Implementation and Development of Enhanced Photovoltaic Solar Panel

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ABSTRACT

The Solar Energy recovery has started to occur all over the globe on the energy market because of the cleanness of electricity generation. The commercial usage of solar energy is unfortunately, at extremely small scale because of its high pricing and low efficiency in comparison to other resources. With this report there is the presentation of the literary review of the implementation and development of enhanced photo voltaic solar panels. The major element is the prosperity of the product is dependent on its material and development procedure. It is also dependent on the way in which product idea is generated till it reaches the final development of the panel. There is lot of research put up on to the materials of solar cells in a way that there can be enhancement in the efficiency however very less efforts are put up on product development procedure of the panels and to improve these procedures. This report evaluates the efficiency of solar cells based on reports collected from different professional resources on the internet and peer reviewed articles.

Keyword – *Photovoltaic cell, Solar Panel*

1. INTRODUCTION

The photovoltaic (PV) solar energy is likely to play a major role in the future global sustainable energy system. In the past decade, it has shown great developments regarding the scale of deployment, decrease of cost and improvement in performance (Magalhães, 2018). The PV conversion is carried out with wide set of materials, technologies and device architectures at highly different levels of economic and technical maturity. Photovoltaic is the area of technology and research linked with devices which lead to direct conversion of sunlight into electricity. The solar cell is the basic building block of photovoltaic technology. The solar cells are built up of semiconductor materials like silicon (Gholampour, Ameri and Sheykh Samani, 2014). One of the attributes of semiconductors is the conductivity which means that it can be easily changed by introduction of impurities in the crystal lattice therefore these semiconductors become highly effective. Solar power frameworks are viewed as a vital device in the energy supply for the current and people in the future. A few variables have advanced the improvement of photovoltaics like ecological concerns, motivators and taxation allowances, a really performing and more affordable innovation and the need to supplant carbon fossil energy frameworks with renewables to guarantee consistence with the goals put forth by the Paris treaty by limiting a global warming to 1.5 ° C (Trace Software, 2020). A solar cell or photovoltaic cell is a gadget that believers the daylight into working energy. The measure of daylight that can be changed over into power is alluded to as solar cell proficiency (Huang and Zhao, 2017). There are a few factors that ought to be mulled over to ensure the ideal effectiveness of the solar panels. Solar PV panels are exceptionally sensitive to solar shadings. Aggregate or half-done shading conditions have a critical effect rate on the ability of delivery of energy and may bring about lower yield and loss of power. Cells in a solar panel are generally associated in arrangement to get a more of voltage and in this manner a proper creation of electric power. Yet, when shading happens, this construction presents a few constraints. Indeed, when a solitary solar cell is shaded, the current of the multitude of units in the string is controlled by the unit that creates the least of current. At the point when a cell has shading, the entire arrangement is practically shaded as well (Ranalli and Starling, 2018). To forestall the deficiency of energy, the establishment typically incorporates bypass diodes. Bypass diodes have wiring in corresponding to the solar cells. At the point when a solar cell has shading, the bypass diode gives a current way that permits the line of

associated solar cells to create energy at a diminished voltage. 1.2 Structure of PV cells Like, while fabricating a photovoltaic solar cell, the silicon is used for increasing the conductivity as it has got 4 valence electrons (Rau, Abou-Ras and Kirchartz, 2011). On one side of the cell there is creation of excessive negative charge carriers while on the other side there is creation of higher affinity than silicon for attracting electrons. As the p-type silicon has intimate connection with the n-type silicon and the p–n junction is setup along with diffusion of electrons from the area of high electron concentration in the area of low electron concentration therefore with the diffusion of the electrons across the P-n Junction there is recombination with holes on the p-type side. But the diffusion of carriers does not take place indefinitely due to the imbalance of the charge instantly on either sides of the junction which come off as electric field (Beşer, 2018). With electric field there is formation of a diode and the current is promoted to flow in just one direction. The ohmic metal semiconductor contacts are created to the p-type and n-type sides of the solar cell so the electrodes are ready to be linked with the external load.

