EUROPEAN COMMISSION BOOSTING R&D IN FLEXIBILITY TO TACKLE THE EU CHALLENGES OF THE NEW ENERGY MARKETS

CONTEXT

Increasing penetration of non-manageable renewable energy sources such as solar or wind power combined with the progressive electrification of the energy system are challenging how TSOs and DSOs manage the grid. The security and reliability of power systems are dependent on the matching the demand and supply of electricity in real time. This balance requires the supply or demand of electricity, or both, to be flexible. The bulk of flexibility in systems has almost exclusively been provided on the supply-side through the adjustable output of power plants such as gas-fired power plants. Flexibility on the supply-side increases not only emissions as power plants are required to operate at lower efficiencies below their rated capacity but also costs due to the high prices demanded in flexibility markets because of the opportunity cost of permanent availability.

Demand-side flexibility provided by energy storage technologies and manageable loads are now enabling TSOs and DSOs to accurately manage demand and provide both cost savings and emission reductions.

In its 2016 report "Perspectives for the Energy Transition", the IEA and IRENA highlighted the importance of demand-side flexibility to accommodate large shares of renewable generation and estimated that by 2050 990 GW of flexibility from demand response and energy storage would be needed. Despite its benefits, demand-side flexibility is in its early days in the EU. Factors such as the lack of meaningful pilots to understand the complexities and impacts of the technology deployment and a fragmented regulatory framework that does not provide adequate incentives for the creation of sustainable business models are hindering demand-side flexibility in Europe.

> "BALANCING ENERGY SUPPLY AND DEMAND WHILE DECREASING EMISSIONS IN A MORE ELECTRIFIED CONTEXT REQUIRE BOTH SUPPLY AND DEMAND TO BE FEXIBLE".

The EC is creating a favorable framework for demand-side flexibility and the H2020 program is a powerful tool to create the capabilities needed to accelerate its uptake.

EC FUNDING MECHANISMS

The European Commission (EC) has established funding mechanisms to apply R&D within the EU. With the main goal of promoting developments capable of generating impact in the mid-to-short-term, the EC created framework programmes (such as the expired FP7 and the well-known H2020) focused on funding cooperation projects at later stages of development or very close to commercialization. The channels to direct these resources from the EC to technology based entities, academic players and other stakeholders are the topics defined to address from a technological perspective specific European challenges.

Referring to the Energy Transition, the transformational movement where i-deals is strongly positioned, the EC outlined its strategy mainly towards the work programme "Secure, clean and efficient energy",

clustering their addressable challenges in different groups of calls, from Energy Efficiency (EE), through Competitive Low Carbon Energy (LCE) to Smart Cities and Communities (SCC).

Energy efficiency, flexibility, demand response, sustainable bio and alternative fuels are examples of the technology fields being funded under this scheme. Taking into consideration the last two H2020 funding periods (2014-2015 and 2016-2017), the EC allocated in total a figure slightly below the €2,000M, divided almost equally in both periods.

> "THE EUROPEAN COMMISSION ALLOCTED €2,000M TO BE A REFERENCE GEOGRAPHY IN TECHNOLOGY DEVELOPMENT AND IMPLEMENTATION WITHIN THE ENERGY TRANSITION".

From this figure, Flexibility, the technology field of analysis in this article, accounted for a share of approximately 18%, reaching around €370 M.

EU ECOSYSTEM FOR FLEXIBILITY

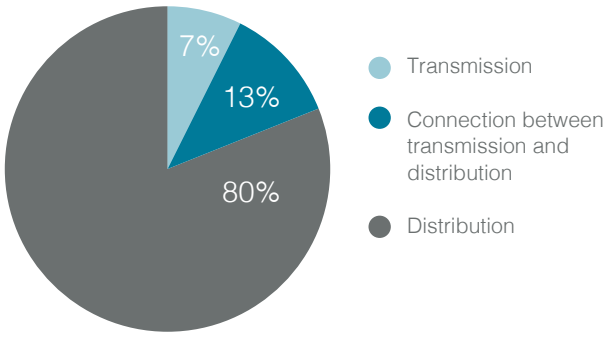
This article aims to characterize the Flexibility ecosystem fostered by the EC based on the analysis of their most relevant supported projects (31) (i.e. involving a total investment of €270M or, in other words, 75% of the previously mentioned €370M)

i-deals has reviewed the most relevant H2020 funded projects and conducted an analysis identifying the main actors involved (from the technology developers to the end users), flexibility sources being tackled and real scale pilot sites among other insights.

