Study on Grid Tie Solar System Using HOMER Pro Software

A report presented in partial fulfillment of the requirements for the degree of Bachelor of science in Electrical and Electronics Engineering(EEE)

By

Md.Naeem Hasan

171-33-437

Md.Nazmul Islam

171-33-412

Supervised by

Dr.Md. Alam Hossain Mondal

Associate professor

Department of EEE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FACULTY OF ENGINEEING

DAFFODIL INTERNATIONAL UNIVARSI

Certification

This is to certify that this project and thesis entitled "**Study on Grid Tie Solar System Using HOMER Pro Software"** 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 Bachelor of Science in Electrical and Electronic Engineering.

Signature of the candidates

____

Name: Md. Naeem Hasan
ID: 171-33-437

____

Name: Md.Nazmul Islam
ID:171-33-412

Countersigned

____

Name of the supervisor

Designation

Department of Electrical and Electronic Engineering

Faculty of Science and Engineering

Daffodil International University

The project and thesis entitled"**Study on Grid Tie Solar System Using HOMER Pro Software,"**submitted by **Md.Naeem Hasan ID:171-33-437, Md. Nazmul Islam ID:171-33-412** Fall 2020& Spring 2021 has been accepted as satisfactory in partial fulfillment of the requirements for the degree of **Bachelor of Science in Electrical and Electronic Engineering .**

BOARD OF EXAMINERS

____

Dr.Engr.---- Chairman

Professor

Department of EEE, DIU

____

Dr.Engr.---- Internal Member

Professor

Department of EEE, DIU

____

Dr.Engr.---- Internal Member

Professor

Department of EEE, DIU

Dedicated to

Our Parents

And Friend

With Love & Respect

ACKNOWLEDGEMENTS

First of all, we give thanks to Allah or God.Then we would like to take this opportunity to express our appreciation and gratitude to our project and thesis supervisor **Dr. Md. Alam Hossain Mondal**. Associate Professor**, Department of EEE** for being dedicated in supporting, motivating and guiding us through this project.This project can't be done without his useful advice and helps.Also thank you very much for giving us opportunity to choose this project.

We'd also like to thank Professor **Dr. Md. Shahid Ullah of the Department of EEE** for his assistance, guidance, and continuous encouragement.

Apart from that, we would like to thank our entire friends for sharing knowledge; information and helping us in making this project a success. Also thanks for lending us some tools and equipment.

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

ABSTRACT

Electricity is needed at all times for a country's long-term growth. Bangladesh's power crisis is one of the main barriers to its economic growth. Currently, the majority of power generation in the world is based on fossil fuels, which are not environmentally friendly and emit greenhouse gases, which contribute to global warming. In Bangladesh, the amount of fossil fuel reserves is insufficient. As a result, solar power is the best solution for reducing this reliance.

The design, simulation, and feasibility study of a solar project are presented in this paper. The most critical step in creating a solar project model is to calculate the load at various times of the year. Measuring the load of 50 houses, mosques, schools, markets,s and others. In this project, the total area is 465.24 km^2 (179.63 sq mi).

A grid-tied solar power inverter does DC-to-AC conversion and minimizes energy transfer losses. This project by using HOMER (PRO). In this thesis, HOMER is the most important simulation program. This software is utilized to identify the least cost design among a lot of options. In our project, the cost of energy is BDT 9.04.

All CONTENTS

Chapter 3: Utility Grid of Solar System

Chapter 4: Analysis and Simulation

Chapter 5: Optimization Result of the Grid Solar System

Chapter 6: Conclusion and Recommendations

List of Tables

List of Figure

List of Abbreviations and Acronyms

PV	Photovoltaic
MPP	Maximum Power Point
MPPT	Maximum Power Point Tracker
C	Capacitor
V	Voltage
L	Inductor
R	Resistor
D	Diode
DC	Direct Current
AC	Alternating Current
ID	Diode Current
Rs	Series Resistance
Rsh	Shunt Resistance
STC	Standard Test Conditions
VOC	Open Circuit Voltage
ISC	Short Circuit Current

Units and Symbols

AH	Ampere hour
KW	Kilowatt
KWh	Kilowatt hour
KWh/m2	Kilowatt hour per square meter
KWh/m2 /d	Kilowatt hour per square meter per day
MW	Mega Watt
m3 /day	Cubic meter per day
TK	Taka
V	Volt
W	Watt
Wp	Watt Peak
AH	Ampere hour
W/m2	Watt per square meter
<	Less than
>	Greater than
0 C	Degree Celsius
km	Kilometer
%	Percentage
W/m2	Watt per square meter

CHAPTER 1

INTRODUCTION

1.1 Introduction

Bangladesh is a vast populated country. About 180 million people are living in this country. To Fulfill the huge amount of people need huge amount of energy. Energy is a physical system's ability to do work. The most common form of energy is electrical energy. Renewable and non-renewable sources are the two basic types of sources used to produce electricity. Renewable energy is derived from renewable resources that are replenished naturally on a human timescale. Renewable energy comes in a variety, wind, hydroelectric, biomass, and geothermal power are all renewable energy sources that depend on sunlight in some .Energy is the world's most plentiful and renewable energy source. It's a kind of radiant energy that comes from the sun and travels through the solar system in waves. Sunlight can be used to power solar cells, which produce electricity. It's a gadget that turns light into electricity. The term "sustainable power supply" refers to energy derived from assets that are naturally recharged on a human timescale, such as sunlight, wind, and storms. Around 16 percent of global last vitality use is derived directly from inexhaustible resources, with traditional biomass accounting for 10% of total vitality (mostly used for warming) and hydroelectricity accounting for 3.4 percent. Small hydro, modern biomass, wind, daylight-based, and geothermal account for another 3% of overall electricity and are rapidly spreading. At least 30 countries around the world now have a clean electricity source that represents more than 20% of overall energy consumption at the national level.

1.2 Problem statement

The most critical aspect of a Grid-tie solar system is to keep costs down. It can be difficult to serve or meet all of the demand for any rural energy needs by using only Grid-tied Solar systems. For grid-connected solar Weather conditions which not always be ideal for a single-source off-grid system. If the irradiation is too tiny, a battery will be unable to charge properly.solve the issue The simplest method is to use the solar system. Solar systems include solar panels, wind turbines, and a backup generator.

There are also several issues that should be addressed. The most serious issue is the high cost. As a result, our research also includes a cost analysis of the solar system grid-tie. Cost is the most critical factor in any renewable energy source.

1.3 Objectives

The improvement of a Grid-tie Connected solar System in which complex and sensitive forces sway exponentially with voltage, as well as the implementation of this model in Ideal Power Stream and analysis of the potential effects, is the main focus of this project.
of the above with those obtained from OPF considers weight models without association to ensure the least debacles and age costs.

➔ To design an effective Solar grid-tie system
➔To calculate or optimize the cost form the system
➔To know about the HOMER Software
➔To know about present renewable condition for Bangladesh.

1.3.1 About HOMER Software

HOMER Energy LLC was established in Boulder, Colorado, in 2009 to commercialize the HOMER Optimization of Multiple Energy Resources (HOMER) model developed by the US Department of Energy's National Renewable Energy Lab. HOMER Energy's primary goal is to maintain HOMER's rise, delivery, and support. HOMER has been around for more than two decades.
Micro-grids' economic and infrastructure facets have been optimized using energy principles. The economist and engineer who developed the HOMER software while at NREL, as well as professional managers, consultants, and industry specialists with entrepreneurial expertise, make up the HOMER Energy team. Our shared goal is to

connect people all over the world with tools, services, and awareness to encourage the implementation of renewable and distributed energy technologies.

1.3 Methodology

It's a platform for modeling and optimizing renewable and non-renewable energy systems, both off-grid and grid-connected, for a wide range of applications. Due to a variety of design options, HOMER has minimized the research issue and micro-grid design.This software includes all expenses, including the initial capital and ongoing repairs, as well as emissions fines. In order to design the optimization scheme, HOMER ensures the best possible balance between supply and design. It encourages energy balance projections for each of the year's 8760 hours.Following the simulation, HOMER displays all of the available device configurations, which can be used to compare system architecture options.

1.4 Thesis Outline

Our study basically shows the cost optimization for grid-tie Solar system. Designing a proper grid-tie Solar system is also a part of this study. Cost optimizing is basically the most important part for any projects. Everything depends on it. Sometimes project success depends on the cost. So our study contains a full Solar system model by using HOMER software and also the cost analysis for this system.

\

CHAPTER 2

Generation of Electric Energy

2.1 Introduction

Electricity is a means of producing power from any primary energy source. The next century the term "electricity" refers to a group of physical phenomena involving the existence and flow of electricity. A charge of electricity Chemical energy, for example, is one of the most well-known sources of electricity. K.E. electricity, rotational energy, solar power, wind energy, and heat energy are all examples of thermal energy.Some of the sources are renewable, while others are non-renewable. The energy supply options, type of generation system, unit and plant ranking, and plant sit are the key parameter choices that must be made for every new electrical power-generating plant or unit.

2.2 Renewable Energy

Energy obtained from natural materials that are populated on a human timescale, such as sunshine, wind, rain, tides, waves, and geothermic heat, is referred to as renewable energy. Electric generation, air and water heating/cooling, transportation, and rural (non-grid) electricity utilities are all traditionally powered by renewable energy. Small hydro, electrical machinery biomass, wind, solar, and geothermal account for a third of overall renewables and are increasingly expanding. At the state level, clean energy accounts for more than 200 percent of overall energy consumption in at least 30 countries around the world. Renewable energy is available in a variety of ways, including wind, solar, and biomass fuel.We try to educate people about the importance and benefits of using renewable energy sources. This is often required because the Earth's oil and coal reserves are rapidly depleting in the face of rising demand. As a result, it is critical that people recognize the importance of safeguarding these finite energy sources and learning how to use energy effectively.

2.2.1 Present Condition of Renewable Energy in Bangladesh

By 2021, the government wants to generate 2000 megawatts of electricity from renewable sources. Currently, 404 MW of power is generated from such sources. Renewable energy would account for 10% of total power output in 2021, increasing to 20% by 2030.In the previous few years, the renewable energy sector has made significant development. At the moment, renewable energy sources provide 404 MW of power. In Bangladesh, the solar home system is a success story, and its popularity is growing in rural areas, particularly in off-grid areas. Table 3 depicts the development made thus far in the renewable energy sector.

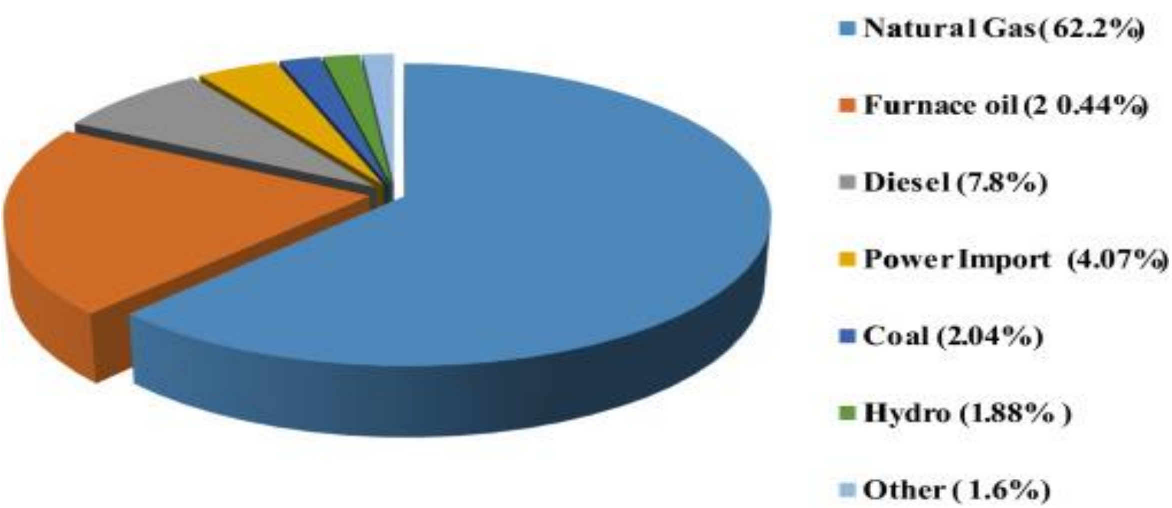


Figure 2.1 : Renewable Energy

2.2.2 Future Condition of Renewable Energy in Bangladesh

According to the International Energy Agency, renewable energy will account for 30% of global energy by 2024, with the majority of this coming from solar and other projects that are being built out at a breakneck rate.

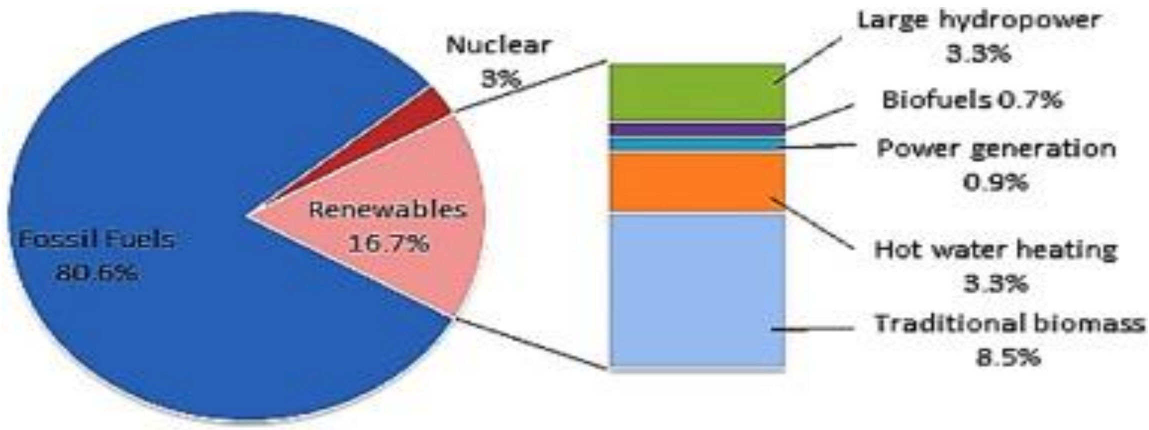


Figure 2.2: Future Renewable Energy

2.3 Solar Energy

Solar heating, star photovoltaics, solar thermal electricity, solar architecture, and artificial photosynthesis are all examples of ever-evolving solar energy, bright light, and warmth harnessing technologies. Based on how they consume, convert, and relay solar energy, solar systems are categorized as either passive or active solar. Active solar methods such as photovoltaic panels and solar thermal collectors are used to absorb the heat. Passive solar strategies include orienting a building to the Sun, choosing materials with suitable thermal mass or light dispersion properties, and planning areas that spontaneously flow into air. An electric cell, also known as a PV cell, is a device that transforms light into electricity. In the 1880s, Charles Frits invented the first electric battery. A German businessman named Ernst Werner von Siemens was one of the first to recognize the importance of the discovery. In 1931, a German inventor named Bruno Linesman invented a photograph cell that used silver selenide instead of copper oxide. though the image Se cells converted but I The transformation of incident light into electricity is chronicled in this book.

Figure 2.3 : Solar Panel

2.4 Hydroelectric Power

A hydro-electric power plant is a generation station that uses the high potential energy of water to produce electricity. Hydro-electric power stations are usually built in mountainous regions where dams are simple to build and massive water reservoirs are available. A hydro-electric power plant generates water head by constructing a dam over a river or lake. From the dam to a water rotary pump, water is LED. The water rotary engine captures the energy present in falling water and transforms hydraulic energy into energy at the rotary engine shaft. The rotary motor powers the generator, which converts energy into electricity. The shape is changed to mechanical machine energy until running water transforms blades in a very rotary motor. The rotary engine rotates the generator rotor, which transforms mechanical energy into a certain source of energy: electricity. We call this electricity power or hydropower for short since water is the initial source of energy.

