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 Austria 2006

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i 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.

ii Introduction

An important deliverable of Task 1 is the annual International Survey Report on PV power applications. This report gives information on trends in PV power applications in the twenty member countries and is 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 National Survey Report gives an overview of the achievements in the area of PV power applications in Austria in the year 2006. It is a summary of the market developments, achievements of the PV industry and non technical factors which provide the framework for the deployment of PV in Austria.

iii Definitions, symbols and abbreviations

For the purposes of the National Survey Report, 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 organization carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed in households and villages that are not connected to the utility grid. Usually a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'.

Off-grid non-domestic PV power system: System used for a variety of 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 on consumers' premises usually on the demand side of the electricity meter. This includes grid-connected domestic PV systems and other grid-connected PV systems on commercial buildings, motorway sound barriers etc. These may be used for support of the utility distribution grid.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station.

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 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.

NC: National Currency

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

Installed PV power

In 2006, the decline of the domestic PV market continued further due to the absence of a federal incentive for PV market implementation. Following the all-time peak of 6,5 MW installed capacity in 2003, the annual PV market has been declining the third year in a row, dropping to 1,56 MW in 2006. This is the lowest figure since the year 2001.

The overall installed PV capacity in Austria reached 25,6 MW at the end of 2006.

Compared to the year 2005 this represents a decline of the market of 47%. On grid applications still dominate the market for PV, with 22,4 MW this sector accounts for about 88% of the cumulative installed capacity.

As during the previous years, the off-grid sector plays a minor role in the Austrian PV market. In 2006 only 0,27 MW were installed in this sector. In total approximately 3,2 MW off-grid systems for domestic and non-domestic applications were installed at the end of 2006.

With the ongoing decline of the national PV market, the average growth of the PV market between 1996 and 2006 was 31% per year.

However, despite the collapse of their home market, Austrian PV industry could again significantly expand their business in 2006. The most important products manufactured in Austria include PV inverters, modules, tracking systems as well as back-sheet laminates for module encapsulation.

Costs & prices

With the dominating German PV market in its direct neighbourhood, PV module as well as system prices in Austria are closely linked to the German development.

Following the international trend, prices for PV modules remained constant or slightly increased during 2006. This development can be associated with the enormous increase of demand of the German PV market, and a general lack of cell supply on the world market.

System prices remained constant and in 2006 turnkey prices for typical residential on-grid systems varied between 5 EUR/W and 6 EUR/W.

PV production

PV production in Austria 2006 can be characterized by an ongoing expansion of the production – and an continued dependency on the export.

Especially Austria's inverter industry is one of the beneficiaries of the booming international market for PV and could extend its output compared to the year before. In total roughly 75 000 inverters for grid-connected applications for a capacity of approximately 250 MW(PV), 210 MW(a.c.) were produced in Austria during 2006. More than 99% of the production was exported, mainly to Germany. Currently two companies are active in large scale production and R&D.

Also the module manufacturing sector saw a significant expansion. The overall PV module production in Austria in 2006 amounted to 46,5 MW, which represents an increase of 130% compared to the previous year 2005.

The world wide leading manufacturer of back sheet laminates used for encapsulation of solar cells likewise reported ongoing growth of its PV business.

Production of large scale two-axis tracking systems more than doubled compared to the year 2005 and reached 25 MW in 2006.

There is still no traditional cell production in Austria, however, two newly established companies have been starting to build up production facilities. According to their plans, pilot production is expected to start in late 2007/early 2008.

Budgets for PV

The feed-in tariff system for electricity from RES introduced in the national Green Electricity Act 2003 is financed by all consumers of electricity via supplements on the electricity price and an obligatory purchase price for Green Electricity which has to be paid by electricity dealers. The feed-in tariffs paid for PV in 2006 amounted to approximately 8,7 MEUR, which represents an increase of 2,4% compared to 2005.

With the introduction of the nation wide feed-in tariff system in 2003, almost all other market incentives have ceased. After the 15 MW cap - up to which the feed in tariffs are granted – had been reached in early 2003, some provinces again re-established own market incentives, such as rebates for the installation of PV systems. In 2006 support schemes for new grid connected PV systems were available in three provinces. The budget spent for the support can be estimated to 3,0 MEUR.

There is no national R&D programme dedicated to PV, however the programme "Energy systems of Tomorrow" launched in late 2003 by the Ministry of Transport, Innovation and Technology includes PV as a side issue. In the absence of a dedicated programme R&D is mainly funded on a project base via various industrial and governmental initiatives, or European research framework programmes.

Public funding for research, development and demonstration declined during the last years and can be estimated to 1,3 MEUR in 2005 (no 2006 data available yet).

