“Our aspirations for a new energy system”
by François Brottes, President of the RTE Management Board

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Our aspirations for a new energy system

MESSAGE FROM FRANÇOIS BROTTES PRESIDENT OF THE RTE MANAGEMENT BOARD

Because it supports and proactively adjusts to the profound changes in power generation and consumption, the electrical grid is on course towards successful completion of the energy transition. An analysis with François Brottes, President of the RTE Management Board since 1st September 2015 and supporter of a revived project.

For 99.9987% of the time, RTE provides power continuity.
The French power grid is ready for the energy and environmental transition

The Paris agreement signed at the end of the COP21 in December 2015 has given fresh impetus to the energy transition. A new road map is emerging, resulting in profound changes for RTE, the transmission system operator.

At a domestic level, energy transition legislation on green growth has brought about behavioural changes, the effects of which can already be felt.

Public energy management policies are starting to bear fruit while at the same time, energy efficiency measures are slowing down the growth of energy consumption. In addition, the growing foothold of renewables on distribution networks is reducing the amount of power being drawn from the transmission grid. This has been confirmed by the electricity report for year 2015: the trend is there and will undoubtedly become a long-term reality.

The economic sector has to face new challenges and is forcing us to partner it in the search for competitive strength. More than ever, access to high-quality energy at the lowest cost for the community is vital for our businesses. That is the aim of the solutions we are developing with a view to strengthening the security of power supply while at the same time reducing our ecological footprint. Our relationship with our customers, regardless of who they are, must support this effort.

The market mechanisms that we design are contributing to the economic optimization of the power system, thus offering better rates for our customers. The organized market is occupying an increasingly large space. EPEX Spot transactions have thus increased by 57% within the space of one year. They have reached a record volume of 100 TWh, tantamount to 20% of French power consumption. Market mechanisms provide the flexibility needed by the grid which is so essential to the growth of renewables. Today, it is essentially generation that is adapting to consumption. Tomorrow, it will be equally important for consumption to adapt to generation. Within all the mechanisms being offered by RTE, demand reduction and power generation are already being placed on an equal footing. RTE has recommended and made significant changes to all rules governing operation of the electricity market in order to acknowledge the role of demand-side management operators and break down all barriers preventing them from gaining access to the market. As a result of this ambitious reform, France is the only European country that effectively enables demand-side management operators to play an active role on electricity markets. This has prompted the Smart Energy Demand Coalition, the European Association of demand-side management operators, to rank France as European leader in the development of demand reduction.

This commitment towards energy management is widely supported by the involvement of regional authorities, who are playing an increasingly active role in regional energy management.

1 Mapping demand response in Europe today 2015, SEDC
François Brottes,
President of the RTE Management Board

“In light of the energy transition, solidarity between the regions is more important than ever.”

4,593 million Euros
Sales figures for 2015

87.7%
Customer revenues from access to the grid: generators, distributors, industrial facilities

10.3%
Revenues from customer interconnection charges

2%
Other services

1.4 billion Euro/year
Estimated capital expenditure over the period of 2015-2024

committed to the construction of
800 to 1,000 km of underground or sub-sea lines
10,000 km of new or refurbished overhead lines
10,000 MW of additional interconnectors
Approx. 10% of the amount for digitisation of the grid
This is reflected in the emergence of positive-energy regions for green growth (TEPCV) and in the willingness to become more involved in all regional energy initiatives. It is together that we will build tomorrow’s power system. Dialogue must underpin our efforts to develop common solutions.

Year 2015 witnessed a new wind power generation record on 29th March at 1 p.m. when 86% of the wind energy fleet (i.e. 8,266 MW) was harnessed to help meet French demand. Unforeseen issues associated with intermittence resulting from the constantly increasing presence of renewables on the grid or self-consumption, not to mention demand reduction efforts, are just some of the challenges and opportunities relating to the management of a grid which has to become increasingly flexible and ever smarter. As is the case with power consumption, generation methods are changing and the role of the grid has consequently been transformed.

While our purpose has not changed (RTE must constantly continue to provide everyone – wherever they may be – with safe, sustainable and cost-effective access to electricity), our strategy for achieving this goal must adjust to these new conditions.

Europe is also forcing us to rethink our strategy: the European Commission has started conducting two surveys aimed at verifying compliance with rules governing State aid. The first survey concerns the capacity mechanism, a market mechanism designed to encourage investment in power generation capacity or demand reduction capacity, thus helping to achieve medium-term security of supply. The second concerns the Landivisiau combined-cycle power plant, a project forming part of the Brittany electricity agreement signed in 2010 by the Prefect of the Brittany region and the President of the Brittany Regional Council, and of which RTE is a key partner. These two procedures have caused uncertainties with regard to our business.

Current debates must also receive special attention. What model do European institutions intend to promote for European transmission system operators? What changes will be made to interconnection status? A system of quantified objectives for country-to-country interconnectors must be assessed in the light of their socio-economic benefits if they are to create added value for Europe. The question of changes to the scope of regional cooperation within Europe must be raised, along with that regarding the coordination of national energy policies and cross-cutting impacts between countries and markets.

For all these reasons, RTE has no choice but to adapt, expand and innovate. That is precisely the intent of the company project, aimed at ensuring that we come out of this transitional phase in a stronger position. It stems from internal organizational changes with the appointment of a new management board for greater collegiality and cross-functionality. It is designed to clarify and share the company’s vision and aspirations. It must be meaningful enough for all RTE entities to follow the course that will be set.

RTE is a decisive participant when it comes to the stability and development of the power system. We must do everything to ensure that RTE remains the central player in the successful completion of the energy transition.

François Brottes, President of the RTE Management Board

“As is the case with power consumption, generation methods are changing and the role of the grid has consequently been transformed.”
Renewed governance

A limited company governed by a Management Board and a Supervisory Board, RTE’s autonomy, administrative independence and neutrality are guaranteed by its articles of association and mode of governance.

THE MANAGEMENT BOARD
On the 1st of September 2015, François Brottes was appointed President of the RTE Management Board, taking over from Dominique Maillard who had occupied the position since 2007. On the 29th of September 2015, the RTE Supervisory Board appointed the members of the new Management Board on the recommendation of the Board’s President, after consulting with the French Energy Regulatory Commission (CRE). The Management Board has sole authority for implementing measures directly relating to the operation, maintenance and development of the public transmission system, as part of the duties assigned to the company. The 5 members of the Management Board are appointed for a 5-year term.

