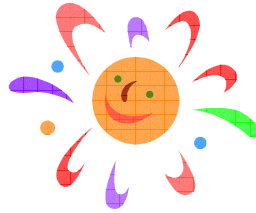


PV: One of Our Core Future Energy Sources

The photovoltaics industry, today and tomorrow

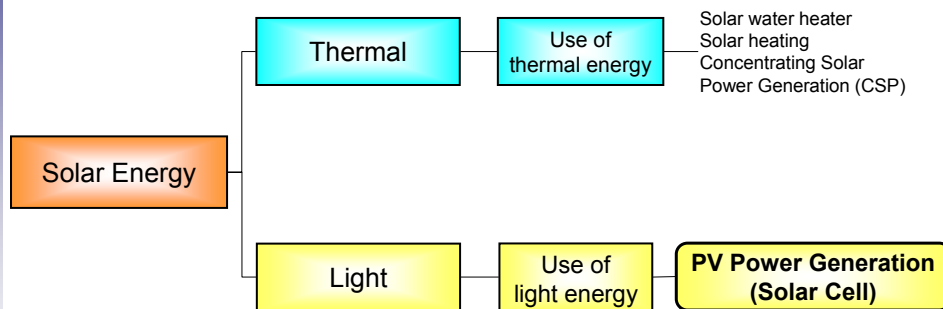


Osamu Ikki, RTS Corporation, Tokyo
ikki@rts-pv.com

14 November 2006
IEA-PVPS Finance Workshop, Zurich



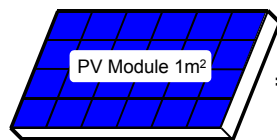
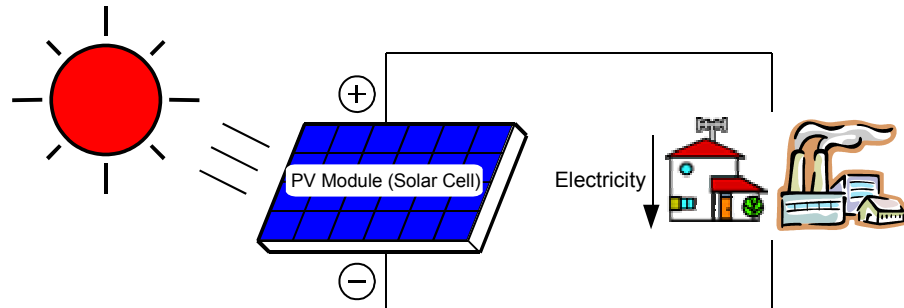
1. Use of Solar Energy



Source: RTS Corporation©



2. Mechanism of PV System

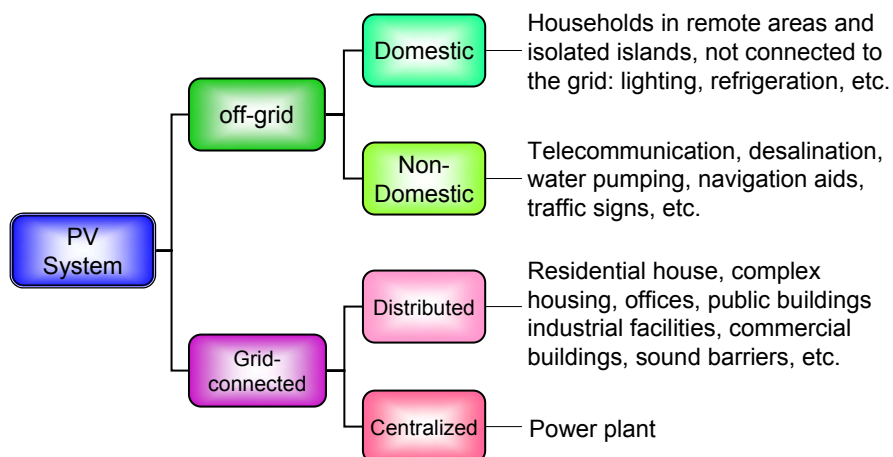


=Power generation capacity: 100 -190 W
(Depending on energy conversion efficiency of Solar Cell)

