D2.1-IT, October 2021

Auctions for the support of renewable energy in Italy

Main results and lessons learnt

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1 Introduction

Italy has a long history with renewables having the first support measure introduced back in 1991. Since then, renewable capacities have grown continuously, reaching a 35% share of renewable electricity in 2019 (SHARES, 2021). The mix of electricity from renewable energy sources (RES-E) is relatively diverse, based mostly on hydro and solar resources, onshore wind, and biofuels.

The large share of renewable electricity enabled Italy to meet its 2020 EU climate targets early without auctions. The report covers the auction scheme introduced in 2019 with four subsequent rounds in the period concluding May 2021. Beyond the two auctions announced by the Italian government to take place before the end of 2021, the future of renewable auctions in Italy is uncertain.

This report provides an overview of Italian renewable energy deployment, examining the evolution of regulation and auction design, and assesses the results of the five concluded tender rounds. Italy operates an auction based, two-sided sliding premium (often referred to as CfD) support scheme, with different technology baskets and features for power plants under and above 1 MW. Most of the organized auctions in Italy were heavily undersubscribed, resulting in strike prices close to the ceiling price. Therefore, one important aim of this report is to identify those factors reducing competition and to recommend ways to reconfigure the design for greater efficiency.

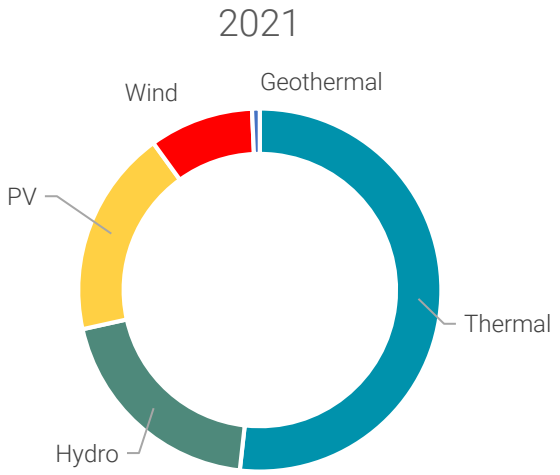
The structure of the paper is the following: Chapter 2 provides a brief overview of the electricity sector of Italy and the status of deployment of different renewable technologies. Chapter 3 describes the main pillars of the country's past support schemes. Furthermore, the key design elements and characteristics of the renewable auction are outlined in Chapter 3. Chapter 4 assesses the main outcomes of the auction. The final section concludes with a summary, lessons learned, and recommendations.

2 Overview of the Italian electricity sector

Photovoltaic and wind capacities expanded significantly over the last 5 years – by 11.5% and 15% respectively – combining almost 30% of total installed capacity in 2021. Even the established hydro capacities accounting for 20% of total installed capacity exhibits growth (3% in the last five years). At the same time thermal capacities dropped by 3.5% although still account for more than half of the total installed capacities in the country. 8 MW of thermal capacities burn coal, which fuel will be completely phased-out by 2025 (IAI, 2018).

Italy has had four nuclear power plants but suspended the operation of the last two plants in 1987. Since then, there have been proposals to revive the national nuclear energy industry, but none have been adopted so far. The 2030 national strategy planning for 25% of electricity production from nuclear was rejected in 2011 (WorldNuclear.com, 2021).

Figure 1: Installed capacities in Italy in 2021 in GW

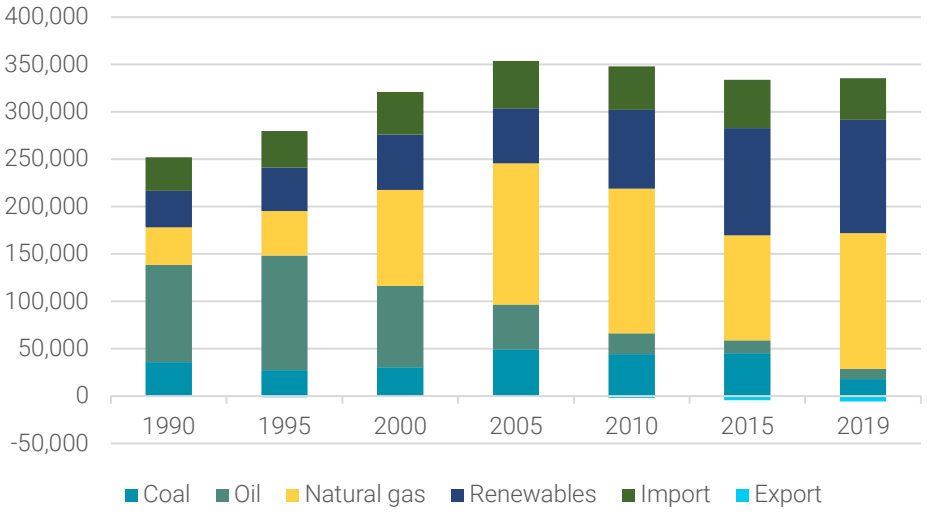


	2016	2021
Total	**114.16**	**116.30**
Thermal	62.43	60.20
Hydro	22.30	23.00
Photovoltaic	19.28	21.50
Wind	9.38	10.80
Geothermal	0.77	0.80

Source: Terna (2021)

Italy's thermal share of electricity generation has fallen far from its mid-2000s peak, stabilizing over the last 5 years. Natural gas and coal replaced oil, though the share of natural gas varies considerably from year to year in response to movements in natural gas and ETS allowance prices.