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

As in most of the other IEA countries, Off-grid installations were the first economic alternative for PV systems. Small autonomous systems provide electricity to technical systems or for domestic use in Alpine areas or mountain huts far away from the grid. But not exclusively in remote areas, also on urban sites PV is an option to supply infrastructure like traffic surveillance systems, communication systems, parking meters and a variety of other applications.

With the introduction of favourable support schemes On-grid Distributed Systems have meanwhile become a common place in public's interest. In Austria this sector now stands for more than 88% of the installed capacity.

With the support schemes limited to small, residential scale systems, Grid-Connected Centralized Systems in form of PV Power plants play a minor role, so far approximately 1,2 MW are installed.

2.2 Total photovoltaic power installed

Approximately 25,6 MW of PV power has been installed in Austria by the end of 2006. While until 2003, capacity grew continuously about 37 % each year, the market size dropped down from its all time high of 6,5 MW in 2003 to only 1,6 MW in 2006.

On grid applications still dominate the market for PV, with grid-connected systems (GCS) accounting for about 88% of the total installed capacity.

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

Sub-market/ application	31 Dec 1992 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
total off-grid	338		908	960	1 213	1 413	1 671	1 857	1 984	2 173	2 645	2 895	3 169
grid-connected distributed	187		761	1 178	1 648	2 119	3 063	4 440	7 857	13 507	17 262	19 973	21 263
grid-connected centralized	N/A		70	70	70	140	140	241	476	1 153	1 153	1 153	1 153
TOTAL	525		1 739	2 208	2 861	3 672	4 874	6 120	10 341	16 833	21 060	24 021	25 585

The rebate programmes for grid connected PV systems introduced in some of Austria's provinces after the end of the federal feed-in tariff scheme (Green Electricity Act, GEA) remained the main drivers of Austria's PV market. In three of the provinces, rebates of up to

3 000 EUR/kW installed capacity were granted. However, due to limitations in available budgets as well as complicated application procedures, these incentives could only provide limited support for the domestic market.

From October 2006, the revised feed-in tariff scheme of the Green Electricity Act 2006 came into effect. The whole support scheme, including applications, is now managed by OeMAG, a company newly established by the Austrian Ministry of Economy.
However, as the first contracts were signed in November 2006, the new support scheme did not have a notable effect on the market in 2006 yet.

More details on the revised feed-in tariff scheme of the Green Electricity Act can be found in section 4.1.

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

With the introduction of the nationwide support for electricity from RES (Green Electricity Act) in 2003, the local and regional programmes initiated by communities, federal states or utilities have ceased or were adapted to the national scheme. No new field test or demonstration programmes have been established in the meantime.

Regarding new PV projects a major trend observed in the last years – optimal architectonical integration of BIPV in newly constructed as well as refurbished buildings – also continued during 2006. Several installations with innovative design aesthetically integrated into buildings document this.

Community Centre in Ludesch, Vorarlberg, Austria.

The most outstanding example of PV in Austria realized in 2005, is the community centre in Ludesch, Vorarlberg, which was realized in the framework of the national “House of the future” R&D program.

When the decision was taken by the municipal administration of Ludesch to build a new community centre, it was intended to be a representative example of an ecological building as well as a lively meeting place for the local people, with PV as a natural part of the concept.

350 square metres of solar modules with transparent solar cells from German company Sunways, laminated by Austrian Ertex Solar are covering the new village square. By this, the PV installation not only takes over the production of electricity, but at the same time, protects against rain and provides shade for the roof-covered square.

The PV solar roof of the community of Ludesch is currently the largest PV system with semi-transparent solar cells in all of Austria.

The PV system has been supported by grants from the province as well as the state and is expected to produce a revenue of approximately 11 300 EUR annually with the enhanced feed-in tariff.

2.4 Highlights of R&D

Austrian PV research activities are mostly focused on national and international project base and are widespread located and decentralized orientated. Some principal descriptions of these projects highlight the general RTD trend of photovoltaics in Austria:

New and improved cell technologies:

- At the University of Salzburg, the initiatives in the field of cell research continued. The aim is to develop solar cells based on new materials such as sulfosalt crystals. In 2006, the negotiations for a so called Christian Doppler Labor "Applications of Sulfosalts in Energy Conversion" (7 years of federal financing) were initiated to research and develop these new materials. The laboratory is operated in collaboration with the Austrian SEZ AG a leading enterprise in the field of facilities for the production of microprocessors and will have a budget of about 2 MEUR.
  The laboratory, headed by Herbert Dittrich, since 2004 Professor for Material Science at the University Salzburg, has been officially opened in June 2007.

