and the resulting local heating can cause the module to be irreversibly damaged.
- A big cause of mismatch in PV modules is the coloring of one area of a module relative to another.

- Mismatch in PV modules happens when one solar cell's electrical parameters are greatly altered from those of the solar cell.

- The residual machines. The mismatch effect and power loss depend on:

➢ The working point of the module PV

➢ The configuration of the circuit; and

➢ Parameters (or parameters) that vary from the rest of the solar cells.

3.7.1 Mismatch in Sequence for Cells Connected

- As most PV modules are series-connected, the most common type of mismatch observed is series mismatches. Two convenient forms of mismatch

➢ Mismatch in the current short-circuit

➢ Mismatch in voltage open-circuit

- A mismatch in the short-circuit current is more common, as shading part of the module will easily trigger it. Often, this sort of mismatch is the most extreme.

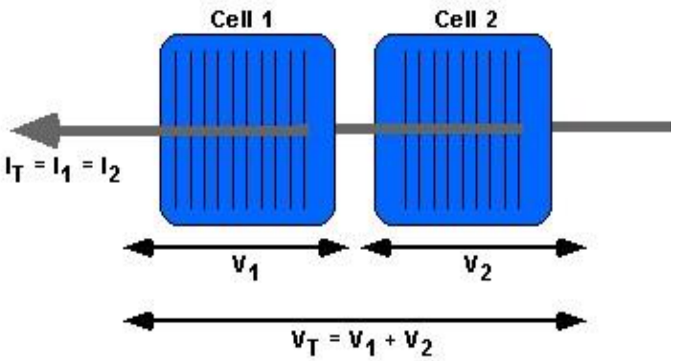


Figure 3-6: Mismatch for Cells in Sequence Linked

Since the current needs to be the same, a current mismatch means that the configuration's total current is equal to the lowest current.

3.7.2 Voltage Mismatch for Open Circuit for Cells In Series Connected

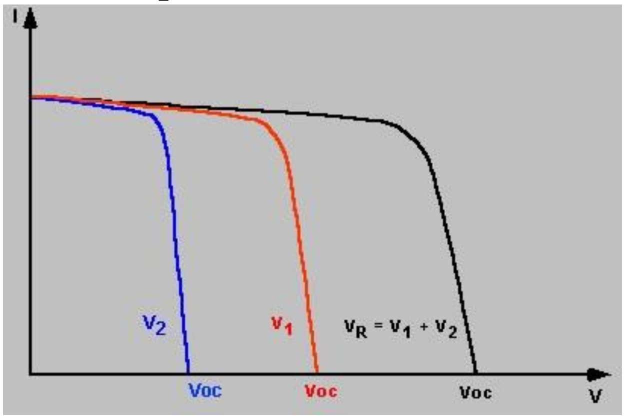


Chart 3-7: The Open Circuit Voltage Graph

The total output is decreased at the highest power stage, since the weak cell consumes less electricity. The current between the two solar cells is the same, since the two cells are connected in sequence, and the total voltage is determined by comparing the two voltages to a given current.

3.7.3 Emerging Short-Circuit Mismatch for Cells In Series Connected

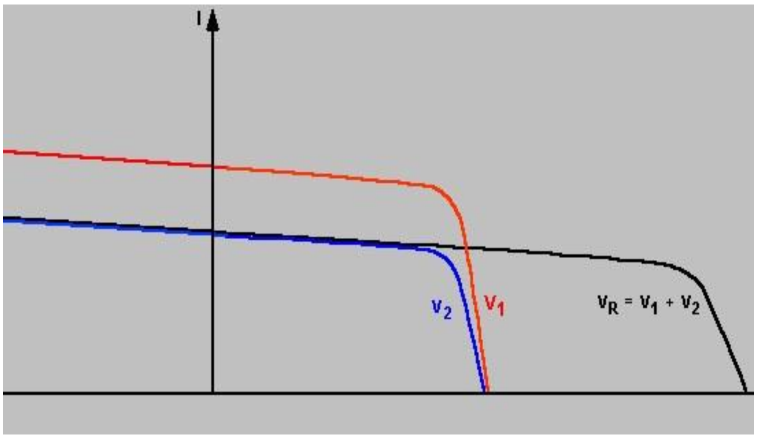


Chart 3-8: Short circuit current graph

For two cells in sequence, the current mismatch may be quite extreme and quite normal. The combination's Isc is confined to the lowest cell Isc.

- The effect of a decreased short-circuit current is comparatively small at open-circuit voltage.
- The mix current may not surpass the weak cell short circuit current.
- The extra current-generating potential of the good cells is not dissipated in each individual cell at low voltages where this situation is likely to occur, but instead is dissipated in the weak cell.

3.8 Heating Hot-Spot

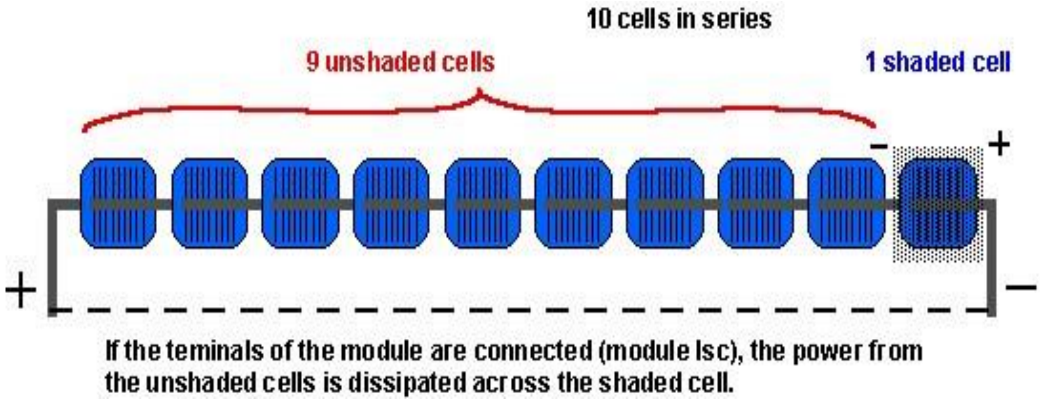
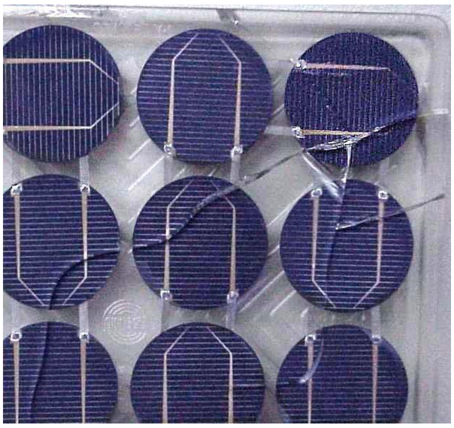


Figure 3-9: Related To Sequence Module

- Hot-spot heating happens in a line of at least many high short-circuit solar cells while there is one low current solar cell.

- In a line, one shaded cell decreases the current through the good cells , allowing the good cells to create higher voltages that can also counteract the bad cell 's bias.



Where a large number of series of attached cells trigger a large reverse bias across the shaded cell, hot-spot heating occurs , leading to broad dissipation of
Control in a cell of oppression.

In the weak cell, the entire generation power of all the healthy cells is effectively dissipated. The immense dissipation of energy that happens in a specific region results in local overheating, or "hotspots," leading to damaging consequences such as shattering of the cell or glass, solder melting, or solar cell deterioration.

