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

2007

Final Version

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Contents

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 21 participating countries are Australia, Austria, Canada, Denmark, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, The United Kingdom and The United States of America. 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. Eleven tasks have been established and currently seven are active. Information about these tasks can be found on the public website www.iea-pvps.org.

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 2007. 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 Reports, the following definitions apply:

Demonstration Programme: Programme to demonstrate photovoltaic (PV) electricity production to various potential users/owners.

Field Test Programme: Programme to test the performance (eg yield and reliability) of photovoltaic (PV) systems/components in real conditions.

Final annual yield: Total photovoltaic (PV) electricity delivered to the load during the year per kW of rated PV power installed.

Grid-connected centralized PV system: Power production system performing the function of a centralized power plant. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Grid-connected distributed PV system: System installed to provide electricity to a grid-connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the customer (demand) side of the electricity meter, on public and commercial buildings, or simply in the built environment. They may be specifically designed for support of the utility distribution grid.

Market deployment initiative: Set of means to encourage the market deployment of PV through the use of market instruments such as green pricing, feed-in tariffs, tax credits, capital subsidies etc. These may be implemented by government, the finance industry, utilities, etc.

Off-grid domestic PV system: System installed to provide power mainly to a household or village not connected to the (main) electricity utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'micro-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV system'.

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 rated PV power.

Photovoltaic (PV) module manufacturer: An organisation carrying out the encapsulation of PV cells in the process of the production of PV modules.

Photovoltaic (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°C, AM 1,5 solar spectrum – (also see 'Rated power').

Photovoltaic (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 (if any) and all installation and control components with a PV power capacity of 40 W or more.

Photovoltaic (PV) system market: The market for all nationally installed (terrestrial) PV applications with a rated PV power of 40 W or more.

Rated power: Available power delivered by a PV module or array under standard test conditions (STC), written as W.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunications system in a remote area are excluded).

1 Executive summary

Installed PV power

In 2007, after a 3 year decline the size of the domestic PV market slightly increased compared to 2006. In 2007, off-grid and grid connected PV systems with a total PV power of 2,1 MW have been installed, which represents a more than 35% growth of the domestic market compared to the year before. Following the removal of the 15 MW cap in October 2006, now again a federal incentive for PV market implementation is available, however at a very low level. Therefore, the PV market in 2007 is still far away from the all-time peak of 6,5 MW installed capacity in 2003.

The overall installed PV capacity in Austria reached 27,7 MW at the end of 2007.

On grid applications dominate the market for PV, with 24,5 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 2007 only 0,06 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 2007.

With the national PV market remaining on a very low level, the average growth of the PV market between 1997 and 2007 was 16% per year.

Costs & prices

With the dominating German PV market in its direct neighbourhood, PV price trends in Austria are closely linked to the prices which are achieved on the German market. However, turn-key system prices are typically about 10 to 20% higher than in Germany, mainly due to the very small domestic market.

Following the continuous strong demand on European PV markets, prices for PV modules again remained constant during 2007. Also system prices remained constant and in 2007 turnkey prices for typical residential on-grid systems varied between 5 EUR/W and 6 EUR/W.

PV production

Despite the negligible home market, Austrian PV industry could again expand their business in 2007. The most important products manufactured in Austria include PV inverters, PV modules and tracking systems as well as back-sheet laminates for module encapsulation or PV Ribbon Wires

Domestic PV module manufacturing remained constant at a high level. The overall PV module production in Austria in 2007 amounted to 47,4 MW (2006: 46,5 MW), which represents an increase of 2% compared to the previous year 2006.

Austria's inverter industry is one of the beneficiaries of the booming international market for PV and could increase its output compared to the year before. In total roughly 101 500 inverters for grid-connected applications for a capacity of approximately 250 MW a.c. nominal power (2006: 210 MW) were produced in Austria during 2007. More than 99% of the production was exported, mainly to Germany. In 2007, two companies were 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 ongoing growth of its PV business. In 2007, laminates for 1 500 MW of PV modules were produced.

The world market leader of large scale two-axis tracking systems also reported an increase of the production, which rose to 29 MW in 2007 (2006: 25 MW).

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, production is expected to start in 2008.