- At the Atom institute of the Austrian Universities in Vienna academic research focuses on the improvement of photovoltaic solar cells made from multi-crystalline silicon. Ongoing research in 2006 focused on different aspects of crystalline silicon cells and module integration:
  - The development of new, stringing techniques for Emitter-Wrap-Through Back-Contact cells,
  - Stringing techniques without soldering for new silicon solar cells and
  - improved etching techniques for crystalline silicon solar cells.

- Organic Solar Cells based on thin plastic films have received increased attention due to their unique properties and are promising to become the cheapest solar technology in the future. Academic R&D at the Linz Institute for Organic Solar Cells (LIOS) on this topic focuses on Plastic Solar Cells based on thin films of Conjugated Polymers.
  In 2006 three new European initiatives started with LIOS' participation and initiation. ORGANISOLAR is a European Science Foundation network project which will enable scientist to travel and make collaborative studies within many European countries (www.esf.org) SolarNType is a research and training network within the 6th Framework programme dedicated to organic solar cells. Last but not least ORGAPVNET is a coordination action programme within the 6th Framework of the EU Commission and will be dedicated to promote, organize and structure the European Research Area in the field of organic solar cells.

BOS components, system aspects quality assurance and training:

- Industrial research and development activities carried out by the large manufacturers are focused on optimization of PV inverters, improvement of module manufacturing technologies, tracking systems and encapsulation materials.

- Grid-interconnection, not exclusively related to PV but more to the integration of decentralised, distributed generation from RES, is the main focus of R&D projects supported

by the European Commission and Austrian Ministries in the framework of the “Energy Systems of Tomorrow” program. These projects are jointly carried out by academic and applied research institutions, industry and utilities.

- In the area of system technology, new activities for quality assurance, certification and testing of PV modules were initiated. The activities in this field are focused on lifetime assessment and reliability issues of PV modules. R&D on this issue is centered at the PV laboratory of arsenal research, Vienna. In 2006, the first pilot course for PV planners and installers attracted broad interest.

- A Master of Building Science at the Danube University in Krems is dedicated to Solar-Architecture where the lectures and the scientific work are focusing more and more on PV Building integration.

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

The major institution dealing with research and development policy is the Federal Ministry of Transport, Innovation and Technology (BMVIT). This ministry is the major organizer and facilitator for public R&D activities in Austria. The majority of public R&D programmes operate under the BMVIT and there are several programmes which focus on energy-related fields. Especially the programme "Energy Systems of Tomorrow" initiated in 2004 is to be named in this context. There is no programme specifically dedicated to PV R&D.

Until June 2007, no data on the public spending for Energy R&D in 2006 were available. The following numbers refer to data for the year 2005.

In 2005 renewable energy received about 36% of the Austrian Energy R&D budget of 33,6 MEUR and increased its share by 6% percentage points. The majority of the RES funds (78%) was spent on bioenergy related R&D. The second-highest priority is laid on solar energy, which comprises solar thermal, cooling and PV. Total funding for all solar energy R&D was equal to 15,4% of the renewable energy R&D budget. PV research accounts for 10,8% of the total budget and thus significantly increased its share compared to the previous year.

In 2005 the overall public spending for PV research, development and demonstration was about 1,31 MEUR (2004: 0,4 MEUR). This represents a 3 times increase of public funding compared with the year 2004.

Not included in these figures is the return from European Community (EC) R&D projects. As Austria is a member of the European Union contributes to the EC R&D framework programmes (FP), the return can be ultimately regarded as a part of public spending. However, no reliable data was available on these funds in 2006.

There are no specific figures available for the share of Demonstration or Field Test activities but as there is no demonstration or field test programme running now, it can be assumed that the share of these activities is negligible.

The total governmental budget allocated for PV R&D, Demonstration and market incentives is shown in Table 2.

Table 2 Public budgets (in MEUR) for R&D, demonstration/field test programmes and market incentives (figures for 2005!).

	R & D	Demo/ Field test	Market *)
National/federal	N/A		0
State/regional	N/A		3
Return from European Commission R&D Framework Programmes	N/A		0
Total	1,31		3

* Not including feed-in tariffs. See also the comments below.

From 2003 the support for electricity from RES has been governed by the Green Electricity Act. The feed-in tariff system is funded by supplements on the electricity price and an obligatory purchase price for Green Electricity which has to be paid by electricity dealers. Because of the fact that this system is not financed by a public body, but instead by all consumers of electricity the according figures have not been included in Table 2 under “Market”. The total amount of feed-in tariffs paid for PV in 2006 was approximately 8,7 MEUR, which represents a 2,4% increase compared to the previous year. The average feed-in tariff paid for PV was 64,5 Eurocent/kWh.

