Portuguese Demo:

Flexibility Hub, provision of active and reactive power and dynamic grid models to the TSO using DSO grid connected resources

The Flexibility Hub (or FlexHub) is a TSO-DSO coordination platform that addresses three innovative services:

- PT-FXH-RP: provision of distributed reactive power flexibility to the TSO at the TSO-DSO connection point, and to the DSO to balance its grid, with a close to real-time intraday market.
- PT-FXH-AP: DSO traffic light qualification (TLQ) procedure to validate activation of distributed resources to provide active power to the TSO at the TSO-DSO connection point, designed to be integrated in an extended version of the current restoration reserve market.
- PT-FXH-DM: Equivalent Dynamic Model of the DSO grid for analysis of voltage and frequency disturbances.

Key Features

- New reactive power close to real-time market to unlock distributed reactive power flexibility for the TSO and DSO. Clearing is performed with a multi-temporal optimal power flow (MOPF) that maximises social welfare.
- New DSO tool, aligned with EU regulation and ENTSOe-E.DSO ASM report to validate activation of distributed active power flexibility. The MOPF checks that no distribution grid constraints are violated, and allows the delivery horizon to be extended, and more complex assets, such as storage facilities, to be represented.
- Dynamic characterisation of distribution grids for voltage and frequency disturbances for TSO dynamic grid analysis

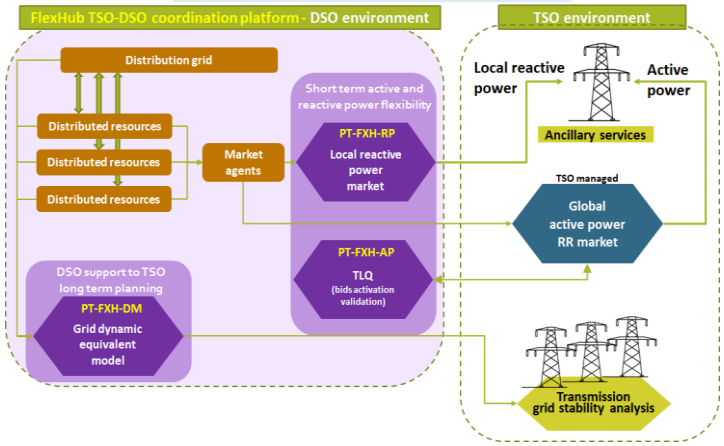
Implementation approach

A market platform was developed for the PT-FXH-RP and PT-FXH-AP demonstrators that manages grid topological information, grid forecasts and bids from market participants, and uses a MOPF to clear the reactive power market, or to compute traffic light qualification of the active power flexibility offered. Settlement and reporting procedures are also available. The platform has two running modes: online, for physical tests, where all participants interact until setpoints are sent to the flexible assets, and offline, with additional components (such as market agents) for full offline simulations.

PT-FXH-RP BUC was demonstrated for the Frades 60 kV E-REDES grid (with Caniçada 2 steps 3.43 MVar E-Redes Capacitor banks, and Barroso II – 12.3MW and Barroso III – 23.1 MW EDPR Wind Farms as flexible resources), while the PT-FXH-RP was demonstrated for Évora 15 kV E-Redes grid (with Valverde 480 kW/360 kWh E-Redes storage and Monte das Flores 2.5 MW EDPR PV installations). In the online mode, grid topology updates and forecasts are sent by web service (SOAP protocol) in XML format and bids via sFTP. Setpoints are validated with Dplan before being applied to the assets.

PT-FXH-DM is based on a “grey-box”-based aggregated representation of the main grid elements, whose parameters are fitted with historical, or detailed model simulated, data using an ESPO algorithm.

Simplified FlexHub architecture



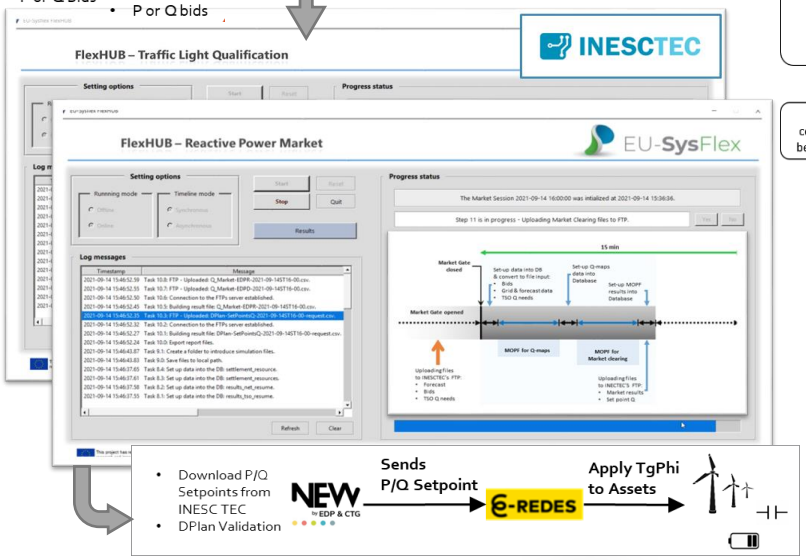
Disclaimer: This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773505.