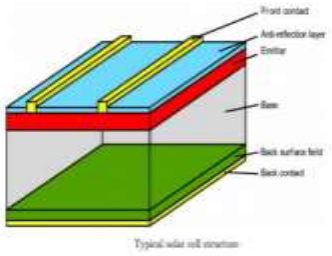

Fig 1: Typical solar cell structure (Source: Goetzberger and Hoffmann, (2010))

With the photons of light falling on the cell there is transfer of energy to the charge carriers. The photo generated positive charge carriers get separated from the negative counterpart by the electric field, also known as the junction. So this leads to extraction of the electric current with the closure of the circuit on an external load. There are different kinds of solar cells yet over 90% of these cells have water based silicon cells. These are either cut from one crystal rod or from any block made up of different crystals and are correspondingly known as mono-crystalline silicon solar cells. The water based silicon solar cells are around 200 ùm thick (Syafaruddin, Latief and Piarah, 2017). One more significant categorization of solar cells is on the basis of thin films which are around 1-2m thick and these need quite less active semiconducting material. These thin filmed solar cells can be created at less cost in large quantities therefore there will be expectation of enhancement of their market share in the future. Yet they have lower efficiencies in comparison to the water based silicon solar sales. This means that for similar kind of performance they would need higher exposure surface and more material to be installed. When different solar cells are electrically attached with one another and mounted in a sole-support structure or a frame, then this frame is termed as a photovoltaic module. Such modulus is created for supplying electricity at a particular voltage like usually it is a 12 volt system (Konishi and Takahashi, 2017). The generated current has direct dependence on the intensity of light that reaches the module.

Various models can be wired together for formation of an array. There is direct current electricity generated by the photovoltaic module ease and arrays. They can be attached in both parallel and series of electrical setups for production of the needed voltage and current. There are two major kinds of photovoltaic systems. The grid-connected systems are attached with the grid and there is injection of electricity in the grid (Lokhat, 2012). Therefore, the direct current generated by solar module is transformed into grid compatible alternating current. Over 90% of the photovoltaic systems all over the world are presently applied as grid-connected systems (Michel and Paredes, 2013). The functioning of the system and the grid is also monitored by the power conditioning unit. This unit can also switch off the system in case of faults. 1.3 Research Aim and objectives The aim of the research is to bring a comprehensive review on solar photovoltaic systems as per their development and use in the present and upcoming scenario. The study will differentiate between the grid connected and off grid SPV power plants and therefore their performance will be analyzed. The objectives of the paper are:

• To reflect the recent advances in the solar PV systems.

• To reflect upon the emerging applications and to identify the thrust aspect of research in the Photovoltaic technology in present scenario.

An Overview This research paper will present an indication of the performances of solar PV projects and a brief procedural way to implement the standard solar PV projects. Thorough study of performances of existing systems will also be taken and the restraining factors linked to particular suggestions for improvement. There will be investigation of different designs and evaluation methods for individual PV power systems. The evaluation will be carried out in terms of technical and economic criteria. It will analyse if Solar PV projects are worth their

investments. This paper would provide analysis which would be useful for the solar PV system producers, academicians, researchers and decision maker.

2. LITERATURE

2.1 Introduction

The attractiveness of utilising solar energy lies in the actuality that it is quite a few times higher than the volume of global energy consumption, its affordability is relatively simple, and it is environmentally friendly to use. With the photovoltaic there is transformation of solar energy directly and constantly into electricity and these are stored in batteries for usage at any time. The photovoltaics are the best realised approach for generation of electric power by use of solar cells so that energy can be converted from the sun in the form of electrons (Son, Lee and Kim, 2016). The photovoltaic effect is the photons of light which accept electrons in higher state of energy therefore these act as charge carriers for an electric current.

