

Distributed Resources in the Italian Ancillary Services Market: taking stock after two years

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Introduction

One characteristic of every power system is the need to guarantee continuously a real-time balance between electricity consumed (e.g. demand from households and businesses) and electricity supplied (e.g. by power plants). Terna guarantees this balance using a highly technological control system, and by running a dedicated market where the “services” required to constantly ensure the continuity and security of the electricity supply are purchased. Today, the main suppliers of these flexibility services are large fossil-fuel power plants. With progressive decarbonisation of production facilities, in future, new, flexible resources will also be required (e.g. industrial production plants, residential water heaters and electric vehicles) to guarantee the adequacy and security of an increasingly heterogenous electricity system, far more complex than the current one (see Figure 1).

In this context, Terna, in agreement with the Italian Regulatory Authority for Energy, Networks and Environment (ARERA), has launched a process for progressive opening of the ancillary services market (“Mercato dei Servizi di Dispacciamento”, MSD) to distributed resources, through definition of pilot projects aimed at measuring the performance of these resources in order to ultimately launch an organic reform of this market.¹ The term “pilot project”, derives from the goal to test functioning of the new resources and subsequently proceed, together with ARERA, with a complete review of the ancillary services market and Grid Code, under which such resources would be fully integrated in the ancillary services market.

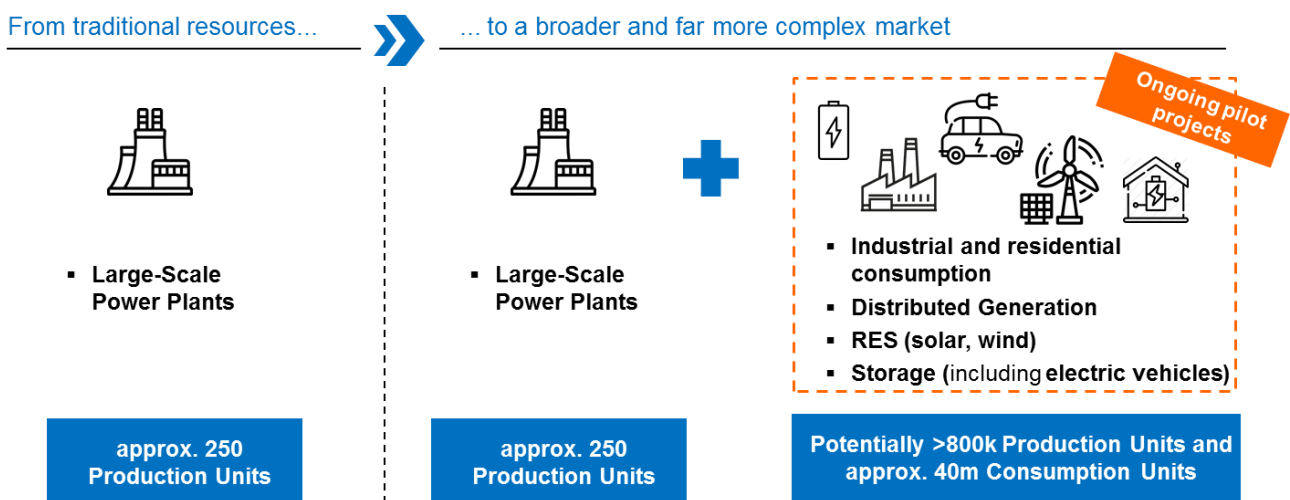


Figure 1: Evolution of the electricity system and opening of the ancillary services market to new resources

The primary aim of pilot projects is therefore to immediately increase the quantity of resources available to guarantee the adequacy and security of the electricity system at a lower cost for the end user, through procurement of reserve services and balancing in the context of the progressive decarbonisation of generation facilities. A further goal is to diversify the types of resources participating in the ancillary services

¹ Resolution 300/2017/R/eel “Initial opening of the ancillary services market (MSD) to electricity demand and production units, also from renewables not yet enabled, as well as storage systems. Establishment of pilot projects with the aim of defining the consolidated rules on electrical dispatching (TIDE) in line with the European Balancing Code”.

market, attributing an active role in relation to demand for generation plants in the “non-significant” category (<10 MVA) and storage systems.

