Innovative approaches to unlock flexibility. The experience of EU-SysFlex

Workshop on Energy System Flexibility, INESC Coimbra. 2 Feb 2022
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1. EU-SysFlex Project Overview
2. Virtual Power Plant: Overview and Key Findings
3. EU-SysFlex: Key messages
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EU-SysFlex is a very large Horizon 2020 project...

- **Timeline**: Nov 2017 - Feb 2022
- **Total Budget**: €26.5 million
- **Horizon 2020 Contribution**: €20.5 million
- **Consortium**: 34 organisations
- **Work Packages**: 12
- **Demonstrations**: 7
- **Deliverables**: 100
...Carried out across Europe in a multi-disciplinary consortium
The project demonstrates reliable and efficient flexibility solutions to integrate 50% RES in the European Power System...
...in a future power system increasingly reliant on variable and non-synchronous sources of electricity
The project delivers a comprehensive roadmap for system flexibility, demos playing a key role testing the various options & contexts for flexibility provision.
In Portugal we have tested two distinct concepts in two demonstrations.

### Virtual Power Plant

**Flexibility from aggregation of generation technologies**
- Joint operation & dispatch of vRES + dispatchable units
- Demonstrate the technical and economic benefits of portfolio management of generation assets
- Demonstrate the possibility of wind farms participating (via VPP) in reserve markets (aFRR, RR)

### Flexibility Hub

**Flexibility from DSO-connected assets**
- Provision of flexibility (P, Q) from assets (RES, storage, etc.) connected to DSO grid
- Technical validation of market flexibility activated by TSO
- Provision of equivalent dynamic model of the DSO grid to the TSO, for operation and planning

### Demo Site

- Venda Nova III Variable Speed Pump Storage Hydro 756 MW
- Alto da Coutada WF 115 MW
- Falperra WF 50 MW

### Q market Demo

- In the HV (60 kV) distribution grid
- 2 Wind Farms Barroso II 12 MW & Barroso III 23 MW
- 2 Capacitor Banks 3.43 MVA

### P market Demo

- In the MV (15kV) distribution grid
- PV Monte das Flores 2.5 MW
- MV Grid Storage Valverde 480 kW / 360 kWh
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VPP, the basic idea: aggregation of generation units

Combining different units’ outputs…

- Intermittent
- Controllable

...to act as one single unit

“Self balanced” unit
The Portuguese VPP: an overview

Flexibility provided by aggregating PSP and RES

- Joint operation & dispatch of a var. speed pumped storage power plant combined with 2 wind farms
- Demonstrate the technical and economic benefits of portfolio management of generation assets
- Demonstrate the possibility of wind farms participating (via VPP) in reserve markets (aFRR, RR)
- Show the replicability potential of the concept, starting with an offline testing in a Hydro+Wind configuration
The Portuguese VPP: the components

Large var. speed storage hydro plant

Venda Nova III
- Variable speed pumped storage Hydro Plant
- 2 x 420 MVA DFIM motors-generators (Europe’s largest of their kind)
- Rated Power: 756 MW (2 x 378)
- Able to inject 840 MVA in the grid in 2 min

Two wind farms

Alto da Coutada
- Rated power: 115MW
- 50 x 2.3 MW machines

Falperra
- Rated power: 50MW
- 25 x 2 MW machines
The VPP: architecture of the deployed infrastructure
Bidding with the VPP: an optimization problem

VPP provides a **decision support tool** to optimize the revenue and the resource use (water) from the combination of the different units.
VPP: the Online Demo

VPP Core

EDP UNGE

VPP Controller

EDP Produção
Testing the VPP offline: comparing different scenarios

- Simulation of performance over one year with VPP Core
  - Simulation of multiple scenarios for demo site based on 1-year historic input data

- Result preparation with Tableau
  - Provide overview on market bidding, power dispatch time series data

- KPI calculation
  - Show imbalance reduce with VPP approach

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Scenario Analysis: Tableau
VPP: Key findings

• **Pooling of volatile producers** (renewable energy resources) reduces relative forecasting errors.

• **Pooling of producers and consumers** reduces effects from uncertainty in market price forecast. Local balancing of power generation and consumption reduces the overall capacities to be traded on energy / reserve markets.

• **Energy storage** can shift power production and consumption, do price arbitrage on markets and handle deviations from forecasts.

• One of the main lever for improving overall output of the VPP will be more **accurate forecasting of market prices** as well as further enhancements of the algorithmic features for market bidding strategies.
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EU-SysFlex: Key messages

As we transition to a European power system with a high share of variable renewables significant technical scarcities in flexibility appear.

Enhanced system services capability will be required from a wide range of technologies in order to mitigate the identified technical scarcities and ensure system flexibility.

Existing energy market structures will not guarantee the required flexibility and volume of system services to address the identified technical scarcities and support investment in low carbon generation.

New flexibility products and market evolution are required to ensure the provision of sufficient system services capability to mitigate the identified technical scarcities.

New operator decision support tools with enhanced forecasting, state estimation and optimisation capabilities are required for the future power system to activate new flexibilities.

Efficient coordination between the transmission system operator (TSO) and distribution system operator (DSO) is critical, given the significant share of future resources connecting to the distribution network.

Aggregation of decentralised resources enables access to a wider range of flexibility options, including the participation of residential customers, and a range of distribution-connected assets.

A customer-centric approach, including standardised access to data and data-driven services, is crucial to guarantee stakeholder and information system interoperability for effective data exchanges at the European level.
EU-SysFlex: 2 upcoming final events

>> 7 Feb: Public final online event
   Including project summary and main results, introducing the project roadmap, and including a roundtable with high-profile speakers

>> 14 Feb: Final Webinar: Demonstration projects
   Presentation of demo projects and their results

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