International Energy Agency
CO-OPERATIVE PROGRAM ON PHOTOVOLTAIC POWER SYSTEMS

Task 1
Exchange and dissemination of information on PV power systems

National survey report of PV Power Applications in Japan 2006

Prepared by

Osamu Ikki

RTS Corporation
2-3-11 Shinkawa
Chuo-ku, Tokyo 104-0033, Japan

Koji MATSUBARA

New Energy and Industrial Technology
Development Organization (NEDO)
Muza Kawasaki Building, 1310, Omiya-cho, Saiwai-ku,
Kawasaki City, Kanagawa, 212-8554, Japan

May 25th 2007

LIST OF CONTENTS

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

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual 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.

ii 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. This report gives information on trends in PV power applications in the PVPS member and other countries and is largely based on the information provided in the National Survey Reports which are produced annually by each Task 1 participant. The public PVPS website also plays an important role in disseminating information arising from the programme, including national information. This template is intended to assist national experts and other participants of Task 1 in the preparation of their annual PVPS National Survey Reports.

As the ***Trends in photovoltaic applications*** report is based on the National Survey Reports it is important that experts follow this template when preparing their national reports. The ***Trends*** report is an external publication of the IEA-PVPS Implementing Agreement so it must not contain confidential information. Similarly, the National Survey Reports are now presented on the public PVPS website and Task 1 participants should make their own arrangements with their sources on how to treat confidential information (e.g. by ensuring anonymity of the data).

National Survey Reports should be produced before the end of May to enable the ***Trends*** report to be published by the end of August.

When preparing their national reports, experts must ensure that all the data are as accurate and correct as possible and follow the definitions given in this template. All sections must be completed as comprehensively as possible.

iii Definitions, Symbols and Abbreviations

For the purposes of the 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^{o}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 organization 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.

Please specify the currency that is used throughout the NSR - countries of Euroland must use the euro (EUR). Please ensure that your NSR follows the recommendations of the internal PVPS report *Writing numerical values, quantities, units and symbols according to International Standards*. This will reduce confusion when preparing the ***Trends*** report, and will reduce the need for editing of material for consistency before loading on to the website.

National Survey Report of PV Power Applications in Japan

1 Executive summary

Activities regarding introduction and promotion of photovoltaic power (PV) systems in 2006 are as follows.

1) Government developed “New National Energy Strategy”, a fundamental energy strategy for the future and promotes “New Energy Innovation Plan”.
2) Agency of Natural Resources and Energy (ANRE) of The Ministry of Economy, Trade and Industry (METI) started to set the target usage amount of new energy by FY 2014 under the Law on Special Measures Concerning New Energy Use by Electric Utilities (Renewables Portfolio Standard Law, RPS Law).
3) New Energy and Industrial Technology Development Organization (NEDO) started “R&D for Next Generation PV Systems (FY 2006 - FY 2009)”, a new 4-year technological development plan, based on the roadmap for technological development of PV systems, “ PV Roadmap 2030 (PV 2030)”.
4) Ministry of the Environment (MoE) started “Solar Promotion Program” to promote introduction of PV systems.
5) Although the national subsidy program for residential PV system, “Residential PV System Dissemination Program” was completed in FY 2005, 319 of local governments provide financial support for dissemination of residential PV system.
6) Under the “Field Test Project on New Photovoltaic Power Generation Technology”, 662 PV systems, totaling 22 MW, were installed.
7) JPEA, Japan Photovoltaic Energy Association, revised its industrial roadmap and announced “Vision of the Future of the Photovoltaic Industry - Aiming to be the World’s Leading PV Nation, 2006” to correspond rapidly growing PV promotion.
8) Conventional solar cell and PV module manufacturers significantly increased their production capacity to correspond growing demand of solar cells and PV modules for 4 years in a row. 3 new companies completed the factory of thin-film PV modules and are preparing for full-scale operation.
9) Electric utilities achieved FY 2005 new energy quota under the RPS law and continued to introduce PV systems through “Green Power Fund”.

Installed PV power

While grid-connected PV systems continued to dominate the PV market in Japan as same as the previous years, total annual installed capacity of the PV system remained roughly flat in 2006, in reversal to the steady increase observed in the past. The total annual installed capacity in 2006 was 286 591 kW. The growth rate slightly decreased by a 1,1 % from 2005 (289 917 kW). The breakdown of installed PV systems in 2006 is 64 kW for off-grid domestic application, 1 467 kW for off-grid non-domestic application, and 285 060 kW for grid-connected distributed application, mainly residential PV systems. No grid-connected centralized application was installed in 2006. Primary factors of the flat growth were termination of the budget for “Residential PV System Dissemination Program” and shortage of silicon feedstock for solar cell.

Costs & prices

The prices of PV modules and PV systems have been steadily decreasing owing to the Government’s support measures on research and development (R&D) and dissemination measures for PV systems and enhancement of production capacity by PV manufacturers for past years. However, the average price of PV modules for residential PV system in 2006 increased by 1,1% from 428 JPY/W in 2005 to 433 JPY/W due to the price hike of silicon feedstock and other

raw materials for solar cell, parts and components.

In addition, price of PV systems with more than 10 kW generation capacity for public and industrial facilities increased by 2,7%, from 730 JPY/W in 2005 to 750 JPY/W in 2006. Typical price of 3- to 5-kW residential PV systems also slightly increased by 2,3%, from 665 JPY/W in 2005 to 680 JPY/W in 2006.

PV production

2006 production volume of solar cells and PV modules in Japan increased for 10 consecutive years, and recorded 916,2 MW. The production volume of solar cells and PV modules in 2005 was 811,6 MW. While Japan has been the largest PV production country in the world since 1999, and the share of Japan in the worldwide PV production has been decreasing in recent years.

The breakdown of production volume was as follows: 346,0 MW of single crystalline silicon (sc-Si) solar cells, 523,5 MW of multicrystalline (mc-Si) solar cells, 46,7 MW of amorphous silicon (a-Si) solar cells.

The market share of crystalline Si solar cells is approximately 95%. mc-Si solar cells have been overwhelmingly dominating the solar cell market in Japan for last 12 years and kept the status with the growth of the solar cell market in Japan. Crystalline Si solar cells have been significantly growing in quantity, with the backing of growth of the PV market for electric power use owing to the Government's "Field Test Project on New Photovoltaic Power Generation Technology" and "Project for Promoting the Local Introduction of New Energy", introduction of PV systems by electric utilities through "Green Power Fund" and demand of general industrial applications such as traffic signs, telecommunication equipment, as well as expansion of export. As for a-Si solar cells, full-fledged commercial production has started for mainly the market of electric power application in Japan and overseas and the a-Si solar cell manufacturers are advancing the plan to increase of production capacity.

Budgets of PV

The FY 2006 national budgets for PV power generation of the Ministry of Economy, Trade and Industry (METI) totaled 16 770 MJPY (17 290 MJPY in 2005), of which was 3 170 MJPY (4 100 MJPY in 2005) for R&D, 13 600 MJPY (10 590 MJPY in 2005) for demonstration/ field test programs. The budget for market incentives (2 600 MJPY in 2005) to create the initial market for residential PV systems was terminated in FY 2005. The budgets for major FY 2006 national programs of METI are as follows (figures in parentheses are the budget of FY 2005);

1) Research and Development on Photovoltaic Power Generation: 3 170 MJPY (4 100 MJPY)
2) Residential PV System Dissemination Program: 0 MJPY (2 600 MJPY, completed in FY 2005)
3) Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications: 100 MJPY (110 MJPY)
4) Field Test Project on New Photovoltaic Power Generation Technology: 11 800 MJPY (9 230 MJPY)
5) Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation Systems: 1 000 MJPY (1 250 MJPY)
6) Verification of Grid Stabilization with Large-scale PV Power Generation System: 700 MJPY (new)
7) Project for Supporting New Energy Operators: 35 270 MJPY (34 500 MJPY)
8) Project for Promoting the Local Introduction of New Energy: 5 180 MJPY (7 600 MJPY)

9) Project for Promotion of Non-profit Activities on New Energy and Energy Conservation: 160 MJPY (170 MJPY)

10) Project for Establishing New Energy Visions at the Local Level: 1 250 MJPY (1 180 MJPY)

11) Demonstrative Project of Regional Power Grids with Various New Energies: 2 850 MJPY (6 000 MJPY)

The budgets for items 7), 8), 9), 10) and 11) include ones for PV and other new and renewable energies.

Besides METI, the Ministry of Land, Infrastructure and Transport (MLIT), the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Ministry of the Environment (MoE) and other ministries are promoting introduction of PV systems, but the detailed budgets were not published.

Local governments and municipalities have implemented their own subsidy programs for residential PV system, but their budgets are unknown.

2 The Implementation of PV systems

2.1 Applications for photovoltaics

National support framework for residential PV system was completed in FY 2005 and the market of residential PV system has shifted to a self-supported market driven by the market mechanism. Currently the sales of prefabricated houses equipped with PV system as standard equipment has been implemented by many housing manufacturers and local developers in addition to major housing manufacturers. Intensive introduction of PV systems in residential estates by developers has been increasing. The demand for residential PV system accounts for 88,7% of the total. As a new movement in residential application, introduction of PV system to collective housings has started.

In 2006, installation of PV systems to public facilities, industrial facilities and commercial buildings were advanced through support framework of METI.

PV systems for public facilities, accounts for 3,6%, steadily installed year after year. 10 - 1 000 kW PV systems have been installed mainly to kindergartens, schools, governmental offices, hospitals, welfare facilities, libraries, parks, public halls, water treatment plants and so on. In 2006, operation of 5-MW PV system installed in a factory was started and it became a forerunner of installation of larger-scale PV systems. Recently, local governments have been active in introduction of the PV system and continuous introduction of PV system by local governments and municipalities is expected.

The demand for PV Systems for industrial and commercial uses has 6,2% share. Introduction of the PV system by companies to positively correspond to the environmental issues is expanding year by year. 10 - 5 000 kW PV systems for industrial use have been installed to rooftops and roofs of factories, warehouses, laboratories and so on. 10 - 300 kW PV systems for commercial uses have been installed to rooftops, roofs, exterior walls and parking lots of headquarters of companies, business offices, branch offices, facilities for theater company and large-scale commercial complexes. PV systems were installed into gas stations, railroad facilities, agricultural facilities and logistics centers. Introduction of PV system to balancing reservoir was also started. In newly constructed buildings, building-integrated PV (BIPV) systems using light-weight PV modules, light-through PV modules including double-glass PV modules and flexible PV modules, have been applied to roofs, rooftops, exterior walls, canopies, blindfold louvers , eaves and so on.

In 2006, two national programs for larger scale PV systems started. One is “Verification of Grid Stabilization with Large-scale PV Power Generation System” conducted by NEDO and 5-MW and 2-MW PV projects were planned. The other is “Model projects of Shared Use of Mega Solar System” implemented by the Ministry of Environment (MoE), in which MW-scale PV system will be installed in 3 sites.

Besides, off-grid non-domestic PV systems without governmental support are utilized as power sources for telecommunication, road sign, traffic sign, remote monitoring, ventilating fan, lighting and the like.

2.2 Total photovoltaic power installed

Table 1 shows cumulative installed capacity of the PV system by application. In 2006, total cumulative installed capacity exceeded 1,7 GW at 1 708 499 kW. Cumulative installed capacity for each application is as follows: 1 212 kW for off-grid domestic, 87 376 kW for off-grid non-domestic, 1 617 011 kW for grid-connected distributed, 2 900 kW for grid-connected centralized.

