Solar Energy: Technology And Incentives

Introduction:

Solar energy is an eco-friendly natural resource available that is free of cost. It is perfect energy and having a low density, the clean and low-density energy is much more suitable for the protection of the environment. Sunlight-based energy is recognized as the fastest-growing of natural energy. As technology is improving day by day the solar energy deletion cost and efficiency prevents, there are two major issues with solar energy mainly they are reliability and variability. Solar energy is the heat that is directly obtained from the sun by using a range of solar energy technologies such as photovoltaics (PV), solar architecture, solar heating etc.

In solar energy technology while deploying the necessary tools and technology there are so many challenges associated with it which is in terms of financially and technologically. Solar energy is mainly used for producing solar electricity for household and commercial purposes. Many of these challenges can be mitigated by proper understanding and awareness also by implementing the solar resource assessment and forecasting methods. There are some other conventional energy sources like wind, bioenergy and geothermal energy. For planning the solar energy park, it requires a lot of assessment which can really help in reducing the risk of choosing the project designing, project location and implementing the new sources of solar power generation integrated into the electricity grid. The forecasting of solar energy is required for the routine operation of an electrical grid with solar power generation. The assessed information through solar resources and accurate forecasting is one of the major constraints of solar energy conservation projects. The produced solar energy is stored and harvested by charging in rechargeable batteries.

The sun is the biggest individual from the nearby planetary group and has the successful black body temperature of 5777 K. the shape of the sun is the sphere and it consists of intense warm gaseous matter having a diameter of 1.39*10^9 M. the highest spectral intensity obtained at 0.48 ?m wavelength visible in green colour in the spectrum of seven colours. The total amount of energy in UV region is 8.73%, the visible region contains about 38.15% and the infrared region contains about 53.12%. the energy produced by the sun is the Nuclear Fusion of hydrogen Nuclei into helium. Sun fuses nearly 620 million metric tonnes of hydrogen which results to make 606 million metric tonnes of helium in each second of time.

Research Methodology:

Identifying the different solar technology, their components, ways of implementing, producing the output, other related analyses. (production, investment, output, usage etc)

Literature Review:

The energy produced from the sun can be converted to thermal, chemical and electrical forms of energy. The direct conversion of solar light into electrical energy by the photoelectric effect, Photovoltaic (PV) systems use semiconductor materials. First experimented by the scientist

called Heinrich Hertz in the year of 1887 which was further elaborated by Albert Einstein in the year 1905. The volume of electrical energy generated by the photoelectric, which is having the high intensity and wavelength of solar radiation available to the Photovoltaic devices. Further detailed explanation in the body about the solar energy technologies as per the latest technology. In this report, we will further discuss solar technology and their further development using different systems for generating electrical energy and utilizing natural resources efficiently.

Presentation:

Types Of Solar Technology:

- Photovoltaic cells
- Concentrated solar power CSP
- Hybrid systems

Solar Energy With Reference To Photovoltaic(PV) Industry:

Electrical energy is the secondary form of energy available in the market which can be broadly derived from the renewable and non-renewable resources of energy. Let’s discuss further solar energy which is a natural resource.

Photovoltaic (PV) technology is rapidly growing which can be helpful in generating electrical energy for a wide range of appliances. Through the power plant where the electricity is produced to the end-user, it contains a long chain passing through the grid to the high transmission lines. Converting that high power in (kV) to (v) till it reaches household appliances. The primary form of producing electricity is from fossil fuel (natural gas, coal and petroleum) it is the process of combustion and nuclear fission it creates heat to turn water into steam energy then the turbine rotates.

Photovoltaic (PV) generates Direct Current (DC) generated electrical power is measured in kilowatts (KW) and watts (W) from the semiconductors which they are supplied by photons.

- Eg – using this produces electricity and pumps out the water.
- There are so many advantages by using photovoltaics:
- There is no waste such as emissions, combustion and radioactive.
- Low running costs.
- Good temperature operation.
- High reliability of the solar modules
- It can be integrated with the existing as well as new building structures.
- Unpredictable output can be measured.
- Lack of economical storage of energy.
- Practical and Live example of working PV, pumping out the water from the underground pump.

