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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 2021

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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, Solar Power Research Institute of Singapore, the Smart Electric Power Alliance (SEPA) and the Solar Energy Industries Association (SEIA) 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 2021. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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COVER PICTURE: Canopy type PV system (Global Zero Emission Research Center (GZR), National Institute of Advanced Industrial Science and Technology (AIST)) with output capacity of 6.9 kW
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 2021 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2021, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

In 2021, 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 (FPV) 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 2021 reached 6,545 MW (DC), an approximately 24.6 % decrease from 8,676 MW (DC) in 2020.

Table 1: Annual PV power installed during calendar year 2021

		Installed PV capacity in 2021 [MW]	**AC or DC**
PV capacity	Off-grid	2.2	DC
	Decentralized	3,551	DC
	Centralized	2,992	DC
	Total	**6,545**	**DC**

Table 2: PV power installed during calendar year 2021

			Installed PV capacity in 2021 [MW] DC value
Grid-connected	BAPV	(1) Residential (< 10 kW)	805
		(2) Commercial (< 50 kW, including ground-mounted)	1,664
		(3) Industrial (50 kW - 1 MW, including ground-mounted)	1,037
		(4) Total of BAPV	3,506
	BIPV	(5) Residential (< 10 kW)	25
		(6) Commercial (10 - 250 kW)	20
		(7) Industrial (> 250 kW)	
		(8) Total of BIPV	45
	Utility-scale	(9) Ground-mounted (1 MW ~)	2,572
		(10) Floating PV systems	120
		(11) Agricultural PV systems	300 (including small-scale systems)
		(12) Total of utility-scale	2,992
Off-grid		(13) Residential	NA
		(14) Other	
		(15) Hybrid systems	NA
		(16) Total of off-grid	2.2
Total		**(17) Total ((4) + (8) + (12) + (16))**	6,545.2

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: based on the 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 (FPV) 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 2021 reached 78,413 MW (DC). The cumulative PV installed capacity by application is; 178.2 MW for off-grid and 78,235 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
2020	176	71,692		71,868
2021	178.2	78,235		78,413

Table 5: Other PV market information

	2021
Number of PV systems in operation in Japan	N.A.
Decommissioned PV systems during the year	< 250 MW
Repowered PV systems during the year	N.A.

Table 6: PV power and the broader national energy market

	2020	2021
Total power generation capacities	270 GW_{AC} [1]	271 GW_{AC} [1]
Total renewable power generation capacities (including hydropower)	120 GW_{AC} [2]	125 GW_{AC} [2]
Total electricity demand	858 TWh [3]	873 TWh [3]
Total energy demand	12,082 PJ [4] (FY 2020)	NA [4]
New power generation capacities installed	5.0 GW_{AC}	1.3 GW_{AC}
New renewable power generation capacities (including hydropower)	8.0 GW_{AC}	5.3 GW_{AC}
Estimated total PV electricity production	71,868 GWh	78,413 GWh
Total PV electricity production as a % of total electricity consumption [1]	8.4 %	9.0 %

[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]: METI statistics. Statistics for FY 2021 are not available at the time of writing this report. Preliminary figures are expected to be released in October or November 2022 and final figures in April 2023.

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 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 7.27 million units of Eco Cute heat pump systems have been installed in houses as of the end of FY 2020.

As for electric vehicles (EVs), the number of units sold in 2021 and the number of units owned as of the end of March 2022 (end of FY 2021) (equivalent to cumulative number of units sold) are listed in Table 7.

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	972,355 kWh (133,759 units)	4,425,845 kWh (624,551 units)	The Japan Electrical Manufacturers' Association (JEMA)
Residential heat pumps	Residential heat pump water heater with natural refrigerant (Eco Cute)	585,989	7,857,953	The Japan Refrigeration and Air Conditioning Industry Association, Heat Pump & Thermal Storage Technology Center of Japan
Electric vehicles (EVs) (number of units)	Passenger car (PC), Light car (LC)	22,010 (2021)	45,329 (2021)	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	308 (2021)	1,871 (2021)	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)
2005	428	
2006	433	
2007	436	
2008	447	
2009	393	
2010	366	
2011	327	
2012	284	120
2013	251	112
2014	227	101
2015	196	89
2016	169	78
2017	150	69
2018	139	62
2019	133	56
2020	127	52
2021	111	58

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	286
Grid-connected commercial and industrial 10 kW- < 1 MW	Commercial and industrial	204
Grid-connected ≥ 1 MW	Power generation business (mainly ground-mounted)	196
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 - 100 kW)	Commercial and industrial (100 kW - 250 kW)	Ground-mounted (≥ 1 MW)
2005	661			
2006	683			
2007	696			
2008	723			
2009	605			
2010	559			
2011	513			
2012	451	410	380	280
2013	405	380	330	260
2014	366	343	290	235
2015	332	313	256	217
2016	293	265	227	192
2017	272	236	202	170
2018	252	217	185	152
2019	242	200	178	139
2020	231	187	165	128
2021	220	178	155	122

2.3 Cost breakdown of PV installations

Cost breakdown of PV installations is the typical value analysed from the 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	Typical value (JPY/W)
Hardware	
Module	174
Inverter	44
Mounting structure	23
Other (electric equipment/ materials of electric equipment, etc.)	2
Soft costs	
Installation	60
Other (promotion/ administration cost, etc.)	
Total (excluding consumption tax)	286

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

Cost category	Typical value (JPY/W)
Hardware	
Module	69
Inverter	15
Mounting structure	19
Measurement/ monitoring instrument, etc.	19
Other (electric equipment/ transformer/ materials of electric equipment, etc.)	
Soft costs	
Installation	53.4
Site development	14
Contribution for grid connection	6
Designing/ development	0.6
Fund raising	
Other (administration cost, etc.)	
Total (excluding consumption tax)	**196**

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 table shows the general financing measures in Japan.

Table 13: PV financing information in 2021

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)	- Financing is provided to the sponsor on a non-recourse or limited recourse basis, collateralized by all assets and interests in the PV project - 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 bonds	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).
Sustainability bonds	Bonds whose purpose of use of raised funds is limited to the projects that contribute to the environmental and social sustainability.
Loan for solar sharing	Loan which is provided by Norinchukin Bank aiming to increase income of Japan Agricultural Cooperatives (JA) and revitalize regional economy
Green loans	Financing used by businesses, local governments, and other entities to raise funds needed for green projects in Japan and abroad
Sustainability linked loans (SLL)	Loans that set action targets (Sustainability Performance Targets (SPTs)) consistent with the borrower's ESG strategy to encourage the borrower to improve its sustainability performance, and provide incentives or disincentives to the borrower based on its progress in achieving the SPTs
Green deposits (environmental deposits)	- Loans must be used only for projects that reduce CO_2 emissions, such as PV power generation - Companies that deposit money contribute indirectly to environmental measures by simply transferring their existing deposits to the Green deposits

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, as the FIT purchase price declines, the service for self-consumption becomes more popular, in which electricity generated by PV systems installed on the rooftops of these facilities is supplied directly to them. Major electric companies, gas companies and Power Producer and Supplier (PPS) are promoting a service to install PV systems for self-consumption at no initial cost (on-site PPA).