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

Sub-market/ application	31 Dec. 1992 kW	31 Dec. 1993 kW	31 Dec. 1994 kW	31 Dec. 1995 kW	31 Dec. 1996 kW	31 Dec. 1997 kW	31 Dec. 1998 kW	31 Dec. 1999 kW	31 Dec. 2000 kW	31 Dec. 2001 kW	31 Dec. 2002 kW	31 Dec. 2003 kW	31 Dec. 2004 kW	31 Dec. 2005 kW	31 Dec. 2006 kW
Off-grid domestic	150	200	250	300	350	400	450	500	550	600	955	1 101	1 136	1 148	1 212
Off-grid non-domestic	15 260	19 170	23 260	29 360	35 890	44 900	52 300	56 200	63 000	66 227	71 692	77 792	83 109	85 909	87 376
Grid-connected distributed	1 220	2 300	5 130	10 820	20 500	43 100	77 750	149 000	263 770	383 086	561 295	777 830	1 044 846	1 331 951	1 617 011
Grid-connected centralized	2 370	2 600	2 600	2 900	2 900	2 900	2 900	2 900	2 900	2 900	2 900	2 900	2 900	2 900	2 900
Total	19 000	24 270	31 240	43 380	59 640	91 300	133 400	208 600	330 220	452 813	636 842	859 623	1 131 991	1 421 908	1 708 499

As shown in Table 1, grid-connected distributed PV application leads the PV market in Japan. As for off-grid domestic market, there are PV applications for mountain cottages, remote area, islands and certain applications for public and industrial uses, but the market scale is quite small. Main PV applications in the off-grid non-domestic market include power supplies for streetlight, telecommunication, remote monitoring, pumping, emergency measure for disaster, agriculture, traffic sign, ventilating fan and the like. The off-grid non-domestic market in Japan has already been established as a commercial market that does not require subsidy.

As for grid-connected centralized application, PV systems for demonstration have been installed so far, but no grid-connected centralized PV systems have been installed since 1995. However, as was mentioned, construction of 2- MW and 5-MW PV power plants by the national program will start in 2007.

Major applications of grid-connected distributed market are private houses, apartment houses, public, industrial and commercial facilities and buildings. The introduction volume of these areas has remarkably expanded year after year mainly because of PV system installations by METI's support measures and other ministries, government offices and local governments which have been taking the lead in installing PV systems to their own facilities.

Thus, development of PV market has been based on 3 - 5 kW residential PV systems and 10 - 1 000 kW scale PV systems for public facilities, industrial facilities and commercial buildings. The recent trend of this application is that installation of larger PV system has started and the number of the PV system with 100 kW or more of output capacity has been increasing. In 2006, a 5-MW PV system installed on the rooftop and walls of a factory started operation.

The activities for introduction of PV systems by supply side have been spreading to housing manufacturers, battery manufacturers, building material manufactures and construction companies from PV manufacturers. As a result, the user-oriented PV market in Japan has been developed and activated. The users have been fostering better understanding and the values of introduction of PV systems year after year, and this trend is spreading among individuals, national and local governments, large companies, small and medium-sized enterprises (SMEs), retailers and non-governmental organizations (NGOs).

In addition, electric utilities support dissemination of PV systems through purchase program of excess electricity, operation of Green Power Fund and implementation of required purchase of new energy set by the RPS law.

2.3 Major projects, demonstration and field test programs

Main demonstration programs implemented in 2006 were "Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications", "Field Test Project on New Photovoltaic Power Generation Technology", "Project for Promoting the Local Introduction of New Energy", "Project for Supporting New Energy Operators" and "Eco-School Promotion Pilot Model Project" (See also Table 1 in Annex C). In addition, support for disseminating PV system and model projects of introduction of PV system under the countermeasures for CO_2 reduction are implemented by the Ministry of the Environment (MoE).

(1) Residential PV System Dissemination Program

"Residential PV System Dissemination Program" started in April 1997 as a succeeding program of "Residential PV System Monitor Program" conducted from April 1994 to March 1997 to enlarge the scale of dissemination of PV systems. The Program that was completed in FY 2005 subsidized the PV installation cost for individuals on a condition that they provide the operation

data of their PV systems. The subsidy for 2005 per 1 kW was 20 000 JPY/kW while that of 2004 was 45 000 JPY/kW, it was increased year by year owing to the PV system price reduction.

3 590 residential PV systems, totaling 13,3 MW were installed between FY 1994 and FY 1996 under “Residential PV System Monitor Program”. From FY 1997 to FY 2004, 213 410 PV systems, 782,0 MW in total were installed. In FY 2004, the final fiscal year of “Residential PV System Dissemination Program”, 36 754 systems, totaling 136,3 MW were installed. Cumulative number of residential PV systems installed under these programs over 12 years reached 253 754 cases, totaling 931 575 kW. Thus, the support program for residential PV system made a substantial contribution in creation of the initial market of residential PV system.

(2) Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications

This program started in FY 1998 as a successor program of “PV Field Test for Public and Other Facilities (FY 1992 - FY 2001)”. Eligible installed sites are industrial and other facilities. The aims are; 1) to install PV systems for trial use employing new technologies effective to introduce to industrial sector, such as industrial facilities, 2) to demonstrate availability for introduction of PV systems by collecting data and analyzing a long-term operation and 3) to correspond further standardization and diversified introduction applications toward full scale deployment of PV systems.

Eligible co-researchers are private company, local public organizations and other organizations, which are going to install modular type PV systems and novel application of PV systems. Co-researchers bear half of PV installation cost. By the end of FY 2002, 740 PV systems, 18 100 kW in total were installed in schools, welfare facilities, manufacturing plants, warehouse, office buildings, private facilities, and so on.

While installation of PV systems was finished in 2002, collection and analysis of the data continued after that. The data collection and analysis finished in the end of FY 2006.

(3) Field Test Project on New Photovoltaic Power Generation Technology

This field test program started in FY 2003 as a successor program of Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications, aiming at adopting new technologies into PV systems for public and industrial facilities and accelerating further development. The object of the program is to promote further introduction of middle- and large-scale PV systems, improve the performance, and reduce the cost by adopting new technologies. Under the program, four system types are defined as the models adopting new technologies: 1) PV system with new type modules (next generation PV modules with solar cells using new materials and new type PV modules with improved functions and performance, total generation capacity: 10kW and more); 2) PV system with building material integrated (BIPV) modules (BIPV modules such as roof-integrated, wall-integrated PV modules, etc., which have function of building materials, total generation capacity: 4kW and more (from FY 2006, previously 10 kW or more); 3) PV system with new control system (PV system with storage equipment and PV system adopting balance of the system (BOSs) with improved performance and functions compared to the conventional ones, total generation capacity: 10kW and more) and 4) PV system aiming at higher efficiency (PV system with higher system efficiency by improving components, design and installation method by modifying conventional PV systems, total generation capacity: 10kW and more).

Eligible applicants for the projects are private businesses, local authorities and organizations. As co-researchers, they collect performance data of the PV system for 4 years and demonstrate the performance of the PV system. 50% of the installation cost is subsidized.

Under the Field Test, 148 PV systems totaling 4 480 kW, 262 PV systems totaling 7 161 kW and 457 PV systems totaling 17 709 kW were installed in FY 2003, FY 2004 and FY 2005 respectively.

In 2006, total 662 PV systems accounting for 22 080 kW were installed. The number of project by each type of PV system is: 2 for new type modules (30 kW in total), 33 for BIPV modules (1 064 kW in total), 17 for new control system (434 kW in total) and 610 for higher efficiency (20 552 kW in total). This project will be continued to FY 2010. Cumulative installed capacity of PV systems introduced by these Field Test Programs between FY 1992 and FY 2006 is expected to reach over 74 000 kW.

(4) Project for Promoting the Local Introduction of New Energy

This project aims at accelerating new energy introduction by supporting the regional projects established by local governments for introduction of new energy and nonprofit projects for introducing new energy systems by nonprofit organizations (NPOs). Local governments and municipalities using this program have been increasing year by year. The project was started in 1997 and NPOs became eligible since FY 2005 in addition to local governments.

Eligible new and renewable energies are PV power generation, wind power generation, use of solar thermal energy, differential temperature energy, natural gas co-generation, fuel cells, waste power generation, thermal utilization of wastes, wastes-derived fuel production, biomass power generation, thermal utilization of biomass, biomass-derived fuel production, thermal utilization of ice and snow and clean energy vehicles. The recipients of subsidy under this program are allowed to install the system within 4 years, so that new energy system can be introduced in multi-fiscal years. PV systems with 10 kW output and over are subsidized in 2005 (from 1997 to 2004, the output capacity of eligible PV system was 50 kW or more). Up to half or one third of system installation cost is subsidized for the project of new energy introduction, depending upon cases, and fixed amount (up to 20 MJPY for multi fiscal year and 5 MJPY for single fiscal year) is subsidized to the projects for enlightenment and introduction activities.

Recipients of the subsidy are required to report the utilization status of the system such as generated electricity for at least 4 years after full-scale operation of the introduced system.

In 2006, 111 projects were newly selected. Among them, 35 PV systems (1 130 kW in total) were granted for city halls and water treatment plants, primary and junior high schools, kindergartens and so on. The accumulated capacity of PV system installed and to be installed from FY 1998 to FY 2009 will be 23 678 kW, 261 PV systems in total.

(5) Project for Supporting New Energy Operators

This project started from 1997 aims at accelerating new energy introduction by supporting the business that launch introduction of new energy, such as PV power generation, wind power generation, solar thermal energy, differential temperature energy, natural gas co-generation, fuel cells, waste power generation, thermal utilization of wastes, wastes-derived fuel production, biomass power generation, thermal utilization of biomass, biomass-derived fuel production, thermal utilization of ice and snow, etc. from a viewpoint of energy security and global environmental protection. Among these new and renewable energies, output capacity of eligible PV system is designated as 50 kW or more. In addition, in case of multiple installations of different energies, PV system with 10 kW or more capacity is also eligible.

Eligibles for the subsidy or the guaranteed debt are private businesses that set about new energy introduction. Maximum third of system installation cost is subsidized (Maximum subsidy for a PV system is 1 billion JPY) and the guaranteed debt is 90% of a debt. The term of a subsidized

project is maximum 4 years.

In 2006, among 54 selected projects, 2 projects were aiming at installing PV system totaling 160 kW. Between 1998 and 2006, 385 projects were newly selected and among them, 14 PV projects, totaling 986 MW were approved. While PV systems are mainly introduced to factories under the Project, PV systems for all-electrified condominium buildings were also installed.

(6) Eco-school Promotion Pilot Model Project

This project was initiated in 1997 with the partnership of METI and the Ministry of Education, Culture, Sports, Science and Technology (MEXT). From 2002, Agriculture, Forestry and Fisheries Ministry (MAFF) joined to the partnership. Ministry of the Environment (MoE) newly joined in the partnership in FY 2005.

The project aims at implementing pilot model projects to promote introduction and demonstration of environmental-friendly schools, providing students with environmental education and improving school facilities.

Eligible projects are for 1) PV power generation, 2) use of solar thermal energy, 3) new energy utilization including wind power generation, geothermal energy and fuel cells, 4) energy conservation and resource saving, 5) symbiosis with nature, 6) utilization of wood building materials, 7) recycle of resources and 8) others (natural lighting and natural ventilation).

The MEXT provides the subsidy of fixed cost for investigation of basic planning, the subsidy of a half of cost for new construction of the school and one third of cost for rebuilding or retrofitting. METI's subsidies described above are available for PV system installation in new construction and renovation of schools.

609 schools were selected as the eco-school between FY 1998 and FY 2006. Total 387 schools were approved to install PV systems; 44 schools in 2006, 59 in 2005, 53 in 2004, 68 in 2003, 49 in 2002, 38 in 2001, and 36 in 2000, 16 in 1999, 11 in 1998, and 13 in 1997.

(7) PV support programs implemented by the Ministry of the Environment

Besides various PV support programs implemented by METI, The Ministry of Environment (MoE) is promoting PV support programs and model projects under the projects for CO_2 emission reduction. MoE established a plan of "Solar Promotion Program", a package of programs for introduction of PV system in 2005 and officially started full-implementation of the program from 2006.

The major subprograms for dissemination of PV system under "Solar Promotion Program" are 1) Town-wide CO_2 20% reduction projects (2 projects were selected in FY 2006 and PV power generation was introduced in one project), 2) Model project for shared use of MW-scale solar (3 sites were selected for 3-year PV installation projects in FY 2006. Total 3 MW of PV systems will be installed), 3) Model project for advanced introduction of renewable energy (2 model regional projects for CO_2 reduction were selected in FY 2005 (1 050 kW of PV systems were installed, new 2 projects are selected in FY 2006 (100kW in total)), 4) Project of environment-friendly renovation of schools (10 schools were selected in 2005, and 6 schools were selected in 2006), 5) Solar mileage club project and 6) Project for pioneering introduction of PV system by local governments.

