

SWITZERLAND

PV TECHNOLOGY STATUS AND PROSPECTS

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GENERAL FRAMEWORK

The year 2000 was a special year for energy matters in Switzerland as the most important decision since 10 years regarding the future energy policy was to be taken in a public referendum in September, following many years of a strong political debate.

Expectations for a stronger role of renewable energies and energy efficiency were very high due to expected longer term promotion, based on the introduction of an ecological tax reform on the one hand and an intermediate energy levy on non-renewable energies on the other hand. Although these energy levies were adopted by both chambers of the Swiss Parliament, the political system in Switzerland also requires an adoption by the citizens in a public referendum.

To the strong deception of the interested parties, the result of the public referendum went against all proposed changes. In the short term, there will therefore be no stronger promotion of renewable energy and energy efficiency as originally planned. On the other hand, the goals set in the Kyoto protocol are still valid and may require the introduction of a CO₂ tax in the next few years unless the necessary progress is achieved regarding climate change issues.

In spite of the general deception about these negative decisions amongst interested parties, some positive aspects can be discerned: The support for a stronger promotion of renewable energies

and energy efficiency was nevertheless by 46% of the population which is a strong minority. Moreover, a detailed analysis of the referendum results shows that many of the urban areas were favourable towards the proposed changes, indicating the sensitivity in these areas suffering more strongly from air pollution and traffic consequences.

This does not change the fact that the promotion of renewable energies will be limited in the years to come, as far as market introduction is concerned. RTD activities are not subject of the discussion and will continue, including the international cooperation within IEA programmes. Support for renewable energies will be based on more regional initiatives in general and on utility involvement for photovoltaics. In the legal framework, the new law on the electricity market will establish full liberalisation for small scale renewable energy. As from 2001, a follow-up of the National Action Programme Energy 2000, EnergieSchweiz – SuisseEnergie – SvizzeraEnergia – SwissEnergy has been launched and will continue the efforts for a sustainable energy supply by promoting energy efficiency and the use of renewable energies in a market oriented approach. As one of the short-term contributions, electricity from renewable energy will be marketed using recently developed, labels (naturemade basic® and naturemade star®) for certification.



PV roof integration in a low energy house with SOLRIF(Solar Roof Integration Frame), 12 kWp, Enecolo

NATIONAL PROGRAMME

The missing short-term support of broad-based incentives for the market introduction of photovoltaics does not imply a strategy away from the market, on the contrary. The Swiss National PV Programme will subsequently continue and even increase the focus on advanced but market oriented technology concepts in all parts of the photovoltaic energy system. Strong industry involvement for a rapid technology transfer remains a strategic issue. Building integration of photovoltaics will be the main application area but activities in other niche markets will be enhanced in order to favour industrial activities. Enhancement of international co-operation and quality assurance measures will follow a continuous, market oriented approach. As established successfully during the last years, a very broad range of stakeholders will be involved in the further technology development and implementation of photovoltaics in order to ultimately form a robust, market-driven energy technology. The recent field of activity on technology co-operation, triggered by the participation in IEA PVPS Task 9, will be further explored to establish more substantial contributions in this area.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

With a focus towards the development of new solutions, products and applications, the Swiss Photovoltaic RTD Programme emphasises cost-reduction, efficiency and industrial compatibility in a system-oriented approach. With more than 80 active projects in R,D&D, all major elements of the photovoltaic (PV) energy system are being investigated: Solar cells covering a large variety of materials, modules and building integration, system technology and quality assurance, combined use with other energy technologies as well as accompanying measures for efficient planning and control. A number of innovative solar cell concepts, derived from advanced semiconductor physics and photoelectrochemistry, have been proposed in the last years. There is a strong focus on thin film silicon materials and their combinations, such as the "micromorph" concept. While terrestrial energy applications are the primary aim of these investigations, small scale appliances and, more recently, space applications using thin film solar cells on polymer substrates have received increased attention. Industrial involvement in the solar cell technology area is increasingly being addressed leading to first industrial production facilities to be expected in a near future.