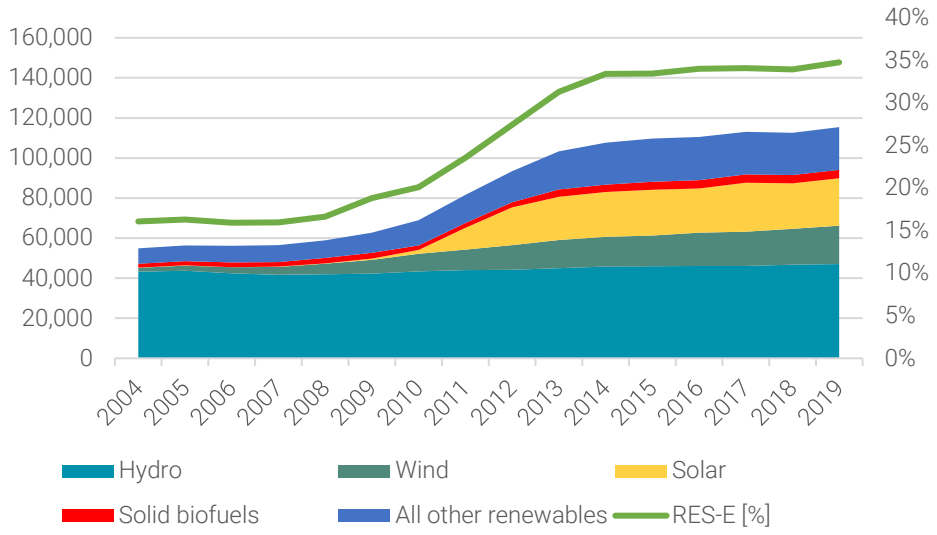
Figure 2: Electricity generation by source, 1990-2019 in GWh



Source: IEA (2021)

The share of fossil fuels in domestic generation was over 80% until 2007 when RES-E began a phase of rapid growth lasting through 2014, led by solar PV uptake. The 2020 target for renewable electricity generation set in the National Renewable Energy Action Plan (26.4%), was already surpassed in 2011 (Tiedemann et al., 2016). The 55% 2030 target indicated in the National Energy and Climate Plan of Italy requires almost the same pace of RES-E expansion as in the 2007-2014 period (European Commission, 2020).

Figure 3: Renewable electricity generation (GWh) and RES-E share in %



Source: SHARES (2021)

3 Evolution of the Italian RES-E support policy

Italy's first RES-E legislation was introduced in 1991 (Law 9/91) and 1992 (CIP6/92 regulation) following renewable objectives and targets announced in strategic documents from earlier in the 80's. The 1991 law simplified the authorization procedures for RES-E projects before the 1992 regulation introduced fixed feed-in-tariffs (FiT) for all RES-E technologies for their first 15 years of production. The tariff was pre-determined and updated yearly and was paid for each renewable source-based MWh of electricity fed into the grid. Beneficiaries were selected by a procedure approved by the Ministry of Economic Development.-Even after the 1991 law, procedures were still considered to be lengthy and varied across the regions of the country. They were not, however, differentiated by project size, which disadvantaged smaller players. Furthermore, grid connection capacities seemed to be very limited in rural areas (IRENA, 2013).

The 1999 legislative Decree (79/99) laid the foundation of the electricity market liberalization and updated RES-E support. It introduced priority grid access for RES-E and replaced the FiT scheme with the green certificate system. The renewable quota set the annual legally binding minimum share of renewables in the electricity mix, beginning at 2% in 2002 with an annual growth of 0.35% until 2006 and 0.75% after 2007so by 2012 the quota reached 7.5%. In this scheme the electricity producers and importers had the obligation to provide more RES-E to the Italian grid and maintain the necessary number of certificates. This established a market based process for promoting RES-E through a tradeable permitting system. Plants in operation or refurbished from April 1999 to 2007 were eligible for support for a period of 12 years. Support was differentiated by technology, with some worth more certificates than others. The following table presents the multiplicative factors of the 2008-2009 legislative revision. Solar PV was not yet included in this scheme and supported through a different channel which will be described later (Gestore Mercati Energetici, 2021).

Table 1: Multiplicative factors of renewable technologies in the GC scheme

Source	Multiplicative Factor
1 Wind (over 200 kW)	1.00
1 Off-shore wind	1.50
3 Geothermal	0.90
4 Waves and tides	1.80
5 Hydro	1.00
6 Biodegradable waste and biomass	1.30
7 Biomass and biogases obtained from agriculture, animal husbandry and forestry on a short supply-line basis	1.80
8 Landfill gas, sewage treatment plant gas and biogases	0.80

Source: Gestore Mercati Energetici (2021)

3.1 Further changes in the support system

After 2008, producing renewable electricity was supported in three ways. Next to the specific scheme for solar PV (elaborated later in the report), smaller RES-E producers up to 1 MW (or 200 kW for wind power plants) received feed-in-tariffs after the electricity fed to the grid while bigger producers over 1MW remained in the green certificate system (CEER, 2013).

The entire RES-E support policy was updated by Ministerial Decree 6 July 2012, replacing the green certificate system with an administratively set sliding feed-in-premium (FiP) for larger projects over 1 MW and maintaining a FiT scheme for the smaller projects under 1 MW. The awarding process also depended on the size of the installation. Very small projects received support directly, medium sized projects up to 5 MW (10MW for hydro and 20 MW for geothermal) received support through 'registry,' and larger projects through an auction procedure (IEA, 2016). As Tiedemann et al (2016) describes in the AURES I case study of Italy medium sized projects in the 'registry' were evaluated and ranked according to predefined criteria. One example for such criteria is the date when the projects received authorisation. In case a project got selected, it could continue project planning and was eligible to receive an administratively set, technology specific support. With slight modifications, this system remained in place until the introduction of the current auction scheme analysed in this case study.

In 2014 the certificate system and mandatory quota expired after it was closed to new installations from 2013 (by the Decree of 2012). By 2012, RES-E support was mostly earmarked for existing installations, leaving little financing for new projects. Just a few years later the first wave of older RES-E installations were nearing the end of their support period, which freed some financing (IEA, 2016). Consequently, in 2015, access to support was restricted to installations below 50-100 kW (depending on technology) that had successfully applied for support in the past.

The support schemes resulted in a boom of RES-E capacities because incentives remained unadjusted while costs fell dramatically (70% between 2008 and 2012). Investing in RES-E became very profitable, especially compared to neighbouring countries. For example, in January 2012, PV incentives in the Italian scheme were two or three times higher than in Germany or France and about 50% higher for wind installations. This resulted in a very costly incentive system which had raised the energy bills for consumers (Italy's National Energy Strategy, 2013).

In parallel with the above mentioned schemes, smaller RES-E producers (20 to 500 kW) benefitted from the application of net metering service and tax credits for PV systems. Tax credits amounted to half of the total PV system costs in 2015 and was then reduced to 36% in 2016. (IEA, 2016)

The 2016 Ministerial Decree defined that new applications after 31 December 2016 were not accepted to the incentive scheme (closing date was one year later for very small projects with direct access) (Rödl&Partner, 2016). An overview and evaluation of the first auctions introduced by the Ministerial Decree of 6 July 2012 was carried out in the Italian case study of the AURES I project (Tiedemann et al, 2016).The study showed that these auction rounds caused reduction in the level of support only for the onshore wind category, while other categories (hydro, offshore wind, biomass and geothermal) were undersubscribed compared to the targeted volumes.

