Current Status and Prospects of PV Power Generation in Korea

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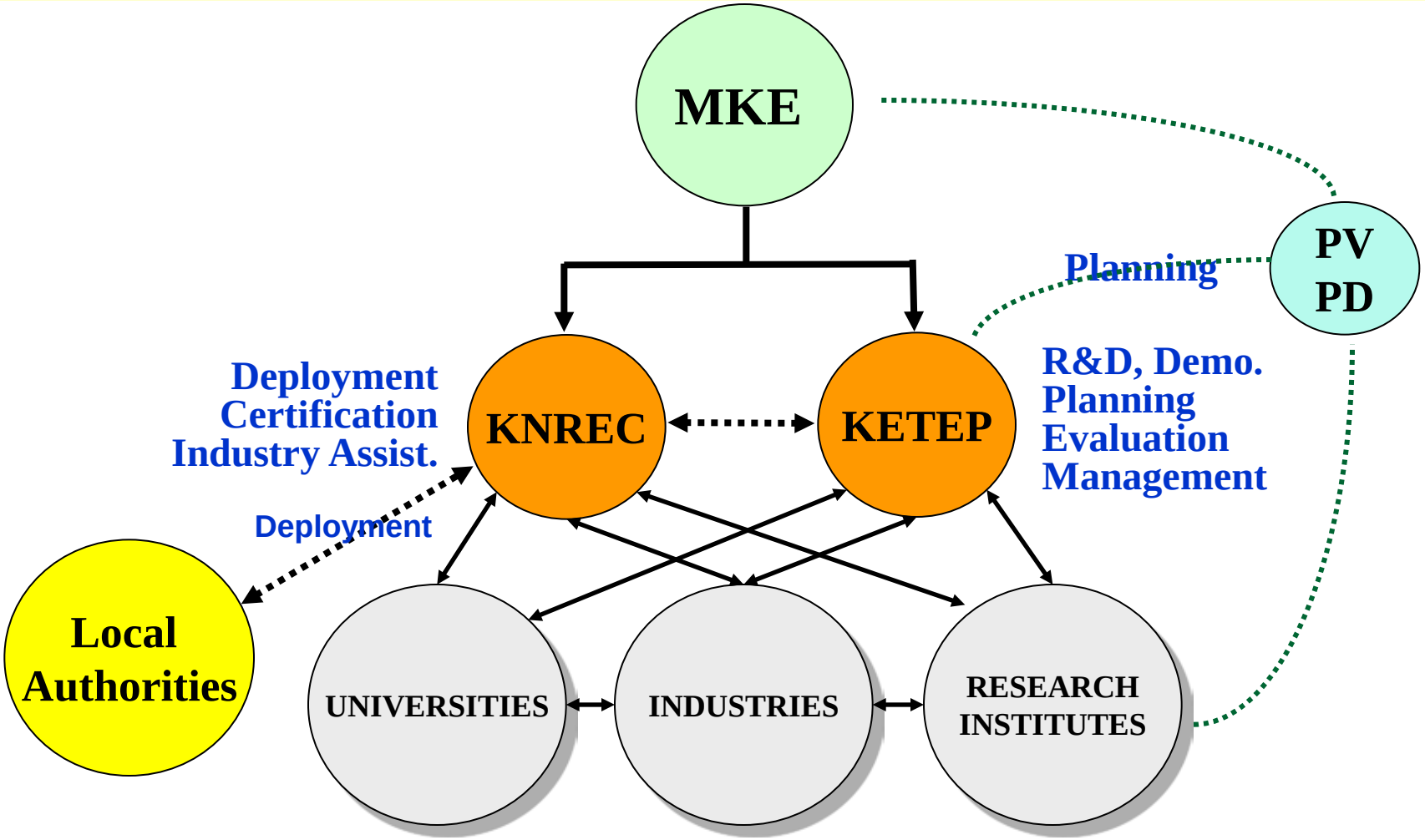
Energy Profile of Korea (2008)

- **Energy Consumption (240 M toe) 9th in the World**
- **Energy Imports : US$ 141.5 billion (Oil : US$ 85.8 billion)**
- **Dependency on Imports of Energy : 97% (as of 2007)**

Source : MOCIE, 2009, BP Statistics 2009

PV Policy - Implementing Structure



MKE	: Ministry of Knowledge Economy
KETEP	: Korea Energy Technology Evaluation & Planning
KNREC	: Korea New & Renewable Energy Center under KEMCO
KEMCO	: Korea Energy Management Corporation
PV PD	: PV Program Director