3.9 PV Module Security

3.9.1 Diodes Bypass

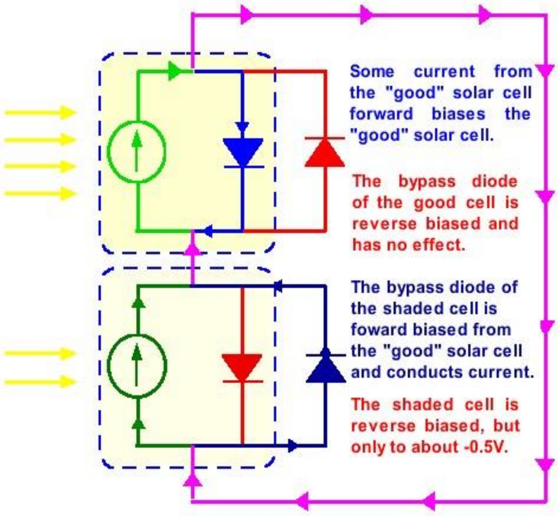


Figure 3-10: Diodes Bypass

- If a solar cell is reverse biased due to a short-circuit current mismatch between several series of attached cells, the bypass diode conducts, causing the current to flow through the external circuit from the good solar cells rather than forward biasing each good cell.
- The cumulative reverse bias is limited to around a single diode drop around the weak cell, thereby reducing the current and avoiding heating from the hot-spot.

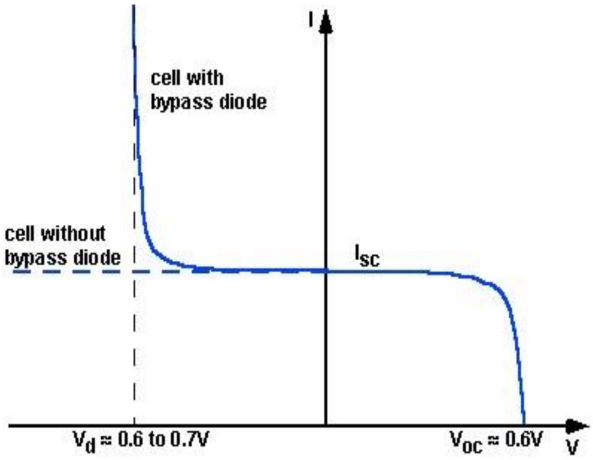


Figure 3-10: Solar cell 's IV curve with bypass diode

• In the shaded cell, the overall power dissipation is roughly equal to the generation potential of all cells in the community.

• For silicon cells, the maximum group size per diode is around 15 cells / bypass diode, without causing damage. Therefore, 2 bypass diodes are used for a standard 36 cell module to ensure that the module will not be vulnerable to "hot-spot" damage.

3.9.2 Diode blocking

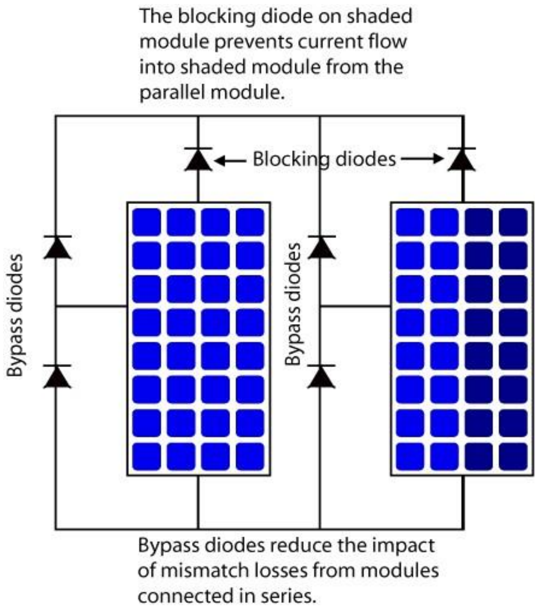


Figure 3-11: The Blocking Diode Circuit Diagram

- To stop the module loading the battery at night by stopping current flow from the battery to the PV array, a blocking diode is used.
- For parallel attached tags, each string should have its own blocking diode to be connected in parallel. This not only decreases the blocking diode 's necessary current carrying power, but also prevents current from flowing into a lower-current string from one parallel string and hence helps to reduce mismatch losses occurring in connected parallel arrays.

3.10 Solar Photocells

A solar cell (also called a photovoltaic cell) is an electrical system that, through a photovoltaic effect, transforms the energy of light directly into electricity. It is a kind of photoelectric cell (in that its electrical properties differ as light appears on it, e.g. current, voltage, or resistance) that can produce and support an electric current as exposed to light without being connected to any external voltage source. The area of technology and research related to the practical application of photovoltaic cells in the manufacture of photovoltaic cells is photovoltaic.

Light electricity, though it is also used explicitly to refer to the production of sunlight electricity. Even when the light source is not actually sunlight (lamplight, artificial light, etc.), cells may be defined as photovoltaic. In such situations, the cell is often used to monitor light or other electromagnetic radiation near the visible spectrum, as a picture detector (such as infrared detectors), or as a light intensity measurement.

A photovoltaic (PV) cell requires 3 basic attributes to operate:

- Light absorption, producing either pairs of electron-holes or exactions.
- The distinction of the opposite forms of charge carriers.
- The independent transfer to an external circuit of such carriers.

3.10.1 The Manufacturing of Solar Cells

Solar cells are semiconductor devices that share some of the same processes of processing and development as other semiconductor products, such as computers and memory chips. The strict cleanliness and quality management standards of semiconductor production, however, are more relaxed for solar cells. Screen printed polycrystalline or single crystalline silicon solar cells are manufactured by most large-scale commercial solar cell factories today.

Poly-crystalline silicon wafers are formed into very thin (180 to 350 micrometer) slices or wafers by wire-sawing block-cast silicon ingots. The wafers are typically lightly doped with p-type. A surface diffusion of n-type pants is carried out on the front side of the wafer to create a solar cell from the wafer. A few hundred nanometers below the surface, this forms a p – n junction.

Next, anti-reflection coatings are usually added to maximize the volume of light attached to the solar cell. Because of its excellent surface passivation properties, silicon nitride has progressively replaced titanium dioxide as the anti-reflection coating. This stops carriers from being

The recombination at the solar cell 's rim. It is usually implemented using plasma-enhanced chemical vapor deposition (PECVD) in a film several hundred nanometers thick. Some solar cells have textured front surfaces that help to maximize the amount of light coupled into the cell, including anti-reflection coatings. Usually, such surfaces can only be formed on single-crystalline silicon, while methods of shaping them on multicrystalline silicon have been established in recent years.

The wafer then has a full-area metal contact on the back side, and using a silver paste, a grid-like metal contact composed of small "fingers" and wider "bus bars" are screen-printed on the front side. By screen-printing a metal paste, usually aluminum, the rear touch is also made.

This touch usually covers the entire rear side of the cell, although it is written in a grid pattern in some cell designs. The paste is then shot at several hundred degrees Celsius in ohmic contact with the silicon to form metal electrodes. To improve cell performance, some businesses use an additional electro-plating step. The solar cells are interconnected by flat wires or metal ribbons after the metal contacts are made, and mounted into modules or' solar panels.' There is a tempered glass layer on the front of the solar panels, and a rubber encapsulation on the bottom.

3.10.2 Materials from Solar Cells

Similar products exhibit different efficiencies and have differing prices. Materials for effective solar cells must have properties that are compliant with the spectrum of light available. Some cells are engineered to absorb wavelengths of solar light that enter the surface of the Earth efficiently. Any solar cells, however, are also designed for light absorption outside the atmosphere of the Earth. In several physical configurations, light absorbing materials may also be used to take advantage of specific processes of light absorption and charge separation. Materials currently used for solar photovoltaic cells include monocrystalline silicon, amorphous silicon, polycrystalline silicon, cadmium telluride,

And selenide / sulfide copper indium. Many solar cells currently available are fabricated from bulk materials cut into wafers between 180 and 240 micrometers thick, which are then treated as most semiconductors. Other materials are generated as layers of thin-films, organic paints, and organic polymers deposited on supportive substrates. Nanocrystals make up a third category which are used as quantum dots (electron-confined nanoparticles). The only substance that is well-researched in both bulk and thin-film forms remains silicon.