3.2 Special status of solar PV

PV support was separated from other renewable technologies in 2005, initiated by 'Conto Energia' (2003) legislative decree and four subsequent iterations until 2013. The first version introduced funding for the operating costs of electricity production and the second, in 2007, simplified the rules for participation and expanded support to gross volumes produced by a plant. The third modification in 2010 was extended to projects including innovative features like concentrated solar power. The fourth modification adjusted support levels downward to match lower costs and introduced an annual cumulative cost limit for PV support. Since the last version of 'Conto Energia' ended in July 2013, PV plants only receive support in the form of a tax reduction and the self-consumption scheme (Scambio sul Posto) (Jäger-Waldau, 2019).

In this period the market adapted to the subsidy-free market conditions, and in 2016 the first private power

purchase agreement (PPA) was announced. The next such agreement would not come until June 2019, with few others announced. Market players expected PPAs to be more popular with more advanced financing structures, but it has not come to fruition yet (Bellini, 2019).

Construction of solar installations is generally a difficult process due to local and national regulatory hurdles. Procedures are fragmented, so that even in Southern Italy, which is the most suitable location for PV construction, solar generation is less developed. Land ownership is another common obstacle, especially for agricultural land. From a regulatory point of view this does not apply to supported projects but raises concerns for PPA projects. Even under these circumstances, Italy is planning to reach 30 GW of PV capacities by 2030, which means 10 GW additional capacities are to be installed in the 2020's (Bellini, 2019).

4 Italian RES-E auction design

Italy organised its first renewable auction in 2019 followed by 5 separate auction rounds to date. The most interesting part of the scheme is that there are entirely different auction procedures for power plants above and below 1 MW. The former is referred to as an "auction" and the latter as "registration". In the smaller sized procurement auction participants compete within a fixed time range for the opportunity to receive support, and are ranked based on their offers and other additional criteria.

The Italian large-scale auction shares several main design elements with European auctions, which are summarised in Table 2. Multi-technology auctions are separated into technology baskets for PV & onshore wind (Category A), hydroelectric and waste gas treatment (Category B) and plant refurbishment for all but solar PV (Category C). The auctions are pay-as bid, price only, multi-unit tenders, where the form of support is a two-sided sliding premium[1].

It also incorporates unique features which are important to highlight. First, the bid itself is not the actual support price, but the price reduction relative to a predefined basket or technology specific reference price. This means producers are competing to offer the largest discount relative to the reference price to win in the tender. Second, unlike most European auctions, this Italian tender has a minimum price limit, i.e. a floor price, as producers are not allowed to offer a discount more than 70% relative to the reference price (can increase up to 90% in later auction rounds).

Finally, the most important characteristic of the Italian auction system is that the exact dates are predefined, along with the planned auctioned capacities and ceiling prices. This significantly reduces bidder and investor uncertainty, theoretically providing a balanced expansion of renewable capacities. However, an additional rule that non-allocated capacities must be tendered in the subsequent auction round on top of the originally planned capacities led to significant undersubscription that will be discussed in more detail later in the study.

The small-scale auction ('registry') and large-scale auctions differ in several ways, as presented in Table 3. Most importantly, the registration procedure is a multi-criteria auction, where the actual price is the last ranking criterion. Locational and other technical specifications are more important in the ranking, leaving power plants with limited opportunity for price competition. On top of that, there is an additional technology basket in the registration scheme for rooftop PVs associated with complete removal of asbestos and slate from old buildings (Category A-2).

Table 2: Main characteristics of the large-scale (over 1 MW) Italian renewable auction

Characteristics	Description of the auction
Characteristics of the national electricity market	The auction design and setup are regulated in Ministerial Decree 04/07/2019 (Official Gazette, 2019) serving as the basis for this summary. Italy's electricity generation is 35% renewable-based. Non-renewable generation consists overwhelmingly of natural gas while oil and coal shares are declining. The country does not have nuclear capacity. Export is negligible, import is around 15-18% of domestic generation since the 1990's. Terna S.p.A. manages the fully liberalized national grid, generation, distribution and supply processes. Formerly an integrated company, ENEL is still an important player in all parts of the supply chain but its dominance in domestic generation has decreased

[1] Often referred to as contract for differences (CfD).

	since the 2000's. ENEL is the main distribution network operator and primary supplier, where it is experiencing an increasing competition. (CMS, 2015)
Name of auction scheme	Procedure d'Asta
Contractual counterparty	The Italian Energy Agency (GSE) organises the auctions and awards support.
Main features	Static Pay-as-bid (PAB) auction separated into various technology baskets. Existing power plants can also participate for refurbishment except solar PV. The auctions are cross-border, open to any EU member state or third country with a free trade agreement. However, only those power plants physically able to transfer their electricity to the Italian system are eligible. The maximum capacity available for a non-domestic company is limited by a predefined formula. In practice however, cross border projects have never participated in the Italian auctions.
Technology focus and differentiation (eligible technologies)	Multi-technology auctions, with different auction baskets specified: Category A – Onshore wind and solar PV, ground-mounted solar plants located on agricultural land are not eligible Category B – Hydroelectric, and plants based on waste gas from purification processes Category C – Onshore wind, waste gas treatment and hydroelectric power plants subject to partial or total revamping Only new PV plants can participate in the auctions. For Category C the additional eligibility criteria are: a) Operational for a period equal to at least two thirds of the conventional useful life of the plant; b) At the date of publication of the procedure, cannot benefit from incentives on energy production awarded pursuant to state regulation; Aggregates may participate as well if all power plants within the aggregate are belonging to the relevant category, with unit power greater than 20 kW and less than 0.5 MW, and total aggregated power output of at least 1 MW.
Lead time before auction	The 2019-2021 timeline for 7 auction rounds was announced in advance. The pre-set time of the auctions (call for tenders) were the following: 1st auction: 30.09.2019 2nd auction: 31.01.2020

