INTERNATIONAL ENERGY AGENCY

CO-OPERATIVE PROGRAMME ON PHOTOVOLTAIC POWER SYSTEMS

Task 1

Exchange and dissemination of information on PV power systems

National Survey Report of PV Power Applications in Switzerland

2011

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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°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 CHF

PV support measures:

Enhanced 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 somewhat higher 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
Net metering	allows PV customers to incur a zero charge when their electricity consumption is balanced by their PV generation, to be charged the applicable retail tariff when electricity is imported from the grid and to receive some remuneration for PV electricity exported to the grid
Net billing	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
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

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 22 participating countries are Australia (AUS), Austria (AUT), 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), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association, the US Solar Electric Power Association and the US Solar Energy Industries Association 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

This report has been prepared under the supervision of Task 1 by

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Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems. 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 Switzerland National Survey Report for the year 2011. 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 EXECUTIVE SUMMARY

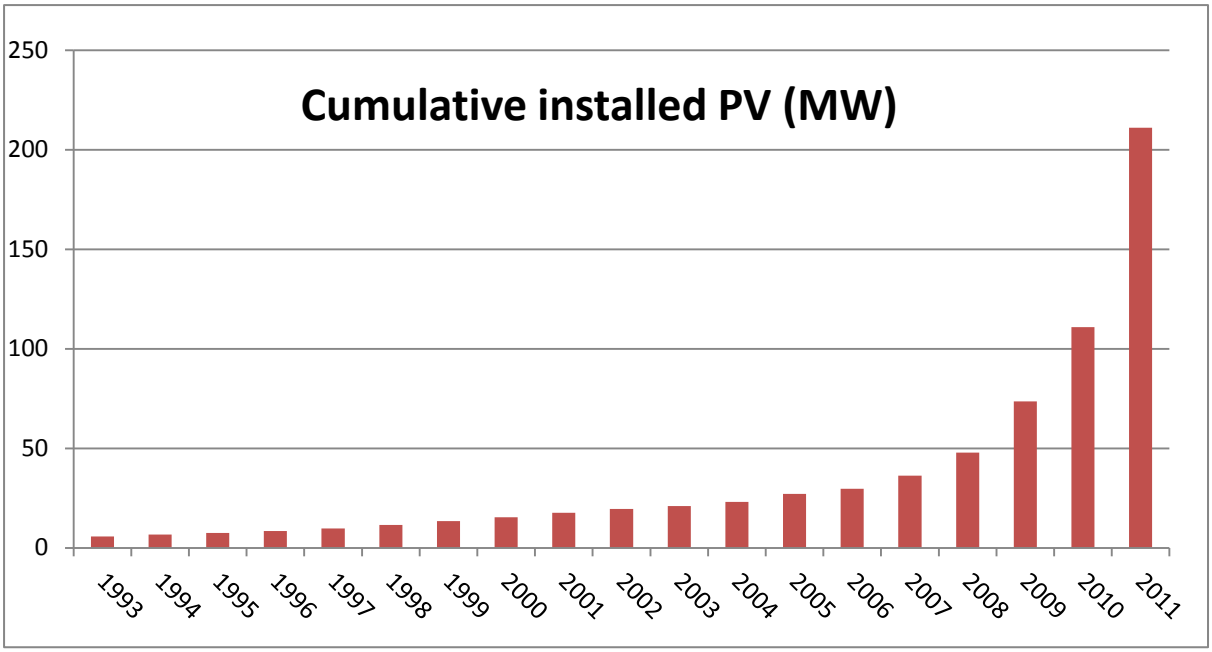
Another strong growth in installed capacity by 300% on a year by year basis. Cumulative installed capacity reached more than 200 MW.

Swiss equipment manufacturer did very well despite a strong decrease in PV module costs. Meyer Burger had a more than 50% growth in turnover, this also due to the takeover of Roth & Rau, Germany.

More and more cantons and regional utilities introduce financing schemes for PV installations in order to overcome the cap of the national FiT scheme.

