The Solar Power Market

Solar Technologies FZE, Dubai

***Solar power is booming**. By the end of 2007, the cumulative installed capacity of all PV systems around the world had surpassed the landmark figure of 9,200 MW. This compares with a figure of 1,200 MW at the end of 2000. Installations of PV cells and modules around the world have been growing at an average annual rate of more than 35% since 1998.*

The market value of the solar PV market reached an annual € 13 billion in 2007. Competition among the major manufacturers has become increasingly intense, with new players entering the market as the potential for PV opens up.

Although growth in recent years has been primarily in the grid-connected sector, the demand side of the international PV market can be clearly divided into four sectors. These market categories are used throughout this report.

Demand Side Market Sectors

1. Goods and services

Large solar power plant in Spain

Applications

Solar cells or modules are used in a wide range of consumer products and small electrical appliances, including watches, calculators and toys, as well as to provide power for services such as water sprinklers, road signs, lighting and phone boxes.

Typical of new applications is the use of PV to control air conditioning in cars. A small system integrated in the roof keeps the temperature inside at a constant level by operating a ventilator when the car is parked, especially in the sun during summertime. This results in lower peak temperatures inside the car and a much cheaper air conditioning system, due to a lower requirement for power. Manufacturers may also be able to save on the cost of expensive heat-resistant materials in the vehicle's interior.

Market development

In 2007, this sector accounted for roughly 1% of global annual production. As demand for a mobile electricity supply increases, it is likely that the consumer goods market will continue to grow in absolute terms (although its relative share will decrease), especially with the introduction of innovative low-cost solar electricity technologies such as organic solar cells.

2. Grid-connected systems

Applications

PV applications which have a permanent connection to the electricity grid are categorised as on-grid applications. PV can be installed on top of a roof or integrated into the roofs and facades of houses, offices and public buildings. Private houses are a major growth area for roof systems as well as for Building Integrated PV (BIPV). A 3 kW solar electricity system in southern Germany delivers approximately 3,000 kWh/year, which is sufficient to supply up to 100% of the annual electricity needs of an energy-conscious household.

PV is also increasingly used as a design feature by architects, replacing elements in a building's envelope. Solar roof tiles or slates can replace conventional materials, flexible thin film modules can even be integrated into vaulted roofs, whilst semi-transparent modules allow for an interesting mixture of shading and daylight. PV can also be used to supply peak power to the building on hot summer days, when air conditioning systems need most energy, thus helping to reduce the maximum electricity load.

If a solar electricity system is recognised as an integral part of a building, then the money

spent on decorative materials for facades, such as marble, can instead be invested in solar modules. Solar power doubles up as both an energy producer and a building material. For prominent businesses, it can provide the public face of their environmental commitment.

Distributed generation using solar facades or roofs can also provide benefits to a power utility by avoiding grid replacement or by strengthening and potentially reducing maximum demand for conventional electricity, especially in countries with a high cooling load. In particular, PV can soften the peak demand caused by the use of air conditioning systems. In many areas around the world, the extensive use of air conditioning during the summer months leads repeatedly to black outs and brown outs. Since supply from PV systems matches perfectly the
demand from air conditioning systems. on bright, sunny days it can help to reduce the number of power cuts or reductions.

Large-scale grid-connected PV arrays (> 1 MW) represent about 10% of the European PV market. These systems are particularly suitable in areas where there is no competition from other land use demands. Such large plants function solely as power plants, and are therefore exclusively delivering electricity to the grid, without self-consumption. Sun-drenched desert regions present good opportunities in the longer term for large-scale plants, especially as module prices continue to fall, for instance in the south-west United States, Africa and Mongolia. In Germany, large-scale ground-based systems in the megawatt class have become a new market in recent years. This offers a fresh source of income for farmers, who can rent their land to investors, with the advantage of a secure revenue for at least 20 years.

Market development
This market segment is the current motor of the PV boom, with most development taking place in the OECD countries. More and more national governments see PV as an important technology for the future and have already established, or are in the process of establishing, support programmes. Whilst in 1994 only 20% of new PV capacity was grid-connected, this had grown to approximately 90% by 2007.

A growing number of countries have followed the successful examples of Germany, Japan and the USA, which have all established support programmes for grid-connected PV systems. These programmes will continue to provide an impetus for market growth for some years to come - until PV becomes competitive with domestic electricity prices (see Part Six: Policy Drivers). Another substantial benefit of the grid-connected domestic market is the control which PV systems allow the consumer over their power supply. Not only is electricity generated at the point of demand, avoiding grid losses of electricity, but the consumer is effectively transformed into the operator of his or her own power station. As international power markets steadily liberalise, this is likely to have increasingly important market implications. The full effect will be visible as soon as PV gets close to achieving parity with domestic electricity prices.

3. Off-grid electrification

Applications
PV provides vital power for communities in the developing world who have no access to mains electricity. About 1.7 billion people around the world currently live without basic energy services. 80% of them live in rural areas. This huge market is a great opportunity for both the PV industry and the local population.


