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 2002

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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 application of photovoltaic conversion of solar energy into electricity.

The twenty participating countries are Australia (AUS), Austria (AUT), Canada (CAN). Denmark (DNK), Finland (FIN), 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. Eight 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 urban-scale deployment of PV systems is 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

As part of the PVPS programme, annual surveys of photovoltaic (PV) power applications and markets are carried out.

The objective of the Austrian national survey report is to analyse and present trends on the PV system and component market. The actual trends are analysed in the context of the business, policy and non-technical environment.

iii. Definitions, symbols and abbreviations

For the purposes of this report, standard ISO symbols and abbreviations are generally used. The electrical generation capacity of PV cells or systems is given as Watt (W), which is the peak power of a PV module or system under standard test conditions of 1000 W/m² irradiance, 25 °C junction temperature and solar reference spectrum AM 1.5. The term PV system includes the modules, inverters, batteries and all associated installation and control components as appropriate. The presented PV capacity represents only systems with a capacity more than 40 W.

The currency used in this report is Euro (EUR).

1 Executive summary

Installed PV power

The overall installed PV capacity reached 9 MW at the end of 2002. This represents a growth of 50% compared to the year 2001.

Around 70% of the installed capacity are grid-connected systems (GCS), nearly 2 MW small autarkic systems (SAS) are installed with the end of 2002.

Between 1995 and 2003 the average growth was about 30% per year.

Costs & prices

During the preceding years system costs remained on a relatively constant level, due to market overheating in several industrial countries. As a result of the significant increase in production capacity in Europe and new companies entering the market, a slight reduction of the turnkey prices for complete PV systems could be observed in 2002. Turnkey prices for typical on-grid systems vary now between 5.50 and 8.00 EUR per W, depending on the used technology and size of the installation.

PV production

In 2002 a first company started manufacturing PV-modules in Austria. The company is producing standard and semi-transparent PV-Modules with purchased cells from companies outside Austria, since there is no cell-production in the country.
Various other companies are manufacturing BOS-components like batteries, inverters, mounting systems or laminating foils.

Budgets for PV

The trend towards international and EU based financing of PV RTD and demonstration continued in 2002. There is no dedicated national programme for the promotion of PV but research activities are supported via various industrial and governmental initiatives.

2 The implementation of PV systems

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 increasing option to supply infrastructure systems like parking meters or rail-greasing systems.

With improved integration into the built environment On-grid distributed systems are meanwhile becoming more and more a common place in public's interest. In Austria this sector now stands for more than 70% of the overall cumulated PV capacity.

Grid-connected centralised systems in form of PV Power plants still play a minor role and so far only 500 kW are installed, e.g. as sound barriers.

2.2 Total photovoltaic power installed

Approximately 9 MW of PV power has been installed in Austria by the end of 2002. Between 1995 and 2002 capacity grew continuously about 30% each year. Until the end of 1996 the off-grid sector was the dominating PV market. However from 1997 the majority of new systems were grid-connected according to the overall trend in the reporting countries.

Table 1 The cumulative installed PV power in 3 sub-markets

Sub-market/ Application	31 Dec 1992 kW	31 Dec 1993 kW	31 Dec 1994 kW	31 Dec 1995 kW	31 Dec 1996 kW	31 Dec 1997 kW	31 Dec 1998 kW	31 Dec 1999 kW	31 Dec 2000 kW	31 Dec 2001 kW	31 Dec 2002
Off-grid (non)domestic	338	423	610	722	908	960	1213	1413	1671	1857	1950*)
On-grid distributed	187	346	453	569	761	1178	1648	2119	3063	4440	6550*)
On-grid centralized	N/A	N/A	N/A	70	70	70	70	140	140	241	500*)
TOTAL	525	769	1063	1361	1739	2208	2861	3672	4874	6538	9000*)

*) Estimated
(Source: Bundesverband PV, G. Faninger, Der Photovoltaikmarkt in Österreich 2002, own inquiries)

2.3 Major projects, demonstration and field test programmes

PV projects realised in Austria 2002 clearly show two main trends: Optimal architectonical integration of BIPV in newly constructed as well as refurbished buildings and large “PV-Power plant” installations in regions with attractive feed-in tariffs.