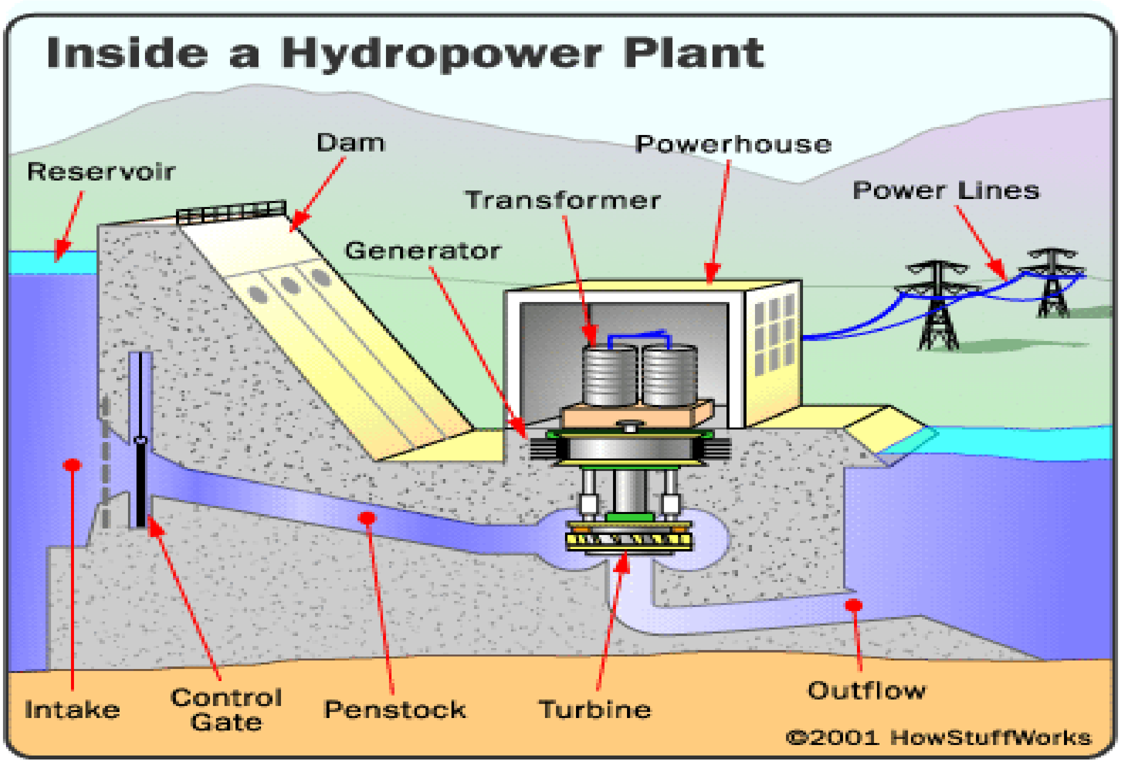


Figure 2.4 :Hydro Power Plant

2.5 Wind Power

Wind has the potential to be a major energy supply for our planet. Several people have seen it in action, propelling sailboats through open seas or spinning windmill blades to grind grain or pump water on a farm. Today's wind turbines are sleeker, more technologically sophisticated versions of older windmills. Instead of trying to do farm work with the wind, they are designed to convert wind energy into electricity. As wind blows over a turbine's rotor, one side of the blade bears more weight than the other. The mechanism of the three connected blades is shown in this way. A number of spinning elements within the rotary engine's body rotate as a result of this rotation. In effect, this turns a battery, which generates electricity. As a result, wind continues to blow everywhere on the planet's atmosphere. Since the only requirement for demonstrating a turbine is that it move air, it is classified as a natural resource. Wind farms don't produce any greenhouse gases.Despite the fact that it is renewable and plentiful, there are a number of reasons why we don't use wind power as much as we could. The first, and perhaps most significant, is that the wind does not always blow in the same direction, and technologies for storing large amounts of energy for later use are currently prohibitively expensive. Long transmission lines are essential to transfer the electricity to wherever it is required. Finally whereas farms are comparatively price low-cost to control they cost plenty to create specially as compared to existing coal and gas power plants.

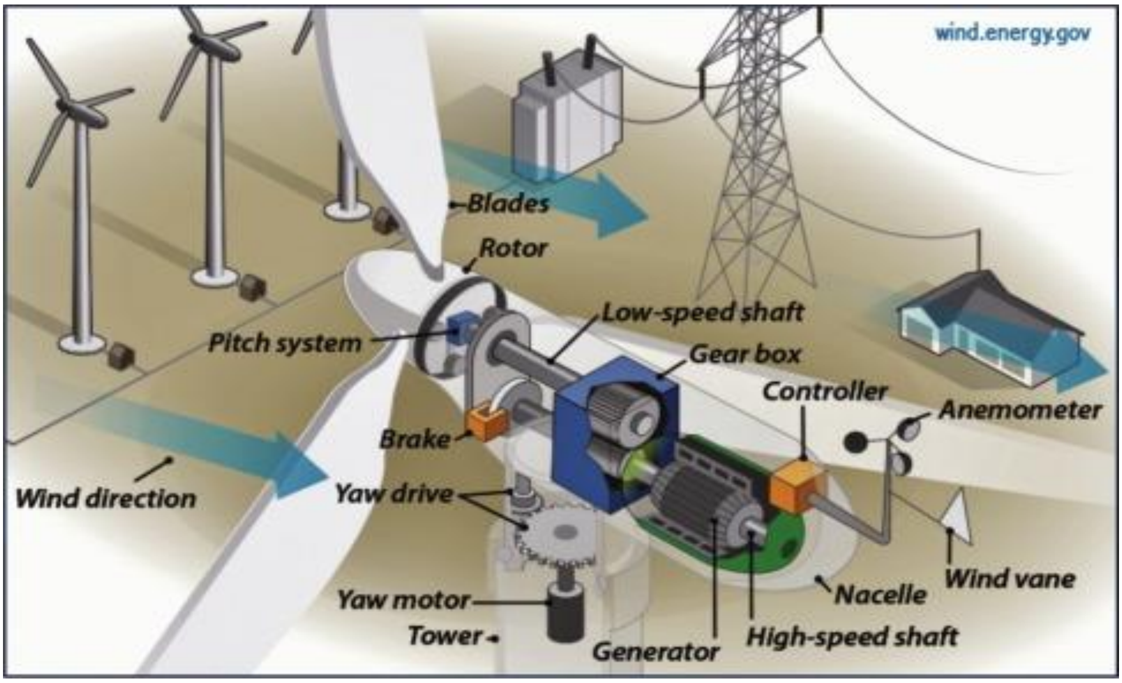


Figure 2.5 :Wind Power

2.6 Geothermal Power

Geothermal is derived from the Greek words geo, which means earth, and thin, which means fire. Geothermal energy is radiation that is generated from the earth's own heat. Underground tanks of high-temperature water or steam heated by a stone up welling.We draw water from these rivers to heat it, which spins turbines and generates electricity. The energy acquired by the earth is geothermal energy. The term geothermal comes from the fact that the source of energy is the earth. At a depth of 80 kilometers, the world's heat is available. It can be reached at depths ranging from 300 to 3000 meters in some places. Energy fields are the names given to such places. Geothermal energy is used to heat water, power plants, generate electricity, and heat greenhouses, among other things. Steam is created directly from the geothermal reservoir in a dry steam powerhouse power plant. This group is fed directly into the rotary engine, which is connected to a generator. Condensation is the name for the water that is pumped out into the atmosphere from the injection well. Natural dry steam hydrothermal sources are becoming increasingly scarce.

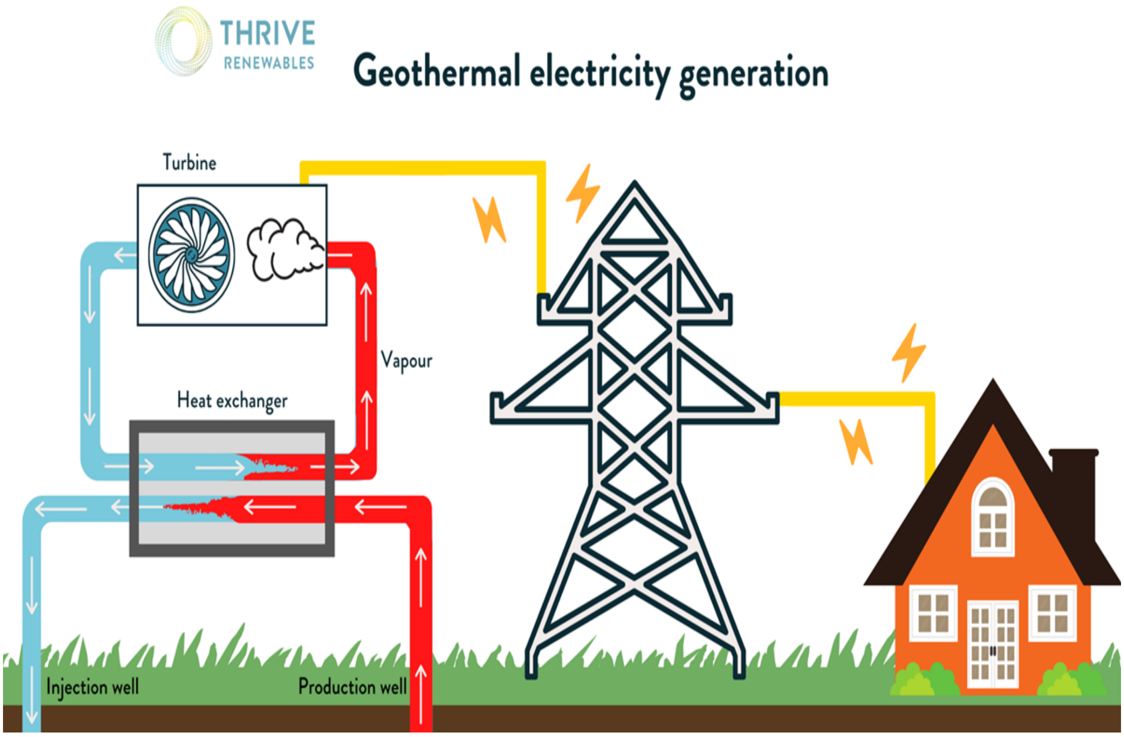


Figure 2.6 : Geothermal Power

2.7 Biomass Power

Both agricultural materials obtained from plants and animals are referred to as biomass. Biomass is a concept that describes a wide range of organic materials that can be used to produce energy. Examples include forest products, energy crops like Miscanthus, also known as elephant grass, and agricultural byproducts.Let's have a look at how fossil fuels like coal, oil, and natural gas are produced to see how biomass can save the climate. Plants absorb carbon dioxide, or co2, as they mature. When the plants perished, some of the carbon from the CO2 remained trapped in the decaying plants. For millions of years, these buried deposits of vegetation are crushed and transformed into coal oil or natural gas. The fuel that was removed from the atmosphere has essentially been buried. Let's take a look at two different methods for heating a building. Coal is used as a fossil fuel in the first case. Coal is extracted from the earth and shipped to the residence. As a result of this process, CO2 emissions are generated. When fossil fuels are burnt, CO2 is emitted into the atmosphere, increasing CO2 levels.

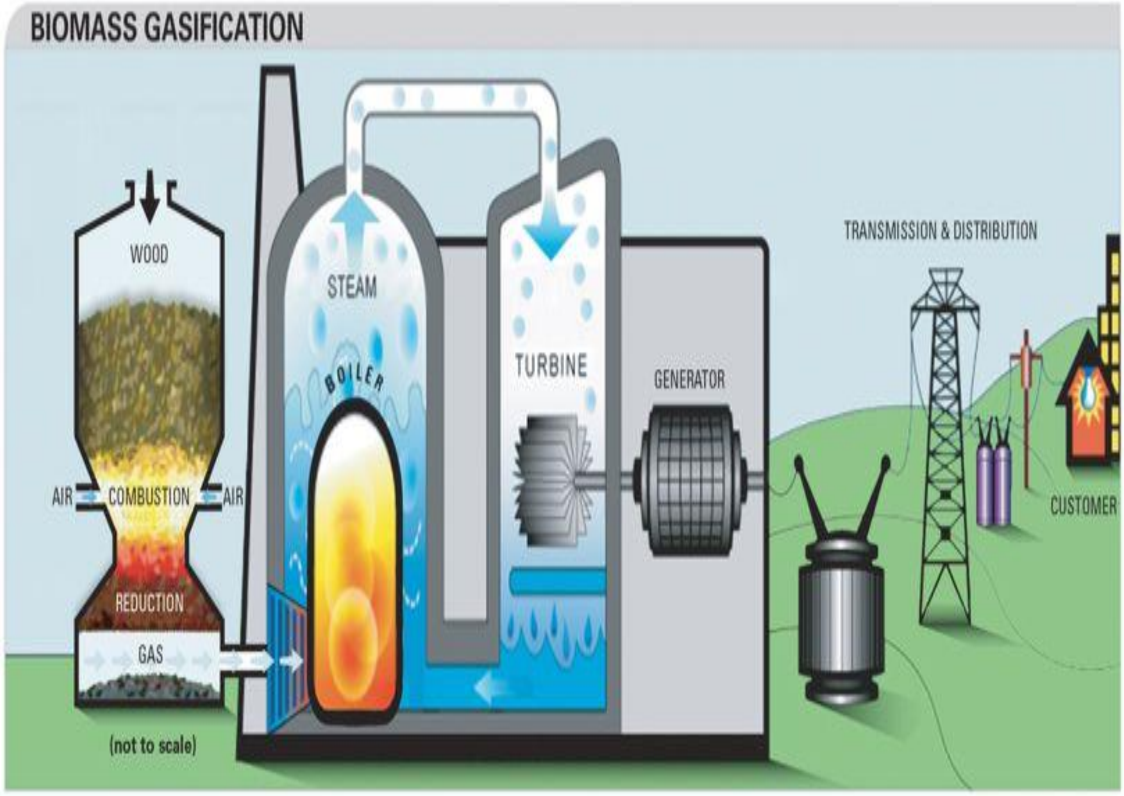


Figure 2.7 : Biomass Power

2.8 Grid tie Solar System

A home solar panel that is grid-tied is one that is already attached to the power grid. Such a machine provides electricity for the home while still feeding any surplus electricity into the grid. The amount of electricity it pumps into the grid will cause the electric meter in your home to slow down as it calculates consumption. It frequently causes the meter to go backward.When the meter "spins backward," it indicates the power is being pumped into the grid.

At present non-renewable energy is declining day by day. The biggest advantage of grid-tied solar systems are that they are much cheaper than other types of solar systems. Their lower upfront cost means higher monthly savings, a higher return on investment (ROI), and the shortest payback period. Among the other advantages is that the geographical condition of Bangladesh is very good and the solar environment is friendly. Due to the geographical location of Bangladesh, it is not possible to develop electricity through wind and consumption from all places. Due to the geographical location of Bangladesh, it is possible to generate electricity through solar power from any place in Bangladesh. So, solar energy is the best grid-tied system.

- → Solar Panel.
- → Maximum Power Point Tracking (MPPT)
- → DC To DC Converter.
- → DC To AC Converter (Inverter).
- → Utility Grid.

DC power from sources such as hydro, wind, or solar is routed through a grid-connected inverter. The inverter checks the frequency of the alternating current mains supply and provides phase-matched power. During a "black out," most inverters can continue to give courtesy electricity if the grid fails to take electricity. The number of grid-tied systems is growing every day by day.

2.9 Grid tie Solar Electric System

A grid-tied electrical system, also known as a connected to grid or grid-tie system, is a semi-autonomous electrical generating or grid energy storage system that connects to the mains in order to feed surplus capacity back into the local electrical grid. When there is a power outage, electricity from the mains grid can be used to make up the difference.When there is a surplus of power, it is transmitted to the mains grid. It is feasible to prohibit any input into the grid when the utility or network operator regulates the quantity of energy that gets into the grid by installing Export Limiting.

A grid-tied electrical system, also known as a tied to grid or grid tie system, is a semi-autonomous power generation or grid energy storage system that connects to the mains in order to pump excess power back into the local electrical grid. When there isn't enough power, electricity from the mains grid will be used to make up the difference. DC power from sources such as hydro, wind, or solar is routed into a grid-connected inverter. The inverter controls the frequency of the alternating current mains supply and produces phase-matched electricity. During a "black out," most inverters will continue to provide courtesy electricity if the grid fails to accept fuel.

Battery-to-grid technology will also reduce the need for fossil-fuel power stations to provide electricity at high demands on the public grid. Using stored battery power during peak hours may gain regions that charge based on time of use metering.

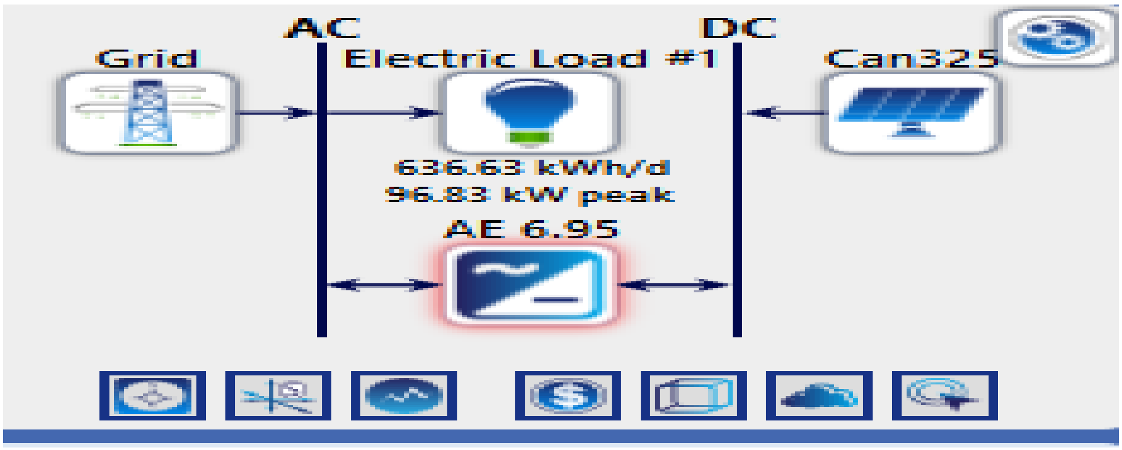


Figure no 2.8 : Block diagram of Grid tied Solar Systems

2.10 Solar Panel

The sun is the source of solar radiation. Solar panels (also known as PV panels) are used to transform light from the sun into electricity that can be used to fuel electrical loads. Light from the sun is made up of energy particles called photons.

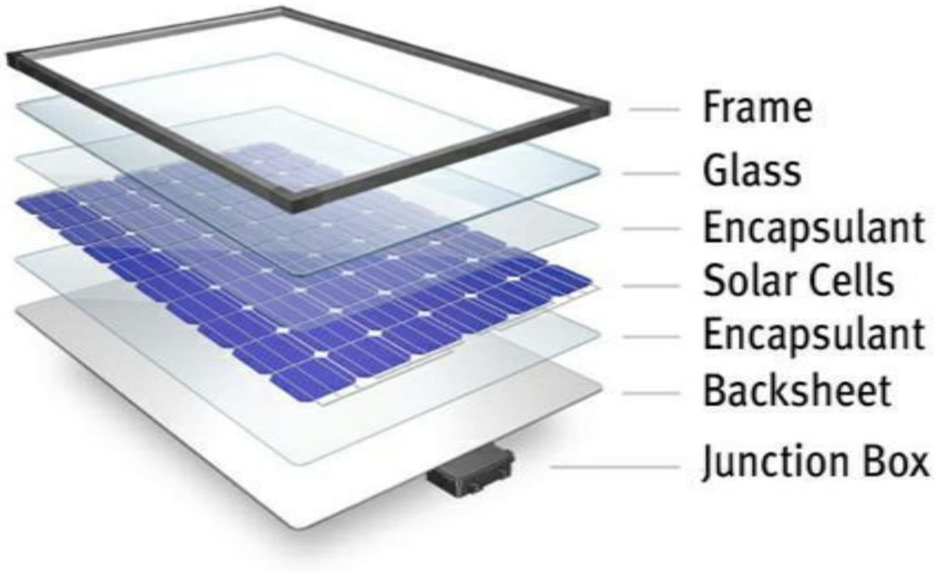


Figure 2.9 : Solar Panel

Pricing of SHS analysis of the foreign market and Bangladesh market: In Foreign market.

