Task 1
Exchange and dissemination of
information on PV power systems

National Survey Report on PV Power Applications in Switzerland 2007

Prepared by
Nova Energie GmbH
Schachenallee 29
CH-5000 Aarau

May – August 2008

On behalf of
Swiss Federal Office of Energy

List of Contents

Foreword 3

i Definitions, Symbols and Abbreviations 4

1 Executive summary 5

2 The implementation of PV systems 6
2.1 Applications for photovoltaics 6
2.2 Total photovoltaic power installed 6
2.3 PV implementation highlights, major projects, demonstration and field test programmes 9
2.4 Highlights of R&D 9
2.5 Public budgets for market stimulation, demonstration / field test programmes and R&D 11

3. Industry and growth 12
3.1 Production of feedstocks, ingots and wafers 12
3.2 Production of photovoltaic cells and modules 13
3.3 Manufacturers and suppliers of other components 15

3.5 Labour places 18

3.6 Business value 18

4 Framework for deployment (Non-technical factors) 20

4.1 New initiatives 21

4.2 Indirect policy issues 21

4.3 Standards and codes 22

5 Highlights and prospects 23

Annex A Method and accuracy of data 24
Annex B Country information 25

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. 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.

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

Pius Hüsser, Nova Energie GmbH, Aarau
Thomas Hostettler, Ingenieurbüro Hostettler, Bern

i 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.

1 Executive summary

In anticipating the coming feed in tariff scheme in Switzerland which had been adopted by Swiss Parliament in March 2007, there was a strong demand for new PV, especially for residential systems.
The istalled capacity in 2007 jumped to 6,5 MW (up from 2,5 MW in 2006). This was due to the fact the Swiss parliament agreed that the new feed in tariffs will include all PV installation commissioned after the 1st of January 2006 (The decree with the exact tariffs have been published in March 2008).

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 coming close to 1 Billion CHF
(1 000 000 000 CHF).

Installed PV power
Total installed PV power in Switzerland rose to a record high of around 36,2 MW of which 90% was delivered by grid-connected installations. Total installed capacity in 2007 was about 6,5 MW, more than doubling the average of the previous years. The market is mainly driven by the the newly adopted preferential feed in tariff scheme for renewable energies. This amendment to the energy law will include installations back to 2006.

Costs & prices
Switzerland is fully depending on the European module market.
Prices in 2007 followed the German market and decreased slightly both for modules as well as for turn key systems.

PV industry

The changes to the previous year are remarkable: The leading Swiss equipment manufacturers increased their turnover in certain cases by 100% or more. Overall net value of business is estimated to reach almost 1 billion Swiss francs in 2007.

It is expected that this growth will continue in the coming years.

2007 was the first year with a notable production of ingots and wafers (Swiss Wafer). At two sites construction began for thin film manufacturing plants in the range of 30 to 50 MW both with Swiss technology (VHF Technology and Oerlikon Solar).

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.

Stade de Suisse, 1.3 MWp, foto courtesy: BKW FMB, Bern

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 2 - 5 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).

2.2 Total photovoltaic power installed

Table 1 - The PV power installed in 4 sub-markets during 2007.

Sub-market/ application ##	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	total
PV power installed in 2007 (kW)	3 200	400	30 040	2 560	36 200

Table 2 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	31 Dec. 2007 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*	3 200*
off-grid non-domestic	70	100	112	143	162	184	190	200*	210*	220*	230*	260*	290*	320*	350*	400*
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	30 040
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
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	36 200

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 2007 the PV market was driven by the fact that the newly adopted law on preferential feed in tariffs planned to be implemented by 2008 will also be eligible for PV installations back to 1. Jan 2006.

- Thus Switzerland had a booming market for new installations beside the normal business with solar stock exchange schemes. Overall this led to a new record in installed capacity per year of 6,5 MW, almost 1W per capita. Year to year growth rate was 140%!