In addition, MoE implements "model town project for virtuous cycle of environment and economy" aiming at achieving city planning including introduction of PV system, developed by local community. Under this program 3-year projects are supported. Number of selected projects so far

was 10 in 2004, 10 in 2005 and 2 in 2006, 22 in total.

2.4 Highlights of R&D

In the end of FY 2005 (March, 2006), 3 R&D projects; “Development of Advanced Solar Cells and Modules”, “Development of PV System Technology for Mass Deployment” and “Investigation for Innovative Photovoltaic Power Generation Technology”, conducted under “5-Year Plan for Photovoltaic Power Generation Technology Research and Development (FY 2001 – FY 2005)” by New Energy and Industrial Technology Development Organization (NEDO) were completed. In FY2006, new “4-Year Plan for Photovoltaic Power Generation Technology Research and Development (FY 2006 - FY 2009)” was launched, based on a roadmap for technological development of the PV system, “PV Roadmap toward 2030 (PV2030)”. Under the 4-Year Plan, 2 new projects, “R&D for Next Generation PV systems” and “PV System Technology for Mass Deployment, Phase II” were started as successive projects. In addition, “PV systems Advanced Practical Technology” to be completed in FY 2007 was continued during 2006. As for new demonstrative research projects a couple of new 5-year projects, “Verification of Grid Stabilization with Large-Scale PV Power Generation System” and “Development of an Electric Energy Storage System for Grid-connection with New Energy Resources”, started in 2006. “Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation Systems” and “Demonstrative Project of Regional Power Grids with Various New Energies” were also continued in 2006.

R&D for Next Generation PV systems aims at establishing elemental technologies to achieve the target PV power generation cost set in PV2030: 14 JPY/kWh for 2020, 7 JPY/kWh for 2030. Based on the outcome of the previous project, “Development of Advanced Solar Cells and Modules” that finished in the end of FY 2005, development of 5 types of technologies and search for new seed technologies started in August 2006. The project covers following 5 technologies.

1) Technological development of high-performance thin-film CIS solar cells: main research topics are development of low temperature process of CIS solar cell with light-weight substrate and development of wide-bandgap material. The target conversion efficiency has 3 categories: 18% for sub-module (10 cm x 10 cm), 16% for larger sub-module (30 cm x 30 cm) and 16% for sub-module using light-weight substrate (10 cm x 10 cm).

2) Development of highly-efficient and high-productivity thin film Si solar cells: major results are large area and high-speed deposition process of of μc-Si films (4 m^2), high-quality wide-gap materials, narrow-gap materials and tandem solar cell. Targets are to achieve at least 15% of conversion efficiency with PV modules and to establish the process with > 2.5 nm/s of film deposition rate.

3) Development of low-cost dye-sensitized solar cells (DSCs): major research issues are new dyes, tandem cell structure, and module process technology for high durability. Targets are 15% of conversion efficiency for small-sized cell and 8% for PV module (30 cm x 30 cm).

4) Development of next generation ultra-thin crystalline silicon solar cells: improvement of quality of multicrystalline silicon ingots, development of slicing technology of ultra-thin wafers and development of high-performance solar cell process using ultra-thin wafers are conducted to achieve 18% of conversion efficiency for 100-μm thick multicrystalline solar cell.

5) Development of organic thin-film solar cell: research for organic thin-film semiconducting materials for solar cell and devices using them are proceded aiming at 7% of conversion efficiency for small-sized cell (1 cm x 1 cm).

As for seed technology search, fundamental research for ultra-high performance solar cell and other technologies was started to achieve higher performance, further cost reduction and improvement in durability.

Development of PV System Technology for Mass Deployment, Phase II is a successor program of Development of PV System Technology for Mass Deployment (FY 2001 - FY 2005),

aiming at developing technological infrastructure for extensive application and mass deployment of PV systems. Projects under this program started in June 2006. Projects to develop evaluation technologies for performance and reliability of PV cell/ module and electricity output were continued. In addition, as environmental technologies for manufacturing process of PV system and disposal of used PV modules, life cycle assessment (LCA) and development of recycling technology of solar cell are conducted.

PV systems Advanced Practical Technology is a 3-year program started to support industrial technology aiming at practical application of the results of R&D so far. In 2006, the middle year of the 3-year plan, following technological development were conducted: recycling technology of silicon feedstock for solar cell, manufacturing technology of spherical silicon solar cells, high-performance inverter and autonomous PV system technology.

Verification of Grid Stabilization with Large-Scale PV Power Generation System was newly started for development of PV system-related technologies. It aims at constructing MW-scale PV power plants, establishing stabilization technologies of output power for the MW-scale PV power plants and verifying effectiveness and usefulness of the developed technologies. The final goal of this research is verifying the technologies to make the business using future MW-scale PV power plants feasible. A 5-MW scale project in Wakkanai City of Hokkaido Prefecture and a 2-MW scale project in Hokuto City of Yamanashi Prefecture were selected and construction was launched in both sites.

Development of an Electric Energy Storage System for Grid-connection with New Energy Resources aims at developing high-performance, low cost storage systems with longer operating time for large-scale energy system including MW-scale PV power plants. In 2006, 11 subprojects on lithium secondary batteries and other batteries and storage system started.

Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation Systems aims at developing general purpose technologies to resolve restraint of power generation and influence to the grid caused by intensively and massively installed grid-connected PV systems with storage batteries. The specific research objectives are 1) development of technology to avoid restriction of PV system output by using storage batteries, 2) analysis and evaluation of higher harmonics, 3) analysis and evaluation of devices for mis-actuation function to prevent islanding operation, 4) development of applied simulations and 5) evaluation of characteristics of power generation and economical efficiency. Installation of 550 residential PV systems with storage batteries in the testing site (residential estate) in Ohta City of Gunma Prefecture was completed by the beginning of FY2006. Operation test and evaluation of output control, evaluation of new devices for mis-actuation function to prevent islanding operation and so on were conducted. This project will be completed in FY 2007.

Demonstrative Project of Regional Power Grids with Various New Energies is conducted to intensively install various types of distributed power sources such as PV systems, fuel cells and wind power generators, etc. in one area, aiming at demonstrating various issues: ensuring quality of electricity, balance between supply and demand of electricity, stability, and studying economical performance of distributed power sources. In FY2003, 3 demonstrative sites were selected across the country: Aichi Prefecture (total 2 225 kW of distributed power generation systems including PV systems totaling 330 kW), Aomori Prefecture (total 714 kW of distributed power generation systems including an 80-kW PV system) and Kyoto Prefecture (total 850 kW of distributed power generation systems including a 50-kW PV system). Demonstrative operation of the power generation systems was started in FY2005 and operation was continued in FY 2006. The power generation systems installed in the premises of the 2005 World Exposition (EXPO 2005), Aichi, Japan, were relocated to Central Japan Airport City in Tokoname City of Aichi Prefecture and the demonstrative research was resumed from August 2006. This research will be completed in FY 2007.

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

The 2006 budgets for PV systems are mainly based on the national budgets on R&D, demonstration programs and market incentives. The budget for R&D was allocated to R&D for Next Generation PV systems", "PV System Technology for Mass Deployment, Phase II" and "PV systems Advanced Practical Technology", etc. The budget for demonstration and filed test was allocated for "Field Test Project on New Photovoltaic Power Generation Technology", "Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications" and "Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation" and Demonstrative projects "Verification of Grid Stabilization with Large-Scale PV Power Generation System", etc. Introduction of PV system is mainly implemented under "Field Test Project on New Photovoltaic Power Generation Technology" and Verification of Grid Stabilization with Large-Scale PV Power Generation System. As for the budget for market initiatives, METI's "Residential PV system Dissemination Program" was completed and current major initiative is "Solar Promotion Program", a newly implemented plan by the Ministry of Environment (Moe). Moreover, PV systems can be installed using the budgets for introduction of new energy such as "Project for Promoting the Local Introduction of New Energy", "Project for Supporting New Energy Operators" and "Demonstrative Project of Regional Power Grids with Various New Energies". However, as these budgets include other new energies, they are not included in Table 2. Also the budget for "International Cooperative Demonstration Projects for Stabilized and Advanced Grid-connection PV Power Generation System" (790 MJPY) and the budget for PV system introduction by other ministries and government offices except METI are not included in Table 2. The budgets of local governments are complementarily appropriated for market incentives for mainly residential PV system. The number of local governments having complementary budgets is 319 in 2006. The amount of subsidy varies by municipalities (e.g. 20 000 JPY/kW to 100 000 JPY/kW), and the total amount is unknown.

Table 2 Public budgets (in National Currency) for R&D, demonstration/ field test programmes and market incentives.

	2004			2005			2006		
	R&D	Demo/ Field Test	Market	R&D	Demo/ Field Test	Market	R&D	Demo/ Field Test	Market
National [1] (MJPY)	6 540	11 110	5 250	4 100	10 590	2 600	3 170	13 600	4 150
Regional [2] (MJPY)	-	-	-	-	-	-	-	-	-
Total	6 540	11 110	5 250	4 100	10 590	2 600	3 170	13 600	4 150

[1]: The figures in Table 2 shows METI's budget. The budgets of other ministries and government offices except METI are unknown.

[2]: 319 Municipalities are implementing additional subsidy program on residential PV systems in 2006, but the budget are unknown.

3 Industry and growth

3.1 Production of silicon feedstock, ingot and wafer for solar cells

In Japan, 3 companies manufacture polycrystalline silicon for the feedstock for solar cell: 1) Tokuyama (production capacity: 5 200 t/year), 2) Mitsubishi Materials Polycrystalline Silicon (production capacity: 1 600 t/year) and Sumitomo Titanium (production capacity: 900 t/year). Production volume for polycrystalline silicon solar cell in 2006 was 1 200 t in total (Tokuyama: 1 000 t, Mitubishi Materials Polycrystalline Silicon: 200 t). In addition, several manufacturers conducted research and development (R&D) of solar grade silicon (SoG-Si): Tokuyama with vapor to liquid deposition (VLD) process, Chisso with Zn reduction process, etc.

Tokuyama has been conducting demonstration of VLD process using a 200-t/year pilot plant and announced enhancement of production capacity of the plant using conventional process, Siemens process, from 5 200 t/year to 8 200 t/year by 2009.

Chisso jointly established a new company, “Japan Solar Silicon (JSS)” with Nippon Mining Holdings and Toho Titanium in 2007 to promote joint development of SoG-Si aiming at commercialization of its Zn reduction process. JSS is planning to construct a pilot plant with a capacity of 100 t/year in middle of 2008.

In addition, JFE Steel (former Kawasaki Steel) started full-scale operation of a 100 t/year-scale plant of SoG-Si and M.Setek started construction of SoG-Si plant with a capacity of 500 t/year. Nippon Steel Corporation also announced to enter SoG-Si manufacturing and established “NS Solar Material”.

M.Setek, SUMCO (former Mitsubishi Sumitomo Silicon) and JFE Steel are manufacturing Si ingots and wafers for solar cells. Space Energy (former Metal Reclaim) and Shin-Etsu Film manufacture Si wafers from purchased Si ingots. Besides these producers, Kyocera manufactures Si ingots and wafers for in-house use.

With expansion of the global demand for solar cell, companies that newly started to manufacture Si ingots and wafers for solar cells have been increasing. The thickness of Si wafers for solar cell has been rapidly getting thinner and thinner and wafers with thickness of 200 μm or less are increasing. The thinnest commercial wafer so far developed was 150 μm thick. In addition to these trends, FujiPream and CleanVenture 21 (CV21) jointly started commercialization of spherical solar cell with lower silicon consumption unit.

Table 3a shows the process of each manufacturer. Technical data of typical products for solar cells are described in Table 3b. Table 3c shows the new developments and products in 2006. Table 3d shows the expansion plan of the manufacturing capacity.

