Technology Collaboration Programme
by iea

International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in Korea

2022

KOREA ENERGY AGENCY

What is IEA PVPS TCP?

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

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

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

Visit us at: www.iea-pvps.org

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 2022. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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COVER PICTURE

Agri-PV System installed in Yeungnam University campus

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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 2022 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2022, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

In Korea, photovoltaic system is mainly applied to the electric power generation. Since 2012, Renewable Portfolio Standard (RPS) was introduced as a flagship renewable energy program, replacing the previous FiT scheme, and thanks to the new RPS scheme (initially with PV set-aside requirement of 1,5 GW cap), significant PV deployment has been achieved: 2 605 MW in 2018, and 3 927 MW in 2019, 4 664 MW in 2020, 3 915 MW in 2021, and 3 278 MW in 2022, respectively. At the end of 2022, the total installed PV capacity was about 24 370 MW, among those the grid-connected centralized system accounted for around 86% of the total cumulative installed power. The grid-connected distributed system amounted to around 14% of the total cumulative installed PV power. The share of off-grid non-domestic and domestic systems has continued to decrease and represents less than 1% of the total cumulative installed PV power. The PV electricity in 2022 corresponds to ~4,9% of total electricity generation (626 448 GWh) in Korea.

PV in buildings is getting more and more interest in urban areas, and recent zero-energy building mandates put more pressure on building owners to install more PVs in the building. Floating PV on the lakes and dams is also getting popular in Korea (with the potential of ~10 GW). Agricultural PV (in short agri-PV) is also getting higher attention, since the flat land for PV installation is getting more difficult to obtain. However, real projects are being delayed due to disadvantageous regulations on using farm land for PV installations. BIPV and VIPV are also being developed through government-led R&D projects which focus on the compatibility of PV modules to design, fire safety, aesthetic appearance as well as functional flexibility.

1.2 Total photovoltaic power installed

Table 1: Annual PV power installed during calendar year 2022

		Installed PV capacity in 2022 [MW]	AC or DC
	Decentralized	453	DC
	Centralized	2 825	DC
	Off-grid	-	DC
	Total	3 278	DC

Table 2: Data collection process

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	All the data is reported in DC
Is the collection process done by an official body or a private company/Association?	official body (Korea Energy Agency)
Link to official statistics (if this exists)	www.kemco.or.kr

Table 3: 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]
1998		0,6	0,0	0.6
1999		3,6	0,0	3,6
2000		4,1	0,0	4,1
2001		4,9	0,0	4,9
2002		5,4	0,0	5,4
2003		6,0	0,0	6,0
2004		8,3	0,2	8,5
2005		12,1	1,5	13,5
2006		25,3	10,5	35,8
2007		41,8	39,4	81,2
2008		58,4	298,5	356,9
2009		82,6	441,1	523,7
2010		116,8	533,5	650,3
2011		152,7	576,5	729,2
2012		214,9	809,5	1 024,3
2013		278,2	1 276,9	1 555,0
2014		347,1	2 134,2	2 481,3
2015		440,9	3 174,3	3 615,2
2016		931,5	3 950,6	4 882,0
2017		1 266,9	5 169,5	6 436,4
2018		1 679,9	7 258,8	8 938,7

2019		2 072,1	10 673,1	12 745,2
2020		2 446,0	14 910,9	17 356,9
2021		2 860,9	18 338,4	21 199,3
2022		3 318,3	21 051,3	24 369,5

Table 4: Other PV market information

	2022
Number of PV systems in operation in your country (a split per market segment is interesting)	unknown
Decommissioned PV systems during the year [MW]	107,8
Repowered PV systems during the year [MW]	unknown

Table 5: PV power and the broader national energy market

	Data	Year
Total power generation capacities [GW]	143,5	2022
Total renewable power generation capacities (including hydropower) [GW]	33,8	2022
Total electricity demand [TWh]	594,392	2022
New power generation capacities installed [GW]	9,5	2022
New renewable power generation capacities (including hydropower) [GW]	3 809	2022
Estimated total PV electricity production (including self-consumed PV electricity) in [GWh]	30 726	2022
Total PV electricity production as a % of total electricity consumption	4,9	2022
Average yield of PV installations (in kWh/kWp)[1]	1 261	2022

[1]It is calculated: total generation (30 726 MWh) divided by installed capacity (24 369.5 MW) as of 2022.

1.3 Key enablers of PV development

Table 6: Information on key enablers.

	Description	Annual Volume	Total Volume	Source
Decentralized storage systems in MWh		200	9 900	Ministry of Trade, Industry & Energy
Residential Heat Pumps [#]				
Electric cars [#]		126 537	337 633	KOSIS
Electric buses and trucks [#]		39 605	85 918	KOSIS
Other (up to you)				

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 7: Typical module prices

Year	Lowest price of a standard module crystalline silicon (optional)	Highest price of a standard module crystalline silicon (optional)	Typical price of a standard module crystalline silicon (mandatory)
2011	1 200		1 400
2012	800		1 000
2013	634		974
2014	634		974
2015	634		974
2016	456		646
2017	450 (import)	800 (import)	500
2018	360 (import)	900 (import)	410
2019	280 (import)	600 (locally manufactured)	370
2020	270 (import)	550 (locally manufactured)	330
2021	290 (import)	450 (locally manufactured)	350
2022	340 (import)	510 (locally manufactured)	450

2.2 System prices

Table 8: Turnkey PV system prices of different typical PV systems

Category/Size	Typical applications and brief details	Current prices [KRW/W]
Off-grid 1-5 kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid. (typically 3 kW for household)	1 600-2 000
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes.	1 500-1 900
Residential BIPV 5-10 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected households. Typically, on villas and single-family homes.	2 000-3 000
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1 300-1 500
Small commercial BIPV 10-100 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1 500-2 000
Large commercial BAPV 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1 200-1 500
Large commercial BIPV 100-250 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1 500-2 500
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	1 150-1 450
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	1 050-1 600
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	1 050-1 600

