CHAPTER 4

LITERATURE REVIEW

1. Britt; Jeffery S. (Tucson, AZ) wiedeman; scoot (Tucson, AZ) (2009). The efficiency of the solar cell is determined by the type of semiconductor material used in a PV cell. Various parameters such as cost, properties of the material as regards to behavior with respect to temperature weight and as well as the other material with which it is used, all this contribute to the deciding factor about the efficacy of the PV cell. The inventor has conducted many experimental researches to find ways and means for forming tiny layers of semiconductor materials to improve the performance of the PV cell.

In multi zone process a semiconductor layer may be sequentially formed. The scope of PV cell is attributed to direct conversion of solar energy into DC electrical power and this effect is known to be PV effect. P configuration and N configuration materials are used to form a solar cell where N configuration materials possess an excess electron and the P configuration possesses excess of holes.

When photons in pinch on the PV cell of the semiconductor material the electron become free from the atom, allowing the formation of free electrons and if the conduction path is extended between the sides of the cell electrons will start flowing from N configuration to P configuration and their by causing the flow of electric current. A PV structure which is appropriately located along with inclusion of electrical contacts being included in the electric circuit constitutes a PV cell. Now a days Thin-Film PV cells have been developed for commercial usage because it requires less light observing semiconductor material. Mass production can bring down the production cost of thin film PV cell which has approached efficiency of 20%.

2. Ho; Frank F., Yeh; Milton Y. (1995), The efficiency of solar cell varies somewhere between 15 to 22 %. Many studies and innovations are being carried out by changing the combination of the semiconductors in the PV cell to find out improved efficiency. The inventor has analyzed the property of semiconductor material through thoroughly has come out with the combination of cells - Cascade cell which permits achieving more than overall efficiency of more than 23%.
Up to the present time it has been proposed to use other material such as germanium or gallium arsenide, as the substrate for solar cells in which the principal active junction is formed of N-type and P-type gallium arsenide. Substrate of gallium arsenide were preferred because of their electrical properties in view of the problems encountered with germanium substrate. This problems have contributed to “Cascade effect”, in which sum of the total output arises from the junction of gallium arsenide with the germanium substrate, which is particularly with responsive to infrared energy and which has a relatively high temperature co-efficient.

However germanium substrate would be preferred for supporting for gallium arsenide solar cell for a number of reasons. Germanium has a number of fracture toughness than gallium arsenide as a substrate. For Example 0.2mm thick germanium wafer is twice as strong as 0.3mm gallium arsenide wafer. Cost wise also germanium is 40 to 50% less than that of gallium arsenide.

Germanium wafer of 0.1mm thickness used for solar cell is 66% lighter in weight than gallium arsenide at 0.33mm thickness. Weight is an important factor for space applications. Yet in addition to cascade effect germanium also evidences so called self doping effects, which occurs at very high temperature, when germanium substrate is exposed to the gasses used to deposit gallium arsenide. Attempts are continuing developing solar cells that efficiently used as much of the solar spectrum possible in order to catch as much as possible photons, this semiconductor materials used in the solar cell must be designed for a small band gap, photon energy lesser than the band gap radiation transferring by the semiconductor material. But the small band gap results in a low photo voltage device low power output. If the band gap is large it results in a bigger output device, but lower energy levels photon absorption gets affected. A solution to the foregoing problems is disclosed where by the efficiency of photo voltage cell is increased to over 23%.

3. Bareis; Bernerd F(2004), A focusing type energy receiver consisting of a parabolic reflector having a centre and a high reflective surface on the concave side of the reflector and this has the focus point extending from the concave side reflector. This also has a conversion module having a reception surface. The reception surface is spaced and
disposed to receive the solar energy from the concave side of the reflector of conversion to electricity. The conversion module comprises of reception surface which is coupled to thermal engine, the mechanical output of an engine can drive a generator to produce electricity. Non focusing type solar collectors receive diffused rays of the sun with an array of PV cell

A concentrator type collector focuses the beam radiations to improve the efficiency of the conversion of solar energy into heat energy or electricity. The existing focused type solar energy receivers have an arrangement of incident solar radiations which is focused at a point from the circular reflector. The main drawback of having a very small volume located at the focal point directly can cause high concentration heat and has to be dissipated. Also a portion the solar radiation spectrum (IR portion) cannot be efficiently converted into electricity. These drawbacks are conveniently overcome by the design modifications.

There is possibility of collecting the energy from the selective solar radiation spectrum which can be converted, processed or stored for a variety of applications. The inventor has allowed varies changes and alterations in the embodiment without departing from the spirit and scope of the innovation.

4. Zhao; Xiaofeng (2011), the efficiency of the solar energy conversion system is mainly influenced by the following factors such as intensity of the solar radiation, its duration, the tilt angle of the collector. In case of a solar collecting and utilizing device, the sun tracking and beam focused radiations are of paramount importance. This device consists of a paraboloidal mirror a sunlight collector, a solar storage and conversion device and a solar tracking equipment were in the said sunlight collector comprises a light guider which converts a facula into substantially parallel light beams and deflect them in a decide direction, and curved surface condensed mirror which receives the substantially parallel light beam reflected from the light guider and converges them into a solar storage and conversion. The said solar device is characterized as a multilayer heat storage structure corresponds to plurality of curved surface mirror and has light a receiving hole for receiving the condensed light from the curved surface mirror the heat structure
contains a working fluid to transfer or storing the energy such as groups of melted salt, water steam, smelting raw material and photoelectric cell.

The inventor has refer to all the previous inventions and problems regarding reflection index, cooling problem of the mirror and as well as the application of solar energy for deriving thermal power and electricity. The device of the present invention uses high temperature solar energy, then the employed device is configured as a multilayer heat reservation structure in order to increase the beam collection extent of light guider and decrease the scattering deflected radiation caused by the poor quality of the mirror surface, light guider composed of reflector having a convex lens rings disposed between the light collecting mirror and guider mirror. Thus the scattered beams at a large deviation angle can be corrected parallel to the desired direction.

Compare to thermal power generation the solar electric power generation reduces the civil work in the building, avoids pollution waste handling air preheat and pollutant treatment.

With comparative calculation for building a solar thermal power station it is inferred that it is cost intensive as compare to convention power station. However, considering environment friendliness, levying of taxes on conventional power usage and conserving fossil fuel may go a long way in building solar power stations.

5.Hachima; Hiroki(1996), Contamination of water in rivers, lake and marshes in areas functioning as sources for a water supply has created a serious social problem. With the development of various solar energy conversion applications technologies many tasks are being accomplished successfully by inventing as to provide an improved apparatus and a facility for treating dirty water having an excellent ability of cleaning water and in which treatment of dirty water can be performed more easily by using a compact apparatus or facilitating deterioration of the natural environment thought to progress of because of influence of home sewage into rivers in and around where sewerage systems and sewage treatment plant are not provided.