Table 3 Production and production capacity information for silicon feedstock, ingot and wafer manufacturers (2006).

Manufacturer	Process & technology [1]	Total Production	Maximum production capacity	Product destination
Tokuyama	Polycrystalline silicon for solar cell (Siemens process)	About 1 000 t	5 200 t/yr (including feedstock for semiconductor)	N.A.
Mitsubishi Materials Polycrystalline Silicon	Polycrystalline silicon for solar cell (Siemens process)	200 t	200 t/yr	N.A.
M.Setec	sc-Si ingot (CZ process[2])	1 017 t	1 200 t/yr	N.A.
	sc-Si wafer	115 MW	140 MW/yr	N.A.
JFE Steel	Cast mc-Si ingot (Directional solidification process)	1 100 t[3]	1 500 t/yr	N.A.
	mc-Si wafer	70 MW	160 MW/yr	N.A.
SUMCO	sc-Si ingot	200 t	200 t/yr	N.A.
	mc-Si wafer [4]	75 MW	75 MW/yr	N.A.
Shin-Etsu Film	Cast mc-Si ingot	30 t	30 t/yr	N.A.
	sc-Si wafer	13 MW	35 MW/yr	N.A.
	mc-Si wafer	50 MW	50 MW/yr	N.A.
Space Energy	sc-Si wafer	50 MW	60 MW/yr	N.A.
Kyocera	mc-Si wafer	180 MW	240 MW/yr	In-house use

[1]: mc: multicrystalline, sc: single crystalline

[2]: Czochralski process

[3]: Based on raw material

[4]: Manufactured by SUMCO Solar (affiliated company of SUMCO)

Table 3a Process and technology for feedstock, ingot and wafer manufacturers (2006).

Manufacturer	Process & technology
Tokuyama	- Polysilicon manufacturing using Siemens process
Mitsubishi Materials Polycrystalline Silicon	- MG Silicon (98%) → Siemens process → polysilicon
M.Setek	- Si feedstock (purchased from the outside) → sc-Si ingot (CZ process[1])→ sc-Si wafer
JFE Steel	- Si feedstock (purchased from the outside) → cast mc-Si ingot (directional solidification process) → mc-Si block and mc-Si wafer
SUMCO	- Si feedstock (purchased from the outside) → cast mc-Si ingot → mc-Si mc-Si wafer - Si feedstock (purchased from the outside) → CZ process → sc-Si ingot
Shin-Etsu Film	- ingot : Si feedstock (purchased from the outside) → cast mc-Si ingot (or → slicing → mc-Si wafer) - wafer : feedstock (purchased from the outside) (sc- or mc-Si ingot) → slicing → sc- or mc-Si wafer
Space Energy	- sc-Si ingot (CZ process, purchased from the outside, supply to affiliate or companies) → sc-Si ingot (by affiliate companies) → sc-Si wafer
Kyocera	- Si feedstock (purchased from the outside) → mc-Si wafer

[1]: Czochralski process

Table 3b Specification of the products for feedstock, ingot and wafer Manufacturers (2006).

Manufacturer	Product	Specification
Tokuyama	High-purity Polycrystalline silicon	N.A.
Mitsubishi Materials Polycrystalline Silicon	Polycrystalline silicon	depends on each user
M.Setek	sc-Si wafer (P-type)	125 mm x 125 mm, 0,5 - 2,0 Ωcm, 235 µm
	sc-Si wafer (N-type)	125 mm x 125 mm, 0,5 - 3,0 Ωcm, 200 µm
JFE Steel	mc-Si ingot (P-type)	850 mm Φ, 1,0 Ωcm, max 250 mm
	mc-Si wafer (P-type)	200 µm
SUMCO		Size: 1) 156 mm x 156 mm, 2) 156,5 mm x 156,5 mm Thickness: 1) 220 µm, 2) 200 µm, 3) 180 µm
Shin-Etsu Film	mc-Si ingot (P-type)	0,5 - 5,0 Ωcm, life time ≥ 5 µsec
	mc-Si wafer (P-type)	155mm x 155mm, 0,3 - 5,0 Ωcm, 180 - 220 µm
	mc-Si wafer (P-type)	125mm x 125mm, 0,3 - 5,0 Ωcm, 180 - 220 µm
	sc-Si wafer (P-type)	155mm x 155mm, 0,3 - 5,0 Ωcm, 200 - 240 µm
	sc-Si wafer (P-type)	125mm x 125mm, 0,3 - 5,0 Ωcm, 180 - 240 µm
Space Energy	P-type	125 - 126 mm x 125 - 126 mm, 3 - 6 Ωcm, 200 - 240 µm
		156 mm x 156 mm, 3 - 6 Ωcm, 200 - 240 µm
	N-type	104 mm x 104 mm, 3 - 6 Ωcm, 220 µm
		125 mm x 125 mm, 3 - 6 Ωcm, 200 µm

Table 3c New products or new development of silicon feedstock, ingot and wafer manufacturers (2006).

Manufacturer	New product/ new development
Tokuyama	- Nothing to report
Mitsubishi Materials Polycrystalline Silicon	- Nothing to report
M.Setek	- sc-Si wafer, 125 mm x 125 mm, 190 µm
JFE Steel	- Nothing to report
SUMCO (former Sumitomo Mitsubishi Silicon)	- Nothing to report
Shin-Etsu Film	- wafer with 150 µm thick
Space Energy	- Nothing to report

Table 3d Plans for expansion of manufacturing capacity for silicon feedstock, ingot and wafer manufacturers.

Manufacturer	Process & Technology	Production capacity in 2006	Production capacity in 2007	Production capacity from 2008 onwards
Tokuyama	Silicon feedstock for solar cell	5 200 t/yr (including Si for semiconductor)		New capacity by the middle of 2009 (for semiconductor and solar cell)
Mitsubishi Materials Polycrystalline Silicon	Polycrystalline silicon[1]	200 t/yr	200 t/yr	200 t/yr
M.Setek	sc-Si ingot	1 200 t/yr	2 200 t/yr	2 500 t/yr
	sc-Si wafer	140 MW/yr	180 MW/yr	295 MW/yr (2008)
JFE Steel	mc-Si ingot	1 500 t/yr	1 500 t/yr	Not yet determined
	mc-Si wafer	160 MW/yr	160 MW/yr	Not yet determined
SUMCO	sc-Si ingot [1]	200 t/yr	200 t/yr	Not yet determined
	mc-Si wafer	75 MW/yr	80 MW/yr	95 MW/yr
Shin-Etsu Film	mc-Si ingot	30 t/yr	50 t/yr	
	sc-Si wafer	35 MW/yr		80 MW/yr (by 2009)
	mc-Si wafer	50 MW/yr		130 MW/yr (by 2009)
Space Energy (former Metal Reclaim)	sc-Si ingot (subsidiary in China)		67.5 t/yr	375 t t/yr (Not yet determined)
	sc-Si wafer	60 MW/yr	60 MW/yr	150 MW/yr (2008) 210 MW/yr (2010)
Kyocera	mc-Si wafer	240 MW/yr	240 MW/yr	500 MW/yr (2010)

[1]: Capacity of sc-Si ingot for solar cell is influenced by the market status of Si for semiconductor

3.2 Production of photovoltaic cells and modules

Table 4 shows the outline of major PV cell and module manufacturers in Japan.

In 2006, 10 companies were listed as PV cell/ module manufacturers Sharp, Kyocera, Sanyo Electric, Mitsubishi Electric, Kaneka, Mitsubishi Heavy Industries (MHI), Hitachi, Fuji Electric Systems, Honda Motor and FujiPream/ CleanVenture 21 (CV21). Among them, Hitachi manufactures bifacial silicon solar cell. Fuji Electric and Honda Motor started to manufacture a-Si PV module and CIGS PV module respectively in pilot scale. FujiPream/ CleanVenture 21 produced spherical Si PV module experimentally.

Fuji Electric Systems completed a 15-MW/year plant in Kumamoto Prefecture. Honda established “Honda Soltec”, a subsidiary for manufacturing, in Kumamoto Prefecture. Showa Shell Sekiyu also completed a 20-MW/year plant for CIGS solar cell in Miyazaki Prefecture aiming at starting operation in 2007.

As for module manufacturers, MSK is specialized in manufacturing PV modules. In 2006, MSK was acquired by Suntech Power Holdings, a major solar cell/ module manufacturers in China.

In 2006, more than 900 MW of solar cell was produced in Japan and the total exported shipment of solar cell/module was 629,1 MW.

Table 4a shows average prices of PV modules for residential PV system. Table 4b shows PV module production processes of the manufacturers in Japan. Table 4c shows the technical data of typical modules for residential and power uses. Table 4d shows the present status of PV module certification of module manufacturers. Table 4e shows new developments and products of PV cell and module manufacturers in Japan. Table 4f shows plan for future expansion in PV cell/ module production capacity.

Table 4 Production and production capacity information for each module manufacturer (2006).

Cell/Module manufacturer	Technology [1]	Total Production (MW)		Maximum production capacity (MW/year)	
		Cell	Module	Cell	Module
Sharp	sc-Si	190,43	113,09	585	N.A.
	mc-Si	236,12	151,01		
Kyocera	mc-Si	180	180	240	240
Sanyo Electric	a-Si/sc-Si (HIT)[2]	150	N.A.	165	95[3]
Mitsubishi Electric	mc-Si	111	111	135	135
Hitachi	sc-Si	4	0,06	10	5
Clean Venture 21	spherical Si	0	-	1	
MSK	sc-Si	-	22	-	-
	mc-Si	-	14	-	200
Fuji Pream	mc-Si	-	0,1	N.A.	N.A.
Showa Shell Sekiyu	mc-Si	-	-[4]	-	-
Thin film manufacturers					
Sharp	a-Si	8,2	8,2	15	15
Sanyo Electric	a-Si[5]	0	5	N.A.	5
Kaneka	a-Si a-Si/poly-Si hibrid	27	27	30	30
Mitsubishi Heavy Industries (MHI)	a-Si	13	13	14	14
Fuji Electric Systems	a-Si	0,05	0,05	3	3
Honda Motor	N.A.	N.A.	N.A.	N.A.	N.A.
MSK	a-Si	-	0,9	-	5
Total		919,8	645,41	1 198	747

[1]: mc: multicrystalline, sc: single crystalline, a: amorphous, µc: microcrystalline

[2]: HIT: Heterojunction with Intrinsic Thin layer solar cell

[3]: Capacity in outside of Japan: 75MW/year

[4]: About 4 MW of mc-Si PV module was purchased from outside in 2006

[5]: For consumer use

Table 4a Typical module prices (JPY/W) for residential use for a number of years.

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
price	966	950	927	764	646	652	652	598	542	481	462	451	441	428	433

Table 4b PV module production processes of manufacturers (2006).

Cell/module manufacturer	Description of main steps in production process
Sharp	- Purchase of sc-Si wafer → sc-Si cells → Modules - Purchase of Si feedstock → sc-Si wafer → sc-Si Cells → Modules - Purchase of mc-Si wafer → mc-Si cells → Modules - Purchase of Si feedstock → mc-Si wafer → mc-Si Cells → Modules
Kyocera	- Purchase of Si feedstock → mc-Si wafer → mc-Si cells → Modules
Sanyo Electric	- Purchase of Si feedstock → sc-Si wafer → HIT cells → Modules ↑ Purchase of sc-Si wafer
Mitsubishi Electric	- Purchase of mc-Si wafer → mc-Si cells → Modules
Hitachi	- Purchase of sc-Si wafer → sc-Si cells → Modules
Clean Venture 21	- Purchase of polysilicon →spherical Si solar cell
MSK	- Purchase of mc-Si, sc-Si cells and a-Si cell → Modules
FujiPream	- Purchase of sc-Si and mc-Si cells → Modules (Standard, light-transmissive type)
Showa Shell Sekiyu	- Purchase of approximately 4 MW of mc-Si modules
Thin-film manufacturers	
Kaneka	- Purchase glass substrate → forming a-Si layer → module
Mitsubishi Heavy Industries (MHI)	- Purchase of Glass substrate → TCO process → formation of a-Si layer → back contact formation → PV module (framing and packaging)
Fuji Electric Systems	- Purchase of SiH_4 → a-Si Modules → Modules

Table 4c PV modules for residential and power uses (2006)(1/2).

