Monthly Sustainability Newsletter

THE GROWING WORLD OF SOLAR

Chairman's Message

Dear members, partners and friends,

It is told in Greek Mythology, a story of Archimedes valiantly repelling the Roman onslaught during the Siege of Syracuse. Archimedes, a bright Greek polymath was credited for designing machines and weapons that had the ability to thwart any Roman aggression. As the Roman ships swarmed the surrounding seas, Archimedes built a Heat Ray machine: a giant mirror able to focus the sunlight enough to set the Roman ships on fire. Alas, the Greeks lost, but, even the earliest civilizations had an understanding of the energy contained in the sunlight.

Solar energy is lauded as an inexhaustible fuel source that is pollution - and often noise - free. The technology is also versatile. For example, solar cells generate energy for far-out places like satellites in Earth orbit and cabins deep in the Rocky Mountains as easily as they can power downtown buildings.

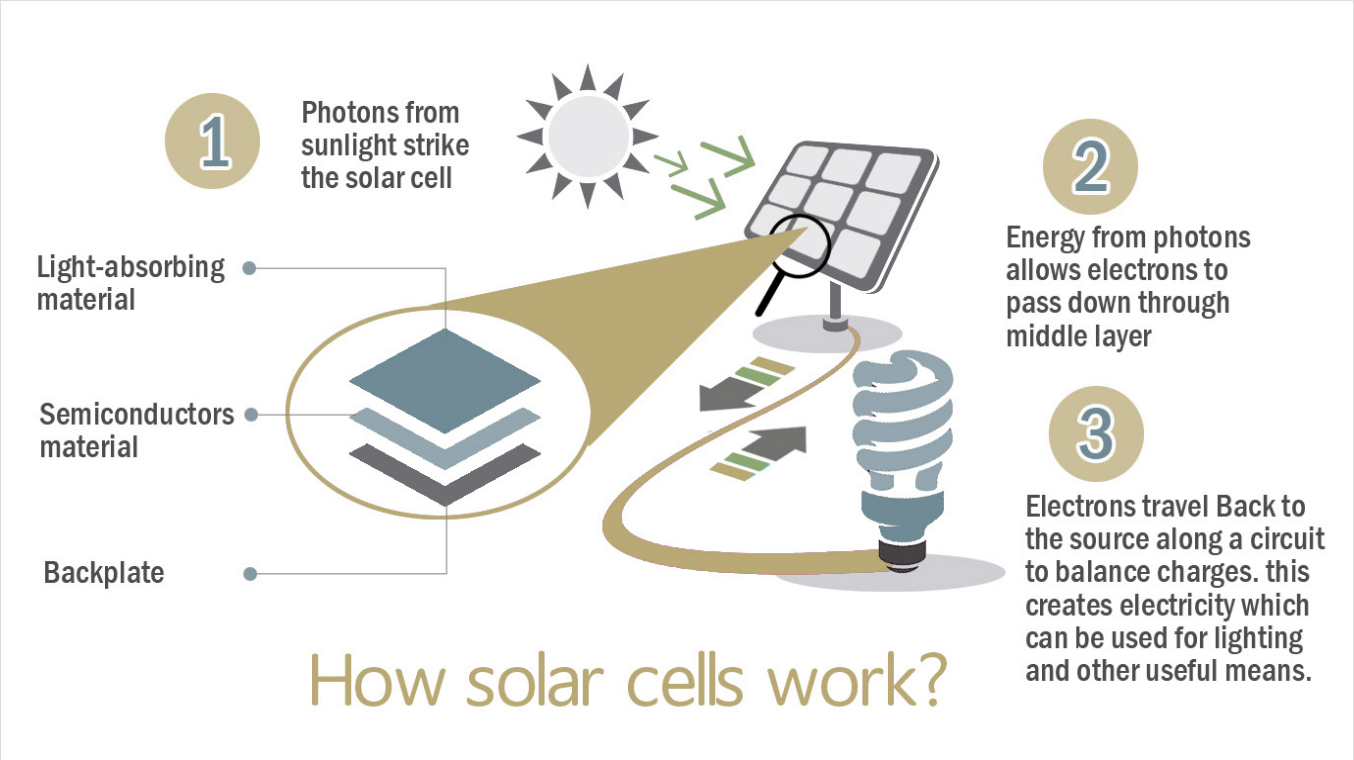
Solar is an energy source accessible to every nation, and with each country having its own energy mix based on local economics, the mix will be constantly varied. Very large energy consumers like the USA, China, Japan etc will have all sources available to them as price risk mitigation strategies. However, given the concern for climate change the world will move towards more renewable energy sources such as solar. In this month's issue, we look at the growing world of Solar, from its genesis to its advanced technology seen today.

