Technology Collaboration Programme
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International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in JAPAN
2019

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What is IEA PVPS TCP?

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The Technology Collaboration Programme (TCP) was created with a belief that the future of energy security and sustainability starts with global collaboration. The programme is made up of 6.000 experts across government, academia, and industry dedicated to advancing common research and the application of specific energy technologies.

The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the TCP's within the IEA and was established in 1993. The mission of the programme is to "enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems." In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas.

The IEA PVPS participating countries are Australia, Austria, Belgium, Canada, Chile, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Smart Electric Power Alliance (SEPA), the Solar Energy Industries Association and the Cop- per Alliance are also members.

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What is IEA PVPS Task 1?

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2019. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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COVER PICTURE: Chiba Ecological Energy, a venture company from Chiba University, installed the Chiba City Okido Agri Energy Unit 1, a 775-kWdc PV system on farmland. Utilizing the fallow land, poles were set up on the farmland of about 10,000 m^2, and PV modules were lined up with a gap. Garlic is grown under the PV modules. Positioning this site as a basic research farm on the next-generation agriculture using renewable energy, Chiba Ecological Energy aims to build a self-consumption model of renewable energy in agriculture.
Photo by RTS Corporation

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, PV installations are included in the 2019 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2019, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

In 2019, as in the previous year, the majority of PV systems were installed under the Feed-in Tariff (FIT) program. As for the utility-scale applications, the majority are ground-mounted systems, but the floating PV systems and agricultural PV systems are also growing. Regarding building-applied PV (BAPV) systems, the main applications are residential, commercial and industrial. For building-integrated PV (BIPV) systems, roof tile-integrated PV modules are installed in some residential applications. While some commercial installations have been reported, BAPV accounts for the majority of installations.

1.2 Total photovoltaic power installed

Annual installed capacity in Japan in 2019 reached 7 031 MW (DC), an approximately 5,5 % increase from 6 662 MW (DC) in 2018.

Table 1: Annual PV power installed during calendar year 2019

		Installed PV capacity in 2019 [MW]	AC or DC
PV capacity	Off-grid	2	DC
	Decentralized	1 123	DC
	Centralized	5 906	DC
	Total	7 031	DC

Table 2: PV power installed during calendar year 2019

			Installed PV capacity in 2019 [MW] DC value
Grid-connected	BAPV	(1) Residential (< 10 kW)	891,9
		(2) Commercial (< 50 kW, including ground-mounted)	2 119
		(3) Industrial (50 kW - 1 MW, including ground-mounted)	1 111
		(4) Total of BAPV	4 121,9
	BIPV	(5) Residential (< 10 kW)	10
		(6) Commercial (10 - 250 kW)	20
		(7) Industrial (> 250 kW)	
		(8) Total of BIPV	30
	Utility-scale	(9) Ground-mounted (1 MW ~)	2724
		(10) Floating PV systems	51
		(11) Agricultural PV systems	102 (including small-scale systems)
		(12) Total of utility-scale	2 877
Off-grid		(13) Residential	NA
		(14) Other	2,116
		(15) Hybrid systems	NA
		(16) Total of off-grid	2,116
Total		**(17) Total ((4) + (8) + (12) + (16))**	7 031,016

* The capacity of PV systems which started operation under the FIT program released by METI

Table 3: Data collection process

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	AC: Figures announcement by the Ministry of Economy, Trade and Industry (METI) DC: Estimated value (DC/AC ratio = 136,2 % (based on the average of overpanelling ratio announced by the Procurement Price Calculation Committee))
Is the collection process done by an official body or a private company/Association?	- Figures for installation volume outside of the FIT program, BIPV, floating PV systems, and PV systems on farmland are estimates by RTS Corporation based on hearings, etc. - Installation volume of off-grid systems is based on shipment statistics from the Japan Photovoltaic Energy Association (JPEA)
Link to official statistics (if this exists)	https://www.fit-portal.go.jp/PublicInfoSummary
Other issues to be noted	DC capacity was estimated in consideration of over-panelling of PV modules

The cumulative PV installed capacify in Japan as of the end of 2019 reached 63 192 MW (DC). The cumulative PV installed capacity by application is; 175 MW for off-grid and 63 017 MW for grid-connected applications.

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

Year	Off-grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural…)	Total [MW]
1992	15	1	2	19
1993	19	2	3	24
1994	24	5	3	31
1995	30	11	3	43
1996	36	21	3	60
1997	45	43	3	91
1998	53	78	3	133
1999	57	149	3	209
2000	64	264	3	330
2001	67	383	3	453
2002	73	561	3	637
2003	79	778	3	860
2004	84	1 045	3	1 132
2005	87	1 332	3	1 422
2006	89	1 617	3	1 708
2007	90	1 823	6	1 919
2008	91	2 044	9	2 144
2009	95	2 522	11	2 627
2010	99	3 496	23	3 618
2011	103	4 741	69	4 914
2012	109	6 522		6 632
2013	123	13 476		13 599
2014	125	23 214		23 339
2015	127	34 023		34 150
2016	161	41 879		42 040
2017	171	49 329		49 500
2018	173	55 989		56 162
2019	175	63 017		63 192

Table 5: Other PV market information

	2019
Number of PV systems in operation in Japan	N.A.
Decommissioned PV systems during the year	< 100 MW
Repowered PV systems during the year	N.A.
Total capacity connected to the low voltage distribution grid	~ 50 000 MW
Total capacity connected to the medium voltage distribution grid	
Total capacity connected to the high voltage transmission grid	~ 12 600 MW

Table 6: PV power and the broader national energy market

	2018	2019
Total power generation capacities	270 GW_{AC}[1]	265 GW_{AC}[1]
Total renewable power generation capacities (including hydropower)	93 GW_{AC}[2]	112 GW_{AC}[2]
Total electricity demand	908 TWh[3]	888 TWh[3]
Total energy demand	13 088PJ[5]	N.A.
New power generation capacities installed	7,5 GW_{AC}	-5,9 GW_{AC}[4]
New renewable power generation capacities (including hydropower)	5 GW_{AC}	6,5 GW_{AC}
Estimated total PV electricity production (including self-consumed PV electricity) in	56 162 GWh	63 192 GWh
Total PV electricity production as a % of total electricity consumption	6,2 %	7,1 %

1: METI's Survey of Electric Power Statistics (Total power generation capacities of electricity retailers, general power transmission and distribution operators, power transmission operators, designated power transmission and distribution operators and power producers) (Distributed systems are NOT included.)

2: Total of hydro capacity + Cumulative installed capacity under FIT program + Total of renewable energy facilities by ten electric power companies (EPCOs)

3: Statistics on actual electricity demand by METI (Total of electricity demand from Jan. to Dec. each year)

4: Oil, other gases, nuclear, geothermal and biomass power generation capacities recorded negative figures

5: METI statistics

1.3 Key enablers of PV development

Table 7 shows the information on key enablers contributing to PV development. The information available at the time of writing this report is listed in the table, since official statistics in Japan are released by fiscal year (April to March).

The shipment data of stationary lithium ion (li-ion) battery storage systems include not only distributed applications but also other applications such as grid-connected applications. However, applications for transportation (electric motorcycles, those related to vehicles, construction equipment and automated carrier machines, etc.) and industrial applications (robots, uninterruptible power system (UPS)) are not included. It is assumed that around 80 % of the reported figures are for residential applications.

A typical heat pump for residential application is “Eco Cute” highly efficient water heater which uses CO_2 as refrigerant. The subsidy program conducted between FY 2002 and FY 2010 encouraged the installation of this heat pump system, and total 6,39 million units of Eco Cute heat pump systems have been installed in houses as of the end of March 2019 (end of FY 2018).

As for electric vehicles (EVs), the number of units sold in FY 2018 and the number of units owned as of the end of March 2019 (end of FY 2018) (equivalent to cumulative number of units sold) are listed in Table 7. The number of units of passenger cars sold in the calendar year 2019 was approximately 21 000.

Table 7: Information on key enablers

	Description	Annual volume	Total volume	Source
Shipment data of lithium ion battery storage systems	Integrated lithium ion battery storage system consisting of li-ion battery, power conversion devices such as inverter and converter	FY 2019: 115 000 units (814 MWh)	As of end of FY 2019: 363 867 units (2 568 MWh)	The Japan Electrical Manufacturers' Association (JEMA)
Residential heat pumps	Residential heat pump water heater with natural refrigerant (Eco Cute)	FY 2018: 1,2 mil. units	FY 2018: 6,39 mil. units	The Japan Refrigeration and Air Conditioning Industry Association, Heat Pump & Thermal Storage Technology Center of Japan
Electric cars (number of units)	Passenger car (PC), Light car (LC)	FY 2018: PC: 22 941 LC: 346	As of end of FY 2018 PC: 105 919 LC: 6 323	Next Generation Vehicle Promotion Center (Numbers of sales and ownership of EV, etc.)
Electric buses and trucks (number of units)	EVs other than passenger car or light car, which are categorized as "Other" in the statistics	FY 2018: 54	As of end of FY 2018: 1 512	Same as above

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 8 shows typical PV module prices for a number of years for residential applications. These are end-user prices. There is a large price gap between residential PV systems and utility-scale PV power plants.

Table 8: Typical residential PV module prices for a number of years (end-user prices)

Year	Average price (JPY/W)	Best price (JPY/W)
1992	996	
1993	950	
1994	927	
1995	764	
1996	646	
1997	652	
1998	674	
1999	598	
2000	542	
2001	481	
2002	462	
2003	451	
2004	441	
2005	428	
2006	433	
2007	436	
2008	447	386
2009	393	347
2010	366	343
2011	327	306
2012	280	269
2013	252	242
2014	197	130
2015	190	N.A.
2016	189	N.A.
2017	131	N.A.
2018	128	56
2019	171	74

2.2 System prices

Table 9 shows typical applications and prices of PV systems by category. Table 10 shows the trends in system prices. The standardization of grid-connected PV systems has progressed with the growth of the PV market in Japan, and the prices have been decreasing. On the other hand, off-grid system prices are determined on a case-by-case basis, because there are various types of applications and the size of each market is small.

Table 9: Turnkey PV system prices of different typical PV systems

Category/Size	Typical applications and brief details	Current prices (JPY/W)
Off-grid < 1 kW	Telecommunications, lighting, traffic and road signs, ventilating fans, pumps, remote monitoring, navigation signs, clock towers, etc.	N.A.
Off-grid ≥ 1 kW	Agricultural facilities, communication facilities, disaster prevention facilities, mountain cottages, park facilities, housing in remote areas, lighthouses, etc.	N.A.
Grid-connected roof-mounted, distributed PV systems < 10 kW	Residential	321
Grid-connected commercial and industrial 10 kW- < 1 MW	Commercial and industrial	222
Grid-connected ≥ 1 MW	Power generation business (mainly ground-mounted)	202
Other category (hybrid diesel-PV, hybrid with battery…)		N.A.

Table 10: National trends in system prices for different applications (JPY/W)

Year	Residential PV systems (< 10 kW)	Commercial and industrial (10 kW - 1 MW)	Ground-mounted (≥ 1 MW)
1994	1 920		
1995	1 510		
1996	1 090		
1997	1 062		
1998	1 074		
1999	939		
2000	844		
2001	758		
2002	710		
2003	690		
2004	675		
2005	661		
2006	683		
2007	696		
2008	723		
2009	605		
2010	559		
2011	513		
2012	451	372	280
2013	413	342	275
2014	385	290	263
2015	379	256	240
2016	365	245	236
2017	363	244	221
2018	342	222	213
2019	321	212	204

2.3 Cost breakdown of PV installations

Cost breakdown of PV installations is the analysed results of hearing survey. Hearing survey was conducted on major suppliers of PV system, installers, and EPCs.

Table 11: Cost breakdown of Residential PV System < 10 kW

Cost category	Average (JPY/W)
Hardware	
Module	171
Inverter	45
Mounting structure	23
Other (electric equipment/ materials of electric equipment, etc.)	2
Soft costs	
Installation	65
Other (promotion/ administration cost, etc.)	
Total (excluding consumption tax)	**306***

* Consumption tax (10 % as of 2020) will be imposed. The consumption tax rate was raised from 8 % to 10 % in October 2019.

Table 12: Cost breakdown of utility-scale PV systems > 1 MW (extra-high voltage)

Cost category	Average (JPY/W)
Hardware	
Module	74
Inverter	17
Mounting structure	21
Measurement/ monitoring instrument, etc.	21
Other (electric equipment/ transformer/ materials of electric equipment, etc.)	
Soft costs	
Installation	57
Site development	15
Contribution for grid connection	6,4
Designing/ development	0,6
Fund raising	
Other (administration cost, etc.)	
Total (excluding consumption tax)	**212***

* Consumption tax (10 % as of 2020) will be imposed. The consumption tax rate was raised from 8 % to 10 % in October 2019.

2.4 Financial Parameters and specific financing programs

Since the FIT program started, a number of commercial PV power plants have been constructed one after another. Following this trend, financing institutions and project developers are now financing through a variety of measures. Corporate finance, project finance, financing via the Infrastructure Fund Market which was established by the Tokyo Stock Exchange (TSE) as well as issuance of green bonds have been conducted. The following are the general financing measures in Japan.

