Spatial Aggregation of Local Flexibility – Horizon2020 project experiences

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377

I. Abstract

With the growth of renewables, the increased interconnection of European grids, the development of local energy initiatives, and the specific requirements on TSO–DSO cooperation as set forth in the different Network Codes and Guidelines, TSOs and DSOs face new challenges that will require greater coordination. The aforementioned measures encourage procurement of services at both the transmission and the distribution level, recognizing that this will enable more efficient and effective network management and will increase the level of demand response and the capacity of renewable generation. Digitalization is a key driver for coordination and active system management in the electricity grid, enabling TSOs and DSOs to optimize the use of distributed resources and ensure a cost-effective and secure supply of electricity. It also empowers end-users to become active market participants, supporting self-generation and providing demand flexibility. To support the transformation, the INTERRFACE project, started in 2019, will design, develop and exploit an Interoperable pan-European Grid Services Architecture (IEGSA) to act as the interface between the power system (TSO and DSO – transmission system operator, distribution system operator) and the customers, and allow the seamless and coordinated operation of all stakeholders to use and procure common services.
This paper describes the approach of one INTERRFACE demonstration, the spatial aggregation of local flexibility and its realization that contributes providing a clear market approach to include local constraints into the already well-established and working wholesale energy market solutions.

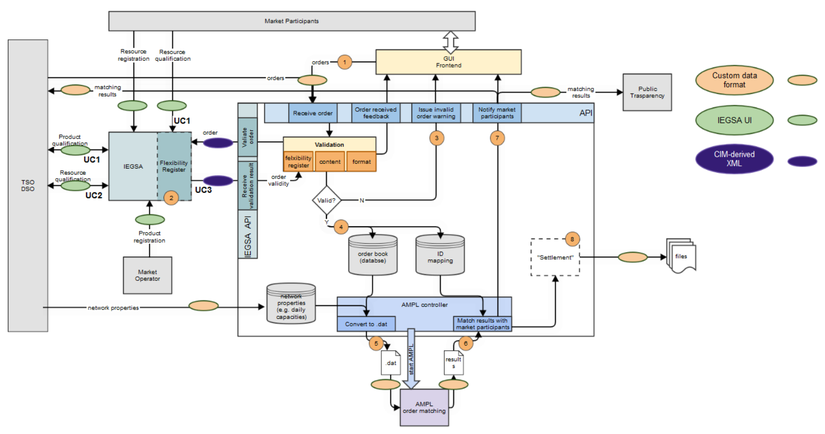
II. Introduction

EU's Clean Energy Package aims to incentivize the participation of the distributed energy resources in the wholesale market by changing its regulation [1]. Aggregators are the key to fully utilize this potential, but aggregation itself is hindered presently, as the current market structure cannot represent the local network constraints (thus true value of distributed resources cannot be monetized), and it neither provides incentives the participation of small units. This is the case in the Romanian market as well, where the power market has evolved throughout the last decades on the premises of aiming towards an unconstrained "copper-plate" wholesale energy trading. This resulting uniform wholesale pricing approach did not lead to the desired outcome, as the socialization of the local network constraints through system usage tariffs led to inefficient price incentives.

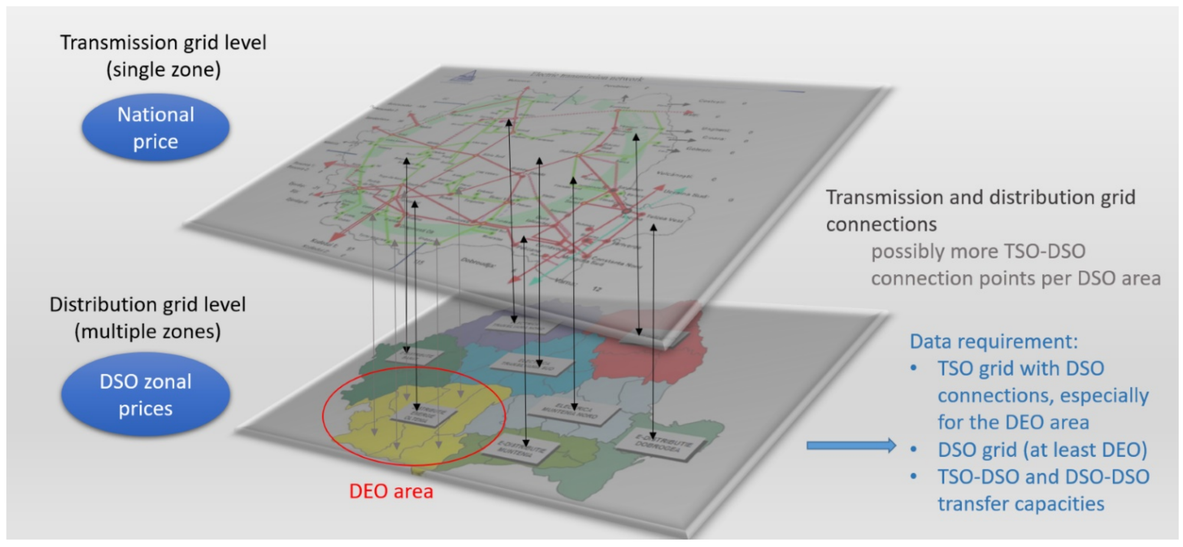
However, if the locational information from the distributed sources providing energy and/or new types of flexibility bids can be channelled into the market optimization algorithm, this new aspect can only provide more welfare outcome of trading platforms. This spatial dimension can be introduced into the current wholesale market design, by the extension of EUPHEMIA's PUN-like (average price based) pricing scheme – with the introduction of a special type of demand bid to be cleared based on average of multiple zonal prices [2].