3.10.3 Definition of Solar Cells

In three phases, the solar cell works:

1. The solar panel is struck by photons in sunlight and absorbed by semiconducting materials, such as silicon.

2. Electrons are shaken loose from their atoms (negatively charged), creating an electric potential difference. In order to cancel the potential, current begins running through the material and this energy is captured. The electrons are only allowed to pass in a single direction because of the unique composition of solar cells.

3. Solar energy is converted into a usable volume of direct current (DC) power by an array of solar cells.

3.11 Solar Power

The radiant (light and heat) energy provided by the sun is solar energy. Through using solar collectors, the solar energy which reaches the earth can be used to generate electricity or heat. As an example, a closed car can be used as a solar collector. The light energy that passes through the window glass is absorbed by the interior of the car and transformed into heat energy that is stored within the vehicle. In optimum regions, the volume of solar radiation dropping on an area the size of a basketball field is equal to the size of a basketball field in terms of thermal radiation.

Around 650 barrels a year of crude. Solar energy is a renewable fuel whose potential availability is not impacted by its use.

3.11.1 From The Sun, Solar Electricity

The departure point is the sun and its electricity. You can see them as the mechanism that powers the atmosphere and the temperature. The planet gets some 178,000 terawatts of energy from the sun over the course of a year. Stated clearly, this is 15,000 times more than the world's oil use currently. The planet consumes 50 percent of this energy and the atmosphere releases 30 percent of it back into space. The remaining 20 percent is driven by the hydrological cycle, and just 0.6 percent of this volume goes into photosynthesis. Photosynthesis is the cornerstone of all types of life on Earth and has produced fossil fuel deposits. It is well-known that these deposits are not infinite, and the drop in the production of fossil fuel energy indicates that the sustainability of fossil fuels is now uncertain. A full transition to green energy supplies as a cheap, safe and silent supply of energy could become imminent in the face of this future crisis. This provides tremendous promise for mitigating global warming and preventing the impacts of climate change.

3.11.2 Benefits of Solar Energy

Solar energy is used in many ways. Those such as;

- Generating energy using solar photovoltaic cells.
- Generate electricity using concentrated solar radiation.
- Generate energy by heating trapped air, which in a solar updraft tower rotates turbines.
- Heat homes, by passive solar building architecture, directly.
- Heat foodstuffs through solar ovens.

- Heat water or air by solar thermal panels for indoor hot water and space heating uses.
- Usage of solar chimneys to heat and cool air.
- Generate energy using solar power satellites in a geosynchronous orbit.
- Solar air conditioning

3.11.3 Benefits of Solar Energy

- The sun's power supply is completely free.
- No waste is created by solar energy generation.
- They have been rendered highly cost-effective by technical developments in solar energy systems.
- During their lifespan, most devices do not need any upkeep, which ensures you never have to invest resources into them.
- Such devices have a 30 to 40-year life cycle.
- For 20 or 30 years or longer, most devices bear a full warranty.
- Many innovative solutions are sleeker, such as Uni-Solar rolls that lie directly on the roof like standard roofing products, unlike typical gigantic panel systems.
- In 35 states, to minimize the need for a storage facility and eradicate or significantly decrease your power costs, solar energy may be fed back to the utilities.
- Solar power modules are already equipped for unique uses. You can turn your outdoor lights, for instance, to solar. The solar cells are immediately mounted on the lights and nobody can see them. You remove the costs involved with the maintenance of your outside lights at the same time.

3.11.4 Range for Renewable Energy

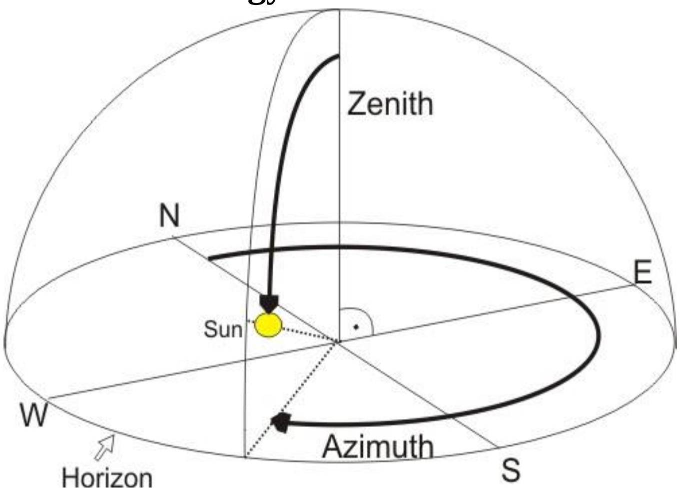


Figure 3-12: Range of Solar Energy-1

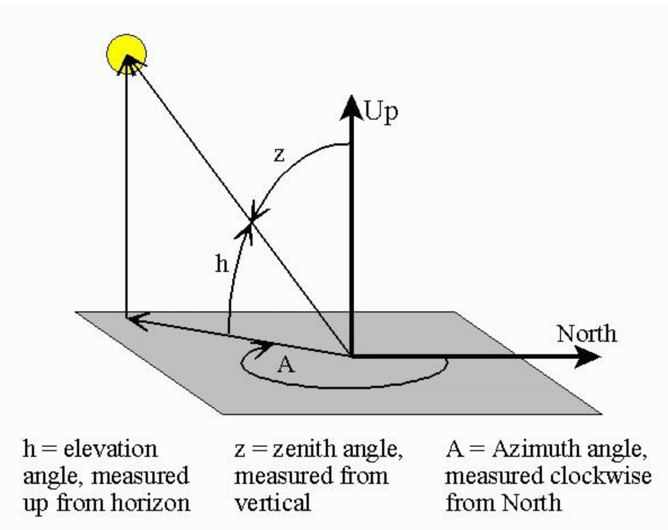


Figure 3-13: Spectrum-2 of Solar Energy

3.12 Light from the Sun

This energy from green sources comes from the sun. As a result of nuclear mergers within it, the sun releases radiant radiation. The reflective energy that clouds, ozone and dust do not absorb or reflect is considered direct radiation and is known as sunshine and heat. The quantity of energy of this kind depends on position and altitude. It also relies on theThe location of the sun, which is aligned with the season, the time of day, and the latitude of the area. Global radiation is, however, also a combination of direct radiation and dispersed radiation from the atmosphere. It contains all solar electromagnetic radiation wavelengths, which are not only visible light. Currently, about 50 percent of this light is visible radiation (wavelengths between 380 and 789 nm), with infrared and ultraviolet radiation being the remaining 50 percent. This component is not visible to the human eye, but in terms of photovoltaic and thermal solar gain, it is also important. Light is a composition of so-called photons of elementary particles. A photon is the source of all wavelengths of electromagnetic radiation, including gamma rays, X-rays, ultraviolet light, visible light, microwaves and infrared light, as well as radio waves. 5 Sunlight can attain a maximum of 1 kW (kilowatt) per square meter, depending on the conditions. As an example, the Auckland area has around 2060 hours of sunshine each year, according to a database from the New Zealand National Institute of Water & Atmospheric Science (NIWA). This is worldwide radiation of about 1530 kWh / a (kilowatt hours each year).

Chapter-4
Solar Technology Aspects of Bangladesh

4.1 Bangladesh's Crisis of Power

Electricity has made life in the world modern and sophisticated. Without energy, it is difficult to picture a civilised planet. The power crisis in Bangladesh is a familiar phenomenon. A day today, a day

This has been a major concern. The causes for lower availability are

- Some plants for maintenance, renovation & redesign are out of service.
- Due to ageing, gas shortages are derived from the capability of some plants.

