

The project SmartNet

Reference call: LCE-6-2015, Research & Innovation Actions

Reference priority elements:

- *“Interaction between the TSO and DSO, information exchange of RES availability, operational parameters and constraints between transmission and distribution systems”*
- *“Advanced architectures and tools for pan-European markets for ancillary services and balancing”*

Priority element *“Joint modelling and simulation of power systems and the underlying ICT infrastructure”* could be pertinent as well.

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1.1 Scope

The increasing integration of massive quantities of generation from Renewable Energy Sources constitutes a challenge for the pan-European system. Reserve provision for the balancing of the network is an important service that, in principle, should be provided by all the units connected to the network, including RES generators themselves as well as flexible loads and storage systems. However, these resources have big peculiarities tied with their relevant technologies and could, beyond providing local services within the distribution grids (e.g. voltage regulation, congestion management), be available to provide reserve for the entire system, through the connection points to the transmission grid.

By the same token, a steadily increasing amount of RES units is connected to the distribution side of the network. In a future when distribution networks will inject a significant amount of energy into the transmission system, these distributed generation units could be connected to local storage and provide both a local compensation and services to the system. Another “tile” of the same mosaic is constituted by demand side management, that could help to smoothen the daily load curve profiles and reduce the need for reserve procurement. This resource could be actively used for the provision of ancillary services. This calls for a more advanced dispatching management of distribution systems by resorting to more advanced ICT systems able to transform distribution from a “passive” into an “active” system and market architectures able to incorporate scattered bids coming from distributed generation and active load. A delicate point is the interface between transmission and distribution that has to be managed in a coordinated manner between TSOs and DSOs in order to achieve an overall efficiency target. The DSO network would have on one side to retrieve resources for local services (e.g. voltage support, congestion management) and on the other side function as a collector of services for the whole system, to be then managed in coordination with the adjoining TSO.

What explained above opens a series of new issues that should be the object of new research activities: devising optimized architectures for the provision of ancillary services both at local and at system level, possibly crossing the borders between control areas, how this provision can be integrated in the real time markets, what kind of monitoring and control signals should be exchanged

between TSOs and DSOs in order to manage the operation, what kind of system planning guidelines could make this coordination efficient, what ICT architectures could support this coordination.

ICT should also be key to allow a strict real-time coordination of the different subjects that are in charge to actuate the provision of ancillary services, and in particular the ones connected to secondary and tertiary regulation: (1) a Market Operator that creates a merit order for the provision of system services and selects the bids by also considering spare capacity of trans-national corridors; (2) the national TSOs that would in any case be in charge of checking the feasibility of the exchanges programmed by the Market Operator on the basis of a more in-depth analysis of the national networks also considering reactive constraints and to control the settings of the PST devices in order to optimally implement the dispatching; (3) the “aggregators” who interface with the Market Operator to submit the bids for the provision of the services, with the local TSO to receive the consequent dispatching orders and to the aggregated distributed resources (generation, flexible demand, storage) and to the involved DSOs, in order to communicate how each dispatching order will in turn be dispatched among the distributed resources it aggregates; (4) the involved DSOs that would be in charge to control their internal network and check the feasibility of the dispatching of distributed resources proposed by “aggregators”.

Sets of bids aggregating availability coming from distributed generation, especially if integrated with local storage (VPPs), as well as from flexible load, could be presented to the trans-national Market Operator allowing a higher market liquidity and a better availability of dispatching solutions on the territory. ICT is going to be key also at this level in order to ensure a seamless integration of these bids coming from distribution within the trans-national ancillary services market and an integration with the control carried out by the DSOs of the dispatching in their relevant areas.

1.2 Objectives

The project aims at providing solutions for clarifying architectures for optimized interaction between TSOs and DSOs in managing the exchange of information for monitoring and for the acquisition of ancillary services (reserve and balancing, voltage regulation, congestion management) in the pan-European context, both for local needs and for the system, taking into account the participation of demand side and distributed generation to system services.