INFRASTRUCTURES IMPACTED

Flexibility related projects are initially classified according to the infrastructure where their core impact is expected. Low Voltage developments focused on distribution networks show the highest investments reaching a share of 80% and involving technology developments within areas of knowledge such as distributed generation, load management, aggregation and storage. With lower investment shares, developments addressing challenges in either the transmission network or in the connection between High and Medium Voltages are also being funded (7% and 13% respectively). The former focused on promoting cross-border flexibility solutions and large scale battery integration, and the latter developing technologies to monitor and control the impact of congestions in Low and Medium Voltage networks.

INITIATIVES ACCORDING TO THE INFRASTRUCTURE IMPACTED



TECHNOLOGY DEPLOYMENT

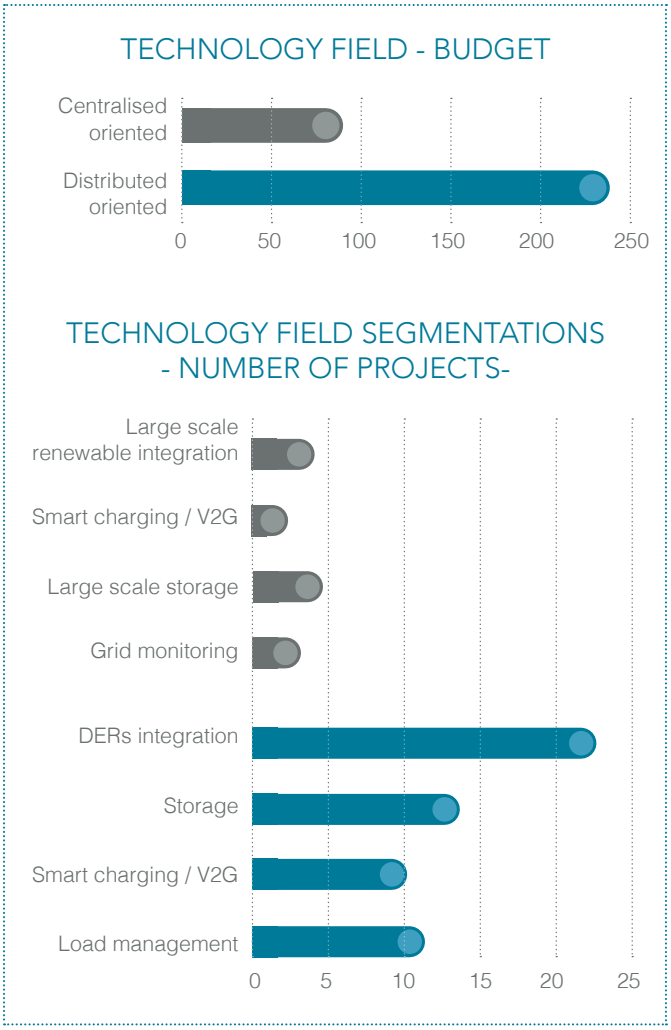
The majority of the projects focuses on deploying technology in applications addressing the residential (e.g. smart homes and buildings) and tertiary (e.g. public facilities and offices) sectors, with an increased interest from municipalities and city districts in applying Flexibility solutions to address the impact of microgrids in their future energy scenarios. To a lesser extent, the EC has also funded projects with research lines oriented to P2P, energy islands and smart cities.

TECHNOLOGY FIELDS

The analysis of the 31 selected projects from a technology field point of view highlights a clear trend on developing solutions oriented to distributed networks. As a matter of fact, 25 of the projects under analysis implement renewable, storage, load management and smart charging technologies from a distributed perspective (€210M).

From this segmentation, DERs integration represents the most active technology field as it accounts for developments in 22 projects. Storage, smart charging / V2G and load management appears in 13 projects, 10 projects and 11 projects respectively. Aiming to impact the whole energy transmission and distribution network, the EC also funds projects directed to implement centralized-orien-

ted solutions (€60M). Large scale renewables and storage show a higher participation with 3 and 4 projects respectively. Less intensively they also foster technology developments addressing grid monitoring (2 projects) and smart charging / V2G challenges (1 projects).

