Nice Grid makes everyone happy

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Distributed generation can be challenging for grid reliability and power quality. But the Nice Grid project demonstrates how to integrate prosumers, retailers, DSOs and TSOs to improve system performance.

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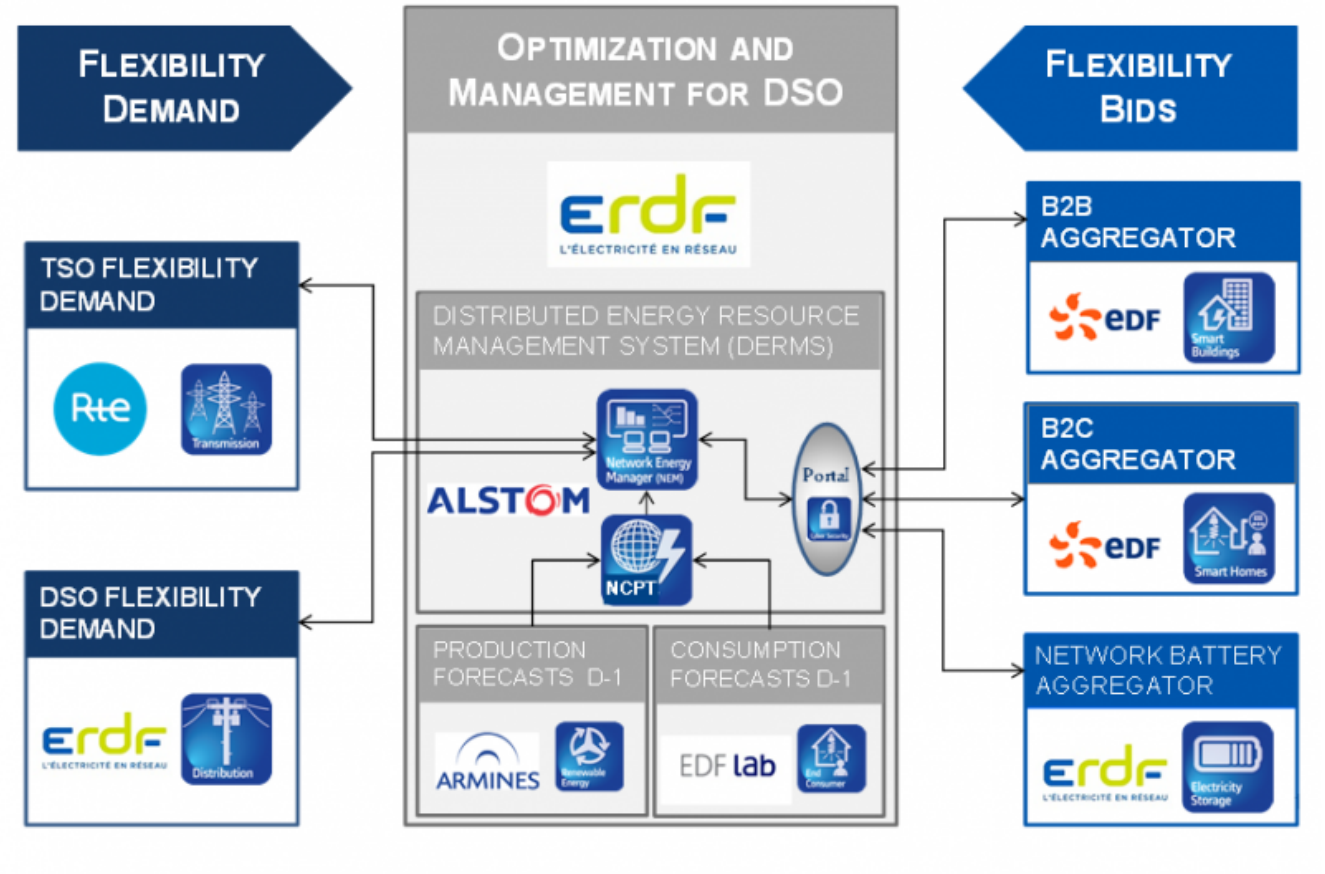
NICE GRID

The grid can be simply defined as a system delivering electricity from producers to consumers thanks to a network of generating stations, high-voltage transmission lines, and distribution lines. That's a good definition of the traditional setup, but with the growth in renewables and other types of distributed generation, and the deployment of microgrids, even basic concepts like "producer" and "consumer" are becoming less useful. "Prosumers" ranging from single households to large commercial and industrial enterprises now both consume electricity and produce it, and feed any surplus into the grid.

