SWITZERLAND

PV TECHNOLOGY STATUS AND PROSPECTS
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Fig. 1 – 5 kWp PV Façade System. Schötz, Lucerne (photo: Solventure GmbH).

GENERAL FRAMEWORK AND IMPLEMENTATION

Recent national energy scenarios and studies have confirmed an important contribution expected from photovoltaics in a future sustainable electricity supply. In 2011, the relevance of photovoltaics has increased following the government's decision to step out of nuclear power as a consequence of the Fukushima nuclear accident. According to the recent scenarios, in absolute terms, some 10 – 12 TWh could come from photovoltaics by 2050, representing some 20 % of the present national electricity consumption. The solar industry claims such contributions to be achievable much sooner.

The development of the photovoltaic sector in Switzerland builds on a strong research and technology base, an increasing industrial activity and, more recently, an acceleration of the market deployment efforts. A comprehensive research programme covers R&D in solar cells, modules and system aspects. The Swiss energy research strategy is defined by an energy RTD master plan updated every four years, with 2011 as the fourth year of the present period 2008 – 2011. The master plan developed by the Federal Commission for Energy Research (CORE) in cooperation with the Swiss Federal Office of Energy (SFOE) is based on strategic policy goals (energy & environment, science & education, industry & society) (www.energieforschung.ch).

Market deployment continues to grow at moderate levels, thanks to the feed-in-tariff scheme now available for a few years. However, the size of the Swiss photovoltaic market is limited by the cap on the amount of support attributed to photovoltaic projects and many projects are presently on a waiting list. To support the deployment of renewable electricity through the feed-in tariff model, a levy up to 0,009 CHF per kWh consumed electricity is being perceived, yielding a total annual amount up to 480 MCHF. This amount is divided into maximum contributions for different renewable energy technologies (hydropower up to 10 MW, biomass, photovoltaics, wind and geothermal energy) depending on their specific generation costs. In respect of PV, these maximum contributions started with 5 % of the available financial envelope and increase over time, as the photovoltaic generation costs come down, up to a maximum of 30 %. Thus photovoltaics and the entire support scheme are subject to a cap. This cap is presently under discussion in the Swiss parliament, particularly related to the new energy strategy for 2050. No short term changes are however expected for the support framework, except for regular reductions of the feed-in tariffs applied.

The photovoltaic sector in Switzerland further developed in the year 2011, the most important increase taking place in the market implementation, whereas R&D and industrial activities remained roughly constant at a high level. On the technology front, the key

Fig. 2 – 81,18 kWp Integrated PV Trapezoidal Roof System. Mörschwil, St. Gallen (photo: ALUSTAND®).

Fig. 3 – 64 kWp PV Installation on the Muottas Muragl Cable Railway. Samedan, Graubünden (photo: gvz-rossat ag/sa).

competence centres continued their efforts in their respective domains (solar cells, modules and systems) while increasing their cooperation with industry and on the international level.

The support of the national PV RTD programme can be expected to continue with a focus on innovative research activities, rapid technology transfer, industrial developments, new products for niche markets and ongoing international involvement. Amplified by the strong Swiss currency, global competition for industry has fiercely increased. Nevertheless, the efforts to bring Swiss technology to the market place continue. Efforts in the technology development will concentrate on short to medium term market oriented approaches and continuous quality assurance.

The strategy to promote international co-operation on all levels will continue, related to activities in the 7th Framework Programme of the European Union, the European PV Technology Platform, the IEA PVPS programme and in technology co-operation projects.

While costs of photovoltaics are rapidly coming down, the policy debate in the new energy strategy for 2050 continues, in particular concerning possible adaptations to the regulatory framework. In parallel, increased interest and market activities can be observed on the utility side.

NATIONAL PROGRAMME

Switzerland has a dedicated national photovoltaic RTD programme which involves a broad range of stakeholders in a strongly coordinated approach (www.photovoltaic.ch). This national photovoltaic programme focuses on R&D,D in a system and market oriented approach, from basic research, over applied research, product development, pilot and demonstration projects all the way to accompanying measures for market stimulation. On the technical level, thin film solar cells and building integration continue to be the topics of highest priority. The programme is organised along the entire value chain and addresses the critical gaps from technology to the market place. Thorough component and system analysis, as well as testing, aim at increasing efficiency and performance. Accompanying measures to raise the quality and reliability of photovoltaic power systems include work on standards and design tools.