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 2021, 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), on-site PPA	“Roof lease model” is available, which leases only the right of use of roofs. However, this business model has legal restrictions. Long-term power purchase agreements (PPAs) to supply PV-generated electricity on-site are being promoted.
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 small- and medium-scale self-consumption type PV systems

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 (2.98 JPY/kWh (May 2020 - April 2021), 3.36 JPY/kWh (May 2021 - April 2022))" 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 December 2021: -1.09 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 December 2021: -1.05 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 December 2021: -1.05 JPY/kWh). *3: There are various price plans depending on time zones and seasons. (Source: TEPCO Energy Partner's website)
Population	125.38 million (Statistics Bureau, Ministry of Internal Affairs and Communications (MIC), as of December 1, 2021)
Country size	377,975 km^2 (Statistics Bureau, MIC) (as of October 1, 2021)
Average PV yield	1,000 - 1,100 kWh/kW/yr
Name and market share of major EPCOs (based on electricity demand of December 2021)	1 TEPCO Energy Partner 26.7 % 2 Chubu Electric Power Miraiz 16.2 % 3 Kansai Electric 14.9 % 4 Kyushu Electric 11.3 % 5 Tohoku Electric 10.8 % 6 Chugoku Electric 7.2 % 7 Hokuriku Electric 4.5 % 8 Hokkaido Electric 3.7 % 9 Shikoku Electric 3.5 % 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 2021)	1 Former General Electricity Utilities (10 EPCOs from Hokkaido to Okinawa) 78.4 % 2 Power Producers and Suppliers (PPS) 21.6 % (Source: Survey of Electric Power Statistics, METI)

3 POLICY FRAMEWORK

Table 16: Summary of PV support measures

	Residential		Commercial + Industrial		Centralized	
Measures in 2021	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	Yes (purchase of surplus electricity)	- Purchase prices for FY 2022 and 2023 were determined	Yes	- Cut in purchase price - Tender scheme (≥ 250 kW)	Yes	- Cut in purchase price - Tender scheme (≥ 250 kW)
Feed-in premium (above market price)	No	Electric companies and PPS set the post-FIT power purchase menu	No	No	No	FIP program is scheduled to start from FY 2022 for ≥ 1 MW
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		There are subsidies intended for PV for self-consumption purpose (non-FIT)		No	No
Net-metering	No	No	No	No	No	No
Net-billing	Yes	Yes	Yes (in case of self-consumption)	Yes (in case of self-consumption)	Yes (in case of self-consumption)	Yes (in case of self-consumption)
Collective self-consumption	No	No				
Commercial bank activities e.g., green mortgages promoting PV	There are loan programs such as mortgage and home improvement loans, etc.		Many financial institutions offer financing options for PV systems with a capacity of 10 kW or more taking advantage of FIT. There are moves to issue green bonds and establish funds for PV power generation, and approaches for non-FIT are emerging.			
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 - It is planned to introduce economic output curtailment (online proxy curtailment) as well as to bring PV power generation, etc. online in order to improve the efficiency of output curtailment			
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 are obliged conform to energy efficiency standards, which took effect on April 1, 2021, and it is proposed to obligate residential buildings to conform to the law starting in 2025 - 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

The Sixth Strategic Energy Plan was approved by the Cabinet on October 22, 2021. Under the new Strategic Energy Plan, the roadmap for energy policy was outlined to achieve carbon neutrality in 2050 and a greenhouse gas reduction target of 46 % compared to FY 2013 levels by FY 2030. Based on the fundamental premise of ensuring safety, initiatives will be promoted to ensure stable supply and reduce energy costs (S+3E) while addressing climate change. The maximum introduction of renewable energy will be promoted while thoroughly making renewable energy the main power source, working on the principle of giving top priority to renewable energy, curbing the burden on the public and maintaining harmony with the local communities. The outlook for energy supply and demand in FY 2030 was also revised, setting new targets for energy conservation, while raising the ratio of renewable energy in the energy mix from conventional 22 to 24 % to 36 to 38 %. Of this amount, the share of PV power generation is 14 to 16 %, with an estimated installation volume of 103.5 to 117.6 GW_{AC} (equivalent to 123 to 139 GW_{DC}).

Table 17: Energy mix in Japan in FY 2030

	Fourth and Fifth Strategic Energy Plan	Sixth Strategic Energy Plan
Renewable energy	22 - 24 %	36 - 38 %
Nuclear power	22 - 20 %	20 - 22 %
LNG	27 %	20 %
Coal	26 %	19 %
Oil, etc.	3 %	2 %
Total electricity generation	Approx. 1,065 TWh	Approx. 934 TWh

3.2 Direct support policies for PV installations

3.2.1 Description of support measures

- Project to promote making renewable energy a mainstream power source/ strengthening of resilience in local communities through reduction of renewable energy price, etc. such as utilization of PPA

This project provides subsidies for the introduction of renewable energy and storage batteries through new approaches such as on-site PPA models, etc. Not subject to feed-in tariff program.

- Project to support realization of sustainable and resilient local communities through planning of maximum introduction of renewable energy and cultivation of local human resources

This project supports the formulation of regional renewable energy introduction targets for 2050, the establishment of an implementation and management system for sustainable implementation of renewable energy introduction projects, and the cultivation of regional human resources to improve the sustainability of regional renewable energy projects.

- Project to promote installation of independent and distributed energy facilities to evacuation centers, etc. which realize resilience and decarbonization of local communities in parallel

This project supports the introduction of renewable energy facilities, etc. to public facilities that are positioned as evacuation centers, etc. in the event of disasters based on local disaster-prevention plans and subsidizes part of the costs.

- 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.

- Project to support establishment of net zero energy houses (ZEHs) at detached houses

The project provides subsidies to those who build new detached houses (custom-built or ready-built) that meet the ZEH requirements and provides a fixed amount of subsidies for the installation of storage batteries.

- Project to promote decarbonization and enhancement of resilience of buildings, etc.

A certain amount of subsidy is provided for the introduction of net zero energy building (ZEB) in commercial facilities and demonstration, etc. of advanced decarbonized buildings that can supply energy even in times of disaster.

- Project to promote CO_2 saving in collective housing (in partnership with METI)

This project subsidizes to support energy conservation, CO_2 reduction and thermal insulation of collective housing, as well as the installation of storage batteries.

- Demonstration project to establish the next-generation technologies utilizing distributed energy resources such as storage batteries, etc.

This demonstration project promotes aggregation technologies, etc. that utilize renewable energy and distributed energy resources such as storage batteries, etc.

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

This subsidy program supports demonstrative research 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 Promote Dissemination of Renewable Energy, etc. in harmony with local communities

This project subsidizes a certain amount of the necessary expenses for private business operators, etc. that intend to build a regional microgrid utilizing renewable energy, etc. or develop a plan to introduce such a microgrid.

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 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 Acts for Establishing Resilient and Sustainable Electricity Supply Systems were enacted in June 2020 and the name of the special measures act was amended to the Renewable Energy Promotion Act (revised Act on Special Measures Concerning Procurement of Renewable Energy Sourced Electricity by Electric Utilities, or the current FIT Act). Two types of power sources, competitive power source and locally-utilized power source were presented. As for competitive power source, the Feed-in-Premium (FIP) program is planned to be introduced from April 2022 for ≥ 1 MW PV systems to promote the integration into the electricity market. As for locally-utilized power source, it is planned to maintain the FIT program after setting the requirements for local utilization. In addition, an approval cancellation system will start in April 2022 to deal with the FIT-approved projects which have not started operation for a long time.

3.2.3 BIPV development measures

The introduction of PV power generation into buildings 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) is promoting Development of Technologies for Wall installed PV Systems under the "Development of Technologies to Promote Photovoltaic Power Generation as a Main Power Source", a new program being implemented since FY 2020. It will develop see-through solar cells and perovskite BIPV modules for aperture area of building walls, formulate guidelines, and conduct system demonstrations.

Also, METI started a three-year project for "International Standardization of Building-Integrated Photovoltaic (BIPV) Systems" in FY 2021. As a project consignee, Photovoltaic Generation Technology Research Association (PVTEC) undertakes international standardization of design standards for indoor window-mounted solar cells, design safety standards for snow-melting type PV modules, weather resistance evaluation methods for BIPV module design, and power generation estimation methods for vertically installed PV modules, etc.

3.3 Self-consumption measures

Table 18: Summary of self-consumption regulations for small private PV systems in 2021

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 has been conducted using FIT, however, introduction of PPA model in combination with electricity retailing is making progress as the purchase price declines.
	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	Support measures for the introduction of supply/ demand integrated systems, such as self-consumption, etc., are strengthened in order to become independent from the FIT.

3.3.1 Dissemination measures related to self-consumption

From FY 2020, under the FIT program, requirements for approving power sources as locally-used power sources for self-consumption are applied to PV systems with a capacity of 10 kW - < 50 kW. The self-consumption rate of 30 % or more is one of the requirements for approval.

3.3.2 Other dissemination measures related to self-consumption

Nothing special to report.

