A GUIDE TO WIDESCALE DEPLOYMENT OF SMART GRIDS

2023 – SUMMARY

think SMARTGRIDS

Soutenu par

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

FNCCR
territoire d'énergie

CONTENTS

EXECUTIVE SUMMARY

This guide presents the challenges and **main use cases for *smart grid*s, which can help local authorities meet the challenges of the energy transition**. Our electricity systems need to transform at an unprecedented pace to achieve our decarbonization objectives, by connecting decentralized renewable energy production and new assets (electric vehicles, heat pumps, electrification of industrial processes, etc.) to the power grid on a massive scale.

Smart grids will play a central role in this transition. Relying on digital technologies, they improve the operation and resilience of electricity grids, speed up the connection of renewable energies at the lowest cost, and offer new services to consumers, such as optimizing their electricity consumption or consuming their own electricity production (known as "self-consumption"). In a report published in September 2022, the International Energy Agency (IEA) estimates that investment in *smart grids* must at least double between now and 2030 in order to achieve "net zero emissions" by 2050.

Local authorities have a major role to play in accelerating the rollout of *smart grids*, not only as regional planners, but also as channels of communication, information and awareness for both citizens and companies.

The Think Smartgrids Territories and Innovation Commission conducted a series of interviews to present **10 *smart grids* use cases, with examples of successful, replicable projects** and recommendations from project leaders. Projects focus on electricity consumption and bill optimization, renewable energy integration, individual and collective self-consumption, smart public lighting, valorization of energy data, deployment of charging infrastructures for electric vehicles and multi-energy solutions. All types of territories are represented, from major cities to rural areas.

TEN SMART GRIDS USE CASES FOR REGIONAL ENERGY TRANSITION

By 2022, the European Union had set four major targets for decarbonizing Europe's energy landscape, as part of the Fit for 55[1] and REPowerEU[2] plans:

- Reduce greenhouse gas emissions by at least 55% by 2030 (as compared with 1990).
- Reduce final energy consumption by at least 40% by 2030 (as compared with 2007).
- Increase the share of renewable energies to 45% by 2030.
- Increase the energy efficiency target for 2030 from 9 to 13%.

Smart grids play an important role in achieving these objectives, enabling:

- Better control of electricity production and consumption, and easier, faster integration of renewable energies.
- The deployment of new use cases, such as the management of electric vehicle charging, the optimization of individual and collective self-consumption, intelligent connection offers for renewable energies...
- Energy savings, particularly for buildings, through intelligent automatic or remote control of lighting, heating and other equipment.
- Energy data collection and exploitation to improve the energy policies of local authorities: optimizing the deployment of renewable energies and charging infrastructures for electric vehicles[3], planning thermal renovations and targeting housing in situations of energy poverty...

Local authorities can initiate and develop smart grid projects on their territory, in conjunction with various players: suppliers, flexibility aggregators, electricity distributors, engineering firms, manufacturers... **Ten use cases have been selected for their ability to accelerate the energy transition while creating value for local communities.**

1. INTELLIGENT CONNECTION OF RENEWABLE ENERGIES: FASTER AND MORE COST-EFFECTIVE

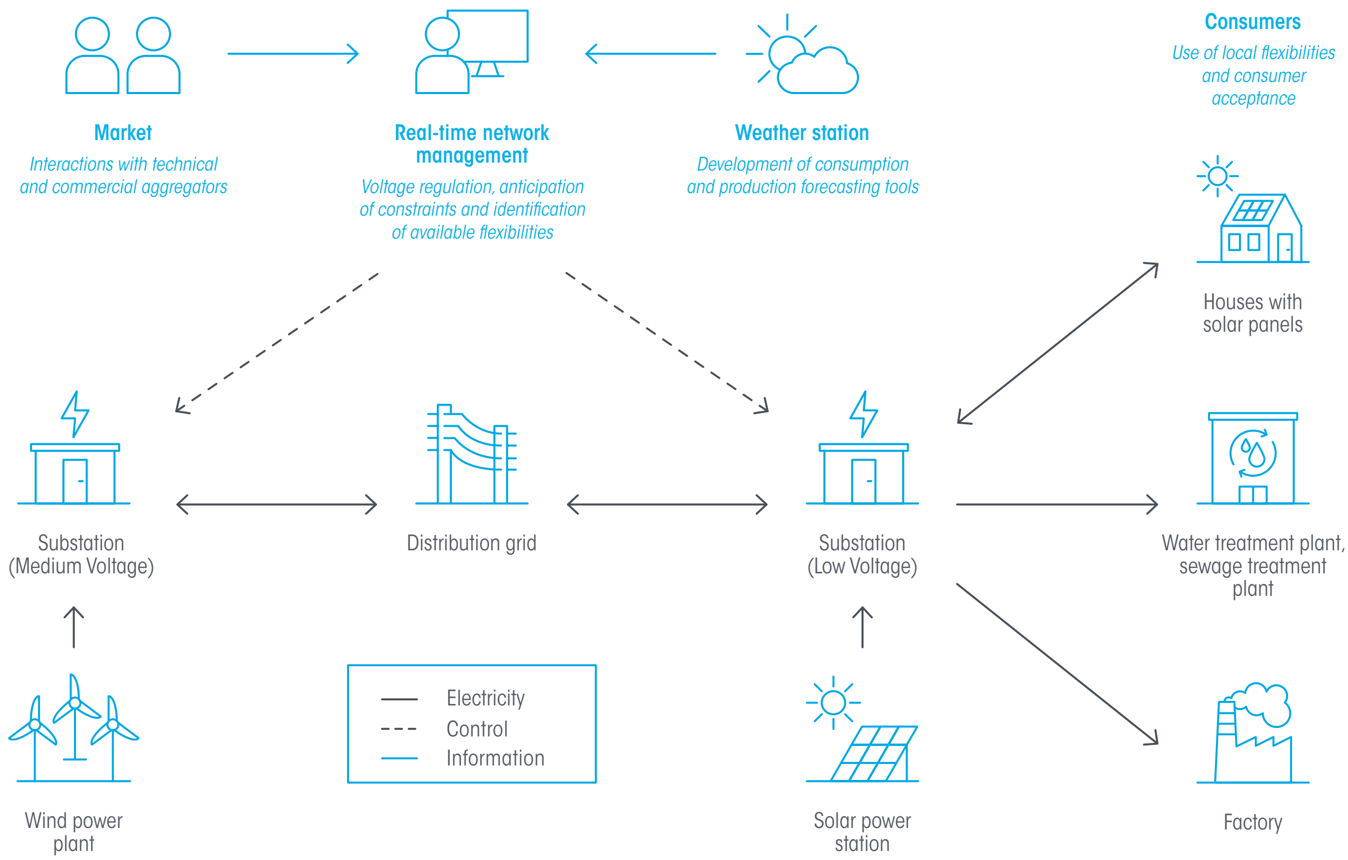
The Smart Grid Vendée demonstrator[4] (2013-2018) was designed to test new solutions for managing and modernizing electricity distribution in the Vendée department as part of the energy transition.