Source: RTS Corporation ©



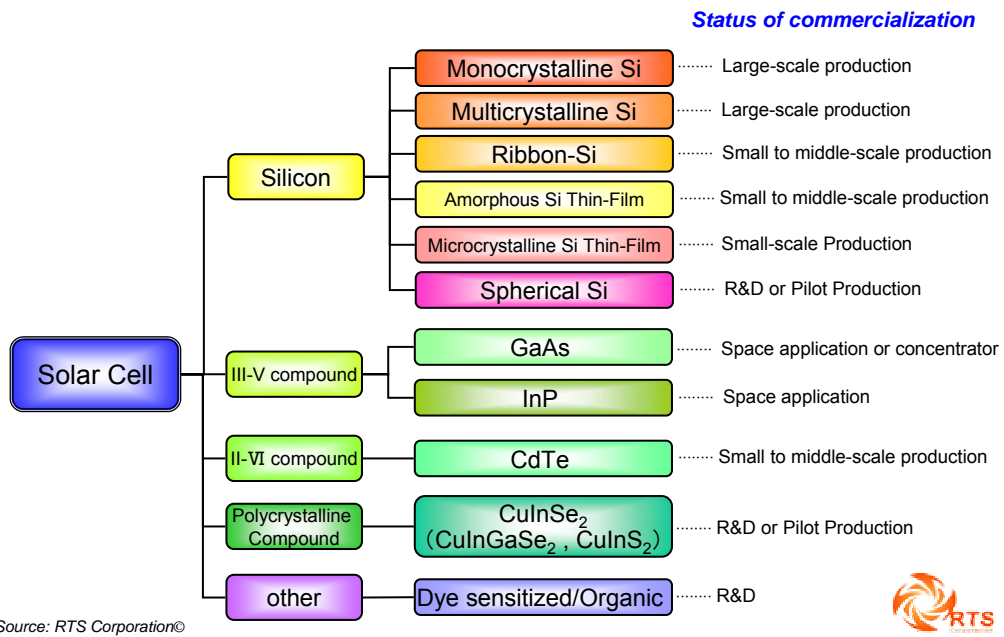
3. Applications of PV System



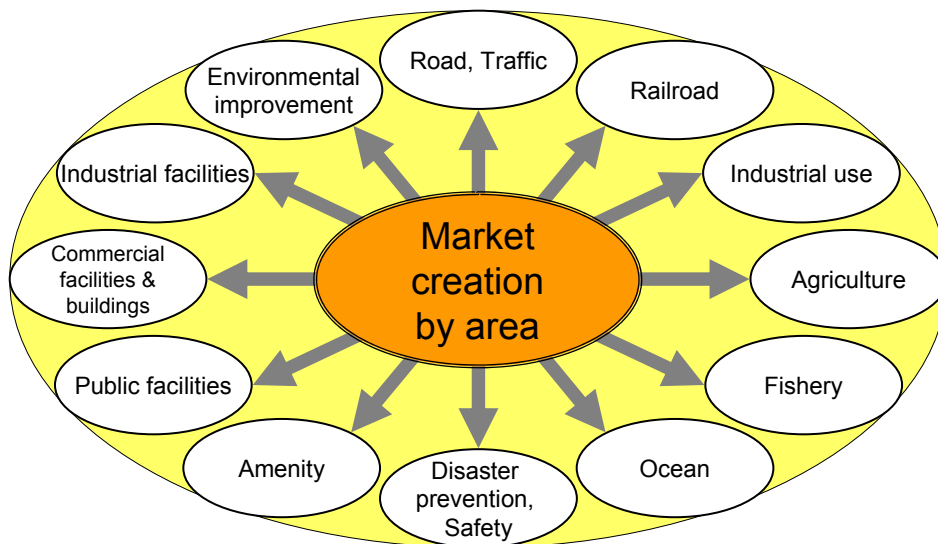
Source: Trends in photovoltaic applications in selected IEA countries between 1992 and 2005, September 2006



