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 Korea 2009

Prepared by

Kyung-Hoon Yoon
Photovoltaics Research Center
Korea Institute of Energy Research (KIER)
71-2, Jang-dong, Yuseong-gu, Daejeon, Korea
e-mail : y-kh@kier.re.kr

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Definitions, Symbols and Abbreviations

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

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

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/m^2, cell junction temperature of 25°C, AM 1,5 solar spectrum – (also see 'Rated power').

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) 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 'mini-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power 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 power system'.

Grid-connected distributed PV power system: System installed to provide power 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 demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. 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.

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 telecommunication systems in a remote area are excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, utilities etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is KRW, Korean Won.

PV support measures:

Enhanced feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility) at a rate per kWh somewhat higher than the retail electricity rates being paid by the customer
Capital subsidies	direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost
Green electricity schemes	allows customers to purchase green electricity based on renewable energy from the electricity utility, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility (often the electricity retailer) source a portion of their electricity supplies from renewable energies (usually characterized by a broad, least-cost approach favouring hydro, wind and biomass)

PV requirement in RPS	a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside)
Investment funds for PV	share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends
Income tax credits	allows some or all expenses associated with PV installation to be deducted from taxable income streams
Net metering	in effect the system owner receives retail value for any excess electricity fed into the grid, as recorded by a bi-directional electricity meter and netted over the billing period
Net billing	the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity fed into the grid is valued at a given price
Commercial bank activities	includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems
Electricity utility activities	includes 'green power' schemes allowing customers to purchase green electricity, large-scale utility PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models
Sustainable building requirements	includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development

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 (AUS), Austria (AUT), Canada (CAN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia, Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey, 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 Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org

Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems. An important deliverable of Task 1 is the annual Trends in photovoltaic applications report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the Korean National Survey Report for the year 2009. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

1 EXECUTIVE SUMMARY

Korea has been making a strong effort to increase the renewable energy portion of “national energy mix”. The goal was newly announced in 2008. Korea’s renewable energy is targeting to take 4,3% of the total energy consumption by 2015. Currently the renewable energy is estimated to account for about 2,4% of total primary energy consumption. The special feature in Korean PV applications during 2009 was a deep fall in the installation capacity, compared to the year of 2008. In 2009, the Korean PV programme has strongly supported the R&D investment. PV has been considered as one of the key sector of the government’s long-term vision in favour of “Low-Carbon Green Growth”.

1.1 Installed PV power

The cumulative installed power of PV system in Korea increased to 441,9 MW by the end of 2009. Annual installed power in 2009 has reached 84,4 MW, which is less than one third of the installation capacity of 276,3 MW in 2008. The share of grid-connected centralized system is 77,6% of the total cumulative installed power, and the grid-connected distributed system accounts for 21,1% of the total cumulative installed power. On the other hand the share of off-grid non-domestic and domestic system has continued to decrease to about 1,3% of total cumulative installed power. In reality there was nearly no further installation of the off-grid systems since 2007.

1.2 Costs & prices

The average PV module price of 2 600 KRW/W in 2009 was 20% off compared to that in the previous year. According to the type of the installed PV system, the price of grid-connected systems varied from 5 850 KRW/W to 7 920 KRW/W. The price of the 3 kW rooftop system was 5 850 KRW/W in 2009, which is 12% lower than 6 662 KRW/W in 2008.

1.3 PV production

In 2009, the PV production took shaped from raw materials to all system components with a focus on upstream sectors. One company produced 9 900 tons of polycrystalline silicon feedstock with an annual capacity of 16 500 ton, and nine companies were involved in the silicon ingot and wafer production. For solar cells, six companies produced 217 MW crystalline silicon solar cells with a total annual capacity of 695 MW. Eleven companies produced about 365 MW of crystalline silicon PV module with total annual production capability of 930 MW. In addition, two companies produced 14 MW of a-Si thin film PV modules. The production capacity was 45 MW.

1.4 Budgets for PV

In 2009 the total budget for PV was 401 469 million KRW which is 47% more than that of 272 369 million KRW in 2008. The budget for R&D in 2009 was 70 369 million KRW, and the budget for market incentives was 330 830 million KRW respectively. These budgets were increased by 20% and 54% compared to 2008.

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.

For the purposes of this report, PV installations are included in the 2009 statistics if the PV modules were installed between 1 January and 31 December 2009, although commissioning may have taken place at a later date.

