Task 1
Exchange and dissemination of
information on PV power systems

National Survey Report on PV Power Applications in Switzerland 2006

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On behalf of
Swiss Federal Office of Energy

List 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 nineteen participating countries are Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), The Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), The United Kingdom (GBR) and The United States of America (USA). The European Commission and the European Photovoltaic Industry Association are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (tasks) is the responsibility of Operating Agents. Ten tasks have been established and currently six are active. Information about these tasks can be found on the public website www.iea-pvps.org. A new task concerning PV environmental safety and health is now being developed.

The objective of Task 1 is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems.

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ii 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. This report gives information on trends in PV power applications in the PVPS member and other countries and is largely based on the information provided in the National Survey Reports which are produced annually by each Task 1 participant. The public PVPS website also plays an important role in disseminating information arising from the programme, including national information.

iii Definitions, Symbols and Abbreviations

For the purposes of the 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.

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 systems 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, utilities 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.

Please specify the currency that is used throughout the NSR - countries of Euroland must use the euro (EUR). Please ensure that your NSR follows the recommendations of the internal PVPS report *Writing numerical values, quantities, units and symbols according to International Standards*. This will reduce confusion when preparing the ***Trends*** report, and will reduce the need for editing of material for consistency before loading on to the website.

1 Executive summary

After new record in installed capacity in 2005, the market in 2006 came back as expected. This due to the fact that two big installations (total 1.8MW) had been commissioned in 2005. About 2,5 MW new capacity, mostly grid connected, has been installed in 2006.

But the outlook for 2007 and onwards are promising since an EEG similar to the German law is under discussion in parliament.

Swiss industry, especially equipment manufacturers, did again very well on the international market thus profiting from the favourable international conditions and the booming market.
We estimate the total value of business for the Swiss PV industry to be around 400 Mio CHF.

Within the PV value chain, the company Swiss wavers started production in 2005 and for 2006 they reported already 30 MW of waver production.

Installed PV power
Total installed PV power in Switzerland rose once more in 2006 and reached a total of around 29,5 MW of which around 26,3 MW was delivered by grid-connected installations.
Total installed capacity in 2006 was about 2,5 MW.
The market is mainly driven by solar stock exchange schemes. This counts especially for the Geneva utility SIG, which contracted another 700 kW to private investors.

Costs & prices
Switzerland is fully depending on the European module market.
Prices in 2006 rose again by about 5% for turn key systems for residential applications while for larger installations above 50kW prices were comparable to 2005.

PV industry
In the production equipment area, there are also a large number of well-known manufacturers that are very well positioned in the international market. The list begins with the two manufacturers of precision wire saws for silicon blocks, the Meyer & Burger AG company in Steffisburg and HCT Shaping Systems SA in Lausanne. In the past year, Meyer & Burger successfully went public and its shares have shown a pleasing development.

Actual production equipment is manufactured by the companies 3S Swiss Solar Systems AG in Lyss and Oerlikon Solar (previously Unaxis Solar) in Pfaeffikon. In particular, Oerlikon presented impressive figures for the previous year; in December 2006, a large order of 320 million Swiss Francs was won for the delivery of manufacturing equipment.

These companies all hold their top position by continuing innovation or are even strengthening it in that they are profiting from the growing markets in Europe, USA and, above all, the Far East.

Outlook
In March 2007 the Swiss parliament adopted a new preferable feed in tariff scheme for new renewables. For Photovoltaic it is expected that the home market will at least double compared to the previous years.

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.

2.1 Applications for photovoltaics

In Switzerland, the majority of PV Installations are grid-connected plant, built mostly on the roofs of buildings. Larger installations (> 50 kW) are usually flat-roof mounted on commercial buildings, offices etc.
The smaller grid-connected PV installations (typically around 3 kW) can normally be found on the roofs of single-family homes. Traditionally, off-grid installations for week-end chalets and alpine huts are relatively small (< 1 kW).

BIPV System (SOLARIF) in Flerden, Switzerland

2.2 Total photovoltaic power installed

Table 1 The cumulative installed PV power in 4 sub-markets.

