



Task 1 Strategic PV Analysis and Outreach

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National Survey Report of PV Power Applications in Italy 2023





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 2023. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

Authors

➤ **Main Content: Task 1 participants:** Francesca Tilli (GSE), Giosuè Maugeri, Andrea Danelli (RSE), Simona de Iuliis, Paola Delli Veneri (ENEA) Celeste Mellone (Green Horse Advisory). **Other contributors:** Vincenzo Surace, Alessandro Pellini (GSE), Michele Carli (Green Horse Advisory)

➤ **Data:** GSE, RSE

➤ **Analysis:** Francesca Tilli (GSE), Giosuè Maugeri, Andrea Danelli (RSE), Simona de Iuliis, Paola Delli Veneri (ENEA) Celeste Mellone (Green Horse Advisory)

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COVER PICTURE

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



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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 2023 statistics if the PV modules were installed and connected to the grid between January 1st and December 31st, 2023, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

PV market in Italy in 2023 continued the growth of 2022, with a new capacity installed of 5.209 MW for a number of 371.442 plants commissioned (see note 5 of table 1 and 2).

At the end of 2023 a number of 1.597.447 plants were installed in Italy, for a total capacity of 30.319 MW. Both number and capacity of plants installed in 2023 are the highest values of the last ten years.

Small plants with a capacity below 20 kW represent 94% of the total installed plants at the end of 2023 and 29% in terms of power, while plants with a capacity >1 MW represent around 22% of the total capacity installed. Almost all plants commissioned in 2023 have a capacity <20 kW, representing 43% of the capacity installed in 2023, while plants larger than 1 MW represent about 21% of the power installed during the year. Ground mounted capacity at the end of 2023 is equal to 9.181 MW.

The average capacity of PV plants commissioned in 2023 is 14 kW, while the average cumulative capacity in 2023 is equal to 19 kW. The national power per capita at the end of 2023 is equal to 514 W, an increase of 99 W compared to 2022.

At the end of 2023, a percentage of 56% of the plants installed in Italy is located in the North (48% in terms of capacity), while 17% is installed in the Centre and 27% in the South.

Most of PV plants installed in Italy (1.568.230 out of a total of 1.597.447, a percentage of 98,2%) is connected to the low voltage distribution grid, while 29.055 plants are connected to the medium voltage grid, representing 49% of total existing capacity. Only a small number of plants are connected to the high voltage grid, with a capacity of 2.357 MW, equal to a percentage of 7,8% of total one.

The total PV production in 2023 is equal to 30.711 GWh, of which 6.552 GWh are generated by domestic sector (with a capacity of 7.031 MW), 5.568 GWh by the tertiary sector (5.878 MW), 2.984 GWh by the agricultural sector (2.877 MW) and 15.608 GWh by the industrial sector (14.533 MW).



Electricity produced and self-consumed in 2023 amounted to 7.498 GWh, a value of 24,8% of total systems production and of 48,6% of self-consumption plants production.

1.2 Total photovoltaic power installed

Table 1: Annual PV power installed during calendar year 2023 ^{(1) (2)}

		Installed PV capacity in 2023 [MW]	AC or DC
	Decentralized ⁽³⁾	4.173	DC
	Centralized ⁽⁴⁾	1.083	DC
	Off-grid		
	Total	5.256 ⁽⁵⁾	DC

¹Source: GSE

²Blank box stands for not available data

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

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

⁵The value indicated in the table results from the difference between the value at the end of 2023 and the value of 2022. It is important to point out that actual installed capacity in 2023 is equal to 5.209 MW, due to decommissioning and statistic power update

Table 2: PV power installed during calendar year 2023 ^{(1) (2)}

			Installed PV capacity [MW]	Installed PV capacity [MW]	AC or DC
Grid-connected	BAPV ⁽³⁾	Residential	4.399	2.122	DC
		Commercial		712	DC
		Industrial		1.565	DC
	BIPV ⁽⁴⁾	Residential			
		Commercial			
		Industrial			
	Utility-scale	Ground-mounted	856	775	DC
		Floating		1	DC
		Agricultural		80	DC
Off-grid	Residential				
	Other				
	Hybrid systems				
Total			5.256 ⁽⁵⁾		DC