Solar Panel Brand	Wtp	Cost US$ per Solar Panel	Efficiency %	Price per Watt	Country of Manufacture.
Canadian Solar	270	$141.75	15.00%	$0.52	China
Sonali	240	$120	15.00%	$0.50	India
REC Solar	250	$131.25	14.30%	$0.52	Singapore
Conergy	260	$130	14.39%	$0.50	China
DM Solar	168	$79.8	15.00%	$0.47	China
Hyundai	260	$136.50	14.20%	$0.52	South Korea
EcoSolargy	240	$114	14.00%	$0.47	China
Schott Solar	250	$125	15.00%	$0.50	China
Sharp	280	$154	14.40%	$0.55	USA
Suniva	240	$117.00	16.20%	$0.50	USA
Suntech	220	$112.75	14.50%	$0.49	China
LG Solar	250	$118.75	15.80%	$0.47	South Korea
Helios Solar	260	$130.00	15.63%	$0.50	USA

Table no 2.1: Price of Solar Panel in Foreign Market.

2.11 Basic Principal of Solar Panel

A solar cell, also known as a photovoltaic cell, is a device that converts sunlight into electricity through the photovoltaic effect. Solar energy can be a method of producing electric power by transforming solar radiation into DC electricity using specially designed p-n junctions that exhibit the photovoltaic effect. It transitions as magnetic pull irradiation falls on such a junction. After receiving energy, an electron in the valence band is promoted to the conductivity band, creating an electron-hole pair. The created electrons and holes would now act as mobile charge carriers, causing a current to flow. Figure 1 depicts this approach for crossing a p-n intersection.

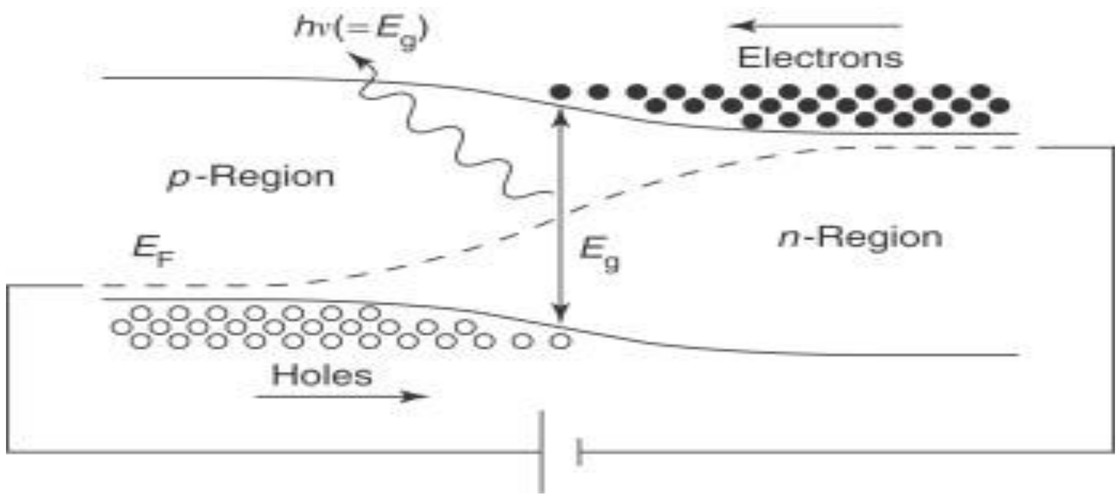


Figure 2.10 : Creation of Electron-Hole Pairs by incident electromagnetic irradiation

2.12 Solar Cell

A solar cell is an electronic unit that converts light energy into electricity. In its most simple shape, a solar cell is a p-n junction diode. The photovoltaic effect is used to transform light energy into electrical energy. While this is originally a junction diode, it is constructed in a somewhat different manner than a traditional p-n junction diode. On a comparatively thicker p-type semiconductor, a very thin layer of n-type semiconductor is fully grown. On the top of the n-type semiconductor plate, we have a few finer electrodes. To obtain the skinny n-type sheet, these electrodes don't block light. A p-n junction exists just under the n-type layer.

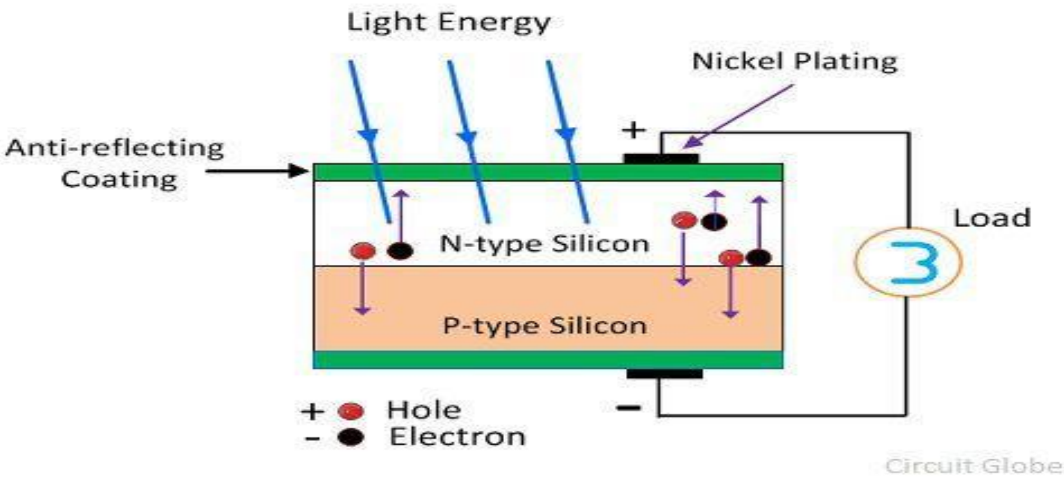


Figure 2.11 : Solar Cell

Photons from the sun directly travel into the thin n-type layer to join the p-n junction when light reaches it. The energy in the form of photons in the light is necessary to produce a number of electron-hole pairs at the junction. The junction's equilibrium is thrown off by the light-weight situation. Free electrons from the depletion area could quickly move to the n-type side of the junction. Similarly, the gaps inside the decay will quickly return to the p-type facet of the junction. The newly formed free electrons are unable to cross the junction due to the junction's barrier potential until they have returned to the n-type side.

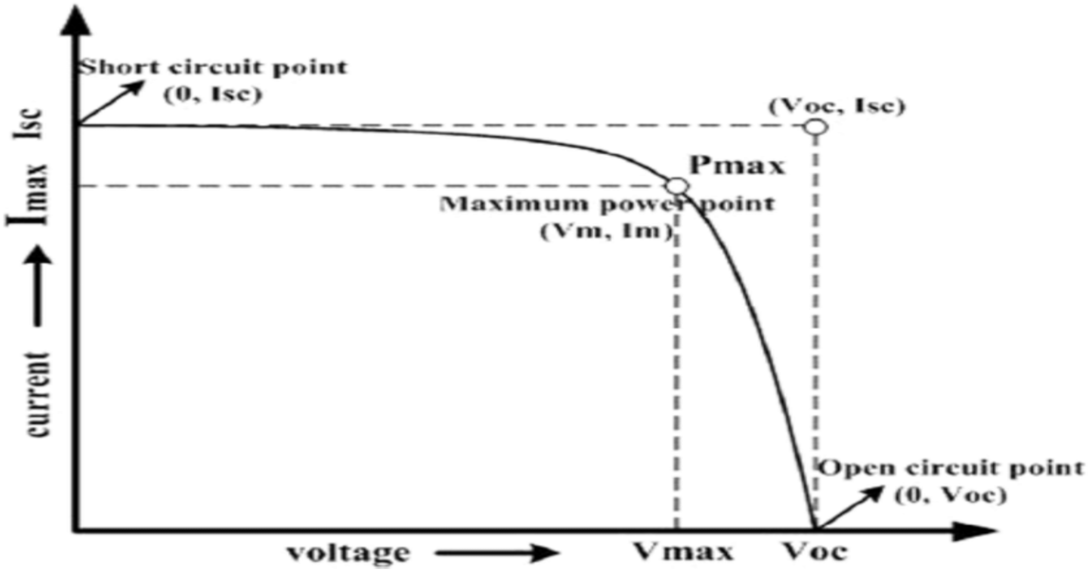


Figure 2.12 : V-I Characteristics of a Photovoltaic Cell

2.13 Operation of a Photovotaic (PV) Cell Modules

A photovoltaic (PV) cell's operation necessitated

* Light emission that results in electron-hole pairs or exactions.

* The isolation of opposite-type charge carriers.

* The extraction of such carriers to an external circuit on their own.

A solar thermal collector, on the other hand, absorbs sunlight to supply heat for either direct heating or indirect electric power generation. A "photo electrolytic cell" (photo electro chemical) is a type of solar cell (such as Edmond Becquerel's and electronic equipment desensitized solar cells) or a battery that uses only solar illumination to divide water directly into gas and oxygen.

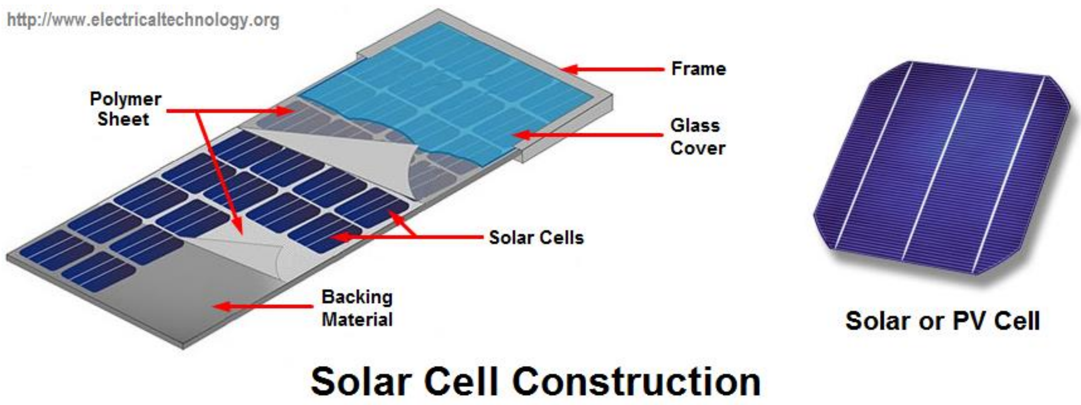


Figure 2.13: Construction of Photovoltaic Solar Panel

2.14 Array

The most important part of a solar panel system is the solar array. It holds all of the panels in your system, which is where sunlight is collected and converted into electricity. Here are some common questions to ask yourself before installing a solar panel system on your home, and to make sure you get the most productive array possible. A PV array is a full power-generating unit made up of any number of PV Modules and other components a few tables.

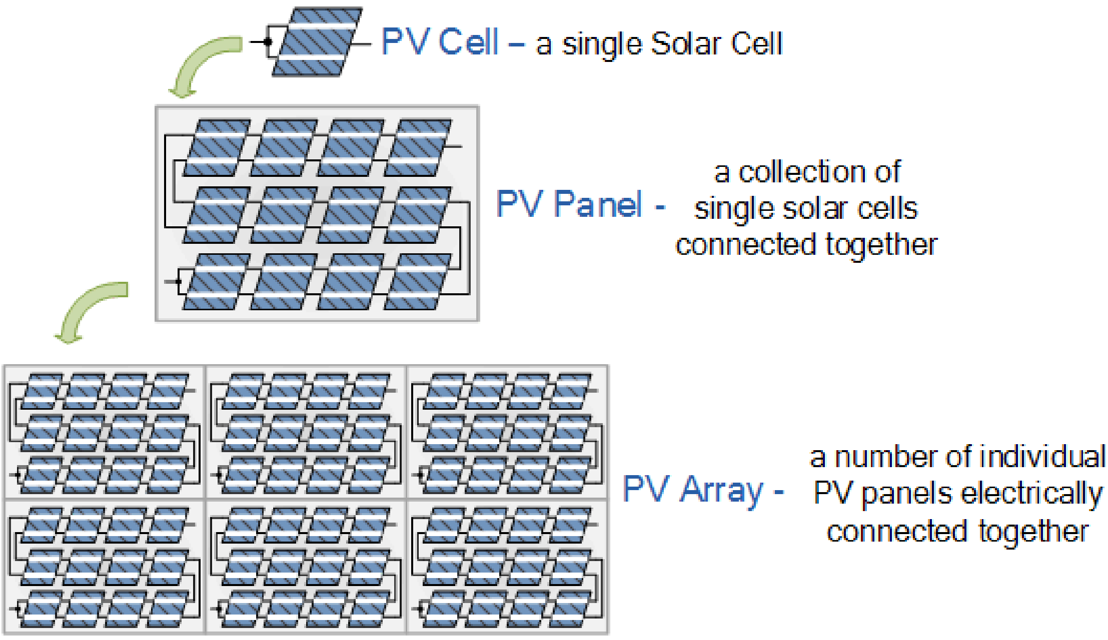


Figure 2.14: Photovoltaic Array

2.15 Photovoltaic Modules

In solar cells, a p-n junction is formed in a very thin wafer or layer of semiconductor. In the dark, the I-V generation feature of a solar cell is exponential, equivalent to that of a diode. As photons are exposed to light, they release photons with a higher energy than the band gap energy.The semiconductor's electrons are captured, creating an electron-hole pair. These carriers are swept apart by the internal electrical fields of the p-n junction and create a current equal to the incident radiation. Until the cell is short-circuited, this current flows inside the external circuit.The intrinsic p-n junction diode shuns this current internally until it is open circuited. The characteristics of this diode thus decide the cell's open circuit voltage characteristics.

2.16 DC to AC Converter (Inverter)

Electrical converters are dc to ac converters. Normally, electrical power is distributed and used in the form of AC. However, certain forms of electrical generation and storage systems, such as PV modules and batteries, produce DC.An electrical converter is a piece of power electronic equipment that converts DC to AC, allowing the DC power produced by these generators to be used with standard AC appliances and/or combined with the grid. Photovoltaic generation is usually connected to the grid bus via a PWM electrical converter, which generates a switch signal by contrast.with a high frequency triangle wave, the requisite sinusoidal output (i.e. the modulated signal or management signal) (carrier signal). The points where the modulating signal and the carrier signal converge are known as intersection points. the points in which the electrical converter's GTOs or thermistors are turned on by change.

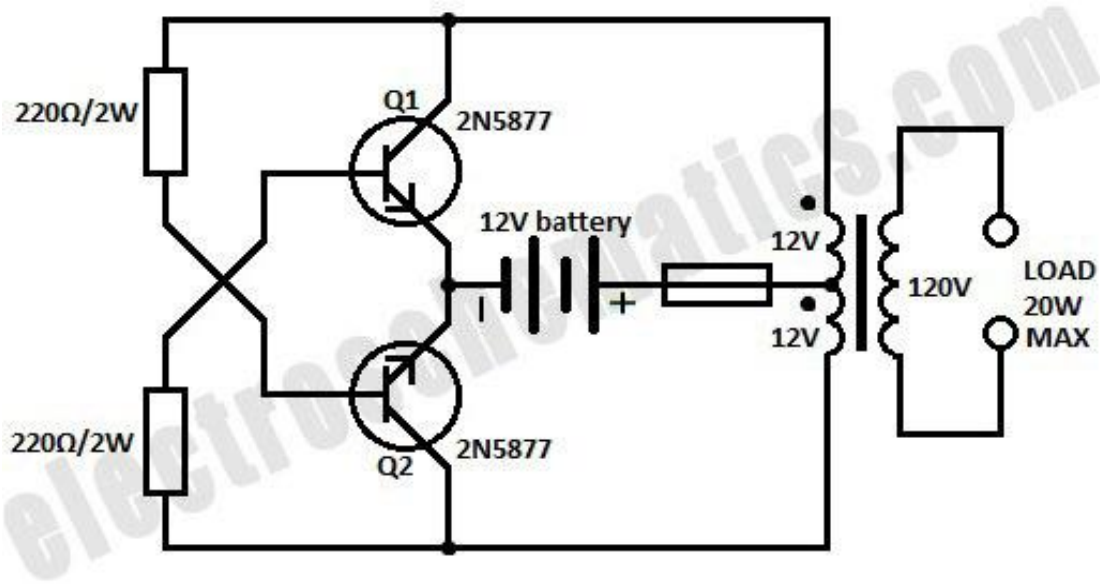


Figure 2.15 : DC to AC Inverter

2.17 Summary

In this chapter, The specification of the solar power system has been addressed in this chapter. To determine the specifications for different types of facilities, a solar power system would be used. Still, the cost of the machinery is being debated. My preferred method of browsing the different websites is to use my preferred value. In this case, an appropriate value is used. The specifications in question are solar panels, wind turbines, pumps, and converters.