In an aquarium tank a water treatment plant such as a filter is disposed above the tank and or at the bottom of the tank. However, fish sometimes die to deteriorated quality of water
caused by food and excretions of fish. Therefore this necessitates frequent changing of water and careful cleaning of the tank, in case of convention type of aquariums. According the first aspect of this invention, there is provided dirty water apparatus which includes

1. A container having air permeability
2. A porous material placed inside the container on to which aerobic bacteria are implanted
3. Dirty water passing means for the dirty water through the porous material
4. Air passing means for circulation of air.

There are many preferred configurations having air permeability such as cylindrical, net or a basket or rectangular. The air passage means include a pipe which penetrate through the porous material and which is formed with air discharge holes. One end is connected to air compressor and the other is connected to the air supply pipe. A solar generator is used as a supply source for the air compressor. In the preferred configuration the porous material may be foamed glass, purmice or field spar.

It is conveniently established that the treatment of dirty water can be performed more easily with a compact apparatus or facility, while providing excellent water cleaning facility/capability. In areas where commercial electric power is not available, a solar generator can be used for operating the dirty water cleaning apparatus.

6. Tomas SUMBERA, Frantisek STRIDA, Zdenek HRADILEK, Stanislav RUSEK (2012), Wind and solar power have great advantages than common sources of electric power that they neither require any fuel for production of electricity nor any hazardous waste material after the power production cooperation possibility of wind and solar power through a common transformer to the 22kV grid network is evaluated in this paper. The voltage fluctuations caused due to individual electric power sources compared with the possible cooperation of wind power plant and solar photovoltaic’s on the grid system as clearly analyzed. However, the unutilized potential power availability (WPP+PV) ratio-vis-a-vis active power ratio is quite interesting. The data for July & October are obtained from WPP&PV, located in Moravian-Silesian, CZ republic. It is
quite well known that wind and solar power are the freely available, clean, inexhaustible sources of energy with the increasing awareness about global warming conserving fossil fuels and energy conservation, various efforts are being made to promote renewable energy technologies at all levels. However the performance efficiency of WPP is about an average of 40 to 50%. The main disadvantage of these two sources of energy is their unstableness and stochastic electrical supply factor unlike sun energy which is available only during day time, wind energy is available all the time with the adoption of appropriate technologies both WPP and PV system are connected together and tied to the supply grid, being called HYBRID power system. However, the present paper throws light on the possibility of using the combined wind power and solar power in “CZECH REPUBLIC” and its effect on the 22kV grid the network is evaluated for technical purposes.

Graphical analysis of the instantaneous power wave forms at hourly intervals for july is considered, the wind power plant availability, non availability solar power availability, etc are all taken in to consideration. The intermittent nature of the power available to the grid which is already connected to other supply sources, experiences severe voltage fluctuation and their effects are investigated in this article.

Because of the non uniformity of the solar radiation in all the regions of the “CZECH Republic”, efforts are being made to locate WPP & solar PV plants at convenient locating to tap this energy. This is being thoroughly investigated by relaying on the average sunshine hours, wind speed, topography and climate of the region conserved for implementation.

It is clearly concluded by the studies carried out that, WPP+PV system, Hybrid system does not contribute any significant change in the power grid connected with it. The big system advantage is possibility of electric supplies at night, when solar plant is out of order.

7. Mehdi Dali, Jamel Belhadj, Xavier Roboam(2007), The ever increasing demand for electricity and the soaring prices of fossil fuels and the emission caused by power generation causing environmental problems has compelled the planners world wide towards renewable energy technologies. However due to the limitations in harnessing the
renewable energy sources despite the added advantages of free clean & pollution free aspect renewable power unit based on a single source carried or solar sources is not economically viable and as well as not reliable, let alone its efficiency. The best alternative solution lies in combining the different renewable energy sources to constitute a system called hybrid system. For rural electrification where grid extension is not technically or economically feasible, hybrid energy system can act as a panacea. The design of a hybrid system must be reliable and economical and therefore at most consideration should be focused for operation of the components and selection of the control.

The modeling of the stand alone hybrid system is developed taking into consideration the integration of the converter losses. For simulation studies average model is used the energy loses associated with the power conditions or converters is analyzed and then a mathematical model is developed.

Bond-graph formalism is used for modeling the system here. Depending on the interface converters, many topologies are available for hybrid systems. Hybrid systems are preferred in the following applications such as water pump, desalination, battery charger etc.. The DC/DC buck converter controls the variable output voltage generated from the PV panel. Similarly the variable frequency and variable output voltage from the wind generating system is rectified initially and then controlled by DC/DC buck converter. The total power so generated will be collected by the DC bus collector to meet the load demand.

The PV & wind systems are modeled taking into consideration of all the relevant parameters such as PV generating system. Buck converter model, Buck losses model, switching losses model, etc,. The performance various charges in response to wind speed and solar radiation intensities.

The Dynamic analysis of the hybrid system by modeling the various associated factors & incorporating electronic devices at appropriate locations have conclusively proved to be a optimal efficient scheme for efficiency improvement.

8. Khaled Toufek, Mourad Haddadi, and Ali Mk,(2011). It is a known fact that lot of innovations & experiments are being conducted across the world to harness the solar
energy in the most effective way and better performance in the design of the associated main parts in the PV system. Solar thermal energy, solar thermo electric energy and solar PV energy are the time tested energy harvesting techniques. A combination of thermal & PV system performance is of more technical relevance. A thermal collector and a photovoltaic module combined together to form a single system allows for increased efficiency of the solar energy conversion efficiency. Combining these two devices in a structure in a judicious manner to those of thermal and photovoltaic’s separately, a synergetic effect can be obtained. Production of total energy depends on the input from hybrid collector and output which is the electric production and the temperature of the system.

An experimental setup for the study of two configurations of hybrid collectors is undertaken. In the first configuration, the absorber plate is made up of galvanized steel and is chosen for the first absorber configuration mainly due to low cost and simplicity, but for the second configuration copper is chosen mainly because of its heat promotion properties.

The first configuration (photovoltaic module) consists of 3 layers: (a large of glass, a layer of cells with EVA & tedlar layer) of mono crystalline long of 1.29m & width 0.33m. The absorber is made the module, better thermal insulation is ensured.

For the second absorber plate copper is used and rest will remain the same as that of first. The very purpose of this setup is to compare the thermal and electrical performances of both types of configurations. The structure of the two collector is inclined at 32° (latitude of the place) and facing south. (Both configurations are housed in the same structure) The circulation of the fluid at the output (water) is continuous, but at the entrance 2 studies are of in the first case water enters continuously in to the two collectors and in the second case, an stops the circulation of water through a valve at the electrons of the two collectors. The input temperature is the low for both and collectors and the temperature difference more than 4°C for the exit. The valves of output temperature, thermal efficiency and electrical efficiency are obtained & analyzed the results.

