Technology Collaboration Programme
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International Energy Agency
Photovoltaic Power Systems Programme

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in Italy

2022

GSE Gestore Servizi Energetici
RSE Ricerca Sistema Energetico
ENEA
ELETTRICITÀ FUTURA imprese elettriche italiane

What is IEA PVPS TCP?

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

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

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

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What is IEA PVPS Task 1?

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2022. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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COVER PICTURE

Source: Catalogue of Photovoltaic Plants Integrated with Innovative Characteristics, Gestore dei Servizi Energetici, GSE

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ACKNOWLEDGEMENTS

This report received valuable contributions from several stakeholders and experts of Italian photovoltaic (hereafter, PV) market: entrepreneurs, manufacturers of PV modules and other components, installers, Architecture School University IUAV of Venice, Nomisma Energia, and others. They all provided data and views included in this report. Many thanks to all of them.

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

Italy in 2022 had a significant growth of PV installations, with almost 2,5 GW of new capacity for a number of around 210.000 plants (see note 5 of table 1 and 2). The number and the capacity of plants installed during 2022 are the highest values observed in the last 9 years.

Total commissioned capacity at the end of 2022 is around 25 GW. Ground plants represent a percentage of 34% of the total capacity.

Small plants with a capacity below 20 kW represent around 93% of the total installed plants and 26% in terms of power, while 20% of the capacity installed in 2022 consists of plants larger than 1 MW. The average capacity of the plants installed in 2022 is 11,8 kW. At the end of 2022, the national power per capita is 415 W per inhabitant, an increase of about 41 W compared to 2021.

Most of PV plants installed in Italy (1.199.756 out of a total of 1.225.431, a percentage of 97,9%) are connected to the low voltage distribution grid, while 25.530 plants are connected to the medium voltage grid, representing the 51,7% of total existing capacity. Only a small number of PV installations are connected to the high voltage grid, with a capacity of around 1.907 MW equal to a percentage of 7,6% of the total one.

At the end of 2022, a percentage of 30,9% of the plants in installed in two regions of the north, Lombardy and Veneto. The national record in terms of installed power is recorded in Lombardy (3,15 GW), which for the first time exceeds Apulia (3,05 GW), in the south of Italy, where many ground plants installations have grown during past FiT Law.

PV electricity production reached 28.121 GWh, of which around 4.727 GWh is generated by domestic sector (with a capacity equal to 4.925 MW), 5.250 GWh by the tertiary sector (with a capacity of 4.937 MW), 3.012 GWh by the agricultural sector (2.651 MW) and 15.132 GWh by the industrial sector (12.552 MW).

In 2022 self-consumption equal to 6.227 GWh, equivalent to a percentage of 22,5% of the total PV production and to the 49% of the PV production of plants under self-consumption scheme.

Polycrystalline silicon PV modules are installed on 65% of the existing capacity, monocrystalline silicon modules on 30% and thin film modules or other materials (which include a-Si, CIS, CdTe) on 5%. Thin-film technology is installed mostly in south of Italy, while the highest percentage of monocrystalline modules is installed regions and/or provinces in the north of Italy.

At the end of 2022 the cumulative number of storage systems installed, mainly in regions with a high number of plants, is equal to 230.496.

1.2 Total photovoltaic power installed

Table 1: Annual PV power installed during calendar year 2022 (1) (2)

		Installed PV capacity in 2022 [MW]	AC or DC
	Decentralized (3)	2.022	DC
	Centralized (4)	448	DC
	Off-grid		
	Total	**2.470** (5)	**DC**

[1] *Source: GSE*

[2] *Blank box stands for not available data*

[3] *Any PV installation which is embedded into a customer's premises (self-consumption)*

[4] *Any PV installation which only injects electricity and is not associated with a consumer (no self-consumption)*

[5] ***The value indicated in the table results from the difference between the value at the end of 2022 less the value of 2021. It is important to point out that actual installed capacity in 2022 is equal to 2.490 MW, due to decommissioning and statistic power update***