The Genesis of Solar Energy

Sunlight, though abundant, can prove difficult to harness and convert to other forms of energy. It wasn't until 1839, that a young scientist name Edward Becquerel created a material that generated electricity when exposed to light. The phenomenon came to be known as the photovoltaic-effect and the material, photovoltaic-cell. In the years that followed, scientists discovered that selenium became electrically conductive when exposed to light. That discovery led to the creation of the first solar cell by Charles Fritts. Albert Einstein won a Nobel Prize in 1905 for illustrating the photoelectric effect: a phenomenon in which electrical particles are released from their bonds when they absorb light - the principle of how the photovoltaic cells work. The Bell Labs created the first commercial Silicon Solar Cells in the 1950s. Shunned by the consumer market for being inefficient and expensive, it proved to be immensely practical for the space programs. The Space Race during the 60s kept the Solar Energy alive, while also improving the technology's cost and efficiency. In the following two decades, Solar Energy's popularity went through the roof. Concerns about fossil fuels' harm on the planet and the rising awareness of climate change sparked vast public funded research on solar energy. Today, Solar Energy is the fastest-growing power source world-over. Nations once hooked to coal are investing in wide-scale implementation of Solar Energy. The cost of generating electricity per watt has been dropping yearly on residential and commercial projects alike. They are creating more new jobs than coal and petroleum. As a technology, Solar presents countless avenues for further research and development.

How do Solar systems work?

The Solar Panel or Solar Modules are made up of photovoltaic (photo = light, voltaic = electricity) cells, transforming light from the sun to electricity. The cells are made up of silicon, which in its natural state does not conduct electricity. But, when doped with impurities like phosphorous or gallium, the chemistry is altered enough for the electrons to break free from the bonds. When exposed to sunlight, the energy instead of turning into heat is converted to electricity. The cells are packed into connected modules, protected by a thin layer of anti-reflective glass. When each individual panel or module is connected by wires, it forms a photovoltaic array. All the wires are then bundled into a box known as the fused array combiner, which protects against the propagation of a module's failure to the entire array and ensures a safe circuit connection with the inverter. Today's Solar Cells covert about 15 percent to 18 percent of the light striking on them into electricity. Solar Cells in Satellites have an efficiency of about 50 percent. When Becquerel created the first photovoltaic cell, it was around 1 percent efficient.



Drivers and growth of Solar energy

Solar energy is becoming increasingly affordable, thanks to the dramatic fall in component prices and the cost of installation and operation, both at utility and distributed level. Countries are increasingly recognising the potential of solar energy to provide sustainable energy, and this is reflected in the growth in the number of targets and support policies enacted by governments. By 2015, 164 countries had renewable energy targets in place; around 45 of them had targets specific to solar energy.

Developing and emerging economies have led the expansion in policy targets in recent years. The world's most established solar markets have all benefited or are currently benefitting from both supply-side and demand-side drivers. For utility-scale solar, subsidies such as feed-in tariffs (FiTs) and feed-in premiums (FiPs) have been particularly successful in Europe, Australia and the United States.

In the United States, utilities sign long-term power purchase agreements (PPAs) with developers, securing income streams for the power plant. Some governments also provide investment or production tax credits to boost solar development. For distributed systems, FiTs and net metering have been successful measures.

