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 Germany 2006

Prepared on behalf of
BMU – German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

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i Foreword

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The nineteen participating countries are Australia (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Mexico (MEX), The Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), The United Kingdom (GBR) and The United States of America (USA). The European Commission and the European Photovoltaic Industry Association are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (tasks) is the responsibility of Operating agents. Ten tasks have been established and currently six are active. Information about these tasks can be found on the public website www.iea-pvps.org. A new task concerning PV environmental safety and health is now being developed.

The objective of Task 1 is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems.

ii Definitions, symbols and abbreviations

BMU: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

KfW: Kreditanstalt für Wiederaufbau (The German Development Bank)

EEG: Renewable Energy Sources Act (Erneuerbare Energien Gesetz)

DBU: Deutsche Bundesstiftung Umwelt (German Federal Environment Foundation)

BSW: German Solar Industry Association, unification of former Bundesverband Solarindustrie (BSi) e.V. and Unternehmensvereinigung Solarwirtschaft (UVS) since 01.01.2006

1 Executive summary

The reduction of greenhouse gas emissions is an ongoing task in Germany. An enhanced utilisation of renewable energies is the key to a sustainable energy system. Moreover, increased independency of energy supply goes hand in hand with growing usage of renewable energies.

For the electricity sector, the Federal Government set a national target for renewable energies of 12.5 % by 2010 and 20% by 2020. While in 2000 a share of 6.3% for renewable energies was assessed, in 2006 already 11.6% were reached.

Photovoltaic (PV) adds to this development. Form the currently installed PV capacity one can estimate a share for PV of roughly 2 % of the renewable power generated in Germany. Driven by the Renewable Energy Sources Act (EEG), PV still shows an impressive development. Additionally, PV has become a real business with noticeable employment and turnover.

The following tables show the impressive development in the booming PV market in Germany and the governmental support in R&D.

Installed PV Power

New installed (power)	> 750 MWp
Total installed power	~ 2.500 MWp
Total number of installed systems	300.000

Source: BSW, March 2007

Cost and prices

Turnkey Prices of Typical PV Applications (VAT excluded, net)

1 – 2 kWp:	5.259 €/kWp (off-grid / grid connected)
2 – 5 kWp:	4.853 €/kWp (usually grid connected)
5 - 10 kWp:	4.624 €/kWp (usually grid connected)
> 10 kWp:	4.403 €/kWp (usually grid connected, large PV power plants)

Source: Photon 4/2007

PV Production

Production of cells	~500 MWp
Production of wafers	~300 MWp
Production of feedstock silicon	6200 t
PV power generation	~2.000 GWh

Source: BSW, March 2007

Budget for PV

R&D budget for PV by BMU	38 Mio. €
Institutional funding for PV Institutes by BMBF	~28 mio. €

Source: BMU

Market data

Turn-over PV industry	~3.7 bill. €
Export quota	34 %
Foreign purchases	1041,5 Mio. €
Labour places	35.000
• Handicraft: 60 %	
• Wholesale: 10 %	
• Industry: 30 %	
Investment in production capacity	~1.000 Mio. €

Source: BSW, March 2007

2 The implementation of PV systems

2.1 Applications for photovoltaics

Off-grid applications
The off-grid sector includes domestic PV applications for the leisure such as electrical power for weekend houses. Non domestic applications are implemented in the 'mobile' sector, such as cars and caravans (sunroofs combined with ventilation), camping, boats, water pumping and electricity supply for many traffic applications and tool sheds, which are increasing and difficult to distinguish in the total number of PV systems installed in the off-grid sector.
Domestic off-grid PV systems are offered by specialized manufacturers, distributors and system-houses as well as by numerous Do-it-yourself and electronic-stores. Differentiated statistics broken down by applications are not available. Compared with 2005 there is a stable and slow increasing request for stand alone systems. First estimates indicate that in 2006 around 3,5 MW were installed.

Grid-connected applications
The German funding strategy favours the installation of grid-connected PV power systems. Therefore, grid-connected rooftop systems and large PV power plant are further on dominating the market.
BSW (Bundesverband Solarwirtschaft – the German Solar Industry Federation) published in March 2007 the new installed capacity of around 750 MW for grid-connected systems. That means in total about 2,5 GWp MW installed capacity by around 300.000 PV power systems.