In this context, it is important to clarify that Terna currently procures services from traditional thermal sources and that diversification of resources, launched through the pilot projects, can contribute to minimising overall costs for the electricity system. Qualitatively, this contribution is illustrated in Figure 2, which assumes an electricity system with two generation plants (both with P_{min} 100 MW, P_{max} 400 MW) and demand of 400 MW, in which the outcome of energy markets (day-ahead and intraday) defines one plant at maximum load (400 MW) and the other one offline. In this context, the system would be without an upward reserve (possibility to increase maximum power issued to the grid), meaning that Terna would have to intervene on the MSD (ancillary services market), reducing the output from the unit at maximum load and activating the other plant. Such actions, aimed at restoring the reserve, are obviously costly as they require accepting sale offers (at the price offered by the offline unit), and purchase offers (at the price offered by the unit that must reduce load), as well as covering activation costs. It is important to note that such costs are incurred by the system independent of whether or not the aforementioned reserve is used for real-time balancing, and are associated exclusively with guaranteeing availability of upward reserve.

Instead, if sales offers (increase in generation and/or consumption) from virtually aggregated units (UVA) were available in the same hour, in sufficient quantities to meet upward reserve demand, it would not be necessary to perform the above-described operations to restore correct reserve margins.

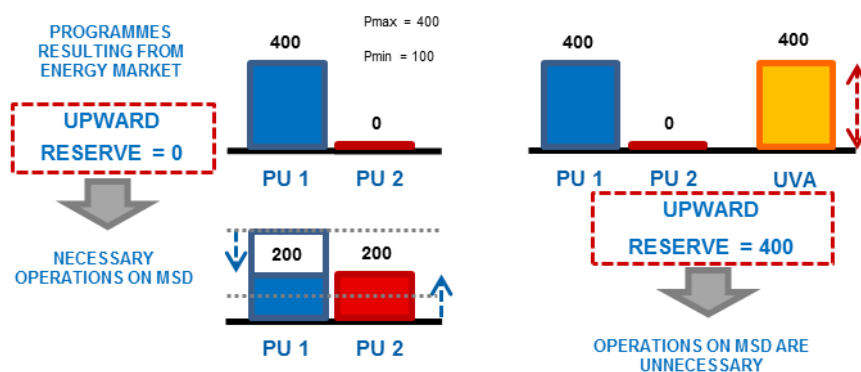


Figure 2: Benefit of distributed resources for the system (illustrative)

Terna, also through dialogue with stakeholders, has identified the following² pilot projects as being particularly innovative:

- Virtually Aggregated Consumption Units (UVAC)
- Virtually Aggregated Production Units (UVAP)
- Virtually Aggregated Mixed Units (UVAM)
- Relevant Production Units (UPR) not subject to mandatory participation

² Another pilot project, UPI, has also being launched regarding provision of the primary frequency regulation service via storage systems that are integrated in large-scale production units. The production units participating in this pilot project may increase the maximum power that can be offered on energy markets by up to 1.5 percentage points (equal to the mandatory half-band for provision of the primary regulation service).

Starting from aggregating only consumption points (UVAC) and only production points (UVAP), the projects identified by Terna have “evolved” towards mixed aggregations (UVAM). Moreover, it is now possible for relevant plants (UPR) which are not already subject to mandatory participation to offer their flexibility in the Ancillary Services Market (MSD).

Specifically, the UVAC and UVAP pilot projects have been launched to enable on the MSD both demand (from June 2017) and distributed generation (from December 2017), respectively, concluded in November 2018 in order to launch the UVAM pilot project, enabling consumption and production units as well as storage systems in these aggregations (see Figure 3). Alongside qualification of virtual units (UVA), in August 2018, a pilot project was launched for voluntary participation in the MSD of UPRs not subject to mandatory participation. This category includes, for example, large-scale wind and solar plants (>10 MVA), that therefore represent significant generation plants but which are not subject to mandatory participation on the MSD.