The electrical efficiency gets reduced because of increase in temperature because a great part of solar radiation absorbed by PV cells is not converted to electricity. The temperature at the collector can be removed by natural circulation of fluid & heat
extracted can be used for other needs. It is conclusively established that thermal and electrical performances are better in the first configuration (galvanized stell absorber plate). As compared to second configuration (copper absorber).

9. S.B. Sadati, M. Yazdani-Asrami, M Taghipour and H. Vahedi (2010), Electricity is one of the basic need for human beings in any developing country. Although energy in any form is being utilized for the day to day needs, electrical energy is most sought after commodity because of its ease, clean & simple way of usage nowadays economic growth of any country is based on the per capita energy consumption of its population and therefore electrical production is an important factor in strengthening the country’s economy. The conventional method of power production has caused considerable depletion of fossil fuels and environment pollutions therefore efforts are being made worldwide to go for clean, green & renewable energy technologies.

Most of the energy needs of the earth is met by the sun. Solar energy is clean, inexhaustible source, which can be utilized by using appropriate technologies. Solar energy is available for free through most part of the year. Photovoltaic system is one such technology where light energy gets converted directly converted in to electrical energy.

A tropical country like IRAN has been taken in to consideration for this paper. The total solar radiation received by different region throughout the year, the average energy consumption required the effect of temperature on voltage current curve characteristics have been considered for evolving the photovoltaic system to meet the domestic required. Economic analysis has been made for justification of the usage of photovoltaic system for specific reasons and prevailing conditions.

The process of changing the irradiated solar energy into electrical energy without the aim of any external machinery is called PV phenomenon.

Basically Photovoltaic system composed of 3 major parts

1. PV PANEL OR ARRAY OF SOLAR CELLS: absorbs solar energy.
2. Conversion part or interface part: To induce electrical energy obtained from PV system.
3. Consumption side: Electrical load side to consume load.
Usually voltage produced in each cell is 0.5V & the semiconductor material used is silicon. By arranging the photovoltaic cell in series-parallel combination required demand can be met. Such a combination is called module and installation of such a module on a holder plate constitutes a solar panel, electrical connection between panels is called array. Battery backup and inverter system can meet any type of consumer load ie.AC or DC.

A detailed cost analysis has been done and has established that photovoltaic system is more economical in cases where houses are remotely located and extension of grid connection is very lengthily uneconomical.

In order to supply electricity to remote areas & where the population is low and is difficult to be connected to the grid network, use of photovoltaic system is most suitable with the new technological aimed at innovative designs in the field of solar cells, cost can be brought down in the later years to come.

10. C.O.C. Oko and S.N. Nnamchi, (2012), Clouds, atmospheric dust and shades constitutes some of the main factors which affects the intensity of the solar radiation falling on the PV system. The designer has to pay more attention towards harnessing the Insolation to the optimum level for effective performance of the equipment. Determination of the tilt angle at lower latitudes as one such effort for a country like Nigeria. The Insolation values are estimated for tilt angles ranging up to 40° on seasonal, monthly and yearly averages. The effect of the tilt angle on the performance of the solar equipments in low latitudes is the crux & here various factors affect the performance of the solar flat plate collector; the angle of latitude, the sun declination angle, slope angle the sun rise, sun set angle hours, and azimuth angle.

To establish the optimum tilt angle for countries like Nigeria which lie at low latitude, 4.86-13.02°N and are compared with the results already established in the literature and are used for designing the solar equipment for low latitude ranges.

It is quite well known that the angle of latitude the declination angle, the sun rise & sun set has angle are beyond human control and are controlled by nature, however the tilt and azimuth angles are controlled by human intervention and it has been found that at azimuth angle of zero for south facing flat plate solar collector proper determination of
the tilt angle is very much essential for optimum performance of the solar flat plate collector. For maximizing the absorbed Insolation, the working fluid temperature, the collector and thermal efficiencies are very much essential.

It is inferred that the tilt angles for various monthly, seasonal & yearly basis for the solar flat plate collectors obtained for the low latitudes of Nigeria considered for low latitude of Nigeria considered for latitude 4.86-13.02°N are very useful. These are clearly established by the graphical & tabular data generated and the polynomial expressions obtained by the authors.

11. Natarajan Pandiarajan, Ramabadran Ramaprabha, Ranganath Muthu (2012). By the use of photovoltaic system the energy is produced and can be directly delivered to the AC main for utilization purpose for catering the power demands of the society in many countries. The operation of the system components and its performance greatly influences the efficient performance of the PV system. Efficiency of the solar system conversion technology stands at about 15 to 25% mainly because of the conversion of DC power to AC power through battery banks. The energy produced in the PV system can be directly delivered to the AC main without battery bank, which ensures reduction in the overall. Studies on the PV systems in operation revel that an average of about 4-5 years duration PV systems fail to work because of the failure of the components. The failure rates are attributed to the components is listed below.

1. Inverters - 63%
2. Modules 15% and
3. other components 23%,

Therefore priority should be given to reduce the failure rate of inverters to have a longer life of PV system for efficient performance. This paper deals with analyzing failure rates comparing the functional models already available but difficulty by the field professionals for adoption and tries to come out with simulink model of PV module to address the model.

A simple PV system is developed incorporating the governing physical equations for analysis purpose is considered. Simulink model for each numerical results of each
equation for varied values of Insolation and temperature are tabulated for analysis and a complete circuit model is evolved.

To obtain the desired voltage and current output levels Solar cells are connected in series and parallel combination PV module. In multi zone process a semiconductor layer may be sequentially formed. The scope of PV cell is attributed to direct conversion of solar energy into DC electrical power and this effect is known to be PV effect. P configuration and N configuration materials are used to form a solar cell where N configuration materials possess an excess electron and the P configuration possess excess of holes.

When photons impinge on the PV cell of the semiconductor material the electron become free from the atom, allowing the formation of free electrons and if the conduction path is extended between the sides of the cell electrons will start flowing from N configuration to P configuration and there by causing the flow of electric current. A PV structure which is appropriately located along with inclusion of electrical contacts being included in the electric circuit constitutes a PV cell. Now a days Thin-Film PV cells have been developed for commercial usage because it requires less light observing semiconductor material. Mass production can bring down the production cost of thin film PV cell which has approached efficiency of 20%.

Experimental and simulation P-V characteristics of current and voltage are plotted. Similarly for V-I characteristics similarly, a circuit oriented model of PV module and design for maximum power extraction system has been using various equations. Using micro controllers programming the hardware setup of proposed setup was carried out for 1000W/m² at 25°C. The results showed a reduction of 2-5% in the power and current values of the PV module.


Inverter is an important module in transforming solar generated DC power to AC power and it acts as an interface between the solar energy and grid power supply system. These inverters are utilized to shape the electrical output of solar panels or photovoltaic energy
(PV) to allow input into the grid system, one of the key components in these inverters is IGBT’s (Insulated Gate Bipolar Transistors).

