

## 1.1 History and development of the Company

EDF was created in 1946. Before 1946, the electricity sector had developed around numerous local companies across France. At the end of the 1930s, there were approximately 200 generation companies, approximately 100 transmission companies and 1,150 distribution companies.

In 1946, the electricity and gas sectors were nationalized. The Act of 8 April 1946 created EDF as a State-owned industrial and commercial establishment and created a special status for the personnel of the electric and gas industries (IEG). The Law nevertheless left in existence a certain number of non-nationalized distributors (DNN) and local distribution companies (ELD).

Between 1946 and 2000, the Group's industrial base was developed. Initially, there was a fleet of thermal generation facilities using coal and then fuel oil, as well as hydropower facilities, in particular with the construction of the dams at Tignes in 1952 and Serre-Ponçon in 1960. In 1963, following the French government's decision to guarantee France's energy independence through nuclear power, EDF commissioned the first commercial-scale nuclear generation unit at Chinon (70MW), the first of a series of six generation units of the Uranium Natural Graphite Gas (UNGG) family, the construction of which continued until 1972. The oil crises of 1973 and 1979 led to accelerated replacement of thermal power with nuclear power. In 1969, the UNGG family was abandoned in favour of the Pressurised Water Reactor (PWR) family, which was used for new power plants: 34 generation units totalling 900MW, which were built until 1988; then, 20 generation units totalling 1,300MW, which were built until 1994; then, four N4 generation units totalling 1,450MW, which were commissioned in 2000 and 2002.

Beginning in the 1990s, EDF embarked on significant expansion abroad in particular with, in December 1998 the acquisition of 100% of London Electricity (which was renamed EDF Energy on 30 June 2003). This policy was pursued in 2001 with the acquisition of 20% of EnBW (a stake that was successively raised to 45.01% by 2005) and in 2001 with the acquisition of equity interests in the Italian company Edison by the IEB consortium (63.8%), in which EDF holds a stake of 18.03%, and in 2002, when London Electricity acquired 100% of the share capital of EPN Distribution Plc. and Seaboard Plc., two distribution companies located, respectively, in the east and the southeast of England.

In France, the major development in recent years has been the liberalisation of the market pursuant to European regulations. In February 1999, sites where electricity consumption exceeded 100GWh per year, *i.e.* 20% of the market, became entitled to choose their supplier. The eligibility threshold was then progressively lowered. In May 2000, 30% of the market was thus opened to competition, then 37% in February 2003. In July 2004, all of the market for non-household customers, equivalent to 69% of the entire market, was liberalised. Since July 2007, the market has been fully liberalised, including for residential customers.

At the same time, the structures necessary for a competitive market to function effectively were set up. The French Electricity Regulation Commission, which became the Energy Regulation Commission (*Commission*

*de Régulation de l'Énergie* or CRE) was created in May 2000. That same year, in order to guarantee non-discriminatory access to all operators in the market, EDF created Réseau de Transport d'Électricité (which became a wholly-owned subsidiary of EDF in 2005 under the name RTE EDF Transport, and which has been renamed RTE Réseau de Transport d'Électricité), an independent internal entity responsible for managing the high voltage and very high voltage public electricity transmission network. In 2000, the Group formed the trading company, EDF Trading, with the trading specialist Louis Dreyfus. It became a wholly-owned subsidiary of EDF in 2003. In 2001, Euronext and various industrial and financial operators in the electricity market, including EDF, created Powernext, the French electricity exchange. In 2001, as a condition for authorising EDF's acquisition of a stake in EnBW, the European Commission required EDF to set up a system of power supply capacity auctions (Virtual Power Plants or VPP) to facilitate access to the market for competitors. In 2003, the EDF group sold its stake in Compagnie Nationale du Rhône to Suez (now Engie).

On 20 November 2004, pursuant to the Act of 9 August 2004, EDF became a French limited company (*société anonyme*) with a Board of Directors.

In 2005, EDF and A2A SA (formerly AEM SpA) entered into agreements for a joint takeover of Edison following the launch of a tender offer. The EDF group has pursued a strategy of refocusing on Europe and sold its controlling interest in its subsidiaries Edenor and Light and its assets in Mexico.

EDF filed for an initial public offering in the second half of 2005. Pursuant to this transaction, the Company offered 196,371,090 newly issued shares and the French government sold over 34.5 million shares it held to employees and former employees of EDF and of certain EDF subsidiaries. Subsequently, on 3 December 2007, the French government sold an additional 45 million of its shares.

In late November 2006, EDF Énergies Nouvelles, a subsidiary in which the EDF group holds a 50% stake, filed for an initial public offering.

Since 1 January 2008, EDF's distribution business has been conducted by Électricité Réseau Distribution France (ERDF), a wholly-owned subsidiary of EDF to which the distribution business was contributed pursuant to the Act of 7 December 2006 on the energy sector.

In 2008-2009, the EDF group became a major player in the revival of nuclear power internationally, by creating a joint venture with the Chinese utility CGN, acquiring British Energy, one of the largest energy companies in the United Kingdom, and acquiring nearly half of the nuclear assets of US-based Constellation Energy. EDF also acquired a 51% stake in the Belgian company EDF Luminus, and subsequently raised its stake in EDF Luminus to 63.5% in 2010.

EDF finalised in 2010 the sale of its British distribution networks to the Cheung Kong group of Hong Kong and, in 2011, it completed the sale of its 45.01% interest in EnBW to the German state of Baden-Württemberg.

In 2011, after ten years of a strategic partnership in which it held a 50% stake in EDF Énergies Nouvelles, EDF confirmed its positioning as a key player in the field of power generation using renewable energies by increasing its stake in the company to 100% pursuant to a simplified alternative cash or exchange tender offer for EDF Énergies Nouvelles shares, followed by a squeeze-out of minority shareholders.

In 2012, after more than seven years of a strategic partnership with A2A, EDF took over Edison, the oldest Italian electricity company and one of the key players in the Italian electricity market, the fourth largest market in Europe. This transaction was carried out as part of the group's gas strategy, which will rely on Edison's expertise at all stages of the gas chain, from hydrocarbon exploration and production to direct sales of natural gas.

In 2013, EDF and Energetický a průmyslový holding, a.s. (EPH), the leading Czech energy company in central and Eastern Europe, signed a final agreement for the sale to EPH of 49% of Stredoslovenská Energetika a.s. (SSE), second electricity distributor and supplier in Slovakia.

In 2014, EDF has delegated to Exelon, the leading American nuclear operator, the operational management of the five nuclear reactors owned by CENG, held by EDF (49.99%) and Exelon (50.01%). Furthermore, EDF took over all of Dalkia's lines of business in France, including the Citelum group, and Veolia took over the Dalkia group's international business. Finally, F2i, Edison and EDF Énergies Nouvelles created the third largest Italian operator in the renewable energy sector, with an installed capacity of approximately 600MW, owned by F2i (70%) and an holding company (30%) owned by Edison and EDF Énergies Nouvelles.

On 10 December 2015, EDF International (EDF I) and EP Energy, a.s., through its subsidiary company EP Hungary, completed the transaction for the sale of EDF's majority stake in Hungary-based Budapesti Erőmű Zrt, that owns three gas-fired cogeneration (combined heat & power) plants.