- Corporate finance: Financing is available at very low cost in case own credit line or collateral such as real estate, etc. can be prepared. However, it requires holding of assets directly for a long time and the available assets for holding can reach the limit in many cases.

- Project finance: All the assets and rights of the project are set as collateral to finance the sponsor with non-recourse or limited recourse loans.

- Asset-based lending (ABL): Facilities are set as collateral for assignment of collective movable assets and power sales are set as collateral for assignment of power sales claims to execute loans.

- Institutional loans by local governments and municipalities (start-up loan): Local governments and municipalities, credit guarantee associations and financial institutions share the risk for the loans by financial institutions at relatively low interest.

- Leasing (sale and leaseback): Leasing companies own the facilities and operating companies pay the lease fee. Sometimes, after transferring one's PV assets to leasing companies, etc., operating companies lease back the PV assets to carry out its business without owning large-scale assets. It is used by combining with other loans at times.

- Infrastructure Fund Market: The Infrastructure Fund Market was established by the Tokyo Stock Exchange (TSE). This is the market where funds investing in infrastructure facilities are listed. Dividends are paid to investors, sourced from the usage fee of infrastructure facilities which are expected to gain stable income. For PV systems, the dividends are funded by the income from selling generated electricity. In parallel, activities on private placement funds are also making progress, targeting only institutional investors.

- Green bond: Bond which is issued for the purpose of raising funds to be allocated to the projects which are effective to improve the environment (green projects). The raised fund is used for development of PV power plants, etc.

There are other financing-related activities as well. Regional banks and Shinkin banks are continuously working on co-financing MW-scale PV power plants. There was a case where a fund to invest in renewable energy projects was established jointly by a trading company and banks. Major financial institutions are actively issuing green bonds and supporting development of PV power plants. Also, solar sharing (PV system installation on farmland while continuing agricultural activities) has been promoted. Norinchukin Bank has been strengthening activities on the PV projects for expanding the areas of loans by Japan Agricultural Cooperatives (JA).

Table 13: PV financing information in 2019

Residential (solar loan/ sales on credit)	Long-term prime rate + approx. 1,5 % (low-interest rate financing is available by combining with home mortgage). Preferential interest rate is available depending on financial institute.
Small to medium size (corporate loan/ sales on credit/ lease)	Long-term prime rate + approx. 1,5 - 2,0 % Guarantor or collateral are required in many cases. Even though the interest rate is high, loan without collateral is available in some cases using sales on credit. In case of the scheme of lease, the facilities are owned by the leasing companies, etc.
Large-scale PV (project finance)	LIBOR or TIBOR + approx. 1,0 - 1,5 % + up-front fee (approx. 1 % of the amount financed) which is paid to financial institutes at the time of financing
Asset-based lending (ABL)	ABL is a financing scheme in which loan is secured with collateral of assets of the power generation business such as power generation facilities, guarantee agreement, electric power selling agreement and insurance, etc.
Infrastructure Fund Market	Raising capital from private investors who seek for long-term stable dividend through listing of stocks on the Infrastructure Fund Market which was established by the Tokyo Stock Exchange (TSE). Raised capital is used for development and operation of power plants and the revenue from sales of electric power is distributed to the investors as dividend.
Green bond	Bond which is issued for the purpose of raising funds to be allocated to the projects which are effective to improve the environment (green projects).
Loan for solar sharing	Loan which is provided by Norinchukin Bank aiming to increase income of Japan Agricultural Cooperatives (JA) and revitalize regional economy

2.5 Specific investments programs

Under the Feed-in Tariff (FIT) program, a wide variety of business models have been introduced by taking advantage of the long-term and stable revenues from selling electricity generated by PV systems fixed for the period of 20 years under the FIT program. Basically, typical business models for investment are loan and lease programs. Other business models include the following:

Regarding the TPO model of PV systems, local governments are conducting public tenders for the lease of the roofs of public facilities such as elementary and junior high schools. Since the risks of collapse of business of the owner or removal of facilities are low compared with the lease of the roofs of private facilities, the tenders are actively responded. Also, the service for self-consumption started, which directly supplies electricity generated from PV systems installed on the rooftops of these facilities. Multiple companies started a service to install PV systems for self-consumption at no initial cost.

Since the FIT program started in Japan, installation of 10 to < 50 kW small-scale PV systems has advanced, and this capacity range now boasts the largest PV installed capacity on a cumulative basis. A tax system to support small- and medium-sized enterprises (SMEs) is utilized and a preferential tax treatment under the Act for Facilitating New Business Activities of Small and Medium-sized Enterprises was continued in FY 2019, which offers immediate depreciation of corporate tax or tax reduction, reduction of fixed property tax for PV systems for self-consumption (selling surplus electricity).

Table 14: Summary of existing investment schemes

Investment Schemes	Introduced in Japan
Third Party Ownership (TPO) (no investment)	“Roof lease model” is available, which leases only the right of use of roofs. However, this business model has legal restrictions. A model to directly supply electricity without passing through transmission grids has started.
Renting	There are some cases where land is rented.
Leasing	It is easier for leasing to secure credit line than bank loans and the procedures are easier. It is not necessary to own excessive asset for a long time. The leasing model has been actively used for these reasons. Leasing is also utilized to support PV systems on farmland while continuing agricultural activities.
Utilization of taxation system	Taxation system which supports investment by small- and medium-sized enterprises (SMEs), mainly dealing with 10 - 50 kW small-scale projects for self-consumption

2.6 **Additional Country information**

Table 15: Country information

Retail electricity prices for a household (Low voltage 100 V or 200 V) (TEPCO Energy Partner)	Base rate: 286 JPY/ 10 A (1 kVA) Charge for the volume of usage: < 120 kWh/month 19,88 JPY/kWh, 120 - 300 kWh/month 26,48 JPY/kWh, > 300 kWh/month 30,57 JPY/kWh (TEPCO Energy Partner, type B, typical ampere for general household: 10 - 60 A, three-phase pricing system with prices varying depending on the volume of usage) *1: "Surcharge to promote renewable energy power generation (2,9 JPY/kWh (April 2019), 2,95 JPY/kWh (May 2019 - April 2020))" will be added on top of the above-mentioned charge, depending on the electricity usage. *2: Fuel regulatory costs will be added or reduced depending on the import prices of crude oil, LNG and coal as well as currency exchange (fuel regulatory cost of low-voltage supply in Kanto Area as of July 2020: -2,44 JPY/kWh). *3: There are various price plans depending on time zones. *4: Electric Power Companies (EPCO) announced various price plans of their own following the full liberalization of electric power including retail electricity prices for households from April 1, 2016. (Source: TEPCO Energy Partner's website)
Retail electricity prices for a commercial company (High voltage: ≤ 6,6 kV)(TEPCO Energy Partner)	Base rate: 1 716 JPY x (185 - power factor)/ 100 per kW Charge for the volume of usage: 17,54 JPY/kWh (summer), 16,38 JPY/kWh (other seasons) (TEPCO Energy Partner, commercial use, from October 1, 2019) *1: Contract electricity volume will be fixed according to annual maximum electricity demand. *2: Surcharge to promote renewable energy power generation will be added in the same way as the one for households. Fuel regulatory costs will be added or reduced (fuel regulatory cost as of July 2020: -2,35 JPY/kWh). *3: There are various price plans depending on time zones and seasons. (Source: TEPCO Energy Partner's website)
Retail electricity prices for an industrial company (High voltage: ≤ 6,6 kV) (TEPCO Energy Partner)	Base rate: 1 815 JPY x (185 - power factor)/ 100 per kW Charge for the volume of usage: 16,16 JPY/kWh (summer), 15,15 JPY/kWh (other seasons) (TEPCO Energy Partner, high voltage electricity (≥ 500 kW), from October 1, 2019) Base rate: 1 292,5 JPY/kW x (185 - power factor)/ 100 per kW Charge for the volume of usage: 17,37 JPY/kWh (summer), 16,24 JPY/kWh (other seasons) (TEPCO Energy Partner, high voltage electricity A (< 500 kW), from October 1, 2019)

	*1: Contract electricity volume will be fixed according to annual maximum electricity demand. *2: Surcharge to promote renewable energy power generation will be added in the same way as the one for households. Fuel regulatory costs will be added or reduced (fuel regulatory cost as of July 2020: -2,35 JPY/kWh). *3: There are various price plans depending on time zones and seasons. (Source: TEPCO Energy Partner's website)
Population as of December 1, 2019	126,144 million (Statistics Bureau, Ministry of Internal Affairs and Communications (MIC), as of December 1, 2019)
Country size	377 975 km^2 (Statistics Bureau, MIC) (as of October 1, 2019)
Average PV yield in kWh/kW	1 000 - 1 100 kWh/kW/yr
Name and market share of major EPCOs (based on electricity demand of December 2019)	1 TEPCO Energy Partner 30,0 % 2 Chubu Electric 16,1 % 3 Kansai Electric 15,4 % 4 Tohoku Electric 10,0 % 5 Kyushu Electric 9,6 % 6 Chugoku Electric 7,3 % 7 Hokuriku Electric 3,7 % 8 Hokkaido Electric 3,6 % 9 Shikoku Electric 3,2 % 10 Okinawa Electric 0,9 % (Source: Survey of Electric Power Statistics, METI)
Name and market share of electric utilities (based on electricity demand of December 2019)	1 Former General Electricity Utilities (10 EPCOs from Hokkaido to Okinawa) 83,9 % 2 Power Producers and Suppliers (PPS) 16,1 % (Source: Survey of Electric Power Statistics, METI)

3 POLICY FRAMEWORK

Table 16: Summary of PV support measures

	Residential		Commercial + Industrial		Centralized	
Measures in 2019	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	Yes (purchase of surplus electricity)	- Purchase price for FY 2020 were determined	Yes	- Cut in purchase price - Tender scheme (≥ 500 kW)	Yes	- Cut in purchase price - Tender scheme (≥ 500 kW)
Feed-in premium (above market price)	No	Electric companies, etc. set the post-FIT power purchase menu	No	No	No	No
Capital subsidies	No	No	There are subsidies for non-FIT applicant		There are subsidies for non-FIT applicant	
Green certificates	Yes		Yes		Yes (rarely used since FIT is more profitable)	
Renewable portfolio standards (RPS) with/without PV requirements	No	No	Transitional measures of the past programs are still valid	No	Transitional measures of the past programs are still valid	No
Income tax credits	Preferential tax treatment under the Act for Facilitating New Business Activities of Small and Medium-sized Enterprises - Intended for companies and individuals who file an income tax return on the blue form - Two options: immediate depreciation (100 %) or 10 % tax credit - Fixed Property Tax is reduced by 50 % for three years as a special measure					
Self-consumption	No	No	There are subsidies intended for PV for self-consumption purpose (FIT is not provided)		No	No
Net-metering	No	No	No	No	No	No
Net-billing	No	No	No	No	No	No
Collective self-consumption and virtual net-metering						
Commercial bank activities e.g. green mortgages promoting PV	There are various financing options as an extension of mortgage and home improvement loans. The interest rate is approx. 1,5 - 2,6 %.		Many financial institutions offer financing options for PV systems with a capacity of 10 kW or more taking advantage of FIT. There are movements to issue green bonds or establish funds for PV power generation.			
Activities of electricity utility businesses	No	Obligation to equip devices to address output curtailment	- Obligation to equip devices to address output curtailment started in 2015 - There are cases where electric companies or their subsidiaries carry out the PV power generation business - In the areas such as remote islands and places where power distribution capacity is saturated, demonstration tests were started to realize both the introduction of renewable energy and stable management of electric grids			
Sustainable building requirements	Based on the “Act for the Improvement of the Energy Efficiency Performance of Buildings”, a gradual change to conformity obligations to energy efficiency standards is promoted. Previous non-binding obligations were changed to conformity obligations for buildings with gross floor area of 2 000 m^2 or more from FY 2017 onwards. Following the revision of the act in May 2019, buildings with					

	gross floor area of 300 m^2 or more will be obliged to conform to energy efficiency standards, which will take effect from April 2021. In case of conformity obligations, a building which primary energy consumption falls below standard as a result of assessment in a specific manner cannot be constructed. It is expected that installation of PV on buildings will increase through conformity obligations because PV is assessed as a device to reduce energy consumption.					
BIPV incentives	No	No	No	No	No	No
Other						

3.1 National targets for PV

In the Fourth Strategic Energy Plan which was approved by the Cabinet in 2014, the significance of securing safety was added as the basics of energy policy, in addition to 3E (Energy Security, Economic Efficiency and Environment). In December 2014, the Long-term Energy Supply and Demand Outlook Subcommittee was established and started discussions on the future of the realistic and well-balanced structure of energy supply and demand. The subcommittee compiled a report on July 16, 2015 and the energy mix for FY 2030 was decided. The energy mix for FY 2030 is estimated to be as follows: 22 to 24 % by renewable energy, 20 to 22 % by nuclear power, 27 % by LNG thermal power, 26 % by coal-fired thermal power and 3 % by oil-fired thermal power. The breakdown of renewable energy sources is as follows: 8,8 to 9,2 % by hydro, 7,0 % by PV, 3,7 to 4,6 % by biomass, 1,7 % by wind and 1,0 to 1,1 % by geothermal power. As a national PV target, the cumulative installed capacity of 64 GW in FY 2030 was set. This target was set by capping the surcharge for the FIT program, which is a burden on the nation, at approximately 3 trillion JPY per annum.

