EU-SysFlex

French Demo:

Aggregation approaches for multi-services provision from a portfolio of distributed resources

In the context of operating power systems with high shares of variable renewables, a new flexibility requirement will be necessary to ensure power system security and reliability. The provision of ancillary services – so far mainly supplied by conventional synchronous units – could also be required for VRG (Variable Renewable Generation) connection, or supplied by storage.

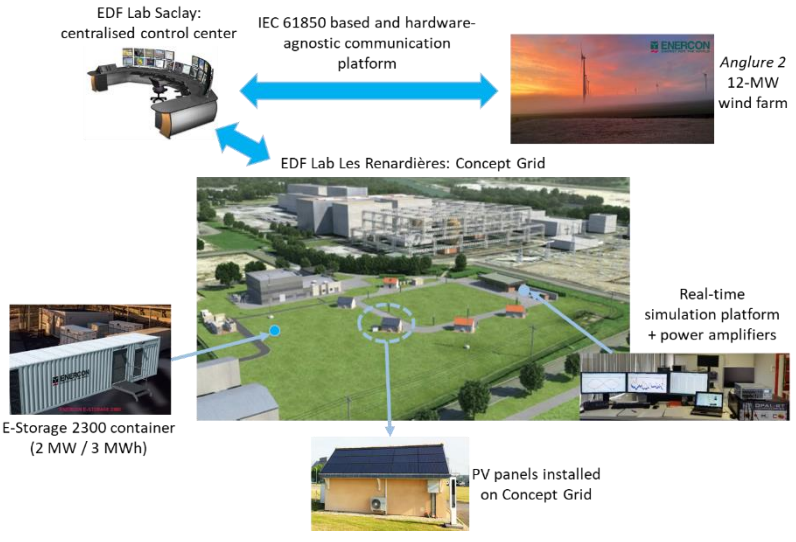
In this context, an aggregation approach based on the concept of Virtual Power Plant (VPP) has been proposed in the French demonstration, which aims at developing and experimenting an innovative 'multi-services multi-resources' control approach. The demonstration was set to provide technical evidence of how the timely provision of the services could be achieved by distributed resources that will be largely present in the future European system, as well as how these new actors could jointly participate in different energy and flexibility markets through an innovative portfolio management.

Key Features

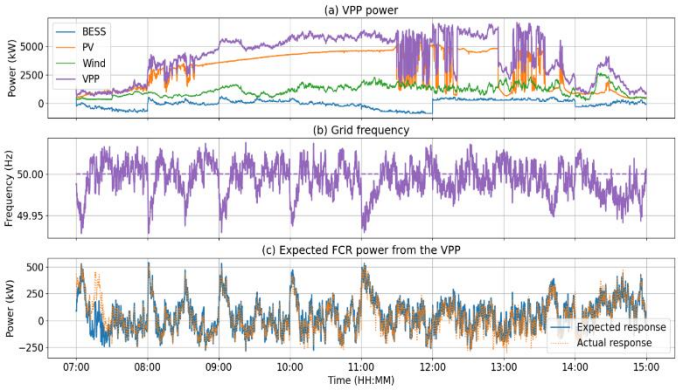
- Demonstration of multi-services provision by a multi-resource VPP, including frequency regulation on different timescales, and flexibility services, such as variable generation smoothing.
- Development of a full-chain VPP solution integrating functions of forecasting, optimization, communication, control, and supervision.
- Demonstration of the capability of wind generation to provide both symmetrical and asymmetrical frequency reserves.
- Performance assessment of the services provided by new actors