2.1 Applications for photovoltaics

The year 2009 showed a deep fall in the installation capacity, compared to the year 2008. This was due to the much decreased annual cap of feed-in-tariff scheme. In 2009, a total of 84,4 MW was installed, among them 54,5% being larger than 100 kW, the 45,6% is smaller than 100 kW. As of end 2009, the grid-connected centralized system accounted for 77,6% of the total cumulative installed power. The grid-connected distributed system amounted to 21,1% of the total cumulative installed power. These systems are mainly installed under the feed-in-tariff scheme and the 100 000 roof-top program. On the other hand the share of off-grid non-domestic and domestic system has continued to decrease to about 1,3% of total cumulative installed power. In reality there was nearly no further installation of the off-grid systems since 2007.

2.2 Total photovoltaic power installed

Table 1 shows the PV power installed in 4 sub-markets during 2009. All the data related to PV installation was provided by the KNREC (Korea New and Renewable Energy Center), the affiliate of the KEMCO (Korea Energy Management Corporation). The individual or the power producers who want to benefit from the government-supported PV demonstration or deployment programme should go through the KNREC.

Table 1: PV power installed during calendar year 2009 in 4 sub-markets.

Sub-market/ application	off-grid domestic	off-grid non-domestic	grid-connected distributed	grid-connected centralized	Total
PV power installed in 2009 (MW)			38,45	45,95	84,4

A summary of the cumulative installed PV Power, from 1992-2009, broken down into four sub-markets is shown in Table 2.

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

	Cumulative installed capacity as at 31 December							
Sub-market	1993	1994	1995	1996	1997	1998	1999	2000
Stand-alone domestic		175	219	256	296	306	316	528
Stand-alone non-domestic		1 506	1 550	1 757	2 046	2 410	2 855	3 076
Grid-connected distributed		0	0	100	133	266	288	356
Grid-connected centralised		0	0	0	0	0	0	0
TOTAL (kW)		1 681	1 769	2 113	2 475	2 982	3 459	3 960

Sub-market	2001	2002	2003	2004	2005	2006	2007	2008	2009
Stand-alone domestic	608	608	628	753	853	983	983	983	983
Stand-alone non-domestic	3 625	4 041	4 382	4 606	4 810	4 960	4 960	4 960	4 960
Grid-connected distributed	524	761	971	3 175	6 551	19 522	36 027	54 852	93 300
Grid-connected centralised	0	0	0	0	1 310	10 381	39 223	296 722	342 672
TOTAL (kW)	4 757	5 410	5 981	8 534	13 524	35 846	81 193	357 517	441 917

