Executive Summary

Regulatory Framework

The European target model for the Internal Electricity Market (IEM) foresees energy markets (day-ahead and intraday) **based on a zonal representation of the European Power System**.

Bidding zones are then essential elements of today's and tomorrow's market design and they "*should be defined in a manner to ensure efficient congestion management and overall market efficiency*", as stated in the EU Regulation 1222 / 2015 (CACM).

The definition of bidding zone borders is therefore a question of major relevance for the IEM and requires dedicated analysis.

This topic has been tackled in the Italian Power System since the beginning of the Electricity Markets: the Italian Control Area has been subdivided in several Bidding Zones in order to cope with internal structural congestions.

Prior to the entry into force of the CACM, the Italian bidding zones review process was based on the regulatory framework set by the Resolution 111/06. According to this process, the efficiency of the existing Bidding Zones configuration was assessed every three years performing a full review aimed at identifying the optimal configuration for the successive three years.

The current Bidding Zones Review is the first national review pursuant to CACM Regulation (in application of article 32.1.b), formally launched by the Italian National Authority (ARERA) with the Resolution 22/2018/R/eel.

The main differences between the old process and the new one can be summarized as follow:

- According to Resolution 111/06, a Bidding Zones review had to be performed every three years (without a triggering event) while, under the CACM Regulation, a review shall be formally launched after a triggering event (this launch is mainly linked to the results of a dedicated monitoring process[1]).
- The list of criteria to be evaluated has been significantly enlarged, according to CACM article 33.1.
- The time horizon under assessment has been enlarged: from 3 years to 10 years, according to CACM article 33.2.

(1) A technical report (prepared by All TSOs) and a market report (prepared by All NRAs) shall be published every three years at European Level. In addition, Italian NRA requested to Terna an annual report (starting from 2019) for monitoring the Italian Bidding Zones efficiency.

Current Bidding Zones configuration and alternatives

The current Italian Bidding Zones configuration has entered into force in 2009[2] and it contains:

- 6 geographical[3] Bidding Zones
- 4 virtual[4] Bidding Zones

Alternative Bidding Zone configurations can be identified according to two different approaches:

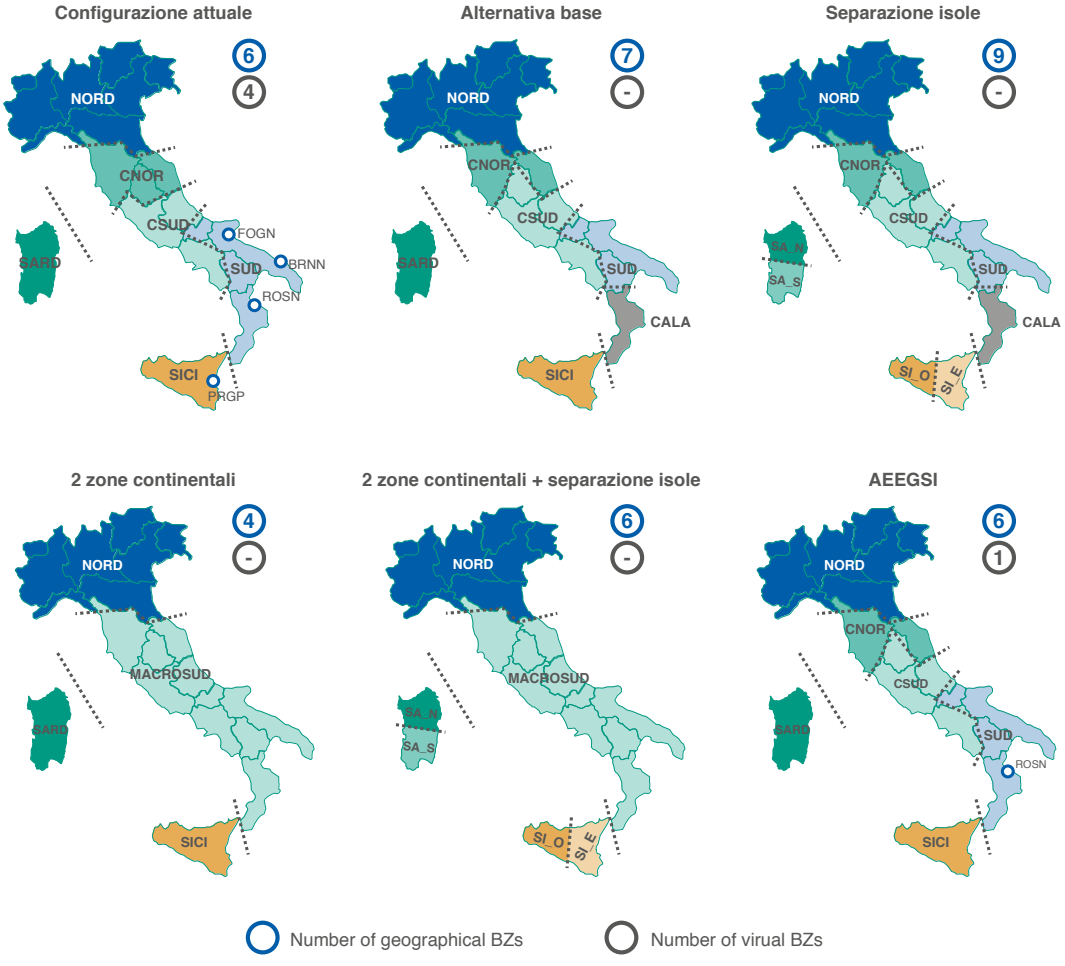
- "Expert-based": different Bidding Zone configurations are defined by TSO's experts according to statistical analysis, their knowledge of the Power System as well as taking into account the outcomes of other studies (eg. Ten Year Network Development Plan, Mid Term adequacy Forecast, National development plan, other studies carried out by Terna). This approach is well established and proved to be effective for the Italian case.
- "Model-based": different Bidding Zone configurations are defined according to dedicated algorithms and clustering techniques. This kind of approaches can produce more efficient delimitations, but they are still in a development stage (eg. there is no a common proposal in literature).

