

Smart Electricity Generation Trends with Solar Technology – A Transformation

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Abstract: According to the present situation it is observed that the energy demands are increasing day by day. This is the outcome of our growing population and henceforth it's increasing energy demands. Thus comes into action the need of hour i.e. uses of several forms of renewable energy. These days the recent trend is to focus on sustainable ecofriendly development. Due to increased load demands and rapidly declining conventional sources like fossil fuels including coal, natural gas and petroleum, there comes the alarming need of introducing interest in development of renewable energy sources including sun, wind, etc. Among these the major development and scope lies in the field of solar energy using photovoltaic cells and panels and their alignment with sun in order to harness maximum possible energy. This paper provides an overview of technical, economic and policy aspects of solar energy development. This paper also provides a review of the recent advances in the field of solar energy including the present scenario, available sources and potential, ongoing projects and future scope to have a better and efficient tomorrow.

Index Terms - renewable energy resources, cumulative capacity, solar energy, energy conservation techniques, solar photovoltaic cells

INTRODUCTION

Energy demands are increasing day by day. Nature has provided humans with plenty of free gifts which if used properly can suffice the present as well as the future energy demands; these are termed as renewable energy resources. The renewable system can convert energy from the sources like water, wind, sunlight etc. into electricity. We all are well aware of the present scenario regarding the energy consumption and production.

Undoubtedly not only India but the whole world has huge reserves of coal which may suffice for the next few hundred years but the unlimited byproducts like ash content and the harmful gas emissions are posing a great threat towards the environment. Thus comes into play the role of renewable energy resources. The generation is unable to cope up with the required needs. As such there arises the use of such source that is available in abundance and eco-friendly i.e. free from harmful gaseous emissions. Then the name strikes: solar power which can be utilized at present directly as well as indirectly. To make it more relevant as solar panels increase the efficiency of the dam and reservoirs by protecting it from evaporation as well as direct isolation and thereby making use of solar trackers for electricity generation. This is how generation is distributed to meet the growing energy needs. The solar tracking system can be operated by the means of stepper motors in accordance

with the microcontrollers. When the earth rotates about its axis, the sun which is actually stationary appears to move, thus solar tracking makes it possible to maintain the required sun's projection on the solar panels. It has been found that the actual potential of solar energy is about 20,000 times the world's demand.

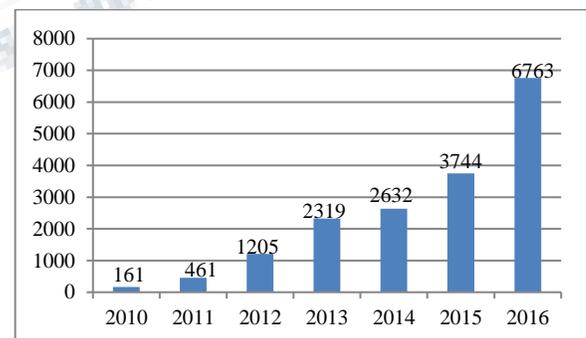


Fig. 1 Year cumulative capacity (in MW) of installed solar PV.[1]

Requirements of electricity generation from solar power

- Land availability and Suitable solar radiation profile
- Closeness to grid
- Skilled layout and workers,
- Sufficient approach and scope
- Economic and Scientific approach for layout.

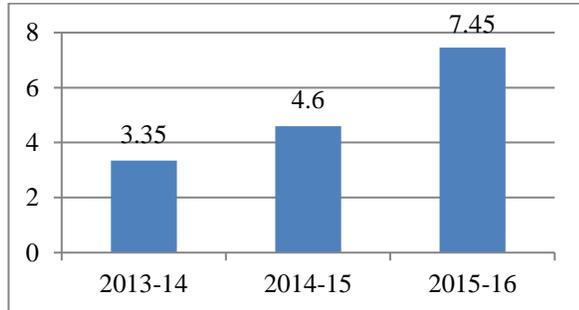


Fig. 2 Yearly solar power generation (billion kWh).[1]