Physical Operation Of The Photovoltaic (PV):

It is made up of semiconductor materials, which is bonded by electrons and come under the valence band in the band of energy. When the energy exceeds some threshold limit known as

bandgap energy which applies to a valence electron, the bonds are broken and the electron is free to move to the higher band group which is known as the conduction band, it can conduct electricity through the material. By this process, free electrons contained in the conduction band are free from the valence band measured in the units of electron volts (eV).

Concentrated Solar Power CSP:

Trapping the sunlight by using the big lenses and Mirrors, the trapped heat is used to produce electric power from conventionally steam turbines. The trapping uses parabolic trough technology. It consists a parabolic reflector that focuses sunlight into a fixed receiver.

Solar Thermal Water Heating:

There are so many companies in the market that produce the Boilers for to install in-house hold for the Hot Water. These systems are very much capable of high efficiency, durability and reliability moreover they are environment friendly with free of cost helps in reducing the monthly power consumption bills by conserving the power of the sun. it leaves zero-emission.

Installation process:

This process depends on the geographical location of the solar thermal unit needs to consider area/size, no of panels required, budget, required output, direct or indirect system. Make sure that the system is registered and certified depending on the standards by some listed Certification Organizations.

Below is the list containing the Annual savings for a household if they use Electricity, Gas, Oil, LPG instead of Solar Thermal Energy.

We can observe huge differences for a single household, the same way we can observe a huge difference if we implement this system in a commercial/big farm.

Electrical energy:

- Fuel cost per Kwh: $0.167
- Boiler efficiency: 100%
- Annual savings: $267

Gas:

- Fuel cost per Kwh: $0.47
- Boiler efficiency: 90%
- Annual savings: $84
- Liquid petroleum Gas:
- Fuel cost per Kwh: $0.057
- Boiler efficiency: 90%
- Annual savings: $101

Oil:

- Fuel cost per Kwh: $0.042
- Boiler efficiency: 90%
- Annual savings: $75

Photovoltaic Materials And Their Classifications:

What is photovoltaic technology?

It is a method of transforming sunlight into DC (direct current) electricity by using semiconductors (SC). When sunlight hits the semiconductor in the photovoltaic cell. The electrons within it are free to move around and form an electric current. As coming to solar photovoltaic technology is implemented on a solar panel where it catches the sunlight and stores in the form of electricity.

• Crystalline silicon technology (crystalline Si c-Si)– this technology is having a wide range of markets in solar Photovoltaic Technology. The cell structures for c-Si-based Photovoltaic cells

• Thin-film technology – this type of technology covers nearly 10% of the total photovoltaic PV industry. Other most popular technologies are copper indium gallium selenide (CIGS) 25%, Cadmium telluride (CdTe) 65%, amorphous silicon (a - si) 10% is the total distribution of the thin-film market.

The below figure represents a circuit of a solar cell:

The amount of the current generated by the solar cell is equal to the produced by a source of the current, excluding the current through the diode and shunt resistor.

- J = Jph?Js?Jsh
- J = output current
- Jph = photo generated current
- Js = diode current
- Jsh = shunt current

The current passed through the different components is ruled by the voltage across them

- Vj = V + JRs
- Vj = diodes voltage
- V = output terminals voltage
- Rsh = resistor

Photovoltaic Materials:

The common elements used are gallium arsenide, silicon (it contains amorphous, monocrystalline, polycrystalline) and other organometallics combined they make photovoltaic materials which is used in the Photovoltaic devices.

Solar Desalination:

It is a technique of separating the large number of salts mixed in the seawater, an aqueous salt solution so that the lowest salt content water can be collected. The left-over water can be used for drinking purposes, household uses, municipal and pharma use. This process is done in industrial with big space and it requires intensive energy machinery also this process consumes a large amount of energy as compared with other process/techniques in the chemical industry.