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, METI established the Smart Community Alliance, a public-private partnership organization with NEDO as its secretariat, and 16 companies are participating as operating companies. In addition, 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 compiled and reported on the results of the "Project to promote introduction of smart communities" in the areas stricken by the Great East Japan Earthquake.

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” was 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, and a total of 40 processes have been completed throughout Japan. 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. From October 2020, a bulk consideration process to secure the grid connection capacity was introduced to replace the tender process to secure the grid connection capacity. In case the capacity of the grid is insufficient, and construction of grid enhancement is required, the general power transmission and distribution operators formulate measures involving neighbouring projects as well. Effective grid maintenance, etc. will be available through sharing the cost of grid enhancement construction among multiple applicants for grid connection. TEPCO Power Grid started accepting applications for the bulk consideration process for the eastern area of Gunma Prefecture on July 13, 2021, and about 20 other processes have been initiated throughout Japan.

- 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 and ≥ 250 kW from FY 2020. For FY 2021, the number of tenders was increased to four times, and the ceiling prices were announced in advance: 11.00 JPY/kWh for the eighth tender, 10.75 JPY/kWh for the ninth tender, 10.50 JPY/kWh for the tenth tender, and 10.25 JPY/kWh for the eleventh tender. The tender capacity was set at 208 MW for the eighth tender and revised for the ninth and subsequent tenders based on the results of the previous tender. Setting 208 MW as the minimum capacity, and if the amount of tenders received exceeds the capacity, the tender capacity will be increased for the next tender. In order to encourage participation in the tender, the requirement to refund the deposit was eased, and the participation fee was lowered. The results of the eighth through tenth tenders are shown in the table below. The results of the eleventh tender will be announced in March 2022.

Table 19a: Results of the eighth tender for FIT capacity in FY 2021

Item	Description
Subject of the tender scheme	≥ 250 MW PV systems
Tender capacity	208 MW (a uniform tender is conducted nationwide)
Ceiling price	11.00 JPY/kWh (preliminarily announced)
Winning bids	137 projects with a total capacity of 208.47 MW (including those awarded following the withdrawal of successful bidders)
Lowest winning price	10.00 JPY/kWh
Highest winning price	10.98 JPY/kWh
Withdrawal after winning the bid	9 projects with a total capacity of 6.80 MW
Paid the second deposit to acquire approval	128 projects with a total capacity of 201.67 MW

Table 19b: Results of the ninth tender for FIT capacity in FY 2021

Item	Description
Subject of the tender scheme	≥ 250 kW PV systems
Tender capacity	224.3357 MW (a uniform tender is conducted nationwide)
Ceiling price	10.75 JPY/kWh (preliminarily announced)
Winning bids	208 projects with a total capacity of 233.8177 MW (including those awarded following the withdrawal of successful bidders)
Lowest winning price	10.28 JPY/kWh
Highest winning price	10.75 JPY/kWh
Withdrawal after winning the bid	29 projects with a total capacity of 43.7739 MW
Paid the second deposit to acquire approval	179 projects with a total capacity of 190.0438 MW

Table 19c: Results of the tenth tender for FIT capacity in FY 2021

Item	Description
Subject of the tender scheme	≥ 250 kW PV systems
Tender capacity	242.6158 MW (a uniform tender is conducted nationwide)
Ceiling price	10.50 JPY/kWh (preliminarily announced)
Winning bids	82 projects with a total capacity of 242.8075 MW (including those awarded following the withdrawal of successful bidders)
Lowest winning price	10.23 JPY/kWh
Highest winning price	10.40 JPY/kWh
Withdrawal after winning the bid	8 projects with a total capacity of 45.9794 MW
Paid the second deposit to acquire approval	74 projects with a total capacity of 196.8281 MW

3.6 Other utility-scale measures including floating and agricultural PV

Although there are no support measures to promote the introduction of floating PV (FPV) systems, the installed capacity of FPV systems in static freshwater such as reservoirs and regulating reservoirs gradually increased, reaching a cumulative capacity of more than 400 MW. There are no actual cases of installations in coastal and offshore areas, although there are cases of feasibility studies. In November 2021, "Guideline for the design and construction of floating PV (FPV) systems" was issued under the commission project of NEDO (this guideline is a provisional version, and a final version will be issued in FY 2023 following the results of research and development and demonstration tests). The guideline is expected to lead to an increase in the installation of FPV systems with higher safety standards than before.

There is no policy to directly promote the introduction of PV systems on farmland, however, through support measures for leading model demonstrations, provision of information such as regular updates of handbooks by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and deployment of best practices, the introduction of PV systems on farmland gradually increased to a cumulative total of more than 3,500 projects, amounting to over 1.1 GW. Moreover, in November 2021, "Guideline for the design and construction of PV systems on

farmland" was issued under the commission project of NEDO (this guideline is a provisional version, and a final version will be issued in FY 2023 following the results of research and development and demonstration tests). The guideline is expected to lead to an increase in the installation of PV systems on farmland with higher safety standards than before.

3.7 Social Policies

Although no support program is available specifically for low-income families, the Ministry of the Environment (MoE) provides generous subsidies to support the introduction of renewable energy to schools and public facilities, including the "Project to promote making renewable energy a mainstream power source/ strengthening of resilience in local communities through reduction of renewable energy price, etc. such as utilization of PPA", the "Project to establish symbiotic and recycling-based community with innovation for decarbonization" and the "Project to promote installation of independent and distributed energy facilities to evacuation centers, etc. which realize resilience and decarbonization of local communities in parallel". In particular, the "Project to promote installation of independent and distributed energy facilities to evacuation centers, etc. which realize resilience and decarbonization of local communities in parallel" subsidizes part of the installation costs for projects to introduce renewable energy such as PV power generation and storage batteries, etc. to public and private facilities that serve as evacuation centers and disaster prevention bases in the event of disasters based on local disaster-prevention plans, etc. METI supports the establishment of regional micro-grids as part of its "Project to Promote Dissemination of Renewable Energy, etc. in harmony with local communities". The Ministry of Education, Culture, Sports, Science and Technology (MEXT) supports the introduction of PV power generation in schools as part of its "Public school facility development project".

From FY 2022 onward, support projects for communities, schools and public facilities are scheduled to be launched through the "Project to grant for transition to local decarbonization and promotion of renewable energy", the " Project to establish leading areas of decarbonization" based on a long-term perspective through 2030 and the " Project to accelerate priority measures".

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 11 JPY/kWh for FY 2021. 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 2020, the subjects of the measures expanded to include the PV projects which were approved between FY 2012 and FY 2016 and for which the deadline for starting operation is not set. In April 2022, the approval cancellation system was launched to set the deadline of approval cancellation in addition to the existing COD deadline. For the projects whose COD deadline is March 31, 2022, or earlier, a grace period before cancellation of approval will be granted upon confirmation of submission of an application of construction start for grid connection on April 1, 2023, and if the submission is not confirmed, the approval will be cancelled at that point.

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.

MoE invited public participation for the " Survey and verification commission project for the introduction of renewable energy, etc. on Iwo Jima and Minami-Tori-shima", located at the easternmost tip of Japan, from FY 2021, and launched a demonstration project to supply the necessary electricity from renewable energy sources. MoE allocated 350 MJPY for related expenses in its budget request for FY 2021. Renewable energy power generation facilities such as PV systems and storage batteries are installed to examine whether it is practical to deploy them on the isolated island 1,800 km away from the mainland Japan. Furthermore, MoE started a project to formulate a plan for a project to introduce facilities to increase the ratio of renewable energy to the total electricity supply on remote islands by strengthening dispatching ability through management and control of renewable energy facilities and demand-side facilities on a group basis under the " Project for introduction and construction of operation and control of facilities to make renewable energy the main power source on remote islands".

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) published a list of "needs" or local issues which local governments are facing and "seeds", such as new technologies from private companies, with the aim of realizing the "Smart Island" concept. MLIT is aiming to revitalize the remote islands by combining the needs of local governments in fields such as transportation, energy and disaster prevention with the seeds of businesses. In the field of energy, technologies to address output fluctuations, etc. are proposed in anticipation of the large-volume introduction of renewable energy. In conducting the demonstration on the remote

islands, it is planned to make an effective use of the storage batteries installed in households while asking for the cooperation of storage battery manufacturers.

