ENEDIS
L'ELECTRICITE EN RESEAU

Flexibilities to enhance the Energy Transition and the performance of the Distribution Network

October 2019

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Due to the increasing levels of renewable generation on the distribution network(1), the development of self-consumption, and the emergence of new electricity uses such as electric vehicles, the challenges of the power system are gradually shifting towards the distribution network.

A major operational issue is to ensure the reliability and quality of the electricity supply given that power flows are increasingly volatile. The challenges are both technical (network management using real time data) and economical (e.g. cost optimisation for Renewable Energy injection) in compliance with the regulatory framework. Additionally, the Distribution System Operator plays an increasingly important role as a market facilitator, helping to develop new levers such as flexibilities to optimise the power system.

In this context, Enedis has been conducting R&D activities and experiments on local flexibilities for several years.

(1) The Multiannual Energy Programme (PPE) published in early 2019 sets out the national and European environmental objectives for the forthcoming years. It notably aims at accelerating the development of solar energy with the connection of more than 28 GW by 2028.

* *Distribution System Operator*
** *CRE: French Energy Regulatory Commission*

"Flexibility[2]" can be defined as a power modulation of demand or generation sites (either upward or downward) in response to an external signal, in order to provide a service to the power system.

From national challenges ...

Flexibility has long been used to balance national supply and demand and to alleviate congestion on the transmission network. Enedis makes its contribution through more than 40,000 sites connected to the distribution network offering flexibility, for a total available power of more than 1,000 MW. However, additional flexibility is required to meet the national ambitions for wind and photovoltaic power, whose production is variable. The French Multiannual Energy Programme thus forecasts that demand side respons could represent a total available power of 6,500 MW by 2028. Most sites participating in demand side respons will do so via aggregators and will be connected to the public distribution network. Enedis plays its part in these flexibility markets while ensuring the security of the grid.

... to local challenges

Flexibilities can also be used to address more local issues. They are of particular interest to territorial stakeholders wishing to enhance local renewable generation, positive-energy buildings, electric vehicle charging terminals, collective self-consumption, eco-neighbourhoods, or positive-energy territories. Enedis is at the service of territorial stakeholders wishing to develop these new services.

(2) Active power or reactive power.

Sources of flexibilities within the distribution network are many and varied, covering all kinds of technologies, for instance those related to storage (electric vehicles, hot water tanks, hydrogen storage, etc.).

They can also be offered by consumers and producers, including:

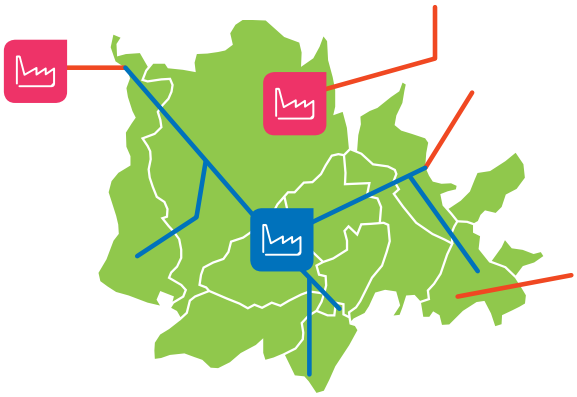
- A power station, increasing or decreasing its production in order to alleviate network congestion
- A group of individuals, decreasing or postponing consumption in anticipation of a cold peak

TO LEARN MORE

https://www.enedis.fr/consultation-flexibilites
(in French)

Moreover, flexibilities can contribute to the planning and real-time management of the distribution grid. Provided that they offer reliability and competitiveness, they may solve problems of congestion, which could otherwise lead to power outages and voltage deviations.

Congestion on the distribution grid is located in limited geographical areas. Hence, **locating opportunities for flexibility is critical**. This is why Enedis refers to **local flexibilities**.



Grid concerned by the flexibility
Grid not concerned by the flexibility
Area of flexibility opportunity

EXPECTED BENEFITS FOR THE DISTRIBUTION GRID INCLUDE:

- Reduced costs and lead times when connecting renewable producers (the most important source of flexibility identified to date) as well as consumers,
- New planning and management tools to operate the grid.