	3rd auction: 31.05.2020 4th auction: 30.09.2020 5th auction: 31.01.2021 6th auction: 31.05.2021 7th auction: 30.09.2021 The submission period for the auction document is 30 days and the results must be published within 90 days of the closure of the tender.
Min./max. size of project	The minimum size limit is 1 MW without a maximum size limit.
What is auctioned?	Auctioned product: MW of power plant capacity connected to the grid.
Budgetary expenditures per auction and per year	There are no separate budget limitations set for the different auctions, however a maximum total support limit of 5.8 billion EUR/year was determined.
Frequency of auctions	7 auction rounds were scheduled between 2019 and 2021 with predefined auctioned capacity.
Volume of the tender	Planned volumes for the tender: Category A: 1st-2nd auction: 500 MW 3rd -5th auction: 700 MW 6thauction: 800 MW 7th auction: 1.6 GW Category B: 1st-2nd auction: 5 MW 3rd auction: 10 MW 4th-5th auction: 15 MW 6th auction: 20 MW 7th auction: 40 MW Category C: 1st – 4th auction: 60 MW 5th auction: 80 MW 6th auction: 100 MW 7th auction: 200 MW As a result of undersubscription, unallocated capacities were auctioned in the next tender, following the regulation. GSE can reallocate capacities between the small project auction ('registry') and the auction procedure for the next round if one size category is undersubscribed. Reallocation is allowed between categories in the same round if one basket is over and the other is undersubscribed. As a result, actual auctioned capacities differ from the previously set auction plan. The actual tendered volumes are the following (auctions 6 and 7 were not concluded at the time this report was written):

	Category A: 1st auction: 500 MW 2nd auction: 500 MW 3rd auction: 778 MW 4th auction: 1.16 GW 5th auction: 1.58 GW Category B: 1st auction: 5 MW 2nd auction: 10 MW 3rd auction: 17.53 MW 4th auction: 32.53 MW 5th auction: 47.53 MW Category C: 1st auction: 60 MW 2nd auction: 98.50 MW 3rd auction: 143.83 MW 4th auction: 180.70 MW 5th auction: 233.46 MW
Costs related to grid connection/access	The grid operators are obliged to provide connection for renewable power plants within a specified amount of time, however the cost of connection is paid by the producers based on the estimation of the grid operator (Res-legal, 2019).
Balancing and profile costs	Producers are responsible for the scheduling and payment of deviations.

Design elements	Description
Auction format	Multi-unit auction
Auction procedure	Price-only, static auction. Pay-as-bid (PAB) Participants offer percentage reduction relative to a predefined reference price. The main decision criterium of the auction is the offered price reduction. Bidders with the highest percentage reduction win the right to complete the project as long as the auctioned capacity limit is not reached. In the case of equal bids, the following hierarchical criteria determine the top-rated offers for Category A and B: 1) Possession of a legality rating[2] 2) Plants that are located in either of the following places: - landfill lots that are closed and restored,

[2] It is designed to induce companies to adopt an entrepreneurial organization based on legality, solvency and transparency of conduct, thus it may be viewed as a Corporate Social Responsibility (CSR) tool (uniba.it)

	- quarries not susceptible to further extractive exploitation for which the competent authority issuing the authorization has certified the completion of the recovery and rehabilitation activities (only relevant for Category A) 3) Hydroelectric power plants with special technical characteristics that:[3]: - do not increase the flow rate derived from the natural body of water in the period of withdrawal; - use return or wastewater of existing utilities without modifying the return or discharge point; - use part of the release of the minimum vital flow net of the portion destined for the ascent ladder, without subtension of the natural riverbed; or waste gas treatment plants which provide for the covering of the digestate tanks. (Only relevant for category B). 4) Date of submission Additional criteria for Category C to break equal bids in order of importance: 1) seniority of the date of entry into operation; 2) greater extension of the exercise period; 3) for wind power plants: lesser amount of electricity not produced in the last calendar year of production following the dispatching orders issued by Terna;
Pre-qualification requirements - Financial	Those who participate in the auction must comply with either of the following criteria: 1) A declaration from a bank certifying the financial and economic capacity of the participant in relation to the extent of the investment. 2) Capitalization in terms of fully paid share of capital and / or payments into future capital: - 10% on the part of the investment up to 100 million EUR; - 5% on the part of the investment between 100 and 200 million EUR; -2% on the part of the investment exceeding 200 million EUR

[3] Decree of 23 Jun 2016 Art 4. Paragraph 3

	All participants must pay a deposit equivalent to 5% of the total investment cost known as a 1st stage bid bond. After winning the auction, the 1st stage bid bonds are returned to the producers who must provide a bank guarantee equivalent to 10% of the investment cots as security for completion of the project. For aggregates the rate of capitalisation requirement and the deposit are halved.
Pre-qualification requirements - Material	There are several general and technology-specific criteria for participants to enter the auction. General criteria: - qualification for the construction and operation of the power plant - accepted connection agreement - registration of plant to the Gaudi system[4] validated by the system operator - power plant is fully permitted Criteria for PVs: - newly made or built with newly made components. - ground mounted PVs cannot be placed on agricultural land Hydroelectric plants (only for new plants): - Environmental assessments of water supply (supply concession)
Pricing rule	Pay-as-bid (PAB)
Price limits	The reduction from the reference price is 2% minimum and 70% maximum. If one or more auction offers reach 70% price reduction, the maximum of the subsequent auction increases to 80%. If repeated, the maximum in the next auction increases to 90%. The reference prices are set separately for each technology - Onshore wind & PV – 70 EUR/MWh - Sewage treatment gas & hydroelectric – 80 EUR/MWh In 2021 from the 5th auction a 2% reduction was applied to Category B and 5% for Category A to lower the predefined ceiling price.
Support period	Hydroelectric – 30 years All other technologies – 20 years

[4] Management System of the Unique Master Data of Production Plants and related units