CHAPTER 3

Utility Grid of Solar System

3.1 Introduction

Solar power, also known as photovoltaic (PV), is a form of renewable energy that has the potential to play a significant role in reducing greenhouse gas emissions. Despite the fact that PV technology is costly, it is receiving strong support from a variety of reward programs around the world. As a result, large-scale solar farms are becoming grid-connected. Due to their limited power transmission capacity, transmission grids around the world are currently having difficulty integrating large-scale renewable systems and solar farms. In a worst-case scenario, new lines could have to be built at a very high cost. To increase transmission capacity, cost-effective techniques should be investigated.When a PV solar farm is used as a Static Compensator, a FACTS device for performing arts voltage control, thereby enhancing system efficiency and increasing grid connectivity of neighboring solar farms, a specific study has been published on the night time use of a PV solar farm (when it's normally dormant). Many shunt linked FACTS devices, such as the Static Var. Since voltage regulation is known to assist with up transient stability and power transfer constraints, compensators and static compensators are used worldwide to increase transmission capability.The solar farm electrical converter is used as a static compensator for voltage control in order to increase power transmitting capacity during the night in this plant, which is a rare night-time application of a PV solar farm. During the day, the solar farm continues to act as a static compensator and supply voltage control using its remaining electrical converter MVA capacity (left when real power production is required). Voltage control has also been shown to significantly improve reliability and power transfer limits.

3.2 Theory of Synchronizing

Be sure the voltages on all sides of a circuit breaker for two energized power system components are identical until shutting it. If this "synchronizing" or "matching" mechanism is not done properly, an impact system may be disrupted, and instrumentation (including generators) may be affected.Three various dimensions of the voltage around the circuit breaker should be carefully watched in order to synchronize properly. The synchronizing factors are the following three components of the voltage.

- The voltage magnitudes
- The frequency of the voltages
- The phase Sequence

3.3 Synchronizing Method

Modem power plants generally utilize automatic synchronizers. The importance of synchronizing can't be overdone. All system operators ought to understand the idea and apply of synchronizing. If 2 power systems are synchronized via an open circuit breaker, and also the synchronizing method isn't done properly, solar system is severely broken.

3.4 Synchronizing

The first situation assumes that 2 islands are about to be connected along using the open circuit breaker as illustrated , since they're independent electrical systems, can have totally different frequencies therefore all 3 of the synchronizing variables should be monitored to confirm they're inside acceptable limits before closing the open circuit breaker. The unit operators for the two islands will most likely have to alter generator MW output levels (or adjust island load magnitudes) in one or both islands to achieve the required changes in frequencies and section angles. To keep voltage magnitudes under acceptable limits, voltage control devices (reactors, capacitors, and so on) may be used.

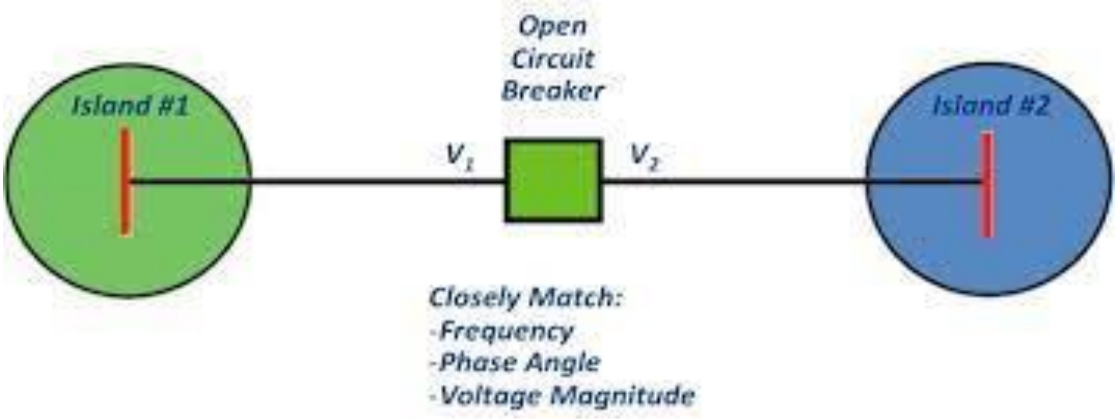


Figure 3.1: Synchronizing

3.5 Establishing the Second tie

The frequency is equal between the two areas until the first transmission line linking the two islands is closed. As a result, one of the three synchronizing variables (frequency) is no longer a consideration. The opposite two synchronizing variables, as seen in Figure 2, should also be tracked.Until closing the second circuit breaker, generation and/or voltage control instruments may be used to ensure that the phase angle and voltage magnitude differences are within reasonable limits. As frequency isnoongora problem, this method should be easier than closing the first transmission line.

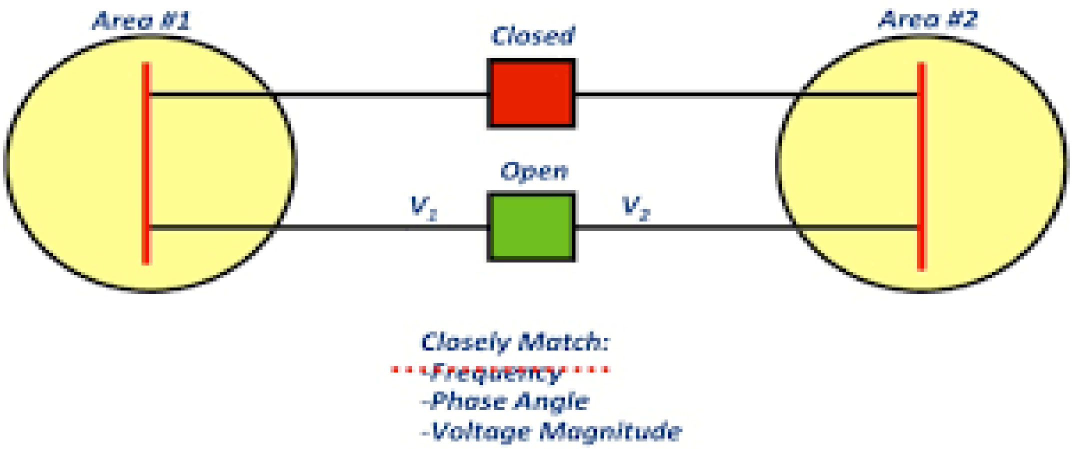


Figure 3.2: Establishing

3.6 Synchronizing Measuring Equipment

3.6.1 Synchro Scope

The three synchronizing variables are kept track of by a synchronizer, which is a basic piece of equipment. A basic synchronizer receives the voltage waveforms from both sides of the open circuit breaker (shown in Figure 3). If the voltage waveforms have the same frequency, the synchronizer does not rotate.If the voltage waveforms are at the same frequency, the synchronizer rotates in response to the frequency difference. The synchronizer needle is now pointed to the voltage phase angle gap.The operator can monitor the "finder" and ensure the circuit breaker is closed at the correct time if the synchronizer is a manual instrument. The synchronizer is usually placed above eye level on a "synch panel." The synch panel also has two voltmeters such that the voltage magnitudes can be compared at the same time.

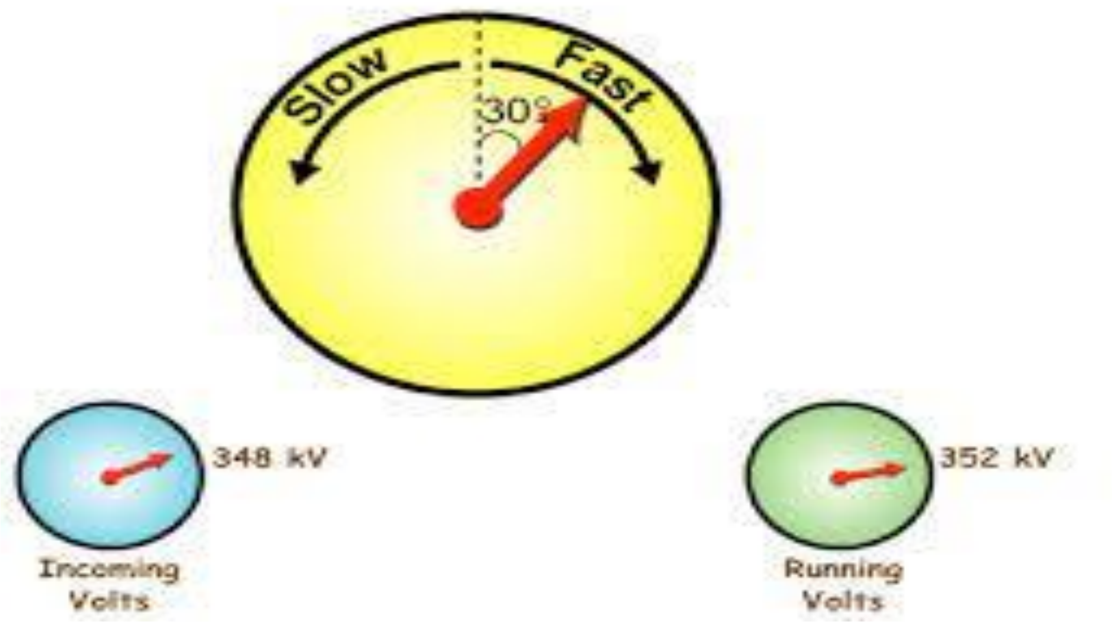


Figure 3.3 : Synchro Scope

3.7 Phtovoltaic Systems Monitoring

To ensure that photovoltaic systems perform properly and provide the maximum possible yield, they must be supervised and managed. The only way to observe an electrical converter is to read values on a monitor (usually LCD). About any grid-connected electrical converter has a display (usually LCD). PV array power, AC grid power, and PV array current are examples of typical values.

3.8 Electric Switchboard

An electric switchboard is a system used to switch power from one source to another. It's made up of a series of tables, each with its own set of switches for rerouting electricity. A switchboard is a large single panel, frame, or arrangement of panels on which switches, relays, and other instruments are placed, according to the National Electrical Code (NEC).On the face, back, or both, assorted shielding equipment, buses, and typically instruments are placed around current and voltage. The role of a switchboard is to break the largest current supplied to it into smaller currents for further distribution, as well as to provide switches,For these various currents, current safety and metering are needed. Transformers, panel boards, management instrumentation, and, finally, system loads are all driven by switchboards.Defense switches and fuses keep the user safe from electrocution. Controls for energy supply to the switchboard, such as frequency regulation of AC power and load sharing controls, as well as frequency gauges and perhaps a synchronizer, could also be present, returning from a generator or bank of electrical generators.Inside the switchboard, the switchgear is connected to a bank of bus bars, which are flat copper or aluminum strips. Insulators support this, allowing broad currents to pass via the switchboard. Though clean bus bars are common, some models now have an insulating cover on the bars that exposes the connection link points.

3.9 Distribution Board

'RA distribution board (also known as a panel board) is a part of an electricity distribution system that separates an electric power feed into subsidiary circuits and protects them with a circuit breaker or fuse. Each circuit has a common enclosure. A main switch is usually present, with one or two switches on newer boards.It's also possible to install residual-current devices (RCD) or Residual Current Breakers with Overcurrent Safety (RCBO).

3.10 Bus bar

A bus bar (also written bus bar, or commonly incorrectly as buss bar or conductor) is a strip or bar of copper used in electric power delivery. The word bus is a variation of the Latin omnibus, which means "for all. A conductor of electricity between a switchboard, distribution board, substation, battery bank, or other electrical devices made of brass or aluminum. Its primary function is to conduct electricity rather than to act as a structural member.

3.11 Electricity Meter

An electricity meter, also known as an energy meter, is an instrument that calculates the amount of electrical energy used by a home, a company, or a device that is powered by electricity. Electricity meters are normally calibrated in billing units, with the kilowatt hour [kWh] being the most common. Electricity meter readings were taken on a regular basis to determine billing periods and energy use.
used throughout a cycle.

CHAPTER 4

Analysis and Simulation

4.1 HOMER Software

4.1.1 Methodology

It is a tool for modelling and optimization system for renewable and non-renewable energy of both off-grid and a grid-connected power system for a variety of application. HOMER is reduce the analysis problem and design of micro-grid, arising due to a number of design option.This software involve also all costs such as the initial capital and maintenance costs including pollution penalties.In order to design the optimization scheme, HOMER ensures the best possible balance between supply and design. It encourages energy balance projections for each of the year's 8760 hours. Following the simulation, HOMER displays all of the available device configurations, which can be used to compare system architecture options.

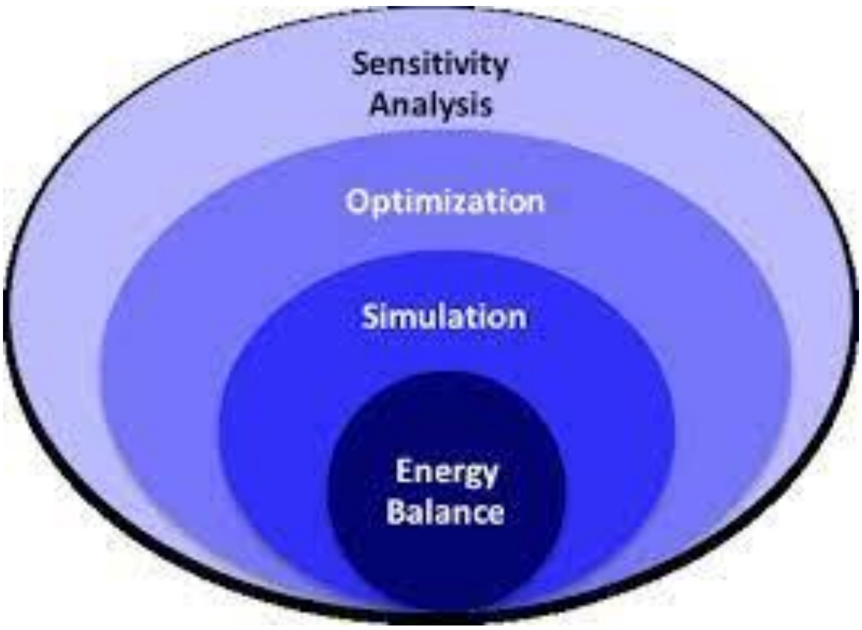


Figure 4.1 : Optimization process of HOMER Software

4.1.2 Optimization Process

The subject of numerous organizational and physical constructions on the location that are feasibly planned with regard to economy, reliability, and environmental controls. The main goal is normally to find a micro grid setup with a low TNPC (total net present cost). Different device architectures, as well as operational limitations, are simulated for this. This results in a variety of device part combinations that the engineer can choose from. Finally, the list of setups is sorted as well as compared.

4.2 Load Profile

The need for power in a very small rural village is just not as strong as it is in urban areas. Electricity is needed for domestic purposes such as lighting, fans, and televisions. During the night, the power demand of the residential unit increases, with only simple electro-mechanical equipment using electricity. During the morning hours, as everyone is leaving for training, service, or food preparation, the load demand decreases. Since nearly half of the family members are outside during the noon hour, the load demand volumes are at their lowest.

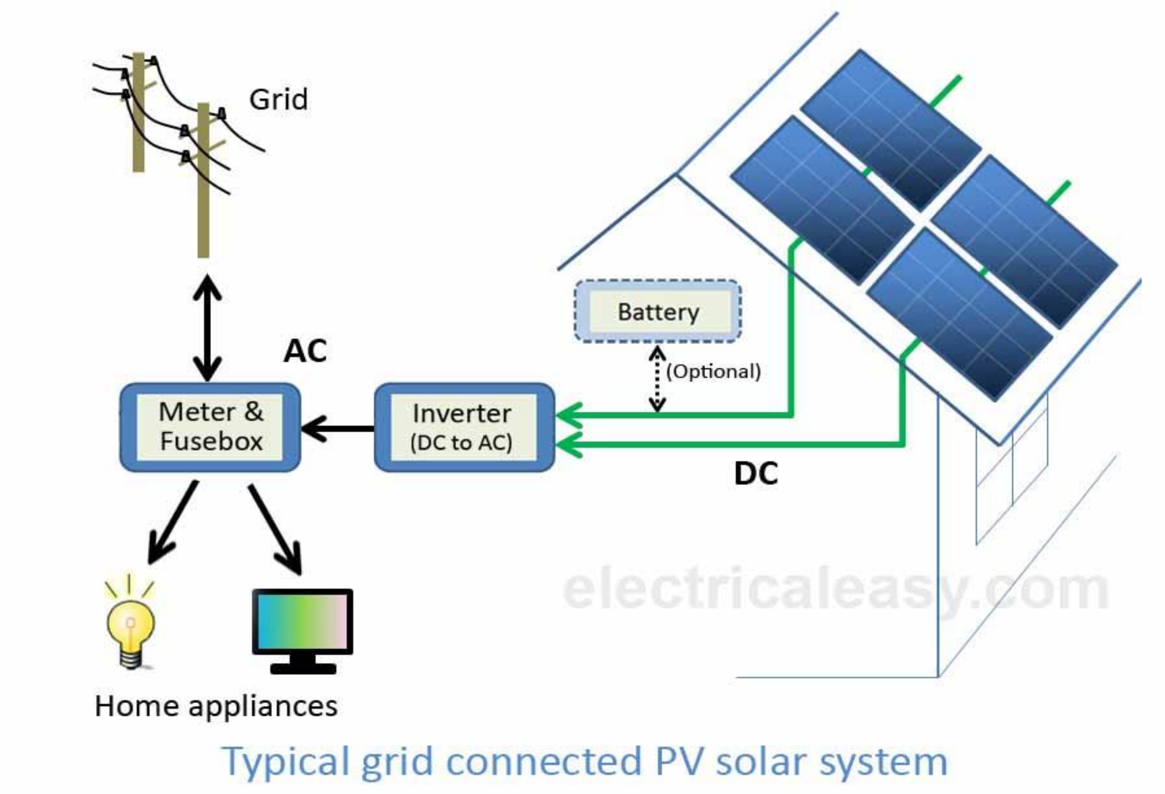


Figure 4.2 : Load Profile

4.3 Solar Energy System

Collectors convert solar radiation into heat in a fluid, energy storage units store energy when it is available and supply it when it is required, means to deliver energy from the storage to a load, and suitable pumps, controls, and other components are all used in solar energy systems. Solar energy systems produce electricity or heat by using the sun's rays. Solar power stations on a large scale are mainly located in the Southwest of the United States. Rooftop photovoltaic cells and hot water systems, on the other hand, are appropriate for any environment.

