IEA INTERNATIONAL ENERGY AGENCY

# National Survey Report of PV Power Applications in Switzerland 2013

Swisspor 1000 kW, courtesy solstis sa

PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

**Prepared by**

**Pius Hüsser, Nora Farrag, Nova Energie GmbH, Aarau**

# TABLE OF CONTENTS

## Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The 24 participating countries are Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), China (CHN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Thailand (THA), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission (EC), the European Photovoltaic Industry Association (EPIA), the US Solar Electric Power Association (SEPA), the US Solar Energy Industries Association (SEIA) and the Copper Alliance are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org

## Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "*Trends in photovoltaic applications*" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2013. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

# 1 INSTALLATION DATA

The PV power system market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, **PV installations are included in the 2013 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2013, although commissioning may have taken place at a later date**.

## 1.1 Applications for Photovoltaics

More than 99% of the Swiss market are grid connected systems. Since also rural areas are fully electrified, there is only a small market for of grid systems.

Most of the systems are BAPV (Building Attached PV, added to a existing tilted roof (tiles) or on flat roofs. Ground mounted systems account for less than 1% of the 319 MW installed in 2013.

PV on sheds (Farm buildings) have an above average share of the installed capacity. This is also due to some financial schemes only for farmers (interest free loans).

Building integrated PV (BIPV) has a reasonable share due to a premium FiT.

## 1.2 Total photovoltaic power installed

Swissolar, the Swiss solar professional association, on behalf of the federal office of energy, is responsible for the annual statistics of installed PV systems. This is done by sending out questionnaires to his member companies (installers, module distributers, manufacturers).

It is estimated, that about 85% of the market is covered with this survey. To validate the data, there is a registration for systems above 30 kVA compulsory since begin of 2013 (Guarantees of origin and electricity labelling).

In coming years, this database will provide more reliable data especially for larger systems.

The quality and accuracy of the data is expected to be around +- 10%.

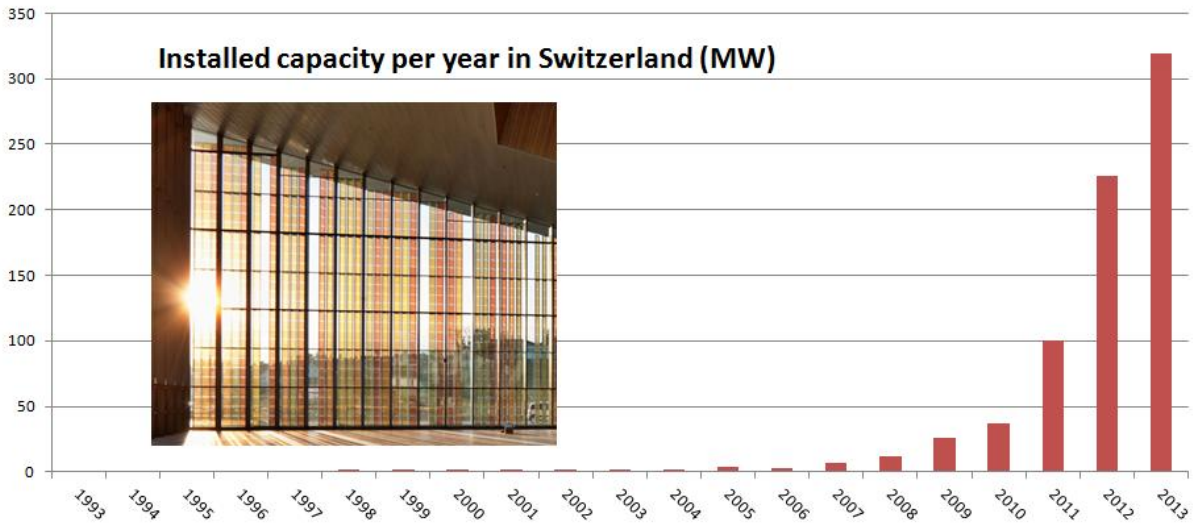

**Table 1: PV power installed during calendar year 2013**

| AC | | | MW installed in 2013 (mandatory) | AC or DC |
|---|---|---|---|---|
| **Grid-connected** | BAPV | Approx. 75%* | 318,900 | DC |
| | BIPV | Approx. 25%* | | |
| | Ground-mounted | Less than 1%* | | |
| **Off-grid** | | Residential | 0,140 | DC |
| | | Other | | |
| | | Hybrid systems | | |
| | | **Total** | 319,040 | |

