SWITZERLAND

PV TECHNOLOGY STATUS AND PROSPECTS
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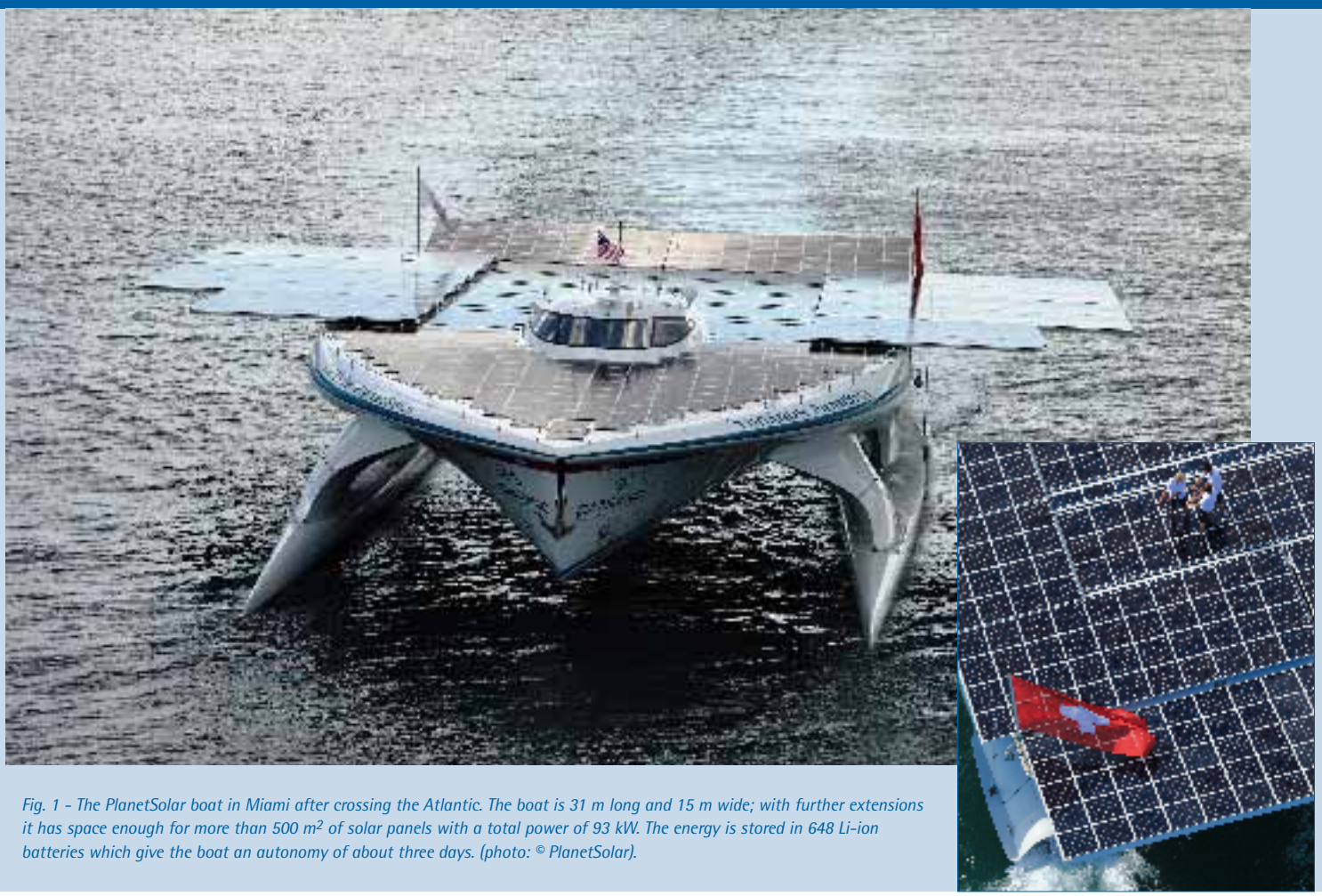

Fig. 1 - The PlanetSolar boat in Miami after crossing the Atlantic. The boat is 31 m long and 15 m wide; with further extensions it has space enough for more than 500 m² of solar panels with a total power of 93 kW. The energy is stored in 648 Li-ion batteries which give the boat an autonomy of about three days. (photo: © PlanetSolar).