The implementation of local flexibilities is based on three convictions, identified and set out in the Economic assessment of smart grids solutions Report published in late 2017 (https://www.enedis.fr/economic-assessment-smart-grids-solutions):

- The value of flexibility is local and temporary. It depends on the solution that the flexibility replaces or supplements,
- Flexibilities will be used with low occurrence, but their value, if any, may be substantial,
- The local value of flexibilities will supplement that resulting from national market mechanisms.

For Enedis, the use of local flexibility levers therefore consists in matching a demand and an offer – in a given area over a given period. This will only come about if grid constraints provide an opportunity ("demand"), a source can be used ("offer"), and an economic interest exists for both parties: the public distribution network and the party offering the service. Enedis wishes to integrate local flexibilities in its activities of grid planning and real-time congestion management.

A FEW TECHNICAL TERMS

- **Demand response:** change of electricity load by final customers from their normal or current consumption patterns in response to external signals, whether alone or through aggregation
- **Intensity:** intensity of the electric current (measured in amperes)
- **LV:** Low Voltage
- **MV:** Medium Voltage
- **Primary substation:** HV (high voltage) / MV (medium voltage) substation
- **RE:** Renewable Energy
- **Reference Connection Offer:** connection offer that guarantees supply / evacuation of 100% of power requested by consumers / producers 24 hours a day
- **Societal Value:** sum of the collective gains (in contrast to the individual gains of Enedis or other private actors for example)
- **Voltage:** an electromotive force or potential difference expressed in volts

3, 2, 1… Flex!

To advance this experimental approach, Enedis launched in late 2018 a public consultation on local flexibilities to identify the expectations and share the conditions for implementing these flexibilities (e.g. competition, contracts, remuneration, etc.) with all relevant actors: electricity suppliers, producers, consumers, aggregators, local authorities, etc.

The high participation rate achieved in this consultation, which synthesis was published in June 2019, strengthens Enedis' resolve to continue its action on the basis of the following objectives:

- To construct, jointly with the external stakeholders, the processes of competitive tendering and local flexibility activation;
- To test the process on real life cases: publication in late 2019 of a request for interest, followed by one or more potential calls for tenders in areas with flexibility opportunities.

This document presents the different "use cases" for local flexibilities serving the Energy Transition, their contractual principles, as well as Enedis' organisation with respect to their experimental implementation and, in the longer term, their industrialisation by the Distribution System Operator.

USE CASES

FLEXIBILITIES TO FACILITATE THE CONNECTION OF CUSTOMERS AND PROMOTE THE INTEGRATION OF RENEWABLE ENERGY INTO THE GRID

The industrialisation of Smart Connection Offers for producers is subject to regulatory changes.
For consumers, the generalisation of Smart Connection Offers also requires preparing various technical and regulatory subjects.

SMART CONNECTION OFFER FOR MV PRODUCERS

- **4 experiments** of smart connection offers production launched,
  e.g. Chauché: connection gains (excluding ENI) = €711k 7-10 month reduction of the period
- General deployment subject to decree

SMART CONNECTION OFFER FOR MV CONSUMERS

- **3 experiments** as part of request for power increase, one seasonal and two subject to conditions.
- Experimental connection offers **in fall 2018**.
  e.g. Moulins Bourgeois: €267k of gains for the customer €188k of CAPEX avoided for Enedis

1 Smart Connection Offers (SCO) to connect customers (consumers and producers) to the MV grid faster and at lower cost

PRINCIPLE

The Smart Connection Offer (SCO) consists in offering faster and less expensive grid connection, at the request of customers (connected or wishing to be connected to the MV grid) when possible, in return for a flexibility commitment. It differs from the Reference Connection Offer.

In this case, demand or production may occasionally be curtailed to solve congestion on the grid.