Table 2: PV power installed during calendar year 2022 (1) (2)

			Installed PV capacity [MW]	Installed PV capacity [MW]	AC or DC
Grid-connected	BAPV (3)	Residential	2.106	1.191	DC
		Commercial		306	DC
		Industrial		609	DC
	BIPV (4)	Residential			
		Commercial			
		Industrial			
	Utility-scale	Ground-mounted	363	361	DC
		Floating			
		Agricultural		2	DC
Off-grid		Residential			
		Other			
		Hybrid systems			
Total			**2.470** (5)		**DC**

[1] *Source: GSE*

[2] *Blank box stands for not available data*

[3] *Building Applied Photovoltaic*

[4] *Building Integrated Photovoltaic*

[5] ***The value indicated in the table results from the difference between the value at the end of 2022 less the value of 2021. It is important to point out that actual installed capacity in 2022 is equal to 2.490 MW, due to decommissioning and statistic power update***

Table 3: Data collection process

If data are reported in AC, please mention a conversion coefficient to estimate DC installations	Data refer to the sum of PV nominal power
Is the collection process done by an official body or a private company/Association?	Public body for statistical data: GSE
Link to official statistics	www.gse.it www.terna.it www.arera.it

Table 4: The cumulative installed PV power in 4 sub-markets (1) (2)

Year	Off-grid [MW] (including large hybrids)	Grid-connected distributed [MW] (BAPV, BIPV)	Grid-connected centralized [MW] (Ground, floating, agricultural…)	Total [MW]
2019		13.021	7.844	20.865
2020		13.656	7.994	21.650
2021		14.546	8.048	22.594
2022		16.661	8.403	25.064

[1]*Source: GSE, TERNA*

[2] *Blank box stands for not available data*

Table 5: Other PV market information (1) (2)

	2022		
Number of PV systems in operation in your country	1.225.431	Residential Commercial Industrial Utility scale	1.005.110 97.449 105.709 17.163
Decommissioned PV systems during the year [MW]	20		
Repowered PV systems during the year [MW]			

[1]*Source: GSE*

[2] *Blank box stands for not available data*

Table 6: PV power and the broader national energy market

	Data	Year
Total power generation capacities [GW]	123.342	2022
Total renewable power generation capacities (including hydropower) [GW]	61.055	
Total electricity demand [TWh]	316,8[1]	
New power generation capacities installed [GW]	3,56	
New renewable power generation capacities (including hydropower) [GW]	3,08	
Total PV electricity production (including self-consumed PV electricity) [TWh]	28,1	
Total PV electricity production as a % of total electricity consumption	8,87%	
Average yield of PV installations [kWh/kWp]	1.191	

[1]*TERNA estimate*

1.3 Key enablers of PV development

Table 7: Information on key enablers, 2022 (1)

	Annual Value[2]	Total Value	Source
Decentralized storage systems (number)	155.176	230.496	GSE, TERNA
Residential heat pumps (number)			
Electric cars, BEV (number)	40.097	158.131	www.aci.it
Electric cars, PHEV (number)	64.632	178.879	www.aci.it
Electric buses and trucks (number)	3.833	13.786	www.aci.it
- of which buses	94	838	www.aci.it
- of which trucks	3.739	12.948	www.aci.it

[1] *Blank box stands for not available data*

[2] *Data obtained as difference between the total fleet in 2022 and total fleet 2021*

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 8: Typical module prices [€/W] (1) (2)

Year	Lowest price of a standard module crystalline silicon	Highest price of a standard module crystalline silicon	Typical price of a standard module crystalline silicon
2009	2,30		2,50
2010	1,50		1,70
2011	1,20		1,50
2012	0,70		0,80
2013	0,50		0,60
2014	0,50	0,80	0,55
2015	0,50	0,75	0,55
2016	0,40	0,65	0,48
2017	0,32	0,56	0,40
2018	0,20	0,48	0,35
2019	0,18	0,45	0,29
2020	0,16	0,44	0,30
2021	0,20	0,52	0,38
2022		0,54	0,45