Module Manufacturer	Typical module data						Residential use	Power use
	Cell technology	W x L x D (mm)	Weight (kg)	P_{max} (W)	V_{op} (V)	I_{op} (A)		
Sharp	mc-Si	1 165 × 900 × 46	14,5	153	20,30	7,54	-	√
	sc-Si	1 165 × 990 × 46	14,5	165	20,56	8,03	-	√
	mc-Si	1 200 × 802 × 46	12,5	132	26,40	5,00	-	√
	mc-Si	1 165 × 990 × 46	14,5	142	19,92	7,13	-	√
	mc-Si	1 200 × 802 × 46	9,9	100	20,38	4,91	-	√
	mc-Si	1 512 × 330 × 34,9	8,8	52,5	10,70	4,91	-	√
	mc-Si	1 535 × 280 × 29,7	7,8	52,5	10,70	4,91	-	√
	mc-Si	1 640 × 994 × 46	21,0	200	28,42	7,04	-	-
	mc-Si	1 323 × 1 004 × 46	16,5	167	22,98	7,27	-	-
	mc-Si	1 200 × 802 × 46	12,5	120	25,43	4,72	-	-
	mc-Si	1 200 × 530 × 35	8,5	80	16,95	4,72	-	-
	sc-Si	1 200 × 530 × 35	8,5	84	17,42	4,83	-	-
	a-Si	1 165 × 990 × 46	19,0	85	49,00	1,74	-	√
	a-Si	1 180 × 985 × 15	39,0	58	—	—	-	-
	a-Si	1 180 × 985 × 27,8	63,0	58	—	—	-	-
Kyocera	mc-Si	972 × 345 × 8	3,7	45	7,4	7,50	√	√
	mc-Si	1 296 × 345 × 8	4,8	60	9,8	7,50	√	√
	mc-Si	1 286 × 1 008 × 36	15,5	180	29,4	7,57	√	√
	mc-Si	1 290 × 990 × 36	15,5	178,6	29,4	7,51	-	√
	mc-Si	1 425 × 652 × 36	12,2	130	21,9	7,39	√	√
	mc-Si	1 290 × 990 × 36	16	175	29,2	7,42	√	√
	mc-Si	1 425 × 990 × 36	18,5	200	32,9	7,61	√	√
Sanyo Electric	HIT	1 319 × 894 × 35	14,0	200	55,8	3,59	√	√
	HIT	1 443 × 812 × 35	14,0	195	38,2	5,11	√	√
	a-Si	-	-	-	-	-	-	-
Mitsubishi Electric	mc-Si	1 271 × 827 × 37	13,0	134	19,4	6,91	√	√
	mc-Si	1 248 × 803 × 46	12,5	134	19,4	6,91	√	√
	mc-Si	1 580 × 800 × 46	15,5	167	24,2	6,91	√	√
	mc-Si	1 425 × 646 × 46	11,5	120	17,6	6,84	√	√
	mc-Si	1 248 × 499 × 46	8,5	77	11,3	6,83	√	√
	mc-Si	1 658 × 834 × 46	19,5	180	24,2	7,45	√	√
	mc-Si	1 495 × 674 × 46	13,5	125	17,3	7,23	√	√
Hitachi [1]	sc-Si	868 × 1 120 × 9	19	102 82	22,3 22,7	4,6 3,6	-	√
MSK	sc-Si	1 480 × 985 × 46	19	210	25,8	8,14	√	√
	mc-Si	1 480 × 985 × 46	19	190	25,8	7,36	√	√
	a-Si	980 × 950 ×10,5	23	38	58,6	0,65	√	√
Fuji Pream	mc-Si	1 580 × 2 413 × 17	174	279	44,7	6,24	-	√[2]
Showa Shell Sekiyu	mc-Si	827 × 1 271 × 37	13	134	19,4	6,9	√	√
	mc-Si	1 012 × 1 290 × 36	16,5	175	23,6	7.4	√	√

[1]: Upper line: surface, Under line: rear face

[2]: Building integrated type

Table 4c PV modules for residential and power uses (2006) (2/2).

Module Manufacturer	Typical module data						Residential use	Power use
	Cell technology	W x L x D (mm)	Weight (kg)	P_{max} (W)	V_{op} (V)	I_{op} (A)		
Thin-film manufacturers								
Kaneka	a-Si	960 × 990 × 40	13,7	60	67[1]	0,90[1]	√	√
	Hybrid	918 × 350 × 34	4,6	17,5	97,2	0,181	√	
	Hybrid	950 × 465 × 38	5,9	36,5	48,6	0,751	√	√
Mitsubishi Heavy Industries (MHI)	a-Si	1 400 × 1 100	21	100	100	1	√	√
Fuji Electric Systems	a-Si	525 × 3 881 × 15	15,7	96	320	0,3		√
	a-Si	460 × 3 399 × 1	1,57	96	320	0,3		√
	a-Si	460 × 1 733 × 1	0,80	48	160	0,3		√
	a-Si	460 × 900 ×1	0,42	24	80	0,3		√
	a-Si	253 × 900 × 1	0,23	12	80	0,15		√

[1]: data for reference

Table 4d Present status of certification of module manufacturers (2006).

Module manufacturer	Certification of modules	Certification of plant
Sharp	IEC 61215 (JET, TÜV) IEC 61646 (JET) UL 1703 TÜV Safety Class II	IEC 61215 (JET, TÜV) IEC 61646 (JET) ISO 9001-2000 ISO 14001 UL 1703
Kyocera	IEC 61215 ISO 9000 UL 1703 TÜV Safety Class II ISO 14001	IEC 61215 ISO 9000 UL 1703 ISO 14001
Mitsubishi Electric	IEC 61215 UL 1703 TÜV Safety Class II	ISO 9000
Sanyo Electric	IEC 61215 ISO 9000 UL 1703 TÜV Safety Class II	IEC 61215 (HIT) ISO 9000 (HIT) UL 1703 (HIT) TÜV Safety Class II
Hitachi	IEC 61215 (JET)	
Clean Venture 21		
Showa Shell Sekiyu	JET (for mc-Si PV module)	
MSK	IEC 61215 (sc-Si, mc-Si) IEC 61646 (a-Si) JISC 8990 (sc-Si, mc-Si) JIS C 8991 (a-Si) UL 1703 (a-Si) TÜV Safety Class ll (sc-Si, mc-Si) JFTPVm (sc-Si, mc-Si, a-Si)	IEC 61215 (sc-Si, mc-Si) IEC 61646 (a-Si) ISO 9000 JISC 8990 (sc-Si, mc-Si) JIS C 8991 (a-Si) UL 1703 (a-Si) TÜV Safety Class ll (s sc-Si, mc-Si)
FujiPream	IEC 61215 (under application)	IEC 61215 (under application)
Thin film manufacturers		
Kaneka	IEC 61646 UL 1703 TÜV Safety Class II JISC8991	
Mitsubishi Heavy Industries (MHI)	IEC 61646 (JET, TÜV) ISO 9000	IEC61646 (JET, TÜV) ISO 9000
Fuji Electric Systems	IEC 61646	

Table 4e New developments and new products of manufacturers (2006) .

Cell/Module manufacturer	New developments an new products
Sharp	- Started to sell FY 2006 model of PV modules for residential application (April 13 2006) - Started to sell a power conditioner for the PV system with higher efficiency (July 24 2006) - Acquired certification of Eco-mark for PV modules for the first time in the industry (August 21 2006) - Started to sell solar light “LN-L19ZA”, achieved the highest brightness for outdoor LED lights in the industry by employing newly developed LED lamp with higher brightness and longer lifetime (September 8 2006) - Enhanced production capacity to 600 MW/year, the world No.1 production capacity (October 30 2006) - Commercialized higher-output PV modules for industrial application and 2 types of thin-film PV module (November 15 2005)
Kyocera	- Commercialized ”ECONOROOTS type R”, PV system achieved light weight and easier installation - Commercialized ”ECONONAVIT ii”, a new power generation monitoring display device showed graphic display, displaying easily understandable data, enabled indoor use - Achieved world highest efficiency of 18,5 % in mc-Si solar cell (155 mm x 150 mm)
Sanyo Electric	- Commercialized 195 W PV module using 66 pieces of HIT cell (125 mm x 125 mm) for domestic market - Developed a 2,7-kW power conditioner, best suited for ≤ 3 kW PV system and commercialized it for domestic market - Developed and commercialized wireless color monitoring device to display power generation data, amount of purchased and sold electricity for residential PV systems in domestic market - Achieved 21,8% of conversion efficiency of HIT cell (100 cm^2) in laboratory level - Developed and commercialized solar charger for nickel hydride battery (eneloop)
Mitsubishi Electric (MELCO)	- Commercialized new PV module using 156 mm x 156 mm cell (conventional one was 150 mm x 150 mm) for overseas market in September 1, 2006 (PV-MF180TD4) - Commercialized 2 types of power conditioners for European market in September 1, 2006 (3,3-kW type: PV-PNS04ATL and 4,6-kW type: PV-PNS06ATL)
Hitachi	- Improvement of output of bifacial PV cell - Cost reduction of double-glass bifacial PV module
Clean Venture 21 (CV21)	- Development of light-collecting spherical solar cell - Establishment of mass-production technologies of light-collecting spherical solar cell
MSK	- Commercialized a roof-integrated PV system (Ecolony, Reroof) - Development of small-sized PV module (5W, 10W, 20W and 40W) - Development of small-sized stand-alone power source - Development of snow-melting PV system
FujiPream	- Building material integrated light-through PV module
Showa Shell Sekiyu	- Commercialized residential PV systems using mc-Si PV module with higher efficiency
Kaneka	- Lead-free PV modules (all the products)
Mitsubishi Heavy Industries (MHI)	- Construction of a 40-MW scale plant for a-Si/µc-Si tandem PV module with 150 W of power generation output - Development of silicon thin-film PV module with 15% of conversion efficiency and 4 m^2 substrates

Fuji Electric Systems	- Development of mass-production technologies using 1-m width film-Established a new manufacturing base, Kumamoto Factory and started operation - Development of building material integrated PV module

Table 4f Plans for future expansion of production capacity.

Manufacturer	Production capacity in 2006 (MW/yr)	Production capacity in 2007 (MW/yr)	Production capacity from 2007 onwards	Technology
Sharp	585	695	N.A.	mc-Si, sc-Si
Kyocera	240	240	500 MW/yr (by 2010)	mc-Si
Sanyo Electric	170	260	350 MW/yr (by 2008)	HIT (a-Si on sc-Si)
Mitsubishi Electric	135	145	230	mc-Si
Hitachi	10	10	30 MW/yr (by 2009)	sc-Si
Clean Venture 21	1	15	155 MW/yr (by 2012)	light-collecting spherical Si
MSK	200	200	Constructing overseas factory by 2010	mc-Si
	5	5	Details are not yet decided	a-Si
Fuji Pream		12	Under review	mc-Si, etc.
Thin film manufacturers				
Sharp	15	15	N.A.	a-Si
Sanyo[1]	5	5	-	a-Si
Showa Shell Sekiyu[2]	-	20	to decide according to future demand	CIS
Kaneka	30	55	70 MW/yr	a-Si, a-Si/μc-Si hybrid
Mitsubishi Heavy Industries	14	28	28 MW/yr	a-Si
	-	40	100 MW/yr (2008) new 100 MW/yr-capacity (plan), 2009 and onward	μc-Si
Fuji Electric Systems	3	12	40 MW/yr by 2009	a-Si

[1]: For consumer products
[2]: Manufacturing will be start by a 100% subsidiary, “Showa Shell Solar” from 2007

3.3 Manufacturers and supplies of other components

While several dozen companies manufacture inverters (power conditioners), over 10 companies manufacture inverters for PV systems in Japan. Most of them are manufacturers of electric appliances, power supply systems, electric components and general electric machines. 6 inverter manufacturers are registered to the voluntary certification program of Japan Electrical Safety and Environment Technology Laboratories (JET): Sharp, Sanyo Electric, Mitsubishi Electric (MELCO), Omron, GS Yuasa (former Japan Storage Battery) and Fuji Electric Systems. The capacity of commercialized inverters in distributed in the market ranges from 1,5 to 5,5 kW, mainly 3 kW, 4 kW, 4,5 kW and 5,5 kW. Standardization and mass production of inverters including islanding prevention system integrated into them for residential PV systems have been promoted as well as miniaturization and weight saving.

