The pivotal role of storage in the Italian electricity market

8° AIEE Energy Symposium – Grid security and energy storage session

Padova, 28th November 2024 – Federico Gallo

Shortcomings of traditional market design

Traditional market design features

- ✓ Short and long-term **efficiency objectives**, ensured by the **promotion of competition**
- ✓ System **adequacy** and **security** largely provided for free by conventional generation

New priorities affecting market design

- ✓ **Decarbonization** at the centre of energy policy developments (stemming from EU-wide target of 45% renewable energy by 2030)

Challenges arising from the integration of RES

- ✓ **Non-dispatchable** and **distributed** nature of renewable energy generation
- ✓ Inadequate **investment signals** from wholesale markets to handle RES peculiar cost structure

A 3-market forward model

Key objectives

Alignment of investment incentives with **system needs**, moving beyond conventional CfD models

PRO-DECARBONIZATION MARKET

Ensuring sufficient **resource availability** during tight system conditions

PRO-ADEQUACY MARKET

Supporting storage capacity rollout to balance RES variability and enhance **system security**

PRO-SECURITY MARKET

- The 3 forward market model first appeared in a work by Rocchio and Boschi in 2020
- The concept is based on the **integration of forward contracting mechanisms with existing market models**
- The model is built on the **sequence of 3 forward markets**, whose linchpin is identified in the procurement of resources functional to the security of the system

Source: adapted from Rocchio, Boschi ”Innovating the electricity market design to achieve an efficient decarbonisation process”, FSR

Storage participation in the market

Can **store excess production** during periods of low demand and release it during peak demand

Absorbs RES over-generation

Contributes to system adequacy and security

Provides **ancillary services** (voltage, frequency, inertia regulation) featuring low/zero technical minimums, **fast activation** and **rapid response** time to load fluctuations (e.g. to cover evening ramps)

Concrete risk of **market failure**

Requires significant **upfront investment** in equipment and infrastructure (e.g. BESS high cost of materials and advanced manufacturing or pumped hydro large-scale construction projects)

High fixed costs

Volatile returns

Returns depend on **exogenous variables** not predictable by the investor (e.g. the level of penetration of RES and grid developments); part of the margins depend on ancillary services hardly predictable and volatile

The Italian way: an application

PRO-DECARBONIZATION MARKET	**FERX Mechanism** to support RES rollout aligning investment incentives and system needs
PRO-ADEQUACY MARKET	**Capacity Market** as a structural feature of the market to provide resources for adequacy purposes (and possible adaptation post-2028)
PRO-SECURITY MARKET	**MACSE** a competitive mechanism to support investment in electricity storage through long-term payments

Deep dive on MACSE

- MACSE **-** Mercato di Approvvigionamento di Capacità di Stoccaggio Elettrico - is the upcoming Italian mechanism to support storage investment, **approved by the European Commission in December 2023**
- The mechanism will incentivize a total of 9 GW (71 GWh) of storage capacity for ten years*, with resources amounting to **17,7 bln €**
- The scheme will support the realization of storage capacity through **long-term payments** to cover investment and operating costs
- The first competitive procedure will consist of **two competitive auctions**: one will be dedicated to lithium-ion batteries, followed by another aimed at pumped hydro

*considering a starting point of electrochemical energy storage installed of 6,6 GWh (2023)

MACSE auctions process

Building the demand curve

- With the announcement of the auction date, **demand requirements** to be procured through the mechanism are defined for each relevant portion of the grid
- Based on these requirements and qualified capacity, the **quotas** for each area are published 20 days prior to the auction
- The **demand curve** built for each area during the auction phase is perfectly inelastic and corresponds to the defined quota

Building the supply curve

- The **supply curve** is built by arranging the bids submitted by auction participants in non-decreasing order of economic merit
- To determine economic merit, bids are adjusted by applying **coefficients** that reflect the varying performance levels of the plants
- The mechanism rewards storage systems capable of delivering **faster charge-discharge times** and **higher efficiencies**

Selection of bidders

- Bids selection is carried out with the aim of maximizing the **net value of transactions** at system level
- The intersection of supply and demand determines a **marginal premium**, corresponding to the highest premium among the selected bids
- The mechanism allows for the **partial contractualization** of the qualified capacity for the last selected bid if necessary

Source: Polimi E&S

MACSE further scope

In exchange for limiting the exposure to market risk (through the long-term payment) MACSE foresees the obligation to **make the storage asset capacity available to third-parties** in wholesale markets

This will enable the pooling and offering of storage capacity to third parties in the form of **standardized time-shifting products**. The SO will allocate physical storage resources to execute the standard time-shifting contracts, optimizing the use of available resources

These contracts can be purchased at auction from market participants through a **centralized platform** or on a **secondary market**, both instruments are managed and regulated by the Italian NEMO

The use of such instruments will allow market operators to **manage the unpredictability of RES generation**, linking this market with the pro-decarbonization one

Next steps of the mechanism

- The Ministry of Environment and Energy Security (MASE) must define **storage demand requirements** after input from the System Operator (Terna)
- The 1st auction should take place after **6 months from the definition of storage demand requirements** by the MASE (now expected June 2025)
- **Auction floor** for competitive procedures must be still identified after consultation by NRA
- First auction concerning **lithium-ion storage** systems only, while methodology and definition of **pumped hydro storage** demand requirements is still ongoing at SO level

BACKUP

Main steps of functioning

	Process phases
Start	**Communication of the competitive procedure:** The communication for the competitive procedure exam will happen at least 180 days before the first auction (270 days of advance from the second competitive procedure)
Phase 0	**Qualification of the plant:** Participants who intend to implement facilities that meet the minimum admission requirements shall make request to qualify for the auctions of the selected reference technology at least 75 days before the auction date
Phase 1	**Participation in auctions and contracting of the facility:** Participants bid qualified capacity in auctions. At this point Terna selects the bids to be accepted and announces the results of the auctions. The selection of bids can be full or partial based on the contractualization or non-contractualization of the entire capacity offered by the participant
Phase 2	**Negotiation of time-shifting contracts:** Terna allocates the total contracted capacity on different Storage Units combined with time-shifting contracts. These contracts can be purchased by auction from market participants through a centralized platform or on a secondary market, both instruments are managed and regulated by the GME
Phase 3	**Execution of time-shifting contracts:** Market operators leverage the virtual storage capacity of Storage Units to trade energy in markets (MGP, CRIDA, XBID) and in bilateral way. Participants are responsible for the proper operation of the facilities that enable such energy movements
Phase 4	**Execution of service markets and real time:** After the closure of energy markets Terna distributes the input and withdrawal schedule resulting from the execution of time-shifting contracts to individual plants, which, before executing it, can change it by offering downward or upward services in the services market

Planning period phase Delivery period phase

- From the time the auction date is announced, the mechanism is structured around four main steps
- Several actors take part in the execution of the mechanism, each with its own stake (MACSE Participants, Terna-System Operator, GME, Market operators)

Source: Polimi E&S