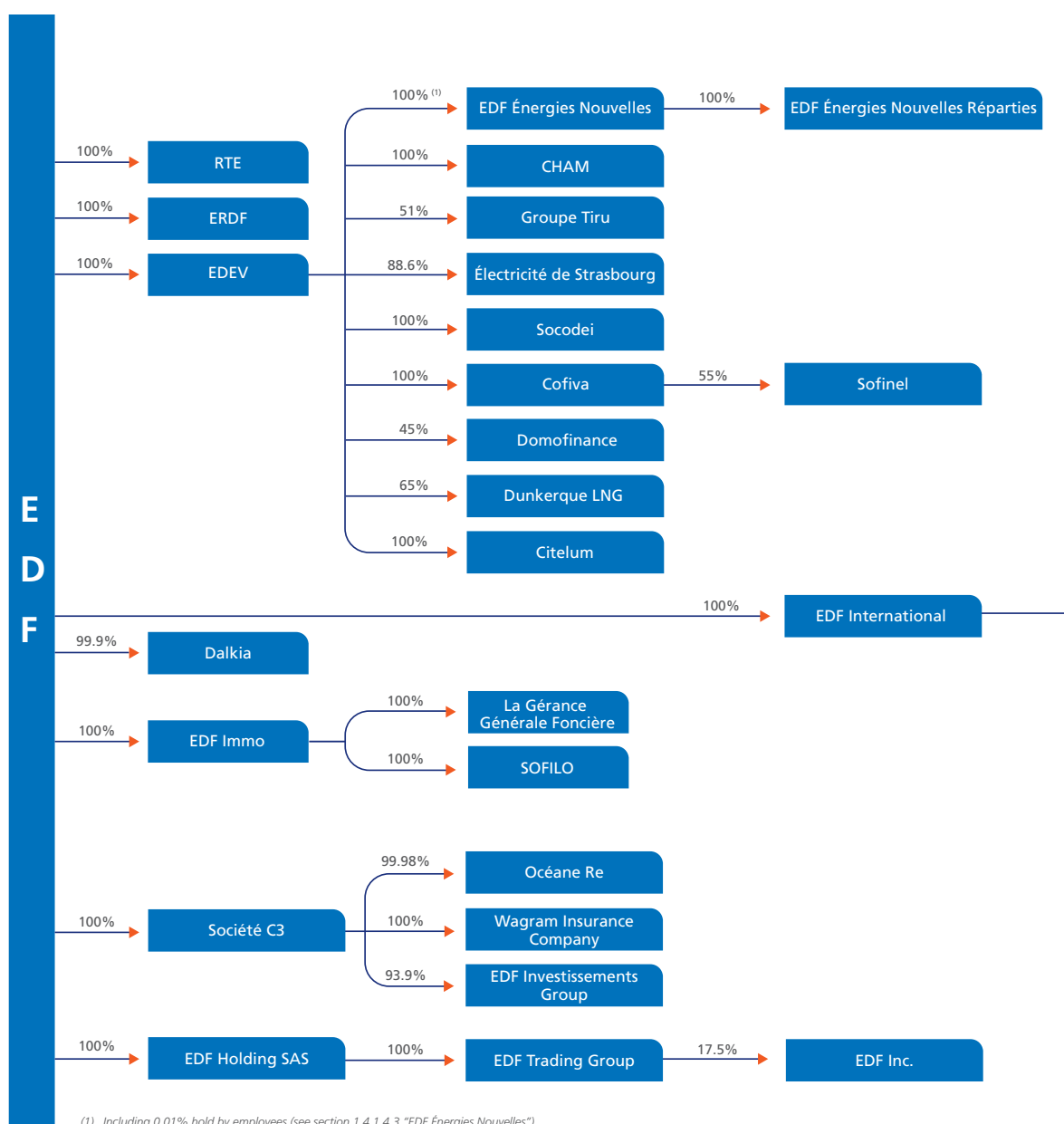
On 21 December 2015, EDF and Macquarie European Infrastructure Fund IV (MEIF4) completed the transaction for the sale of EDF's minority stake of 25% in Energie Steiermark AG to MEIF4. EDF announced on 10 July 2015 it had entered into an agreement with MEIF4.

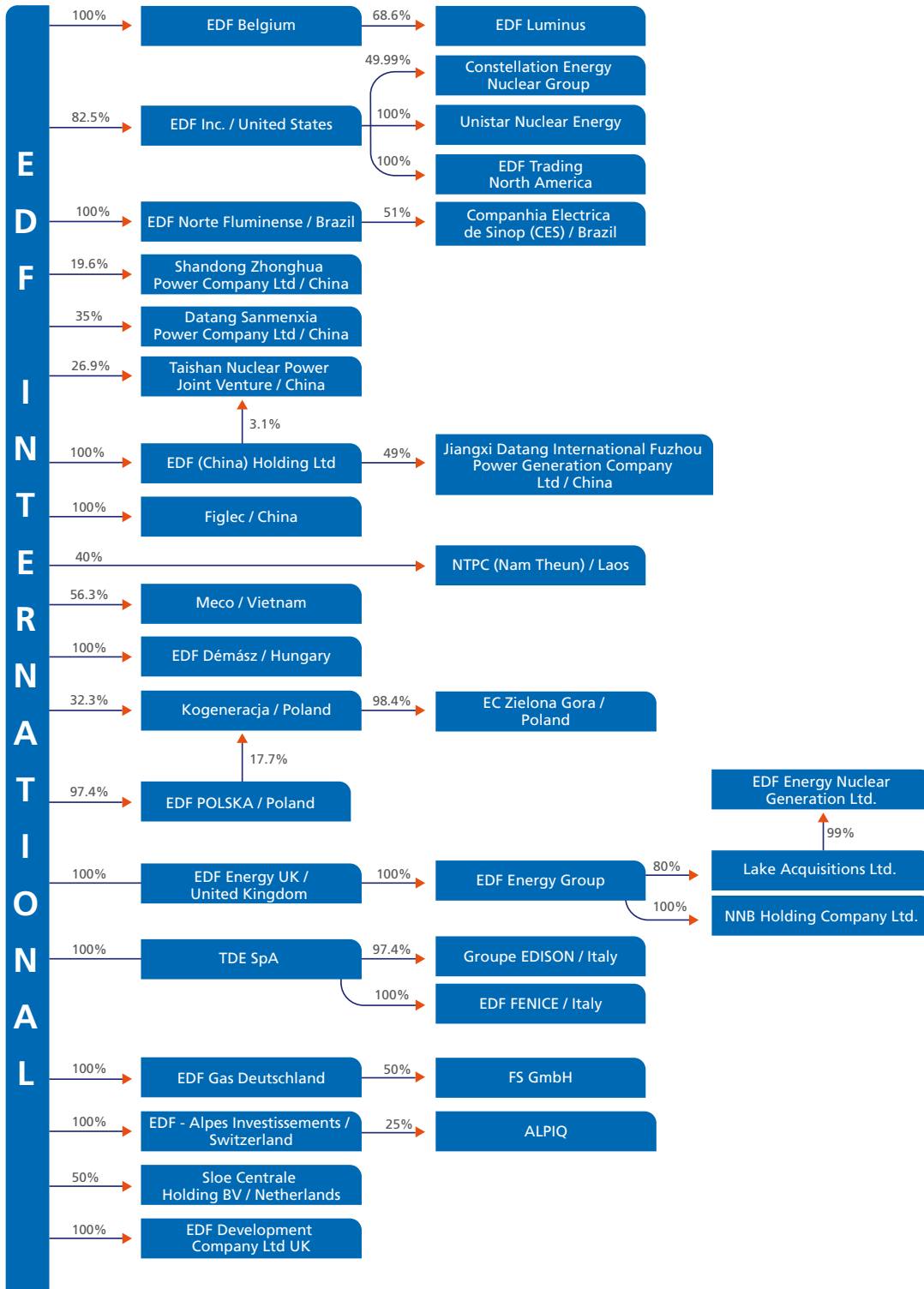
## 1.2 Organisation of the Group

## 1.2.1 ORGANISATIONAL CHART

A simplified organisational chart for the Group, as of 31 December 2015, is presented below. The percentages for each entity correspond to the ownership interest in capital.