Floating Centralized PV	Grid-connected, mounted on a structure that floats on the surface of the water, distributed PV systems installed to produce electricity using public waters, such as reservoirs, artificial basins, lakes, etc.	1 350-1 800
Agricultural PV	Grid-connected, farming land-mounted, centralized PV systems that work as a central power station. The electricity generated in this type of facility is not tied to a specific customer, and the purpose is to produce electricity for sale.	Market, not established yet

Table 9: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5-10 kW [KRW/W]	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10-100 kW [KRW/W]	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100-250 kW [KRW/W]	Centralized PV Grid-connected, ground-mounted, centralized PV systems 10-50 MW [KRW/W]
2011	4 000			
2012	3 000			
2013	3 000			
2014	3 000	2 900	2 900	2 250
2015	1 750	2 250	2 250	1 700
2016	1 600	1 550	1 500	1 500
2017	1 520	1 500	1 450	1 500
2018	1 474	1 430	1 400	1 582
2019	1 434	1 400	1 350	1 465
2020	1 500	1 390	1 300	1 100
2021	1 500	1 370	1 250	1 050
2022	1 700	1 400	1 350	1 325

2.3 Cost breakdown of PV installations

The cost breakdown of a typical 5-10 kW roof-mounted, grid-connect, distributed PV system on a residential single-family house and a typical >10 MW Grid-connected, ground-mounted, centralized PV systems at the end of 2022 is presented in Table 10 and Table 11, respectively.

The cost structure presented is from the customer's point of view. I.e. it does not reflect the installer companies' overall costs and revenues. The “average” category in Table 10 and Table 11 represents the average cost for each cost category and is the average of the typical cost structure. The average cost is taking the whole system into account and summarizes the average end price to customer. The “low” and “high” categories are the lowest and highest cost that has been reported within each segment. These costs are individual posts, i.e. summarizing these costs do not give an accurate system price.

Table 10: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of 5-10 kW

Cost category	Average [KRW/W]	Low [KRW/W]	High [KRW/W]
Hardware			
Module	450	330	550
Inverter	175	100	250
Mounting material	255	200	310
Other electronics (cables, etc.)	140	110	170
Subtotal Hardware	**1020**		
Soft costs			
Planning			
Installation work	200	180	220
Shipping and travel expenses to customer	50	50	50
Permits and commissioning (i.e. cost for electrician, etc.)	50	50	50
Project margin	139.5	119	160
Subtotal Soft costs	**439.5**		
Total (excluding VAT)	**1459.5**		
Average VAT	0.1		
Total (including VAT)	**1605.45**		

Table 11: Cost breakdown for a grid-connected, ground-mounted, centralized PV systems of >10 MW

Cost category	Average [KRW/W]	Low [KRW/W]	High [KRW/W]
Hardware			
Module	350	270	430
Inverter	70	60	80
Mounting material	255	220	290
Other electronics (cables, etc.)	215	150	280
Subtotal Hardware	**890**		
Soft costs			
Planning	30	25	35
Installation work	225	180	270
Shipping and travel expenses to customer	70	50	90
Permits and commissioning (i.e. cost for electrician, etc.)	155	130	180
Project margin	80	70	90
Subtotal Soft costs	560		
Total (excluding VAT)	1450		
Average VAT	0.1		
Total (including VAT)	1595		

2.4 Financial Parameters and specific financing programs

Table 12: PV financing information in 2022

Different market segments	Loan rate [%]
Average rate of loans – residential installations	6~7%
Average rate of loans – commercial installations	6~7%
Average cost of capital – industrial and ground-mounted installations	10%

2.5 Specific investments programs

Investment Schemes	Introduced in Korea
Third party ownership (no investment)	No
Renting	No
Leasing	Korea Energy Agency (KEA) offers solar lease program for households which use electricity more than 200 kWh/month on the average in the previous year period. The household pays less than 80% of the typical electricity bill for (PV leasing fee + electricity fare), and the leasing company provides O&M services and makes profit from collecting leasing fee from the household and selling renewable energy point (REP) to the RPS obligators.
Financing through utilities	No
Investment in PV plants against free electricity	No
Crowd funding (investment in PV plants)	Private companies attract investors for PV power plants by crowdfunding scheme, and typical earning rate is about 7-8%.
Community solar	Maximum 20% increase in REC multiplier is given when community residents are involved in the projects under RPS scheme.
International organization financing	No
Other (please specify)	-

2.6 Merchant PV / PPA / CPPA

Please describe how Merchant PV/PPA/CPPA (PV outside of support mechanisms) is developing in your country. Describe briefly which segments are developing (commercial and industrial systems, utility scale… etc), the type of principal actors (private utilities, commercial developers, corporate consumers etc..) and the type of remuneration models commonly

practiced (merchant PV ie selling electricity on the market, PPA ie mid to long term power purchase agreement with a reseller and CPPA, PPA's with an end- consumer…).

2.7 Additional Country information

Table 13: Country information

Retail electricity prices for a household [KRW/W] (mandatory)	910 KRW + 120,0 KRW/kWh for 0~200 kWh; 1 600 KRW + 214,6 KRW/kWh for 201~400 kWh; 7 300 KRW + 307,3 KRW/kWh for 400 kWh or higher for low voltage[1] (910 KRW + 120,0 KRW/kWh for 0~300 kWh; 1 600 KRW + 214,6 KRW/kWh for 301-405 kWh; 7 300 KRW + 307,3 KRW/kWh for 450 kWh or higher for low voltage)[2]
Retail electricity prices for a commercial company [KRW/W] (mandatory)	6 160~8 230 KRW (base fare) + 83,5~139,3 KRW/kWh[3]
Retail electricity prices for an industrial company [KRW/W] (optional)	5 550~7 470 KRW (base fare) + 82,3~140,9 KRW/kWh[3]
Population at the end of 2022	51 816 000
Country size [km^2]	100 443,6
Liberalization of the electricity sector	Not liberalized

[1]Low voltage: 110-380 V; High voltage A: 3 300-66 000 V; High voltage B: 154 000 V; High voltage C: 345 000 V or higher.

