IMPACT

A BRIGHT FUTURE FOR INTEGRATING RENEWABLES

SmartNet

RSE Ricerca Sistema Energetico

SMARTNET-PROJECT.EU

Impact Objectives

- Compare alternative architectures for optimised interaction between transmission system operators (TSOs) and distribution system operators (DSOs) for the acquisition of ancillary services (reserve and balancing, voltage regulation, congestion management) using simulation scenarios in Denmark, Italy and Spain
- Implement three physical pilots to demonstrate monitoring-and-control capability of distributed energy resources (DERs) connected to distribution grids and flexibility services they can offer to the system (thermal inertia of indoor swimming pools, distributed storage of radio-base stations)

A bright future for integrating renewables

***SmartNet Project Coordinator Gianluigi Migliavacca** talks about the challenges involved in integrating renewable energy sources into Europe's existing electricity transmission network and how his latest project will support future innovations in this area*

From your perspective, what are some of the biggest challenges facing Europe's electricity industry?

The energy world is facing major challenges as fossil fuel generation is replaced with renewable generation, which is often characterised by intermittent behaviour. This increases the need for resources to be used to guarantee frequency stability, congestion management, voltage regulation and power quality. At the same time, there is an increasing number of local small-generation and storage systems that are often located on the distribution grid. These resources, along with demand management, could potentially be available to provide network services if they are aggregated effectively. To achieve this, however, the roles of the diverse network stakeholders – transmission systems operators (TSOs), distribution systems operators (DSOs) and aggregators – should be reshaped. In tandem with this, the way real-time electricity markets are organised also needs to be adapted to reflect the new operating environment.

How is it hoped SmartNet will address these challenges?

All these topics are central for SmartNet. This project will compare different TSO-DSO interaction schemes and different real-time market architectures with the aim of finding out which would deliver the best compromise between costs and benefits for the energy system. A cost-benefit analysis will be implemented to evaluate simulation cases on three benchmark nations – Italy, Denmark and Spain – and will allow us to draw conclusions on possible regulatory gaps both at European and national level. This simulation platform will be scaled up to a full replica lab where the performance of real controller devices will be tested. At the same time, three technological pilots for testing specific technological solutions will be implemented to enable monitoring, control and participation in ancillary services provision from flexible entities located in distribution.

The Italian pilot looks at the technical feasibility of key communication processes such as monitoring the generators in distribution networks while enabling them to participate in frequency and voltage regulation. The Danish pilot studies the capability of flexible demand to provide ancillary services for the system by looking as a benchmark case to the thermal inertia of indoor swimming pools (thermostatically controlled load). The Spanish pilot focuses on distributed storage present in backup batteries of mobile networks' base stations as a source of flexibility for the system.

What is the expected impact of SmartNet?

By the end of the project we expect to be able to answer six key questions: How should the real-time markets be optimally organised for enabling flexible generation and load to provide their contribution to system services? Which interaction scheme between a TSO and a DSO would prove to be the most efficient one? What concrete economic benefits could the system draw from this? What is the trade-off between these benefits and the extra costs for ICT deployment to implement these new schemes? What regulatory impact could all of this have on the present European and national regulation? And, finally, what technological solutions could make it possible to realise a seamless monitoring and control of distributed energy resources (DERs) located in distribution? We are following closely the evolution of European and national regulation and the newly proposed Winter Package, which should be the basis for a more active participation of distribution grids. We aim at providing clear answers to benefit both the European Commission and the national regulatory authorities.

Guiding the way to a smart and flexible electric grid

*The **SmartNet** consortium is working to improve integration of intermittent renewable energy and enhance distributed generation, ultimately delivering a smarter and more efficient power network for Europe*

Small-scale local generation and flexible loads can provide numerous benefits for the whole system if enabled to participate in real-time electricity markets, by contributing to reduce transmission losses and reducing carbon emissions, and by increasing security of supply. When it comes to electricity reserves, system balancing, voltage regulations and demand management, new thinking is required.

The EU Horizon 2020 SmartNet project, which started in early 2016 and is set to run for three years, is hoping to provide just this. With 22 partners spanning academia, research organisations and industry across 9 countries, a vast breadth and depth of experience is being drawn on to achieve the project objectives.

COLLABORATIVE EFFORT

Project Coordinator Gianluigi Migliavacca of Italian research company RSE explains that through an ad hoc developed simulation platform the SmartNet team is going to compare different coordination schemes between transmission systems operators (TSOs) and distribution systems operators (DSOs) and different real-time market architectures. 'The SmartNet project aims at providing guidance to the European Commission and policymakers on how to increase the integration of renewable energy sources by strengthening the process of reserve acquisition and making real-time markets more fluid by allowing them to incorporate local generation and flexible loads,' says Migliavacca. 'At the same time, we aim at quantifying the economic advantages that such small distributed energy resources (DERs) can offer.'