Target for NRES

Target share of NRES among Total Primary Energy Supply

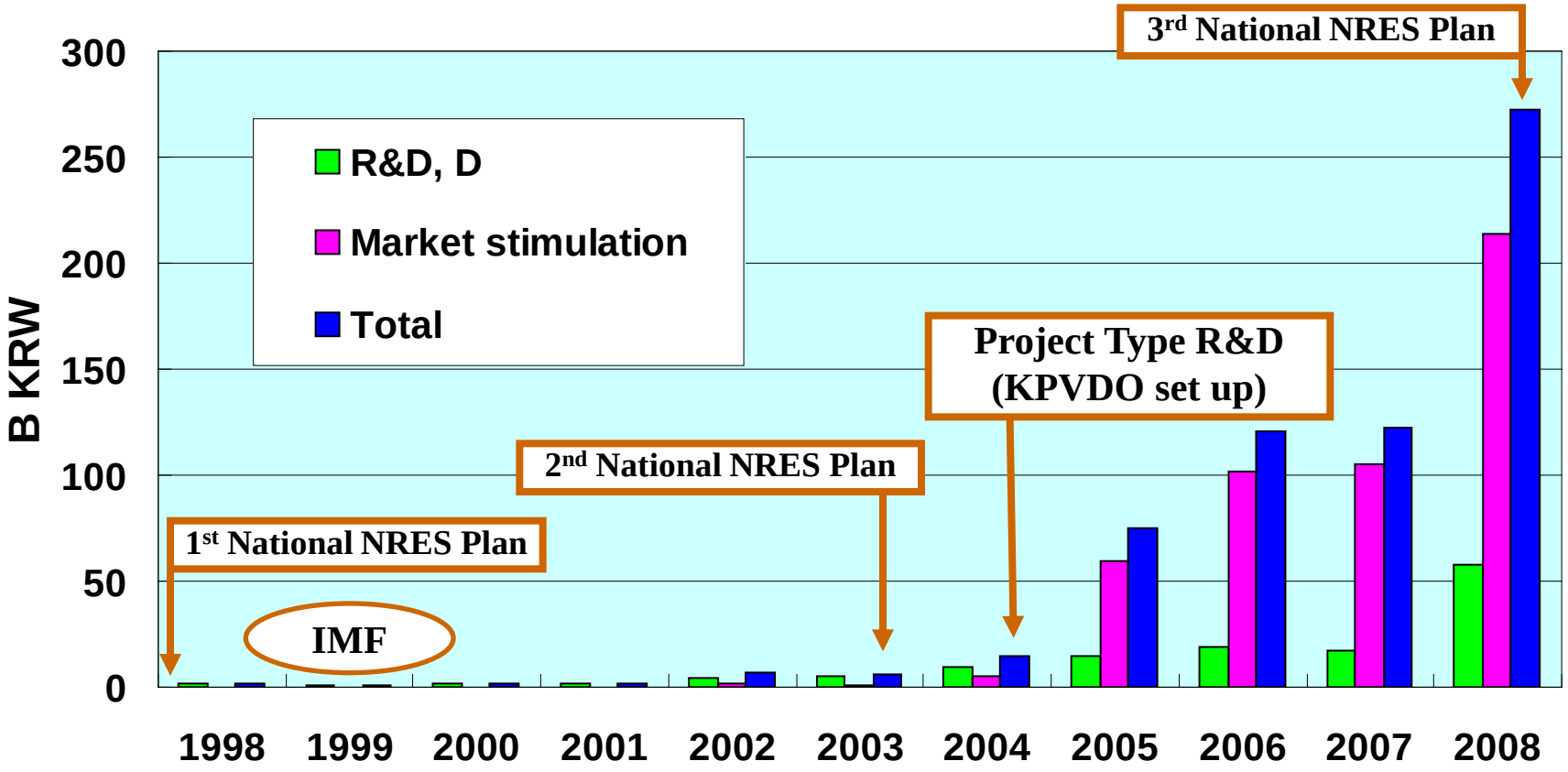
	2007	2015	2020	2030
NRES (BaU)	2.4 % (BaU)	4.3 % (3.6 %)	6.1 % (4.2 %)	11 % (5.7 %)
PV Share	0.9 %	2.7 %	3.2 %	4.1 %

Grid parity
- PV : 2015 for 1st, 2nd PV, 2020 for 3rd PV
- Wind : 2010 for 2 MW, 2016 for 5 MW
- Solar thermal power : 2012 for 10 kW dish

- Grid parity until 2020
- 1 million Green Home by PV, solar thermal, FC, wind, bio, geothermal (includes 100,000 PV roofs) until 2020
- 200 Green Villages until 2020
- RPS from 2012 (3 % in 2012, > 10 % in 2020) : share to be determined
- Investment fund for NRES
- NRES for public, commercial buildings and new town construction : from 5 % of construction to > 5% of total energy load