[2]For hot summer season (1 July ~ 31 August)

[3]Retail electricity prices for commercial companies and industrial companies vary depending on the contract power (lower or higher than 300 kW), existence or absence of divided meters, time or season of use (summer, spring & fall, winter, day or night), and supply voltage. Electricity prices for educational facilities and farming use follow different fare structure.

3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing or simplifying or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

Table 14: Summary of PV support measures

Category	Residential		Commercial + Industrial		Centralized	
Measures in 2022	**On-going**	**New**	**On-going**	**New**	**On-going**	**New**
Feed-in tariffs	Yes	-	-	-	-	-
Feed-in premium (above market price)	-	-	-	-	-	-
Capital subsidies	Yes	-	-		-	
Green certificates	Yes	-	Yes	-	Yes	-
Renewable portfolio standards with/without PV requirements	-	-	Yes	-	Yes	-
Income tax credits	-	-	-	-	-	-
Self-consumption	Yes	-	Yes	-	-	-
Net-metering	Yes	-	Yes	-	-	-
Net-billing	-	-	-	-	-	-
Collective self-consumption and delocalized net-metering	-	-	-	-	-	-
Sustainable building requirements	Yes	-	Yes	-	-	-
BIPV incentives	Yes	-	Yes	-	-	-
Merchant PV/PPA facilitating measures	Yes	-	Yes	-	Yes	-
Other (specify)	-	-	-	-	-	-

3.1 National targets for PV

In July 2020, Government announced Korean-type Green New Deal Plan to recover Korean economy suffered from COVID-19 and move towards carbon-neutral society. Government also declared the leapfrog towards low-carbon and eco-friendly nation by disseminating 26,3 GW of PV and wind by 2022 and 42,7 GW by 2025, which is one step forward from Renewable Energy 3020 plan announced in 2017. The 2022 target of PV and wind was barely met by installing 24,370 GW PV (cumulative) and 1,946 GW wind (cumulative). In 2022, new government announced 10th Electricity Demand and Supply Plan which contains the renewable electricity target of 21,5% by 2030 (from 9,2% renewable electricity as of 2022F). For PV sector in particular, a Common-use PV Research Centre will be established by 2023 to fortify competitiveness of domestic PV manufacturing enterprises. The Centre will also assist PV companies in quality evaluation and performance certification of the developed products. To promote new & renewable energy (NRE) market, the mandated percentage of NRE for public institutions will be raised to 40% by 2030 from currently 30%, and the RPS requirement percentage will be set for 10% in 2023. To promote the dissemination of low-carbon PV products, a 'Carbon Accreditation Measure' has been introduced and applied to the market with detailed criteria with 'Operational Notice.' Green certificate scheme and PPA have also been introduced since 2019 to assist the RE100 campaign for companies.

3.2 Direct support policies for PV installations

Korea has been trying to change its energy infrastructure from using a centralized system with more than 75 percent coal and nuclear into a more distributed system to accommodate more renewable energy resources. This new policy is supported by many citizens suffering from coal power plants (fine dust problems) together with the nuclear safety issue (magnified by the recent earthquakes near the nuke-populated areas). The new government announced the 10th Electricity Demand and Supply Plan which contains the renewable electricity target of 21,5% by 2030. In this context, many support measures were designed and implemented. Korea's current policy structure to promote PV deployment can be categorized into four areas: 1) subsidies for installation, 2) incentives, 3) obligatory measures, and 4) infrastructure building. However due to the recent crisis in the global community including the war in Ukraine, the war between Israel and Hamas as well as the global supply chain disruption, energy security issue has risen as one of the top priorities in the national energy policy. Nuclear power is getting more attention in this context, and thus a policy change is expected in the near future.

3.2.1 Subsidy programs for PV installation

<Subsidy for Residential Installation>

This program was launched in 2004 that merged the previous 100 000 rooftop PV system installation program. In general, single-family houses and multi-family houses including apartments can benefit from this program. The KEA provides part of the initial PV system cost for single-family and private multi-family houses. The maximum PV capacity allowed for a single-family household is 3 kW, and for multi-family houses it is 30 kW. The subsidy amount is different for the type of modules (general vs. low-carbon module) used in the installation.

<Subsidy for Building Installation>

The KEA supports part of the installation cost for PV systems (below 200 kW) in buildings for commercial use. In addition, the KEA supports maximum 80% of initial cost for special purpose demonstration and pre-planned systems in order to help the developed technologies and systems to diffuse well into the market. BIPV system is prioritized in the subsidy evaluation.

<Subsidy for NRE Infrastructure Expansion>

The KEA supports up to 50% of the project cost for PV systems in local government owned buildings, facilities and welfare facilities. In the case of BIPV, up to 70% of the installation cost is supported by KEA. This subsidy scheme is designed to facilitate strengthening the local government's ability to manage the energy supply and demand system as well as development of regional economy through deployment of region-specific and eco-friendly NRE systems.

<Subsidy for Hybrid Installation>

This is a new NRE subsidy program started in 2013. A consortium led either by local authority or public institution with NRE manufacturing companies and individuals can apply for this program. The program is designed to help diffuse the NRE into socially disadvantaged and vulnerable regions and classes such as islands, remote areas (not connected to the grid), long-term rental housing district, etc. Local adaptability is one of the most important criteria for this program, and thus, the optimal integration of various NRE resources (PV, wind, electricity and heat) and the complex between areas (home, business and public) are primarily considered to benefit from this program. The KEA supports up to 50% of the total project cost and up 70% of curtain wall type vertical BIPV systems.

