

SWITZERLAND

PV TECHNOLOGY STATUS AND PROSPECTS

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GENERAL FRAMEWORK

For the policy framework, the year 2001 was characterised by the launch of the new Swiss energy programme, SwissEnergy (www.swiss-energy.ch). SwissEnergy is a Swiss federal government programme for the promotion of renewable energy and more efficient use of energy. It involves the collaboration of the cantons and of a great many local authorities as well as the private sector, and various environmentalist and consumer groups. SwissEnergy is the follow-up to the Energy 2000 Action Programme and like it, will have a duration of 10 years.

The objectives that have been set for the new SwissEnergy programme are derived from the Swiss federal constitution, the federal energy law and the CO₂ law, and also reflect Switzerland's commitments under the international convention on climate warming. Specifically, these objectives are as follows:

- The consumption of fossil fuels in Switzerland and the corresponding CO₂ emissions must be reduced by 10 percent between 2000 and 2010.
- The growth of electricity demand must not exceed 5 percent.
- Hydropower's share of final electricity consumption must not be reduced despite deregulation of the Swiss electricity market.
- The contribution made by other forms of renewable energy must increase to 0.5 Terawatt-hours (TWh) or 1 per cent of total electricity production, and in the case of heating energy to 3 TWh or 3 per cent of the total.

Other important SwissEnergy objectives that are less easy to measure include the development of a greater awareness of the energy dimension among the general public as a prerequisite for the optimum implementation of voluntary measures; even closer cooperation among all partners; a spirit of innovation in all fields and an overall strengthening of the Swiss economy in the end.



Fig. 1 - Photovoltaic metal roof system using amorphous thin film solar cells.
(photo NET)



Fig. 2 - The world's largest solar electricity boat, Mobicat, for 150 passengers.
(photo NET)

NATIONAL PROGRAMME

The national photovoltaic programme focuses on R&D in a market oriented approach, with the implication of a broad set of stakeholders, from basic research, over applied research, product development, pilot and demonstration projects all the way to market stimulation. To increase the quality of new systems, a number of software tools for improved project design and recommendations for project implementation are available. Further accompanying measures which help to support and promote market deployment include the customer-oriented promotion in the campaign "solar electricity from the utility." Finally, the programme emphasizes information and communication in order to raise the awareness for opportunities involving photovoltaics. Direct promotion of the market through incentive schemes has become 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. On the technical level, thin film solar cells and building integration remain the foremost topics of priority. The subject of technology co-operation with developing countries has gained increased interest and new concrete activities are in progress.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

The Swiss Photovoltaic RTD Programme is based on a 4 year RTD concept, presently covering the period from 2000 – 2003. Overall, 80 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.

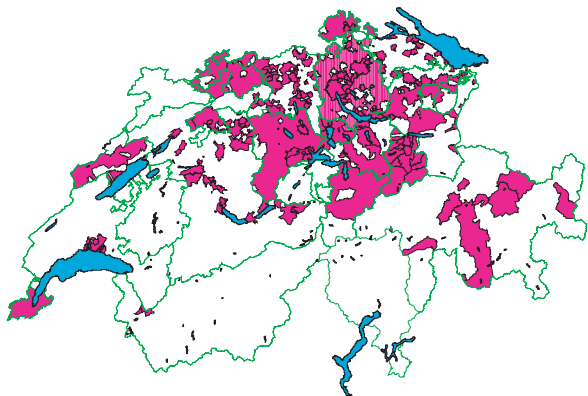


Fig. 3 - Availability of solar electricity in the service territories of the Swiss utilities

For solar cells, the main focus remains on thin film solar cells with projects in a wide variety of materials (amorphous and microcrystalline silicon, silicon-germanium, compound semiconductors, dye-sensitised cells). Depending on the advancement of this R&D work, transfer to industry is more or less developed. A number of new ventures with industry have begun throughout the year. Further basic R&D is carried out in new materials, e.g. in zeolyte crystals. A strong emphasis is 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. Two new roof mounting systems involving advanced frames (Solrif® and AluTec / AluVer®) have been particularly successful in the market, corresponding to about 5 MWp of installed power, and have resulted in considerable export shares. New building integrated projects have been realised with thin film modules (Figure 1), including CIS cells. Stand-alone systems have found new applications in solar boats, including the world's largest solar driven catamaran (Figure 2) for 150 passengers.

With the ongoing market development, quality assurance of products and systems, as well as standardisation are becoming topics 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 20 years of operation. International co-operation continues to form a strong pillar of the R&D activities with about 20 projects running in the RTD-programmes of the European Union. 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.