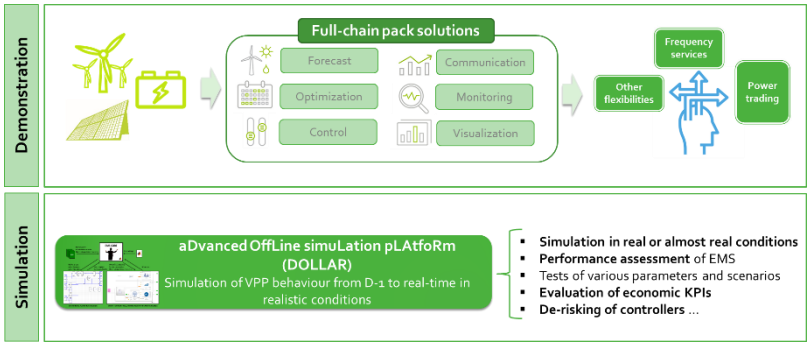
Implementation approach

The VPP includes several decentralized assets including a 12-MW windfarm, a photovoltaic generation unit and a 2-MW/3-MWh battery energy storage system. Thanks to a central Energy Management System (EMS), the different assets were managed in a coordinated and optimal manner. Based on multiple criteria such as weather forecasts, energy and services market prices and availability of assets, the EMS developed proved capable of providing optimal energy and multi-service schedules for the VPP and of allocating frequency reserve on the controlled assets, at regular intervals, by considering the most recent forecasts and measures. To ensure robust and cyber-secured data exchange between assets and the EMS, a full IEC-61850-based and hardware-agnostic communication platform was created.



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





Key Achievements

- Development of an advanced VPP Energy Management System (EMS) for optimal management of multi-resources.
- Development of a standardised, cyber-secured and evolutive communication platform, allowing replicability and scalability of the demonstrated solution.
- Long-term technical economic assessment performed through a dedicated offline simulation platform which precisely models the behaviour of the entire VPP from day ahead to real time.
- Concept of advanced battery and wind generation local controllers for multi-services provision and activation.

Findings

The French demonstration provided practical evidence for successful portfolio management of several distributed resources, which have different specificities, for joint participation in the energy market, and coordinated provision of different flexibility services. The VPP proved to be an efficient aggregation approach to reduce the impact of renewable generation variability by lowering power imbalances and enhancing the availability of the power reserve provided at the VPP level. This contributes to more stable power system operation and results in easier integration for renewable generation.

Furthermore, the VPP approach helps to increase renewable generation revenue, in the future, when feed-in tariffs, or other subsidies, could disappear, through participation in ancillary services and flexibility markets. The integration of a storage system in the management pool proved very useful to strengthen the exploitation potential of all flexibilities available within the VPP, thus allowing optimal reserve constitution and easier access to both current and future flexibility markets, which will encourage renewable generations to play a more active role in power system operation.

Recommendations and Lessons

Lessons	Technics	Windfarms can efficiently contribute to frequency services such as FFR and FCR (notably in terms of dynamics). VPPs have the capability to enhance the performance of the frequency support services and to enable the provision of new flexibilities, when a coordinated and optimized control of the assets is applied. Communication infrastructure is of great importance for a reliable VPP operation; it needs to be robust, secured while remaining evolutive.
	Economics	Windfarms can suffer from significant financial shortfall if upward reserve needs to be provided, as generation curtailment is necessary during the minimum availability duration imposed by market rules and TSOs' requirement. VPPs could be one solution to prevent unnecessary shortfall of individual assets though optimal use of multiple assets (ex: downward reserve by windfarms and upward by storage).
Recommendations	Technics	Given the technical capabilities of windfarms in terms of frequency services, SOs could adapt their qualification and performance assessment rules to facilitate wind generation's participation (current rules were shaped mainly by considering conventional generation's specificities). SOs should carefully consider the exploitation of the technical potential of virtual power plants in fulfilling the flexibility needs of future power systems.
	Economics	Markets should be adapted to encourage the participation of new players such as renewable producers and VPPs: asymmetrical products should be allowed considering that wind or PV are more suitable for providing downward reserve only. VPPs should be more seriously envisaged as they would facilitate the participation of new players and small-scale actors in one or several electricity markets, both for energy and flexibilities, thus potentially leading to an increasing profitability at VPP level.

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