10 - 1 000 kW PV systems have been installed for public and industrial facilities. As NEDO promoted standardization of 10-kW inverters under the Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications and Field Test Project for Public Facilities, large numbers of 10-kW inverters are supplied for this application area. 10-kW inverters are also accredited by JET, and Sharp, GS Yuasa, Sanyo Denki, Mitsubishi Electric are registered. As under the Field Test Project on New Photovoltaic Power Generation Technology, capacity of the inverters is not specified, standardization of 100-kW scale inverters is advancing for larger PV system. Sharp, GS Yuasa, Sanyo Denki, Meidensha, Matsushita Electric Industrial, etc. entered this area. Generally, 10-kW inverters are connected in parallel for PV installations ranging 10 to 100 kW. However, due to price reduction of 100-kW inverter, 100-kW unit inverters were started to be adopted for PV system with the capacity of 100 kW or more. It is expected that further cost reduction and standardization of 100-kW inverters will be advanced with the increase of larger PV system with 100 kW or more output capacity. In addition, monitoring and control functions of inverters as well as parallel operation function for PV system for public and industrial uses have been reinforced for PV system with larger capacity.

In near future, PV system will be installed with storage batteries having longer lifetime, which has been developed recently, as PV systems can be installed network with improved autonomy using micro-grid or PV systems can correspond to linearization of electric load.

In Japan, currently, installations of stand-alone PV systems remain much less common than that of grid-connected PV systems, so that, standardization of stand-alone system is less advanced. If micro-grid with storage batteries is realized, it is expected that standardization of inverters and storage batteries for those applications.

Table 4g shows the prices of inverters sold for grid-connected PV application.

Table 4g Price of inverter for grid-connected PV applications (2006).

Size of inverter	Average price per kVA in 2005 (JPY)	Average price per kVA in 2006 (JPY)
≤ 1 kVA	-	-
1,5 - 5,5 kVA [1]	77 000	77 000
10 - 100 kVA [2]	100 000	96 500
> 100 kVA [3]	100 000	93 000

[1] : Single phase, 3-5 kW for residential use

[2] : 10-100 kVA, in case of three phase 10 kW unit is used

[3]: > 100 kVA, in case of three phase 100 kW unit is used

3.4 System prices

Table 5 shows the typical application of PV systems and the price by category. Table 5a shows the trends in system prices from 1992. The standardization of grid-connected systems has progressed with the growth of the PV market in Japan, and the prices have been reducing. On the other hand, the off-grid system prices are determined case by case because there are various types of application areas and each market scale is small.

Table 5 Turnkey Prices of typical applications (2006).

Category / Size	Typical applications and brief details	Typical price (JPY/W)
Off-grid [1] Up to 1 kW	Telecommunications, lighting, traffic and road signs, pumps, ventilating fans, remote monitoring, navigation signs, clock towers, etc.	Depending on cases
Off-grid > 1 kW	Agricultural facilities, communication facilities, disaster prevention facilities, mountain cottages, park facilities, remote area housing, lighthouses, etc.	Depending on cases
Grid-connected up to 10 kW	Residences, park facilities, small public facilities, etc.	680 JPY/W
Grid-connected > 10 kW	Plants, warehouses, commercial buildings, larger public facilities, road buildings, railway facilities, etc.	750 JPY/W

[1] : Prices do not include recurring charges after installation such as battery replacement or operation and maintenance

Table 5a National trends in system prices (JPY/W).

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Public & Industrial (>10 kW)	4 300	3 400	2 800	2 400	1 500	1 300	1 190	1 040	1 010	850	840	770	770	730	750
Residential (3-5 kW)	-	3 500	1 920	1 510	1 090	1 060	1 070	940	860	770	710	680	670	665	680

3.5 Labor places

Estimated labor places are as follows;

a) Research and development (not including companies): about 500

b) Manufacturing of PV systems components, including company R&D: about 6 200

c) All other, including within electricity companies, sales and installation companies etc.: about 11 000

3.6 Business value

Table 6 shows business value of the domestic market of PV systems.

Table 6 Business value of PV system market.

Year	1999	2000	2001	2002	2003	2004	2005	2006
Business value	76,5 BJPY	84,9 BJPY	110 BJPY	150 BJPY	170 BJPY	200 BJPY	215 BJPY	205 BJPY

4 Framework for deployment (Non-technical factors)

Table 7 shows measures and frameworks for dissemination of PV system implemented in 2006.

Table 7: PV support measures (2006)

	National / Regional (State) / Local
Enhanced feed-in tariffs	-
Direct capital subsidies	- 319 local governments
Green electricity schemes	- Utilities (Green Power Fund, all over Japan)
PV-specific green electricity schemes	-
Renewable portfolio standards (RPS)	- National
PV requirement in RPS	-
Investment funds for PV	-
Tax credits	- National - Corporate bodies or individuals to introduce PV system (100 kW or more) are eligible for 3 years reduction of property tax (7/8) - Individuals who apply blue return or corporate bodies are eligible for special deduction (7%) or special depreciation (max. 30%)
Net metering	-
Net billing	- Voluntary purchase program for excess electricity by utilities (all over Japan)
Commercial bank activities	- Low interest loan - Introduction of PV systems to company-owned buildings
Electricity utility activities	- Voluntary buyback system for excess electricity by utilities (all over Japan) - Introduction of PV systems to public and welfare facilities by Green Power Fund - Introduction of PV systems for in-house use
Sustainable building requirements	-

4.1 New initiatives

a) Promotion initiatives

While the Ministry of Economy, Trade and Industry (METI) continued following support programs: “Field Test Project on New Photovoltaic Power Generation Technology”, “Project for Promoting the Local Introduction of New Energy”, and “Project for Supporting New Energy Operators”. METI did not start new initiatives in 2006.

The Ministry of the Environment (MoE) started “Solar Promotion Program”, a package of several project to advance countermeasures against global warming. Solar Promotion Program consists of 5 programs: 1) Community council called “Solar mileage club project”, 2) Town-wide CO_2 20% reduction project” for large-scale housing area, 3) “Model project for shared use of megawatt solar” and “Model project for advanced introduction of renewable energy” for large scale and intensive introduction, 4) “Project for initiative introduction of PV system by local governments” and “Project of environment-friendly renovation of schools and project of model school for environmental education” for municipalities and schools, 5) “National movement” for dissemination and enlightenment. MoE is planning to establish dissemination programs within each program and will promote introduction of PV systems.

b) New plan of PV system introduction

METI will enhance and expand introduction of PV systems in non-residential facilities such as public, commercial and industrial facilities, where dissemination of PV systems has not been advanced compared to the residential market, using “Field Test Project on New Photovoltaic Power Generation Technology”. In 2007, It is planned to introduce total 30 MW of new types PV systems aiming at expansion of dissemination of middle and large scale PV systems with the capacity of 10 kW and over. Improvement of system efficiency, cost reduction, extension of installation sites and volume, development of new installation method and so on are expected through the Project. Moreover, METI will construct 5-MW and 2-MW PV plants in Wakkanai City of Hokkaido and Hokuto City of Yamanashi Prefecture respectively for the purpose of demonstrating measures to stabilize grid-connection of larger PV systems and technology to meet the peak demand.

The Ministry of the Environment (MOE) will introduce 1 MW PV systems in Saku City of Nagano Prefecture, Iida City of Nagano Prefecture and Konan City of Kouchi Prefecture respectively as a part of activities under Model project for shared use of megawatt solar under its Solar Promotion Program. Each City will introduce PV system into the public, commercial and industrial facilities and operate power generation.

In addition, The Ministry of Land, Infrastructure and Transport (MLIT) continues to promote to introduce PV systems following “the Guidelines for Planning Environmentally-Friendly Government Building (Green Government Office Buildings)”.

c) Utilities’ perceptions to PV

Electric utilities has been supporting deployment of the PV system through 1) net billing system for surplus electricity generated by the PV system, 2) implementation of Green Power Fund, and 3) compliance of the Law on Special Measures Concerning New Energy Use by Electric Utilities (Renewables Portfolio Standard Law, RPS Law (Renewables Portfolio Standard Law (RPS Law)).

Electric power companies have been consistently continued the net billing since 1992, and buying back surplus electricity generated by PV from their customers at the selling price of electricity across the country on a voluntary basis. Other initiatives, such as green pricing, rate-based incentives have not been studied in Japan. During FY 2005 (April 2005 to March 2006), the

electric power companies bought surplus PV power of 540,4 TWh. The volume of surplus electricity bought by the electric companies has been increasing year by year.

Moreover, the utilities introduced “Green Power Fund” to promote utilization of natural energy in October 2000. Electric power companies contribute to the Fund the same amount as the total sum collected on the basis of 500 JPY/month per share from their customers who support the purpose of “Green Power Fund”. The Fund is utilized to introduce PV and wind power plants. By the end of FY 2005, 597 PV systems, 12 812 kW in total were installed mainly public facilities such as schools and hospitals by Green Power Fund. In FY 2006, 149 projects, 2 162 kW in total were granted.

Electric utilities had achieved to purchase required amounts of new energy designated in 2003, under the Renewable Portfolio Standard (RPS) Law that was enforced from the same year. They archived the quota set by RPS in FY 2005 and enhanced actions to expand usage of new energy to achieve the required purchase amounts in 2006. Usage volume of electricity generated by new energy by utilities in FY 2005 was 5 576 TWh in total, including 458 TWh from PV power generation. The accredited facilities for power generation using new energy under the RPS Law was 266 915 systems totaling 3 751 MW as of March 2006. Among them, PV systems are 265 963, accounting for 988 MW of generation capacity.

d) Changes in public perceptions of PV

Public perception to PV and awareness for introduction of PV system in Japan is getting more positive through initiatives of PV introduction and promotion, and publicities via media such as television and newspapers year by year. Although the government backed “Residential PV System Dissemination Program” ended in FY2005, introduction of the residential PV system has been continued without subsidies.

Furthermore, willingness to contribute to the environment by businesses is increasing, and introduction of PV systems by businesses has been increasing through “PV Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications”.

e) Others

Local governments consistently started to establish its own new frameworks for dissemination of residential PV system: subsidy according to the excess electricity output amount and green electricity certificates for in-house consumed electricity from PV system, in addition to subsidy according to installed volume (subsidy/kW).

Housing manufacturers, building material manufacturers, construction companies and power supply equipment manufacturers promote to develop products using PV systems, and enhance their sales and began to play a role in PV deployment. In addition to this, local electric equipment stores, electric appliance stores, building contractors, roofers, etc. promote sales and installation of PV systems, and the distribution chain of residential PV systems, from solar cell manufacturers to the end uses was formed. The government’s effort for further introduction of new energy started to spread into whole industries in Japan, and movement to recognize PV business as a future business opportunity is expanding.

4.2 Indirect policy issues

National Government established 5 basic plans on 1) diversification of petroleum supply sources, 2) diversification of energy sources such as nuclear energy and renewable energy, 3) promotion

of energy conservation, 4) stockpile, 5) security of energy supply systems based on “the Basic Law on Energy Policy” principled “stable energy supply”, “environmental harmony” and “utilization of market mechanism”.

In 2005, the government newly established the Kyoto Protocol Target Achievement Plan to fulfill the greenhouse gas reduction target designated by the Kyoto Protocol. Among the actions and the measures, the Plan regards PV and wind power generation and biomass, etc. significantly contributes to measures against global warming and improvement of self-sufficiency ratio of energy supply. In addition, it is mentioned that microgrid utilizing PV and wind power generation, biomass, fuel cells and other new energy will be introduced to promote implementation, technological development and demonstration of advanced model projects, in order to facilitate multifaceted introduction of new energy and secure the flexibility of energy.