<Solar Lease Program>

In 2013, MOTIE (through KEA) introduced this new scheme to promote PV deployment and launched a few demo projects for 60 detached houses. The Solar Lease program fully began in 2014, and it is designed in such a way that the private companies take care of installations and maintenance without support from the Government, while consumers pay the leasing fee. Household owners of using more than 200 kWh/month (monthly average in the recent one-year period) can apply for this program. Owners pay PV system leasing fee (monthly maximum: 35 000 KRW) for minimum 7 years and can use the PV system with no initial investment and O&M cost for the leasing period. PV leasing companies recover the investment by earning PV leasing fee from the households and selling REP (Renewable Energy Point) to RPS obligators with no multiplier. Leasing fee, lease period and REP price are properly set to motivate the participation of PV leasing companies and consumers. The maximum PV capacity allowed for a household is 3 kW for houses of consuming 200~599 kWh electricity monthly average and maximum 9 kW for houses of consuming 600 kWh or higher electricity monthly average. But unfortunately, this program was terminated in 2021F due to poor economic feasibility.

3.2.2 Incentive and obligatory programs for PV installation

<Capital Subsidy (NRE Loan) Program>

This program is aimed at tackling the up-front cost barrier, either for specific equipment for NRE use or facilities for NRE products. The KEA evaluates the proposal from the companies and provide the financing fund to participating financial institutions such as banks, and the

participating banks lend money (up to 90% of the necessary fund) to the companies with low interest rate (variable in quarters), grace period option (1 to 5 years) and amortization option (2 to 10 years). This subsidy loan can be used for financing facilities (purchase, installation, upgrade, etc.), production funds as well as the working capital. However, the budget for this program in 2024 will be reduced by 21.0% compared to that of 2023.

<NRE Loan Program for Residents' Participation>

This program is designed to loan a funding at relatively low interest rate to the local residents who participate in solar power generation business. Up to 20 billion KRW (and up to 90% of the project cost) can be loaned to the resident with 20 years grace period.

<Green Guarantee Program>

This program is designed to strengthen technological competitiveness in the field of NRE by supporting companies with technological capabilities but unable to receive bank loans due to lack of credit and collateral through green guarantees. Korea Credit Guarantee Fund and Korea Technology Finance Corporation are participating in this program.

<RPS Program for Power Businesses>

The RPS is a mandated requirement that the electricity utility business sources a portion of their electricity supplies from renewable energies. In Korea, 25 obligators (electricity utility companies with electricity generation capacity of 500 MW or above) as of April, 2023 are required to supply 13% of their electricity from NRE sources by 2023, starting from 2% in 2012. The PV set-aside requirement was set to be 1,5 GW by 2015, and the goal was surpassed. In 2022 alone, 2 825 MW was installed under this program (86.2% of the total installation). The RPS has been the major driving force for PV installations in the last 10 years in Korea with improved details such as boosting small-scale installations (for systems less than 100 kW size) by adjusting the REC and multipliers and unifying the PV and non-PV markets. To further enhance the predictability of profit (to attract project financing entities), Government launched a new long-term (max. 20 years) fixed price (SMP+REC) RPS scheme in 2017. This scheme has an advantage of guaranteeing the long-term power purchase with a fixed price which is determined by the market-following system including the competitive bidding. The fixed price of the first half of 2022 was 155 KRW/kWh. To facilitate the involvement of local communities, Government also launched a new REC multiplier scheme, in which maximum 20% increase in REC multiplier when community residents are involved in the projects. Grid connection of PV systems is guaranteed up to 1 MW by the Government since 2017, but due to the grid interconnection issues recently developed in Korea the grid connection guarantee scheme will soon be terminated. The adjusted REC multiplier scheme based on five evaluation criteria (economic feasibility, environmental effect, potential, industry promotion effect, and policy priority) is summarized below.

[REC Multipliers in RPS]

Multiplier	Eligible Energy Sources	
	Installation Type	Details
1,2	On land (general)	Smaller than 100 kW
1,0		100 kW ~ 3 000 kW
0,8		Larger than 3 000 kW
0,5	On forestland	Regardless of capacities

1,5	On building or existing facilities	Smaller than or equal to 3 000 kW
1,0		Larger than 3 000 kW
1,6	Floating on the water surface	Smaller than 100 kW
1,4		100 kW ~ 3 000 kW
1,2		Larger than 3 000 kW
1,0	Self-use PV electricity transaction	

<Korean-type Feed in Tariff (FiT)>

To improve the bankability of small-scale distributed PV system installations, a new temporary (5 years for the period of 2018-2022) subsidy measure was introduced in 2018. A fixed contract price (for maximum 20 years) will be provided through bidding for systems less than 100 kW, and the price will be the sum of SMP and REC. This program was terminated in July, 2023.

<NRE Mandatory Use for Public Buildings>

The new buildings or renovated buildings of public institutions, the floor area of which exceeds 1,000 m^2, are obliged by the law to use more than 32% (in 2023) of their total expected energy from newly installed renewable energy resources. Public institutions include state administrative bodies, local autonomous entities, and state-run companies and institutions. The building energy mandate percentage will increase up to 30% by 2020 and 40% by 2030.

3.2.3 BIPV development measures

The KEA supports up to 70% of the installation cost for BIPV systems in public owned buildings with the size greater than 500 m^2, facilities and welfare facilities. This support scheme will be extended to private owned buildings with the size greater than 1 000 m^2 from the year 2025.

<Accreditation of Zero-energy Buildings>

The Ministry of Trade, Industry & Energy (MOTIE) and the Ministry of Land, Infrastructure & Transport (MOLIT) together operate this measure by the 'Green Building Construction Support Law.' Central government administration institutions, local governments, public institutions, provincial/municipal office of educations are obliged to get accredited for zero-energy for the buildings with the floor area greater than 1 000 m^2 since 2020. Incentives for the accreditation include mitigation in construction constraints by 15% (floor area ratio to height), 15% reduction in acquisition tax, 15% mitigation in infrastructure facility donation requirement, prioritized subsidy for NRE installations, enlargement of loan limit for public rent/parcel out, long-term low-interest loans for the investment in energy saving facilities. The MOLIT has a plan to make the nearly ZEB as a mandatary requirement for all new buildings with the size greater than 500 m^2 from 2030.