¹Source: GSE

²Blank box stands for not available data

³Building Applied Photovoltaic. BIPV is included since there are not specific data on BIPV applications

⁴Building Integrated Photovoltaic

⁵The value indicated in the table results from the difference between the value at the end of 2023 and the value of 2022. It is important to point out that actual installed capacity in 2023 is equal to 5.209 MW, due to decommissioning and statistic power update

**Table 3: Data collection process**

<i>If data are reported in AC, please mention a conversion coefficient to estimate DC installations</i>	Data refer to the sum of PV nominal power
<i>Is the collection process done by an official body or a private company/Association?</i>	Public body for statistical data: GSE, TERNA
<i>Link to official statistics</i>	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
2023		21.060	9.259	30.319

¹Source: GSE, TERNA

² Blank box stands for not available data

Table 5: Other PV market information ^{(1) (2)}

	2023		
Number of PV systems in operation in your country	1.597.447	Residential Commercial Industrial Utility scale	1.350.269 111.360 118.484 17.334
Decommissioned PV systems during the year [MW]	9,11		
Repowered PV systems during the year [MW]			

¹Source: 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]	129,0	2023
Total renewable power generation capacities (including hydropower) [GW]	66,7	
Total electricity demand [TWh]	306,1 ⁽¹⁾	
New power generation capacities installed [GW]	5,7	
New renewable power generation capacities (including hydropower) [GW]	5,7	
Total PV electricity production (including self-consumed PV electricity) [TWh]	30,7	
Total PV electricity production as a % of total electricity consumption	10%	
Average yield of PV installations [kWh/kWp]	1.122	

¹ TERNA estimate

1.3 Key enablers of PV development

Table 7: Information on key enablers, 2023 ⁽¹⁾

	Annual Value ⁽²⁾	Total Value	Source
Decentralized storage systems (number)	298.644	536.611	GSE ⁽³⁾
Residential heat pumps (number)			
Electric cars, BEV (number)	61.409	219.540	ACI ⁽⁴⁾
Electric cars, PHEV (number)	66.265	245.144	ACI
Electric buses and trucks (number)	6.047	19.833	ACI
- of which buses	452	1.290	ACI
- of which trucks	5.595	18.543	ACI

¹ Blank box stands for not available data

² Data obtained as difference between the total fleet in 2023 and total fleet 2022

³ Best estimate

⁴ Automobile Club d'Italia, www.aci.it



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	0,22	0,54	0,40
2023	0,14	0,48	0,32

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 2023 ⁽¹⁾ ⁽²⁾

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.	1,25 – 1,70
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.	1,15 – 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.	1,10 – 1,35
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	0,85 – 1,15
Small centralized PV 1-10 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.	0,70 – 0,90
Large centralized 10-50 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.	0,50 – 0,75

¹GSE specific survey

² Excluding VAT


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	
2023	1,45	1,32	1,18	0,60

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, 2023 ⁽¹⁾

Cost category	Average (€/W)	Low (€/W)	High (€/W)
Hardware			
Module	0,37	0,32	0,48
Inverter	0,18	0,17	0,20
Mounting material	0,36	0,29	0,42
Other electronics (cables, etc.)			
Subtotal Hardware	0,91	0,78	1,10
Soft costs			
Planning ⁽²⁾			
Installation work	0,10	0,09	0,11
Shipping and travel expenses to customer	0,03	0,02	0,03
Permits and commissioning ⁽³⁾	0,10	0,09	0,11
Project margin	0,31	0,26	0,37
Subtotal Soft costs	0,54	0,46	0,62
Total (excluding VAT)	1,45	1,24	1,72
VAT	10%	10%	10%
Total (including VAT)	1,60	1,36	1,89

¹ GSE specific survey

² Planning cost are included in the other soft costs

³ Including financing


Table 12: Cost breakdown for a grid-connected centralized PV system of >10 MW 2023 ⁽¹⁾

