FACT SHEET

Solar energy

Solar energy explained

Solar power is the conversion of radiant light and heat from the sun into electricity, either directly, using photovoltaic (PV) cells, or indirectly, using concentrated solar power (CSP).

How it works

In solar PV cells, semiconducting materials (traditionally crystalline silicon) knock free the electrons in absorbed sunlight and the current of free electrons then moves in a single direction. Many cells are connected in an array and the aggregate flow of electrons is converted into usable electric current.

CSP uses mirrors and/or lenses to focus sunlight into a contained liquid, which creates steam capable of turning a turbine as well as providing heat for combined heat and power (CHP). Similar technologies, broadly called low-temperature solar thermal, can be used to heat water to provide hot water onsite or to concentrate solar energy into a cooking container to heat food.

Opportunities in Asia and the Pacific

India's National Solar Mission: As part of its National Action Plan on Climate Change, the Government of India enacted a number of policies to drastically increase solar PV and CSP production to 22,000 MW by 2022. The goal is to achieve national grid parity by 2022, and KPMG International analysis projects that grid parity across India could be achieved between 2017 and 2020.[1]

China leading the world in PV manufacturing: Chinese manufacturing accounts for more than one third of worldwide PV cell production, more than any other country. Although nearly 11,000 MW of PV panels were produced in China in 2010, followed by Japan with 2,200 MW, only 8 per cent remained in the country for domestic use. To generate domestic demand for its solar manufacturing, the Government initiated the national Golden Sun Programme that subsidizes half the costs for the capital investment and grid connection for a solar project, with the purpose of expanding 1,000 MW of domestic installation per year starting from 2012.[2]

PV costs approaching grid parity: Significant reductions in PV manufacturing costs, primarily from Chinese production, are quickly pushing solar PV power towards grid parity. The Energy Research Institute, a think tank supported by China's National Development and Reform Commission, projects that grid parity for solar PV in China could be reached by 2015.[3]

Trends in development

In 2009, solar PV provided just 4,205 GWh, or 0.06 per cent of the electricity supply across the region. CSP plants have been even slower to take off, with just 4 GWh of electricity production in 2009, all generated in Australia.[4] Passive and off-grid use of solar energy is difficult to gauge for the region.

[1] KPMG International, *The Rising Sun: A Point of View on the Solar Energy Sector in India* (Delhi, India, 2011). Available from www.kpmg.com/IN/en/IssuesAndInsights/ThoughtLeadership/The_Rising_Sun_full.pdf (accessed 10 October 2011).

[2] Earth Policy Institute website, "Solar Power: Solar PV Break Records". Available from www.earth-policy.org/indicators/C47 (accessed 15 February 2012).

[3] F. Wong and R. Lian, "China to Double Solar Capacity by Year End: Report", *Reuters*, 12 August 2011. Available from www.reuters.com/article/2011/08/13/us-china-solar-idUSTRE77C0AR20110813 (accessed 14 October 2011).

[4] Aggregation of 2009 renewable energy generation data from IEA for Asia, excluding China, and OECD Asia and Oceania. International Energy Agency (IEA), *Statistics and Balances* (Paris, IEA and OECD, 2009). Available from www.iea.org/stats/index.asp (accessed 15 February 2012).

Strengths with solar energy

- **Easy access:** A major advantage of solar energy is that solar radiation resources are fairly uniform across sub-regions; thus the resources and energy production capability are not as site-specific as it is for wind, hydro or geothermal sources. Solar PV modules are inherently scalable, broadening their potential for deployment at many levels.
- **Increased access to modern energy:** Off-grid solar thermal, solar home systems and solar-powered mini-grids have a great potential to increase access to electricity in rural Asia and the Pacific. Small solar thermal can offset traditional biomass cooking and heating and thus reduce indoor air pollution and associated health impacts. Appliance-based PV systems can help provide basic services, such as clean water and lighting to rural homes.[5]
- **Job creation:** A study from the (American) University of Berkeley's Renewable and Appropriate Energy Laboratory found that solar PV creates more jobs per unit of electricity output than any other form of electricity generation. The study report notes that the highly distributed nature of solar PV installations may lead to its considerably higher job multiplier.[6]

Challenges to using solar energy

- **Intermittent power generation and seasonal fluctuations:** Energy production from solar PV is limited to daylight hours. Currently available battery storage technologies are not cheap or efficient enough for utility-scale deployment. CSP plants have some storage capacity and can enhance this capacity with additional thermal storage infrastructure to hold heat excess in molten salts to be used to generate electricity during periods of cloud cover or even at night.

- **High costs and low efficiencies:** A major challenge for grid-connected solar energy development is the high cost of power. Investment costs are dropping with developments in thin-film solar modules, which rely on less expensive semiconducting materials than the traditional crystalline silicon. However, the panels' low conversion rates (from solar to electrical energy) are currently keeping the cost of electricity high, relative to other sources of power in many Asian markets.

Implementing strategies

Hybrid systems to help circumvent intermittency issues and storage deficiencies: By offsetting the need for some diesel fuel imports to remote locations, solar-diesel hybrid mini-grids can actually increase the reliability of access to electricity for users who may not always be able to afford diesel fuel when prices jump. Pairing solar generators with pumped storage hydro-electric plants may be another way to increase the input of solar energy into the grid.

Support of research and development to bring down costs: Investment in solar energy research can help bring down manufacturing costs and increase conversion efficiency of both PV and CSP technologies. Although generally less efficient than the older crystalline silicon solar cells, thin-film technology, in particular, presents great scope for deployment in emerging economies and developing countries. They are less expensive to manufacture than crystalline silicon cells, and they have no moving parts, lowering maintenance servicing and costs relative to solar thermal plants.

Increasing grid flexibility: In the long run, increasing the flexibility of the grid to accommodate solar variability will be important to allow even more solar energy to feed into the grid. Such measures include expansion of the supply market to smooth regional supply fluctuations, electricity demand management, smart metering and enhanced distributed energy storage (electric vehicle batteries). Although these are long-term measures, they have long lead times, and planning and investment are needed in the immediate term.[7]

[5] International Energy Agency, *Energy Poverty: How to Make Modern Energy Access Universal* (Paris, OECD/IEA, 2010a)

[6] M. Wei, S. Patadia and D.M. Kammen, "Putting renewable energy and energy efficiency to work: How many jobs can the clean energy industry generate in the US?", *Energy Policy* (2010) vol. 38, pp. 919–931. Available from http://rael.berkeley.edu/sites/default/files/WeiPatadiaKammen_CleanEnergyJobs_EPolicy2010.pdf (accessed 14 October 2011).

[7] International Energy Agency, *Technology Roadmap: Solar Photovoltaic Energy* (Paris, IEA and OECD, 2010b).