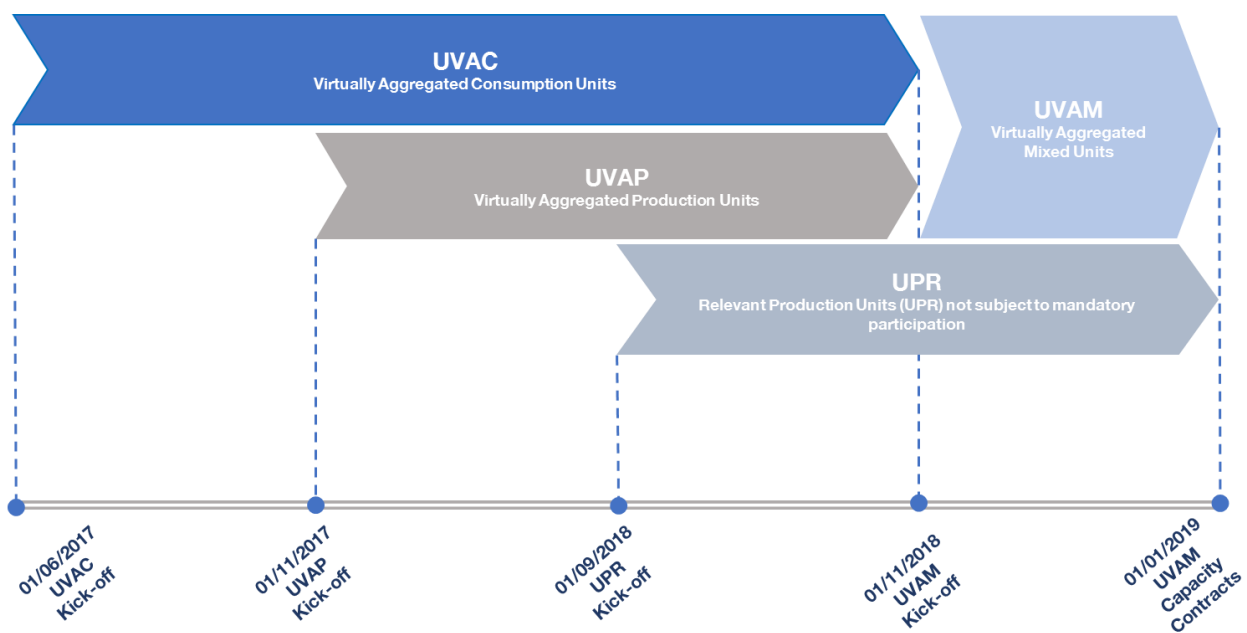


Figure 3: Pilot-project timeline

This article focuses on virtual-units (UVA) pilot projects, including aggregations of consumption/generation and mixed points (UVAC, UVAP and UVAM). Starting from an overview of participation requirements and remuneration mechanisms, the initial results of these projects are then presented, analysing power subject to contract, remuneration level and cost for the electricity system.

How to participate in pilot projects

Via pilot projects, also **distributed resources** which do not meet the minimum requirements defined by the Grid Code³ may be enabled to provide certain **ancillary services, such as congestion management, balancing and tertiary reserve services**. These resources cannot, however, at least in the initial phase, provide other services such secondary reserve.

The UVA are composed of aggregations of consumption and/or generation points and storage systems (including e-mobility charging stations), that are connected to the grid at any voltage level and fall within the scope of aggregation defined by Terna (group of provinces). For the first time in Italy, the figure of aggregator has also been introduced, the Balancing Service Provider (BSP): the party which is managing the UVA and responsible for provision of services traded on the MSD that does not necessarily have to correspond with the Balancing Responsible Party (BRP). In fact, the BSP does not have a contractual relationship with the BRP and provides services directly to the grid operator, while the BRP is responsible for payment of the imbalancing fees.

The UVA aggregate consumption and/or production points (that may be included under ownership of different BRPs) are relevant only for participation in the MSD and not in energy markets, unlike traditional dispatching points that also participate in energy markets (e.g. large power stations).

Figure 4 illustrates the different types of virtual units.

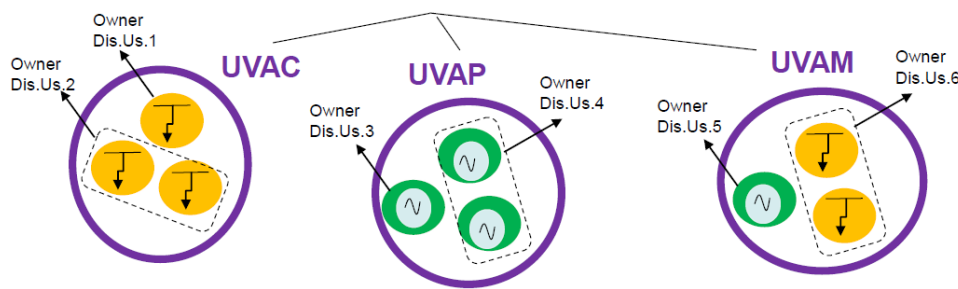


Figure 4: Types of Enabled Virtual Units

Each point included within the UVA must be equipped with a “Peripheral Monitoring Unit” (UPM). This is a device capable of measuring electricity generated/consumed and sending such measurement data to the hub, i.e. the device for interface with Terna systems that sends aggregate measurements/estimates every 4 seconds (for consumption points with adjustable power <1 MW and generation points with adjustable power <250 KW the frequency is every 60 seconds; for all others it is every 4 seconds).