► François BROTTE, President of the RTE Management Board (since 1st September 2015)
► Valérie CHAMPAGNE, Executive Vice President in charge of finance and procurement
► Olivier GRABETTE, Executive Vice President in charge of long-range planning, expertise and solutions
► Clotilde LEVILLAIN, Executive Vice President in charge of development & engineering, operation and services
► Xavier PIECHACZYK, Executive Vice President in charge of networks, customers and regions

EXECUTIVE COMMITTEE
The Executive Committee comprises the 5 members of the Management Board and:

► Hervé LAFFAYE, Deputy President in charge of European and international affairs
► Alain FIQUET, Executive Vice President in charge of legal matters & oversight
► Olivier LAVOINE, Executive Vice President in charge of diversification & leverage
► Bertrand SIGNÉ, Executive Vice President in charge of human resources

SUPERVISORY BOARD
The Supervisory Board comprises 4 State representatives, 3 of which are appointed by the shareholder on the State’s recommendation, 4 EDF representatives (sole RTE shareholder) and 4 administrators elected by the workforce.

Administrators representing the State
► Didier MATHUS (Chairman)
► Marie-Solange TISSIER
► Michel PINET
► Thomas GOSSET, appointed by the State

Administrators representing EDF
► Thomas PIQUÉMAL (Vice-Chairman)
► Marc ESPALIEU
► Nicole VERDIER-NAVES
► Valérie LEVKOV

Administrators elected by the workforce
► Wilfried DENOIZAY
► Jean-Louis DUGAY
► Dominique LORET
► Christophe AIME

Supervisory Board Secretary
► Alain FIQUET
An efficient and sustainable grid

A grid that drives regional growth and development

Sales
€4,593 M

Net earnings
€215 M

Capital expenditure
Approx. €1.4 Bn/year (2015-2024)

RTE foundation
€6.2 M in support of 340 projects since 2008

Procurement
€2 Bn

Taxes and duties
€498 M

Environmental safety
€105 M spent in 2015

Personnel hired (2015)
421

Continuity of electricity supply
99.9987%

Sustained jobs
73,880

Workforce
8,500

RTE SA, PUBLIC UTILITY AND REGULATED MONOPOLY
The grid

- 105,448 km power lines
- 53.8% of regional high-voltage lines (150, 90, 63 kV)
- 46.2% of ultra-high voltage lines (400, 225 kV) for transmitting power over large distances and interconnection with neighbouring countries
- 20,000 km of optical fibres
- 50 cross-border links
- 97% of the new 90-kV and 63-kV lines commissioned from 2013 to 2015 are underground
- 1,231 transformers
- 2,710 substations
- 3,504 delivery points
- 1 national grid control centre
- 7 regional grid control centres

Electricity flows in 2015

- 495 TWh\(^{(1)}\) injected into the transmission system by power plants
- 121 TWh\(^{(1)}\) exchanged at the borders (contractually binding aggregate)
- No contractually binding net import days in 2015

New equipment commissioned in 2015

- 24 new substations including 17 RTE substations and 7 customer substations
- 625 km of new or refurbished power lines
- 86 km of 400-kV lines
- 234 km of 225-kV lines
- 305 km of 150, 90 and 63-kV lines

\(^{(1)}\) billions of kWh
2015
on the move

FRANCE-SPAIN INTERCONNECTOR PROJECT

The longest underground interconnecting line of this capacity in the world

Inaugurated on 20th February 2015 by the French Prime Minister Manuel Valls and the Spanish Prime Minister Mariano Rajoy, this interconnector symbolises the three pillars of European energy policy: security of European power supply, the fight against climate change and development of the European energy market to reap the benefits of increasingly competitive electricity. The project cost 700 million Euros, equally paid for by RTE and the Spanish transmission system operator REE via their jointly owned subsidiary, Inelfe. Declared a project of common interest, it was subsidised by the European Union to the tune of 225 million Euros, as well as receiving a loan of 350 million Euros from the European Investment Bank.

By doubling exchange capacity between both countries (from 1,400 to 2,800 MW), the new line has significantly boosted the European power system by enhancing security of supply for the 34 interconnected countries in Europe. With market coupling (see opposite) extended to the Iberian Peninsula since May 2014, the entire European power system is gaining in flexibility, security of supply and integration, thus increasing the competitive strength of French and European industries.

97% of the new 90-kV and 63-kV lines commissioned from 2013 to 2015 are buried

Integration of the European electricity market

In February 2015, integration of the European electricity market took another step forward with the system being extended to Italy, Austria and Slovenia. The coupling of daily markets directly optimizes available generation capacity and electricity demand by pairing supply and demand on power exchanges of the different coupled markets while taking account of cross-border capacities provided by transmission system operators. This is the most effective method for allotting day-ahead cross-border capacities, thus facilitating price convergence and stability. Since then, 19 countries have been coupled in this way, making up approximately 80% of European power consumption.

PACA SAFETY NET: THE END OF A HISTORICAL WEAKNESS

107 km of new underground power lines designed to strengthen the grid in the east of the PACA region were inaugurated in April 2015. Rolled out at a vigorous pace, this 171 million-Euro project seeks to meet the needs of a constantly growing population by providing 1,000 MW of additional transmission capacity. With the energy transition underway, it offers new opportunities for harnessing renewables in the region and beyond, both in France and in Europe. In order to build the buried electrical infrastructures for this safety net, RTE has pushed back the limits of previously used technologies and methods. RTE has used a new civil engineering system which improves efficiency by 50% while at the same time reducing filler materials by 45% and excavated materials by 35%. All these innovations have resulted in a 25% saving on the project’s overall cost.
RTE obtains “advanced” status from UN Global Compact

As part of its commitment to the United Nations Global Compact, RTE undertook to externally assess its communication on Progress 2015, commonly known as COP. This assessment took the form of a peer review.

RTE COP 2015 was awarded “advanced” status, the highest Global Compact ranking. This ranking seeks to create a high standard of RSE performance while fostering transparency on diverse topics such as governance, the fight against corruption, environmental protection, human rights and the upholding of UN objectives, etc.

Certification

The AFNOR certification entity has renewed RTE’s ISO14001 certificate for the period of May 2015 to November 2016. All RTE activities have been certified to ISO14001 since 2004.

Initial assessment of SmartGrid solutions

Within the scope of the SmartGrid programme, RTE developed a forward-looking SmartGrid methodology in 2015 in conjunction with the sector’s stakeholders. Thanks to this methodology, the socio-economic and environmental performance of different SmartGrid solutions can be compared on the basis of a standardized model in order to facilitate the structuring of a competitive French industrial sector. More specifically, the results of this assessment have highlighted a generally positive level of economic and environmental performance for the SmartGrid solutions assessed (the reduction of greenhouse gas emissions achieved by active demand management has been estimated at somewhere between 2,000 and 30,000 tons of CO2 equivalent per million Euros spent).

1 A programme initiated by the French government

An integrated energy efficiency policy

In January 2015, RTE adopted an integrated energy efficiency policy with regard to all energy consumption items in order to ensure consistency of actions underway and to address this issue more effectively. The year was punctuated by a number of actions: energy audits were conducted on energy consumption items; an “energy efficiency” criterion was added to procurement procedures; an in-house challenge was held in November to embed this policy within the entire workforce; last but not least, an energy efficiency advocacy network is being formed within RTE. As a concrete illustration of this policy, most of RTE’s information system will migrate to new data centres in 2015, thereby reducing energy consumption by more than 60% in this particular area.