IGBT being a semiconductor device is temperature sensitive, with a significant degrading performance approaching operating temperature of 70°C. Therefore efforts have to be made to stop the switching failure of IGBT’s under critical conditions due to excessive temperature levels. Therefore, by designing & developing an optical fiber based sensor the switching failure can be pre-empted. This paper deals with the design, characterization and implementation of a Fiber Bragg Grating (FBG) temperature sensor in a power electronic inverter which was a high electromagnetic interference (EMI) radiation. A comparison is made between the performance of the enhanced (FBG) sensor and a thermocouple in a high EMI environment and results are analyzed.

An experimental setup in the proposed IGBT equipped inverter to convert the DC power obtained from the PV module into AC power is configured. The IGBT are switched at 20 KHz level in order to generate the AC power to the electrical grid.

A web based application, lab view HTTP web server, is used to provide an online supervision, monitoring & assessment of the IGBT temperature. The temperature of the FBG sensor and the reference thermocouple are continuously assessed on the university local networks for over 7 hours. After 7.5hours IGBT experienced a 6°C temperature rise, which peaked at 30°C. These fluctuations are caused by the amount of power generated by the solar panel as the switching frequency of the IGBT is controlled to provide constant electrical output power to the grid.

The comparison between the temperature readings measured using the FBG sensor and the thermocouple shown that thermocouple reading is erratic. The errors are due to the EMI generated by various components inside the inverter box. It was found that placing the thermocouple inside the inverter box, instead of the heat sink, generates even more significant errors. This will increase even more with the IGBT frequency increase.

The thermal expansion of the optic fiber is enhanced by mounting the FBG to a metal sheet. Due to this FBG sensor, recorded an improvement in-of linearity and sensitivity. With the experimental investigation it is clearly established that with enhancement capability of the optic fiber, the performance of FBG sensor gets improved & FBG can be used in the inverter system to preempt switching failures of IGBT.
13. Randall Thomas and Max Fordham (2001), the author explains the possibility of paradigm shift in the design of the architectural buildings for promoting solar energy technologies. It is well-known fact that there is significant reduction in the carbon emission levels by the use of PV technologies. This paper deals with many variations of solar PV collectors such as Flat plate and concentrating plate collector, building integrated PV collector system (BIPV). The integration of the thermal solar collector and PV module is an important objective for developing newly design architectural building. Much emphasis is laid on incorporating the active solar system in the design aspects of the building than near solar technologies.

To reduce the CO\textsubscript{2} emissions the planners must be sensitive thereby bringing in suitable legislation such that new buildings should incorporate the solar active system for sustainable architecture and ensuring sustainability.

14. Jozef FIALA, Anna MICHALÍKOVÁ, The author emphasizes the importance of using transferring solar energy into chemical energy for surface treatment of metals, surface treatment enhances the quality of the treated equipment. Surface treatment greatly influences the maintain aspects such as servicing usability and availability in the industry the author has further dwelt with various advantages of electrical energy for application in industries because of its simplicity, cleanliness and fastness.

The author has also explain about the various forms of solar energy usability and stresses the solar suns energy as the main prime mover in realizing various forms of renewable energy.

Surface treatment mainly focuses in electroplating technologies and electrochemical reaction while dealing with metal coatings. Metals like copper, nickel, cadmium, zinc, silver, gold, tin etc.. can be used for metal coating. Copper coating is widely used as a cementing coat in silver, gold ornaments and it also act as a protective layer. Because of the low capacity the whole system is now used for bright copper plating can be used in small areas in 1.10dm\textsuperscript{2} and to some extent up to 4.5dm\textsuperscript{2} under ideal conditions. The author deals with the findings of experiments conducted on a parabolic dish solar collector. The parabolic collector has an inner reflecting coating of a depth opening 2.2m
dia, to facilitate the orientation of the dish to separate rotating jacks are used for the support. Thermal conduction is the most pronounced way of energy transfer in many applications such as high temperature exchangers, boilers, rocket proposition systems, steam engines and solar concentrators, the high concentrated solar systems such as parabolic dish reflectors. Many researches have taken place in high concentrated solar thermal power technologies. In another experimental setup two dish are used for analysis purpose. The first dish is a thick coated surface and another is a thin disk and are kept at the focal point.

15. V. A. Boichenko, E. Greenbaum, and M. Seibert, The author discusses about the current energy scenario and the importance of energy availability for sustainable world. The fossil fuels are depleting at faster rate and the governments are finding it very difficult to supply energy to the people at affordable prices. It is well known that the energy is the prime requirement for the development of any nation. Energy consumption is often regarded as an yardstick for measuring the prosperity of a country. The unchecked growth of industry, vehicle and fossil fuel consumption are adversely affect environment culminating in climatic variations. The greatest challenge lies in providing energy at an affordable price to the consumer for improving the living standard and ensuring eco friendly pollution free atmosphere for avoiding global warming and other climate related problems. Of late scientists have discovered that for a sustainable development renewable alternate energy sources are the best options. By correlating the technique involved in the photo synthesis process of the plant the society can benefit by harnessing the solar energy for sustainable development.

16. Chieh-Li Chen, Chia-En Ho and Her-Terng, The author mainly harpes on the usage of solar energy in thermal processes and other thermal related applications. It is well known that to have high degree of heat energy from solar PV cell, one has to have a concentrated PV cell optimizing the performance of a sterling engine which works on solar energy is the main focus here. A study conducted on the exchange of heat transfer between the sterling engine and the concentrating solar PV cell using quantitative techniques, a generic algorithm is used to determine the system parameters for the maximum power adopted at the sterling engine. The finite time thermo dynamics can be used for
understanding of the dynamics of the energy flow and entropy flow in a non-equilibrium thermo dynamic systems. Classical thermo dynamics mainly related to problems of thermal equilibrium.

Many researches have taken place on thermal efficiency analysis for practical processes. To obtain an adequate PV cell thermo system for thermal efficiency a study has to be made for the exchange of heat transfer between the engine to the solar collector and surroundings.

17. W.T.T. Dayanga and K.A.I.L.W, the author highlights about the advantage of solar thermal power plants to that of conventional power plant. Solar energy is harvested in more than two ways. However, the thrust is laid on the following methods

1. Solar PV System: Here the solar energy is directly converted into electrical energy without any mechanical moving parts. Here the power generated is DC.

2. Solar thermal System: The solar energy is converted into heat based on the thermo dynamic cycle. However, it has been found that the efficiency of the solar thermal power plant is comparatively more than the efficiency of a solar PV cell which is around 20% as of now.

Compared to the other conventional power plant the running cost of a solar thermal power plant is low, even though the initial cost is high in the initiation stage.

