Guest Article

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Solar Power - Clean Energy for a Cleaner World

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A humble beginning in 1839 when Alexandre Edmond Becquerel discovered the photovoltaic effect which explains how electricity can be generated from sunlight. He claimed that 'shining light on an electrode submerged in a conductive solution would create an electric current'. From the middle of 19th century to the industrial revolution; solar energy plants were developed to heat water that created steam to drive machinery. However, even after much research and development subsequent to the discovery, photovoltaic power continued to be at nascent stage and solar cells were used mainly for the purposes of measuring light. Over 100 years later, in 1941, Russell Shoemaker Ohl, an American engineer invented the solar cell which transformed to become the modern solar system.

Nearly 240 million people lives without regular or reliable access to electricity in India. World Bank Report.

In terms of the sustainability of energy resources we need to recognize that per capita energy demand is continuously increasing in emerging economies. Increasing demand for energy in developing countries is expected to raise energy consumption and making them as dominant players in energy market. The forecast says that the global energy demand is expected to increase by around 45 percent by 2030 from the current consumption level. Most of the demand would comprise of fossil energy with coal accounting for more than a third of overall rise. Fossil fuel prices as a consequence are expected to continuously rise with increasing degree of volatility. Developing countries including India would find it difficult to get access to energy from international market both on account of depleting fossil energy resources as well as their rising prices. The best possible option is to increase the renewable energy generation with focus on solar power.

Today, solar power is a rapidly developing energy source around the world. The potential is huge for using the sun to produce energy and directly supply to our power needs. Solar panels are environment friendly, generate electricity without any pollution or waste residue and do not depend on the earth's natural resources. Without any moving parts, solar modules are more reliable and have a long life span, relatively easy to install and have very low maintenance.

The most common form of solar energy used today is photovoltaic (pv) solar panels, which absorb the sun's light to create electricity. They can be used for large machinery to small household appliances and machines which only need small amounts of electricity. The most important part of solar photovoltaic power generation is that it can be installed on any scale as opposed to conventional forms of power generation that require large scale plant and maintenance. Solar panels can be installed to generate power where it is needed, which removes the need to transmission and distribution of electricity over long distances to remote areas.

Solar Power in India

India is the world's third largest consumer of electricity and home of 1.32 billion people. As per an estimate, there are over 450 million ceiling fans in use and 40 million are sold each year. India is a vast country with diverse demographic and climate conditions where the hot summer lasts about three times more than the colder days. According to the World Bank report, nearly 240 million people lives without regular or reliable access to electricity. Demand for electricity is growing at the same rate as in France or Germany as millions of people in rural or semi-urban areas are seeking access to power in their homes and workplaces.

With about 300 clear and sunny days in a year, India can generate 5000 trillion kilowatt-hours (kWh) per year of solar energy. The solar energy available in a single year exceeds the possible energy output of all the fossil fuel energy reserves in India. The daily average solar-power-plant generation capacity in India is 0.20 kWh per sqmtr of used land area, equivalent to 1400–1800 peak (rated) capacity operating hours in a year with available, commercially-proven technology. The recent giant step India has taken towards solar energy is it achieved the earlier set 20 GW target for 2022, four years in advance in February 2018 itself. The policy thrust has been a key factor in driving the rapid increase in installed solar power capacity from 10 MW in 2010 to 20 GW by Feb 2018. It shows the development work and a strong push by the Modi government towards solar power. In fact, after PM Modi came to power, he increased the solar power capacity target to 100 GW by 2022.

In the first week of January 2018, the central government controlled Solar Energy Corporation of India (SECI) has tendered out over 1,200 MW of projects, including 750 MW in Andhra Pradesh, 200 MW in Karnataka, and 275 MW in Uttar Pradesh. The recovery began in December 2017, when around 3,000 MW worth of projects were auctioned and tendered by the SECI and various state governments, including 1,300 MW in Maharashtra, 860 MW by Karnataka, and around 750 MW by the SECI. The solar plant in Kamuthi, Tamil Nadu, has a capacity of 648 MW and covers an area of 10 sq km has become the largest solar power plant at a single location, taking the title from the Topaz Solar Farm in California, which has a capacity of 550 MW.

The sector had witnessed a sharp fall in activity over October and November last year as it battled flat power demand and rising solar panel costs. So, against the yearly target of 15,000 MW for the 2018 financial year, India commissioned just over 3,000 MW of solar power as of December 2017. To meet the broader goal of capacity addition of another 80 GW by 2022, the ministry of new and renewable energy decided to make amends in November last year, promising to lay out bids for 3,000 MW of solar projects in January 2018; 5,000 MW in February, and 6,000 MW in March 2018.

In August 2017, the ministry introduced new norms for procuring solar power from solar farms set up through auctions. These norms made the process more transparent and prevented the unilateral termination of power purchase agreements. With these new norms in place, there was increased activity towards setting up solar plants and solar farms in different states and we believe that 10-12 GW capacity addition is easily achievable per year for the next four years in line with the target of completing 60 GW of grid-connected solar power by 2022. One of the major issues the solar power developers will face is proposed introduction of anti-dumping duties on imported solar panels which might slam the brakes on growth. This move could push up tariffs, hitting project viability.

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Energy Scenario

The current energy scenario in our country indicates that

only around two third of our primary energy requirement is met by domestic resources. Our energy needs are expected to grow around three folds by the year 2032. Around 60% of this would be required to be imported coupled with rising energy prices would mean a steep rise in energy import bill.