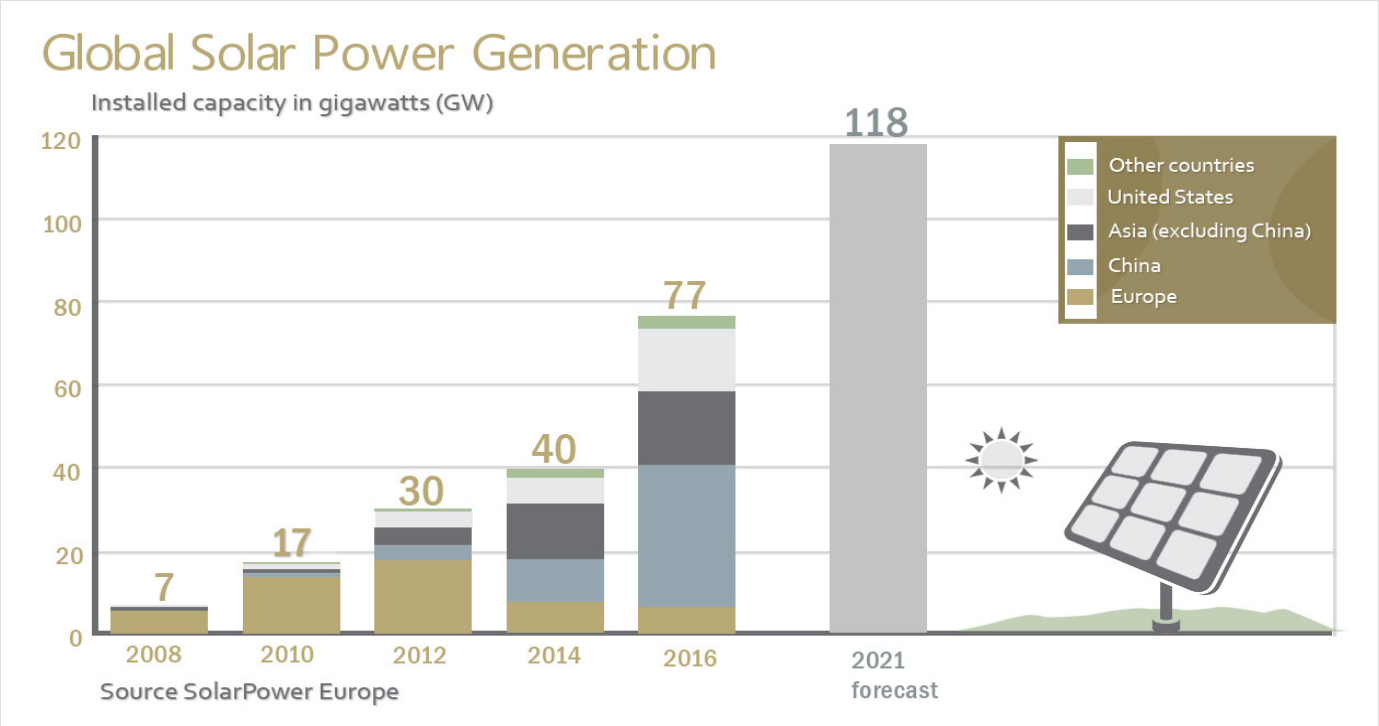
Solar Power Generation by Country

Many major energy consuming nations have installed significant solar power capacity into their electrical grids to supplement or provide an alternative to conventional energy sources while an increasing number of less developed nations have turned to solar to reduce dependence on expensive imported fuels. Long distance transmission allows remote renewable energy resources to displace fossil fuel consumption.

The top solar panel installers of 2016 were China, the United States, and India. There are more than 24 countries around the world with a cumulative PV capacity of more than one gigawatt. Austria, Chile, and South Africa, all crossed the one gigawatt-mark in 2016. The available solar PV capacity in Honduras is now sufficient to supply 12.5% of the nation's electrical power while Italy, Germany and Greece can produce between 7% and 8% of their respective domestic electricity consumption.

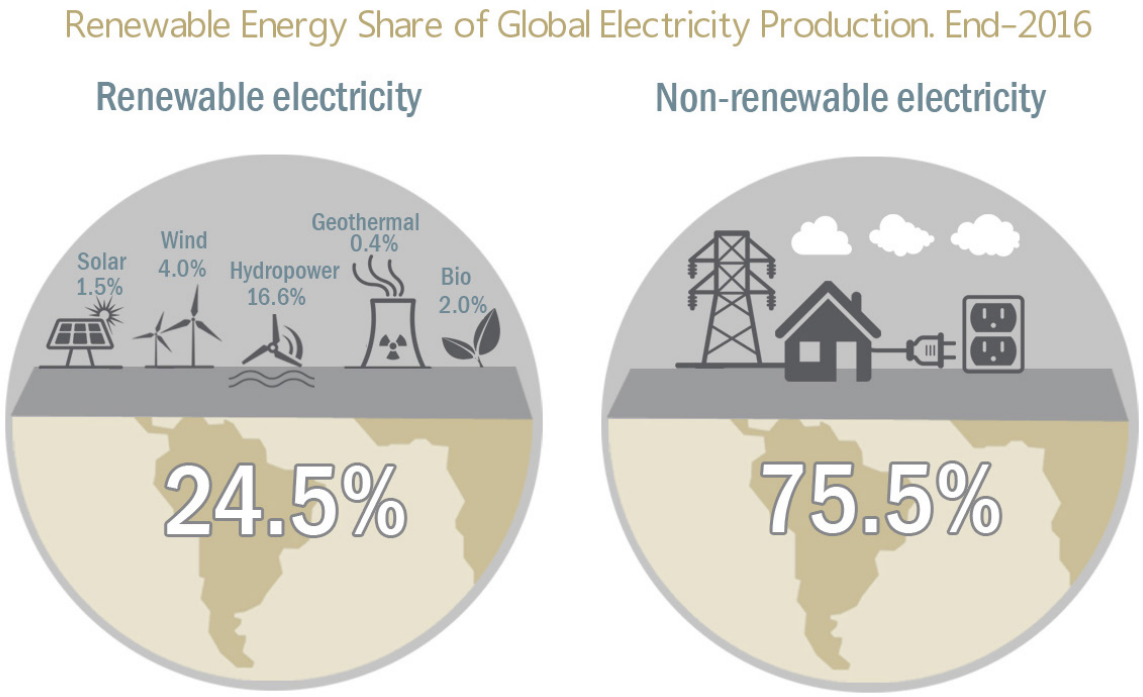
As of January 2017, the largest solar power plants in the world are the 850 MW Longyangxia Dam Solar Park in China for PV and the 377 MW Ivanpah Solar Power Facility in the United States for Concentrated Solar Power (CSP).