[1] *GSE specific survey*

[2] *Blank box stands for not available data*

2.2 System prices

Table 9: Turnkey PV system prices of different typical PV systems in 2022 (1) (2) (3)

Category/Size	Typical applications and brief details	[€/W]
Residential BAPV < 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.	1,30 – 1,80
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.	1,25 – 1,50
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.	1,15 – 1,40
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	0,90 – 1,20
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] *GSE specific survey*

[2] *Excluding VAT*

[3] *Blank box stands for not available data*

Table 10: National trends in system prices for different applications [€/W][(1) (2) (3)]

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system < 10 kW	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10-100 kW	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100-250 kW	Centralized PV Grid-connected, ground-mounted, centralized PV systems 10-50 MW
2011	3,60		2,70	2,80
2012	2,60		1,80	1,70
2013	2,20		1,40	1,20
2014	1,67		1,40	1,03
2015	1,60		1,32	0,96
2016	1,55		1,22	0,88
2017	1,44		1,10	0,80
2018	1,41	1,20	1,08	0,69
2019	1,34	1,15	1,00	0,63
2020	1,33	1,15	1,00	0,62
2021	1,44	1,36	1,10	0,71
2022	1,60	1,42	1,28	

[1] *GSE specific survey*

[2] *Excluding VAT*

[3] *Blank box stands for not available data*

2.3 Cost breakdown of PV installations

Table 11: Cost breakdown for a grid-connected roof-mounted, distributed residential PV system of <10 kW, 2022 (1)

Cost category	Average (€/kW)	Low (€/kW)	High (€/kW)
Hardware			
Module	0,49	0,42	0,54
Inverter	0,19	0,18	0,20
Mounting material	0,38	0,29	0,43
Other electronics (cables, etc.)			
Subtotal Hardware	**1,06**	**0,89**	**1,17**
Soft costs			
Planning(2)			
Installation work	0,09	0,07	0,11
Shipping and travel expenses to customer	0,03	0,02	0,03
Permits and commissioning(3)	0,10	0,08	0,11
Project margin	0,32	0,26	0,37
Subtotal Soft costs	**0,54**	**0,43**	**0,62**
Total (excluding VAT)	**1,60**	**1,32**	**1,79**
VAT	10%	10%	10%
Total (including VAT)	**1,76**	**1,45**	**1,97**

1 GSE specific survey

2 Planning cost are included in the other soft costs

3 Including financing

2.4 Merchant PV / PPA

In Italy RES producers can stipulate private PPA but there are not specific regulations or measures that could boost this development.

2.5 Additional Country information

Table 12: Country information

Retail electricity prices for a household [€c/kWh] (1)	36,43
Retail electricity prices for a commercial company [€c/kWh] (2)	32,1 – 58,5
Retail electricity prices for an industrial company [€c/kWh] (3)	34,80
Liberalization of the electricity sector	In Italy, the electricity sector is liberalised. The energy crisis with rising prices that started in 2021 became more intense in 2022 and has already forced the government to postpone to 2024 the mandatory transition to the free market for all citizens (who, however, can already access it voluntarily).

[1, 3] ARERA (Energy Authority) provides a single price the entire sector for 2022, without distinctions for bands of consumption

[2] Nomisma Energia best estimate

3 POLICY FRAMEWORK

Table 13: 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	-	Yes	-
Feed-in premium (above market price)	-	-	-	-	-	-
Capital subsidies (1)	Yes	-	Yes	-	-	-
Green certificates	-	-	-	-	-	-
Renewable portfolio standards with/without PV requirements (2)	-	-	-	-	-	-
Income tax credits	Yes	-	-	-	-	-
Self-consumption (3)	Yes	Yes	Yes	Yes	Yes	-
Net-metering	-	-	-	-	-	-
Net-billing (4)	Yes	-	Yes	-	Yes	-
Collective self-consumption and virtual net-metering (5)	Yes	-	Yes	-	-	-
Sustainable building requirements	Yes	-	Yes	-	-	-
BIPV incentives(6)	-	-	-	-	-	-

