STUDY

# THE DIGITAL TRANSFORMATION OF UTILITIES

## Meeting the challenge of integrating data to serve networks and customers

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think SMARTGRIDS

FRENCH SOLUTIONS FOR SMARTGRIDS

**This study was conducted by the Data & Digital Transformation working group of the association Think Smartgrids.**

# SUMMARY

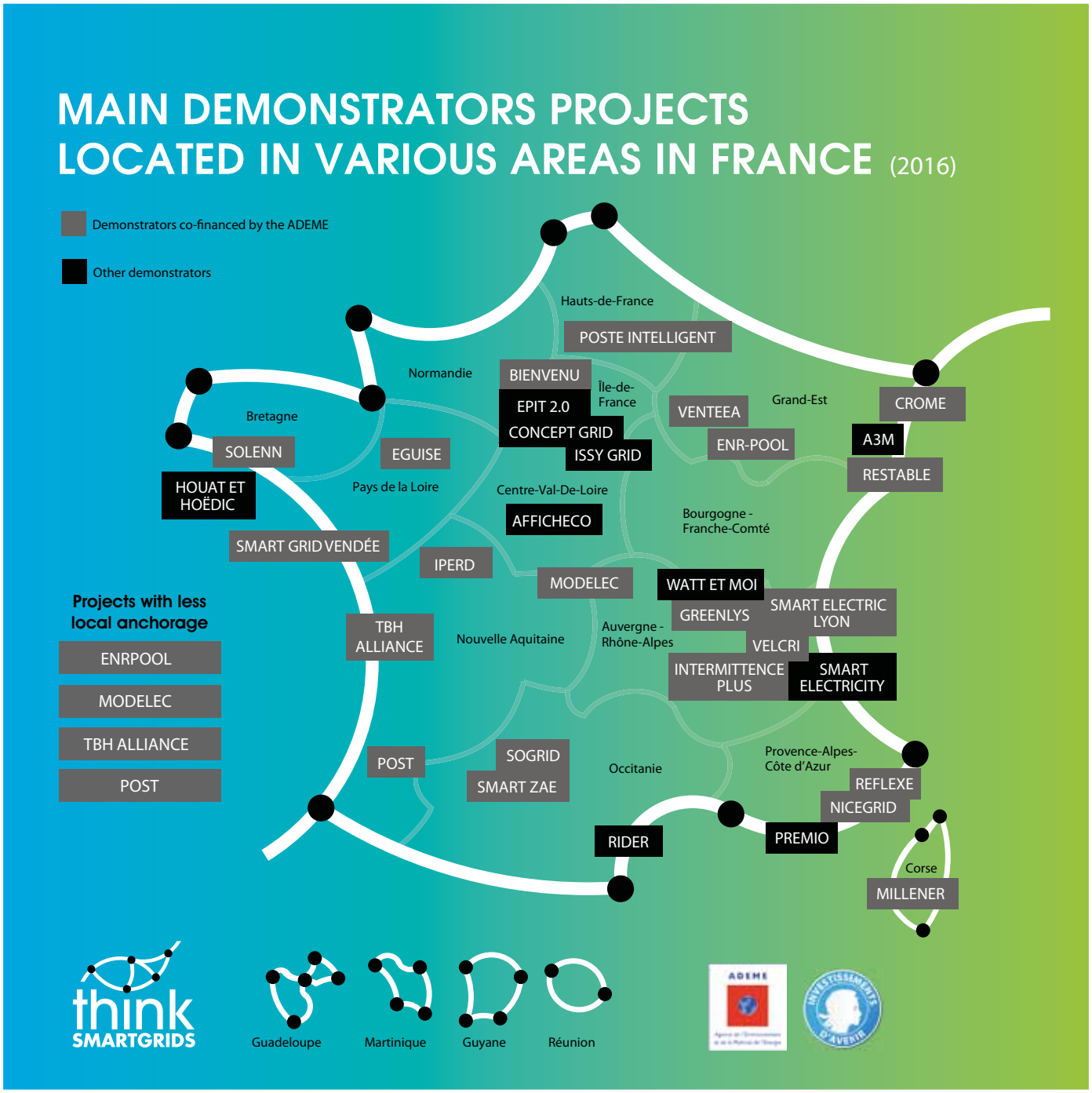
**Created in April 2015, Think Smartgrids aims to federate and represent the smart grid sector in France, and to promote it both in Europe and internationally.** With the ambition of creating a «Team France» for smart grids, the association has about a hundred members, including large groups, SMEs or start-ups, from the entire value chain.

Think Smartgrids is helping the sector place itself among the world's largest players, in a global market estimated at more than €30 billion in 2018 and which could reach up to €100 billion by 2022. Thanks to its action and the support it offers, the association is counting on the creation of 10,000 direct jobs in France by 2020, and on the continued expansion of its export production..