With the commencement of the Green Electricity Act in 2003, almost all further market incentives from regional governments, communities and municipalities, or utilities have ceased. In 2006 in the provinces of Upper Austria, Lower Austria and Vienna a substantial regional support in form of rebates on the costs of the PV system (investment subsidies) was granted. The figure stated in Table 2 under “regional” represents the total budget spent for this purpose 2006 in the three provinces.

3 Industry and growth

3.1 Production of feedstock and wafers

No production facilities for silicon feedstock or wafers existed in Austria in 2006.

Table 3: Production and production capacity information for the year for silicon feedstock, ingot and wafer producers

Producers	Process & technology	Total Production	Maximum production capacity	Product destination	Price
	Silicon feedstock	*tonnes*	*tonnes/year*		
	sc-Si ingots.	*tonnes*	*tonnes/year*		
	mc-Si ingots	*tonnes*	*tonnes/year*		
	sc-Si wafers	*MW*	*MW/year*		
	mc-Si wafers	*MW*	*MW/year*		

3.2 Production of photovoltaic cells and modules

Despite the stagnating home market, Austrian PV industry could significantly expand their production in 2006. Currently six Austrian companies are involved into the production of PV-modules namely:

Solon-Hilber Technologie, since 2005 a 100% subsidiary of German Solon AG, is manufacturing framed laminates exclusively for the use on the “SOLON Mover” tracking systems. The cells (crystalline silicon) are delivered by the German SOLON AG.

PVT AUSTRIA, which started the production in 2002, manufactures standard and tailor-made PV-Modules. The single and multi-crystalline silicon cells are purchased from various manufacturers, mainly Germany, Spain, the U.S. and Taiwan. Special products include semi transparent modules with insulation glass and PV-modules made of custom-tailored coloured solar cells which can be individually designed according to the customer’s requirements.

RKG-Photovoltaik GmbH., recently renamed to KIOTO Photovoltaics GmbH is affiliated to Europe’s largest manufacturer of Solar Thermal Collectors, GREENoneTEC Solar Industries Ltd. The company is manufacturing standard modules based on imported cells.

Energetica Energietechnik GmbH, located in Klagenfurt, Carinthia, is producing standard framed laminates and glass-glass laminates based on single and multi crystalline silicon cells. The cells are imported from various sources.

SED, focuses on the production of PV-roof tiles. The used multi crystalline cells are imported from France. New developments and research activities in 2006 include an integrated module concept for PV noise barriers and a product for high-speed train noise barriers.

Ertex-Solar, affiliated to Ertl Glas AG, a large manufacturer of safety glass products, is producing tailor made modules for BIPV, especially façade integration. The cells are imported

from Germany. New products 2006 include laminated safety glass PV-Modules and insulated glass modules.

In total, Austrian module manufacturers could again boost their output compared to the previous year. The total production in 2006 was 46,5 MW. Compared to 20,5 MW in 2005. this figure represents a more than doubling of their output. However, due to the lack of cell supply on the international market, the production capacity could not be used to full capacity.

The major share of the module production is exported to Germany.

Table 4: Production and production capacity information for the year 2006 for each manufacturer (figures for 2005 in brackets)

Cell/Module manufacturer	Technology (sc-Si, mc-Si, a-Si, CdTe)	Total Production (MW)			Maximum production capacity (MW/yr)		
		Cell	Module	Conc.	Cell	Module	Conc.
1 SOLON Hilber Technologie	mc-Si / sc-Si	-	25 (10)	-	-	N/A (N/A)	-
2 PVT Austria	mc-Si / sc-Si	-	10,1 (4,5)	-	-	30 (6)	-
3 Energetica	mc-Si / sc-Si	-	6,0 (2,0)	-	-	10 (5)	-
4 RKG Photovoltaik	mc-SI / sc-Si	-	5,0 (1,5)	-	-	5,4 (2)	-
5 ERTEX Solar	mc-Si / sc-Si	-	0,25 (<0,5)	-	-	0,25 (N/A)	-
6 SED	mc-Si	-	0,12 (0,2)	-	-	2 (2)	-
TOTALS	-	-	46,5 (20,5)	-	-	>70 (N/A)	-

In 2006 there was no production of solar cells in Austria. Most of the modules produced include cells imported from various countries, such as Germany, Spain, The U.S., Taiwan or France.

However, in 2006 the following activities and new initiatives can be reported in the field of new cell production capacities:

- **Blue Chip Energy GmbH**, founded in spring 2006 is currently building up a production for high-efficiency single crystalline silicon solar cells in the municipality of Güssing. In spring 2007, German SOLON AG has signed a strategic partnership with Austrian Blue Chip Energy GmbH and holds now 19% of the company's shares. The first production line with a capacity of 20 MW/a is scheduled to start operation in early 2008. The full capacity to be installed is planned to 100 MW/a.