Source : National Basic Energy Plan, 3rd Basic Plan on NRES R&D and D, MKE, 2008

PV Budget



§ Big increase in budget since 2005 and jump in 2008

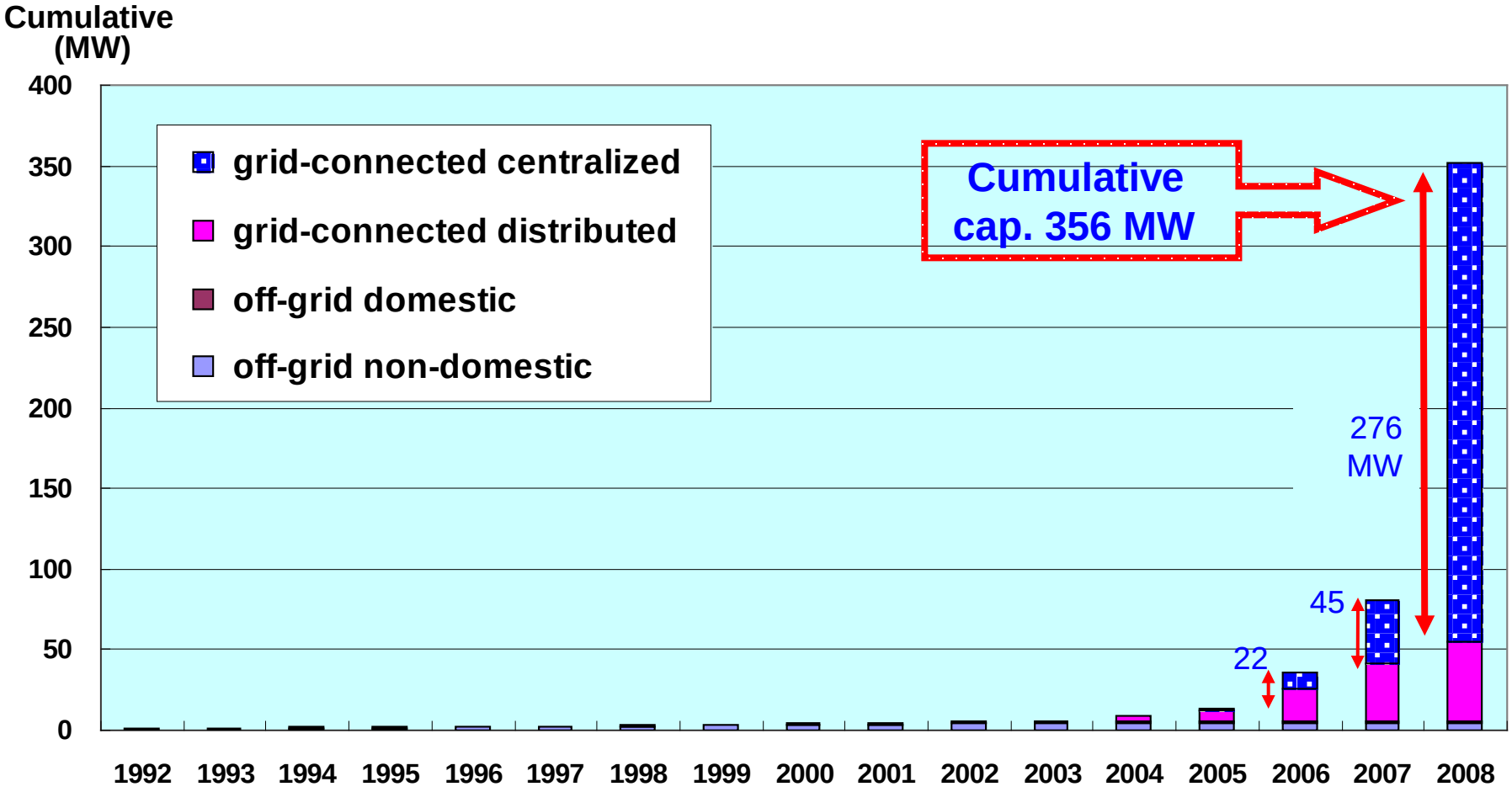
§ In 2008 : 272 B KRW

- R&D, D : 58 B KRW (3rd after USA, Germany)
- Market : 214 B KRW (FIT : 113 B KRW , 100,000 PV roofs : 48.9 B KRW