4. Diversification of Solar Cell in the Market



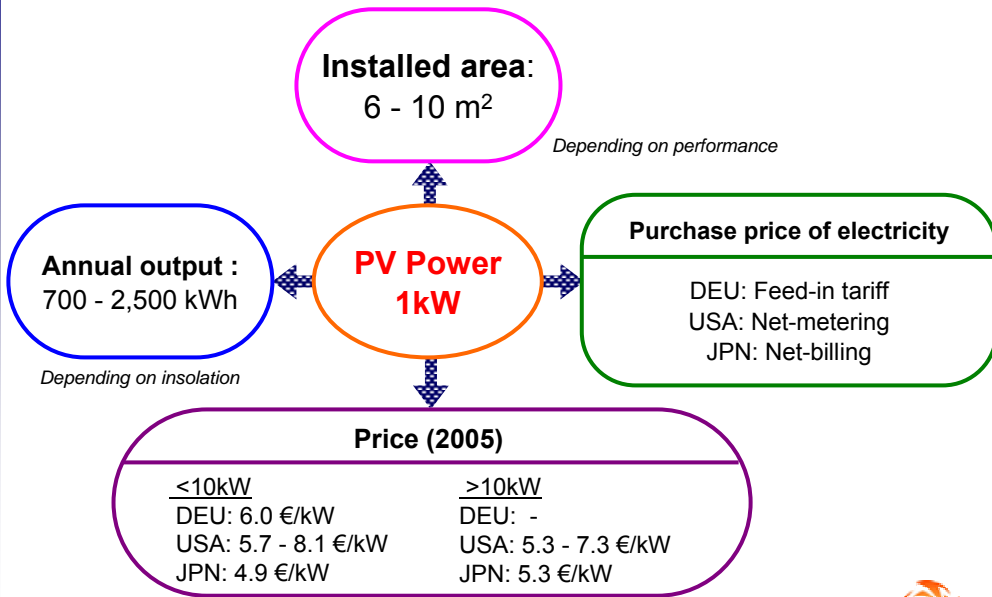
5. Market creation by application area



Source: RTS Corporation©



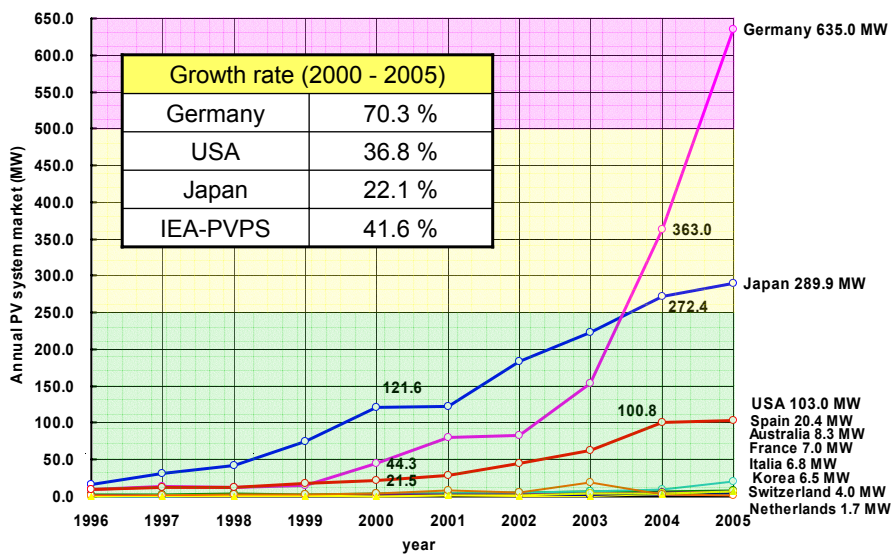
6. 4 points to understand PV System



Source: RTS Corporation ©, IEA-PVPS Task1 Trends in Photovoltaic applications between 1992 and 2005



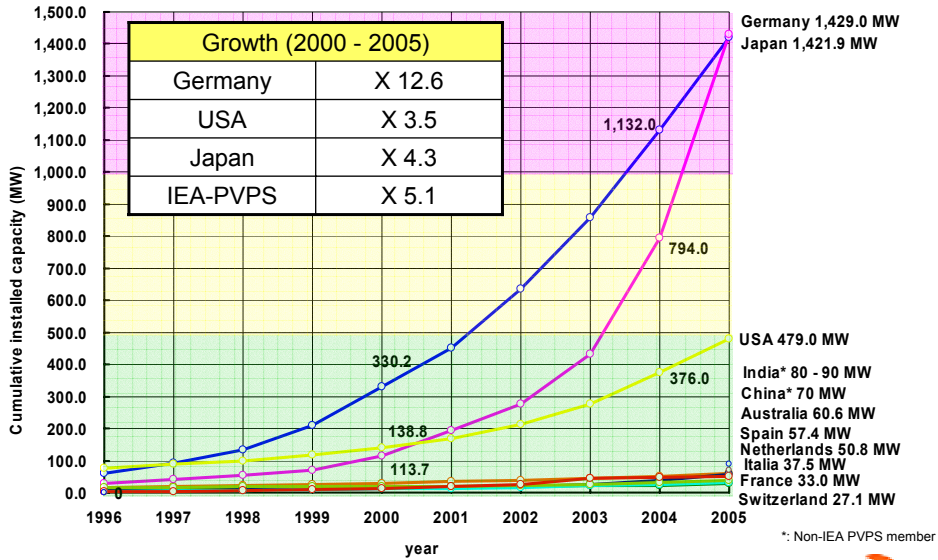
7. Size of PV System Market



Source: Trends in photovoltaic applications in selected IEA countries between 1992 and 2005, September 2006



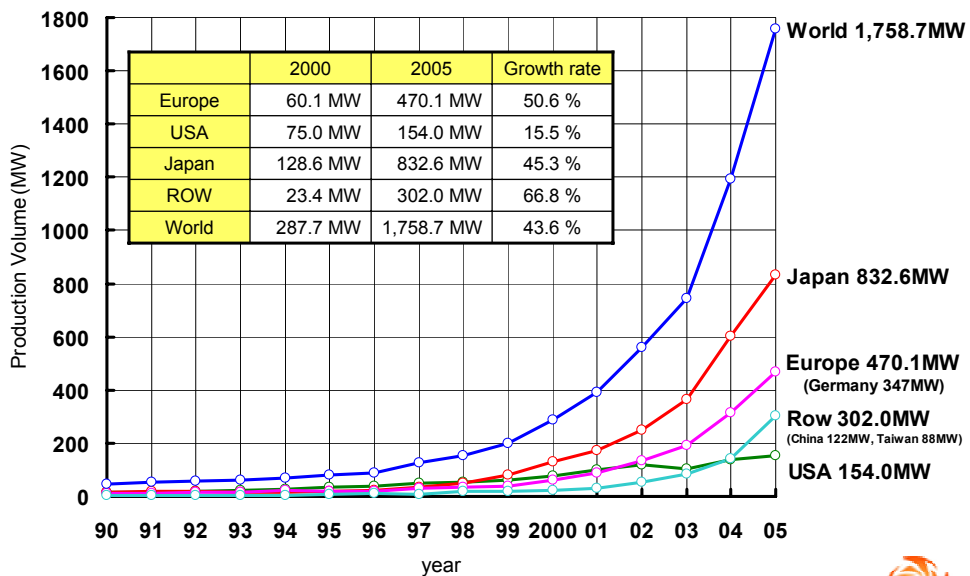
8. PV capacity



Source: Trends in photovoltaic applications in selected IEA countries between 1992 and 2005 September 2006