For UVAM (and in past for UVAP), the BSP has to communicate a baseline day-ahead, i.e. the overall power programme expected for the units included within the UVAM, net of consumption of interruptible loads. The baseline is then modified by Terna through a correction factor, estimated on the basis of the difference against the measured value. The corrected baseline plus the sum of upward or downward quantities activated on the MSD determines the final programme that is compared with the measurement⁴ of overall electricity exchanged (consumed/generated) from the points included with the UVAM, for verification of the correct performance of the operation requested by Terna.

³ See Chapter 4 of the Terna Grid Code

⁴ The measurement figure communicated by the relative Distributors or by the Integrated IT System pursuant to arts 38 and 38-bis of the TIS – consolidated rules on settlement. In the absence of quarter-hourly measurements, Terna will conventionally divide the hourly measurement figure by four.

Remuneration of availability in addition to activated energy

For the first time in Italy, economic regulation defines two remuneration mechanisms, the first linked to energy activated (€/MWh) and the other linked to availability (capacity cost, €/MW).

The current framework defines remuneration for all UVA, as for large-scale power plants, of the quantities accepted on the MSD and fees for failure to respect orders. Finally, as actions issued by Terna must not have effects on the imbalancing paid by the BRP, the BSP is required to communicate the ratio for division of the quantities accepted on the MSD for each dispatching point. This enables Terna to proportionally correct the programmes resulting from the energy markets of the dispatching consumption and/or generation points and thus “cleanse” relative charges, that remain with the BSP.

First for UVAC and then for UVAM, in addition to valuation of the quantities accepted on the MSD, the regulation defines that Terna can purchase options on dispatching resources and consequent recognition of a fixed fee for availability of capacity.

This capacity is allocated through auctions on the fixed premium from 30,000 €/MW/year, with pay-as-bid allocation. In particular:

- for UVAC, in 2018, only resources located in the North and Centre-North market zones were allowed and the requested capacity was 500 MW.
- for UVAM in 2019, resources located within the entire national territory were allowed and two areas of allocation were defined with different requested capacities: 800 MW for zone A (North and Centre-North), 200 MW for zone B (Centre-South, South, Sicily and Sardinia).

The assignee BSP commit to present offers from Monday to Friday for a certain number of consecutive hours (different for UVAC and UVAM) during the period 14:00-20:00 and at a price no greater than the Strike Price of 400 €/MWh. Terna pays the BSP a fixed fee for each day in which the offer obligations are observed.

Below is an overview of the different types of virtual units, indicated characteristics, service modes and remuneration.

PILOT PROJECT	SPECIFICATIONS	MINIMUM POWER THRESHOLD	SERVICES	MODE	REMUNERATION	VALIDITY
UVAC	<ul style="list-style-type: none"> points of withdrawal 	from 10 MW to 1 MW	<ul style="list-style-type: none"> «Upward» tertiary reserve «Upward» balancing 	Reduction of withdrawal by at least 1 MW within 15 minutes of Terna request	Remuneration of quantity accepted on ASM/penalties + LT contracts	From June 2017 To October 2018
UVAP	<ul style="list-style-type: none"> Small-scale PUs 	from 5 MW to 1 MW	<ul style="list-style-type: none"> Congestion management («upward» and/or «downward») Tertiary spinning reserve («upward» and/or «downward») Tertiary replacement reserve («upward» and/or «downward») Balancing («upward» and/or «downward») 	«Upward» and/or «downward» flexibility, of at least 1 MW within 15 minutes of Terna request	Remuneration of quantity accepted on ASM/penalties	From November 2017 To October 2018
UVAM	<ul style="list-style-type: none"> points of withdrawal that do not include PUs Small-scale PUs Larger PUs not subject to mandatory MSD participation Stand-alone storage systems or those combined with PUs 	1 MW	<ul style="list-style-type: none"> Congestion management («upward» and/or «downward») Tertiary spinning reserve («upward» and/or «downward») Tertiary replacement reserve («upward» and/or «downward») Balancing («upward» and/or «downward») 	«Upward» and/or «downward» flexibility, of at least 1 MW within 15 minutes of Terna request	Remuneration of quantity accepted on ASM/penalties + LT contracts	From November 2018

Figure 5: UVA pilot projects

Over 800 MW of UVA capacity qualified for MSD

The figure below presents the trend of UVA capacity qualified for MSD participation, including those with a capacity contract. The period begins from June 2017, the month of launch of the UVAC, with power of around 100 MW, until reaching a peak of 600 MW certified capacity between UVAC and UVAP in October 2018. There was then a decrease in qualified capacity in November 2018, due to the launch of UVAM which required new qualifications, but in the initial months of 2019, capacity has already stabilised around 600 MW, reaching 830 MW⁵ in June, with 83% subject to contracts. The goal is to allocate 1000 MW of capacity by the end of the current year, through auctions.