1.1 Installed PV power

PV capacity in Switzerland reached 210 MW by the of 2011 (26 W/capita). Within 3 years, since introduction of the Feed in Tariff (FiT) scheme, the capacity has tripled.



In 2011, 100 MW have been installed despite another FiT reduction of 18%. This is almost 3 times more than in 2010.

1.2 Costs & prices

FiT has been decreased by approx. 18% 2010/2011. Thus also costs for PV have been reduced by approx. 20%. Besides this there is also some pressure from Germany with installers from Germany looking for new markets across the border.

1.3 PV production

Few companies with limited production serving only niche markets, in particular modules used in BIPV (Building integrated PV). The a-Si-production of PRAMAC in Southern

Switzerland suffers from the rapid price decrease of crystalline modules from China.

For BOS components the strong global demand help companies like Multi Contact (junction boxes, connectors), Huber & Suhner (cables, connectors) and Sputnik Engineering (Inverters) to a distinct increase of their volume of business but also facing tougher competition with many new companies entering the global PV market.

1.4 Budgets for PV

Further small reduction of research budgets on a federal lever but increase in market support budgets (Fit & direct subsidies) on national and regional level.

Swiss PV Conference April 2011, Fribourg

2 THE IMPLEMENTATION OF PV SYSTEMS

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.

For the purposes of this report, PV installations are included in the 2011 statistics if the PV modules were installed between 1 January and 31 December 2011, although commissioning may have taken place at a later date.

2.1 Applications for photovoltaics

In Switzerland, the majority of PV Installations are grid-connected plants, built mostly on the roofs of buildings. Larger installations (> 100 kW) are usually flat-roof mounted on commercial buildings, offices etc. A new market developed in the last years with tilted roof installations on farmhouses with sizes ranging from 30 up to more than 100 kW.

The size of residential systems increased from a de facto standard in earlier years of 3 kW to up to 15 kW. The trend goes towards using the whole roof facing South (SE to SW) and not only a part of it. This is due to the fact that the Swiss FiT has no upper limits concerning the size of the installation. With decreasing costs also east/west facing low tilted roofs are attracting higher interested.

2.2 Total photovoltaic power installed

The numbers are derived from the `Markterhebung Sonnenenergie 2011´.
Total delivered capacity was 119.5 MW. Estimated installed capacity in 2011 is 100 MW since installers tried hard to have no modules on stock by the end of the year and there was also pressure from the plant owners to finish installations before the end of the year in order to profit from a higher FiT (8% decrease from 1.1.2012).

For further information see www.swissolar.ch

Table 1: PV power installed during calendar year 2011 in 4 sub-markets.

Sub-market/ application	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	Total
PV power installed in 2011 (MW)	0,2 (estimation)		100	0	100,2
Amount of CPV in the above (MW)		(0)	(0)	(0)	
Amount of PV in hybrid systems (MW)	(0)				

Table 1a: PV power and the broader national energy market.

Total national (or regional) PV capacity (from Table 2) as a % of total national (or regional) electricity generation capacity	New (2011) PV capacity (from Table 1) as a % of new electricity generation capacity	Total PV electricity production as a % of total electricity consumption
1,2%	New installed capacity within FiT scheme (all renewables): 100 MW Share of PV: approx. 33 MW (approx. 67 MW of PV have been installed but are not yet eligible for the federal FiT scheme)	Approx. 0.27%

Maximum production capacity for Switzerland is 17,8 GW, highest load (2010) approx. 10 GW.

Table 2: The cumulative installed PV power in 4 sub-markets.