Favourable treatment of specific actors	Waste gas treatment and hydro power plants compete in separate technology baskets with higher ceiling price, which can be considered favourable treatment. Additionally, aggregates pay half of the deposit with half the rate of capitalisation compared to other power plants.
Realization time limit	Realisation times differ by technology and categories: Category A and B: - Solar PV – 24 months - Onshore wind – 31 months - All other technologies – 51 months Category C: - Onshore wind – 16 months - Hydroelectric – 36 to 48 months depending on additional criteria. - Waste gas treatment plant – 24 months
Penalties	If the project is not completed on time, it loses the 2nd stage bid bond and eligibility for support. GSE charges 30% of the bid bond If producers waive support in the first 6 months after the publication of auction results and 50% from 6 months to one year.
Form of support auctioned	Two-sided sliding feed-in premium. Support is suspended if negative prices occur in 6 consecutive hours.
The method of reference wholesale price calculation	The support need or repayment obligation is calculated as the difference of the actual market price and the zonal wholesale electricity price. The financial settlement is completed on a monthly basis.
Support level adjustments	No adjustment
Transferability of support right	It is possible to transfer the right of support but doing so before the start of the power plant's operation will cost a 50% reduction relative to the bid price.
Other	Starting from the 3rd procedure, GSE checks if the following holds true for groups A and B: a) the combined capacity for each basket exceeds 130% of the capacity made available; b) the total power of qualified plants in each basket is more than 70% of the same source and the minority source makes up at least 20% of the capacity made available;

	c) the average value of the reductions offered from minority plants is equal to at least half of the average value of the reduction offers made by the plants referred to in letter b. If the above conditions hold, GSE will formulate a 30% mandatory quota for the minority power source in the next auction and multi-technology competition will only apply to the remaining 70% of the auctioned capacity.

Table 3: Main characteristics of the **small-scale (less than 1 MW)** Italian renewable auction

Characteristics	Description of the auction
Name of the auction scheme	Procedure dei Registri
Main features	Static Pay-as-bid (PAB), multi-criteria auction. The auction is separated by technology. Existing power plants can apply for refurbishment with the exception of solar PV. Instead of price, location and other technical criteria are more important to the project ranking.
Technology focus and differentiation (eligible technologies)	Multi-technology auctions with different auction baskets specified: Category A: Onshore wind and solar PV. Ground-mounted solar plants located in agricultural areas are not eligible. Category A-2: PV systems fully replacing slate or asbestos from roofs or rural buildings. Category B: Hydroelectric and waste gas from purification processes. Category C: Onshore wind, waste gas treatment and hydroelectric power plants subject to partial or total revamping. Additional requirements: a) Must be operational for at least two thirds of the conventional useful life of the plant; b) At the date of publication do not benefit from energy production incentives awarded pursuant to state regulations; In all categories, aggregates of the relevant category with capacity above 20 kW and below 1 MW may participate.
Min./max. size of project	Power plants below 1 MW. Only aggregates have minimum capacity (20 kW/unit).
Volume of the tender	Planned volumes for the tender: Category A: 1st-2nd auction: 45 MW 3rd -4th auction: 100 MW 5th-6thauction: 120 MW 7th auction: 240 MW Category A2: 1st-6th auction: 100 MW 7th auction: 200 MW

	Category B: 1st-6th auction: 10 MW 7th auction: 20 MW Category C: 1st – 4th auction: 10 MW 5th – 6th auction: 20 MW 7th auction: 200 MW As a result of undersubscription, unallocated capacities were auctioned in the next tender according to the regulation. If the auction of one size category is undersubscribed, GSE can rebalance capacities between them in the next round. This can also be done in the same auction round if one is undersubscribed and the other is oversubscribed. As a result, actual auctioned capacities differ from the predefined plan, shown below (6th and 7th rounds not executed): Category A: 1st auction: 45 MW 2nd auction: 45 MW 3rd auction: 100 MW 4th auction: 112.19 MW 5th auction: 147.55 MW Category A2: 1st auction: 100 MW 2nd auction:192.07 MW 3rd auction: 269.52 MW 4th auction: 351.01 MW 5th auction: 387.15 MW Category B: Same as planned for all rounds. Category C: 1st auction: 10 MW 2nd auction: 16.88 MW 3rd auction: 25.26 MW 4th auction: 34.38 MW 5th auction: 53.77 MW

Design elements	Description
Auction procedure	Multi criteria, static auction. Pay-as-bid (PAB) Participants offer a percentage reduction relative to a predefined reference price. The decision criteria are the following in order of importance: 1. Plants built in one of the following locations (only relevant for Category A) - landfill lots that are closed and restored - quarries not susceptible to further extractive exploitation for which the competent authority issuing the authorization has certified the completion of the recovery and rehabilitation activities 2. systems built on schools (only relevant for Category A2) 3. systems built on hospitals (only relevant for category A2) 4. systems built on public buildings (only relevant for Category A2) 5. Hydroelectric power plants with special technical characteristics (same as large size auctions) or waste treatment gas plants covering digestate tanks. (Only relevant for category B). 6. Systems connected with charging stations for electric cars, provided that the total charging power is at least 15% of the system power and each charging point has a power of not less than 15 kW. 7. Aggregates 8. High percentage of tariff reduction 9. Low absolute tariff 10. Time of bid submission
Pre-qualification requirements - Financial	All participants larger than 0.1 MW must pay the 1st stage bid bond deposit equivalent to 1% of the total investment cost. After winning the auction, the 1st stage bid bods are returned to the producers, who must then deposit 2% of the investment costs through a bank guarantee as a security for completion. For aggregates the rate of both required deposit is halved.
Price limits	There is no minimum reduction rate and the maximum allowed reduction is 30% in all auction rounds relative to the predefined reference prices.

	The reference prices according to technology and size in 2019 and 2020 were the following: PV less than 0.1 MW – 105 EUR/MWh PV & onshore wind more than 0.1 MW – 90 EUR/MWh Onshore wind less than 0.1 MW – 130 EUR/MWh Waste gas treatment less than 0.1 MW – 110 EUR/MWh Waste gas treatment power plant more than 0.1 MW – 100 EUR/MWh Run of River plant less than 0.4 MW – 155 EUR/MWh Run of River plant more than 0.4 MW – 110 EUR/MWh Other hydroelectric power plants – 90 EUR/MWh In 2021 (5th auction round) a reduction of 2% of the reference price was applied to power plants in Category B and 5% in Category A.
Support period	Run of river more than 0.4 MW or other hydroelectric power plants – 25 years All other technologies – 20 years
Favourable treatment	Participants of Category A-2 auctions receive an additional bonus of 10 EUR/MWh. Power plants using regenerated components for construction can receive a 20% reduction from the final tariff, which can also be considered unfavourable treatment. Power plants less than 0.1 MW operating in buildings receive a bonus of 10 EUR/MWh based on the share of net production consumed on site. To receive this bonus, annual self-consumption must be at least 40% of the total produced energy. Power plants less than 0.1 MW are not required to pay a bid bond.
Realization time limit	Realisation times differ by technology and categories: Category A, A2 and B: - Solar PV – 19 months - Onshore wind – 24 months - Hydroelectric plants – 31 to 39 months depending on additional criteria - All other technologies – 31 months Category C: - Onshore wind – 16 months - Hydroelectric – 36 to 48 months depending on additional criteria. - Waste gas treatment plant – 24 months

Penalties	If a power plant does not start operation within the given time frame, a reduction of 0.5 percentage point relative to the original offer is applied. The maximum allowed delay is 6 months, after which producers lose the bid bond (if applicable) and the eligibility for support. Additionally, if a project that lost eligibility after 6 months re-enters a subsequent auction round, an automatic 5 percentage-point reduction is applied in payments, relative to the offer. If the withdrawal from the tender occurs within six months after the announcement of the auction results, than the above mentioned 5%-point reduction is not applicable.