[1]*At regional level; most of tenders are for PV on public administration buildings and for small / medium-sized enterprises (SME)*

[2] *No obligations for utilities to obtain a minimum percentage of their power from renewable energy sources*

[3] *On-going measure, real time self-consumption. New measure, collective self-consumption and energy community*

[4] *Up to 500 kW*

[5] *Virtual net metering under some condition (paragraph 3.4)*

[6] *Regional tender(s) for supporting RES integration in public administration buildings*

3.1 National targets for PV

The proposal for an Integrated National Energy and Climate Plan that Italy sent to the European Commission in June 2023, foresees a strong increase of RES electricity share in consumption. The main contribution is expected from PV technology, with a target of

cumulative PV capacity of about 80 GW by 2030 and a corresponding electricity production of about 100 TWh/year.

3.2 Direct support policies for PV installations

Italy in 2009 switched from a net-metering mechanism to a net-billing scheme for systems with a capacity below 500 kW. Electricity fed into the grid is remunerated through an “energy quota” based on electricity market prices and a “service quota” depending on grid services costs. A gradual phase out from net-billing scheme is foreseen. Market prices are applied for the electricity fed into the grid as an alternative to net-billing. Real time self-consumption is allowed for all PV system sizes.

The 2019 decree (MD of July 4th, 2019) aims at supporting energy from new, refurbished and upgraded plants from the following RES: PV (with a capacity over 20 kW), onshore wind, hydro and sewage gas for a total capacity of about 8 GW. Competitive auctions (for capacities over 1 MW) for groups of technologies and registries for smaller plants (with a capacity up to 1 MW), with some competitive elements are foreseen. The support for the plants with a capacity up to 250 kW is a Feed-In Tariff, and over 250 kW a sliding Feed-in Premium, so-called “two-ways mechanism”: the producer receives an incentive equal to the difference between a reference tariff and the hourly zonal price of energy. There are also additional remunerations: for plants installed on buildings (P≤100 kW), on self-consumed energy (if self-consumption exceeds 40% of yearly net production), and for PV plants replacing asbestos.

Tax credit mechanisms are available for small size plants up to 20 kW and for storage devices. A tax credit measure has been introduced in 2020 (so-called Superbonus 110%) for refurbishment of building energy efficiency, installation of PV systems and infrastructures for charging electric vehicles. PV has to be coupled with building energy efficiency intervention in order to access the measure. The aforementioned mechanism, however, is changing, lowering the percentage of state contribution.

An important contribution came from regional policies, such as, i.e., tenders for capital subsidies for PV/BIPV plants, sometimes together with other RES, building energy efficiency interventions, storage systems.

3.2.1 BIPV development measures

In 2022 Lombardy Region set up a regional tender for supporting RES integration in public administration buildings.