Public 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 2007 amounted to approximately 9,5 MEUR (2006: 8,7 MEUR).

As the federal feed-in tariff is limited in terms of the available annual budget, some provinces are continuing their market incentives in form of rebates for new PV installations. In 2007, such schemes were available in 4 out of 9 provinces. The budget spent for the support can be estimated to 5 MEUR (2006: 3,0 MEUR).

There is no national R&D programme dedicated to PV, however the programme "Energy of Tomorrow" launched in 2007 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.

After a peak in 2005, public funding for research, development and demonstration declined during the 2006 and can be estimated to 0,54 MEUR in 2006 (no 2007 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 Application of PV systems

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 1,8 MW are installed.

2.2 Total photovoltaic power installed

Approximately 27,7 MW of PV power has been installed in Austria by the end of 2007 (2006: 25,6 MW). While until 2003, capacity grew continuously about 37 % each year, the market size has been dropping down from its all time high of 6,5 MW in 2003 to only 2,1 MW in 2007.

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 shows the PV power installed in 4 sub-markets during 2007.

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

Sub-market/ application	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	total
PV power installed in 2007 (kW)	55		1 458	603	2 116

To highlight the development of the national PV market over the last 15 years, Figure 1 shows the annually installed capacity from 1992 until 2007.

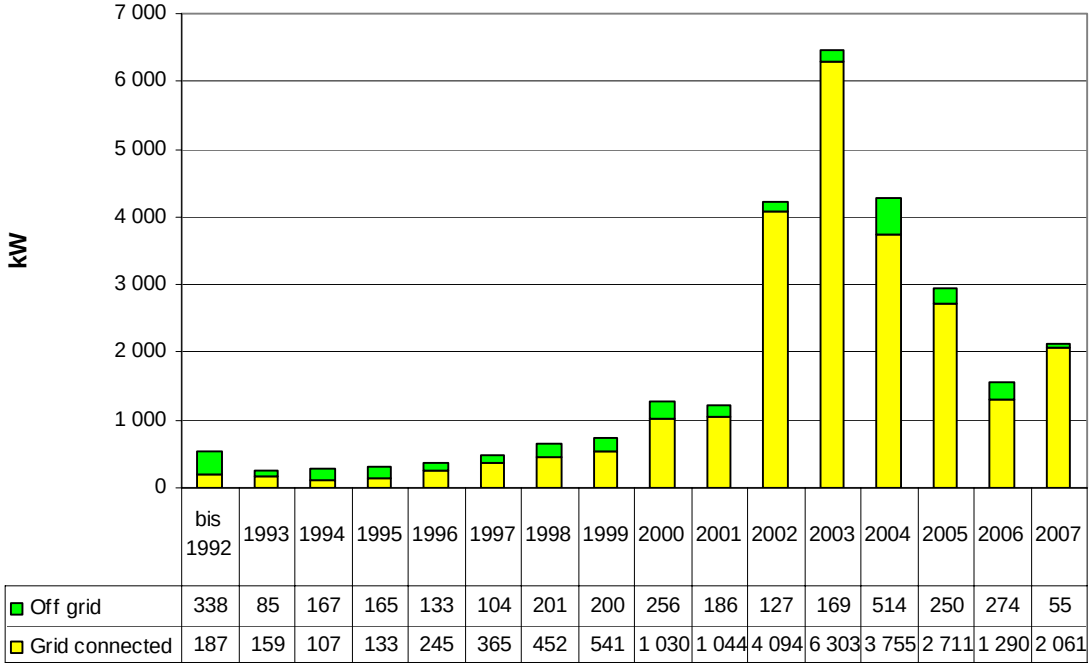

Figure 1 Annual installed PV power in Austria from 1992 until 2007. Data source until 2006: Faninger (2007); 2007: arsenal research; Graph: arsenal research

In addition, table 2 indicates the total **cumulative** installed PV power for each sub-market on the 31 December of each year from 1992 onwards until 31 December 2007.

Table 2 - The cumulative installed PV power in 4 sub-markets.