The electricity crisis is the product of lack of transmission (technical failure and non-technical lack), failure of equipment, loss of distribution and corrupt governance. Consumption errors, billing errors and processing losses are non-technical losses. If electricity demand rises, it is necessary to set up new power plants in order to resolve excess demand. Yet it couldn't be possible to build new power plants in our nation without a massive fund. The life cycle of the old power plants, on the other hand, is over. Often any of the units or whole station have fallen in that situation. The national grid breaks down for that cause, and the entire country goes into darkness.

4.1.1 Details on Bangladesh 's Power Crisis

Year	Installed capacity (MW)	Generation capability (MW)	Demand forecast (MW)	Load shedding (MW)
2003-04	4680	3592	4259	694
2004-05	4685	3782	4375	800
2005-06	4690	3810	4490	1312
2006-07	4693	3849	4550	1212
2007-08	5466	4415	4800	385

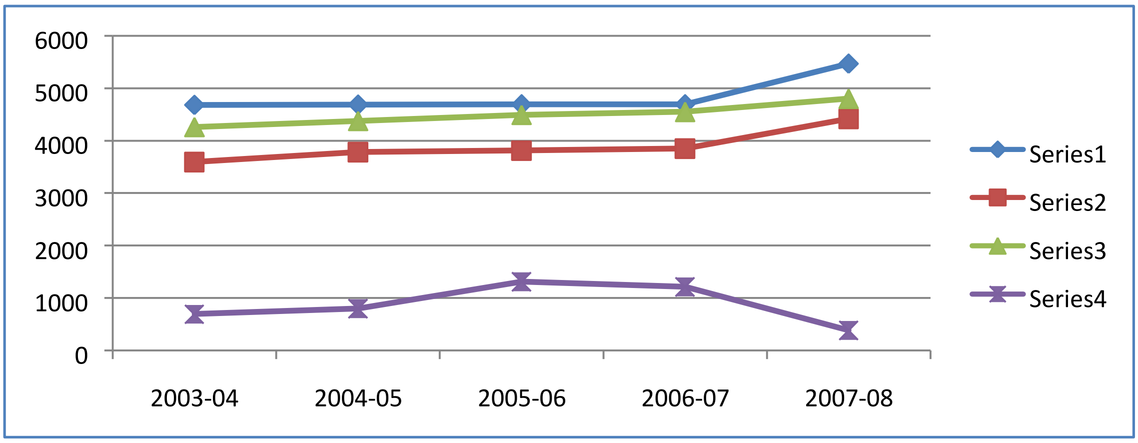


Chart 4-1: Power Crisis Graph

4.2 Bangladesh's Solar Energy

Bangladesh is a subtropical region, Bangladesh is losing 70 percent of the year's sunshine. For this purpose, we can basically use solar panels to generate electricity. In Bangladesh, solar radiation ranges from season to season. The average daily solar radiation obtained by Bangladesh is 4-

6.5 / m2 kWh. Full number and minimal in the following statistic on NovemberDecember-January1. Dhaka University's Renewable Energy Research Centre (RERC) is the only outlet that has long-term verified Dhaka Solar Energy data that can be a fantastic tool for solving Bangladesh's power crisis. Bangladesh is located at latitudes between 20.30 and 26.38 degrees north and 88.04 and 92.44 degrees east, which is an excellent position for the use of solar energy.

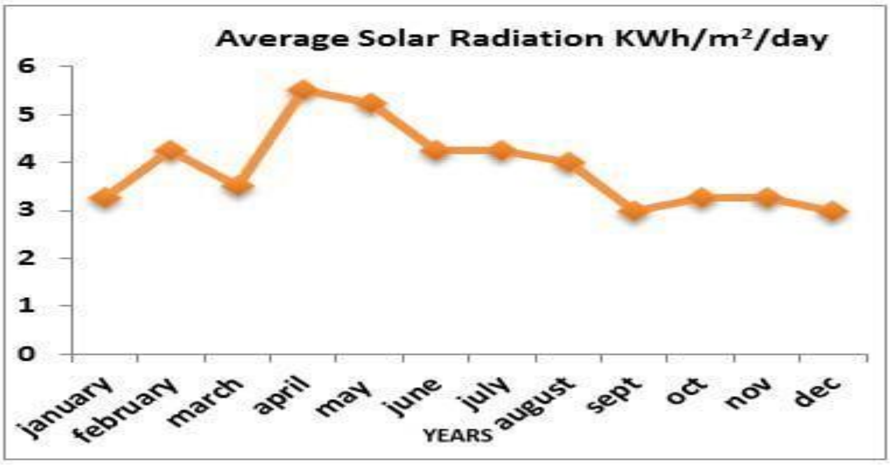


Figure 4-2: Map of the monthly average profile of solar radiation in Bangladesh

The highest and lowest direct radiation rate at this stage in W / m2 is also seen in Figure 2 below. So, Bangladesh is in the right spot. In reality, several steps have recently been taken by the Bangladesh government to enable people to use photovoltaic electricity. About every newly constructed apartment building now uses solar panels to get help during the load shedding time along with the grid connection. Also in rural areas, several NGOs have worked to provide villages with solar panels at a cheap price. Illustration 4-2. Shows the approximate division wise installation of SHSs. It demonstrates that in Dhaka district the distribution of the SHSs is largest, while in Sylhet it is lowest.

Now, from the following calculation, solar power can be calculated:

Solar Capacity, Psolar = (Area per sq-ft x sq-ft watts).

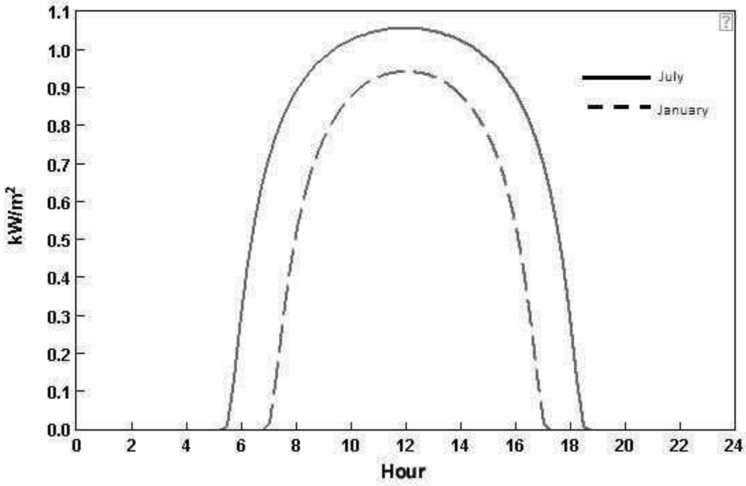


Figure 4-3: The maximum and lowest W / m2 direct radiation rate

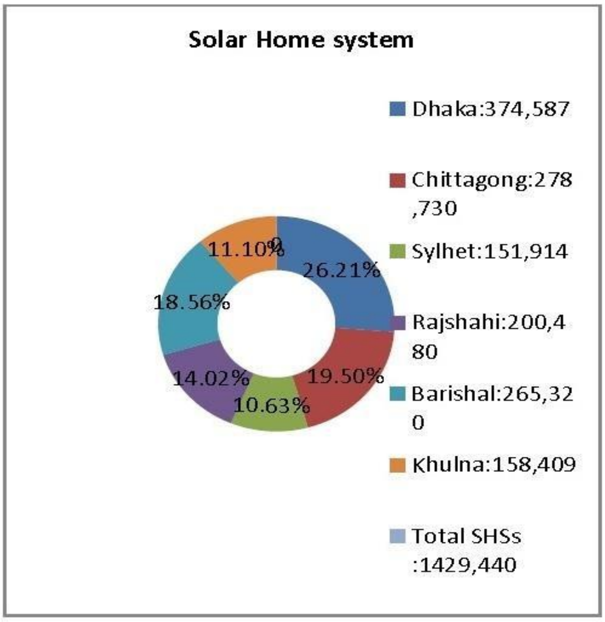


Figure 4-5: Distribution of the home solar system in Bangladesh 's six divisions by January 2013

4.3 Initiative on Solar Energy

Under the Rural Electrification and Clean Energy Growth Initiative (REREDP), the Infrastructure Development Company Ltd. (IDCOL) supports Solar Home Systems (SHSs). In the region of the Chittagong hills, GOV has implemented a solar energy production policy. Of the two schemes, one was successfully completed in the Rangamati region of Juraichhri. There were about 600 homes under the program.