For 5 years, this true "open-air laboratory" involved more than 150 local authorities, manufacturers, startups, researchers, engineers and teachers. It has enabled the development and deployment of technological and organizational solutions for better integration of renewable energies and adaptation of the distribution network, at the lowest possible cost. In particular, Smart Grid Vendée has experimented with intelligent connection solutions for renewable energies: two wind farms and a photovoltaic farm have been connected to the nearest distribution network, reducing the cost and time required to connect them to the grid, in exchange for occasional limitations on production.

This project, supported and co-financed by Ademe, was carried out by *SyDEV*[5], *Vendée Departmental Energy and Equipment Syndicate*, and Enedis, the main electricity Distribution System Operator (DSO) in France, together with six other partners.

1. Council of the European Union - Adjustment to Objective 55
2. European Commission - REPowerEU: affordable, safe and sustainable energy for Europe
3. Guide Ministère de la Transition Écologique - IRVE master plans
4. SYDEV: the Smart Grid Vendée project
5. SYDEV website

Smart Grid Vendée project architecture and overview of tested solutions



RECOMMENDATION

The Smart Grid Vendée project has made it possible to set up Smart Connection Offers (SCOs) for medium-voltage (MV) renewable electricity production. The economic gain, depending on the type of network, can reach €90K/MW.

Such projects also reduce carbon footprint, as civil engineering work is reduced. Today's industrial SCOs could be extended to the low-voltage power grid, subject to a positive feasibility study and cost-benefit analysis.

The offers could thus be extended to the numerous projects involving the deployment of solar panels with an installed capacity of less than 250 kVA.

2. OPTIMIZE ELECTRICITY CONSUMPTION AND BILLS

Reducing energy consumption in public buildings

Several energy efficiency measures can be implemented to reduce energy consumption in public buildings, such as improving the energy performance of buildings or setting up equipment control and active management systems. *Smart grids* also allow close monitoring and control of the electricity consumption of buildings. Smart buildings use sensors and advanced control systems to schedule energy consumption (heating, electricity, lighting, etc.) according to the occupants' needs.

Reducing the energy consumption and bills of citizens

On the consumer side, the rollout of Linky smart meters in France has enabled electricity suppliers and numerous solution providers to develop applications to monitor and analyze energy consumption, and even to operate some of the equipment.

Some local authorities have also developed their own applications. **Ecolyo**[6], developed by Greater Lyon, enables users to **visualize their electricity, water and gas consumption on a single platform**, and to receive support to control their consumption through tips, **eco-actions and fun challenges**.

This pilot project was made possible thanks to the smart meters deployed across France (Linky (electricity), Gazpar (gas) and Téléo (water)), which collect energy consumption data from users, with their consent. In addition, an innovative approach to personal data management - ***self data*** - has been implemented, allowing users to regain control over their data. Greater Lyon has chosen to develop this service in ***open source*** in order to facilitate its replication, with a view to pooling resources with other cities and territories.

RECOMMENDATION

To develop energy consumption management, present and future tools need to be standardized to make them interoperable and thus enable savings for local authorities (in particular through the pooling of human resources dedicated to implementation, updates and maintenance of these tools).

6. Ecolyo website

3. DEVELOPING FLEXIBILITIES

Flexibility is the voluntary modulation of power by one or more sites, over a given period and in response to an external signal, in order to provide a service. For instance, it can consist in temporarily lowering one's consumption to help manage a constraint on the power grid[7].

Consumption demand response is an important lever for managing the supply-demand balance on the grid, or local congestion. In France, demand response mechanisms could mobilize some 3,300 MW by 2022. In its "Energy Pathways to 2050" study[8], the French Transmission System Operator (TSO) RTE assesses the need for electrical flexibilities in France at 15 GW by 2050. A scheme to support the development of demand response has been put in place: the Demand response call for tenders (*Appel d'Offres Effacement* or AOE) scheme offers consumers an additional remuneration on top of what they already receive for developing their flexibility under the capacity mechanism. This schemed started in 2021, and this additional remuneration will bring the total remuneration to a maximum of €60,000/MW.