2.2 Total photovoltaic power installed

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

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Off-grid	0,2	0,3	0,7	1,6	3,6	6,6	9,1	11,4	13,7	16,6	20	23	26	29	32
Grid-connected	5,4	8,6	11,7	16,1	24,2	35,2	44,7	58,0	100,0	178,0	258	408	1008	1758	2.508

The capacity installed in recent years is still a topic of discussion. But meanwhile, the data provided by the BSW and the analysis of the Photon Magazine seem to converge. The dilemma is based on the fact that the high number of installations makes it difficult to track each single system.

BSW published in March 2007 an additional installed capacity of around 750 MW for 2006 showing a temporary stagnation of the market. At the same time a revision of the date for 2004 and 2005 was published which is already incorporated into Table 1. It is recommended in order avoiding confusion for the future to take the figures of BSW as the official association of the German PV industry. Therefore, the total installed capacity for 2006 should be corrected to 2.500 MWp.

While in Photon 1/2007 a number of 700 MW was given for 2006, in issue 5/2007 Photon estimates preliminary a new installed capacity in Germany about 1.150 MW

For reasons of consistency, we take the figures of BSW as the official ones.

In addition to the market of grid connected systems, there is a stable and slowly increasing request for stand alone systems. First estimates indicate that in 2006 around 3.5 MW were installed mainly for industrial applications as the automotive sector, traffic signals etc.

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

Since 2004, Germany is the country with the highest annual PV installation world-wide. This remarkable development is based on the following measures in the area of market introduction:

The "Electricity Feed Law" introduced in 1991 was replaced by the “Renewable Energy Sources Act (EEG)” in April 2000. The EEG rules the input and favourable payment of electricity from renewable energies by the utilities. In 2004 the EEG was amended and the feed in tariffs were adjusted mainly according to changes in accompanying market introduction programmes. The tariffs for new installed PV systems drop year by year by 5%. Table 1 shows the development of the basic PV tariff. The rates are guaranteed for an operation period of 20 years.

Table 1 - Development of the basic PV feed-in tariff of the EEG

	2003	2004	2005	2006	2007
Tariff* (Ct/kWh)	46.0	57.4	54.5	51.8	49.2

* For rooftop- systems smaller than 30 kW; for bigger systems there are lower tariffs; façade integrated systems get a bonus of 5 Ct/kWh.

At the end of 2003 the “100 000 Rooftops Solar Electricity Programme” terminated. With a total granted capacity of 345.5 MW and 65 700 systems built, this programme was a real success. The support of PV systems by soft loans is maintained for example by the new programme “Solar Power Generation”. Under this programme 30 284 loans representing a total volume of 237.4 MW equivalents to 946.6 MEUR investments were granted since 2005.

2.4 Highlights of R&D

In November 2005 a R&D roadmap was developed during the 9th BMU R&D strategy meeting. This roadmap developed by representatives from industry and research institutes puts emphasis on a stable decrease of the costs of electricity from PV. It demands the need for an efficient consumption of raw materials, especially of silicon, as well as higher efficiencies in general, long-term stability of all system components and innovative production technologies.

In general, the federal PV R&D strategy is designed to support the German PV industry to reach, maintain and extend their leadership in all relevant disciplines. Therefore, key-projects in the areas silicon wafer technology, thin-film concepts and system technologies are funded. In 2006 the BMU support for R&D projects on PV amounted to about 38 MEUR shared by 121 projects in total. The distribution of the budget shows that one focal point still is on wafer based silicon technologies (40% of the budget). But thin-film technologies receive an increasing share of the budget (48%). The development of system technology (10%) and alternative technologies like organic PV and concentrating PV (3%) are funded as well.

In addition to the BMU grants, the BMBF provides funds for the development of PV technologies as well; in 2005 approximately 22 MEUR were spent.

In accordance with the PV R&D strategy outlined above 45 new grants were contracted by the BMU in 2006. The funding for these projects amounts to 43.4 MEUR in total (after 32.3 MEUR in 2005 and 29.5 MEUR in 2004).