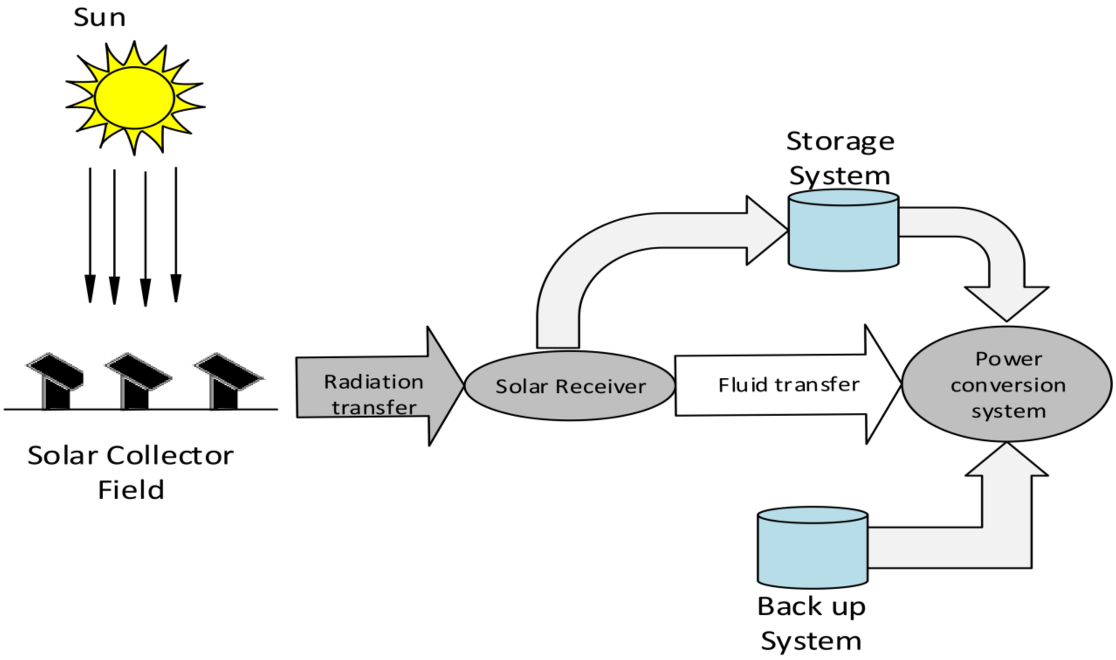
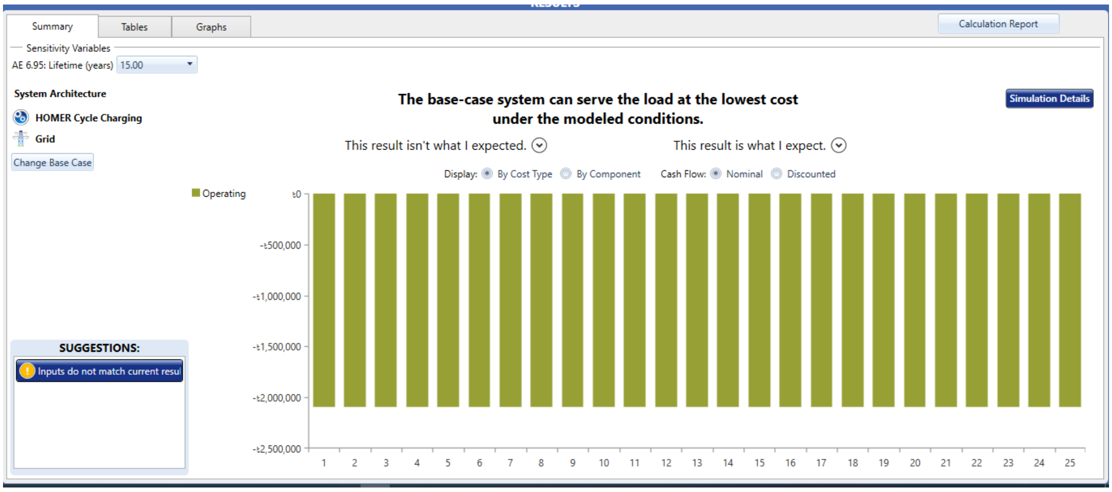


Figure 4.3 : Solar Energy System

4.4 Simulation Result

Simulation is the process of simulating the behavior of a real-world system or computer over time. First and foremost, For simulations, models are required; the model represents the key features or actions of the chosen system or process, while the simulation represents the model's evolution over time. Simulators are also run on computers.



4.5 Economic Input Analysis

A solar system is an essential component of a system's fixed investments and operating and maintenance costs. This price is entered into the HOMER software. Land, infrastructure, and related buildings, as well as distribution facilities and materials costs, are all fixed capital costs in a Grid scheme. Salary is also used to cover the burden of the system's fixed running and maintenance. For this Solar System power system, a 1 km area was considered. Solar panels generate electricity.This electricity delivery is based on a 50-household district. The components used in electricity distribution include wire, posts, circuit breakers, energy meters, multipole breakers, and labor wages. So, the average system fixed capital cost in this location is BDT 702787, and the system fixed O&M cost for salaries is BDT
459486.

4.6 Summary

Solar systems are made up of a mix of traditional and non-traditional energy sources and technologies. Solar power systems are available in grid and grid-tide configurations. In the power market, the solar power system is critical. Since this technology was formerly used to generate a large volume of electricity. As a developing world, the power sector is extremely critical. Electricity-based manufacturing, trucks, and mega projects are all increasing day by day. as a result.Using HOMER Software, optimize the cost and environmental analysis of a solar system. This is how technology has aided in the development of power.

CHAPTER 5

Optimization Result of the Grid Solar System

5.1 Area of Mawna ,Sreepur,Gazipur,Dhaka.

Mawna city Located 28.0 km norty of city of Gazipur, Bangladesh. Sreepur is located at 24.2000°N 90.4667°E. It has 65435 households and total area 465.24 km.At the 1991 census Bangladesh census, Sreepur had a population of 320,530, of which 166,988 were aged 18 or older. Males constituted 51.13% of the population, and females 48.87%. Sreepur had an average literacy rate of 30.3% (7+ years), against the national average of 32.4%.[2]

Population Total 337367; male 172186, female 165181; Muslim 324285, Hindu 12508, Buddhist 331, Christian 8 and others 235. Indigenous communities such as santal, Koch, rajbangshi, Mandi, Nunia and Bhangar belong to this upazila. Water bodies Main rivers: banar, Kaoraid, Labandaha.

Figure 5.1 : Gazipur Area

Mawna,Sreepur,Gazipur	
•Total Area	465.24 km^2 (179.63 sq mi)
• Total	320,530
• Density	690/km^2 (1,800/sq mi)
Time zone	UTC+6 (BST)
Postal code	1740
Website	sreepur.gazipur.gov.bd

5.2 Load Assesment Profile

4.2.1 Summer Season Load Profile (March to October)

At maximum energy consumption is summer seasonal because that time use is a ceiling fan, light, and TV. Using by here maximum energy consumption of Ceiling Fan. Here, celling fan operation hours 13.30hr and Power Rating 70W. Light operation hours 6hr and Power Rating 20W, TV operating hours 4.30hr and Power Rating 50W.

Total Equipment:

Sr. No	Name of the equipment 50 House	Number of equipment	Watt	Ratted power (Watt)
01	Light (Bed room)	05	20	20*5 =100
02	Light(Wash room)	03	11	11*3 =33
03	Light(Kitchen room)	02	12	12*2 =24
04	Ceiling Fan	05	60	60*5 =300
05	Table Fan	02	50	50*2 =100
06	Refigerator	01	200	200
07	T.V	01	50	50
08	Motor	01	746	746
09	Mobile Charger	03	15	15*3 =45
10	Computer	01	50	50
11	LED Light	06	20	20*6 =120
12	Dream Light	08	11	8*11 =88
13	AC	02	100	1000*2 =2000

Summer

March to October(8 Month)

50 House Load ,Gazipur,Sreepur,Mawna.

Duration	**Total 50 house (W)**	**Mosqus**	**School**	**Market**	**Total Load (W)**	**Total Load (KWh)**
0-1 AM	27500	_	_	1160	28660	28.6
1-2 AM	25000	_	_	1160	26160	26.1
2-3 AM	25000	_	_	1160	26160	26.1
3-4 AM	25000	958	_	1160	27118	27.1
4-5 AM	27500	963	_	1615	30078	30.0
5-6 AM	34150	863	_	1505	36518	36.5
6-7 AM	20350	688	_	5701	26739	26.7
7-8 AM	54050	746	1801	5701	62298	62.2
8-9 AM	53300	_	900	4900	59100	56.1
9-10 AM	6000	_	900	4900	11800	11.8
10-11 AM	7500	_	700	4500	12700	12.7
11-12 AM	7500	_	850	850	9200	9.2
12-13 PM	15000	825	850	850	17525	17.5
13-14 PM	18500	925	800	5246	25471	25.4
14-15 PM	34250	750	905	4500	40405	40.4
15-16 PM	33500	_	700	1400	35600	35.6
16-17 PM	15150	1013	650	1300	18113	18.1
17-18 PM	20000	_	1350	4500	25850	25.8
18-19 PM	21650	1013	1396	5411	29470	29.4
19-20 PM	38850	1609	_	3905	44364	44.3
20-21 PM	27950	958	200	4955	34063	34.0
21-22 PM	35000	913	50	4705	40668	40.6
22-23 PM	30000	743	_	1305	32048	32.0
23-24 PM	25000	170	_	1205	26375	26.3
24 hours						722.5KWh/day

Summer total load, 50 house,Mosqus,School,Market,Other=722.5 KWh/day

Summer Maximum Power Consumption Demand =722.5 KWh/day

4.2.2 Winter Season Load Profile (November to February)

The winter energy consumption half of the summer energy consumption due to the use of one ceiling fan. The winter load has considered half of the summer load due to the absence of one ceiling fan not in operation. The winter peak load of the system with 50 households considered as 5.04 kW and daily energy consumption as 461.3kWh/day.

Winter

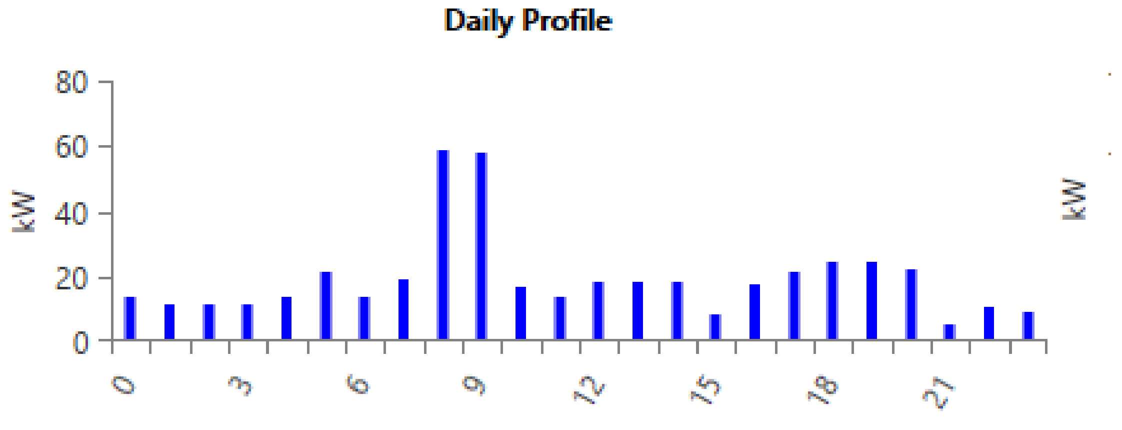
November to February(4 Month)

50 house Load,Gazipur,Sreepur,Mawna.

Duration	Total 50 house(W)	Mosqus	School	Market	Total Load(W)	Total Load (KWh)
0-1 AM	12500	_	_	1450	13950	13.4
1-2 AM	10000	_	_	1450	11450	11.4
2-3 AM	10000	_	_	1450	11450	11.4
3-4 AM	10000	143	_	1505	11648	11.6
4-5 AM	11650	313	_	1450	13413	13.4
5-6 AM	19150	358	_	1615	21123	21.1
6-7 AM	11650	834	_	1455	13939	13.9
7-8 AM	13500	50	1101	4396	19047	19.0
8-9 AM	54050	_	300	4506	58856	58.8
9-10 AM	54050	_	300	3900	58250	58.2
10-11 AM	12500	_	100	3900	16500	16.5
11-12 AM	10000	_	100	3650	13750	13.7
12-13 PM	15000	1659	100	1650	18409	18.4
13-14 PM	13500	225	100	4396	18221	18.2
14-15 PM	12500	708	846	4446	18500	18.5
15-16 PM	5000	_	100	3450	8550	8.5
16-17 PM	13250	_	100	3865	17215	17.2
17-18 PM	15000	1071	100	5101	21272	21.2
18-19 PM	20350	105	_	4015	24470	24.4
19-20 PM	20350	313	_	3905	24568	24.5
20-21 PM	17500	170	200	4015	21885	21.8
21-22 PM	15000	313	_	3905	5718	5.7
22-23 PM	6650	120	200	3905	10875	10.8
23-24 PM	6050	170	_	3005	9225	9.2
24 Hours						461.3 KWh/day

Winter total Load,50 house,Mosqus,School,Market,Other= 461.3 KWh/day

Winter Maximum Power Consumption Demand= 461.3 KWh/day



Hour

Figure5.2: Electric Load Profile

5.3 Various Types Of On Grid System Optimization Result for DC Load

Tecnical and economic parameters of solar photovoltaic.

Capital Cost	BDT/KW	6024.37 Taka
Replacement Cost	BDT/KW	48384.62 Taka
O&M Cost	BDT/KW/yr	100
Tracking System	No tracking System	0.05
Life time	years	25

1. PV+Converter+load
2. PV+Converter+load+Grid

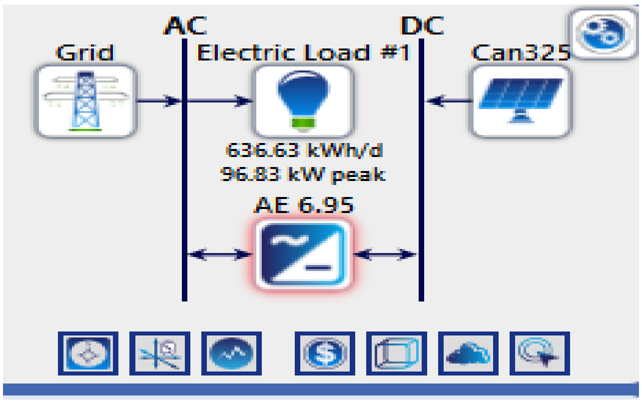
Shown here two energy generation systems. This system simulated by using HOMER software. HOMER software by finding out various optimization results. We will choose the Correct result from the inside.

5.4 (PV+Converter+Grid) Eenrgy Generation System

5.4.1 System Components Assessment

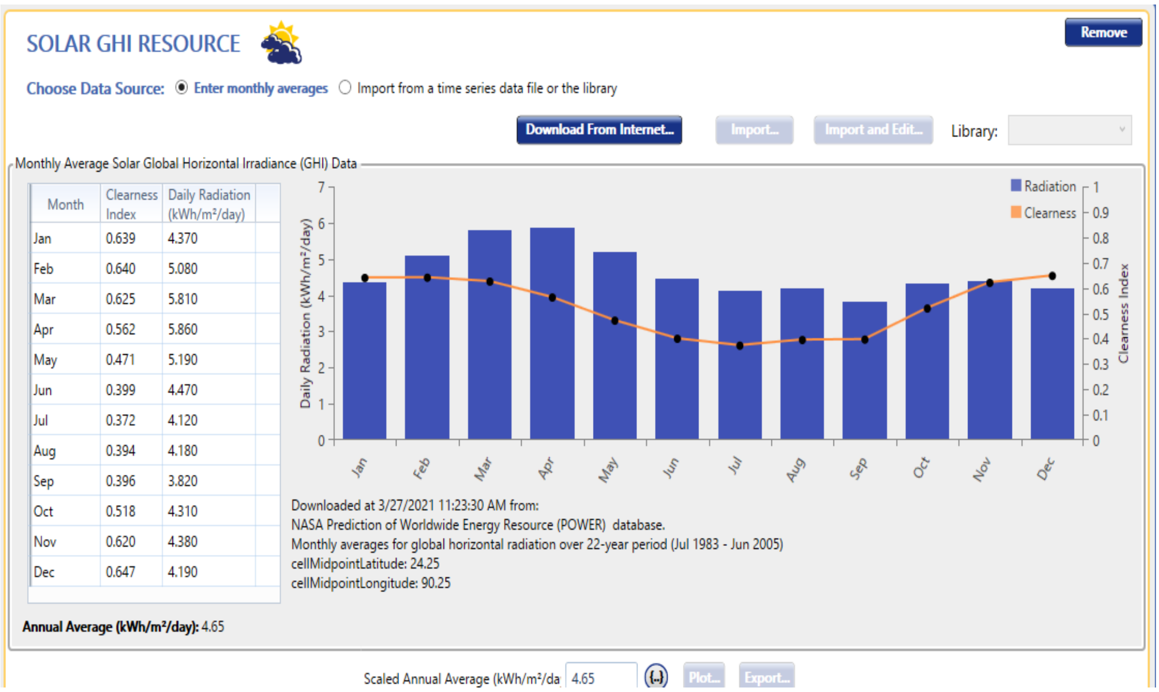
The energy system components are PV Modules, Solar System, Solar and Power Converter. The cost, number of units to be used, operating hours, etc. need to be specified in HOMER software for each of this equipment.This information details involved in the previous section.In this system, the main component is the renewable energy component its PV Panel. Further alternative energy component which Solar System. produce to AC current but Load is DC, So use Rectifier. The rectifier will change AC to DC Current. Here, use is a Large amount of PV Panel component, PV Panel component have the other component involved such as a Solar panel model (Canada Solar panel).

