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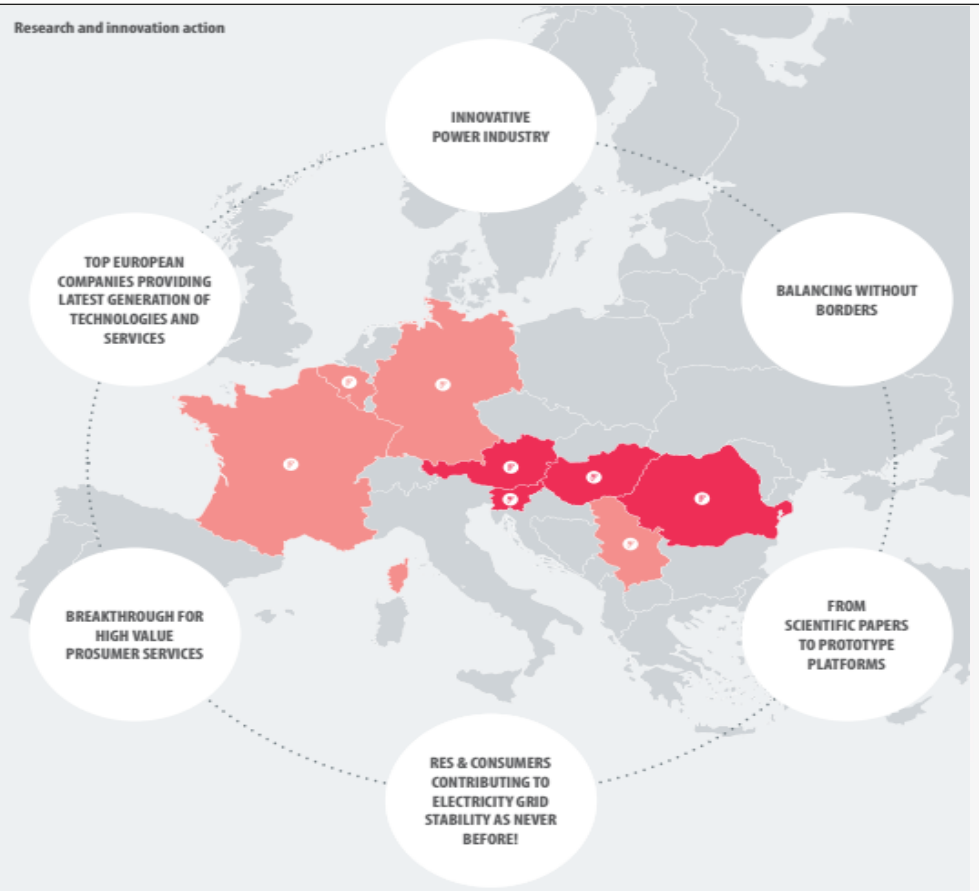
ETIP SNET
EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM
SMART NETWORKS FOR ENERGY TRANSITION

Digitisation of the electricity system and Customer participation

FutureFlow

Project overview



12 partners from
Austria, Belgium, Germany, Hungary, France, Romania, Serbia, Slovenia

HORIZON 2020, Call:	H2020-LCE-2015-3 Advanced architectures and tools for pan-European markets for ancillary services and balancing
Project title:	Designing eTrading Solutions for Electricity Balancing and Redispatching in Europe
Project acronym:	FutureFlow
Grant Agreement No.:	691777
Duration:	4 years (1.1.2016 - 31.12.2019)
Coordinator:	ELES d. o. o., Slovenia
Consortium:	12 partners from 8 countries
General objective:	To design and pilot test for access of advanced consumers and distributed generators to a Regional Platform for balancing and redispatching services
Maximum grant amount:	12,9 mio EUR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 691777

Project Context and key objectives

Context of FutureFlow

- **Europe's low carbon strategy** states that nearly 100 % of the electric energy should come from renewable sources by 2050 -> need to replace existing flexibility sources with **CO2 free flexibility** sources
- The **growing share of variable renewable sources** has considerably reduced capabilities of conventional, fossil-fuel based power plants to ensure balancing activities and congestion relief through redispatching
- **Changes in electricity consumption** like electric vehicles, heat pumps, electricity storage, home automation, progress in the ICT, smart meters
- **Network Codes**, especially the electricity balancing guideline (**EB GL**) is opening the (advanced) balancing services to the EU electricity markets creating a level-playing field for all potential providers of balancing services, including demand response, energy storage and intermittent sources, harmonising processes, standardising products
- **Clean energy package** goes even further in empowering (active) consumers, distributed generators and aggregators across Europe

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Project Context and key objectives

Overarching objective of FutureFlow

To design and pilot test,
at a plausible scale,
comprehensive techno-economic models for open and non-discriminatory access of advanced consumers and distributed generators
to a Regional Platform for ancillary/balancing and redispatching services