In France, local authorities can contact their suppliers, RTE, Enedis (or local distribution company) or flexibility operators (aggregators) to discuss the conditions for implementing demand response. For local authorities, flexibilities can both safeguard the power grid and become a source of revenue. It also encourages the integration of local renewable energies.

Demand response can also be implemented by controlling industrial equipment. This approach has been tested by one local authority for its hydraulic equipment. In the case of the wastewater treatment plant, the temporal offset of certain processes was studied, with the aim of allowing demand response without adverse consequences for the plant. The switchover of the drinking water treatment plant's power supply to a generator was also tested. The first objective of the project was to assess the ability of the technical teams to implement an efficient organizational and decision-making chain to apply the switch-off procedures. The second objective was to measure the financial and human resources cost. The local authority feels that this project has helped to raise awareness and train teams, as well as to assess the risks and additional costs for industrial equipment that could potentially be switched off. This project can be replicated at other water treatment plants managed by the same local authority.

The Flex Mountain project at Isola 2000 (Alpes-Maritimes), an example of how flexibility can be rewarded

Demand response can also involve public or semi-public players, by involving them in a flexibility remuneration mechanism. This is the case of the *Société d'Economie Mixte des Cimes du Mercantour*, which signed a contract with Enedis in 2021[9], to cut its consumption during peaks in activity at the Isola 2000 ski resort to guarantee continuity of supply to the resort's electricity network.

Nice Grid: reducing peak consumption

The Nice Grid project[10] (part of the European Grid4EU project[11]) experimented from 2012 to 2017 with a smart solar district, which was generating part of its electricity via local photovoltaic production. Thanks to the deployment of 2,500 advanced Linky meters, various energy demand management and demand response solutions were tested. 217 volunteer households were encouraged to reduce their electricity consumption between 6 pm and 8 pm and let their Linky meter control their electric heating. **This resulted in an average of 22% reduction in consumption on peak days.**

A partnership with companies in the region (10 MW of power in total) allowed them to reduce their consumption by 10% between 6 pm and 8 pm, during the evening peak consumption period. This was made possible by the remote control of some of their electrical equipment. Finally, eight of the local authority's streets were equipped with **street lighting control solutions, reducing electricity consumption by 30% during peak consumption periods.**

RECOMMENDATION

On a national level, it would be useful to identify the most flexible collective facilities (water treatment plants, water towers, cold storage facilities for food, etc.) and to work with elected representatives to find ways of making the best use of these sources of "flexibility" for the benefit of the community. To raise awareness of the issues surrounding the development of flexibility, Think Smartgrids will publish a white paper at the end of 2023, defining flexibility precisely, explaining its contribution to the energy transition and *smart grids*, and detailing the various relationships between flexibility players.

7. Definition of flexibility by the French electricity grid operator: Enedis
8. RTE - Energy Pathways 2050
9. Enedis - Flexibility secures Isola 2000's power supply
10. ADEME fact sheet - The NICE GRID project
11. European Commission - The Grid4EU project

4. INTELLIGENT STREET LIGHTING

Intelligent lighting makes it possible to vary the light intensity of a lamp according to the users' needs, and thus to save energy. According to the French Environment Agency (ADEME)[12], lighting accounts for 37% of the overall energy bill of local authorities. So, being able to dim or switch off street lighting when a street is deserted is an important lever for reducing energy bills. In practice, optimizing street lighting consumption means installing LED bulbs, taking care not to increase light intensity, and coupling them with sensors to dim lighting according to the presence of humans or vehicles.

These devices can also integrate connected sensors linked to a single hypervisor, to optimize the urban planning policies of local authorities by mapping certain parameters (temperature, acoustic noise levels, etc.), but also to facilitate lighting maintenance activities by reporting breakdowns immediately and precisely. In Angers, a pioneer city in the development of an Intelligent Territory[13], a 65 to 80% reduction in electricity consumption has already been observed following the installation of intelligent lighting devices, and significant fuel savings are anticipated to result from the elimination of lighting control inspections, replaced by targeted maintenance actions.

Finistère Smart Connect: new services thanks to connected objects

Launched in 2019, the Finistère Smart Connect smart lighting project is supported by the *Finistère Energy Syndicate (SDEF)* and aims to develop new services thanks to connected objects, first in a pilot area, then eventually across the whole department. The public lighting service has been improved, thanks to remote detection of faults and outages, as well as better programming of lighting periods according to user needs. The system also tracks consumption data. Other use cases are now being deployed using the same IT and telecom infrastructure: monitoring building consumption, optimizing waste collection, remote reading of water meters and parking management. The project involves setting up a shared core network infrastructure, a hypervision platform used by municipalities and Public Establishments for Intercommunal Cooperation (EPCI), a radio network and sensors.

The Finistère Smart Connect project[14] was deployed in a pilot phase in 24 municipalities, including the island of Ouessant. The infrastructure used is a low-bandwidth radio network based on LoRa open-source technology, which provides a long-range, low-energy offering and bidirectional transmission both indoors and outdoors.

Deploying the radio infrastructure in all 24 municipalities has enabled to test the project in real-life conditions, and to identify anomalies that would not have been detected in a smaller area. A gradual roll-out to the entire department is planned.