The PV panel to produced is DC and PV connected DC bus so, this current is not converted because the load is DC. Grid System has a backup system.
Shown figure …. (PV+Converter+Grid)Energy generation system.

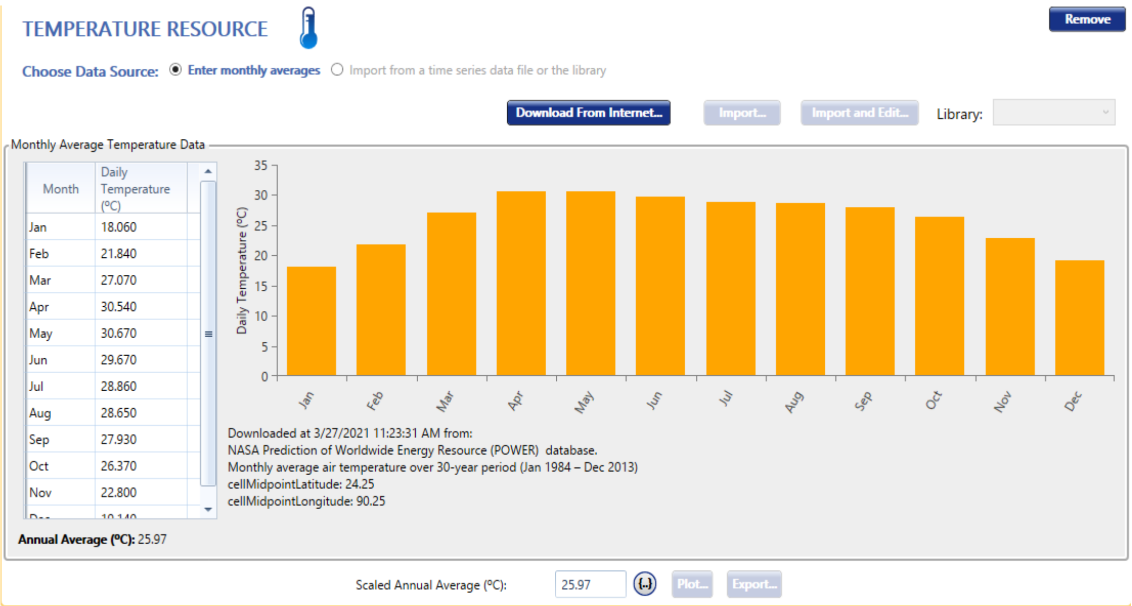


5.4.2 Solar Resource Data

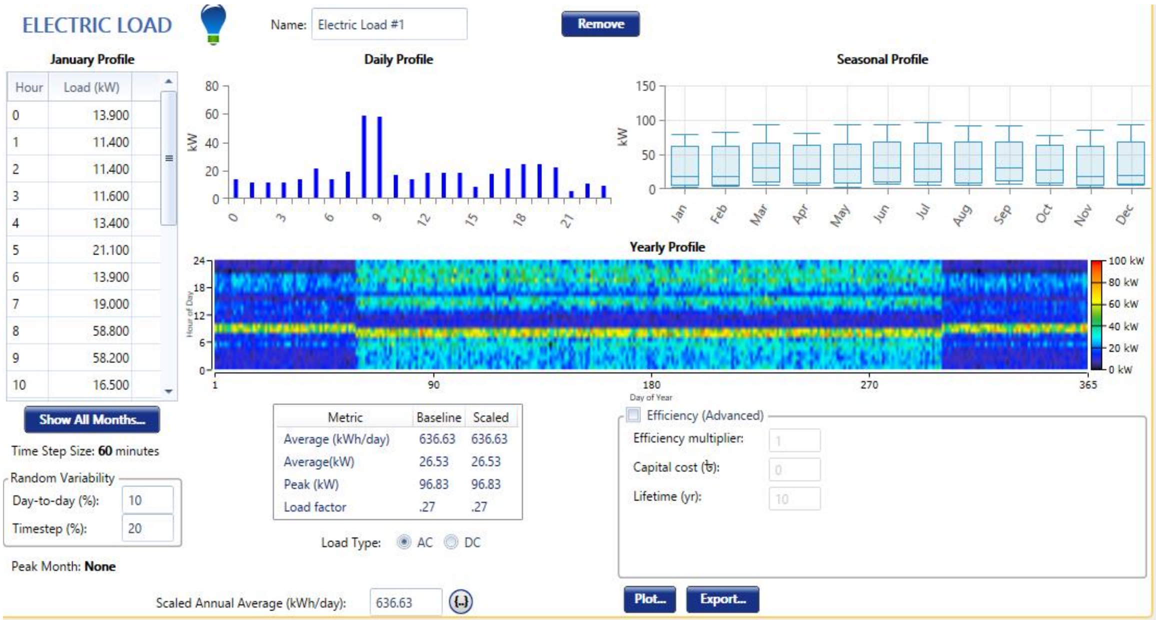
Bangladesh is very good for the purpose of electricity generation from solar irradiance, a measure of incoming solar radiation. This has been Location consider is Sreepur, Mawna industrial city is big area has been Energy side. Latitude and Longitude are 24.25 North and 90.25 East. Predictions of global energy resource (power) database from NASA. Monthly annual horizontal radiation averages over a 22-year cycle (jul 1983-jun 2005).



Solar GHI Resource



Temperature Resource Value



Electric Load

5.4.3 PV (Photovoltaic) array Model

A solar generator connected to a DC bus. For remote electrification commonly used in Solar Generator.Because it is high cost, easy to install and electric operation system.Use to Canadian Solar CSI-400TL-CT (240). There are various range of Solar generators, choose the inappropriate model for this Location.This case use is 1KW Solar generator and cost are taken BDT 48384.62.The minimum load ratio 30%. The lifetime rating is taken per hr. The per-hour unit BDT 9.04 taka.

Properties

Name: **Canadian Solar325CS6X-325P**

Abbreviation: **Can325**

Panel Type: **Flat plate**

Rated Capacity (kW): **0.325**

Temperature Coefficient: **-0.400200**

Operating Temperature (°C): **45.8**

Efficiency (%): **13**

Manufacturer: **Canadian Solar**

CEC PV Modules

Notes:

This component comes from the CEC module database, which was most recently updated in

Cost

Capacity (kW)	Capital (৳)	Replacement (৳)	O&M (৳/year)
1	48,384.62	48,384.62	100.00

Lifetime

time (years): 25.00

More...

Simulation Results

System Architecture: Grid (999,999 kW)

Canadian Solar325CS6X-325P (0.995 kW) HOMER Cycle Charging

AE Solar Energy AE7.0 (240V) (6.95 kW)

Lifetime (15.00 years)

Total NPC: ৳27,141,430.00

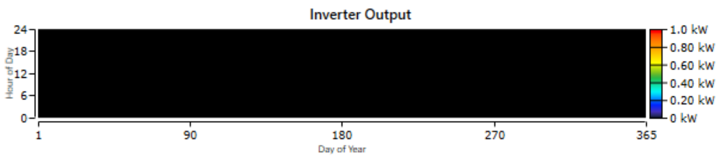
Levelized COE: ৳9.04

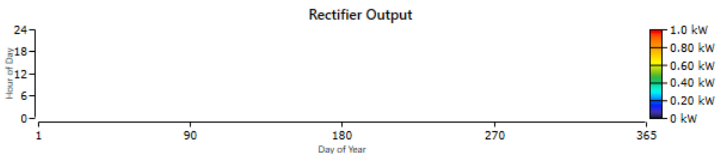
Operating Cost: ৳2,092,545.00

Cost Summary | Cash Flow | Compare Economics | Electrical | Renewable Penetration | Canadian Solar325CS6X-325P | Grid | AE Solar Energy AE7.0 (240V) | Emissions

Quantity	Inverter	Rectifier	Units
Capacity	6.95	0	kW
Mean Output	0	0	kW
Minimum Output	0	0	kW
Maximum Output	0	0	kW
Capacity Factor	0	0	%

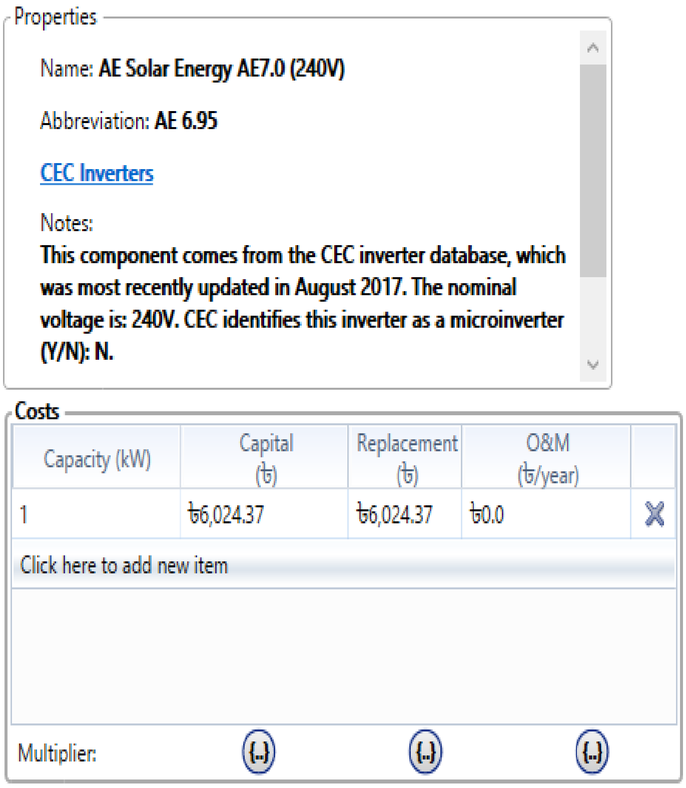
Quantity	Inverter	Rectifier	Units
Hours of Operation	0	0	hrs/yr
Energy Out	0	0	kWh/yr
Energy In	0	0	kWh/yr
Losses	0	0	kWh/yr

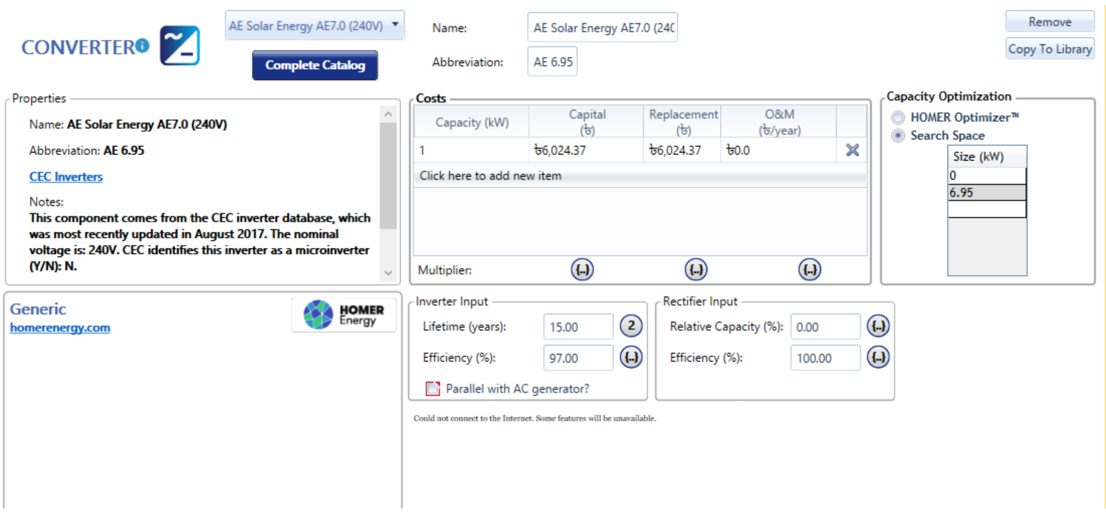


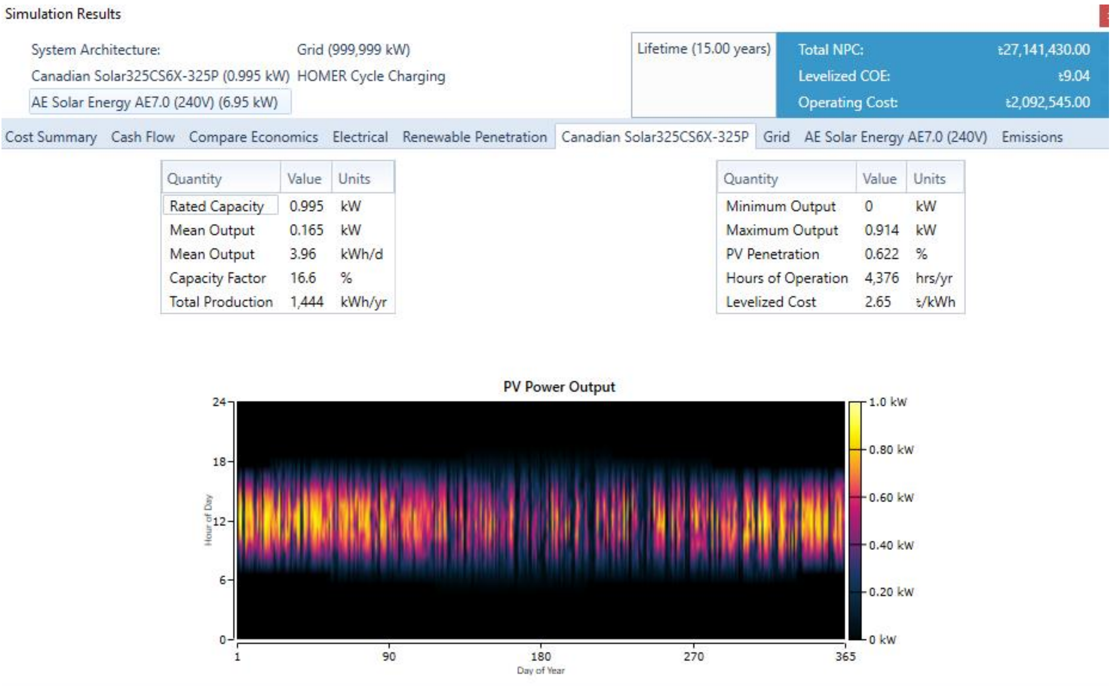


5.4.4 Power Converter Model

Use to AE Solar Energy AE 7.0 (240) and Capacity power 1-4, Inverter Efficiency 97% and lifetime (years) 15. A power electronics converter is used to convert AC to DC and DC to AC. The simulation range of the power converter is 1KW to 5KW. We use a 5KW converter in this case. A lifetime of a unit is considered to be (15 years).



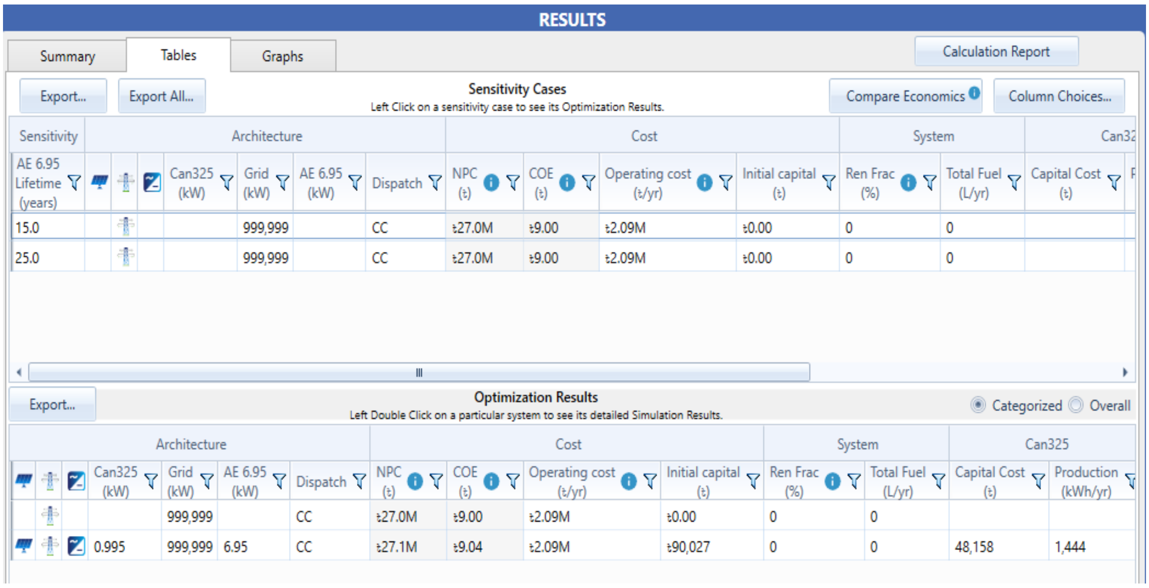




5.4.5 Simulation Results

The project's life expectancy is estimated to be 25 years. A 1kW PV array, a Canadian Solar 325 CS6X-325P view, and a 1kW rectifier are the best power system components for our case study. This machine is valued at (0.325) of the PV cost. For such a Solar system, the gross net present expense, capital cost, and cost of energy (COE) are 6.68M, BDT.48158.5, and 9.04/kWh, respectively.

Grid (kW)	AE 6.95 (kW)	Dispatch	NPC (৳)	COE (৳)	Operating cost (৳/yr)	Initial capital (৳)	Ren Frac (%)	Total Fuel (L/yr)	Capital Cost (৳)
999,999		CC	৳27.0M	৳9.00	৳2.09M	৳0.00	0	0	
999,999	6.95	CC	৳27.1M	৳9.04	৳2.09M	৳90,027	0	0	48,158



RESULTS

Summary | Tables | Graphs | Calculation Report

Export... | Export All...