Electrified strength. In Thanchi Upozila, Rangamati district, the 2nd phase was conducted. This project involves 600 SHSs of 120 WP each, 20 sets of Solar Photovoltaic (PV) street lighting systems of 75 WP each, 2 sets of Solar PV submersible water pumps of 50,000 liters a day of lifting power of each pump of 1800 WP each, 6 sets of Solar PV Vaccine Refrigerators for Health Care Centers of 360 WP each. In separate areas of Bangladesh, the Rural Electrification Board (REB) has taken over three solar PV schemes, which are as follows:

1. In the two unions of Narshingdi Sadar Thana (Karimpur & Nazarpur) along the Meghna River, Project One was initiated in 1994 and completed in 1998. Approximately 1000 numbers in different types were used in the initiative.
2. Project two based primarily on the Bay of Bangal (Cox's Bazar) islands of Austragram (Kishoreganj), Shingra (Natore), Kotalipara (Gopalganj), Moheskhali, Kutubdia, and St. Martine. The primary aim of the project is to have 6000 Nos. For remote and isolated rural areas, the PV Solar Home Device.
3. The three goals of the project are Sirajganj, Natore, Pabna, Barisal, Bazar of Cox and Sunamganj. The key aim of the project is to have 16000 SHSs in rural areas and to support over 80,000 people.

On the other hand, IPP and some private companies, such as Brac Bangladesh, Summit Strength, Grameen Shakti, Rahim Afroaz and ENERGYPAC, play a significant role in the solar energy initiative.

4.4 Development of the Project for Solar Energy

There are few centers for renewable energy and, relative to other nations, they are not well known. So, there are no experts coming from there. Because of the crisis of tremendous funds and experienced personnel, Bangladesh imports solar cells from abroad and only panels are available here. It's expensive and difficult to use for that purpose, so consumers are not interested in using solar panels. Yet Bangladesh's solar energy policy has glorious prospects. A solar energy production program has already been implemented by GOV in the Chittagong Hill Tract district. This policy can be extended to the country's rural regions. It is important to set up at least 10 modern renewable energy research centers to develop the solar energy programme, from which trained specialists who can teach others can come. There could be a public-private investment scheme with significant funds. Encourage IPP to extend their framework. Champaign should be necessary in order to make people aware of the use of solar cells, and GOV should include solar cell import subsidies.

4.5 Rural Bangladesh's Solar Home Systems

Bangladesh is bordered to the east, west and north by India and to the south by the Bay of Bengal. On the south-eastern side, there is also a wide stretch of boundary with Myanmar. Bangladesh has a 147,570 sq. area. The Km. (The World Factbook, 2011) and a projected population of 158,570,535 (July 2011). Rural areas are home to more than 75 % of the population (Bangladesh Bureau of Statistics, 2009a). Bangladesh ranked 146 among 177 countries with a Human Development Index (HDI) score of 0.543 in the Human Development Report (2009). An array of PV cells are used to construct solar home systems (SHSs) in developing countries like Bangladesh, where the national grid expansion is not economically and physically feasible. To illuminate rural households and fuel other important home appliances, such as lamps, radios and tiny black and white televisions, the SHSs use PV technology. A solar panel, a battery, and the main components As well as a charge controller that can be worked with minimal preparation (Islam & 2001 Infield, pp. 50). In general, solar photovoltaic systems reflect the technologies by which sunlight (one source of energy) can be turned into electricity (another type of energy) without any moving parts being used. Figure 2.1 indicates that no fossil fuel consumption is needed to produce energy by the use of solar power, as sunlight is the primary raw material. Sunlight is a fair and efficient source of fuel that is readily available. In addition, the solar home system will operate seamlessly with a little maintenance of the equipment and produce electricity for decades.

4.6 Description of Villages and Features of Households

It is important to draw a general image of the situation and circumstances within villages and households before focusing on energy problems and related socio-economic impacts in the sense of this investigation. Any basic information on the socio-economic background, challenges and aspirations of rural Bangladeshi households will be provided in the following subsections.

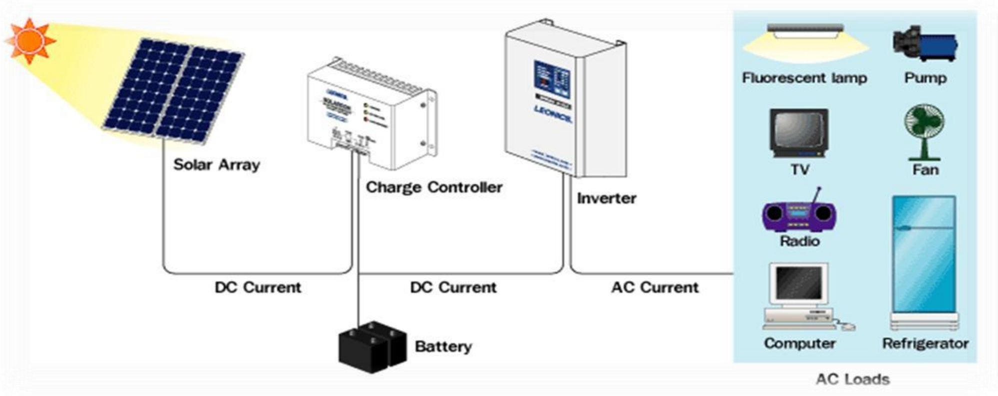


Figure 4-6: Solar Home Systems for Light Generation

4.6.1 Category of Household Income

7100 BDT was the average gross monthly household income. It may also be claimed that the villagers were neither exceedingly prosperous nor impoverished, and that the economic condition of the villagers was also well represented.

An typical group of rural residents. In order to give rural households a clearer impression of the realities of wages, wages allocation needs to be taken into account.

4.6.2 Households by Group of Professions

In all phases of agricultural operations, rural citizens are directly and indirectly concerned with significant involvement in post-harvest practices, home planting, food and nutrition affairs, etc. The highest percentage of respondents (36 percent) was agriculture, while industry was around 32 percent of the total respondents.

4.7 Owners have agreed to purchase a Solar Home System

We asked owners to list up to three reasons why they made the transaction as an example. Both the top two results, enhanced light efficiency and increased ease of study, was attributed to the 100-fold rise in light from a kerosene lamp to a SHS. TV for personal use was the third most common answer.

4.8 Public enterprise of BRAC

Background

In December 1998, the BRAC Solar Energy Initiative for Sustainable Growth was launched. An interconnected and multipurpose network, its programs are distributed throughout the country in a wide variety of settings, including homes, BRAC and other NGO offices, educational centres, schools , health clinics, cyclone shelters, a weather forecasting station, a government rest house and income generation centres such as carpentry, tailoring shops, fabric dyeing and printing shops, leather workshops, repair facilities, The goal of the project was to improve the overall socio-economic status of the rural population in the project areas by providing new jobs, growing hours of schooling and helping the poor conduct income-generating activities.