Sub-market/ application	31 Dec 1992 kW	…	31 Dec 1998 kW	31 Dec 1999 kW	31 Dec 2000 kW	31 Dec 2001 kW	31 Dec 2002 kW	31 Dec 2003 kW	31 Dec 2004 kW	31 Dec 2005 kW	31 Dec 2006 kW	31 Dec 2007 kW
total off-grid	338		1 213	1 413	1 671	1 857	1 984	2 173	2 645	2 895	3 169	3 224
grid-connected distributed	187		1 648	2 119	3 063	4 440	7 857	13 507	17 262	19 973	21 263	23 721
grid-connected centralized	N/A		70	140	140	241	476	1 153	1 153	1 153	1 153	1 756
TOTAL	525		2 861	3 672	4 874	6 120	10 341	16 833	21 060	24 021	25 585	27 701

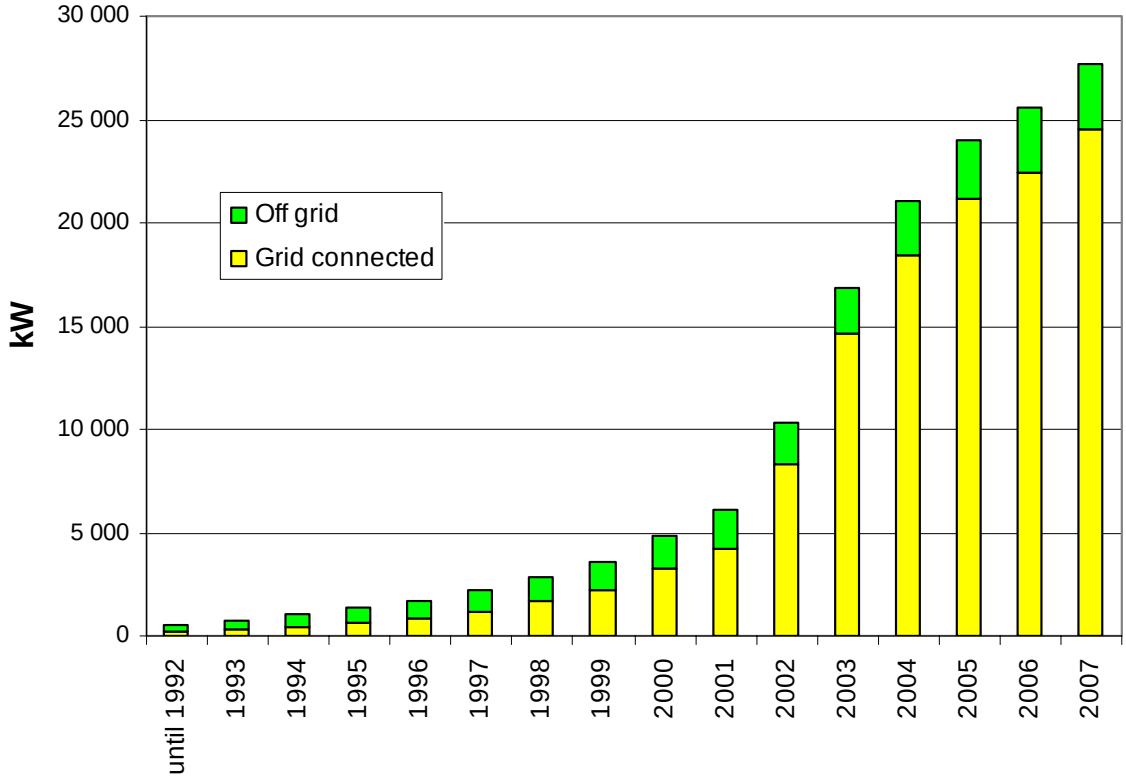

Figure 2 Cumulative installed PV power in Austria from 1992 until 2007. Data source until 2006: Faninger (2007); 2007: arsenal research; Graph: arsenal research

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 (www.oem-ag.at), a company newly established by the Austrian Ministry of Economy.

More details on the current feed-in tariff scheme of the Green Electricity Act 2006 as well as the provincial rebate programmes 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 until the end of 2007.

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 2007. Several installations with innovative design aesthetically integrated into buildings document this.

Fronius International production and logistic centre in Sattledt

In 2007 the company Fronius opened a new production and logistic centre in Sattledt where one of the largest PV-plants of Austria has been installed. The entire PV-plant consists of 3 units; a system with three trackers, a façade integrated part and a flat roof mounted part. While on the roof and at the trackers standard modules are used, the façade integrated modules are tailored modules.

