

**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  
2010**

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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<sup>2</sup>, 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 system 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, electricity utility businesses 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 business) 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 business, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price

Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility business (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
Activities of electricity utility businesses	includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) 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 22 participating countries are Australia (AUS), Austria (AUT), Canada (CAN), China (CHN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association, the US Solar Electric Power Association and the US Solar Energy Industries Association are also members.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, 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](http://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 Korea National Survey Report for the year 2010. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website [www.iea-pvps.org](http://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 aiming at obtaining 4,3% share of the total energy consumption by 2015. Currently the renewable energy is estimated to account for about 2,5% of total primary energy consumption. Since the record annual installation capacity of 276 MW in 2008, the PV market in Korea continues to decrease, installing about 131 MW in 2010. Nonetheless, the Korean government continued to support strongly the PV R&D and market promotion. With the involvement of many large companies and the support from the government, the Korean PV industry becomes characterized by an export-oriented industry.

### **1.1 Installed PV power**

The cumulative installed power of PV system in Korea increased to 655 MW by the end of 2010. Annual installed power in 2010 has reached 131 MW, which is about 20% less than the installation capacity of 166,8 MW in 2009. The share of grid-connected centralized system is 79% of the total cumulative installed power, and the grid-connected distributed system accounts for 20% 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 0.9% of total cumulative installed power.

### **1.2 Costs & prices**

The average PV module price of 2 400 KRW/W in 2010 was about 8% 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 4 290 KRW/W to 5 060 KRW/W. The price of the 3 kW rooftop system was 5 060 KRW/W in 2010, which is 13% lower than 5 850 KRW/W in 2009.

### **1.3 PV production**

In 2010, the PV production took shaped from raw materials to all system components with a focus on upstream sectors. Three companies produced about 20 000 tons of polycrystalline silicon feedstock with an annual capacity of 36 200 tons, and nine companies were involved in the silicon ingot and wafer production. For solar cells, nine companies produced 770 MW crystalline silicon solar cells with a total annual capacity of 1 310 MW. Eighteen companies produced about 925 MW of crystalline silicon PV module with total annual production capability of 1 845 MW.

### **1.4 Budgets for PV**

In 2010 the total budget for PV was 517 543 million KRW which is 29% more than that of 401 469 million KRW in 2009. The budget for R&D(demonstration projects are included) in 2010 was 83 920 million KRW(12% more than 2009), and the budget for market incentives was 433 623 million KRW(31% more than 2009) respectively.

## 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 2010 statistics if the PV modules were installed between 1 January and 31 December 2010, although commissioning may have taken place at a later date.**

### 2.1 Applications for photovoltaics

Since the installation of 276 MW in 2008, the PV installation continues to decrease, installing about 131 MW in 2010. This is mainly due to the limited FIT scheme. As of end 2010, the total installed capacity is about 655 MW, among them the grid-connected centralized system accounted for 79% of the total cumulative installed power. The grid-connected distributed system amounted to 20% of the total cumulative installed power. These systems are mainly installed under the FIT program and the One Million Green Home program. On the other hand the share of off-grid non-domestic and domestic system has continued to decrease to about 0.9% of total cumulative installed power.

The total capacity of 655 MW corresponds to 0,82 % of total electricity generation capacity of about 80,4 GW, and the installed PV power of 131 MW in 2010 accounts for 4,79% of total power generation capacity newly installed in 2010, as can be seen in Table 1a.

### 2.2 Total photovoltaic power installed

Table 1 shows the PV power installed in 4 sub-markets during 2010.

**Table 1: PV power installed during calendar year 2010 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 2010 (kW)			52 300	78 900	131 200

**Table 1a: PV power and the broader national electricity market.**

Total national (or regional) PV <u>capacity</u> (from Table 2) as a % of total national electricity generation capacity	<u>New</u> (2010) PV capacity (from Table 1) as a % of new electricity generation capacity	Total PV <u>electricity</u> production as a % of total electricity consumption
0,82%	4,79%	0,15%

A summary of the cumulative installed PV Power, from 1992-2010, 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	1994	1995	1996	1997	1998	1999	2000	2001
Stand-alone domestic	175	219	256	296	306	316	528	608
Stand-alone non-domestic	1 506	1 550	1 757	2 046	2 410	2 855	3 076	3 625
Grid-connected distributed	0	0	100	133	266	288	356	524
Grid-connected centralised	0	0	0	0	0	0	0	0
TOTAL (kW)	1 681	1 769	2 113	2 475	2 982	3 459	3 960	4 757