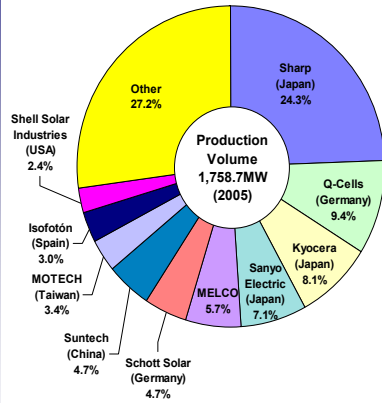
9. Solar Cell Production



Source: PV News, arrange by RTS corporation



10. Top Solar Cell Manufacturers



Year	2000	2005
No. of manufacturers	~ 30	~ 50
Manuf. preparing	~ 15	> 40

Japan	MW	Rank
Sharp	427.6	1
Kyocera	142.0	3
Sanyo Electric	125.0	4
Mitsubishi Electric (MELCO)	100.0	5
Kaneka	21.0	19
Mitsubishi Heavy Industries (MHI)	12.0	29
Hitachi, Ltd.	5.0	32

USA	MW	Rank
Shell Solar Industries	42.0	10
BP Solar	23.0	16
United Solar Ovonic (Uni-Solar)	22.0	18
First Solar	20.0	20
GE Energy	18.0	22
Evergreen Solar	14.0	26
Other	15.0	-

Europe	MW	Rank
Q-Cells (Germany)	166.0	2
Schott Solar (Germany)	82.0	6
Isofotón (Spain)	53.0	9
Deutsche Cell(Germany)	38.0	12
Photowatt International (France)	24.0	15
ErSol (Germany)	20.0	20
Other	87.1	-

ROW	MW	Rank
Suntech (China)	82.0	6
MOTECH (Taiwan)	60.0	8
Other Chinese companies	40.0	11
BP Solar (Australia)	35.0	13
E-TON (Taiwan)	28.0	14
SunPower (Philippines)	23.0	16
Other	34	-

Source: PV News, arrange by RTS corporation, RTS Corporation



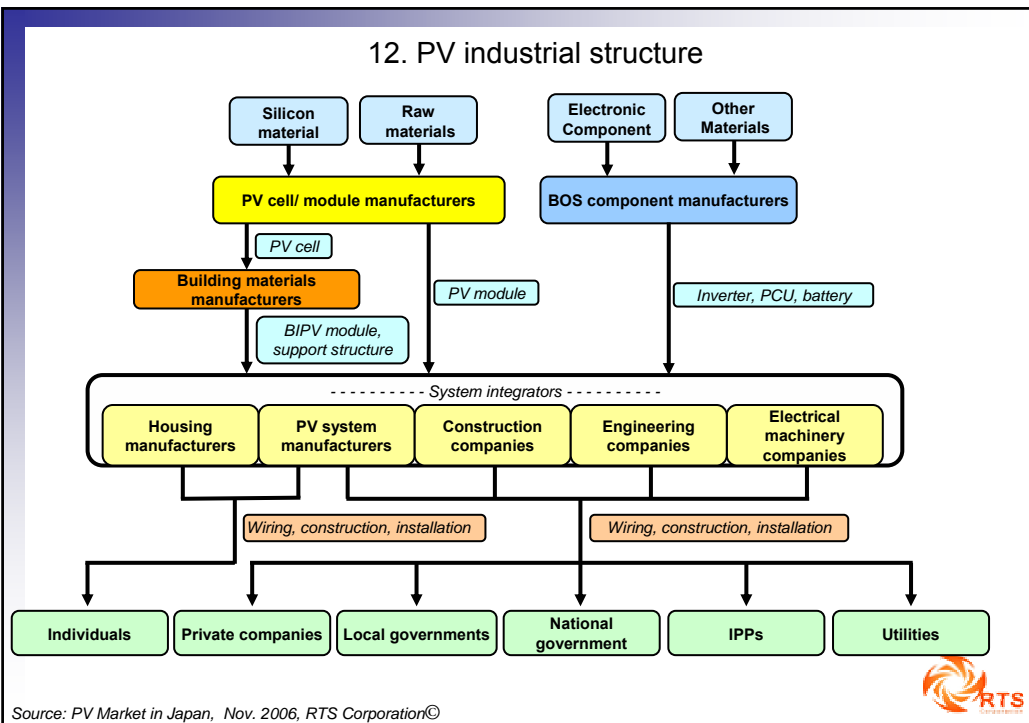
11. Price Reduction of Grid-Connected PV System