3.2 Direct support policies for PV installations

3.2.1 Description of support measures

- Program to promote autonomous dissemination of renewable energy-based electricity and heat

This program provides subsidy to PV systems, etc. for self-consumption and local production and local consumption of electricity. The FIT program is not applied under the subsidy.

- Subsidy for project expenses to implement a special scheme for surcharge under the FIT program

For energy-intensive industries, reduction of surcharge payment is eligible. The amount of reduced surcharge is compensated with the national budget.

- Program to promote low-carbon houses through introduction of net zero energy house (ZEH), etc.

This program grants a fixed amount of subsidy for newly-built or existing detached houses which meet the requirements of the subsidy for net zero energy house (ZEH).

- Program to promote introduction of net zero energy building (ZEB) and saving of CO_2 emissions in commercial facilities, etc.

This program grants a fixed amount of subsidy to pioneering demonstration projects, etc. which aim to realize ZEB in the facilities owned by local public organizations and small- and medium-scale private commercial buildings, etc.

- Model project for advanced measures against CO_2 emissions for public facilities, etc.

This project aims to realize interchange of electricity and heat using renewable energy, etc., in the areas where multiple facilities such as public facilities exist.

Establishment of independent and distributed energy systems, etc.

- Project to demonstrate establishment of virtual power plants (VPPs) utilizing energy resources on the consumer side

This project aims to establish a technology to control VPPs, etc. and promote expansion of renewable energy introduction, enhancement of energy conservation and leveling of the load of electricity, etc.

- Subsidy for project expenses to support promotion of renewable energy introduction in Fukushima Prefecture

This subsidy program supports demonstrative researches on introduction of renewable energy-based power generation facilities, establishment and improvement of storage batteries and power transmission lines, and toward commercialization of renewable-energy related technologies in Fukushima Prefecture.

- Project to develop the next-generation power control technology toward large-volume introduction of renewable energy

This project aims to solve the issues of establishing the Japanese version connect & manage as well as the distributed network system, and to develop a system of offshore direct current power transmission and element technologies.

- Subsidy for project expenses to promote introduction of residential power storage systems which can be utilized in case of disaster

This is designed to subsidize consumers who own < 10 kW PV systems to cover a part of the expenses to install residential power storage systems.

3.2.2 Description of support measures excluding BIPV and rural electrification

The Ministry of Economy, Trade and Industry (METI) is taking initiative in supporting introduction of PV systems under the Feed-in Tariff (FIT) program. In order to achieve a well-balanced introduction of renewable energy while curbing of national burden, the “Act on Special Measures Concerning Procurement of Renewable Energy Sourced Electricity by Electric Utilities (Renewable Energy Act or FIT Act)” was amended and the “revised FIT Act” was enacted. Effective from April 2017, the FIT program was fundamentally reviewed and revision of approval scheme, change of method to set FITs, change of entities obliged to purchase FIT electricity, improving transparency of issues related to electric grids and revision of the surcharge reduction system were implemented. In August 2017, from the viewpoint of reducing the national burden, the Ministerial Ordinance which regulates overpanelling of PV modules after approval was revised. In December 2018, the retroactive measures were decided for the first time to deal with the FIT-approved PV projects which have not started operation for a long time. The revised FIT Act is designed to undergo a drastic review by March 31, 2021, and the direction to establish a support scheme according to the characteristics of

power sources was indicated and two types of power sources, competitive power source and locally-utilized power source were presented. As for competitive power source, it is planned to be integrated with the electricity market under the Feed-in Premium (FIP) program, as the market-integrated support for installation. As for locally-utilized power source, it is planned to maintain the FIT program after setting the requirements for local utilization.

3.2.3 BIPV development measures

The building-integrated PV (BIPV) is adopted in the demonstration jointly supported and promoted by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), METI and the Ministry of the Environment (MOE), in order to realize net zero energy house (ZEH) and net zero energy building (ZEB) as the measures for energy conservation of houses and buildings.

The New Energy and Industrial Technology Development Organization (NEDO) implemented a research project in FY 2019 on the potential of PV installations toward renovating existing buildings into ZEB as a new market for PV. The research was conducted on the markets and technical trends both home and abroad with regard to PV installations on the parts of the buildings such as windows as an opening area where it is possible to install PV modules at the time of renovation.

Also, METI worked on a project on “International standardization of BIPV modules” for three years from FY 2015 to FY 2017. From FY 2018, it started the “International standardization of BIPV modules and systems” as a succeeding project. This three-year project (FY 2018 - FY 2020) has been promoting activities to revitalize international standardization and the BIPV market, covering not only BIPV modules but also BIPV systems. As a project consignee, Photovoltaic Generation Technology Research Association (PVTEC) is conducting a research on standardization, covering the test method of laminate glass for BIPV, a new test method regardless of the size of BIPV module.

3.3 **Self-consumption measures**

Table 17: Summary of self-consumption regulations for small private PV systems in 2019

PV self-consumption	1	Right to self-consume	Transfer of environmental value is available through green power certificates, etc. In other cases, the right to self-consume attributes to the consumer.
	2	Revenues from self-consumed PV	Self-consumed electricity is not subject to taxation.
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	The fee will not be charged in case of self-consumption.
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	FIT for surplus electricity is set. For the post-FIT residential PV systems, electricity retailers set the purchase price.
	5	Maximum timeframe for compensation of fluxes	Measured by installing two meters (sale/ purchase) and bill separately on a monthly basis. Therefore, there is no compensation.
	6	Geographical compensation (virtual self-consumption or metering)	There is no compensation.
Other characteristics	7	Regulatory scheme duration	Surplus power purchase periods under FIT program: 10 years for < 10 kW and 20 years for ≥ 10 kW systems
	8	Third party ownership accepted	So far, the roof-lease business was conducted mainly by using FIT. However, introduction of the power purchase agreement (PPA) model in combination with electricity retailing is making progress.
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	Except for respecting the regulations set at the time of grid connection and paying the amount required by electric companies, there are no charges intended for renewable energy such as fees that arise out of ancillary service, etc.
	10	Regulations on enablers of self-consumption (storage, DSM…)	For residential PV systems, responses to the mode to promote self-consumption (Green Mode) are being promoted, in preparation for the termination of the FIT purchase period
	11	PV system size limitations	Purchase of surplus electricity for < 10 kW systems. For ≥ 10 kW systems, there is no size limitation as far as power transmission and distribution operators permit.
	12	Electricity system limitations	There is no major barrier at present
	13	Additional features	Promotion and support measures for self-consumption have been strengthened, aiming for independence from FIT.

3.4 Collective self-consumption, community solar and similar measures

There is no established scheme for the use of electricity from PV systems by multiple consumers. However, the Ministry of Economy, Trade and Industry (METI) published the list of examples of smart communities, which use energy effectively within communities and is promoting smart communities across Japan through companies and organizations. The New Energy Promotion Council continues to accept applications for the “Project to promote introduction of smart communities” which is designed to contribute to establishing smart energy systems and smart communities that are resistant to disasters in the areas stricken by the Great East Japan Earthquake. In FY 2019, a call for proposals for the "II. Smart Community Development Project" was conducted and subsidy was provided for the expenses required for systems and equipment to be installed, project management and promotion activities out of the master plan that is the outcome of the "I. Project to Formulate Smart Community Master Plan".

3.5 Tenders, auctions & similar schemes

There are two types of tenders: tender for grid connection capacity and tender for FIT capacity.

- Tender for grid connection capacity

The “tender process to secure the grid connection capacity” is conducted to bid for grid connection capacity in areas where projects of various power sources such as PV are concentrated into specific power transmission and distribution lines. Under the tender process to secure the grid connection capacity, reduction of the burden of each business operator is aimed to be achieved through cost sharing with neighbouring projects. The cost for enhancement of bulk power system is the general burden which is widely covered by consumers based on the guideline by METI. As for the enhancement cost of power transmission and distribution facilities other than those for bulk power system, the ratios of general burden and burden for business operators (specific burden) are calculated for each tender process. A ceiling price was set for the general burden, at the uniform price of 41 000 JPY/kW for all the power sources.

The Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO) is the organizer of the tender process and the tender process can be started when the requirements are satisfied following the application for the start by the business operator. General power transmission and distribution operators are in charge of the procedures and they present tender capacity and minimum tender price (minimum unit price of tender burden) per kW for each area. Power producers bid for the planned system capacity and tender price (unit price of tender burden) per kW and the priority for grid connection is decided in descending order according to tender price. The tender process becomes effective when the product (result of multiplication) of unit price of tender burden and capacity exceeds the construction cost for that tender. As of December 2019, a total of 40 tender processes have been started throughout Japan of which 31 processes have been completed. Due to the long construction period of the grid enhancement, a policy to make maximum use of the existing grid was presented so that power sources can be connected to the grid as soon as possible. With regard to the grid enhancement, consideration of the facility configuration nationwide based on a cost-benefit assessment will be carried out.

- Tender for FIT capacity

Following the incorporation of the tender for FIT capacity in the revision of the Renewable Energy Act which was enacted on May 25, 2016, a tender scheme for 2 MW and larger PV projects was introduced from FY 2017. The scope of PV projects subject to the tender scheme was expanded to include ≥ 500 kW from FY 2019. The tender capacity for the fourth tender conducted in FY 2019 was 300 MW. A total of 71 projects with a total capacity of 266,19 MW participated in the tender and a total of 63 projects with a total capacity of 195,9 MW won the tender. The ceiling price which was not disclosed at the time of the tender was set at 14,00 JPY/kWh and the lowest winning price was 10,50 JPY/kWh. The winning projects are required to firstly pay the second deposit (5 000 JPY/kW) and acquire approval, and 55 projects with 184,5 MW paid the deposit. The projects which won the tender at the lowest bidding price withdrew in the middle of the process. The tender capacity for the fifth tender was 416 MW and a total of 27 projects with 39,8 MW won the tender. The ceiling price which was not disclosed at the time of tender was set at 13,00 JPY/kWh, the lowest winning price was 10,99 JPY/kWh, and the highest winning price was 13,00 JPY/kWh. A total of 26 projects with 37,9 MW paid the second deposit. The results of the fourth and the fifth tenders were verified, and discussions were made on the sixth and the seventh tenders scheduled to be conducted in FY 2020. The scope of PV projects subject to the tender scheme will be extended from ≥ 500 kW projects to ≥ 250 kW projects. The tender capacity will be 750 MW for each of the sixth and seventh tenders, and will be a total of 1 500 MW/year. The ceiling price will not be disclosed. As for regional and public projects, as with FY 2018, projects certified by municipalities will be exempt from paying the first and the second deposits based on the Act on Promoting Generation of Electricity from Renewable Energy Sources Harmonized with Sound Development of Agriculture, Forestry and Fisheries. As for payment of deposit, it is allowed to pay the deposit with the guarantee from financial institutions with a certain level of rating.

Table 18a: Results of the fourth tender for FIT capacity in FY 2019

Item	Description
Subject of the tender scheme	≥ 500 MW PV systems
Tender capacity	300 MW (a uniform tender is conducted nationwide)
Ceiling price	14,00 JPY/kWh (not disclosed at the time of bidding)
Winning bids	63 projects with a total capacity of 195,9 MW
Lowest winning price	10,50 JPY/kWh (withdrawal after winning the bid)
Highest winning price	13,99 JPY/kWh
Withdrawal after winning the bid	8 projects with a total capacity of 11,4 MW
Paid the second deposit to acquire approval	55 projects with a total capacity of 184,5 MW

Table 18b: Results of the fifth tender for FIT capacity in FY 2019

Item	Description
Subject of the tender scheme	≥ 500 kW PV systems
Tender capacity	416 MW (a uniform tender is conducted nationwide)*
Ceiling price	13,00 JPY/kWh (not disclosed at the time of bidding)
Winning bids	27 projects with a total capacity of 39,8 MW
Lowest winning price	10,99 JPY/kWh
Highest winning price	13,00 JPY/kWh
Withdrawal after winning the bid	1 (1,9 MW)
Paid the second deposit to acquire approval	26 projects with a total capacity of 37,9 MW

* Since the bidding capacity of the fourth tender was 266 MW, which was lower than the tender capacity of 300 MW, the difference of 34 MW was subtracted from the originally set tender capacity of 450 MW.

3.6 Other utility-scale measures including floating and agricultural PV

Regarding floating PV (FPV) systems, although no specific measures have been taken to promote them, the installed capacity of FPV systems has been steadily growing in Japan.