As a representative of the first trend an part of the activities of “Graz 2003 - Cultural Capital of Europe” an old, unused industrial building was rebuilt and converted to a multifunctional event-hall to host the three well-known festivals “steirischer herbst”, “Styriarte” and events of Graz 2003. The 35 kW PV system forms an integral part of the “Helmut List Hall” and demonstrates the unique synergies of science, high tech and culture. Funded and operated by a private company with support from the municipality of Graz and the regional government the by now largest façade-integrated PV installation in Austria is also a part of “Graz, Eco-City 2000” and the municipal energy-concept.

In the course of the reconstruction of the cable car station “Kriegerhorn” in Lech/Arlberg a 9,5 kW PV system was integrated into the glass-façade. Semi-transparent Power-Cells and an innovative mounting-system without penetration of the outer glass-surface are two special features of this installation which was supported by an EC-funded project.

In the framework of the EU project HIP-HIP (House Integrated Photovoltaics – High-tech In Public), installations with a total capacity of 200 kWp were realised in 2002 with the aim of optimal integration into buildings. One very visible project, a PV installation on a commercial building demonstrates various forms of integrating PV into building structures. In the futuristic “Energy plus” house, 21 kW PV modules were integrated into façades, the parapet, garage doors and the roof.

An ambitious initiative underway since 1999 is the 200 roofs programme in Hartberg. There the local utility together with the regional government plan to install 200 rooftop PV-systems with a total capacity of 500 kW. So far there are 70 installations with 240 kWp already in operation. For the different target groups, private customers as well as companies, various subsidising mechanisms have been established.

Due to the very attractive feed-in tariffs paid in the state of Salzburg, several PV installations were realised there in 2002. One of the largest in Austria, a 235 kW multi-crystalline system is situated on a slope in the community of Werfenweng. Due to optimal orientation and location in a very sunny region the system is expected to produce about 290 MWh of electricity per year.

Table 2 Summary of major projects, demonstration and field test programmes

Project Date plant Start up	Technical data/ Economical data	Objectives	Main accomplish-ments until the end of 2002 / problems and lessons learned	Funding	Project management	Remarks
PV façade at the Helmut List Hall, Graz 2002	Grid-connected Power: 35 kW multi-crystalline PV cells area: 350 m² orientation: South	Conversion of an old industrial building to a multifunctional Event-hall. The building is used by three festivals, for science and conferences.	Optimal architectonical integration of a PV system, by far the largest PV façade in Austria right now.	The project is funded with a contracting model by the company Ökoplan, the municipality of Graz and Land Steiermark (regional government)	Ökoplan, an affiliate of Stadtwerke Hartberg (regional utility)	
Kriegerhorn cable car station Lech/Arlberg 2002	Grid-connected Power 9,5 kW Façade integration Semi-transparent Power-Cells Orientation: South/West	Demonstrate the symbiosis of architecture and ecological production of electricity in a technical building in the mountains	Test of a new mounting system for façades, without penetration of the outer glass surface.	Lift Company Lech/Arlberg with support from an EC funded project	A.T.B Becker, Absam (planning & installation company)	
PV Power Plant Werfenweng Salzburg 2002	Grid-connected Power 235 kW Ground mounted / roof integration	Help the “climate alliance” community Werfenweng to reach CO_2 reduction targets		Community of Werfenweng,	NET Neue Energie Technik, Salzburg (planning & installation company)	
PV façade Wels trade-fair center, Wels 2002	Grid-connected Power: 17 kW Multi-crystalline PV Façade integration	Refurbishment of an already existing commercial building with PV		Wels trade fair Municipality of Wels		

Project Date plant Start up	Technical data/ Economical data	Objectives	Main accomplish-ments until the end of 2002 / problems and lessons learned	Funding	Project management	Remarks
200 roofs programme Hartberg Start 1999 Duration 4 to 5 years	Grid-connected So far 70 installations Power: 240 kWp Planned total power: 500 kWp	Further optimisation and standardisation of rooftop installations	Long term programme	Stadtwerke Hartberg (urban utility) Municipality Hartberg Private	KW-Solar Stadtwerke Hartberg	
HIP-HIP House integrated PV – High-tech in public	Grid-connected Various installations Power: 190 kW	foster market penetration of grid-connected PV, developing new PV products for the building industry		EC	SED KW-Solartechnik (planning & installation companies)	Part of an international initiative to reduce total costs. www.hip-hip.net

2.4 Highlights of R&D

Austrian PV research activities are mostly focussed 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:

- Organic Solar Cells based on thin plastic films have received increased attention due to their unique properties. These cell types are probably promising to become the cheapest solar technology in the future.
- Encapsulation of solar cells, the development of new contact pattern for crystalline cells and coloured cells are investigated at the academic institutes.
- New concepts for PV-inverters and various aspects of grid-interconnection, not exclusively related to PV but more to Distributed Generation from RES in general, are the main focus of several EU financed projects, which are jointly carried out by research institutions, industry and utilities.
- New solutions for building integration of PV are investigated to reduce the costs and address the building industry by aiming to create a better understanding about chances and challenges of high integrated concepts for roofs, facades and other building elements.