2.2 Background of a solar PV

The solar energy is attractive to be used because it has affordability and it is somewhat simple with environmentally friendly usage (Şentürk and Eke, 2015). There has been constant growth in use of the renewable energy in solar energy for useful applications. Particularly this usage has been observed after the oil crisis in the late 1970s. This had brought in the need for the scientist and policy makers all over the world to find out the diverse approaches of harnessing solar energy in highly effective and efficient manner. In the terrestrial areas solar energy can be utilised in two different ways – One, by the solar thermal usage by use of solar collectors, dryers or heaters and other would be solar electricity by use of solar photovoltaic (Novoa, Miller and Dauskardt, 2015). The photovoltaic type is direct converting of sunlight into electricity with no use of interface. The designs of solar PV systems are simple and rugged with modular form therefore there is need of very less maintenance. Such design also helps in generating the power from microwatts to megawatts standing alone. This standalone behaviour of PV system has brought highly significant improvement in the electrification of rural areas in the developing nations. A solar PV module and charge controller along with the battery as per need is adequate to electrify the rural home and it is termed as solar home lighting system (WANG, 2018). This enhances the need for solar PV for different kinds of applications. Each solar cell can be combined for forming a module which is commonly termed as solar panels. With usual single junction silicon solar cell, there can be production of maximum open circuit voltage of around 0.5 up to 0.6 volts (Johnston, 2010). Even though, this is not huge still the solar cells are tiny and these can be combined into large solar panels therefore these panels can lead to generation of considerable amount of renewable energy.

2.3 Construction of solar cell

Solar cell is mainly a junction diode and its construction is somewhat non similar to conventional p – n junction diodes. There is extremely thin layer of p-type semiconductor which is grown on somewhat thicker n-type of semiconductor (Kande, MM and SG, 2016). After this there is application of a few finer electrodes over the P type semiconductor layer. With these electrodes, there is no obstruction of light to reach the thin p-type layer. Just under the p-type layer there is a pn Junction. There is also a provision of a current gathering electrode at the bottom of the n-type layer and the whole assembly is encapsulated by thin glass for protecting the solar cell from any kind of mechanical shock.

2.4 Working standard of Solar Cell

As the light arrives at the P - n Junction, the light photons can simply get into the junction by an extremely thin P type of layer. The light energy is there in the form of photons and it provides with adequate energy to the junction for creating numerous electron-hole pairs. Thermal equilibrium condition of the junction is broken by the incident light (Roesch et al., 2013). The free electrons in the depleting area are fast to approach the n-type side of the junction. In this same way the holes in depletion can fast come to the p-type side of the junction. As the newly generated free electrons reach the n-type side then there is no additional capability of crossing the junction due to barrier potential of the junction. As again the newly generated holes reach the p-type side then there can be no further crossing of the junction. Since the concentration of electrons is more on one side that is the n-type side of the junction and then it shifts to be higher on the P side therefore the p – n junction acts like a tiny battery cell. There is setting up of a voltage which is termed as photo voltage. In case there is a small load connected across the junction