Initiatives for sustainable environmental protection

Partnership agreements in 2015

RTE is mindful of its stakeholders’ opinions when it comes to jointly developing sustainable and common solutions. In 2015, this commitment was reflected in the signing of a new partnership agreement with Réserves Nationales de France and a three-year joint undertaking with France Nature Environnement (FNE) to extend the cooperation agreement initiated in 2012. A partnership agreement signed in 2015 renewed the public interest sponsorship with the Comité National Avifaune (Seine-Maritime). Last but not least, the partnership agreement signed with the Ligue de Protection des Oiseaux (LPO) has continued with the development of spherical bird diverters, beacons that can be seen by birds from all angles of approach and that are compatible with almost all grid conductors.

Biodiversity: a cornerstone of RTE’s environmental protection policy

By the end of 2015, RTE had laid out 648 hectares of biodiversity-friendly land. Jointly developed with local players, these amenities have strengthened the company’s regional ties. In conjunction with the Ministry for the Environment, Sustainable Development & Energy, and the Foundation for Research into Biodiversity (FRB), the progress of 15 research projects focusing on the link between linear transmission infrastructures, biodiversity and landscapes was reviewed in October 2015. In 2015, RTE signed a new partnership agreement with Réserves Naturelles de France.

9,688 hours
devoted to awareness-training of RTE personnel on the subject of environmental hazards in 2015
Moving from local to European scale, promoting electrical solidarity among the regions

At the heart of the French and European power system, RTE adapts this system to the pace of the energy transition and contributes to regional economic growth. With a view to addressing our fellow-citizens’ concerns and minimizing our ecological footprint, our priority is to make the most of existing infrastructures by coming up with innovative ideas to extend their service life and increase their value for the community.
Economic growth and development of renewables

The energy transition has brought about profound changes within the power system: diversification of generation capacity with local and intermittent renewable sources playing an increasingly active role; more and more players in the power system including consumers who are balancing supply and demand; and a greater focus on economic competitiveness for our customers.

RTE supports the regions while they adjust to this new dynamic and is doing all it can, along with all regional and local players, to find the most suitable solutions for its projects. Demographic growth trends, changing consumer habits, the development of industrial activities and the inclusion of renewables in the power system are just some of the factors being considered by RTE to improve its high and ultra-high voltage transmission system.

Supporting demographic and economic growth in the Rhône-Alpes region

In the Rhône-Alpes region, RTE will be committing 1 billion Euros of capital expenditure over the next 5 years, including 500 million for a new underground power line between France and Italy (see page 9). The other half of this expenditure will be committed to enhancing the reliability and efficiency of the electrical grid in the Rhône Valley, and to supporting the economic boom by building a substation to connect the future Hecel plant in Isère, which produces carbon fibres.

Meeting electricity challenges in the Greater Paris Area

The commissioning of the Boule substation in 2015, a compact facility needed to ensure security of electricity supply in the Seine Défense sector, forms part of the efforts being made to support the Greater Paris Area and its economic hubs. Grand Paris is an extraordinary urban, social and economic development project. By 2030, forecasts predict that the demand for electrical power will have grown by 2,200 MW, tantamount to three quarters of current demand. RTE is planning to commit 510 million Euros of capital expenditure over the period of 2015 to 2020. In order to ensure the security of the region’s electricity supply, grid connections must be extended to cover a wider area. RTE has started modernizing the line connecting Le Havre to Rouen: a crucial link in the chain that will transmit electricity from the offshore wind farm at Fécamp to Paris. With 83 wind turbines spread across an area of 67 sq. km, this facility with a total capacity 498 MW will be gradually commissioned as of 2018. This will be a vital contributor to the successful completion of the Grand Paris project, as well as to the energy transition.
Modernising the grid in the Champagne-Ardenne region

Year 2015 saw the start of reconstruction work on the 400-kV power line running between Charleville-Mézières and Reims (Lonny-Seuil-Vesle), in order to increase its capacity. 110 million Euros have been committed to this project. The line is scheduled to be commissioned in the autumn of 2016. It has been routed in such a way as to avoid urban areas, heritage sites and sensitive natural spaces. The electrical grid in the Champagne-Ardenne region, built around a single line connecting Charleville-Mézières to Troyes, is in particularly high demand. It will not be able to carry future loads, predicted to have reached around 1,750 MW by 2020. This is due to regional economic growth and to the boom in renewables (the former administrative region of Champagne-Ardenne is in leading position on the national wind energy scale).

Haute-Durance project: supporting local employment

24 April 2015: Start of modernisation work on the Hautes-Alpes electrical grid. The Haute-Durance project entails 100 km of new underground power lines, 100 km of new overhead power lines, and 100 km of new underground power lines. This large-scale project has already involved 62 local businesses from Haute-Loire and Loire since it started in January 2015.

Did you know?

RTE provides all stakeholders with the information they need to understand the energy transition: Every year, we publish France’s electrical performance report as well as that of each region in order to keep all stakeholders informed and highlight the contribution of regional exchanges, a contribution that varies according to weather conditions, generation capacity and volatility of demand.

73,880 indirect jobs have been created through RTE’s business activities. For one job directly created by RTE, 7.3 indirect jobs are created in France. (Survey: Local Footprint Utopias, Direct and indirect jobs; jobs induced by taxes and resulting GDP).

CLOSE-UP

SUSTAINABLE ENERGY FOR THE 2 LOIRES

Contributing to local development means doing everything to ensure that local businesses derive maximum benefit from spin-offs generated by our projects. This year is a case in point, with the reconstruction of the line running between Le Puy-en-Velay (Haute-Loire) and Saint-Étienne (Loire). Built in 1941, the existing line has reached its technical limits. In support of current developments and in preparation for future regional growth, the existing line is being replaced by a new higher-capacity line with an improved route. Houses that currently overlook the existing line will not do so in the future. In addition to local economic spin-offs in the hotel and catering industries for example, this large-scale project has already involved 62 local businesses from Haute-Loire and Loire since it started in January 2015.
lines and the dismantling of 200 km of existing overhead lines, at a total cost of 230 million Euros. This ambitious project is helping to support growth in the upper Durance valley and meet the region’s needs.

Committed to boosting regional vitality, RTE has founded the Challenge Emploi local et solidaire. Three prizes will be respectively awarded to the contract companies that distinguish themselves by creating spin-offs for the local economy; local employment; integration of disabled and unemployed people into the labour market. This challenge follows on from the one-stop shop Haute-Durance Initiative set up in conjunction with the Hautes-Alpes Chamber of Commerce and Industry to encourage the involvement of local businesses in the various projects being run by RTE.

Providing everyone with affordable, safe and sustainable access to electrical power

The electrical grid makes optimal use of the power system by combining the different sources of energy distributed throughout France and further afield in Europe, while also adapting to the regional differences in demand for electrical power.