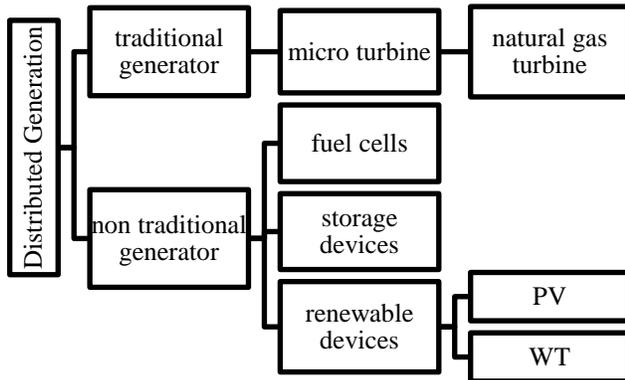


Fig. 3 Classification of distribution of generation

LITERATURE SURVEY

Significance of solar power

- Solar power is pollution free and has no harmful by products.
- Its available in abundance and free of cost
- Easier set up and handling and maintenance.
- It has a numerous applications starting from watches to supplying power to utility grid.

1) Solar photovoltaic technology

An historical development took place with the discovery of photoelectric effect in 1839 by F. C. Becquerel wherein the electrons emitted from matter when energy is absorbed by them in the form of solar radiations. Here materials like monocrystalline, polycrystalline and amorphous silicon etc. were employed using the doping technique (introducing impurity in intrinsic semiconductor to change its electrical

properties). Then the photodiode is subjected to sunlight electrons gets excited this freed electrons in n region to constitute to the flow of current in a particular direction.

The figure gives a clear explanation of about how the process takes place in accordance with the source point up to final point of utilization in the required form of energy

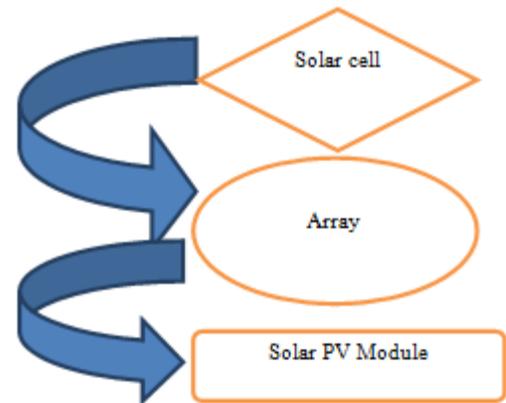


Fig. 4 Solar energy harnessing process

This takes into account of the logic of distribution of generation that leads to cope up with the situation of insufficient energy. [2] There is a rapid expansion in solar technology in India and India is estimated as the second largest in the field of energy supplier by 2035. Above all the major concern is to spread knowledge and take serious action in this regard. This is only possible with prior knowledge of the above mentioned facts to a greater extent such that the target fixed by NAPCC (national action plan of climate change) to be 15% of total energy demands need to be sufficed by the use of renewable sources only by 2020

- The electricity act 2003 further specifies feed in tariff and enhance utility from renewable energy sources in accordance to grid connectivity Section 61 (h) [3]
- The operation, maintenance and cost efficiency shall be governed by local bodies like Panchayats, BDO etc. [4].
- Keeping economy and availability in mind rural Electricity Corporation of India (REC) will focus on solar energy harnessing techniques and utilization shall continue in accordance with the connectivity of the grid [5]

TABLE I
SOLAR CELL BEST EFFICIENCIES: INDIA

TECHNOLOGY	AREA SQ. CM	EFF.	Group
SINGLE CRYSTAL	64.00	19.7	CEL
MULTI CRYSTAL	100.00	16.8	Tata BP
a-Si SINGLE JUNCTION	1.00	12.0	IACS
a-Si MULTI JUNCTION	1.00	11.5	IACS
a-Si/ μ c-Si(nc-Si)	1.00	9.0	IACS
CdTe	1.00	12.0	NPL
CIGS	0.41	13.0	IISC
Si FILMS	0.98	8.7	Jadavpur
Dye Sensitized	1.00	9.5	Amrita
Organic cells	1.00	6.2	NPL