3.3 Self-consumption measures

Self-consumption measures are implemented as previously described “Subsidy for Residential Installation’ and ‘Subsidy for Building Installation’ in Korea.

3.4 Collective self-consumption, community solar and similar measures

Collective self-consumption, community solar and similar measures are implemented in the existing subsidy schemes described above. No other special new measures are not introduced yet.

In Korea, community solar is increasing due to the recent announcement by the Government. The new scheme provides maximum 20% increase in REC multiplier when community residents are involved in the projects.

3.5 Tenders, auctions & similar schemes

Tenders, auctions and similar measures are implemented in the existing subsidy schemes described above. No other special new measures are not introduced yet.

<Tenders and Auctions>

Currently Korea's RPS scheme relies on the auction system with upper and lower bound managed by the Government.

<Opening of Negawatt Electricity Market>

Government announced the opening of DRR (Demand Response Resource) electricity trading market as of November 25, 2014 by approving the revision of 'Electricity Trading Market Operating Rules' on October 3, 2014. This so-called 'Negawatt Electricity Market' was launched as one of 'the Six Energy-related New Industry Development Plan for Climate Change Response.' Now new businesses for trading saved electricity are slowly growing since 2016.

3.6 Other utility-scale measures including, floating and agricultural PV

Measures favouring the development of large-scale, ground-mounted, floating PV are currently implemented within the context of RPS scheme in Korea. As described above, the REC weighting factor of 1,5 is given for floating PV. The support scheme for Agri-PV is under legislation status and expected to be legislated in 2024.

<Floating PV Installation>

Floating PV on the lakes is getting popular in Korea (with potential of ~10 GW). In July 2017, Korea Rural Community Corporation conducted a study about South Korea's potential of on-water PV and estimated 3,26 GW from water reservoir (10% of the total reservoir), 2,633 GW from fresh-water lakes (20% of the total) and 73 MW from irrigation and drain channels (2% of the total). In addition, K-Water can utilize 8% of the dams, which sums up to 3,7 GW. Therefore, the total on-water PV potential in Korea is estimated to be about 9,7 GW. Floating PV gets 1,5 REC multipliers under current RPS scheme and thus is quite attractive to the developers. Also, Korean government recently announced 'The 4 GW Saemangeum Project' in the region southwest of the capital city and that includes about 2,8 GW of PV and 1 GW of off-shore wind. The Saemangeum area was originally in the sea, and now it is reclaimed but still many parts are covered by salty water. Thus, the technology developed for floating PV will have more

opportunities to be used in that area but in a salty water situation. Several big projects are currently under construction or planning.

<Agricultural PV Installation>

Agricultural PV (in short Agri-PV) is also getting higher attention, and many demonstration projects are being undertaken by power producing companies collaborating with local authorities. The 3,3 GW by 2022 and 10 GW by 2030 Agri-PV installation is planned by the Government, and congress level legislation process are on the way to facilitate Agri-PV installations and expected to be realized in 2024.

<RE100>

A voluntary campaign (led by CDP Committee) by enterprises with greater than 500 TWh per year electricity consumption towards 100% renewable electricity for company's electricity consumption - total 426 global companies including Google and Apple are currently participating in the RE100 campaign. 36 Korean companies are participating in this campaign as of December, 2023. A demonstration project was initiated in the second half of 2019 for a few Korean companies. Companies can get REGOs through green pricing or direct installations of RE power plants. Government legalized the RE100 measures with the modification of electricity business law to introduce PPAs and then implement this in full-scale later.

3.7 Social Policies

Korean government runs the so-called 'Energy Voucher' system to help the handicapped or vulnerable households to pay the energy bills during the summer and winter periods, but this is not yet aligned with PV installation for the needed households.

3.8 Retroactive measures applied to PV

3.9 Indirect policy issues

3.9.1 Rural electrification measures

Rural electrification measures are adopted and implemented mainly by the local authorities. For example, Incheon city implemented a project, installing PV power of 250 kW, small size (10 kW) wind power of 40 kW, energy storage of 1 125 kW in Backa island, and finished the project at the end of 2014 to make the island carbon-free. Similarly, PV power of 120 kW and wind power of 30 kW were installed in Jungma island, which will provide 388 000 kWh electricity annually. 1 200 kWh size ESS (Energy Storage System) was also installed, and the diesel power is now serving as the supplementary power for the island. These types of measures and programs are being gradually expanded by many other local governments in Korea.

'Carbon-free Island Jeju by 2030 Project' was jointly planned by Jeju provincial government and central government in 2012 and will be expanded to more islands in Korea. Wind power, PV, geothermal, ESS, and EV will be utilized within the smart grid infrastructure to increase the NRE portion in the energy mix for the islands. Jeju island plans to make the island completely fossil free by 2030.

<Eco-friendly Energy Town Program>

A new demo program has been launched by the Korean government (MOTIE, MOE and MSIP) in 2014 for three regions (Gwangju (MOTIE), Hongcheon (MOE) and Jincheon (MSIP)), which is designed to deploy eco-friendly energy generation facilities to the avoiding facilities or sites such as waste incinerators and waste landfill sites. The Korean government has a plan to strengthen and expand this program into the whole nation since 2015 by improving the program details from the lessons learned from these demo programs.

3.9.2 Support for electricity storage and demand response measures

ESS demo project was first launched in 2009, and the early ESS was typically used for frequency regulation purposes. Due to the recent support from the Government since 2016, mainly giving incentives in electricity fare for consumers equipped with ESS system for peak-load reduction, the cumulative ESS installation was remarkably increased in the recent few years (30 MWh in 2013, 206 MWh in 2016, 723 MWh in 2017, and 3 632 MWh in 2018). Consumers can get maximum 50% savings in their electricity use under the current scheme.

However, the market shrank 33.9% in 2019 compared to that of 2018 due to frequent fire incidents and reduced REC weighting factor scheme.