Capacity	2000	2005
<10kW	7 - 10 €/W	5 - 8 €/W
>10kW	5 - 12 €/W	5 - 7 €/W

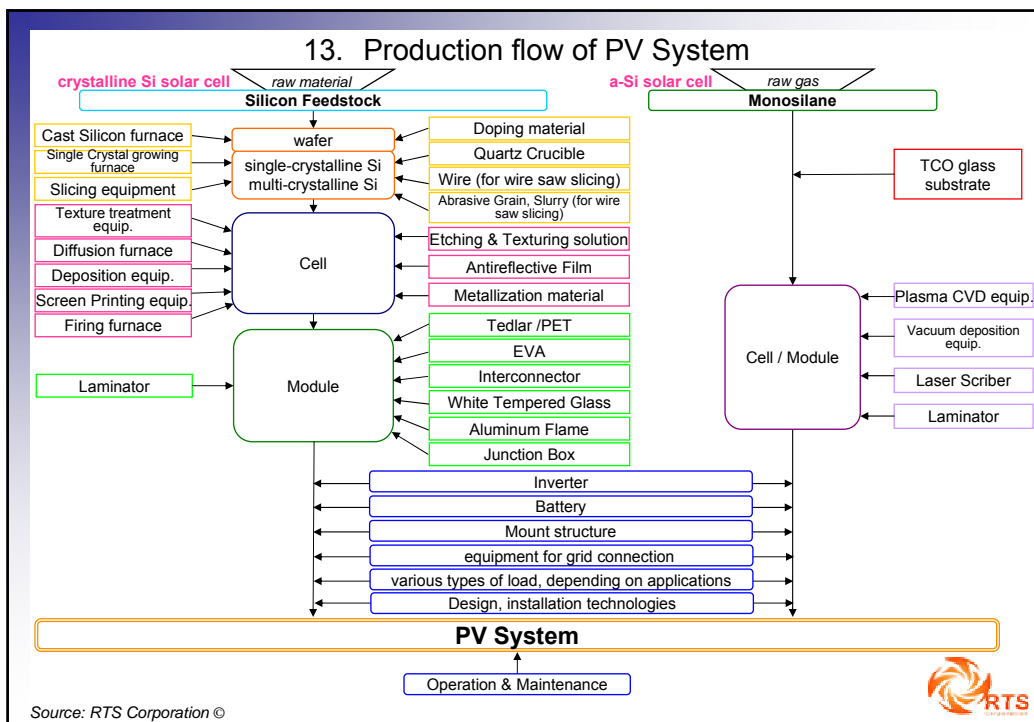
Source: leveled based on IEA PVPS Task 1 National Survey Reports (figures are converted from national currency to Euro)



12. PV industrial structure



13. Production flow of PV System



14. Key Players in PV Industry (Europe)

Polysilicon, ingot and wafer	PV Crystalox Solar (DEU), Wacker Polysilicon (DEU), REC (NOR), Joint Solar Silicon (DEU), Deutsche Solar (DEU) ...	
Raw material	Isovolta (AUT), Multi-Contact (CHE) ...	
PV	Cell	Q-Cells (DEU), Schott Solar (DEU), Deutsche Cell (DEU), ErSol (DEU), Shell Germany (DEU), Sunways (DEU), Antec (DEU), Isofotón (ESP), BP Solar (ESP), Photowatt International (FRA), EniTecnologie (ITA), Helios Technology (ITA), Intersolar (GBR), Photovoltech (BEF), Konkar (CRO) ...
	Module	Solon (DEU), Saint Gobain (DEU), Solar-Fabrik (DEU), Webasto (DEU), Solarwatt (DEU), Solarc (DEU) ...
BOS (inverter/charge controller)	Kaco Geratetechnik (DEU), Siemens (DEU), SMA Technologie (DEU), Mastervolt (NLD), Philips (NLD), Fronius (AUT) ...	
Integrator/Installer	IBC Solar (DEU), Schüco International (DEU), Phönix SonnenStrom (DEU), Conergy Systems (DEU) ...	
Equipment	Gebr. Schmid (DEU), Centrotherm (DEU), M+W Zander (DEU), Roth & Rau (DEU), Aixtron (DEU), Baccini (ITA), HCT Shaping system (CHE), Meyer & Burger (CHE), Oerlikon (LTU) ...	

Source: RTS Corporation ©



15. Key Players in PV Industry (USA)

Polysilicon, ingot and wafer	Hemlock Semiconductor (HSC), Advanced Silicon Materials (ASiMI), Solar Grade Silicon (SGS), MEMC Electronic Materials ...	
Raw material	DuPont Microcircuit Materials, Ferro Electric Material Systems ...	
PV	Cell (affiliation)	Solar World (DEU, former Shell Solar Industries), BP Solar (GBR/NLD), United Solar Ovonic, First Solar, GE Energy, Evergreen Solar, Schott Solar (DEU) ...
	Module	-
BOS (inverter/charge controller)	SatCon Power Systems, Xantrex Technology (CAN), Morningstar ...	
Integrator/Installer	PowerLight, SunEdison, Akeena Solar, SunWize ...	
Equipment	BTU International, GT Solar Technologies, MVSystems, Spire Solar ...	