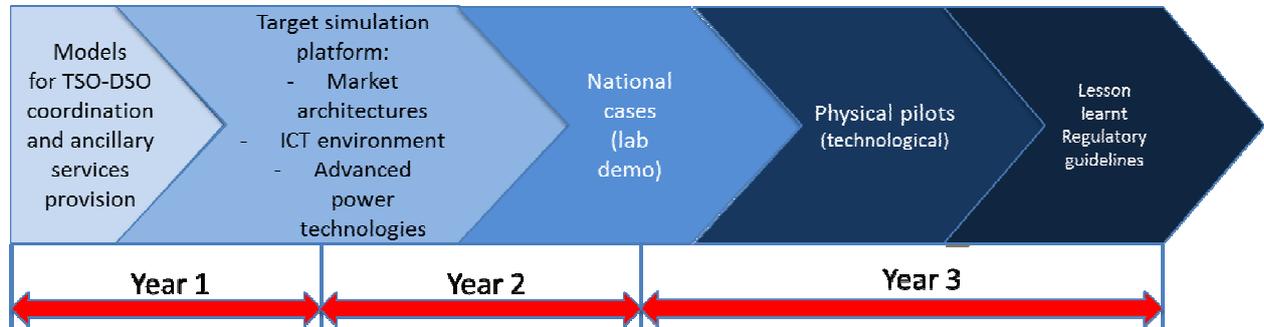
The following topics should be investigated in-depth and then integrated into a coherent vision:

- which ancillary services could be provided from distribution to the whole system (via transmission),
- which optimized modalities could be adopted for managing the network at the TSO-DSO interface and what monitoring and control signals could be exchanged to carry out a coordinated action,
- how the architectures of the real time markets (in particular the balancing markets) could be consequently revised,
- what information has to be exchanged and how (ICT) for the coordination on the distribution-transmission border, starting from monitoring aspects, to guarantee observability and control of distributed generation, flexible demand and storage systems,
- which implications could the above issues have on the on-going market coupling process, that is going to be extended to real time markets in the next years, according to the draft Network Code on Electricity Balancing by ENTSO-E.

Different TSO-DSO interaction modalities are compared on the basis of national key cases. Physical pilots are defined for the same national cases (Italy, Denmark, Spain). A further layer of transnational cross-border exchange of ancillary services is experimented as well.

1.3 Project Layout

The project is organized around four phases, that have an equilibrated role within the three-year development of the project activities.



Chronological phases of the project

In order to develop the sequence of activities shown above, the following work packages are planned:

WP1 – TSO-DSO coordination for accommodating ancillary services from distribution networks

- What ancillary services from distribution
- DSO-TSO coordination schemes
- Possible role for advanced power technologies
- Specifications for the simulation environment

WP2 – Market architecture for ancillary services markets integrating DG and DSM

- Market architecture(s) for local and system ancillary services
- Possible extension to exchange of cross-border balancing services
- Specifications for ancillary services markets and aggregator models for the simulation environment

WP3 – Communication and ICT requirements

- ICT for exchange of market and dispatching coordination between the different subjects (DSO, TSO, aggregator, MO, VPP...)
- Specification of ICT to be integrated in the simulation environment (simulated and hardware)

WP4 – Development of the national cases in lab test environment

- Realization and validation of the SW modules
- Realization of national cases (data and modules adaptation to national peculiarities)
- Run of the national cases with the different DSO-TSO schemes
- Analysis of results and cost-benefit analysis of the different schemes
- Validation in the lab environment

WP5 – Physical pilots realization

WP6 – Regulatory, planning and operation implications of TSO-DSO coordination

- Lessons learned and regulatory guidelines
- Analysis of present regulation (barriers, weak points)

Additionally, two work-packages are dedicated to dissemination, stakeholders involvement, impact assessment and exploitation (**WP7**) and administrative and technical management (**WP8**).

Both technical and administrative management are under responsibility by RSE.

The consortium is formed by a well-equilibrated mix of research partners (8 leading European research centres belonging to the EERA JP SmartGrids) and industrial partners (among which: 2 TSOs, 3 DSOs, 3 ICT manufacturers).