§ Cumulative R&D,D = 146.2 B KRW until 2008

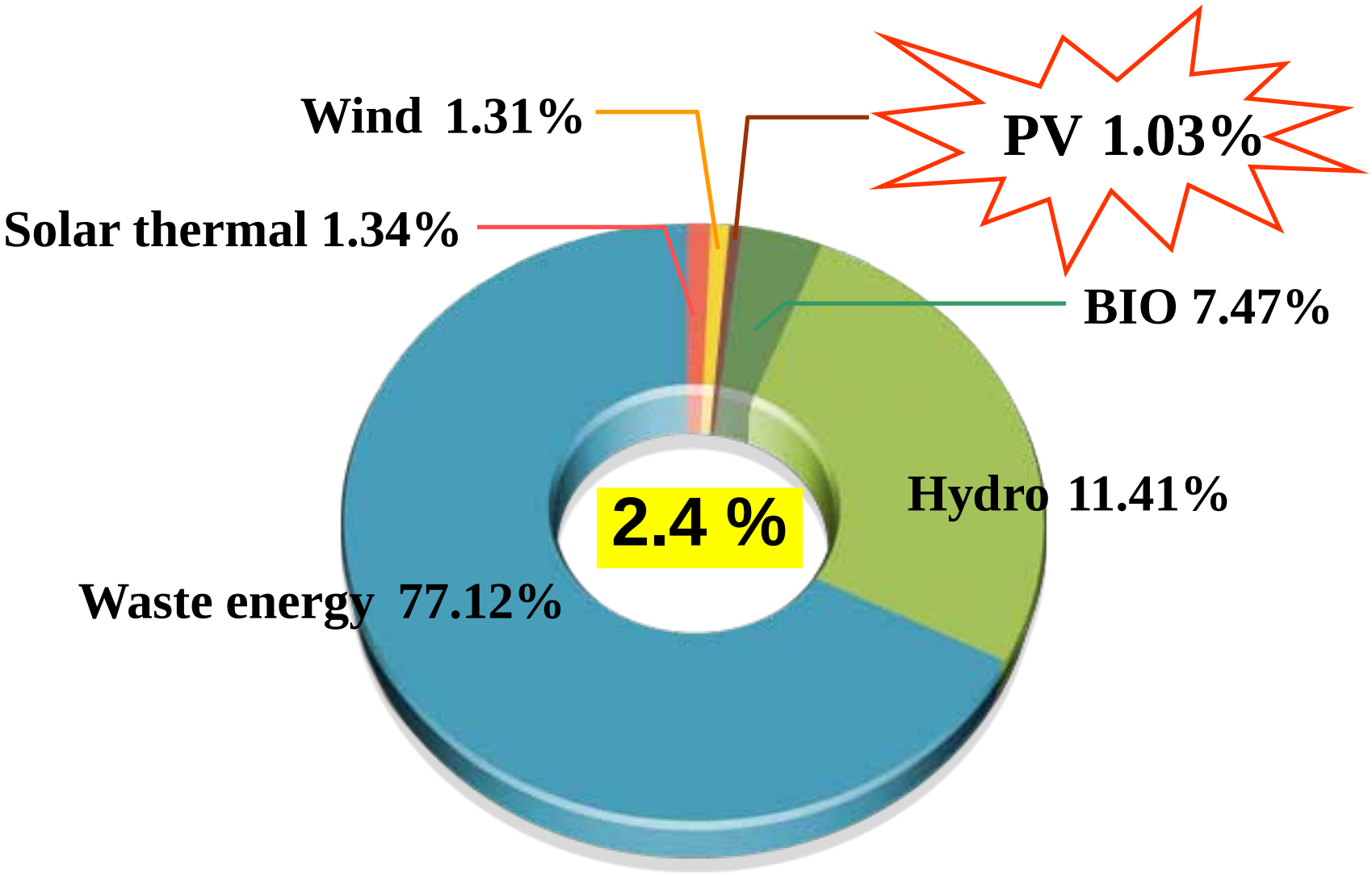
§ 2009 > 2008 for R&D and others

PV installed in Korea : Annual & Cumulative



	2009	2010	2011
Installation forecasted (MW)	98	132	162

New & Renewable Energy Supply (2008)



c-Si PV Cells Production

Wafer-based Cell

Cell Manufacturer	Technology	2008		2009		2010		2011		2012	
		Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)
1 KPE	sc-, mc-Si	25	36		96						
2 Hyundai Heavy Industry	sc-Si	20	30		330						
3 Millinet Solar	sc-Si	12.8	30		90						
4 Shinsung Holdings.	sc-Si	1.3	50		100		300				500
5 STX Solar	c-Si				50						300
6 Hanwha Chemical	c-Si				30						330
7 LG Electronics	c-Si						120		240		
8 Samsung Electronics	c-Si				30						
Total		59.1	146		726		1 146		1 386		2 516

Production cap.

= 146 MW in 2008

> 700 MW in 2009

> 1 GW in 2010

c-Si PV Module Production

Wafer-based module

Cell Manufacturer	Tech.	2008		2009		2010		2011		2012	
		Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)
1 Hyundai Heavy Industry	sc-Si	25	70		190						
2 Symphony Energy		30	100		150						
3 S-Energy		30	80		100						
4 Kyungdong Solar		12	20		60						
5 LS Industrial Systems		5	10		50						
6 Unison		2.5	10		10						
7 Solar Tech		1.6	10		20						
8 Solar World korea					150						
9 Dongyang Creditech					20						
10 Seoul Marine					100						
11 Solal River					10						
12 Kyungwon					30						
13 Shinsung CS					10						
Total		106	300		900						

Production cap.
= 300 MW in 2008
> 900 MW in 2009

Thin Film Module Production

Thin film module

Cell Manufacturer	Tech.	2008		2009		2010		2011		2012	
		Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)	Prod. (MW)	Cap. (MW)
1 Korea Iron & Steel	a-Si	8.3	20		20						
2 Alti Solar	a-Si				25						
Total		8.3	20		45						

Production cap.
= 20 MW in 2008
> 45 MW in 2009

PV Industry

- **Feedstock : 1 (OCI) + 3 planned**

- **Ingot & Wafer : 8 (Woongjin Energy, Nexolon, etc.)**

- **Materials**
  - **Silane : Sodiff Adv. Mtls**
  - **EVA, backsheet, electrodes**