Source: RTS Corporation ©



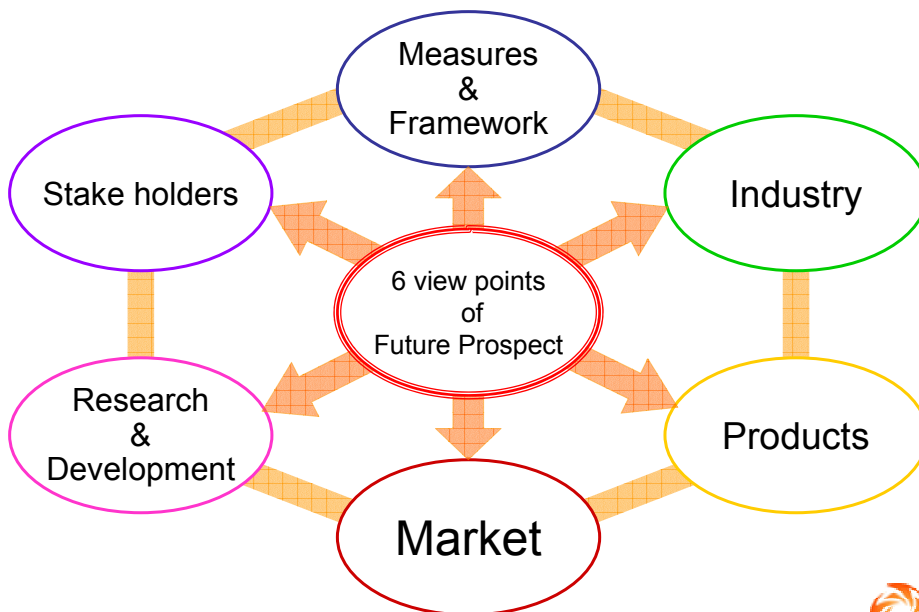
16. Key Players in PV industry (Japan)

Polysilicon, ingot and wafer	Tokuyama, JFE Steel, M.Setek, SUMCO, Space Energy ...	
Raw material	Asahi Glass, Nippon Sheet Glass, Sankyo Aluminium Industry, Bridgestone, Mitsui Chemicals Fabro, Toray ...	
PV	Cell	Sharp, Kyocera, Sanyo Erectric, Mitsubishi Electric (MELCO), Kaneka, Mitsubishi Heavy Industry (MHI), Hitachi, Showa Shell Sekiyu, Fuji Electric Systems, Honda Motor ...
	Module	MSK (Suntech, Chine), Fujipream ...
BOS (invertor/ charge controller)	Omron, GS Yuasa, Nisshin Electric, Tabuchi Electric, Sanyo Denki ...	
Integrator/ Installer	Gantan Beauty Sanko Metal Industrial, Sekisui Chemical, PanaHome, Kajima, Shimizu, NTT Facilities ...	
Equipment	Shimadzu, NPC ...	

Source: RTS Corporation ©



17. Future Prospect: 6 view points



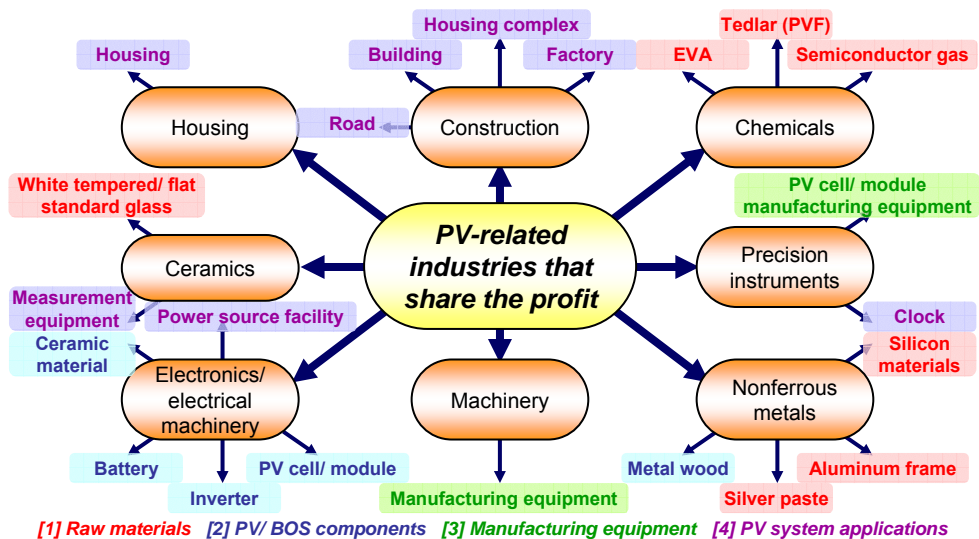
18. Future Prospect 1: Continuous PV Support by Government and Utilities

	Feed-in Tariff	Net-metering/ Net-billing	Direct Subsidy	Tax credit	RPS
Europe	☆☆☆☆ (Germany, Spain, Italy, France, Greece ...)	-	☆☆☆☆ (Belgium, Cypress, Greece, Portugal ...)	☆☆ (France, ...)	☆☆ (UK, Ireland, etc.)
USA	☆☆ (State)	☆☆☆☆ (State)	☆☆☆☆ (State)	☆☆☆☆ (Federal/ State)	☆☆☆☆ (State)
Japan	-	☆☆☆☆ (Utilities)	☆☆☆☆	-	☆☆☆☆
Note	Incentive for power generation (kWh)		Incentive for installed capacity (kW)	Incentive based on kW or price	Obligation of share of renewables