2) Physical structure of solar PV

- Monocrystalline Solar cell including a silicon ingot sliced to make it thin and then semiconductor being embedded in it. It has leads for tying multiple cells in series
- P V Modules are the number of solar cells wired in series being housed in a weatherproof enclosure. Thus forming a module or panel
- Array is a collection of the linked solar panels which makes use of an inverter to convert DC power into Ac power for the subsequent loads
- Mounting systems forms the distribution part of the system that can be further classified as ground (for solar parks), roof (flat tops) or pole (having antenna) mounted types.

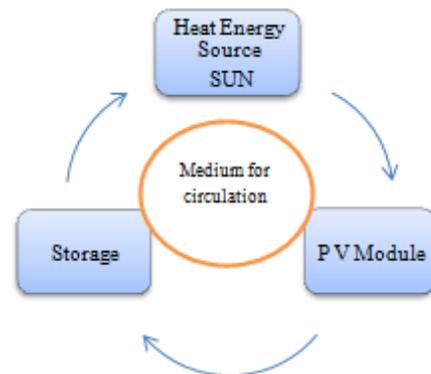


Fig. 5 Solar energy circulation arena and distribution

Solar Tracker which is an electromechanical device that orients in accordance with the position of the sun. It has panels mounted on top to track the motion of the sun for maximizing the radiation falling on the panels.

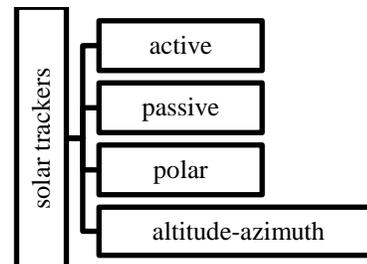


Fig. 6 Classification of solar trackers

Solar trackers are classified on the basis of elevation and axis adjustments

- Active two axis trackers make use of motors to direct the heliostats so as to absorb maximum solar radiations. Due to consumption of energy by the motor it is used on a periodic basis.
- Passive ones use the hydraulic dampers that use a compressed gaseous fluid with low boiling point which drives the tracker in case of imbalance. They may also include a hologram at back side of the PV cells to enhance the module efficiency.
- Polar trackers as the name suggest align themselves with the earth's N-S axis. It is adjusted such that the angle between this axis

and vertical is equal to your latitude faced as being higher in summer and lower in winter.

- Altitude- azimuth has one axis horizontal (altitude) with telescope to make upward and downward movement and other vertical (azimuth) that lets it follow a circular movement parallel to ground.

3) Trends in existence

- Solar thermal including the parabolic trough collector technology is gaining importance these days. They constitute of parabolic mirror segments approximately 400 meters in length that track the path of sun and cause the final radiations on sophisticatedly coated evacuated absorber tube receivers. This radiation causes the heating of the thermo oil inside the receiver up to 400 degree Celsius so as to result the steam generation by the downstream heat exchanger. In some countries the CSP has install capacity as high as 200 MW [6]. This is helpful even in the absence of the sun.
- Tata power looks forward to install solar panels having 35% efficiency manufactured by stacking indium, arsenide and gallium at the bottom layer. Thus making them capable of absorbing different wavelengths of sunlight for conversion into electrical energy [7].
- Keeping in mind the sustainable and green development of the utility grid, harmonics can be reduced thereby balancing the reactive power by use of solar inverters in remote locations.
- Nano pillars developed at the University of California are narrow at top allowing absorption (99%) of array without reflection and thicker at bottom so as to ease the conversion into electricity. They reduce material costs as only one third of semiconductor material like cadmium telluride (thin film) is required.
- Nanowire and powerful multi junction solar cells comprising of nanowires 10 to 100 nanometers wide and nearly 5 microns in length. The length enhances absorption while width causes mobile collection and movement of electrons. They account with 40% of the efficiency
- Fabric made cloth from Solar cell fabrics as developed in japan utilizes solar energy when one moves in sunlight. This generates enough electricity