The companies or groups of companies within the Group's scope of consolidation are indicated in Note 51 to the consolidated financial statements for the year ended 31 December 2015.





## 1.2.2 INTRA-GROUP CONTRACTS

**Cash pooling agreements entered into between EDF and its subsidiaries**

The cash pooling system set up by EDF centralises all the cash positions of its subsidiaries and thus optimises the Group's liquidity. Cash pooling consists of grouping all the cash balances of subsidiaries at the level of the parent company. It includes certain French and international subsidiaries. It does not include RTE.

The cash pooling system in place for companies of the EDF group is defined under cash agreements. Bilateral agreements between EDF and each subsidiary define the specific conditions for each arrangement (remuneration of balances, etc.).

At international level, subsidiaries participating in the system enter into a framework agreement, whereby EDF serves as the Cash Centre.

EDF also centralises all the currency flows from its French subsidiaries.

**Financial flows between EDF and its subsidiaries**

In addition to the financial flows relating to the cash pooling agreements mentioned above, financial flows between EDF and its subsidiaries are also related to distributions of dividends within the Group. A substantial portion of the dividends paid by some of the Group's subsidiaries (including EDF Energy) is paid exclusively to EDF International. Total dividends received by EDF International in 2015 amounted to €217 million. In 2015, EDF received a total of €2,066 million in dividends from its consolidated subsidiaries.

Other financial flows between EDF and its subsidiaries correspond mainly to loans, asset transfers and guarantees made by the parent company of the Group for the benefit of certain subsidiaries.

In the context of the Group's financing centralisation policy, decided on in 2006, EDF centralises the financing of its subsidiaries. In this context, EDF created a subsidiary located in Belgium, EDF Investissements Groupe, which aims to grant medium- and long-term intra-group financing.

In addition, the nuclear fuel purchases are managed centrally by EDF SA, including the purchases intended to its subsidiary EDF Energy.

With regard to financial flows related to fees paid by subsidiaries, contracts for the supply of intra-group services have been concluded with the main subsidiaries under the scope of consolidation since 2012. EDF may also be required to provide specific services to certain subsidiaries or entities outside the Group. In addition, following EDF brand development work, the Company has set up licensing agreements with subsidiaries that use the EDF brand.

## 1.3 Group strategy

## 1.3.1 ENVIRONMENT AND STRATEGIC CHALLENGES

The market and the regulatory environment are currently constraining the economic model of European electricity producers, at a time when significant investment is required to maintain existing assets and, over the longer-term, to renew the generation fleet:

- electricity demand in Europe is subdued (annual average of +0.6% between 2000 and 2014<sup>1</sup>) but significant subsidised energy capacity has been connected to the grids (+45GW of wind between 2010 and 2014, representing +53%<sup>2</sup>), creating over-capacity in the European generation fleet;
- fuel prices have fallen (oil, gas, coal) and this intensified at end-2015;
- the price of CO<sub>2</sub> is very low, which is inconsistent with the low carbon and energy transition goals in Europe;
- the upshot is lower prices in the electricity market, which fell at a quicker pace at end-2015;
- this overcapacity of the European generation fleet may continue (except in the United Kingdom (UK)) if the public authorities do nothing to alter the market environment.

By way of contrast, electricity consumption is rising fast in emerging markets, especially in Asia, benefiting the electricity producers in these regions with forecasts<sup>1</sup> of around +190TWh per year in China between 2013 and 2040 (+2.5% per year on average) and +50TWh/year in Africa (+3.9% per year), versus +7TWh per year in the European Union (+0.2% per year).

In Europe, France and the United Kingdom are developing low-carbon energy independence policies, primarily built around a mix combining energy efficiency, renewable and nuclear energies, with an additional gas component offering flexibility to electricity systems. In France, electricity is also used as a means of migrating to low carbon, and the United Kingdom has established a market model consistent with this policy (Carbon Price Floor, Contracts for Difference, capacity market, etc.).

The agreement reached in Paris at the 21<sup>st</sup> session of the Conference of Parties (COP 21) confirms the effort being made to combat climate change and the ramping up of energy transitions beyond Europe.

Furthermore, local communities and customers are looking to increasingly take ownership of their consumption and of their energy policy. These new expectations are forcing energy producers to come up with new solutions and new more decentralised models, facilitated by innovations in telecommunications and digital technologies, and the emergence of new uses.

The electricity sector is thus changing more than ever, at the centre of medium and long-term societal and technological trends. Against this background, and with this in mind, European electricity producers have scaled back their investments and focussed them on targeted segments, particularly renewable energy, growth areas, distribution, network and services.

EDF is thus faced with specific strategic challenges:

- to play a responsible role in combating climate change: to contribute to the achievement of the goals set out in the Energy Transition and Green Growth Law in France, in the Climate Change Act in the UK, and more broadly in the 2020 and 2030 Energy and Climate Change Packages in the European Union;

1. Source: AIE, World Energy Outlook, November 2015.

2. Source: Enerdata.

- to ensure the economic performance and safety of the nuclear assets;
- to innovate in order to set itself apart and to have the technological and economic capabilities to renew and expand its generation and its services to customers, in particular digital, and thereby play a role in energy security;
- to ensure that the EDF group is consistently a stellar public service operator, in particular in terms of solidarity and the fight against energy poverty, respect, responsibility and ethics in the way it runs its business;
- to adapt to put the Group on a sustainable value creation path for all stakeholders;
- to mobilise employees and create an environment that hitches each person's development to the Group's transformation.

### 1.3.2 STRATEGIC VISION

A responsible, efficient electricity producer that champions low carbon growth: this is the goal of the EDF group, driven by the CAP 2030 strategy. This goal can be split into three priorities, which combine the search for growth drivers with the optimisation of existing assets:

- proximity to customers and local communities;
- low carbon generation, with a balanced mix of nuclear and renewable energy;
- international expansion.

#### 1.3.2.1 Proximity to customers and local communities

In order to support customers and local communities with their energy transition, the EDF group is already developing competitive low carbon energy solutions for its customers and the local communities, and is an industrial leader in smart grids.

The Group's strong position in energy services in France via Dalkia should provide a basis to support companies and local authorities in achieving energy performance and developing decentralised, local generation. A range of digital energy services for residential customers will be rolled out by 2018 in France and in the core European countries (real time consumption monitoring amongst others). In parallel, relationship with these customers will be enhanced thanks to new digital technologies and functionality, particularly downstream with smart metering systems rolled out in a number of countries.

The EDF group is achieving the energy transition:

- by developing energy saving solutions for its customers (insulation, high-efficiency solutions, deployment of digital tools as e.quilibre enabling customers to pilot their consumptions...);
- by working to replace fossil fuels with new efficient uses of electricity, so that they represent an additional 15 to 30TWh in France by 2030 (electric mobility, low carbon habitat, etc.);
- by developing and operating heating networks that use renewable and recovery energies;
- by leveraging the specific experiences from island regions.

Finally, the development of renewable energies, the roll-out of Linky smart meters and the emergence of metropolitan areas are putting the distribution networks at the heart of the electricity system. The distributor plays a key role, making it a facilitator of the energy transition.

To support the energy transitions, the Group accelerates Research & Development on storage, solar, electric mobility and new networks. It also redoubles its efforts in terms of innovation to offer to its clients solutions and services that best meet their needs.