Cost category	Average (€/W)	Low (€/W)	High (€/W)
Hardware			
Module	0,20	0,14	0,25
Inverter	0,07	0,06	0,08
Mounting material	0,13	0,12	0,14
Other electronics (cables, etc.)			
Subtotal Hardware	0,40	0,32	0,47
Soft costs			
Planning ⁽²⁾			
Installation work	0,03	0,02	0,05
Shipping and travel expenses to customer	0,02	0,01	0,03
Permits and commissioning ⁽³⁾	0,02	0,02	0,03
Project margin	0,13	0,11	0,16
Subtotal Soft costs	0,20	0,16	0,27
Total (excluding VAT)	0,60	0,48	0,74
VAT	10%	10%	10%
Total (including VAT)	0,66	0,53	0,81

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 were not specific regulations or measures that could boost the development until the implementation of European legislation regarding the reform of the EU electricity market. Legislative decree 199/2021 has introduced a RES long-term PPA bulletin board (*Bacheca PPA*) organized and managed by the GME (*Gestore dei Mercati Energetici*) with the following purposes:

- to facilitate the connection of parties potentially interested in entering into long-term renewable energy PPAs;
- to enable the fulfilment of the obligation to register long-term renewable energy power purchase agreements concluded between operators.

The bulletin board is divided into sections highlighted below:

- *Announcements Section*, where operators interested in proposing or seeking long-term renewable energy PPAs can anonymously and non-bindingly publish their respective sales or purchase announcements. Operators interested in such announcements can view them and express their interest.
- *Contract Registration Section*, where selling operators fulfill the obligation to register long-term renewable energy power purchase agreements concluded.

In 2023 the European Institutions started a procedure with the aim to reform the EU electricity market. The procedure has been concluded enacting Directive (2024/1711) and Regulation (2024/1747). The latter came into effect on July 16th, 2024, while the Directive must be transposed by member states by January 17th, 2025.

2.5 Additional Country information

Table 13: Country information, 2023

Retail electricity prices for a household [€/kWh] ⁽¹⁾	38,64
Retail electricity prices for a commercial company [€/kWh] ⁽²⁾	34,2 – 42,7
Retail electricity prices for an industrial company [€/kWh] ⁽³⁾	28,90
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 with some effects also in 2023. In mid-2024 the full transition to the free market for all domestic customer was completed.

^{1, 3} ARERA (Energy Authority) provides a single price the entire sector for 2023, without distinctions for bands of consumption

² Nomisma Energia best estimate



3 POLICY FRAMEWORK

Table 14: Summary of PV support measures

Category Measures in 2023	Residential		Commercial + Industrial		Centralized	
	On-going	New	On-going	New	On-going	New
Feed-in tariffs ⁽¹⁾	-	-	Yes	-	Yes	-
Feed-in premium ⁽¹⁾	-	-	Yes	-	Yes	-
Capital subsidies ⁽²⁾	Yes	-	Yes	-	-	-
Green certificates	-	-	-	-	-	-
Renewable portfolio standards with/without PV requirements ⁽³⁾	-	-	-	-	-	-
Income tax credits	Yes	-	-	-	-	-
Self-consumption	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⁾	Yes	Yes	-	-	-	-

¹ Feed-in tariff, up to 250 kW. Feed-in Premium, over 250 kW

² At regional level

³ No obligations for utilities to obtain a minimum percentage of their power from renewable energy sources

⁴ Up to 500 kW, a phase out is foreseen

⁵ Virtual net metering under some condition (paragraph 3.4)

⁶ Regional tender(s) for supporting RES integration mostly in public administration buildings



3.1 National targets for PV

In July 2023 Italy submitted to the European Commission the updated draft of the Integrated National Energy and Climate Plan to meet the increased energy and climate targets and objectives under the European Green Deal, which foresees a strong increase of RES electricity share in consumption (40,5%). 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.

In December 2023 the European Commission published its assessment¹ of the updated draft of the National Energy and Climate Plan (hereafter, NECP)², together with individual assessments and country-specific recommendations³.