- For 2008 it is expected that the market will still grow, but not as much as the year before due to the cap built in the feed in tariff law. This will also lead to a decrease in the following years since the cap is limited to approx. 25 to 28 MW in total until the average costs per kWh within the scheme will fall below approx. CHF 0.60 / kWh.

- Within the solar stock exchange schemes in several Swiss cities and regional utilities, more than 1,5 MW have been installed. The lead is still taken by the utility of Zürich (ewz) with more than 5 MW under contract and another 1 MW to be added in 2008.

- In Bern the regional utility BKW (major shareholder Kanton Bern) added another 450 kW to the existing 850 kW on the roof of the football arena “stade de Suisse”. The whole production will also be sold within their solar stock exchange scheme.

- 3 out of 4 Swiss football stadium serving the 2008 European football championship do have PV on their rooftop.

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

In March 2007 the Swiss parliament adopted a preferential feed in tariff scheme for renewable energies. The revised Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency, the mainstay of which is the compensatory feed-in remuneration scheme for electricity generated from renewable energies. The revised Energy Ordinance approved by the Federal Council in mid-March 2008 lays down the principles governing compensatory feed-in remuneration, the documents to be submitted for registration, and the compensation rates (cents per Kilowatt hour) for the various types of facility.

From 2009 a compensatory feed-in remuneration will be granted for electricity which is produced from renewable energies and fed into the Swiss electricity grid. Producers of renewable electricity from hydro power (up to 10 Megawatts), photovoltaic energy, wind power, geothermal power and biomass energy can register their facilities for the compensatory feed-in remuneration from May 2008.
A surcharge of up to 0.6 cents per Kilowatt hour will be levied on high-voltage grid transmission costs from 1 January 2009, in order to fund the compensatory feed-in remuneration. This will bring in up to CHF 320 million per year.

For PV a cap has been set at 5% of the yearly amount fed by this levy until the feed in tariffs decrease below a certain level (approx. CHF 0,60). After reaching this level, another 5% of the yearly amount will set aside for PV.
It is estimated that for the first stage about 25 to 28 MW are eligible within this scheme.
For the initial compensatory feed-in remuneration phase, the Swiss federal Office of Energy has defined a special quota for upgrades of facilities which went into operation between 1 January 2006 and 30 April 2008 or which already meet the conditions governing progress reports (construction permit granted and connection application approved by grid operator). This quota will provisionally amount to 10 MWp and should be sufficient to accommodate all facilities.

Besides the federal energy act there are still very well working solar stock exchange schemes provided by several big utilities. It is expected that also besides the federal feed in tariff scheme there will be a steady growing market for PV. It is estimated that in 2007 this marked counts for approx. 20% to 25% of the newly installed capacity.

2.4 Highlights of R&D

(Excerpts from the PVPS annual report Switzerland)
The Swiss Photovoltaic RTD Programme is based on a 4 year RTD master plan, covering the period 2004 – 2007. In the last year of this period, overall 55 projects, supported by various national and regional government agencies, the research community and the private sector were 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 2007, 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) and intermediate reflector layers. In the area of thin film silicon, strong co-operation with the companies VHF-Technologies and Oerlikon solar continued. During 2007, the equipment manufacturer Oerlikon solar extended its activities as a leading supplier of manufacturing systems of thin film silicon solar cells on glass and was able to acquire a number of important large orders.
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 2007, the spin-off company FLISOM, active in this solar cell technology, continued its efforts towards an industrial product.
For dye-sensitised solar cells, work continued on new dyes and electrolytes as well as high temperature stability of the devices. 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 25 years of operation. Continuous development of system solutions has resulted in a number of industrial products which are increasingly being exported.
Along with the examples of the solar powered airplane project SolarImpulse (www.solar-impulse.com) by Bertrand Piccard and the solar powered boat project PlanetSolar (www.planetsolar.org), both of which plan to travel around the world by air and respectively on water in the coming years, the solar powered car project Solartaxi (www.solartaxi.com) started its actual trip in 2007. By the end of 2007, it had reached the Asia Pacific area and was in Bali during the UNFCCC Climate Change Conference. International co-operation continues to form a strong pillar of the R&D activities with 11 projects running in the 6th and 7th framework RTD programmes of the European Union during 2007, of which 3 are integrated projets. Swiss research groups are participating in the integrated projects FULLSPECTRUM, PV-ATHLET and PERFORMANCE. International projects are also carried out as part of programmes such as the European Space Agency: The project envisolar aimed at the increased use of satellite based solar radiation information in solar energy industries and for monitoring purposes.
The co-operation within the IEA PVPS programme has remained a further strategic activity. Founded in 2005, a national IEA PVPS pool receiving support from the electric utilities of the city of Zurich, the Cantons of Basel as well as Geneva, the Mont-Soleil Association and SWISSOLAR contributed to the Swiss expert participation in IEA PVPS. The support to Swiss IEA PVPS activities could thus be broadened, in particular for activities in Tasks 2 and 10.