In 2006, the highlights of R&D were as follows:

- Systems with high efficiencies are crucial for a further reduction of costs of solar power. Significant progress was achieved in two projects:
- Rear contact solar cells with efficiencies of 21% were developed in the project QUEBEC that is carried out by the company Q-Cells AG together with the Fraunhofer-Institute für Solare Energysysteme (FhG-ISE) and the Institut für Solarenergieforschung Hameln (ISFH). In 2007, this development will be transferred into pilot production [4].
- A record efficiency of 18.8% for large area screen printed solar cells was reported by the company SolarWorld Industries Deutschland GmbH, Munich. The company is now optimistic to realise 20% cells using this technology [5].

- Today, PV systems show a typical lifetime of more than 20 years. For a live after the live recycling concepts are developed by the project SOMOCELL. Under the leadership of the company Deutsche Solar in Freiberg this project deals not only with the re-usage of silicon wafers but also develops recycling concepts for thin film technologies.

- Currently, a significant extension of thin film production capacities founded on sustainable funding of R&D is been undertaken. The main technologies of interest are based on amorphous / microcrystalline silicon (aSi/µSi) and on the compound semiconductor CIS.

In the coming months the realisation of a aSi/µSi pilot production line at Brilliant234, an extension of aSi module production at Schott Solar as well as the implementation of full CIS production capacity at Würth Solar are on the agenda. All initiatives are supported by accompanying R&D projects.

- PV has also the ability to contribute to enhanced power quality and secured power supply. This kind of added value can be achieved by adding a UPS function (Uninterruptible Power Supply) to the PV inverter. In 2006 two projects were launched which address this issue.

- In November 2006, Concentrix Solar GmbH a spin-off of the Fraunhofer-Institute für Solare Energysysteme (FhG-ISE) received a contract for the erection of a 500 kW concentrating solar power plant at the Spanish province of Castilla-La Mancha. This proofs the high confidence in Concentrix's FLATCON® technology, which is based on a development started at the FhG-ISE in the late 1980ties. In 2006, a new grant was contracted mainly for the development of efficient production processes for FLATCON® modules.

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

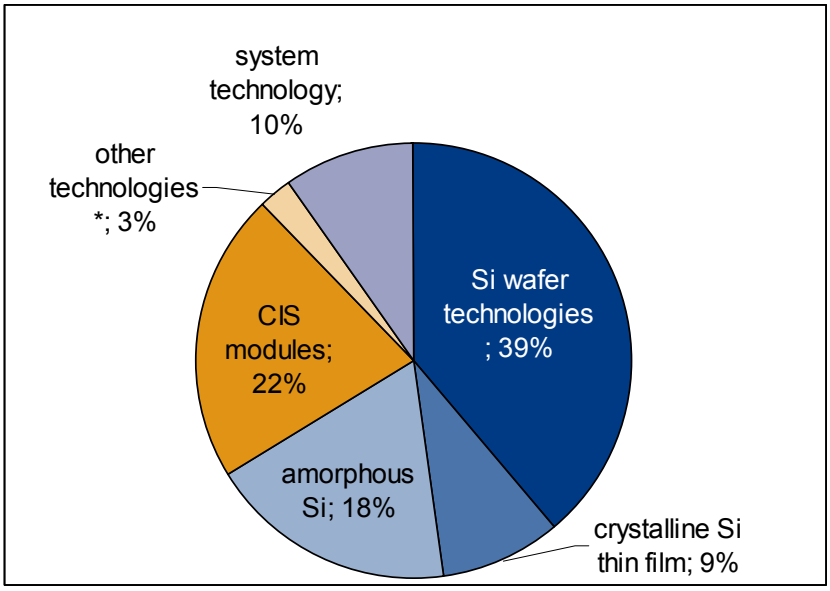
The “Renewable Energy Sources Act (EEG)” is the driving force for the development of the PV market in Germany. The EEG rules the input and favourable payment of electricity from renewable energies by the utilities for an operation period of 20 years.

The support of PV systems by soft loans is maintained for example by the new programme “Solar Power Generation”. Under this programme 30 284 loans representing a total volume of 237.4 MW equivalents to 946.6 MEUR investments were granted since 2005.

Other measures like programmes of the Federal States (Länder) and the Federal German Environmental Foundation (DBU) are designed for a local or an application specific support of PV. Moreover, a number of utilities have launched initiatives to build PV-demonstration and pilot systems or to provide advice and information.

In 2006 the BMU support for R&D projects on PV amounted to about 38 MEUR shared by 121 projects in total.