Sensitivity Cases
Left Click on a sensitivity case to see its Optimization Results.

Compare Economics | Column Choices...

Sensitivity	Architecture							Cost				System		Can32
AE 6.95 Lifetime (years)				Can325 (kW)	Grid (kW)	AE 6.95 (kW)	Dispatch	NPC (৳)	COE (৳)	Operating cost (৳/yr)	Initial capital (৳)	Ren Frac (%)	Total Fuel (L/yr)	Capital Cost (৳)
15.0					999,999		CC	৳27.0M	৳9.00	৳2.09M	৳0.00	0	0	
25.0					999,999		CC	৳27.0M	৳9.00	৳2.09M	৳0.00	0	0	

Export...

Optimization Results
Left Double Click on a particular system to see its detailed Simulation Results.

Categorized | Overall

Architecture							Cost				System		Can325	
			Can325 (kW)	Grid (kW)	AE 6.95 (kW)	Dispatch	NPC (৳)	COE (৳)	Operating cost (৳/yr)	Initial capital (৳)	Ren Frac (%)	Total Fuel (L/yr)	Capital Cost (৳)	Production (kWh/yr)
				999,999		CC	৳27.0M	৳9.00	৳2.09M	৳0.00	0	0		
			0.995	999,999	6.95	CC	৳27.1M	৳9.04	৳2.09M	৳90,027	0	0	48,158	1,444

5.4.6 Cost Summary

The whole project cost summary shown in below figure . However once PV installed,the maintainance and operating cost become very cheap then Solar generator system. Fixed capital cost of this project are BDT 2092545.00 .And the operating and maintainance cost is estimated to be BDT 27141430.00 The rate of repair is BDT 17764.08. Various civil constructions, manpower, logistics salaries, necessary permits, administration and government approvals, and other miscellaneous costs are included in the system's fixed capital costs.

Total NPC: 27141430.00 Taka

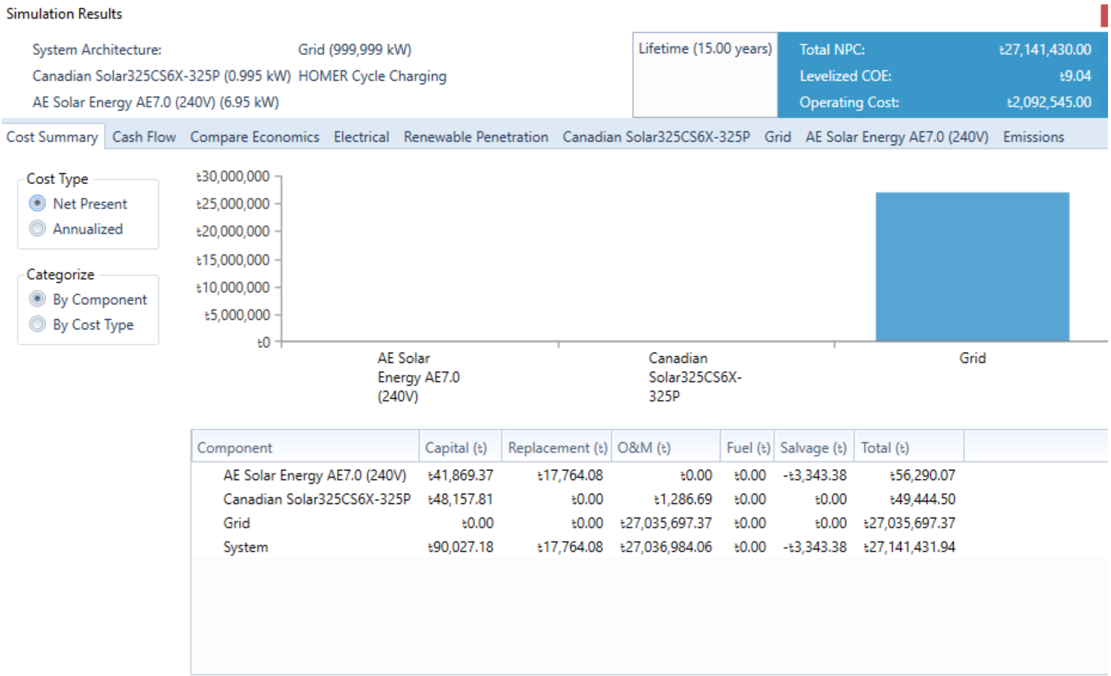
Levelized COE: 9.04 Taka

Operating Cost: 2092545.00 Taka

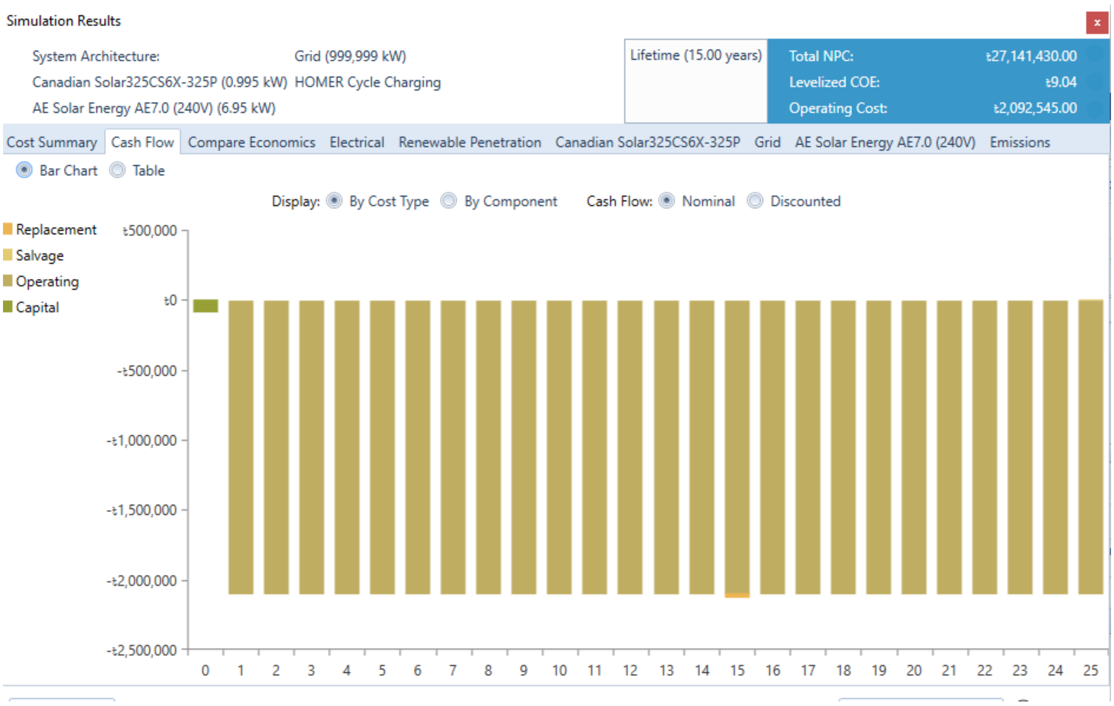
Lifetime:15.00 years

Cost Summary Value:

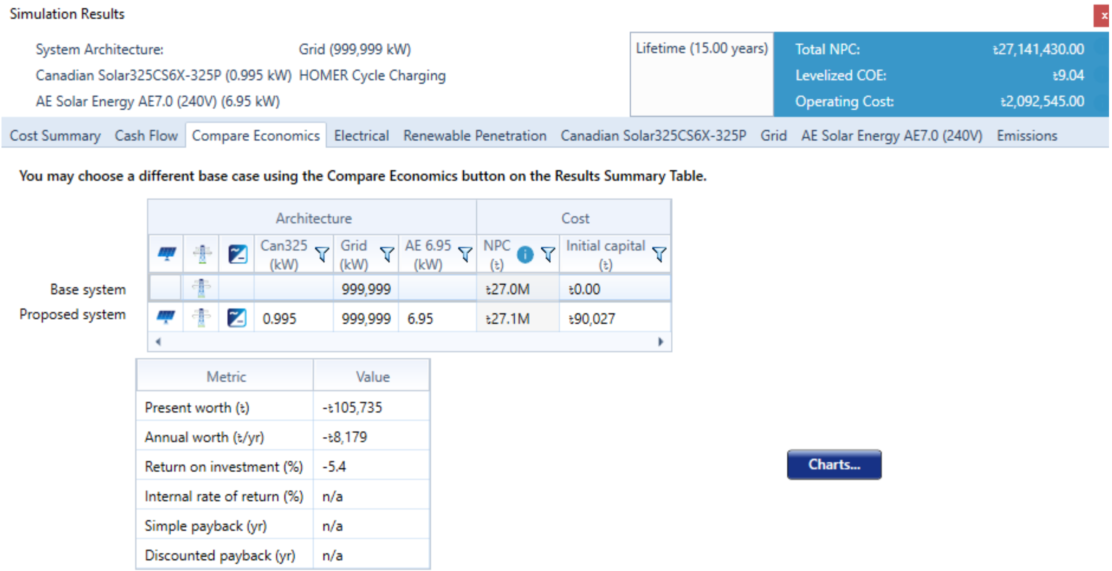
Component	Capital (৳)	Replacement (৳)	O&M (৳)	Fuel (৳)	Salvage (৳)	Total (৳)
AE Solar Energy AE7.0 (240V)	৳41,869.37	৳17,764.08	৳0.00	৳0.00	-৳3,343.38	৳56,290.07
Canadian Solar325CS6X-325P	৳48,157.81	৳0.00	৳1,286.69	৳0.00	৳0.00	৳49,444.50
Grid	৳0.00	৳0.00	৳27,035,697.37	৳0.00	৳0.00	৳27,035,697.37
System	৳90,027.18	৳17,764.08	৳27,036,984.06	৳0.00	-৳3,343.38	৳27,141,431.94



Cost Summary



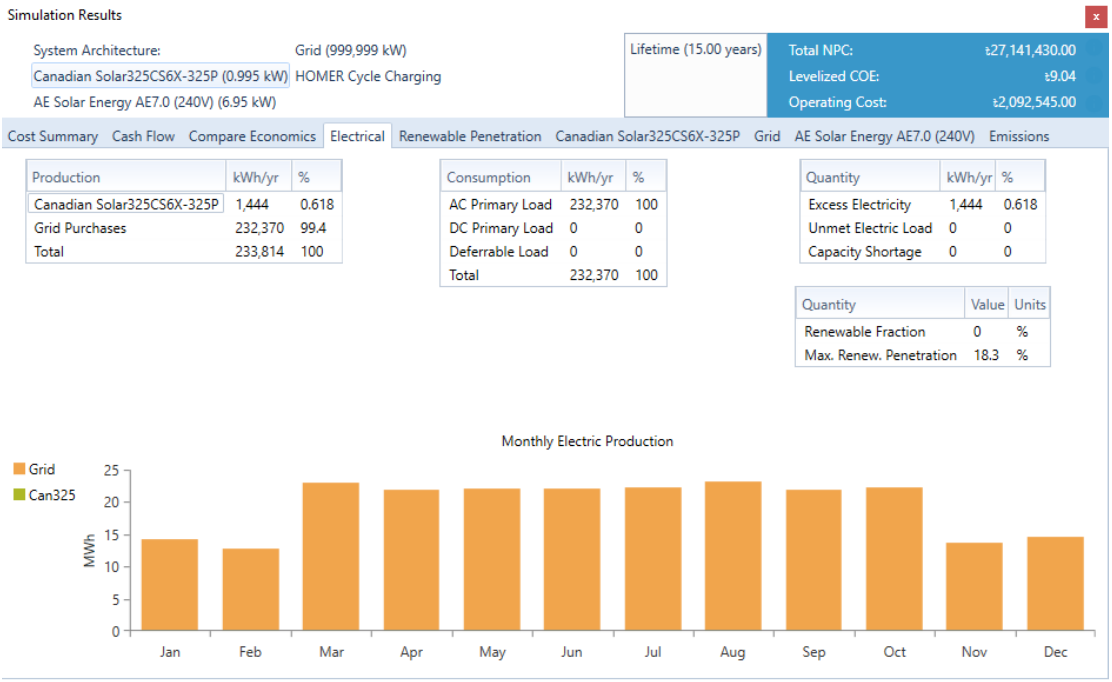
Cash Flow



	Can325 (kW)	Grid (kW)	AE 6.95 (kW)	NPC (৳)	Initial capital (৳)
Base system		999,999		৳27.0M	৳0.00
Proposed system	0.995	999,999	6.95	৳27.1M	৳90,027

Metric	Value
Present worth (৳)	-৳105,735
Annual worth (৳/yr)	-৳8,179
Return on investment (%)	-5.4
Internal rate of return (%)	n/a
Simple payback (yr)	n/a
Discounted payback (yr)	n/a

Compare Economics

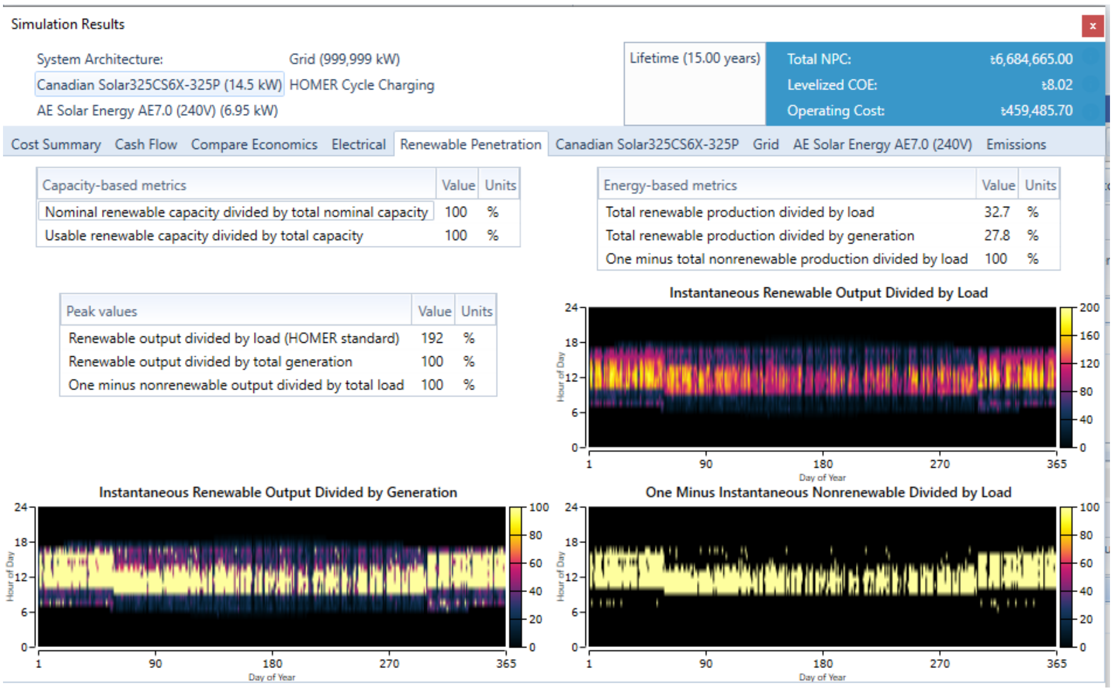


Production	kWh/yr	%
Canadian Solar325CS6X-325P	1,444	0.618
Grid Purchases	232,370	99.4
Total	233,814	100

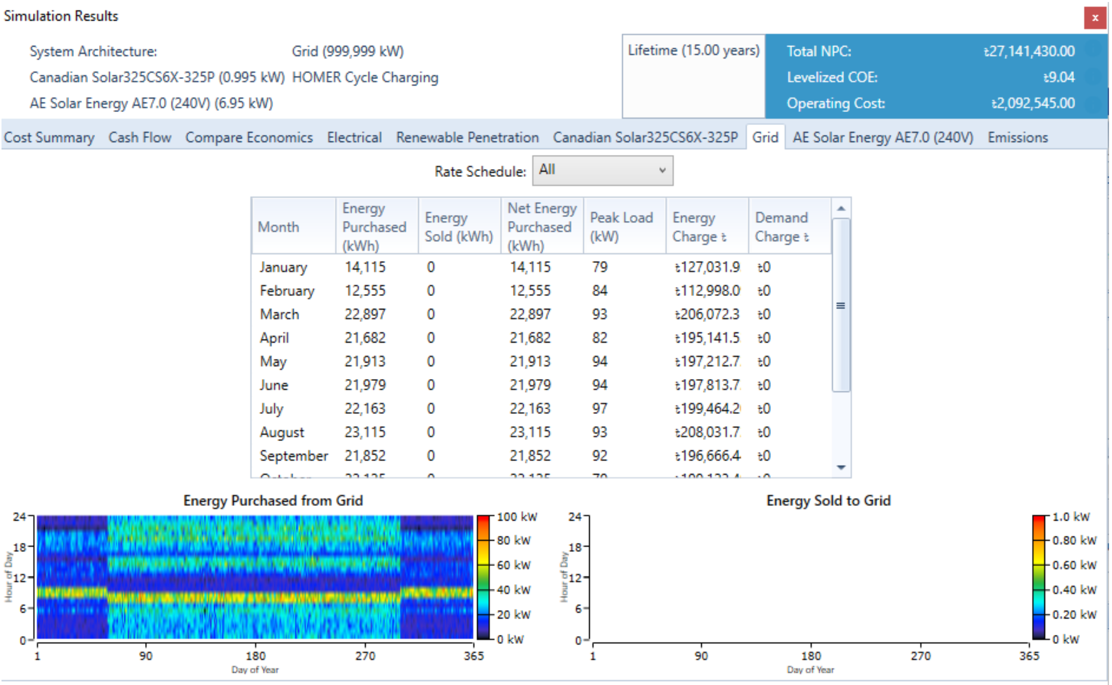
Consumption	kWh/yr	%
AC Primary Load	232,370	100
DC Primary Load	0	0
Deferrable Load	0	0
Total	232,370	100

