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 2005

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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 is also a member.

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. Nine tasks have been established, and currently five are active. Information about these tasks can be found on the public website www.iea-pvps.org. A new task concerning PV hybrid systems 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 2005. 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 2005, the stagnation of the domestic PV market continued due to the absence of a nationwide incentive for PV. With the 15 MW cap reached in early 2003, which caused a fundamental reduction of the Austrian PV market in 2004, the newly installed capacity in 2005 was only 3 MW.

The overall installed PV capacity in Austria reached 24 MW at the end of 2005.

Compared to the year 2003 this represents a decline of the market of 30% compared to the year 2004. On grid applications still dominate the market for PV, with 21 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 2005 only 0,25 MW were installed in this sector. In total approximately 2,9 MW off-grid systems for domestic and non-domestic applications were installed at the end of 2005.

However, despite the collapse of their home market, Austrian PV manufacturers could again significantly expand their business in 2005. Austrian inverter production increased by 40% compared to the year before and also module manufacturers substantially increased their production. With new companies manufacturing PV products in Austria in 2005, Austrian PV industry's portfolio was extended to tracking system and innovative module technologies.

With the decline of the market in 2005, the average growth of the PV market between 1996 and 2005 was 36% per year.

Costs & prices

Following the international trend, a slight increase of prices for PV modules can be reported for 2005. This development can be associated with the enormous increase of demand of the German PV market, and a general lack of supply on the world market.

System prices remained constant and in 2005 turnkey prices for typical residential on-grid systems varied between 5 EUR/W and 6 EUR/W.

PV production

PV production in Austria 2005 can be characterized by a massive expansion of the production. 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 with a capacity of approximately 200 MW were produced in Austria during 2005. More than 99% of the production was exported, mainly to Germany. Currently two companies are active in large scale production and R&D.

The world wide leading manufacturer of back sheet laminates used for encapsulation of solar cells likewise reported a tremendous growth of its PV business. In 2005 encapsulation materials for approximately 650 MW were produced.

Further important PV products mainly dedicated to export are large scale two-axis tracking systems. In 2005, systems with a capacity of 10 MW were produced.

Also the module sector saw a significant expansion with new companies entering the market. The overall PV module production in Austria in 2005 was 20,5 MW.

There is still no traditional cell production in Austria. However, some companies are developing plans to build up large scale cell production.

Budgets for PV

The feed-in tariff system for electricity from RES introduced in the national Green Electricity Act 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 2005 amounted to approximately 8,4 MEUR.

With the introduction of the nation wide feed-in tariff system in 2003, almost all other market incentives have ceased. After the cap - up to which the feed in tariffs are granted – had been reached in early 2003, some provinces again re-established own market incentives. Currently support schemes for new grid connected PV systems are available in three provinces. About 4,6 MEUR were spent for this purpose.

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 0,6 MEUR in 2005.

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 most of the support schemes limited to small 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 24 MW of PV power has been installed in Austria by the end of 2005. While until 2003, capacity grew continuously about 37 % each year, the market growth dropped down in 2004. Since then the annual market is stagnating at a level of 3 MW in 2005.

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
total off-grid	338		908	960	1 213	1 413	1 671	1 857	1 984	2 173	2 645	2 895
grid-connected distributed	187		761	1 178	1 648	2 119	3 063	4 440	7 857	13 507	17 262	19 973
grid-connected centralized	N/A		70	70	70	140	140	241	476	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

2.3 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 2005. Several installations with innovative design aesthetically integrated into buildings document this.

SOL4 Business and Training Center Eichkogel, Lower Austria

One of the outstanding examples realized in 2005 is SOL4 a commercial office building, which was realized in the framework of the national "House of the future" program. SOL4 is an exemplary pilot project in a new semi-urban district for the sustainable construction of a working and living environment. The building complex serves as a business and training centre, as well as a centre of competence for advanced standards in ecological development, construction and workplace design. It is currently the largest passive solar office building in Austria with a floor space of more than 2 000 m².