<Support Measures for PV+ESS Installation>

Government provides very attractive REC weighting factor for PV power with ESS system. It is a temporary subsidy, though, giving 5,0 REC weighting factors for 2018 and 2019, and it will be decreased to 4,0 in 2020. Also, self-use PV electricity transactions get 1,0 REC weighting factors. However, the PV+ESS weighting factor bonus was expired in 2020.

3.9.3 Support for electric vehicles (and VIPV)

The Government announced a very aggressive plan to expand the domestic production of eco-friendly vehicles, and the cumulative EVs are 423 551 (337 633 passenger vehicles and 85 918 electric buses) as of 2022F (89 918 vehicles as of 2019). The cumulative hydrogen fuel cell vehicles is 29 623 (29 337 passenger vehicles and 286 commercial vehicles) as of 2022F (5 083 vehicles as of 2019). To achieve these goals, the obligatory purchase percentage of eco-friendly vehicles by public entities will rise to 100% by 2020. Hydrogen taxis are being operated in Seoul as a demonstration and test since 2019. Charging infrastructures for EVs (205 205 as of December, 2022) and hydrogen fuel cell cars (229 as of December, 2022) have been increasing by local governments with support from the central government. Currently this movement in Korea is not directly related with the Vehicle Integrated Photovoltaics (VIPV) development, but automobile companies (Hyundai/Kia) are developing VIPV as an option for eco-friendly vehicles. The first VIPV electric vehicle showed up in 2019 made by Hyundai/Kia.

3.10 Financing and cost of support measures

The cost of PV incentives in Korea is mainly covered by the central and regional governments (tax payers' money). Some costs are covered by the 25 RPS obligators indirectly affecting the electricity prices (Government controls the electricity price).

3.11 Grid integration policies

3.11.1 Grid connection policies

In Korea, grid connection fee for small-scale (< 1 MW) PV installation has benn paid by KEPCO with the policy of unlimited grid connection guarantee for small-size installation since 2017.

However, due to the recently encountered grid congestion problems and KEPCO's financial burden issues, the grid connection guarantee policy will be expired in 2024, and the cost for grid connection will be imposed to the power generation companies. Currently about 2,5 GW of PV systems are on the waiting list of grid connection as of 2022F.

3.11.2 Grid access policies

Please describe briefly grid acces (use of the grid) policies and *how they are currently affecting market development*. Are costs energy or capacity based or a mix? Is grid access a significant part of OPEX costs? Are there curtailment policies ?
Due to the grid congestion problems encountered recently, Government announced the curtailment of PV electricity up to 1,05 GW in 2023 and has actually curtailed the PV electricity several times. The situation is expected to get worse in the near future unless the investment on the transmission and distribution infrastructure is made properly.

4 INDUSTRY

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

Table 15: Silicon feedstock, ingot and wafer producer's production information for 2022

Manufacturers	Process & technology	Total Production	Product destination	Price
OCI*	Silicon feedstock [Tonnes]	4 700	China, Taiwan, Germany, etc.	-

*OCI is the only company in Korea producing polysilicon, and it's total production capacity is 39 700 tonnes including 35 000 tonnes in Malaysia.

OCI stopped its solar-grade polysilicon production in Korea since 2020, and the Korean plant is only producing polysilicon for semiconductor industry with the capacity of 4 700 tonnes. All solar-grade polysilicon is produced in Malaysia.

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

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

Total PV cell and module manufacture together with production capacity information is summarised in Table below.

Table 16: PV cell and module production and production capacity information for 2022

Cell/Module manufacturer	Technology	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
Hyundai Energy Solution	sc-Si	520	1120	650	1400
Shinsung ENG	sc-Si / mc-Si	0	640	0	800
S-Energy	sc-Si / mc-Si	0	320	0	400
HanSol Technics	sc-Si / mc-Si	0	400	0	500
SDN	sc-Si / mc-Si	0	320	0	400
JSPV	sc-Si / mc-Si	0	400	0	500

Topsun	sc-Si / mc-Si	0	120	0	150
Solarriver	sc-Si / mc-Si	0	16	0	20
Solar Flex	sc-Si / mc-Si	4	4	5	5
SDPV	sc-Si / mc-Si	0	240	0	300
Korea Eco-friendly Energy Technology	sc-Si / mc-Si	0	80	0	100
Hanwha Solution	sc-Si / mc-Si	3600	2320	4500	2900
Thin film manufacturers					
Manufactory 5		x	x	y	y
Manufactory 6					
Cells for concentration					
Manufactory 7		g		h	
Totals		**4124**	**5980**	**5155**	**7475**

LG Electronics stopped its solar business as of June, 2022 due to deteriorating business environment and disappeared from the company list in Table 18.

Hanwha Solution's China plant has the additional capacity of 3 200 MW cells and 3 900 MW modules, and its Malaysian plant has the additional capacity of 2 300 MW cells and 2 300 MW modules. Hanwha opened a new US plant with the capacity of 1 700 MW modules. Hanwha Solution has a plan to construct the 'Solar Hub' in Georgia, U.S.A. investing ~2.46 Bill. USD to establish an integrated production of ingot/wafer/cell/module. The capacities are 3.3 GW each for ingot, wafer, cell and module. Its existing 1.7 GW module production will be increased to 5.1 GW by the end of 2023, which will make US module production to 8.4 MW.

OCI's US PV module factory (Mission Solar Energy) has a plan to expand its module production capacity from 210 MW to 1 GW by the end of 2023, investing 40 Mill. USD.

Korean players have been pursuing the technological edge of premium solar cells and modules, incorporating diverse technical approaches such as n-type mono wafer, PERC (Passivated Emitter and Rear Contact) process, half-cell technology and bifacial modules. They are also developing the perovskite-silicon tandem solar cells.

4.3 Manufacturers and suppliers of other components

<PV Inverters (for Grid-connection and Stand-alone Systems) and their Typical Prices>

As the volume of Korean PV market increases, many foreign inverter players like Chinese companies and European makers have been breaking into Korean PV market by establishing sales points and service networks in Korea.