3.3 Self-consumption measures

Table 14: Summary of self-consumption regulations, 2022

PV self-consumption	**1**	*Right to self-consume (real time)*	Yes
	2	*Revenues from self-consumed PV*	Savings on the electricity bill
	3	*Charges to finance Transmission, Distribution grids & Renewable Levies*	No
Excess PV electricity	**4**	*Revenues from excess PV electricity injected into the grid*	Net-billing, based on energy and services; indirect sale through a dedicated withdrawal and, in case of collective self-consumption and solar community, an incentive is granted on the shared energy [(1)]
	5	*Maximum timeframe for compensation of fluxes*	Net billing scheme, energy fluxes are calculated on a yearly basis. Collective self-consumption and energy communities, energy fluxes are calculated on an hourly basis (see paragraph 3.4)
	6	*Geographical compensation (virtual self-consumption or metering)*	On site. Meter aggregation and virtual net-billing are allowed for some specific cases, i.e., Municipalities of up to 20.000 inhabitants and the Ministry of Defence. In 2019/2020 a new measure, concerning energy communities, has been introduced for renewable plants with capacity < 200 kW
Other characteristics	**7**	*Regulatory scheme duration*	Real time self-consumption, unlimited. Net-billing is yearly renewed, even if a gradual phase out is foreseen
	8	*Third party ownership accepted*	Yes, with condition
	9	*Grid codes and/or additional taxes/fees impacting the revenues of the prosumer*	None
	10	*Regulations on enablers of self-consumption (storage, DSM…)*	Tax credit for storage, coupled with PV
	11	*PV system size limitations*	Self-consumption, none. Net-billing, up to 500 kW
	12	*Electricity system limitations*	None
	13	*Additional features*	None

[1] Managed by GSE. Concerning sale, the producer may choose between GSE dedicated withdrawal and market sale

3.4 Collective self-consumption, solar community and similar measures

The Italian Parliament approved in 2019/2020 a measure about self-consumption, allowing final consumers/RES producers to group together in order to share electricity locally produced by new RES plants with a capacity ≤ 200 kW. The Decree of 16 September 2020 completed the regulatory framework on energy communities and self-consumers. GSE made available the website to send the preliminary request to access to incentives (alternative to net-billing scheme) foreseen for two categories of prosumers:

- RES consumers acting collectively in a group located in the same building
- RES energy communities

A group of RES self-consumers acting collectively consists of at least two RES self-consumers. The PV plant may be owned and/or managed by a third party.

In the energy community members may be private persons, small and medium-sized enterprises, local or regional public administration authorities. The main features of the RES energy communities are listed below:

- the withdrawal points of consumers participating in the community, as well as the entry points of the related plants, must be located on the LV electricity grids underlying the same MV/LV transformer substation;
- the consumption users included in the community remain connected to the existing public distribution network and they are not physically connected, but virtually;
- relations between consumers are regulated through a private contract by identifying a delegated person responsible for the allocation of shared energy and any other tasks;
- it is possible to exit the configuration at any time, possibly by paying contractual fees.

Two different contributions are granted for 20 years:

- a premium tariff for the shared electricity (100 €/MWh for the group of prosumers, 110 €/MWh for energy communities). The shared electricity is the lowest value, calculated on an hourly basis, between the electricity fed into the grid and the electricity withdrawn from the points of connection;
- a contribution which is the sum of transmission fee and the highest value of the variable distribution component for consumers/loads in low voltage. Moreover, for a group of self-consumers acting collectively, an additional contribution, due for avoided network losses, is granted.

It is also possible to request the withdrawal for the electricity injected to the grid managed by GSE. Moreover, the access to 50% of tax deduction is allowed. For PV plants under 20 kW, in addition, the access to the 110% tax deduction scheme is possible under the condition of not accessing to the premium tariff and of delivering the electricity injected to the grid to GSE.

At the end of 2022 GSE registered 46 RES consumers acting collectively in a group located in the same building and 21 RES energy communities for a total capacity of 1,4 MW. PV represent most of the capacity installed.

Meter aggregation and virtual net-billing are allowed for some specific cases, i.e., Municipalities of up to 20.000 inhabitants and the Ministry of Defence.

3.5 Tenders, auctions & similar schemes

Regional tenders support RES, (building) energy efficiency, storage systems, energy communities and electric vehicles.

For FiT tenders, see paragraph 3.2.

3.6 Other utility-scale measures including floating and agricultural PV

The Law Decree 76/2020 allowed the access to support mechanisms for PV systems built on abandoned/degraded areas even if classified as agricultural. Measures supporting AgriPV and floating PV will be adopted.