In November 2013, the Act on Promoting Generation of Electricity from Renewable Energy Sources Harmonized with Sound Development of Agriculture, Forestry and Fisheries was enacted, with the aim of revitalizing agricultural, forestry and fishing villages by properly developing renewable energy generation facilities in agricultural, forestry and fishing villages in coordination with land use, etc., and promoting initiatives that contribute to the sound development of the regional agriculture, forestry and fisheries.

In this context, PV systems on farmland (solar sharing), in which farming and PV power generation are carried out at the same time by sharing the sunlight are promoted, aiming to expand the size of the farming business and encourage the transition to the sixth industry through income from the sale of agricultural products as well as from the sale of electricity and in-house use of the generated electricity. As shown in Table 19, the Ministry of Agriculture, Forestry and Fisheries (MAFF) issued a notification on the PV systems on farmland in 2013, which clarified the handling of PV systems on farmland. This led to the expansion of installed capacity of PV systems for solar sharing. Also, PV systems for agricultural applications were introduced in the Investments for the Future Strategy 2017 which was approved by the cabinet in June 2017. Furthermore, in May 2018, MAFF eased the regulations and extended the term of permission for conversion of farmland for PV installations from 3 years to 10 years, as part of encouraging installations of PV systems for agricultural applications.

Table 19: Policies related to solar sharing

Period	Responsible organization	Details
March 2013	MAFF[1]	Issuance of agricultural promotion notification No. 2657 (FY 2012) "Handling of PV power generation facilities, etc. under the permission system of farmland conversion, by installing PV systems above farmland with supporting poles and continuing agricultural activities".
April 2016	MAFF	Revision of the notification (final revision of the former notification)
March 2017	The Democratic Party[2]	Bill to promote solar sharing by the Democratic Party
June 2017	Cabinet of Prime Minister Shinzo Abe	PV systems for agricultural applications were introduced in the Investments for the Future Strategy 2017
November 2017	MAFF	Release of guidebook by MAFF
April 2018	MOE[3]	PV systems for agricultural applications were introduced in the Fifth Basic Environment Plan
May 2018	MAFF	Revision of the notification (Permission term for temporary farmland conversion was conditionally extended to within 10 years) "Changes in handling permission of farmland conversion for PV power generation facilities for agricultural applications"

1: Ministry of Agriculture, Forestry and Fisheries

2: Current Democratic Party for the People

3: Ministry of the Environment

3.7 Social Policies

Although no specific programs are available for low-income families, regional public organizations are supporting the introduction of renewable energy and conducting advanced model projects to establish independent and distributed energy systems at public facilities, etc. Under the Program to promote autonomous dissemination of renewable energy-based electricity and heat, a part of costs for consideration of commercialization and facility installation will be subsidized for such cases as follows: 1) Projects which are conducted with active participation and involvement of regional public organizations; 2) Activities on installation of PV systems mainly on farmland on the premise of continuing agricultural activities; 3) Projects to install and utilize energy storage systems, etc. Under the Model project for advanced measures to reduce CO_2 emissions of public facilities, etc., it is planned to establish around ten advanced models of measures to reduce CO_2 emissions on a community level, which is more effective and efficient than measures to reduce CO_2 emissions at individual public facilities, by utilizing renewable energy facilities and own electric lines in the community district with multiple public facilities. By introducing the established model to other regions, the measures to reduce CO_2 emissions on a regional basis will be enhanced.

3.8 Retrospective measures applied to PV

Since the start of the FIT program in July 2012, installation of ≥ 10 kW commercial PV systems rapidly increased, and the purchase price (FIT) more than halved from 40 JPY/kWh for FY 2012 to 14 JPY/kWh for FY 2019. Under the scheme where FIT is set at the time of approval, there are a large number of FIT-approved PV projects which have not started operation for a long time while keeping the high FIT, which brought up the following issues: 1) Concerns over the future increase in the financial burden of the nation; 2) Stagnation in new development and cost reduction and 3) Occupation of open grid capacity. In order to further increase the installed capacity of renewable energy while curbing the national burden, new measures were decided on December 5, 2018 to handle the FIT-approved PV projects which have not started operation. Among the commercial PV projects which acquired FIT approval between FY 2012 and FY 2014 and have far exceeded three years, which is an indicative period of starting operation after acquisition of approval, the following measures have been taken for the projects for which the deadline for starting operation was not set: 1) FIT responding to the timing of starting operation is applied instead of the higher FIT based on the cost at the time of approval, if the preparations for starting operation have not started by the end of FY 2018 (March 31, 2019) in principle and 2) One-year deadline for starting operation is set in principle, in order to secure the start of operation as early as possible. In FY 2019, the subjects of the measures expanded to include the PV projects which were approved between FY 2012 and FY 2015 and for which the deadline for starting operation is not set.

3.9 Indirect policy issues

3.9.1 Rural electrification measures

Since the entire nation is almost 100 % electrified in Japan, there are no rural electrification measures. However, there are support measures for remote islands in order to reduce carbon emissions in remote islands not having grid connection with the mainland. These islands depend on expensive fossil fuel-based energy such as high-cost diesel power generation, therefore, they are susceptible to the changes in fossil fuel prices and have an issue of large amount of CO_2 emissions. Given this, METI and the Ministry of the Environment (MOE) have carried out dissemination measures for renewable energy such as PV and installation of storage batteries in remote islands to reduce fossil fuel usage. Since the feed-in tariff (FIT) program was introduced, installation of PV systems has increased even in the remote islands with idle lands. However, problems such as suspension of responses to applications for grid connection contracts and output curtailment became obvious because of the limit of adjusting power which was caused by limited demand. Accordingly, in remote islands of Tokyo Metropolitan Government (TMG), a demonstration test was started to realize both the introduction of renewable energy and stable management of electric grids. In the Hahajima Island of the Ogasawara Islands, this demonstration test aims to cover half of the annual electric consumption of the island with PV power generation. TMG plans to disseminate the results of the demonstration test to other regions after establishing a model to utilize renewable energy in remote islands. In FY 2018, a series of power outages occurred in rural areas for long periods of time because of natural disasters. As a result, the installation of residential storage systems expanded and approximately 100 000 houses introduced storage systems.

3.9.2 Support for electricity storage and demand response measures

With regard to demand response, public invitation for “Subsidy for project expenses to demonstrate establishment of virtual power plants (VPPs) utilizing energy resources on the consumer side” (METI), was carried out by the Sustainable open Innovation Initiative (SII). The public invitation was conducted in the following four categories: A) Projects to establish VPP infrastructure; B-1) VPP aggregator projects; B-2) V2G aggregator projects and C) Projects to promote introduction of VPP/ V2G resources. For the Projects to promote introduction of VPP resources, subsidy is granted to support the equipment cost including storage batteries and the installation cost. In FY 2019, a subsidy program was implemented for storage systems of industrial applications (storage batteries + inverters). The target price of a storage system was set at 190 000 JPY/kW, and 60 000 JPY per one kW of rated capacity (one third of the maximum equipment cost) was subsidized.

As for residential storage batteries, the "Subsidy for projects to promote introduction of residential storage systems that can be used in the event of a disaster (temporary and special measure)" (METI) was applied and the subsidy amount of 20 000 JPY/kWh for the disaster-response type, 30 000 JPY/kWh for the network type, 40 000 JPY/kWh for the frequency control type, etc were granted.

Furthermore, with regard to electricity storage for industrial applications, etc., "Subsidy for storage batteries, etc. to enable the operation using renewable energy as a supply capacity even in the event of a disaster" (METI) was implemented and a subsidy program was carried out for electricity storage facilities installed for the purpose of supplying electricity to the electric grid in response to the requests from electric companies in the event of a disaster. The facilities eligible for the subsidy are storage facilities which cost equal to or below the target price of 220 000 JPY/kW. Between one third and a half of the cost (depending on the size of the company) will be subsidized.

The MOE also provided subsidies for the installations of net zero energy house (ZEH) and demonstration projects of net zero energy building (ZEB) as a subsidy program. “Project to support net zero energy house (ZEH)” was implemented by the SII as a liaison for this program. In case of introducing a storage system to the eligible ZEH, 20 000 JPY is granted for one kWh of storage capacity with the cap of the subsidy amount of 200 000 JPY.

Following the establishment of negawatt trading market in April 2017, a mechanism in which negawatt can be traded as a supply capacity as is the case with the generated electricity was developed. Following the full liberalization of electricity retailing, general power transmission and distribution operators are conducting public invitation for dispatching ability used for frequency control and adjustment of supply and demand balance within the electricity supply service area. In order to utilize demand response (DR) as a dispatching ability, requirements for participation in public invitations have been improved to make it easier for DR operators to participate in the public invitation.

Dissemination of residential storage batteries for stationary applications has advanced thanks to the subsidy program for support projects of ZEH. However, many of them are for emergency use at the time of electric outage, etc. or operated in the mode to store electricity in the middle of the night and discharge in the daytime and rarely used to mitigate the impacts of naturally variable power sources on electric grids.

From November 2019, the surplus power purchase under the FIT program started to be terminated for PV systems. It is assumed that the operation in demand response mode will start, following the change of the operation mode.

3.9.3 Support for electric vehicles (and VIPV)

Since FY 2009, METI has been providing subsidy for the introduction of clean energy vehicles. This scheme has been reviewed following the change of policy, etc. In FY 2019, a part of the subsidy scheme for the purchase of clean energy vehicles such as electric vehicles (EV) and plug-in hybrid vehicles (PHV) was changed. Since EVs and PHVs are now able to travel longer distances on electric power alone (EV driving distance) thanks to the improved battery performance, the models with shorter EV driving distance are no longer eligible for subsidies. However, the scheme remains unchanged for small passenger cars and minicars. As for EV, the subsidy amount is calculated as follows: The driving distance of one charging (JC08 mode value) x 1 000 JPY and 400 000 JPY or less. The amount ranges from 301 000 JPY/unit to 400 000 JPY/unit depending on the model. The subsidy amount for clean diesel vehicles (CDVs) was reduced and the subsidy amount for PHV was 200 000 JPY (capped at 200 000 JPY). In addition, as for electric motorcycles, the " type two motorcycles" (125 cc or less) were added to the scope of subsidies. A new subsidy program was introduced for power feeders (external power feeders) that supply electricity from vehicles to houses, etc. as V2H (the subsidy rate is one third with no upper limit). The aim is to promote the use of external power feeders so that EVs can be used as "mobile storage batteries" in the event of a disaster, etc. through dissemination of external power feeders. The subsidy amount for FCV and CDV is based on the price difference with the gasoline vehicles of the same class. For FCV, however, the whole amount of price difference is the subsidy amount, and 2,02 to 2,08 MJPY is subsidized. The amount of subsidy for CDVs varies from 15 000 JPY to 150 000 JPY since it is calculated with the subsidy rate of one-twelfth and 150 000 JPY or less. These subsidies are managed by the Next Generation Vehicle Promotion Center. There is another requirement that the beneficiaries of the subsidy are not allowed to change the vehicle for four years. As for EV and PHV, they are 100 % exempt from the vehicle acquisition tax, as well as the vehicle weight tax. Also, 75 % tax reduction of the vehicle tax, which is set for payment in the next year of purchase according to the amount of displacement, is also applied. EV and PHV fall under the displacement category of 1 000 cc or less, and the annual vehicle tax is 29 500 JPY, which will be reduced to 7 500 JPY with the 75 % tax reduction applied.

Similar to the previous year, in FY 2019, under the project to establish charging infrastructure, subsidies were provided to charging facilities installed at rest areas of express ways, roadside rest areas, commercial and accommodation facilities, condominiums, offices and factories.

While there are no specific subsidies from the government for VIPV, NEDO provides public funding support for R&D and demonstration to promote the spread of PV mounted on vehicles, based on the accomplishments of the PV-powered vehicle Strategy Committee and the projects to promote the development of innovative and high-performance solar cells. Based on the accomplishments so far, VIPV is expected to be an opportunity to create new markets and solve energy and environmental issues, and the future support measures are anticipated.

3.9.4 Curtailment policies

Power generation amount of renewable energy sources such as PV varies depending on the natural environment. Accordingly, in case the power generation amount within a region exceeds the local electricity demand, output curtailment is conducted to maintain stable supply of electricity. Based on the priority dispatch rules which were stipulated by the Ordinance for Enforcement of the FIT Act and Operational guidelines for the power transmission and distribution business, etc. by the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO), curtailment of thermal power generation, operation of pumped storage power generation and utilization of inter-regional interconnection lines will be

conducted. In case where the power generation amount remains excessive even with these measures, output curtailment of renewable energy sources will be conducted. In October 2018, the first output curtailment on the mainland was conducted on the Kyushu mainland. Following this, the following efforts have been made to reduce the output curtailment: 1) Further utilization of inter-regional interconnection lines; 2) expansion of online control to enable flexible adjustment; 3) reduction of the minimum output capacity of thermal power generators and 4) economic adjustment of output curtailment to secure fairness among power producers and efficient output curtailment. From October 2019 onwards, Kyushu Electric has improved the method of calculating the output curtailment amount for which the curtailment order is issued on the previous day and changed an operation method to the one that gives priority allocation to off-line curtailment, in order to reduce the output curtailment amount of renewable energy.