	Cumulative installed capacity as of 31 December 2011 (kW)																			
Sub-market	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
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	4 200	4 400
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
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

- Swiss PV market deployment almost tripled in 2011 to 100 MW newly installed capacity (13 W/capita). This was driven by another reduction of Feed in Tariffs (FiT) by approx. 20% at the beginning of 2011. Due to this reduction the federal office of energy could increase the yearly cap for PV considerably.
- Besides the (capped) national FiT scheme there are many regional, local and utility support schemes either with direct subsidies or FiTs equal or below those on the federal level.
- Federal government as well as the Parliament agreed to a step by step phase out of nuclear power production (by the end of livetime of each of the 5 nuclear power plants) starting from 2019.
- Swiss PV promoters like Swissolar, the Swiss Solar Energy Professionals Association successfully introduced the goal of 20% PV electricity production by 2025. The fact that PV can cover not only a minor part of the overall electricity production but, besides hydropower, will become second in ranking of renewable electricity sources becomes widely accepted.

2.3 PV implementation highlights

With the decision of the federal council and supported by Swiss parliament not to replace the existing nuclear power production capacity at the end of there respective lifetime, the perception of PV as a potential new source of energy has increased dramatically. Preliminary new federal goals for PV electricity production in Switzerlandhave been increased to levels of 20% and more. PV is getting widely recognized as for having the biggest potential among new renewable energy sources in Switzerland.

2.4 Highlights of R&D

(Excerpt from the PVPS annual report Switzerland)

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 Strategy policy goals (energy & environment, Science & education, industry & society) (www.energieforschung.ch).

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 Neuchatel 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 0/o 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 0/o 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 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 fwww.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 fwww.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 ofthe possibilities ofsolar 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 Strategie activity.

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

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

Table 2:
Public budgets for R&D, demonstration/ field test programmes and market incentives. In Mio CHF

	R & D	Demo/ Field test	Market incentives
National/federal	n/a yet	n/a yet	FiT for approx. 50 MW of new installations in 2011
State/regional	n/a	n/a	7,4

Please refer also to the Photovoltaic Programme Edition 2011, Summary Report, Project List, available soon at www.photovoltaic.ch

3 INDUSTRY AND GROWTH

3.1 Production of feedstocks, ingots and wafers

There is only one producer of ingots and wafers in Switzerland.

Table 3: 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)
Swisswafers	sc-Si ingots.	900 T	Export	n/a
	mc-Si ingots			
Swisswafers	sc-Si wafers	Approx. 120 MW	Export	n/a
	mc-Si wafers			

All numbers are estimates, more and detailed information is available from the homepage of Swiss wafers: www.swisswafers.ch

Swiss Wafers AG is specialized in manufacturing silicon wafers for photovoltaic applications (solar cells).

It converts silicon raw material of various specification to mono- and multi-crystalline silicon wafers and supplies them to solar cell producers worldwide. The photovoltaic industry Swiss Wafers AG is one of few independent producers of solar silicon wafers. Since its foundation the company has grown continuously at a fast pace.

3.2 Production of photovoltaic cells and modules

There are only few companies manufacturing modules in Switzerland. Production as well as capacity is limited. Products are mostly sold in niche markets.

Table 4: Production and production capacity information for 2011

Cell/ Module manufacturer	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 Solterra	Modul production stopped in 2009, selling GESOLAR-Modules under own branding				
2 SES Solar Inc	sc-Si	-	n/a	n/a	n/a
3 3S PHOTOVOLTAICS	sc-Si, mc-Si	0	Approx. 5 MW	0	n/a

4 Sunage SA, Mendrisio	sc-Si	*n/a*		*n/a*	
Total					
Thin film manufacturers					
5 Pramac Suisse SA, Riazzino	a-Si	*n/a production stopped spring 2012*		*30 MW*	
6 VHF Technologies SA (Thin Film)	a-Si	n/a		10 MW	
TOTALS		**n/a**		**n/a**	

Notes on manufacturers:

No.1: Solterra stopped their own production in Switzerland in 2009 and distribute GESOLAR (China) modules with SOLTERRA branding.

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 3S PHOTOVOLTAICS, a subsidiary of MEYER BURGER AG , (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.4: 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. 5 Pramac produces Micromorph Silicon Module since 2009 with technology from Oerlikon solar.