Sub-market/ application	31 Dec. 1992 kW	31 Dec. 1993 kW	31 Dec. 1994 kW	31 Dec. 1995 kW	31 Dec. 1996 kW	31 Dec. 1997 kW	31 Dec. 1998 kW	31 Dec. 1999 kW	31 Dec. 2000 kW	31 Dec. 2001 kW	31 Dec. 2002 kW	31 Dec. 2003 kW	31 Dec. 2004 kW	31 Dec. 2005 kW	31 Dec. 2006 kW
off-grid 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*
off-grid non-domestic	70	100	112	143	162	184	190	200*	210*	220*	230*	260*	290*	320*	350*
Grid-connected distributed	2 200	2 900	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
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
TOTAL	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

Notes

* Author's estimates. Exact figures for the proportion of off-grid power for domestic and non-domestic applications are not available.

** In 2005 newly built 1 MWp System, ground mounted, in Geneva

- In 2006 the PV market was driven mainly by small to medium size grid connected systems: 250 new installations in comparison to 2005 with 200 installations. Due to the lack of new large PV projects as in the previous year (1 MW in Geneva, 850 kW on the football stadium in Berne) the installed capacity in 2006 was still only 2.5 MW (2005: 4MW). Potential investors were also waiting for a decision by Swiss parliament for a new feed in tariff law which has been finalized before the end of 2006.

- Once again sales of PV electricity on the solar stock exchange scheme increased which will lead to at least another 2 MW of new PV which will go into operation in 2007. The utility of the city of Zurich (ewz) contracted another 1,7 MW under this scheme which will be commissioned in 2007.

2.3 PV implementation highlights, major projects, demonstration and field test programmes

For the time being, market implementation of PV systems continues to be mainly driven by green power marketing schemes of utilities. Since the introduction of the naturemade® labels for renewable electricity, utilities have started introducing different product brands, some with a mix of different renewable energy sources and others with technology specific products, e.g. the product "Premium Solar" by the utility of the city of Zurich. Solar electricity is thus part of mixed green power products, according to naturemade star® labelled brands. With a strong and consistent marketing approach, typically around 5 % of the customer base can be attracted to pay the comparatively high prices for solar electricity, in the best cases. With mixed products, more customers can be attracted. Market implementation is further supported by regional initiatives, for example in the cantons of Basel and Geneva. Small scale private, domestic and non-domestic systems form a complementary part of the Swiss photovoltaic market which is served by local businesses. With the ongoing policy debate in parliament and the accompanying media coverage, a growing interest can be observed from a broad public in this market segment.

A workshop for the financial and investment community was organised in Zurich under the leadership of the Swiss and Japanese Task 1 experts.

2.4 Highlights of R&D

The Swiss Photovoltaic RTD Programme is based on a 4 year RTD master plan, presently covering the period 2004 – 2007. Overall, 50 projects, supported by various national and regional government agencies, the research community and the private sector are conducted in the different areas of the photovoltaic energy system. 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 cells). During 2006, emphasis on transfer from R&D to industrial processes and products continued. Work on thin film silicon at the University of Neuchâtel concentrated on the efficiency and reproducibility of micromorphous solar cells as well as the rapid large area deposition of its individual layers of amorphous and microcrystalline silicon, including work on transparent conductive oxides (TCO). In the area of thin film silicon, strong co-operation with the companies VHF-Technologies and oc oerlikon (formerly Unaxis Solar) continued. During 2006, the equipment manufacturer oerlikon extended its activities as a leading supplier of manufacturing systems of thin film silicon solar cells on glass. With regard to CIGS solar cells, the Federal Institute of Technology in Zurich focused the work on high efficiency flexible CIGS cells on plastic and aluminium. During 2006, the spin-off company FLISOM, active in this solar cell technology, received different awards as a promising and innovative high-tech company. For dye-sensitised solar cells, work

continued on new dyes and high temperature stability of the devices. Flexible solar cells were also a subject for this technology. Exploratory work was undertaken on new solar cell concepts (organic solar cells) at the Swiss Federal Laboratories for Materials Testing and Research EMPA.