3.9.5 Other support measures

3.9.5.1 International policies affecting the use of PV Power Systems

In order to achieve the reduction target of greenhouse gas (GHG) emissions which was presented in the Intended Nationally Determined Contributions (INDC) of Japan, which was approved by the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21), the national government formulated the “Plan for Global Warming Countermeasures” in May 2016, in which a mid-term plan for Japan’s global warming prevention measures is indicated. This plan specifies the actions to be addressed by the national government, local governments, business operators and general public and the national measures and draws a path for achieving targeted reduction, as well as establishing a goal to reduce the GHG emissions by 80 % by 2050 as a long-term target. In this plan, it is stated that renewable energy should be “introduced to the maximum extent possible”. In November 2016, the Japanese government approved the accord on the Paris Agreement in the plenary session of the House of Representatives. Japan established a goal to reduce the GHG emissions by 26 % by FY 2030 compared to FY 2013 (25,4 % decrease from FY 2005) and by 80 % by 2050.

The national government held the 40th meeting of the Global Warming Prevention Headquarters on June 11, 2019 and made a cabinet approval on the “Long-Term Low Greenhouse Gas Emission Development Strategies under the Paris Agreement (the Long-term Strategies)”. The Long-term Strategies proclaims the realization of a “decarbonized society” by making Japan’s GHG emissions substantially zero in an early stage of the second half of the 21st century. Towards the goal to reduce the GHG emissions by 80 % by 2050, the Long-term Strategies proposed specific measures as follows: making renewable energy a mainstream power source; utilization of hydrogen energy and dissemination of technologies to recover and utilize emitted CO_2. Through the business-led “discontinuous innovation," decarbonization will be realized. Some businesses and communities will be able to realize decarbonization before 2050. In response to the decision, the national government submitted the Long-term Strategies to the Secretariat of the United Nations Framework Convention on Climate Change.

3.9.5.2 The introduction of any favourable environmental regulations

- Establishment of a disaster-resilient distributed power system (the revision of the Electricity Business Act)

Concerning the promulgation of the “Acts for Establishing Resilient and Sustainable Electricity Supply Systems (Act to revise a part of the FIT Act and the Electricity Business Act, in order to promote establishment of the resilient and sustainable electricity supply framework)” in June 2020, the partial revision of the “Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities” has significant direct impacts on PV power generation.

In addition to the above, the partial revision of the Electricity Business Act has led to promoting the enhancement of cooperation at the time of disaster, strengthening the resilience of power transmission and distribution networks and the establishment of the disaster-resilient distributed electricity system. Above all, the partial revision is expected disseminate distributed power sources including PV power generation taking root in local communities by the following approaches, in order to disseminate the disaster-resilient distributed electricity system: 1) the power distribution business is positioned so that its distribution network can be operated as an independent network in case of emergency, 2) the aggregators are positioned as the electricity supplier who aggregate distributed power sources, etc. and supply electricity from them and 3) the rules of the Measurement Act were rationalized to promote utilization of distributed power sources such as storage batteries for residential use.

- Enhancement of energy conservation standards in buildings and the promotion of net zero energy house (ZEH) and net zero energy building (ZEB)

The “Act to revise a part of the Act on the Improvement of Energy Consumption Performance of Buildings (the revised Building Energy Efficiency Act)” was promulgated in May 2019. Under the revised act, non-residential buildings that have a floor area of 300 m^2 or more are required to comply with the energy conservation standards and newly-built houses/buildings that have a floor area of 300 m^2 or more are required to notify the energy conservation plan. Newly-built houses (floor area of less than 300 m^2) are not required to comply with the standards under the revision this time, though they were included in the targets of the obligation in the initial plan. However, the ranges of the target for which the architect’s accountability for the conformity with the energy conservation standards is required and the ranges of the target which must conform to the standards of the Housing Top-Runner Program were expanded (the obligation to notify the energy conservation plan and the Housing Top-Runner Program are already implemented and the rest will take effect in April 2021). Concerning the energy conservation standards (the standards of energy consumption performances), it requires that the design value of the “primary energy consumption”, which is the subtraction of the amount of energy generated by PV, etc. from the accumulated amount of energy consumption such as air conditioning and ventilation, lighting, hot-water supply, etc., is below the standard value which is set for each region.

Three ministries, namely METI, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the MOE, jointly formulated a roadmap of the net zero energy house (ZEH) in December 2015. The roadmap aims to disseminate houses whose primary energy consumption is zero or below by improving energy saving performances such as heat insulation, and strengthening introduction of energy creation. In FY 2018, the roadmap was reviewed, which set targets to make more than half of the newly built custom-built detached houses built by homebuilders ZEH by FY 2020, and to make all the newly-built houses ZEH on average across Japan by FY 2030. The definition of ZEH is subdivided, such as “Nearly ZEH (available in limited regions)”, “ZEH+ (the higher-grade ZEH)”, “ZEH+R (a disaster-response type ZEH)”, “ZEH-Oriented (ZEH for small rooftops, etc., generation of

energy is not required)" and "ZEH-M (Ready/Oriented, ZEH for condominiums with multiple dwelling units called "Mansion" in Japanese)".

Similarly, net zero energy building (ZEB) is a building which aims to make the balance of annual primary energy used by the building zero, while realizing the comfortable interior environment. The roadmap proclaims the goals to realize ZEB for newly-built public buildings, etc. by the scale/use of the buildings by FY 2020 and to realize ZEB for all newly-built buildings on average by FY 2030. In addition to "Nearly ZEB" and "ZEB Ready (50 % or more reduction of primary energy consumption by energy conservation and generation)" which have been popular, the government established "ZEB Oriented (energy generation is not required)" for the rapid dissemination of ZEB, since it is difficult to make commercial buildings completely zero-energy buildings.

Homebuilders, mainly the major ones as well as major construction companies, have been enhancing activities on ZEH and ZEB and proposing houses and buildings equipped with PV systems, home energy management systems (HEMS) and storage batteries.

3.9.5.3 Policies relating to externalities of conventional energy

While the operation of nuclear power plants is suspended after the Great East Japan Earthquake, electricity supply capacity has been secured by increasing the operation of thermal power generation facilities as shown in Figure 1. The share of thermal power generation in the generation mix was approximately 65 % in FY 2010, before the earthquake, which increased to around 84 % in FY 2015. In FY 2018, it slightly decreased to approximately 77 %. While the share of fossil fuels decreased, the share of nuclear power and renewable energy increased to about 6 % and about 17 %, respectively.

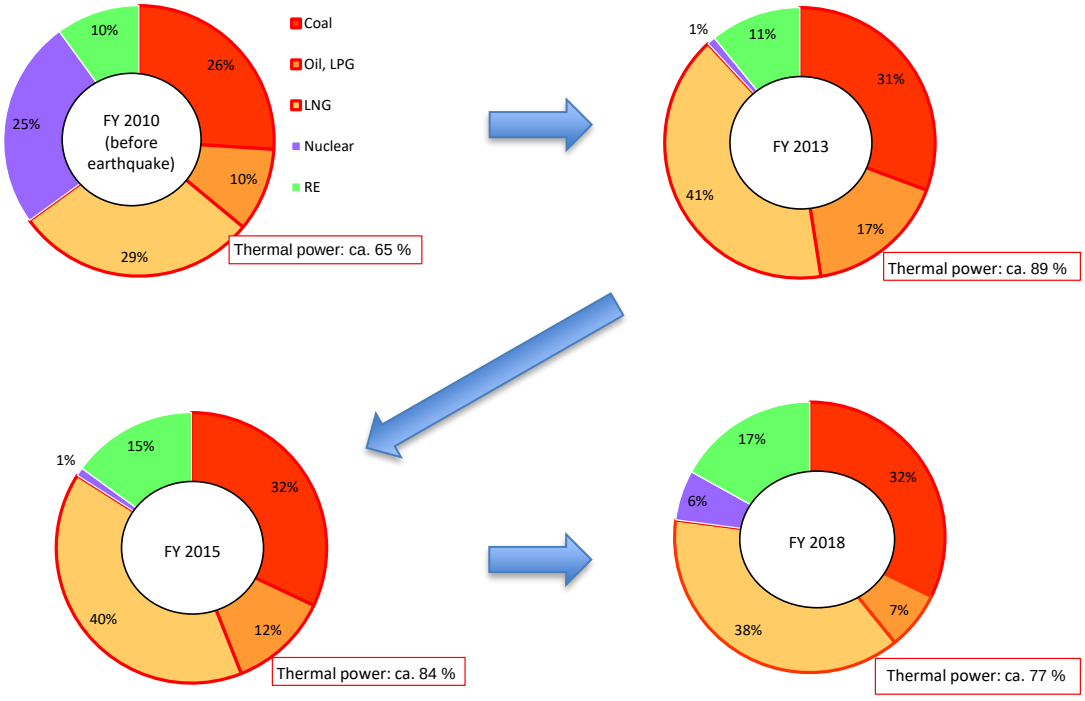

Figure 1 Generation mix of the electric companies

Source: Report on electricity supply-demand verification (October 2017) and White Paper on Energy 2020

Following the increased operation of thermal power generation facilities, greenhouse gas emissions in the electricity sector has increased to 573 million t-CO_2/year in FY 2013 from 438 million t-CO_2/year in FY 2010, before the earthquake. In recent years, greenhouse gas emissions are turning to the declining trend, due to promotion of energy conservation, expansion of renewable energy introduction, restart of nuclear power plants, and so on. However, the figure of FY 2017 was at a high level of 492 million t-CO_2/year. To achieve the mid-term target of the Paris Agreement, that is, by FY 2030, to reduce greenhouse gas emissions by 26 % from the FY 2013 level, further reduction of emissions is required. Under such circumstances, the Fifth Strategic Energy Plan was approved by the Cabinet in July 2018, which shows the direction of Japan's new energy policy toward 2030 and further toward 2050. Japan will be committed to promoting efforts to realize the energy mix for 2030 and make renewable energy a mainstream power source. In the Strategic Energy Plan, it is stated that renewable energy does not emit greenhouse gases and is a promising and important domestic energy source that can contribute to energy security as well, although there are currently various issues in terms of cost and stable supply. In FY 2018, CO_2 emissions derived from electricity decreased from FY 2017.

- PV's contribution during peak demand hours

  After the Great East Japan Earthquake, electricity supply and demand status has become tight in Japan. Accordingly, METI evaluates the actual performances and makes a forecast on electricity supply and demand from the viewpoint whether electricity can surely be supplied to cover the demand in peak hours in the summer and in the winter. Following full liberalization of electricity retailing from April 1, 2016, from the winter of 2016, supply and demand of all areas including Power Producers and Suppliers (PPS) were included in the scope of verification in addition to former General Electricity Utilities. Verification is conducted by OCCTO and the actual power supply capability records of PV systems are also evaluated.

As shown in Table 20, in the summer of 2019, electricity supply capability in the peak hours of the day with the peak demand was 27,79 GW in total against the PV installed capacity of 48,61 GW (excluding Okinawa Prefecture). It is estimated that the supply capability in the summer of 2020 will be 13,02 GW (excluding Okinawa Prefecture), which is below the previous year's result. This estimation assumes that, since the PV power generation cannot always expect sufficient irradiation in the peak hours of electricity demand, supply capability of PV is expected conservatively.

Table 20: Evaluation of power supply capabilities of PV systems in the summer by electric companies in Japan (MW)

Former General Electricity Utilities by area		Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushu	Total
Summer of 2019 (Actual)	Assumption	100	990	2 520	2 180	240	1 470	1 270	730	3 430	12 920
	Actual supply capability records on a day and an hour of peak demand	**860**	**3 060**	**6 410**	**4 310**	**620**	**2 990**	**2 750**	**1 460**	**5 340**	**27 790**
	Actual output ratio	**54,4 %**	**61,6 %**	**50,1 %**	**52,4 %**	**66,8 %**	**63,4 %**	**63,6 %**	**64,6 %**	**60,6 %**	
	Installed capacity	1 580	4 970	12 790	8 230	930	4 720	4 320	2 260	8 810	48 610
	Peak demand date and hour in Japan	2 - 3 p.m., Friday, Aug 2, 2019									-
	Peak electricity demand	4 290	14 170	55 090	25 370	5 030	28 160	10 750	5 010	15 620	163 490
	PV ratio to peak demand	20,0 %	21,6 %	11,6 %	17,0 %	12,3 %	10,6 %	25,6 %	29,1 %	34,2 %	17,0 %
Summer of 2020 (Forecast)	Estimated peak demand hours	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	2 - 3 p.m.	-
	Estimated supply capability	**180**	**1 320**	**3 560**	**2 280**	**310**	**1 620**	**1 480**	**770**	**1 520**	**13 020**
	Output ratio	**8,5 %**	**22,5 %**	**24,4 %**	**25,3 %**	**29 %**	**26,4 %**	**26,8 %**	**29,7 %**	**15,5 %**	-

Source: Report on electricity supply-demand verification (October 2019 and May 2020)

*1: "Supply capability" of PV power generation is the installed capacity of PV systems which contributed in the peak demand hours. As for estimated supply capability, each electric company is responsible for evaluating the supply capability which is surely expected to be secured in the peak demand hours. Irradiation of three days of each year with the largest electricity demand over the past twenty years is collected, and the average figure of five days with the lowest demand is evaluated as the stable supply capability.