Installation of a PV system on a roof

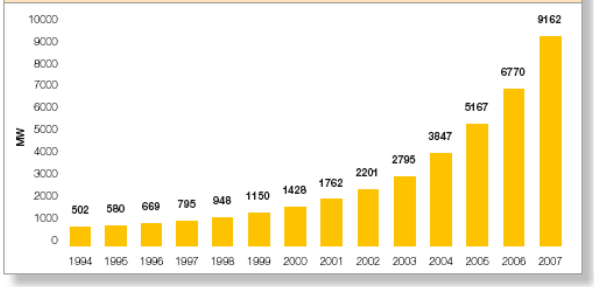
PV can provide electricity for both private consumption and industrial uses. Domestic energy systems provide high quality lighting and communications (radio/TV/internet), whilst energy used for cooling, water pumping

or powering tools can be a crucial motor for local economic development. PV has the potential to deliver much more than just electricity for lighting or improved health care. By providing the power supply for computers, for example, it can enable people to access better education or information through the internet.

There is also a powerful need to provide clean drinking water in the developing world. The World Health Organisation estimates that 10,000 children die each day from water-borne diseases. Solar-powered water purification systems and pumps are easily transportable, easy to maintain and simple to use and, as part of rural health initiatives, could be an important tool in the fight against disease.

Market development

Figure 2.1: Global cumulative PV capacity



Apart from its clear social advantages, the economic justification for using PV is through the avoided fuel costs, usually expensive diesel, or by comparison with the cost of extending the grid. For subsistencelevel communities, the initial stumbling block is often the capital cost of the system. Although numerous rural development programmes have been initiated in developing countries, supported both by multi- and bilateral assistance programmes, the impact has so far been relatively small. However, it is expected that this market segment will capture a substantial part of the global PV market share in the coming decades. In 2007, approximately 4% of global PV installations were dedicated to rural electrification.

PV systems integrated in the façade of a building

4. Off-grid industrial

Applications

The most common industrial uses for off-grid solar power are in the telecommunications field, especially for linking remote rural areas to the rest of the country. In India, for example, more than a third of the PV capacity is devoted to the telecommunications sector. There is a vast potential for repeater stations for mobile phones powered by PV or PV/diesel hybrid systems.

Desalination plants are another important off-grid application for PV. Others include traffic signals, marine navigation aids, security phones, weather or pollution monitors, remote lighting, highway signs and wastewater treatment plants.

Market development

Figure 2.2: Global annual PV market

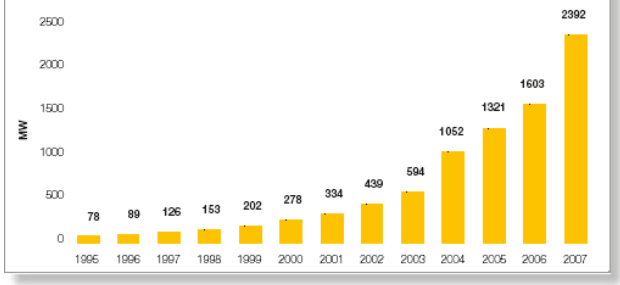
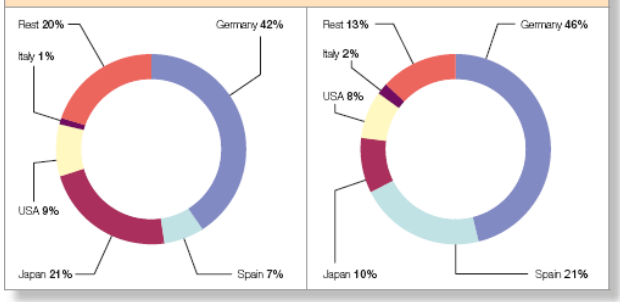


Figure 2.3: Top 5 PV country markets



Top 5 Total installed capacity 2007 (MW)		Top 5 New capacity 2007 (MW)	
Germany	3,900	Germany	1,100
Spain	632	Spain	512
Japan	1,938	Japan	230
USA	814	USA	190
Italy	100	Italy	50
		Rest	310

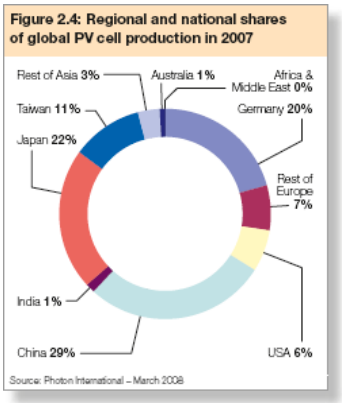
Apart from avoided fuel costs, by totally or

partly replacing a diesel engine for example, industrial PV systems offer high reliability and minimal maintenance. This can dramatically reduce operation and maintenance costs, particularly in very remote or inaccessible locations.

The demand for off-grid industrial PV systems is expected to continue to expand over the next decade and beyond, especially in response to the continued growth of the telecommunications industry. Mobile telephone masts and repeater stations offer a particularly large potential, especially in countries with low population densities. Providing communications services to rural areas in developing countries as part of social and economic development packages, will also be a major future market opportunity for photovoltaics. About 4% of global PV installations were used for PV industrial off-grid applications in 2007.