No.6: VHF Technologies produces thin-film amorphous cells on plastic foil (polyimide) substrate. Brand name "Flexcell" owing to its highly flexible PV foil, Flexcell is able to deliver innovative mobile solar chargers and to provide integration solutions for the building industry (Building Integrated Photovoltaics).

3.3 Module prices

Table 6 provides year 2011 PV module prices (excluding VAT): for small and large (best price) orders CHF/W:

Table 5: Typical module prices for a number of years

Year	2004	2005	2006	2007	2008	2009	2010	2011
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
Best price, large systems (>100kWp)	4.10	4.60	5.00	4.80	4.80	3.30	2.20	1.30

3.4 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

3.5 System prices 2011

Table 8 gives turnkey system prices (excluding VAT/TVA/sales tax) per Watt for the various categories of installation. Prices do not include recurring charges after installation such as battery replacement (where applicable) or operation and maintenance. Additional costs incurred due to the remoteness of the site or special installation requirements are not included.

Table 6: **Turnkey Prices of Typical Applications**

Category/ Size	Typical applications and brief details	Current prices per W[1]
ON-GRID up to 10 kW	Roof mounted (attached)	5.00
ON-GRID up to 10 kW	Roof mounted (BIPV)	6.00
ON-GRID > 10 kW to 100kW	Industry, Farmhouse (attached)	3.50
ON-GRID > 10 kW to 100kW	Industry, Farmhouse (BIPV)	4.00
ON-GRID > 100 kW to 1000 kW	Industry or public building (attached)	3.00
ON-GRID > 100 kW to 1000 kW	Industry or public building (BIPV)	4.00

[1] Photovoltaik (PV) Anlagekosten 2012 in der Schweiz, NET Nowak Energie & Technologie AG, 2012

Table 8a: National trends in system prices (CHF) for on-grid standard installations (Prices in CHF / W for 10 - 20 kW flat roof and 3 to 4 kW residential systems)

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
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
3-4 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

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.

3.6 Labour places

No exact figures are available for the number of persons employed in the PV area. The following figures are an estimate based on installed power, PV industry turnover, imports and budgets for research and development in 2011

Table 7: Estimated PV-related labour places in 2011

Research and development (not including companies)	200
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	1 000
Distributors of PV products	200
System and installation companies	2 500
Utilities and government	100
Other: Equipment manufacturer along the value chain	6 000
Total	**10 000**

3.7 Business value

The value of PV business was approximately the same as the year before with an increase on the installer side and a decrease on the equipment manufacturer side.

Total value of PV related equipment: approx. 1 250 Mio CHF

Total value of BOS components and modules: approx. 550 Mio CHF

The total end financial value of PV plant installed is estimated at around CHF 400 Million. This is estimated on the basis of PV power installed in 2011 and average turn-key prices.

As practically all cells and the greater part of PV modules in Switzerland are imported, the added value figure is probably more interesting: This amounts to around CHF 150 million.

Table 8: Value of PV business

Sub-market	**Capacity installed *in 2011* (kW)**	**Price per W (estimated average)**	**Value**	**Totals**
Off-grid domestic	*100*	*15*	*1 500 000*	
Off-grid non-domestic	*100*	*15*	*1 500 000*	
Grid-connected distributed	*100 000*	*4.00*	*400 000 000*	
Grid-connected centralized			*0*	
Total installed PV				*Ca. 403 000 000*
Export of PV products (estimate)				*1 800 000 000**
Change in stocks held *(no information available)*				*0*
Import of PV products *(estimate)*				*150 000 000** *
Value of PV business				***2 053 000 000***

* Inverters, BOS components, manufacturing equipment
(HCT, Oerlikon, Meyer Burger, 3S, Multi Contact, Huber & Suhner, Komax etc.)