GENERAL FRAMEWORK

The development of the photovoltaic sector in Switzerland builds on a strong research 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 2010 as the third 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). It confirms the important position of photovoltaic RTD in the Swiss energy RTD landscape.

Market deployment continued at a moderate level, thanks to the feed-in-tariff scheme which became effective the year before. The size of the Swiss photovoltaic market is however 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 presently 0,9 cCHF 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. Concerning photovoltaics, these maximum contributions begin with 5 % of the available financial envelope and can increase over time, as the photovoltaic generation costs come down, up to a maximum of 30 %. Both the total envelope as well as the possible contribution by photovoltaics are thus capped.

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. Activities in pilot and demonstration projects continued to be limited during 2010. 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. Through component and system analysis 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.

Fig. 2 - Edisun Power 840 kW PV on 3 different roofs at the PISTOR facility in Rothenburg (photo: PISTOR).

Fig. 3 - Solar Impulse flying near Mont Blanc in July 2010. (photo: © Solar Impulse).

RESEARCH, DEVELOPMENT AND DEMONSTRATION

In the third year of the present RTD master plan, around 65 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 11,9 % 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 17,6 % was announced for CIGS solar cells on plastic substrate. For dye-sensitised solar cells, 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 for 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.

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 25 years of operation. Continuous development of system solutions has resulted in a number of industrial products well positioned in the export market.

From vision to reality: The first prototype of the solar powered airplane SolarImpulse (www.solar-impulse.com) by Bertrand Piccard has reached a major milestone by achieving a first 26 hour non-stop flight. On the other hand, the solar powered boat PlanetSolar (www.planetsolar.org) finished its construction phase early in the year and started its world tour in September in Monaco. The boat reached Cancun right in time for the 16th United Nations Climate Change Conference in December 2010.

International co-operation continues to form a strong pillar of the R&D activities with 18 projects running in the 7th framework RTD programmes of the European Union during 2010. During 2010, a second joint call was terminated together with other European PV RTD programmes in the field of grid integration of photovoltaics. 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), the European Photovoltaic Technology Platform (www.eupvplatform.org) and the European Solar Industry Initiative.

INDUSTRY STATUS

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.

Fig. 4 - Building integrated systems benefit from higher feed-in tariffs and represent 25 % of the systems installed: 46,8 kW system on a farm house in Uettligen (Berne) (photo: Swiss Federal Office of Energy).

Industrial activities evolve in the field of process equipment (oc oerlikon) and products based on thin-film technology (Flexcell® from VHF-Technologies, FLISOM, Pramac). Furthermore, Swiss Solar Systems (3S) is building some of the world's largest PV module laminators whereas Komax is active in various steps of the module manufacturing chain. 3S and Meyer Burger have merged their activities thereby becoming the largest PV industry group in Switzerland.

In the inverter area, some products have achieved a high export rate. The Sputnik Company produces grid-connected inverters at a capacity of 800 MW/year and presently ranks as number 3 in the European market. The Studer Company produces stand-alone inverters and is also very successful in exporting.

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 and is estimated at more than 2 000 MCHF in 2010.

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 is manifested by the regular investment analysis reports published by the Bank Sarasin (www.sarasin.ch).

MARKET DEVELOPMENT

The market development, which was formerly mainly driven by green power marketing schemes of utilities, has experienced a strong development in the framework of the new feed-in tariff support scheme. The Swiss legislation explicitly foresees the possibility of switching between the feed-in tariff and the voluntary green power marketing approach.

The feed-in tariff for PV systems 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 feed-in 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. Due to the tariff applied for BIPV systems, this market segment corresponds to 25 % of the installed systems. The majority of systems are realised as building applied systems (74 %) whereas ground based systems only account for 1 %.

The annual market volume for grid-connected systems is estimated to a value around 30 MWp. The total installed capacity has thus risen to more than 100 MW (Figure 5), corresponding to more than 13 W/capita. The PV energy statistics have been established by tracking the energy produced by grid-connected PV systems and their statistical distribution since 1992 (Table 1). The total energy production of grid-connected photovoltaic systems up to 2009 is thus approaching 50 GWh.

FUTURE OUTLOOK

The photovoltaic sector in Switzerland developed considerably in the year 2010, be it in research and technology, industry or the market. On the technology front, the key competence centres continued their efforts in their respective domains (solar cells, modules, systems) while increasing their cooperation with industry and on the international level.