3.9.2 Support for electricity storage and demand response measures

Regarding demand response, METI announced a public invitation for “Demonstration project to establish the next-generation technologies utilizing distributed energy resources such as storage batteries, etc.”, carried out by the Sustainable open Innovation Initiative (SII). The "Renewable energy aggregation demonstration project" was added along with the demonstration projects on the consumer side until FY 2020, covering the following: 1) demonstration to avoid imbalance in renewable energy generation; 2) verification to increase profits from market trading; and 3) demonstration of renewable energy generation forecasting. Three consortiums participated in these demonstration studies: ENERES, Next Kraftwerke Toshiba and SB Energy. The existing project was renamed "Demonstration project for further utilization of distributed energy resources (DER aggregation)," and further divided into the following categories: Project A) Infrastructure development project; Project B) DER aggregation project; and Project C) Introduction of DER, etc. Project A was conducted by Waseda University and Project B was conducted with ENERES and Kansai Electric Power as consortium leaders.

Under the DER aggregation project, the equipment and construction costs, including storage batteries, are eligible for subsidies, and in FY 2021, subsidies were also provided for residential and industrial energy storage systems (storage batteries + PCS). The target price for industrial energy storage systems was set at 210,000 JPY/kW, and subsidies of 70,000 JPY/kW (capped at one third of the price) were provided for those below the target price. For residential storage batteries, a target price of 165,000 JPY/kWh was set, and subsidies of 40,000 JPY/kWh to 55,000 JPY/kWh were provided for storage batteries purchased at or below the target price. In the area of industrial energy storage, etc., MoE provided subsidies for the introduction of self-consumption type PV systems, storage batteries, etc. that contribute to the promotion of decarbonization and disaster prevention as part of the "Project to promote making renewable energy a mainstream power source/ strengthening of resilience in local communities through reduction of renewable energy price, etc. such as utilization of PPA".

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 establishment of net zero energy houses (ZEHs) at detached houses” is implemented by the SII as a liaison for this program. In case of introducing a storage system to the eligible ZEH, 20,000 JPY/kWh is granted for an energy storage system that costs 165,000 JPY/kWh or less.

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. 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 is progressing thanks to the subsidies provided by the support projects of ZEH. Many of them were 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. However, the surplus power purchase under the FIT program started to be terminated for PV systems from November 2019, and the operation in demand response mode started, following the change of the operation mode.

METI held the "Study group for expanding the dissemination of stationary storage batteries" four times between November 2020 and February 2021 and presented the measures for expanding the dissemination of storage batteries until 2030. In FY 2022, the "Project to promote the introduction of grid-scale storage batteries, etc. toward accelerating the introduction of renewable energy" will be implemented.

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 2020, subsidies were granted through the "Subsidy for project expenses to introduce clean energy vehicles that can be used in times of disaster" which was included in the third supplementary budget. The subsidy is available for individuals who purchase electric vehicles (EVs), plug-in hybrid vehicles (PHVs), and fuel cell vehicles (FCVs). The maximum subsidy amount is 800,000 JPY for EVs, 400,000 JPY for PHVs and 2.5 MJPY for FCVs. In addition, subsidies for charging facilities are also provided to individuals and businesses, covering one half of the cost of the facilities or a maximum of 750,000 JPY. Construction costs are subsidized at a fixed amount, with the maximum amount of 400,000 JPY for individuals or 950,000 JPY for businesses. Aside from government subsidies, local governments also provide subsidies for the introduction of EVs.

While there are no specific subsidies from the government for vehicle-integrated PV (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 was implemented in mainland Kyushu. Kyushu Electric Power conducted a PV output curtailment simulation and reported that the output curtailment rate was projected to be 4.6 % in FY 2021 and 5.2 % in FY 2022. Output curtailment forecasts for FY

2022 were also presented for the Tohoku, Shikoku, and Okinawa areas. METI summarized the basic direction of a comprehensive package to reduce renewable energy output curtailment including the following: 1) improvement of efficiency in output curtailment; 2) supply measures; 3) demand measures, and 4) grid measures. Consideration is also underway regarding the application of non-firm connection, which was applied to the bulk power system from January 2021. As for the local grid, Tokyo Electric Power (TEPCO) and NEDO are conducting a pilot project, and studies are underway with the aim of starting to accept applications by the end of FY 2022. Regarding the method to control congestion in the grid where non-firm connection is applied, re-dispatching method by general power transmission and distribution operators will be adopted at first.

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 and established goals 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. In 2020, a new target to further accelerate this goal was announced. Prime Minister Yoshihide Suga declared in his first Policy Speech at the 203rd extraordinary session of the Diet held on October 26, 2020, that "Japan aims to reduce greenhouse gas emissions to net zero by 2050, achieving carbon neutrality and decarbonized society by 2050. In this speech, he presented the realization of a green society which creates a virtuous circle between the economy and the environment as a pillar of Japan’s growth strategy. He also mentioned the maximum introduction of renewable energy as well as the promotion of nuclear power policies with safety as the highest priority and explained the policy to achieve both decarbonization and stable power supply. Furthermore, he indicated his intention of accelerating commercialization of progressive innovation such as the next-generation solar cells and carbon recycling, considering them as the key factors, and announced the drastic conversion of the policies for coal-fired thermal power generation. In response to this decision, the Ministry of Economy, Trade and Industry (METI) announced that it will formulate an action plan in the end of 2020 that will show the way to achieve this goal by 2050. METI will discuss them intensively at the Advisory Committee for Natural Resources and Energy and Green Innovation Strategy Meeting. Meanwhile, the Ministry of the Environment (MoE) announced a policy to revise the Law Concerning the Promotion of the Measures to Cope with Global Warming to promote introduction of renewable energy.

3.9.5.2 The introduction of any favourable environmental regulations

Regulatory Reform by the "Task Force for comprehensive review of regulations, etc. on renewable energy"

The need for regulatory reform is becoming a major challenge to maximize the introduction of renewable energy by making renewable energy a main power source toward carbon neutrality by 2050. In order to address the necessary regulatory reforms as a national issue and to strongly promote speedy reforms beyond the framework of ministries and agencies, the "Task Force for comprehensive review of regulations, etc. on renewable energy" was established in December 2020 under the leadership of Taro Kono, Minister for Administrative Reform and Regulatory Reform. Some examples of the outcomes are shown below. The Task Force is continuing and producing results in FY 2022.

- Approaches to location restrictions, such as elimination of single income requirement on devastated farmland and conversion of devastated farmland that is difficult to reclaim into non-agricultural use

- Establishment of the "renewable energy value trading market" where consumers can trade directly

- Review of grid restrictions on transmission networks, such as non-firm connections of local grids

- Compliance with electrical safety regulations, such as expanding the scope of pre-use self-confirmation for small-scale renewable energy facilities

- Compliance with regulations under the Fire Service Act concerning stationary lithium-ion storage battery facilities

- Clarification of technical standards for PV power generation facilities

- Reform of the Chief Electrical Engineer system

- Relaxation of requirements for the promotion of power generation facilities on farmland and use of agricultural reservoirs for the dissemination of floating PV (FPV) systems

- Strengthening of energy conservation standards for buildings and promotion of net zero energy houses (ZEH) and net zero energy buildings (ZEB)

In August 2022, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), METI and MoE compiled a list of housing and building measures toward achieving carbon neutrality in 2050 and presented the ideal vision for housing and buildings in 2050 and 2030 as well as the way forward for energy conservation measures and other initiatives.

Table 20: Ideal vision for housing and buildings in 2050 and 2030

2050	The energy conservation performance of the ZEH/ZEB standard level is secured on average in the stocks, and the introduction of renewable energy such as PV systems becomes common in houses and buildings where the introduction is reasonable.
2030	Energy conservation performance at the level of ZEH/ZEB standards shall be ensured for newly constructed houses and buildings, and 60 % of newly constructed detached houses shall be equipped with PV systems.

How to proceed with energy conservation measures, etc.