*Best estimate based on FiT registered installations until 2013

**Table 2: Data collection process:**

| | |
|---|---|
| Data collection is done by sending out a questionnaire to installers and distributors/importers<br>It is expected, that the reported market data account for 85% of the overall PV market. | Done by Swissolar on behalf of the Federal office of energy |
| Links to official statistics | www.swissgrid.ch Statistics of the FiT registered PV systems<br>www.swissolar.ch Official statistic as mentioned above |
| Accuracy of data | +- 10% |

**Table 3: PV power and the broader national energy market.**

| *Energy market* | 2013 numbers | 2012 numbers |
|---|---|---|
| Total power generation capacities (all technologies) | Approx. 18,7 GW | Approx. 18,3 GW |
| Total power generation capacities (renewables including hydropower) | Approx. 14,7 | Approx. 14,3 GW |
| Total electricity demand (= consumption) | 59,3 TWh | 59,0 TWh |
| New power generation capacities installed during the year (all technologies) | 0,4 GW | 0,3 GW |
| New power generation capacities installed during the year (renewables including hydropower) | 0,4 GW | 0,3 GW |
| Total PV electricity production in GWh-TWh | 544 GWh | 320 GWh |
| Total PV electricity production as a % of total electricity consumption | 0.9 % | 0,5 % |

**Table 4a: PV systems - market segmentation (numbers)***

| **Type of system** | **2013 new added** | **2013 cumulated** |
|---|---|---|
| single family homes: | **4078** | 16'570 |
| apartment buildings: | **781** | 2'515 |
| Industrial buildings | **967** | 5'485 |
| Farm houses | **1063** | 4'310 |
| Commercial buildings | **95** | 465 |
| Municipal & state owned buildings | **274** | 1'945 |
| Traffic infrastructure and buildings | **7** | 60 |
| others: | **2** | 225 |
| **Total:** | **7267** | **31.765** |

*Markterhebung Sonnenenergie 2013, Juni 2014, Bundesamt für Energie

**Table 4b: PV systems size (only FiT scheme registered systems)***

| System size | 2013 | Cumulated 2008-2013 |
|---|---|---|
| **0 - 10 kW** | 32% | 63% |
| **10,1 - 30 kW** | 23% | 18% |
| **30,1 - 100 kW** | 26% | 12% |
| **100,1 - 1000 kW** | 19% | 7% |
| **> 1000 kW** | 0% | 0% |

*Swissgrid, KEV-Bezüger 2013

Table 4c: Other information

| | |
|---|---|
| Capacity of decommissioned PV systems during the year in MW | 0 |
| Total capacity connected to the low voltage distribution grid in MW | Approx. 95%<br>Normally up to 1 MVA can be connected to the low voltage grid |
| Total capacity connected to the medium voltage distribution grid in MW | Approx. 5% |
| Total capacity connected to the high voltage transmission grid in MW | 0% |