PARTNERING FOR SUCCESS

One of the strengths of the SmartNet project is the presence of a high number of industrial companies in the consortium, including TSOs (Energinet.dk, Terna), DSOs (Endesa, SE, Edyna), manufacturers (Selta, Siemens), and telecommunication company (Vodafone). Support and contributions from key research centres – DTU (Denmark), Tecnalia (Spain), SINTEF (Norway), Strathclyde University (UK), VITO (Belgium), VTT (Finland) and RSE (Italy) – are also essential to the success of the project. The industrial participation, notes Migliavacca, helps to maintain a focused approach oriented to 'best exploit the state-of-the-art present technological solutions that are key for the technological pilots, while the research partners have a strong technology background and can combine the right mix of vision and disciplines to analyse current issues and develop better-performing solutions'.

The first year of the SmartNet project was mainly spent setting up specifications for both the simulation platform and the three technological pilots. Data collection followed, which according to Migliavacca was not an easy task due to the heterogeneity and amount of the data that had to be collected over the three target countries: Italy, Denmark and Spain. 'We are now starting the creation of the simulation platform itself,' says Migliavacca. 'This should be ready along with the data by mid-2017, so that both the simulations and the three pilot studies can start during the second half of the year'. An important challenge for this second year will be the widening of the modelling framework to 'include a more realistic implementation of the aggregation strategies including arbitrage possibilities between markets'. This will allow bidding strategies and simulated market outcomes to be compared in a more realistic way.

PILOT PROJECTS

The three pilot projects have their own targets and implement target-specific technological solutions to enable 'monitoring, control and participation in ancillary services provision from flexible entities located in distribution,' says Migliavacca. The Italian pilot, with participation from Terna, the Italian TSO, and Edyna, an Italian DSO, along with two manufacturers – Siemens and Selta – aims at demonstrating the possibility of implementing a fast monitoring (every 20 seconds) of the

“The SmartNet project aims to provide guidance to the European Commission and policymakers on how to encourage the integration of renewable energy sources”

status of entities located in distribution. The signal is then brought to the control room of the DSO and transmitted to the TSO. The TSO elaborates set points for active and reactive control that are subsequently sent back to the flexibility provider for actuation.

The Danish pilot, conducted by DTU along with the Danish TSO Energinet.dk and Syd Energi, a Danish DSO, aims at demonstrating the possibility of aggregating a wide number of thermostatically controlled loads of indoor swimming pools, managed by holiday rental company Novasol, to supply bid flexibility services. The intelligent algorithm considers information on typical comfort intervals and a characterisation of the thermal profiles for the indoor swimming pools.

The Spanish pilot, managed by Endesa, one of the biggest Spanish DSOs, and telecommunication company Vodafone, is investigating services that could be provided by mobile network base stations. These are endowed with local storage facilities that could be used as a temporary power supply, enabling provision of system services for both congestion management and system balancing.

The project has already enjoyed several successes. The team has carried out an in-depth analysis of the different coordination schemes between TSOs and DSOs to make it possible for DERs to participate in the ancillary services markets. Migliavacca reports that five schemes have been selected, whose efficiency will be compared in simulation: ‘With these we can carry out a neutral impact analysis on a wide set of situations to finally select the best performing scheme. I am also very proud of the advanced ancillary-services market architecture that has been proposed and will be compared against the status quo.’

SHARING THE KNOWLEDGE

The final year of the project (2018) will involve consulting with the European and national stakeholders. Three different workshops will be organised with targeted stakeholders, as well as a final project workshop to be held mid-2018 in Brussels. With this research being so vital to EU energy security, it is crucial that the outcomes are aligned with other European initiatives. There is a key relationship between the work SmartNet is undertaking and the new European regulations proposed in the Winter Package, observes Migliavacca: ‘In particular, this package includes two directives about the evolution of the internal energy markets, highlighting how DSOs should take a more active role in managing local resources for congestion management and promoting a more integrated exchange of information with TSOs so as to enable distribution entities to provide services for the system.’

To ensure the results from SmartNet are widely shared, every year physical meetings are organised with the project Advisory Board. In addition, SmartNet participates in the BRIDGE process set up by the European Commission for facilitating exchange between ongoing research projects. Within this process, four Working Groups have been formed that periodically provide documents requested by the European Commission to help harmonise the relationships between different EU projects in terms of ongoing legislative initiatives. SmartNet actively participates in the Working Group on Policy and Regulation. Finally, the project website (http://smartnet-project.eu/) is constantly updated with all project-related news and any kind of interaction is encouraged and facilitated by means of periodic web consultations (around June–July every year) and the possibility to download and comment on all finalised project deliverables.

Project Insights

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Dr Gianluigi Migliavacca graduated in Electronic Engineering at the Polytechnic University of Milan in 1991 and joined the Automation Research Center of ENEL in 1994, working on mathematical modelling and dynamic simulation of thermal power plants. In 2000 he joined CESI and then CESI Ricerca (now RSE), where he led research activities on deregulated electricity markets. He has been Head of the Transmission Network Planning research group and during 2005 he was a consultant at the Italian Regulator on the development of a common energy market in South-East Europe and on congestion management in Central-South Europe. He coordinated the European FP7 research project REALISEGRID, and was a Work Package Leader in the important e-Highway2050 project.

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