RECOMMENDATION

Deploying a proprietary infrastructure ensures data sovereignty and security. Of course, it is also possible to choose "operated" solutions hosted in the cloud. The key to these different infrastructure choices is pooling, which means that the same intelligent public lighting infrastructure can be used to address several different use cases, to meet different needs and keep costs under control. If certain local authorities do not wish to manage this type of infrastructure themselves, it is possible to subcontract this mission to an energy syndicate, with governance remaining at local authority level.

12. ADEME Expertises - Street lighting: a source of energy savings
13. Angers Loire Métropole - Intelligent territory
14. SDEF - Finistère Smart Connect project

5. MAKING THE MOST OF LOCAL ENERGY DATA

In France, utilities are required by law to make local energy data available. The major players in the sector have turned this regulatory requirement into an opportunity to develop renewable energy production, self-consumption and electric mobility. With the volume of data produced doubling every two years, **utilities are becoming data operators for local areas**[15]. They are faced with a dual challenge: on the one hand, they must guarantee data protection and respect for user consent, and on the other hand, they have to make more and more data available to local authorities and businesses in order to enable the development of new services[16].

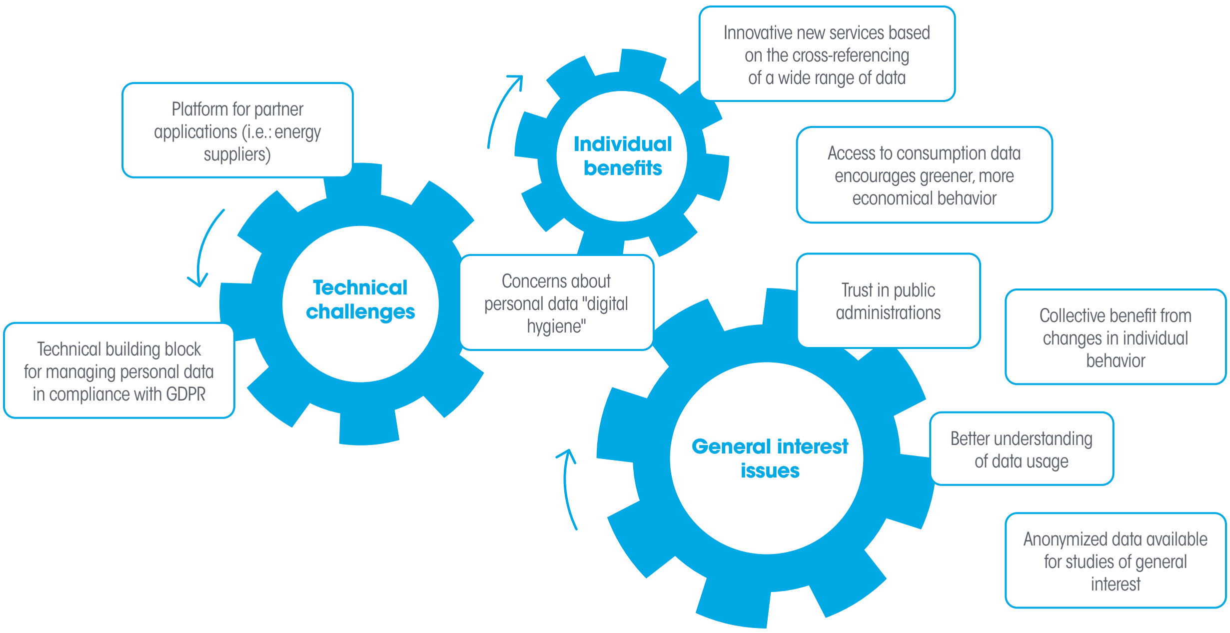
To accelerate the deployment of solar energy projects, several solar land registers have been developed in France, including the one in Saint-Nazaire at the initiative of the Loire-Atlantique Departmental Energy Syndicate[17]. This energy register, or "energy cadastre", characterizes the photovoltaic and thermal solar potential of the roofs of all buildings (initially public, then private) in the area, as well as the potential of free land to receive photovoltaic awnings. The collected data is then used as the basis for an assessment of the economic benefit of installing solar infrastructure, whether thermal or photovoltaic, at each studied location.

The Energy Register project of Greater Lyon

The Energy Register[18] of Greater Lyon is primarily aimed at energy efficiency professionals to support the home renovation process. This tool can be used to identify buildings where energy consumption is too high, and to prioritize actions: renovation or support to reduce consumption if the building already has a good energy performance. Consumption levels and energy performance are scrutinized for gas, electricity and the heating network.

Note that single-family homes and buildings with fewer than 10 dwellings are not included, as the data is not publicly available. Greater Lyon is working on aggregating this data, anonymizing it and integrating it into its tool. The tool will also be used to evaluate the city's public policies. The project, which has been online since August 2022, aims to eventually integrate new functionalities to process more data (energy performance diagnosis, individual houses, energy networks). This tool is open-source so that it can be extended to other territorial partners.

The Management of personal data - "self data" - at Greater Lyon



15. opendatasoft - Why is it in the interest of energy companies to share their data?
16. Smart grids-CRE - The legal nature of collected data
17. Espace presse Saint-Nazaire - A new tool to measure the region's solar potential
18. Energy Cadastre - Metropole de Lyon

RECOMMENDATION

The potential of land registers (energy and/or solar) is based on the cross-referencing of data from multiple players. To develop these tools, which will accelerate the deployment of renewable energies, elected representatives need to bring together a wide range of players (network operators, renewable energy project developers, public/private landowners, landlords, etc.) to help projects emerge. Investments must be targeted to maximize energy savings and, at the same time, to optimize the renewable energy capacity deployed.