Italy was amongst the few countries to have proposed a sufficient level of contributions for 2030. European Commission recommended Italy, *inter alia*, to elaborate more in depth how these targets would be reached.

On July 1st, 2024, Italy has submitted to the European Commission the definitive updated Integrated National Energy and Climate Plan aligned with the European Commission recommendation. As to RES implementation Italy set the goal to reach a renewable source capacity of 131 gigawatts by 2030. Nearly eighty (79,2) of these are expected to come from solar, 28,1 from wind, 19,4 from hydro, 3,2 from bioenergy, and 1 gigawatt from geothermal.

According to scenario assumptions developed in the NECP, nuclear power from fission, and in the long term from fusion, could provide about 11% of the total electricity demand by 2050, with a possible projection toward 22%.

On August 7th, 2023, Italy submitted its amended National Recovery and Resilience Plan (hereafter, NRRP), which includes a Repower EU chapter focused on green transition, with

¹ https://commission.europa.eu/publications/commission-eu-wide-assessment-draft-updated-necp-2023_en

² Piano nazionale integrato Energia e Clima (PNIEC), in Italian

³ https://commission.europa.eu/document/download/af5bd599-e8b5-49fd-a498dc00d6b81a0f_en?filename=Recommendation_draft_updated_NECP_Italy_2023.pdf



39% (37,5% in the original plan) of the available funds to support climate objectives. The plan foresees funds for 194,4 billion €, of which 122,6 in loans and 71,8 in grants. In December 2023 the plan has been approved by the Council of the European Union.

3.2 Direct support policies for PV installations

Italy in 2009 switched from a net-metering mechanism to a net-billing scheme (so called *Scambio sul Posto*, hereafter SSP) 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.

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. At the end of June 2023, a capacity of almost 8,7 GW is under SSP mechanism. A gradual phase out from net-billing scheme has been introduced by legislative decree 199/2021. The end of the net-billing mechanism shall move owners of small PV plants toward different forms of incentives, such as energy communities or dedicated withdrawal managed by GSE.

The 2019 decree (MD of July 4th, 2019, so-called DM RES 1) 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 (hereafter, FiT), and over 250 kW a sliding Feed-in Premium (hereafter, FiP), so-called “two-ways mechanism”: the producer receives from GSE an incentive equal to the difference between a reference tariff and the hourly zonal price of energy and *vice versa*.

There are also additional remunerations: for plants installed on buildings ($P \leq 100$ kW), on self-consumed energy (if self-consumption exceeds 40% of yearly net production), and for BAPV/BIPV plants replacing asbestos.

A large number of PV plants commissioned between 2005 and 2014 still access to 20 years FIT tariff under the so-called *Conto Energia* scheme.

A tax credit measures for refurbishment of building energy efficiency, installation of PV systems and infrastructures for charging electric vehicles, as well as storage systems, have been introduced in the recent years (so-called Ecobonus, Superbonus).

Such mechanisms differ for allowed admissible expenditure, value of tax credit contribution (ranging from 50% to 110% for the Superbonus reduced to 90% in 2023), timings for carry out intervention and subjective requirements (private, corporate entities). Generally, PV plants and storage system have to be coupled with building energy efficiency interventions in order to access the measure.



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

During the last years, some regions introduced measures aimed at spreading the realization of RES and PV plants on residential and Public Administration buildings (for both BAPV and BIPV).

The above-mentioned measures are not focused specifically on BIPV, even if BIPV is allowed, sometimes suggested. These incentives mainly consist of capital grant expenditure.