3.7 Social Policies

The municipality of Porto Torres (Sardinia region), in cooperation with GSE, introduced in 2017 the so-called reddito energetico, energy income project: the municipality allocated public resources to purchase PV systems, sold on loan to families in energy poverty conditions, to benefit them from PV self-consumption, reducing their energy bills. The revenues of the net-billing feed a public fund, in order to support the purchase of PV plants for other families.

After this pilot project, many other municipalities and regions are carrying out similar support mechanism.

3.8 Retroactive measures applied to PV

Law 116/2014 defined procedures related to incentives granted to electricity produced by PV plants under the past Feed-in Laws. From 2015, tariffs for plants with a capacity over 200 kW were adjusted according to different options taking into account tariffs reduction or a longer period of incentive scheme.

3.9 Indirect policy issues

Administrative simplifications have been introduced for RES plants authorizations (Legislative Decree 77/2021, Legislative Decree 199/2021), as it follows:

- simplified procedures for large plants in the suitable areas are foreseen in compliance with regions, together with the extension to different categories of large plants (up to 20 MW for PV systems built in particular sites, up to 10 MW in suitable areas and for agricultural plants and floating), and with modification of the environmental integrated authorization criteria (capacity increased to 10 MW);
- simplified procedure for small BIPV plants increased up to 50 kW.

3.9.1 Rural electrification measures

The decree of February 14, 2017 grants subsidies to electric RES and thermal plants in small Italian geographical islands not connected to the mainland electricity grid, with an area greater than 1 km^2, located more than 1 km from the continent and with a resident population of at least 50 people.

The mechanism foresees a 20 years feed-in tariff for the electricity fed into the grid (GSE is also in charge for withdrawal and for the sale the electricity on the market). For self-consumed electricity (real-time consumption) a feed-in premium is applied. Moreover, a bonus for PV replacing asbestos is foreseen.

This support is alternative to the net-billing scheme, or dedicated withdrawal, or other public incentives.

The so-called Agrisolar Park is foreseen in the National Recovery and Resilience Plan (NRRP), aiming to support PV plants on building roofs in the agricultural and agro-industrial sector. The resources allocated by NRRP for Agrisolar plants are 1,5 billion € for PV on the roofs of building and greenhouses of agricultural businesses (agricultural and agri-food). Moreover, the improvement of the building energy efficiency (i.e, thermal insulation of the roof, ventilation system) and the disposal of asbestos are also supported (coupled with PV). The PV capacity foreseen by Decree to access to the measure is between 6 and 500 kW. Storage capacity, if any, can also be supported. GSE grants a capital support according to different businesses, related to eligible costs and according to other parameters.

3.9.2 Support for electricity storage and demand response measures

In 2022, 155.176 storage systems were installed in Italy for a total number of 230.496. Storage systems are mainly concentrated in regions with a high number of installations. As a matter of fact, around 45% of the systems is concentrated in three regions of the North of Italy.

Tax deduction for storage (mainly) coupled with PV plants is in force.

3.9.3 Support for encouraging social acceptance of PV systems

After the booming market of the past FiT Law, which allowed the installations of around 18 GW of capacity, an increasing opposition from population and local authorities is reported, mostly for ground plants. Given the recent energy crisis, demand and social acceptance for small plants is increased.

Few superintendencies showed interest for BIPV in 2022, in order to integrate PV in Italian historical centers.

The new legislation on energy communities, which will allow them to be created considering large areas, will constitute a further element in favor of the social acceptability of the plants.

3.10 Financing and cost of support measures

The cost of the incentives for the Feed-in Tariff / Feed-in Premium is covered by a component of the electricity tariff paid by all final electricity consumers. The economic resources for the RES decree of July 4, 2019 are covered in the same way. In 2021, the cost of incentives for photovoltaics stood at 7,2 billion euros (data for 2022 are not yet available)

3.11 Grid integration policies

3.11.1 Grid connection policies

The regulation of grid connections is under revision in order to simplify the procedures currently in force. A consultation is underway concerning the regulation (TICA, Testo Integrato Connessioni Attive) by the Energy Authority (ARERA). Connection costs are covered by the producers on the basis of tariffs defined by ARERA. The approval of connections depends on several factors, such as: high or medium/low voltage grid connection, TSO (longer timeframe) or DSO (shorter timeframe) decisions, construction permitting (this may lead to significant delays).