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

Table 3 Public budgets for R&D, demonstration/field test programmes and market incentives.

CHF	R&D	Demo	Market
National/feder	9,5	0,1	0,5
State/regional	4,0	0,1	1,9
Total	13,5	0,2	2,4

Please refer also to the Photovoltaic Programme Edition 2008, Summary Report, Project List, Annual Project Reports 2007 (Abstracts) www.photovoltaic.ch

3. *Industry and growth*

Besides a very strong equipment manufacturing industry there are new companies starting production along the PV value chain.
With an estimated production of 60 MW or even more, Swiss wafers AG is the only company in Switzerland for ingots and wafers.
Qcells invested in VHF Technology and intends to set up a thin film manufacturing plant in Yverdon. Italian investors announced a Oerlikon Solar based thin film production in the canton of Tessin near the Italian border.

3.1 Production of feedstocks, ingots and wafers

These figures are estimates

Table 4

Producers	Process & technology	Total Production	Maximum production capacity
Swiss Wafers	sc-Si ingots.	*<60MW*	*N/A*
Swiss Wafers	mc-Si ingots		
Swiss Wafers	sc-Si wafers	*60 MW*	*120 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 2007.
Unfortunatly the biggest producer in Switzerland, Solterra SA,is not willing to disclose its production figures

Table 5: Production and production capacity information for the year for each manufacturer (*a-h, x, y are examples)*

Cell/Module manufacturer	**Technology**	**Total Production (MW)**		**Maximum production capacity (MW/yr)**	
		Cell	Module	Cell	Module
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***	
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 6: Typical module prices for a number of years in CHF (crystalline silicon) (all prices concern imported modules)

Year	2004	2005	2006	2007
Module price(s): large quantities (500 kWp) -> average	4.30	4.80	5.20	5.00
Module price(s): large quantities (500 kWp -> Best price	4.10	4.60	5.00	4.80

3.3 Manufacturers and suppliers of other components

As the international market is still expanding further, success was achieved above all 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 produce just 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 for a few areas:

a) PV inverters (for grid-connected and stand-alone systems)
First of all, the robust development of the **Sputnik Engineering AG** company must be mentioned. Alongside the absolute leader in this area, SMA, this company is one of the three largest manufacturers world-wide. The trend is still towards further, strong expansion. In 2007, Sputnik produced inverters with a total rated output of almost 190 MW; at the end of 2007 the company provided employment for 105 own employees in Switzerland and around 100 persons at Swiss subcontractors. The average prices for installers fell from approximately 0.60 €/W in the year 2000 by a good 30% to a current level of somewhat less than 0.42 € per watt. Under the wings of its big mother company Solon, **ASP** in Laupen was once more able to increase business, particularly in the mains-inverter area, by almost 20%. The split between mains-connected and stand-alone inverters developed from 50:50 to 75% mains-connected and 25% stand-alone.