**Table 5: The cumulative installed PV power in 4 sub-markets.**

| | Cumulative installed capacity as of 31 December 2013 (kW) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-market** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** |
| **Stand-alone domestic** | **1 540** | **1 675** | **1 780** | **1 940** | **2 030** | **2 140** | **2 210** | **2 300*** | **2 390*** | **2 480*** | **2 570*** | **2 740*** | **2 810*** | **2 930*** | **3 050*** | **3 200*** | **3 800** | **4 000** | **4 100** | **4 200** | **4 MW** | **4 MW** |
| **Stand-alone non-domestic** | **70** | **100** | **112** | **143** | **162** | **184** | **190** | **200*** | **210*** | **220*** | **230*** | **260*** | **290*** | **320*** | **350*** | **400*** | | | | | | |
| **Grid-connected distributed** | **2200** | **2900** | **3 600** | **4 050** | **4 850** | **5 950** | **7 630** | **9 420** | **11 220** | **13 340** | **15 140** | **16 440** | **18 440** | **21 240** | **23 740** | **30 040** | **41 540** | **67 040** | **104 140** | **206 700** | **433 MW** | **752MW** |
| **Grid-connected centralised** | **900** | **1 100** | **1 200** | **1 350** | **1 350** | **1 450** | **1 470** | **1 480** | **1 480** | **1 560** | **1 560** | **1 560** | **1 560** | **2 560** | **2 560** | **2 560** | **2 560** | **2 560** | **2 560** | | | |
| **TOTAL (kW)** | **4 710** | **5 775** | **6 692** | **7 483** | **8 392** | **9 724** | **11 500** | **13 400** | **15 300** | **17 600** | **19 500** | **21 000** | **23 100** | **27 050** | **29 700** | **36 200** | **47 900** | **73 600** | **110 900** | **211 100** | **437 MW** | **756 MW** |

- Swiss PV market increased in 2013 by 46 % to about 319 MW newly installed capacity (39 W/capita). This was driven by another reduction of Feed in Tariffs (FiT) by approx. 10% during 2013. Due to this reduction the federal office of energy could increase the yearly cap for PV.
- Besides the (capped) national FiT scheme there are still many regional, local and utility support schemes either with direct subsidies or FiTs equal or below those on the federal level.

## 2 COMPETITIVENESS OF PV ELECTRICITY

### 2.1 Module prices

Module prices vary between 0,75 and 1,15 CHF/$W_p$ depending on origin and module type.

Lowest prices are for standard modules from China whereas BIPV modules produced in small quantities may even be more expensive than the above mentioned 1,15 CHF/$W_p$

**Table 6: Typical module prices for a number of years**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| Standard module price for small systems in the range of 3 to 10 kWp | 4.30 | 4.80 | 5.20 | 5.00 | 5.00 | 3.80 | 3.60 | 2.50 | 1.30* | 1.00* |
| Best price, large systems (>100kWp) | 4.10 | 4.60 | 5.00 | 4.80 | 4.80 | 3.30 | 2.20 | 1.30 | 0.85* | 0.80* |

*Source Photovoltaik-Grossanlagen in der Schweiz, Branchenstruktur und Preisentwicklung Mai 2014, Ernst Basler + Partner AG, May 2014

### 2.2 System prices

A summary of typical system prices is provided in the following tables.

**Table 7**: **Turnkey Prices of Typical Applications**

| Category/Size | Typical applications and brief details | Current prices per W |
|---|---|---|
| OFF-GRID Up to 1 kW | Holiday houses, traffic control and many other applications | 8.00 to 15.00 |
| OFF-GRID >1 kW | Alpine huts, alpine dairies<br>Maximum size for large alpine huts in the range of 10 to 20 kW | 6.00 to 12.00 |
| Grid-connected Rooftop up to 10 kW (residential) | Roof mounted (attached) | 3.00 to 4.50* |
| Grid-connected Rooftop from 10 to 250 kW (commercial) | Roof mounted (BIPV) | 2.10 to 3.30** |
| Grid-connected Rooftop above 250kW (industrial) | Industry or public building (attached) | 2.10** |
| Grid-connected Ground-mounted above 1 MW | Industry or public building (BIPV) | No data available, no market |

*Source: Erfassung der Referenzpreise von PV-Anlagen, Swissolar Juni 2014

**Source: Photovoltaik-Grossanlagen in der Schweiz, Branchenstruktur und Preisentwicklung Mai 2014, Ernst Basler + Partner AG, May 2014

**Table 8: National trends in system prices (current) for different applications**

| YEAR | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-20 kW | 13.00 | 13.00 | 12.50 | 11.80 | 11.00 | 10.40 | 10.20 | 10.10 | 9.90 | 9.40 | 9.20 | 8.40 | 7.50 | 8.5 | 9.00 | 9.10 | 8.70 | 7.25 | 6.50 | 4.5 | 3.50 | 3.25 |
| 3-4 kW | 13.40 | 13.30 | 13.20 | 12.80 | 12.60 | 12.30 | 12.30 | 11.90 | 12.50 | 12.20 | 11.00 | 9.25 | 9.10 | 10.00 | 10.0 | 9.65 | 9.80 | 8.80 | 7.00 | 6.50 | 5.00 | 4.50 |

The standard size for single family houses, for many years in the range of 2 to 4 kW, increased in the last couple of years considerably to 5 to 10 kW. The specific costs for systems of 3 kW or less thus remained comparatively high due to fixed costs like administration (grid connection), security issues while working on a roof etc.