#### 1.3.2.2 Low carbon generation: nuclear and renewable energies

To remain the leader in large low carbon electricity generation facilities, the Group is looking to balance its generation mix by accelerating the development of renewable energy and by ensuring the safety and performance of the existing nuclear fleet and of nuclear new build. In fact, EDF's nuclear fleet is already giving France a major lead vis-à-vis its neighbours in terms of limiting greenhouse gas emissions.

The low carbon generation goal requires the development of the Group's renewable energy and hydropower asset base, with the aim of almost doubling its installed capacity: from 28GW in 2014 to 50GW in 2030. The development of these assets outside France will be done in line with the Group's international strategy.

Subject to the necessary approvals, EDF will invest to extend, under the highest safety conditions, the operating life of the French nuclear fleet beyond 40 years, the economic and carbon competitiveness of this fleet being in fact proven. In this context, the "Grand Carénage" principle has already been approved on 22 January 2015 by the Board of Directors of EDF. There will also be investment to extend the operating life of the existing UK fleet by an average of 8 years. The Group also wants to ensure the competitiveness of the nuclear new build to offer an option to renew all or part of its European fleets. As a responsible electricity producer, the Group will also carry on being involved in the preparations for the decommissioning of the nuclear fleet and for the management of waste in France and the UK.

In line with the priority of having low carbon generation, EDF supports changes to electricity market design in Europe, in particular an increase in the CO<sub>2</sub> price in order to send a strong economic signal regarding the competitiveness of low carbon investments.

#### 1.3.2.3 International expansion

The EDF group wants to be a key player in the energy market in France and in its core countries by playing a role in energy security, in the enhancing of economic competitiveness and in the migration of the European economy to low carbon, in line with public policy.

The Group is also looking to expand outside the European plate, now highly exposed to the market prices decrease and whose growth prospects are limited. In this context, it focuses on a limited number of international target countries, on which it can deploy its industry expertise alongside partners in organic growth projects.

The Group will call upon all of its areas of expertise that can contribute to this growth: renewables, energy services, nuclear new build but also other engineering (network, thermal, hydropower, etc.), trading and gas delivery capabilities in Europe and worldwide.

#### 1.3.2.4 Broad principles of CAP 2030

##### 1.3.2.4.1 Transformation

The Group is mobilising employees around a new human vision that reflects its challenges and the expectations of its employees: health & safety, digital and new work practices, responsibility and streamlining, skills, recognition model.

In order to further this human vision, the Group is adapting its managerial practices, streamlining its organisations and modus operandi and enhancing cross-disciplinarity and promotion of innovation.

EDF's digital transformation is accelerating: for employees and internal modus operandi, for customers, for the management and the design of industrial assets.

As both an input and outcome of the transformation programme, improved performance is a priority. The Group is strengthening control of its costs to bring them into line with its environment. The approach is adjusted depending on the scopes involved (cross-disciplinary segments, operating entities, etc.).

#### 1.3.2.4.2 EDF in 2030

The CAP 2030 goal allows the Group to develop an asset portfolio built around low carbon energy: services for customers, decentralised energy solutions, nuclear and renewables. The key factors to the success of CAP 2030 are:

- the control of major projects and the success of "design to cost" (i.e. a design that ensures both safety and competitiveness) of new nuclear reactor models;
- the selectiveness of international investments;
- the leveraging of the customer portfolio;
- the transformation of the Group's modus operandi and the collective commitment.

### 1.3.3 INVESTMENT POLICY

#### 1.3.3.1 Investments in 2015

The Group continued its programme of gross operating investments totalling €14.8 billion in 2015, versus €13.7 billion in 2014. Gross operating

investments for development represented €5.1 billion in 2015, including €1.8 billion in renewable energies (including hydropower) and €1.7 billion in New Nuclear. Net investments, including Linky and new developments net of assets disposals, totalled €12.7 billion in 2015, versus €11.9 billion in 2014, split across regulated (26%) and non-regulated activities (74%).

In the non-regulated field, net investments of development of new capacities (in particular renewable energy and nuclear new build in France and the UK) amounted to €3.2 billion. Investments in maintenance totalled €6.2 billion, including €3.6 billion for nuclear maintenance in France.

Net investments in France (€9.1 billion) were up 3.5%, reflecting the Group's desire over the past years to invest in the industrial facilities. The Group continued its efforts made in international investments (€3.1 billion), in particular through its EDF Energy subsidiary in the UK for close to €1.8 billion, and via its Italian subsidiaries (Edison and Fenice) for €0.6 billion. €0.5 billion was also invested in other activities (EDF Énergies Nouvelles, gas business and Dalkia in particular), mostly located in France.

#### 1.3.3.2 Investments over 2016-2018

For the 2016-2018 period, the Group will deliver large industrial projects, some of which are already at an advanced stage, such as the LNG terminal in Dunkirk or the EPR (European Pressurized water Reactor) of Flamanville 3. The Group also plans to continue investing in nuclear new builds in the UK, distribution networks in France, and in renewable energy in accordance with its integrated electricity producer strategy and in light of the CAP 2030 programme. Thus, the Group reached an amount of net investment peak in 2015 of €12.7 billion, i.e. €12.4 billion excluding new developments net of assets disposals. These investments should reduce gradually as significant projects are commissioned, to attain a maximum of €10.5 billion in 2018, excluding new developments net of assets disposals. The development projects will have to be financed through the sale of non-strategic assets, in line with the CAP 2030 strategy.

## 1.4 Description of the Group's activities

The EDF group is an integrated utility, active in all electricity businesses: nuclear, renewable and thermal generation, transmission, distribution, supply, efficiency and energy services and trading. It is the leading player in the French electricity market and holds strong positions in Europe (United Kingdom (UK), Italy, central and eastern European countries), which makes it one of the world's leading electric utility and a renowned gas player.

With a global installed net generation capacity of 134.2GWe<sup>1</sup> as at 31 December 2015 producing 619.3TWh<sup>1</sup>, the Group has one of the largest generation fleet in the world. Among the ten largest global power suppliers, it produces the smallest amount of CO<sub>2</sub> per kilowatt-hour generated<sup>2</sup> thanks to the share of nuclear, hydro and other renewable energies in its generation mix.

The EDF group supplies electricity, gas and related services to 37.6 million customer accounts<sup>3</sup> worldwide (of which 27.8 million in France).

Electricity generation is a non-regulated activity, which is open to competition in the same way as the sale of electricity and gas (see section 1.4.2 "Sales and supply activities") and upstream/downstream optimisation (see section 1.4.3 "Optimisation and trading activities"). The Group is thus implementing an integrated model for the joint operational management of its portfolio of assets upstream (generation and procurement of energy and fuels) and downstream (wholesale and retail) to guarantee supply of energy to its customers through the best possible management of operational and market risks and with a view to maximising gross margin.

In addition, the Group is also active in regulated sectors such as electricity transmission and distribution (see section 1.4.4 "Regulated activities in France").

1. Source: EDF. Figures calculated on the basis of the consolidation accounting rules.

2. Source: Comparison based on data published by these ten groups.

3. A customer can have two customer accounts: one for electricity and one for gas.

### 1.4.1 ELECTRICITY GENERATION ACTIVITIES IN FRANCE

In mainland France, the electricity generation activities have been split since 2015 across the Nuclear and Thermal Fleet Department and the Renewable Energy Division. In addition to these two departments, the Engineering and Nuclear New Build Project Department is responsible for the development projects for the Group's new nuclear generation assets, in France and abroad. Each of these three departments has all the expertise and performance drivers required to operate the leading European electricity generation fleet and ensure its development and sustainability, and offer their technical and industrial expertise to the whole Group in these three areas (also see section 1.4.5 "Group's international business").