	SPECIFIC OBJECTIVES
O1:	To design and configure cross-border balancing and redispatching mechanisms (including the common activation function tailored to congested borders), based on a harmonized set of requirements for demand response (DR) and distributed generation (DG) in aFRR markets.
O2:	To prototype the DR and DG flexibility platforms for aFRR
O3:	To prototype a Regional Balancing and Redispatching Platform embedding a Common Activation Function
O4:	To pilot test the prototype DR and DG flexibility aggregation platforms and the prototype Regional Balancing and Redispatching Platform based on a set of use cases with their own KPIs to access performances
O5:	To recommend a deployment roadmap for the most promising use cases involving TSO's cooperation based on an impact analysis of the proposed solutions
O6:	To prepare exploitation strategies of the demonstrated solutions by the participationg non-regulated players
O7:	To engage in dialogue with the impacted stakeholders through broad dissemination activities

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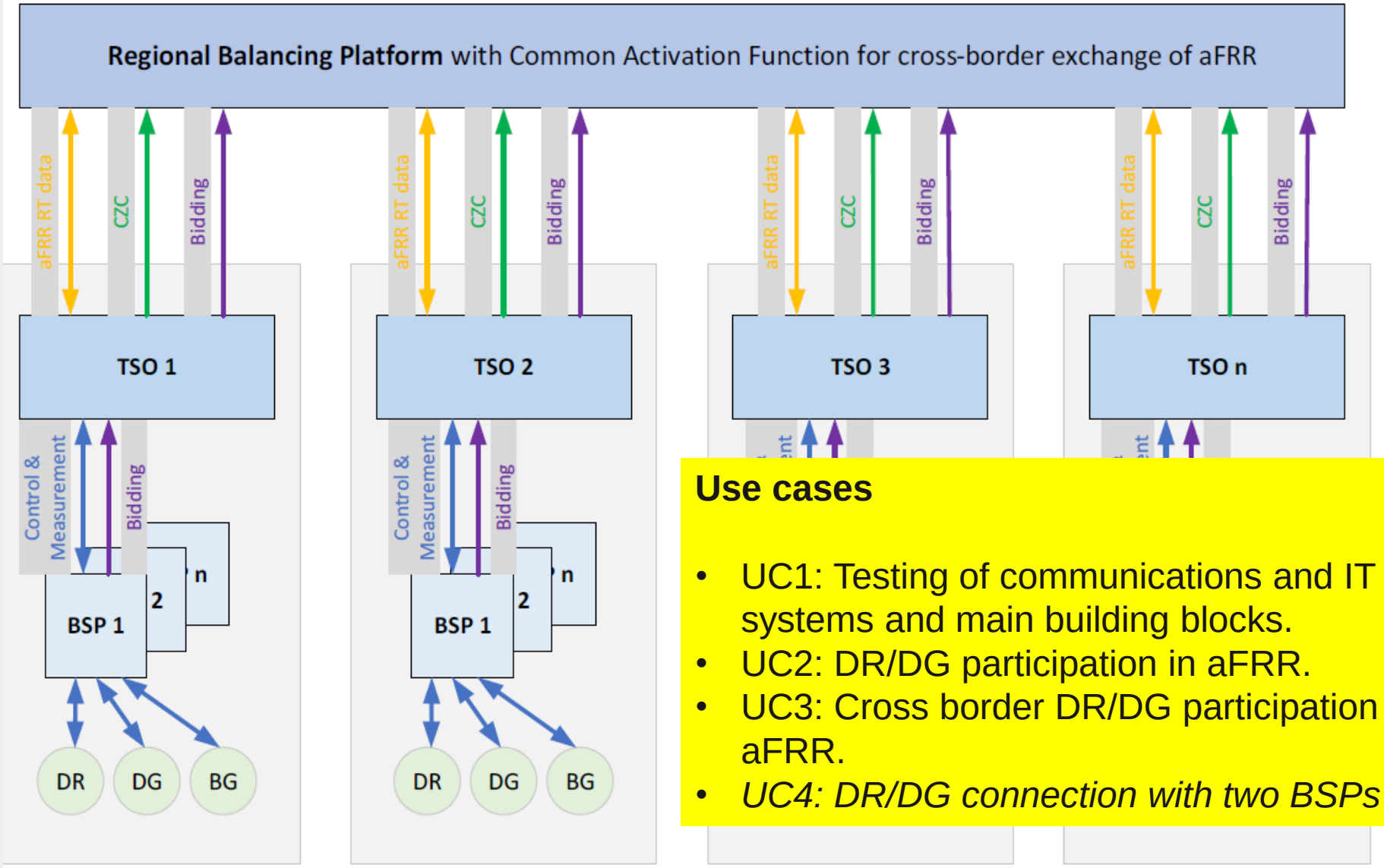
FutureFlow envrionment



Use cases

- UC1: Testing of communications and IT systems and main building blocks.
- UC2: DR/DG participation in aFRR.
- UC3: Cross border DR/DG participation in aFRR.
- *UC4: DR/DG connection with two BSPs*.