- **Powerquant** a spin-off company from the Technical University of Vienna, is building up a production for multi-crystalline silicon solar cells with diagonal busbars and optimized finger grid. However, due to the shortage of solar cells on the international market, the activities were widely halted in 2006.

- Another recent start-up, the company **FalconCell** is currently building up cell production facilities. In 2006, the work on a 15 MW crystalline silicon production line was continued. The pilot phase is expected to start in late 2007. The company is linked to the first Austrian PV-Module manufacturer PVT-Austria.

Table 4a indicates the typical module prices for the year 2006 as quoted by the manufacturers. The price range reflects the prices for different module types for typical orders (5 kW). With the ongoing boom in several European markets, mostly Germany which led to an ongoing shortage on the European and International cell market, prices of PV modules remained constant or slightly increased compared to 2005.

Table 4a: Typical module prices (EUR per Watt) for a number of years

Year	2002	2003	2004	2005	2006
Module price(s):					
Standard framed laminates	4,50	3,10 – 3,20	3,60 – 3,70	3,60 – 3,90	3,60 – 4,30

3.3 Manufacturers and suppliers of other components

Austria has a long tradition as one of the largest inverter producing countries in Europe. Following the overall expansion of the world-wide PV market in 2006, the two large manufacturers could again extend their output in 2006. In total an estimated sum of 75 000 inverters with a capacity (rated AC output capacity) of approximately 250 MW(PV), 210 MW(a.c.) were produced. More than 99% were exported, mainly to the European market.

- Austria's largest producer of inverters, **FRONIUS INTERNATIONAL GmbH**. has been engaged in solar-electronics for a long time and is now Europe's second largest manufacturer of inverters for grid connected PV systems.

- The second producer, **SIEMENS AG AUSTRIA** is manufacturing and developing string-inverters in the range of 1,5 kW to 4,6 kW for grid connected applications.

Besides inverter manufacturing, Austria hosts also one of the largest manufacturers of back sheet laminates for PV modules.

- **ISOVOLTA AG** is the world market leader for flexible composite materials used for encapsulation of solar cells. The ICOSOLAR back sheet laminates are available in various colours and are used by many module manufacturers in the world. New developments are focussing on new encapsulation materials, reduction of costs and optimisation of the encapsulation.

- **SOLON Hilber Technologie**, a 100% subsidiary of German SOLON AG, is manufacturing tracking systems for PV power plants. In 2006, 2 800 "MOVER" tracking systems for PV installations with a capacity of 25 MW were produced. New products introduced or developed in 2006 include the new "Mover XL" and "XL Eco" tracking systems as well as the mounting system "FlexNet".

3.4 System prices

The stagnation of turnkey prices for complete PV systems, which was already observed in 2005 continued also during 2006. Due to the continued high demand of the European PV market and the stringent supply of PV modules on the world market, prices remained on the same level.

In 2006 turnkey prices for typical on-grid systems varied between 5 EUR/W and 6 EUR/W, depending on the used PV-technology, size and type of the installation.

The according figures for typical PV applications are shown in Table 5. The considered installations are domestic, rooftop systems. Prices for specific building integrated systems are typically considerably higher and depend on the specific case. Therefore, these are not reported here.

Table 5: Turnkey Prices of Typical Applications

Category/Size	Typical applications and brief details	Current prices in EURO/W
OFF-GRID Up to 1 kW	Basic electricity supply for mountain huts.	8 to 15 *)
OFF-GRID >1 kW	AC Electricity supply for larger mountain huts. System size between 1 and 8 kW.	8 to 15 *)
GRID-CONNECTED Specific case	2-3 kW roof-mounted system.	5 to 6
GRID-CONNECTED Up to 10 kW	Typical roof-mounted system for a single or multifamily house.	5 to 5,5
GRID-CONNECTED >10 kW	Larger system for commercial / industrial applications. PV-power plants	4,8 to 5,5

Prices do not include VAT. All figures are estimated based on information provided by installation companies.

*) For off-grid systems prices vary widely depending on the application (DC appliances or AC island grid) and the mounting-site.

Table 5a shows the development of turnkey prices (excluding VAT) for a typical residential, grid-connected roof-mounted system with a power of 2 kW to 3 kW during the last years.