#### Strengths of the generation fleet

The Group's generation fleet has significant strengths:

- a competitive generation mix with low variable generation costs<sup>1</sup> and limited exposure to hydrocarbon and carbon market fluctuations due to nuclear and hydropower facilities;
- a variety of means of generation, which enable adequate coverage of EDF's downstream portfolio needs (end users, sales to alternative suppliers, sales on the wholesale markets, etc.). Use of the fleet's various components is managed by giving priority, at any given time, to the generation type offering the lowest variable costs: run-of-river hydropower plants are used for base generation; nuclear plants, because of their low variable generation costs, are used for base and mid-merit generation; adjustable hydropower generation (coming from dams) and thermal plants are used for mid-merit and peak generation;
- a significant standardised fleet of nuclear facilities, for which EDF provides full control over their entire life cycle. Moreover, EDF is working towards extending the operating life of its power plants and improving their technical performance;
- a fleet generating at over 95% without CO<sub>2</sub> emissions due to the predominance of nuclear and hydropower generation facilities, in an increasingly restrictive environmental regulatory context;
- a geographical position at the junction of electricity exchanges between the continental platform and the electric peninsulas (Italy, Spain and the UK).

#### Composition and specifications of the installed fleet

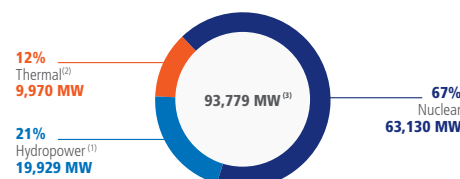
With a total installed generation capacity of 95.2GW in mainland France<sup>2</sup> at 31 December 2015, EDF has the largest generation fleet in Europe, accounting for nearly 10% of the total installed capacity of the main countries of Europe (the 35 member areas of ENTSO-E – the European Network Transmission System Operators for Electricity – that includes Germany, Italy and Spain<sup>3</sup>).

In 2015 in France, EDF's generation fleet produced 455.7TWh excluding pumped storage hydropower, and 462.5TWh including pumped storage hydropower.

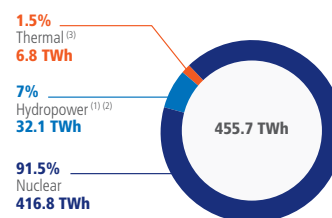
At 31 December 2015, the capacity of EDF's generation fleet in mainland France was composed of:

- 58 nuclear units based on pressurised water reactors (PWR) (a unit is defined as a generation unit including a reactor, steam generators, a turbine, a generator, the related equipment and the buildings that house them). These units have electrical power capacities varying from 900MW to 1,500MW and are spread out over 19 sites, with an average age of 30 years;
- 27 functioning thermal units, with those in service having an average age of approximately 24 years;
- 433 hydropower plants, with an average age of 71 years<sup>4</sup> (see section 1.4.1.4.1 "Hydropower generation in France");
- the wind power generation capacities of EDF Énergies Nouvelles in France (see section 1.4.1.4.3 "EDF Énergies Nouvelles") and the incineration plants of the Tiru group in France (see section 1.4.6.1.3 "Tiru");
- 81 hydropower plants owned by Group subsidiaries: SHEMA (100%), FHYM (98.82%), CERGA (owned 50/50 with the German electricity company EnBW). These plants represent a total of approximately 184MW of installed capacity in 2015 and approximately 951GWh of energy production<sup>5</sup>.

#### 2015 INSTALLED CAPACITY AND OUTPUT IN MAINLAND FRANCE



NB: Expressed in MW of maximum capacity attached to the network.  
 (1) Excluding Corsica and overseas departments, 440 MW in 2015.  
 (2) Excluding Corsica and overseas departments, 874 MW in 2015.  
 (3) Not including wind generation capacities of 12 MW, and including tidal capacity of 240 MW.



(1) Excluding Corsica and overseas departments, 1.3 TWh in 2015.  
 (2) Net pumped storage generation: the electricity consumption needed for the operation of pumped storage power plants (STEP) amounted to 6.8 TWh in 2015, resulting in hydropower generation (including pumped storage consumption) of 38.9 TWh, including generation from the tidal power plant on the Rance river (530 GWh).  
 (3) Excluding Corsica and overseas departments, 1.7 TWh in 2015.

1. Variable generation costs are all costs that vary directly with the amount of energy generated. Variable costs for electricity generation are mainly fuel costs.  
 2. For Corsica and the French overseas departments, see section 1.4.4.3 ("Island Energy Systems").  
 3. Calculation based on the ENTSO-E statistics for the year 2014, as the statistics for the year are only available on 30 April of the following year.  
 4. Arithmetic mean.  
 5. Generation and capacity are indicated in proportion to participation.



### 1.4.1.1 Nuclear electricity generation

The electricity generated by EDF from its fleet of nuclear power plants represented 91.4% of its total electricity generation in 2015 excluding pumped storage hydropower.

#### 1.4.1.1.1 EDF's nuclear fleet

EDF's PWR model is divided into three series of available electrical power:

- a 900MW series consisting of 34 units of approximately 900MW (for a total power capacity of 30,770MW) with an average age of 34 years;
- a 1,300MW series consisting of 20 units of approximately 1,300MW (for a total power capacity of 26,370MW) with an average age of 27 years;
- the N4 series, which is the most recent with an average age of 15 years, consisting of 4 units of approximately 1,500MW (for a total power capacity of 5,990MW);

for a total of 58 units spread over 19 sites owned by EDF, and constituting a total installed capacity of 63,130MW as at 31 December 2015. With an average age of approximately 30 years for an estimated technical operating life of over 40 years (benchmark time for accounting purposes and corresponding to the initial nuclear unit design), the EDF's nuclear fleet is in the average of the fleets installed worldwide.

The commissioning and most recent ten-year inspection (VD) dates for these units as of end-2015 are as follows:

Units	Year of industrial commissioning	Most recent ten-year inspection	Next ten-year inspection	Units	Year of industrial commissioning	Most recent ten-year inspection	Next ten-year inspection
Fessenheim 1	1978	2009	VD4	Gravelines 6	1985	2007	VD3 *
Fessenheim 2	1978	2011	VD4	Cruas 3	1984	2014	VD4 *
Bugey 2	1979	2010	VD4	Cruas 4	1985	2006	VD3
Bugey 3	1979	2013	VD4 *	Chinon B3	1987	2009	VD3
Bugey 4	1979	2011	VD4	Chinon B4	1988	2010	VD3
Bugey 5	1980	2011	VD4	Paluel 1	1985	2006	VD3
Dampierre 1	1980	2011	VD4	Paluel 2 **	1985	2005	VD3
Gravelines 1	1980	2011	VD4 *	Paluel 3	1986	2007	VD3
Gravelines 2	1980	2013	VD4 *	Paluel 4	1986	2008	VD3 *
Tricastin 1	1980	2009	VD4	Saint-Alban 1	1986	2007	VD3
Tricastin 2	1980	2011	VD4	Flamanville 1	1986	2008	VD3 *
Dampierre 2	1981	2012	VD4 *	Saint-Alban 2	1987	2008	VD3
Dampierre 3	1981	2013	VD4 *	Flamanville 2	1987	2008	VD3 *
Dampierre 4	1981	2014	VD4 *	Cattenom 1	1987	2006	VD3
Tricastin 3	1981	2012	VD4	Cattenom 2	1988	2008	VD3
Tricastin 4	1981	2014	VD4 *	Nogent 1	1988	2009	VD3
Gravelines 3	1981	2012	VD4 *	Belleville 1	1988	2010	VD3 *
Gravelines 4	1981	2014	VD4 *	Belleville 2	1989	2009	VD3 *
Blayais 1	1981	2012	VD4 *	Nogent 2	1989	2010	VD3
Blayais 2	1983	2013	VD4 *	Penly 1	1990	2011	VD3
Blayais 3	1983	2015	VD4 *	Cattenom 3	1991	2011	VD3
Blayais 4	1983	2015	VD4 *	Golfech 1	1991	2012	VD3 *
Saint-Laurent 1	1983	2015	VD4 *	Cattenom 4	1992	2013	VD3
Saint-Laurent 2	1983	2013	VD4 *	Penly 2	1992	2014	VD3 *
Chinon B1	1984	2013	VD4 *	Golfech 2	1994	2014	VD3 *
Cruas 1	1984	2015	VD4 *	Chooz B1	2000	2010	VD2
Chinon B2	1984	2006	VD3	Chooz B2	2000	2009	VD2
Cruas 2	1984	2007	VD3 *	Civaux 1	2002	2011	VD2
Gravelines 5	1985	2006	VD3	Civaux 2	2002	2012	VD2