## 2.3 Financial Parameters and programs

**Table 9: PV financing scheme**

| Type of system | Average Cost of capital (Interest rate) |
|---|---|
| Residential systems are mainly financed by increasing the mortgage | 1% - 2.5 % |
| PV on commercial buildings owned and operated by the building owner also get low interest mortgages | 1% - 3.5 % |
| Third party investors on rented roofs have to pay higher interest rates depending also on the bankability of the project and the credibility of the investor | 2% - 6% |

## 2.4 Additional Country information

This paragraph provides additional information regarding the country's population and additional parameters linked to its electricity system.

**Table 10: Country information**

| | |
|---|---|
| Retail Electricity Prices for an household (range) | Household: Varies greatly according to area and utility. Prices typically:<br>Night time: CHF 0.08 – 0.12 per kWh<br>Day time: CHF 0.14 – 0.25 per kWh |
| Retail Electricity Prices for a commercial company (range) | Commercial / Public institution: Strongly dependent on consumption and regional utility:<br>Night time: CHF 0.07 – 0.09 per kWh<br>Day time: CHF 0.12 – 0.16 per kWh |
| Retail Electricity Prices for an industrial company (range) | Industry can mostly negotiate electricity prices depending on demand / supply situation and own power production. |
| Population at the end of 2013 (or latest known) | 8 136 689 |
| Country size ($km^2$) | 41 285 |
| Average PV yield (according to the current PV development in the country) in kWh/kWp | Typical values of kWh / kW for PV systems: 950 – 1100 kWh/kW for central plain. Higher in mountainous areas and in southern Switzerland. |
| Electricity industry structure | No major utility<br>Structure and ownership: Heterogeneous with both vertically integrated and separate generation, transmission and distribution. Both municipal and state owned as well as private organisations are involved. Trend toward liberalisation and privatization. An electricity industry regulator www.swissgrid.ch is responsible for the high voltage transmission. Approx. 75% of the utilities are public owned. |

# 3 POLICY FRAMEWORK

## 3.1 Direct support policies

**Table 11: PV support measures (summary table)**

| | On-going measures | Measures that commenced during 2013 |
|---|---|---|
| Feed-in tariffs | Starting in 2009, the Feed in Tariff system is similar to that from Germany with different prices for small and big systems and type of installation, BIPV, roof mounted, ground mounted.<br>Duration of payment: 25 years<br>Cap: Approx. 60 MW in 2013 | Swiss parliament increased the levy per kWh form 0,9 Rp/kWh to 1,5 Rp/kWh<br>Average FiT approx. minus 20% compared to the 2012 FiT average |
| Capital subsidies for equipment or total cost | Some cantons with direct subsidies<br>3 cantons with FiT (Geneva, Basel Stadt, Basel Land) | |
| Green electricity schemes | Naturemade, certified renewable electricity scheme | |
| PV-specific green electricity schemes | Solar stock exchange | |
| Renewable portfolio standards (RPS) | Only on a voluntary basis by some utilities | |
| PV requirement in RPS | Low, mostly hydro, wind and biomass | |
| Investment funds for PV | None | |
| Income tax credits | yes | |
| Prosumers' incentives (self-consumption, net-metering, net-billing…) | Some utilities for small installations only | Swiss parliament voted for a self consumption scheme in 2013. Put into force in 2014. |
| Commercial bank activities e.g. green mortgages promoting PV | none | |
| Activities of electricity utility businesses | Many utilities build and operate their own small up to large PV plants | |
| Sustainable building requirements | yes | |

## 3.2 Direct Support measures

### *3.2.1 Support measures in 2013*

*3.2.1.1 Description of support measures excluding prosumers, BIPV, and rural electrification*

The FiT scheme for all renewable has still strong support from Swiss parliament and administration. For PV, although there is a cap, it has a strong influence on the market.
A lot of installations are built in hope, that within a couple of years they will profit from the FiT scheme.