The total installed PV capacity is 603 kW. In peak times the PV-plant supplies approximately 75% of the needed electricity. The expected energy yield of the system is 577 600 kWh.

In combination with the biomass power station the production facility is independent of fossil energy sources.

The project is supported by feed-in-tariffs, without investment subsidy.

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, initiatives are focused on solar cells based on sulfosalt crystals. In 2007 the Christian Doppler Laboratory “Applications of Sulfosalts in Energy Conversion“, headed by Herbert Dittrich, has been officially opened. 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.
  At the moment, the first essential results are available. First all sputtered sulfosalt thin film solar cells were produced in a cluster sputter plant, consisting of a triple stacking of Mo backcontact, sulfosalt absorber, and ZnO:Al as a window layer on glass substrates. Efficiencies are still very low but this will be, of course, the main topic for further research and development in the near future. New ternary and

multinary sulfosalt compounds were synthesized and contributions to the complex structure systematic of sulfosalts are under way.

- 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 2007 focused on the development of a new electrode for the front side of crystalline cells. The aim is to replace the conventional screen-printing of silver contacts by other chemical or electrical plating techniques and thus save the silver, which is not sufficiently available for Terawatt scale cell production. First tests show promising results with even lower losses as conventional silver contacts.
  Research on new, stringing techniques without soldering for new silicon solar cells resulted in a new cell concept, where the usual ribbons are replaced by numerous thin wires. First tests indicate that this will increase the output power of the PV modules produced with this technology.
  Furthermore, new etching techniques for crystalline silicon solar cells were transferred to the industrial scale (Company Falconcell, see section 3.2).

- Academic R&D at the Linz Institute for Organic Solar Cells (LIOS, headed by Professor Niyazi Serdar Sariciftci) focuses on Plastic Solar Cells based on thin films of Conjugated Polymers. Activities in 2007 were dominated by the preparation of new projects as well as the organisation of the international symposium "Towards Organic Photovoltaics" which took place in February 6-8, 2008 at the Johannes Kepler University, Linz. The conference attracted over 300 experts and collected the " who-is-who" in this field of science and technology. The complete Video Documentation of the Linz Symposium is freely available at the VIRTUAL ACADEMY on the LIOS homepage www.lios.at.

- Konarka Austria GmbH successfully continued the research efforts on highly efficient organic solar cells. The Austrian research team of Konarka Inc. contributed to the realization of the up to date most efficient organic solar cells world wide. Cells with an active area of 1 cm2 were certified with an efficiency of 5.2 % by NREL and taken up in the official champion PV list, published regularly in the journal "Progress in Photovoltaics":

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, 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 of Tomorrow” program. These projects are jointly carried out by academic and applied research institutions, industry and utilities.

- The Austrian research and testing centre arsenal research offers accredited qualification and type approval tests of PV modules according to IEC 61215 Ed 2 and PV inverters.) in 2007 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. Furthermore arsenal research has continued in 2007 the “Certified PV Training” with another two trainings for installers and planners in order to improve the quality of the installed systems.

- 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.

In 2007, based on the strategic process “Energy 2050”, the new RTD programme “Energy of Tomorrow” was initiated. This energy research programme targets three main challenges, efficient use of energy, renewable energy technologies and intelligent energy systems.

There is no programme specifically dedicated to PV R&D, instead PV R&D is mainly funded within the framework of the energy R&D programmes mentioned above.

Until May 2008, no data on the public spending for Energy R&D in 2007 were available, therefore the following numbers refer to data for the year 2006.

In 2006 renewable energy received about 33% of the Austrian Energy R&D budget of 42,4 MEUR (+41% compared to 2005). The majority of the RES funds (82%) 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 about 14% of the renewable energy R&D budget. PV research accounts for 28,1% of the solar energy R&D budget.

In 2006 the overall public spending for PV research and development was about 0,54 MEUR (2005: 1,31 MEUR). This represents a 60% reduction of public funding compared with the year 2005 and is roughly the same figure as 2004.