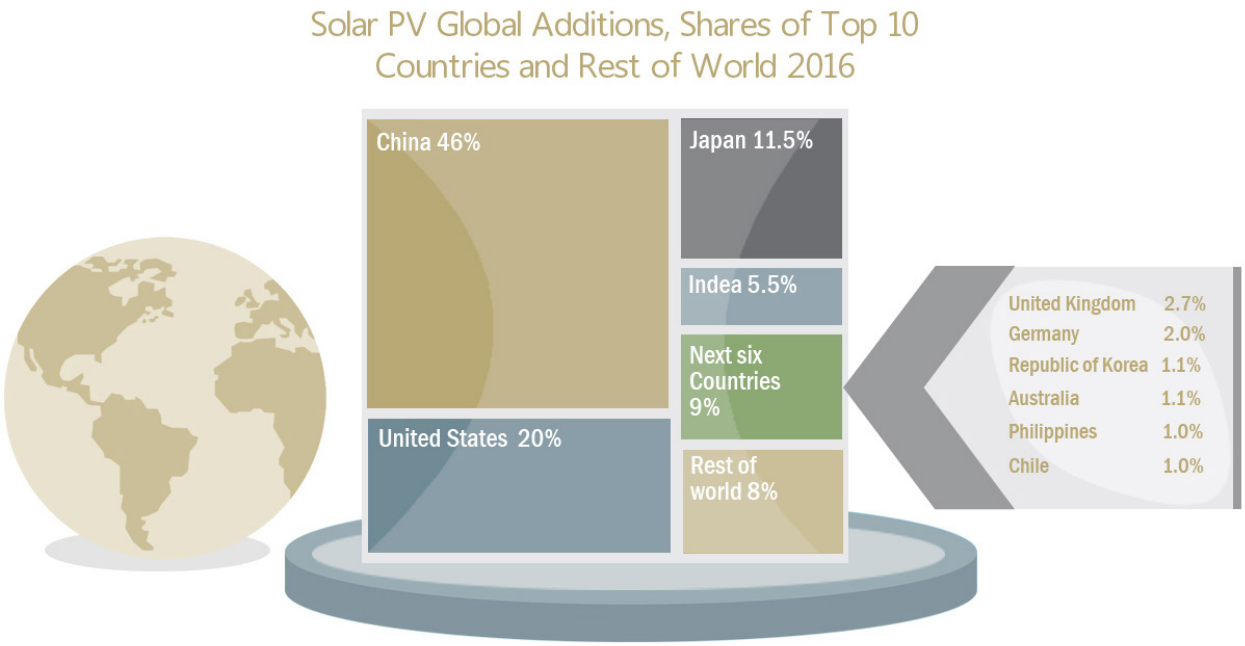
Other large CSP facilities include the 354 megawatt (MW) Solar Energy Generating Systems power installation in the USA, Solnova Solar Power Station (Spain, 150 MW), Andasol Solar Power Station (Spain, 150 MW) and the first part of Shams solar power station (United Arab Emirates, 100 MW).



Leading Countries in Manufacturing of Solar Panels

Globally, around 50% of the total solar panel production is handled by only 20 companies. During the recent years, there have been an exponential rise in using solar energy as the source of electricity and many countries including Canada, the US and China are setting up targets to start solar powered electricity production. This has led to a steep rise in solar panel production. This is all defined by the dynamics of the market and comes as no surprise that the top five manufactures come from these three countries that are dominant players in advancing research, manufacturing and distribution in the renewable energy market.