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
There is only a single manufacturer who produces solar batteries in Switzerland: the **Levo Batterien AG** in Dietgen. The other two manufacturers, Johnson Controls Batterie AG (formerly Oerlikon or AVB Batterie AG respectively) in Regensdorf and Saentis J. Goeldi AG in Ruethi in the St. Gall Rhine valley still sell products under their own name, but, however, have them manufactured in Europe. Developments towards OEM products can be observed especially well here; the manufacturer Johnson Controls Batterie AG, for example, sells various products under different names (Varta, Oerlikon, etc.).

c) Battery charge controllers
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
In the year under review, **ABB** were able to launch the re-worked QDC circuit-breaker (formerly known under the name CMC in Schaffhausen) now named S 800 PV. As before, it is manufactured in Switzerland.

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. This company has extended the range of possible applications of the system in that glass-glass laminates can now also be framed. In 2007, approx. 5 MW were implemented using this integration system.
For about the same amount of installed power, the AluStand system was used which has been 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 of France.

f) Manufacturing equipment
In the manufacturing equipment area, there are once more a large number of well-known manufacturers who 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. The latter company was taken over in 2007 by the large supplier Applied Materials Inc.

Actual production equipment is manufactured by the companies **3S Swiss Solar Systems AG** in Lyss and **Oerlikon Solar** (previously Unaxis Solar) in Pfaeffikon. In the year under review both clearly moved up a notch; in particular, 3S succeeded in doubling their sales and increased profits substantially. In order to complete their product range, 3S took over the **Belval SA** company in Neuchatel. This company manufactures cell and module test equipment.

These companies all hold their top placings through continuing innovation or even by extending their lead in that they profit from the up-and-coming markets in Europe, USA and, above all, in the Far East.

g) Various
Here, a whole series 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 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 7: 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	17.0 – 22.0
OFF-GRID >1 kW	Alpine dairy farms	15.0 – 17.0
GRID-CONNECTED Specific case	Residential, 2-4 kW, roof-mounted system	9.65
GRID-CONNECTED Up to 10 kW	Farmhouse, big residential house, -10 kW, roof-mounted system	9.30
GRID-CONNECTED >10 kW	"production plants" mostly on flat roofs for solar stock exchange schemes	9.10 >100 kW: CHF 7.50

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 7a: 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	2007
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
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

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, PV industry turnover, imports and budgets for research and development in 2007

Table 8

Category	R&D	Cell / Module Manufacturing / Inverters	Planning / Installation	Manuf. facility suppliers, other BOS Components	Total
Labour places	around 200	around 600	around 200	around 3000	around 4000

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

3.6 Business value

The value of PV business has increased by almost 100% from 2006 to 2007. This is due to a very competitive export industry of PC production equipment, inverters and other BOS components.

The total end financial value of PV plant installed is estimated at around CHF 60 Million. This is estimated on the basis of PV power installed in 2007 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 15 to 20 million.

Table 9: Value of PV business (CHF)

Sub-market	**Capacity installed *in 2006* (kW)**	**Price per W** *(from table 5)*	**Value**	**Totals**
Off-grid domestic	*150*	*15*	*225 000*	
Off-grid non-domestic	**50**	**15**	*750 000*	
Grid-connected distributed	**6 300**	**9**	*56 700 000*	
Grid-connected centralized	**0**		*0*	
				57 675 000
Export of PV products				*950 000 000**
Change in stocks held				*0*
Import of PV products				*40 000 000***
Value of PV business				***967 000 000***

* Inverters, BOS components, manufacturing equipment
** Panels, BOS components

4 Framework for deployment (Non-technical factors)

Table 10: 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 The revised Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency, the mainstay of which is the compensatory feed-in remuneration scheme for electricity generated from renewable energies. Start 1.1.2009 but installations back to 1.1.2006 will be eligible for this tariffs as well.
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

In spring 2007 the Swiss Parliament concluded its deliberations on the Electricity Supply Law and the changes in the Energy Law (that concerned the promotion of renewable energy). Since, with the coming into effect of these laws, the new financing instrument KEV (cost-covering buy-back price) is to be made available, most of the Swiss Cantons terminated their PV promotion schemes at the end of 2007.

