The first neighborhood microgrid of shared energy: RennesGrid®, a local demonstration of the energy transition

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Abstract:
Given their commitment to saving energy and to the energy transition, the Rennes Metropolitan Area and Schneider Electric have recently launched RennesGrid®, a 20-year experiment in managing energy consumption at Ker Lann in Bruz township (twelve kilometers southwest of Rennes, France). The Ker Lann urban development zone covers more than 160 hectares grouping: approximately sixty high tech companies; seventeen establishments of higher education, research and training; and residential units with dormitories for students. RennesGrid® will make Ker Lann less dependent on carbon energy thanks to the production from local, renewable sources of energy, in particular photovoltaic installations. For consumers, the objectives are to reduce their energy needs and consume locally the renewables produced locally. Planned for operation at the end of 2017 and endowed with a global investment budget of €5.8 million, this experiment, a partnership with Rennes and Bruz, is privately run; three hectares have been expropriated and leased for twenty years. However the business model is mainly based on cooperation, in particular with the zone's residents, and on innovative arrangements for participatory funding.

The decrease in fossil fuel resources along with the long-term increase in their prices, the rising needs for energy along with difficulties on the supply side, the energy sector's share in CO_2 emissions and the fight against climate change are forcing us to adapt our ways of producing and consuming energy.[1] Actions have been undertaken in response to these problems. In France, the so-called TECV act on the *"energy transition for green growth*" has set an ambitious objective, namely: for renewables to make up 32% of total energy consumption by 2030.[2]

However, the proliferation of *ad hoc* installations has a well-known impact on electricity systems and networks. Part of the production from renewable sources is intermittent, and can hardly (or not all) be controlled, whereas electricity grids were originally designed to transmit the electricity generated in a centralized plant in a single direction, from place of production to place of consumption. To adapt to this input from intermittent renewables, the grids must innovate and become "smarter" by integrating new information and communications technology (henceforth ICT) in order to favor the two-way, real-time circulation of information and to be managed more efficiently. Microgrids might be a solution for integrating renewables while satisfying the fundamental objectives assigned to the grids, namely: to be reliable, secure and of good quality.

[1] This article has been translated from French by Noal Mellott (Omaha Beach, France).
[2] Act n°2015-992 of 17 August 2015, available at:
https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000031044385.

A microgrid is an energy system that allows for a building or neighborhood to have an autonomous supply of electricity (or other sorts of energy) while remaining connected to the national grid. Thanks to digital technology, these grids can be more easily managed and controlled so as to:

— integrate and store locally produced renewables;

— ensure the grid's security at all times;

— understand and act, day after day, on energy consumption; and

— foster "electricity mobility".

Before installation on a larger scale, microgrids must address several problems, such as: anticipating trends in their environment of production (the prediction of input from intermittent renewables), adopting ICT while making it compatible with existing installations on the grid, and managing the grid so as to optimize the flow of current.

For a secure energy supply, a group of local authorities in western France made a strong commitment to an efficient energy transition. The SMILE program (Smart Ideas to Link Energies) was recently declared a *"showcase of industrial excellence*" at the service of the energy transition and green growth in France. The local authorities grouped in this program are sponsoring seventeen projects in the central part of the Loire valley and Brittany. One project (Zone d'Activités Intelligentes) will launch approximately ten smart microgrids in urban development zones, environmentally friendly neighborhoods or ports.

The pioneer is the Rennes Metropolitan Area. Managing energy is a major preoccupation in this dynamic, thriving area. The microgrid, a "natural" response to this preoccupation, opens a new phase in local history. The RennesGrid® project lies at the crossroads of three major issues related to the metropolitan area's development: urban renewal, energy management and excellence in the application of digital technology.

This project is being implemented at the scale of the Ker Lann neighborhood, which covers 165 hectares to the north of Bruz (twelve kilometers southwest of Rennes). There is a potential here for using a microgrid technology to come up with integrated solutions that can be exported to other areas. This locality groups about two dozen private or public establishments of education and training, and approximately sixty high tech firms as well as residential units (more than a thousand rooms), dining halls and accommodations for students. Electricity, the principal source of energy, is used for several purposes, mainly for residential heating.

The RennesGrid® project, initiated by Schneider Electric, is a demonstration on a pilot scale (but of significant size) about how to organize the distribution of the electricity generated from renewable sources (photovoltaic units) coupled with stationary storage facilities. Above all, RennesGrid® will design and use new business models based on innovative services and an active management of energy and digital applications. It fits fully into the process for flexibly adapting to the upsurge in renewables foreseen under the TECV act. It will try to make the electricity grid more flexible and to extend solutions to other local areas suited to a TECV approach.

