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 2001

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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 seven are active.

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 peak (Wp), which is the peak power of a PV module or system under standard test conditions of 1 000 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 6,5 MW at the end of 2001. Around 70% of the capacity are grid-connected systems (GCS). Nearly 2 MW small autarkic systems (SAS) are installed with the end of 2001. Between 1995 and 2001 the average growth was about 30% per year.

Costs & prices

During the last three years system costs remained on a relatively constant level, because of the increased module prices due to market overheating in several industrial countries. Component costs fell slightly. Turnkey prices for typical on-grid systems vary between 6.50 and 9.00 EUR per Wp, depending on used technology and the size of the installation.

PV production

In 2001 no solar cell and module manufacturer existed in Austria. Producing companies were mainly dealing with components.

Budgets for PV

With the end of accompanying measures within the 200 kWp rooftop programme and the trend towards international and EU based financing the governmental R&D budget decreased significantly from 1.8 MEUR in 1998 down to 0.65 MEUR in 2000.

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 build 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.

Due to limited space available, grid-connected centralised systems play a minor role and so far only 241 kW are installed, mainly as sound barriers.

2.2 Total photovoltaic power installed

Approximately 6,5 MW of PV power has been installed in Austria by the end of 2001. Between 1995 and 2001 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 kWp	31 Dec 1993 kWp	31 Dec 1994 kWp	31 Dec 1995 kWp	31 Dec 1996 kWp	31 Dec 1997 kWp	31 Dec 1998 kWp	31 Dec 1999 kWp	31 Dec 2000 kWp	31 Dec 2001*) kWp
Off-grid (non)domestic	338	423	610	722	908	960	1213	1413	1671	1955
On-grid distributed	187	346	453	569	761	1178	1648	2119	3063	4440
On-grid centralized	N/A	N/A	N/A	70	70	70	70	140	140	241
TOTAL	525	769	1063	1361	1739	2208	2861	3672	4874	6496

*) Estimated

(Source: Faninger, Photovoltaikmarkt in Österreich)

2.3 Major projects, demonstration and field test programmes

As an integrated part of the Styrian state exhibition “Energy” held in summer 2001 in Gleisdorf, the “Street of Solar Energy” was inaugurated to illustrate the potential of solar energy to the more than 200.000 visitors of the exposition. Along the 3,2 km long route 80 objects demonstrate the use of solar energy for publicity, light, communication and traffic purposes.

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 60 installations with 160 kWp already in operation. For the different target groups, private customers as well as companies, various subsidising mechanisms have been established.

A large PV sound barrier is now in operation along the A2 highway at Gleisdorf. As a part of the new concept for noise based traffic control the new PV system not only supplies the traffic control system but also acts as a noise protection element. The PV generator is divided into to two parts equipped with amorphous and multicrystalline cells. The modules are fully integrated into the 1,3 km long barrier wall and offer a power of 101 kWp. Another objective is to gain further experiences with the operation of such a system nearby a highway. The project is co-financed by the Styrian regional government and the Austrian highway financing company.

One of the first PV installations equipped with CIS thin film modules has been installed on the roof of the newly built congress centre in Salzburg. The 40,8 kWp system consists of a 420 m² rooftop and a 40m² facade array and supplies the exposition forum.

Within the EU project HIP-HIP (House Integrated Photovoltaics – High-tech In Public) two installations with a capacity of 19 and 1,5 kWp were realised with the aim of optimal integration into buildings.