*2: PV generated power used for self-consumption is evaluated as energy conservation and not included in supply capability. Only the surplus electricity connected to electric grids is evaluated here.

*3: Output ratio is the ratio of actual output to the rated capacity of power generation facilities

*4: Detailed numbers for the adjustment factors are available on the website of the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO)

3.9.5.4 Taxes on pollution (e.g. carbon tax)

In Japan, "Tax for Climate Change Mitigation" has been imposed since October 2012, which requires the public to widely and fairly share the burden for the usage of all the fossil fuels including petrolium, natural gas and coal, in proportion to their enviromental load (CO_2 emissions). This tax is imposed on top of the conventional Petroleum and Coal Tax, in proportion to the usage amount of fossil fuels. Tax rate has been increased step by step over three and half years. 289 JPY/t-CO_2 has been added from April 2016. For the period between October 2012 and March 2014, in combination with the conventional Petroleum

and Coal Tax, the tax rates were 2 290 JPY/kl for crude oil and oil products, 1 340 JPY/t for hydrocarbon gas and 920 JPY/t for coal. From April 2014 to March 2016, as part of the phased tax rate increase, the rates were increased to 2 540 JPY/kl, 1 600 JPY/t and 1 140 JPY/t, respectively. From April 2016 (start of FY 2016) onwards, when the phased tax rate increase was completed, the definitive tax rates have been applied and the rates are 2 800 JPY/kl for crude oil and oil products, 1 860 JPY/t for hydrocarbon gas and 1 370 JPY/t for coal.

Revenue from the Tax for Climate Change Mitigation is expected to be 262,3 BJPY from FY 2016 onwards, which will be used for implemention of various measures to curb energy-based CO_2 emissions including energy-saving measures, dissemination of renewable energy, and greening and streamlining of fossil fuels. For instance, revenue from the Tax for Climate Change Mitigation will be utilized as financial resources of various measures such as promotion of domestically-located innovative low-carbon technology-intensive industries such as lithium ion batteries, promotion of introduction of energy-saving systems by small- and medium-sized enterprises (SMEs), etc., and promotion of introduction of renewable energy in consideration of geographical characteristics taking advantage of the Green New Deal Funds, etc. As for the effets of CO_2 emisison reduction via the Tax for Climate Change Mitigation, price effects (effects of curbing CO_2 emissions via taxation) and effects on financial resource (tax revenue for curbing energy-based CO_2 emissions) are expected. According to the estimate by a research institute on the price effects and the effects on financial resource by the Tax for Climate Change Mitigation, it is estimated to reduce CO_2 emissions by approximatly 0,5 % to 2,2 %, or reduce emission amount by around 6 million t to 24 million t by 2020 compared to the 1990 levels.

The subjects of taxation under the Tax for Climate Change Mitigation are limited and the usage of tax revenue is limited to measures to address global warming. Accordingly, in order to archieve the commitment of the Paris Agreement, the Ministry of the Environment (MOE) started discussion on adopting the environment tax (carbon tax) which expands the subjects of taxation as well as the usage. The Fifth Basic Environment Plan, which was approved by the Cabinet on April 17, 2018, states that the ministry will promote making the whole taxation system greener.

MOE has been discussing carbon pricing since FY 2018 in the Subcommittee on the Use of Carbon Pricing under the Global Environment Committee of the Central Environment Council. In August 2019, the Subcommittee issued an "interim report of the discussions on the potential use of carbon pricing". In June 2019, the government held the 40th meeting of the Global Warming Prevention Headquarters and approved the "Long-Term Low Greenhouse Gas Emission Development Strategies under the Paris Agreement (Long-term Strategies)" by the Cabinet. Under the Long-term Strategies, the government aims to reduce greenhouse gas emissions by 80 % by 2050 and has set forth specific measures such as making renewable energy a mainstream power source, the use of hydrogen energy and the dissemination of technologies to capture and utilize the emitted CO_2. As for carbon pricing, it was clearly stated that "it is necessary to discuss international trends, the situation in Japan and the international competitiveness of the industry". A similar statement was included in the MOE's requests for the tax system reform for FY 2020 Tax Reform Request.

3.9.5.5 National policies and programmes to promote the use of PV in foreign non-IEA countries

Japan has been promoting activities for international cooperation to disseminate PV power generation so that it can play an active role in disseminating PV power generation particularly in Asia, in order to address global warming issues, to improve living standards in developing countries, to reduce energy consumption in other countries, and to contribute to energy security, etc.

In order to achieve the reduction target of greenhouse gas emissions, Japan has implemented the Joint Crediting Mechanism (JCM). The JCM is a mechanism in which credits issued depending on the reduced amount of greenhouse gas emissions are utilized to achieve target of Japan's greenhouse gas emissions reduction through support for dissemination of high-quality low carbon technologies, etc. to developing countries. As of July 2020, Japan has signed the bilateral documents with 17 countries namely Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Vietnam, Laos, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar, Thailand and the Philippines. In these countries, approximately 600 funding projects and demonstration projects (MOE/ METI) were adopted. As of July 2020, 95 PV-related projects with a total capacity of 1,5 GW have been promoted by Japanese companies. With these projects, support has been provided to projects to introduce PV systems and various feasibility studies have been conducted including the following: introduction of high-efficiency PV systems and appropriate O&M; application of PV systems as a substitute for grid elecricity by diesel power generation or fossil fuel power generation, as well as a substitute for self-generation, and installation of floating PV systems.

In addition to JCM, PV-related technology demonstration projects were conducted in 2019 in Indonesia and India, among non-IEA countries, under the Demonstration Project of Technology/System for International Energy Consumption Efficiency, etc. by NEDO.

The Japan International Cooperation Agency (JICA) conducted inter-governmental cooperation, through grant aid or loan assistance, as well as technological cooperation based on requests from developing countries. It supports developing master plans mainly for rural electrification using PV power generation through the study of development for rural electrification. In 2019, JICA has agreed with the government of the Solomon Islands to implement a project to formulate a roadmap for the development of renewable energy. In Vietnam, the Asian Development Bank (ADB) signed a contract to provide financing for Vietnam's first 47,5 MW floating PV project ($ 37 MUSD in total) by using the Leading Asia's Private Infrastructure Fund (LEAP) which JICA funded. In Mongolia, the 16,4-MW PV system jointly developed by Thailand's Sermsang Power (SSP) and Sharp was financed by ADB and LEAP and constructed within the framework of the JCM project by the Ministry of Environment (MOE) with the support of JICA.

The Japan Bank for International Cooperation (JBIC) actively provides financing support to environmental preservation projects such as installation of PV systems and energy-efficient power plants and introduction of energy-saving facilities in developing countries as part of its "GREEN (Global action for Reconciling Economic growth and ENvironmental preservation)" support program. As of the end of March 2019, 33 projects were approved, mainly renewable energy projects planned in India, Turkey, Southeast Asia and Latin America. In 2019, JBIC announced a loan to support the dissemination of renewable energy in Vietnam and Africa. JBIC signed a loan agreement with the US and Vietnamese subsidiaries of Nippon Sheet Glass and conducted a co-financing with Sumitomo Mitsui Banking Corporation (SMBC) and others. Nippon Sheet Glass will use the funds for the

manufacturing and sales business of TCO (transparent conductive oxide) glass for thin-film PV modules in both countries.

3.10 Financing and cost of support measures

Under the FIT program, the largest incentive for PV dissemination, which took effect in July 2012, all the electricity consumers share the cost which electric companies paid for purchasing the electricity generated by renewable energy power generation systems, in the form of surcharge in proportion to the amount of electricity they consume. The surcharge is added to the electricity bill. In order to remove regional discrepancies in surcharge collected by electric companies, “Organization to adjust cost burden” (consigned by the Green Investment Promotion Organization (GIO)) collects the surcharge once and distribute the grant to electric companies in proportion to their records of purchasing renewable energy-based electricity. Under this scheme, however, high-volume electricity consumers such as manufacturers are entitled to reduction of surcharge under the FIT program. METI covers the expenses required to compensate the losses generated from the surcharge reduction and incurred by the Organization to adjust cost burden in the form of subsidy through the national budget. The budget amount is; 7 BJPY in FY 2012, 19,1 BJPY in FY 2013, 29,0 BJPY in FY 2014, 45,6 BJPY in FY 2015, 48,3 BJPY in FY 2016, 29,2 BJPY in FY 2017, 15,5 BJPY in FY 2018, 8,2 BJPY in FY 2019 and 8,2 BJPY in FY 2020. Following the revision of the FIT Act in 2016 and the enactment in April 2017, the surcharge reduction system was reviewed, and it was decided to set the reduction rate according to the type of business and the status of efforts to improve the electric consumption unit. Amount of purchased electricity generated by PV systems under the FIT program is around 261,9 TWh cumulatively as of the end of December 2019, exceeding 10,2898 TJPY in total.

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

Table 21: Silicon feedstock, ingot and wafer producer's production information for 2019

Manufacturers	Process & technology [1]	Total Production	Product destination	Price
Tokuyama	Polysilicon (for semiconductor, Siemens process)	Undisclosed		
Mitsubishi Materials	Polysilicon (for semiconductor, Siemens process)	N/A		
OSAKA Titanium technologies (OTC)	Polysilicon (for semiconductor, Siemens process)	Very small amount		
Ferrotec	Si ingot			
	Si wafer			
M.SETEK	sc-Si ingot			

[1]: Si: silicon, sc-Si: single crystalline silicon

As of 2019 in Japan, the scale of production of polysilicon, silicon ingot and wafer for solar cells is not large. As for high purity polysilicon for semiconductor-grade silicon wafers, Tokuyama and Mitsubishi Materials manufacture it. Tokuyama manufactures polysilicon in full capacity at its factory in Shunan City, Yamaguchi Prefecture. Tokuyama is focusing on the production of high-purity products to meet the increasingly stringent quality requirements for the most advanced silicon wafers. Mitsubishi Materials is manufacturing polysilicon in Japan and the USA. OSAKA Titanium technologies (OTC) terminated the long-term polysilicon purchase agreement with SUMCO, a major semiconductor-grade silicon wafer manufacturer at the end of March 2019 which is earlier than the scheduled termination of the agreement and withdrew from the polysilicon manufacturing business.

M.SETEK, a subsidiary of a Taiwanese company AU Optronics (AUO), manufactures sc-Si ingots for solar cells at its factory in Suzaki City, Kochi Prefecture and supplies to AUO, etc. M.SETEK started manufacturing of silicon ingots of semiconductor-grade up to 300 mm (12 inch) in 2018, which are processed into wafers for sale by its affiliated company. Ferrotec manufactures 150 mm (6 inch) and 200 mm (8 inch) semiconductor-grade silicon ingots and wafers in China. Also, the company started to manufacture 300 mm products in 2019. The company proceeded to withdraw from the silicon wafer business for the PV products and shifted to the semiconductor-grade product.

4.2 Production of photovoltaic cells and modules (including TF and CPV)

Production and shipment volumes of Japanese PV cell/ module manufacturers in 2019 stayed on the decreasing trend. According to PV shipment statistics by the Japan Photovoltaic Energy Association (JPEA), total PV module shipments by domestic production in Japan in 2019 (from January to December) were approximately 1,0 GW (a 31,0 % decrease year on year). Overseas manufacturers were aggressively operating in Japan taking advantage of their price competitiveness, mainly for industrial applications. The ratio of overseas production shipped in the domestic market grew to 82,9 %, a further increased from the previous year with 74,9 %.

Mitsubishi Electric terminated manufacturing and sales of its own brand PV modules and inverters in March 2020 and shifted to procure from Kyocera. In May 2019, Panasonic agreed with GS Solar (China) on transferring its factory in Malaysia and jointly investing and managing a new company on research and development of PV modules. However, in the end of July 2020, Panasonic announced to cancel this partnership agreement on the PV business due to GS Solar's failure to fulfil the requirement necessitated to launch by the deadline agreed to in the contract. In the end of May 2020, Panasonic halted production of heterojunction solar cells in its factory in Buffalo, New York, US and announced to cancel its joint production with Tesla (USA). Solar Frontier, which became a subsidiary of Idemitsu Kosan in April 2019 following the merger of its parent company, Showa Shell Sekiyu with Idemitsu, concluded a Memorandum of Understanding (MOU) with Triumph Science and Technology Group (China) in the preliminary survey related to product development of building-integrated PV (BIPV) utilizing CIS thin-film technology. The company plans to start the sales of c-Si PV modules (general-purpose model) utilizing OEM by overseas manufacturers within 2020.