3.11.2 Grid access policies

The regulation of the connections is composite; the above-mentioned consultation aims to simplify the procedures.

4 INDUSTRY

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

Information on Italian manufacturers of PV cells and modules for the production year 2022 is summarised in the Table 15. The list includes the manufacturers who answered to RSE survey, and those for whom the information was available and updated on the company website.

Table 15: PV cell and module production, production capacity information for 2022 [1] [2]

Cell/Module manufacturer	Technology	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
Eclipse Italia	sc-Si, mc-Si, a-Si	0	42,00	0	200,00
EXE s.r.l.	mc-Si	0	0	0	100,00
Enel Green Power SpA – 3SUN	Si-HJT			200,00	200,00 [3]
FuturaSun [3] [4]	sc-Si, mc-Si	0	0	0	
Gruppo STG	sc-Si, mc-Si	0	6,06	0	26,00
Trienergia srl	sc-Si, mc-Si	0		0	24,00
Total			**48,06**	**200,00**	**550,00**

[1] *RSE specific survey*

[2] *Blank box stands for not available data*

[3] *Gigafactory process started, not yet completed*

[4] *Italian company with production plants in Asia*

The Italian PV industry includes companies with expertise in specific markets, such as integrated PV(i-PV) in buildings (BIPV or BAPV) or electric mobility (VIPV), aiming to the development of innovative high-efficiency PV module technologies.

In 2022, the total annual production of the reported companies is 48,06 MW, out of a total production capacity of 550,00 MW/year. It should be noted that this production capacity could be higher, as some companies who did not participate in the interview are not included in the list.

However, the market is expected to grow within the next two years. Indeed, a number of Italian companies have recently started the process of setting up gigafactories in Italy. This goes in the same direction of the European target, which aims to reach at least 40% of the Union's needs for the production of strategic zero-emission technologies by 2030.

For example, Enel Green Power (EGP) is investing in a production line of photovoltaic cells and modules with a target of annual capacity of 3 GW by 2024 in its factory in Catania. EGP announced the production of photovoltaic modules in tandem configuration planned for the end of 2025.

Moreover, FuturaSun announced investments in a new gigafactory in Padua to set a photovoltaic module production line with an annual capacity of 2 GW.

This expected growth of photovoltaic manufacturers is considered a positive element for the Italian photovoltaic industry. However, the achievement of new national targets by 2030 – a total installed PV capacity of 80 GW - is expected to bring further positive effects on the Italian photovoltaic industry sector.

It is worth to mention that the Italian Photovoltaic Network for Research, Development and Innovation (ReteIFV) has been launched, promoting collaboration between research centres and PV industry on technological and innovation topics to accelerate energy transition.

4.2 Manufacturers and suppliers of other components

Relevant national PV inverter manufacturers both for small-scale and utility-scale applications are Elettronica Santerno S.p.A, Elpower s.r.l, Borri S.p.A, Fimer S.p.A, Friem S.p.A., Reverberi Enetec s.r.l, Nidec ASI S.p.A., Riello Solar Tech - RPS S.p.A., and Siel S.p.A. In the framework of energy storage systems, also for residential applications, relevant national companies are Aton, Fiamm, Reverberi Enetec, SIEL.

In the field of mounting structures for PV modules, relevant Italian companies specialized in the development of single-axis trackers for PV utility-scale applications are Convert Italia SpA, Comal, AcriGroup srl, REM Tec, RCM Italia srl, Soltigua srl. Among these, Convert Italia SpA, Comal and REM Tec offer tracker systems for agrivoltaic applications.