### The main missions of Think Smartgrids:

- Organize events in France and abroad to promote the French expertise and know-how in smart grids,
- Support the development of its SMEs / SMIs,
- Ensure the representation of its members to public authorities and European and international institutions,
- Communicate on topics and issues related to the smart grids sector.

## Since 2008, more than 120 smart grid demonstrators have been built/installed in France.



# Associated members / observers

# Partner members

**Think Smartgrids was created in April 2015 by RTE, following the implementation of the Smart Grid plan promoted by the French Ministry of Industry. The Energy Regulation Commission and the General Directorate for Enterprises are observer members of the association's board of directors.**

*Think Smartgrids and the Data Working Group are grateful for the time and support of Cosmo Tech and DCbrain, in particular Mathilde Emery-Roch and Sarah Paronto, in preparing the final version of this document.*

# The digital transformation of electrical systems, a response to the major challenge of global warming

The latest IPCC report illustrates the urgent need to act on global warming. Energy is at the core of this action, and the transformation of electrical systems has already been engaged in France and across Europe. The rapid expansion of renewable energy, the transformation of consumption patterns and uses, and the introduction of new players are all factors transforming the electrical system and changing the role of transmission and distribution system operators.

In a rapidly changing system, network planning and security are becoming increasingly complex. Nonetheless, the fact remains that the growth of decentralized production requires reconciling several territorial scales, from regions in the European Union, as well as the United States.

In this context, it is the responsibility of grid operators to ensure the permanence of public service missions such as the continuity of power supply, the electrical solidarity between territories, and the integration of renewable energies, while controlling the costs for the community.

Faced with these multiple challenges, the aim is to render the grids more flexible, more scalable, and to optimize the management of existing lines. The energy grids of tomorrow therefore must be digital. Their ability to adapt easily to changes in their environment, due to scalable and easily reconfigurable technologies, will be a key asset to enabling a low-cost energy transition and maximizing value creation for citizens.

Real-time knowledge of weather conditions and real-time use of equipment, power lines, and substations are essential levers in the optimization of flow management and network maintenance.

Digital technologies will also allow more electricity to be transmitted with the existing infrastructure. Where yesterday's solutions would have demanded the development of new costly and, potentially, rapidly obsolete infrastructures, digitalization makes it possible to make the most of the existing infrastructure by exploiting the flexibility of the electricity system.

But it is also necessary to know how to adequately integrate these digital technologies and make the best use of the data collected. To be successful, these digital networks will first and foremost have to be co-constructed with all stakeholders.

The emergence of new flexibilities, made possible by the digitalization of networks, is only possible with the active participation of the various actors in the electrical system: if the transmission of information in real time allows the manager to optimize flow management locally, facilitating the integration of renewables, it must also allow the producer to reduce the production of their fleet and the consumer to adjust his energy usage, depending on the appearance of constraints on the network.

Finally, to effectively link their infrastructure to digital technologies, grid managers will have to rely on a whole ecosystem of performance, from start-ups to small and medium-sized businesses or from the academic world to local stakeholders.

Thus, Think Smartgrids' unifying role takes on its full meaning, because it is through the development of synergies between the various players in the electrical system that we will be able to meet the challenge of digitizing the networks, an essential key to the energy transition.

**Olivier Grabette,** *Member of the Executive Board and Deputy Chief Executive Officer of RTE, Chairman of Think Smartgrids.*

# A reflection to support operators in their digitalization projects

Throughout Europe, network operators are initiating Data projects, aiming to improve their operational performance. For them, these projects represent both potential added value and new challenges..

The **Data Working Group** was initiated in 2017 by two members of Think Smartgrids, Cosmo Tech and DCbrain, with contributions from Accenture, Atos, SenX, Colombus Consulting, la CRE, L'École Des Ponts Paristech, GE, Gimelec, Images & Réseaux, Nokia, RTE, Siemens, Strasbourg Électricité Réseaux, Trialog and Yélé.

The objective is to try to provide answers to operational issues and questions of grid operators regarding these digital projects:

- What should the data processing chain be and what are the technological issues associated with each of its stages?
- What are the real capabilities of existing technologies? Machine Learning, Deep Learning, Artificial Intelligence, Blockchain...?
- How can data aspects (production, security…) be better controlled?
- How can the production value be enhanced? And how can the framework of the Proof of Concept (POC) be overcome?

Nevertheless, all electricity grid operators, in France and Europe, have successfully launched tests and even industrial data processing projects. Some have even initiated technological partnerships with disruptive players. The objective of the Data Working Group is to become one of the forums for exchange and reflection on these topics.

The approach used by the Data Working Group has already made it possible to compare the visions of various stakeholders in the sector: network operators, suppliers, associations, regulatory authorities/licensors, creating a link between Think Smartgrids and players in the European market.

This first study aims to describe the state of use for operational data optimization purposes, how these use cases are managed, and the obstacles and solutions in the deployment of these use cases by assessing the perspectives of TSOs/RMGs, solution providers, and institutions.