The main advantage of solar thermal power plant is that the CO₂ emission by it is very least compare to other types of conventional thermal power plants which emit high levels of CO₂ into the atmosphere.

To establish an upper limit for conversion efficiency for conversion of solar energy, energy conversion model is used. The reflector reflects the impinging solar radiations to the absorber plate(concentrator collector) where a working fluid is heated, which can drive a turbine for power generation.
18. David Tschanz, The main focus by the author is towards the multi functional converters. The cost of a solar power water pumping system is realized by eliminating DC/DC converter substantial cost reduction and enhance reliability are the main factors being taken to consideration. Heither to solar pumps used to a booster converter for power point tracking and use a motor inverter to propel the movement for the pumps. In the conventional DC pump the current at DC input and one phase control is provided on the motor side the reduction in the cost is achieved by realizing a multi functional converter where only one current sensor is used, which inturn at the same time allows the sensation of PV input current and currents on the motor side control the sum of the three phase current gives the impact current and therefore it is sufficient enough to measure only input current. The multi functional converter system (MES) uses the combination of motor inverter function into a link co switch inverter bridge.

The boost converter ensures the stabilized DC voltage to the motor inverter, from the solar panel. In the proposed method a single three phase bridge inverter acts both like a boost converter and motor inverter, while the panel is connected to the STAR point. This element is need for boost converter resulting in reliable and reduces cost.

19. DENNIS D. MCCARTHY: The author discusses about the astronomical times and its importance besides explaining about the need to understand about astronomical times.

Earth is not a symmetrical round body its movement gets influenced by the gravitational interactions from other planets in the solar system. Therefore although these phenomenon do not produce uniform time scales, it is important to know the time which are derived from them. It is important for the observers which include navigators, astronomers and geodesists to know the orientation of the earth from a reference frame.

Astronomical times is very important in modern day times and is based on the rotation of the earths around the sun. Coordination of the clock time scale approximate the earths rotational time(UTC). The current method practice in these days to add integral second(Leap seconds), to keep the difference between the UTC and UT1, less than 0.9sec. The international earth rotation service(IERS) is the designated body entrusted with responsibility of adding leap seconds.
20. Shirish Garud, Fellow and Ishan Purohit, The author discusses about the application of solar energy for power generation through thermal generation method and the challenges and opportunities.

For any country to progress, power sustainability is the prime requirement. It is quite well known that a country can be termed as fully developed only when all the people get the power to prosper and better their standard of living. With the high carbon emission produced by the consumptions of the fossil fuels and the fast depletion of the availability of the fossil fuels in nature has inevitably directed to look into other sources of energy and renewable energy source have come as a boon to the mankind.

Solar thermal power generation can be considered as a viable option, since its running cost are comparatively less with respect to the conventional thermal power plants. The peak power shortage is estimated at about 10% and overall power shortage is about 7.5% in our country by the year 2030. The installed generating capacity will be 800000MW as per the integrated energy policy of the India and renewable energy contributes a major share into this capacity. This clearly indicates the move from the government for promoting renewable energy in a big way to overcome the power crises and the other disadvantages being faced with the use of conventional fossil fuel.

Solar thermal power generation system used a high concentrated solar radiation as an energy source with very high temperature to generate electrical power. It is pertinent to note that the operating temperature of non concentrated solar cell is about $120^\circ$C which is not enough to dry a heat engine. Where a minimum input temperature required is about $300^\circ$C. Hence concentrated solar PV system is used for thermal power generation. Of course, these is more suitable in areas where direct solar radiations is high.

The solar radiation which is collected in the concentrated PV panel and the generated heat is transferred to a working fluid which may be any heat transfer oil or air or water oblique steam from this hot fluid steam or hot gas is generated which can able to drive a turbine for generating electrical power.
21. Mrityunjaya Kappali* 1, Dr. Uday Kumar R. Y. 2 and V. R. Sheelavant, Although, Solar energy is gaining much importance all over the world, in our country people are still reluctant to use the same in a big way. This is mainly attributed to the factors such as high initial cost, performance efficiency, availability of spares and reliability of supply from these energy sources. One way of bringing down the cost is through mass production of the PV panels along with promotional incentives by the government. Another way is to improve the harnessing capacity of the PV panel for a given unit area. By using devices like Maximum power point tracking (MPPT) the efficiency can be improved. Many researches are taking place for bringing down the cost of the PV system by focusing on aspects like enhancing harnessing capacity, cheap and reliable inverters, type of the semiconductor material combination etc.

22. Goswami, D.Y (1999), in this paper the author dwells up on the many applications of solar energy such as Refrigeration, Drying and curing of agricultural produce, Industrial process heat air conditioning and electricity power generation. The author also mentions about the types of solar collectors used in PV systems and type of components that are as follows

- Flat plate collectors---These are also called as absorber plate and they are coated darkly so as to absorb more heat from the SUN.
- Insulation behind the collector plate so as to avoid loss of heat from the collector
- Glass cover—this allows passage of solar radiations with short wave lengths. But blocks the passage for long wave lengths,. This means that the generated heat caused by short wave length solar radiations is trapped inside the collector which is covered by the glass.
- Heat transfer medium—such as air or water to transfer he generated heat from the collector
- With the advancement of new innovative technologies solar collectors are so designed to achieve very high degree of temperature. The same principle is adopted in case of SOLAR PONDS where short wave length solar radiations strike the bottom most level of the pond, but the long wave length radiations are blocked to remain inside the pond itself, by providing a transparent cover over the
top of the pond. To increase the density of the water inside bottom water layer of
the pond salt can be added and such type of ponds are called solar gradient pond.
Electrical power can be produced using solar thermal energy and applying
thermodynamic cycles to the rankien, stirling and brayton cycles the obtained
temperature from the solar collector will determine the particular cycle which
can be then employed for power generation.

23. F. Marzari1, P. Tricarico1, and H, The planets Neptune and Uranus has got Trojan
orbits and the stability analysis of the same is presented in this paper by the authors .For a
large sample of Trojan orbits with short numerical integrations in the space, the diffusion
speed is measured using Frequency Map Analysis (FPA) .For different initial
inclinations, high resolution diffuse maps are derived The study of the map gave an
overview about the stability of the orbits in the Trojan clouds. Detailed analysis of the
newly discovered Neptune Trojan2001orbit was carried out by the author. It is also
opined that main stellar resonance can disturb the Trojan orbits of Uranus and Neptune
and also culminate in to many states of instabilities in the phase space.