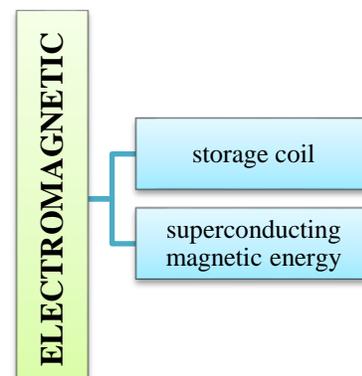
to charge mobiles and other portable gadgets.

- Flexible and as thin as 15 – 20 micrometers solar cells that are cheaper to manufacture and are made up of soft polymers with glass or plastic substrate have shown efficiency of about 12 %
- In japan solar panels are being fitted on the vehicles to charge their batteries and increase their overall electrical efficiency same as the roof tops of buildings being equipped with solar panel roofs [8].

Solar cells can be operated only in the presence of sunlight. But an alternative way is to split water into hydrogen and store it to be used at any time. This is achieved by using a catalyst Nano net during the reaction. In Germany it was observed that titanium disilicide worked as a Nano net constituting flexible wires about 15 nanometers in thickness.

ENERGY STORAGE TECHNIQUES

The storing of solar energy is necessary since its availability is dependent on environmental and periodic factors. Devices like accumulators, rechargeable battery systems, thermal energy systems and many more count to their best. Some of the techniques in existence are listed as



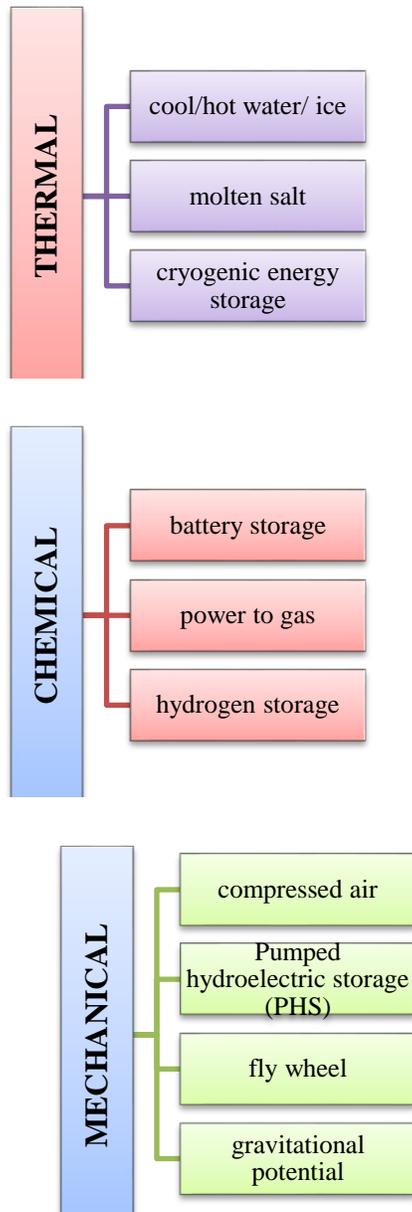


Fig. 7 Solar energy storage techniques

GOVERNMENT SUPPORT TO RENEWABLE ENERGY

Electricity Act, 2003

Section 3(1) specifies development based on optimal utilization of renewable sources of energy

Section 4 of the Act specifies that the Central Government has to prepare a national policy, in

consultation with the state governments, permitting standalone systems for rural electrification

Section 61 (h) tariffs must be prescribed by the SERCs to promote co- generation and generation of electricity renewable sources of energy.

Section 86(1) (e) empower the SERC's to specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of distribution licensee also introduce measures for connectivity with the grid and sale of electricity to any persons.