Utilities fulfilled their power-source declaration obligations on a large scale without encountering any problems (see also 4.2). The appropriate information can be found on the websites of most utilities.

As far as the inter-departmental platform REPIC (Renewable Energy Promotion in International Co-operation) was concerned, 2007 was an important year. On the one hand, it was decided to continue the project with doubled resources and, on the other hand, its topics were extended to cover the subject of energy efficiency. This work is being carried out within the framework of IEA Task 9, Photovoltaic Services for Developing Countries.

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. In this way, such publications are to provide a long-term increase of customer awareness; the influence on an increased demand for photovoltaic power is, however, still difficult to quantify.

After the referendum period elapsed unused, both the Electricity Supply Law as well as the changes in the Energy Law cleared an important hurdle in summer 2007. The administration took on the processing of the relevant regulations and it was long hoped for, that the whole packet could be put into force on January 1st, 2008. For various reasons further delays occurred so that the EEG will only come into force in the course of 2008. Since, however, a retroactive stipulation offered a certain amount of investment security, many PV installations were built. In this way, the KEV has turned out be an important factor for the support of increased activity in addition to the "Solar Stock Exchanges".

After protracted discussions lasting over three years, the Swiss Parliament completed its deliberations on the CO2 Law in spring 2007 and decided on the rates for the levies on combustibles.

4.3 Standards and codes

In 2007, a whole series of standards was put into effect at the IEC level. Above all, they have effects on local manufacturers of products. The following norms are to be mentioned above all:

- EN 61730-1:2007 Photovoltaic (PV) module safety qualification - part 1: Requirements for construction
- EN 61730-2:2007 Photovoltaic (PV) module safety qualification - part 2: Requirements for testing
- EN 60904-9:2007 Photovoltaic devices - part 9: Solar simulator perfomance requirements
- IEC / TS 61836:2007 Solar photovoltaic energy systems - Terms, definitions and symbols

The work was carried on within the framework of TK 82 and the technical association guaranteed the participation of members interested in the formation of opinions. Towards the end of the year the association organised a workshop under the patronage of the IEC on the subject of Arcing in PV DC Systems together with the University of Applied Sciences in Burgdorf, thus providing important impulses for topics still pending in standardisation work.

After this conference, the long-standing chairperson of TK 82, Dr. Markus Real, passed on the chair to newly-elected Peter Toggweiler.

The importance of photovoltaics in politics has been made clear with the transfer 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) that was made for the European Commission. Work on anchoring and making the platform well known is continuing at a high rate.

5 Highlights and prospects

In March 2007 the Swiss parliament adopted a preferential feed in tariff scheme for renewable energies. The revised Energy Act contains a package of measures aimed at promoting renewable energies and energy efficiency, the mainstay of which is the compensatory feed-in remuneration scheme for electricity generated from renewable energies. The revised Energy Ordinance approved by the Federal Council in mid-March 2008 lays down the principles governing compensatory feed-in remuneration, the documents to be submitted for registration, and the compensation rates (cents per Kilowatt hour) for the various types of facility.

The Swiss PV industry kept track with global market growth. Equipment manufacturer succeeded in increasing turnover as well as earnings. Overall industry turnover reached almost 1 billion Swiss francs, more than 50% increase compared to the previous year.

Industry outlook for the coming years is very bright since they all are more or less global players and can react to newly emerging markets (Korea, China) as well as serving the “old” markets as Germany or Spain.

Since the preferential feed in tariff scheme for PV has an overall cap of approx. 25 to 30MW for the coming years it is expected, that the annually installed capacity will be around 5 to 10MW for 2008/2009/2010.

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 2005. Households account for approx. 30% of Swiss electricity consumption in 2005. Total per capita electricity consumption in 2005: 7 643 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: 3,25%

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

8) price of diesel fuel (NC) 1.75 CHF

9) Typical values of kWh / kW for PV systems in parts of your country: 950 – 1050 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)