Supply Side Market - Manufacture

Silicon is the basic material required for the production of solar cells based on crystalline technology – 90% of the world market. The availability of sufficient silicon at reasonable prices is therefore an essential precondition for a dynamic PV industry.



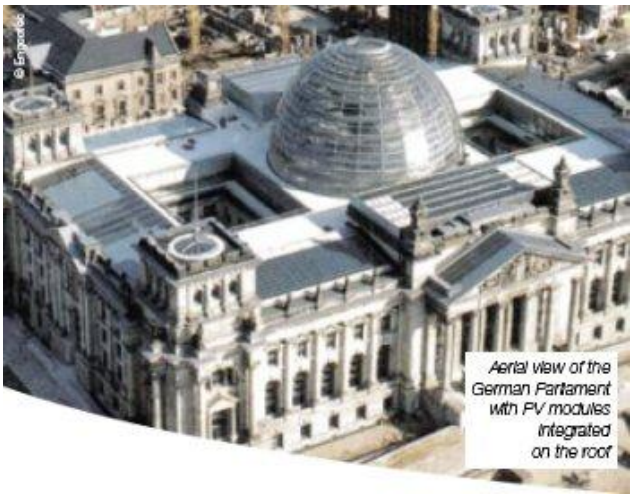
Until recently, the silicon industry produced electronic grade silicon exclusively for the semi-conductor industry, mainly for use in computers. Only a small fraction was delivered to the PV industry, which represented a good way for the suppliers to level out demand fluctuations from the semi-conductor industry. With the dynamic growth of the PV industry in recent years, however, the situation has changed. In 2007, more than half of the worldwide production of electronic grade silicon was used to produce solar cells.

This growing demand has motivated the silicon industry to change its approach. Silicon for solar cells can be of lower quality than that required for semiconductors, and can thus be produced more cheaply. Several companies have therefore begun to develop processes for producing solar grade silicon. The development of these production lines and construction of the first factories will still take time, however. So, until all the new planned production facilities for solar grade silicon are operational, the PV industry will continue to compete with the semi-conductor industry for the currently limited supply available on the market.

It is expected that by 2008 the availability of solar grade silicon for the PV industry will lead to a much more relaxed situation in the silicon market. Between 2008 and 2010 it is projected that more than €4.1 billion will be invested in up-scaling silicon production capacities.

Solar cell and module production

In 2008, the level of investment in new plants to manufacture solar cells and modules is expected to exceed €1.6 billion. This excludes wafer and silicon manufacturing capacities. This figure underlines the pace at which the PV industry is expanding in order to satisfy global demand.

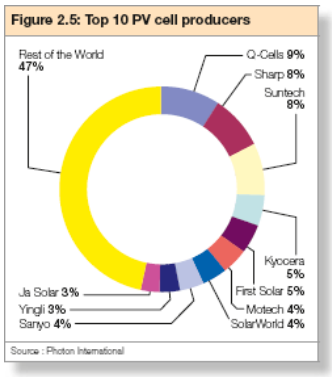


Aerial view of the German Parliament with PV modules integrated on the roof

Up to now, the manufacture of solar cells and modules has been concentrated in three key geographical areas – Europe, Japan and the United States. However, the country with the strongest growth in production facilities is China.

The leading cell production companies can be

seen in Figure 2.5. Although until a few years ago the market was dominated by BP Solar, a subsidiary of the multinational oil company, this situation has radically changed with the entry of new Japanese and European players. More recently, the leading company in cell production has been the Japanese company Sharp. However, in 2007 Sharp has continued to lose market share relative to its competitors, in particular the German-based Q-Cells and Solarworld and the Chinese Suntech.



These have together decreased the dominant position of Sharp from 23.6% in 2005 to 8.5% in 2007. In 2007 Q-Cells became the new market leader. Just over 53% of all cell production is handled by the 10 biggest companies (compared to 75 % in 2006); nearly all of these are currently investing heavily in new production facilities.

An important issue for manufacturers is being able to match the opening of new production capacity with expected demand. Investors need a planning horizon that goes beyond a typical factory's write-off period of five to seven years. Some smaller companies have nonetheless been able to obtain investment from public share ownership, often through one of the increasing number of green investment funds. This is why the relative stability of systems such as the German feed-in tariff, has proved crucial to business commitment. In anticipation of a flourishing market, Germany has seen a steady increase in both solar cell and module manufacture from 1995 onwards. Further encouraged by the Renewable Energy Law, updated in 2004, annual production of PV cells increased from 32 MW in 2001 to around 850 MW in 2007.

The higher up the PV value chain one travels, the fewer companies are involved. At the upper end of the chain, silicon production requires substantial know-how and investment, as does the production of wafers. At the level of cell and module producers, on the other hand, where knowhow and investment needs are smaller, there are many more players in the market. At the end of the value chain, the installers are often small, locally-based businesses.

A Green Message

Using renewable solar energy enables us to reduce the use of fossil fuels to generate energy. Fossil fuel energy generation pollutes our environment. You are empowered to help. Do your part. Be a responsible global citizen. **Save Gaia.**