6. SELF-CONSUMPTION AND ACCELERATED DEVELOPMENT OF RENEWABLE ENERGIES

The principle of self-consumption is to develop the consumption of locally produced, renewable electricity. **Individual self-consumption** involves a single producer consuming all or part of their own electricity production. **Collective self-consumption** involves sharing locally generated electricity (in France, within a perimeter of 2km around a district substation, or 20km by derogation in dispersed housing) between producers and consumers connected to the public distribution network.

Communicating meters are an essential prerequisite for the development of collective self-consumption: they enable the Distribution System Operator to record the load curves of consumption and production, to calculate the share of local production to be allocated to each consumer according to the distribution agreement, and to consolidate the data for project stakeholders[19].

Three collective self-consumption projects in Brittany

The Langouët town council has launched a project for a collective self-consumption loop of renewable energy around a solar tracker, which was commissioned in 2020[20]. The solar tracker was installed by the local semi-public company ***Energ'iV*** on land owned by the town council. It supplies a dozen homes as well as the town's public buildings.

As the regulatory framework for collective self-consumption is rather recent in France, the project is advancing step by step. An ad hoc structure has been set up to manage the project: an association acts as the sole contact for the Distribution System Operator Enedis, and as the *Personne Morale Organisatrice* or PMO (legal entity responsible in France for distributing self-generated electricity among the various consumers). *The Ille et Vilaine* Energy Syndicate (SDE35) and the local energy agency are members of the PMO and contribute to its funding. Finally, the town uses the platform of an external service provider to monitor electricity production and consumption, and to dispatch invoices between the customer's traditional supplier and the solar tracker's production. Over time, the project aims to integrate private production on the roofs of individual or collective homes.

In Mélesse, Ille-et-Vilaine, a second collective self-consumption loop project was commissioned in September 2022, based on the main lessons learned from the Langouët project. It includes three collective buildings, each with a rooftop photovoltaic system. The local semi-public company is the project's PMO, to simplify the contractual set-up and to limit the number of stakeholders. The Mélesse project[21] generates a significant production surplus, which is fed into the grid. The more advantageous tariffs applicable from 2021 for injecting surplus production into the grid have made this operation attractive.

A third project, initiated by a citizen cooperative, CIREN[22], is currently being developed in a district of the city of Rennes. The ECLAIRS project[23] involves a much larger number of voluntary residents than the two previous projects. This project also includes charging stations for electric vehicles. **Increasing the amount of self-consumed electricity has enabled costs to be effectively reduced.**

19. Enedis - Is collective self-consumption right for you?
20. BDI - Langouët's collective self-consumption project on the rise
21. SED35 - Success of the Mélesse self-consumption loop
22. Énergies du Pays de Rennes - A citizens' cooperative for renewable energye
23. Énergies du Pays de Rennes - The ECLAIRS project: Collective self-consumption in Rennes Sud

RECOMMENDATION

While individual self-consumption is now profitable over the long term[24], the initial investment is still high. Thus, more people will have to be convinced of its benefits in order to democratize this practice. In the case of collective self-consumption, overall economic optimums have yet to be found[25], and investment subsidies are generally still required. In France, rising energy prices and recent regulatory changes (adaptation of grid usage tariffs, better remuneration for injection of surpluses into the grid) have improved the economic profitability of these projects.

7. RAISING CONSUMER AWARENESS: TOWARDS THE PROSUMER

Prosumers are consumers who take ownership of their act of consumption. In the context of *smart grids*, the prosumer aims to control and reduce their energy consumption and/or to consume renewable and local energy.

While smart meters such as Linky, for electricity, and Gazpar, for gas, theoretically provide consumers with the details of their energy consumption, reading the data provided by these meters is not always straightforward. Several smart grid projects in France have been aimed at informing inhabitants on how to read their energy bills and to control their consumption.

Lorient's SOLENN (*SOLidarité Énergie iNNovation*) projec

Between 2014 and 2018, 900 households in the Lorient agglomeration, equipped with a Linky meter, volunteered to control their electricity consumption. They were provided with the visualization of their consumption, individual coaching and group events. According to the results of this experiment conducted by Enedis in partnership with a dozen other players, including the local energy agency ALOEN and the Brittany Region, 50% of households that actually used the portal saw their consumption fall by an average of 2% to 7%[26].

RECOMMENDATION

The Linky meter and the Enedis[27] interface, or that of the energy supplier, enable consumers to visualize and analyze their electricity consumption, in order to reduce it. Smart meters can also control various items of equipment, but this often requires the addition of extra equipment (such as a local radio transmitter, or LRT). It is important that electricity suppliers take greater advantage of the possibilities offered by smart meters. A national consultation involving the relevant stakeholders could enable the industrial deployment of solutions such as Home Energy Management Systems. The Linky Ready® indication is a first initiative which certifies that devices bearing this label are equipped to receive the Linky meter's TIC (Tele-Customer Information) data.