National Electricity Policy 2005

National electricity policy 2005 which elaborately specifies that importance of non-conventional sources will increase by promoting it cost wise and making it available by competitive bidding of distribution companies

Tariff Policy 2006

It fixed that the purchase of energy at minimum tariffs with account availability of resources. It must be made mandatory by the SERC's

NAPCC

The target fixed by NAPCC (national action plan of climate change) to be 15% of total energy demands need to be sufficed by the use of renewable sources only by 2020

FUTURISTIC APPROACH

India has huge potentials and reserves of solar energy but due to some reasons the system faces constraints. Presently many projects have been proposed in India.

In India lies the Thar Desert, with extreme generation potential of nearly 2000 GW.

Rural electrification projects with present capacity of 66MW have already gained pace and are advancing as solar lanterns, street lighting and many more.

In July 2009, a \$ 19 billion solar power plan was passed aiming at generation of 20 GW of solar power by 2020.

By 2022 the project named The Jawaharlal Nehru solar mission (JNNSM) targets 20,000 MWs

From time to time huge investments are being made like latest in 2014 finance minister Jaitley proposed 500 crores rupees to develop mega solar projects in Gujarat, Tamil Nadu, Rajasthan and Ladakh. He also announced the solar agro water pumping and solar parks to be developed in the country approximately costing \$74

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million and \$18.5 million respectively. Undoubtedly India is giving prime importance to generation of solar power with accordance to the National solar mission. So we can now imagine India to be a solar driven country in the near future [9].

CONCLUSION

Global warming is increasing at tremendous rate and so are the increasing energy demands. Pollution is another result of byproducts of the Conventional sources which are nearing extinction as well as their harmful emissions are a serious matter of concern. Today all of a sudden it's not possible to change the scenario worldwide being a slow process. The world is realizing the importance of renewable energy generation methods. As the paper concludes the huge potential and scope of solar energy leading to a green, energy efficient and better tomorrow. Thus it leads to successful comparison and one can find all the technical specifications in one paper. The paper requires a tough survey of various papers and technical articles. This paper permits the reader to explore the hidden potential of all the renewable energy sources and allows a wide future scope about what all can be done. The need is to primarily focus upon the new emerging trends in this field and help the government to complete its proposed projects. The author of this paper would like to thank from the core of my heart, for encouraging me for preparing this survey report.

REFERENCES

- 1) "Solars share in India's power generation on the rise". Retrieved 4 January 2017.
- 2) W El-Khattam and M.M.A Salama, "Distributed generation technologies, definitions and benefits", Electric Power Systems Research, vol. 71, Issue 2, p.p., 119–128, October 2004.
- 3) MadhuKhanna, KusumMundra, AmanUllah, "Parametric and Semi-Parametric Estimation of the Effect of Firm Attributes on Efficiency: Electricity Generating Industry in India", Journal of International Trade and Economic Development. Pp. 419–436.vol. 8, No. 4, Sept. 2011.
- 4) Giuseppe Buglione, Guido Cervigni, Eileen Fumagalli, Elena Fumagalli and Clara Poletti, "Integrating European Electricity Markets", Center for Research on energy and

environmental economics policy, Report 2, Oct. 2009.

- 5) G. D. Kamalapur and R. Y. Udaykumar, "Rural Electrification in the Changing Paradigm of Power Sector Reforms in India", International Journal of Electrical and Computer Engineering, p.p., 147-154, vol. 2, No.2, April 2012.
- 6) DolfGielen, "Concentrating Solar Power technology", Energy Technology Systems Analysis Programme, International Renewable Energy Agency, January 2013.
- 7) Electronics for You, "Most efficient Solar Cell", Technology news, January, 2013.
- 8) John Badding, "Flexible Silicon Solar-Cell Fabrics May Soon Become Possible", Journal Advanced Materials, Penn State University, 6 December 2012.
- 9) Ministry of New and Renewable Energy Website