- Obligation to comply with energy conservation standards including for residential buildings by FY 2025

- Increasing the energy conservation standards to the level of ZEH/ZEB standards by 2030 at the latest, and make it mandatory to comply with them

- Promoting the installation of PV systems by considering all possible means, including future mandatory installation as one of the options

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 2020, it slightly decreased to approximately 76 %. While the share of fossil fuels decreased, the share of nuclear power and renewable energy increased to 3.9 % and 19.8 %, respectively.

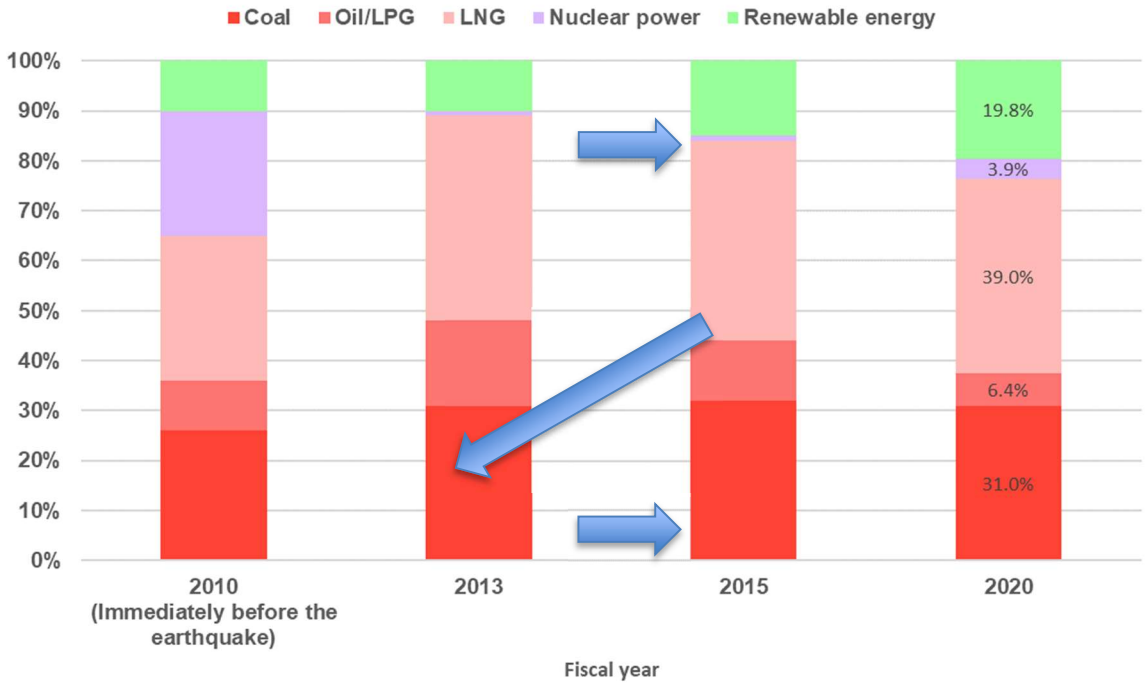

Figure 1 Generation mix of the electric companies

Source: Report on electricity supply-demand verification (October 2017) and White Paper on Energy 2022

Based on the Fifth Strategic Energy Plan approved by the Cabinet in July 2018, studies were conducted to address the fade-out of inefficient coal-fired thermal power plants. A policy was presented that inefficient coal-fired power plants should be steadily faded out

by 2030, and that in addition to taking both regulatory and directive measures, the efforts of business operators should be confirmed and secured through the fade-out plan. In the Sixth Strategic Energy Plan approved by the Cabinet in October 2021, renewable energy is described as a promising, diverse, and important domestic energy source that can contribute to energy security because it is a decarbonized energy source that does not emit greenhouse gases and can also be produced domestically. It was noted that the policy includes thoroughly making renewable energy a main power source through a principle of placing the highest priority on renewable energy. As for thermal power generation, while it is necessary for the time being as a supply capacity/dispatching ability to cover the volatility of renewable energy, it is fundamental to reduce the ratio of thermal power generation in the energy mix to a level as low as possible by FY 2030. Based on the premise of securing stable supply, while working on environmental measures toward decarbonization of thermal power generation, issues such as strengthening the competitiveness and improving the economic efficiency of thermal power generation will be addressed. From the perspective of ensuring stable supply, in light of growing concerns about supply capacity shortages due to the ongoing closure and decommissioning of existing thermal power plants, it is planned to proceed with studies on measures to prevent the withdrawal of power sources and strengthen efforts to secure fuel, while securing the necessary installed capacity over the mid- to long-term by means of the capacity market.

- 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 capacity records of PV systems are also evaluated.

As shown in Table 21, in the summer of 2021, electricity supply capacity in the peak hours of the day with the peak demand was expected to be 15.11 GW (excluding Okinawa Prefecture), but the actual supply capacity was 39.19 GW in total. It is estimated that the supply capacity in the summer of 2022 will be 19.35 GW (excluding Okinawa Prefecture). This estimation assumes that, since the PV power generation cannot always expect sufficient irradiation in the peak hours of electricity demand, supply capacity of PV is expected conservatively.

Table 21: Evaluation of power supply capacities 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 2021 (Actual)	Assumption	**190**	**1,800**	**4,080**	**2,810**	**400**	**1,710**	**1,750**	**880**	**1,480**	**15,110**
	Actual supply capacity records on a day and an hour of peak demand	**1,200**	**3,830**	**10,810**	**4,730**	**910**	**4,270**	**4,060**	**1,980**	**7,410**	**39,190**
	Actual ratio of adjustment factor (%) records on a day of peak demand	**59.9**	**57.5**	**65.1**	**46.8**	**84.7**	**66.1**	**72.0**	**68.7**	**70.2**	
	Peak demand date and hour in Japan	1 - 2 p.m., Thursday, Aug 5, 2021									-
	Peak electricity demand	4,440	14,620	54,530	24,770	5,220	28,220	10,990	5,030	15,450	163,280
	PV ratio to peak demand	27.0 %	26.2 %	19.8 %	19.1 %	17.4 %	15.1 %	36.9 %	39.4 %	48.0 %	24.0 %
Summer of 2022 (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 capacity	**230**	**2,210**	**5,250**	**3,710**	**530**	**2,600**	**2,000**	**1,140**	**1,670**	**19,350**
	Adjustment factor (%)	**7.8**	**24.7**	**25.3**	**24.2**	**31.7**	**27.1**	**26.9**	**32.1**	**17.1**	**-**

Source: Report on electricity supply-demand verification (October 2021 and June 2022)

*1: "Supply capacity" of PV power generation is the installed capacity of PV systems which contributed to the peak demand hours. With regard to PV power generation, since the PV power generation cannot always expect sufficient irradiation in the peak hours of electricity demand, in the preliminary assumptions, the stable power source replacement value of thermal power and other power sources based on the calculation of expected unserved energy (EUE) was included in the supply capacity.

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

*3: Detailed numbers for the adjustment factors are available on the website of the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO). The OCCTO's electricity supply plan uses a stochastic calculation method to assess the reliability of electricity supply, and the supply capability of power sources is calculated as follows: Supply capacity = Installed capacity x Adjustment factor. The adjustment factor varies by area and is published as a reference material in the OCCTO's electricity supply plan. For further information, please visit the following website (Japanese only):
https://www.occto.or.jp/kyoukei/teishutsu/files/2022-4_kyoukei_sankoushiryou_rev1.pdf

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).

The FY 2021 tax revenue from the petroleum and coal tax, including the Tax for Climate Change Mitigation, was 606 BJPY. Of this amount, revenue from the Tax for Climate Change Mitigation is expected to amount to about 260 BJPY. This tax revenue 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.