24. Maximizing individual self-consumption can save a few dozen euros a year on your bill, thanks to the positive difference between the loss of income from electricity resale (~10 c€/kWh) and the gain from electricity "non-consumption" (~13.5 and 18 c€/kWh at the Regulated Sale Tariff).
25. In fact, there may be other benefits than economics resulting from collective self-consumption, such as consuming local or "green".
26. Think Smartgrids – L'heure du bilan pour l'expérimentation Solenn à Lorient
27. Enedis - My customer account

8. ELECTRIC MOBILITY: OPTIMAL DEPLOYMENT OF CHARGING STATIONS AND CHARGING MANAGEMENT

Electric Vehicle Charging Infrastructure Master Plan (SDIRVE)

In France, the deployment of electric vehicle charging stations is planned in consultation with local stakeholders and the Distribution System Operator. The Electric Vehicle Charging Infrastructure Master Plan[28] sets precise targets for the number of charging points, their location and power, with time frames that are both operational (within 3 years) and more forward-looking (over 5 years).

Launched in 2022 by the FNCCR, the collaborative *France Data Réseau* platform[29] provides a trusted framework for sharing and leveraging territorial data. In the case of charging stations, it will enable the 3 syndicates participating in this project (currently responsible for 850 charging points) to jointly define future areas to be served, share the location of their charging stations, better identify the stations and improve their accessibility for users.

Electric vehicle charging management

Smart charging systems allow owners of electric vehicles to schedule their charge during periods when electricity is cheapest. It also helps to reduce stress on the power grid by shifting vehicle recharging towards nighttime. It is possible to manage vehicle charging by using apps from car manufacturers, or through domestic Linky smart meters.

Led by Enedis and financed by ADEME, the aVEnir[30] project brings together a consortium of 13 industrial and academic partners. It aims to support the large-scale development of electric mobility by experimenting with the interactions between the public electricity distribution network, charging stations and electric vehicles. The experiment covers technological, economic, sociological and regulatory aspects.

In terms of **charging management**, several use cases are being tested in real-life conditions on tertiary sites or on roads, such as the sending of a signal by the electricity Distribution System Operator to terminal operators or to an aggregator to activate the modulation of vehicle charging. More complex control solutions such as *Vehicle-to-Grid* (V2G) or synchronization of electric vehicle charging with photovoltaic production are also being tested. The aVEnir project will deliver its conclusions in 2023. While the technical feasibility of the solutions has already been demonstrated, other issues still need to be consolidated, such as standardizing data exchange protocols and making the most of the diffuse local flexibility provided by electric vehicles.

The Yonne Departmental Energy Syndicate (SDEY) has deployed an experimental project for **bi-directional charging** stations, which provides a local response to the structural problems of storing electricity, particularly renewable electricity, and smoothing out electricity consumption. Jean-Noël Loury, Chairman of the SDEY, comments: "This innovative project is a powerful factor in the modernization, growth and attractiveness of our region. The energy transition requires us to develop *smart grids* that combine new sources of local production and flexibility with new players and models of cooperation. In just a few years, local authorities have become real incubators of innovation".

Dynamic power control, i.e., the distribution of charges for a cluster of charging points in a building according to the overall power available on the site, is also technically possible. This is a means of reducing the subscribed power or the maximal power of the connection to the grid. However, according to the Seine-et-Marne Departmental Energy Syndicate (SDESM), this power modulation is not appropriate for on-street charging stations, as it does not meet the needs of users looking to recharge their vehicles as quickly as possible.

28. Schéma Directeur des Infrastructures de Recharge pour Véhicules Électriques
29. FNCCR - Sharing local data to improve public services
30. aVEnir-emobility.org

Synergies between local renewable energies and electric mobility

To maximize "green charging" on the one hand, and relieve the power grid on the other hand, charging stations can be coupled with local photovoltaic generation. For example, one large city has equipped a park and ride facility with solar canopy systems coupled to batteries to power electric vehicle charging stations. Incentive pricing (variable pricing according to power, duration of use of the charging station and type of electricity used) was also experimented in this project. Here are the lessons learned from this project:

- Connected charging infrastructures are essential for optimizing charging control.
- To maximize self-consumption when charging electric vehicles, drivers should be encouraged to charge their vehicles during the day under solar canopies, particularly in park and ride facilities.
- Vehicle chargers have current operating ranges that should be favored. For example, when the power available from a photovoltaic canopy is insufficient, "energy block" charging (i.e., charging the vehicle at maximum power, then stopping, then resuming recharging at maximum power) should be preferred to reducing the power level of charging over the whole charging time. This reduces the risk of non-engagement of the charging process.
- Two apps are needed to control the charging station infrastructure: the energy manager's app, which limits the inrush current drawn from the grid, and the charging station manager's app, which decides which vehicle(s) to charge. This makes it possible to optimize the charging station's capacity connection to the electrical grid.
- A stationary battery optimizes the self-consumption of charging stations and can avoid excessive power demands, but it is important to ensure a good fill rate right from the design stage, and to carry out an overall cost-benefit analysis of the different solutions (with or without a battery) to ensure its relevance. Deploying a battery is not systematically necessary, and its financial viability has yet to be proven. Besides, it requires operators with the relevant expertise and imposes certain constraints (technical premises, safety perimeter, etc.). Furthermore, performance during rapid discharges is poor (high power batteries are the preferred choice).
- Finally, self-consumption can be encouraged by incentivizing rates.

The SMAC project[31], deployed in Champagne-Ardenne between 2018 and 2021, aimed to synchronize electric vehicle charging with periods of high wind generation in the region. The project explored several use cases, ranging from controlling consumption and local constraints on the grid according to local wind generation, to V2G. Using simulations, the project demonstrated the relevance of simple charging management from an economic point of view (charging when there's a lot of wind and electricity is cheapest).