IMPLEMENTATION

The majority of the market implementation of PV systems continues to be driven by the campaign for "solar electricity from the utility." By the end of 2001, more than 130 utilities (1996: 7) provided solar electricity to their customers. Different financial models are being implemented according to the preferences of the utilities. Meanwhile, more than 50% of the Swiss population have access to solar electricity and more than 30 000 customers annually subscribe to about 4 GWh of this new energy service (Figure 3). Through the past 5 years, this concept has enabled about 5 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 a strong and consistent marketing is undertaken. Benefits were identified also by the utilities in introducing new customer relationships.

With the introduction of the labels "naturemade basic®" and "naturemade star®" for green power products (www.naturemade.ch), promotion of green power includes portfolio approaches of different technologies. For the "nature made star®" label, 2.5% of the total energy delivered in a service area has to be from new renewable energies (photovoltaics, wind, biomass). Using these labels, green electricity is now also promoted as part of the SwissEnergy programme.

INDUSTRY STATUS

Swiss industrial PV products cover 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. On the PV industry supply side, different products count among the world leaders, e.g. for wire-sawing machines and measuring equipment for PV module manufacturers. In the past, assembled PV modules based on crystalline silicon technology were introduced into the market to form aesthetically attractive products for building integration. Whilst the main market driver, the campaign "solar electricity from the utility," has favoured least cost solutions on flat roofs (Figure 4), industrial development shows a trend towards higher integration and innovation, partly with thin film technologies.

More recently, industrial activities have started in the field of process equipment and small scale products based on thin-film technology. This development reflects the existing technological know-how within the research community, combined with an increasing awareness of new market opportunities by the industry.



Fig. 4 - 240 kWp PV system on the Basel fair building. (photo energiebüro)

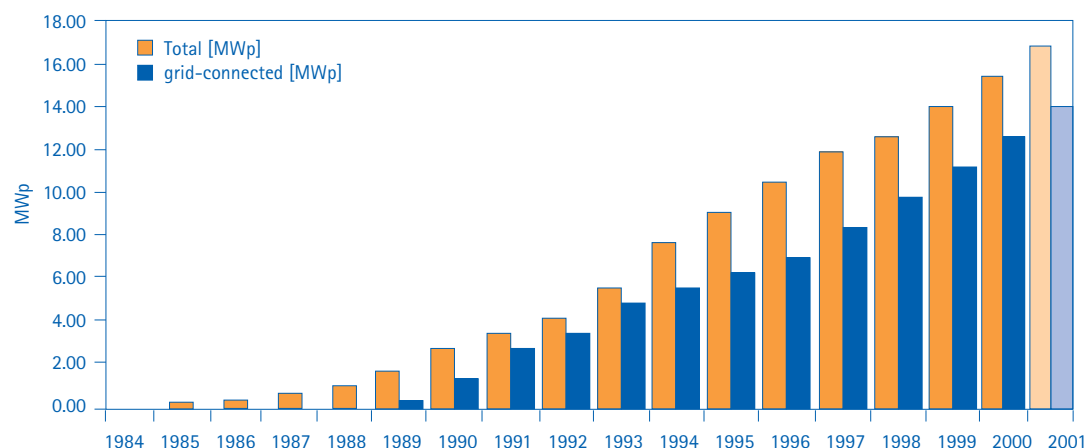


Fig. 5 – Evolution of the installed photovoltaic capacity in Switzerland between 1984 and 2001 (total and grid-connected, estimated values for 2001)

Based on the 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. A new agency, BASE, (www.energy-base.org) seeks to facilitate investment in renewable energy and energy efficiency projects. 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. Following the results of the referendum regarding Swiss energy policy in the year 2000 and a stagnating market for grid-connected systems, a certain consolidation of the industry can be observed with a trend to more international involvement of the engaged companies, both in market orientation as well as industry and investment structure.

MARKET DEVELOPMENT

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 and demonstration projects within the national programme. The annual market volume for grid-connected systems is estimated to be about 2,2 MWp, that is in the range of previous years. The total installed capacity thus rises to about 17 MWp (Figure 5), corresponding to about 2,4 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 for 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.

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 year 2002 will bring another important energy policy decision relating to the new law on the electricity market. If accepted, this law would favour the implementation and use of renewable energy through preferential conditions in the market access.

The strategy to promote international co-operation on all levels will continue, related to activities in the 5th and 6th framework programme of the European Union, the IEA PVPS programme and in-creasingly in technology co-operation projects.

TABLE 1: SWISS PHOTOVOLTAIC ENERGY STATISTICS FROM 1989 – 2000

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	12,7	9 700	810

(grid-connected systems)