Not included in these figures is the return from European Community (EC) R&D projects. As a member of the European Union, Austria contributes to the EC R&D framework programmes (FP), hence 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 was no demonstration or field test programme running in 2007, 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 (2006)	Demo/ Field test	Market stimulation (2007) *)
National/federal	N/A		0
State/regional	N/A		5
Return from European Commission R&D Framework Programmes	N/A		0
Total	0,54 (2006 data!)		5

* 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 2007 was approximately 9,5 MEUR (2006: 8,7 MEUR), which represents a 9% increase compared to the previous year. The average feed-in tariff paid for PV was 62,4 Eurocent/kWh (2006: 64,5 Eurocent/kWh) which represents a 3,3% reduction compared to the previous year.

In addition to the federal incentive governed by the Green Electricity Act, some provinces (Upper Austria, Lower Austria, Burgenland and Vienna) continued running their regional support in form of rebates on the costs of the PV system (investment subsidies). The figure stated in Table 2 under “regional” represents the total budget spent for this purpose 2006 in these provinces.

3 Industry and growth

3.1 Production of feedstock, ingots and wafers

No production facilities for silicon feedstock or wafers existed in Austria in 2007.

Table 4 - Production and production capacity information for the year for silicon feedstock, ingot and wafer producers

Manufacturers	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 small home market, Austrian PV industry could again expand their production in 2007.

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.

- **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.

- **KIOTO Photovoltaics GmbH**, formerly RKG-Photovoltaik 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.

- **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.

- **SED**, focuses on the production of PV-roof tiles and small size modules for special applications.

In total, Austrian module manufacturers could slightly increase their output compared to the previous year. The total production in 2007 was 47,4 MW. Compared to 46,5 MW in 2006 this figure represents an increase of 2%. The minor increase is mainly due to the lack of cell supply on the international market. Thus the production capacity could not be fully used.

Practically the whole production is exported, either directly or indirectly via distributors. According to the Austrian PV industry, the main export markets in 2007 (according to nominations) are Germany, Italy, Switzerland, Spain, USA, Hungary, Turkey, Korea, Sudan, Croatia and China.

In 2007 there was no industrial 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, China and others.

However, in 2007 the following activities and new initiatives can be reported in the field of new cell production capacities:

- The company **FalconCell** has finalised building up the first cell production line with a capacity of 15-20 MW per year. In December 2007, the first multi-crystalline solar cell in Austria was industrially produced. The company is linked to the first Austrian PV-Module manufacturer PVT-Austria.

- **Blue Chip Energy GmbH**, founded in spring 2006 and since 2007 in a strategic partnership with German SOLON AG, which holds 19% of the shares has built up a production for high-efficiency single crystalline silicon solar cells (Blue Chips) in the municipality of Güssing. The first production line with a capacity of 20 MW/a will start operation during the first half of 2008. The full capacity to be installed is projected as 100 MW/year.

- **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. In 2007, the module technology for design

solar cells, which will be finally produced by the company FalconCell was further developed.

Details on module production in Austria for 2007 are given in Table 5.

Table 5 - Production and production capacity information for the year for each manufacturer (figures for 2006 in brackets)

Cell/Module manufacturer	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total production (MW)** Cell	Module	**Annual maximum production capacity (MW)** Cell	Module
Silicon wafer based manufacturers					
1 SOLON Hilber Technologie	mc-Si / sc-Si	-	25 (25)	-	29 (N/A)
2 PVT Austria	mc-Si / sc-Si	-	10 (10,1)	-	N/A (30)
3 Energetica	mc-Si / sc-Si	-	7 (6,0)	-	N/A (10)
4 RKG Photovoltaik	mc-SI / sc-Si	-	5 (5,0)	-	N/A (5,4)
5 ERTEX Solar	mc-Si / sc-Si	-	0,37 (0,25)	-	N/A (0,25)
6 SED	mc-Si	-	0,033 (0,12)	-	1 (2)
Thin film manufacturers					
-	-	-	-	-	-
Cells for concentration					
-	-	-	-	-	-
TOTALS	**-**	**-**	**47,4 (46,5)**	**-**	**N/A**

Table 6 indicates the typical module prices for the year 2007 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 PV markets and the still remaining shortage on the world-wide cell market, prices of PV modules remained constant compared to 2006.