3.3 Self-consumption measures

Table 15: Summary of self-consumption regulations, 2023

PV self-consumption	1	<i>Right to self-consume (real time)</i>	Yes
	2	<i>Revenues from self-consumed PV</i>	Savings on the electricity bill
	3	<i>Charges to finance Transmission, Distribution grids & Renewable Levies</i>	No
Excess PV electricity	4	<i>Revenues from excess PV electricity injected into the grid</i>	Net-billing (SSP), 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	<i>Maximum timeframe for compensation of fluxes</i>	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
	6	<i>Geographical compensation (virtual self-consumption or metering)</i>	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. On December 7 th , 2023, the Ministry of Environment and Energy Security enacted the decree no. 414 which took effect on January 24 th , 2024, outlining new incentive schemes to support RES communities, groups of self-consumers, and remote self-consumers
Other characteristics	7	<i>Regulatory scheme duration</i>	Real time self-consumption, unlimited. Net-billing is yearly renewed, even if a phase out is foreseen
	8	<i>Third party ownership accepted</i>	Yes, with condition
	9	<i>Grid codes and/or additional taxes/fees impacting the revenues of the prosumer</i>	None
	10	<i>Regulations on enablers of self-consumption (storage, DSM...)</i>	Tax credit for storage coupled with PV
	11	<i>PV system size limitations</i>	Self-consumption, none. Net-billing, up to 500 kW
	12	<i>Electricity system limitations</i>	None
	13	<i>Additional features</i>	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 the decree of September 16th, 2020, a measure regarding self-consumption, allowing final consumers/RES producers to group together in order to share electricity locally produced by new RES plants with a capacity \leq 200 kW.

On December 7th, 2023, the Ministry of Environment and Energy Security enacted decree no. 414 (so-called CACER decree), which took effect on January 24th, 2024. The annex to ARERA Resolution 727/2022/R/eel (Testo Integrato per l'Autoconsumo Diffuso, TIAD), established the mechanism and the contributions for self-consumed energy. The decree supports energy communities and self-consumption both with a FiT scheme and with capital incentives in particular cases. Following 60 days from the enactment of the operating rules of the decree no. 414, the decree of September 16th, 2020, has ceased its effectiveness.

The FiT scheme is foreseen for PV plants under a widespread self-consumption schemes up to a cap capacity of 5 GW and commissioned until December 31st, 2027. The main general requirements of the PV plants are the following ones:

- maximum eligible capacity of 1 MW;
- new plants (or new sections of existing plants);
- plants commissioned after December 15th, 2021;
- built with new components;
- in line with DNSH (Do Not Significant Harm) principles;
- not under net-billing scheme (SSP) or other incentives;
- PV capacity installed to meet new buildings requirements cannot access the measures.

Different options based on a virtual model are foreseen, as highlighted below:

1. Renewable Energy Communities (RECs). The REC is a legal entity, and member may be private persons, small and medium-size enterprises, local public administration authorities, research and training bodies, religious organizations, other. The scope of the Community is to provide environmental, economic or social benefits to the Community and to its members. Central Public Administrations and all enterprises cannot join the group, but they can be a third party producers.
2. Renewable energy self-consumers groups. Central Public Administrations and all enterprises can join the group. Plants and consumption must be in the same building. Energy companies cannot be members, but they can be third party, as producers.
3. Remote renewable energy self-consumer, which is the owner of the connection points (production and consumption). Third party producers may also be part of this configuration.

Self-consumption users indicated above in point 1,2 and 3 access to a FiT scheme for twenty years (flat tariff) higher for small plants (80 €/MWh for plants with a capacity up to 200 kW, 60 €/MWh for a capacity larger than 600 kW). FiT is granted on the shared electricity, which 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. In addition to the flat tariff, there is a variable tariff depending on the market price and a on geographical compensation. The PV maximum



total tariff range is between 100 and 120 €/MWh in the South of Italy, between 104 and 124 MWh in the Center and between 110 and 130 €/MWh in the North of Italy.

There are other configuration only accessing to the contribution for the value of self-consumed energy, like active customer groups, remote active customer, and Citizen Energy Communities (CECs).

The configurations for which it is possible to access to capital support are CERs and groups of renewable energy self-consumers who are located in small towns (with a population of less than 5.000 people). The support can cover up to 40% of the cost of renewable energy project. Applications have to be submitted by March 31st, 2025, and all projects must be completed by June 30th, 2026. The cap foreseen is 2,2 billion €.

In case of capital support, the decree foresees reductions of FiT proportional to the contribution.