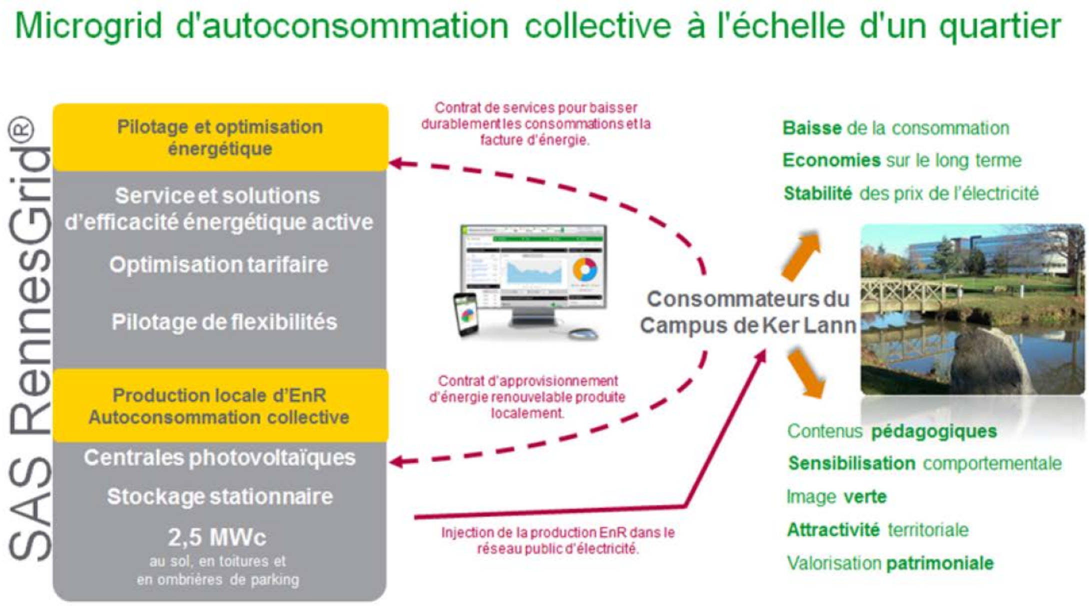

Figure 1: Microgrid for the consumption of self-produced electricity at the neighborhood level. *Source*: Schneider Electric

In pursuit of these objectives, the project seeks to promote a global approach to the energy transition by developing new energy technology, experimenting with it and then demonstrating that it can turn a profit. This new technology is based on:

— the production of renewables, mostly from a photovoltaic plant on the ground along with units installed on roofs and parking shades;

— an "active management" of the demand for energy and of the consumption of locally produced renewables; and

— storage facilities so that renewables can be used during peak hours of consumption.

Schneider Electric, Langa, Enercoop and Enedis, along with local institutions (Caisse des Dépôts et Consignations, the Rennes Metropolitan Area and Éco-Origin) decided to create RennesGrid® during the second semester 2017. This joint stock company will rally around this experiment other investors, users and institutions, whether businesses or academic establishments. Ker Lann is site full of promise.

Energy management in Ker Lann should make this locality autonomous in relation to energy and market fluctuations, and less dependent on carbon-based energy. The means to this end is the pooling of locally produced renewables and the consumption of self-produced energy. The project will also serve to promote new practices in the use of electricity among Ker Lann's residents.

With a budget of approximately €5.8 million, RennesGrid® should gradually become a business success story. It should be capable of being reproduced owing to its original, innovative business model. This model cleverly combines services for controlling the demand for energy and the supply of locally produced renewables (through photovoltaic installations coupled with stationary storage facilities). Emphasis is placed on optimizing local photovoltaic production and its consumption by Ker Lann's inhabitants. This project is also to be a player on the load management market. This increase in flexibility is at the service of the electricity grid and of local needs (maximize the consumption of self-produced electricity and eventually respond to the grid manager's needs).

The project's profit-earning capacity will mainly come from selling the green energy produced at optimized rates to firms, educational establishments and private persons in Ker Lann and from the offer of a broad range of services for load management and shedding and for energy efficiency.

RennesGrid® proposes to significantly increase the penetration rate of intermittent renewables by: developing, in this urban area (where the tertiary sector has a strong presence), the production of photovoltaic electricity so that it becomes a major share of consumption (25%); using techniques of "smart management" to distribute this self-produced energy; acting to reduce consumption (by about 25%); and adopting an original business model that is winner-winner for both shareholders and users.

In conclusion, strongly stimulating the local consumption of the renewable electricity produced locally should, along with demand-side incentives, have several effects.

— Economically, it should lead to robust know-how for the energy industry in a dynamic of national and international growth. This demonstration should help work out a solution that, borne by small, medium-sized and big firms in France, can be reproduced in new or older neighborhoods and soon attract the interest of the marketplace.

— Societally, it should improve the national or even international visibility of this local area and of its commitment to the energy transition and innovation. The positive aspects of the innovations made (services and rates) should become a major factor for making the local area more attractive.

— Socially, it should help cope with the problems of "energy poverty" and data control.

— Environmentally, it should reduce CO_2 emissions (approximately 434 tonnes/year by 2025, *i.e.*, 20% compared with 2017) and the consumption of fossil fuels.