Emphasis continues to be given to the application of building integration, both for new solutions involving thin film solar cells as well as for new mounting systems and structures for sloped roofs and facades. With the ongoing market development, quality assurance of products and systems, as well as standardisation, continue to be of high priority. The centres of competence at the Technical Universities of Burgdorf and Lugano carefully evaluate products such as PV modules, inverters and new systems. Long term experience with the operation of photovoltaic power systems is carefully tracked for a number of grid-connected systems, ranging between 10 and almost 25 years of operation. Continuous development of system solutions has resulted in a number of industrial products which are increasingly being exported.

Following the example of the project SolarImpulse (www.solarimpulse. com) by Bertrand Piccard for a non-stop flight around the world in a solar powered airplane, another visionary project of this kind was announced in 2006: The project PlanetSolar (www.planetsolar.org) plans to sail around the world by a boat powered by solar photovoltaic energy. The concept study of the boat foresees a trimaran of 30 m length and 16 m width powered by 180 m2 of solar cells corresponding to some 30 kW peak power, yielding an average cruising speed of 10 knots.

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.

CHF	R&D	Demo	Market
National/federal	10.9	0.2	0.5
State/regional	4.0	0.1	2.4
Total	14.9	0.3	1.9

For the first time since 2003, two new P+D Projects were begun in the year under review. One of them
is concerned with the topic of optimal integration of photovoltaic installations in the energy concept of
a zero-energy school building in Kreuzlingen, Switzerland, the other with the integration of thin-film
photovoltaic elements into the roof of a gymnasium. In spite of these two new projects, the P+D programme has, meanwhile, shrunk to just a few projects which are almost all in the closing phase. This development is to be regretted very much,

as here an essential link in the transfer of research and development findings to industrial products and methods - and, therefore, to the market - is weakened to a great degree. Thus, the effect of this part of the programme remains limited and, in combination with the stagnating local market being noted for some years now, means that Swiss companies have increasing difficulty bringing new and innovative products in the photovoltaics field of application onto the market. International conferences show clearly that Swiss companies can hold their ground in the field of production equipment and, partly, in the field of inverters and are able to report increasing sales figures. In the fields of product innovation and installation implementation, however, the innovations mostly come from Germany, Japan or the USA. Nevertheless, some successful Swiss projects have still had an effect in the German market over the last few years.

Please refer also to the Photovoltaic Programme Edition 2007, Summary Report, Project List, Annual Project Reports 2006 (Abstracts) www.photovoltaic.ch

3. Industry and growth

3.1 Production of feedstocks, ingots and wafers

Producers	Process & technology	Total Production	Maximum production capacity
Swiss Wafers	sc-Si ingots.	*N/A*	*N/A*
Swiss Wafers	mc-Si ingots	*N/A*	*N/A*
Swiss Wafers	sc-Si wafers	*30 MW*	*50 MW*
Swiss Wafers	mc-Si wafers		

The whole production is exported.
More and detailed information is available from the homepage of Swiss wafers: www.swisswafers.ch

3.2 Production of photovoltaic cells and modules

The following table provides a quick overview of PV module production in Switzerland for 2006.
Unfortunatly the biggest producer in Switzerland, Solterra SA,is not willing to disclose its production figures

Table 4: Production and production capacity information for the year for each manufacturer (*a-h, x, y are examples)*

Cell/Module manufacturer	Technology (sc-Si, mc-Si, a-Si, CdTe)	Total Production (MW)			Maximum production capacity (MW/yr)		
		Cell	Module	Concentrators	Cell	Module	Concentrators
1 Solterra	sc-Si	See note			***N/A***		
2 SES, Société d'Energie Solaire SA	sc-Si	See note			***N/A***		
3 Swiss Sustainable Systems	sc-Si and mc-Si	See note			***N/A***		
Thin film manufacturers							
1 VHF Technologies SA (Thin Film)	a-Si	***0,03***	***0,03***		***0,05***	***0,05***	
TOTALS		***0,03***	***0,03***		***0,05***	***0,05***	

Notes on manufacturers:
No.1: Solterra SA produces a range of PV cells and modules as well as large-format roofing "tiles". Figures on production are not available.