Top Five Manufacturing Companies in the World

Trina Solar:

The Chinese Solar firm Trina is the largest manufacturer of Solar Panel in the world. Its biggest market is the domestic country itself and it also has strong networks in the USA, India and Europe. Trina's growth has come along with the strong demands for solar power in both developed and developing nations. Currently, the company has distribution networks in 63 countries around the globe. It is also renowned for innovation in polycrystalline panels, holding more than 900 patents in solar technology. In 2017, Trina shipped panels worth 9GW in capacity. It also ranks in the top 100 of Forbes fastest growing companies.

Jinko Solar:

Jinko Solar is another Chinese firm dominating the solar markets. They control the entire operations along their solar manufacturing supply chain, with a capacity of 7 GW for silicon ingots and wafers, 4.5 GW for solar cells, and 8 GW for solar modules. It services both residential and commercial facilities in China, the United States, Japan, Germany, United Kingdom, Chile, South Africa, India, Mexico, Brazil, the United Arab Emirates, Italy, Spain, France, Belgium, and other countries and regions. With 8 production facilities in China and 16 subsidiaries around the world, Jinko employs more than 15,000 people worldwide.

JA Solar:

Finishing the top 3 dominance by Chinese Firms, JA Solar is the third largest manufacturer of Solar Panel in the world. They design and manufacture most components along the supply chain, along with expertise in solar plant investments, development, construction, operation and maintenance. The company prioritises Research & Development and customer-oriented service. With eleven production facilities world-wide, the production capacity for silicon wafer, cell and module production reached 3.0GW, 6.5GW and 7.0GW respectively in 2017.

Canadian Solar Inc:

Canadian solar produced a total cell capacity of 5.45 GW in 2017. The company though based in Canada has most of its manufacturing in China, along with 24 subsidiaries in the 6 continents. The Americas is its largest market, contributing to 51 percent of the net revenue, followed by Asia at 41 percent and the rest at 7 percent. In the past 16 years, the company has shipped over 70 million photovoltaic cells, translating to 25GW capacity. It also holds over 600 solar patents and employs over 12,000 people around the world.

First Solar:

First Solar is America's largest and the world's fifth biggest solar company. It specialises in thin-film solar panels, which are immensely popular in South Asia and EMEA region. Investments in R&D have pushed its proprietary Thin Film technology to match the efficiency levels of Multicrystalline panels. Its focus is largely on utility power - providing finance, construction, maintenance and end-of-life panel recycling services. The

company made news last year after seeing their stock price soar by 110 percent, selling projects worth $150 million more than the estimation. It aims to follow the trend and increase the current capacity of 4GW to 5.7GW by 2020.

Advance in Technology

Solar Power today has barely scratched the surface and there is tremendous room to improve and innovate. Even the best solar panels today are not more than 25 percent efficient. That is not bad at all considering the first photovoltaic cell only converted 1 percent of lighting into electricity. But, it could be higher, through the better understanding of the physics of light, photoconductivity and the composition of materials. MIT scientists are exploring nanophotonic crystals that can absorb a wider spectrum of light which could obtain efficiencies of up to 80 percent. Because heat can be stored for longer periods, the solar cells can operate hours after sunset or during intermittent daylight.

Solar has seen a tremendous rise in popularity this decade. In 2016, new installations totalled to 75GW in capacity worldwide. Its biggest demands are in the regions that also tend to have the highest pollution rates, like China, USA and India, helping tackle the issues of climate change. It outpaced coal in new capacity additions and jobs created in the market for 2017. For consumers, it provides an investment opportunity with incrementing returns, as the cost of generating electricity drops year on year.

The industry-famous Tesla Powerwall, a rechargeable lithium ion battery product launched in 2015, continues to lead the pack with regard to market share and brand recognition for solar batteries. Solar storage is still a fairly expensive product, but a surge in demand from solar shoppers is expected to bring significantly more efficient and affordable batteries to market.

Current technologies such as Polycrystalline and Monocrystalline panels are expected to improve in efficiency by 5 percent in the coming years, judging by the past trends. With steady improvements in Battery life-cycles, Solar in the future could be a zero-maintenance product for up to10 years from purchase.

While significant, long-term funding for basic research and development will always be important, the urgency of mitigating climate change means that there is no time to wait for the next generation of technology before rapidly scaling up solar generation. And with solar rapidly becoming the cheapest source of electricity in more and more parts of the world, the deployment of current solar technologies far and wide today is necessary, even as we continue to develop the technologies of tomorrow.

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