The technologies and design objectives implemented in the project sought to maximize "green" surfaces (e.g., green roof systems, open infiltration surfaces, etc.). Special attention was paid to using the latest developments of environmentally friendly construction materials as extensively as possible. The facility's energy management system optimises ventilation and air conditioning by means of a closed-loop heat distribution circuit with ground-coupled and ventilation heat exchangers. Passive cooling is enabled by concrete core activation in the panels of the roof construction. The grid-tied photovoltaic system provides electricity to cover the remaining energy demands of the mechanical systems.

The heating demand of the building is less than 15 kWh/m² and therefore, a conventional heating system could be omitted. The remaining demand is covered by a heat pump system which is supplied by a 30 kW PV system integrated into the façade of the building.

Church St. Franziskus, Wels, Upper Austria

The first church building according to passive house standards (heat demand less than 15 kWh/m²) was finished in early 2005 in the municipality of Wels, Upper Austria. The energy supply of the building is completely covered by renewable sources. For electricity supply, two PV systems with 10,6 kW and 8,7 kW are integrated into the façade and roof of the building.

The total costs of 4,2 MEUR were funded by the diocese of Linz, the municipality of Wels and the province of Upper Austria. For the innovative energy concept, additional funds were provided in the framework of the Upper Austrian Green Electricity program.

Passive-House Kinder garden, Wels, Upper Austria

Another innovative passive house project incorporating PV was completed in early 2005. The energy demand of 15 kWh/m² is covered by 16 m² of solar thermal collectors and a 4 kW PV installation integrated into the roof of the building. The project was supported in the framework of the national "House of the Future" program.

Municipality of Vienna - Historic municipal building

Another interesting example for the application of PV in urban areas was realized by the municipality of Vienna. In the framework of the refurbishment of one of the municipality's historic office complexes, the attic floor was converted into office space. In order to use the new space

made available on the roof as well as to cover the increased electricity demand of the building, in total three PV systems were integrated into the development. In addition, the aim was to compare different technologies for building integrated PV in a real-life environment and gain experiences with the application of PV in historic, municipal buildings.

The PV installation consists of three systems, demonstrating different BIPV technologies. The main part consists of a 25 kW generator with amorphous silicon modules which is mounted on the flat part of the roof. A second 1 kW generator based on flexible amorphous silicon modules is directly attached to the metal roof. For comparison and to increase the capacity, a 7 kW generator using high-efficiency s-c silicon modules is mounted on a flat part of the roof.

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, a new initiative was started in the field of cell research. The aim is to develop solar cells based on new materials such as sulfosalt crystals. In late 2005, a Christian Doppler laboratory (7 years of federal financing) was initiated to research and develop these new materials.

- 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. Research in 2005 focused the characterisation of conventional solar-cells, new automated pattern recognition and metal front contact patters following the grain boundaries of multi-crystalline solar cells. Furthermore methods have been developed to analyse and simulate multi-crystalline 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. A spin-off company founded by the R&D group was meanwhile taken over by the U.S. based Konarka Group and is now working on the commercialization of these organic solar technologies. In summer 2005, Konarka Austria signed a “Joint development agreement” with the company Leonhard KURZ which aims at building up a production line for organic collar cells. Austrian Christoph Brabec has recently been appointed Chief Technology Officer of Konarka worldwide.

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 Distributed Generation from RES in general, is the main focus of R&D projects supported by the European Commission and Austrian Ministries. These projects are jointly carried out by 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.

- 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 2006, no data on the public spending for Energy R&D in 2005 were available. The following numbers refer to data for the year 2004.

In 2004 renewable energy received about 30% of the Austrian Energy R&D budget of 34 MEUR. The majority (75%) 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% of the renewable energy R&D budget, PV research accounts for 4% of the total budget.

In 2004 the overall public spending for PV research, development and demonstration was about 0,4 MEUR. This means a drop of public funding of almost 70% compared with the year 2003. Not included in this figure is the return from European Community (EC) R&D projects. Since Austria as 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. In 2004 this figure can be roughly estimated to amount 0,2 MEUR for PV R&D.

There are no specific figures available for the share of Demonstration or Field Test activities but since 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.