5 PV IN THE ECONOMY

5.1 Labour places

Table 16: Estimated PV-related full-time labour places in 2022 (1)

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	
Distributors of PV products and installations	
Other	
Total	6.840 (2)

[1] Blank box stands for not available data

[2] GSE estimate. Preliminary data concerning permanent jobs, in terms of FTE (Full Time Equivalent), directly and indirectly related to O&M activities on existing PV plants

5.2 Business value

Table 19: Rough estimation of the value of the PV business in 2022 (VAT is excluded) (1)

Sub-market	Capacity installed [MW]	Average price [€/W]	Value of PV business [Billion €]
Off-grid			
Grid-connected	2.490(2)	1,145	2,85

[1] Blank box stands for not available data

[2] 2.490 MW is the actual installed capacity in 2022 (see note 5 of Table 1 and Table 2)

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Italian electricity sector went through a deep reform over the last 20 years that changed it from a vertically integrated monopolistic structure to a liberalized market. The process started in 1999 but the complete liberalization was decided only in August 2017 and it is expected to be fully completed after 2024, when the tariff system will be eliminated also in the domestic sector. After the energy crisis of 2022, some important changes are likely and the possibility to postpone again after 2024 the full liberalization of the domestic sector due to the sharp rise of electricity tariffs.

The former monopolist Enel still holds relevant market shares in all segments, especially in the domestic sector and in distribution. Enel is a private stock company where the state holds a 24% stake.

Generation, transmission and distribution are separated. Generation is liberalized, and the first six groups industrial companies (Enel, Eni, Edison, A2A, EP Produzione and ENGIE) hold 49.6% in 2022 of the national gross production, while the rest is scattered among several players.

Transmission is a regulated activity conducted by the transmission system operator (TSO) Terna, a stock company with the state holding a 30% stake. Again, also distribution is a regulated activity, where e-distribuzione (Enel group) is the first operator with around 85% market share, followed by the other three major operators (Unareti, Areti, Ireti).

Retail activity is liberalized even if with regulated tariffs for the domestic sector (for customers who decided not to switch to the liberalized market) until 2023. Some companies with activities in production, distribution and retail are former municipalities owned by local authorities.

The Energy Authority (Italian Regulatory Authority for Energy, Networks and Environment, ARERA) was created in 1995 and regulates the electricity sector following directives from the Italian Government and the Parliament.

6.2 Interest from electricity utility businesses

Italian electricity utilities are committed in RES/PV sector and in innovative projects.

6.3 Interest from municipalities and local governments

Public Administration owns 22.078 PV plants at the end of 2022, for a total capacity of around 910 MW. They are strictly involved in the achievement of sustainability goals, given their key role in RES/PV/building energy efficiency projects and in climate issues awareness.

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

All 2022 figures show the important growth of PV market in Italy. The total number of PV plants grew by 20,5% compared to 2021, the cumulative capacity of 10,9% and PV production in 2022 grew by 12,5% compared to 2021. It Is important to highlight that out of around the installed capacity of 2,5 GW, more than 2 GW is installed on buildings (or i.e., shelter, or other) following the booming effects of the new tax deduction scheme and the concerns for the rising energy prices.

As well as in 2021, small plants are mainly defining the Italian PV market, where 75% of the number of commissioned plants have a capacity below 20 kW. Even in the last year, however, large photovoltaic systems were also installed in market parity.

It is worth to mention a secondary market of managing and acquisition of large (incentivized) plants.

7.2 Prospects

In the ambitious target of the Integrated National Energy Climate Plan presented to the European Commission, PV is expected to contribute the most with capacity of around 80 GW by 2030.

New regulations concerning AgriPV and energy communities are expected. They will contribute to the growth of a market that experienced an important increase in 2022.

Administrative simplifications foreseen by decrees will help to address permitting issues.

Italy is the country with the highest concentration of heritage buildings and towns that makes difficult, sometimes, to integrate PV technology. Anyway, in 2022 few superintendencies have shown interest to integrate BIPV products in historical centers.