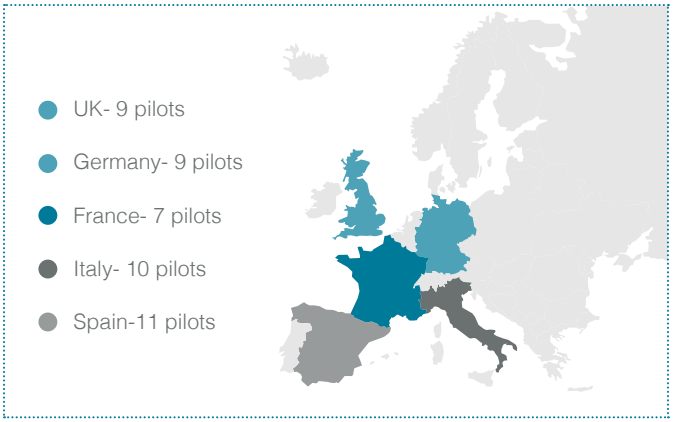


"THE EC MAINLY INVESTS IN DISTRIBUTION ORIENTED SOLUTIONS TO OVERCOME CHALLENGES IN THE FUTURE ELECTRIC SYSTEM. DERS, STORAGE AND SMART CHARGING/V2G WILL BE THE TECHNOLOGY ENABLERS".

REAL SCALE PILOT SITES

The H2020 framework targets technology applications at higher Technology Readiness Levels to ensure their rapid market deployment, maximizing their mid-to-short-term impacts while minimizing their real scale implementation risks. For this purpose, real scale pilot sites are being created across the EU to serve as testing environments for high-tech developments. Considering Flexibility, the most active countries in piloting technology are Spain and Italy with 11 and 10 real scale sites, followed by Germany, the UK and France with 9, 9 and 7 respectively.

More than 220,000 residential and tertiary end users, 2,000 secondary substations, 5,500 km of Low and Medium Voltage lines, 70 MW of DERs and more than 100MW of large scale renewables, hundreds of kW of storage and hundreds of EV chargers are the available infrastructures used by the EU for demonstration purposes.



Reference pilot sites in terms of available infrastructure are located in cities such as Bilbao (Spain) involving 1,075 secondary substations, 800 Low Voltage lines and more than 190,000 customers, and Huesca (Spain) focusing on office buildings integrating 735 kW of DERs (e.g. wind turbines and solar PV), 410 batteries and 250 kW of hydrogen power production. Between Puglia and Basilicata (Italy) a real scale testing infrastructure is located with 7 different backbones lines of 150kV, about 100 MW of large scale renewables (e.g. wind and PV power plants) and more than 50 MW of industrial loads. It is also underlined the municipality of Wunsiedel (Germany) with an infrastructure that includes 50 residential prosumers (end users who consume and produce energy), 25 residential flexible consumers and 2 commercial customers equipped with advanced BMS and DERs, London (UK) involving 2 commercial businesses and 53 residences with an annual consumption of 1,96 GWh and thermal storage technologies, and Paris and Montigny (France) with 2 fully equipped buildings comprising heat pumps of 130 kW, a connection to the heat distribution network, renewables penetration (solar), 800 workstations, 12 second life batte-

ries (192 kW in total), and additional 500 parking spaces and 130 EV charging stations.

"THE EC HAS CREATED A NETWORK OF TESTING FACILITIES ACROSS THE EU TO BRING MEMBER STATES THE POSSIBILITY TO VALIDATE THEIR TECHNOLOGIES, GUARANTEEING THEIR IMPACT IN THEIR RESPECTIVE ENERGY MARKETS".

STAKEHOLDERS

The funding scheme proposed by the EC involves the participation of a wide variety of stakeholders. From private entities (e.g. utilities, manufacturers, start-ups, etc.), to academic players (e.g. universities and technology centres) and public bodies, they mainly act as technology developers, system integrators, infrastructure providers, end users, regulators or new business case designers.