*3.2.1.2 Prosumers' development measures*

In 2013 Swiss parliament adopted a new legislation which allows self consumption. The surplus must be purchased by the DSO with a minimum price according to the Swiss market prices for standard electricity.

This comes into force in 2014.

*3.2.1.3 BIPV development measures*

The FiT scheme has an extra category for BIPV systems with a tariff slightly higher than for "normal" roof mounted systems (BAPV)

*3.2.1.4 Rural electrification measures*

There are more or less no rural, inhabited areas which are not connected to the grid

*3.2.1.5 Decentralized storage and demand response measures*

Research and simulation of decentralized high penetration of PV systems in combination with local and on site storage is done by some utilities as well as the universities.
But there is no support scheme for the time being for decentralized storage.

### *3.2.2 Support measures phased out in 2013*

None

### *3.2.3 New support measures implemented in 2013*

None

### *3.2.4 Measures currently discussed but not implemented yet*

In order to have future zero energy buildings, it is under discussion to have new building codes where the onsite electricity production for new buildings become compulsory. For most of the buildings this means PV.

### *3.2.5 Financing and cost of support measures*

The FiT is financed by a levy on the electricity bill. In 2013 this was 0.45 Rp/kWh. For 2014 this levy has been increased to 0.6 Rp/kWh (and 1.1 Rp/kWh for 2015).
The maximum levy has been increased to 1.5 Rp/kWh by the Swiss parliament in June 2013.

Besides this, residential systems also get tax incentives and in a number of cantons direct subsidies if the owner declares not to profit from the national support scheme in future.

## 3.3 Indirect policy issues

### *3.3.1 Taxes on pollution (e.g. carbon tax)*

The $CO_2$-Tax for fossil fuels for heating purposes has been increased but has a low effect on electricity production costs since there is only a small share of fossil electricity production in Switzerland

### *3.3.2 National policies and programmes to promote the use of PV in foreign non-IEA countries*

REPIC is an interdepartmental platform for the promotion of renewable energy and energy efficiency in international cooperation. It is a joint initiative of the Swiss State Secretariat for Economic Affairs (SECO), the Swiss Agency for Development and Cooperation (SDC) as well as the Swiss Federal Office of Energy (SFOE).

There is a list of more than 20 PV projects, mostly in African countries dealing with a wide variety of topics like training courses for PV installers, BIPV, Business models etc.

# 4 HIGHLIGHTS OF R&D

## 4.1 Highlights of R&D

Excerpt from the Swiss PVPS Annual Report:
In 2013, more than 75 projects, supported by various national and regional government agencies, the European Commission and the private sector, were conducted in the different areas of the photovoltaic energy system. Innovative solutions, cost reduction, increased efficiency and reliability, industrial viability and transfer as well as adequate market orientation 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 (crystalline silicon, 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 is being concentrated on micromorphous solar cells with a particular emphasis on silicon oxide intermediate reflector layers. Significant progress is also being achieved in the area of high-efficiency heterojunction silicon solar cells, reaching efficiencies above the 22% mark. Industry co-operation has been extended with various companies. In 2013, with important support by the Swiss Confederation, CSEM (Centre Suisse d'électronique et microtechnique) has established a new photovoltaic technology centre in Neuchâtel. The mission of this PV technology centre is to accelerate the transfer of innovative PV technologies to the industry by an increased collaboration and a dedicated infrastructure.

With regard to CIGS solar cells, the Swiss Federal Laboratories for Materials Testing and Research EMPA focuses the work on high efficiency flexible CIGS cells on plastic and metal foils. As a highlight, a new record efficiency of 20.4 % was announced in 2013 for CIGS solar cells on plastic substrates, thus representing a substantial increase of the last record of 18.7% achieved the year before. This efficiency record is slightly higher than that for CIGS cells on glass and in the range of best multicrystalline silicon solar cells.