Major Japanese PV manufacturers are reorganizing the production framework from around 2017 and are transferring its business model from the traditional PV module sales business to the PV solutions business. They actively worked on providing comprehensive PV solutions including PV systems for self-consumption and ZEH applications, as well as combination of PV systems with HEMS, storage batteries, hybrid inverters, etc. Besides, they started a service to purchase power from the post-FIT PV systems with their FIT purchase period terminating sequentially from November 2019. Manufacturers are cooperating with electric companies, trading companies, etc. and are starting to offer a plan to install residential PV systems for free of charge combining with Power Purchase Agreement (PPA), which is expanding to industrial applications as well. Further, more manufacturers are entering the electricity business such as the renewable energy power generation business and the energy aggregation business, with a focus on PV power generation. These major Japanese manufacturers are also progressing technology development towards commercialization of heterojunction back contactcrystalline silicon, highly efficient solar cell such as tandem type of perovskite/ c-Si and perovskite/ CIGS, as well as light weight flexible PV module, aiming for cultivation of new markets.

Table 22: PV cell and module production and production capacity information for 2019

Cell/Module manufacturer	Technology [1]	Total Production (MW)		Maximum production capacity (MW/yr)	
		Cell	Module	Cell	Module
Wafer-based PV manufacturers					
1 Sharp Energy Solutions	c-Si	Undisclosed	Undisclosed	Undisclosed	Undisclosed
2 Kyocera	c-Si	500			
3 Panasonic	sc-Si (HIT)	Undisclosed	Undisclosed	Undisclosed	Undisclosed
4 Kaneka	sc-Si		41		
5 Mitsubishi Electric	sc-Si	-	60	N/A	N/A
6 Fujipream	sc-Si	0	3,0	0	6
7 Choshu Industry	sc-Si				
	mc-Si				
8 INFINI	sc-Si				
	mc-Si				
9 KIS	sc-Si		8		10
Thin film PV manufacturers					
1 Solar Frontier	CIS	410	410	900	900
2 Kaneka	a-Si				
3 FWAVE	a-Si				
Cells for concentration					
1 Sumitomo Electric Industries	CPV				20
Totals [2]		**1 400 [2]**	**2 549 [2]**	**950 [2]**	**3 090 [2]**

[1]: c-Si: crystalline silicon ,sc-Si: single crystalline silicon, mc-Si: multicrystalline silicon, a-Si: amorphous silicon, OPV: organic thin-film PV

[2]: Source: RTS Corporation

4.3 Manufacturers and suppliers of other components

- PV inverters

PV inverters for residential applications shifted towards certification of multiple-unit grid-connection type inverters. Manufacturers such as Omron, Tabuchi Electric, Panasonic, Kyocera, Sharp, Mitsubishi Electric, SMA Solar Technology (Germany) and Delta Electronics (Taiwan), Huawei Technologies (China) and SolarEdge Technologies (Israel) have acquired certificates from the Japan Electrical Safety & Environment Technology Laboratories (JET) for their products.

For 10 kW to < 50 kW inverters for low-voltage grid connection, major inverters on the market used to include a 9,9-kW inverter, a 25-kW inverter and a 33-kW inverter by Tabuchi Electric; a 5,5-kW inverter, a 9,9-kW inverter, a 10-kW inverter and a 12,375-kW inverter by Omron; and 10-kW inverter by Yaskawa Electric, GS Yuasa, Sanyo Denki and Shindengen. Recently, overseas manufacturers such as SMA Solar Technology, Huawei Technologies and Delta Electronics are increasing their market shares.

For the systems with a capacity of 50 kW or more, which are connected to high-voltage or extra-high voltage electric grids, two or more inverters are often installed in order to increase the total capacity as well as the system reliability. Unit capacities of inverters include 25 - 50 kW, 100 kW, 250 kW, 500 kW, 660 kW, 750 kW, 1 000 kW and 2 000 kW. Tabuchi Electric, SMA Solar Technology, Huawei Technologies, Sungrow Power Supply (China) and Delta Electronics have entered the distributed inverter market. Players in the central inverter market with the capacity range of 250 kW or more are heavy electric machinery manufacturers including Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC), Hitachi, Fuji Electric, Daihen, Nissin Electric and Meidensha. Overseas manufacturers such as SMA Solar Technology, General Electric (GE) (USA) and Sungrow Power Supply also comprise this market. Installation of distributed inverters has advanced in MW-scale PV power plants as well as small- and medium-scale PV projects, and the competition between large-capacity central inverters and distributed inverters has intensified. In this sector of the market, DC voltage of systems has increased and more systems now correspond to DC 1 000 V, up from the conventional DC 600 V. As for extra-high voltage grids with the output capacity of 2 MW or more, the trend is shifting to higher-voltage products corresponding to DC 1 500 V systems.

Reflecting an increasing demand in overseas markets, Japanese manufacturers have expanded their overseas businesses. TMEIC and Hitachi are strengthening production facilities and expanding overseas manufacturing sites. TMEIC established a factory in India and started full operation in 2017 for shipment to Southeast Asia, Europe and so on.

For ≤ 20 kW inverters, a certification scheme by the Japan Electrical Safety & Environment Technology Laboratories (JET) has been introduced. JET certification is shifting to the certification of multiple-unit grid-connection type inverters. Certification of multiple-unit grid-connection type inverters is designed for inverters that employ the Standard active islanding detection scheme for single-phase utility-interactive power conditioners (inverters) of distributed power sources (A frequency feedback method with step injection of reactive power) (JEM 1498) and an FRT (Fault Ride Though) function. Following the revision of the Ministerial Ordinance in January 2015, management of the FIT program was reviewed, which is requiring inverters to respond to remote-controlled output curtailment. Moreover, individual test method for grid protection devices has been revised and measures following the addition of complementary information to JEM 1498 have been promoted. For > 10 kW inverters, approval is given by electric companies individually.

- Storage batteries, inverters with storage function

Storage batteries are used in net zero energy house (ZEH) in combination with PV systems, as measures to address peak cut and peak shift as well as to stabilize electric grids. In particular, lithium ion storage batteries are used for ZEH and major manufacturers launched new products one after another with long lifetime, large capacity and high reliability. Panasonic, GS Yuasa, Nichicon, Eliiy Power, Murata Manufacturing, etc., supply storage batteries in Japan. Looop launched its original brand storage batteries for residential use. As such, new entries have advanced. Some companies are importing storage batteries from other countries such as South Korea and delivering to many storage system manufacturers.

Residential storage systems are sold as hybrid inverters, etc. by Sharp, Nichicon, ITOCHU, Choshu Industry, Panasonic, Omron, Tabuchi Electric, Kyocera, Murata Manufacturing and so on. The inverter capacity usually ranges from 4,5 kW to 5,9 kW and the capacity of storage batteries ranges from 2,7 kWh to 12 kWh.

Some companies from abroad entered the Japanese market. PV manufacturers such as Hanwha Q CELLS Japan and Canadian Solar are selling residential PV systems equipped with storage batteries.

Large-scale lithium ion batteries with MWh level capacity, sodium-sulfur (NAS) batteries, etc., are installed for grid stabilization by electric companies and demonstration tests are conducted by Hokkaido Electric Power, Tohoku Electric Power, Chugoku Electric Power, Kyushu Electric Power, etc.

In the service area of Hokkaido Electric Power, systems with MWh-level lithium ion batteries are operating as a backup power supply for dispatching power source under the FIT program.

- Battery charge controllers

Battery charge controllers are used for small-scale off-grid power supply systems for rural electrification, etc. The number of products for installation in Japan is very small.

- DC switch gears

Also called junction boxes, DC switch gears are manufactured by such manufacturers as Nitto Denko, Kawamura Electric and Wave Energy, who are exclusively engaged in DC switch gear manufacturing. Some products for MW-scale PV power plants have string monitors embedded, which are used for operation and maintenance (O&M) of PV power plants. Overseas manufacturers in this area include Weidmueller (Germany) and ABB (Switzerland). In addition to the products applicable to DC 1 000 V, adoption of products applicable to DC 1 500 V is increasing.

- Supporting structures

For supporting structures, hot-dip steel plate with high corrosion resistance, molten hot-dip galvanizing steel plate and single-tube pipes, aluminium and stainless steel are used. Among them, those made of hot-dip steel plate with high corrosion resistance are the most popular. They are manufactured by such manufacturers as Neguros Denko and Okuji Kensan, who are exclusively engaged in this field. As the demand for industrial PV systems has increased rapidly, overseas manufacturers such as POWERWAY of China have entered the Japanese market, in addition to domestic manufacturers. Along with the expansion of PV installed capacity, installation locations are getting more diverse. Accordingly, development has advanced on new products which can be easily installed on slopes, products exclusive for rooftop installation, new installation methods which can reduce the installation period, automated installation systems as well as lightweight mounting structures for PV modules.

Regarding brackets for supporting structures, development of lighter-weight products using aluminium is underway, in order to meet the demand for rooftop installation for industrial applications.

5 PV IN THE ECONOMY

This chapter aims to provide information on the benefits of PV for the economy.

5.1 Labour places

Table 23: Estimated PV-related full-time labour places in 2019

Market category	Number of full-time labour places	
	2019	2018
Research and development (not including companies)	600	600
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	74 000	75 500
Distributors of PV products		
System and installation companies		
Electricity utility businesses and government		
Other		
Total	**74 600**	**76 100**

5.2 Business value

Table 24: Rough estimation of the value of the PV business in 2019 (VAT is excluded)

Sub-market	Capacity installed in 2019 (MW)	Average price (JPY/W)	Value (MJPY)	Totals (MJPY)
Off-grid	2,1			
Grid-connected roof-top < 10 kW (for residential)	902	321	289 542	
Grid-connected for commercial	2 139	212	453 468	
Grid-connected for industrial	1 111	212	235 532	
Grid-connected ≥ 1 MW	2 877	204	586 908	
Total	7 031			1 565 450
Export of PV products				4 825
Change in stocks held				
Import of PV products				149 880
Value of PV business in 2019				**1 420 395**

Import value described in Table 24 is an estimated value of import of PV modules. Although some overseas manufacturers are exporting their inverters to Japan, the total amount of their shipment volume is not included since it is unknown.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Following full liberalization of electricity retailing from April 2016, new players entered into electricity retailing business one after another. The number of registered electric retailers was 619 (as of December 2019) and these Power Producers and Suppliers (PPS) and ten former General Electricity Utilities that used to conduct regional monopolistic business are competing in the electricity market. Although the share of PPS increased to 16,2 % (as of December 2019), the situation of the electricity market in which former General Electricity Utilities are dominant remains unchanged and the same situation is observed in the power generation sector. The share of trading quantity on the Japan Electric Power Exchange (JEPX) rose to 39,5 % (as of December 2019). Electric companies were preparing to demerge the general power transmission and distribution business since legal separation of the power transmission and distribution division of the former General Electricity Utilities was conducted by April 2020. Tokyo Electric Power (TEPCO) has already shifted to a holding company structure, whereas Okinawa Electric is approved of not demerging the power transmission and distribution division, considering the circumstances of the region. Creation of new market is progressing as a part of the electricity system reform. The non-fossil fuel energy value trade market was established that trades non-fossil fuel value of renewable energy, etc. apart from the value of electricity, and the non-fossil fuel value of FIT electricity is being traded. In addition, the capacity market that trades the value of kW as a supply capability, and the supply/demand adjustment market for that trades the value of ΔkW as a dispatching ability are also being considered.

6.2 Interest from electricity utility businesses

- Introduction of large-scale PV power plants by electric companies

Federation of Electric Power Companies (FEPC) of which the ten General Electricity Utilities are members announced in October 2008 that they would construct large-scale PV power plants with a total capacity of 140 MW. Construction has been almost completed. PV power plants developed by electric companies themselves are not eligible for the power purchase under the FIT program. Since it has been clearly stated in the Fifth Strategic Energy Plan that efforts will be made to make renewable energy a mainstream power source, electric companies are advancing activities to promote renewable energy. Partnerships between electric companies and renewable energy-related companies are also progressing.

- Plans and reorganization that promotes renewable energy

Electric companies are presenting their renewable energy development targets while progressing reorganization towards promotion of renewable energy. Tohoku Electric announced a plan to increase renewable energy capacity by 2 GW. Chubu Electric will newly develop renewable energy with a capacity of more than 2 GW by 2030. In addition, Chubu Electric established the “Renewable Energy Company” in April 2019, that takes charge of hydro and PV power generation. Kansai Electric Power (KEPCO) aims for new development of more than 2 GW in Japan and abroad to achieve 6 GW of renewable energy in the 2030s. In addition, the company reorganized in July 2019, and established “Renewable Energy Business Division”. TEPCO Energy Partner established “Renewable Energy Marketing and Sales Department” in September 2019 to consolidate its renewable

energy related business. Tokyo Electric Power Company Holdings decided on its policy to demerge its renewable energy power generation business by April 1, 2020. The new company name was decided as “TEPCO Renewable Power”.