The other use cases, *Vehicle-to-Home* (V2H), *Vehicle-to-Building* (V2B) and V2G, have been partially tested. Less mature than simple charging control, re-injection into the grid is still at the experimental stage. **Bidirectional charging stations, with vehicles capable of re-injecting electricity stored in their batteries back into the grid, are currently very much in the minority in France**.

Other smart charging innovations

In addition, other innovative projects are targeting on-street charging using public lighting masts, to optimize the system, reduce civil engineering work and give everyone the possibility to charge their vehicles (e.g., La Roche-sur-Yon with *SyDEV*).

RECOMMENDATION

Accelerating the deployment of electric mobility is a major challenge for the decarbonization of mobility. Nevertheless, to limit the impact on the power grid, we need to target the actions to be carried out as a priority and at the lowest cost, in particular shifting charging to off-peak hours of electricity consumption or during peak wind and solar production. Before the generalization of *smart charging* or even *Vehicle-to-Grid* (V2G) to meet the need for real-time flexibility (system services), very simple applications already exist to control off-peak charging. These become profitable in less than a year, with a direct impact on consumers' electricity bills. In France, the cheapest solution is to control the charging of your electric car using the "Peak / Off-peak" signal supplied by the TIC (Télé Information Client) an output on the Linky meter, which provides the data recorded by the meter in real time; this signal can be transmitted by the meter's radio transmitter (Emetteur Radio Linky or ERL) to a receiver integrated into the charging terminal, without the need for a wired connection[32].

31. SMAC project presentation on ADEME's website
32. Enedis - Practical guide: Linky smart meter

9. CORRÈZE RESILIENT GRID: A MICROGRID TO SECURE ELECTRICITY SUPPLY IN RURAL AREAS

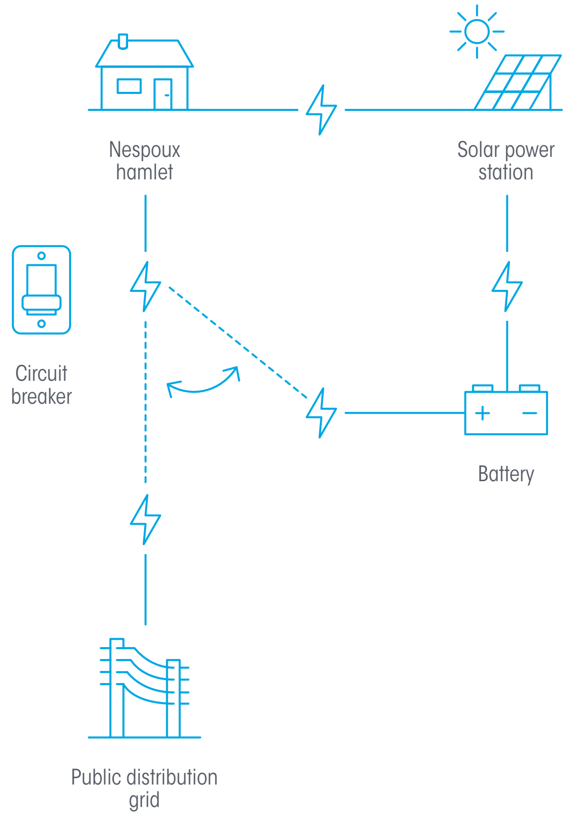
To guarantee the supply of electricity to the isolated hamlet of Nespoux, which is prone to electrical incidents due to the climatic hazards, Enedis, *the Diège energy syndicate*[33], the Corrèze department and the city of Lestards have joined forces to set up the Correze Resilient Grid microgrid[34], in service since late 2020 and based on the use of a high-capacity battery.

As shown in the grid diagram, in the event of an incident on the public electricity grid, the circuit breaker isolates the hamlet from the upstream power grid. A signal is then sent by the battery to the photovoltaic power station. The power plant (which normally injects the electricity it generates into the public grid) then starts charging the battery, which in turn supplies electricity to the hamlet of Nespoux, while the public grid is being repaired.

This *microgrid* protects the hamlet's inhabitants from relatively frequent power cuts (around ten days per year), which are particularly inconvenient as the drinking water network is supplied by electric pumps. When Nespoux's electricity network is isolated from the public grid ("islanded" network), Linky meters, at residential homes and in collective infrastructures, measure the power supplied by the photovoltaic power plant and the global consumption in order to adjust supply and demand in real time via a dedicated information system.

This pilot project enabled the partners to evaluate the benefits and difficulties of a *microgrid* in a rural environment, as an alternative to reinforcing the power grid.

Working principle of Corrèze Resilient Grid, from the project's press kit



RECOMMENDATION

Despite the complexity of implementing the project, it is a technical success to be able to "island" a hamlet and supply it with power in a matter of minutes, thanks to photovoltaic panels, a battery and smart meters. The replicability of such a project cannot be envisaged today without removing many obstacles, both regulatory and economic, the cost of the battery in particular being prohibitive to scale-up. R&D activities are currently focusing on solutions requiring little or no storage capacity.

33. Syndicat de la Diège
34. Conseil départemental de Corrèze - The "Correze Resilient Grid" project

10. COMPLEMENTARITY BETWEEN POWER AND MULTI-ENERGY NETWORKS

Although the production of hydrogen by electrolysis is not yet profitable, it is a useful complement to the decarbonization of certain industries, or even to heavy mobility or boats (see for instance the Hylias project[35] for transporting passengers on an electro-hydrogen powered boat in the Gulf of Morbihan).