5 Auction results and evaluation

5.1 Auctions for large-scale projects – Category A

This section presents and evaluates the results of Italy's 5 completed auctions rounds, beginning with the large-scale (larger than 1 MW) project segment.

Table 4 shows the auctioned and awarded capacities from Category A in all consecutive rounds. It is evident that PV and onshore wind power plants competed for support and, except for the 1st round, all tenders were heavily undersubscribed. Although the first tender was oversubscribed, the competition was not intense, as only a total of 595 MW capacity was submitted for the total tendered 500 MW. With time, the rate of competition has been continuously declining with less submitted bids. Second round submissions fell to 425 MW, and by the 5th round totalled only 74 MW. This translates to a 0.85 and 0.05 level of competition respectively.

Table 4: Auctioned and awarded capacities of large-scale Italian tenders (Category A)

	Total auctioned capacity (MW)	Originally planned auctioned capacity (MW)	Total submitted capacity (MW)	Level of competition[5]	Total awarded capacity (MW)	Total awarded capacity – PV (MW)	Total awarded capacity – Wind (MW)
1st auction	500	500	595	1.19 (1.19)	500	5	495
2nd auction	500	500	425.5	0.85 (0.85)	425.5	19.4	406.1
3rd auction	778	700	313.9	0.40 (0.44)	313.9	95.6	218.3
4th auction	1160	700	279	0.24 (0.39)	279	20	259
5th auction	1580	700	73.7	0.05 (0.11)	73.7	32.1	41.4

Source: Own calculation based on GSE's webpage

Several different factors can explain the massive undersubscription of Italy's PV and onshore wind tenders. Auctions were organised frequently and only permitted relatively advanced projects with a connection agreement registered in the Gaudi system to apply. Market participants tend to bemoan Italy's cumbersome and time-consuming permitting process, which entails the submission of documents to several authorities and differing standards region to region (Globaldata, 2020; Evwind, 2020). Under these conditions, the frequency of the auctions itself may result in undersubscription.

This is compounded by the fact that auctioned capacities are predetermined without the possibility for downward adjustment. Given the above-mentioned regulatory design, it appears the predefined values for auctioned capacities were set too high for such a frequency, making it nearly impossible to award all auctioned capacities. To increase submitted applications, permitting bottlenecks should be better managed and/or less mature projects should be allowed to participate.

Still, in the Italian system, the rate of undersubscription increases drastically from round to round because on top of the predefined auctioned capacities there is an additional regulation prescribing that unallocated capacities must be tendered at the next auction round. As a result, it jumped from 500 MW in the 1st round to 1.58 GW in the 5th. This regulation is unconventional and can greatly reduce efficiency. In some European

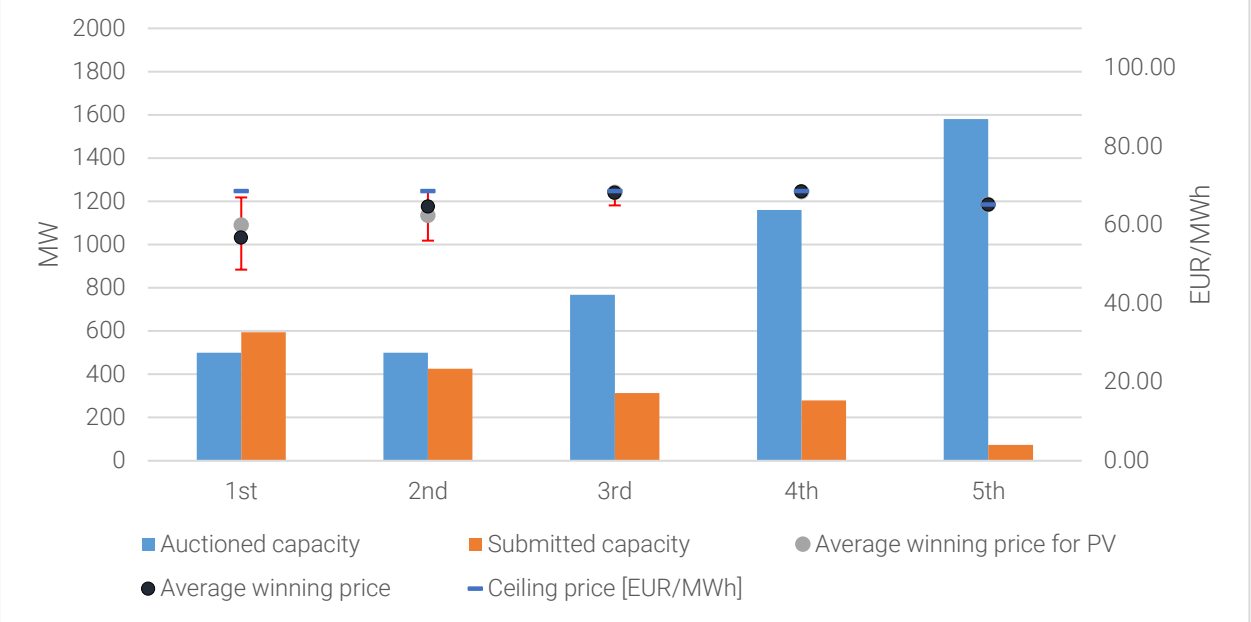
[5] In parenthesis the level of competition relative to the originally planned auctioned capacity.

countries like Greece (Anatolitis, 2019), it is the opposite mechanism, whereby if an auction round is undersubscribed the auctioned capacity in the next round is lowered to enhance competition.