For dye-sensitised solar cells, work continues at EPFL on new dyes and electrolytes as well as high temperature stability of the devices. Important progress has been achieved at the Laboratory of Photonics and Interfaces at EPFL concerning perovskite-sensitized solar cells. Using sequential deposition for the formation of the perovskite pigment, solar cell efficiencies of more than 15% were achieved in 2013 and have since reached values of 17%. Perovskite-sensitized solar cells have thus demonstrated the steepest efficiency increase in recent years and attract a large interest by the global PV research community.

Organic solar cells are the research subject at the Swiss Federal Laboratories for Materials Testing and Research EMPA, the University of Applied Sciences in Winterthur (ZHAW) as well as at CSEM in the Basel region. In this technical area, CSEM coordinates the large European project Sunflower.

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. Related to BIPV systems in the market support schemes, the requirements for the recognition as BIPV systems have been clarified. Various other PV applications on built infrastructure, e.g. ski lifts or snow avalanche protections, have recently been proposed and realised in pilot installations.

As a recent topic rapidly gaining relevance in some countries and regions, grid integration has continued to generate interest and recent projects have extensively analysed the

implications of PV on the distribution grid. Methods to considerably increase the share of PV in distribution grids have been identified based on detailed modelling work. High levels of PV penetration in distribution grids are thus no longer considered as insurmountable barriers.

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 Universities of Applied Sciences of Lugano and Burgdorf carefully evaluate products such as PV modules, inverters and new systems. The test infrastructure is continuously expanding and in-cludes the accredited test centre for IEC module certification (Lugano, http://www.supsi.ch/isaac/swiss_pv_module_test_centre.html) as well as the largest solar simulator for inverter testing up to 100 kW capacity (Burgdorf, www.pvtest.ch). 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 30 years of operation. Continuous development of system solutions has resulted in a number of industrial products well positioned in the export market.

Work continued on the second prototype of the solar powered airplane SolarImpulse (www.solar-impulse.com) by Bertrand Piccard, André Borschberg and their team. Meanwhile, further flight experience was gained with the first prototype with a flight across the USA. The solar powered boat PlanetSolar (www.planetsolar.org), after its tour around the world by solar energy completed in 2012, accomplished the 2013 DeepWater expedition, a scientific mission across the Atlantic ocean contributing to the understanding of the gulf stream relevant for climate research.

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 2013. The co-operation within the IEA PVPS programme has remained a further strategic activity.

Regarding international co-operation on the programme level, the new European SOLAR-ERA.NET project (www.solar-era.net) launched its first joint call for projects covering both PV and concentrated solar power (CSP) which had a high resonance in the research community. The col-laboration with the European Photovoltaic Technology Platform (www.eupvplatform.org) continued throughout the year, establishing a new strategy of this relevant European platform.

## 4.2 Public budgets for market stimulation, demonstration / field test programmes and R&D

Public budgets have been slightly increased in the last couple of years (since Fukushima)

**Table 12: Public budgets for R&D, demonstration/field test programmes and market incentives.**

| | R & D | Demo/Field test/market incentives |
|---|---|---|
| National/federal | n/a | FiT: 65 Mio |
| State/regional | n/ | Approx. >10 Mio market incentives |
| Total | Approx. >100 Mio | |

# 5 INDUSTRY

## 5.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

There is no feedstock, ingots and wafer production in Switzerland anymore.

Swiss Wafers went bankrupt mid 2013

**Table 13: Production information for the year for silicon feedstock, ingot and wafer producers**

| Manufacturers (or total national production) | Process & technology | Total Production | Product destination (if known) | Price (if known) |
|---|---|---|---|---|
| none | Silicon feedstock | tonnes | | |