To this end, the Data Working Group conducted more than 20 interviews with various key stakeholders:

**TSO**

**DSO**

**Supplier**

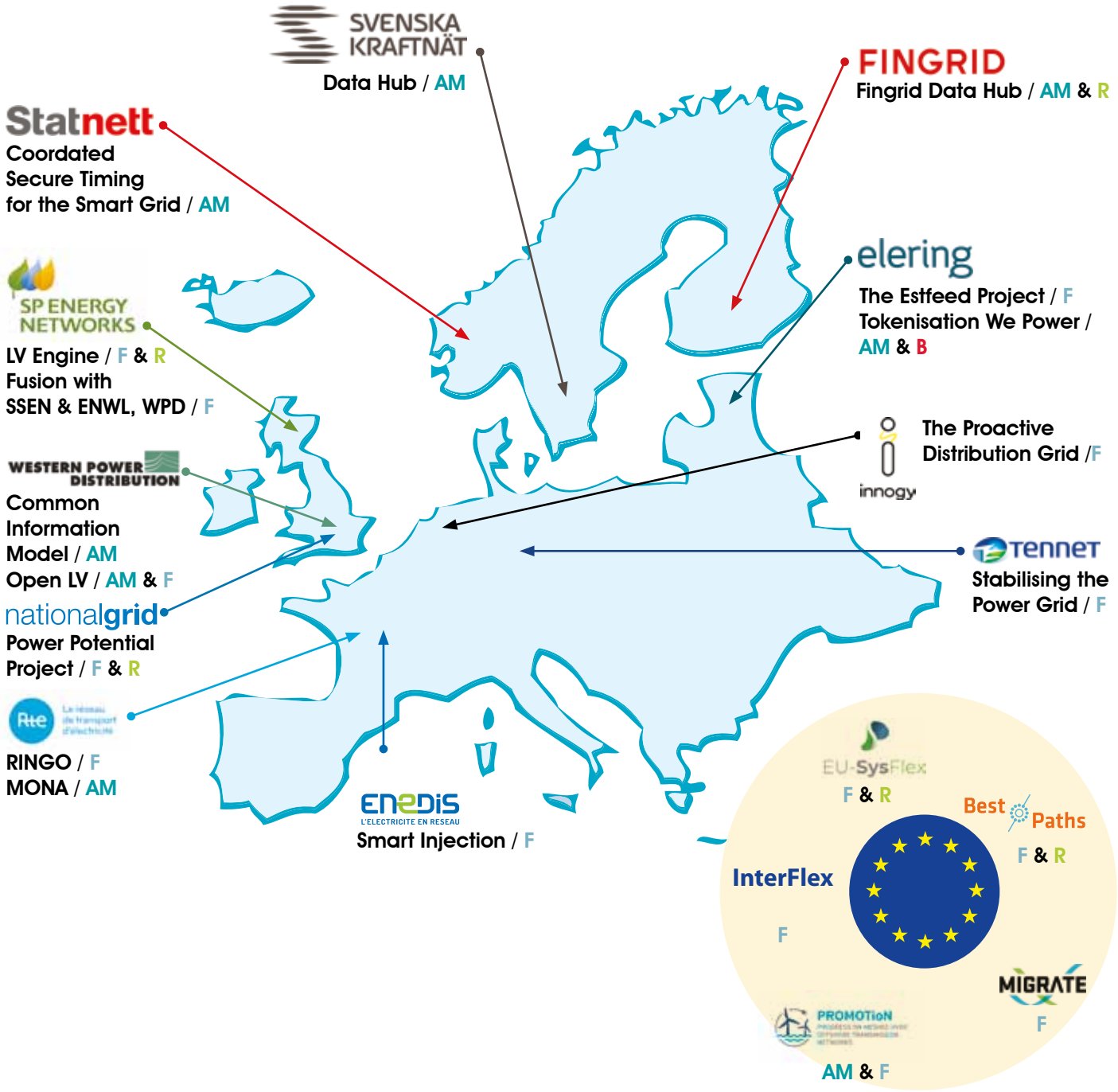
**Others**

Europe is a dynamic space where many players are involved in data projects. Some consortium projects are supported by the European Commission via the Horizon 2020 Research Framework Program (2014-2020), or within networks such as ENTSO-E (https://www.entsoe.eu/data/it-platforms/). Others are carried out by DSOs or TSOs concerning their own field of transformation.

If, within the framework of this study, the actors consulted were rather geographically located in southern Europe, the panorama of Data projects carried by DSOs/TSOs in northern Europe makes it possible to complete the overall vision. It also includes some H2020 projects to which many European players contribute (DSO, TSO, vendors...).

## EXAMPLES OF DATA PROJECTS FROM NORTHERM EUROPE

**AM Asset Management / B Blockchain / F Flexibility / R Renewables**



# Projects around data: numerous use cases and a complex value chain

**The Data projects address several major use cases:**

- **Flexibility management** to better exploit new information and communication technologies, new forms of decentralized production and consumption (electric vehicles, batteries, etc.) and the optimization of the functioning of the energy network;
- **Asset management** to better understand system behaviors, improve asset management, process an increasing type and amount of data, and move towards predictive maintenance;
- **The integration of renewable energies**, which are by nature variable, to facilitate their connection and better manage the associated changes.