From Table 4 it is clear that onshore wind dominated the tender. Except the 5th round, more than 100 MW were awarded to onshore wind in each round while PV was less than 50 MW in all but the third round. With such favourable natural properties for solar PV, the dominance of wind is more a consequence of the regulatory environment. In Italy it is not possible to install ground mounted PV on agricultural land, which market participants argue severely limits the installation options resulting in less favourable locations (Globaldata, 2020). As a result, the regulator received significantly less PV bids than onshore wind.

Figure 4 summarises the final prices awarded in the five auction rounds, following the expected trend with an increasing rate of undersubscription in consecutive.

Figure 4: Average, minimum and maximum awarded prices in the Italian large-scale auctions



Source: Own calculation based on GSE's webpage

The first auction round in 2019 was the only in which Category A was oversubscribed and resulted in relatively competitive prices. The average price across all technologies was 56.75 EUR/MWh, close to that of the auctions in continental Europe. However even the first auction was relatively uncompetitive, resulting in a wide price range of winning offers from the lowest, 48.62 EUR/MWh, to the highest, 66.99 EUR/MWh, approaching the ceiling price of 68.60 EUR/MWh. In all likelihood, competitive bids were made but some market participants, expecting less competition, submitted bids well above their actual cost levels.

The above hypothesis is strengthened by the fact that in the later severely undersubscribed rounds all winning bids started to converge towards the ceiling price. In the 4th auction round, for example, the lowest winning bid was 68.51 EUR/MWh compared to the highest which arrive at the administratively set ceiling price, 68.60 EUR/MWh. There is a small price decline in the 5th round because the price ceiling was lowered by 5%, but all bids were still up to this ceiling price. It is reflective of an administratively set FIT scheme, where projects with necessary licenses at the offered price level will be realised.

There is not a large price difference between onshore wind and solar PV prices. Onshore wind enjoyed a price advantage over PV in the first round, while in the second round PV projects bid on average lower prices. In all other rounds the two technologies bid very close, which is attributable to low competition, though there are certainly cost differences between PV and onshore wind in Italy. This seems to be supported by the recently published LCOE data. According to IRENA (2021) the weighted average LCOE for utility scale solar PV in Italy

was 68.53 EUR/MWh6 in 2019 and 66.25 EUR/MWh in 2020 compared to 90.23 EUR/MWh and 75.38 EUR/MWh in Germany. The LCOE values for wind were 61.68 EUR/MWh and 62.82 USD/MWh for the same years compared to 67.39 EUR/MWh and 61.68 EUR/MWh in Germany.7 According to IEA (2020) calculations, the LCOE derived for two utility scale solar PV plants was 68.59 EUR/MWh and 74.34 EUR/MWh respectively, and for two separate onshore wind projects 62.44 EUR/MWh and 70.29 EUR/MWh respectively. These LCOE values were calculated assuming a 7% WACC, which corresponds to the average WACC for wind projects reported by Roth et al. (2021)8.

From the auction results it can be concluded that the large solar and onshore wind auctions can neither be considered effective nor efficient. The completion rate of the projects is not known, however because of undersubscription, even with a 100% completion rate, the installed capacity will not reach the auctioned capacities, thus a priori effectiveness has not been achieved. On top of that, because of low competition, all project promoters bid very close to the ceiling price, which is a very inefficient allocation of support.

Auctions for large-scale projects – Category B & C

Table 5 summarises the main results of Category B (waste gas treatment plants and hydroelectric plants) and Category C (refurbishment). For Category B only two of the five rounds were successful with valid bids. In the 1st and 5th rounds the auctioneer received 1-1 valid bids, meaning that both auctions were heavily undersubscribed and bids were very close to the ceiling price. The former was 78 EUR/MWh and the latter 76.80 EUR/MWh with a ceiling price of 78.4 EUR/MWh. One explanation for the low participation could be the low ceiling price, typically higher in European auctions. For example, in Poland, hydro power and biomass auctions operated with a ceiling price of more than 100 EUR/MWh (Diallo et al, 2018). However, from the results it is evident that demand for Category B capacities was weak even with a low (5 MW) initially tendered capacity.

Table 5: Large-scale auction results for Category B and Category C

	Category B			Category C		
	Auctioned capacity[9] (MW)	Total winning capacity (MW)	Average price (EUR/MWh)	Auctioned capacity[10] (MW)	Total winning capacity (MW)	Average price (EUR/MWh)
1st auction	5 (5)	0	Not applicable	60 (60)	21.48	52.06
2nd auction	10 (5)	2.47	78	98.50 (60)	14.68	74.48
3rd auction	17.53 (10)	0	Not applicable	143.83 (60)	23.12	78.31
4th auction	32.53 (15)	0	Not applicable	180.70 (60)	27.26	78.39
5th auction	47.53 (15)	2.93	76.80	233.46 (80)	20.95	76.82

Source: Own calculation based on GSE's webpage

Category C follows the trend of Category A, heavily undersubscribed in all five rounds with a continuously declining rate of competition attributable partly to the capacity accumulation mechanism. It is important to

6 The exchange rates used are average annual values retreived from Eurostat, we used 1.1422 (2020 USD/EUR) in case of data from IRENA and 1.1810 (2018 USD/EUR) in case of data from IEA,

7 For the LCOE and other cost data included in IRENA (2021) see the "downloadable chart data" at https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020.

8 They found WACC to range between 4.6-6.0% for onshore wind in Italy.

9 In parenthesis the originally planned auctioned capacity.

10 In parenthesis the originally planned auctioned capacity.

highlight however, that even with the originally planned volumes, total submitted capacity probably would have been less than the auctioned capacities. The total submitted bids are relatively constant between 20 MW and 30 MW in all rounds. The first round was competitive in terms of prices, with a weighted average bid price of 52.06 EUR/MWh. In subsequent rounds, however, producers read the situation and bid very close to the ceiling price (78.40 EUR/MWh), with average bids varying between 74.48 EUR/MWh and 78.39 EUR/MWh. Hydroelectric won the refurbishment auction rounds except for a few successful bids for onshore wind in the 1st round.

Similarly to Category A, neither Category B nor Category C auctions can be considered efficient and effective because only a small volume of capacities were awarded and there was a pervasive lack of competition that inflated prices towards the ceiling price.