24. 1) Ramteen Sioshansi, Ohio 2) Paul Denholm,

Here the author ties to point out the additional advantages of having concentrated solar
power panel(CSP) along with Thermal Energy Storage (TES).In his view Thermal
Energy Storage(TES) can enhance the value of the CSP by allowing more heat energy.
The value of having a TES has been well analysed as applicable to 4 regions of
Southwest AMERICA. If the PV generation system is located in a large field and if the
power generation supply from the CSP is shifted to peak price hours, TES can enhance
the value of the CSP by allowing more thermal energy in the CSP field. Unlike the PV
cells which use the technology of directly converting SUNs light in to electricity, CSP
uses the thermal energy of the solar light to produce electric power. Parabolic trough and
solar power towers are the most commonly available forms of concentrated solar power.
The power tower converts the solar light and directs it on to a heat transfer fluid which is
used to generate power by driving a turbine.
The quantum of thermal power available mainly depends on the available solar irradiance in the field. The sizing of the solar field should so designed that the energy produced should sufficient enough to meet the required power demand.

25. Chacko, R.V.; Sreekumari, B.; Fathima, K.A.; Lakaparampil, Z.V. (2000), In this paper the author highlights about the applications of solar power where high frequency devices are employed. He has also explained about the advantages for solar pumping applications in remote villages. The Maximum power point tracking and energy efficient operations are some of the other aspects which are being discussed by the author. For conventional energy sources, renewable energy sources like wind, bio-mass, solar etc. are becoming variable substrata. All the SPV operated pump sets are connected to the DC bus array and use DC motors to drive the pumps. However for running AC pumps, the voltage has to be converted in to AC first and they use AC inverter for this purpose and an ac motor. Induction motor is the most popular AC motor known for its simplicity, size and price apart from its ability to work in tough operating conditions as compared to a DC motor. Although the initial cost of the SPV appears to be more, the cost will come down soon because of the government policies in promoting green energy. The MPPT should be an integral part of the solar water pumping system for increased performance of the PV energy harvesting. The author also suggests about incorporating a inverter control for the MPPT through a software.

26. Faruk Yildiz, The author deplores about the possibility of future energy harvesting system to be used for production of electrical energy. Harvesting the energy from the environment (Ambient energy source) is called as ENERGY Harvesting or Energy Saving. The nature is an infinite source of various available sources such as Bio-mass, solar, wind, water, ocean power, tidal power, thermoelectricity, peizo electricity, etc. Including physical motions. Ambient energy sources are called power distribution methods, or power scavenging methods which may culminate in providing a complete wireless or portable system which are independent of the batteries and are self sustaining. Energy harvesting can also be done from the effects such as mechanical vibrations,
electromagnetic sources, temperature variations, lightning, heat, sound, and flow of air. In general the process of conversion of ambient energy sources available in the environment into electrical usage is called ENERGY HARVESTING. The environment can be regarded as a relatively infinite source as compared to the energy storage devices like batteries, capacitors which have limited energy storage.

27. Volker Quaschning 1), Manuel Blanco Muriel 2) 1) DLR, 2) CIEMAT,

In this paper the author explains in detail about the solar thermal power generation and solar photovoltaic technologies. The semiconductor material combination used to form a P-N junction in the PV cell is the main component in the PV cell used for generation of electricity. The impinging sun rays on the PV panel dislodges the loosely bound electrons in the outermost orbit of the semiconductor material and facilitates the free flow of electrons in the circuit resulting in electricity production. The current so produced is DC in nature. The DC power is then fed to the inverter system to get AC power. Since the size and capacity of the PV panel can be matched to the power requirement needs within a short time, it has become more popular especially in small industries and residential buildings as well.

The solar thermal power generation can be done in two ways
1) Solar parabolic Trough
2) Solar power tower plants

28. By Rajiv k verma, Ravi seethapathy, in this paper, the authors have presented a novel concept about how a renewable source (solar) connected to the grid transmission line to improve power transfer capability and transient stability. Large scale solar farm are making involved in to the modern power system by getting connected to the grid. The authors have also decided about the advantage of the solar pv system especially in reducing the green house gases and its promotion by the governments all over the world. However there are many challenges being faced by the transmission network due to the integration of renewable because of the limited transferring capability. Of course by
adopting the usage of FACT devices the power transfer for capacity of transmission line can be improved.

However in extreme cases, the cost of building of new transmission line is expensive and effort have to be made for exploring the adoption of cost effective technique to increase transmission power handling capacity. The author also explains how a PV solar form can be utilized as a STATCOM in conjunction with the fact devices under certain circumstances (day and Night) for analysis of improvement in the transmission level. An improvement in transmission is evaluated both day and night by using electromagnetic transient software.

29. Priscila Facco de Melo, Roger Gules, (2010), The author has proposed a method for improving the efficiency of the inverter for high power factor rectifier and universal input voltage. A modified vision of single ended primary inductance conductance(SEPIC) is explored to be utilized for universal base the author has conducted and experimental study and obtain the results from a 150W universal low power factor correction prototype. The theoretical and experimental values are compared with the classical boost converter.

In order to improve power factors boost converters are employed in the HPF(high power factor) rectifier, boost converters are also reduce the third harmonic distortion(THD), but in case of universal input voltage applications. The efficiency may be lowest in the low input voltage and the worst operating conditions has to be considered while designing the power converter. The author argues that the use of high gain low switch voltages topologies can improve the efficiency at low operating input voltage conditions in order to increase the static gain and reduced switching voltage a technology called voltage multiplier technique is introduced. The proposed structure can make it an interesting attractive to universal input HPF rectifier or variations of voltage applications. here explains about a modified SEPIC converter for high power factor rectifier and universal input voltage application, which will in turn help in improving efficiency of inverter.

30. Søren Bækhøj Kjær (2005), the author emphasis the need to develop low cost inverter which it should be simple in design and reliable in service, to be used in PV applications.
It is an established fact that the demand for energy is increasing all over the world and with scarcely available fossil fuels, it is difficult to fulfill the energy demands therefore, new ways of exploring the possibility of utilization of energy sources and appropriate technologies are being developed for tapping the inexhaustible source of energy i.e solar energy.

In the PV cell technology the sun light gets converted into electricity directly without movement of any mechanical parts or thermal inter link. The combination of joining PV cell into a group constitutes a PV module. A PV module consisting 72 PV cell can provide a power upto 160W with the generation of DC voltage ranging between 23 V to 45V and this generation depends on the quality and quantum of solar irradiation falling on the PV module. Since most of the electrical appliances work on AC power, the power generated from the PV module cannot be used directly owing to the fact that the power generated in the PV cell technology is Dc. Therefore the Dc power has to be fed to the inverter and the inverter converts the DC power into AC power and these is connected to the load point or grid. Hence, the inverter has the obligation of performing two tasks-

1. To suitably load the PV system so as to avoid the maximum energy and then to inject the grid or the load point with AC power.
2. The author proposes to develop new concepts for converting PV power and injecting the AC power into the grid.