Although renewable generation and flexible demand are integrated at the highest level in power exchange markets and as part of TSOs' reliability strategy, their impact on distribution grids is not taken into account in the day-to-day operation. The Nice Grid project was launched to examine these aspects and facilitate the massive insertion and use of distributed energy resources in a distribution network.



Eco System of the Network Energy Manager, the brain behind the microgrid.

1 __An EU-wide project

Nice Grid is one of six demonstration projects in the **GRID4EU** initiative funded by the European Commission. The initiative will test the potential of smart grids in renewable energy integration, electric vehicle development, grid automation, energy storage, energy efficiency and load reduction. The project brings together 6 DSOs, covering over half of metered electricity customers in Europe, and 27 other partners, including utilities, energy suppliers, manufacturers, and research institutes.
Nice Grid is so-called because the test site is in Carros, a small town near Nice with a wide variety of industrial and residential electricity consumers in different types of housing. Matthias

Muscholl, Alstom Grid's Smart Grids Pilot Technology Leader, sees a number of other advantages to the site. "The zone is characterised by a massive insertion of photovoltaic production (PV), but even so, local generation represents only ten percent of the consumption load. Under peak loading, the area can be vulnerable to the risk of single contingency conditions, in other words, last backup plan before hitting a severe network situation. Not to mention the risk coming from forest fires to the operation of high-voltage lines. The south-east of France is also known as an electric peninsula of the national power system, connected to the bulk power grid through a single transmission corridor."

2__Shifting boundaries

Nice Grid focusses on the role of microgrids in enhancing system reliability and congestion management, while interconnected with the main grid. But as Muscholl points out, "here we run up against another problem with definitions: the boundary of utility-owned microgrids is not obvious, given that distribution grids are evolving over time and can be reconfigured when needed. The challenge is therefore to identify microgrids that can best support the DSO in managing constraints which may evolve due to power injection from renewables or self-consumption."
This requires new concepts and functions to complement the pure energy balancing function known from microgrid controllers. In order to support the DSO in his evolving role to maintain the system reliability and efficiency, the proper coordination of the partners is key. The system has to cope with constraints imposed by the local assets within the microgrid itself as well as external entities and assets when these are interconnected. Muscholl sums it up as acting as an honest broker. "That means, among other things, monitoring and anticipating flexibility needs; providing information and guidance to the different partners in a

timely, non-discriminatory manner; and adapting to changing grid topologies and the evolution of generation and demand."

3 __ Not just technology

How is it done? Alstom has packaged components and services available in the e-terra product family to propose solutions required for Distributed Energy Resource Management Systems. The demonstrator tests how a number of these technologies work together at all levels, including the control room, big data transmission, substation automation, battery storage, and low-voltage monitoring, as well as how customers engage with the system.

Beyond the technology, Alstom also had to propose a market mechanism for local flexibility that could meet the sometimes conflicting wishes of many different actors. The solution deployed is called the Network Energy Manager (NEM). This has been integrated within it a network calculation function that identifies violated constraints in the distribution grid called the Network Congestion Prediction Tool (NCPT). The NEM is deployed and runs on the IT infrastructure of the Distribution System Operator (DSO) and integrates with its legacy information system. This platform allows the operator to organise the day-ahead transaction process, and is completed with a set of applications to analyse distribution network constraints.

NEM control loop

4 __Active participation

Muscholl explains how the system works in practice. “We provide a market participant portal that allows aggregators to submit their offers on an equal footing. The portal implements standard domain protocols, such as ENTSO-E ERRP, that are well known to the players. The portal also defines gates that structure the business day and define the time windows during which each member has to perform their tasks”.
Grid operators decide by means of market clearing which offers best cover their needs. They reserve these offers and free up those they discard. The aggregators can then use their flexibility as long as the grid constraints are respected. The grid operators determine during the day which of the reserved offers are executed and send an activation message to the respective aggregator.