These projects also cover the entire value chain, from the digitization of control commands to the implementation of IIoT (Industrial Internet of Things) to produce data, as well as data analysis applications (Data Analytics) and new data exchange platforms that allow, for example, better flexibility management.

Interoperability, standardization of exchanges, the opportunity of blockchain for certain types of flow exchanges, cybersecurity of industrial structures and systems, and the addition of new smart functions on these links in the value chain are the topics underlying most of these projects.

## Data value chain

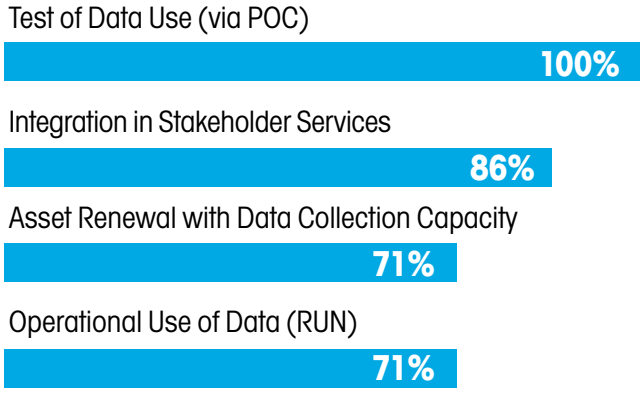
# European actors are carrying out numerous projects focusing on data and its exploitation

The current status of Data projects among network operators reflects an already high use of data from the network and the asset base. The regulatory functions of operators' networks, such as network control and structure operation, are based on SCADA (Data Acquisition and Control System), among other things. These systems have been in operation for several years.

For example, all the interviewed operators already have one or more POCs (Proof of Concept - or tests) around the data. More than 2/3 of them have industrialized some of these POCs.

## Actions launched by TSOs/DSOs

(% of positive responses)



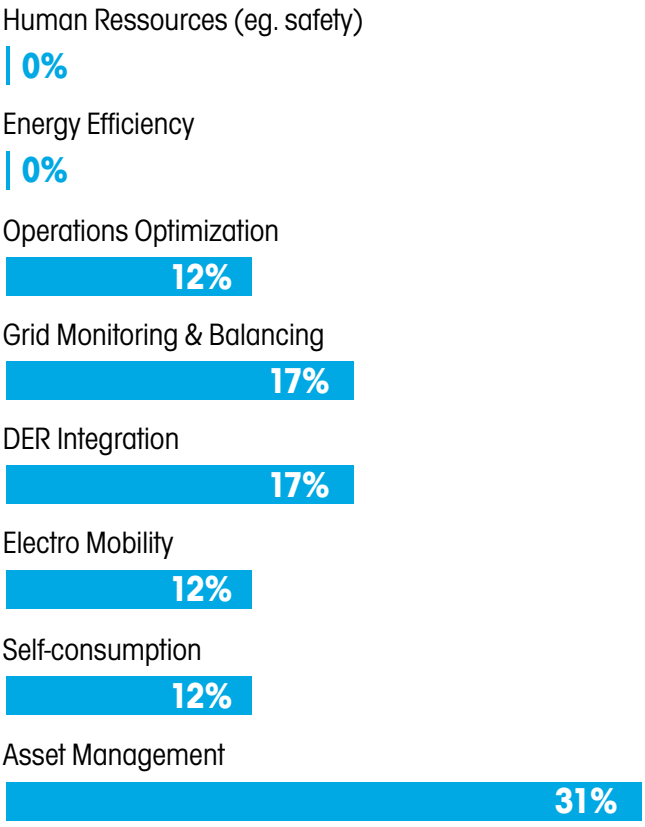

At the French electricity transmission company RTE and its Italian counterpart TERNA, leading data experts use their expertise as part of the system and develop forecast balances by making data related to network balance and capacity, available to external system players in a transparent manner. This transparency is mandatory and fixed by the European REMIT regulation (Regulation EU 1227/2011). The volume of data produced and processed is already impressive. At TERNA, 400,000 real-time data are calculated and/or measured every second.

However, new needs and opportunities are emerging. Several major issues are arising and can be addressed through the use of data, in order to strengthen the robustness and performance of the system while developing new services and new interactions with other stakeholders, including territories.

The use cases between the different European operators are similar. Two main axes emerge from the first studies carried out: flexibility, with priority given to TSOs for application projects, (DSOs targeting exploration projects such as Interflex, etc.) and asset management.