GSE, at the end of June 2023, registered a number of 74 collective self-consumption configurations and 35 energy communities, for a capacity of 2.740 MW.

3.5 Tenders, auctions & similar schemes

For regional tenders and FiT tenders supporting RES, building energy efficiency, storage systems, energy communities and electric vehicles, see paragraph 3.2.

3.6 Other utility-scale measures including floating and agricultural PV

During 2023 Italy intensified its work on the support mechanism for agricultural PV (Agri PV). The decree was adopted in December 2023, after having been checked by the European Commission in April and become effective in February 2024. The mechanism is dedicated to advanced Agri PV (with certain requirements in terms of height from ground and monitoring systems) developed by agricultural companies (or temporary associations between investor and agricultural companies) and is composed of an incentive tariff granted for 20 years and capital contributions up to 40% of the investment costs. Competitive auctions are foreseen.

Italy also intensifies working on the support mechanism for cost-competitive RES technologies, including ground mounted PV plants. The mechanism of the draft decree is based on competitive tenders and provides for the “two-ways mechanism” tariff for a 20-year period. PV on areas classified as agricultural will be supported by this mechanism.

In March 2023 Italy sent to the European Commission the draft of decree for supporting less cost-competitive RES technologies, including floating PV (on sea and closed basins), based as well on competitive tenders and providing a “two-ways mechanism” tariff for a 20-year



period. The European Commission has approved the draft decree in June 2024 and the Ministry of Environment and Energy Security has signed the decree on July 1st, 2024, which has become effective on August 13th, 2024.

In the implementation of the provisions of Article 19 of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, article 46 of legislative decree 199/2021 establishes specific provisions on Guarantees of Origin (GO). The GO is an electronic certification issued by the GSE for every MWh of renewable electricity fed into the grid by IGO-qualified plants. All GO titles are issued, transferred and cancelled electronically through the dedicated Web Portal.

3.7 Social Policies

After the pilot project of the so-called *reddito energetico* (energy income) started in 2017 by the municipality of Porto Torres (Sardinia region), in cooperation with GSE⁴, many other municipalities and regions are carrying out similar support mechanisms.

In addition to social policies introduced mostly at regional level, the Ministry of Environment and Energy Security enacted MD of August 8th, 2023, no. 261, which established a 200 million€ fund targeted at households in energy poverty conditions for the purpose of install PV systems for self-consumption during 2024 and 2025. The installations must be carried out on roofs and/or surfaces of buildings, real estate units and/or their appurtenances. The PV capacity foreseen is between 2 and 6 kW.

⁴ 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



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 of 2005-2013. From 2015, tariffs for plants with a capacity over 200 kW accessing the above-mentioned tariffs 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, law decree 181/2023 enacted in law in February 2024 and MD of June 21st, 2024 concerning suitable areas requiring regions to identify them by December 2024), 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 12 MW for PV systems built in particular sites), and with modification of the environmental integrated authorization criteria (capacity increased to 12 MW for EIA screening and 25 MW for EIA).
- simplified procedure for small BIPV plants increased up to 50 kW.

The regulation of the authorization procedures for RES is under revision. A first draft of the so-called *Testo Unico FER* (single primary legislative act, foreseen by NRRP and by the Law no.118 of August 5th, 2022) has been issued in May 2024 and is expected to be finalized and adopted in the second half of 2024.

3.9.1 Rural electrification measures

The decree of February 14th, 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 km², located more than 1 km from the continent and with a resident population of at least 50 people.

The mechanism foresees a 20-year FiT 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 FiP 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 NRRP, aiming to support PV plants on building roofs in the agricultural and agro-industrial sector. The resources allocated 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 1000 kW. Storage systems and charging stations, if any, can be included in the admissible expenditure.

3.9.2 Support for electricity storage and demand response measures

In 2023, 298.644 storage systems coupled with PV plants were installed in Italy for a total number of 536.611. Storage systems are mainly concentrated in regions with a high number of installations. As a matter of fact, around 42% of the systems is concentrated in three regions of the North of Italy (Lombardy, Veneto and Emilia Romagna).