Terna applied an "expert-based" approach for the purposes of this first review, designing in parallel a step-by-step process for developing and fine-tuning **"model-based" techniques to be applied in the future** to the Italian case[5].

(2) In 2012 the virtual Bidding Zones "Monfalcone" has been merged to the geographical Bidding Zones "Nord".
(3) A geographical Bidding Zone is a zone with a direct link with a geographical area.
(4) A virtual Bidding Zone is a zone composed by some power plants having a direct infeed on some preselected 380kV nodes.
(5) In accordance to ARERA's Resolutions 496/2017/R/eel and 22/2018/R/eel, Terna sent a first proposal to the Italian NRA on the 28th of February 2018.

In total, **six Bidding Zone configurations have been assessed** in the current review:

- "Configurazione attuale": current configuration
- "Alternativa base":
  - Umbria region moved from "Centro-Sud" to "Centro-Nord" Bidding Zone
  - All the virtual Bidding Zones merged to the connecting geographical Bidding Zone
  - New geographical Bidding Zone "Calabria"
- "Separazione Isole": in addition to "Alternativa base" changes, Sardinia and Sicily Bidding Zones are splitted.
- "2 zone continentali": all the continental bidding zones under assessment[6] are merged.
- "2 zone continentali con separazione delle isole": in addition to "2 zone continentali" changes, Sardinia and Sicily Bidding Zones are splitted.
- "AEEGSI":
  - Umbria region moved from "Centro-Sud" to "Centro-Nord" Bidding Zone
  - "Foggia", "Brindisi" and "Priolo" virtual Bidding Zones are merged to the connecting geographical Bidding Zone



(6) Bidding Zone "Nord" is not in the scope of this study since it is covered by the "FIRST EDITION OF THE BIDDING ZONE REVIEW" launched by ACER on the 21st of December 2016.

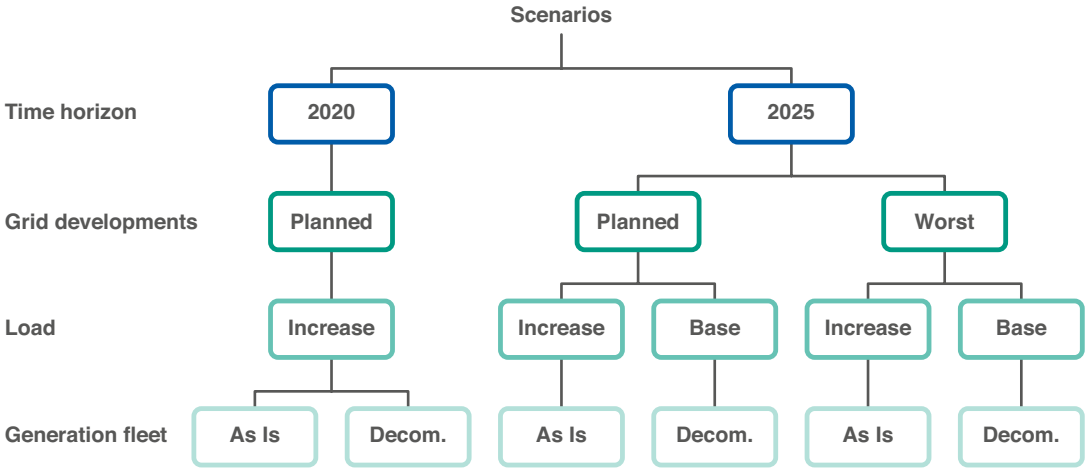
Scenarios under assessment

In order to cover a time horizon of ten years and to cope with the uncertainties of the future changes, Terna considered important to assess the impact of the identified Bidding Zone configurations on different scenarios.