This electrical solidarity among the regions is essential for providing everyone with affordable, safe and sustainable access to electrical power. The boom in wind and solar energy sources has given the electrical grid a central role. We are connecting future offshore wind farms and large solar facilities, as well as scheduling the connection of renewables in conjunction with regions and distribution network operators by drawing up regional renewable energy grid-connection plans (S3REnR in French). We are also tailoring our systems to manage intermittent generation methods, a source of challenge and innovation for the power system. We are leveraging the contribution of renewables by offsetting their variability through the sharing of resources, achieved through intermeshing of the power transmission system.

Did you know?

The maintenance of existing infrastructures is essential for the sound operation of the grid. One of our major challenges is to maintain the operability of our structures, including during maintenance periods, in order to provide high-quality electricity and reliable connection conditions for our customers. January 2015 witnessed the introduction of a new initiative involving 4,000 co-workers and seeking to provide our customers with more flexible and innovative maintenance, while at the same time meeting the needs of the community.

**SOME STATISTICS**

In total, close to 2,000 km of ultra-high voltage structures have been built or strengthened over the past decade.

- **1,200 km** of new underground and sub-sea DC structures.
- **600 km** of electrical grid reinforcements or new overhead AC circuits to replace existing structures.
- **Nearly 900 km** of underground lines and slightly more than 400 km of overhead 225-kV AC lines.
- **10,000 MW** of capacity for interconnection with our European neighbours.
- **More than 400 projects** are listed in the 2015 ten-year development plan, all voltage levels combined.

The ten-year network development plan (SDDR) lists our planned infrastructures for the forthcoming 10 years. Every year, this plan is submitted to the CRE for approval.

BRL Ingénierie, an independent engineering firm, has been selected by RTE to carry out an environmental assessment of the 2015 RTE ten-year development plan.
Electrical solidarity is also an optimisation factor at European level, particularly with respect to renewables. France is surrounded by countries including Germany, Spain and Italy, all of them highly ambitious when it comes to the development of renewables.

Located at the crossroads of European exchanges, France is developing interconnector projects in support of energy transition initiatives throughout Europe. These are crucial to European solidarity. Combined with the coupling of European electricity markets, they provide France with access to the most cost-effective electricity both in France and in Europe.

Facilitating cross-border exchanges
We have accomplished a major step for the European power system with the successful launch, in May 2015, of electricity market coupling via a new calculation method based on electricity flows. The first countries to be involved are France, Germany and the Benelux. This coupling system stems from the “flow-based” method developed by RTE, which allocates physical power transmission capacities to commercial exchanges at the border where they are most effectively used. Based on a more detailed description of the grid, this method improves the standardization of prices in Central West Europe (CWE) while maintaining consistent security of supply. Benefits of this method include more efficient use of power generation capacity in the CWE region, an increase in power exchanges between like-for-like infrastructures and a decrease in generation costs.

In order to connect France to England, a cable layer will run two cables measuring 13 cm in diameter under the seabed, using trenching technology.

50 cross-border connections between France and its neighbours

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Exports</th>
<th>Total Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>91.3 TWh</td>
<td>13.4 TWh</td>
</tr>
<tr>
<td>Switzerland</td>
<td>20.1 TWh</td>
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</tr>
<tr>
<td>Germany</td>
<td>20.1 TWh</td>
<td>20.1 TWh</td>
</tr>
<tr>
<td>Austria</td>
<td>12.0 TWh</td>
<td>12.0 TWh</td>
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<tr>
<td>Belgium</td>
<td>13.3 TWh</td>
<td>13.3 TWh</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>6.4 TWh</td>
<td>6.4 TWh</td>
</tr>
<tr>
<td>Netherlands</td>
<td>10.4 TWh</td>
<td>10.4 TWh</td>
</tr>
<tr>
<td>France</td>
<td>20.4 TWh</td>
<td>20.4 TWh</td>
</tr>
</tbody>
</table>

Source: 2015 electrical performance report – RTE

1 9 players are involved in the CWE Flow-Based project: 2 power exchanges (Epex Spot and APX-Belpex) and 7 transmission system operators covering France, Germany, Austria, Belgium, Luxemburg and the Netherlands.
interconnectors in Europe
Europe is the world’s most interconnected region, offering essential exchange opportunities to optimise the power system.

estimated at around 100 million Euros a year across the region. “This is a fantastic example of how power exchanges and transmission system operators help to make the European energy market more competitive and reliable”, explain Wim Michiels (Elia), Jean Verseille (RTE) and Andrew Claxton (APX), chairmen of the Flow-Based project’s steering committees.

Combining the use of France’s and England’s energy mixes
In 2015, we continued to hold discussions on the new “IFA2” interconnector (the first one having been built in 1986). IFA2 was declared a Project of Common Interest by the European Union in 2013. In 2020, this 250-km sub-sea interconnector will provide 1 GW of additional exchange capacity between the two countries. It will support the more effective use of very different energy mixes on either side of the Channel and the North Sea. It will also be a new contributor to the energy transition. The substantial development of renewables in both countries will give rise to exchanges in both directions, varying significantly according to weather conditions. Another consequence will be the narrowing of electricity market price differences on both sides of the Channel.

CLOSE-UP

The new Savoie-Piemonte Interconnector

- **The project:** Construction of a 190-km buried DC interconnector between Savoie and Piemonte (95 km in France and 95 km in Italy)
- **Duration:** 2015-2019
- **Capital expenditure:** 500 million Euros
- **Purpose:** Declared a European project of common interest, it will help to increase exchange capacity between France and Italy by 60%, thus enhancing both countries’ security of electricity supply and maximising the benefits of the energy mix on either side of the Alpine border.
- **Record:** It will be the world’s longest underground DC line of this capacity (1,200 MW). It breaks the previous record of the 65-km France-Spain interconnector, inaugurated in February 2015.
- **Distinguishing feature:** On the French side, the line will essentially be incorporated into existing road infrastructures and will not alter the beauty of the Savoie landscapes. In France, it will be the first time that a underground power line runs alongside a motorway in an effort to save space.
- **Benefits:** A more densely intermeshed European grid; better integration of renewables; greater competitive strength for French, Italian and European businesses.
A key player in French and European energy policy, RTE stands at the crossroads of three major challenges: fight against climate change; competitiveness of the French and European economy; security of electricity supply. The electrical grid must face these three challenges head on. RTE is adjusting to climate change and is helping to reduce French and European greenhouse gas emissions.
The transmission system at the crux of climate challenges

From 30th November to 11th December 2015 in Paris, France chaired the 21st United Nations Conference of the Parties: 195 States got together to reach a new climate agreement.

While the States are in the front line when it comes to climate negotiations, all public and private stakeholders are affected. RTE chose to work alongside national partners (FNH, UFE, SER, etc.) ahead of this event in order to explain the grid’s contribution to the fight against climate change.