With time this is likely to become a bigger challenge on account of rising prices in the world energy markets and energy security risks are likely to be much more serious issues in years to come. We need to rapidly enhance domestic energy production as well as to take calculated and planned efforts to increase our renewable energy including big push for solar power generation. With the technology adoption and new development, the high cost of solar energy is expected to reach parity with prevailing commercial prices. When these energy forms will actually be able to overtake fossil energy would depend on how aggressively we are securing energy resources of all kinds, emphasis on renewable and nuclear energy resources would not only enable relatively cheaper energy production within the country but would also be consistent with the need to reduce our carbon foot print.The current focus on solar energy is important as it can support our energy needs in to the future. It can be used in two ways; the thermal route of solar using heat for drying, heating, cooking or generation of electricity or through the photovoltaic route which converts solar energy into electricity that can be used for a myriad purposes such as lighting, pumping, transportation and generation of electricity. With its pollution free nature, virtually inexhaustible supply and global distribution- solar energy is very attractive energy resource.

Technology

Solar Photovoltaic

Solar photovoltaic (SPV) cells convert solar radiation (sunlight) into electricity. A solar cell is a semi-conducting device made of silicon and/or other materials, which, when exposed to sunlight, generates electricity. Solar cells are connected in series and parallel combinations to form modules that provide the required power. There is different kind of solar cells available like crystalline silicon solar cells (C-Si)-monocrystalline and polycrystalline and thin-film solar cells-amorphous silicon solar cells (A-Si) etc. PV modules are manufactured by assembling the solar cells after stringing, tabbing and providing other interconnections. PV modules and arrays are just one part of a PV system. Systems also include mounting structures that point panels toward the sun, along with the components that take the direct-current (DC) electricity produced by modules and convert it to the alternating-current (AC) electricity used to power the appliances in our homes or offices.

Some solar cells are designed to operate with concentrated sunlight. These cells are built into concentrating collectors that use a lens to focus the sunlight onto the cells. This approach has both advantages and disadvantages compared with flat-plate PV arrays. The main idea is to use very little of the expensive semiconducting PV material while collecting as much sunlight as possible. But because the lenses must be pointed at the sun, the use of concentrating collectors is limited to the sunniest parts of the country. Some concentrating collectors are designed to be mounted on simple tracking devices, but most require sophisticated tracking devices, which further limit their use to electric utilities, industries, and large buildings. The performance of a solar cell is measured in terms of its efficiency at turning sunlight into electricity. Only sunlight of certain energies will work efficiently to create electricity, and much of it is reflected or absorbed by the material that makes up the cell. Because of this, a typical commercial solar cell has an efficiency of 15 percent about one-sixth of the sunlight striking the cell that generates electricity. Low efficiencies mean that larger arrays are needed, and that means higher cost. Improving solar cell efficiencies while holding down the cost per cell is an important goal of the PV industry.

SPML Infra has taken the initiative and installed 21 KW capacity rooftop solar power generation plant at its office in Gurgaon, Haryana. The instantaneous generation capacity of the solar module will help SPML to save more than 27,000 units of electricity per year whereas the carbon footprint will be reduced by 43,800 lbs/year. Apart from that, SPML Infra is also executing rooftop grid connected solar PV project in 4 States; Delhi, Haryana, Rajasthan, and Madhya Pradesh to design, engineering, erection, and commissioning of solar power plant of 1000 KW in each state.

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Solar Thermal

Solar thermal power systems also known as concentrating solar power systems uses concentrated solar radiation as a high temperature energy source to produce electricity using thermal route. High temperature solar energy collectors are basically of three types: parabolic trough system, at the receiver can reach 400° C and produce steam for generating electricity; power tower system, the reflected rays of the sun are always aimed at the receiver, where temperatures well above 1000° C can be reached; and parabolic dish systems where temperature at dish can reach 1000° C at the receiver, and achieve the highest efficiencies for converting solar energy to electricity.

India's Unique Proposition

Solar power is India's trump card to achieve its developmental ambitions. It has good economic value as generation of solar energy coincides with the normal peak demand during daylight hours in most places, thus mitigating peak energy costs, reducing energy bills, and averts the need to build as much additional generation and transmission capacity as would be the case without PV. India being a tropical country receives adequate sun light for almost 300 days, amounting to 3,000 hours of sunshine equivalent to over 5,000 trillion kWh. Almost all the regions receive 4-7 kWh of solar radiation per sqmtrs with about 2,300–3,200 sunshine hours/ year, depending upon the location. Electricity losses in India during transmission and distribution have been extremely high over the years and it is still above 20 percent. India is in a pressing need to tide over a peak power shortfall of 13 percent by reducing losses and solar power should be the key area of focus.

India climbed to the 2nd spot in E&Y attractiveness index for renewables last year. This was made possible due to a combination of strong government support and increasingly attractive economics. Solar photovoltaic prices is dropped and capital cost of solar power project has reduced significantly from about Rs.14.4 crore per MW in 2011-12 to around Rs. 7 crore recently. The renewable energy is growing so quickly that India's 2030 goal of achieving 40 percent renewable energy mix in the total installed capacity will be achieved much earlier. If the new draft electricity plan is implemented, India could even reach 57 percent renewable energy share in the country's energy mix by 2027. ■