\* Pending confirmation by the ASN (the French Nuclear Safety Authority) of the reactor's suitability to continue operations (the ASN must give its approval – just like after any shutdown – to restart the reactor, and then issue, where applicable, technical recommendations determining the conditions for the continuing operation for another ten-year period).

\*\* The third ten-year inspections are ongoing at Paluel unit 2.

EDF first-generation design plants have been gradually shut down and are currently being decommissioned (see section 1.4.1.1.6 "Decommissioning of nuclear power plants").

### Generation allocation contracts

EDF has developed industrial cooperation with European operators in the nuclear industry, in the form of generation allocation contracts backed by units of the EDF French nuclear fleet.

In its fleet, EDF has ten generating units participating in the contracts (up to 1.5GW) with the following European energy companies:

- Fessenheim 1-2: EnBW (17.5%) and the Swiss electricity group CNP (15%);
- Cattenom 1-2: EnBW (5%);
- Bugey 2-3: Électricité de Laufenbourg<sup>1</sup> (17.5%);
- Tricastin 1 to 4: Electrabel<sup>2</sup> (12.5%);
- Chooz B1-B2: EDF Luminus, EDF subsidiary in Belgium (3.3%).

The purpose of these generation allocation contracts is to make available to each partner the proportion of energy generated actually due to them – in return for payment of their share of the construction costs, annual operating costs (including upstream and downstream fuel costs), local taxes and taxes specific to nuclear energy, and the costs relating to decommissioning. In these transactions, the partners have shared with EDF the industrial risks in the development of the fleet (three series heads are concerned) and assume the risks on performance linked to the current operation of the power plants. On the other hand, they have no operational role.

Furthermore, EDF signed a second type of generation allocation contract (totalling approximately 2GW) that enables its partners to receive a share of the electricity generated from a given power plant fleet based on the average actual performance of that fleet. These contracts mainly concern the following power plants:

- Chooz B1-B2 (N4 initial series unit): Electrabel (21.7%);
- Cattenom 3-4: Électricité de Laufenbourg (7.8%) and CNP (21.8%).

#### 1.4.1.1.2 Operation and technical performance of the nuclear fleet

Nuclear power is a means of generation whose variable cost, mainly fuel-related costs, is low since it represents less than 30% of operating costs<sup>3</sup>. The main competitive levers of the nuclear fleet in its operating phase are thus the amount of generated energy and the optimisation of fixed operating and maintenance costs. The levers relating to the fuel cycle are further discussed in section 1.4.1.1.4 "The nuclear fuel cycle and related issues".

### Operation methods of the nuclear fleet

#### Generation cycle and planned outages

To reconcile the challenges linked to the strong variations in seasonal consumption in France, due to its strong temperature sensitivity, the availability of maintenance resources and the efficient use of reactor fuel,

EDF has now adopted generation cycles of 12 and 18 months for its fleet. At the end of 2015, this breakdown was as follows:

- 28 units of the 900MW series have an operating cycle of approximately 12 months;
- 6 units of the 900MW series, 20 units of the 1,300MW series and 4 units of the N4 (1,450MW) series have an operating cycle of approximately 18 months.

At the end of these operating cycles, shutdown periods are programmed in order to replace a fraction of the fuel loaded in the core and perform maintenance work.

Two types of planned outages are alternated at the end of each generation cycle:

- an ordinary shutdown for refuelling, for a standard period<sup>4</sup> of approximately 35 days, during which unloading spent fuel and reloading new fuel is the main operation performed; although light maintenance or periodic testing may also take place during this type of outage;
- a partial inspection for refuelling and maintenance, for which the standard period<sup>4</sup> lasts approximately 70 days.

Every ten years, the power plant is shut down for a standard period<sup>4</sup> of approximately 110 days in order to carry out a ten-year inspection. This length of time varies according to the works and maintenance programme, as well as the series concerned. The programme for a ten-year inspection includes the following:

- unloading of spent fuel and reloading of fresh fuel, as at each outage;
- hydropower tests of the primary circuit, a leak test of the vault, and inspection work of the reactor's pressure vessel;
- modification work, associated with ten-year safety re-evaluations;
- other specific maintenance operations, in particular renovation or replacement of major components.

At the end of the ten-year inspection, the ASN decides whether to authorise the restart of the reactor and then issues technical prescriptions setting the conditions for continuing operation for another ten-year period.

#### Operation of EDF's nuclear fleet

Nuclear generation resources, owing to their low variable cost are first used for base-load generation, immediately after run-of-river hydropower and other unavoidable renewable energies, as well as the energy purchased under buying obligations from decentralised energy producers. Variations in the energy consumption of EDF's final customers over one year (summer-winter, day-night) and the currently restricted fluidity of wholesale markets due to limited interconnections on the borders lead nuclear energy to be used also for mid-merit generation. High variations in seasonal consumption in France and its major variation during winter months require that planned nuclear fleet outages be concentrated between April and October. The 2003 heat wave highlighted the consequences of very strong warming of rivers, especially on the conditions for operating "riverside" units. The scheduling of unit outages was therefore reviewed to reduce the number of outages of "riverside" units in July and August to encourage these units to continue operating as much as possible since cooling capacities are less dependent on weather conditions.

1. Axpo Group.

2. Engie Group.

3. Operating costs are defined as follows: fuel costs (including downstream expenses in the fuel cycle), operating expenses (purchases and external services, employee expenses) and maintenance costs (expenses and investments). They do not include investments related to construction or decommissioning expenses.

4. Standard durations are adapted to the volume of routine maintenance required.

**Generation and technical performance**

The nuclear fleet produced 416.8TWh in 2015, up 0.9TWh compared to that of 2014.

Nuclear generation expressed in annual energy corresponds to a load factor rate referred to as "Kp" for the French nuclear fleet (defined as the ratio of energy generated to the maximum theoretical energy, or the energy generated if the installed capacity were operated year-round). This rate is obtained by multiplying two coefficients ( $Kp = Kd \times Ku$ ):

- the availability factor, "Kd" (the available energy<sup>1</sup> as a percent of the theoretical maximum energy, or the energy generated if the installed capacity were operated year-round);
- a utilisation factor, "Ku" (energy generated compared to energy available). The Ku factor reflects environmental and social constraints, supply of system services and optimisation implemented by EDF (fuel and modulation).

In 2015 the Kp factor was 75.4%, up compared to 75.2% in 2014. This results from a Kd of 80.8%, almost unchanged compared to 2014 (80.9%) and a Ku of 93.3%, up 0.3 points compared to 2014.