31. Michael Frisch, Vincotech GmbH, Finsinger Feld (2008). The author sheds light on the emerging scenario of new generation inverters and lays more thrust for high efficiency of the PV systems. The author also explains the working of the electronic components like MOSFET and IGBT used in the switching circuit of the inverter. The MOSFET achieves at partial power because of its linear characteristic and it supports higher switching frequency. IGBT is the key component in most of the present day inverter topologies. IGBT has a non-linear characteristic. The cost and efficiency at maximum power is a key factor in evaluating the performance of the inverter. At maximum power excitation the non-linear characteristic of on-state voltage is advantageous. However at partial load conditions it is disadvantageous.
32. Mahmud Wasfi (2011), in this paper the authors dwells about the wave length spectrum of the sun light falling on the earth. It is given to understand that human beings can recognized visible lights from 400-700nm spectrum of the solar light. At this band width the amount of power received will be from $1.5w/m^2$ to $1.75w/m^2$.

The author also discusses about two methods of power generation from solar energy. The thermal power generation from solar energy is through concentrating solar power either by mirror or other type of reflectors, which is mainly hinging on the fact that the high temperature is required for power generation. The high temperature so generated is then transferred to working fluid either water? Oil. The water gets converted into steam which is potent enough to drive a turbine for generating electricity.

The author also explains about the power generation from PV system basically a PV system consists of

- Solar panel
- Batteries
- Charge controller
- Inverter
- Wiring circuit and Battery.

The impinging solar radiations excites the electrons in the conduction band in the outer most orbit of the semiconductor cell, their by facilitating flow of electrons which in turn results in electricity production.

33. Ward Bower1, Scott Kuszmaul2, Sig Gonzalez2, Abbas Akhil3,

The author in this paper explains about the advanced technologies aimed at encouraging PV power generation. The Solar Energy Grid Integration Systems mainly concerns with the developments of improved and advanced technologies for promoting more and more PV generating systems into the grid, while at the same time it trying to maintain the power quality and reliability of the utility grid. The author also explains that high quality inverter systems and efficient controlling systems are being incorporated in the PV system installed at residential and commercial installations. Hardware for smart meters is
also in place to handle the issues of net metering apart from focussing on the maintains issues involved in availing line clear by the operating staff of the utility for carrying out regular maintains works. In the light of the above emerging energy scenario and penetration of the PV system into the grid deserves further investigations aimed at obtaining the tangible solutions.

34. Yunjie Gu, Wuhua Li, Yi Zhao, Bo Yang, Chushan Li, Xiangning He, Fellow, Providing a virtual DC bus for transformer less solar PV inverter system is discussed by the author in this paper. The virtual DC bus concept is a possibility for eliminating common mode leakage current in the inverter system. In the proposed arrangement the negative pole of this DC bus is connected to the grid neutral. By eliminating the stray capacitances between the ground and PV panel, the ground leakage current is completely suppressed the author suggests that for increasing the efficiency and reducing the cost and size, removal of the isolation transformer is a way out.

35. Minas Patsalides1, Demetres Evagorou1, George Makrides1, Zenon Achillides1, George E. Georghiou1, Andreas Stavrou2, Venizelos Efthimiou2, Bastian Zinsser3, Wolfgang Schmitt3 and Jürgen H. Werner3. With the deep penetration of the solar PV system into the utility grid, major issues like power quality and reliabilities are to be examined and this is what the author wants to discuss in this paper. PV electric generation system is becoming increasingly popular because of its least polluting character. Also the governments in many counties are promoting PV generated systems to tied over the power crises and as well as environmental problems because of the high cost of purchasing the fossil fuels for power generation and emissions reaching alarming levels of pollutions. However the problems of efficiency cost and reliability on the renewable power systems is yet to get the acceptance of the consumers. PV generation is resorted to avail electricity in stand alone systems and is also used to produce cheaper electricity by the consumers - producers for power trading purposes also. The changes in the solar irradiance have a toll on the quality of the generated power in the solar PV system. The main draw back in availing the renewable energy is that it is entirely controlled by the nature and man has to
utilize it only when it is available and it cannot be stored. The author has considered fourteen grid connected PV system analyzing the power quality and quantity of power produced at different intervals of time, due to variations in the solar irradiance. Environmental conditions and design of the PV system module greatly influences the performance of the PV cell and these in turn can affect the efficiency and power quality of the entire system. The other parameters that affect the power quality of the PV cell are fluctuations in the solar irradiance, ambient temperature and choice of proper semiconductor device.

36. Ravi Tejwani, Chetan S Solanki, in this paper the author focuses on the importance of keeping the solar PV panels clean. The power generation capacity of a PV panel can result in as much as 50% reduction of the output, if the PV panel surfaces are not kept clean and free from dust the accumulation of the dust on the PV panel surface is more in case of tropical countries like India, where the PV panels are generally kept in the dusty environment.

A sun tracking cum cleaning device has been developed in order to regularly clean the surface of the panel automatically. The cleaning automated mechanism is implemented using a microcontroller 8051. The author stresses future need for regular cleaning of the PV panels for better performance and long life in tropical countries by means of regular cleaning of PV panel surfaces.

37. Abusaleh M. Imtiaz and Faisal H. Khan, In this paper the author explains about the converter unit components and its role in the PV system. Discrete components are used for the manufacturers of converters and its associated components and hence mass production of converters is difficult. Also a considerable labour cost has to be incurred for connecting the PV panels, inverters and the grid, adding extra cost.

The author insists for a paradigm shift in the design of the entire PV power system to reach the goal of 1$/W. The active and passive elements of a converter unit greatly affect the reliability. Power converter units are inevitable, indispensable, in any renewable energy harnessing systems. The switching components in the unit are constantly vulnerable for failures because of varied load conditions, over voltages and supply
fluctuations. Thus power converters are the weakest link in the PV system as compared to the PV panel which has a comparatively long life.

38. Behnam Tamimi, Claudio Cañizares, Fellow, and Kankar Bhattacharya, (2012),

The author here explains about the system stability impact of Large-scale and Distributed Solar Photovoltaic Generation, by conducting a case study in Ontario Canada.

A comparative method of solar PV effect on system stability at different penetration levels has been made by the author. There are three different scenarios with their relevant dynamic models are considered, namely, distributed units, and centralized farms with and without voltage regulation capabilities. Based on these models, the impact is examined through Eigen value, voltage stability and transient stability analysis using real network data. This impact is quantized in monetary terms based on the Long Run Marginal Cost of electricity production in Ontario. It is demonstrated that distributed solar PV generators are significantly more advantageous, from the stability point of view, than solar farms.

The author also explains about the impact of SPVG penetration level on the stability of Ontario power system was assessed. Ontario’s system data was used in these for analyzing the interaction among the SPVG and a real system. Three scenarios with their relevant grid-side dynamic models for the SPVG were considered; these non-proprietary models can be used to represent centralized farms, with and without voltage control, and distributed rooftop installations.