At the UFE COP21 symposium held in December 2015, François Brottes, President of the RTE Management Board, highlighted the way in which the grid forms a link between local initiatives, national policy and European optimisation. An opportunity to review the spectrum of measures available to bring more and more renewables into the power system: development of demand-reduction measures; integration of information and communication technologies; development of new technologies.

The publication of an EpE1 (Entreprises pour l’Environnement) report in March 2015, focusing on “business strategy for climate” provided RTE with an additional opportunity to explain what it is doing to fight climate change. This report was used as input for France’s Agenda des Solutions, which describes existing initiatives and solutions.

In all parts of France, numerous initiatives have been developed to bring us closer to our stakeholders and more effectively address our daily challenges.

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1 Businesses for the Environment

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At the COP21 conference on 1st December 2015, François Brottes – President of the RTE Management Board – attended a round table meeting hosted by UFE with Francesco Venturini, CEO of ENEL Green Power, Bertrand Piccard, pioneer and inventor of the solar plane, Henri Lachmann, former CEO of Schneider Electric, and Jean-Louis Borloo, in charge of Africa’s grid connection project.
Adjusting to exceptional climate events

In order to provide access to electrical power at all times, including during exceptional weather events, we need to make our infrastructures more resilient. Strengthening metal structures, widening the corridors around our overhead lines to minimize the effects of falling trees and installing “anti-cascading” pylons are just some of the ways in which to prevent these hazards.

Nearly 91% of the grid reinforcement programme was completed by the end of 2015. In the wake of the 1999 storms, RTE initiated this ambitious programme in order to maintain supply to almost all substations following the occurrence of weather events not exceeding the severity of the 1999 storms. The programme seeks to restore basic services following severe weather conditions within no more than five days and to prevent equipment from falling on people and property.

RTE spent 2,400 million Euros on the completion of this programme, which covers 48,000 km of power lines and 2,900 substations. We take all possible measures to make our infrastructures more resistant to severe weather conditions: reinforcement of metal structures, widening of overhead lines to mitigate the risk of trees falling on cables, installation “anti-cascading” pylons, which are stronger than the existing ones. This programme will be completed in 2017.

A workforce ready to respond to exceptional episodes

RTE emergency response teams are spread across the country. They routinely perform drills in order to be able to respond effectively in the event of emergencies or serious failures.

In 2015, equivalent outage time (TCE\(^1\) in French) for RTE customers amounted to 7 minutes and 2 seconds, of which 5 minutes and 44 seconds were during the heatwave of 30th June to 4th July, which caused numerous failures on instrument transformers.

Based on a review of its event investigations, RTE has identified equipment that could potentially fail in the future and has established an accelerated replacement policy which sets priorities according to the most exposed geographical areas, malfunction rates per equipment category and potential consequences for the grid in terms of services rendered. This programme will be completed in the course of 2017. Mid-June 2016 will see exceptional efforts being galvanized to replace priority equipment with maximum involvement of RTE personnel, contractors and equipment suppliers.

\(^1\)This indicator represents average outage time for RTE customers (calculated on the basis of the power that should have been transmitted without a power cut).
Fostering efforts to modulate power consumption

While our ways of generating and consuming electrical power are changing, demand side management is a resource which in terms of like-for-like service, is equivalent to generation.

Improving the flexibility of the power system

In conjunction with power system players, RTE devises and recommends solutions for the reduction of power demand. In 2015, a number of improvements were made to increase the flexibility of the NEBEF mechanism (block exchange notification of demand response mechanism). New rules have been established to permanently embed this system, which was trialled throughout 2014. NEBEF stands out from other flexibility tools developed by RTE in recent years. It allows industrial facilities and demand-side operators to directly redeem their energy savings on the electricity market. Industrial facilities can already respond to the market price one day ahead and plan to reduce demand. In another step forward this year, consumers can help to build up reserves following the enforcement of the rules in 2014. These reserves are automatically activated in the event of urgent need, within a time frame ranging from a few seconds to a few minutes.

In 2015, up to 10% of primary reserve needs were covered by consumers. RTE also has “rapidly retrievable and supplementary reserves” (which can be activated in less than 15 or 30 minutes). These are generated through calls for tender and the selected players are then brought onto the balancing mechanism, depending on the needs of the power system (thus reducing the amount of automatically activated reserves). The proportion of energy savings associated with rapidly retrievable and supplementary reserves is constantly growing. In 2015, 9 players were selected to participate in these reserves, including 3 demand-side operators.

4 FLEXIBILITY TOOLS SUPPORTING DEMAND REDUCTION

The capacity mechanism

The capacity mechanism encourages investment in generation and demand reduction facilities. This solution contributes to security of supply by predicting medium-term capacity needs.

Energy markets

RTE has developed a set of rules for the NEBEF mechanism, enabling energy savings to be redeemed on the energy market, just like power generation.

The balancing mechanism

The balance between power supply and demand is achieved through forecasts that are updated up to a few minutes from the deadline. The balancing mechanism supports the use of supplementary reserves within the hour preceding the deadline. Producers and consumers (demand side) can participate in the balancing mechanism provided that they have at least 10 MW. Since 1st April 2015, a trial has been underway, enabling 1-MW capacities to participate in the balancing mechanism. This volume can be achieved by combining several small capacities.

System service (frequency)

As part of the frequency system service, reserves can be automatically activated within a few seconds to a few minutes. These are essential for balancing supply and demand. While for a long time, only generation utilities could participate in this service, industrial consumers have also been able to participate since July 2014 by reducing demand by at least 1 MW.

DID YOU KNOW?

ÉCO2MIX, AN ECO-CITIZEN INITIATIVE

The éCO2mix application was selected as one of the good practices of year 2015 by Renewables Grid Initiative (RGI). This European prize, organized by RGI, fosters the sharing of good practices between TSOs and NGOs on issues of acceptability, environmental protection, design and technologies facilitating integration of renewables into power transmission systems. In 2015, we launched a new version of éCO2mix, our “energy clock”, which enables real-time monitoring of the electricity generated and consumed in France and in each region. With its 3.5 million connections a year, it features new proximity functions including regional data for solar and wind power generation.

In addition, a partnership agreement signed by RTE and Labo citoyen on 8th September 2015 will help citizens to better understand their role in energy consumption. Initiated by the Labo citoyen association, the Citizen Watt project enables volunteer households equipped with a Citizen Watt meter to view their power consumption in real time. By combining this individual approach with collective data provided by RTE’s éCO2mix application, the new partnership agreement will help to foster an energy culture among users.

2 RGI is an association comprising NGOs and TSOs, which seeks to promote the development of renewables and support the European energy transition.
Cascading the benefits of renewable power generation

The generation of renewables including wind and solar power does not coincide with local demand.

By transmitting electricity generated from these sources to areas where it is needed and offsetting their variability on a European scale, the electrical grid increases the value of renewables for the community and limits the use of supplementary generation capacity, which often emits greenhouse gases.