Four drivers have been considered in the scenario definition:

- **Time horizon**: 2020 and 2025 have been identified as relevant years to cover the whole period;
- **Grid developments**: several grid reinforcements are expected to be commissioned by 2025, anyhow some of them are still in a preliminary phase and their commissioning can be delayed due to authorization or external issues. For this reason, a "planned" and a "worst" grid scenario have been considered.
- **Load**: due to the long-term prospective, for the 2025 scenario, 2 different levels of demand have been considered;
- **Generation fleet**: due to the decommissioning trend registered in the last years in the Italian Power System, a base case and a decommissioning scenario[7] have been considered both for 2020 and 2025.

In total, **six scenarios have been considered in this study**:



Evaluation of Bidding Zones Configuration

CACM Regulation (article 33.1) requires to assess the performances of the different configurations in terms of network security, overall market efficiency and stability and robustness. These high level criteria are also detailed providing a list of aspects to be considered.

In order to cope with these requirements, **Terna developed a system of quantitative indicators which enable a direct comparison between different configurations**.

The indexes can be linked to the CACM criteria as follow:

- Network security:
  - Operational Secuirty: *Cindex*
  - Security Of Supply: *EENSadeguatezza*

(7) RES installed capacity is expected to grow in both cases, but thermoelectric capacity is expected to decrease in the second one.

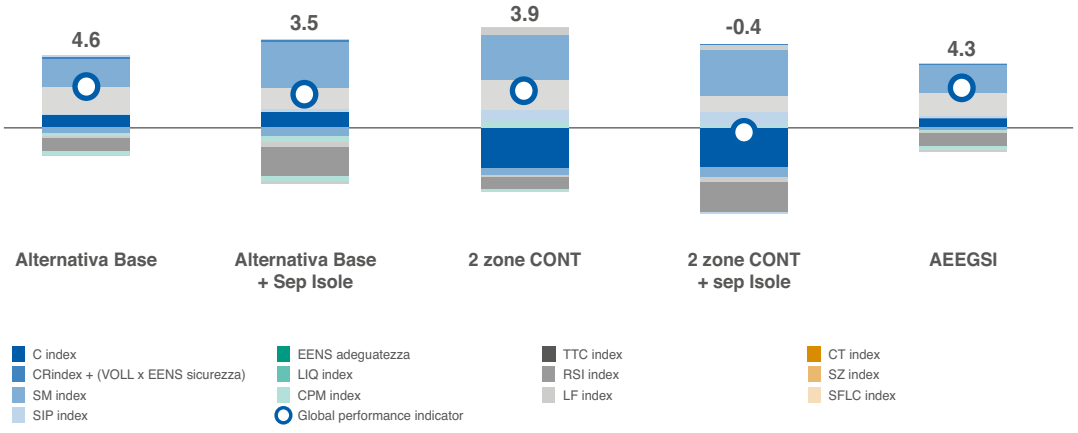
  - Uncertainties in the capacity calculation: *TTCindex*
- Overall Market Efficiency:
  - Economic efficiency/surplus: *CTindex*
  - Firmness costs, feasible market outcomes: *CRindex + (VOLL x EENSsicurezza)*
  - Market liquidity: *LIQindex*
  - Market concentration and power, effective competition: *RSI index*
  - Price signals for building infrastructure: *SZ index, SM index*
  - Accuracy of price signals: *CPMindex*
  - Robustness of price signals: *SIPindex*
  - Unscheduled flows: *LFindex*
- Stability and robustness:
  - Location and frequency of congestions: *SFLCindex*

Please note that, instead, the following CACM criteria are implicitly satisfied by:

- the examined configurations:
  - *"the need for bidding zones to be consistent for all capacity calculation time-frames"*
  - *"the need for each generation and load unit to belong to only one bidding zone for each market time unit"*
- the scenarios considered in the study:
  - *"the need for bidding zones to be sufficiently stable and robust over time"*
  - *"the cost of building new infrastructure which may relieve existing congestion"*

The only criterion not covered in the present report is the "transition and transaction costs" criterion. For this reason, **a dedicated survey has been submitted to the relevant Stakeholders during the public consultation process**. The answers to this survey will be collected and processed in order to complement the final report with a dedicated assessment.

Final normalized values of the quantitative indexes are reported in the figure below (positive values mean a benefit compared to current configuration).



Please note that in order to obtain a final global indicator:

- Scenarios are weighted in order to attribute more relevance to the short-medium term timeframe (2020), assuming that a new review can be anyhow relaunched in case big issues will appear by 2025.
- Some indexes are weighted more than others in order to properly take into account the partial overlapping of them (eg. Cindex and CTindex are considered the most relevant ones).

Conclusions and recommendations

On the basis of the analysis carried out, **Terna recommends to amend the current Bidding Zones configuration, adopting the "Alternativa Base" option**. Alternatively, adopt the "AEEGSI" configuration, which has very similar performance to the best one.

The outcomes of this study also suggest to **reassess the Bidding Zones configuration before 2025**, when it is expected that structural congestions in the Continental Italy will be relieved by planned grid investments. In the new review, also model-based configurations should be considered.

This study represents the first attempt to implement CACM Bidding Zones Review process at national level. For this reason, several methodological improvements have been identified by Terna and transparently reported in the document: Terna will work in order to adapt its models and tools in order to implement all the identified developments before the next review process.