A few pioneering departments (*SDEM-Morbihan énergies* and *SyDEV* in the Vendée department) have experimented with the production of carbon-free hydrogen, sometimes aiming to absorb variable renewable energy production.

Thus, electrolyzers can be used to develop the flexibility of the electrical system (based on electricity / hydrogen complementarity). Nevertheless, this complementarity needs to be discussed locally between elected representatives, private players and the electricity grid operators.

Sector coupling is another axe of research studying the interdependence and complementarity of energy networks. In addition to storage and conversion into electricity via fuel cells, hydrogen can also be injected into gas networks. Ultimately, "Electricity / Hydrogen / Gas / Heat" *sector coupling* could optimize the integration of local renewable energies, while reducing the cost of investment in the electrical infrastructure.

Example of a Power-to-H2-to-Power facility[36]

The Syndicat Mixte Pau Béarn Mobilités[37] has decided to equip its buses with fuel cells and hydrogen tanks, to produce the electricity needed for their electric motors directly in the buses.

This solution offers greater autonomy than electric batteries, reducing the number of buses required by the local authority (8 purchased with the hydrogen solution versus 10 or 14 for buses equipped with electric batteries, using either opportunity charging - during stops at bus stations - or only at the depot).

An analysis of the overall cost of the bus network (including purchase and operating costs of the buses themselves) showed that, for the same level of service, the use of hydrogen is more economical for this territory, despite the much lower efficiency of the conversion chain compared with electric batteries (25% vs. 70%).

RECOMMENDATION

These projects are still at the experimental stage and are highly prospective. Greater collaboration between grid operators and local authorities will be needed to ensure coordinated planning of the energy system. Rapid deployment of new demonstrators is needed to test the technical and economic viability of certain solutions.

35. BDI - The Hylias project
36. ADEME data sheet - Hydrogen chain efficiency
37. Pau: commissioning of Fébus hydrogen buses

GENERAL RECOMMENDATIONS

Pooling infrastructures

Pooling infrastructures is key to achieving economies of scale. In the case of SDEF's **Finistère Smart Connect** project, developing several use cases from a single technical base shared by several territories has optimized project costs. The syndicate and local authorities co-finance the infrastructures (radio antennas in this example) and their operation. In addition, pooling, territorial partnerships and demonstration by proof help to convince elected representatives of the usefulness of such projects by presenting them with real-life use cases. In the case of ***SyDEV's* Smart Grid Vendée** project, the pooling of communications infrastructure for smart building management at regional level is currently seen as the only profitable business model for public building management. *SyDEV* thus aims to develop a service solution, supported by the syndicate itself, available to all local authorities in the area.

Developing *smart grids* expertise within local authorities

To develop a *smart grid* project, local authorities can first turn to energy associations or public services with expertise in energy issues. Think Smartgrids can also provide guidance to local authorities according to their needs. Exchanging with other local authorities who have already implemented a similar project will provide beneficial feedback, and sometimes avoid needlessly redeveloping an existing tool. However, recruiting energy experts at a local level (intercommunal body, department) and training local authority teams in energy and *smart grid*s issues are important prerequisites. In addition, projects will often require multidisciplinary skills (developers, legal experts specializing in personal data, social psychologists, etc.).

Ensuring the relevance of the use case

Ensuring the relevance of a use case means being transparent about the cost/benefit ratio of a *smart grid* project, from both an environmental and a financial point of view. It is also recommended to measure, upstream, the real benefit of automating certain processes. The various environmental impacts of the project need to be integrated into the specifications. Finally, project teams need to ensure that projects are correctly sized.

Promoting project acceptability

To promote the acceptability of projects and the commitment of citizens, clearly displaying the reductions in CO_2 emissions, energy savings and reduced expenditure achieved thanks to a *smart grid* project are interesting avenues to explore. In addition, it is crucial to have local energy specialists available to advise communities on complex projects (solar panels, self-consumption, etc.).

Ensuring the sustainability of a *smart grids* project

If a local authority cannot provide its own resources, it must at least involve a long-term player or partner in its *smart grid* project (energy syndicate, local energy agency, etc.). Funding must also be sustainable. Public funding is often limited in time, and the profitability of projects once subsidies have ended should be assessed.

Assessing the obstacles to collective self-consumption

To develop collective self-consumption projects, consultations are needed to remove certain regulatory constraints and simplify project design and development, both technically and contractually. As far as local authorities are concerned, it is essential to anticipate the human resource costs required to manage the project and the billing process. It is also important to ensure that the electricity bills sent by suppliers to private customers take into account the production and consumption of electricity generated by their photovoltaic panels.

Think Smartgrids association federates the French smart grids ecosystem, from startups to major groups and power grid operators, as well as research laboratories, universities, competitiveness clusters and associations. Its members' activities cover the entire smart grids value chain: network management, electronic engineering, automation, equipment and information systems, digital services, training, studies and consultancy, research and regulation. The French Energy Regulatory Commission and the French government, through the Direction des Entreprises and the Direction Générale de l'Energie et du Climat, are observer members of the association.

Think Smartgrids – Phone: +33 1 42 06 52 50 – contact@thinksmartgrids.
www.thinksmartgrids.fr - @ThinkSmartgrids

Design: Agence 9 | Une bulle en plus - 2023 - Printed on 100% recycled paper