In addition, the government laid out “New National Energy Strategy” in 2006 and presented the image of future energy that Japan should work on hereafter. The Strategy stipulates dissemination of PV system in “New Energy Innovation Plan” and defines the target cost of power generation by PV system: PV power generation cost is to be reduced to the same as the conventional power generation cost by 2030.

The Ministry of Economy, Trade and Industry (METI) enforced “the Law Concerning the Use of New Energy by Electric Utilities (Renewable Portfolio Standard (RPS) Law)” in April 2003 as a new measure to promote further dissemination of new and renewable energy. The RPS Law obliges electric power companies to expansion of use of electricity generated from new energy. The target minimum ration of renewable energy usage in 2010 is 12 200 GWh, which accounts for 1,35% of net sales energy demand. In 2006, METI launched to set new target ratio for 2014.

The Ministry of Land, Infrastructure and Transport (MLIT) established “Guideline for Planning Environmentally-Friendly Government Building (Green Building)” and has been advancing construction of green government buildings equipped with PV systems for the national governmental facilities such as the local branch office of the national government.

The Ministry of the Environment is promoting projects to reduce CO_2 emission by use of natural energy under “Law Concerning the Promotion of Measures to Cope with Global Warming” enforced in 1998. In addition, it implemented “Law on Promotion of Green Purchasing” in April 2001, and commodities procured by the national and local governments have to be replaced to environmental-friendly products, and specified PV systems as one of the special procurement products.

4.3 Standards and codes

In 2006, the following standards are published.

- “On-site measurements of crystalline photovoltaic array I-V characteristics” (JIS C 8953-2006)
- “Design guide on electrical circuits for photovoltaic arrays” (JIS C 8954-2006)
- “Standards for safety design of electrical circuit in photovoltaic power generating systems for residential use” (JIS C 8981-2006)
- “Photovoltaic (PV) module safety qualification –. Part 1: Requirements for construction” (TS C8992-1/IEC 61730-1
- “Photovoltaic module (PV) safety qualification –. Part 2: Requirements for testing” (TS C 8992-2/IEC 61730-2)

Japan Electrical Safety & Environment Technology Laboratories (JET) started a certification

program of PV modules, “JETPVm certification” in October 2003. The program for PV modules with certified labels started April 1, 2005. In the certification, tests for accrediting performance and reliability of manufactured PV modules are implemented. In the certification process, test to confirm compliance with domestic standards (consistent with international standards, IEC 61215 and IEC 61646) and inspection of the PV module manufacturing factory in order to confirm compliance of manufacturing system are required. Manufacturers of PV modules can obtain the trust from end-users in Japan by this certification. In addition, it is expected that PV manufacturers can easily obtain certification in overseas through the framework of international cross certification. At the same time, it is expected importing PV modules manufactured in overseas to Japan will be facilitated. In the end of FY 2006, number of certified PV modules from 13 manufacturers are 105 types (980 types if similar types are included) for crystalline silicon and 15 types (166 types if similar types are included) for thin-film.

Moreover, JET conducts a certification program for the performance and reliability of grid connection protecting unit (power conditioner, or inverter) for small-sized PV systems with 10 kW and less capacity to connect low-voltage grid. This certification aims at accrediting protecting and controlling functions for grid connection stipulated in “Guideline of Grid Connection Requirement (an instruction issued by the chief of public utility department of Agency for Natural Resources and Energy (ANRE) of METI in August 1986, revised in March 1998)”. In October 2006, the law was amended and the guideline was divided 2 parts: safety of the grid and maintenance of quality of electricity. Consequently, JET established the standard adding technological standard for electric facilities and Electrical Appliance and Material Safety Law and continued the certification program. As of March 2007 (the end of FY 2006), 42 types of power conditioners of 10 companies (195 types if similar types are included) are listed as certified products.

The following Japanese Industrial Standards (JIS) and Technical Report (TR) are at the stage of discussion and will be published in the near future.

Discussion of following standards was almost finished.

- Standardization of “Evaluation method of weatherability of crystalline silicon PV module on atmospheric corrosion test”

Note) Technical Report (TR) is aiming at forming consensus and earlier establishment for JIS by providing information on standardization of PV power generation technology, in which technological innovation has been advanced

Discussion is underway for the following standards.

- Draft revision of “General rules for stand-alone photovoltaic power generating system (JIS C 8905)”
- Draft revision of “Measuring procedure of photovoltaic system performance (JIS C 8906)”
- Draft revision of “General rules for photovoltaic array (JIS C 8951)”
- Draft revision of “Indication of photovoltaic array performance (JIS C 8952)”
- Draft revision of “Measuring procedure of power conditioner efficiency for photovoltaic systems (JIS C 8961)”
- Draft revision of “Testing procedure of power conditioner for small photovoltaic power generating systems (JIS C 8962)”
- Draft revision of “Power conditioner for small photovoltaic power generating system (JIS C 8980)”
- Testing method of islanding prevention of power conditioner (tentative title)

5 Highlights & Prospects

5.1 Highlights

2006 was the first year to make a step forward the road toward the independent and self-sustainable PV market, after graduating from Residential PV system Dissemination Program that have been supporting the PV market in Japan, and a number of related-sectors including national and local governments, the PV industry, utilities, distributors and users of PV system, worked on dissemination of the PV system and made a significant progress.

For governmental organizations, Ministry of Economy, Trade and Industry (METI) mapped out "New National Energy Strategy" and set a goal figures to achieve until 2030. The PV system is positioned as a major pillar of the "New Energy Innovation Plan" of the same strategy with strong support. Ministry of the Environment (MoE) started "Solar Promotion Program" in order to further disseminate the PV system. Local governments independently not only continues support projects for residential PV system on its own expenses, but also made active efforts to expand the PV system in unique ways such as purchasing the electricity after issuing green certificate for power generation for self-consumption from the PV system in Saga Prefecture.

In the PV industries, many companies aimed to enhance production facilities and achieve new entries. This trend can be found and expanded not only in solar cell manufactures but also manufacturers of silicon feedstock, silicon ingot and wafer, materials and manufacturing equipment for PV cell/ module. As for the materials for solar cell, in addition to conventional crystalline silicon, commercial production of PV modules new materials including thin-film silicon and CIGS was started. In particular, the following events occurred: 1) Announcement of revised PV industrial roadmap, "Vision of the Future of the Photovoltaic Industry - Aiming to be the World's Leading PV Nation" by Japan Photovoltaic Energy Association (JPEA), 2) start of operation of pilot plants for commercial production of silicon feedstock for solar cells by new entries, 3) production capacity by solar cell manufacturers and extension of overseas production sites, 4) constructions of manufacturing plants for thin-film PV module by new entries, 5) acquisition of Japanese PV module manufacturer by a Chinese manufacturer, 6) enhancement of solar cell business by components/ raw materials and device manufacturers for solar cell manufacturing, and 7) new market cultivation such as MW-scale PV systems, and development were advanced. With rapid movement, establishment of a group of PV industries has been promoted.

Utilities continue to install PV systems supported by purchase of excess electricity and Green Power Fund with continuous support for dissemination of the PV system.

As for distribution of the PV system, efforts have been made by key prefabricated housing makers to install the PV system as standard equipment, in line with the movement towards reduction of CO2 emissions and 100% electrification.

Supported by the enhanced dissemination measures for public and industrial use by the national government, PV system users moved toward introduction of the PV systems, expanding from the PV industry to a wide variety of industries.

5.2 Prospects

Dissemination framework of PV system in Japan will be developed as a new framework aiming at self-independent PV market. The government will work on dissemination of the PV system based on "New National Energy Strategy" established in 2006. Following the Ministry of Economy, Trade and Industry (METI), the Ministry of the Environment (MoE) launched measures to introduce PV system, and new dissemination framework of the PV system will be advanced.

In 2007, the Law on Special Measures Concerning New Energy Use by Electric Utilities (the RPS

Law) is scheduled to be revised, and it is expected that PV system will be preferentially treated. Thus, regulatory framework for PV dissemination will be advanced.

In the supply framework of PV cell/ module, the industrial structure around PV cell/ module will be enhanced and expanded over the whole value chain in several aspects as well as increase of production capacity by PV cell/ module manufacturers: 1) new entry of thin-film PV manufacturers, 2) new entry of raw material manufacturers into production of silicon feedstock for solar cell, 3) enhancement of production capacity by manufacturers of raw material and component for PV cell/ module, 4) formulation of the sales channel of residential PV system. These movement will contribute to the establishment of the supply framework.

In the domestic PV system market, product development of PV system for public, industrial and commercial use as well as residential use will be advanced. Moreover, demonstrative research of MW-scale PV system will be advanced, aiming at power supply. Users of PV system including individuals, private companies and local governments will understand significance of achieving the targets of Kyoto Protocol and are becoming more willing to introduce the PV system.

The PV industry in Japan will establish collaborative and cooperative framework with not only METI but also other ministries and agencies, local governments, related industries as well as users, in conjunction with national energy strategies and enhance the efforts to achieve full-scale dissemination of PV system.

Annex A Method and accuracy of data

The work was performed in collaboration with PV modules and BOS components manufactures, housing manufacturers, government agencies running PV programs/projects. The data were collected by hearing and questionnaires.

As regards off-grid sector, some of these systems implement PV modules that have a capacity lower than 40 W. In this report they are included because it is very difficult to distinguish the application types and rated voltages.

The accuracy of data is ±10% for cumulative installed PV power, ± 10% production and production capacity.

Annex B 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 require more detailed data.

Please provide the following, including a short reference as to the source of the information (for example, author's estimate, electricity supply association etc.):

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

- Household: 22,31 JPY/kWh (type B, usage volume: ≥ 301 kWh)
- Commercial: 12,00 JPY/kWh (summer), 10,90 JPY/kWh (other season) (high-voltage, business use)
- Industry, high-voltage, ≥ 500 kW : 10,69 JPY/kWh (summer), 9,72 JPY/kWh (other season)
- Industry, high-voltage, < 500 kW : 11,84 JPY/kWh (summer), 10,76 JPY/kWh (other season)

(Source: Tokyo Electric Power Co., Inc. (TEPCO), 2007 April)

2) Typical household electricity consumption

301,6 kWh/month (2004)

(Source: The Japan Atomic Energy Relations Organization (JAERO), February 2006)

3) Typical metering arrangements and tariff structures for electricity customers (for example, interval metering, time-of-use tariff)

- Interval Metering (30 minutes)
- Time-of-use tariff is available

(Source: websites of electric utilities)

4) Typical household income (NC)

- 5,804 million JPY (2004)

(Source: The National Livelihood Survey, The Ministry of Health, Labor and Welfare)

5) Typical mortgage interest rate

- 3,53 to 3,77% (minimum rate and maximum rate from June 2006 to May 2007, standard)

(Source: People's Finance Corporation)

6) Voltage (household, typical electricity distribution network)

- Household: 100 V
- Distribution network: single phase 3 line 100/200 V

7) Electricity industry structure and ownership

- All the utilities are investor-owned; generation, transmission and distribution are vertically integrated
- Independent power producers (IPPs) also generate electricity
- Electricity industry Regulator: Agency for Natural Resources and Energy (ANRE) of the Ministry of Economy, Trade and Industry (METI)

8) Price of diesel fuel (NC)

- High-octane gasoline: 140 - 155 JPY/litter (April 2006 to April 2007, including 5% consumption tax)
- Regular gasoline: 129 - 144 JPY/litter (April 2006 to April 2007, including 5% consumption tax)
- Diesel oil: 108 - 121 JPY/litter (April 2006 to April 2007, including 5% consumption tax)

(Source: The Oil Information Center)

9) Typical values of kWh/kW for PV systems in parts of your country.