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

Since there is no dedicated PV R&D programme in Austria, PV R&D activities are supported by various national funds and international (EC) projects.

With the ending of the national 200kWp Rooftop Programme in 1999, the largest PV field-test programme in Austria so far, a significant decline in national funding was accompanied. In 2002 overall national spending for PV R&D can be estimated to be about 1 MEUR.

Market incentives in 2002 were mostly funded by local governments, communities and municipalities, supported by utility companies. Resulting from this diversity in support mechanisms, it is very difficult to get data and therefore clear numbers concerning budgets can hardly be estimated.

The total governmental budget allocated for PV R&D is shown in Table 3.

Table 3 Budgets (in MEUR) for R&D, demonstration/field test programmes and market incentives in 2002 *)

	R & D	Demo / Field Test	Market Incentives
National	1 *)	N/A	N/A
Federal States	0.1 *)	N/A	N/A
Total	1.1 *)	N/A	N/A

*) Estimated

Compared to the preceding years there has been a significant decrease regarding governmental R&D budgets from 1.8 MEUR in 1998 down to 1.1 MEUR in 2002. The most important reasons for the decline are the ending of the national field test programme and the change towards international and EU based financing.

3 Industry and growth

3.1 Production of photovoltaic cells and modules

In 2002 a first company started manufacturing PV-modules in Austria. The company is producing standard and semi-transparent PV-Modules with purchased cells from companies outside Austria, since there is no cell-production in the country.

PVT Austria is manufacturing standard and semi-transparent PV-Modules using multi-crystalline cells.

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)	
		Cell	Module	Cell	Module
1 PVT Austria	mc-Si	-	N/A	-	N/A
2					
TOTALS					

*) Due to the fact the manufacturer just started production in the second half of 2002 further information would not be representative and will be provided in the 2003 NSR.

Table 4a: Typical module prices (NC) for a number of years

Year	1992	1993	……..	2002
Module price (EUR/W)				4.50

3.2 Manufacturers and suppliers of other components

Various other companies are manufacturing BOS-components like batteries, inverters, mounting systems or laminating foils.

ISOVOLTA is manufacturing coloured back sheet laminates for PV modules for almost all module manufacturers in the world.

FRONIUS has been engaged in solar-electronics and is now the world-wide second largest inverter producer for grid connected and stand alone PV systems. So far more than 5000 units have been produced whereof 90% were exported.

BANNER BATTERIES is an important manufacturer of lead-acid batteries for off-grid PV applications.

Table 5 Price of inverters for grid-connected PV applications.

Size of Inverter	<1 kVA	1-10 kVA	10-100 kVA
Average Price per kVA (EUR)	1300-1500	600-700	N/A

3.3 System prices

Due to the significant increase in production capacity in Europe, a slight reduction of the turnkey prices for complete PV systems could be observed in 2002.

Table 6 Turnkey Prices of Typical Applications

Category/Size	Typical applications and brief details	Price per W in €
Grid-connected Up to 10 kW	Typical roof-mounted system for a single or multifamily house.	6.00 to 8.00
Grid-connected > 10 kW	Larger system for commercial / industrial applications.	5.50 to 7.50

For off-grid systems prices vary widely depending on the application and the mounting-site. Typical system costs range between 20 and 30€ per W and have not changed significantly within the last years.

Table 6a: National trends in system prices for a typical roof-top system <10kW

YEAR	1992	1993	……..	2001	2002
Price EUR/W:				7.50	7.00

3.4 Labour places

In Austria it can be estimated that about 350-500 labour places are directly or indirectly connected to PV Research and Development, manufacturing of PV components and services, planning & installation.

3.5 Business value

No data was collected so far.