SmartGrids supporting renewable energy sources

The spring of 2015 witnessed the implementation of the SmartGrid road map, submitted to the French President on 7th May 2014. Smart grids provide the flexibility that is so essential for the integration of renewables into the power system at the lowest cost for the community. Energy companies, grid operators, research centres and public entities were involved in the preparation of this road map by identifying 10 actions, two of which are being overseen by RTE: creating a French smart grid team to support the sector abroad and to assess spin-offs in terms of job creation and benefits reaped by the community from the deployment of smart grids in France and abroad, while at the same time minimizing our ecological footprint. The “Think SmartGrids” association, of which Olivier Grabette, member of the RTE Management Board, is Vice-President, and Philippe Monloubou, Chairman of the ERDF Management Board, is President, was founded on 20th April 2015, while an initial report entitled Valorisation socio-économique des réseaux électriques intelligents (maximizing the socio-economic benefits of smart grids) was published in July 2015.

Exemplifying improvements made to the grid with a view to making it ever smarter, a trial was initiated by RTE’s R&D department in July 2015 to utilize 3D technologies for purposes of asset management and optimized maintenance. Augmented reality can now be used to tour a simulated model of the Blocaux smart substation and get a safe close-up view of all its electrical components.

In 2015, renewables accounted for nearly 19% of French power consumption. France is aiming to extend this coverage to 23% in 2020 and 32% in 2030. In support of this nationwide ambition, RTE is expanding the grid to include renewable power generation. Wind and solar power are the renewables which contribute most to the growth of renewable energy sources, growing by nearly 2,000 MW in 2015. Both these sectors now make up one third of renewable energy capacity in France.

RTE connects Europe’s biggest solar power facility

Operated by Neoen, the 300-MW Cestas solar farm near Bordeaux can generate up to 350 GWh a year by using one million solar panels. In order to integrate this renewable energy into the power system, RTE has built a 225-kV substation and two underground lines of the same capacity covering a distance of 1.6 km between the new substation and the power plant. The work was completed in 33 months, a phenomenal achievement for a project of this magnitude. The plant was energized for the first time on 28th September 2015.

**CLOSE-UP**

RTE, FIRST FOUNDING MEMBER OF THE PAYSAGE ET ÉNERGIE RESEARCH CHAIR PROGRAMME

On 7th April 2015, Ségolène Royal, the Minister for the Environment, Sustainable Development & Energy, oversaw the signature – in Versailles – of the Paysage et Énergie research chair programme, together with RTE and the École Nationale Supérieure de Paysage (ENSP), based in Versailles. Through the medium of a space designed for research, design, training and exchange, the Paysage et Énergie research chair programme will seek to design landscapes generated by the energy transition.
In 2015, RTE published the 5th statutory report on its greenhouse gas emissions (BEGES) for year 2014.

In this report, RTE includes all direct and indirect emissions. This three-yearly inventory forms part of a continuous improvement programme, aimed at verifying the effectiveness of measures taken and identifying new improvement opportunities. In total, direct emissions (scope 1) and indirect emissions (scope 2 and 3) generated by RTE in 2014 amount to 1.59 million tons of CO2 equivalent. Three items account for almost all emissions: one half relates to power losses caused by the Joule effect during power transmission; one third relates to emissions generated by RTE’s industrial assets; 8% relate to emissions of SF₆, a high-performance insulating gas used on high and ultra-high electrical equipment.

Approx. 30% of SF₆ emissions
Aggressive measures were taken to prevent the emission of 38,400 tons of CO₂ equivalent over the period of 2008 to 2014. After a brief decline of these good results in 2015 due to equipment faults (5.8 tons of SF₆ emitted), RTE is now aiming to keep its SF₆ emissions at a stable level of 5 tons from 2015 to 2018.

Moving towards a carbon-free European economy
The France-Spain interconnector exemplifies the combined use of French, Spanish and more broadly, European electricity mixes. By improving access to the European energy market for 30 GW of Spanish renewable capacity, this link contributes to the energy transition. It will also help to save up to 1 million tons of CO₂ equivalent every year.

In order to create a carbon-free economy, Europe must take a long-term approach to its energy infrastructures. For this purpose, it has started conducting several extensive studies. Running from 2012 to 2015, the E-Highway 2050 project brought together a consortium of 28 partners, academics, consultants, manufacturers and transmission system operators, including RTE. Together, we set out the main options for expanding the grid over the period of 2020 to 2050. This resolutely pan-European approach hinges on the sharing and combining of resources. The study’s findings identified common solutions to all scenarios, including wide power flow corridors between north and south.

DID YOU KNOW?
A BUTTERFLY CORRIDOR UNDER THE POWER LINES ALONG THE BASQUE COAST
A programme seeking to restore natural habitats under certain RTE power lines was initiated in April of 2015. Designed by members of the Aquitaine natural habitat conservation society and RTE personnel, this programme aims to relocate and reconnect existing Alcon Blue populations. This daytime butterfly lives in wet heaths and features on the red list of endangered and protected species in France. Often disturbed by changes in our lifestyles, numerous plant and animal species take refuge under power lines. Creating biodiversity zones on the land we occupy is also a means of fighting the effects of climate change.

Learn more about it at lemag.rte-et-vous.com
Our expert solutions for tomorrow’s electricity

The energy transition is a source of innovation and manifests itself through gradual capability enhancements within the entire RTE workforce, either in terms of more flexible maintenance, the use of new types of equipment to manage electricity flows, or the development of more and more tools and services in support of economic efficiency, environmental protection and security of electricity supply. RTE uses its expert skills to serve its customers and the community through the construction of tomorrow’s power system.
In the future, the power system will be safer, more efficient, more economical, cleaner and more streamlined. Undergoing constant changes, the pace of its transformation is being accelerated in response to major challenges. New working methods, new tools and new focus areas: the women and men of the RTE workforce are preparing themselves and honing their expert skills to successfully complete the energy transition.

The increasing role of renewables has brought about greater variety in European power generation and electricity flows. These flows are becoming increasingly large and volatile. They are all the more volatile with France standing at the geographic crossroads of European power exchanges. Our solution: technological innovation, market mechanisms for greater flexibility of the power system and a wide range of new methods, as well as new prediction and maintenance tools – these are just some of the solutions that are transforming grid operation.

2015 was a year of closer coordination, both internally and with RTE’s partners taking part in Coordinated Short-Term Studies (ECCT), involving eight control centres using the RTE power system. They are analyzing all criteria that contribute to grid safety for the forthcoming 24 hours, with hourly updates. We have also started using Tao, a tool that computerizes and speeds up the processing of orders as part of the balancing mechanism (see page 13).

Successfully completing the technology transition with the women and men of the RTE workforce. It is the first time that a direct-current connector has been incorporated into an AC grid. New operating methods have had to be developed in minute detail, together with Red Electrica, the Spanish transmission system operator. These changes are not only technical in nature: the development of demand reductions within the market mechanisms we design, as well as our SmartGrid projects, help to make the grid smarter and bring about changes in the way the grid is operated. The grid is no longer a “vertical” link running from the producer to the consumer. It is constantly opening up to the consumer, who can become an active player within the power system.