It is remarkable the participation of manufacturers like Schneider (8 projects), and Siemens (5 projects) as they are the most active players. Due to their importance in the Energy Transition, most active DSOs are Terni (4 projects), RWE (3 projects) and EDP (2 projects). DSOs participate in all phases across the projects execution but having their key role as end-users providing the infrastructure and test environments. Other relevant players are TSOs as they principally offer their facilities and knowledge to develop solutions at the transmission level. Terna (2 projects), and ELES (2 projects) are the reference entities.

Completing the ecosystem, academic stakeholders such as Fraunhofer (5 projects), Ciemat (2 projects), CEA (2 projects) and Cardiff University (2 projects) also participate in R&D projects funded by the EC. They are mainly in charge of leading technology developments, but also participate designing new business models, and even coordinating the implementation of the demonstration projects.

Using their knowledge and expertise to enable the development of Flexibility services in the new energy scenarios, aggregators such as Kiwi Power (3 projects), VCharge (1 project), and Restore (1 projects) also participate in the execution of EC funded projects.

"A WIDE VARIETY OF STAKEHOLDERS FROM DIFFERENT GEOGRAPHIES ARE BENEFICIARIES OF THE FUNDING SCHEME PROPOSED BY EC, INVOLVING THE CREATION OF A MULTINATIONAL AND MULTISECTORIAL NETWORK AROUND FLEXIBILITY".

MOST AMBITIOUS PROJECTS

As a final remark, the most ambitious projects (most of them ongoing) stands out over the rest. inteGRIDy is the top reference in terms of Demand Response storage-centric applications, being WISEGRID a cutting edge project involving the implementation of different types of technologies (EV, residential loads monitoring, aggregation and VPPs). HOLISDER, also focused on the Distribution network, is a best in class project referring to the integration of EMS in buildings enabling the development of Demand Response applications. From a transmission perspective, OSMOSE highlights the development of solutions to achieve an optimal and flexible integration of RES and storage at a TSO level. Addressing mid-to-long-term applications SmarTest outstands as the referent project in P2P technology developments.

"THE EC DEVELOPS MECHANISMS TO TACKLE THE CHALLENGES BEHIND THE FUTURE ENERGY SCENARIOS. FOSTERING EUROPEAN R&D CAPABILITIES, PROMOTING THE COOPERATION BETWEEN STAKEHOLDERS AND CREATING TESTING INFRASTRUCTURES ARE THE TOOLS UTILISED BY THE EC TO BE A STEP AHEAD IN THE ENERGY TRANSTITION.

AS A RESULT, CUTTING-EDGE R&D PROJECTS ARE CREATED, BEST IN CLASS TECHNOLOGY SOLUTIONS ARE DEVELOPED AND VALIDATED, AND REFERENCE ENTITIES EXPONENTIALLY BOOSTED".

CONCLUSIONS

The increasing electrification and the variation of the consumption profiles cause mismatches between energy supply and demand leading to an energy system increasingly difficult to manage. The traditional implementation of flexibility solutions in the supply side has involved increasing inefficiencies and growing greenhouse gas emissions. Aiming to tackle such challenges, demand side technologies and flexibility solutions across the whole energy value chain are being developed in recent years.

Designing common technology pathways to ensure an adequate balance between supply and demand in a way that environmental damage is minimized has to be the starting point. It is therefore encouraged to foster both public and private investments in R&D towards the development and implementation of shared technology roadmaps. Considering the big picture described in this article, the first step may be focusing on demand side flexibility to develop load management solutions that integrate DERs technologies to maximize self consumption. Once this phase is successfully accomplished technologies focused on resource optimization and demand aggregation may be proposed as a preliminary step to add the capability of operating the grid from the demand perspective. Finally VPP functionalities would be implemented matching the available demand already optimized with the energy market needs. As a result, the impact of increasing electricity demand scenarios would be minimized at the same time that a distributed energy network is created capable of achieving a more balance energy system.

I-DEALS AND THE ENERGY TRANSITION

i-deals, a reference entity in the Energy Transition ecosystem, acts as a dealer between technology producers and consumers with the main goal of fostering technology development and implementation. Having references with the main players and top innovators in the energy market, we have developed the methodology *inspire & explore, deploy & scale* allowing us to impulse the Energy Transition through real field testing and escalation of disrupting technologies and business models.

In case you are interested in this article or i-deals' core business and references, please do not hesitate to contact us.

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