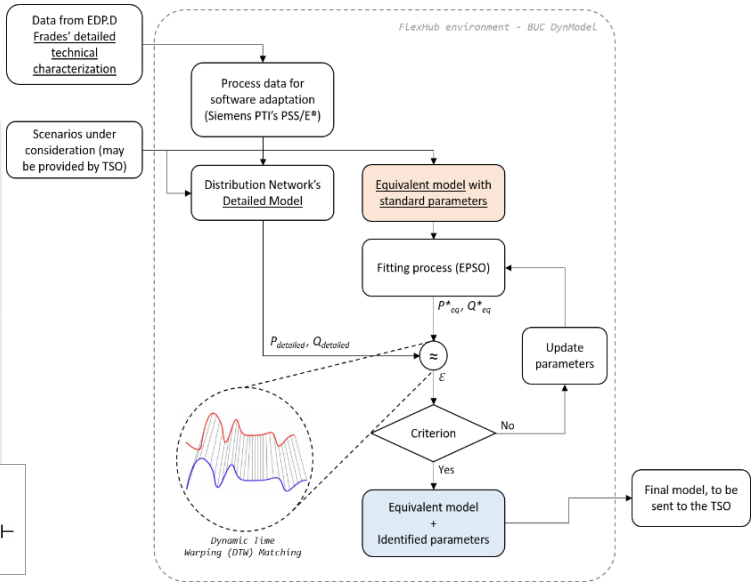

E-REDES
- PQ forecast
- P or Q Bids

NEW by EDP & CTG
- TSO Q needs
- P or Q bids

FlexHub market platform



Dynamic model fitting process



Key Achievements

- New TSO-DSO improved coordination platform for:
  - ✓ Short-term active and reactive power flexibility provision.
  - ✓ Long term studies coordination with a better characterization of distribution grid dynamics.
- Market-based mechanisms to incentivize the provision of active and reactive power
- TSO-DSO cost sharing mechanism for coordinated use of distribute reactive power flexibility.
- Development of market platform simulation framework, MOPF market clearing and TLQ, dynamic model fitting tool.

Findings

Developing TSO-DSO coordination mechanisms to unlock distributed active and reactive power flexibility seems essential and feasible for improved system operation towards energy system decarbonisation, where traditional generation power plants will be progressively replaced with distributed renewable generation facilities. The Flexibility Hub platform is a step further towards TSO-DSO coordination, with the provision of market-based short-term active and reactive power to the TSO, and integration of distribution grid characterisation into TSO transmission grid dynamic studies.

Recommendations and Lessons

- Local flexibility markets for coordinated TSO-DSO use of reactive power seems feasible and promising. However, further studies are needed to assess the benefit for market participants and the potential need for additional incentives.
- The TLQ is aligned with EU regulation and ENTSOe-E.DSO Active System Management as a key step in active power flexibility activation, since all involved system operators should be able to validate the impact of distributed flexibility before its activation. In addition, the TLQ considers complex assets with inter-temporal constraints, such as storage facilities. However, a TSO may need to improve its bids selection procedure to adapt it to larger delivery horizons, more appropriate, for example, to incorporate storage facilities.
- Further work is needed to integrate and test simplified transmission grid models for TSO-DSO coordination, already proposed in the EU-SysFlex WP6 demonstrator, when there are multiple TSO-DSO connection points.
- National regulations should evolve faster to allow local flexibility markets, and to provide incentives to integrate distributed flexibility into their operation and planning processes, while properly assessing the benefits compared to traditional grid reinforcements.
- Accurate, but simplified, models of the distribution grid, not disclosing sensitive distribution grid data, are feasible, and could be of relevance to improve current dynamic TSO analysis.

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https://eu-sysflex.com/documents/