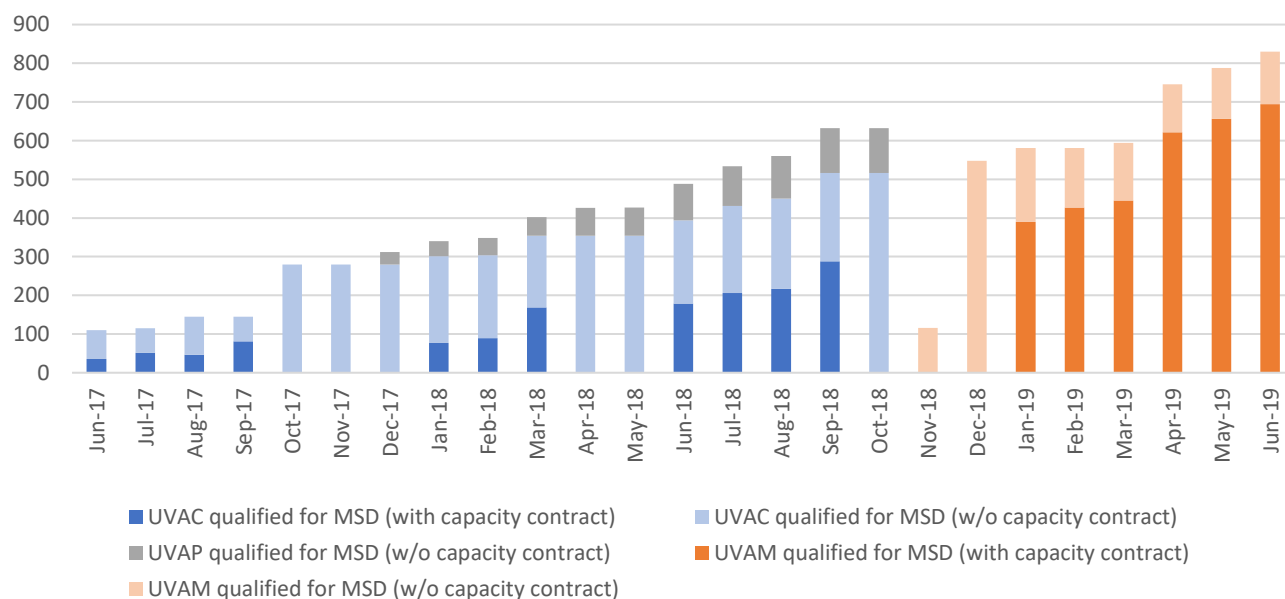


Figure 6: Power enabled and subject to contracts on the MSD (MW)

In 2017 and 2018, capacity contracts for UVAC were established only for high-consumption periods (winter and summer), whilst with the introduction of UVAM, auctions with annual/intra-annual/monthly validity are planned to cover the whole of 2019.

The decision to remunerate the **availability** (originally only for UVAC, then also for UVAM), is motivated by the economic considerations set out in the introduction, as well as the fact that the participating resources on the consumer side are mainly represented by industrial production plants. These parties, to provide flexibility to the ancillary services market, must bear fixed investment costs for installation and calibration of equipment required to develop the service (e.g. an UPM) and annual operational management costs (e.g. establishment of energy trading rooms). Furthermore, to meet Terna's requirements, they must interrupt and/or vary the industrial production cycle, facing economic expense for an activity which is not their core business. Remuneration of activated energy alone, that is influenced by the volatility of spot prices and is difficult to forecast and programme, is generally insufficient to cover such costs. It is therefore fundamental to have a "capacity market" where the availability to provide services can be subject to option contracts, against fixed remuneration ("option price").

⁵ In June 2019, the UVAM capacity was composed 65% by mixed points (generation/consumption), 21% by generation points and the remainder consumption only, 80% of which located in the North zone.

European comparison

Initial results of the pilot projects **are very encouraging when compared with other European countries**. From the smartEN⁶ study⁷ on the use of distributed resources in European ancillary services markets, it emerges that Italy has a good level of performance. In fact, alongside Austria and Belgium, it presents a minimum adjustable power threshold of 1 MW (France and the Netherlands require 10 MW and 20 MW, respectively) and has allowed significant participation of distributed resources, achieving more qualification of aggregated units than France or Finland in just one year from launch of the first pilot project (in June 2019 Italy has qualified the same capacity of Belgium in 2018, see Table 1).