## 5.2 Production of photovoltaic cells and modules (including TF and CPV)

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

**Table 14: Production and production capacity information for 2013**

| **Cell/Module manufacturer (or total national production)** | **Technology** (sc-Si, mc-Si, a-Si, CdTe) | **Total Production (MW)** | | **Maximum production capacity (MW/yr)** | |
|---|---|---|---|---|---|
| | | Cell | Module | Cell | Module |
| *Wafer-based PV manufactures* | | | | | |
| 1 SES Solar Inc | sc-Si | *Small quantities* | | *Small quantities* | |
| 2 Meyer Burger | sc-Si, mc-Si | 0 | Approx. 10-20 MW | *Small quantities* | |
| 3 Sunage SA, Mendrisio | sc-Si | *Small quantities* | | *Small quantities* | |
| 4 Megasol | sc-Si, mc-Si | *Small quantities* | | *Small quantities* | |
| Total | | | | | |
| *Thin film manufacturers: none* | | | | | |
| *Cells for concentration: none* | | | | | |
| **TOTALS** | | **n/a** | **Max. 50 MW** | **n/a** | **Max. 100 MW** |

Notes on manufacturers:

No.2: SES Switzerland (formerly SES, Société d'Energie Solaire SA), based in Geneva, produces and sells the "SUNSLATES", "SUNWALL" and "SUNSHADE" lines – standardised building elements for roofing and facades - as well as customer-specific modules. Figures on production are not available. www.sessolar.com

No.3: The MEYER BURGER (formerly 3S Swiss Sustainable Solutions) company is an equipment manufacturer for the global PV industry and, as a side business, produces custom laminates up to sizes of 2 x 3.5 m using bought-in cells laminated onto glass. Also, appropriate roof and façade-mounting systems are developed and sold.

No.3: SUNAGE SA was founded in October 2007 in Switzerland . The SUNAGE technology relies upon the certified and reliable process of monocrystalline silicon. The basic module supplies by 220 through 250 Wp in 7 power classes at nearly 50 volts and 5 amps.

No. 4 Megasol has a small pilot production for modules in Switzerland and also some production in China.

## 5.3 Manufacturers and suppliers of other components

Switzerland has a strong industry for BOS-components. Among them are the following companies:

**Inverters:**
Sputnik engineering is one of the world leading manufacturer of Inverters for grid connection applications.
Studer electronics manufactures inverters for standalone systems.

**Junction Boxes/connectors:**
Multi Contact AG is the leading manufacturer of junction boxes , cables and connectors

**Cables:**
Huber & Suhner has a variety of dedicated PV cables since more than 20 years

**Supporting structures:**
*montavent* offers mounting systems for profiled metal and corrugated roofs.
*ALUSTAND* has mounting structures for tilted and flat roofs.

**Storage batteries:**
Leclanché develops and produces amongst others energy storage systems with large format lithium-ion cells.

# 6 PV IN THE ECONOMY

## 6.1 LABOUR PLACES

**Table 15: Estimated PV-related labour places in 2013**

| | |
|---|---|
| Research and development (not including companies) | 200 |
| Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D | 4 500* |
| Distributors of PV products | |
| System and installation companies | |
| Electricity utility businesses and government | 200 |
| Other (Equipment manufacturer) | 1 500* |
| **Total** | 6 400 |

*Based on the value of business in table 16

## 6.2 Business value

2013 the value of business of the PV installations exceeded the value of business of the equipment & components manufacturers for the first time since writing an NSR Switzerland report.

**Table 16: Value of PV business**

| **Sub-market** | **Capacity installed *in 2013* (MW)** | **Avarage Price per W (estimate)** | **Value** | **Totals** |
|---|---|---|---|---|
| **Off-grid domestic Off-grid non-domestic** | **.1** | **10** | *1 000 000* | |
| **Grid-connected distributed Grid-connected centralized** | *319* | *2.75* | *879 000 000* | |
| | | | | *880 000 000* |
| **Export of PV products (mostly manufacturing equipment and inverters) Best estimate** | | | | *550 000* |
| **Change in stocks held** | | | | *n/a* |
| **Import of PV products (modules, inverters etc.), Best estimate** | | | | *- 400 000 000* |
| *Value of PV business* | | | | ***1 030 000 000*** |

# 7 INTEREST FROM ELECTRICITY STAKEHOLDERS

## 7.1 Structure of the electricity system

In Switzerland operate about 700 utilities. Most of them serving only one village or town (DSO, Distribution System Operator) and are mostly publicly owned or organized as a cooperative of the customers.