Tax deduction for storage (mainly) coupled with PV plants is in force (especially Superbonus mechanism which provided for 90% tax credit for interventions carried out in 2023).

Moreover, Ministry of Enterprise and Made in Italy directorial decree of December 6th, 2023, granted the support for eligible applications related to the purchase and related installation of charging infrastructure carried out from January 1st, 2023, to November 23rd, 2023, with an allocated funding of 40 million euro for 2023.

2023 has been an important year for the discussion of new revenues mechanisms for storage plants. In particular, the *Mercato di approvvigionamento della capacità di stoccaggio elettrico* (MACSE) mechanism has been put out for public discussion in light of its approval for year 2024. Also, Capacity Market mechanism (already into force) has undergone modifications in order to be a more attractive mechanism for operators.

3.9.3 Support for encouraging social acceptance of PV systems

After the booming market of the past FiT Law 2005-2013), 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 the last years, 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, constitutes a further element in favor of the social acceptability of the plants (see paragraph 3.4).

3.10 Financing and cost of support measures

The cost of the incentives for the FiT/FiP mechanisms is covered by a component of the electricity tariff paid by all final electricity consumers. The economic resources for the RES decree of July 4th, 2019, are covered in the same way. In 2022, the cost of incentives for photovoltaics stood at 6,2 billion € (data for 2023 is 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 has been launched by the Energy Authority (ARERA) in 2023 concerning the regulation (TICA, *Testo Integrato Connessioni Attive*) and in August 2023 a number of changes with immediate effects have been introduced, pending the definition of the new simplified procedures that will replace those currently in force. 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.

The applicable regulation requires the grid operators to give priority access and priority dispatch to renewable energy plants.



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 2023 is summarised in the Table 16. The list includes the manufacturers who answered to RSE survey, and those for whom the information was available and updated on the company website. The data in the table refer only to production in Italy (some of the companies on the list currently have production plants in other countries as well).

Table 16: PV cell and module production, production capacity information for 2023 ^{(1) (2)}

Cell/Module manufacturer	Technology	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
<i>Wafer-based PV manufactures</i>					
3SUN S.r.l.	Si-HJT			200,00	200,00 ⁽³⁾
Eclipse Italia	sc-Si, mc-Si, a-Si	0	40,00	0	200,00
EXE s.r.l.	mc-Si	0	0	0	
FuturaSun ⁽⁴⁾	sc-Si, mc-Si	0	0	0	
Gruppo STG	sc-Si, mc-Si	0	3,74	0	26,00
Trienergia srl	sc-Si, mc-Si	0		0	24,00
Total			43,74	200,00	450,00

¹ RSE specific survey

² Blank box stands for not available data

³ 3SUN's site is in an advanced construction phase to complete the project that will lead to the evolution of the Catania-based cell and module solar factory producing 200 MW modules/year into a Gigafactory with a production capacity of 3GW/year

⁴ FuturaSUN, an Italy-based solar module manufacturer with production facilities in Asia, is currently in the process of establishing a gigafactory in Italy, which is still under construction

The Italian PV industry consists of companies with specialized expertise across various markets, including integrated PV (i-PV) for buildings (BIPV or BAPV) and electric mobility (VIPV). These companies are dedicated to developing innovative high-efficiency PV module technologies. In 2023, the total annual production reported by these companies was 43,74 MW, out of an overall production capacity of 450 MW per year. It is important to note



that the actual production capacity may be higher, as some companies that did not participate in the survey are not included in these figures.

The PV industry is expected to experience significant growth in the coming years. Several Italian companies have recently begun establishing gigafactories in Italy. For example, 3SUN, a company within the Enel group, plans to start producing innovative photovoltaic cells and modules in the second half of 2024, with an anticipated production capacity of 3 GW (5 million modules per year) by the end of 2025.