1 000 to 1 100 kWh/kW/year

Annex C: Table 1 Summary of major projects, demonstration and field test programs (1/7)

Project name	Residential PV System Dissemination Program (1994 - 2005)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2005/ problems and lessons learned	Funding	Project Management	Remarks
- Grid connected, residential - Eligible system rate 1994~1996 : ≤ 4~5 kW 1997 : ≤ 4 kW 1998~1999 : ≤ 10 kW 2000 : ≤ 4 kW 2001 : < 10kW 2002 : < 10 kW 2003 : < 10 kW 2004 : < 10 kW 2005 : < 10 kW - Subsidy: 2001: 120 000 JPY/kW + consumption tax 2002: 100 000 JPY/kW + consumption tax 2003: 90 000 JPY/kW + consumption tax 2004: 45 000 JPY/kW+ consumption tax 2005: 20 000 JPY/kW+ consumption tax	- Perception to PV - Dissemination of PV - Creation of the initial market for residential PV system - Collection of PV operation data	- 115 765 residential PV systems were installed in total from 1994 to 2002 (421,4 MW). - 46 760 PV systems were installed in 2003 (173,7 MW). - 61 407 PV systems were installed in 2004 (233,0 MW). - 36 754 PV systems were installed (136,3MW), and total installation over 12 years is 253 745 cases, totaling 931 575 kW in 2005. - Better understanding to PV has been promoted. - Cost of systems reduced to 680 000 JPY/kW. - Building integrated PV modules such as roof material integrated and triangular-shaped PV modules were developed. - Commercialization of Housings equipped PV systems as standard equipment was promoted. - Education for installers of residential PV systems was advanced.	- METI[1], ANRE[2] - Budget: 1994: 2 030 MJPY 1995: 3 310 MJPY 1996: 4 056 MJPY 1997: 11 110 MJPY 1998: 14 700 MJPY 1999: 16 040 MJPY 2000: 14 500 +3 300 MJPY 2001: 23 506 MJPY 2002: 23 204 MJPY 2003: 10 500 MJPY 2004: 5 250 MJPY 2005: 2 625 MJPY	- NEF[3]	- The program was terminated as the initial object, creation of the initial market was achieved in 2005 - Although the applications for the program increased year by year, acceptance of application was closed in October 2005 as the budget was cut by half compare to the previous fiscal year - Total budget 1994 to 2005 was 134 131 MJPY.

[1] : METI: Ministry of Economy, Trade and Industry

[2] : ANRE: Agency of Natural Resources and Energy
[3] : NEF: New Energy Foundation

Annex C: Table 1: Summary of major projects, demonstration and field test programs (2/7)

Project name	Field Test Project on Photovoltaic Power Generation Systems for Industrial and Other Applications (1998 -2006)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2006/ problems and lessons learned	Funding	Project Management	Remarks
- Grid connected (10 kW and over) - Industrial facilities, such as factory, warehouse, commercial building - Cost sharing: 50% of installation cost - Eligible systems - Modular type: combined systems with 10 kW PV unit - Novel application type: systems with thin film solar cells, building integrated PV systems.	- Collection and dissemination of operational data - Cost reduction - Standardization of PV systems - Demonstration of new type PV system	- From 1998 to 2002, 15 560 kW of 643 modular type PV systems and 2 540 kW of 97 novel application types were installed to factories, warehouses, laboratories, commercial buildings, schools, etc. (new installation was finished in 2002 and data collection and analysis is conducted in 2003). 1998: 73 cases (1 940 kW) 1999: 93 cases (2 790 kW) 2000: 149 cases (3 680 kW) 2001: 218 cases (4 890 kW) 2002: 207 cases (4 800 kW) - Perception of industries is being spread. - Cost of PV systems for public facilities and industrial use (≥ 10kWh) reduced to 820 000 JPY/kW. - Better understanding to PV has been promoted in the local residents. - Variety of novel types of PV systems was installed.	- ANRE, METI - Budget: 1998: 2 400 MJPY 1999: 2 410 MJPY 2000: 4 000 MJPY 2001: 1 990 MJPY 2002: 4 500 MJPY 2003: 262 MJPY 2004: 137 MJPY 2005: 109 MJPY	-NEDO[1]	- Total budget 1998 to 2006 was 15 900 MJPY. - Installed capacity 1998 to 2002 by sector Private companies: 295 cases (7 760 kW) Public-service corps.: 123 cases (3 750 kW) Local governments: 322 cases (6 590 kW) Total: 740 cases (18 100 kW) - Installation was finished in 2002. - While installation ended, monitoring has been continued after that.

[1] : NEDO: New Energy and Industrial Technology Development Organization

Annex C: Table 1: Summary of major projects, demonstration and field test programs (3/7)

Project name	Field Test Project on New Photovoltaic Power Generation Technology (2003 -)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2006/ problems and lessons learned	Funding	Project Management	Remarks
- Grid connected (10 kW and over) - Industrial facilities, such as factory and warehouse, public facilities such as government building, hospital and schools, commercial building such as restaurant. - Cost sharing: 50% of installation cost - Eligible system 1) PV system using New modules (≥ 10 kW) - PV modules with improved functions compare to the conventional ones - The next generation PV module using solar cell made from new material 2) PV system using building material (≥ 4 kW)integrated modules - PV modules with functions as building material such as roofing materials 3) PV system using new control systems (≥ 10 kW) - PV system using storage equipment aiming at disaster or peak cut - PV system using BOS with improved function or performance compared to conventional ones such as snow melting function or string voltage adjustment function 4) the PV system aiming at higher efficiency (≥ 10 kW) - PV system with improved efficiency by	- Collection and dissemination of operational data of middle and large scale PV system (≥ 10 kW) - Cost reduction of PV systems for public and industrial facilities - Standardization of those PV systems - Demonstration of new type PV system, PV systems using new material and technologies	- In 2005, 457 PV systems totaling 17 709 kW were installed in factories, ware houses, laboratories, commercial buildings, school, etc.: PV system using new modules: 8 cases (130 kW), PV system using BIPV modules: 20 cases (393 kW), PV system using new control system: 8 cases (281 kW), PV system aiming at higher efficiency: 421 cases (16 868 kW) - In 2006, 662 PV systems totaling 22 080 kW were installed: PV system using new modules: 2 cases (30 kW), PV system using BIPV modules: 33 cases (1 064 kW), PV system using new control system: 17 cases (434 kW), PV system aiming at higher efficiency: 610 cases (20 552 kW) - 2003: 148 cases, 4 480 kW, installed - 2004: 262 cases, 7 161 kW, installed - 2005: 457 cases, 17 709 kW, installed - 2006: 662 cases, 22 080 kW, installed - Industrial sector began to understand the value of introduction of PV system - Cost of PV system for public and industrial facilities (≥ 10kW) reduced to 750 000 JPY/kW - Local residents grew understanding of PV - Diversification of PV system using new	- ANRE, METI - Budget: 2003: 3 496 MJPY 2004: 5 026 MJPY 2005: 9 230 MJPY 2006: 11 800 MJPY	- NEDO	- Total budget 2003 to 2006 was 29 552 MJPY. - Installed capacity 2003 to 2006 by sector Private companies: 881 cases (34 659kW) Public-service corps.: 391 cases (8 852 kW) Local governments: 270 cases (5 374 kW) Total: 1 542 cases (48 884 kW)

modifying the standard system with design, installation method and equipments		technologies, materials and control system, etc. has been promoted			

Annex C: Table 1 Summary of major projects, demonstration and field test programs (4/7)

Project name	Project for Promoting the Local Introduction of New Energy (1997 -)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2006/ problems and lessons learned	Funding	Project Management	Remarks
- New energy in general - Eligible PV systems: grid-connected (10 kW and over) - Subsidy: 50% or one third of installation cost - Eligible: Local governments, Non-profit organizations, NPOs	- Enhancement of promotion of new energy to public facilities - Education and promotion of new energy to local inhabitants	- 78 systems (9 995 kW) were installed in from 1997 to 2002. - 70 PV systems (8 301 kW) out of 101 qualified systems in 2003. - 45 PV systems (3 433 kW) out of 71 qualified systems in 2004. - 33 PV systems (870 kW) out of 103 qualified systems in 2005. - 35 PV systems (1 130 kW) out of 111 qualified systems in 2006. - 261 PV systems totaling 23 678 kW will be installed during 1998 ~ 2009. - Planned installation of multiple numbers of PV systems in local governmental offices, schools, libraries, water purification plants, kindergartens etc., which NPOs operate, can be implemented. - Qualification of larger-scale PV systems with more than 100 kW output was started.	- ANRE, METI - Budget: 1997: 2 430 MJPY 1998: 4 379 MJPY 1999: 6 760 MJPY 2000: 6 430 MJPY 2001: 11 502 MJPY 2002: 12 702 MJPY 2003: 12 710 MJPY 2004: 11 031 MJPY 2005: 7 602 MJPY 2006: 5 181 MJPY	- NEDO	Total budget from FY 1997 to FY 2006 is 80 727 BJPY

Annex C: Table 1 Summary of major projects, demonstration and field test programs (5/7)

Project name	Project for Supporting New Energy Operators (1997 -)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2006/ problems and lessons learned	Funding	Project Management	Remarks
- New energy in general - Eligible PV systems: grid-connected (≥ 50 kW) (≥ 10 kW PV system is also eligible in case of multiple installation of renewable energy system) - Subsidy: one third of installation cost or guaranteed debt	- Support of private industries who introduce new energy - Encouragement of introduction of new energy by private industries	- 4 PV systems out of 155 qualified systems were installed in a commercial building (118 kW), a distribution center (100 kW) and a tourist hotel (25 kW) and an ironworks (140 kW) from 1997 to 2002. - 2 PV systems out of 39 qualified systems were installed to a factory (200 kW) and a wind power plant (17 kW) in 2003. - 3 PV systems out of 67 qualified systems was installed to a wind farm (10,8 kW), factories (70 kW) and a condominium building (66,5 kW) in 2004. - 3 PV systems out of 90 qualified systems was installed to golf course (17 kW), wind farm (10,2 kW) and a condominium building for rent (53,38 kW) in 2005. - 2 PV systems out of 54 qualified systems was installed to a condominium (93,64 kW), and a rental housings (66,71 kW) in 2006.	- ANRE, METI - Budget: 1997: 1 123 MJPY 1998: 5 393 MJPY 1999: 10 340 MJPY 2000: 11 490 MJPY 2001: 14 040 MJPY 2002: 23 618 MJPY 2003: 38 818 MJPY 2004: 48 255 MJPY 2005: 34 540 MJPY 2006: 35 272 MJPY	- NEDO (-2002) - METI (2003 -)	The total budget from FY 1997 to FY 2006: 222,9 BJPY

Annex C: Table 1 Summary of major projects, demonstration and field test programs (6/7)

Project name	Eco-school Model Promotion Pilot Project (1997 -)				
Technical data/ Economic data	Objectives	Main accomplishments until the end of 2006/ problems and lessons learned	Funding	Project Management	Remarks
- New energy use school (PV, solar thermal, etc.) energy efficient school etc. - Eligible Energy: New energy including PV - Subsidy: Investigation; fixed cost (METI's subsidy is available for PV system installation) - Eligible: Local government	- Demonstration and promotion of environment-friendly school - Environmental education to students	- PV systems were installed to 163 schools in 1997 to 2002. - PV systems were qualified to 68 schools in 2003. - PV systems were qualified to 53 schools in 2004. - PV systems were qualified to 59 schools in 2005. - PV systems were qualified to 44 schools in 2006. - Schools introduced PV systems were expanded to387 - Students understanding PV systems were increased. - Environmental education was implemented and enhanced.	- METI: METI's subsidy is available for PV systems installed under Eco-school Infrastructure Promotion Pilot Project (Reference) - Budget of MEXT[1]: 1998: 28 MJPY 1999: 28 MJPY 2000: 28 MJPY	- MEXT[1] - ANRE[2]/METI - MAFF[3] - MoE[4]	- Under additional budget in FY 1998, 85 schools, 3 590 kW in total were installed in national universities, national high schools, etc.

[1]: MEXT: Ministry of Education, Culture, Sports, Science and Technology

[2] : ANRE: Agency of Natural Resources and Energy/ Ministry of Economy, Trade and Industry

[3] : MAFF: Ministry of Agriculture, Forestry and Fisheries

[4] : MoE: Ministry of the Environment