- **PCS > 5 (Hex Power etc.)**

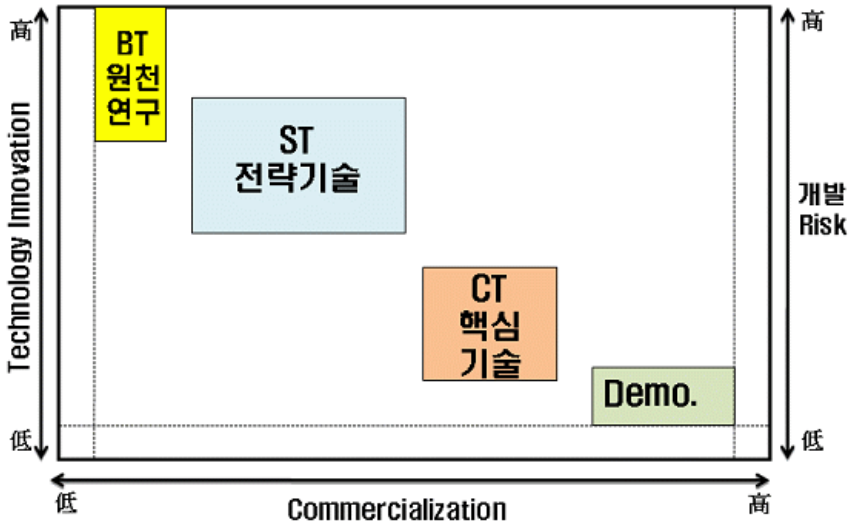
- **Installer > many hundreds**

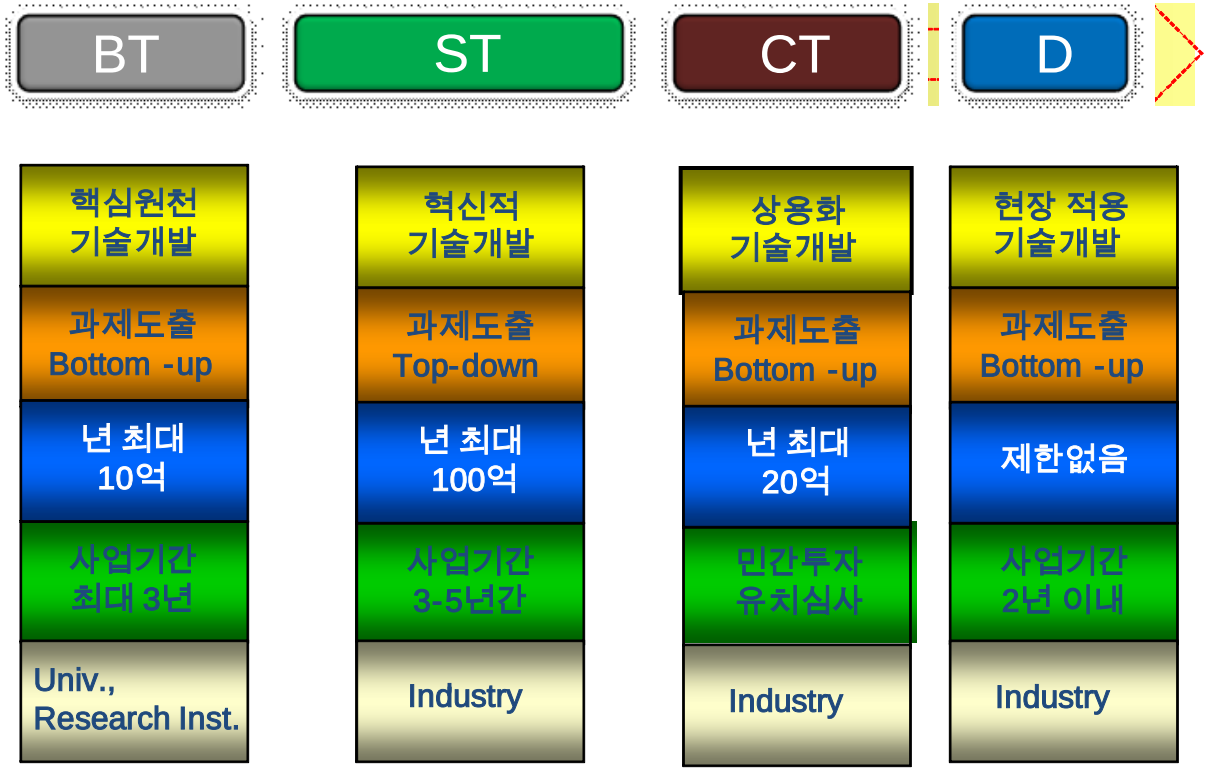
- **Manufacturing equipments > 10 (Jusung Eng. Etc.)**

R&D, D Program Portfolio

Breakthrough Technology	10 %
Strategic Technology	50~55 %
Core Technology	25~30 %
Demonstration	10 %

(R&D Planning)





Industrialization

Materials Components

Systems Equipments

R&D Projects

Strategic Technology Program (8 projects)

- 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 Micron
- 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.

Breakthrough Technology (20 projects)

- Si feedstock & cell : 4
- Si thin film : 3
- CIGS & CdTe : 3
- Polymer : 6
- TCO, III-V, System

Core Technology (16 projects)

- Materials, Ingot, TCO
- Si thin film, CIGS, III-V
- DSSC
- Inverter

University Research Center for PV

Mission : To develop breakthrough technologies which can be extended to strategic technology projects

In 2009, three Universities :

Ø High-Efficiency Crystalline Si : Korea Univ.

Ø Compound Semiconductor : Sungkyunkwan Univ.

Ø Next-Generation Thin Film : Hanyang Univ

PV Deployment Measures

- Feed-in-Tariff (FIT)
- 1 Million Green Home Program

  (merged 100,000 PV Roof Program)
- Deployment Aid Program
- Public Building Program
- Loan
- Others

Feed-in-Tariff (FIT)

- Since Oct. 2006

- Current PV Cap : 500 MW (Wind : 1 000 MW, FC : 50 MW)
  Among the 500 MW cap, 300 MW was completed by the 2008
  remaining 200 MW was distributed for three years
  - 50 MW for 2009, 70 MW for 2010, 80 MW for 2011
  (public organizations will no more benefit FIT from now)

- Current FIT applicable since Oct. 2008 (30% less than previous)
  - beneficiaries choose period to be 15 years or 20 years

- New FIT for 2010 was announced very recently
  - FIT in 2010 is about 13.6 % less than in 2009
  - Bonus 7 % for BIPV

- In 2012, RPS will replace FIT.

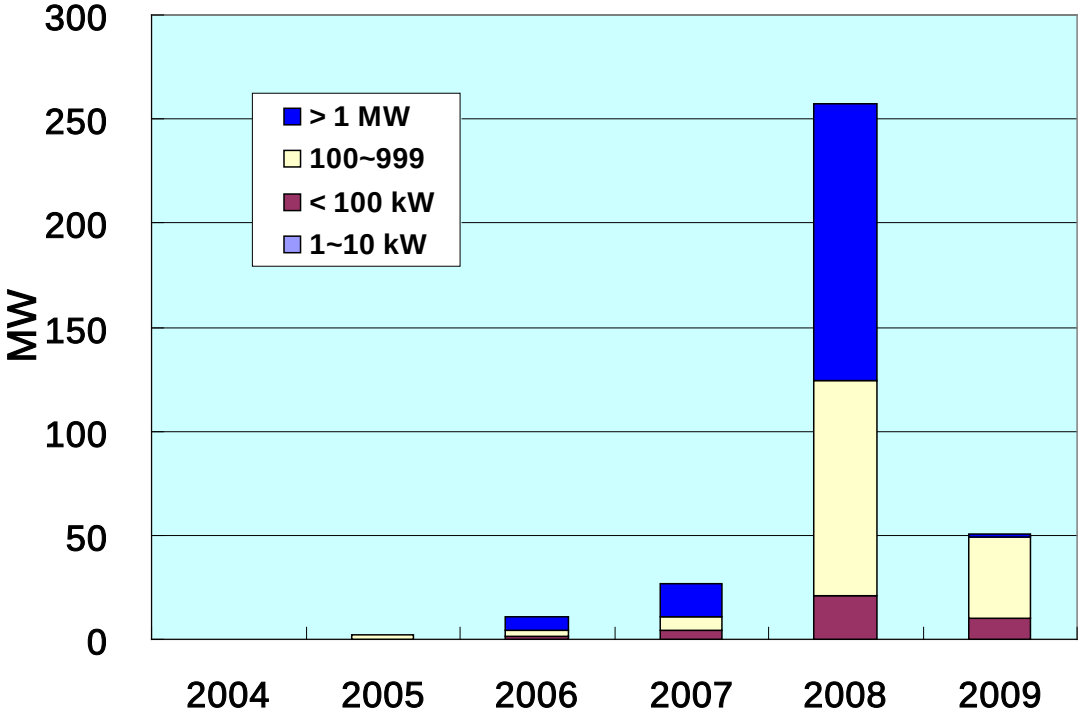
Feed-in-Tariff (FIT)