Table 6 – Development of typical PV module prices since 2002

Year	2002	2003	2004	2005	2006	2007
Standard module price:	4,50	3,10 – 3,20	3,60 – 3,70	3,60 – 3,90	3,60 – 4,30	3,60 – 4,30
Best price	N/A	N/A	N/A	N/A	N/A	N/A
PV module price for concentration	N/A	N/A	N/A	N/A	N/A	N/A

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 2007, the large manufacturers could again extend their output in 2007. In total an estimated sum of 101 500 inverters with a capacity (rated AC output capacity) of approximately 250 MW(a.c.) were produced. More than 99% of the production were exported.

- 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** has been manufacturing and developing string-inverters in the range of 1,5 kW to 4,6 kW for grid connected applications in 2007.

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 2007, back sheet laminates for 1 500 MW of PV modules were produced.

- **SOLON Hilber Technologie**, the world market leader for tracking systems for PV power plants, a 100% subsidiary of German SOLON AG. In 2007, more than 3 300 “MOVER” tracking systems for PV installations with a capacity of 29 MW were produced.

- **Ulbrich Austria Gmbh**, a subsidiary of U.S. American Ulbrich Corp. is manufacturing flat wires (PV ribbon) for the European solar industry.

3.4 System prices

The stagnation of turnkey prices for complete PV systems, which was already observed in 2006 continued also during 2007. Due to the continued high demand of the European PV market and the stringent supply of PV modules on the world market, only a minor reduction of prices was reported.

In 2007 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 7 - 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.	4,8 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 7a 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 7a: National trends in system prices (EUR/kW) for a typical 2 – 3 kW grid connected system

YEAR	Pre 2001	2001	2002	2003	2004	2005	2006	2007
Price/W:	N/A	7 500	7 000	6 000	5 500	5 500	5 400	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 46 (2006: 40)
- Manufacturing of PV system components, including company R&D: about 1 000 (2006: 830)
- All other, including within electricity companies, installation companies etc.: about 175 (2006: 30)

With the continued expansion of their business Austrian PV manufacturers again significantly extended their workforce in 2007. In total it can be estimated that at the end of 2007 more than 1 200 jobs (2006: 900 jobs) were directly linked to PV R&D, manufacturing and installation in Austria.

3.6 Business value

In 2007 about 2,1 MW (2006: 1,6 MW) of PV systems were installed in Austria which provides an estimated value of the national market of 12 MEUR (2006: 8,9 MEUR), based on average turnkey prices for off-grid and grid connected systems.

The domestic production has meanwhile become a significant factor and now outweighs the domestic demand by a factor of more than 20.

The value of exported PV components was calculated by multiplying the capacity of products produced (PV modules, inverters, tracking systems and encapsulation materials) with their specific gross-sales price. For 2007 this figure can be estimated to be approximately 383 MEUR.

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 134 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 8 provides an overview on the estimated 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. The numbers should not be seen as exact figures.

Table 8: 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	0.06	9	0.54	
Grid-connected	2.1	5.5	11.55	
				12
Export of PV products				383
Change in stocks held				0
Import of PV products				-134
Estimated value of PV business				**261**

4 Framework for deployment (Non-technical factors)

4.1 Support measures and new initiatives

Table 9 summarizes the PV support measures which were in place in Austria during 2007:

Table 9 - PV support measures

	Ongoing measures	Measures that commenced during 2007
Enhanced feed-in tariffs	National level, Green Electricity Act	-
Capital subsidies for equipment or total cost	Limited to selected provinces.	-
Green electricity schemes	UZ46, green electricity scheme established on the national level.	-
PV-specific green electricity schemes	UZ46, green electricity scheme established on the national level.	-
Renewable portfolio standards (RPS)	-	-
PV requirement in RPS	-	-
Funds for investment in PV	-	-
Income tax credits	-	-
Net metering	Selected DNOs	-
Net billing	-	-
Commercial bank activities eg green mortgages promoting PV	-	-
Electricity utility activities eg network support	-	-
Sustainable building requirements	-	-

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.

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 became effective in October 2006. 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.

- The total funds for the feed-in tariffs for new installation are limited on a per year basis. For 2007, the available budget (for all new RES installations) amounted to 17 Mio €.

- Uniquely for PV, the provinces are requested to double this federal subsidy, which makes the support system even more complex.