RESEARCH, DEVELOPMENT AND DEMONSTRATION

In the fourth year of the present RTD master plan, around 70 projects, supported by various national and regional government agencies and the private sector, were conducted in the different areas of the photovoltaic energy system. Innovative solutions, 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 and organic solar cells). Work on thin film silicon at the Swiss Federal Institute of Technology (EPFL) in Neuchâtel concentrated on micromorphous solar cells with a particular emphasis on silicon oxide intermediate reflector layers. Significant progress was also achieved in the area of high-efficiency heterojunction silicon solar cells. Industry co-operation was extended with various companies. Based on these co-operations, the oerlikon solar Company announced a new record efficiency of 12,5 % for micromorphous solar cells.

With regard to CIGS solar cells, the Swiss Federal Laboratories for Materials Testing and Research EMPA focused the work on high efficiency flexible CIGS cells on plastic and metal foils. As a highlight, a new record efficiency of 18,7 % was announced for CIGS solar cells on plastic substrate. For dye-sensitised solar cells,

Fig. 4 – 60,3 kWp Single Axis PV Tracker System with Solar Wings on Ski Lift. Tenna, Graubünden (photo: hassler energia alternativa ag).

work continued at EPFL on new dyes and electrolytes as well as high temperature stability of the devices. Exploratory work was undertaken on new solar cell concepts (organic and extremely thin absorber (ETA) cells) at EMPA. An increasing interest for photovoltaic technology can be observed at various research institutions as well as from industry. In line with the international trend to a broader scientific and technological base, increased activities take place in the fields of nanotechnology, chemistry and numerical modelling.

On the part of application oriented research, emphasis continues to be given to building integrated photovoltaics (BIPV), both for new solutions involving thin film solar cells as well as for new mounting systems and structures for sloped roofs and facades. A dedicated website deals with the topic of BIPV (www.bipv.ch) and includes information about available products.

As a new topic, grid integration has received increased interest and new projects have started in this area. With the ongoing market development, quality assurance and reliability of products and systems, as well as standardisation, continue to be of high priority. The Swiss centres of competence at the Technical Universities of Burgdorf and Lugano carefully evaluate products such as PV modules, inverters and new systems. The test infrastructure is continuously expanding and recently includes the largest solar simulator for inverter testing up to 100 kW capacity (Burgdorf, www.pvtest.ch) as well as a new test centre for IEC module certification (Lugano, www.isaac.supsi.ch/pv/labo). Long term experience with the operation of photovoltaic power systems is carefully tracked for a number of grid-connected systems, ranging between 10 and 30 years of operation. Continuous development of system solutions has resulted in a number of industrial products well positioned in the export market.

Work continues for the first prototype of the solar powered airplane SolarImpulse (www.solar-impulse.com) by Bertrand Piccard. Meanwhile, the solar powered boat PlanetSolar (www.planetsolar.org) has continued its journey around the globe throughout the whole year. The completion of the first maritime journey around the world solely by solar energy is expected in May 2012.
On its way, the boat has stopped in many prestigious places to convey the message of the possibilities of solar photovoltaic energy.

International co-operation continues to form a strong pillar of the R&D activities with more than 20 projects running in the 7th framework RTD programmes of the European Union during 2011. The co-operation within the IEA PVPS programme has remained a further strategic activity.

On the programme level, international co-operation is also taking place through the European PV-ERA-NET project (www.pv-era.net) and the European Photovoltaic Technology Platform (www.eupvplatform.org).

INDUSTRY AND MARKET DEVELOPMENT

Since a few years, Swiss industrial PV products cover the full value chain starting from materials, production equipment and small scale manufacturing of solar cells, over diverse components and products all the way to system planning and implementation.

On the PV industry supply side, different products count among the world leaders, e.g. for wiresawing machines from Meyer Burger as well as from Applied Materials Switzerland; and measuring equipment for PV module manufacturers from Pasan (now a part of Meyer Burger Group). Solar plugging systems are offered by Multicontact as well as Huber & Suhner.

Industrial activities evolve in the field of process equipment (oc oerlikon) and products based on thin-film technology. Swiss Solar Systems (3S), also part of the Meyer Burger Group, is building some of the world's largest PV module laminators. Roth & Rau, largely acquired by Meyer Burger, has intensified its Swiss R&D activities into heterojunction silicon solar cells. Komax is active in various steps of the module manufacturing chain.