By the Help from WB / GEF / GTZ / Kfw 1.38 Mw power installed BRAC (September 2007) Standalone Solar Home System to provide electricity in rural off-grid areas and supported 56,444 (31 March 2010) users.

Today's BRAC Solar:

As one of BRAC 's three Renewable Companies, BRAC Solar today operates and has come up with energy-efficient and sustainable solar solutions. In its ongoing adherence to environmental values in its corporate practices, BRAC Green Companies engages in environmentally sustainable initiatives to ensure that its procedures, goods and services meet existing environmental issues sufficiently. BRAC Green Enterprises is a mixture of three firms operating under the umbrella of delivering sustainability products to the metropolitan business market. BRAC Solar Company is interested in electricity projects, BRAC Nursery for landscaping and leasing of trees, and BRAC Recycled Paper for office stationery. Together, this community of green companies is active in the development of environmentally sustainable goods and, as a result, leads to the socioeconomic upheaval of both rural and urban green initiatives. This project is very interesting in that many clean energy firms offer promising goods in developed markets, but BRAC Green Enterprises has launched a full office solution and its widespread adoption will promote the process of greening our country's business environment.

Chapter- 5
Solar Home System

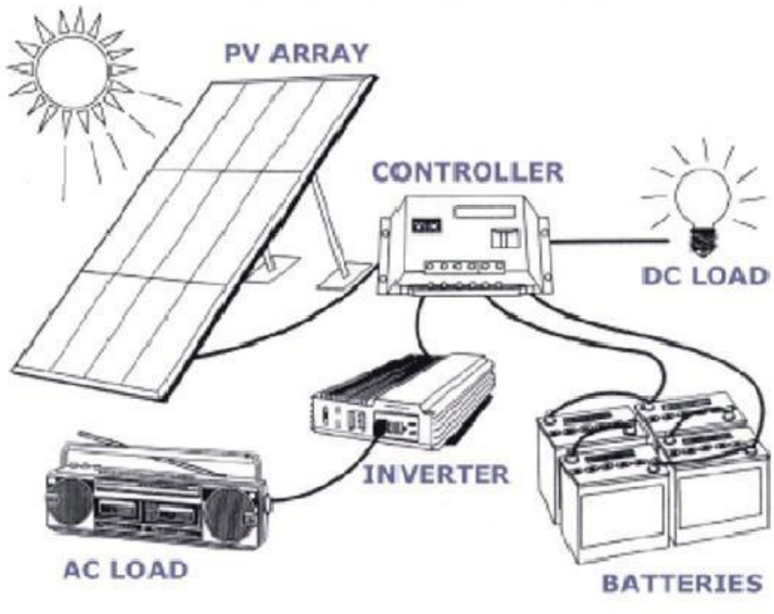
5.1 Development of Solar Home Systems
Part Basics:

1. Module

2. Batteries

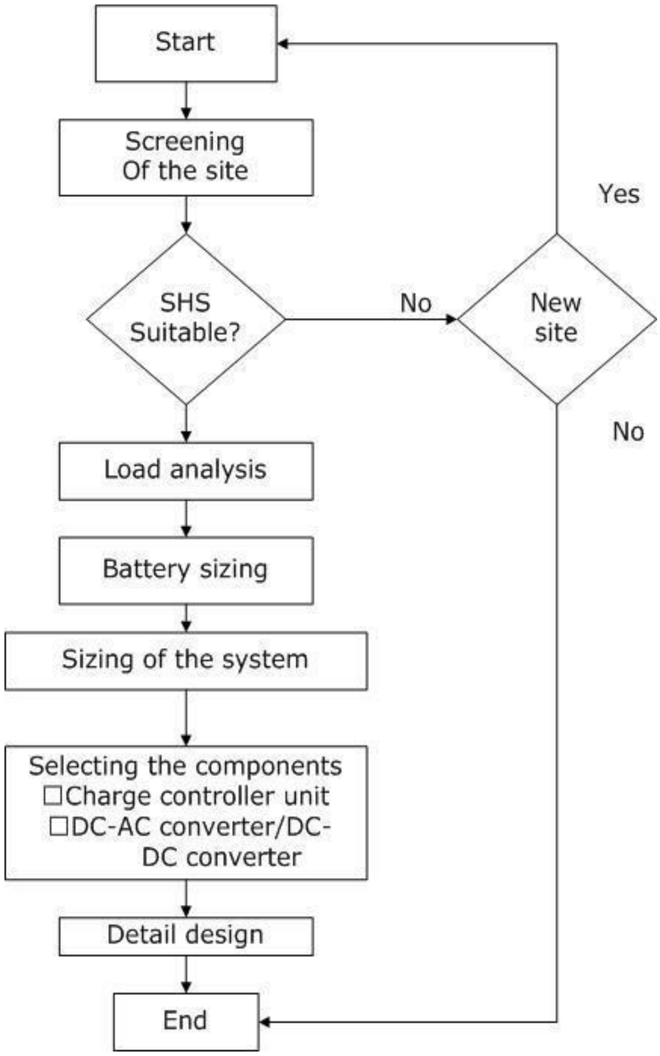
3. Controller for Fee

4. Load



Explanation 5-1: Construction of Solar Home Systems

5.2 Block Diagram of the phase of solar home system design



In the above Block Diagram, the solar home system design process is shown. The approach starts with the scanning of the site. This suggests that it must be situated in a location where ample sunshine remains. Then the first step is load calculation and the scale of the battery after that. Other device components are then chosen, such as the charge controller unit and the voltage converter (if required). The entire machine architecture is processed in this manner.

5.3 Solar Home Device Circuit Diagram

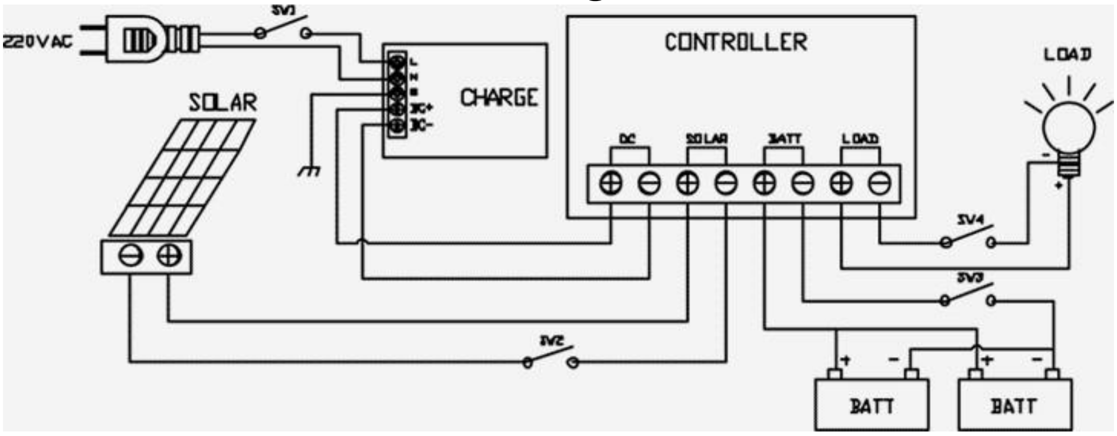


Figure 5-2: Solar Home Panel Circuit

5.4 Site Screening

In this portion of the design, we will first examine the position of the solar system installation where sunlight is accessible. As we know, sunlight in all areas is not equivalent, so this aspect is really important. And the whole system's price depends on it.

5.5 Commitment of Loads

A family consists of 4 people using TV for 5 hours, 6 Led Bulbs for 6 hours, 3 fans for 15 hours everyday, Laptop for 1.5 hours, to figure out the actual average load.