This result is even more significant considering that in the previous smartEN assessment (named SEDC until 2017), the Italian market was assessed as totally closed to distributed resources. Through comparison with the current assessment, it emerges that **Italy is the European country that has made the most significant progress in relation to enabling distributed resources on the dispatching services market** (see Figure 7).











COUNTRY	TYPE OF POOLING	MINIMUM POWER THRESHOLD	AVAILABLE CAPACITY
 ITALY	Pooling of withdrawal points (non residential) and distributed generation	1MW	830 MW*
 AUSTRIA	Pooling of withdrawal points (non residential) and distributed generation	1MW	N.A.
 BELGIUM	Pooling of withdrawal points and distributed generation	1MW	830 MW
 FINLAND	Pooling of withdrawal points and distributed generation	5MW	300 MW
 SWITZERLAND	Pooling of withdrawal points and distributed generation	5MW	50 MW
 NETHERLANDS	Pooling of withdrawal points and distributed generation	20MW	150 MW
 IRELAND	Pooling of withdrawal points (non residential)	4MW	480 MW
 GREAT BRITAIN	Pooling of withdrawal points and distributed generation	3MW	135 MW
 GERMANY	Pooling of withdrawal points and distributed generation	5MW Germany-Luxemburg LFC block 1 MW LFC Area	N.A.
 FRANCE	Pooling of withdrawal points and distributed generation not allowed	10MW	500 MW

Table 1: Benchmarking of distributed resources in European Ancillary Services Markets (Source: The smartEN Map 2018), Italian value updated June 2019

⁶ smartEn is an association of market operators promoting decentralised energy solutions

⁷ The smartEn Map 2018, see <https://www.smarten.eu/thSMARTENmap/>

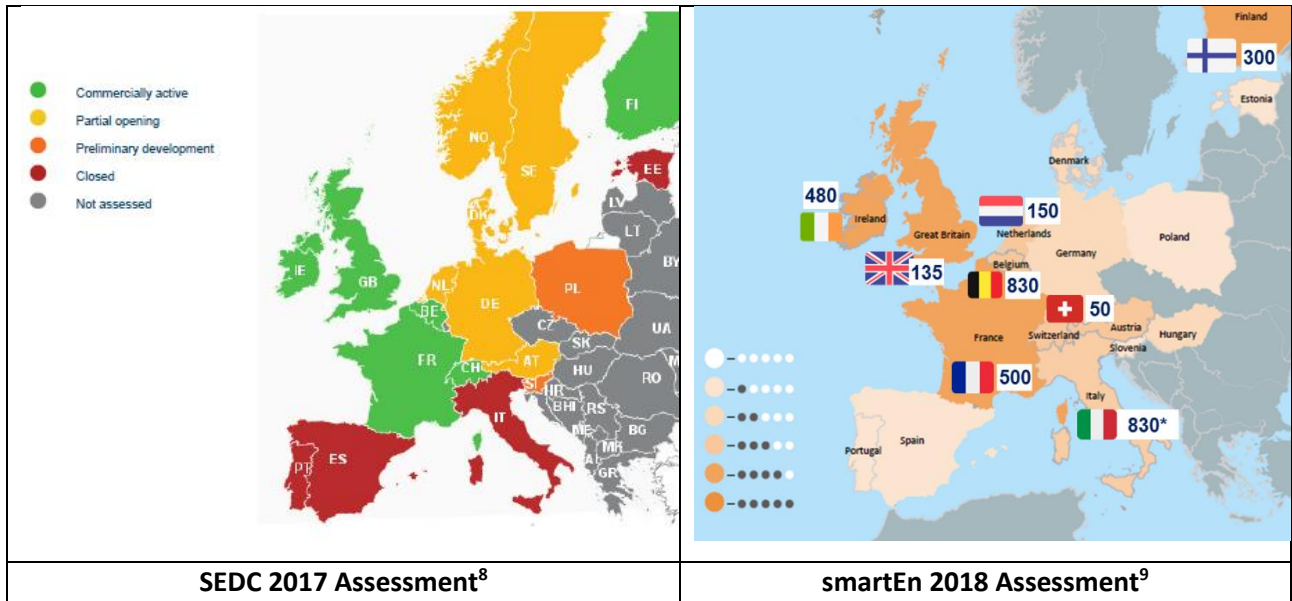


Figure 7: Degree of opening of dispatching services market to distributed resources, SEDC/smartEn

⁸ Explicit Demand Response in Europe – Mapping the Markets 2017

⁹ The smartEN Map 2018, Italian value updated June 2019

2019 UVAM Allocations: more than 650 MW of power subject to contracts in May

Table 2 presents the results of allocation of capacity contracts at the 2019 annual auction (January–December), the infra-annual auction (April–December) and monthly auctions, with the average weighted price. Today, in the April–December 2019 period, overall power subject to contracts totals **510 MW** (345 MW for annual auction and 165 MW for interim auction).