The year 2015 is characterised by:

- ongoing good performance in terms of unplanned outages (a rate of 2.5% in 2015 compared to 2.4% in 2014), thanks to the proactive maintenance strategy implemented in 2007 for renovation and replacement of major components;
- managed outage periods, with average planned outage times cut in half between 2013 and 2014 and down 0.4 days between 2014 and 2015. This is the result of the procedures for managing planned outages implemented in 2013 and strengthened since then, aiming to stabilise the volume of regular maintenance during outages, improve the quality of preparation of maintenance work and strengthen the control of restart operations.

However, as the fleet has entered a significant maintenance programme scheduled for the coming years, including a substantial volume of work resulting in extended outage times, the challenge in future years will be to industrially control the programme and its impact on the duration of outages. Moreover, in view of the strong seasonal demand for electricity in France and of the state of development of renewable energies, the challenges have moved. Today, EDF's objective is to have a maximum generation capacity in winter, including sustained availability of the nuclear fleet greater than 90% during this important period of the year. In winter 2015-2016<sup>2</sup>, this reached 93.4%.

**Investment programme for the existing nuclear fleet in France**

On 22 January 2015, EDF's Board of Directors approved in principle the major overhaul programme (so-called "Grand Carénage") aimed at refurbishing the French nuclear fleet, enhancing reactor safety, and, if conditions allow, extending their operating lives, involving total investment of up to €<sub>2013</sub>55 billion by 2025 for the 58 reactors currently operating. This figure represents ongoing maintenance investment of around €3 billion a year (including ongoing maintenance, ten-year inspections and periodic safety review) together with additional investment of between €1 and €2 billion a year on average, reflecting the extraordinary nature of the "Grand Carénage" (such as renovation of large components, replacing of steam generators at

midlife and incorporating Fukushima's feedback). Beyond 2025, investments will gradually return to former levels. The figures presented by the French *Cour des Comptes* in its report of 10 February 2016 cover a longer time horizon, up to 2030, and a wider scope including, beyond the investment, some operating expenses. Both assessments are consistent, as stated by the *Cour des comptes* in its report. Indeed, in the comprehensive program of the *Cour des Comptes* close to €<sub>2013</sub>100 billion for the 2014-2030 period, it distinguishes investment expenditures estimated at €<sub>2013</sub>74.73 billion and operating expenditures estimated at €<sub>2013</sub>25.16 billion. Within the €<sub>2013</sub>74.73 billion of investment expenses between 2014 and 2030, about €<sub>2013</sub>20 billion are dedicated to the 2026-2030 period, which allows connecting the two estimates established by the EDF group and the *Cour des Comptes*. This indicative number will be confirmed at a later date following optimisation of the solutions used to implement the programme, additional assessment work and consideration of the multi-year energy plan together with the resulting strategic plan, provided for in the Energy Transition for Green Growth Law. The optimisation work undertaken in 2015 has already lead to a downward revision of the overall cost of the programme to €<sub>current</sub>51 billion over the 2014-2025 period, which represents a €<sub>2013</sub>9 billion decrease. This revision was obtained mainly through continued efforts of optimisation regarding the adopted technical solutions, as well as their finest deployment including the capacities of industrial frame.

This industrial programme will be gradually implemented, in compliance with the objectives of the Energy Transition for Green Growth Law, multi-year energy plans, the opinions and orders of the French Nuclear Security Authority (ASN), as well as the procedures for authorisation for reactors to run for more than 40 years (see section 1.4.1.1.5 "Preparing for the future of the nuclear fleet in France").

EDF will thus continue a large volume of work, aiming in particular to sustain and develop its technical and industrial assets through technical, organisational and human actions. Programmes for renovation or replacement of major components of power stations such as alternators, transformers or steam generators will continue. At the end of 2015:

- the alternator stators were renovated on 42 units, for a total of 49 units to renovate;
- the programme for preventive replacement of the poles in the main transformers is ongoing. 78 main transformer poles out of 174 were replaced, i.e. approximately 45% of the programme;
- between 1990 and the end of 2015, steam generators were replaced in 27 units, of which 1 in 2015. Amongst these, the replacement of three steam generators in Blayais 3 was completed during the third ten-year inspection of the unit. This had been delayed in the expectation that AREVA, supplier of this equipment, would provide proof of meeting all requirements required by the Decree of 12 December 2005 on nuclear equipment under pressure (the "ESPN" Decree), in view of its assembly and commissioning.

Concerning the organisational aspects of routine maintenance, EDF continues to deploy the AP 913<sup>3</sup> procedure aiming for reliability and the preparation of health reports of materials in order to reduce unplanned outages.

Strengthening the operational management of power generation and planned outages also continues, through the systematic implementation, for each outage, of an Operational Centre for Continuous Management of Unit Outages and by rolling out a new Information System. The ultimate goal is to reduce the average time of outage extensions by continued management of the outage's critical activities and a reactive response to technical alerts.

1. Available energy is equal to the maximum theoretical energy less losses for technical reasons inherent to power plants, such as planned outages, unplanned outages due to failure or safety requirements, and performance of regulatory tests.

2. Period from 1 December 2015 to 14 February 2016.

3. See glossary.

The average time of extension of planned outages has been halved between 2013 and 2014, and decreased by 0.4 days between 2014 and 2015.

The industrial project for the nuclear fleet will continue beyond 2015 on the occasion of the third and fourth series of ten-year inspections of 1,300MW units, the fourth series of ten-year inspections of 900MW units and the second and third series of ten-year inspections of N4 units. This project will provide the opportunity to incorporate additional safety improvements identified following the Fukushima accident as well as modifications allowing the operation of facilities to be extended significantly beyond 40 years (see section 1.4.1.1.5 "Preparing for the future of the nuclear fleet in France").

#### 1.4.1.1.3 Environment, nuclear safety, radiation protection

##### Environmental protection

EDF bases its environmental procedure on an ISO 14001-certified management system (see section 3.2.2.1.1 "Environmental management system (SME)"), rolled out in 2002 at a number of sites and then extended to all nuclear generation units.

In terms of the radioactive waste management, Very Low-Level Waste (VLLW) has been removed to the Morvilliers disposal facility in the Aube since 2004. Concerning Low- and Intermediate-Level operating Waste (LILW), EDF is continuing to take steps to limit its intermediate storage on all nuclear sites and relies on the Centraco factory (SOCODEL, a subsidiary of the EDF group), where the melting oven was restarted in April 2015 and which is now once again operating normally.

For a description of radioactive waste processing downstream of the fuel cycle as well as decommissioning, see sections 1.4.1.1.4 "The nuclear fuel cycle and related issues" and 1.4.1.1.6 "Decommissioning of nuclear power plants".

##### An ever-present nuclear safety procedure

EDF, in its capacity as a nuclear operator, takes responsibility for nuclear safety and, in a rapidly-changing context (market competition, environmental issues, etc.), reaffirms as its absolute priority the protection of human health and the environment through the prevention of accidents and the limiting of their consequences as regards nuclear safety, especially as the Codified Law of 13 June 2006 on nuclear transparency and safety (see section 1.5 "Legislative and regulatory environment") grants public access to information regarding in particular the nuclear safety measures taken by the operator and establishes a formal basis for transparency on nuclear safety.