No.2: 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.

No.3: The 3S Swiss Sustainable Solutions company 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. Production only on a pilot line scale.

No.4: VHF Technologies produces thin-film amorphous cells on plastic foil (polyimide) substrate (Brand name "Flexcells"). Initial applications are in small electronics applications and various products are commercially available, including a charger for portable phones that can be rolled up. A pilot line for larger foil-modules is in operation, production figures are confidential.

Module Prices

Table 4a: Typical module prices for a number of years in CHF (crystalline silicon)
(all prices concern imported modules)

Year	2004	2005	2006
Module price(s): large quantities (500 kWp) -> average	4.30	4.80	5.20
Module price(s): large quantities (500 kWp -> Best price	4.10	4.60	5.00

3.3 Manufacturers and suppliers of other components

Since the international market is expanding still further, the greatest successes were, above all, achieved in the manufacturing and subcontracting fields. The largest manufacturers defended their top positions in the international market. On account of an export ratio that increased once more, further progress along the path to becoming a quite normal industry could be clearly observed. This meant, in particular, that fewer complete components and devices were produced and that OEM manufacturers only produce according to specification. The companies keep only their kernel processes in-house and, in addition to support activities, only sell the complete products.

In the following, the most important manufacturers and suppliers of other components are briefly presented:

a) PV inverters (for stand-alone and grid-connected systems)
First of all, the robust development of the **Sputnik Engineering AG** company must be mentioned**.** For a few years now, the company has been number 3 in Europe as far as for is concerned. In 2006, they produced inverters with a total rated output of 125 MW; at the end of 2006, the company employed around 85 internal employees and around 65 persons at subcontractors in Switzerland. The average inverter prices for installers fell from around 0.60 €/W in 2000 by more than 20% to somewhat less than 0.47 € per watt currently. the wings of its big mother company Solon, **ASP** in Laupen was able to clearly increase business, particularly in the mains-inverter area. The between mains-connected and stand-alone inverters is about 50:50.

A further well-known manufacturer, albeit with less production volume, is the **Studer Innotec** company in Sion which produces automatic charger controllers as well as stand-alone inverters. In earlier years, **Hardmeier Electronics AG** and **LEC**, Leutenegger Energie Control, also manufactured inverters; today, they only ensure after-sales-service.

b) Storage batteries
With a relatively good degree of certainty, only two companies produce accumulators in Switzerland that are also used as solar batteries. These are **Levo Batterien AG** in Dietgen and **Saentis J. Goeldi AG** in Ruethi in the St. Gall Rhine valley. Developments toward to OEM products can be especially observed in this area. For example, the manufacturer Varta belongs to Johnson Control and sells the same products, just with another label.

c) Battery charge controller
As mentioned under a), the **Studer Innotec** company in Sion is the main manufacturer. There are certainly a number of further companies which produce charge controllers in small and smallest series; they are, however, not important for total market figures.

d) DC switchgear
ABB **Normelec** in Zurich (formerly known the name CMC in Schaffhausen) has further improved the QDC power breaker, which has been successfully used for over 15 years now. Production will be started in 2007.

e) Supporting structures
The proposition formulated in the introduction that activities in the PV area are becoming “normal industry” applies, above all - and in addition to accumulators - to the area of supporting structures. Most installation and marketing companies have mounting systems for flat-roof, facade and sloping-roof applications made by subcontractors according to their specifications. In particular, the **Ernst Schweizer Metallbau AG** in Hedingen must be mentioned as an important subcontractor for several module manufacturers. Up to now, installations with a peak power of between 11 and 13 MW were implemented using the company’s Solrif integration system,