Table 5a: National trends in system prices (EUR/kW) for a typical 2 – 3 kW grid connected system

YEAR	1992		2001	2002	2003	2004	2005	2006
Price /W:			7 500	7 000	6 000	5 500	5 500	5 400

3.5 Labour places

No precise numbers can be given on the number of labour places in the various sectors. The following figures represent a rough estimation, based on information from the manufacturing companies and R&D institutions:

- Research and development (not including companies): about 40
- Manufacturing of PV system components, including company R&D: about 830
- All other, including within electricity companies, installation companies etc.: about 30

With the continued expansion of their business Austrian PV manufacturers again significantly extended their workforce in 2006. In total it can be estimated that at the end of 2006 roughly 900 jobs were directly linked to PV R&D, manufacturing and installation in Austria.

3.6 Business value

In 2006 about 1,6 MW of PV systems were installed in Austria which provides an estimated value of the national market of 8,9 MEUR, based on average turnkey prices for off-grid and grid connected systems.

While until 2003 modules were almost exclusively imported, the domestic production has meanwhile become a significant factor and now outweighs the domestic demand by a factor of 29.

The value of exported PV components was calculated by multiplying the capacity of products produced (mainly modules, inverters, mounting systems and encapsulation materials) with their specific gross-sales price. For 2006 this figure can be estimated to be approximately 350 MEUR, which represents an almost 60% increase compared to 220 MEUR in 2005.

Imports of PV products consist of solar cells used for the module production and complete systems as well as modules. This figure can be estimated to 135 MEUR.

Raw- and intermediate products not considered as “PV products”, such as electronic components for inverter manufacturing are not included in this calculation.

Eventual changes of stocks held were not considered, as it was not possible to obtain detailed figures from the manufacturers.

Table 6 provides an overview on the value of PV business in Austria, total Export and Import of PV products as well as the domestic market. The figures presented are a rough estimate which can be used to demonstrate the development of PV business in Austria. However the numbers should not be used as exact figures for the value of PV business.

Table 6: Value of PV business (estimation)

Sub-market	**Capacity installed *in 2005* (MW)**	**Price per W** *(from table 5)*	**Value (MEUR)**	**Totals (MEUR) Rounded!**
Off-grid	0,27	9	2,4	
Grid-connected distributed	1,29	5,4	6,4	
Grid-connected centralized	0	-	0	
				9
Export of PV products				348
Change in stocks held				0
Import of PV products				-135
Value of PV business				**222**

4 Framework for deployment (Non-technical factors)

Table 7 summarizes the PV support measures which were in place in Austria during 2006:

Table 7: PV support measures

	National	Regional (State)	Local	Other
Enhanced feed-in tariffs	Yes	Yes (co-financing)	-	-
Direct capital subsidies	-	Yes (3 out of 9 provinces)	-	-
Green electricity schemes	Yes	-	-	-
PV-specific green electricity schemes	Yes (UZ46)	-	-	-
Renewable portfolio standards (RPS)	-	-	-	-
PV requirement in RPS	-	-	-	-
Investment funds for PV	-	-	-	-
Tax credits	-	-	-	-
Net metering	-	-	-	Some DNOs
Net billing	-	-	-	-
Commercial bank activities	-	-	-	-
Electricity utility activities	-	-	-	-
Sustainable building requirements	-	-	-	-

4.1 New initiatives

Until today public support schemes for PV in Austria have been mainly characterized by discontinuity:

While until 2003 the Austrian framework for renewable energy support had been based on diverse local and regional incentives, the implementation of the federal Green Electricity Act (Ökostromgesetz) marked an important turning point. The support in form of preferential feed-in tariffs for electricity from renewable sources together with a purchase obligation for green electricity created a very attractive environment for investment into green electricity in general and PV in detail. For PV systems installed in the framework of this legislation, the feed-in tariff was set to 60 Eurocent per kWh for systems up to 20 kW and 47 Eurocent for larger installations.

Due to the fact that the availability of the PV feed-in tariffs was capped to a national limit of 15 MW – which had been reached already during the first weeks after the GEA has become effective – the role of PV in the future electricity scenario was limited from the very beginning.

After a period of about 3 years with no federal support for PV, Austria's parliament passed a revision of the green-electricity act in May 2006, which affects also the PV market. The key items in the new revision are:

- The GEA 2006 governs now not only the support for green electricity but also for electricity from combined heat and power generation. A new paragraph now supports also the larger hydro power plants (50-100 GWh/a).

- The GEA 2006 sets a target to meet 10% of the public national electricity demand with electricity generated from 'new' renewable energy sources by 2010 (RES (not including hydropower) as well as additional 9% by small hydropower until 2008, respectively.

- RES are supported mainly via long-term guaranteed feed-in tariffs to achieve the above mentioned political target quotas. The feed in tariffs are stated by the federal Ministry for Economics and financed by a supplementary charge per "metering point", which depends on the network connection level and a fixed price purchase obligation for electricity dealers.