New solutions for building integrated photovoltaics are being developed with the aim of better integration concepts for a variety of situations (flat and sloped roofs, facades, other building elements and noise barriers). This constitutes the primary application sector targeted and a number of successful products and systems have been developed in the last years. Due to the increasing number of installed PV systems in the last 10 years in Switzerland, system technology has matured towards a range of industrial products for inverters, electrical connections products and planning tools. Practical experience from realised projects is collected, carefully analysed and used to further improve the products and solutions. Further technological development in the area of building integrated PV is expected from the introduction of thin-film technologies.



PV roofs in the old town of Interlaken, semi-transparent modules, 6 kWp, Fabrisolar

International co-operation through the programmes of the EU and the IEA is sought in all these sectors and has been successfully established. As the programme follows an application and system-oriented approach, a strong co-operation involving all stakeholders exists between the research community, the industry, the public sector and the utilities.

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 2000, more than 100 utilities (1996: 7) provided solar electricity to their customers. Different financial models are being implemented according to the preferences of the utilities. More than 3 Mio customers meanwhile have access to solar electricity and more than 21 000 customers annually subscribe to about 3,5 GWh of this new energy service. Through the past 4 years, this concept has enabled about 4 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. A marketing study revealed that there remains an untapped potential for this action to further contribute to the deployment of PV systems.

INDUSTRY STATUS

Swiss industrial PV products used to cover mainly components for grid-connected building integrated systems where inverters, components for electrical connection, mounting systems for building integration and custom designed PV modules form the major products. 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 last years, assembled PV modules based on crystalline silicon technology were introduced into the market to form aesthetically attractive products for building integration, in particular regarding roofing shingles.

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

Table 1: Swiss photovoltaic energy statistics from 1989 – 1999 (grid-connected systems)

Year	Number of systems	Installed Capacity [MWp DC]	Energy Production [MWh]	Specific Energy-Production [kWh / kWp]
1989	60	0,3		
1990	170	0,8	400	
1991	380	1,8	1 100	
1992	490	3,1	1 800	800
1993	600	4,0	3 000	810
1994	680	4,8	3 500	800
1995	740	5,4	4 000	815
1996	820	6,2	4 700	825
1997	950	7,4	6 000	880
1998	1 100	9,1	7 100	858
1999	1 220	10,9	7 700	770

know-how within the research community, combined with an increasing awareness of new market opportunities by the industry. In the future, this could evolve towards integrated PV products for building integration based on thin-film technology. Solar cells "made in Switzerland", a long expected evolution, are about to become a reality.

Besides this increased interest from the manufacturing industry,

MARKET DEVELOPMENT

Thanks to the campaign "solar electricity from the utility" and together with the support from the federal government subsidy programme (including pilot & demonstration systems), the annual market volume for grid-connected systems was about 1,6 MWp. The total installed capacity thus rises to 15 MWp or more than 2 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 increased focus on industrial developments, new products for niche markets and ongoing international involvement. For solar cells and modules, the next generation of thin film technologies are about to enter into the market, including some products from Switzerland. Efforts in the technology development will concentrate on market oriented approaches and continuous quality assurance.

PV market implementation will be limited to indirect promotion measures within the federal energy programme, the activities of regional authorities and the initiatives by the utilities. These activities nevertheless form interesting opportunities which will however lead to stronger regional differences than in the past. With the new law on the electricity market and the introduced labels for ecological electricity products, new opportunities for renewable energy technologies are expected due to increased product differentiation and free trade of these products. Further support is sought within the structure of the feed-in tariffs for renewable energies.



PV façade on a school building in Zurich, insulating glass modules, 11,5 kWp, TNC (façade view)

the finance sector is currently developing new products oriented towards renewable energy. Increased investments have occurred in the renewable energy sector, including photovoltaics, and new, dedicated funds have been established by important finance organisations. This trend clearly demonstrates the growing perception of the renewable energy sector as a field of increasing business opportunities.