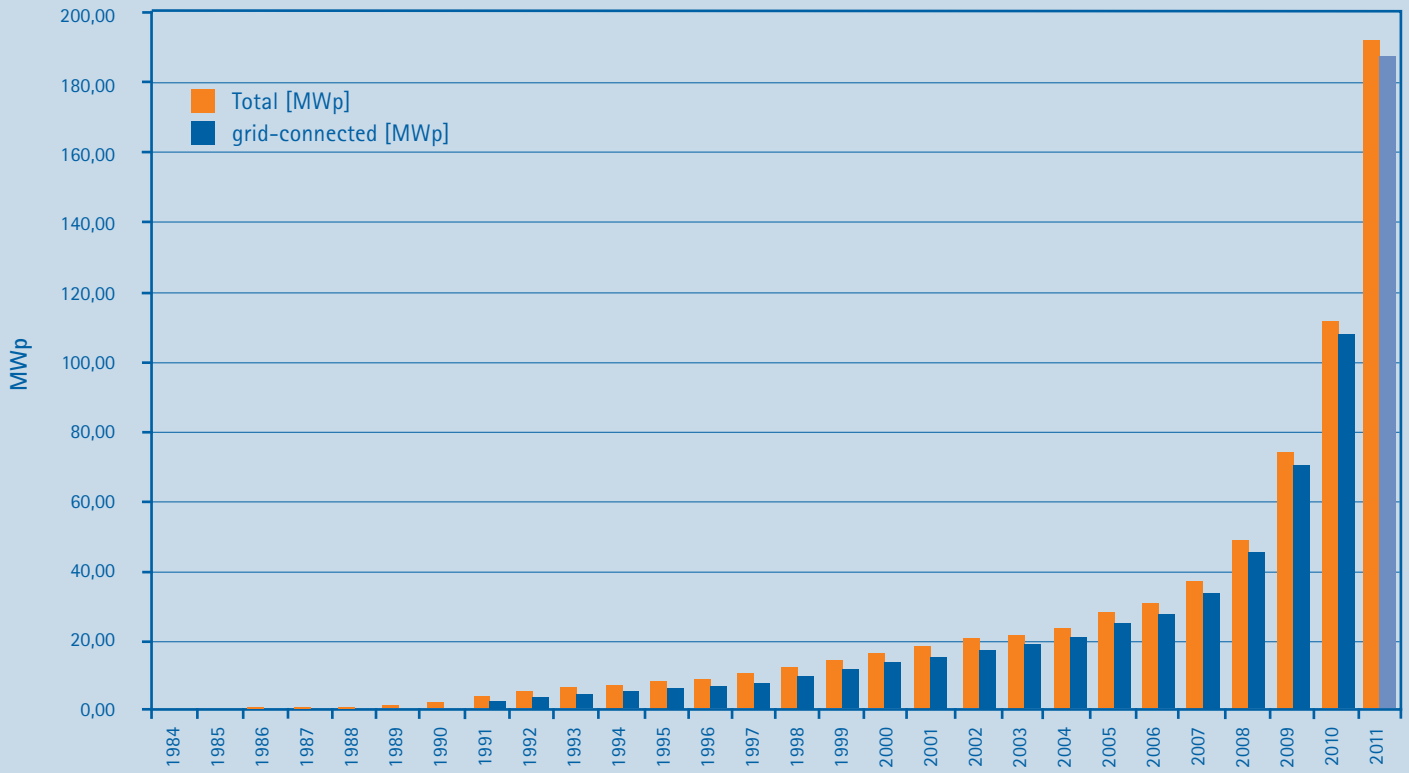

Fig. 5 - Evolution of the installed photovoltaic capacity in Switzerland between 1984 and 2011 (total and grid-connected, estimated values for 2011).

Inverters have proved to be an export success. Sputnik Engineering produces grid-connected inverters with a capacity of 600 MW per year and presently ranks as number 3 in the European market. Studer Innotec has had comparable success with their stand-alone inverters. More recently, ABB has entered the inverter market.

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. The export volume of Swiss photovoltaic products continues to be high, with more than 90 % of the annual turnover.

Besides an increased interest from the manufacturing industry, the finance sector continues to promote financial services directed towards renewable energy. This trend is manifested by the regular investment analysis reports published by the Bank Sarasin (www.sarasin.ch).

Formerly mostly driven by utilities own green power marketing schemes, there has been a strong development in the framework of the new feed-in tariff support scheme. This PV feed-in tariff distinguishes between three different categories of systems, namely ground based, building applied and building integrated systems (BIPV) for which the highest tariff can be obtained. The applicable tariff also depends on the size of the PV system. In this way, a differentiated scheme is used which is based on regular market analysis to follow the dynamics of the market.

Fig. 6 - 5,1 kWp ARTline PV Façade System, Alp Dado/Laax, Graubünden (photo: SolarMarkt GbmH Aarau).

The annual market volume for grid-connected systems is estimated to a value around 100 MWp, of which about 80 MWp were installed in 2011. The total installed capacity has thus risen to more than 190 MW (Figure 5), corresponding to close to 25 W/capita.