4 Framework for deployment (Non-technical factors)

4.1 New initiatives

There is no national programme dedicated to the promotion of PV in Austria, but several regulations are defining the framework for the promotion of RES:
Most important are the principles of the electricity law “ElWOG 2” which has gone into force via federal decrees in each of the nine regions in 2001. The regional governments had to determine the different types of promotion strategies and incentives that are used. These circumstances led to a very diverse situation with very ambitious incentives in some regions and made it difficult for investors and planners to keep an overview about all the regulations. The feed-in tariffs for example varied between 0.10 and 0.74 EUR/kWh, depending on the region, on the system size as well as on seasonal and day/night aspects.
To harmonize these situation a special new law for Green Electricity called “Ökostromgesetz” was adopted in 2002 by the federal government regulating issues concerning the electricity supply from RES on the national level.
The new regulation, becoming effective at the beginning of 2003, will move the competencies from the regional governments to the federal government and define preferential feed-in tariffs for RES that have to be paid by the distribution network operators.
For PV there will be one nationwide tariff of 0.60 EUR/kWh for installations up to 20 kWp and 0.41 EUR/kWh for larger systems. The extra costs for the network operators will be compensated by an additional supplement on the customer invoices.
Furthermore a limit of 15 MWp total installed capacity is stated in the law, up to which the high tariffs will be paid. Compared to the installed capacity of 9MW at the end of 2002, and including the applications for new PV installations the limit is expected to be reached already in the first months of 2003.
This makes the feed-in tariff system almost ineffectively and threatens the further deployment of PV by generating uncertainty among investors and installers of PV systems.

4.2 Indirect policy issues

As in most of the other countries, the reduction of greenhouse gas emissions which is the main target of the environmental policy following the Kyoto-Protocol is the major indirect policy issue for the deployment of RES. At the Kyoto conference, Austria committed to reduce 13% of its greenhouse gas emissions from today’s 7.6 tons per capita and year towards around 6.6 tons per capita and year in 2010. Despite the fact that appropriate reduction measures and procedures are still in discussion, it is expected that photovoltaics can contribute to reach the targets in the long term

With the opening of the electricity market, Green Electricity has become a general tradable good, and several new companies are offering their green products directly to the customers. Another increasing popular mechanism to promote the market introduction of Renewable Systems are Ecolabels. Ecolabels are voluntary Instruments based on economic-political grounds for transferring ecological values of generation processes.

Within the certification procedures certain criteria are checked through independent certification institutes. One criteria which has to be fulfilled for getting the Austrian Ecolabel "Umweltzeichen" is to verify the share of at minimum 1% PV within the portfolio of the labeled green electricity. The positive image of solar electricity in the mind of the customers led to this jointly defined requirement.

4.3 Standards and codes

Regulations concerning grid connected PV generators are governed by the preliminary standard ÖNORM/ÖVE E 2750, the national counterpart of the EN 61727. Within the standard all the safety relevant aspects regarding planning, installation and operation of grid connected PV installations are defined. In detail, the ÖNORM/ÖVE E 2750 covers the following matters:

- PV modules (mechanical & electrical characteristics)
- Interconnection of PV generators (safety aspects, Power Quality issues,...)
- Inverters (over-voltage & -current protection, EMC, grid disturbances)
- Operation

The standard is currently under major revision and several requirements will be adapted according to recent developments.

For PV-modules the relevant international standards apply likewise.

5 Highlights and prospects

The favorable feed-in tariffs paid in some federal states and the new green-electricity law "Ökostromgesetz" regulating the feed-in tariffs for electricity from renewable energy sources on a national level already led to an enormous boom in applications for new PV installations. Due to that the limit of 15 MW total installed capacity, up to which new PV installations are supported by the feed-in tariffs, will be already reached in the first quarter of 2003. This fact creates the paradox situation that the law will be obsolete - at least for PV - before it really has become effective. It remains to be seen, whether the PV lobby is able to persuade the Austrian government to abolish the narrow restrictions and pave the way for a widespread dissemination of PV in the country.

PV research and development will more and more be concentrated on international projects and networks, following the dynamic know-how and learning process of the world-wide PV development progress.

With the increasing number of applications and PV systems installed the demand on training and education services will emerge. The more the industry and research organizations contribute to the application of PV the more will be automatically supported the aspect of vocational schools and universities. It is urgently necessary to develop up-to-date tutorials for growing interest groups in Austria.

Financial incentives and voluntary approaches are the basis for a stronger PV market in Austria. The new regulations coming into effect with 2003 will certainly yield a substantial effect for a lasting development towards a powerful dissemination of PV in the whole country.