Quantity	kWh/yr	%
Excess Electricity	1,444	0.618
Unmet Electric Load	0	0
Capacity Shortage	0	0

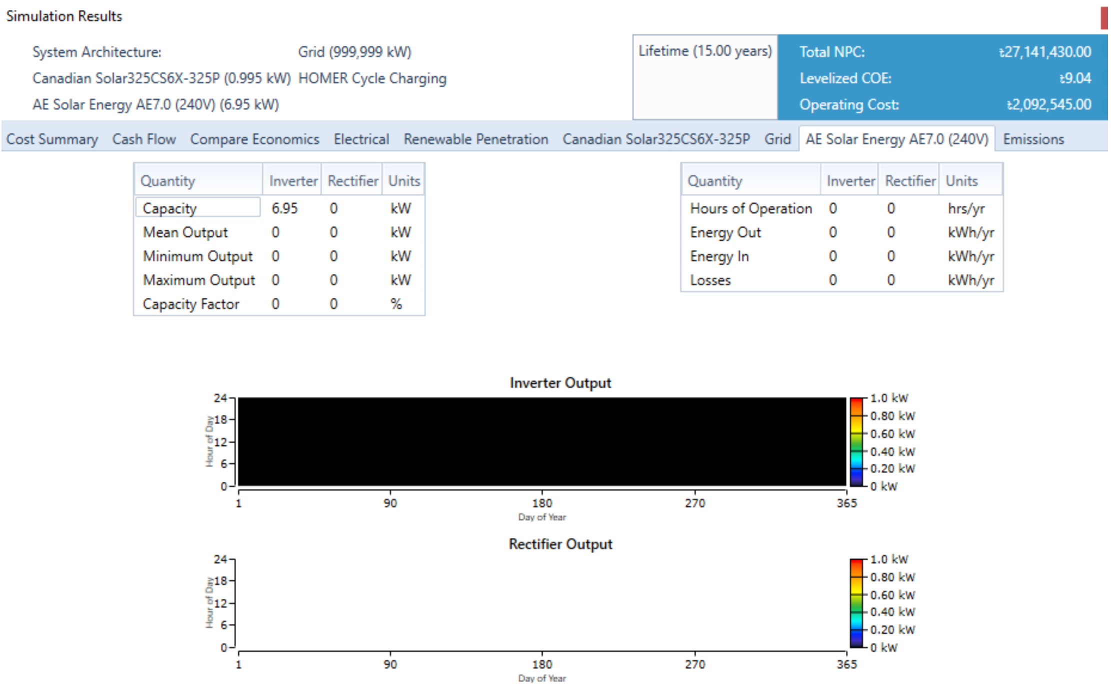
Quantity	Value	Units
Renewable Fraction	0	%
Max. Renew. Penetration	18.3	%



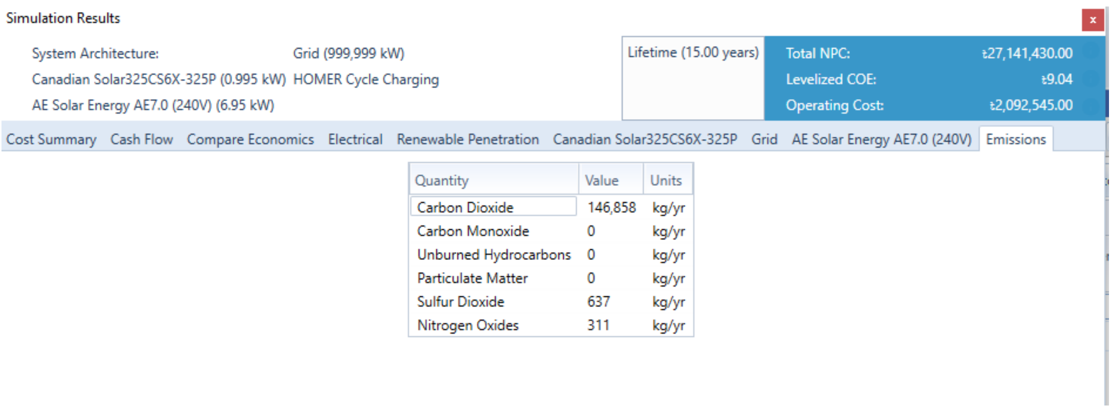
Renewable Penetration



Grid Value



AE Solar Energy AE 7.0

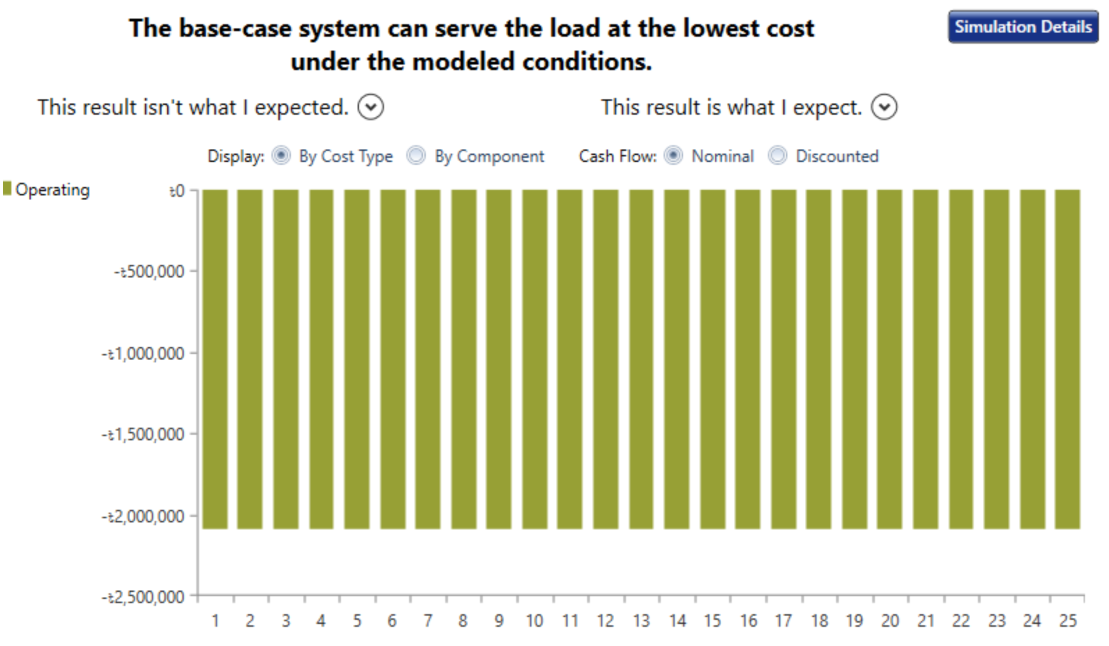


Emissions

5.4.7 Cash Flows

The below figure,we can see that ,the total NPC is BDT 27141430.00. And the levelized COE is 9.04/kwh. Finally the operating cost is BDT 2092545.00 /yr.

Lifetime (15.00 years)	Total NPC:	৳27,141,430.00
	Levelized COE:	৳9.04
	Operating Cost:	৳2,092,545.00



5.4.8 Monthly Average Electric Production

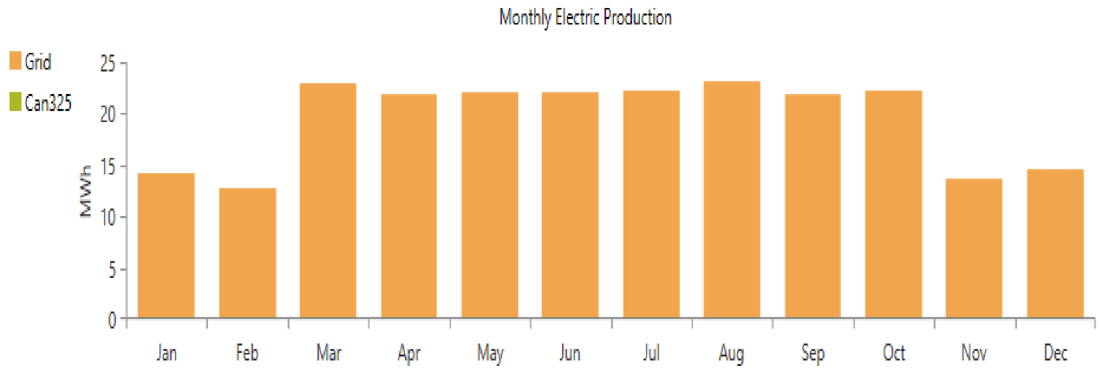
The monthly distribution of electricity generated in kW by the (PV) and Grid is depicted in the graph below. Between March and October, the solar system is mostly used in conjunction with the grid. In addition, the peak load is faced by (PV) and Grid from November to February. Due to a lack of solar radiation during the winter months, we rely on grid generators for the majority of our electricity.

Production	kWh/yr	%
Canadian Solar325CS6X-325P	1,444	0.618
Grid Purchases	232,370	99.4
Total	233,814	100

Consumption	kWh/yr	%
AC Primary Load	232,370	100
DC Primary Load	0	0
Deferrable Load	0	0
Total	232,370	100

Quantity	kWh/yr	%
Excess Electricity	1,444	0.618
Unmet Electric Load	0	0
Capacity Shortage	0	0

Quantity	Value	Units
Renewable Fraction	0	%
Max. Renew. Penetration	18.3	%



Simulation Results

System Architecture: Grid (999,999 kW)
Canadian Solar325CS6X-325P (0.995 kW) HOMER Cycle Charging
AE Solar Energy AE7.0 (240V) (6.95 kW)

Lifetime (15.00 years)

Total NPC:	৳27,141,430.00
Levelized COE:	৳9.04
Operating Cost:	৳2,092,545.00

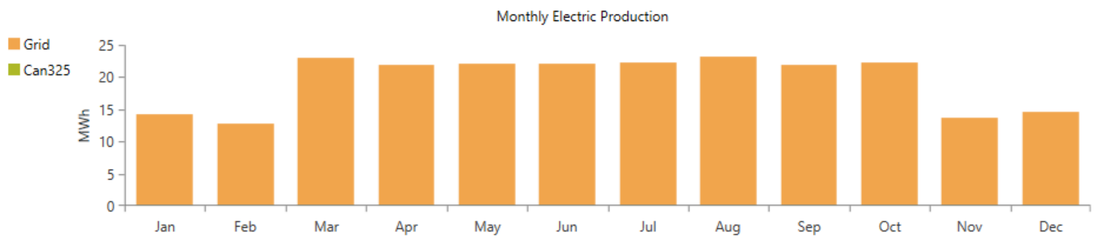
Cost Summary Cash Flow Compare Economics Electrical Renewable Penetration Canadian Solar325CS6X-325P Grid AE Solar Energy AE7.0 (240V) Emissions

Production	kWh/yr	%
Canadian Solar325CS6X-325P	1,444	0.618
Grid Purchases	232,370	99.4
Total	233,814	100

Consumption	kWh/yr	%
AC Primary Load	232,370	100
DC Primary Load	0	0
Deferrable Load	0	0
Total	232,370	100

Quantity	kWh/yr	%
Excess Electricity	1,444	0.618
Unmet Electric Load	0	0
Capacity Shortage	0	0

Quantity	Value	Units
Renewable Fraction	0	%
Max. Renew. Penetration	18.3	%



The below table shows the electricity production of the system components.

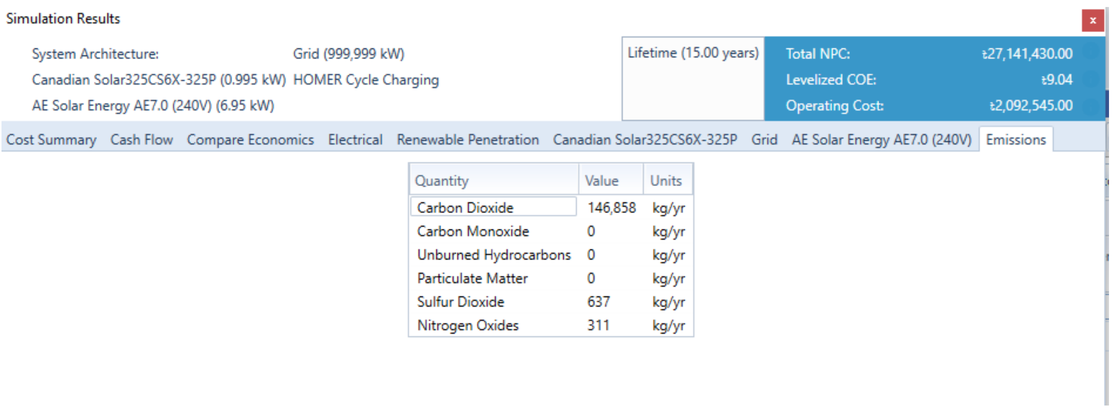
Production	KWh/yr	%
PV Array	1444	0.618
Grid Purchases	232370	99.4
Total	233814	100

Table 6.3: Electricity production of the system components

5.5 Emission

We can see below this figure the major emission comes from carbon dioxide.

Quantity	Value	Units
Carbon Dioxide	146,858	kg/yr
Carbon Monoxide	0	kg/yr
Unburned Hydrocarbons	0	kg/yr
Particulate Matter	0	kg/yr
Sulfur Dioxide	637	kg/yr
Nitrogen Oxides	311	kg/yr



5.6 Summary

In this chapter, Our total demand is 11,838 KWh. We are getting 1414KWh from renewable energy. The cost is like 9.04 taka. It is helpful. Because emissions are low from the grid generation. Output data for various models are shown and these give the comparative results. By analyzing outputs data. It is shown that the output is feasible. It solar cost and low.

CHAPTER 6

Conclusion and Recommendations

6.1. Conclusion

The generation Cost of the Grid is much high than our system. The emission of gaser is low in our system. So, the Grid-tied system is environs friendly than the Grid system. Renewable Source is always better than Non-renewable source This research presents the optimization of the solar system generates power connected to a DC load. Electricity is that the basic necessity for the economics of a country. As solar energy is linked to the national grid, total generation capacity is increased. As a result, we're looking at how to add solar energy to the national grid. Over the last decade, growing solar cell demand, falling PV system prices, increasing government incentive schemes. A solar energy generation system can be a feasible and optimized solution in this regard. In HOMER shows that component sizes, cost summary, cash flow summary, electrical production, and cost of PV- Generator. In this study, a PV- generation system was found most feasible and optimized. Our Optimization results are total Cost NPC: BDT 27.1M and COE:9.04. Operating cost:2.09M/yr Taka and Initial capital: 90027. Canadian Solar total capital cost 48158 and Production cost 1444 Kwh/yr. AE 6.95 Converter us. Grid energy purchased 232370 Kwh. In our project, the cost of energy is BDT 9.04. This Project Lifetime 25years.The system will absorb sunlight, convert DC to AC energy, and then send AC power to the grid.

6.2 Recommendations

a) Bangladesh's rural population is unaware of solar energy technologies. As a result, a presentation is required to hit this audience with the facts.

b) For rural residents to be able to afford the scheme, a suitable financial structure is needed. This may be in the form of a monthly payment plan, a service fee, or other appropriate payment options.

6.3 Future Scopes of the Work

In this thesis, only the potential of solar energy at the village is included. This analysis can be extended to other places of Bangladesh where the renewable sources are available.

6.4 Summary

Bangladesh exports a variety of fuels and is a renewable energy provider. Electricity makes green energies more reliant. As a result of nuclear energy's gradual depletion. Currently, there are a number of megaprojects in the works. Ruppur Nuclear Power Station, Matarbari Coal Power Plant, Rampal Coal Power Plant, among others.This will result in a massive amount of energy being generated. This initiative satisfies our need for electricity. As a result, Bangladesh is not the poorest country in the world. Bangladesh is now a developing country in the world.

REFERENCES

1. https://patents.google.com/patent/US8779627B2/en
2. https://www.google.com/search?q=hydroelectric+power+pictures+hd&tbm
3. https://www.solaris-shop.com/inverters/
4. https://www.solaris-shop.com/inverters/

5. https://www.alibaba.com/trade/search?fsb=y&IndexArea=product_en&CatId=&Se
6. rchText=Inverter+AE+Solar+Energy+AE+7.0+%28240%29

7. https://www.alibaba.com/product-detail/Solar-Inverter-Inverter-Solar-High-
8.Performance_62424115494.html?spm=a2700.galleryofferlist.normal_offer.d_image
.20183c4eaJZIso&s=p

9. Bangladesh Population Census 2001, Bangladesh Bureau of Statistics; Cultural survey report of Sreepur Upazila 2007.

10. https://en.wikipedia.org/wiki/Sreepur_Upazila,_Gazipur
11. https://www.electricaleasy.com/2015/12/solar-power-system-how-does-it-work.html

12. https://www.mrsolar.com/what-is-a-solar-panel/

13. https://www.google.com/search?q=Grid+tie+Solar+Electric+System&source=lmns&bih=667&biw=1349&rlz=1C1CHBD_enBD888BD889&hl=en&sa=X&ved=2ahUKEwiw9orF_LHwAhVDXCsKHQGBBGcQ_AUoAHoECAEQAA

14. https://www.solar-energy-at-home.com/solar-electricity.html

15. https://www.google.com/search?q=Solar+Energy+System&tbm=isch&hl=en&chips=q:solar+energy+system,g_1:diagram:UjU8_fd3cpY%3D&rlz=1C1CHBD_enBD888BD889&sa=X&ved=2ahUKEwjp786ltrTwAhUhkuYKHWAdD1QQ4lYoAHoECAEQGA&biw=1349&bih=610#imgrc=TfakK0wEmMg8EM&imgdii=HsHWvc9zOEA-TM.

16. https://en.wikipedia.org/wiki/Simulation.