On the other hand, Korean government is tightening up the criteria of safety standards related with inverters. It is due to the increasing fire accidents and O&M troubles connected with the inverters.

<Storage Batteries>

In Korea, PV systems combined with ESS were previously spotlighted, because the system has been awarded with higher subsidies, multiplied REC (Renewable Energy Certificate) values. However, the systems combining PV and ESS recently suffered from many unspecified fire accidents. It hindered developers from investing in PV systems combined with ESS, because there were not clear clues.

Korean government has a plan to revitalize ESS industry to mitigate the intermittency of renewable power into the grid.

<BIPV Products>

Due to increased subsidy measures for BIPV installations and policy for the accreditation of zero-energy buildings, BIPV market in Korea is expected to grow up to 887 billion KRW by 2030 (230 billion KRW as of 2023), and many companies, especially some of the major construction companies, are expanding their business into the BIPV. Kolon Global, Hyundai Construction and SK Ecoplant are the major players coming into the BIPV market.

Several companies including the start-ups are developing various types of BIPV products with much improved aesthetic appearance and colors.

5 PV IN THE ECONOMY

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

5.1 Labour places

Table 17: Estimated PV-related full-time labour places in 2022

Market category	Number of full-time labour places
Research and development (not including companies)	-
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	6 375
Distributors of PV products and installations	11 815
Other (PV power generation businesses)	141 826
Total	**160 016**

5.2 Business value

Table 18: Rough estimation of the value of the PV business in 2022 (VAT is excluded)

Sub-market	Capacity installed [MW]	Average price [KRW/W]	Value	Sub-market
Off-grid				
Grid-connected distributed	453	1 483	671 799 000 000	671 799 000 000
Grid-connected centralized	2 825	1 325	3 743 125 000 000	3 743 125 000 000
Value of PV business in 2022*				**4 414 924 000 000**

*Annual sales amount of solar energy generation materials and equipment manufacturing in 2022 was estimated to be 8 619,4 Billion KRW including sales from overseas factories; Annual sales amount of solar energy power generation facility construction was 5 009,1 Billion KRW including sales from overseas operation; Annual sales amount of solar energy power generation business was 7 980,4 Billion KRW including overseas operation.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

The electricity industry landscape in Korea can be summarized as below:

Structure - vertically integrated structure

Retailers and network businesses - integrated (monopoly)

Ownership - public ownership (government owned)

Electricity industry regulator - regulated by the central government

6.2 Interest from electricity utility businesses

Since 2012 the RPS scheme started and replaced the FiT which lasted until 2011. Total 25 companies including electricity generation companies, electricity generation business companies and other corporates which have the electricity generation capacity greater than 500 MW have participated the RPS scheme mandatorily. In 2012, only 64.7% of the first year's RPS duties were attained, while 95.7% of RPS PV set-aside amounts were attained. This caused the cost of REC (Renewable Energy Credit) for PV to drop significantly together with the fast-falling PV product prices. The electricity utility businesses preferred to have more PV to replace the non-PV RPS to lower the cost and fulfil their duties. In March 2016, PV REC market and non-PV REC were merged into one. After the market merger, the annual average REC price increased from 92 638 KRW/MWh in 2015 to 144 136 KRW/MWh in 2016. In 2017, 92.9% of the duties was attained, supplying 17 626 GWh (duties: 18 975 GWh). The REC price was also stabilized down to average 131 000 KRW/kW. However, since the previous government announced the RE3020 plan in 2017 and incentivized PV installations, due to oversupply of PV systems with ever-decreasing PV system cost, the REC price has fallen very rapidly in the recent years.

In the RPS scheme, REC weighting factor is introduced to balance the utilization/dissemination and promotion of technology development. In determining the PV REC weighting factors, considerations were given to address the following five criteria: 1. Influence on environment, 2. Technology development and industry vitalization, 3. Cost in electricity generation, 4. Potential amount, and 5. Policy priority. In practice, however, there exist some mismatches and conflicts to hinder the RPS participants from fulfilling their duties. Some regions with large PV potential have either low REC weighting factor or under strict regulation. The first year's RPS practice revealed many of these problems. Thus, Korean government simplified the REC weighting factor scheme in 2014, and minor adjustments were made from time to time to reflect the issues arising from implementation in the last 10 years.

Electricity utility businesses in general were originally hesitant to participate aggressively in the PV deployment, asking for more support from the Government. However, since the start of previous government in 2017 and due to the RE3020 plan, electricity utility businesses started to actively engage in PV deployment. Large-scale PV deployment projects were being announced competitively by the electricity utility businesses. Especially, the 4 GW Saemangeum project that includes about 2,8 GW of PV and 1 GW of off-shore wind was a milestone to drive the electricity utility businesses more into participating in the PV installations.

Solar lease program (third party ownership) was introduced in 2014, and grew fast in the following years. A so-called "Negawatt" market was also introduced in 2014 and has been fully

operational. This is an electricity trade scheme not on a production or supply basis but on a saving and peak time trading basis.

KEPCO, the largest and only electricity business company in Korea, participated in many PV related activities including "Energy-independent Islands Project" and "Korea Smart-grid Project." Especially after the announcement of "RE3020 Plan," KEPCO started to more actively engage in various PV development and dissemination projects. Most of the KEPCO's subsidiary companies such as KHNP (Korea Hydro and Nuclear Power Co., Ltd.), KOEN, KOMIPO, KOSPO, EWP, KOWEPO also began to participate in RE deployment including many large-scale PV installations.

K-water, which owns large hydro-dams in Korea, started to pursue several Floating PV (FPV) projects in Korea and has a plan of installing total 10 GW of FPV.

However, this very speedy deployment of PV systems without improving the infrastructure to accommodate the RE power, especially in the grid infrastructure, caused several issues in grid congestion as well as issues in social acceptance. Due to these and change in geopolitics due to war in Ukraine, energy security issue has risen to the surface of the national energy policy.

Since the start of the current government, regulations on PV development was fortified, curtailment policy has been newly introduced, which affected the financing environment, causing PV development to slow down. Public owned utility companies also began to slow down the PV installation projects.