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Key outcomes of the project

- **Innovative solutions (mainly TRL1/4->6/7, 15 exploitable results/solutions in total):**
  - **VPP aggregation platform for aFRR** by cyberGrid (cyberNOC) – TRL9
  - **FutureFlow Cloud software** by SAP (incl. optimization algorithm) – TRL8
  - **Blockchain gateway** by Gemalto, preventing the risk of multiple selling of flexibility – TRL 4/5
  - **Balancing real-time platform and DEMOX simulator** with integrated TSO environment by EIMV, able to simulate real aFRR market environment with TSOs load flow controllers.
  - **Enhanced renewable energy forecasting for DR/DG's** power production by 3E
  - The redispatching cost-sharing key: Concepts of power flow decomposition called the **Power Flow Coloring** (PFC) method by EKC. The operational implementation of this concept is currently being discussed among TSOs and national regulators in different European Capacity Calculation Regions (CCRs).
  - **MQTT (with CIM based semantics)** successfully tested as an option for applications in the electric power system domain (real time and market data) – proposed to SGCG
  - **Models for scaling DR/DGs** by EIMV prototyped in Python and Matlab and tested against specific use cases developed in the project.

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Key outcomes of the project

- **Environmental:** approx 100 MW of DR/DG activated (75% with low CO2 emissions); 160 hours of pilot test -> 10.417 tons of CO2 saved of equivalent thermal power plant. (Theoretical europwide potential of DR 93GW)

- **Consumer Benefits and Empowerments** – in general (from deliverables)
  - End consumers - reduced energy prices,
  - TSOs - more available flexibility capacity,
  - Retailers - better market opportunities with increase in market reach /liquidity
  - Vendors would benefit from technology and product development and implementation

- **Economic benefits** (comparison between separated and coupled markets for aFRR activation)
  - Energy prices have decreased by 23.3 % for downward bids and 73.0 % for upward bids.
  - aFRR activation costs were reduced by 29.7 %.
  - imbalance netting flows in coupled market reduced the need for aFRR energy by 29.5 %.
  - VPP is cost efficient and competitive 1,4 mio € spent on DR/ DGs --> 57.000 €/MW (@24MW base availability (TESLA‘s 100 MW costs 660.000 €/MW)

- **Potential for replication and adaptation**:
  - The developed solutions were also tested for scalability, ICT security, robustness and replicability.
  - The results showed linear scalability of the FutureFlow platform regarding increasing classical and DR/DG bids, number of participating units, number of TSOs, etc.
  - The ICT communications were subject to penetration testing by Gemalto. No major issues.

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Some lessons learned

- After analysing more than 300 hours of real-life tests with more than 95 units participated, it can be concluded that the **DR&DG units aggregated in a proper portfolio inside the VPP are able to provide fast, reliable and technical and economical competitive aFRR service** on the energy market..
- In most analysed test cases the **improvement of ACE quality performance indicators** (ACE mean value and standard deviation) is observed with the introduction of **regional aFRR cooperation**
- **Creation of regional market (UC3) benefits increase of market liquidity** since instead of several fragmented markets (UC2), there is one joint market with increased number of offers. In terms of DR/DG, their inclusion has positive effect on the market liquidity as well.
- Introduction of FutureFlow cooperation benefits **decrease of overall cost of aFRR energy in the region**, as well as **increase in price convergence between the different countries**
- Reservation of portion of CZC for the needs of cross-border balancing is not desirable since it definitely decreases the CZC for commercial exchanges, and it would be **better to invest into late Flow-based capacity recalculation for the needs of balancing**.
- Main motivation to encourage VPP and DR&DG to participate in aFRR is to **be prepared for the future**
- Although FutureFlow is a research project, **some TSOs went even further and initiated the implementation of some FutureFlow outputs**

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Obstacles and Barriers to overcome

Identified barrier	Type of barrier
Communication/ Cybersecurity	T
Interoperability	T
Requirements for equipment shall be adapted to the size and type of resource	T
The cross-border organised market shall be established	R/E
Cross-zonal capacity for balancing rules	T/E/R
Authorized participation in the market	E/R
Aggregation shall be allowed	E/R
Rules and framework for aggregation shall be in place	R
Existing rules might include barriers for the DG&DR participation	R
Rules for aggregation between the end customer and aggregator shall be established	R
aFRR market rules shall be transparent and non-discriminatory	E/T
PRODUCT DESIGN	
Full Activation Time (call time) should be as long as possible	E
Product resolution in MW and time	E
Symmetrical products should not be obligatory	E
Price transparency	E
Settlement	E
Procurement cycle as short to real-time as possible	E
Differences in aFRR operation	
Baseline methodologies	T

Technological
Economic
Regulatory

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Needs for future R&I activities

Not comprehensive proposals:

- Go from regional redispatiching simulation mode to real life tests
- Further investigate in smart contracts for bid and activation management
- Establish standards (communication and semantics) in the balancing market domain
- Further elaborate on flow based calculation for cross zonal capacities (PTDF)

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