then there will be small current which flows through it. 2.5 The materials utilised in SPV cell The materials utilised for this purpose should have a band gap close to 1.5 EV and the usual materials utilised are silicon, GaAs, $CuInSe^2$, and CdTe. For these materials to be utilised in the solar cell there should be a band gap from 1 ev to 1.8 ev. Also, there should be high optical absorption with high electrical conductivity. These raw materials have to be available in abundance and the cost should be low as well. The majority of commercially available solar panel has got the capacity of generating electricity for at least two decades. The usual warranty provided by the manufacturers of the panel is over 90% of the rated output for the initial decade and more than 80% for the subsequent decade. The panels are likely to be in function for 30 to 35 years (Kim et al., 2014). The major steps for commercialization of photovoltaic cells started in 1940s and the beginning of 1950 when the Czochralski procedure was created to produce highly pure crystalline Silicon. The scientists at Bell Laboratories were dependent on this process in 1954 for developing crystalline Silicon photovoltaic cell with an efficiency of 6%. As the solar cells are semiconductor devices therefore there is somewhat similar kind of manufacturing and processing method like other semiconductor devices such as memory chips and computer. But the stringent needs for quality control and cleanliness of semiconductor manufacturing are highly relaxed for the solar cells. Presently, a lot of large scale commercial solar cell manufacturers generate screen-printed polycrystalline or single crystalline Silicon solar cells. These polycrystalline Silicon Wafers are created of wire-sawing flock cast silicon transformed into extremely thin Wafers or slices. These are generally slightly p-type doped. For conversion of vapour into solar cell there is surface diffusion of N type dopants carried out on the front side of the wafer. This way a p – n junction is created a few hundred nanometres underneath the surface. After this, there is application of anti-reflection coating for enhancing the level of light attached to the solar cell. There is gradual replacement of titanium dioxide by the silicon nitride has the anti reflection coating due to its supreme surface passivation attributes. By this there is prevention of career recombining at the surface of solar cell. It is usually implemented in a layer which is many hundred mm thick (HASAN and SASAKI, 2013). This is done by use of plasma-enhanced chemical vapour deposition. A few of the solar cells have textured front surfaces which also act as the anti reflection coating for enhancing the amount of light linked with the cell. This type of surfaces can normally be created on single crystal silicon only even if in the past years the approaches to form them on multi crystalline Silicon has been created. After this, the vapour has complete area metal contact created on the backside and a great the light metal contact on the fine side or front surface by use of silver paste. The rear contact is also created by screen printing a metal paste which is generally aluminium. Generally this contact has coverage of the whole rear side of the cell even if in a few cell designs there is printing on a grid pattern. After this, the paste is fired at various hundred degrees Celsius to create metal electrodes in ohmic contact with the Silicon (Kumar and Raghuwanshi, 2019). A few of the organisations make use of extra electroplating for enhancing the efficiency of the cell. Once there is creation of metal contacts then the solar cells are linked in series by the flat wires or by metal ribbons and there is assembly in solar panels (Hurley, 2012). These panels have a sheet of tempered glass in the front and the back has got a polymer encapsulation. These high efficiency solar cells can help in decreasing the cost of solar energy. However, the solar power plants usually have cost to be proportional to the area of plant. When there is a high efficiency cell then it can lead to reduction of area and cost of plant even if the cell itself is very expensive. The cost of a solar cell is provided in terms of per unit of peak electrical power. The cost to manufacture would usually involve the cost of energy needed for manufacturing. The 16 specific feed-in tariffs are different all over the world and also for each state in different countries. This kind of feed in tariff can be extremely useful to encourage the development of solar power projects.

3. METHODOLOGY

3.1 Introduction This chapter is created for describing and providing justification for the selected methodology in the research. The explanation of the methodology is highly important as it provides understanding of the research process and its relation with the topic understudy. The choice of research methodology has been made on the basis of the research onion given by Saunders et al in 2016. So, in this chapter is research onion is utilized wherein the reflection is provided from moving from outer layer towards inner layer. The ethical issues are also provided for the research along with limitations and summary of the study. With outermost layer of the onion, there is use of research philosophy that is based on the four areas which are positivism, realism, interpretivism and pragmatism.

This paper aims to show the procedure of carrying out a secondary analysis of primary qualitative datasets. Even as there is a deep-rooted custom of performing a secondary analysis of quantitative datasets in social and health study, this has not been the instance of qualitative datasets. In spite of a recent development interest in the secondary analysis of qualitative data, extremely little information is available with respect to the procedure, as publications have a tendency to lay stress on the results of study.

3.2 Research philosophy

There is interpretivism philosophy applied in this study to make an assessment of the construction and creation of PV cells. There has been use of analysis to understand different kinds of solar PV cells with the perspective of the researcher before drawings of perspective of others. With this there is inclusion of different factors which might have impacted the perspectives of others. The interpretivism offers perspective of diverse opinions due to social aspects which could helpful in understanding the realities of Solar PV cells (Chowdhury, 2014).

