

## CHAPTER-2

### Renewable Energy Technology

#### 2.1 Renewable Energy

In modern world the demand for energy has increased dramatically in the past century and it will grow even further in the near future than ever before. As the fossil fuel based conventional energy sources are limited and depleting every day, the world community has been searching some alternative source of energy. Renewable Energy is a socially and politically defined category of energy sources. Renewable energy is generally defined as energy that comes from resources which are continually replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat. Unlike conventional forms of energy, renewable energy will not get exhausted. It is also termed as “green energy”, “clean energy”, “sustainable energy” and “alternative energy”. This form of energy has the following over-riding advantages than the conventional energy sources:

- Renewable energy sources are available in nature free of cost
- They produce no or very little pollution
- They are inexhaustible
- They have low gestation period

Renewable energy source has the following constraints:

- In general, the energy is available in dilute form from these sources
- Though available freely in nature, the cost of harnessing energy from non-conventional source is generally high
- Availability is uncertain; the energy flow depends on various natural phenomena beyond human control
- Difficulty in transporting such forms of energy

## **2.2 Criteria of Choosing Renewable Energy**

Renewable energy carries with itself a number of benefits providing social, environmental and economical security. The following criteria should be met by efficient energy sources:

- Not deplete or adversely affect natural resources
- Have minimal or no negative impact on environment or society
- Be safe to consume today and not possess the uncertainty risk for future generations
- Protect air, land and water against pollution
- Have little or no emissions of greenhouse gases or net carbon
- Meet the needs of consumer today and in the future in an accessible and efficient way

All these criteria could be met by renewable energy and thus it could become sustainable for future. Solar energy fulfills all the above criteria and has established its creditability as one of the efficient source of renewable energy in the world.

## **2.3 Solar Energy**

Solar energy is one of the forms of renewable energy which can minimize the energy crisis of the world power sector. Solar radiation is available at any location around the world. The intensity of the sun on the earth, the kW per square meter is about 1.35. It is estimated that the whole surface of the earth's solar energy falling is around  $1.22 \times 10^{14}$  TCE (ton coal equivalent) in one year. In other words, the amount of incoming solar energy in one year, fifty times the known reserves of coal, 800 times the known oil reserves. Bangladesh is situated in 20.30 and 26.38 degree north latitude and 88.04 and 92.44 degree east which is the best suitable place for utilizing the solar radiation.

## **2.4 Necessity of Solar Energy**

The use of the sun as an energy source can be traced back to Ancient Greece. Near populated areas, the Greeks ravaged forests for wood to heat their homes and cook food. Wood supplies dwindled,

and wood had to be imported. With wood scarce and sources of supply far away, the Greeks turned to an energy source that was plentiful and free -- the sun. The Greeks learned to build their houses to take advantage of the sun's rays. Solar architecture -- designing buildings to make optimal use of the sun -- was born. A solar-oriented home decreased dependence on wood, thus conserving fuel and saving money. Twenty-five hundred years later, solar energy can still save us money. It can reduce our dependence on foreign oil. Most importantly, the use of solar energy can help us save our planet.

Today, the government, electric utilities, and businesses across the country recognize that solar energy will play a major role in our energy future. The Million Solar Roofs Initiatives indicative of a growing commitment to renewable energy. The Initiative will increase momentum for more widespread use of solar power. Increasing the demand for solar energy systems, photovoltaic, solar hot water, and solar space heating systems will lower the cost of these technologies, making them accessible to more people. This will put the solar energy industry in a stronger position in the expanding international renewable-energy market.