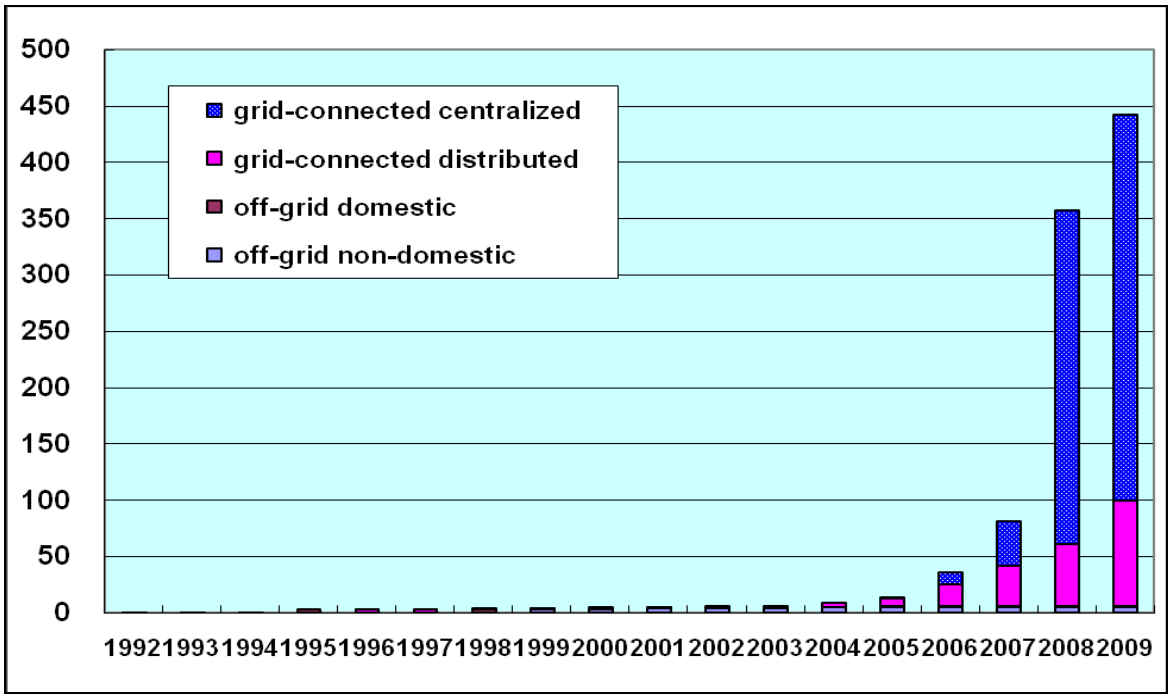

Figure 1 : The cumulative installed PV power in 4 sub-markets

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

The Ministry of Knowledge Economy (MKE) has been implementing, via the KNREC, various deployment initiatives and programs for PV systems. In 2008, the “Third Basic Plan on New and Renewable Energy Sources R&D, D” based on the “National Basic Energy Plan” was made public in order to enhance the level of self-sufficiency in energy supply, to meet the challenging of climate change and to consolidate infrastructure of NRE industry. The goal of NRE deployment is to achieve 4,3 % share of total primary energy supply by 2015. This goal of share is lower than the previously set goal of 5% by 2012. PV still remains as one of the prioritized area. This plan includes the construction of “One Million Green Home” and “200 Green Villages” until 2020. It was also planned that the RPS (Renewable Portfolio Standard) will replace the existing “Feed-in-Tariff” scheme from the year 2012. This plan aims at the grid parity until 2020.

- One Million Green Home Program: This program that merged the 100 000 rooftop PV systems aims at the construction of one million green home utilizing PV as well as solar thermal, fuel cells, wind, bio-energy and geothermal until 2020. In general single-family houses and multi-family houses including apartments can benefit from this program. The government provides 60% of initial PV system cost for single-family and private multi-family houses, and 100% for public multi-family rent houses. Until the end 2009, a total of 43,7 MW capacity and 38 535 households benefited from this program. In 2009, the number of households benefited was 14 895 and the installed capacity was 13.5 MW.
- Feed-in Tariff Program: Since October 2008, the FIT rate was much reduced as seen in the table. The cap was increased from 100 MW to 500 MW. The beneficiaries can choose the period to be 15 years or 20 years. If the new 500 MW cap is not reached in 2009, the fixed price applicable in 2010 will be announced later. Until 2009, a total of 350 MW was installed under this scheme. In 2009, 50 MW was installed and the annual spending in 2009 was 236 700 million KRW, which is two times higher than in 2008.

Feed-in-Tariff (Fixed Price (Won/kWh)

~ 30 Sep. 2008	Location	Period	< 30 kW	> 30 kW			
		15 years	711.25	677.38			
1 Oct. 2008 ~ 2009	-	Period	< 30 kW	30 kW ~ 200 kW	200 kW ~ 1 MW	1 MW ~ 3 MW	> 3 MW
		15 years	646.96	620.41	590.87	561.33	472. 70
		20 years	589.64	562.84	536.04	509.24	428.83
2010	Ground	15 years	566.96	541.42	510.77	485.23	408.62
		20 years	514.34	491.17	463.37	440.20	370.70
	Built Environ ment	15 years	606.64	579.32	546.52	-	-
		20 years	550.34	525.55	495.81	-	-

- Deployment Aid Program: The government supports 60% of installation cost for conventional PV systems with a capacity below 50 kW and 80% for special purpose demonstration and pre-planned systems by local authorities and public organization. Since 2008, this program merged the “General Deployment Program” and “Regional Deployment Program”. In 2009, 132 PV systems with a total of 6,0 MW were installed. Various grid-connected PV systems with a power capacity of 5 ~ 200 kW were installed in schools, public facilities, welfare facilities and universities.
- RPS Demonstration Program : Before starting the RPS from 2012, the Government initiated RPS demonstration program for three years from 2009 until 2011. The total capacity was fixed to be 101,3 MW. Six electricity companies construct their own PV plants or purchase PV electricity from private. In 2009, 12,5 MW was installed under this program.
- Public Building Obligation Program: New public buildings larger than 3 000 sq meter must spend 5% of total construction budget in installing renewable facility. As the government pursues for “New Administration-Oriented City Plan” and “Plan for Public Enterprise Relocation”, new public buildings are planned all over Korea and thus this program will contribute to the expansion of Korea PV market.