Fixed Price (Won/kWh)

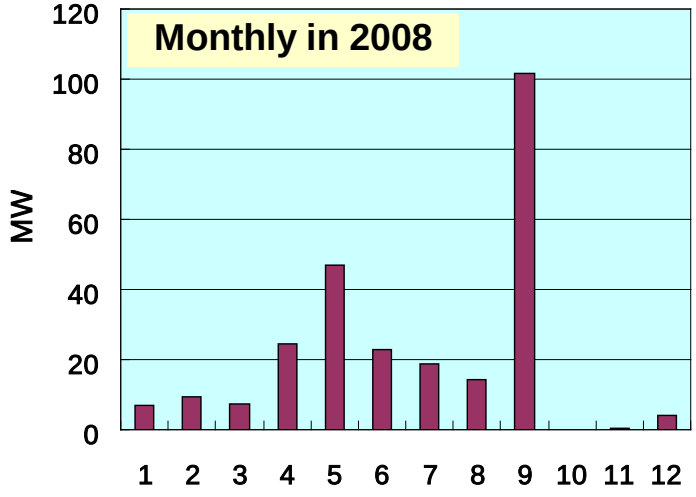
~ 30 Sep. 2008	Location	Period	< 30 kW	> 30 kW			
		15 years	711.25	677.38			
1 Oct. 2008 ~ 2009	-	Period	< 30 kW	30 kW ~ 200 kW	200 kW ~ 1 MW	1 MW ~ 3 MW	> 3 MW
		15 years	646.96	620.41	590.87	561.33	472. 70
		20 years	589.64	562.84	536.04	509.24	428.83
2010	Ground	15 years	566.96	541.42	510.77	485.23	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	-	-

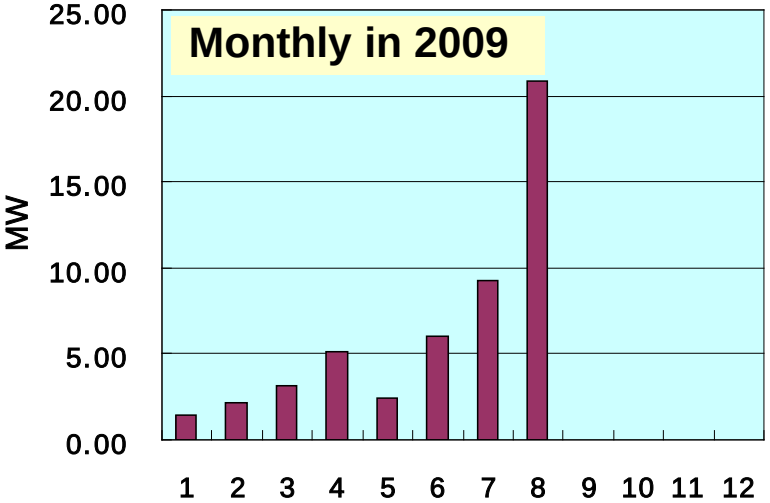
- FIT in 2010 is about 13.6 % less than in 2009
- Bonus 7 % for BIPV