Moreover, FuturaSun, an Italian solar module manufacturer, operates in over 70 countries, including Europe, South America, Africa, and Asia. Its largest production plant, located in Asia, has a capacity of 1 GW per year. The company is expanding its manufacturing activities with a new 12 GW TOPCon and IBC cell manufacturing plant in Huai'an, Jiangsu province, and the development of a new headquarters in Suzhou featuring a 2 GW PV module line. Additionally, FuturaSun has announced plans to invest in a new gigafactory in Padua, aiming for an annual production capacity of 1,5 GW. Recently, FuturaSun acquired the start-up Solertix, which focuses on perfecting and optimizing the tandem composition and architecture of modules combining perovskite and silicon. Solertix originated from the academic excellence of the Centre for Hybrid and Organic Solar Energy (CHOSE) at the University of Rome Tor Vergata.

The anticipated growth of the PV industry presents a promising outlook for the Italian PV market, particularly when aligned with the new national target for 2030, which aims for a total installed PV capacity of 80 GW. Achieving this target is expected to yield additional positive effects within the sector.

Finally, the recent initiative by the Italian Photovoltaic Network for Research, Development, and Innovation (RetelFV) is enhancing collaboration between the research and academic communities and the PV industry. This collaboration aims to advance technological innovations and accelerate the energy transition in the PV sector.

There are no relevant industrial initiatives in the area of concentrating photovoltaics.

4.2 Manufacturers and suppliers of other components

National suppliers of various components for PV systems include Enertronica Santerno S.p.A., Elpower s.r.l., Friem S.p.A., Riello Solar Tech - RPS S.p.A., Siel S.p.A., and Zucchetti ZCS S.p.A. Companies like Aton and Fiamm offer a range of energy storage solutions.

In the field of mounting structures for PV modules, Italian companies specializing in the development of single-axis trackers for PV utility-scale applications are Convert Italia SpA (a Valmont Industries company), Comal SpA, AcriGroup srl, REM Tec srl, RCM Italia srl, and Soltigua srl. Among these, Convert Italia SpA, Comal, and REM Tec also provide tracker systems for agrivoltaic applications.

Finally, Ecoprogetti srl, a leading company in the design and assembly of production machines and quality control of photovoltaic modules, is mentioned.



5 PV IN THE ECONOMY

5.1 Labour places

Table 17: Estimated PV-related full-time labour places in 2023 ⁽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	8.056 ⁽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 18: Rough estimation of the value of the PV business in 2023 (VAT is excluded) ⁽¹⁾

Sub-market	Capacity installed [MW]	Average price [€/W]	Value of PV business [Billion €]
Off-grid			
Grid-connected	5.209 ⁽²⁾	1,132	5,90

¹ Blank box stands for not available data

² 5.209 MW is the actual installed capacity in 2023 (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 25 years that changed it from a vertically integrated monopolistic structure to a liberalized market. The process started in 1999, but the total liberalization was decided only in August 2017, and it was fully completed in mid-2024, with the tariff system eliminated in the domestic sector. It is still valid for a fraction of the market, the so-called vulnerable clients, consumers under conditions of energy poverty.

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, EPH, Iren and ENGIE) hold around 50% of the national gross production in 2023, 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 mid-2024. 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 21.755 PV plants at the end of 2023, for a total capacity of around 877 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 2023 figures show the important growth of PV market in Italy. It is important to highlight that out of around the installed capacity of 5,2 GW, more than 80% is installed on buildings (BAPV and/or BIPV) following the booming effects of tax deduction schemes and of the rising energy prices.

As well as in 2022, small plants are mainly defining the Italian PV market, where around 95% of the number of commissioned plants in 2023 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, as well as the increase of revamping interventions aimed at improving the efficiency and performance of PV plants and extend their lifetime beyond the end of the FIT period.

7.2 Prospects

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

The new regulations concerning energy communities and AgriPV will contribute to the growth of a market that experienced an important increase in 2023, together with the new administrative simplifications, addressing permitting issues.

Italy is the country with the highest concentration of heritage buildings and towns that makes difficult, sometimes, to integrate PV technology. In any case, also in 2023 some superintendencies are showing interest to integrate BIPV products in historical centres.