Table 2: BMU funding of R&D in 2006 (* organic and concentrating PV)



3 Industry and growth

3.1 Production of feedstocks, ingots and wafers

The German PV industry experienced a period of strong growth over the last years. And it seems that this growth will even ascend in the next few years. The range of companies dealing with PV is expanding along the whole value chain. Especially the capacity of thin film production facilities is expected to grow significantly in the near future taking advantage from the current global silicon supply shortage. But for the moment, the growth of the market as well as the production is limited by that shortage. And it is estimated that this shortage will maintain until 2008. The production figures given below are based on an analysis of the PV magazine “Photon”

Silicon feedstock

Wacker one of the world largest supplier of Silicon for the semiconductor and PV industry again enhanced its silicon production to 6 200 t in 2006. This is equal to a PV production of approximately 510 MW. An extension to 9 000 t until 2008 is already decided.

With Joint Solar Silicon, Scheuten Solar and City Solar AG three additional producers will enter the market in 2007/8 introducing new ways for the production of solar silicon.

Wafer production

The total production of wafer amounted to 310 MW in 2006 and stayed on almost the same level as in 2005 (300 MW).

The main supplier of silicon wafers is still Deutsche Solar AG in Freiberg. The company produced approximately 180 MW on mono- and multi crystalline wafers. Besides Deutsche Solar there are two further Germany based wafer manufacturers: PV Silicon at Erfurt and ASI at Arnstadt. It is estimated that both companies together sold up to 100 MW in 2006. Silicon ribbons are produced by Schott Solar (EFG-Si-ribbon) in Alzenau and EverQ (String-ribbon) in Thalheim.

From 2007/8 on two other companies namely Conergy AG in Frankfurt (Oder) and WPI Wafer Production International in Leipzig will start production.

Solar cell production

The cell production in Germany shows a steady growth. Starting from 58 MW in 2002 the production arrived at 510 MW in 2006. Currently, mainly eight companies are engaged. These are Deutsche Cell in Freiberg, ErSol Solar Energy in Erfurt, EverQ and Q-Cells in Thalheim, Scheuten Solar in Gelsenkirchen (former Shell Solar), Schott Solar in Alzenau, Solarwatt Cells in Heilbronn and Sunways in Konstanz and Arnstadt.

With Conergy AG and Arise Technologies Corp. (Bischofswerda), a Canada based company, ready to build up production capacities in 2007 and ongoing measures to expand existing plants an increase in production to almost 900 MW in 2007 seems possible.

Solar modules

The production of solar modules grew again but was once more limited by the shortage of silicon. After assembling of 40 MW in 2002, the output of modules from more than 30 companies reached 330 MW in 2006.

Because of the ongoing strong demand for modules and hoping for a better supply with silicon solar cells many manufacturers are aiming for further production extension. Therefore, in 2007 a production of 650 MW seems to be likely.

Thin-film technologies

In addition to the silicon wafer activities, thin-film technologies from Antec Solar Energy (CdTe), CSG Solar (crystalline silicon), Schott Solar (amorphous silicon) and Würth Solar (CIS) reached a total volume of another 10 MW. These activities were on the same level as in previous years.

But for the coming years this will change significantly. For 2007 one can expect shipments of more than 90 MW and from 2008 on a production of more than 500 MW seems likely:

- CSG Solar is going to double its production capacity to 20 MW.

- API GmbH, Brilliant 234, Ersol Solar Energy and Schott Solar announced to establish (additional) production capacities of 220 MW of amorphous silicon modules until the end of 2007.

- Avancis (former Shell Solar), Johanna Solar Technologies, Nanosolar Inc., Sulfurcell Solartechnik and Würth Solar are going to invest in CIS technologies. Together, a production capacity of more than 160 MW will be build up during 2007.

- First Solar and Calyxo will start the production of CdTe modules aiming for a capacity of 100 MW and 20 MW respectively.

Besides the manufacturing of wafers, cells and modules, the production of inverter technology shows impressive growth rates. For 2006 a production of 900 MW was estimated.

In Conclusion, the German PV industry is not only a fast growing industry but is also offering innovative products along the whole value chain. During the last years, equipment and production companies became the most experienced ones world-wide.

More and more companies are entering into the business making PV to a real opportunity for employment and business in general.