Photovoltaic-Feed-in-tariffs in 2007 ranged from 46 €Cent/kWh for installations < 5kW down to 32 €Cent/kWh for >10kW systems. Compared to the regulation before 2006, the tariffs have been cut as well as the time frame for the feed-in-tariff has been reduced. For installations supported under the feed-in tariff scheme 100% of the source/size specific tariff is paid for the first 10 years. Afterwards, the tariff is cut to 75% in year 11 and finally 50% in year 12. After this period, only the gross sales price for electricity is paid.

For PV systems installed in the framework of this legislation in 2007, the feed-in tariff was set to:

up to 5 kW	46 Eurocent/kWh (2006: 49 Eurocent/kWh)
above 5 kW up to 10 kW	40 Eurocent/kWh (2006: 42 Eurocent/kWh)
above 10 kW	30 Eurocent/kWh (2006: 32 Eurocent/kWh)

The first year with the GEA 2006 fully effective has confirmed the scepticism of national PV stakeholders. In particular, the complexity of the support system and the modest financial limits could not foster the Austrian PV market.

Besides the GEA 2006, mainly 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 and aimed at overcoming the limitations of federal incentives. However, in most cases the regional support is only granted in case the installation is not supported by the federal feed-in tariff scheme.

In 2007 the following programmes provided support for PV installations:

- Upper Austria is still running 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 2007, installations with a capacity of 1,3 MW (2006: 0,6 MW) were supported in the framework of the ÖKOP IV by funds of 3,8 MEUR (2006: 2 MEUR).

- Lower Austria offers a specific support scheme for PV-installations. The incentive is based on a rebate of up to 3 000 EUR per kW installed, which is granted for residential installations up to 5 kW. However, due to limitations of available funding and the number of applications, only a rather limited support is granted in practice. In 2007, a capacity of 0,04 MW (2006: 0,2 MW) was supported. The total budget spent for this purpose was 0,1 MEUR (2006: 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 2 700 EUR per kW (max. 40%) of the total investment. In 2007, installations with a capacity of 0,43 MW (2006: 0,09 MW) were supported by a total of 1,1 MEUR (2006: 0,23 MEUR).

- Burgenland offers a rebate in the range of 750 EUR to 1000 EUR per kW installed, which – unlike the other provinces – was granted in addition to the federal feed-in tariff. In 2007, installations with a capacity of 0,07 MW were supported by a total of 0,056 MEUR.

- In the remaining 5 provinces (Kärnten, Salzburg, Steiermark, Tirol and Vorarlberg) only the federal feed-in tariff scheme was available in 2007.

Initiated by the Ministry of innovation and technology, the National PV roadmap, developed by arsenal research in collaboration with the national PV association has been finally published in 2007. 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 was worked out in a wide discussion process amongst the main national PV stakeholders.

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. However, currently only 65% of the electricity demand in Austria is covered by RES.

Furthermore, a new EU directive now sets targets for the share of RES in the total energy consumption. For Austria, this target has been set to 34%.

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 2007 no new developments on national standards and codes were reported.

5 Highlights and prospects

PV Industry & production

By far the largest share of the Austrian PV production is exported to those European Union countries, where attractive and stable incentives created a 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 will help 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.

Stakeholder initiatives and awareness raising

Photovoltaic Austria, the National Photovoltaic Association continued its activities by creating a national network for dissemination of information on PV and initiating awareness raising activities. At the end of 2007, more than 100 companies and persons involved into the PV business were members of the Association.

The annual national photovoltaic conference 2007 was jointly organised by arsenal research and the national PV association with support of the ministry of Transport, Innovation and Technology. With about 200 participants it has been a big success and attracted broad interest among stakeholders from industry, politics and research.

Market & deployment initiatives

When looking at the domestic market the situation of PV remains complex and unsatisfactory. The revision of the main framework, the Green Electricity Act from May 2006 does not provide any substantial support for PV and further complicated the situation in comparison to the period before. Moreover, also the current draft of the upcoming 2008 revision of the Green Electricity Act will not provide significant improvement for PV.