The dynamic behavior of the system including SPVG installations was examined for different penetration levels, by means of small-signal stability, voltage stability and time-domain contingency analysis. Eigen value analysis showed Changes in the active power generation from a PV installation are inevitable because of the variation in the solar irradiation, which in turn, depends on weather conditions. However, the total solar generation at its maximum penetration level makes around 6% of the system power generation in the presented study. Therefore, the variations would not be
expected to cause a drastic change in the results, given that the study uses a data set pertaining to a summer day and hence clouding effects should be minimum. Moreover, the land area required for the panels distribution and installation is consider- ably large, resulting in a natural averaging effect which filters possible sharp changes, thus minimizing temporary clouding effects.

39. David Brunelli, Clemens Moser, Lothar Thiele (2009), the author propose an integrated scavenging PV system for low power application and environmental embedded system. The modern embedded system and the mobile devices have limited battery life time and this in turn necessitates frequent recharging of batteries or replacements. The value of the embedded system and personal devices get increased by the use of solar energy and small size PV system can act as a good solution. To meet the needs of low power applications a battery less circuit having solar harvesting is proposed in this paper the use Maximum power point tracking (MPPT) for energy harvesting results reduced size of the PV module. The configuration of the circuit is analyzed using simulation techniques and extensive testing. Greater thrust is given to identifying the losses occurred in the different circuit elements of the switching components.

40. H.O Nijoku and O.V.Ekechukwu,(2011),

There are many applications of solar energy catering to varied demands of the society which are cost effective and culminate in efficient effective are cost effective use of solar thermal power which are usually required for low temperature applications. Some of the popular applications are Arresters, crop drivers, solar cookers, solar skills / solar ponds etc. However, lot of research is still going on about incorporating these appliances with some more design modifications so as to explore for higher efficient performances. Shallow solar pond (distinct from the non-convective salt grandest solar ponds which are of considerable depths), is a type of “collection-cum-storage” water heater. The conventional type solar ponds attain temperatures ranging up to (<100°C). however, theoretical propagation with some changes in the configuration are done by the author to buttress their point that reverse absorber type shallow solar power performance with higher efficiencies and low loss heat co efficient as compared to conventional sallow
solar ponds. The effect of the pond depth on the proportion of the radiations incident on the RASSP that collected either as thermal energy or lost has also been studied.

The theoretical thermal analysis and simulation of the performance of two configurations of reverse absorber shallow solar pond one with top insulated other with top exported are presented in the equation are solved to obtain desired performance parameter simulation studies are carried out and graphical description are made in the proposed research work by using EESP software.

The ssp is in the form of a tray of shallow depth blackened in the inside, with the sides and bottom insulated and covered at the top with a glazing. The tray is filled to the brim with water to be heated to prevent evaporate cooling. SSPs are useful for production quantities of hot water of temperature $< 100^0$C because of the huge converter radiation top. By the results obtained and analyzed, it has proved that RASSP would be the most efficient and also have the least overall heat loss coefficient, while the highest temperature would be generated at RASSP. However both configuration i.e. RASSP and perform better than CSSP.

41. A.k kamble, m.deshmukh and s.r gadge (2011), The abundant availability of solar energy for most part of the year in tropical countries like INDIA are drawing more attention towards utilizing their freely available, non-pollution energy source in many possible ways for required application. Solar drying is one such process which is mainly employed in farm produces. The advancement of appropriate technologies has contributed not only in the quality of the finished product of the farm produce, but also in terms of fatness and investment recovery as well.

The authors conducted a case study on drying of goose berry candy in AKOLA district of Maharashtra state where high temperature solar radiation is abundantly available. The main objective was to study the conventional method of goose berry candy preparation, drying methods, equipment used and identification of the drying methods for improvement in drying methods in small scale industries have been successfully carried out to show that solar drying can result in value addition to their produce, apart from enhanced quality and saving in terms of moving with has utilization of energy.
Small scale industries involved in the goose berry candy production were studied at random and experiments were done by employing the portable drier with shade drying, without shade drying and conventional methods of drying under the parameter specifying number of days. Number hours of sunlight radiation explore, temperature of the trays at bottom, middle and top, moisture reliability, weight loss were tabulated and analysis done to arrive at the conclusion.

Procedure for goose berry candy making was studied and process flow chart was developed. In the conventional method the processed candy was dried in shade using M.S racks with polymath, over sun drier and open shade drying. Similarly portable drier was employed for drying with shade and without shade. The number of trays was loaded equally with goose berry and the weight was checked at 9 A.M and 16.00 hrs daily between March to April 2007 samples were taken and the initial and final moisture contents were determined using standard oven drying method. The loss in weight was recorded at every 2 hrs.

The solar radiation was tabulated. It was found that thermal efficiency of the drier with PVC green sheet on the first day was bit higher and gradually decreased as compared to without drying. Flavor of goose berry was faced to be superior in portable shade drying than without shading. The color of portable shade dried candy was little red and was attractive as compared to conventional drying. The economic analysis of the system was carried and proved that it is profitable to go for portable solar drier. From the findings it is clearly established that farm solar drier is a simple, convient and efficient at low cost for drying agricultural products, resulting in efficient usage of solar power and savings in time.

42. R.aliev, m.a alivazarova, r.b.ikramov and o.t ibmanova (2011), many studies and researched are being carried out regarding improving the performance of the solar cell and their importance because the efficiency of solar cells is only about up to 2.2% only. Therefore the various parameters which may affect the performance of the solar cells has to be carefully evaluated for proper arrival of the studies being carried out by the researchers. The solar cell efficiency is determined not only by high values of photocurrent and photo voltage, but also by the quality of current-voltage performance.
This is characterized by the fill factor. And maximal power. An investigative analysis has been carried out in this paper as to how the main photo electric parameter influence solar cell temperature performance particular emphasis is laid on the fill factor’s role on the current voltage performance.

An experimental and calculated relationship between the no load voltage, the fill factor of solar current-voltage performance and the temperature are compared by referring the relevant equations and respective graphs are plotted the relationship of fill factor is given by

\[
F_f = \frac{P_{eff}}{P_{max}} = \frac{I_{eff} V_{eff}}{J_{sc} U_{no\ load}}
\]

Where,
- \( I_{eff} \): efficient current
- \( V_{eff} \): efficient voltage
- \( J_{sc} \): short circuit current
- \( U_{no\ load} \): No load voltage
After transformation of the equation with the equivalent experience it is shown that the non-ideality co-efficient of the solar cell current-voltage performance practically independent on temperature in the temperature range of 100<T<500k. Usually the main equation for solar cell current-voltage performance is used to determine the no load voltage and non-ideality co-efficient. It is assumed that the photo galvanic performance of the solar cell should be independent of non-ideality co-efficient of the current-voltage performance. The non-ideality co-efficient and the electric current that passes through the diode structure. The experiment and numerical results are compared to show that no load voltage is independent of the non-ideality co-efficient of solar cell current-voltage performance under T>115k. The solar cell made of the crystalline silicon is under T<112 and T>550k.