PV systems installed under FIT scheme



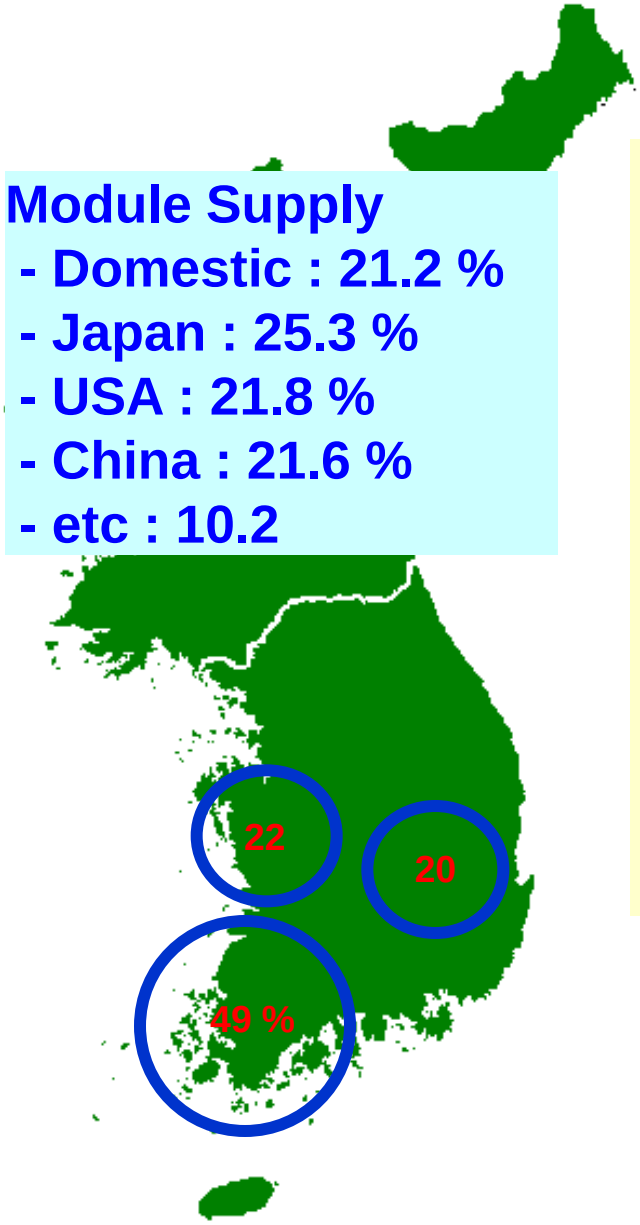
	MW	
1~10 kW	0.5	0.1%
11~99	35.9	10.3%
100~999	154.5	44.5%
1000~	156.3	45.0%
Total	347.2	

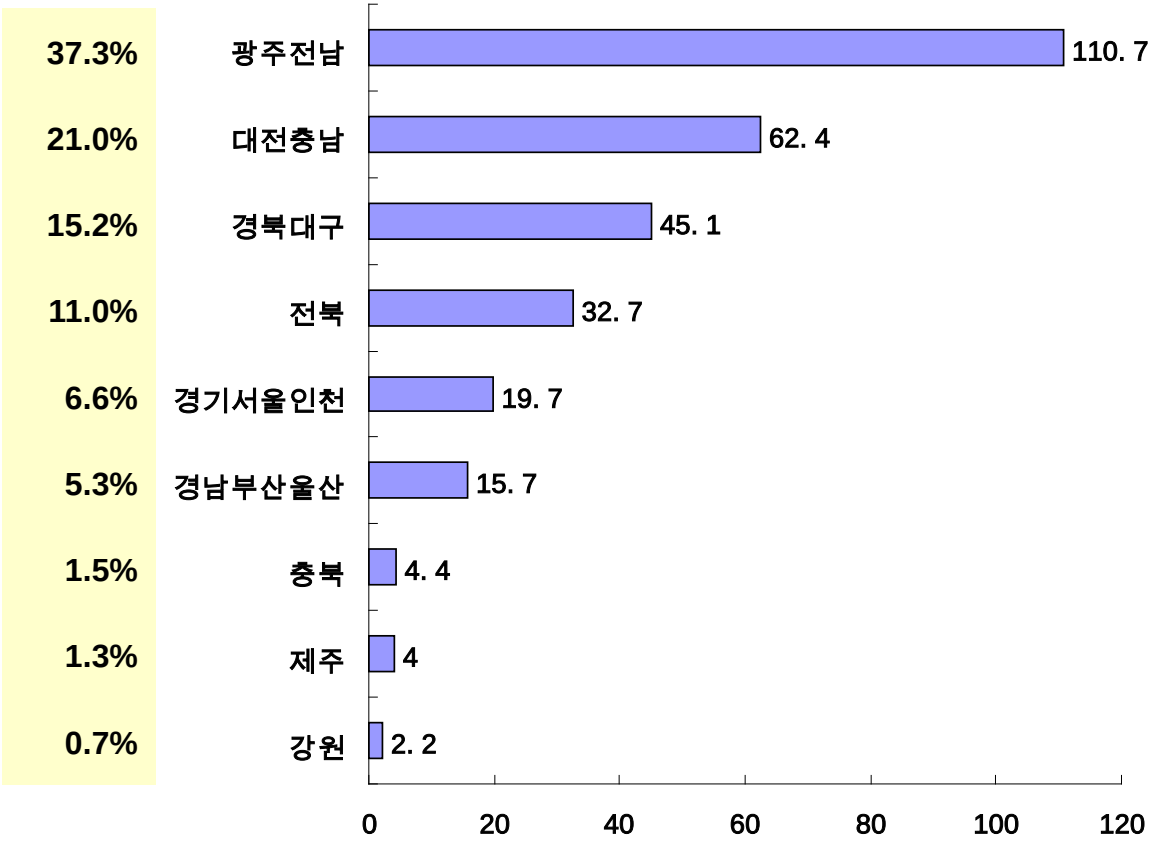




PV systems installed under FIT scheme

Module Supply
- Domestic : 21.2 %
- Japan : 25.3 %
- USA : 21.8 %
- China : 21.6 %
- etc : 10.2





1 Million Green Home (incl. 100,000 PV Roof)

- **Government subsidy**
  - 60% for single-family & private multi-family
  - 100% for public multi-family rent

- **Guidelines in 2009**
  - unit system < 3 kW/household, - price < 4.3 k KRW/W for fixed system
  - individual evaluation for tracking & BIPV system
  - through bid for public multi-family
  - PV budget in 2009 : 65.4 B KRW (total budget : 104.3 B KRW)

Achievement		2004	2005	2006	2007	2008	2009[1)]	total
태양광	No. of households	310	907	5,964	7,317	9,142	8,018	31,658
	Installed capacity (MW)	0.8	2.4	7.3	9.2	10.5	12.4	42,617
	Budget (B KRW)	6.3	15.8	48.9	49.0	48.9	53.0	221.9