For about the same amount of installed power, the **AluStand** system was used. This was developed by the **Urs Buehler Energy Systems and Engineering** company in Cham and is being marketed by the **BE Netz AG** company in Lucerne.
In the previous year, the **Solstis Sarl** company also re-worked and re-launched its mounting structures for sloping and flat roofs. Above all, this company serves French-speaking Switzerland as well as the bordering areas in France.

f) Manufacturing equipment
In the production equipment area, there are also a large number of well-known manufacturers that are very well positioned in the international market. The list begins with the two manufacturers of precision wire saws for silicon blocks, the **Meyer & Burger AG** company in Steffisburg and **HCT Shaping Systems SA** in Lausanne. In the past year, Meyer & Burger successfully went public and its shares have shown a pleasing development.

Actual production equipment is manufactured by the companies **3S Swiss Solar Systems AG** in Lyss and **Oerlikon Solar** (previously Unaxis Solar) in Pfaeffikon. In particular, Oerlikon presented impressive figures for the previous year; in December 2006, a large order of 320 million Swiss Francs was won for the delivery of manufacturing equipment.

Not are be forgotten is the measuring equipment used in the production lines of module manufacturers made by the **Belval SA** company in Neuchatel.

These companies all hold their top position by continuing innovation or are even strengthening it in that they are profiting from the growing markets in Europe, USA and, above all, the Far East.

g) Various
Here, a large number of companies are active and successful in the market. In the area of simulation software, for example, the **Meteotest AG** company in Berne (Meteonorm) as well as the **CUEPE** Institute at the University of Geneva (PVSYST) are active. In the year under review, a new version of PVSYST was released with which DC-coupled pump systems can now also be simulated. In co-operation with the **Enecolo AG** company, Meteotest AG sells the Spyce satellite-supported monitoring system for PV plant launched in 2005.

As far as manufacturers are concerned, the two companies **Multi-Contact AG** in Basel (plug-and-socket connector) and **Huber & Suhner** in Pfaeffikon are to be especially mentioned. Both used an early window of opportunity and expanded into the solar area; they were thus able to profit from their good starting position in recent years.

3.4 System prices

Table 5: Turnkey Prices of Typical Applications

Category/Size	Typical applications in your country and brief details	Current prices per W (to one decimal point)
OFF-GRID Up to 1 kW	week-end chalets and alpine huts	15.0 – 20.0
OFF-GRID >1 kW	Alpine dairy farms	12.0 – 15.0
GRID-CONNECTED Specific case	Residential, 2-4 kW, roof-mounted system	10.0
GRID-CONNECTED Up to 10 kW	Farmhaus,big residential house, -10 kW, roof-mounted system	9.50
GRID-CONNECTED >10 kW	"production plants" mostly on flat roofs for solar stock exchange schemes	9.00

Prices exclude sales tax. The figures are estimated on the basis of data provided by engineering offices and consultants involved in the building of PV installations.

Table 5a: National trends in system prices 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
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
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

3.5 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, imports and budgets for research and development in 2005.

Category	R&D	Cell / Module Manufacturing / Inverters	Planning / Installation	Manuf. facility suppliers	Total
Labour places	around 150	around 300	around 100	around 400	around 950

There was a overall increase in labour places in Switzerland due to the strong world market. Mainly equipment manufacturer like Meyer & Burger (wire saws), 3S (laminators), oerlikon solar (thin film equipment) etc. had a very high production increase.

3.6 Business value

The total end financial value of PV plant installed is estimated at around CHF 25 Million. This is estimated on the basis of PV power installed in 2006 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 10 million.