- In addition specific shares for energy sources are defined. About 30% of the support will be dedicated to solid biomass and waste with high share of biomass, additional 30% to biogas. Wind as well shall be supported with 30%. Remaining 10% are reserved for all other sources, including PV, liquid biomass, co-firing power plants or others.

- Starting with October 2006 up to 2010, each year another 17 Mio € will be dedicated for covering the feed in tariffs for the newly installed energy systems.

Concluding from that, for PV an annual maximum of 1,5 Mio € from federal budget can be expected; specifically for the PV support, the provinces are requested to double this federal subsidy, which makes the support system even more complex.

Photovoltaic-Feed-in-tariffs in 2006 were set to 49 €Cent (< 5kW), 42 €Cent (< 10 kW) as well as 32 €Cent (>10kW). Compared to the former regulation, the time frame for the feed-in-tariff has been reduced, as well the tariffs are reduced in total (100% of the source/size specific tariff in year 1 to 10, 75% in year 11, 50% in year 12). Furthermore a decrement factor has been be implemented (to reduce the source/size specific maximum tariffs each year about a few %).

It can be expected that this new regulation will lead to about 3 MW annually installed systems in Austria. However, no definitions for supporting special PV applications (as e.g. Building Integrated PV) niche markets, where Austrian companies could potentially reach a leading position, had been made. Currently the provinces are developing individual strategies to complement the federal support systems.

National PV stakeholders questions the effectiveness of the support system mainly because of the complexity of the support system and the modest financial limits, which might not be able to significantly foster the Austrian PV market. A significant market stimulation aiming at establishing a domestic market for the Austrian PV industry will not be achievable.

As the revision of the GEA has become effective in October 2006, and due to the fact that also under the federal programme, PV support is limited on a per year basis, some provinces are still running rebate-programmes. These programmes were originally introduced in 2004-2005 to overcome the lack of federal incentives after the cap of the federal support had been reached.

In 2006 the following programmes provided support for PV installations:

- In Mid 2004 Upper Austria introduced its so called Green Electricity Programme ("Ökostrom Programm Oberösterreich" – ÖKOP) which aims at increasing the use of renewable energy sources for electricity generation. The main incentive in this programme is a subsidy of 65% of total investment costs up to 3 000 EUR per kW installed. The support is granted for installations with an installed module power between 1 and 3 kW integrated into buildings. In 2006, installations with a capacity of 0,6 MW were supported in the framework of the ÖKOP IV by funds of 2 MEUR.

- Lower Austria introduced a specific support scheme for PV-installations. The incentive is based on a rebate of up to 3 700 EUR per kW installed, which is granted for residential installations up to 10 kW. However, due to limitations of available funding and the number of applications, only a rather limited support is granted in practice. In 2006, a capacity of 0,2 MW was supported. The total budget spent for this purpose was 0,5 MEUR.

- In the capital Vienna, in the framework of the Green electricity support programme investment subsidies are granted to new installations, including PV. The support is limited to 40% of the total investment. In 2006, installations with a capacity of 0,09 MW were supported by a total of 0,23 MEUR.

- In the remaining 6 provinces (Burgenland, Kärnten, Salzburg, Steiermark, Tirol and Vorarlberg) no substantial PV incentives were available in 2006.

Initiated by the Ministry of innovation and technology, a National PV roadmap has been jointly developed in 2006 by arsenal research in collaboration with PV Austria, the national PV association. The roadmap focuses mainly on technology aspects in order to find out the needs for establishing PV as substantial source of electricity in Austria. Furthermore also the possible future role of Austria's industry in the world wide PV market is drafted. This roadmap, which was worked out in a wide discussion process amongst the main national PV stakeholders under the leadership of the mainly governmental research centre will be published in summer 2007.

4.2 Indirect policy issues

As in most of the other countries, the reduction of greenhouse gas emissions according to the targets of the Kyoto-Protocol is the major indirect policy issue for the deployment of RES. For Austria the reduction target is 13% from today's 7,6 tons per capita and year towards around 6,6 tons per capita and year in 2010. Appropriate actions and procedures are still in discussion, and it can be doubted if photovoltaics will be a part of the measures to contribute to a sustainable energy supply in the long term.

The ministry of Environment, engaged in climate protection has 2004 started a large programme of initiatives to reduce CO2 emissions ("klima:aktiv" - "climate:active"), by addressing and fostering various technology sectors like biomass-heating, solar thermal systems, heat-pumps, low energy buildings, environmental benign transport and others. In 2006, the development of a specific programme for photovoltaics, concentrating on awareness raising, education and information about the potential and possible future contribution of PV to the general energy supply has been started.