- Purchase of surplus electricity from the post-FIT residential PV systems

The scheme to purchase surplus electricity generated by residential PV systems started from November 2009, and was passed on to the Feed-in Tariff (FIT) program on and after 2012. There are residential PV facilities with their purchase period terminating from November 2019 since the purchase period is 10 years, and the power sales price and conditions for these facilities were presented. The surplus power purchase price after the termination of the purchase period is different among electric companies. For example, TEPCO Energy Partner set the price at 8,5 JPY/kWh; Chubu Electric at 9 JPY/kWh; KEPCO at 8 JPY/kWh, etc. Power Producer and Supplier (PPS) are also offering the purchase menu of surplus electricity and are purchasing surplus PV power.

- Output curtailment of PV systems

Following the expansion of PV introduction, in October 2018, the first output curtailment of renewable energy on the mainland Japan was conducted on the Kyushu mainland. Initially, output curtailment was conducted on weekends, when demand for electricity is relatively low, but with the expansion of PV installations, etc., output curtailment is now also carried out on weekdays. Total 61 times of output curtailment (one time each in January and February, 16 times in March, 20 times in April, 10 times in May, two times in October, 10 times in November and one time in December) were conducted in 2019. The appropriateness of output curtailment was verified, and the verification results were published by the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO).

- Enhancement of inter-regional grid connection lines

There are two frequencies for the electric grids in Japan: 50 Hz for the eastern part of Japan and 60 Hz for the western part of Japan. The frequency conversion station connecting Tokyo area and Chubu area has the capacity of only 1,2 GW. It has also been pointed out that inter-regional grid connection lines to transport electricity from the areas with abundant land and renewable energy resources to the areas of demand for electricity are fragile. In order to solve these issues, inter-regional grid connection lines need to be enhanced. In connection with the Electricity System Reform, discussions were made on the capacity of grid connection lines which need to be enhanced and a guideline for cost sharing was established. As for the frequency conversion station, construction to increase 900 MW is scheduled by FY 2020, and another 900 MW enhancement is scheduled by FY 2027, which will make the total capacity of 3,0 GW. Construction to increase the capacity of Hokkaido-Honshu HVDC Link, the grid connection lines between Hokkaido and Honshu (main island of Japan), from 600 MW to 900 MW is progressing, which started operation in March 2019. As for the Hokkaido-Honshu HVDC Link, a cost-benefit assessment was conducted and it is planned to increase the capacity by another 300 MW. Improvement plan of the grid connection lines between Tohoku and Tokyo was also announced. The construction started from April 2017 to add 4,55 GW, which is scheduled to be completed in November 2027. Despite the withdrawal of some applicants in 2019,

OCCTO continues to work on the enhancement based on the results of the cost-benefit assessment. Kyushu Electric increased the capacity of renewable energy transmission of the Kanmon link line by up to about 300 MW by using the transfer trip system developed as part of the "Project to develop technology to reduce output curtailment amount of renewable energy" by the Ministry of Economy, Trade and Industry (METI).

- Responses to accept grid connection

Along with the growth of PV installed capacity, some electric companies announced that they would suspend responses to new applications for grid connection in 2014. After that, they announced “30-day, etc. output curtailment capacity”, which sets the limit of output curtailment to 30 days/year or 360 hours/year. This is subject to revision as needed depending on the calculation results of each fiscal year. In case the “30-day, etc. output curtailment capacity” is exceeded, output curtailment will have “no limit without compensation”. As of December 2019, six electric companies, namely Hokkaido Electric Power, Tohoku Electric Power, Hokuriku Electric Power, Chugoku Electric Power, Shikoku Electric Power and Kyushu Electric Power have taken this measure. In parallel with these restrictions, a variety of information including open capacity of electric grids is released by electric companies. OCCTO announced its long-term policy on the cross-regional coordination of electric grids and set out an initiative of utilizing the existing grids to the maximum. In order to overcome grid restrictions, rationalization of expected power flow has been started on the “Japanese version connect & manage” which thoroughly utilizes the existing grids, followed by advanced application of N-1 (N minus one) electric control. As such, efforts have been made to realize the “Japanese version connect & manage” at an early date. TEPCO Power Grid started applying non-firm connections in some areas as a trial approach so that grid connection can be carried out as soon as possible even when there is no capacity left due to the constraints of the bulk transmission lines.

6.3 Interest from municipalities and local governments

In addition to the national support programs, PV support programs implemented by local governments and municipalities play an important role for the dissemination of PV systems. While the subsidy program for installation of residential PV systems by the national government was terminated, a large number of local governments and municipalities have implemented subsidy programs to support installation of residential PV systems. In most cases, the amount of subsidy ranges from 10 000 JPY/kW to 50 000 JPY/kW. To award the subsidy, some of them present several requirements including installation of HEMS and residential PV systems at the same time. Moreover, some local governments and municipalities started to provide service of low-interest credit type loan in cooperation with financial institutions and subsidy program for conventional homes which introduce a set of PV system and storage batteries. As for support programs for industrial PV systems, subsidy for installation, loan support and preferential tax treatment are granted. Some programs require self-consumption, installation of PV systems and storage batteries, etc. at the same time, or installation of residential PV systems in facilities which are used as evacuation or disaster prevention centers. Furthermore, Tokyo Metropolitan Government (TMG) selected companies providing a service to install PV systems at not initial, to which TMG will provide a subsidy of 100 000 JPY/kW. The companies receiving this subsidy will return the whole amount to homeowners through such measures as reduction of the monthly service fee and a cashback.

Following the expansion of PV introduction, many cases of troubles with local residents occurred one after another, which urges several municipalities to revise their guidelines on the installation of PV systems and expanding the scope of PV projects subject to environmental impact assessment (EIA). Tono City of Iwate Prefecture decided a policy of effectively not accepting new development of large-scale PV power plants and stipulated the issues including the following: 1) PV projects covering the area of over 1 ha will not be permitted; 2) the entire city is designated as a restricted area; 3) obligation to hold a briefing session for residents in the preliminary consultation phase. PV projects covering the area of 0,3 ha or more were switched from the current notification system to the permission system. Hyogo Prefecture has mandated EIA for the plans of PV facilities with the project site of 5 ha or more. As of March 2020, the mandatory subject of "5 ha or more" is the smallest in Japan.

Some local governments and private companies are working together to invite applicants to purchase PV facilities and electricity and select developers and suppliers of facilities through tenders to deliver facilities and electricity to the residents at reasonable prices. Kanagawa Prefecture, in cooperation with iChoosr, started business to jointly purchase PV facilities. They will promote the dissemination of PV power generation by inviting purchasers and ordering the facilities in bulk to keep the installation cost lower. Tokyo Metropolitan Government (TMG), in cooperation with iChoosr, launched a service to provide electricity generated from renewable energy sources to households in Tokyo at a reasonable price.

Following large-volume introduction of PV power generation, some municipalities are considering a recycle method with which 3R (reduce, reuse, recycle) and appropriate treatment of used PV power generation facilities, which are expected to be disposed in a large volume, will be promoted. TMG held a meeting of the “Study Panel on recycling of used PV facilities in Tokyo” and confirmed the progress of the study on the environmental risks of PV modules. Given the absence of a finalized version of the environmental impact and risk assessment of PV power generation, the need to develop an appropriate assessment scheme as soon as possible was emphasized. Based on the records of the PV module elution tests conducted by the Ministry of the Environment (MOE) in the past, TMG reported that, although the amount of elution of lead and selenium, which are toxic substances, exceeded the standard values in some PV modules, there might be variations in the amount of elution depending on the adjustment method of the samples and the analysis institution.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

As a policy of establishing the business environment for 2020 onwards toward the drastic revision of the Feed-in Tariff (FIT) program, which started in July 2012, and toward making renewable energy a mainstream power source, the Ministry of Economy, Trade and Industry (METI) determined the direction to focus on the following three pillars: 1) support schemes corresponding to the characteristics of power sources; 2) promotion of renewable energy introduction taking root in local communities and 3) the next-generation electricity networks in the era of renewable energy as a mainstream power source. With regard to 1) support schemes corresponding to the characteristics of power sources, power sources are broadly divided into two types of power sources: competitive power source and locally-utilized power source. With the “competitive power source,” investment incentives will be secured and integration with the electricity market will be promoted under the new Feed-in Premium (FIP) program. With the “locally-utilized power source,” local production and local consumption of generated electricity will be promoted under the framework of the FIT program. Among PV systems, large-scale PV systems are positioned as the competitive power source, whereas small-scale PV systems including residential systems are positioned as the locally-utilized power source, and the introduction across the two fields will be facilitated. With regard to 2) promotion of renewable energy introduction taking root in local communities, it was decided to set up a scheme to secure accumulation of funds to cover the disposal cost of PV modules, and to formulate PV-specific technical standards for installation. With regard to 3) the next-generation electricity networks in the era of renewable energy as a mainstream power source, a policy was decided to support large-volume introduction of renewable energy through such measures as formation of push-type grids and promotion of distributed grids.

The Ministry of the Environment (MOE) decided to oblige 40 MW or larger PV power plants to undergo environmental impact assessment (EIA), while promoting the measures to achieve a decarbonized society where renewable energy is introduced to the maximum extent. Although the two ministries have been promoting dissemination of renewable energy from their own perspectives so far, they have established a collaborative team toward a full-scale introduction of renewable energy hereafter.

In the Japanese PV market, a large number of residential PV systems reached the expiration of the 10-year power purchase period under the FIT program. Nevertheless, no confusion was observed and a new scheme to sell the surplus electricity of these residential PV systems in the general market was launched, which started the competition over purchasing surplus PV electricity. Meanwhile, as for newly-built PV systems, new business models emerged one after another, including installation of PV systems at no initial cost under the third-party ownership (TPO) model.

In the industry, conventional energy industries such as the electricity industry started recognizing the significance of the renewable energy industry and are entering the PV business. Japanese PV manufacturers promoted new business expansion while reestablishing their businesses through reduction of domestic production framework, etc.

Under such circumstances, cumulative capacity of facility approval under the FIT program and cumulative commissioned (start of operation) capacity as of the end of December 2019 increased to 72,6 GWAC and 48,3 GWAC, respectively. Accordingly, the annual and the

cumulative PV installed capacity in 2019 in Japan reached 7 GWDC and 63,2 GWDC, exceeding 60 GW.

7.2 **Prospects**

The current FIT Act has been revised in 2020 in preparation for the drastic revision of the FIT program, looking toward the future. The dissemination environment of renewable energy will enter a new phase. PV power generation is expected to be disseminated as a power source for self-consumption and as locally-utilized power source which does not impose burden on the nation and the grid aiming for market integration and independence, assuming that PV will no longer receive favourable support but must compete with conventional energy sources.

Following the enactment of the Acts for Establishing Resilient and Sustainable Electricity Supply Systems including the drastic revision of the FIT Act, the Ministry of Economy, Trade and Industry (METI) will design a new scheme to disseminate renewable energy toward enforcement of the Acts in April 2022. Also, METI will revise the Fifth Strategic Energy Plan, which was formulated in 2018 with a clear description, for the first time, of making renewable energy a mainstream power source, and start working on the formulation of the Sixth Strategic Energy Plan. Based on the rapid growth of renewable energy in 2015 onwards as well as the global trends, the next strategic energy plan is expected to step further from making renewable energy a mainstream power source, and launch a policy of “creating a renewable energy-oriented economic society” by promoting measures focusing on the following three pillars: 1) evolution into the competitive renewable energy industry; 2) improvement of social infrastructure such as networks to support renewable energy and 3) establishment of local communities harmonized with renewable energy. Japan will move to creating a renewable energy-based society and promote energy transition in the 2020s, through specific measures such as introduction of the FIP program, revitalization of the aggregator business, acceleration of introduction of distributed power sources centered on “integrated supply and demand” type, review of the rules for the utilization of bulk power transmission lines to make renewable energy a mainstream power source, as well as improvement of industrial infrastructure to support renewable energy.

Year 2020 will be a transition period from the current FIT Act and the new FIT Act. While the construction of FIT-approved projects which have not started operation under the current FIT Act is progressing, 2020 will be a starting year of PV installations in new formats in collaboration with electricity users, including a PPA scheme which does not depend on the FIT program. The purchase prices (FIT) of PV systems in FY 2020 under the current FIT Act have been reduced: 1) 24 JPY/kWh to 21 JPY/kWh for < 10 kW systems; 2) 14 JPY/kWh to 13 JPY/kWh for 10 - < 50 kW systems (only for surplus electricity) and 3) 14 JPY/kWh to 12 JPY/kWh for 50 - <250 kW systems. 250 kW or larger systems, previously 500 kW or larger systems, are now subject to the tender scheme and the tender target capacity is limited to 1,5 GW annually.

PV installations in Japan in the first half of the 2020s are expected to comprise of the construction of PV projects which have not started operation for a long time under the current FIT program, and the new installations of PV systems based on the purchase prices under the new FIT Act. In the second half of the 2020s, the installations are estimated to shift to independent ones under market principles. The market is forecasted to diversify, by shifting from the one focusing on large-scale ground-mounted PV power plants to the one focusing on

rooftop systems for the supply-demand integrated market and the market for local utilization of PV systems, independent of the FIT program, developing new areas of applications.