Source: RTS Corporation©



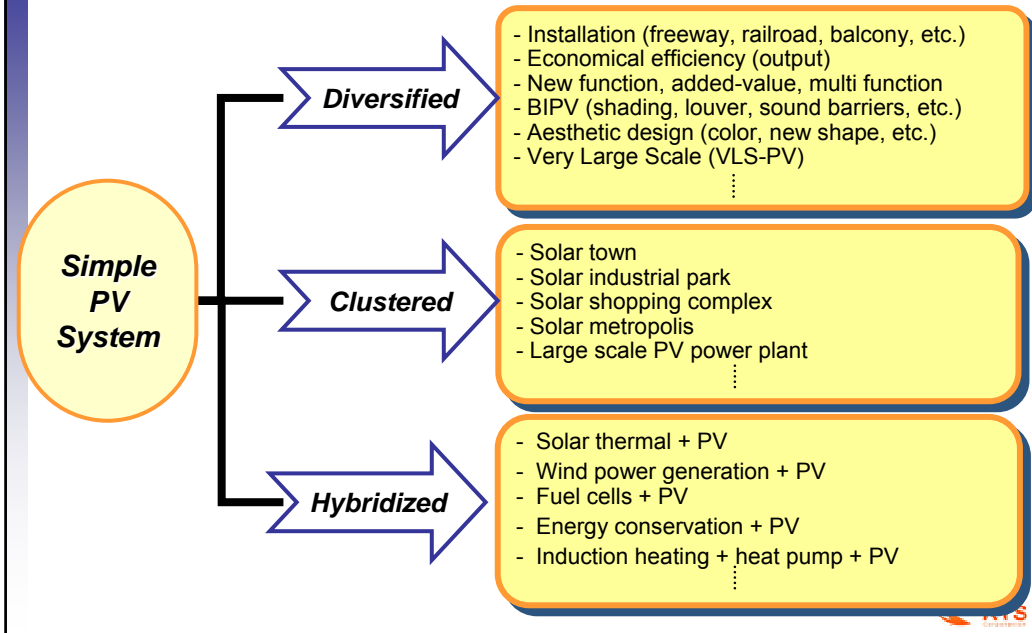
19. Future Prospect 2: Enhancement of PV Industry Structure for Further Growth



Source: "PV Activities in Japan", RTS Corporation







20. Future Prospect 3: Advancement of Product Development



21. Future Prospect 4: Promotion of aggressive R&D - Target cost of PV electricity

(Unit: Eurocent/kWh)

		2005	2010	2015	2020	2030	2050
		30.0		15.0		6.0	3.0
		45	30		10		
	Residential	18.0 - 25.1	10.2 - 14.1	6.3 - 7.8			
	Commercial	12.5 - 17.3	7.1 - 9.4	4.7 - 6.3			
	Utility	10.2 - 17.3	7.8 - 11.8	3.9 - 5.5			
		27.47	15.41		9.38	4.69	

Source:

EU: Strategic Research Agenda (SRA) for Photovoltaic Solar Energy Technology, PV-TRAC (July 2006)

Germany: PV R&D Roadmap, developed during the 9th BMU strategy meeting of representatives from German industry and research institutes (November 2005) (in Southern Europe)

USA: The Solar America Initiative, NREL (February 2006)

Japan: PV Roadmap Toward 2030 (PV2030), NEDO (June 2004)

Conversion Rate: 1 USD = 78.4191 EUR, 1 JPY = 0.67 EUR (as of November 1, 2006)



22. Future Prospect 5 : Expansion of PV Market (Near term)

Market Size/Year	Country
300 - 1,000 MW	Japan, Germany
100 - 300 MW	USA
50 - 100 MW	Spain
10 - 50 MW	Italy, Australia, France, Korea, China
5 - 10 MW	Switzerland, Greece, India
1 - 5 MW	Austria, Netherlands, UK, Canada, Mexico, Portugal
Below 1 MW	Sweden, Finland, Denmark, Norway