Specifically:

1. An MV customer **requests a connection** to the MV grid from Enedis;
2. Enedis carries out a study to identify the **impacts** of connecting the installation **to the grid** in accordance with the regulations and Enedis' technical reference documentation in force;
3. The MV customer can either choose the Reference Connection Offer or request a Smart Connection Offer if the grid configuration allows it;
4. For the Smart Connection Offer, Enedis concludes a contract with the customer for **a faster and/or less expensive connection** to the existing grid instead of building a new MV line;

5 Once the connection is operational, Enedis **asks the customer to limit demand or production temporarily** by sending **a power limitation order** whenever needed to meet intensity or voltage requirements on the network.

Watch the SCO video on:
https://www.enedis.fr/raccordement-intelligent
(in French)

POTENTIAL GAINS

These offers provide faster connections and/or significant savings for the customer.

For MV producers, the studies carried out by Enedis as part of the economic assessment of smart grids forecast a connection cost reduction of around **€90k/installed MW.**

Enedis wants to start testing these new S3REnR planning methods. In particular, this will require defining the technical and contractual arrangements for their activation, as well as an appropriate regulatory framework. The decision of whether or not to use this lever for a given region would be formalised as part of the regional consultation process used to revise each S3REnR.

2 Promoting the development of RE by optimising grid planning under the Regional Renewable Energies Connection Master Plans (S3REnR)

PRINCIPLE

As part of the energy transition and in line with the PPE guidelines, RE connection master plans are implemented at the regional level.

Their objective is to facilitate the integration of Renewable Energies into the system by optimising grid planning and by pooling costs among the producers involved.

The Regional Renewable Energies Connection Master Plans provide long-term visibility on RE hosting capacity on the distribution and transmission networks.

Enedis wishes to integrate the occasional use of flexibilities in studies aimed at optimising the sizing of the shared S3REnR network infrastructure, in order to host more renewable production (more quickly) in return for a very limited curtailement on production (estimated at 0.06%).

This new lever would enable more renewable installations to be connected more quickly for the same amount of work.

The reduction in connection lead times could be measured in years.

POTENTIAL GAINS

- The grid could immediately host up to 2.5 GW additional capacity;
- By 2035, additional capacity could reach 7.4 GW, the equivalent of one-third of the additional transformation capacity to be installed in the baseline case;
- The additional power injected into the grid would be ten times greater than the curtailed energy (0.06%);
- Estimated collective value: 250 M€ by 2035.

LOCAL FLEXIBILITIES TO OPTIMISE PLANNING AND OPERATION ON THE DISTRIBUTION NETWORK

Introducing flexibilities for grid management and operation could limit customer outages and restore power more quickly in the event of an incident.

This would also reduce the need for other solutions such as generators, and reduce operating costs through a competitive flexibility service.

Taking these new levers into account at the planning stage could help to avoid or defer some investments. The risk that these investments are intended to cover would be transferred to the grid operation management.

1 Flexibilities as an alternative to power resupply resources before or following an incident

PRINCIPLE

In this case, flexibilities would enable better congestion management when congestions do not justify specific investment in the grid (low levels of congestion, too unlikely situations). They would be used as an alternative or in addition to the usual solutions such as power generators. **Activation would be without availability payment.**

This type of flexibility may be used:

- In anticipation of an exceptional climate event such as a "cold spell". In this case, the flexibility need could only be assessed four days ahead (first reliable weather forecast) or a day ahead/intraday (activation);

- Following an incident: the flexibilities may in this case be used as a lever to help resupply customers once the automated operations on the grid have been carried out (< 15 minutes).

ASSESSMENT OF THE GAINS

In terms of value, the Economic assessment of smart grids solutions report has focused on the Societal benefits that flexibilities could provide in terms of distribution grid management.

Given the low outage frequency on the grid, activation at a given point on the grid, would be rare in practice.

However, the maximum value for society of activations facilitating power restoration following an outage could vary from €0 to €20k/MWh, depending on the service provided locally (restoration lead times and number of customers).

2 Flexibilities to enhance work planning

PRINCIPLE

Local flexibilities can be used to prevent an outage linked to planned works on the distribution grid.

