

SWITZERLAND

PV TECHNOLOGY STATUS AND PROSPECTS

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Fig. 1 - 5,5 kWp Freestyle® thin film system on the roof of a single-family house in Lutry.
(photo: Solstis)

GENERAL FRAMEWORK

During the entire year 2003, the main policy framework set by the *SwissEnergy* Programme (www.swiss-energy.ch) was the subject of difficult parliamentary discussions in the context of a wide-ranging government savings message for the period 2004 to 2006. This ongoing political debate throughout 2003 gave rise to large insecurities to all those involved in the field. Originally, it was proposed that the programme should come to an end by 2006 but support from a wide range of partners, including the cantons, led to the programme's survival, however at a reduced budget. *SwissEnergy* is focussed on market oriented support actions for energy efficiency and renewable energy; hence, this area will be most affected by the budget cuts. Further budget reductions are to be expected.

Another important decision regarding energy policy matters was the public referendum regarding the proposed abandon or moratorium for nuclear energy. The two initiatives were rejected by the voters, following strongly polarised public discussions. Both policy elements lead to a more stringent framework regarding the deployment of new, and in particular, renewable energy technologies. In the future, energy research will be affected in the area of market related activities, namely pilot- and demonstration projects. The stronger emphasis on relevance for climate policy goals is not favourable for the more short-term aspects of photovoltaics.

Based on strategic policy goals (energy & environment, science & education, industry & society), the Federal Commission for Energy Research (CORE), in cooperation with the Swiss Federal Office of Energy (SFOE), developed a new 4 year energy RTD master plan for the period 2004 – 2007, split up into programmes and sub

programmes. This master plan establishes the goals and priorities for energy RTD. According to this master plan, RTD in photovoltaics remains a subject of priority for the considered period.

NATIONAL PROGRAMME

Switzerland has a dedicated national photovoltaic RTD programme which involves a broad range of stakeholders in a strongly coordinated approach (www.photovoltaiic.ch). This national photovoltaic programme focuses on R&D in a system and market oriented approach, from basic research, over applied research, product development, pilot and demonstration projects all the way to market stimulation. On the technical level, thin film solar cells and building integration are the foremost topics of priority. The programme is organised along the entire value chain and addresses the critical gaps from technology to the market place.

Accompanying measures to raise the quality and reliability of photovoltaic power systems include thorough component analysis, work on standards and design tools. On the market side, deployment is promoted by a customer-oriented approach in the campaign "solar electricity from the utility." Finally, the programme puts emphasis on information and communication in order to raise the awareness for opportunities involving photovoltaics. Direct promotion of the market through incentive schemes is within the responsibility of the cantons on a voluntary basis. This has led to regional differences whereby the governments of the cantons define their priorities between promotion of energy efficiency and/or renewable energies. Support for photovoltaics through direct subsidy schemes is limited to a few cantons presently.



*Fig. 2 - 70 kWp flat roof system at the exhibition centre Palexpo in Geneva.
(photo: NET)*

Through the bias of Task 9 of the IEA PVPS Programme, the subject of technology co-operation with developing countries has received increased interest. During 2003, the concept of a new interdepartmental platform for the promotion of renewable energy in international co-operation was developed. As a side-effect of the Swiss participation in PVPS Task 9, the Swiss engineering company Enecolo became involved in a GEF-supported project on building integrated photovoltaics in Malaysia.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

The Swiss Photovoltaic RTD Programme is based on a 4 year RTD master plan, 2003 being the last year covered in the period from 2000 – 2003. A follow-up master plan will be published in 2004. Overall, 85 projects, supported by various national and regional government agencies, the research community and the private sector are conducted in the different areas of the photovoltaic energy system. Market orientation, cost reduction, industrial viability and transfer as well as increased efficiency and reliability are the main objectives of the technical R&D.

For solar cells, the main focus remains on thin film solar cells with projects in a wide variety of materials (amorphous and microcrystalline silicon, compound semiconductors, dye-sensitised cells). Transfer to industry of these RTD activities has continuously increased over the past years. The spin-off company VHF-Technologies is setting up a manufacturing plant of amorphous silicon solar cells on plastic substrates. Another technology transfer is occurring with the equipment manufacturer Unaxis. Building on the strong synergies with this company's expertise for production equipment of flat panel displays, Unaxis is setting up a new business unit Unaxis solar.