The development of advanced desalination technology and methods by the US Department of interior Office saline water (OSW) till 1972. They carried out extensive research and development by constructing sample desalination water plants.

Desalination methods are broadly classified into two types under the type of energy:

• Thermal driven desalination methods:

- Solar distillation
- Humidification/Dehumidification
- Thermal vapor compression
- Membrane distillation

• Electrical driven desalination methods:

- Electrodialysis
- Reverse electrodialysis
- Reverse osmosis process
- Mechanical vapour compression

It is a solar-assisted desalination method by capturing solar radiation solar in solar fields. This is a dual plant technique that contains two independent and different systems by capturing and converting using solar collectors and photovoltaic cells.

Solar collectors directly convert the radiations from the sun either as sunlight to power regular distillation plants TVC – MED then further converted into electricity.

Photovoltaic cells convert sunlight directly into electrical energy/wind energy also an indirect solar energy structure that can be used to generate electrical energy for the purpose of desalination.

Solar desalination units of small and medium for 5000 cubic meters of freshwater production in a single day.

There are some trends in the solar desalination process that scientist has discovered after years of extensive research. It enhances the efficiency and performance of solar power generation plants. Some of the new trends and technologies discovered are:

- Hybridization – Plant operation optimization.
- Forward osmosis – separation of dissolved salts from the seawater by creating an osmotic gradient.

Solar Cooling:

This technology uses range of processes, absorption-based cooling, solar ejector cooling, vapor compression and evaporative cooling. In some cases, it generates and saves conventional energy the threshold capacity is in the peaks when it is in the peak stage. These solar cooling devices can able to meet the demands in high-temperature regions for cooling in noon.

Vapor compression:

It is a refrigeration system used to circulate the liquid form which absorbs and removes the heat from the medium which has to be cooled. This vapor compression technique is widely used in Air Conditioning and refrigerators. This is a mechanical process there is a sequence of evaporator, condenser and an expansion valve is arranged in a closed loop.

Absorption cooling:

It is a four-step process of condensation, absorption, regeneration and evaporation within the evaporator water is evaporated in low pressure. The water flows through on cooling pipes through a chilled liquid.

The most commonly refrigerant combination in chilling machines contains ammonia and lithium bromide water mixtures.

Solar Heating:

Solar heating is used to heat the water for households and swimming pools. The simple working principle is when radiation of sunlight directly falls on the tube collectors and heats up the liquid inside the collector from this the energy passes to the water tank/hot water system, which is already installed.

There are two methods:

- Flat plate collectors
- Evacuated tube collectors.

Conclusion:

in this report of solar energy technology and incentives, I thoroughly achieved the learning outcome of solar energy utilization starting from conservation to utilization. Also learned the importance of solar energy technology to utilize natural resources available free of cost in different ways without wasting. It is having zero-emission unlike other natural resources like fossil fuels, coal etc which emits Co2 harmful to the environment creates breathing problems for humans.

World consumption of renewable energy:

- Solar – 2.2%
- Wind – 4.8%

- Geo – 0.3%
- Bio – 2.0%
- Hydro – 15.8%

Future solar technology:

Major growth in the solar energy production industry should be developed. As per current statistics efficiency of solar panels is 33%. Current production is 1% and is expected to rise by 16% till 2050 globally. The government is providing subsidies while installing the solar units so it is cheap.

References:

1. G K Tiwari, solar energy technology advances | New York Published by Nova science publishers, Inc., 2006.
2. Antonio Luque and Steven Hegedus Second Edition, A Handbook of Photovoltaic Science and Engineering | West Sussex, UK John Wiley & Sons, Ltd 2011.
3. Sohail Anwar, Harry Efstathiadis & Salahuddin Qazi Handbook of research on solar energy systems and Technologies | Hershey PA, the USA Published by engineering science references IGI Global 2013.
4. Vassilis Belessiotis, Soteris Kalogirou, Emmy Delyannis, Desalination methods of Technologies – water and energy | 2016 Elsevier Ltd.
5. Guidebook of Viessmann Industry company Manufacturer of heating, Industrial systems.