3.3 Research approach

There are 3 kinds of research approaches, like abduction, induction and deduction. The induction method has been applied in a systematic way of analyzing qualitative data and there are chances of guidance to be achieved from specific evaluation. Thus the reasoning is transforming from specific evaluation to generality.

3.4 Research strategy

In this case, the secondary analysis of the past data sets is taken to present with outline of the original study and applying data collection and analytical procedures. Since there is a need for transparency for the secondary analysis therefore this thesis includes the details of methodological and ethical considerations for producing knowledge (Danieli and Woodhams, 2015). This is with reference to repairing the secondary assessment that is a fit between the primary datasets and the secondary research questions which have been mentioned in the first chapter. The choice of the secondary research is made on the basis of sufficient proximity between the questions of the primary researches which have been taken as the base however in those cases the collected data and analytical techniques are just like those that will be used in the secondary analysis. By profession of different types of solar PV cells there can be comparison made amongst the existing kinds and usually it is kind of analysis is exploratory, descriptive and explanatory in nature. This has been done by the systematic literature review of the secondary sources so that the particular topic is researched by synthesizing the scholarly material. There would be unbiased reproducible method to analyze different research papers and articles by a systematic procedure carried out for the purpose of study. This means that this research will exhaustive summary related with the Solar PV cells on the basis of available literature.

3.5 Research Selection

There has been a choice of using secondary analysis to address the sensitive area of the research and also to access the research population to which it is not possible to perform primary research as there are different factors acting as barriers. The secondary in this case the secondary analysis of the qualitative data is utilized from the existing data to find responses to the research questions that are different from the questions asked in the original research. Since the aim of this research is to come up with a comprehensive review on the solar photovoltaic systems for the recent advancements and the emerging applications in the present and future scenarios therefore there will be use of the relevant keywords for finding out the existing researches like photovoltaic solar panel, PV cells, and solar PV systems. In this research there will be evaluation of the performance of off grid and grid-linked SPV power plant as well. The secondary analysis is usually carried out with quantitative search wherein the quantitative datasets are used like in case of policy assessment, quantitative social research and the business decision making of lots of organizations. Still reuse of archived data sets as well as secondary assessment has got lot of interest and momentum because of the understanding by few researches that lots of qualitative data sets provide with narratives which help in discussing the problems linked with the primary research questions (AlDahdouh, 2018). There will be use of the secondary analysis which is a different approach looking for critical assessment of the methods theories and findings from the existing qualitative research so that there can be generation and synthesis of meanings from various studies.

3.6 Time Horizon

The time horizontal help in plan of the process and laying down the timelines for data collection from the literature reviews for the analysis of past research papers will be performed to carry out the study.

3.7 Research method

There is use of qualitative study to enquire about the Solar PV cells. The research has been applied due to the using secondary data to be evaluated for the research questions. There will be inclusive of the research material taken from the past research papers, journals, articles and web Publications.

3.8 Ethical considerations

Whenever there is secondary research performed then it is important that the proper kind referencing is performed from the past research. This will also help in making sure that there is integral kind of research and the data taken is not having any kind of errors. The research has to be compliant with the ethical norms so even if there are no participants included in this study is still the ethical norms are highly significant to provide with the full details of the material used for the research (Çelik, Baykal and Memur, 2020). Limitations In this case the limitation would include no involvement of the respondents. The research has been organised with the study of different kinds of PV cells so that there is complete knowledge regarding the collected data. Even if there are these limitations to the research still this paper is important and it has got the suitable approach because there has been use of past research papers on the given relevant keywords.

3.9 Summary

In this chapter there is understanding of the methodology used for the research and strategy used along with the research philosophy. The research design as seen explain with the use of secondary data and in-depth analysis of the given topic of PV solar cells. To make sure that there is no subjectivity for analysing the data there has been application of various resources and those have also been referenced appropriately

4. RESULTS AND DISCUSSIONS

4.1 Introduction

The photovoltaic industry has been expanding highly because of the support by the governments and installing of grid connected plants as well as residential rooftop program all over the world find the private,public and governments all over the globe are encouraging the use of solar energy based power plants so that there is an investment in the amount of renewable energy based electricity generation for real life use (Dufour, 2012). This would lead to sustainable development and even the environmental aspect would be given a preference. A lot of nations are offering incentives for the solar applications and renewable energy based generation of energy so that there is reduction in any kind of work done on the environment.