## 2.5 Distribution of Solar Energy

The solar energy is distributed throughout the earth by following way

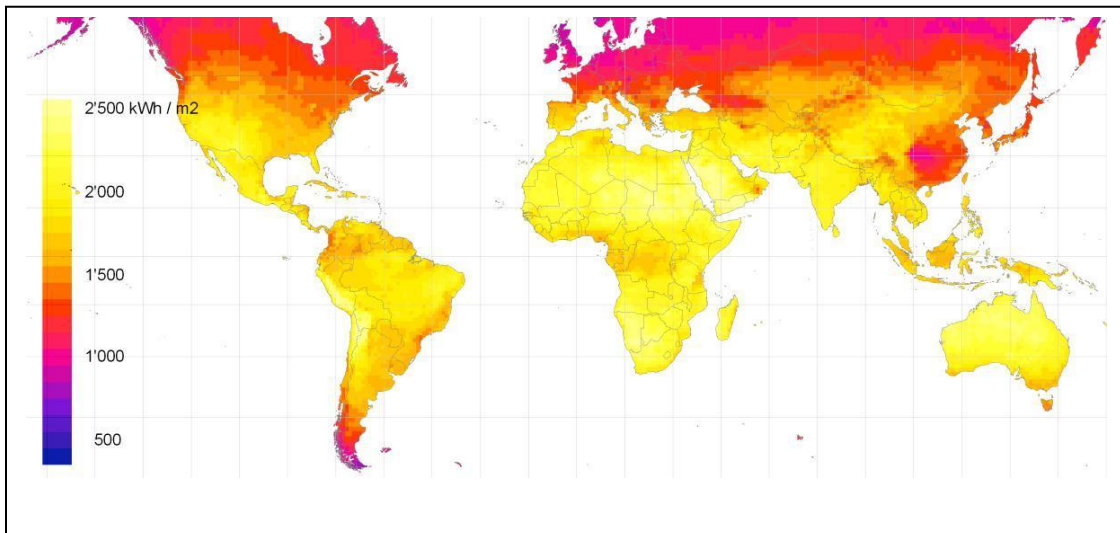


Figure 2.4.1 : Distribution of Solar Energy Throughout the World

## Solar power absorbed by the earth

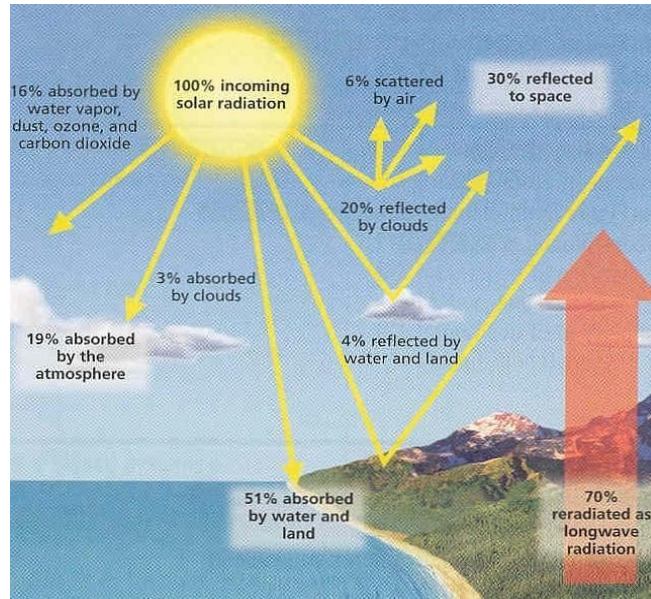


Figure 2.4.2 : Absorbed Solar Power

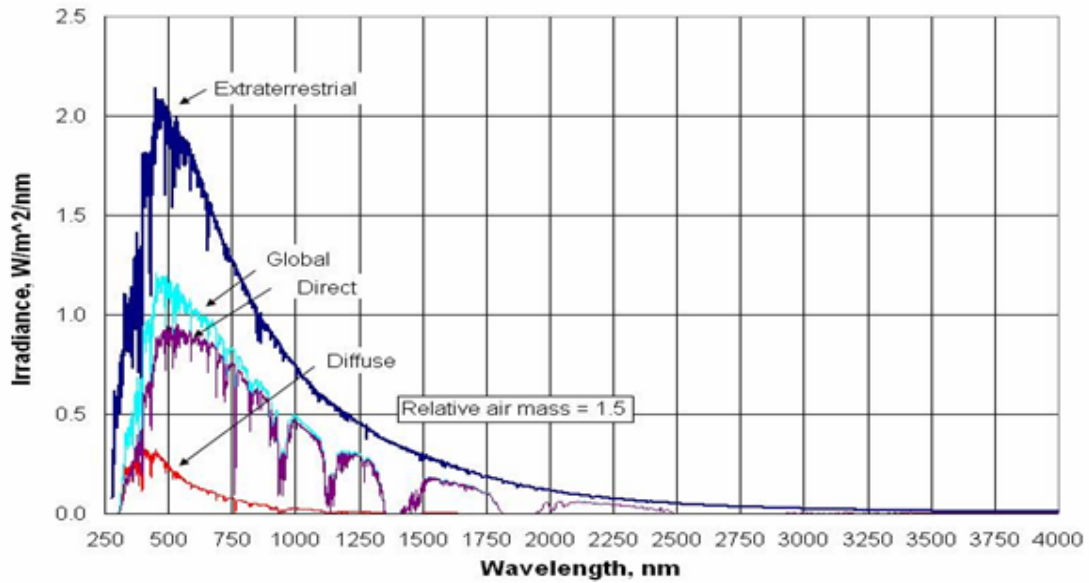


Figure 2.4.3 : Graphical Representation of Solar Power

## 2.6 Solar Radiation

Sunlight on the Earth's surface comprises a direct portion and a diffuse portion. The direct radiation comes from the direction of the sun and casts strong shadows of objects. By contrast, diffuse radiation, which is scattered from the dome of the sky, has no defined direction. Depending upon the cloud conditions and the time of day (solar altitude), both the radiant power and the proportion of direct and diffuse radiation can vary greatly.