## Operators' priorities in terms of Data project

(% of positive responses)



As for flexibility, TSOs will have to move from an order of magnitude of around 100 means of electricity generation to several hundreds of thousands means of generation (with an integration grid created by the DSOs), in particular because of the integration of renewable energies and distributed generation. Meeting future challenges, such as the inclusion of electric mobility in the network, also requires long-term projections. These new constraints and uses are leading TSOs to set up innovative flexibility systems, beyond the current systems, which are rather static. DSOs, on the other hand, do not directly erase or work on future flexibilities (at the connection level, for example). However, they need to develop innovative systems that make massive use of data and enable optimized network management.

With regard to asset management, the ageing of network assets built after the war remains an essential issue for the maintenance of the network among TSOs and DSOs in Europe. This is particularly true in a context where it becomes necessary to achieve the technical and economic optimization of the system, by aligning not only costs and investments, but also risks and business processes with the TSO/DSO strategy. Here again, data is seen as a means of making this use case possible: it allows for better understanding, forecasting and action.

## Flexibility case

In a context of transforming the electricity world, TSOs have already launched strategies on balancing network loads a long time ago. The Dutch operator Tennet offers dynamic flexibility services, however these services require accessible data.

Until then, DSOs had little visibility on their network. Today, they need to have a dynamic view in real-time, in order to identify instability problems on the network, and to detect problems more quickly.

To move to the scale of transnational markets, the barrier of data standardization remains an obstacle despite the stakeholders who have data.

Flexibility solution providers, such as SAFT and Energypool, use data to monitor flexibility systems, such as industrial batteries, and ensure a level of performance. Due to the complexity of the analysis of the data provided by these systems, suppliers instead provide turnkey solutions, integrating data analysis into their solutions.

While these players currently provide mostly complete tools for long-term operation, monitoring, and reliability analysis, they plan to position themselves also on data availability platforms in the future. These platforms will allow TSOs/DSOs to create their own analyses, foreshadowing the emergence of a new ecosystem. These new services are currently being tested in the form of POCs, and their transition to the industrial phase is planned for this year at certain sites.

Among DSOs, the use cases linked to optimized network management concern, above all, the fact that it is easier to operate the entire network. This requires a better knowledge of their customers' consumption (smart meters), and a better visibility on their networks. DSOs are also starting to offer innovative connection offers. They connect faster to producers, integrating flexible solutions. In particular, this makes it possible to make the producer's business model more reliable, while guaranteeing the integrity of the network.

## Asset management case

On the other hand, asset management often emerges as a priority requiring the use of new data processing technologies. All operators have launched POCs on these topics to optimize OPEX, CAPEX and Risks.

Digital transformation drives the use of sensors installed on assets for predictive maintenance, when weak signals of potential failures or failures are detected by the sensors. However, these technologies do not seem to be very suitable for TSOs at this stage. Indeed, maintenance among the TSOs surveyed (ELIA, TERNA, RTE) monopolizes resources on assets that are largely built to have a long life, and which will therefore not necessarily break down regularly (e.g. pylons on the electricity grid). In fact, predictive maintenance is not perceived as a must have use case, and to date, it is difficult to prove the return on investment of digital sensors and associated means of data analysis on most assets, with the exception of the most critical, which represent only a limited part of expenses and resources.
In general, asset management issues with the arbitration of performance-risk-cost ratio remain much more strategic in the long term.

Coupled with physical failure models derived from historical asset data (double digital), the decision is, in addition to data, also based on the business expertise of asset managers and mathematical probability models. This allows operators to implement conditional maintenance, which provides a clearer return on investment (ROI). The other priority need is the possibility of deciding between network maintenance and investments over periods aligned with the life of the assets (over fifty years).

Initiatives were launched by RTE, with augmented intelligence approaches combining Big Data, Artificial Intelligence, and human expertise to anticipate the impact of their decisions on their assets on the short, medium, and long term, therefore allowing them to make optimal choices. As data alone will not be sufficient enough to encompass all the information needed to support their decisions to stakeholders, this combined approach has proven to be essential to increase the decision-making capacity of asset managers.

These players base their policies on having assets built to last and need to support the transformation of their network over time, at an optimized cost, while maintaining an adequate level of security.

### Elia : The complementary Data vision of asset managers

Sur la base de leur expertise, les gestionnaires d'actifs d'Elia ont créé des indices de santé pour certains équipements critiques du réseau (transformateur, disjoncteurs…). Ces indices se basent sur des données internes (âge de l'équipement, date des dernières révisions, utilisations passées…) et externes (environnement, climat…). La récupération des données permet de mettre à jour cet indice de santé et de remettre en cause les plannings de maintenance. On passe donc d'une maintenance systématique, par gamme, à une maintenance conditionnelle.

The other primary need is the ability to arbitrate network maintenance and investments over periods aligned with asset life (over 50 years). These players base their policies on having assets built to last, and need to support the transformation of their network over time at an optimized cost, while maintaining an adequate level of security. In this context, one of the first actions is to set up an exhaustive "Asset" database internally. This requires digitizing certain information (e. g. paper maintenance reports):

- Retrieving historical information,
- Digitalization of the asset life cycle,
- Systematic update of the referential documents.