	Cumulative installed capacity as at 31 December								
Sub-market	2002	2003	2004	2005	2006	2007	2008	2009	2010
Stand-alone domestic	608	628	753	853	983	983	983	983	983
Stand-alone non-domestic	4 041	4 382	4 606	4 810	4 960	4 960	4 960	4 960	4 960
Grid-connected distributed	761	971	3 175	6 551	19 522	36 027	54 852	79 033	131 333
Grid-connected centralised	0	0	0	1 310	10 381	39 223	296 722	439 379	518 279
TOTAL (kW)	5 410	5 981	8 534	13 524	35 846	81 193	357 517	524 355	655 555

### 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 2010, about 68 MW capacity and about 65 000 households benefited from this program. In 2010, the number of households benefited was 26 360 and the installed capacity was about 24 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. Until 2010, a total of 500 MW was installed under this scheme. In 2009 and 2010, 139 MW and 61 MW were installed, respectively. FITs in 2010 and 2011 were reduced by 10 to 15% compared with the previous year. For BIPV 10 % bonus is given. A BIPV system larger than 1 MW is accounted as a ground installed system.

#### 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 Environment	15 years	606.64	579.32	546.52	-	-
		20 years	550.34	525.55	495.81	-	-
2011	Ground	15 years	484.52	462.69	436.50	414.68	349.20
		20 years	439.56	419.76	396.00	376.20	316.80
	Built Environment	15 years	532.97	508.96	480.15	-	-
		20 years	483.52	461.74	435.60	-	-

- **General Deployment Subsidy Program:** The government supports 50% of installation cost for PV systems with a capacity below 50 kW. In addition, the government supports 80% of initial cost for special purpose demonstration and pre-planned systems in order to help the developed technologies and systems to advance into the market. This is the “Test-period deployment subsidy program”. In 2010, 41 PV systems with a total of 0,6 MW were installed. Various grid-connected PV systems were installed in schools, public facilities, welfare facilities and universities.

- Regional Deployment Subsidy Program: The government supports 50% of installation cost for PV systems owned and operated by local authorities.
- 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 2010, 17,9 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. In 2010, approximately 12 MW was installed under this program.

## **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 showed 20% increase in 2009 and another 12% increase in 2010.

In 2010, the 25 new and 59 continuous projects have been initiated under the five R&D sub-program categorized into "Strategic R&D", "Basic & Innovative R&D", "Core Technologies Development", "Demonstration" and "International Joint Research". The R&D budget for 25 new projects amounts to 27,5 billion KRW. The representative "Strategic R&D" projects funded newly in 2010 is "Development of commercialization technologies of high efficiency c-Si solar cells and modules with ultra-low cost".

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

In 2010 the total budget for PV was 517 543 million KRW which is 29% more than that of 401 469 million KRW in 2009. The budget for R&D(demonstration projects are included) in 2010 was 83 920 million KRW(12% more than 2009), and the budget for market incentives was 433 623 million KRW(31% more than 2009) respectively.

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.**

	<b>R &amp; D</b>	<b>Demo/Field test</b>	<b>Market incentives</b>
National/federal	83 920		393 816
State/regional			39 807
Subtotal (Million KRW)	83 920		433 623
Total (Million KRW)	517 543		

### 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 2010 took shaped from raw materials to all system components with a focus on upstream sectors. OCI has expanded their annual production capacity of poly-silicon feedstock up to 27 000 ton in 2010. Two news companies have started their production of poly-silicon feedstock in 2010. The production capacity and the total production of feedstocks in 2010 were about 36 200 ton and 20 000 ton, respectively. Nine companies were involved in the silicon ingot and wafer production. The production capacity of ingot and wafer in 2010 were 1 740 and 1 270 MW, respectively. The wafer production was about 800 MW in 2010. More companies will join this sector in coming years.

**Table 4: Production information for the year for silicon feedstock, ingot and wafer producers**

Manufacturers (or total national production)	Process & technology	Total Production	Production capacity	Product destination	Price (if known)
OCI	Silicon feedstock	20 000 ton	27 000 ton		N.A.
HK Silicon	Silicon feedstock		3 200 ton		N.A.
KCC(KAM)	Silicon feedstock		6 000 ton		N.A.
subtotal		20 000 ton	36 200 ton		
Glosil	Ingot / wafers (MW)	~/800 MW	100 / 30		N.A.
Elpion	Ingot / wafers (MW)		- / 20		N.A.
LG Siltron	Ingot / wafers (MW)		50 / 50		N.A.
Neosemitech	Ingot / wafers (MW)		200 / 100		N.A.
Woongjin Energy	Ingot / wafers (MW)		530 / 140		N.A.
Nexolon	Ingot / wafers (MW)		600 / 600		N.A.
OSung LST	Ingot / wafers (MW)		100 / 250		N.A.
Lexor	Ingot / wafers (MW)		100 / 80		N.A.
SK Solmics	Ingot / wafers (MW)		60 / -		N.A.

subtotal	?/800 MW	1 740/1 270		
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### 3.2 Production of photovoltaic cells and modules

Total PV cell and module manufacturers together with production capacity information in 2010 is summarised in Table 5. In 2010, nine companies produced 770 MW crystalline silicon solar cells with a total capacity of 1 310 MW. Eighteen companies produced about 925 MW of crystalline silicon PV module with a total production capability of 1 845 MW. Two amorphous silicon thin film module manufacturers with a total capacity of 45 MW stopped temporarily their production in 2010.