Source: RTS Corporation©



23. Future Prospect 5 : Expansion of PV Market (middle- and long-term)

Annual market size by region

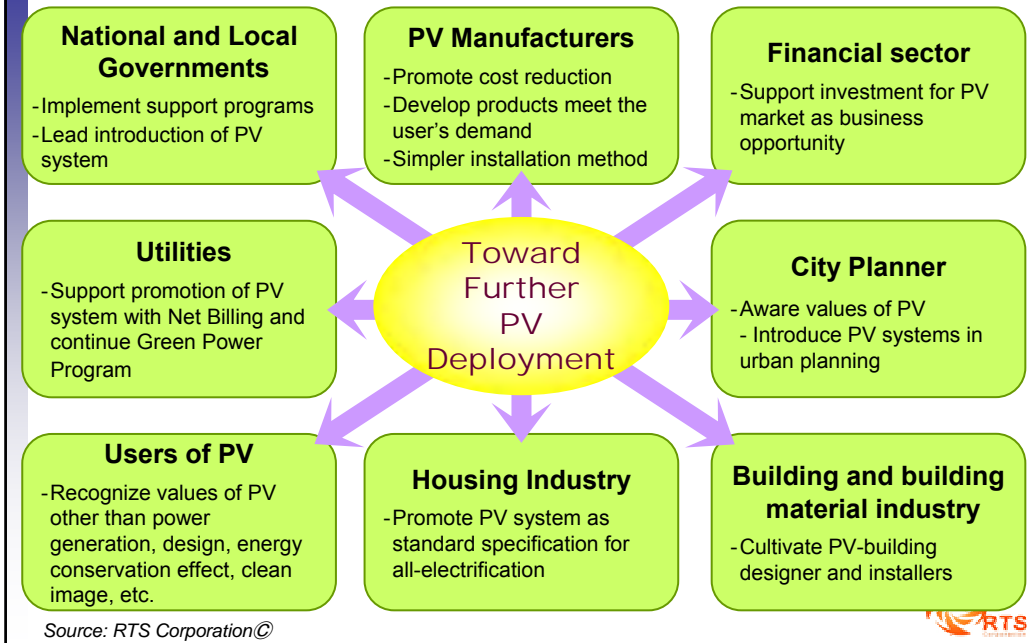
(Unit: MW)

Region	Country	2005	2010	2015	2020	2025
Europe	Germany	700	1,200	1,293	1,359	1,428
Asia	Japan	291	1,038	2,451	3,129	2,975
	China	44	211	1,351	8,657	13,942
	India	16	180	968	1,947	3,509
	Thailand	8	82	306	762	1,227
Oceania	Australia	8	89	398	989	1,412
North America	USA	105	603	2,240	3,608	5,811
South America	Brazil	3	62	332	827	2,057

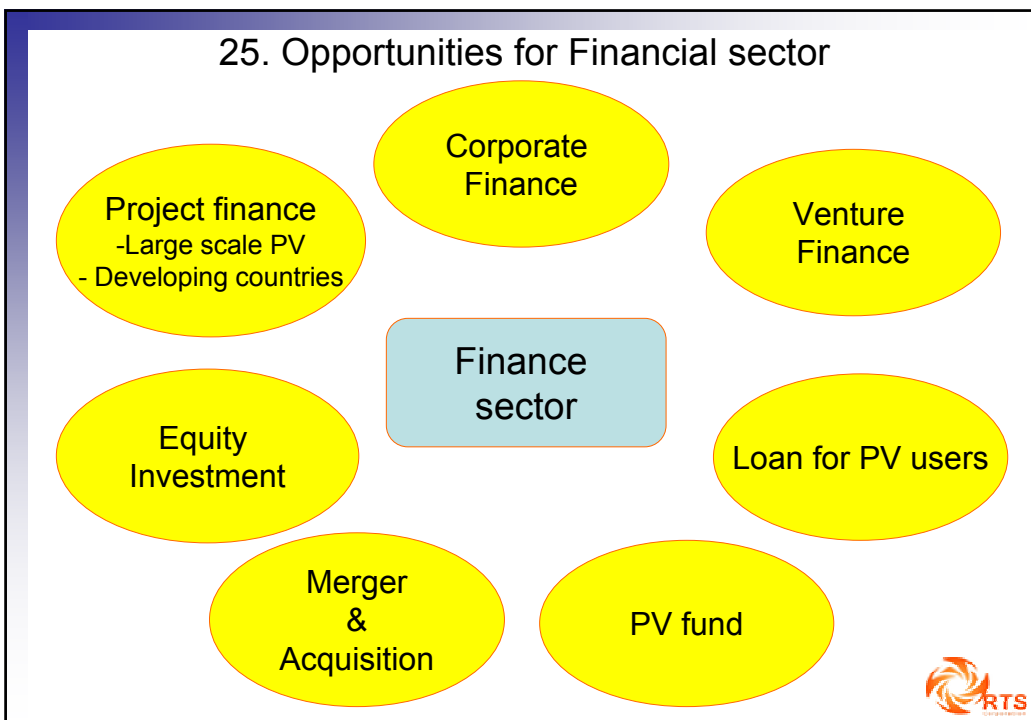
Source: EPIA, Greenpeace, "Solar Generation", September 2006



24. Future Prospect 6 : Expansion of Stake holders



25. Opportunities for Financial sector



PV as one of core energy sources

Global Contribution:

expectation is raising as energy can overcome energy security, global environment, economic growth

Efforts to introduce PV system:

Extended from advanced countries to developing countries

Dissemination of PV System:

Global trend

PV market: being diversified:

residence, public, industrial commercial buildings, power plants, etc.

Production of solar cell toward 5 GW/year:

- Manufacturing sites: extending to world
- Production volume: globally expanding

PV industry:

growing toward 10 billion Euro scale with the involvement of related industries

PV industry structure:

being developed covering whole value chain: Si feedstock to sales channel

PV technology:

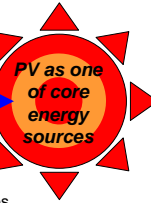
advancing toward further cost reduction & still has a room for innovation

Cost reduction:

toward 3 Euro/W → 1 Euro/W: On going!

Awareness of PV:

Public awareness for PV system is globally extending



Thank you for your kind attention !