The new France-Spain interconnector exemplifies the technological changes challenging the RTE workforce. It is the first time that a direct-current connector has been incorporated into an AC grid. New operating methods have had to be developed in minute detail, together with Red Electrica, the Spanish transmission system operator. These changes are not only technical in nature: the development of demand reductions within the market mechanisms we design, as well as our SmartGrid projects, help to make the grid smarter and bring about changes in the way the grid is operated. The grid is no longer a “vertical” link running from the producer to the consumer. It is constantly opening up to the consumer, who can become an active player within the power system.

France-Spain interconnector
VSC technology has brought proven benefits to grid operation, making it possible to reverse power within 150 milliseconds.

Optimising the use of infrastructures

RTE dispatchers operate the grid on the basis of maximum allowable current in order to ensure the safety of people and property, as the electricity flowing through power lines influences their distance from the ground. These maximum limits generally consist of static data. A new method is being used to adjust these values in real time, based on current weather conditions or by directly monitoring the height of the lines to guarantee constant adherence to safety standards. Meteorological sensors will be fitted to the Blocaux smart substation to monitor outside temperature and wind (which naturally cools the power lines). Sensors designed to monitor the height of power lines were tested in Savoie and since 2015, have been fitted to a new line near Montélimar. Approved in 2015, this real-time monitoring system will be more widely rolled out as of 2016. Initial operating experience shows that the method alleviates grid operating constraints. The system will also help to integrate more electricity generated by renewable sources such as wind power, comparing like-for-like infrastructures.
A new type of component in grid operation: the SVC

High power demand in the Greater Paris Area requires the ability to make discreet voltage adjustments. In order to maintain constant voltage levels, an essential factor when it comes to grid stability, RTE has installed compensatory systems in the Greater Paris Area including a high-tech component known as the SVC (static var compensator) at the Nanterre substation.

A smart system

The SVC is an electronic power system designed to adjust its response to grid requirements, with the flexibility of continuous voltage control and high-speed capability (100 to 150 milliseconds). The SVC undergoes a monthly inspection. Once a year, “minor” maintenance is performed. The first large-scale maintenance will be performed in 2027 after twelve years of service. The SVC is a “smart” component: it combines power electronics and control devices for an ultra-fast and automatic response.

NEW CHALLENGES: THE SOLAR ECLIPSE

On 20th March 2015, a solar eclipse moved through Europe, including France. Resembling a sunrise or sunset but 4 to 6 times faster than usual, it posed an unprecedented challenge for transmission system operators. Indeed, since the last similar eclipse in August 1999, solar generation capacities have multiplied 100-fold in Europe, reaching 89,000 MW. The challenge for European TSOs was to absorb a fast and significant drop in power generation. RTE teams prepared for this event long in advance together with their European partners. As an example, we increased daily generation reserves and activated supplementary generation capacities, essentially hydro, which can be started up in less than 15 minutes. Mission accomplished without a glitch... and we’re now preparing for the next solar eclipse in France, expected in June 2021.
A new area of expertise: marine energy

France’s marine energy potential is one of the biggest in the world, with 11 million square kilometres of maritime environment. France aims to develop 6 GW of off-shore wind generation capacity along the French coasts by 2020. Yet another resource, Europe’s second largest hydro reserve, estimated at somewhere between 3 and 5 GW, essentially located between the Cotentin and the Channel Islands. There are also some suitable sites in Brittany.

After two initial calls for tender issued by the French government in 2011 and 2013 for the development of offshore wind farms, and after the awarding of three contracts – Eolien Maritime France for wind farms at Fécamp, Courseulles-sur-Mer and Saint-Nazaire, Ailes Maritimes SAS for Saint-Brieuc and Les Éoliennes en Mer for wind farms at Dieppe Le Tréport and Yeu Noirmoutier – a call for projects was issued in 2015 for pilot floating wind farms in four favourable areas in the Mediterranean and in Brittany. With the development of marine renewables and the European electrical grid, sub-sea connectors are central to large-scale projects and are opening up a new field of expertise for RTE teams.

Connecting an off-shore wind farm to the grid requires the use of new expert skills. For instance, probes and radar systems can be used to map the relief of seabeds and identify the potential presence of metal structures like shipwrecks. Huge cables (each section measuring several kilometres in length) also have to be loaded onto cable layers and then unrolled onto the seabed, inside a trench dug by a sub-sea plough. Research into underground and sub-sea power cables has brought about major progress. Among some of the innovations, the use of a plastic insulator instead of the usual paper has made the manufacturing process easier and less costly. The use of aluminium instead of lead to protect cables from environmental hazards such as moisture has reduced their mass by a factor of 3! In January 2015, RTE and the École Centrale de Nantes launched an international research chair programme focusing on smart grids. This research will specifically focus on the development of new dynamic high and ultra-high voltage cables, the only cables designed to support the movement of rigs or floating wind farms.

The seabed is surveyed by performing core-drilling operations to determine the route of sub-sea connectors.

RTE has initiated a pilot project aimed at testing a new marine-environment monitoring tool to assess the potential effects of laying and operating sub-sea power lines. Ridges in scallop shells are observed in order to distinguish stress caused by the presence of power cables from stress caused by pollution, storms or other events. In conjunction with the TBM environnement engineering firm (Auray – 56) and two CNRS-affiliated university laboratories, LEMAR (Brest – 29) and Gipsa-lab (Grenoble – 38), RTE decided to initiate this innovative and unusual project by using the scallop’s natural characteristics. Two sub-sea connector projects in the Baie de Seine were chosen as research sites for the deployment of the protocol developed by these scientists: connection of the Calvados offshore wind farm and the IFA2 France-England interconnector. This initiative supports the commitments undertaken by RTE towards users of the sea. Research into the siting of future off-shore monitoring stations began in the last quarter of 2015.

Learn more about it at lemag.rte-et-vous.com

The number of technical and contractual documents prepared by RTE in order to compile the call-for-tender package issued in July 2015 for the connection of off-shore wind farms currently being developed off the coast of Fécamp, Courseulles-sur-Mer and Saint-Nazaire.
Local information campaign on the Lyon peninsula

Initiated on the Lyon peninsula in February 2016, the reconstruction project involving the 225-kV buried connector (Saint-Amour-Vaise) was the object of intense preliminary consultations. RTE, construction companies and all of the city's public service entities jointly pre-assessed the consequences of this project. This successful joint effort involved a local information campaign aimed at local residents for each of the project's phases. Efforts were also made to ensure that users would enjoy the benefits of an uninterrupted public service (public transport, etc.). RTE and its partners will continue to roll out these efforts for the rest of the project, which will run until 2017, from the Part-Dieu area to the Vaise district, passing through four Lyon boroughs.