On the European Union (EU) level, increasing the share of renewable energy for electricity generation has a high priority. In this context, the “Directive on the promotion of electricity produced from RES (RES-E Directive)” was published in September 2001 by the European Commission. The goal set in the directive is to increase the share of RES-E in the European Union to 22,1 % until 2010. For Austria the individual target is to reach a share of 78,1 % of electricity from RES.

4.3 Standards and codes

Generally European PV Standards are likewise applied in Austria. Grid-interconnected PV applications are covered in detail by the national standard ÖNORM/ÖVE E 2750, which defines all safety relevant aspects regarding planning, installation, grid-interconnection, requirements for components and operation of grid connected PV installations.

In 2006 no new developments on national standards and codes were reported.

Besides the national PV standard, European PV Standards (EN) are likewise applied in Austria.

5 Highlights and prospects

However, despite the collapse of their home market, Austrian PV manufacturers could again significantly expand their business in 2006. Austrian module production increased by almost 100% compared to the year before and also BOS manufacturers substantially increased their production.

By far the largest share of the Austrian production is exported to those European Union countries, where attractive and stable incentives created an substantial market for PV. It is expected that the overall positive development of the international PV market will provide the basis for a further ongoing growth of the Austrian PV manufacturers and helps to strengthen the position of Austria as an important supplier of components for PV systems. New activities in the field of cell production and further extension of module production and product portfolio also document this trend.

Photovoltaic Austria, the National Photovoltaic Association has further expanded their activities by creating a national network for dissemination of information on PV and initiating awareness raising activities. By fostering the political contacts and intensive political lobbying work for PV, the association is aiming at changing the legislative frame conditions for PV by introducing stable and supportive PV market incentives. At the end of 2006, about 75 companies and persons involved into the PV business are members of the Association.

The annual national photovoltaic conference 2006 (for the first time a two days event) was jointly organised by arsenal research and the national PV association with support of the ministry of Transport, Innovation and Technology. With about 150 participants it has been a big success and attracted broad interest. Beside technical presentations an “industry forum” was part of the Conference where all relevant national market players (module producing companies, BOS producing companies, research experts etc.) informed the audience about their latest developments.

When looking at the domestic market the situation of PV remains unclear and unsatisfactory. The revision of the main framework, the Green Electricity Act, which has been finally agreed on positively in May 2006 does not provide any substantial support for PV implementation and moreover further complicated the situation. Furthermore, no definitions for supporting special PV applications (as e.g. Building Integrated PV) niche markets, where Austrian companies could potentially reach a leading position, had been made.

Annex A Method and accuracy of data

The market statistics on installed capacity, share of grid-connected and off-grid applications has been collected by Prof. Gerhard Faninger from the University of Klagenfurt, supported by Werner Weiß and Irene Bergmann, AEE INTEC, Gleisdorf and Dr. Peter Biermayr, Dr. Lukas Kranzl, Energy Economics Group, TU Wien by order of the Federal Ministry for Transport, Innovation and Technology (BMVIT). The data is based on a data provided by manufacturers, retailers and importers of PV components as well as network operators and e-control (National authority for the regulation of the liberalized Electricity Market). In the annual report ("Der Photovoltaikmarkt in Österreich 2006") PV applications are divided into

- Off-grid installations (including domestic and non-domestic applications)
- Grid-connected systems

No further breakdown is made in the study between centralized and distributed systems. Therefore the share of grid-connected centralized systems had to be determined by summarizing all large PV-installations which are dedicated as power-plants.

Grid-connected PV-installations have been reported by the grid-operators. Since 2003, the control zone managers (major transmission network operators) are obliged to submit data on grid-connected PV systems to e-control (Company responsible for monitoring, supporting and regulating the liberalization of the Austrian electricity and natural gas market). However, since the stop of the support for new PV installations by special feed-in tariffs which are regulated on the national level many installations were installed outside this framework. Data on these systems, which are supported by regional initiatives or other programs, is not included in the national Energy Statistics, since the capacity of these installations is below 1 MW. Thus the installations reported by the control zone managers do not provide a complete picture of the situation in Austria.

The uncertainty of the figures presented is estimated to be about ± 20 %.

Data on funding for PV R&D is taken from the report "Energieforschungserhebung 2005, Ausgaben der öffentlichen Hand in Österreich, Erhebung für die IEA" compiled by the Austrian Energy Agency. Data for 2006 will be available in late autumn 2007.

Industry data on actual production, production capacity, workforce, new products, prices and other market figures is based on information provided by manufacturers, installers and the Austrian PV association. An estimation of the corresponding accuracy cannot be provided.