So bellow is given to the power requirement of different types of loads:

Item /loads	**Rated power**
Television	60W
Led Bulbs	6W
Electric Fan	65W
Laptop	70W

Solution:

The regular energy available for the family in question is 5 * 60 + 1.5 * 70 + 3 * 15 * 65 + 6 * 6 * 6 * 6 * 6 *

= 3.546 Wh

5.6 Sizing the batteries

The following features are required for the battery of a solar home system:

- Broad life-span for a deep loop
- Low repair
- High room for charging
- The power to fully discharge,
- Low internal rate of discharge
- Durability
- Minimum difference at excessive temperature

5.7 Sizing Array

A PV system's array scaling involves the measurement of the number of PV modules.

5.8 The Charge Controller Range

Application parameters of the charge controller for solar home systems

- Max current from the PV panel getting
- Capability of full load power supply
- Label the low level of voltage
- Label the elevated voltage level
- Electrical defense against thunder
- Efficient control
- Protecting toward reverse polarity
- Device voltage change

5.9 The Converter Range

Usage of a solar home system includes ac and dc voltage for appliances. Because the output voltage of the solar cell is dc, this device requires a dc-dc converter or a dc-ac converter. Any of the load is related to the appropriate converter.

5.10 Wiring of the machine

Electrical wiring is needed from the PV module down to the device component. The voltage drop happens in the wire 's inner resistance. This voltage drop should be kept within a cap for the solar home system. The cost of the wire is very high and the wire length must be minimal. The solar part relation under Dement must be fulfilled.

- The device must be stable.

- These cables do not create output problems for device modules.
- Each element performs according to its optimum efficiency.
- Usage of the unified 12volt dc system where necessary
- Usage of the unified 24volt dc system where necessary

Cross sectional area(mm^2)	Wire Gauge (AWG or SWG)	Current Rating (A)
1.0	18	10
1.5	16	15
2.5	14	20
4.0	12	30
6.0	10	35
10.0	8	50
16.0	6	70
25.0	4	90

5.11.1 Overall wire length with a reduction of 0.6 volt in the 12 volt grid

Cable size(mm^2)	Maximum cable Length (m) for various load Requirement							
	Load power(w)	24	36	48	60	72	96	120
	Current at 12 v (A)	2	3	4	5	6	8	10
1.5		12	8	7	5	5	4	3
2.5		20	13	10	8	7	6	5
4.0		31	21	16	13	11	8	7
6.0		46	31	23	19	16	12	10
10		76	51	38	31	26	20	16

5.11.2 Overall wire length in the 12 volt system with a 1.2 volt reduction

Cable size(mm^2)	**Maximum cable Length (m) for various load Requirement**							
	Load power(w)	**48**	**72**	**96**	**120**	**144**	**192**	**240**
	Current at 12 v (A)	**2**	**3**	**4**	**5**	**6**	**8**	**10**
1.5		**23**	**16**	**12**	**10**	**8**	**7**	**5**
2.5		**38**	**26**	**20**	**16**	**13**	**10**	**8**
4.0		**61**	**41**	**31**	**25**	**21**	**16**	**13**
6.0		**91**	**61**	**46**	**37**	**31**	**23**	**19**
10		**151**	**101**	**76**	**61**	**51**	**38**	**31**

5.12 A 12 volt small size Home Machine Configuration

Let, determination of load for a 12 volt solar home system configuration for 3546Wh / Day. The 85Wp module (Isc= 7.9A, Imp= 7.00A & nominal voltage=12), 660 Ah battery (DOD= 60 percent, Efficiency= 80 percent) will be used here.

Maximum 5 percent decrease in Cabal voltage

Max power loss of 5%

90 percent quality inverter

Size of battery

DC Wh / day = 3546 ÷ = 4147.36Wh (0.9 * 0.95)

Regular load = 4147.36 Wh ÷ 12V = 345.61Ah Wh 12V = 345.61Ah

Quality of battery = 80 percent

DOD (Discharge Depth) = 60 percent

If the battery range is 3 days,

So Battery Amp-hour= (345.61 * 3)÷(0.6 * 0.8)= 2160.06Ahh(0.6 * 0.8)= 2160.06Ah

Needed number of batteries = 2160.06 ÷ 660 = 3.27 ?? 4 Needs 4 batteries.

It's 660Ah each.

Sizing array

Production of the regular PV module = 12 * 7.00 * 6= 506 Wh / day

Nominal Voltage of Module = 12V

Avg. Daily. Select isolation = 6 hours

15 percent loss summary PV Array Sizing= 506 * 0.15=75.6Wh

DC watt-hours = 506-75.60Wh = 430.4Wh Usable

So module no. = 3546/430.4 = 8.24 ?? 9 = 8.24 = 9

Scale inverter

Inverter size = 355/ (.9) * 1.25 = 493.06W ?? 500W

And you need a 500W inverter.

5.13 Solar Power System Cost (3,546 kw-h)

Sl. No	Description of items	BDT
1	Solar Panel(9)	79500
2	Battery(4)	24000
3	Charge Controller	2500
4	Wire	3500
5	Panel Mounting	5500
6	Miscellaneous	2000
7	Maintenance Cost(Labor & Others)	25000
Total		142000

5.12.1 DESCO Power Cost (3.546 kw-h)

Power Cost per Unit from DESCO to BDT 7

Power cost per annum from DESCO= BDT 9060

Absolute expense for 20 years (without taking any operating costs into consideration)

= BDT 9060x2020

= 181200 BDT

5.14 DESCO Contrast Between Solar Home System and Electricity

Comparison	Solar Home System	Powered From DESCO
Cost	Total cost for 20 Years = BDT 142000	Total cost for 20 Years (without considering any maintenance cost) = BDT 9060×20 = BDT 181200
Load Shedding	No	Yes
Cost Variation Due time	No	Yes
Utility Bills	Low	High
Back up Capability	Around 4 day	No
Source of Production	Sunlight (No green house gases)	Coil, Burning, Gas, Water, Garbage etc.

5.15 The Relevant Costs Recognition

Items for direct costs are usually divided into two types:

A. Capital expenses

B. Maintenance and activity Expenses

5.15.1 Costs of Resources

- Land and other natural capital that have alternate existing applications
- Technology and architecture in depth
- Preparatory installation work
- Price of vehicles, raw materials and building supplies
- Effect of construction and secondary installations
- Technical and operating costs during construction
- Costs in organization
- Running costs for cycles

- Contingencies

5.15.2 Cost of Operation and Repairs

- Raw machines and other materials
- Electricity and Oils
- Labour
- Rent and protection
- Natural resource loss
- Contingencies
- In the technical report, the above elements are listed and should also be expressed in the financial review.
- Sunken Risk

- That are the expenses accrued by the project due to its evaluation.
- Shadow rates
- Such prices are the values of project inputs and outputs that represent their relative scarcity or accessibility.

5.16 The Solar Home Device Advantage

1. Immediately Save money on energy bills

The installation of home solar panels will significantly cut your energy bills considerably. Some homeowners save 30% on their energy bills, others even remove their electric bill entirely.

A average Bangladeshi household consumes 3,546 days of electricity. A Green Energy Company residential solar installation of 840 kWh a month will almost completely cover the power costs.

Your real savings would depend on the energy needs of your house, the capacity for a photovoltaic device available, and the orientation of your PV system. For an overview and an estimation, contact Renewable Energy Company.

2. Secure oneself against rising prices of electricity

During the last five years, energy prices have risen by more than 21 percent.

Rates in 2006 alone soared 10.3 percent.

The supply of fossil fuels is declining, which would lead to higher energy prices.

Solar power locks in your electrical costs and saves you from increasing prices of electricity.

3. Scaling down your carbon footprint

By electrical usage, the average American household emits 7.4 tons of carbon dioxide (CO_2) per year.