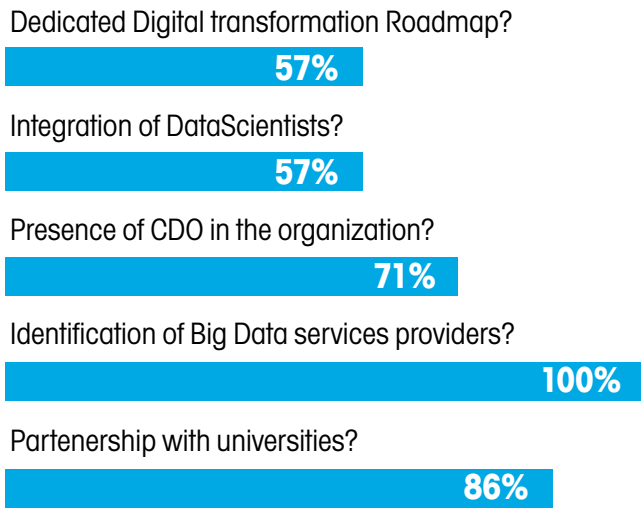
Beyond the strategic choices of the company, there is a clear desire to promote and structure data sharing at a European level between the various operators, in particular through the exchanges organized by ENTSO-E.

# How do operators use the digital lever in their evolutions?

If the data allows networks to operate differently, operators must integrate its impacts, whether they are organizational or related to tools and processes. In order to keep control of their core business, operators have begun to do so, i.e. the operation of networks, helped by certain suppliers who are developing dedicated tools, specialized by stage of the value chain or integration.

## Actions taken by operators

(% of positive responses)




We see here that network operators have all identified providers on data subjects, whether on recovery, aggregation or analysis. The same goes for universities: it is a simple way to launch innovation projects, often supported by the European Union.

Most operators have created the position of Chief Data Officer, making it possible to customize a desire to work with data better. However, a number of questions remain about this new position, in particular its connection to innovation, DDI, and Business Management.

To make further progress on the integration of Data skills, some operators have recruited data scientists. This action is not shared by everyone, because recruitment poses many problems: diversity of profiles, Data project management, costs/competition for each recruitment, etc.

**Concerning processes**, network operators prioritize topics for data quality control. Ultimately, as Enedis' experience shows, it is essential to demonstrate the value produced by the generated quality data at all levels of the company and in all business lines. This transversal objective makes it possible to develop all the company's processes. The example of predictive maintenance is revealing: to build a relevant database, it is necessary to have a broad history of accurate data on maintenance operations, as well as on incidents on assets that have occurred. In the most extreme cases, the first step is to digitize paper logs... One of the questions that arises is "data" governance, i.e. the ability to match business needs with quality data, and therefore to integrate more and more possibilities offered by the data. To this end, RTE has set up an ad hoc comitology.

### Enedis: data quality at the heart of the transformation

Enedis has implemented new processes to improve overall data quality. This transformation is based on 3 pillars: a business reference framework for produced data, clear roles and responsibilities for each of the business lines, and a leadership role for the IT department. This has made it possible, for example, to clearly define the rules for the dissemination of data externally (public or semi-public). This is a key issue in a context where individual data and their processing are being questioned (GDPR, Cambridge Analytica scandal...). One of the other aspects addressed is the notion of «data culture» that Enedis aims to implement at each level of the organization. This concept is part of a specific project sponsored by one of Enedis' deputy directors.

**Regarding tools,** operators want to keep control of the data feedback and analysis process. However, they have become more complex as the volume of data produced has increased. For a transport network, several hundred thousand data points can be uploaded every second. It is then a question of processing them in an industrial and automated way, according to the different use cases.

Several strategies coexist: working with global IoT platforms, evolution of operational data historians (Elia), strengthening links between existing data silos, integrating different hardware and software layers (RTE), using custom integration of Open Source tools (Tennet)... However, not enough time has passed to receive feedback to evaluate these strategies and all operators want to keep their skills in these areas, which are eminently close to their historical core business.

The smaller players have also begun their digital transformation by modernizing their IT architecture with a first objective: to be able to easily integrate all the data that is beginning to be produced by networks.

### Example EDS: IT transformation as a concrete example of data integration

EDS participated in the Dream project (http://www.dream-smartgrid.eu/) between 2013 and 2016 with 14 partners at the European level. EDS, in charge of field operations, did not give a global follow-up, due to the absence of immediate needs for a DSO. This project made it possible to challenge the existing IT architecture at this DSO. EDS has therefore launched a project to renew their various business application building blocks (GIS, Control System, Asset Management).

There is still no consensus for IoT platforms, whose overall value proposition would greatly simplify the upstream phases of data processing. Is this objective of a single base realistic or utopian? While the addition of platforms would generate additional costs, this is the question that operators are asking themselves.