Typical dashboard for managing multiple microgrids

Nice Grid is due to run until January 2016, but a number of lessons can be drawn already. For Muscholl, perhaps the most important one is that: “focus on energy-centric services and related business and data models is only part of it. The active participation of numerous end-users also required deeper insights into the commercial, societal, legal and regulatory constraints.”

Interview with Rodolphe de Beaufort
Alstom Grid Smart Grid Marketing Director

What were Alstom’s objectives for Nice Grid?
We had three objectives. First, leverage our R&D resources to develop industrial solutions for DSOs, ready to scale, to enable massive photovoltaic integration through automated congestion management as well as centralised network storage at primary substation level. Second, to demonstrate this in a real-world setting and innovative market design involving major DSOs, TSOs, suppliers,

aggregators and over 1000 residential, commercial and industrial end-users. Third, demonstrate existing Alstom product performance in a microgrid environment such as wideband power line carrier telecommunications and local grid controllers (MCU and FCU).

What does that mean for the end-users?
Alstom technology is transparent for the end-users as our objective is to make the grid smarter without making the use of electricity more complicated. Commercial, industrial and residential customers have been offered innovative tariff structures or service offerings by EDF. This is one of the interests of the Carros area, which mixes all types of customer in the same grid pocket. These innovative offerings have been accepted by a large number of the local customers using the new Linky meter from ERDF. They now constitute the Nice Grid community, motivated by innovation and sustainability. Globally, these offering allow them to dynamically and transparently adapt local consumption to local generation in Carros when the grid reaches its limits, improving local renewable penetration, network costs and supply resiliency.

What other projects are you involved in?
We have projects all over the world at different stages. For instance, Alstom Grid supplied its Integrated Distribution Management System (iDMS) for a US Department of Energy project in North Carolina. The iDMS can integrate multiple types of distributed resources and monitoring information from several distributed interfaces. In this

case, Alstom will help the operator reach its smart grid targets for 2030, including a 40% improvement in system efficiency. In Spain and Ireland, the Green eMotion project uses our intelligent control systems for a DC fast-charging station that can charge three electric cars simultaneously. In Singapore, the Renewable Energy Integration Demonstrator Singapore (REIDS) initiative will encompass the construction of a microgrid at the Nanyang Technological University (NTU) campus to manage and integrate electricity generated from multiple sources including solar, wind, tidal, diesel, as well as energy storage and power-to-gas solutions.

Interview with Remy Garaude-Verdier
GRID4EU Project Coordinator and head of the Smart Grids Unit within the ERDF Technical Department

What's your impression of the Nice Grid project?
The smart grid community worldwide is asking questions about how to manage smoothly the injection of decentralised and intermittent renewable energy into the distribution grid; how to enable consumers to become active participants in the local energy balance via load shifting; and how to operate a small pocket of the low voltage network in islanding mode during a limited period of time. So we are thrilled to hear about the very positive results from Nice Grid, and to learn that the main objectives of the demonstrator are welcomed by institutions as prestigious as the International Energy Agency or the Institute for Electric Innovation of the

Edison Foundation.

Can you give us some results from your customers?
In this context, the results from the first megawatt-scale smart-solar district, which integrates storage systems and deploys centralised demand management, are closely monitored by ERDF and all the partners involved. For active demand, the first results show that "time of use" pricing with "Solar Bonus" allowed around 50 customers to consume an additional 22% of locally generated PV energy (load shifting). The "Smart Water Tanks" increased the share of energy consumption during the high PV production period (12 a.m. to 4 p.m.) from 16.7% to 25.1%, with negligible impact on daily consumption, thus avoiding grid constraints.

What's the most interesting innovation for you?
In particular, the Network Energy Manager using solar generation and load forecasts tests a new model of interactions between different energy actors: consumer, commercial aggregator and the DSO. It puts together an optimisation programme based on load flexibility bids. The bids, proposed by aggregators, ease the voltage and current constraints resulting from a high level of PV tied into the LV distribution grid. A test is being carried out on a 250 kW island including no rotating machines, which is, to our knowledge, a world first!

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