2.4 Highlights of R&D

The KETEP (Korea Energy Technology Evaluation and Planning) is playing a leading role in Korea’s PV R&D program since 2008. The R&D budget tripled in 2008 compared to the year 2007, and 20% increase in 2009. The government sets up a new R&D strategy. This new initiative is composed of four programs, namely, Strategic Technology Program; Breakthrough Technology; Core Technology; Demonstration & Planning Program. The key is industry-led strategic technology program. About 50~55% of the R&D budget is allocated to this program. The remaining 10% budget is for breakthrough technology, 25~30% for core technology and 10% for demonstration and R&D planning. Some of the big projects under the strategic technology program are as follows.

- Module manufacturing equipment for 150 mm solar cells : S-Energy
- Large-area a-si/c-Si heterojunction solar cells : Samsung Electronics
- Low-cost large-area Si thin film PV modules : LG Electronics
- Glass substrate CIGS thin film PV modules : LG Innotek
- Low-cost, high-efficiency c-Si solar cells and manufacturing equipment : SNT
- Manufacturing equipment for solar grade polysilicon : Silicon Value
- Highly reliable DSSC module manufacturing : Dongjin Semichem
- High-efficiency back-contact solar and module manufacturing : Hyundai H.I.

Only the breakthrough technology is led by the university or research institutes. The core technology projects are also led by private industry targeting earlier commercialization. These projects are focusing on developing manufacturing technologies for solar cells, ingot & wafer, BIPV modules and power conditioning systems including inverter.

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

In 2009 the total budget for PV was 401 469 million KRW which is 47% more than that of 272 369 million KRW in 2008. The budget for R&D in 2009 was 70 369 million KRW, and the budget for market incentives was 330 830 million KRW respectively. These budgets were increased by 20% and 54% compared to 2008.

The market incentives include the budget for FIT scheme and were offered to individuals and private companies that applied for the construction of PV systems through “one Million Green Home”, “Deployment Aid Program” etc. The government also provided low-interest loans every year for renewable energy production or PV system application facilities, which were not included in the budget figures.

Table 3: Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test	Market incentives
National/federal	70 639		330 830
State/regional			
Total (million KRW)	401 469		

3 INDUSTRY AND GROWTH

3.1 Production of feedstocks, ingots and wafers

As can be seen in Table 4 and 5, the PV production in 2009 took shaped from raw materials to all system components with a focus on upstream sectors. One company produced 9 900 tons of polycrystalline silicon feedstock with an annual capacity of 16 500 ton, and two news companies constructed production facilities and one company launched the construction of manufacturing facilities. Nine companies were involved in the silicon ingot and wafer production. More companies will join this sector in coming years

Table 4: Production and production capacity information for the year 2009 for silicon feedstock, ingot and wafer producers

Manufacturers	Process & technology	Total Production	Maximum production capacity in 2009	Product destination	Price
OCI	Polysilicon	9 900 ton	16 500 ton		N.A.
Woongin Energy	Ingots	380 MW	Ingot 400MW Wafer 30MW		N.A.
Rexor	Ingot/wafers	N.A.	Ingot 50MW Wafer 40MW		N.A.
Glosil	Ingot/wafer	N.A.	Ingot 30MW Wafer 20MW		N.A.
Neosemitech	Ingots/wafers	N.A.	Ingot 200MW Wafer 100MW		N.A.
NEXOLON	Ingots/wafers	N.A.	Ingot 320MW Wafer 230MW		N.A.
Osung LST	Ingots/wafers	N.A.	Ingot 40MW Wafer 40MW		N.A.
LG Siltron	Ingots/wafers	N.A	Ingot 30MW Wafer 30MW		N.A.
Elpion	Wafer	N.A.	Wafer 20MW		N.A
Semimaterials	Wafer	60MW	Wafer 100MW		N.A

3.2 Production of photovoltaic cells and modules

Total PV cell and module manufacturers together with production capacity information in **2009** is summarised in Table 5 below. In 2009, six companies produced 217 MW crystalline silicon solar cells with a total annual capacity of 695 MW. Eleven companies produced about 365 MW of crystalline silicon PV module with total annual production capability of 930 MW.