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

Producers	Process & technology	Total Production	Maximum production capacity	Product destination ?	Price ??
Silicon feedstock					
Wacker-Chemie	Silicon feedstock	*6200 t*	*6500 t/year*		
Deutsche Solar AG (Solarworld)	mc-Si ingots	*?*	*?*		
PV Silicon AG	sc-Si ingots.	*?*	*?*		
WAFER		*MW*	*MW/year*		
ASI Industries	sc-Si wafers	40	45		
Deutsche Solar AG (Solarworld)	mc-Si wafers	180	220		
EverQ	mc-Si wafers	15	30		
PV Silicon	sc-Si wafers	60	70		
Schott Solar GmbH	EFG, mc-Si wafers	15	18		

Source: Photon, 1/2007

3.2 Production of photovoltaic cells and modules

Table 4: Production and production capacity information for the year 2006 for each manufacturer

Cell/ Module manufacturers	Technology	Total Production (MW)			Maximum production capacity (MW/yr)		
		Cell	Module	Concentr.	Cell	Module	Concentr
1. Aleo AG			45			90	
2. ASS Automotiv Solar Systems GmbH			4,5			8	
3. Deutsche Cell GmbH, Freiberg	mc-Si	70			166		
4. Ersol Solar Energy GmbH Erfurt	mc-Si	43			60		
5. EverQ GmbH	string-ribbon, mc-Si	15	15		30	30	
6. Heckert B.X.T. Solar GmbH			5			25	
7. Scheuten Solar Technology (cell production sold to Solarworld on 1.September 2006)	sc-Si, mc-Si	5	23		6,25	55	
8. GSS GmbH and IPEG GmbH, Löbichau	mc-Si		4			12	
9. Q-Cells AG, Thalheim	mc-Si	255			336		
10. Schott Solar GmbH, Alzenau	EFG, mc-Si	80	22		115	22	
11. Schüco international KG			3			5	
12. Shell Solar GmbH, Gelsenkirchen	sc-Si, mc-Si	3			12,5		
13. Solara AG, Hamburg			10			12	
14. Solar Fabrik GmbH, Freiburg	sc-Si , sc-Si		17			50	
15. Solar Factory GmbH (Solarworld)			55			75	
16. Solarnova GmbH, Wedel	sc-Si, mc-Si		3,2			12	
17. Solarwatt Solar-Systeme GmbH, Dresden	misc. sc-Si and mc-Si		47			100	
18. Solarwatt Cells GmbH		8			9		
19. SOLON AG, Berlin	Misc. Sc-Si , mc-Si		75			90	
20. Sunways A.G.	'power cells'	25			46		

Konstanz	mc-Si						
21. Webasto Systemkomp. GmbH, Stockdorf	Sc-Si, mc-Si		1,5			5	
Thin Film manufacturers							
22. AnTec Solar GmbH, Rudisleben	Cd-Te		4			10	
23. Würth Solar GmbH, Marbach am Neckar	CIS		1			14,8	
Contentrators							
24. Concentrix				0			0
25. SolarTec AG				1			1
26. Others:		< 10	5,8				
TOTALS		**514**	**341**	**1**	**780,75**	**633**	**1**

Source: Photon, 1/2007

Table 4a: Typical module prices for a number of years

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004.	2005	2006
Module price(s): Typical	5,98	5,93	5,42	4,91	4,5	4,14	3,73	3,63	3,58	3,53	3,5 - 4,3	3,1 - 3,9	3,0 – 9,6	4,0 – 6,0	4,0 – 5,3
Best price															4,0

The PV module prices are varying in a wide range depending on the type of application. It is evident that PV modules, custom-made for special building integrated projects or solar roof tiles are much more expensive than standard PV modules.

An indicative module price in a range from 4,3 to 5,3 €/Wp for installed systems should represent the main market prices in Germany for 2006.

Photon 2/2007 gives a detailed market overview about the German market for solar modules. It is reported a wide range of end prices for modules from 2,5 €/Wp (Thailand) to 8,48 €/Wp (Danmark) (16 % VAT excluded) for single modules (130 – 220 Wp per unit). But most of them are typically in the range of 4,0 to 5,30 €/Wp.

The module prices of the producers are mainly between 3 and 3,5 €/Wp.

There is broad mixture of imported and local manufactured modules. Main module producers for the German market are Asian und German companies using all type of cells available on the world market.