Meanwhile, in May, purchases totalled **694 MW**.

Validity periods	Available capacity (MW)		Allocated capacity (MW)		Average weighted price (€/MW/yy)	
	zone A	zone B	zone A	zone B	zone A	zone B
Jan-Dec 2019	800	200	327,8	17,1	29.979,7	29.999,0
Apr-Dec 2019	472,2	182,9	144,5	20,3	29.985,5	29.997,4
January 2019	472,2	182,9	38,9	5,9	29.992,1	30.000,0
February 2019	472,2	182,9	71,9	10,4	29.997,3	30.000,0
March 2019	472,2	182,9	83,1	17,5	29.999,5	30.000,0
April 2019	327,7	162,6	84,2	27,7	29.999,0	29.967,0
May 2019	327,7	162,6	123,7	22,7	29.992,0	29.982,0
June 2019	327,7	162,6	155,0	29,5	29.982,7	29.986,1

Table 2: 2019 UVAM allocation

In the 2019 annual auction, there were 11 BSP assignees for zone A (North and Centre-North), which rose to 14 for the April–December interim auction (see Figure 8). Enel X holds 41% of the market share for all allocated capacity in 2019 (694 MW), followed by Burgo Energia with around 14%, Ego trade with 11%, and the remaining BSP below 6%.

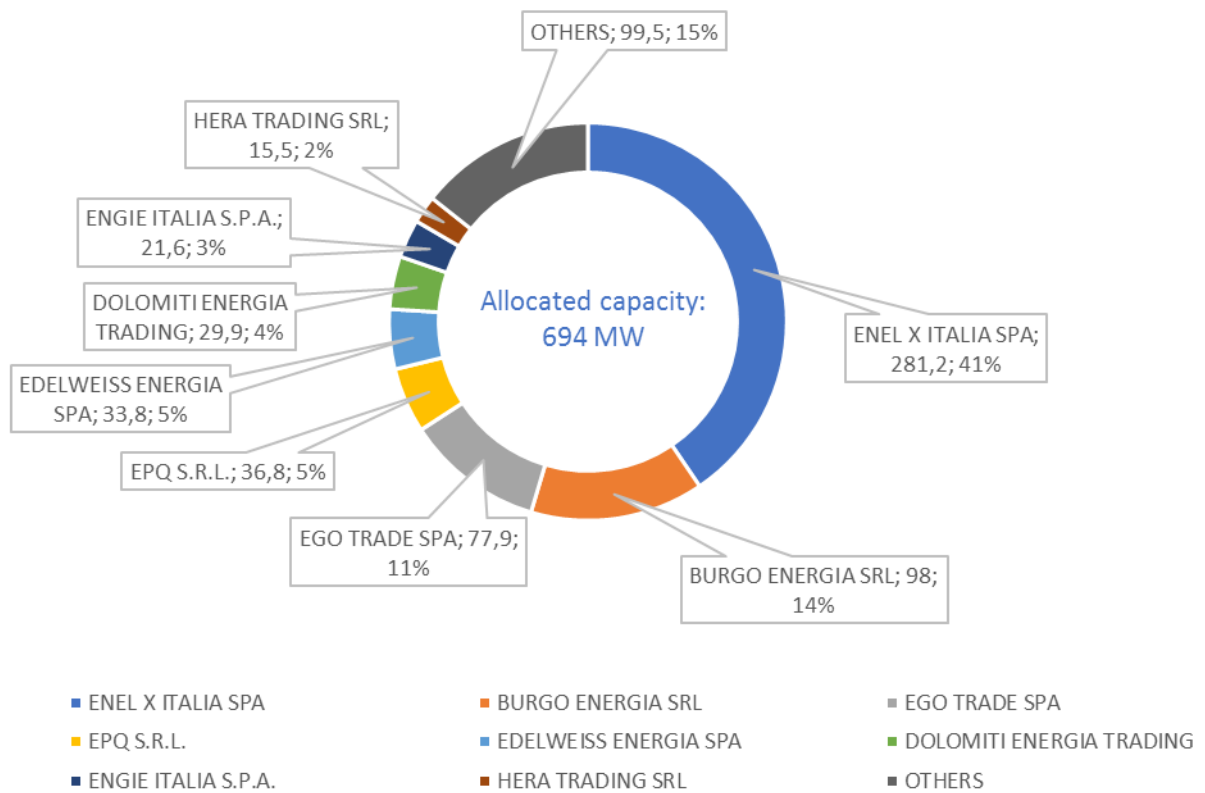


Figure 8: BSP assignees of capacity contracts (updated June 2019)

The overall cost of pilot projects is led primarily by the cost of capacity contracts

As for remuneration that is divided into cash flow linked to availability and activation, two categories of costs can be distinguished: a capacity cost and an activation cost based on the quantities accepted on the MSD.