In addition, two companies produced 14 MW of a-Si thin film PV modules. The production capacity was 45 MW.

Table 5: Production and production capacity information for 2009 for each manufacturer

Cell/Module manufacturer	Technology (c-Si, a-Si, CdTe)	Total Production (MW)		Maximum production capacity (MW/yr)	
		Cell	Module	Cell	Module
Wafer-based PV manufacturers					
1 KPE	c-Si	23		90	
2 Hyundai Heavy Industry	c-Si	60	100	330	270
3 Millinet Solar	c-Si	60		90	
4 Shinsung Holdings.	c-Si	70		100	
5 Symphony Energy	c-Si		30		100
6 S-Energy	c-Si		43		100
7 Kyungdong Solar	c-Si		17		80
8 LS Industrial Systems	c-Si		20		30
9 SolarWorld Korea	c-Si		80		80
10 Solartech	c-Si		4		10
11 Samsung Elec.	c-Si		N.A	30	30
12 Seoul Marine	c-Si		4		50
13 Jes Solar	c-Si	2		30	
14 Bibong E&G	c-Si		N.A		25
15 STX Solar	c-Si	2		25	
16 Haesung Solar	c-Si		N.A		10
17 T&Solar	c-Si		6		50
18 Kyungwon	c-Si		10		40
19 Shinsung CS	c-Si		4		5
20 Luxco	c-Si		N.A		50
Total	c-Si	217	365	695	930
Thin film manufacturers					
1 Korea Iron & Steel	a-Si	10	10	20	20
2 Alti Solar	a-Si	4	*4*	25	25
Total	a-Si			45	45
TOTALS		**231**	**379**	**740**	**975**

3.3 Module prices

The average PV module price was 2 600 KRW/W in 2009, which is 20% off compared to that in the previous year as shown in Table 6.

Table 6: Typical module prices for a number of years

Year	1995	2003	2004	2005	2006	2007	2008	2009
Standard module price(s): Typical (Thousand KRW)	9,4	7,0	4,6	4,6	4,4	4,0	3,26	2,6
Best price (Thousand KRW)						3,9	3,02	2,4
PV module price for concentration								

3.4 Manufacturers and suppliers of other components

The Hex Power Systems is a leading company in grid-connected inverter business with an annual production capacity of 90 MW. Since 2006, several new companies such as Willings(55 MW/year capacity), Dathtech(15 MW/year capacity) and Hanyang Electric(2,5 MW/year capacity) have entered grid-connected inverter market.

3.5 System prices

Depending on the type of the installed PV system, the price of grid-connected systems varied from 5 850 KRW/W to 7 920 KRW/W. The price of the 3 kW rooftop system was 5 850 KRW/W in 2009, which is 12% lower than 6 662 KRW/W in 2008.

Table 7a shows the price trends of a typical 3 kW-capacity residential roof-top system.

Table 7: **Turnkey Prices of Typical Applications**

Category/Size	Typical applications and brief details	Current prices per W KRW/W
OFF-GRID Up to 1 kW		
OFF-GRID >1 kW		
ON-GRID Specific case	3 kW roof-mounted system	5 850
ON-GRID up to 10 kW	PV power plant, roof-mounted system	7 500
ON-GRID >10 kW	PV power plant, public building, multi-family apartment	7 920
GRID – CONNECTED (centralized, if relevant)		N.A.

Table 7a: National trends in system prices for 3 kW-capacity residential roof-top system

YEAR	1998	2002	2003	2004	2005	2006	2007	2008	2009
Price KRW/W:	18 000	14 300	13 700	12 000	9 800	8 550	8 400	6 662	5 850

3.6 Labour places

The labour places estimated are as follows.

a) Public research and development (not including private companies); 700

b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D; 4 100

c) All other, including within electricity companies, installation companies etc.; 1 700

Table 8: Estimated PV-related labour places in 2009

Research and development (not including companies)	700
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	5 600
Utilities and government	100
Other	100
Total	6 500

3.7 Business value

The value of PV business in Korea was estimated to be 2 205 382 million KRW. This value was calculated from the PV power installed to which PV products export was added.