For PV, there is only a regulation on a national level which defines how much a utility has to pay for solar electricity as a minimum. A lot of utilities pay a premium which is normally below the national FiT but still helps their local producer to cover at least a part of the production costs.

## 7.2 Interest from electricity utility businesses

Many DSO start to develop new support schemes for Prosumers within their servicing area.

Besides this they begin to build own PV installations in order to sell the solar production within the national grid scheme but more and more also for specific electricity products with a high share of PV besides other renewable.

## 7.3 Interest from municipalities and local governments

There is great interest by municipalities in Switzerland. For new buildings like schools it becomes a quasi standard to build a PV system on the roof.

Besides this municipalities are increasingly purchasing solar electricity within the framework of switching to 100% renewable electricity for community needs.

# 8 STANDARDS AND CODES

Since December 2013 the so called “Planvorlagepflicht” has been increased from 10 kVA to 30 KVA for PV systems. This lowers the burden for the administration for small PV plants remarkably.

# 9 HIGHLIGHTS AND PROSPECTS

### Highlights

The Swiss parliament adopted the increase of the levy per kWh of electricity from 0.9 Rp/kWh to a maximum of 1.5Rp/kWh.

Besides this, it also ruled that small systems below 10 kW are not eligible any more for the FiT scheme but instead get direct subsidies in the range of one third of the costs.

Also self consumption has been regulated and officially defined as a support measure for PV.

This will all become into force in 2014.

### Prospects

- With the new support scheme with direct subsidies and self consumption for small systems up to 30 kWp (no waiting list), it is expected, that this market segment will grow faster than the larger systems.

- For SME, self consumption can become a major driver with further decreasing costs for PV systems.

- On a technology level, new glass coatings which will allow to have panels with different shades of colours may attract more architects

Long term goals for PV and other renewable are being discussed in parliament under the Energy Strategy 2050 starting in 2014. The proposal of the administration has set the 2050 target for PV by around 20% of the electricity demand. The goal for 2020 is about 1.2 GW but most probably this will be reached already in 2015.

## Definitions, Symbols and Abbreviations

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40 W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/m$^2$, cell junction temperature of 25$^o$C, AM 1,5 solar spectrum – (also see 'Rated power').

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

CPV: Concentrating PV

Hybrid system: A system combining PV generation with another generation source, such as diesel, hydro, wind.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'mini-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV power system'.

Grid-connected distributed PV power system: System installed to provide power to a grid-connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices

associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunication system in a remote area are excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, electricity utility businesses etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is x

PV support measures:

| | |
|---|---|
| Feed-in tariff | an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh that may be higher or lower than the retail electricity rates being paid by the customer |
| Capital subsidies | direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost |
| Green electricity schemes | allows customers to purchase green electricity based on renewable energy from the electricity utility business, usually at a premium price |
| PV-specific green electricity schemes | allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price |
| Renewable portfolio standards (RPS) | a mandated requirement that the electricity utility business (often the electricity retailer) source a portion of their electricity supplies from renewable energies |
| PV requirement in RPS | a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside) |
| Investment funds for PV | share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends |

| | |
|---|---|
| Income tax credits | allows some or all expenses associated with PV installation to be deducted from taxable income streams |
| Compensation schemes (self-consumption, net-metering, net-billing…) | These schemes allow consumers to reduce their electricity bill thanks to PV production valuation. The schemes must be detailed in order to better understand if we are facing self-consumption schemes (electricity consumed in real-time is not accounted and not invoiced) or net-billing schemes (the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity account is reconciled over a billing cycle). The compensation for both the electricity self-consumed and injected into the grid should be detailed. Net-metering schemes are specific since they allows PV customers to incur a zero charge when their electricity consumption is exactly balanced by their PV generation, while being charged the applicable retail tariff when their consumption exceeds generation and receiving some remuneration for excess electricity exported to the grid |
| Commercial bank activities | includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems |
| Activities of electricity utility businesses | includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models |
| Sustainable building requirements | includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development |

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