Within this task, spatial dimensions will be introduced into an existing wholesale market design by a holistic mathematical formulation for optimal market outcomes and the optimal use of local flexibilities [3]. Shadow-prices to determine order clearing prices are used, as an efficient way of solving grid related constraints regarding flexibility sources on the DSO level, and to demonstrate by simulation. Effects of DSO-usage of such resources on bidding zone market outcomes were simulated, and a relevant subset of different usages were prototyped. Data used for the demonstration was provided by affected DSOs and TSOs, while the behaviour of market players is to be examined by the involvement of actual market participants of the demonstration area [4].

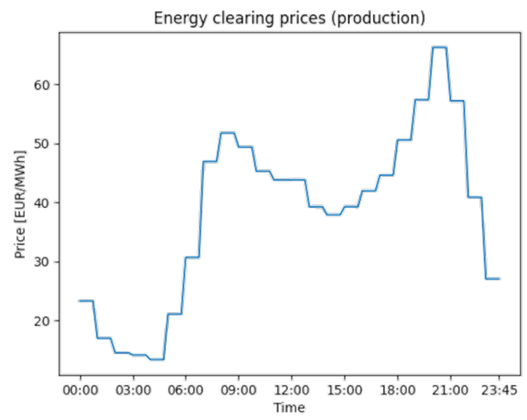
III. Demo progress and architecture

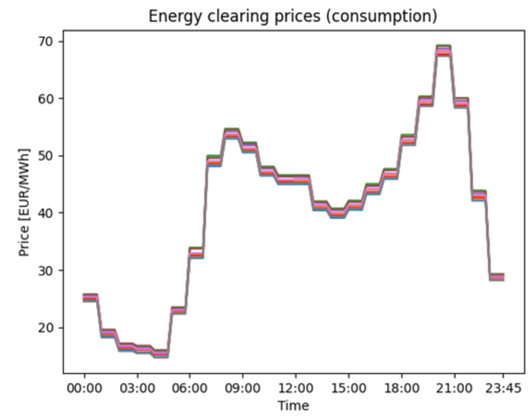


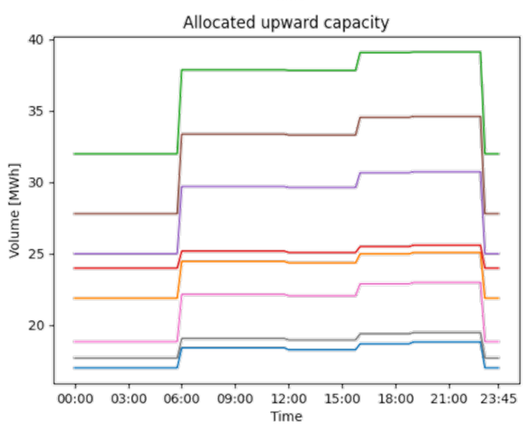
IV. Network constraints and auxiliary parameters

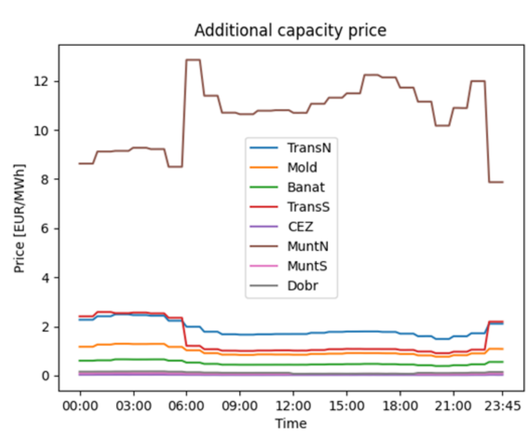


V. Algorithm framework









VI. Conclusions

The market design and functionality have been set in collaboration with demonstration partners and analysis of the Romanian market design. The method to include spatial dimension and the resolution of the spatial dimension has been selected, zonal representation is favoured to align the market algorithm to the existing EUPHEMIA-type common European Single Day Ahead Coupling Solution. The DSO usage of local flexibility will be realized in simulation. In alignment with the WP3 results, it is defined as an mFRR-like capacity product. The market provides short-term congestion management services as its primary grid service, according to the stakeholder needs. Also, this intraday auction based platform provides opportunity to trade energy in a finer, 15-min. time granularity (that allows BRPs to mitigate balancing cost), while allowing pricing of internal congestions according to corresponding Capacity Allocation and Congestion Management Network Code.
Regarding the EUPHEMIA-based market platform to include local flexibility resources tool ("Spatial Aggregation of Local Flexibility" demo), the technical description of the tool was elaborately presented, along with the list of IEGSA requirements that are covered by the demo. Moreover, the Scenario and results have been discussed and analysed.

Acknowledgement

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