	R & D	Demo/ Field test	Market *)
National/federal	0,39		0
State/regional	0,05		4,9
Return from EC FP	0,20		0
Total	0,64		4,9

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

Since 2003 the support for electricity from RES is 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 2005 was approximately 8,4 MEUR, which represents a 12% increase compared to the previous year. The average feed-in tariff paid for PV was 65 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 2005 in the provinces of Upper Austria, Lower Austria and Vienna a regional support (investment subsidies) was granted. The figure stated in Table 2 under “regional” represents the total budget spent for this purpose 2005 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 2004.

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 2005. With a new company entering the market in 2005 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. New developments in 2005 were cooled modules and modules made with surface treated glass.

The third company, SED, focuses on the production of PV-roof tiles. The used multi crystalline cells are imported from France. New developments in 2005 include an integrated module concept for PV 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.

RKG-Photovoltaik GmbH., affiliated to Europe’s largest manufacturer of Solar Thermal Collectors, GREENoneTEC Solar Industries Ltd. is manufacturing standard modules based on cells imported from Germany.

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.

In total, Austrian module manufacturers could again increase their production compared to the previous year. The total production in 2005 was 20,5 MW. This figure represents more than a doubling compared to the year before. 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 for each manufacturer

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	-	10	-	-	N/A	-
2 PVT Austria	mc-Si / sc-Si	-	4,5	-	-	6	-
3 Energetica	mc-Si / sc-Si	-	2,0	-	-	5	-
4 RKG Photovoltaik	mc-SI / sc-Si	-	1,5	-	-	2	-
5 ERTEX Solar	mc-Si / sc-Si	-	< 0,5	-	-	-	-
6 SED	mc-Si	-	0,2	-	-	2	-
TOTALS	-	-	20,5	-	-	>15	-

In 2005 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 2005 several activities were initiated to build up cell production capacities in Austria.

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 current activities are halted.

Another recent start-up, the company FalconCell is currently building up cell production facilities. The company is linked to the first Austrian PV-Module manufacturer PVT-Austria.

Table 4a indicates the typical module prices for the year 2005 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 a general shortage on the European and International cell market, manufacturers increased their prices by 3% to 5% compared with 2004.

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

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

3.3 Manufacturers and suppliers of other components

Austria has a long tradition as one of the largest inverter producing countries in Europe. Thanks to the overall expansion of the European market in 2005, the two large manufacturers could again extend their output in 2005. In total roughly 75 000 inverters with a capacity of approximately 200 MW were produced. More than 95% were exported, mainly to Germany.

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. New developments in 2005 included the introduction of central inverters with a capacity range of 24 – 40 kW and data communication devices.

The second producer, SIEMENS AG AUSTRIA started large-scale manufacturing and development of string-inverters in the range of 1,5 kW to 4,6 kW for grid connected applications 3 years ago.

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. In 2005 encapsulation materials for about 650 MW of PV modules were produced. 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 2005, 1 400 "MOVER" tracking systems for PV installations with a capacity of 10 MW were produced.

3.4 System prices

The stagnation of turnkey prices for complete PV systems, which was already observed in 2004 continued also during 2005. 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 2005 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.	15 *)
OFF-GRID >1 kW	AC Electricity supply for larger mountain huts. System size between 4 and 8 kW.	10 to 20 *)
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 6
GRID-CONNECTED >10 kW	Larger system for commercial / industrial applications. PV-power plants	5 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
Price /W:			7 500	7 000	6 000	5 500	5 500

3.5 Labor 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 720
- All other, including within electricity companies, installation companies etc.: about 40

With the continued expansion of their business Austrian PV manufacturers again significantly extended their workforce in 2005. In total it can be estimated that at the end of 2005 roughly 800 jobs were directly linked to PV R&D, manufacturing and installation in Austria.

3.6 Business value

In 2005 about 3 MW of PV systems were installed in Austria with an estimated value of the national market of 17 MEUR, based on average turnkey prices (5,5 EUR/W). While until 2003 modules were almost exclusively imported, the domestic production has meanwhile become a significant factor.

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 2005 this figure can be estimated to be approximately 220 MEUR which is a considerable increase compared to 2004.