MoE started studying carbon pricing in January 2017 and discussions are ongoing. As for the options of carbon pricing, various methods such as carbon border adjustment mechanism (CBAM) and internal carbon pricing within a company, in addition to carbon tax, cap-and-trade and credit trading, are being discussed. MoE published an interim report on the use of carbon pricing in August 2021, but it is not intended to indicate a specific direction or conclusion. In February 2021, METI launched a study group on economic methods for achieving carbon neutrality in the world as a whole, etc., and started discussions on the system design of carbon pricing that would contribute to Japan's growth. In August 2021, METI compiled the results of discussions into a draft interim report. As part of the framework to bring about behavioral transformation in the mid- to long-term, it was proposed to establish a "Carbon neutral top league (tentative name)" in which businesses set emission reduction targets and the government verifies their performance, and a "Carbon credit market" in which businesses trade high quality credits from Japan and abroad.

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

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 2022, 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, from FY 2013 to FY 2021, more than 700 funding projects and demonstration projects (MoE/ METI) were adopted. As of June 2022, 146 PV-related projects with a total capacity of approximately 2.2 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, international demonstration projects through NEDO started in FY 1993, and "International Demonstration Project on Japan's Energy Efficiency Technologies" is being implemented from FY 2017. Demonstration projects focusing solely on PV technology are currently not being conducted. In non-IEA countries, a smart community demonstration project is being conducted in Slovenia for the period from 2016 to 2022.

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 2021, JICA signed a project finance loan agreement with Prime Road Alternative (Cambodia) of Cambodia for the development of the Kampong Chhnang PV power plant. This is a large-scale solar IPP project, which has few precedents in Cambodia. In addition to the effect of reducing greenhouse gas emissions, the project is expected to reduce electricity prices in Cambodia, as the electricity will be supplied at a low generating unit price of 3.877 cents/kWh. JICA provided 150 MUSD to the Bangladesh Infrastructure Finance Fund, an infrastructure fund in Bangladesh.

The Japan Bank for International Cooperation (JBIC), in its environmental initiatives, contributes to addressing global environmental issues through a variety of financial options to support the export of sophisticated environmental technologies from Japan and overseas development. In 2021, JBIC invested in Energy Fiji Limited (EFL), an electric company in the Republic of Fiji, jointly with Chugoku Electric Power. They work on the development of renewable energy in the country. For Benin of Africa, JBIC arranged a 30 MEUR co-financing together with a private bank to support the development of electric grids through PV power generation, which is being promoted by the government of Benin. In July 2021, as part of its "GREEN Global action for Reconciling Economic growth and ENvironmental preservation)" support program, JBIC invested 30 MUSD in overseas public/private fund, targeting renewable energy power generation projects, etc. in developing countries in Asia, Latin America, and Africa. Dai-ichi Life Insurance and MUFG Bank also invested in the fund, bringing the total investment by the three parties to approximately 100 MUSD. In the GREEN support program, 250 MUSD was also provided to a project by the Saudi Electricity Company (SEC) on power transmission and distribution, which will contribute to reduce the environmental burden. In January 2021, a new financing menu "Post-COVID-19 Growth Facility" was established and launched for a limited period of one year. In the "Decarbonization Promotion Window" of this facility, the framework for financing renewable energy, energy conservation, and other development projects undertaken overseas by Japanese companies to reduce greenhouse gas emissions was strengthened. Hydrogen and biomass fuel projects were added to the scope of financing. Moreover, JBIC provides assistance to the projects registered in the Joint Crediting Mechanism (JCM) through co-financing with private banks.

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, 8.2 BJPY in FY 2020, 8.0 BJPY in FY 2021 and 8.0 BJPY in FY 2022. 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 407.5 TWh cumulatively as of the end of December 2021, exceeding 15.5876 TJPY in total.

4 INDUSTRY

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

Table 22: Silicon feedstock, ingot and wafer producer's production information for 2020

Manufacturers	Process & technology	Total Production	Product destination	Price
Tokuyama	Polysilicon (for semiconductor, Siemens process)	Undisclosed (production capacity: 8 500t/year)		
Mitsubishi Materials	Polysilicon (for semiconductor, Siemens process)	N/A		

As of 2021 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 asking wafer companies to correct the price due to the heavy burden of capital investment in reducing the percentage of impurities in silicon wafers for cutting-edge semiconductors. Mitsubishi Materials is manufacturing polysilicon in Japan and the USA. At its US manufacturing base, profitability was improved in the first half of FY 2020 as a result of reduced manufacturing costs. Both companies do not conduct manufacturing of solar cells, but occasionally supply off-grade semiconductor-grade products for solar cells.

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

According to PV shipment statistics by the Japan Photovoltaic Energy Association (JPEA), domestic shipments of PV module in 2021 totalled 5,099 MW. Of this amount, 88 %, or 4,501 MW, was imported. Foreign manufacturers appear to have occupied the top positions in terms of shipments, as in the previous year (JPEA's shipment statistics do not include the shipments by JinkoSolar (China) and Trina Solar (China)). Total PV module shipments by domestic production in Japan in 2021 (January-December) were 606 MW. Of this total, 8 MW was shipped overseas, and the volume of overseas shipments of overseas-produced products was 28 MW. Panasonic and Solar Frontier, which were the major domestic PV manufacturers, withdrew from production, however, they continue to work on the PV power generation business.

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 are continuing their efforts to provide 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

are also focusing on sales of power purchase services and storage battery systems linked to PV for the owners of 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. Leading suppliers of c-Si PV modules are Sharp Energy Solutions, Kyocera, Panasonic, Kaneka, Fujipream, Choshu Industry, INFINI, KIS, and Solar Frontier. Among them, Kaneka manufactures BIPV modules for residential use. Kyocera also supplies roof-tile integrated PV modules. These major Japanese manufacturers are also progressing technology development towards commercialization of 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. In 2021, Japanese companies made progress in their efforts for recycling PV modules in anticipation of future market expansion. As for thin-film solar cells, F-Wave continues to manufacture a-Si flexible solar cells, and Panasonic produces a-Si solar cells for low-power consumption applications such as watches, etc. Solar Frontier, which used to manufacture CIS solar cells, withdrew from manufacturing, but continues to conduct research and development.

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, Diamond & Zebra Electric MFG, Panasonic, Kyocera, Sharp, 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 33.3-kW inverter by Diamond & Zebra Electric MFG; a 21-kW inverter and a 42-kW inverter by Fuji Electric; and 10-kW inverter by Yaskawa Electric, GS Yuasa, Sanyo Denki, etc. Recently, overseas manufacturers such as Huawei Technologies, Sungrow Power Supply and SolarEdge 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, 1,000 kW, 2,500 kW and 4,400 kW. As PV power plants become larger in capacity, the unit capacities of inverters are also getting larger. Diamond & Zebra Electric MFG, 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 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. Hitachi owns a factory in India.

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). 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 often given by electric companies individually. JET started a certification system for high-voltage grid connected protective equipment in February 2021, which is intended for ≤ 2 MW inverters, and Fuji Electric obtained the certificate.

- 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, Eliiy Power, Murata Manufacturing, etc., supply storage batteries in Japan. Many domestic manufacturers import storage batteries from South Korea and other foreign countries and incorporate them into their own systems for delivery.

Residential storage systems are sold as hybrid inverters, etc. by Sharp, Nichicon, ITOCHU, Choshu Industry, Panasonic, Omron, Diamond & Zebra Electric MFG, Kyocera, Murata Manufacturing and so on. The inverter capacity usually ranges from 4 kW to 9.9 kW and the capacity of storage batteries ranges from 2.2 kWh to 16.4 kWh.

Some companies from abroad entered the Japanese market. PV manufacturers such as Hanwha Q CELLS Japan, Canadian Solar and JinkoSolar Japan 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. The storage battery manufacturers for these large-scale projects are GS Yuasa, LG Chemical,

Samsung SDI and Toshiba for lithium-ion batteries, NGK Insulators for NAS batteries, and Sumitomo Electric for redox flow batteries.

- 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), etc. 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. As for the float for floating PV system (float + PV module supporting structure), in addition to reservoir solar company (Tameike Solar), Kyoraku, etc., overseas companies such as Ciel & Terre (France) engage in the market.