5.2 Auctions for small-scale projects (registry)

As mentioned, for smaller power plants (less than 1 MW) a completely different auction system is organised. The main difference is that the selection criterion is not solely based on the bid price, which in fact is the least important in the Italian scheme. The ranking is mainly based on locational and technology specific characteristics which were described in detail in Table 3. Additionally, there are separate technology baskets, such as Category A-2 for installations replacing asbestos and slate from old buildings. The small size tender is organised at the same time as the large size auctions, so similarly 5 rounds were concluded. The outcomes are summarized in Table 6.

The first two rounds of Category A (onshore wind and PV) were oversubscribed and competitive. In the 1st round bids totalled 68 MW for 45 MW of auctioned capacity, falling to 50 MW in the 2nd round. These two rounds resulted in an average tariff reduction[11] of 1.47% and 2.55% relative to the reference price according to technology and size. Most of the participants bid 0% reduction with some offering higher. However, the increasing auctioned capacity, as a result of intentionally planned auctioned capacity increase and the capacity accumulation mechanism, in the latter rounds led to significant undersubscription and lower competition. Therefore, beginning with the 3rd round the weighted average tariff reduction for Category A remained below 1%. It is worth noting that even though small power plants participated, winning bids were divided between onshore wind and PV, so PV did not dominate the tender as in the Polish small size auction (Diallo et al, 2018).

[11] In registry procedures reference prices differ within Categories as well, therefore average tariff reduction should serve as a universal measure to compare results, not absolute price.

Table 6: Results of the small-scale auctions, by technology categories, Note: In parenthesis the originally planned auctioned capacity

	Category A			Category A-2			Category B			Category C		
	Auctioned capacity (MW)	Awarded capacity (Mw)	Average tariff reduction (%)	Auctioned capacity (MW)	Awarded capacity (Mw)	Average tariff reduction (%)	Auctioned capacity (MW)	Awarded capacity (Mw)	Average tariff reduction (%)	Auctioned capacity (MW)	Awarded capacity (Mw)	Average tariff reduction (%)
1st auction	45 (45)	45	1.47	100 (100)	8	0.40	10 (10)	10	0.52	10 (10)	3.1	0.24
2nd auction	45 (45)	45	2.55	192 (100)	23	0.20	10 (10)	10	0.40	17 (10)	1.6	4.42
3rd auction	100 (100)	61	0.38	270 (100)	19	0.34	10 (10)	16.2	0.01	25 (10)	0.9	0.34
4th auction	112 (100)	84	0.55	351 (100)	64	0.01	10 (10)	10	0.19	34 (10)	0.6	0
5th auction	148 (120)	112	0.33	387 (100)	71	0.03	10 (10)	14.3	1.44	54 (20)	2.9	0.20

Source: Own calculation based on GSE's webpage

In Category A-2 (PV replacing slate and asbestos), the auctions were largely undersubscribed. This is mainly the result of the high 100 MW capacity limit under which participants faced absolutely no competition. Therefore, in all rounds the average tariff reduction was less than 1%, with only 0.01% and 0.03% in the last two.

Category B (hydroelectric and waste gas treatment) is the only technology basket which was oversubscribed in all 5 rounds because auctioned capacities were relatively low (10 MW) and constant. The level of competition declined each round. Excess capacities (valid but non-winning bids) decline from 20 MW in the 1st to 3.5 MW in the 5th. Even with this oversubscription, only the 5th round produced an average tariff reduction of more than 1%.

The reason behind this phenomenon lies in the auction design itself. A general pattern in all technology baskets is that those power plants with an advantageous ranking (because of other non-bid related criteria) tend to offer less reduction from the reference price than those without locational or technological advantages. This way participants with 0% reductions can and do win, while others do not have a chance even with the prospect of higher reductions. This is highly inefficient for prices, as many participants are not incentivised to offer reduction and more competitive offers have no opportunity to win the tender. In our view the situation can be improved by replacing the ranking of criteria with some type of aggregate scoring. This would maintain the multi-criteria nature of the auction while enhancing competitive pricing.

Finally in Category C (refurbishment) all auctions were massively undersubscribed, resulting in an average tariff reduction of less than 1%. The only exception was the 2nd round with an average reduction of more than 4%. For unknown reasons two out of the three winning hydroelectric projects offered a tariff reduction of 5% relative to the reference price.

6 Conclusions

Italy has designed a complex renewable auctions support system to promote the penetration of renewables, but in practice the system is far from ideal. Most of the technology baskets both in small and large size auctions were heavily undersubscribed, which resulted in high awarded prices close to the ceiling price. This is a clear signal of inefficient support allocation and leaves most tendered capacities unawarded.

This report identified several regulatory, administrative and auction design elements for the pervasive undersubscription of Italian auctions. First, there are many regulatory barriers present in the county. The permit granting procedure is lengthy and cumbersome according to the market participants. Additionally, Italian regulation forbids the installation of ground mounted solar PV plants on agricultural lands, which significantly reduces available sites for PV. It is important to note however, that the Italian government is planning to announce new regulatory measures in August 2021, to streamline permitting procedures, boost renewable deployment, and improve the overall efficiency of the renewable auctions. Details of these proposed measures are not yet public.

Second, in addition to the regulatory issues, several auction design elements diminish efficiency. All Italian auctions in 2019-2021 have a pre-set date and planned auctioned capacity which helps reduce investor uncertainty, but the upward correction of the predefined tendered capacity rate is a design flaw. If this design feature is abolished upcoming auctions may face higher level of competition.

In addition, there are several other elements which can be adapted to improve efficiency. Both the small and large-scale auctions operate with a maximum allowed rate of tariff reduction, which seems unnecessary as it would limit the achievable price reduction in case of a high number of participants. In the multi-criteria auction procedure (less than 1 MW) competition does not necessarily reduce prices because the ranked criteria are in strict hierarchical order. This means that those power plants meeting specific criteria are not incentivized to submit competitive offers. A shift toward an aggregated score system based on the applied criteria should enhance competition.

To conclude, the currently existing Italian auction system cannot fulfil its purpose because undersubscription drags down competition and results in higher prices. In order to achieve a more efficient outcome both in terms of prices and awarded capacity, Italy must address the above mentioned regulatory and auction design elements.

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AURES II is a European research project on auction designs for renewable energy support (RES) in the EU Member States.

The general objective of the project is to promote an effective use and efficient implementation of auctions for RES to improve the performance of electricity from renewable energy sources in Europe.

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