4.2 Analysis

In the recent past there have been lots of installations of key projects and still many more are in the pipeline. As per the performance study of the grid connected photovoltaics systems of the 200 kW at Jean University was carried out by Drif et al in 2017. In that study the key objective was integration of a medium scale Photovoltaic plant in the University Campus to carry out the research and development and assessment of the performance. The entire capacity of the photovoltaic system was approximately 8% of the complete demand for electricity in the university. There was study of system 1 and system 3 and their comparison was made with the system to and system 4. System 1 and system 3 had the power of 70 kilowatt and 20 respectively while system 2 and system 4 had power of 70 kilowatt and 40 respectively. Once there was data assessment it was observed that the average yearly energy generation registered was approximately 168 MwH on annual basis that is approximately 6.45 % of the entire power used by the University. Similarly when there was a study carried out by Congedoet al (2013), the study reflected the assessment of performance of mono crystalline silicon PV module was set up in the South eastern Italy with complete capacity of 960 kwp in two sections. There was evaluation of energy and power created, performance ratio, photo voltaic system efficiency, final lead and cell temperature losses in two diverse angles. This study reflected that the PV system efficiency is varying amongst the maximum value of around 17%. In the spring season and it was released in summer with around 15%. The performance ratio teaches the utmost level of 86.5% in March with the least level of 79% Fortune. Even with the analysis it is observed that this study had the cell temperature loss recorded to absolute minimum of 3.45 per cent in October and absolute greatest to 8% in the month of June. As per the outcomes of this study it was observed that the system has worked great amounts of performance which is generally around 80% and sometimes even more. It was also observed that the values of reference yield and finally yield to be more than the average evaluated values in different PV systems. In the study by Kamalakar (2017), there was monitoring of a small grid linked PV system which has got 20 dual junction thin film amorphous Silicon PV module for each of these models was of 1 kilowatt and the manufacturing was done by BP solar. These models were laid on the rooftop of the constructed site at Warsaw, Poland for the 12 months period. There was monitoring of various parameters like AC power, DC and AC currents, DC and ac voltages, completed AC energy provided to the grid, every day's AC energy production, irradiance on the PV array, a utility grid impedance, ambient temperature, and solar irradiance on horizontal plane, wind velocity and PV module temperature (Ritter, 2015). Even there was floating of the data on the graph to compare the output power for solar irradiance and it was seen that there is linear

and hands mint in the power output with the changes in irradiance. Moreover the PV module spur found to be efficient who is the level of 4-5 per cent whereas it was seen to be somewhat more in case of the standard test conditions which is an obvious instance in the majority of uses of experimental gadgets. Moreover the energy generated was approximately 830 kwh in the initial fear of operating which is somewhat more than the simulated outcomes of the given installed PV system. The decrease in efficiency might be because of some usual causes like temperature of the module, deposition of dust particle on PV module and low irradiation level. With one more study carried out on the energy generation in France in the year 2010, by Leloux, Narvarte and Trebosc, (2012), it was observed that 78% of the installed PV systems are created of the Classic crystalline Silicon while 2% are made up of amorphous silicon 17% are made from heterojunction with intrinsic thin layer (HIT), and 2% each are made from CIS and CDTE whereas the complete set of energy generation was approximately 1163 kWh/kWp. It was given that only the energy created by a common PV system in France is approximately 15% less than the energy generated by extremely high quality PV system in the set of residential buildings in Belgium. Moreover the real power of PV module was approximately 4.9 % less than the corresponding nominal power provided on the usual data sheet of manufacturers. Moreover the PV systems, that have HIT modules, show the higher performance than the normal value whereas the systems which have got copper indium selenide (CIS), will give approximately 16 % lower the real power then the normal values.. The study carried out by Sastry et al (2010), included the performance study and the eminence of monocrystalline PV module which head got exposure to the external around meant for approximately 1 decade constantly and normal location in the Northern region of India. There was test for over 35 diverse kinds of PV module with supply from over 11 manufacturers and the photographic view of the external test where the Solar Energy centre was taken. This view is reflected in the below image:

Fig 11: Solar Energy centre (Source: Chimtavee et al, (2011))

From these 35 models the 30 had been set up outdoor whereas 4 modules stored as pair and one was utilised as the reference module. Generally the voltages current as well as power output from PVR the factors that have been considered in this case just like other project and there was grouping of all the PV module in particular category. On the basis of the assessment it was seen that after one decade of constant use the power output from one and two was degraded by 10% whereas for the third and fourth there was lower output by 28 % on average. There was an analysis done by Chimtavee et al. (2011) which led to evaluation of the performance of 10 kwp PV system for the isolated building of Thailand and it was done for around 6 months.

The PV system was set up for an arrangement with three diverse kinds of PV module which had got amorphous thin film of 2880 W respectively and it made a full peak power off 1015 to kilowatt. Once the system was evaluated for six months consistently it was observed that the elements and system were effective and there was generation of around 7852 KwH energy with usual daily generation of 43.6 KwH. There was evaluation of the average efficiency for the whole PV panel system,hybrid solar cell panel, polycrystalline panel and amorphous thin film panel which resulted in 8.82%, 13.78%, 10.48% and 6.26 % of average efficiency respectively. There was a performance study carried out for 120 kwp PV system by use of polycrystalline kind of PV module setup at SRET, Naresuan University in Thailand by Rajagukguk and Aritonang, et al (2020). With this study the voltage, power, current, module temperature and records for irradiation were tract from November 2008 up till October 2009 with the outputs given in the below image with respect to the outcomes for efficiency and energy output:

4.3 Analysing the kinds of cells

With an analysis it can be observed that mono crystalline or single crystal solar PV panels are one of the highly reliable oldest and most effective approaches to generate electricity from the solar energy (Ma, Zheng and Zhang, 2014). In this case there is fabrication of every PV module from solitary silicon crystal. There is purification and melting of the silicon which is followed by crystallizing into ingots, which are segregated into thin wafers to generate individual cells. The usual colour of mono crystalline PV is sparkling blue and black. The mono crystalline