Flexibility to avoid planned works outages requires high reliability levels, often for extended periods of time. Indeed, if these flexibilities are unavailable when needed, customers will face an unscheduled outage.

These flexibilities will therefore require a guaranteed availability, remunerated with a fixed part, with associated penalties in the event of non-availability.

ASSESSMENT OF THE GAINS

The maximum value for society of flexibilities in this use case varies between €0 and €20k/MWh (similar to the previous case), broken down into a fixed part for the guaranteed availability and a variable part to cover variable costs.

ARTICLE 199 AND THE FOURMANOIR EXPERIMENTATION

The Energy Transition for a Green Growth act (Loi de Transition Énergétique pour la Croissance Verte) enables Enedis to sign contracts with local communities for the experimental use of flexibilities.

Enedis has reached a milestone with this new framework, tested out during 2018-2019 winter. The first remunerated "local flexibility" service (decrease in demand) involves the Cœur de l'Avesnois local authority, the Canelia Petit Fayt dairy and the Avesnes electricity board.

This experiment aimed at ensuring the security of supply pending further substation investments.

In concrete terms, in the event of high demand forecast, Enedis can activate a flexibility service provided by the Canélia dairy. The industrial site then reduces its demand for the requested period (up to 3 MW over 3 hours) and receives remuneration for the service provided.

3 Flexibilities to defer investments

PRINCIPLE

Not all investments can be associated with a flexibility opportunity: for example, the burial of overhead lines, the renewal of old technology cables, etc.

However, in some cases, integrating flexibility services in grid planning could help to defer investment by one or several years.

This use of flexibilities to postpone an investment requires strong commitment. The operational risk that the investment is intended to cover is being transferred from grid planning to real time grid management. **These flexibilities will therefore require a guaranteed availability, remunerated owith a fixed part, with associated penalties in the event of non-availability.**

ASSESSMENT OF THE GAINS

The use of flexibilities to defer an investment would generate a maximum Value for Society, which depends on the local situation within a range of €0 to €24k/year for each MW of guaranteed availability(3).

The remuneration depends not only on the characteristics of the congestion area (local transits, structure of the grid, incident statistics, etc.), but also on the characteristics of the flexibilities offered (implementation lead time, location, etc.). Calculating the value of the flexibility in advance is therefore very complex.

DEMONSTRATORS HAVE GRADUALLY ENRICHED FLEXIBILITY STUDIES AND ITS IMPLEMENTATION

Since 2011, Enedis launched several demonstrators and experiments in France and in Europe, thus enriching its knowledge in flexibility implementation.

Since September 2019, Enedis manages the aVEnir demonstrator, with 11 industrial partners, to support the large-scale electric mobility development through flexibility levers.

REALIZED	REALIZED	REALIZED	IN PROGRESS	IN PROGRESS
GreenLys	NICE GRID	smart GRID VENDÉE	Smart Occitanie / NICE SMART VALLEY	Article 199, ORI Demand
2012-2016	2012-2016	2013-2018	2017-2020	Since 2018
60 000 load shedding events *(residential)*	300 demand response customers *(residential, storage)*	3 Smart connection offers MV Prod.	112 buildings *(17 MWh load shedwinter 2017-2018)*	Other demonstrators	Fourmanoir Art. 199	Smart connection offers Demand

(3) Source: Economic assessment of smart grids solutions Report, valuation carried out on a few substation investment cases.

ENEDIS' WORK PROGRAMME

ENEDIS WANTS TO USE MARKET MECHANISMS TO CONCLUDE FLEXIBILITY CONTRACTS

1 The call for flexibility process

The process adopted by Enedis following the public consultation on flexibilities aims at being **pragmatic** and sets out the **major themes** that reflect the challenges associated with the **use of market mechanisms** to conclude flexibility contracts.

Where flexibility might solve congestion, Enedis is making a request for interest to identify potential flexibilities that could be activated in the concerned areas.

These requests for interest are a prerequisite to any competitive procedure.