3.3 Manufacturers and suppliers of other components

Besides the manufacturing of wafers, cells and modules, the production of inverter technology shows impressive growth rates. For 2006 a production of 900 MW was estimated.

3.4 System prices

Photon (Photon 4/2007) reported the following average prices (mounted on roof, end price for consumer) for different scales (without VAT, in Germany 16% in 2006, 19 % in 2007):

Table 5: Turnkey Prices of Typical Applications (VAT excluded, net)

1 – 2 kWp:	5.259 €/kWp (off-grid / grid connected)
2 – 5 kWp:	4.853 €/kWp (usually grid connected)
5 - 10 kWp:	4.624 €/kWp (usually grid connected)
> 10 kWp:	4.403 €/kWp (usually grid connected, large PV power plants)

The general tendency is that after a remarkable increase from 2003 to 2005 the prices in 2006 are more or less constant with tendency to lower prices in 2007. Photon reported about 8 % from 2006 to 2007. It is assumed that the huge demand for modules determines the selling prices and the effect of cost reduction in production were not referred to the consumers. An indication for this effect on prices can be seen in the record earnings of PV producers and manufactures. Recently in Germany starts a discussion whether the EEG with its high guaranteed tariffs over 20 years for PV systems has an influence on the hesitant price reduction for the end consumers.

Table 5a: National trends in system prices in for a roof mounted 2 - 5 kW PV system (VAT included)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Price €/kW	**8 390**	**7 720**	**7 060**	**6 540**	**6 190**	**6 540**	**6 400**	**5 600**	**5080**	**5300**	**5600**	**5400**

Thin-film modules still play no important role in the market, but the German thin-film producers are increasing their capacities.

3.5 Labour places

The BSW estimates that meanwhile around 5 000 companies with 35.000 employees are active in the PV business. The turnover in 2005 amounted to 3,7 billion EUR and is still growing.

3.6 Business value

Table 6: German Photovoltaic Market Key Data 2006 (BSW, March 2007)

New installed (power)	> 750 MWp
Total installed power	~ 2.500 MWp
Total number of installed systems	300.000
Turn-over in 2006	~3.7 bill. €
Export quota	34 %
Production of cells	~500 MWp
Production of wafers	~300 MWp
Production of feedstock silicon	6200 t
Foreign purchases	1041,5 Mio. €
Labour places	35.000
• Handicraft: 60 %	
• Wholesale: 10 %	
• Industry: 30 %	
Investment in production capacity	~1.000 Mio. €
PV power generation	~2.000 GWh

4 Framework for deployment (Non-technical factors)

Table 7: PV support measures

	National / Regional (State) / Local
Enhanced feed-in tariffs	Renewable Energy Sources Act (EEG), 51.8 €ct/kwh for PV
Direct capital subsidies	Yes, in some states, REN Programm
Green electricity schemes	Yes, some utilities offer „green electricity“
PV-specific green electricity schemes	no
Renewable portfolio standards (RPS)	No obligations for utilities to obtain a minimum percentage of their power from renewable energy resources
PV requirement in RPS	none
Investment funds for PV	On commercial basis by banks or investment funds dedicated to renewable energies, particularly large solar power plants
Tax credits	None specific for PV, but the regular depreciations by commercial investements
Net metering	yes
Net billing	yes
Commercial bank activities	yes
Electricity utility activities	yes
Sustainable building requirements	Yes, by law for new buildings, there are provisions for energy efficiency

Table 7a: PV support measures

Federal Government	Kind of Funding	Name of Programme
BMU/ KfW DBU (foundation)	Low interest loan (~4,5%) Subsidy	"Solar Power Production" and other environmental and CO_2-reduction programmes
Federal States		
Hessen	Project support for PV plants outside KfW	Low interest loans for grid-connected PV systems
Niedersachsen	1. Loans 2. Subsidies for PV systems in some regions (Hannover) 3. Subsidies for PV systems in agriculture	1. Loans for energetical modernization of buildings 2. Max. 7 670 Euro per system
NRW	Subsidies for PV systems	REN Programme
Schleswig-Holstein	Further reduction of interest rates of some KfW programmes (0,15 %)	
Thüringen	Subsidies for PV-systems	

4.1 New initiatives

The new 5th Energy Research Programme is designed to be valid for the period from 2006 to 2008. Under this programme, a call for tender was released in September 2006.