** Modules and BOS for Swiss PV installations

4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 9: PV support measures

	On-going measures	Measures that commenced during 2011
Enhanced 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 the art of installation, BIPV, roof mounted, ground mounted. Duration of payment: 25 years Cap: Approx. 50 MW in 2011	FiT decreased by approx. 18% for 2011
Capital subsidies for equipment or total cost	Some cantons with direct subsidies 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	
Net metering	no	Only with certain utilities due to the new FiT scheme
Net billing	no	Only with certain utilities due to the new FiT scheme
Commercial bank activities e.g. green mortgages promoting PV	Low	

Activities of electricity utility businesses	Solar stock exchange, RPS schemes	
Sustainable building requirements	Yes	

4.1 Indirect policy issues

After the Fukushima nuclear accident electricity consumers started to get aware of the Swiss electricity mix (40% nuclear). Some more decided to switch to 1005 renewable products offered by many local utilities.

Especially local and regional utilities started to design new 100% renewable products with a increasing share of PV. Besides this, the announced changes in procurement strategies in order to increase the share of renewables remarkably.

Decreasing module and system costs will lead to an even earlier than expected grid parity for residential customers. With tax rebates this can be already before 2015.

The Plus Energy House is recognized as a building standard of the future with examples already realized in the last couple of years. Since this is done by combining PV with a low energy house with heat pump system more and more advanced architects and engineers start to integrate PV into their building design.

Interest from municipalities and local governments: Also caused by the Fukushima disaster, local government started to install PV on public owned building.

4.2 Standards and codes

Switzerland is very actively engaged in the standardizing work for photovoltaic on a national as well as on a IEC level.

Installers have been trained in new course offered by Swissolar, the Swiss solar industry association. The collaboration with the federal electricity board (ESTI) is well established.

5 HIGHLIGHTS AND PROSPECTS

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 0/o of the present national electricity consumption. The solar industry Claims such contributions to be achievable much sooner.

Due to this and much lower system costs, the cap for PV installation is expected to be significantly increased..

The installed capacity in 2011 reached a new all time high of more than 100 MW (13 W/capita).

For 2012 to 2014 it is expected, that about 50 to 60 MW per year can be financed with the FiT scheme.

In November 2011 Swiss government announced a further decrease of the feed in tariffs starting March 2012 by 10% in average over all categories.

ANNEX A: COUNTRY INFORMATION

1) Retail electricity prices (for "normal" power, i.e. not special quality such as hydropower or solar electricity). Average price for end users (household) in 2011: approx. CHF 0, 16 / kWh

Household: Varies greatly according to area and utility. Prices typically:

Night time: CHF 0.08 – 0.12 per kWh

Day time: CHF 0.14 – 0.25 per kWh

Commercial / Public institution: Strongly dependent on consumption and regional utility:

Night time: CHF 0.07 – 0.09 per kWh

Day time: CHF 0.12 – 0.16 per kWh

Industry can mostly negotiate electricity prices depending on demand / supply situation and own power production.

2) Typical household electricity consumption (kWh): Around 5 500 kWh per household in the year 2011. Households account for 31,2% of Swiss electricity consumption in 2010.

Total per capita electricity consumption in 2010: 7 639 kWh

Growth of Population: 1% (2009 -> 2010)

3) Typical metering arrangements and tariff structures for electricity customers:

- Day-rate and off-peak tariffs for households.
- Special tariffs for interruptible supply (eg for heat pump installations)
- Net-metering for domestic PV installations < 3 kW since Feb. 2010
- Special rates for trade and industry as well as for large-scale consumers

4) Average household income 2009 - brutto: CHF 112 400

5) Typical mortgage interest rate in 2011: 2,25%

6) Voltage (household, typical electricity distribution network): 230V ac

7) Electricity industry 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.

8) price of diesel fuel (NC) 1.80 CHF

9) Typical values of kWh / kW for PV systems: 950 – 1100 kWh/kW for central plain. Higher in mountainous areas and in southern Switzerland.

(Sources: Swiss Statistical Yearbook, Swiss Federal Office of Energy, Association of Swiss Electricity Utilities, individual utilities, Swiss Solar Power Statistics)