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

Project Date plant Start up	Technical data/ Economical data	Objectives	Main accomplishments until the end of 2001 / problems and lessons learned	Funding	Project management	Remarks
PV noise barrier highway A2 at Gleisdorf 2001	Grid-connected Power: 101 kWp 2/3 amorphous cells 1/3 multicrystalline PV cells area: 1600 m² tilt angle: 60° orientation: SW	To obtain experiences with the operation of a PV system nearby a highway (risk of corrosion due to salt and pollutants, car accidents).	PV system fully integrated into sound barrier – dual function: Electricity production & noise protection;	ASFINAG (Highway financing and operating company) Amt der steiermärkischen Landesregierung (regional government)	Feistritzwerke STEWEAG GmbH (urban utility) Land Steiermark (regional government)	Monitoring to evaluate performance and reliability of the used technology and what has to be improved for future projects
200 roofs programme Hartberg Start 1999 Duration 4 to 5 years	Grid-connected So far 60 installations Power: 160 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	
Solar energy street Gleisdorf	Length: 3,5 km 80 solar objects Exhibition 'Energy'	Dissemination of PV technologies improved perception within the public, local availability of environmental benign energy	Increase the public awareness	Feistritzwerke (urban utility) Municipality Gleisdorf	Feistritzwerke STEWEAG GmbH (utility company)	
Congress center Salzburg	Grid-connected Power: 40,8 kW CIS thin film solar cells Area: 420 m² at rooftop 40 m² façade	Ecological energy concept	First large CIS thin-film installation in Austria	Salzburg Congress Municipality Salzburg	Siemens AG	Monitoring

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

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 2000 *)

	R & D	Demo / Field Test	Market Incentives
National	0.64	N/A	N/A
Federal States	0.01	N/A	N/A
Total	0.65	N/A	N/A

*) 2001 Data not available

Compared to the preceding years there has been a significant decrease regarding governmental R&D budgets from 1.8 MEUR in 1998 down to 0.65 MEUR in 2000. The most important reasons for the decline are the ending of the 200kWp Rooftop Programme, the largest PV field-test programme in Austria so far, in 1999 and the change towards international and EU based financing.

3 Industry and growth

3.1 Production of photovoltaic cells and modules

Currently there is no manufacturer of PV-cells or modules in Austria but several companies are producing components for PV applications like inverters, back sheet foils or PV roof-tiles.

3.2 Manufacturers and suppliers of other components

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

Table 4 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

Despite the rise of module prices caused by the brisk demand, the turnkey prices for complete systems remained on a relatively constant level during the last years.

Table 5 Turnkey Prices of Typical Applications

Category/Size	Typical applications and brief details	Price per Wp in €
On-grid Up to 10 kWp	Typical roof-mounted system for a single or multifamily house.	6.90 to 9.00
On-grid > 10 kWp	Larger system for commercial / industrial applications.	6.50 to 8.00

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

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.

4 Framework for deployment (Non-technical factors)

4.1 New initiatives

2001 was one of the most important regarding the electricity market in Austria. Based on the principles of the Electricity Law so called EIWOG 2 the electricity market has been 100% liberalized since 1 October 2001. By fully liberalizing the electricity industry electricity becomes an article of merchandise. The whole process and the market rules are observed by a new independent regulatory body, the Electricity Control Commission (www.e-control.at). The following objectives shall be reached through the Electricity Law EIWOG 2:

1. Free customer choice - Customers can choose freely from whom to purchase electricity. The prices of electricity are significantly decreased due to the access of all consumers to the open European electricity market. This significant decrease of electricity prices might be contra-productive to the PV market penetration due to the higher costs in comparison with competitive technologies.

2. RES target quotas - The main important part regarding the market penetration of new renewable energy like PV, biomass, wind power etc. are the energy political target quotas rising from 1 % in 2001 up to 4% in 2007 in two years steps. Let us have a look on the actual electricity market: About 70% of approximately 60 TWh annual electricity consumption is generated by renewable energy sources, almost exclusively from hydro power. This is the highest figure of all European Union member states and mainly caused by Austria's topographic situation and the historical development of the electricity market. For promoting the extension of new RES the legislators of EIWOG 2 fixed the above mentioned target quotas. The share of at minimum 1% or about 600 GWh couldn't be reached on 1st of October, 2001. The missing share of about 0.4% new plants shall be financial supported via funds which are paid through penalties of network operators with quotas less than the legislative targets.

3. Disclosure of primary energy shares - The law states that consumers' invoices must describe the portions of primary energy sources from which the delivered electricity has been generated. Traders and suppliers are obliged to ensure that this information is in place. The first disclosure appeared at the end of October 2001. The verification system is settlement based and the rules are as follows: i) certificates of origin issued by recognized and chartered certification organizations are accepted, ii) statements concerning the origin of

primary energy, officially published in annual business reports and approved by the chartered auditor are accepted and iii) if neither of the above are available then the UCTE-mix applies.