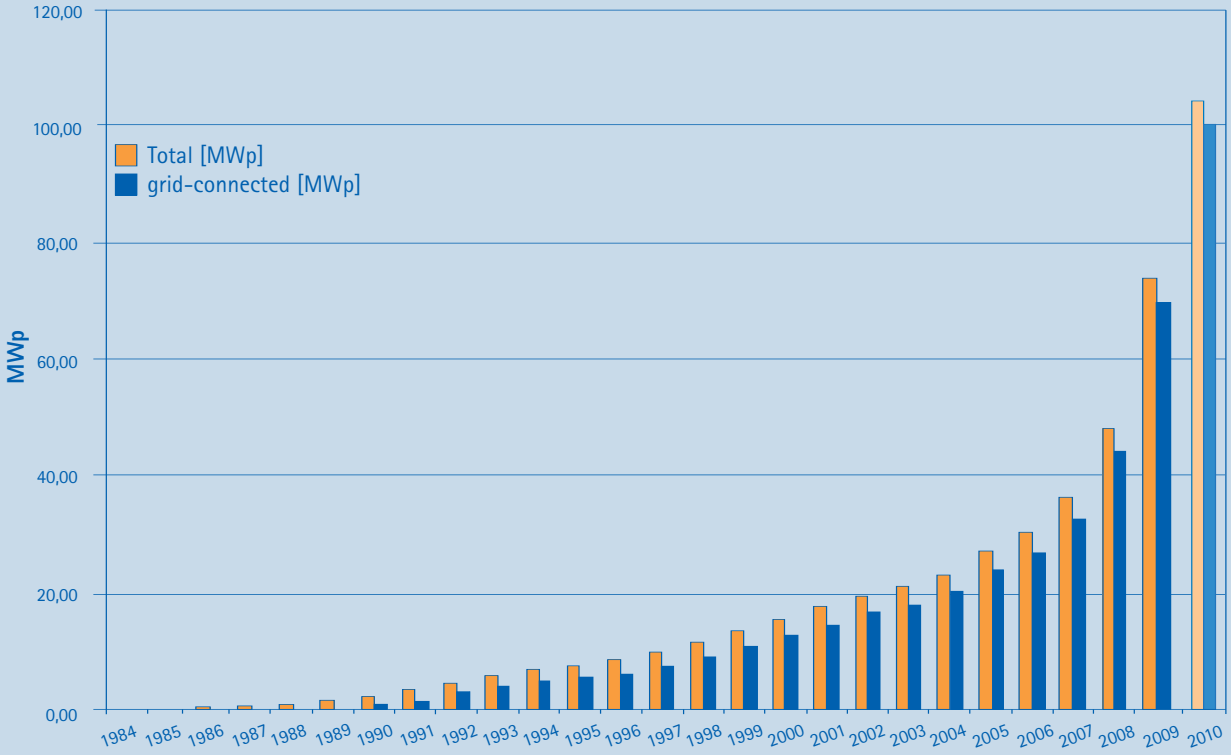

Fig. 5 - Evolution of the installed photovoltaic capacity in Switzerland between 1984 and 2010 (total and grid-connected, estimated values for 2010).

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. For solar cells and modules, the efforts to bring Swiss technology to the market place is expected to materialise in further industrial activity. Efforts in the technology development will concentrate on short to medium term market oriented approaches and continuous quality assurance. In parallel, the more basic and longer term research activities are being increased.

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 increasingly in technology co-operation projects. Stronger co-operation with other European PV RTD Programmes and further joint projects will be established in the framework of the PV-ERA-NET project.

Based on the experience with the feed-in tariff scheme and as a result of the ongoing policy discussion, the next years will be most interesting concerning the domestic market development. On the supply side, new players can be expected, leading to increased competition. On the demand side, stronger marketing activities and end-user orientation will need to take place in order to reach and satisfy new customers.

TABLE 1: SWISS PHOTOVOLTAIC ENERGY STATISTICS FROM 1989 - 2009 (GRID-CONNECTED SYSTEMS)

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	16,6	12 000	810
2003	75	1 600	17,9	15 100	875
2004	100	1 700	19,5	15 200	815
2005	200	1 900	23,6	18 200	850
2006	250	2 150	26,1	21 000	845
2007	525	2 675	32,6	25 700	875
2008	1 200	3 875	44,1	33 400	865
2009	1 900	5 775	69,6	49 000	860