**Table 5: Production and production capacity information for 2010**

Cell/Module manufacturer (or total national production)	Technology (sc-Si, mc-Si, a-Si, CdTe)	Total Production (MW)		Maximum production capacity (MW/yr)	
		Cell	Module	Cell	Module
<i>Wafer-based PV manufactures</i>					
<b>1 Hyundai Heavy Ind.</b>	sc-Si mc-Si	770	925	400	400
<b>2 LG Electronics</b>				120	120
<b>3 Shinsung Solar Energy</b>				250	-
<b>4 Millinet Solar</b>				200	-
<b>5 KPE</b>				90	-
<b>6 Samsung Electronics</b>				30	30
<b>7 Hanwha Chemical</b>				30	-
<b>8 STX Solar</b>				60	-
<b>9 JES Solar</b>				30	-
<b>10 S-Energy</b>				200	
<b>11 Solar World Korea</b>				200	
<b>12 Symphony Energy</b>				140	
<b>13 KD Solar</b>				100	
<b>14 T &amp; Solar</b>				50	
<b>15 Seoul Marrine (SDN)</b>				200	
<b>16 Kyungwon</b>				50	
<b>17 Bibong E &amp; G</b>				25	
<b>18 Shinsung CS</b>				10	
<b>19 Haesung Solar</b>				10	
<b>20 LS IS</b>				50	

<b>21 EOS Solar</b>					15
<b>22 Topsun</b>					100
<b>23 luxco</b>					70
<b>24 GNR</b>					30
Total		770	925	1 310	1 845
<i>Thin film manufacturers</i>					
<b>1 Altı Solar</b>	a-Si			25	25
<b>2 Korea Iron &amp; Steel</b>	a-Si			20	20
<b>total</b>		0	0	45	45
<i>Cells for concentration</i>					
<b>1</b>		0	0	0	0
<b>TOTALS</b>		<b>770</b>	<b>925</b>	<b>1 355</b>	<b>1 890</b>

### 3.3 Module prices

The average PV module price was 2 200 KRW/W in 2010, which is 8% off compared to that in the previous year as shown in Table 6.

**Table 6: Typical module prices for a number of years**

Year	2003	2004	2005	2006	2007	2008	2009	2010
Standard module price(s): Typical (KRW/W)	7 000	4 600	4 600	4 400	4 000	3 260	2 600	2 400
Best price (KRW/W)					3 900	3 020	2 400	2 000
PV module price for concentration (if relevant)								

### 3.4 Manufacturers and suppliers of other components

In 2010, seven companies such as Hex Power Systems, Hyundai Heavy Ind., Willings, Dathtech, Hanyang Electric, LS IS, Hyosung and Sungho were involved in inverter production.

### 3.4 System prices

Depending on the type of the installed PV system, the price of grid-connected systems varied from 4 290 KRW/W to 5 060 KRW/W. The price of the 3 kW rooftop system was 5 060 KRW/W in 2010, which is 13% lower than 5 850 KRW/W in 2009.

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
OFF-GRID Up to 1 kW		
OFF-GRID >1 kW		
ON-GRID Specific case	For example: 1-5 kW roof-mounted system, if relevant	
ON-GRID up to 10 kW	3kW for roof-mounted system	5 060 KRW
ON-GRID >10 kW	30kW field-mounted system	4 290 KRW
GRID – CONNECTED (centralized, if relevant)		

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

YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
Price KRW/W:	14 300	13 700	12 000	9 800	8 550	8 400	6 662	5 850	5 060

### 3.5 Labour places

Provide an estimate of labour places in the following (where these are mainly involved with PV):

- a) Public research and development (not including private companies); 800
- b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D; 9 300
- c) All other, including within electricity companies, installation companies etc.; 1 200

**Table 8: Estimated PV-related labour places in 2010**

Research and development (not including companies)	800
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	10 200
Distributors of PV products	
System and installation companies	
Electricity utility businesses and government	200

Other	100
<b>Total</b>	<b>11 300</b>

### 3.6 Business value

The value of PV business in Korea was estimated to be 4 675 000 million KRW. This value was calculated from the PV power installed to which PV products export was added. The value of export in 2010 represents 87% of PV business value, this value of export accounted for 75% in 2009. The export of PV products started to increase remarkably since 2008.