Meyer Burger, a wire saw manufacturer, increased its net turnover “solar” by 75% compared to 2005

Table 6: Value of PV business (CHF)

Sub-market	**Capacity installed *in 2006* (kW)**	**Price per W** *(from table 5)*	**Value**	**Totals**
Off-grid domestic	*120*	*15*	*1 800 000*	
Off-grid non-domestic	**30**	**15**	*450 000*	
Grid-connected distributed	**2500**	**9**	*22 500 000*	
Grid-connected centralized	**0**		*0*	
				22 725 000
Export of PV products				*400 000 000**
Change in stocks held				*0*
Import of PV products				*15 000 000***
Value of PV business				***408 000 000***

* Inverters, BOC components, manufacturing equipment
** Panels, BOC components

4 Framework for deployment (Non-technical factors)

Table 7: PV support measures

	National / Regional (State) / Local
Enhanced feed-in tariffs	National: CHF 0.15 Regional (utilities): up to CHF 0.80 -> solar stock exchange
Direct capital subsidies	Only in few cantons up to CHF 2000.- /kW
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
Tax credits	yes
Net metering	yes
Net billing	yes
Commercial bank activities	low
Electricity utility activities	Solar stock exchange, RPS schemes
Sustainable building requirements	Yes

4.1 New initiatives

On the basis of Swiss energy legislation, promotion is the business of the Cantons. They are supported by the Confederation within the framework of global budgets. As a result of this situation, the situation for photovoltaics in Switzerland is a difficult one. The continuing reduction of cantonal promotion was stopped and a small change in trends was initiated. Thus, at the beginning in 2007, 9 of 27 cantons (including the Principality of Liechtenstein) have a promotion program at cantonal level. In a further 6 cantons either individual municipalities or, i the canton of Grisons, a power utility, support the building of PV plant. The still remains quite unpleasant and consequently results in an increased load being placed on private persons and industry.

The "Solar Power from the Utility" activities continue running at a low level and concentrate on small and medium-sized power utilities, since the larger utilities have already introduced programs some time ago.

The obligatory declaration of power sources was implemented on a large scale by electricity utilities without any problem (see also 4.2). For most utilities information is available on websites. Further utilities have started and promotion activities in their business areas which allow customers to choose their production-mix. If no from the customer received by the utility by a fixed date, the customer is placed in a category which contains a slightly more ecological, more sustainable mix than before. The EWB (the City of Berne utility) can be mentioned as an example of such a utility.

The inter-departemental platform REPIC (Renewable Energy Promotion in International Co-operation) continued its work. This works is done within the framework of Task 9, Photovoltaic Services for Developing Countries

In order to allow in selected projects within the framework of the IEA PVPS Program, a Swiss PVPS Pool has been set up. It was possible to integrate important market players into the program such as, for example, the electric power utility of the City of Zurich (ewz), the Canton Basel -Stadt and the Mont Soleil Society as well as the Swiss Professional Association for Solar Energy, Swissolar.

4.2 Indirect policy issues

The suppliers' declaration obligation for their energy deliveries was successfully introduced. This requires, on the one hand, annual information for customers on their bills as well as, additionally in most cases, the provision of this information on the enterprise's own website. It is still, however, very hard to estimate to what extent photovoltaics profits from the publication of this information.

A very important promotional instrument, the Swiss version of the EEG, is being discussed in parliament. In 2006, the first reading in the small chamber (Staenderat, Council of States) as well as the second reading in the Nationalrat (National Council, large chamber) were completed. Actually, the legislation was supposed to have been passed in the December session in 2006 but, once more, delays resulted from political manoeuvres. Pleasing to note is the good co-operation between various technical organisations, which is aiming to help this important legislation make its final breakthrough.

A further long-lasting parliamentary debate concerned the planned obligatory revision of the CO2 law. After first work was started in 2005, the debate only went forward sluggishly in 2006, and was even temporarily faced with a total blockade. The large chamber watered down the law in its summer session 2006 quite considerably; fortunately, this was at least partially patched-up again by the small chamber in the December session, however. After this decision, real hopes exist that the legislation can be finally be passed in the spring session in 2007.

4.3 Standards and codes

The implementation of the IEC 60364-7-712 installation norm continued well in 2006. At the IEC level, no new were published in 2006, only the revision of IEC 61173- Ed. 1, "Overvoltage protection for PV power generating systems" was concluded and put into effect. On the other hand, work on a large number of further was carried on in a determined manner, so that some will reach the final voting stage in 2007. The

professional association guarantees participation of its interested members in the decision process within the framework of TK 82.