Table 9: Value of PV business

Sub-market	**Capacity installed *in 2009* (kW)**	**Price per W** *(from table 7)*	**Value (Million KRW)**	**Totals (Million KRW)**
Off-grid domestic				
Off-grid non-domestic				
Grid-connected distributed	**38 450**	**5 850**	*224 932*	
Grid-connected centralized	**45 950**	**7 000**	*321 650*	
				546 582
Export of PV products *(including information from Tables 4 & 5)*				*1 658 800.*
Change in stocks held *(including information from Tables 4 & 5)*				*N.A.*
Import of PV products *(including information from Tables 4 & 5)*				*N.A.*
Value of PV business				***2 205 382***

4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 10 lists the main support measures for PV during 2009.

Renewable Portfolio Agreement (RPA) : Utility companies are asked to adopt renewable energy in their total power supply. The program is not mandatory as is the case with the renewable portfolio standard (RPS).

Table 10: PV support measures

	On-going measures	Measures that commenced during 2009
Enhanced feed-in tariffs	V	
Capital subsidies for equipment or total cost	V	
Green electricity schemes		
PV-specific green electricity schemes		
Renewable portfolio standards (RPS)		Demonstration
PV requirement in RPS		
Investment funds for PV	V	
Income tax credits		
Net metering		
Net billing		
Commercial bank activities e.g. green mortgages promoting PV		
Electricity utility activities		
Sustainable building requirements		

4.1 Indirect policy issues

Considering that the energy sector is responsible for the major part of the greenhouse gas emissions in Korea, it is inevitable to accelerate the use of clean energy. Therefore, these issues will undoubtedly have a great impact on the promotion of PV market in near future. In particular, the PV emerges as one of the key sector for government's long-term vision in favour of "Low-carbon Green growth".

4.2 Standards and codes

Korea has been adopting IEC TC 82 standards as Korean Standards under the responsibility of KATS(Korea Agency for Technology and Standards). The KATS and KNREC have been working together to prepare guidelines and regulations for massive dissemination of PV system.

The certification program for inverter and crystalline silicon PV module has been implemented since 2005. Under the IECEE scheme, the KNREC is designated as NCB(National Certification Body) and KTL(Korea Testing Laboratory) and KIER(Korea Institute fo Energy Research) are as CBTL(Certification Body Testing Laboratory) for inverters and crystalline PV modules. For the government-supported PV systems the use of certified products is obligatory.

5 HIGHLIGHTS AND PROSPECTS

During 2008, the annual installed capacity exceeded 276 MW which are nearly six times more than that installed in 2007. This big jump was mainly due to the construction of a tremendous number of large size PV plants under the feed-in-tariff scheme. In addition, the 100 000 roof-top programmes also played a certain role. In 2009, however, the annual installation was reduced to 84,4 MW due largely to much decreased annual cap of feed-in-tariff scheme.

It is expected that the Korean government will continue to support the PV R&D and dissemination programmes in order to promote the PV as one of Korea's new growth driving industry.

In accordance with global PV boom and the government's strong drive policy, many companies have already entered into the PV industry and more companies are preparing to enter into PV industry. The Korean PV community is expecting the concrete and massive investment of large companies, which especially have a good technological background in semiconductor and display industry.

ANNEX: COUNTRY INFORMATION

This information is simply to give the reader some background about the national environment in which PV is being deployed. It is not guaranteed to be 100 % accurate nor intended for analysis, and the reader should do their own research if they want more detailed data.

1) retail electricity prices (NC) - household, commercial, public institution

Household

Fixed rate per home		Electricity rate per kWh
less than 100kWh	370 KRW	55,10 KRW
101~200 kWh	820 KRW	113,80 KRW
201~300 kWh	1 430 KRW	168,30 KRW
301~400 kWh	3 420 KRW	248,60 KRW
401~500 kWh	6 410 KRW	366,40 KRW
More than 500kWh	11 750KRW	643,90 KRW

2) typical household electricity consumption (kWh) : about 300 kWh/month

3) typical metering arrangements and tariff structures for electricity customers (for example , interval metering? time-of-use tariff?) : one month-of-use tariff

4) typical household income (NC) : 41 Million KRW/ per year

5) typical mortgage interest rate : 6%/yr

6) voltage (household, typical electricity distribution network) : 220 Volt (household)

7) electricity industry structure and ownership : generation and transmission & distribution are separated. The generation part consists of several companies.

8) price of diesel fuel (NC) : 1 380 KRW per liter

9) typical values of kWh / kW for PV systems in parts of your country. : 1 105 (annually)