This new venture of Unaxis with the Institute of Microtechnology at the University of Neuchâtel intends to develop a leading position in the industrial production equipment of thin film "micromorphous" silicon solar cells.

A strong emphasis continues to be placed on the application of building integration, both for new solutions involving thin film solar cells as well as for new mounting systems and structures for sloped roofs and facades.

With the ongoing market development, quality assurance of products and systems as well as standardisation continues to be of high priority. Three centres of competence have been established which evaluate products such as PV modules, inverters and components for building integration. Long term experience with the operation of photovoltaic power systems is carefully tracked for a number of grid-connected systems, ranging between 10 and more than 20 years of operation. Continuous development of system solutions has resulted in a number of industrial products which are increasingly being exported.

International co-operation continues to form a strong pillar of the R&D activities with about 25 projects running in the 5th framework RTD programme of the European Union during 2003. International projects are also carried out as part of programmes such as the European Union Altener Programme or the European Space Agency. The co-operation within the IEA PVPS programme has remained a further strategic activity for which target-group specific dissemination is crucial.



*Fig. 3 - 9,7 kWp façade system at the cable-car station Piz Nair in St. Moritz.
(photo: NET)*

IMPLEMENTATION

The majority of the market implementation of PV systems continues to be driven by the campaign for "solar electricity from the utility". Since the introduction of the naturemade® labels for renewable electricity, utilities have started introducing different product brands, some with a mix of different renewable energy sources and others with technology specific products, e.g. the product "Premium Solar" by the utility of the city of Zurich. Increasingly, solar electricity is thus part of mixed green power products, according to naturemade star® labeled brands. The willingness to pay the comparatively high prices for solar electricity is typically around 5 % of the customers in the best cases and requires a strong and consistent marketing approach. With mixed products however, more customers can be attracted.

In the absence of broad national incentive schemes, this concept has enabled more than 7 MWp of PV systems installed with a high awareness effect among the public. The campaign has proved to be a successful approach, involving different stakeholders, provided that a strong and consistent marketing is undertaken. More than 5,5 GWh are annually subscribed under this model and another 0,7 GWh of solar electricity is part of mixed products. Benefits were identified also by the utilities in introducing new customer relationships. However, the total market volume under this scheme is presently saturated at about 1,5 MWp/year.

INDUSTRY STATUS

Some years ago, Swiss industrial PV products covered mainly system components such as inverters, both for grid-connected and stand-alone applications, components for electrical connection, mounting systems for building integration and custom designed PV modules. Over the past years, industrial activities in the area of solar cells, solar modules and manufacturing equipment for both of these areas have increased considerably.

In the inverter area, some products have achieved a high export rate. The Sputnik Company produces grid-connected inverters at a capacity of 50 MW/year and presently ranges as number 3 in the European market. The Studer Company produces stand-alone inverters and is very successful in the export too. On the PV industry supply side, different products count among the world leaders, e.g. for wire-sawing machines from HCT as well as Meyer & Burger and measuring equipment for PV module manufacturers from Belval. In addition to the solar plugging systems from Multi-Contact, another company, Huber & Suhner, has entered into this market.

More recently, industrial activities have started in the field of process equipment (see above, Unaxis solar) and small scale products based on thin-film technology (Flexcell® from VHF-Technologies). Furthermore, Swiss Sustainable Systems (3S) is building some of the world's largest PV module laminators.

Based on long term experience and the large number of installed systems, considerable know-how is available amongst engineering companies for the design, construction and operation of a large variety of different applications, ranging from small scale, stand alone systems for non-domestic, professional applications and remote locations, over small domestic grid-connected systems to medium and large size grid-connected systems in various types of advanced building integration.

Besides an increased interest from the manufacturing industry, the finance sector continues to promote financial services directed towards renewable energy. Increased investments have occurred in the renewable energy sector, including photovoltaics, and dedicated funds are operated by important finance organisations. This trend clearly demonstrates the growing perception of the renewable energy sector as a field of increasing business opportunities.