The incumbent suppliers of network operators, such as GE or Schneider Electric, are positioned on this data recovery and aggregation brick, with offers such as a "Smart Metering Platform", in connection with the installation of connected meters on the DSO side. For Schneider, the primary brick is the ability to filter data, easily identifying erroneous data. This makes it possible to automate the main use case "Data" of the DSOs, i.e. the invoicing of users.

### Example RTE: Network Together, or the desire to control its industrial and digital tools from start to finish

With the Network Together approach, RTE aims to equip its network with new generation substations, capable of transmitting much more data and controlling the French transmission network more precisely (example: via real-time operation of the substation, visualization of the residual margins of each equipment, etc.). Today, a parallel digital system has been built around the electrical system, which must be controlled and then enhanced. To achieve this, RTE is positioning itself as a system solutions integrator, at the heart of a more transparent ecosystem.

One of the problems encountered is the coexistence of different equipment, being that of the equipment lifetime and the long period of fleet replacement. RTE has therefore instituted the notion of a digital gateway, which makes it possible to decouple the physical from the digital.

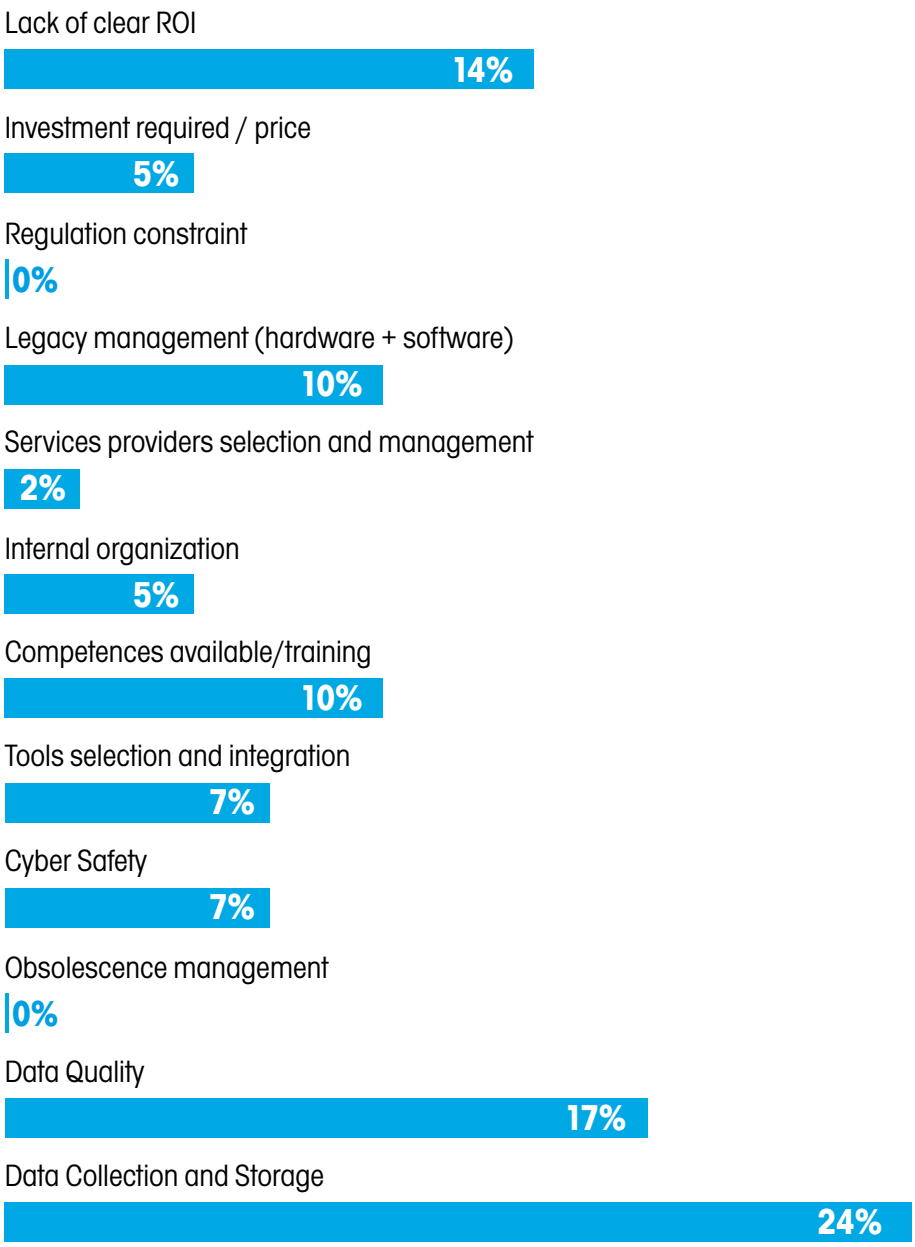
**On organizational and skills issues**, network operators have integrated the «given» impacts on their organization with different responses in terms of profiles sought, structuring, and animation. Operators have clearly understood the challenges of digital technology and they have generally equipped themselves with a CDO or monitoring teams. The most mature or important players have also integrated data scientists, generally centralized within the same team, even if this organization is still under discussion. The challenge at this stage is to move from an organization that allows innovation to an organization that allows production / industrialization. The business divisions must therefore take over the skills developed.

