

Solar photovoltaic energy

Thanks in no small part to good legislation in California, China, Germany, Japan, Spain and elsewhere, the world-wide installed capacity for solar photovoltaic (PV) energy is increasing by 50% a year. On rooftops and in solar farms, sunlight is being converted directly into electricity and, in many countries, sold into the national grid. As the industry grows, the price of the energy is falling. In 1995, PV energy cost US\$0.50 per kwh. By 2005 it had fallen to around \$0.20, depending on latitude and solar irradiation. As the price of solar PV continues to fall, and the price of fossil fuels rises, many in the industry now expect to achieve widespread "grid parity" – the point where electricity from the sun can be produced as cheaply as it can be bought from the grid – within 3 to 5 years. In Japan, where electricity is expensive, grid parity has already been achieved.

There is no limit to the amount of energy we can generate from PV panels. It is just a political decision: how many panels do we want to build?

A standard photovoltaic (PV) solar electric system is made up of a number of individual PV cells, which are small devices made of semiconductor materials such as silicon that absorb sunlight and convert it directly into electricity. Each cell usually produces about 1-2 watts of power, and these cells are connected together to form PV systems of varying size. While they generate most energy on a sunny day, they work even in cloudy conditions.



A rooftop PV installation

Technological improvements are expected to bring about dramatic cost reductions in the next few years. New developments are increasing the efficiency of silicon based solar cells. "Thin-film" technology uses very small amounts of raw material compared with traditional wafer-based cells, and usually no silicon at all, which gives it the potential to significantly reduce the

cost of PV energy. Research into thin-film processing has been underway for a number of years, and mass production has now begun. One product uses what is described as a thin layer of solar-absorbing nano-ink, which is laid onto thin metal sheets with a printing press-style machine. Other companies are using mirrors or optics to concentrate the sun's rays on small amounts of PV material, thus reducing costs.

Increases in the German feed-in tariff for PV – which guarantees a good price over 20 years for solar energy fed into the grid – have had a huge effect on the PV market. The first increase in 2000 resulted in a huge boom in solar manufacturing, and when the tariff was increased further to between €0.54 and €0.62 per kilowatt hour (kwh), the annual growth of the German PV market exceeded 50%. Germany remained the fastest-growing PV market in the world during 2005-2006, and by the end of 2006 some 55% of the global surface of PV panels was to be found there.



Nanosolar's PowerSheet thin film PV cell

Chinese company QS Solar claims that once critical mass is reached in the construction of its major PV plants, the company will be able to sell electricity at 1 yuan (14 US cents) per kwh. The Californian company Nanosolar claims its thin film technology will soon enable it to produce generating capacity at \$0.99 a watt, roughly equivalent to the cost of a coal-fired power station – a gigawatt (one billion watt) coal plant costs about \$1 billion to build.

The only limitation of solar PV is that it ceases to generate power as the sun sets. This is one reason why it is important wherever possible to link regions, through a supergrid, to mountainous areas where energy can easily be stored by pumping water into uphill reservoirs. If storage capacity is increased, then solar PV and wind can both provide a steady supply of power 24 hours a day.