6.3 Interest from municipalities and local governments

Chungbuk Technopark is located in Cheongju city and actively engaged in PV module (including BIPV) testing and certification. The province is trying to host the KITECH (Korea Institute of Industrial Technology) Chungbuk Branch and building a 'PV Tech Support Center' for region's SMEs.

KIER (Korea Institute of Energy Research), a national laboratory covering all kinds of energy except nuclear energy, is located in the neighboring metropolitan city, Daejeon, and KIER is building PV cell/module development platform in Daejeon to develop the next-generation PV devices including the perovskite/Si tandem cells.

The metropolitan city, Daegu has been advocating "Solar City" as its slogan, and hosting many world-renowned international meetings, conferences and expos. Recently, Daegu hosted "Solar City Congress," and has been regularly hosting IGEEC (International Green Energy Expo and Conference) every year in which PVMI (PV Market Insight) conference was being held regularly as a parallel event. The "22nd World Energy Congress" in 2013, "7th World Water Forum" and "ISES Solar World Congress" in 2015 were also held in Daegu. Daegu city recently announced the 1,5 GW roof-top PV installation project to replace the roofs of factories in Daegu.

Solar Cell/Module RIC (Regional Innovation Centre) and MOTIE-sponsored MW-scale PV Testbed are located in Yeungnam University in the neighboring Gyeongbuk province which also emphasizes Green Energy Industry as its new growth engine industry. Gyeongbuk province launched a project called "Sunlight Energy Farming" in 2015 to secure regular incomes for rural households (relatively disadvantaged from recent Free Trade Agreement (FTA) with foreign countries) using low interest rate fund from provincial government and REC purchasing agreement with KHNP (Korea Hydro & Nuclear Power). Gyeongbuk province also announced the 3 GW roof-top PV installation project in the industrial complexes in the province.

Jeonnam Province selected “NRE Industry” as one of its major leading industries of the region and has invested its resources to promote PV industry development and PV deployment. Jeonnam province has the best insolation in Korea and thus the largest number of PV power plants in Korea. KEPCO, KPX, Honam PV test-bed at Jeonnam Technopark and KITECH (Korea Institute of Industrial Technology) Jeonnam Branch are both located in Jeonnam province and the neighbouring city, Gwangju (meaning ‘Sunshine Village’). GEI (Green Energy Institute) is also located in the neighbouring city, Mokpo. Naju city in Jeonnam province where KEPCO headquarter is located and Korea Institute of Energy Technology (KENTECH) was established in 2021 has a vision to host “Energy Valley Cluster” in the region and is trying to invite several giant national projects in the region. One of the most recent projects hosted from the central government is the world’s first Global Innovation Special Zone for “DC Power Grid Commercialization Platform,”

Jeonbuk Province launched with a strong support from the central government, “the 4 GW Saemangeum RE Project” and has a plan to construct renewable energy industry complex near the Saemangeum area.

Jeju Special Self-governing Province launched the ‘Carbon-free Island Jeju’ project and aims at becoming a 100% carbon-free island by 2030.

Other provinces including Busan metropolitan city (the second largest city in Korea), Gyeonggi province, Ulsan city and Chungnam province also began to be actively engaged in PV deployment and PV related industry development, especially related with PPA project aiming at providing friendly environment for RE100 campaign of the enterprises.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

Since "The Renewable Portfolio Standards" (RPS) replaced the Korean FiT at the end of 2011, the Korean PV market followed an upward trend that stabilized around the 3-4 GW mark, but due to the challenges encountered such as grid congestion and social acceptance together with reemphasis on the energy security, PV installation in Korea has begun to decrease since 2020. Korea installed 3 278 MW in 2022, after having installed 3 915 MW in 2021.

Utility-scale PV plants accounted for around 2 825 MW of the installed capacity in 2022. Distributed PV systems amounted to around 13,6% of the total cumulative capacity. The share of off-grid PV systems has continued to decrease and represents less than 1% of the total cumulative installed PV capacity. At the end of 2022, the total installed capacity reached ~24,4 GW. PV contributed to ~4,9% of the total electricity consumption in 2022.

Various incentives have been used to support PV development. The RPS scheme launched in 2012 has been the major driving force for PV installations in Korea, with improved details such as boosting the small-scale installations (less than 100 kW size) by adjusting the REC and multipliers, and unifying the PV and non-PV markets. Although some changes are expected to be made in the existing incentives and policies, PV will remain as the most important renewable power source in Korea due to the carbon neutralization plan by 2050. About 60-70 GW cumulative PV installation is expected by 2036, which means at least annual ~3 GW PV installations.

Korean PV industry, once established the complete value chain for crystalline silicon solar cells from raw materials (polysilicon), ingot and wafers, cells, modules, systems and to power plants, has recently experienced hard times due to China's dominance in all the PV value chain sectors and some of the major PV companies stopped its PV businesses. LG Electronics stopped its PV business in 2022, and OCI moved all its polysilicon production facilities to Malaysia, for example. Hanwha Solution is still holding its silicon solar cell and module business in the global arena and aggressively entering into to US market with IRA incentives. However, Hanwha is also shrinking its production in Korea due to the decrease in domestic market. Korea cell players have been pursuing the technological edge of premium solar cell and module incorporating diverse technical approaches such as n-type mono wafer, PERC (Passivated Emitter and Rear Contact) process, half-cell technology and bifacial modules as well as developing perovskite/Si tandem solar cells.

7.2 Prospects

Based on the "10th Electricity Demand & Supply Plan" released on January, 2023, cumulative solar PV is expected to be 46,5 GW by 2030, and 65,7 GW by 2036. Although there can be slight changes made in the cumulative PV installation target due to the upcoming "11th Electricity Demand & Supply Plan" in 2024, annual ~3 GW PV installations are expected in the upcoming years. PV manufacturing, however, is expected to be more active in overseas operations due to beneficial business environment in countries like USA and Malaysia.