The **competitive mechanisms will be open to all** those who may wish to take part, even if they have not responded to the request for interest.

For the first experimental calls for flexibility, Enedis will provide support to stakeholders, to facilitate their understanding, their participation in the calls for tender and allow them to access the market, in compliance with the existing rules (European Directive and Public Procurement Code - non-discrimination, competition and transparency).

The specifications will detail the market players expected commitments in term of results.

PUBLIC CONSULTATION AND SYNTHESIS

The consultation launched in November 2018 marked a new step for Enedis stressing its commitment to use market mechanisms to conclude flexibility contracts.

Enedis introduced a complete process for using local flexibilities and invited stakeholders to express their views on its proposals.

The number of respondents, the diversity of the profiles as well as the quality of the responses provided a broad and in-depth vision of their expectations.

The responses published in June 2019 further strengthens Enedis' resolve to carry out experimental implementation.

Topics of the public consultation

- REQUEST FOR INTEREST
- COMPETITIVE TENDERING
- TENDER OFFERS
- RANKING
- CONTRACT
- ACTIVATION
- MEASUREMENT VALIDATION AND SETTLEMENT

2 Summary of the contractual principles by use case

The table below provides a summary of the different use cases, their main characteristics and the associated contractual principles.

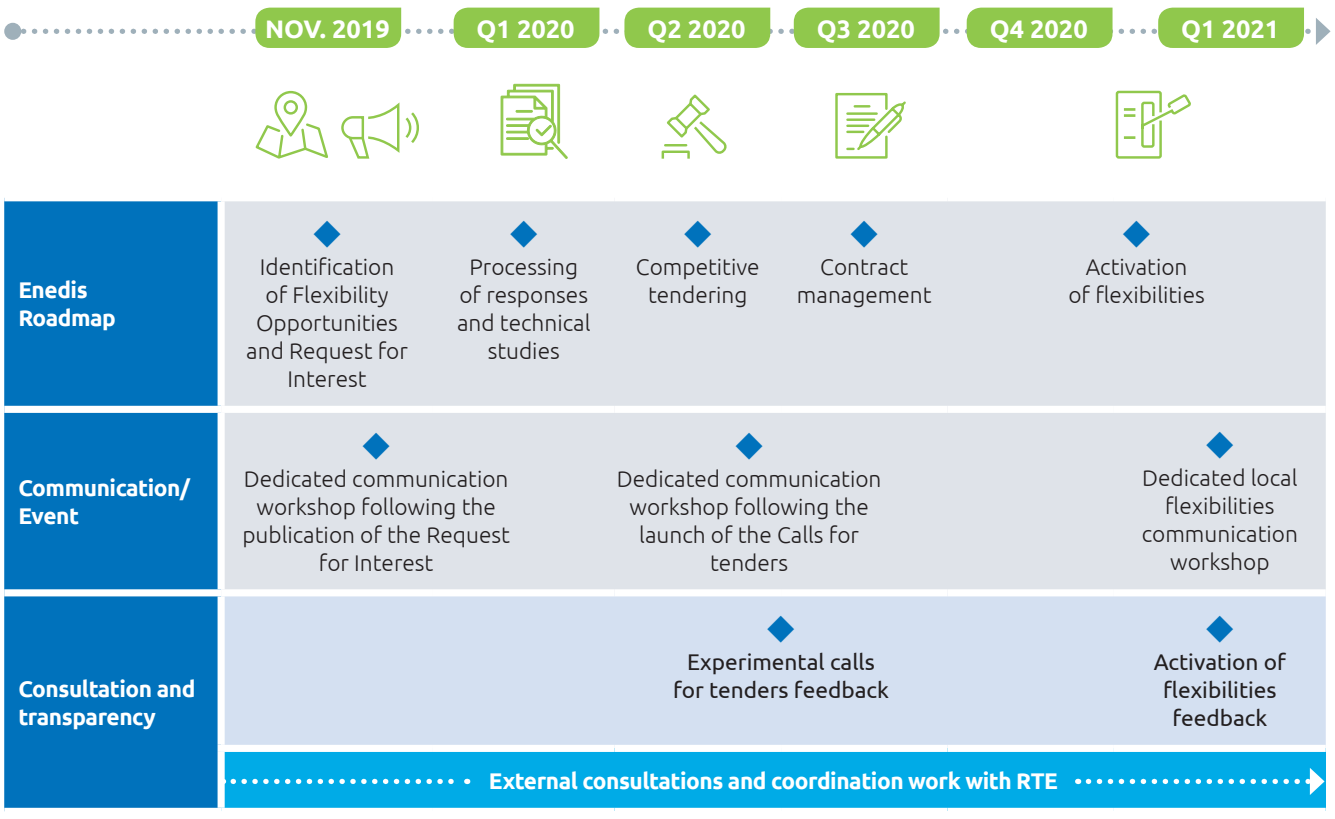
	Connections	Optimisation of investments in S3REnR	Investment postponement	Work planning	Incident management
Value of the flexibility	Connection costs and reduction of the delay for the customer	Maximum value for society of €250M by 2035 *(alternative to investments)*	Maximum value for society from €0 to €24k/MW/year* *(Investment postponement)*	Maximum value for society from €0 to 20K/MWh* *(must be compared with the alternative usual solutions, such as power generators)*	
Importance of the location	Yes whatever the use case				
Sources of flexibility	MV site to be connected	Producers, storage, electric vehicles, demand response, with active or reactive power for voltage congestions - Enedis is technologically neutral			
Duration of activation and occurrence	Depends on the case	0.06% of limitations	Between 0 and a few hours per year depending on the case	During the work *(according to network needs)*	A few hours per year *(low occurrences)*
Contractual principles	Bilateral contract	Competitive process according to the defined call for flexibility process and in compliance with the existing rules enforced**			
Remuneration principles	Remuneration included in the connection offer	Contract with guaranteed availability** Minimum size of the offer: 500 kVA *(obligation of result)* *Guaranteed availability, remunerated with a fixed part, with associated penalties*			Framework contracts without guaranteed availability: *variable part depending on activation*