As no explicit remuneration of UVAP availability is defined, the overall cost for 2018 for capacity is equal to the cost of UVAC, which costed the electricity system just over € 4.8 million, around 0.3% of total MSD cost (provisional figure of €1,573 million) and grew proportionally in relation to the progressive increase in capacity contracted. The cost was zero in the months of April, May and October 2018, when there were no capacity contracts. Remuneration of UVAM availability began in January 2019 and grew constantly with the growth in contracted capacity (see Figure 9).

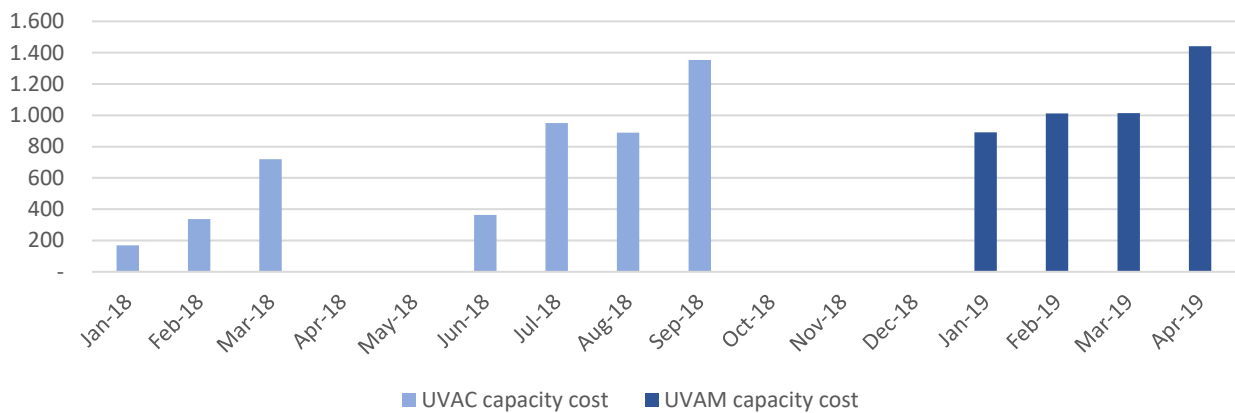


Figure 9: UVAC and UVAM fixed fee cost (€k)

Regarding energy activated for 2018, costs for quantities accepted on the MSD were € 290,000, 70% of which were UVAC alone, while for the initial months of 2019, UVAM represented just over € 20,000.

Comparing the two cost categories, it is evident that cash flows relative to capacity represent almost the entire overall cost. This is also due to the fact the until now, the activation rate for UVA has been relatively low.

Conclusions and next steps

The participation rate of distributed resources in Ancillary Services Markets is currently growing in many foreign countries, and will progressively assume a fundamental role to satisfy the flexibility needs of the future power system. The International Energy Agency estimates that in 2050, demand response from industrial, tertiary, residential and transport sectors (essentially due to the development of electric vehicles) in Europe may reach 150 GW.¹⁰

With almost 830 MW of capacity qualified for MSD so far, and the goal of contracting 1000 MW by the end of 2019, the Italian pilot projects, whilst having their limit, may be considered a success, as also confirmed by the European benchmark. From analysis performed by smartEN, it clearly emerges that Italy is the European country that has made the most significant progress in the last two years for enabling distributed resources on the dispatching services market.

Considering the promising results, Terna intends to continue with implementation of further pilot projects with the following key aims:

- experiment with participation of distributed resources in other services (frequency regulation as well as voltage regulation, etc.)
- incentivise competition and increasing participation of resources in existing services, attempting to also progressively involve other low-consumption resources in the tertiary and/or domestic sector
- leverage the experience gained through pilot projects to develop proposals for a complete redesign of the ancillary services market.

Terna is committed to solid continuation of this testing due to the importance it holds in the context of the energy transition. These pilot projects allow Terna to test the performance of distributed resources whilst also allowing them to involve and incentivise operators, from within and outside the electricity sector, to research innovative solutions for the provision of ancillary services.

¹⁰ Source: International Energy Agency (IEA), Re-powering Markets 2016