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 2021

Market category	Number of full-time labour places	
	2021	2020
Research and development (not including companies)	400	400
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	68,400	74,400
Distributors of PV products		
System and installation companies		
Electricity utility businesses and government		
Other		
Total	**68,800**	**74,800**

5.2 Budget for research and development

As for R&D, D activities concerning PV, technology development for commercialization administered by METI, has been conducted by the New Energy and Industrial Technology Development Organization (NEDO) and fundamental R&D administered by Ministry of Education, Culture, Sports, Science and Technology (MEXT), has been promoted mainly by the project of the Japan Science and Technology Agency (JST) and the project to subsidize the scientific research fund.
METI's R&D budget for FY 2021 was 3.3 BJPY. NEDO made an additional public offering in FY 2021 for the Development of Technologies to Promote Photovoltaic Power Generation as a Main Power Source (FY 2020 - FY 2024) and selected five themes. These themes include development of technology to evaluate generation amount to support the next-generation O&M, as well as technology to forecast solar irradiation for a short-term forecast of generation amount. A demonstration experiment to ensure safety of PV systems on slopes, AgroPV and floating PV systems is conducted as well.
In 2021, the government established a 2 TJPY, ten-year fund called the Green Innovation Fund (GIF) as part of NEDO for development of decarbonization technology and R&D on social implementation to realize carbon neutrality by 2050. Projects across 18 areas, the important areas for which implementation plans were formulated under the Green Growth Strategy by METI, will be conducted between FY 2021 and FY 2030. As part of the GIF project, NEDO started the Next-Generation Solar Cell Development Project in 2021 as the 10-year project between FY 2021 and FY 2030 with total budget of 49.8 BJPY. In FY 2021, six themes were selected to develop fundamental technologies of film-type perovskite solar cells with the performances equivalent to existing solar cells as well as technologies for commercialization. Sekisui Chemical, Toshiba, EneCoat Technologies, Aisin, Kaneka and the National Institute of Advanced Industrial Science and Technology (AIST) were selected. Demonstration tests are also planned to be conducted in FY 2023 onwards, aiming to achieve social implementation of

these cells. Furthermore, the project of Hydrogen production with water electrolysis using electricity derived from renewable energy, etc. was also started under the GIF project.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Following full liberalization of electricity retailing from April 2016, new players entered the electricity retailing business one after another. The number of registered electric retailers was 735 (as of December 2021) 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 approximately 22 % (as of December 2021), 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 trading quantity on the Japan Electric Power Exchange (JEPX) accounts for around 40 % of the total demand (as of December 2021). The power transmission division and the power distribution division of the former General Electricity Utilities were legally separated by April 2020, and electric companies demerged the general power transmission and distribution business. New markets were created as a part of the electricity system reform. In the non-fossil fuel energy value trade market that trades non-fossil fuel value of renewable energy, etc. apart from the value of electricity, the non-fossil fuel values of FIT electricity and non-FIT electricity are traded. The auctions of the renewable energy value trading market started in November 2021, allowing consumers to directly purchase FIT non-fossil fuel energy certificates. In addition, auctions were held in the capacity market that trades the value of kW as a supply capacity (targeting to start supply in FY 2025), and the supply/demand adjustment market that trades the value of ΔkW as a dispatching ability started its operation and some products began to be traded.

6.2 Interest from electricity utility businesses

- Introduction of PV power generation by electric companies

Federation of Electric Power Companies (FEPC) of which 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. Also, introduction of PV power generation with the third-party ownership (TPO), which enables installation of PV systems at no initial cost (on-site PPA), has been progressing, targeting electricity users, and off-site PPAs are also being proposed for large customers.

- Plans and reorganization that promotes renewable energy

Electric companies are presenting their renewable energy development targets while progressing reorganization towards promotion of renewable energy. Hokkaido Electric Power announced the "Hokuden Group Management Vision 2030" with plans to increase its renewable energy capacity by more than 300 MW in Hokkaido Prefecture and other regions, and to achieve zero CO_2 emissions from the power generation sector in order to become carbon neutral by 2050. Tohoku Electric announced that it will achieve its renewable energy

development target of 2 GW as early as 2030 onwards. Chubu Electric formulated the "Chubu Electric Power Group Management Vision 2.0" towards 2030 with the aim of developing more than 3.2 GW of renewable energy. Hokuriku Electric established a Renewable Energy Department to accelerate the development of renewable energy in order to achieve the "Hokuriku Electric Power Group 2030 Long-term Vision". Kansai Electric Power (KEPCO) formulated the "Kansai Electric Power Group Medium-term Management Plan (2021-2025)" and will invest 340 BJPY in renewable energy-related projects. Chugoku Electric set a target to introduce 300 to 700 MW of renewable energy by FY 2030 under its group management vision " Energia Change 2030" to achieve carbon neutrality by 2050. Shikoku Electric announced its challenge to achieve carbon neutrality by 2050. Shikoku Electric will work on new development of renewable energy, aiming to introduce 500 MW by FY 2030 and 2 GW by FY 2050. TEPCO Renewable Power succeeded approximately 10 GW of renewable energy power sources (hydro, wind, and PV) in 168 locations from TEPCO and aims to develop around 6 to 7 GW of renewable energy projects in the first half of the 2030s both in Japan and abroad.

- 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 in and after 2012. There are residential PV systems with their purchase period terminating from November 2019 onwards since the purchase period is ten years, and the power sales price and conditions for these systems 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 8 JPY/kWh; KEPCO at 8 JPY/kWh. Power Producer and Supplier (PPS) are also offering the purchase menu of surplus electricity by the service area of electric companies and are purchasing surplus PV power. There are also plans available that allow customers to use surplus electricity at home even if they do not have storage batteries installed.

- 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 carried out on weekdays as well. In 2021, total 81 times of output curtailment were conducted (once in January, five times in February, 12 times in March, 21 times in April, 15 times in May, three times in June, four times in September, 11 times in October, seven times in November, and once in December). 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 need to be enhanced. As

for the frequency conversion station, the capacity was enhanced by 900 MW in FY 2020, and another 900 MW enhancement is scheduled by FY 2027, which will make the total capacity of 3.0 GW. The capacity of Hokkaido-Honshu HVDC Link, the grid connection lines between Hokkaido and Honshu (main island of Japan) is planned to be expanded by another 300 MW from 900 MW. Construction for a 4.55 GW expansion of the grid connection lines between Tohoku and Tokyo is underway, scheduled to be completed in November 2027. Under the Acts for Establishing Resilient and Sustainable Electricity Supply Systems which was enacted in June 2020, a master plan was formulated and a policy to promote the establishment of the push-type grids was presented. Several scenario analyses are being conducted by the OCCTO to study proposed grid enhancement. As for the cost to enhance inter-regional interconnection lines, among the benefits of price reduction and CO_2 reduction, the cost for the effects derived from renewable energy is covered by the renewable energy surcharge, and the cost for other effects is covered by two entities on both ends of the link and nine companies, based on the national adjustment scheme. As for the cost for the benefits of stable supply, etc., individual general power transmission and distribution operators bear the cost as they conventionally do, which will be collected from the regional wheeling charge.

- 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 be revised as needed depending on the calculation results of possible grid connection capacity for each fiscal year. In case the “30-day, etc. output curtailment capacity” is exceeded, output curtailment will have “no limit without compensation”, and the rule of “no limit without compensation” has applied to all the areas, effective from April 2021. 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. To overcome grid restrictions, efforts have been made to realize the “Japanese version connect & manage” at an early date, in which the existing grid is thoroughly utilized. Non-firm connections have been applied to bulk power system where available capacity is insufficient since January 2021. TEPCO and NEDO are conducting a trial non-firm connection to local grids, with the aim of gradually accepting applications around the end of FY 2022.

6.3 Interest from municipalities and local governments

In FY 2021, many municipalities enhanced their subsidy programs for the introduction of PV systems and storage batteries, contributing greatly to the deployment. It is often the case that the amount of subsidy for PV ranges from 10,000 JPY/kW to 50,000 JPY/kW, and that for storage batteries is around 20,000 JPY/kWh.

The Tokyo Metropolitan Government (TMG) subsidizes 100,000 JPY/kW for PV as part of its "Zero emission housing introduction promotion project". In addition, each ward, city, and town in Tokyo provides additional subsidies.