**Table 9: Value of PV business**

<b>Sub-market</b>	<b>Capacity installed in 2010 (kW)</b>	<b>Price per W (KRW)</b> <i>(from table 7)</i>	<b>Value (Million KRW)</b>	<b>Totals</b>
<b>Off-grid domestic</b>				
<b>Off-grid non-domestic</b>				
<b>Grid-connected distributed</b>	52 300	5 060	<i>264 638</i>	
<b>Grid-connected centralized</b>	78 900	4 290	<i>338 481</i>	
				<i>603 119</i>
<b>Export of PV products</b> <i>(including information from Tables 4 &amp; 5)</i>				<i>4 071 800</i>
<b>Change in stocks held</b> <i>(including information from Tables 4 &amp; 5)</i>				<i>N.A.</i>
<b>Import of PV products</b> <i>(including information from Tables 4 &amp; 5)</i>				<i>N.A.</i>
<i>Value of PV business (Million KRW)</i>				<b><i>4 674 919</i></b>

#### 4 FRAMEWORK FOR DEPLOYMENT (NON-TECHNICAL FACTORS)

Table 1 lists the main support measures for PV during 2010.

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 2010
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		

If relevant, please provide a brief description of **one** interesting PV financing scheme currently operating in your country in Table 10a.

**Table 10a: PV financing scheme**

PV financing scheme

#### 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". In addition PV was designated as one of the most important new growth driving industry.

#### 4.2 Interest from electricity utility businesses

Six Korean electricity generation companies have signed the 'RPA(Renewable Portfolio Agreement)' with the Government in order to increase the share of renewable energy electricity generation. From the year 2012, the RPS(Renewable Portfolio Standard) will replace the FIT scheme applicable until 2011. Before launching the RPS, the Government has been implementing 'RPS Demonstration' from 2009 until 2011 in order to further increase the PV market size and to prepare for the related regulation to RPS. Total thirteen companies including 6 electricity generation companies, electricity generation business companies and two other corporates are planned to participate at RPS.

For PV, obligatorily allocated capacity is 1,2 GW for five years covering 2012~2016.

YEAR	2012	2013	2014	2015	2016
Capacity (MW)	200	220	240	260	280

#### 4.3 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 of 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

Since the record annual installation capacity of 276 MW in 2008, the PV market in Korea continues to decrease, installing about 131 MW in 2010. In comparison the Korean government's expenditure on PV continues to grow, particularly on PV R&D and market promotion. From the year 2012 when the RPS implementation will be launched, the PV market will be at least larger than 200 MW size

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 export of PV products started to increase remarkably since 2008. 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.

In October 2010, the Korean government announced a renewable energy industry development plan to invest 40 trillion KRW by 2015 into boosting its competitiveness in renewable energy, aiming to join the world's top five countries in the sector. Under the plan, the government will work together with the private sector to invest 20 trillion KRW in solar power, 10 trillion KRW in wind power, 900 billion KRW in fuel cells and another 900 billion KRW in the bio sectors. The Ministry of Knowledge Economy(MKE) projected that such investment will be able to create 110,000 jobs while elevating the country's exports of renewable energy to around \$36.2 billion. It intends to obtain 15 % of the global PV market share by 2015. The investment is part of the Korea government's "green growth" strategy aimed at turning environmental technologies into the main drivers of economic growth and new sources of jobs. The Korea government wants to nurture PV industries as the 'next semiconductor' industries and make them the backbones of the future national economy.

## Annex A: 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 (low voltage less than 3 kW)

Fixed rate per home		Electricity rate per kWh
less than 100kWh	380 KRW	56,20 KRW
101~200 kWh	840 KRW	116,10 KRW
201~300 kWh	1 460 KRW	171,60 KRW
301~400 kWh	3 490 KRW	253,60 KRW
401~500 kWh	6 540 KRW	373,70 KRW
More than 500kWh	11 990KRW	656,20 KRW

#### Commercial A (contracted power less than 1 000 kW)

		Basic rate per kW (KRW/kW)	Electricity rate per kWh (KRW/kWh)		
			Summer 7~8	Spring Autumn 3~6, 9~10	Winter 11~2
Low Voltage		5 280	93,50	58,30	74,70
High Voltage A	Option I	5 790	98,10	61,20	77,60
	Option II	6 660	94,70	57,70	73,60
High	Option I	5 790	96,30	60,20	75,80

Voltage B	Option II	6 660	91,90	55,80	71,40
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Low, standard voltage : 110~380 V, High A : 3 300~66 000 V, High B > 154 000 V

- 2) typical household electricity consumption (kWh) : about 5 300 kWh/year
- 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) : 44 Million KRW per year
- 5) typical mortgage interest rate : 5,5%/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 six companies.
- 8) price of diesel fuel (NC) : 1 500 KRW per liter
- 9) typical values of kWh / kW for PV systems in parts of your country. : 1 105 (annually)