1 Million Green Home (incl. 100,000 PV Roof)

Target	’04~’08	’09~’12	’13~’16	’17~’20	Total
Target (Households)	24,000	105,760	275,600	619,140	1,024,500
Investment (B KRW)	287,7	1,181.3	3,596.0	9,445.0	14,510

MKE, Oct. 2009

Single-family houses, Cheonan, Habitat

Apartment Complex, Gimcheon

Deployment Aid Program

- **General Deployment Program :**
  - **max. 60% aid of installation cost for unit system < 50 kW**
  - **5.5 k KRW/W for fixed - 6.5 k KRW/W for tracking**
  - **8.98 k KRW for BIPV system**
  - **PV budget in 2009 : 34.1 B KRW**

- **Demo. & Planned Deployment Program : max. 80% aid of installation cost**
  - **application of R&D results**
  - **planned by local-authorities & public organization**

	- 2004	2005	2006	2007	2008	2009	Total
No. of Systems	137	106	141	179	162	134	859
Capacity (MW)	4.5	3.3	4.5	6.8	8.3	6.6	34.0
Budget (B KRW)	50.8	26.1	36.2	35.2	52.1	34.1	233.7

PV Systems

24 MW, Nov. 2008, Shinan, Dongyang Constr., 1-axis Tracking

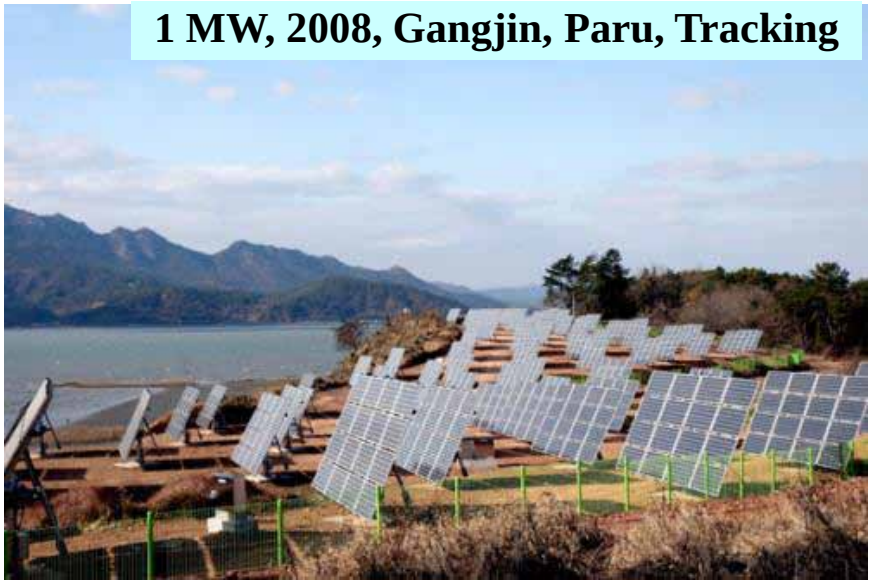
신안 태양광발전소

18.4 MW, Oct. 2008, Gimcheon, Samsung Everland

PV Systems

14 MW (9 MW + 5 MW), July 2008, Taean, LG Solar Energy

1 MW, 2008, Gangjin, Paru, Tracking



0.5 MW, Nov. 2008, Haenam, a-Si module

RPS

- RPS will replace RPA and FIT from the year 2012
- RPS demonstration project will be launched for three years from 2009 until 2011
  - capacity : 101.3 MW
  - Six electricity companies will construct their own PV plants or purchase PV electricity from private.

Public Building Program

- New public buildings over 3,000 ㎡ total floor area
  - 5 % of the total construction budget spent for NRE system
- Under consideration
  - investment : > 5 % of total energy load
  - include existing buildings ?
  - floor area >1,000 m2 ?
  - include schools and military buildings ?

Loan

- Low interest rate loans (2.75 %) for power systems or manufacturing facilities
- 5 yr grace and 10 yr repayment period
- PV budget in 2009 : 88.5 B KRW (total : 132.9 B KRW)

Others

- **Tax Incentives**
  - Income tax credit for 10 percent of the total investment in NRES projects
- **RPA (Renewable Portfolio Agreement)**
  - Agreement on NRES dissemination between energy utility companies and the Government
  - will be replaced by RPS since 2012
- **Eco-cities :**
  - New Inno-city, Admin. City (10%) will enhance the use of NRES
- **Certification**
  - Certification program to guarantee the quality of NRES facilities for public acceptance of the technology
- **NRE Specialty Company**
  - Companies meeting certain criteria may participate in the deployment program
  - 154 companies for PV in 2009 : 125 fixed system, 22 tracking system, 7 BIPV

Summary

- **PV emerges as one of the key sector of the Gov.'s long-term vision in favor of "Low-carbon Green growth", "Green Energy".**
- **PV budget for R&D and deployment continues to increase substantially.**
- **FIT scheme boosted PV installation in 2008, but since Oct. 2008 the FIT was reduced by more than 30%. In 2010, further reduction of 13.6% is decided, but 7% bonus for BIPV.**
- **Business value of PV in 2008 : 1, 341 B KRW**
- **PV market size will depend on the Gov.'s policy such as FIT and RPS.**
- **Korea's PV industry continues to grow with the participation of much larger companies, but needs more efforts to maximize the use of domestic products.**
- **New R&D Initiative was launched in 2008, focusing on equipment development for crystalline Si solar cells and intensifying R&D on thin film solar cells.**

Thank you very much

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