As for support for the introduction of storage batteries, the "Self-consumption plan project" provides support for the introduction of storage batteries that can be used in combination with the national government subsidy. The subsidy amount is 70,000 JPY/kWh for storage batteries or one-half of the equipment cost, whichever is less, with a ceiling price of 420,000 JPY.

In Tokyo, TMG conducts the “TMG Project to enhance renewable energy for local production

and local consumption" for business operators. Under this project, TMG provides support for storage batteries, etc. to be installed together with PV systems. For small- and medium-sized enterprises (SMEs), etc., the subsidy is limited to two-thirds of the eligible expenses (maximum subsidy amount: 100 MJPY), and for other businesses, the subsidy is limited to one-half of the eligible expenses (maximum subsidy amount: 75 MJPY). This subsidy is scheduled to be implemented for FY 2022 with an expanded budget and scope of application.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

The year 2021 was a year for Japan to choose its energy options, with the formulation of the "Sixth Strategic Energy Plan" and the "Plan for Global Warming Countermeasures" in response to the national target of "46 % reduction of greenhouse gas emissions in 2030". By significantly raising the ratio of renewable energy sources to 36 to 38 % in 2030, renewable energy will become the core of Japan's energy policy in the future, and Japan's commitment to the formation of a decarbonized society was demonstrated to the world. Another major achievement is that the Sixth Strategic Energy Plan will promote the expansion of renewable energy in Japan through collaboration with related ministries and agencies and regulatory reform, rather than the sole responsibility of the Ministry of Economy, Trade, and Industry (METI), as well as regulatory reform. In particular, regarding PV power generation, the ambitious introduction target for FY 2030 was set at 117.6 GW (of which 55.8 GW was already installed), with 31.8 GW by METI, 24.2 GW by the Ministry of the Environment (MoE) (partly in cooperation with the Ministry of Agriculture, Forestry and Fisheries (MAFF)), and 5.8 GW by the Ministry of Land, Infrastructure and Transport (MLIT), bringing the total to 61.8 GW. These ministries and agencies already incorporated budgets for expanding the introduction of PV power generation in their FY 2021 supplementary budgets and in their FY 2022 budgets.

METI will work to create an environment to facilitate and accelerate the expansion of renewable energy introduction through the Renewable Energy Promotion Act (revised Act on Special Measures Concerning Procurement of Renewable Energy Sourced Electricity by Electric Utilities, or the current FIT Act), the Electricity Business Act, and the Act Concerning the Rational Use of Energy (Energy Conservation Act). MoE will focus on giving top priority to and maximizing the introduction of renewable energy and will start supporting the introduction of renewable energy to public facilities and local governments based on the revised Law Concerning the Promotion of the Measures to Cope with Global Warming and the Local Decarbonization Roadmap. Support for private companies to introduce PV systems for self-consumption will also be strengthened. MLIT will promote ZEH and ZEB for housings and buildings based on the "MLIT Environmental Action Plan" and expand the introduction of PV power generation using public rental housing, government facilities, and infrastructure spaces such as roads, airports, ports, parks, and sewage systems. MAFF will promote the introduction of PV systems on farmland in accordance with the Act on Promoting Generation of Electricity from Renewable Energy Sources Harmonized with Sound Development of Agriculture, Forestry and Fisheries and the Green Food System Strategy, while reviewing regulations on conversion of farmland to expand the introduction of PV systems. The Cabinet Office's "Task Force for comprehensive review of regulations, etc. on renewable energy" will review all regulations related to renewable energy across relevant ministries and agencies to advance regulatory reforms to expand the introduction of PV power generation.

The PV industry initiated new trends that could not have happened in the 2010s, in response to the global movement toward a decarbonized society. Various approaches have started, including large-scale investment in renewable energy projects by the conventional energy industry, utilization of PV power generation by the real estate and general contractor industries, non-firm connections by electric companies, collaboration among different industries to strengthen renewable energy businesses, acceleration of renewable energy investment and financing by the financial industry, and trading and overseas expansion of PV power plants.

Despite these trends, Japanese PV manufacturers were unable to keep up with global price competition and were forced to withdraw from domestic production.

In the Japanese PV market, approval of new projects did not increase, and the expansion of installation slowed due to rising PV module prices, stagnant shipments of inverters caused by a shortage of semiconductors, and soaring costs of mounting structures. Nevertheless, introduction through the PPA, which does not require initial cost, started to expand as a new business model, especially in the on-site market, and corporate PPAs have started adopting the same model in the off-site market as well.

Under these circumstances, as of the end of December 2021, Japan's cumulative approved PV projects and cumulative start of operation capacity (installed capacity) under the feed-in tariff (FIT) program grew to 76.4 GW (AC) and 59.3 GW (AC), respectively. The annual installed capacity in 2021 was 6.5 GW (DC) and the cumulative installed capacity reached 78.4 GW (DC), approaching the 80 GW level.

7.2 **Prospects**

In Japan, new introduction system and introduction expansion will start from 2022 onward in order to achieve the ambitious PV installation target outlined in the Sixth Strategic Energy Plan. Up to now, the FIT program led to the introduction of slightly below 60 GW (AC) of PV systems over the nine years from 2012, however, with the new introduction expansion, the PV dissemination structure in Japan will change drastically. The FIT-only dissemination structure, which consists of the public's burden, will come to an end, shifting to a new dissemination structure that makes full use of various players and methods, including related ministries and agencies, local governments, regulatory reform, business models, customer participation, and technology development.

With the enforcement of the Acts for Establishing Resilient and Sustainable Electricity Supply Systems by METI in April 2022, market-linked FIP programs, reserve fund to cover disposal costs related to PV power generation, approval cancellation system, push-type grid enhancement, and introduction of licenses for power distribution businesses and designated wholesale suppliers (aggregators) will start to be implemented to replace the existing FIT program under the Renewable Energy Promotion Act and Electricity Business Act. Meanwhile, with the enforcement of the revised Law Concerning the Promotion of the Measures to Cope with Global Warming by MoE, the introduction of PV system will start to expand through the establishment of renewable energy introduction target amount and renewable energy promotion zones by local governments. Policy responses based on the Sixth Strategic Energy Plan will further strengthen measures such as securing suitable sites, strengthening business discipline, reducing costs, integrating into the electricity market, overcoming grid constraints, streamlining regulations, and promoting technological development, in order to maximize the introduction of renewable energy. In terms of deployment by responsible ministries and agencies, GW-scale introduction will be promoted in the areas of public facilities, housing, industrial facilities, and agricultural land, etc., respectively, by mobilizing the laws, systems, measures, budgets, and regulatory reforms under the jurisdiction of METI, MoE, MLIT, and MAFF, respectively. As for regulatory reform, based on the FY 2021 Regulatory Reform Implementation Plan, a comprehensive review of regulations and impediments across relevant ministries, agencies, and local governments will continue, leading to the introduction and expansion of PV power generation. In terms of deployment by local governments, introduction expansion of PV systems for local production and local consumption will become fully fledged

based on the Local Decarbonization Roadmap and establishment of PV installation targets, while utilizing subsidies for introduction, such as grants for renewable energy. In particular, 100 locations nationwide are targeted to be selected from FY 2022 as leading areas of decarbonization, where the installation of PV systems will begin intensively in the local communities. Business models for the expansion of installation will include the introduction of the PPA model, a third-party ownership model that does not require installation costs, and other business models for the expansion of installation, which will promote the spread of PV systems without the need for government support. In strengthening the shift by the conventional energy industry to renewable energy businesses, they will promote a stable energy supply and gain more confidence from the renewable energy industry by becoming a renewable energy supply player. In accelerating the power shift to renewable energy by electricity consumers, investment in the development of renewable energy power sources will advance, and the demand side will take the lead in the dissemination and expansion of renewable energy. Acceleration of technological development will enable the introduction of PV systems in areas where PV systems could not be introduced previously and will expand the scope of introduction through the creation of new markets.

The PV industry will be responsible for the introduction of more than 50 GW (AC) in the future in order to achieve the new introduction target for 2030. Although there is a mixture of challenging phases and promising phases due to the drastic changes in the business environment, the industry will move away from the conventional FIT-based business model and transition to a sustainable business model.