The transfer of PVGAP (Global Approval Program) into the structure of IECEE, responsible for all certification activities, took a good step forward.

In 2006, an important SIA (Swiss Association of Engineers and Architects) norm was put into force, i.e. the SIA 112/1 "Sustainable building - building construction". In addition, an updated version of the D0216 documentation, SIA Efficiency Path Energy, was published. Both standards have an indirect influence in that - particularly in the case of SIA 112/1 - efforts are made to already propagate the consideration of the use of solar power at a very early stage in planning. In addition, concrete references and aids are mentioned which can positively influence decisions to the benefit of PV plant.

The importance of photovoltaics in politics has been made clear with the of the European Photovoltaics Technology Platform into practice. This platform is based on the report "A vision for Photovoltaics" by the Photovoltaics Technology Research Advisory Council (PV-TRAC) made for the European Commission. Work on anchoring and making the platform well known is continuing at a fast rate.

5 Highlights and prospects

On account of continuing growth, many Swiss companies are increasing their capacities in a generous way; meanwhile, the political process itself is only moving forward in a slothful manner. At least the prospect of a Swiss EEG has not deteriorated. Having become a little careful as a result of previous experience, hope nevertheless remains positive.

On the other hand, enormous growth can be seen as far as business is concerned. Solar Plant Swiss is, for example, strongly pushing on work for a solar module manufacturing facility in Linthal (canton Glarus) and by the end of the year already collected share capital of over 32 million CHF and already chosen of the manufacturing equipment to be used. Things are moving even faster in the case of Swiss Wafers AG in Weinfelden. This company had, by the end of the year, built up a nominal production capacity for mono- and polycrystalline silicon wafers of 50 MWp and, for 2007, plans additional production capacity in a new facility that will make an additional production of 130 MWp possible (in total: 180 MWp).

In its first year of operation, the biggest PV installation yet implemented on the roof of a football stadium provided very pleasing results. The PV plant on the Stade de Suisse in Berne produced somewhat less than 835'000 kWh. The unexpectedly fast sale of the entire power produced motivated the power utility to authorise the building of the second phase. This means that installed power will be increased from 855 kWp to somewhat less than 1.3 MWp in total. The extensions to the plant are to be installed and start feeding into the mains in the summer in 2007.

Annex A Method and accuracy of data

The Data on PV Installations and plant presented in this report have been collected from federal institutions, manufacturers and their professional associations, engineering and consultancy offices and private and institutional initiators of building projects. Much data is taken from the annual reports of the Swiss Federal Office of Energy.
The Figures presented in this national report come from various sources and exhibit various degrees of accuracy. Key figures such as installed power are correct to about +/- 5%. Data concerning national R+D funding are exact. The figure for regional funding of market-oriented activities and subsidies is the sum on data from the 26 Swiss Cantons.
Price and market figures are based on information provided by manufacturers, and we can therefore not quote any percentages on the accuracy of these data.
As for our own estimates, we have quoted any base data sources and stated any assumptions made directly in the text of the report.

a) Annex B Country information

Annex B Country information

1) Retail electricity prices (for “normal” power, i.e. not special quality such as hydropower or solar electricity)

Household: Varies greatly according to area and utility. Prices typically:
Low period: CHF 0.09 – 0.10 per kWh
Peak: CHF 0.18 – 0.22 per kWh

Commercial / Public institution: Strongly dependent on consumption and regional utility:
Low period: CHF 0.07 – 0.09 per kWh
Peak: CHF 0.13 – 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 5 400 kWh per household in the year 2004. Households account for approx. 30% of Swiss electricity consumption in 2004.
Total per capita electricity consumption in 2006: 7 646 kWh

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
- Special rates for trade and industry as well as for large-scale consumers

4) Average household income: CHF 105 000

5) Typical mortgage interest rate: 3%

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 is planned. Approx. 75% of the utilities are public owned.

8) price of diesel fuel (NC) 1.70 CHF

9) Typical values of kWh / kW for PV systems in parts of your country: 850 – 950 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)