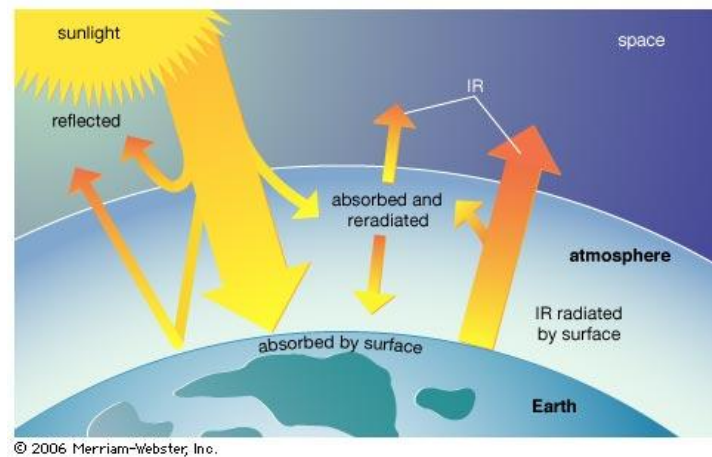


Figure 2.5 : Direct and Diffuse Radiation

## 2.7 Angle Definition

Exact knowledge of the sun's path is important for calculating irradiance values and the yields of solar energy systems. The sun's altitude can be described at any location by the solar altitude [2] and the solar azimuth . When talking about solar energy systems, due south is generally given as a = 0°.Angles to the east are indicated with a negative sign (east: a = -90°). To the west, angles are given without a sign (or with a positive sign) (west: A = 90°).Depiction of angles in solar techniques.

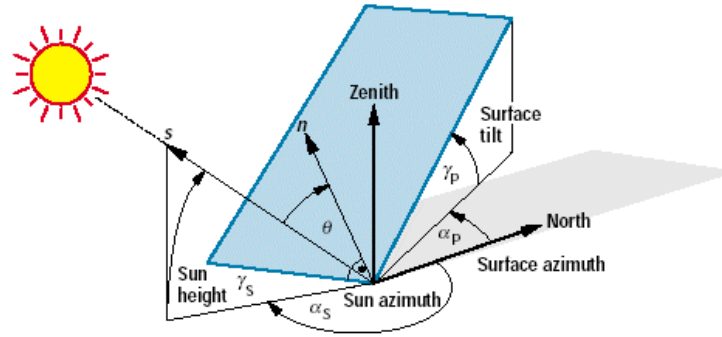


Figure 2.6 : Defining Angles in Solar Technology

## 2.8 Solar Energy Utilization

Now-a-days, solar technology is being used in so many aspects of our day to day lives. Many technologies have been developed to make use of solar radiation. Some of these technologies make direct use of the solar energy (e.g. to provide light, heat, etc.), while others produce electricity.

- **Solar Power Plants**

Solar power plants strive to convert sunlight into electricity, either directly using photovoltaic (PV), or indirectly using concentrated solar power(CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic converts light into electric current using the photoelectric effect.

- **Solar Cooking**

Solar cooking uses the sun as the source of energy instead of standard cooking fuels such as charcoal, coal or gas. Solar cookers are an inexpensive and environmentally sound alternative to traditional ovens. They are becoming widely used in areas of the developing world where deforestation is an issue, financial resources to purchase fuel are limited, and where open flames would pose a serious risk to people and the environment.

- **Solar Heating**

The sun may be used to heat water instead of electricity or gas. There are two basic types of active solar heating systems based on the type of fluid — either liquid or air — that is heated in the solar energy collectors. (The collector is the device in which a fluid is heated by the sun.) Liquid-based systems heat water or an antifreeze solution in a "hydronic" collector, whereas air-based systems heat air in an "air collector." Both air and liquid systems can supplement forced air systems.

- **Solar Cells**

Solar cells can be used to generate electricity from sunlight. It is a device that converts light energy into electrical energy. Sometimes the term solar cell is reserved for devices intended specifically to capture energy from sunlight, while the term photovoltaic cell is used when the light source is unspecified. Solar cells have many applications. They have long been used in situations where electrical power from the grid is unavailable, such as in remote area power systems, Earth-orbiting satellites and space probes, consumer systems, e.g. handheld calculators or wrist watches, remote radiotelephones and water pumping applications.