Imports of PV products consist mainly of solar cells used for the module production and complete systems. This figure can be estimated to 60 MEUR.

Eventual changes of stocks held were not considered, since it was not possible to obtain detailed figures.

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)**
Off-grid	0,25	10	2,5	
Grid-connected distributed	2,71	5,5	14,9	
Grid-connected centralized	0	-	0	
				17
Export of PV products				220
Change in stocks held				0
Import of PV products				-60
Value of PV business				**177**

4 Framework for deployment (Non-technical factors)

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 nationwide 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, the role of PV in the future electricity scenario was limited from the very beginning. With the limited availability of the support in mind, a run for permissions for the PV-capacity took place in the first weeks of 2003. Already in mid January the limit was reached and until mid 2003 the granted capacity was installed.

To overcome the lack of federal incentives while at the same time avoiding a total collapse of the local market for PV, three provinces again reintroduced own support schemes.

- In Mid 2004 Upper Austria introduced its so called Green Electricity Programme ("Ökostrom Programm Oberösterreich" 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 2005, installations with a capacity of 1,3 MW were supported.

- Lower Austria introduced a specific support scheme for PV-installations. The incentive is based on an investment subsidy 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 in granted in practice.

- 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 2005, installations with a capacity of 0,17 MW were supported.

- In the remaining 6 provinces (Burgenland, Kärnten, Salzburg, Steiermark, Tirol and Vorarlberg) no dedicated PV incentives are available at all.

A further commercial initiative which aims at overcoming the lack of public support is the "Solar-Partnership" introduced by an innovative Green Electricity Company. Customers who have an electricity purchase contract with the company are awarded a preferential tariff for the energy produced by their own PV installations on a net metering base. Although this incentive alone

does not allow a cost covering operation of a PV-system, it is a very attractive option in combination with other schemes, e.g. the Upper Austrian Green Electricity Programme.

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.

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 2005 no new developments on standards and codes were reported.

5 Highlights and prospects

In 2005, the stagnation of the domestic PV market continued due to the absence of a nationwide incentive for PV. With the 15 MW cap reached in early 2003, which caused a fundamental reduction of the Austrian PV market in 2004, the newly installed capacity in 2005 was only 3 MW. This is a further 30% drop compared to the 4,3 MW installed in 2004. .

However, despite the collapse of their home market, Austrian PV manufacturers could again significantly expand their business in 2005. Austrian inverter production increased by 40% compared to the year before and also module manufacturers substantially increased their production. With new companies manufacturing PV products in 2005, Austrian PV industry's portfolio extends to tracking system and innovative module technologies.

By far the largest share of the Austrian production is exported to Germany, where attractive and stable incentives created an enormous boom in 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 development and module production also document this trend.

When looking at the domestic market the situation of PV remains unclear and unsatisfactory. A revision of the main framework, the Green Electricity Act had been foreseen for 2005, but a consensus between the two main parties in the national council was hard to find. Final negotiations about acceptance of the revision with the EC and legal accuracy were finally completed and the draft was agreed positively in May 2006.

The revised GEA now defines a total maximum amount of additional support for new RES power plants for the years 2006 to 2011. The time frame for the feed-in-tariff is planned to be reduced. As well the tariffs are planned to be reduced in total (100% of the source/size specific tariff (which are not announced yet) in years 1 to 10, 75% in year 11, 50% in year 12). As well a decrement factor shall be implemented (to reduce the source/size specific maximum tariffs each year about a few %).

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. Although PV still plays a minor role in the revised draft, a small support seems to be possible, but will depend on the exploitation of the max amount by other competing sources (mainly co-firing or liquid biomass power plants).

A significant market stimulation aiming at establishing competitive Austrian PV industry will not be achievable. Furthermore, no definitions for supporting special PV applications (as e.g. Building Integrated PV) niche markets, where Austrian companies could maybe 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 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 2005") 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 "Energie: Forschung, Entwicklung und Demonstration - Ausgaben des Bundes, der Länder und der Industrie im Jahre 2004" compiled by the Austrian Energy Agency. Data for 2004 will be available in late summer 2006.

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.