* *According to the examples studied in the Economic assessment of smart grids solutions report.*
** *For the S3REnR, if competition is unsuccessful, curtailement of connected producers according to terms to be defined in the contract for access to the grid.*

THE LOCAL FLEXIBILITIES ROAD MAP

The success of the consultation on local flexibility, which synthesis was published in June 2019, strengthens Enedis' resolve to continue its action on the basis of the following objectives:

- To construct, jointly with the external stakeholders, the processes of competitive tendering and local flexibility activation;
- To test the process around specific cases: publication in late 2019 of a request for interest, followed by one or more potential calls for tender in areas with flexibility opportunities, for Primary substation and MV network needs(4).



(4) Enedis also study the opportunity of using flexibility to meet LV network needs and experiments the conditions for using LV connected flexibilities.

ENEDIS COMMITMENTS FOR THE INTEGRATION OF FLEXIBILITY LEVERS INTO ITS CORE BUSINESSES

Flexibilities are a real performance lever for all Distribution System Operations, from grid planning to real-time grid management.

Provided that they offer reliability and competitiveness, flexibilities can be used as an alternative to network reinforcements when integrated into network planning activities. They can also be used as an alternative to power generators or other mobile means of power restoration in grid management activities.

The growing digitalization of power networks makes it possible to use flexibilities. Indeed, IoT tools such as the Linky smart meter are improving network data modeling to enhance short, medium and long-term forecasting as well as network optimization. The integration of flexibilities requires complementary modeling tools, adapted to these various timescales.

These commitments are part of a broader effort to improve network operations as well as network planning for society as a whole.

Enedis, l'électricité en réseau

Enedis is a public-service company managing the electricity-distribution grid.
It develops, operates and modernises the electricity grid and manages the associated data.
It performs customer connections, 24/7 emergency interventions, meter reading and all technical interventions. Enedis is independent from the energy providers, which are responsible for the sale of electricity and the management of the supply contract.

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