On-line digital metering data

2015 witnessed the birth of an on-line metering system to better support our industrial customers. The 258 industrial companies directly connected to the RTE grid are more than ever in need of reliable, accurate and rapidly retrievable information on the power they consume and generate. This is even more important when these customers are able to redeem their energy demand savings on the power markets. Teams from the CNER (Centre National d'Expérience Réseau), from the Information System, from the maintenance department and from the trading department worked together to develop an on-line metering system which significantly improves the quality of this data. A first set of customers successfully tested this solution, which was designed and developed by RTE. The first cooperation agreements for the piloting of these new industrial customer services were signed in 2015.

New levels of technical and economic flexibility, energy transition, societal expectations: these changes affect all RTE areas of business: analysing reliable and accurate data on electricity flows in order to operate the grid; delivering new services to our customers; getting to grips with new electrical equipment; developing new offshore expertise; using sociological and environmental research to address our stakeholders' expectations prior to infrastructure development projects and during consultation phases, etc.

Professional expertise

Consultation methods are changing

In 2015, RTE started preparing a thesis on innovative mechanisms for a better understanding of acceptance issues involving electrical structures and implementation of the necessary measures. This research is being scientifically overseen by the Centre de Recherche et d'Analyse Géopolitique. The geopolitical strand of the research examines the contradictory spatial perceptions that stakeholders form and disseminate on the subject of regions and their inhabitants. This research aims to develop innovative consultation methods. It includes an analysis of the views, opinions and perceptions held by all players during consultation phases, during theoretical research into participative democratic systems and consultation, as well as the analysis of a case study on the Avelin Gavrelle project. The second strand of this research will entail developing innovative solutions and testing them in pilot areas, drawing on the example of existing North-American models in Quebec and California. Conditions for the French transposal of these systems will also be observed. Stakeholder understanding of the TSO's role and purpose is essential for bringing about the changes needed to successfully complete the energy transition and develop common solutions. A monopoly by nature, RTE has used transparency and dialogue to drive its performance, thus going beyond its statutory obligations.
Growing digitization of the economy combined with the development of new products and services, new customer and partner expectations and new economic models have prompted us to increase our innovation capabilities by a factor of 10. RTE takes an active interest in innovative ecosystems by using the solutions developed by start-up companies.

“Our utility has to focus on real-time issues”, François Brottes remarked on the 16th of December 2015, while presenting the results of the first RTE SmartGrid competition. The event was an opportunity to showcase RTE’s commitment to Open Innovation, revolving around three priorities: investment in collaborative R&D projects that will become tomorrow’s innovative services and solutions thanks to the REI challenge (established with the joint support of our partners, SmartGrids France and the Pacte PME association); financing of new innovative businesses with the creation of the first institutional support fund to be set up by a TSO in conjunction with Truffle Capital; the roll-out of more mature projects beyond the technological demonstrator stage: this is exemplified by an initial partnership agreement signed with the CoSMo start-up company and the MONA project, devoted to optimized management of grid equipment (pylons, transformers, etc.). Through these projects, RTE is actively contributing to an industrial boom geared towards future technologies by supporting innovative businesses in the smart grid sector.

The MONA project: complex systems and modelling for optimised asset management
In order to meet the challenges posed by the management and replacement of numerous facilities (pylons, power lines, substations) over the...
FOCUS
UNDERSTANDING THE SMART SUBSTATION

Inaugurated in the spring of 2016, the Lille showroom hosted an exhibition presenting the new technologies developed by RTE. The exhibition includes the future smart substation project. It began in the Somme, where it will run for 4 years. It is one constituent part of tomorrow’s smart grid. It includes numerous functions: built-in digital technologies, data processing, integrated weather station, forecasting and self-repair, etc. In addition, it will help to integrate more renewables into the power system comparing like-for-like infrastructures while at the same time improving grid resilience.

next 20 years, RTE has identified the need for a technological solution that effectively supports strategic decision-making with regard to maintenance or replacement of its industrial assets. The MONA project, jointly developed with The CoSMo Company, specialising in the modelling and simulation of complex systems, will develop a decision-making process that makes optimal use of RTE’s technical, human and financial resources. MONA will assess maintenance requirements for each grid infrastructure component and determine the most suitable preventive maintenance periods. By 2017, different versions of the MONA project will have been developed. By demonstrating the benefits for the French transmission system, the biggest in Europe, it is expected that this application will be sold to other transmission system operators around the world faced with similar maintenance issues.

The fully digitized smart grid
Real-time adjustment to weather conditions, optimised integration of wind and solar power flows, grid restoration following an incident... The advantages of the smart substation are multiple. This demonstrator will be used to specify the next generation of fully digitized instrumentation and control systems, planned for roll-out across the country as of 2020.
In order to better understand the changes in the energy sector and grasp the implications of fast technological advances and the emergence of new needs, we are already making plans to maintain and develop the skills of our entire workforce, while also endeavouring to attract new talent.

A strong focus is being placed on apprenticeship in the work place. Learning initiatives are regularly organized like the one held in the spring of 2015, attended by young trainees at our Jonage training centre in the Lyon outskirts, accompanied by maintenance teams while performing a full transformer refurbishment job in Savoie. In-house training delivered at the two sites of this ISO 9001-certified training centre accounts for approximately 62% of total training volume.

Developing skills also entails providing RTE personnel with new tools. Since 4th January 2016, maintenance teams working on substations have been using the new “VIP” (substation maintenance) application developed by RTE personnel. 320 touch-screen tablets have now replaced the 3,500 binders which previously contained all the data collected during annual transformer maintenance. Thanks to this modern tool, operators can directly capture and share data. Users can focus on their work practices while being able to retrieve the information they need. In the latter months of 2015, about 100 sessions were organised to familiarise all substation staff (about 600 people) with the tablet and the application. More generally speaking, digitization of the electrical grid through monitoring, communication and control system upgrades has given rise to new working methods fostering cooperation among all links in the chain.

Ongoing cooperation between RTE and its suppliers for safer work conditions
In 2015, RTE continued to cooperate with its suppliers’ risk-prevention experts by implementing a collaborative system to talk about good practices and hazardous conditions and by inviting suppliers to participate in RTE events such as the industrial safety challenge, where several contract companies were rewarded for their good health and safety practices. The involvement of everyone is essential for the long-term improvement of health and safety in the workplace, specifically by reinforcing accident prevention expectations among RTE employees and contractors.

260 new work placement agreements were signed in 2015. By the end of 2015, 460 people had work placements at RTE.

79% of RTE employees underwent some form of training in 2015.

52 hours Average annual training time per employee in 2015.

600 Number of employees trained to use the VIP (substation maintenance) application.

20.8% Percentage of female staff by the end of 2015 Since September 2015, 2 women have sat on the 5-member RTE Management Board.

22.5% Gender equality target for year 2018 The agreement was signed in 2015.
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