The Change Management theme is also at the core of the acceptance of the data value. All levels of an organization need to be aware of the importance of data and its quality. In addition to a team of data scientists, Elia has set up «digital» working groups per business line, which make it possible to report needs and set up a roadmap supported by the company's management.

# There are still obstacles to the industrial use of data

The two most important obstacles concern the phases prior to the tasks included in the data value chain: **data recovery and data quality**, which remain operational pain points for operators despite the projects implemented. The third obstacle for operators is **the absence of ROI on Data projects**.

## Perception of the obstacles to the industrialization of data projects



**On the data recovery part**, it is necessary here to separate internal data, generated by equipment belonging to the company, from external data. The first category depends on two topics:

- investment in more «Smart» equipment capable of generating data, which raises the problem of the coexistence of different fleets, with extremely heterogeneous levels of data production;
- internal reconciliation of the different repositories. This subject is problematic and requires the implementation of precise data mapping and dedicated processing (transversal organization).

The recovery of external data depends largely on the willingness of operators to open their data to allow rapid integration into the various information systems. Open data, despite the initiatives of recent operators, does not yet allow for true interoperability.

A concrete example is that of aggregators, which recover production projections from all suppliers and demand projections from TSOs. There are some automated interfaces, but aggregators still have to manually integrate a number of data formats. This does not necessarily impact their core business but makes processes more complex.

Concerning data sharing, and therefore information sharing, concrete feedback on specific initials is often not shared enough, despite the work of different associations, such as ENTSO-E. This subject particularly concerns sharing the ROI of the various projects carried out, whether they are exploratory or at a more advanced stage. It is therefore complex to use these projects to improve the entire supply chain. For example, the Managing Authority of the Smile program has set up the PRIDE platform (regional innovation platform for energy data), which serves as a platform for the exchange of information between projects (standards, norms, performance indicators).

The third subject raised by network operators concerns **the absence of clear ROI and therefore of need**. However, the case of asset management use, prioritized by operators (see above) is debated, particularly in terms of added value. For example, Elia does not want to move towards predictive maintenance because the difference, in terms of value, with conditional maintenance is perceived as too small. The complexity of dimensioning projects, due to the age of the technologies and the low feedback, makes these profitability calculations even more complex.

Finally, in connection with the calculation of the ROI, is the question of need. The market has not evolved sufficiently and network operations for some sectors have remained the same (see the low integration of renewables). For example, the Dream project, partly led by EDS, did not have an industrial suite with this actor, due to the concrete lack of need.

**The subjects of tools and skills are also perceived as obstacles by organizations.** There are many tools on the market, as well as at all stages of the value chain. Technologies are also evolving very rapidly, although it is not clear whether the evolution is more a matter of buzz words or bridging a real gap in data processing and analysis.

Visibility/understanding problems also arise on skills. Electrotechnical skills must be supplemented, and sometimes replaced, by digital skills. This subject of competence also impacts regulatory authorities or licensing authorities. To better understand these subjects, the Brittany Region has created a position of Data Chief Officer, who works on legal and IT aspects. The region also wants to integrate data scientists in the long term, to better understand the actions carried out by network operators. This raises **the question of strengthening data competence (architecture and analysis)** at larger or smaller institutions, which must manage several subjects.

Finally, the subject of **cybersecurity** is also at the heart of this transformation, with a growing need to control IT architectures and data recovery processes.

In addition to the points discussed with operators (see graph), other points inherent to this sector are likely to hinder the adoption of these technologies:

- **The speed of change in the sector:** network operators have long investment cycles and therefore long decision-making cycles. To scale up, an innovation must therefore to be sustainable over many years.
- **The "cultural" reluctance** to let "machines" make decisions, using black box approaches, where machines have a behavior that is not necessarily understood (opacity of the models). This is the subject of the fear inspired by Artificial Intelligence.

# The sector remains ahead of the use of data, although some questions remain pending

The overall understanding from operators is that Data must remain a means to achieve business objectives. Operators try to achieve these objectives and are experimenting with use cases, even if it means not being able to calculate positive ROI.

While operators of all sizes have started experiments, the transition to industrialization has not yet been achieved by many actors, mainly due to a lack of clear ROI. Additionally, predictive maintenance always raises questions about the different use cases and this subject is not necessarily perceived as mature by all actors.

In order to promote the use of data, operators have begun the transformation of their processes. For example, data quality is now a shared goal in organizations and operators have also evolved their operations. On these subjects, there are still many points to clarify: Where should the Chief Digital Officer (CDO) be positioned? Which skills are to be integrated? How many data scientists should be recruited? Etc.

Finally, the ability to share ROI between actors on these subjects would undoubtedly make it possible to promote the use of data.

Study conducted with the participation of

COSMOTECH

DCbrain

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