Concerning PV, the call addresses five focal points:

- Silicon feedstock and wafer technology, especially the production of solar silicon, reduced material consumption and the development of new cell and module concepts.
- Thin film technologies, especially transfer of concepts and processes into an industrial environment, optimisation of processes considering reduction of costs and investigation of degradation processes aiming for long term stable structures.
- System technology, especially for decentralised grid structures, adaptation to future module generations and standardisation of island systems for global applications.
- Alternative concepts, which are both suitable for power applications and feasible for industrial production.
- Cross-cutting issues like enhancement of the lifetime of all system components, avoidance of materials, which are harmful to the environment, reduction of energy usage in the production and recycling.

4.2 Indirect policy issues

The German Government finalized the ecological tax reform in 2003. Moreover, since early 2005 an emission trading system is established within the European Union.

The Government supports a lot of public relation e.g. internet portals, conferences, events, journals to increase the awareness of renewable resp. PV. Further on there are a lot of associations of industry, handcraft and of a private basis which promote PV in Germany. Main Universities or Instituts in Germany engaged in PV Technologie are in Konstanz, Stuttgart, Hameln und Freiburg.

Links related to PV:

http://www.bmu.de
http://www.solarwirtschaft.de
http://www.photon.de/
http://www.solarserver.de/
http://www.dgs-solar.org/
http://www.solarcontact.de/
http://www.solarfoerderung.de
http://www.sonnenertrag.de/
http://www.eurosolar.de/
http://www.top50-solar.de/
http://www.sonnenertrag.de/
http://www.bine.info/
http://www.dena.de/
http://www.bmu.de/files/pdfs/allgemein/application/pdf/jb_ee_2006_engl.pdf

4.3 Standards and codes

The elaboration of standards and codes for PV is performed on the European level (CENELEC) and international level (IEC). The actual list of international standards and codes can be found on the web site: www.iec.ch.

5 Highlights and prospects

After significant growth rates well above the global average the German PV market came to a temporary stagnation in 2006. This effect seems to result from the current shortage of silicon supply as well as from the interdependency between system prices and feed-in tariffs. But for 2007 an expansion of the market is expected: The Sarasin study of December 2006 anticipates a volume of approximately 750 MW while Photon 1/2007 considers up to 2 GW as possible.

For 2007 an evaluation of the EEG is scheduled which was already predefined when this law was adopted. The assessment has to be presented to the parliament by the end of 2007. It will cover the status of the market introduction of the renewable energies as well as the electricity production costs of these technologies. If necessary, an adaptation of feed-in tariffs and their degression rates shall be suggested.

At the same time, one can observe numerous activities of PV companies in Germany. Many companies are expanding their production capacities or are going to invest into new business opportunities. In total, the production of PV components and systems grows currently much faster than the global average. This seems to be a first step for a change from an importing to an exporting country.
In an environment of competition, it is important to offer high quality state of the art products. Therefore, the current technical and economical status does not allow standstill. Enhancement of production efficiency and at the same time lowered costs stay on the agenda. For that reason, high-level R&D together with sustainable market supporting mechanisms like the EEG is needed.

The current situation in Germany and in Europe in general feeds the conviction that PV will continue its way successfully.

Annex A

Method and accuracy of data
The accuracy of the assessed data for the installed power is about +/-10%.

Annex B

Country information
1) Electricity prices: 0,17 – 0,24 €/kWh + basic fee for households. As an average 0,19 €/kWh is adequate. For industrial supply, the prices are lower depending on consumption. The production cost of conventional power plants are in the range of 5 – 8 €ct/KWh
2) Typical household consumption: 4000 kW/yr.
3) Typical metering and tariff structure: The metering systems are installed in the household. The measurement takes place once a year and a payment in a one or two month period with an invoiced at the end of the year.
4) Average household income: 19.600 €/yr (net, 2005); 32.100 €/yr (gross, 2002).
5) Typical mortgage interest rate: around 5 %/yr
6) Voltage: 230 V / 380 V
7) Electricity Structure: There are parallel structure of large enterprises (i.e. E-on, RWE, Vattenfall), city owned companies and industrial producers for their own facilities. The grid belongs mostly to the producers.
8) Price of diesel fuel: 1,00 – 1,15 €/l.
9) Typical values for PV system of household: 1- 5 kWp.