solar panels have major advantages in terms of longevity, higher heat resistance, low cost of installation, high electricity, space efficiency, and embodied energy (Ritter, 2015). Since there is fabrication from the highest grade silicon so it becomes highly cost effective in the long run. Even if there are so many benefits still the huge initial expenses and fragility are the key drawbacks of this kind of panel. There is use of Czo chlarski procedure for producing mono crystalline Silicon which includes huge amount of wastage of silicon as well (Chaibi et al., 2019). This kind of solar panels are utilised for large scale applications like residential and commercial solar installing and even for small scale applications like charging of digital cameras on mobile phones or laptop. The polycrystalline for the multi crystalline panels make use of solar cells which are created from multifaceted Silicon crystals. This kind of polycrystalline cell does not have uniformity like the mono crystalline solar cells (Couto and Estanqueiro, 2020). There is a surface which has random patterns of physical borders and not solid colour of the solitary crystal cells. As there is application of low-cost silicon for fabrication of polycrystalline cells therefore the effectiveness is within the range of 12% and 14% which is somewhat lower than the mono crystalline cells yet it is superior to the solar technologies like thin film. The multi crystalline solar panels can be advantages because there is simplicity in procedure of producing and the silicon wastage and there is somewhat lower level of heat tolerance, in comparison to the single crystal panels. There is higher temperature coefficient so there can be decrease in the panel output with the rising temperature yet these are minimum variations. The type of materials is usually applied on the earth and there is a huge range of power ratings that is from 5 watt still 250 watt or even further therefore it can be utilised in the commercial and residential installations (Wolfe and Mensah, 2012). HIT solar cell has been researched because of low process temperature then the crystalline Silicon solar cells and due to higher efficiency. There is usage of thin transit amorphous Silicon layers which acts as surface passivation along with a buffer layer on the top as well as bottom. This purple layer is made up of crystalline Silicon wafer of n-type. With the positive kind of N-type layer, which is extremely doped, there is provision of back surface field whereas with the thin p-type of aSi layer, there is setup of an emitter. There is inclusion of the amorphous layers therefore there is prevention of electron recombination and reduction of the link power loss which helps in delivery of industry-leading performance. With the exclusive structure there is maintenance of high conversion efficiency and it can perform at hot temperatures also there is more energy generated through the day. The production of thin film solar panels is mainly performed by application of thin layers of semiconductor material on the diverse kinds of surfaces, such as glass (Rahman, Aripriharta and Putranto, 2019). There are 4 key kinds of thin films: amorphous silicon; organic photovoltaic cells (OPC); copper, indium, gallium, selenide (CIGS) and cadmium telluride (CdTe) (azocleantech, 2016). Energy conversion effectiveness of thin film solar cells is quite lower than the crystal silicon PV cells. These are usually utilised in home light applications, electronic powering circuits, and in solar pitches. Since it is likely to make the cell transparent, making goods for architectural applications such as skylights and windows that utilise these cells can be created. Each board is typically associated together in a framework in which power is shipped off an inverter to give the force expected to run household electric gadgets. Effectiveness is frequently subject to the plan of the board and how it is designed to catch various frequencies of light energy. Think about the below designs:

• Mono crystalline Silicon Panels - Mono crystalline, or single, silicon boards are currently the most effective type of photovoltaic sun-powered board available. They are more expensive than alternative types of boards due to the higher silicon content in the design. Because more energy is converted into power, most rooftop facilities use fewer boards to fulfil the same force requirements. These sorts of square-formed boards are ideal for rooftop mounted sun based electric frameworks.

• Polycrystalline Silicon Panels - Polycrystalline, or complicated, silicon boards are usually less expensive than their more productive counterparts due to the lower silicon content. They implement a strategy to assist mitigate this inefficiency, allowing them to be employed on rooftop-mounted frameworks. Because they are less expensive, they are appropriate for larger projects and institutions.

• Building Integrated Photovoltaic Panels - A structure's appearance is very important. Owners of many notable structures, or those with exceptional engineering ideas, may be hesitant to change the nature of a structure by installing a solar-powered electric system.Building integrated photovoltaic is available to assist alleviate the aesthetic alterations that sunlight-based boards may bring. While they may have the appearance of traditional material, these types of boards are more expensive and ineffective than the other possibilities.

• Thin-Film Solar Cell Technology – Thin film photovoltaic cells are a relatively recent solar innovation that consists of one or more layers of delicate photovoltaic films that are applied to existing material, such as metal or glass windows. These photovoltaic movies are meagre permitting them to be lighter and more adaptable contrasted with other PV frameworks. While slender film innovation is very flexible, it includes some significant pitfalls. Flimsy film frameworks are less productive and can debase quicker than conventional heavenly bodies, however are developing with innovation progressions.

5. CONCLUSIONS

There has been a growth in the solar cell industry in the past few years because of the strong interest in two renewable energy and the challenges of global climatic changes. This has caused significant as bank for success of any kind of solar Technology. The current solar cells are insufficiently effective and efficient, and they are prohibitively expensive to manufacture for large-scale electricity generation. However, future advances in nanotechnology may offer promising opportunities for making solar cells that are both cheaper and more efficient. Nanotechnology has been great breakthrough in the area of solar energy. Therefore nanotechnology might be capable of increasing efficiency of solar cells however the highly beneficial use of Nanotechnology is the decrease of manufacturing costs. The photovoltaic Solar Energy based on different organic materials, CdTe, CIGS and CIS are being created with the purpose to reduce the price per watt, with decrease in reliability and conversion efficiency.

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