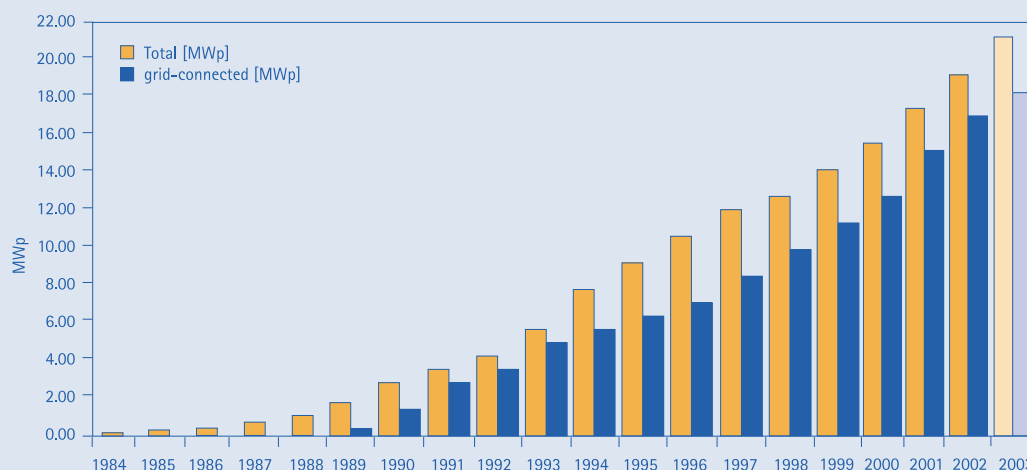


Fig. 4 – Evolution of the installed photovoltaic capacity in Switzerland between 1984 and 2003 (total and grid-connected, estimated values for 2003).

MARKET DEVELOPMENT

The market development has been mainly driven by the federal campaign "solar electricity from the utility," supported by promotional programmes and actions in some cantons as well as pilot & demonstration projects within the national programme. The annual market volume for grid-connected systems is estimated to about 1,9 MWp, similar to previous years. The total installed capacity thus rises to about 21 MWp (Figure 4), corresponding to about 3 Wp/capita. The PV energy statistics has been established tracking the energy produced by grid-connected PV systems and their statistical distribution since 1992 (Table 1).

FUTURE OUTLOOK

Regarding photovoltaic technology in Switzerland, the broad support of the national PV programme can be expected to continue with an ever-increasing focus on industrial developments, new products for niche markets and ongoing international involvement. For solar cells and modules, the effort to bring Swiss technology to the market place will continue. Efforts in the technology development will concentrate on market oriented approaches and continuous quality assurance. The strategy to promote international co-operation on all levels will continue, related to activities in the 6th framework programme of the European Union, the IEA PVPS programme and increasingly in technology co-operation projects.

In the next years, PV market implementation will increasingly depend on the initiatives of regional authorities and even more on those from the private sector, namely the utilities. A market volume of about 2,0 MWp/year can be expected under these circumstances.

PV market implementation will continue to be limited to indirect promotion measures within the federal energy programme, the activities of regional authorities and the initiatives by the utilities. The strategy to promote international co-operation on all levels will continue, related to activities in the 6th framework programme of the European Union, the IEA PVPS programme and increasingly in technology co-operation projects.

TABLE 1: SWISS PHOTOVOLTAIC ENERGY STATISTICS FROM 1989 – 2002

Year	Number of New Systems	Total Number of Systems	Installed Capacity [MWp DC]	Energy Production [MWh]	Specific Energy-Production [kWh / kWp]
1989	60	60	0,3		
1990	110	170	0,8	400	
1991	210	380	1,8	1 100	
1992	110	490	3,1	1 800	800
1993	110	600	4,0	3 000	810
1994	80	680	4,8	3 500	800
1995	60	740	5,4	4 000	815
1996	80	820	6,2	4 700	825
1997	130	950	7,4	6 000	880
1998	150	1 100	9,2	7 100	860
1999	125	1 225	11,0	7 700	770
2000	100	1 325	13,0	10 000	810
2001	125	1 450	15,0	11 000	800
2002	75	1 525	17,0	12 000	810

(grid-connected systems)