Considerable progress is not to be expected before 2009. From this year, incentives such as the 10 000 roof-top programme of the national Climate and Energy Fund as well as the Climate-Active initiatives of the federal Ministry for Agriculture are currently under consideration. However, the details of these programmes are still to be defined. Hence the situation for PV in Austria will remain unclear also for the year to come.

Annex A Note to reader - method and accuracy of data

The market statistics on installed capacity, share of grid-connected and off-grid applications as well as the industry data has been collected by Natalie Glück, arsenal research, supported by Hubert Fechner, arsenal research under the coordination of Peter Biermayr, 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. In the annual report ("Erneuerbare Energie in Österreich, Marktentwicklung 2007") PV applications are divided into Off-grid installations (including domestic and non-domestic applications), and 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.

With the establishment the new organisation managing the feed-in tariff scheme, all statistics on renewable energy installations funded under the feed-in tariff scheme are now reported by OeMAG. Data on the total amount of budget spent for PV feed-in tariffs is provided by OeMAG.

However, as a considerable share of new PV installations is installed outside this feed-in tariff framework, data on these systems, which are supported by regional initiatives or other programs, are not included in the national Energy Statistics, since the capacity of these installations is below 1 MW. Thus the installations reported by OeMAG do not provide a complete picture of the situation in Austria.

The uncertainty of the figures related to the installed capacity is estimated to be about ± 10 %.

Due to the changes in the method as well due to further companies which are now included in the of data collection, minor inconsistencies between pre-2007 and 2007 data cannot be avoided.

Data on funding for PV R&D is taken from the report "Energieforschungserhebung 2006, Ausgaben der öffentlichen Hand in Österreich, Erhebung für die IEA" compiled by the Austrian Energy Agency by order of the Federal Ministry for Transport, Innovation and Technology (BMVIT).

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

Annex B Country information

This annex provides some background about the national environment in which PV is being deployed. The data are not guaranteed to be 100 % accurate nor intended for analysis, and the reader should do their own research if they require more detailed data.

Electricity in Austria (Source: VEÖ Association of the Austrian Electricity companies)

General data about Austria :

- Territory: 83 850 km2
- Inhabitants (2001): 8,031 560
- Domestic electricity consumption (excl. PS): 62 778 GWh
- Electricity consumption per inhabitant: 7.82 MWh/year
- Domestic electricity generation: 60 081 GWh

Number of power plants subject to reporting obligation (including voluntary reporting):

- 552 run-of-river plants
- 102 pumped-storage plants
- 1 507 non-allocated hydro-power plants
- 148 thermal power plants

Number of network levels: 7

- Levels 1-3: high and ultra-high voltage
- Levels 4-5: medium voltage
- Levels 6-7: low voltage

1) retail electricity prices (2007)

	Net-price	**Energy tax**	**VAT**	**Total taxes**	**Final price**
	EUR/kWh	EUR/kWh	EUR/kWh	EUR/kWh	EUR/kWh
Electricity price (Industry)	0,08	0,02	0,00	0,02	0,10
Electricity price (household)	0,11	0,02	0,03	0,05	0,16
Source: E-Control					

2) Typical household electricity consumption:

4200 kWh (Source Statistik Austria www.statistik.at)

3) Typical metering arrangements and tariff structures for electricity customers (for example, interval metering? time-of-use tariff?)

For normal households: Typically fixed tariff (no time-of-use) or day/night time dependent tariff.

4) Typical household income:

27 371 EUR per year (2006 data) – according to EU SILC 2006 (Source Statistik Austria www.statistik.at)

5) typical mortgage interest rate:

N/A

6) voltage (household, typical electricity distribution network)

Single phase 230 V, 3 phase 400 V; 50 Hz;
Electricity networks structured in Transmission (220 kV – 400 kV), sub-transmission (110 kV), medium voltage distribution (10 kV – 30 kV), and low voltage distribution (400 V)

7) price of diesel fuel (2007):

	Net-price	**Energy tax**	**VAT**	**Total taxes**	**Final price**
	EUR/l	EUR/l	EUR/l	EUR/l	EUR/l
Diesel fuel (private use)	0,49	0,36	0,17	0,53	1,02
Source: Bundesministerium für Wirtschaft und Arbeit					

8) Typical values of kWh / kW for PV systems in parts of your country
850 kWh/kWp to 950 kWh/kWp
Source: Authors estimation.