This translates to 185 tons of CO_2 for 25 years, which is how long the solar panels of the Solar Planet are guaranteed to work. Carbon dioxide causes global warming that significantly impacts our climate, causing the disappearance of ice, destruction of shorelines and endangering many wildlife around the globe.

4.Retain our natural capital

A adequate amount of sunlight reaches the planet every hour to fuel the earth for a year.This is 400 trillion gigawatts a second and enough to provide 400 quintillion homes with electricity. Putting the sun to work lowers the amount of coal and nuclear electricity used to fuel the house, helping to sustain the flow of non-renewable fuels to the planet. Vast volumes of water are used by coal and nuclear energy output. As a result, more than 16,000 gallons of water each year can be conserved by solar at your house.

5. Il for Freedom of Electricity

We will reduce our dependency on global and non-renewable energy sources by harnessing the sun.

6. Increase the worth of your house

Studies suggest that solar panels will increase the worth of your house by 20 times the annual savings on electricity. In comparison, solar-system homes tend to sell quicker than solar-free homes-15% quicker in some surveys.

7. Utility Bill Elimination

Your energy bill will drop dramatically as you start to produce your own solar electricity. How much you will save will depend on the capacity of your solar panel and the energy intake of your household. Any electricity would also be extracted from the electricity grid, but at a lower-priced service point. Solar City will build a scheme for your home that is correct and decide the optimum arrangement of the service cost for your remaining energy needs.

8. Minimal effects on the climate

While solar panel manufacturing requires some raw materials and energy inputs, the environmental effect of solar power is negligible. The system emits no emissions of biomass, methane or particulate matter emitted from fossil fuels and does not require large-scale mining. Or procedures for fracking. Since panel arrays can be installed on rooftops or in remote desert areas, the physical footprint of solar power is also manageable.

5.17 Affecting the Solar Home Panel System

- The high price of SHS results in a small range of vendors and a lack of expertise in the solar energy industry. So it is critical to raise the technology market
- Sunlight is often not available during the rainy season.
- The initial cost is high, which is why some middle-class families can not afford it.
- If the solar panel is destroyed, so the panel needs to be modified.

Chapter-6
Conclusion

6.1 Recommendations and Future Emphasis

In the short term, we can assume that SHS's rising levels is about the middle class family and it can yet not be afforded by the lowest. Once again, to get more fresh ideas, we would recommend growing their research & development business. Any techniques could include:

- Provide a minimal system such that the total amount of money is minimized.
- Cross-subsidies will make SHS more affordable to the disadvantaged.
- Installing SHS in school , college, company will improve working hours.

There is currently a small number of vendors and a lack of expertise in the demand for solar energy , resulting in SHS's high price. Again, it is not always accessible or difficult to supply the components. So it is, The technology demand continues to expand. All together, Pos could make that happen.

Nowadays, a new factor is being introduced with the growing number of SHS implementation health issues. The recycling process for batteries is a necessary activity for each company to ensure health and environmental issues. In addition, accepted requirements, standards & technologies should be revised regularly at the top end of the organisation tree to function in the new world of electricity. Again, the need to improve their professional expertise to ensure the right repair service at the bottom of the association chain. There are complaints, however, that newly installed SHS output from the original installations is definitely declining. Thus, worrying about their consistency should concern the potential outlook of the SHS company. But the increasing SHS rate is still really impressive and that loan goes to the partner company. We should also expect that they can have a strong effect on national power production by can their operation.

Appendix A

Solar Energy-Related Concepts

The foregoing are words used in this report relating to solar power and/or are widely applied related to the subject matter relevant to this report.

Different meanings are found in popular literature in some cases. Where different specified words exist, federal or state guidelines and generally accepted consensus-developed codes and standards are given priority. Different meanings of the same word are given in some situations.

Absorber: A solar collector part that absorbs radiant energy and converts that energy into a fluid as heat.

Gap. Aperture. Opening of the solar collector through which un-concentrated solar radiation is accepted.

Collection. A mechanically assembled assembly of modules or panels with a support system and base, a tracker and other components to form a direct-current power-producing unit, as required. See the Photovoltaic Array as well.

Integrated Photovoltaics house. Photovoltaic cells, systems, components, or standardized materials that are built into a building's exterior surface or framework and act as a building's exterior protective shield.

Controller of Fee. Equipment used for charging a battery that regulates dc voltage or dc current, or both.

Collector Concentration. A solar collector that redirects and concentrates the solar radiation passing through the aperture to an absorber using reflectors, lenses or other optical components. See also the Sun Collector.

Network for Electrical Processing and Delivery. A power storage, delivery, and consumption mechanism which is external to and not operated by the photovoltaic power system, such as a grid system and attached loads.

Fluid for Heat Transfer. A fluid that is used in a device to transfer thermal energy between parts.

Framework with hybrids. A device composed of several sources of electricity. Photovoltaic, wind, micro-hydro generators, engine-driven generators and others can be included in these power sources, but they do not include energy generation and distribution network networks. For the purposes of this concept, energy storage devices, such as batteries, do not represent a power source.

The Collaborative Framework. A solar photovoltaic system that functions in parallel with an electricity generation and distribution network and can supply power to it. Power, for the purposes of this description,

A solar photovoltaic system's storage subsystem, such as a capacitor, is not another type of electrical output.

Inverter. Equipment that is used to modify the level of voltage or waveform of electrical energy, or both. An inverter [also referred to as a Power Conditioning Unit (PCU) or Power Conversion System (PCS)] is typically a mechanism that converts the dc input to an AC output. Battery chargers that use alternating current from another source to convert it into direct current for charging batteries may also act as inverters. Electric energy converter that converts direct electric current to alternating currents in single or poly-phase.

Module. A complete, environmentally protected, tracker-exclusive device consisting of solar cells, optics, and other components intended to produce DC power when exposed to sunlight. See also the Photovoltaic Module.

Panel. A series of mechanically connected, wired, and engineered modules designed to provide a field-installable device. See the Photovoltaic Screen as well.

Set of Photovoltaics. Assembly of and service system of mechanically assembled and electrically coupled PV modules, PV panels or PV sub-arrays. Note: its base, monitoring apparatus, thermal control and other such instruments are not included in the PV collection.Ingredients. See also the 'Collection'.

Assembly for Photovoltaic. PV parts, including parts, support systems, supports, plumbing, monitoring apparatus and thermal control (where specified), which are assembled outdoors and remote from their loads, including junction boxes, charge controls and inverters based on the configured configuration of the system.

Cell for Photovoltaic. The most simple photovoltaic system. See also-Solar Cell as well.

Application for Photovoltaic. Full and environmentally safe assembly of photovoltaic interconnected cells. See also the 'Panel'. Board of Photovoltaics. Mechanically integrated, pre-assembled and electrically interlinked PV units. See also-Panel as well. System of

Photovoltaics. Assembly of components that, by converting solar energy, generate and provide electricity.

Voltage of Photovoltaic Devices. Direct current voltage (dc) of any photovoltaic source or circuit for photovoltaic output. The maximum voltage for any two dc conductors is the photovoltaic device voltage for multi-wire installations.

Solar Photocell. The simple photovoltaic system which, when exposed to light, generates electricity. Even see-Photovoltaic Cell.

The Solar Gatherer. A system intended to absorb solar radiation and transfer the thermal energy thus produced to a fluid that passes through it. See also: Collector Focusing.

Solar Energy. The sun emits radiation in the form of electromagnetic energy. Note: it is widely known that solar energy requires all energy produced available by the collection and transfer of solar radiation.

Device of Solar Heating. The device is composed of solar collectors and other thermal energy distribution elements.

Photovoltaic Solar. Concerning PV equipment under the influence of sunshine.

Photovoltaic Solar System. Complete components and subsystems which, in combination, convert solar energy into electricity suitable for connection to the load of use.

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