Developments in Photovoltaic Energy Conversion

or

Status of PV in Europe, Japan and the US

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In 2001, the photovoltaic industry delivered world-wide some 395 MWp of photovoltaic generators and the Sarasin Study 2002 [1]. forecasts sales of approximately 500 MW in 2002. In the past years, the yearly growth rate had an average of 30%, making further increase of production facilities an attractive investment for industry. About 85% of the current production volume uses crystalline silicon technology. This technology is well established in the markets, achieves sufficient efficiency for at least 20 years of lifetime and constitutes a low-risk investment with high expectations on return on investments. Should growth in this technology continue as in the past years, the supply of cost-effective silicon feedstock might give reason to lower the limits in cost reduction, if feedstock costs cannot be kept below some 0,50 €/Wp.

Similar to learning curves in other technology areas, a second generation of devices will steadily increase its market share. This 2nd generation technology, after years of research and technology -but also lawsuits-, is readily available and just on transition from pilot to industrial production. This regards equally thin film Silicon, CdTe and CI(G)Se. This trend will be accelerated by the positive market development and there are many indications that the required scale-up to manufacturing units of 50 MWp yearly capacity will soon join 1st generation silicon devices in satisfying the demand. However, the growth of thin film production capacity within this decade must be at least 40% to achieve a market share of 50% in the photovoltaic production of 2010, assuming that total PV growth continues at a constant 27% per year. By then, Silicon technology would deliver about 1500 MWp per year, requiring probably 12,000 metric tons of Si-Feedstock, about half of today's entire Silicon world production, and one can speculate that thin-film technology will continue to grow even faster. Further cost reduction will depend not only on the scale-up benefits, but also on the cost of the encapsulation system, as efficiency will remain limited below 15%, stimulating strong demand for very low area-proportional costs.

For bulk power production with a significant share in the electricity generation, the

years beyond 2015 require a new 3rd generation technology, where further cost reduction can only be achieved by a significant higher conversion efficiency, assuming that area-proportional costs cannot be further reduced. In a very simplistic view, R&D of the past two decades can be divided along two major avenues. One being the continuous efficiency improvement of conversion, material use and production processes, the other being the development of materials other than silicon, either allowing higher conversion efficiency or lower production costs.

Consistent with the time needed for any major change in the energy infrastructure, another 20 to 30 years of sustained and aggressive growth will be required for PV to substitute a significant share of the conventional energy sources. This growth will be only possible if a continuous introduction of new technologies takes place, made possible by sound fundamental research.

The rising number of market implementation programmes in Japan and the European as well as the different regional incentive programmes in the US, contribute to increase the demand for solar systems. In the long-term the growth rates for photovoltaics will continue to be high, even if the economic frame conditions can lead to a short-term slow down of the growth rates. This presentation tries to give an overview about the current activities in Japan, the US and Europe regarding Research, Manufacturing and Market Implementation.

[1] Sarasin Studie: PV 2002 Markt, Akteure und Prognosen, August 2002 (www.sarasin.ch/sustainability)