4. Standardized energy supply patterns - Network operators manage the continuos availability of electricity by using standardized energy supply patterns of small and middle size systems. The most grid-connected PV systems and small hybrid systems are matching to this low power segment with less 50kW connected load and less 100,000 kWh/a. The reason for accepting standardized energy patterns lies in the legislative framework for guaranteeing the grid access of renewables without any discriminations.

The principles ElWOG 2 are going into force via federal decrees in each of the nine regions. The federal governments determine the different types of promotion strategies by designing the financial incentives and allowing voluntary approaches like e.g. Green Tariffs. Two general types of financial incentives are used: i) The feed-in tariffs paying the supplied solar electricity per kWh and ii) the investigation support paying the subsidy per kWp capacity. The feed-in tariffs of grid-connected PV systems (GCS) vary 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. The investigation support is foreseen for small GCS and is limited up to 4000 EUR per kWp. As a result of the higher feed-in tariffs the extra costs for the network operators will be compensated by an additional supplement on the customer invoices.

Newcomer on the electricity markets are offering their green products directly to the customers. Green Electricity is a general tradable good like e.g. biological food. An 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. The aim of such a labeling is to enhance market transparency and allow customers to make informed choices among different products and suppliers by guaranteeing the origin of supplied Green Electricity. 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. So far, only young players on the electricity market got the Austrian Ecolabel “Umweltzeichen”.

Due to the fact that the regulations are within the competence of the federal states, there exist 9 different policies in Austria. Each state has its own promoting scheme hence the situation for planners is quite complex. Furthermore many of the promoting-programmes are time-limited and so far clear trends cannot be recognised.

But nevertheless, some regional governments established very ambitious programmes to subsidise PV:

In Vorarlberg preferential tariffs range between 36 and 73 €cent per kWh depending on the size of the installation and are guaranteed for 15 years. 30% of the expected income of the PV installation during this period are paid in advance. Upper-Austria, that accounts for about 40% of all grid-connected PV-installations in the whole country, up to 50% of the total costs are subsidised and tariffs between 10 and 20 €cent are paid. Carinthia’s feed-in law is one of the most attractive for PV with feed-in tariffs of 73 €cent per kWh for systems up to 10 kWp and 55 €cent per kWh for larger ones.

Several other states are now preparing their own programmes which will surely lead to new perspectives for the installation of PV systems.

Aside from green tariffs private shareholder and donation projects have been launched too. An example for a very successful shareholder programme is the "SONNENSCHEIN" campaign in the province of Vorarlberg where from 1998 till 2001 about 130 kW of decentralized systems have been installed. This programme is still ongoing.

4.2 Indirect policy issues

Within the framework of the 'Campaign for Takeoff' the federal ministry of agriculture and environment ordered a study to examine the potential for New Renewable Energy Sources (NRES) in Austria. In this study a research team of the Technical University of Vienna carried out the technical potential as well as the corresponding costs for three different scenarios until 2010: Business as usual, moderate forcing and ambitious forcing. Regarding PV, the authors recommend a combination of investment subsidies, preferential feed-in tariffs and the development of standardised optimised systems for grid connection with guaranteed performance ratio. Additionally more emphasis should be laid on market information about building integration and compact systems.

In August 2001 the EU parliament issued a directive to "promote the electricity production from renewable energy sources" within the deregulated EU domestic market. There targets values for the share for electricity from renewables to be reached until 2010 are stated. In the Austrian case an increase of the share of renewable energy from today's 70 to 78,1% is stipulated.

Another campaign is the 'Solar Youth Award' where creative and professional project ideas from young people in the field of PV and hybrid-systems are pre-prized.

4.3 Standards and codes

Regulations concerning grid connected PV generators are governed by the 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 (short-circuit aspects...)

Inverters (over-voltage & -current protection, EMC, grid disturbancies)

Operation

Grid-connection

Since the 1995 update, the use of MSD impedance measuring techniques to prevent islanding are explicitly allowed.

5 Future trends

The reached position of PV research and development has to be continuously improved for following the dynamic know-how and learning process of the world-wide PV development progress. The demand on training and educating will emerge automatically with the increasing number of PV applications. 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. Some new regulations in Austria could yield a substantial effect for a lasting development towards a powerful dissemination of PV, even though only in some parts of the country.