The implementation of the French nuclear power programme led EDF to establish a safety procedure that:

- takes into account, from the design stage, the risks that might arise during the operation of the power plants, whether relating to the actual operation of the facilities or to internal or external attacks;
- is based both on the application of strict rules of operation, and on the cautious and inquiring attitude of the technical teams by means of the establishment of a true safety culture;
- is based on the cumulative experience of a standardised fleet of 58 reactors (*i.e.*, more than 1,700 reactor-years of operation (the arithmetic sum of years of operation of EDF's PWR power plants));
- incorporates a continuous improvement approach that is notably embodied by the ongoing efforts to decrease the number of automatic reactor trips;

- benefits from integrated nuclear engineering and Research & Development within the Group in order to anticipate the correction of failures, maintain the facilities in good working order, develop materials/equipment on an ongoing basis, reassess safety margins and monitor technology advances, as well as the implementation of more effective new technologies and the management of sites being decommissioned;
- relies strongly on the development of skills; with this objective in mind, each nuclear generation site is equipped with a simulator used for training to cope with any type of situation.

Nuclear safety is subject to numerous controls, both internal and external. The external control of the safety of nuclear facilities in France is carried out by the ASN.

At the national level, there are two types of audits:

- scheduled or unannounced regulatory inspections carried by the ASN (473 inspections in 2015 over all EDF nuclear facilities);
- a periodic (ten-year) review process designed to improve the compliance of operating nuclear plants with safety standards, and to reassess these standards based on feedback and new knowledge. The targets are established by the ASN which monitors compliance; EDF proposes solutions to meet them and implements them after obtaining the approval of the ASN (see section 1.4.1.1.1 "EDF's nuclear fleet"). The periodic safety review is an important step in extending the operating life of power plants (see sections 1.4.1.1.5 "Preparing for the future of the nuclear fleet in France" and 1.5.6.2.2 "Specific regulations applicable to basic nuclear facilities").

At the international level, regular inspections are held making it possible to share the experience gained worldwide:

- the OSART (Operational Safety Review Team) of the IAEA (International Atomic Energy Agency) performs reviews at the request of the French government with the objective of formulating recommendations and promoting good working practices; in particular, the first Corporate OSART of EDF was held in 2014 and concluded that EDF is fully compliant with the standards defined by the IAEA;
- the international "peer review" inspections carried out by the WANO (World Association of Nuclear Operators) are organised at the request of EDF to assess safety performance compared to best international working practices.

EDF has also implemented internal control procedures. For example, every three to four years, EDF performs overall safety assessments for each nuclear power plant, which take place over a three-week period and involve approximately 30 inspectors. In addition, the General Inspector for nuclear safety and radiation protection, reporting to and appointed by EDF's Chairman and CEO, performs annual audits to issue an opinion on the overall safety of the nuclear fleet and suggests improvement actions to the company's management.

Efforts by EDF, notably to improve human performance, have resulted in a reduction over the last few years of the annual average number of automatic reactor trips. In 2015, they amounted to 38.

##### Warning system

In the event of an accident, a crisis plan is in place to limit impacts on the environment and people, and to ensure the safety of the facility. This crisis system is based on two closely coordinated plans, designed for both local and national use. These are:

- the Internal Emergency Plan, prepared by EDF; and
- the Special Intervention Plan, prepared by French prefectures in collaboration with the French government and EDF.

In order to provide greater effectiveness and thus improved protection of populations, these plans in particular take into account external risks (flooding, etc.) and internal risks (fire, etc.). The relevance of the system for warning, informing and protecting people is regularly assessed through accident simulation exercises. Each year, approximately 100 exercises are organised for the entire French nuclear fleet, *i.e.*, approximately one drill every three days. Approximately ten exercises are on a national level, under the management of the ASN and involve EDF and the public authorities, in particular the prefectures. In 2015, 4 national-scale exercises were organised.

After its initial analyses following the Fukushima accident in March 2011, EDF supplemented its crisis management organisation with a national team capable of quickly delivering material and human assistance to a site in great difficulty. This system, called the Nuclear Rapid Action Force (FARN), has had many simulation exercises from regional bases located at Civaux, Paluel, Dampierre and Bugey and can be sent to a unit at any site in difficulty. The FARN is capable of a simultaneous response at six units on a single site.

### Significant events regarding safety

The operational safety of nuclear facilities is taken into consideration from the initial design stage, and is regularly monitored, together with the implementation of an employee motivation policy and large-scale investment programmes. The Group's nuclear safety policy is incorporated into training for both EDF employees and subcontractors.

### Control and surveillance

Nuclear safety is subject to internal controls (annual reviews, internal control plans and nuclear inspection audits in France) and external controls (peer reviews between corporate members of WANO and OSART, and audits conducted by experts from the IAEA).

In France, the safety of nuclear facilities is controlled by the ASN. Events are classified on a scale from 1 to 7, with 7 being the most serious (INES scale<sup>1</sup>). Incidents of no consequence for nuclear safety are classified as "deviations" or "level 0 events". Since the establishment of a scale of this kind in France in 1987, no level 3 event (serious incident – very low external emission, and exposure of the public representing a fraction of regulatory limits) or above has occurred in the French nuclear fleet.

The ASN also approved the creation of an additional crisis management system, the Nuclear Rapid Action Force (FARN) following additional safety evaluations carried out by EDF after the Fukushima accident.

### Results for 2015

As in 2014, no major safety or radiation protection event was recorded in France in 2015 and, for the second consecutive year, the EDF group did not experience a significant safety event (ESS) classified at INES 2 or higher.

Following on from the results obtained in 2014, the 2015 results were relatively stable with an average of 1.16 level 1 event per reactor (*i.e.* 67 events) versus 1.14 a year earlier, and the average number of unclassified events (level 0) falling to 8.88 ESS per reactor (*i.e.* 515 events), versus 9.66 in 2014. Since 2002, for its entire fleet, EDF has recorded a yearly total of at most one level 2 event (incident with a significant failure in safety systems).

The number of automatic reactor trips was 0.66 per reactor (0.53 in 2014).

The 2015 detailed results on nuclear safety are published in the annual report created by the General Inspector for Nuclear Safety and available on the Internet.

### Radiation protection

Work by field operatives has enabled continuous improvement of performance in terms of protection of employees against the effects of ionising radiation. Thus, the average annual collective dose of all workers, both employees of EDF and outside companies intervening in power plants, has been halved in less than ten years. In 2015, the average individual dose was 0.71 man-Sievert per reactor (or a collective annual dose of 41.2 man-Sieverts in 2015). The collective dosimetry in 2015 is down compared to 2014 (41.6 man-Sieverts). EDF is proactively implementing an ALARA (As Low as Reasonably Achievable) policy to limit the collective dose with a view to the workload involved in the industrial project on the fleet in operation over the coming years.

EDF is furthermore committed to continuing to lower exposure to radiation below the regulatory limit of 20mSv over 12 rolling months for the whole body. Accordingly, throughout 2015 and over 12 rolling months, none of the participants, neither EDF employees nor contractors, was exposed to an individual dose of higher than 14mSv.

In the coming years, given the levels already achieved, efforts will have to be focused on power plants with the poorest dosimetric results, in particular by cleaning their circuits.

### 1.4.1.1.4 The nuclear fuel cycle and related issues

The average annual reference volume for nuclear fuel used by reactors in the EDF fleet in France is approximately 1,200 tonnes (tonnes of heavy metal: natural enriched uranium, enriched reprocessed uranium, plutonium), of which approximately 1,050 tonnes corresponds to ENU fuel (enriched natural uranium), 120 tonnes to MOX fuel (fuel produced from reprocessed plutonium) and 30 tonnes to ERU fuel (enriched reprocessed uranium).

The nuclear fuel cycle encompasses all industrial operations in France and abroad involved in the supply of fuel for energy generation in reactors, as well as removal and processing of the fuel. The cycle can be broken down into three stages:

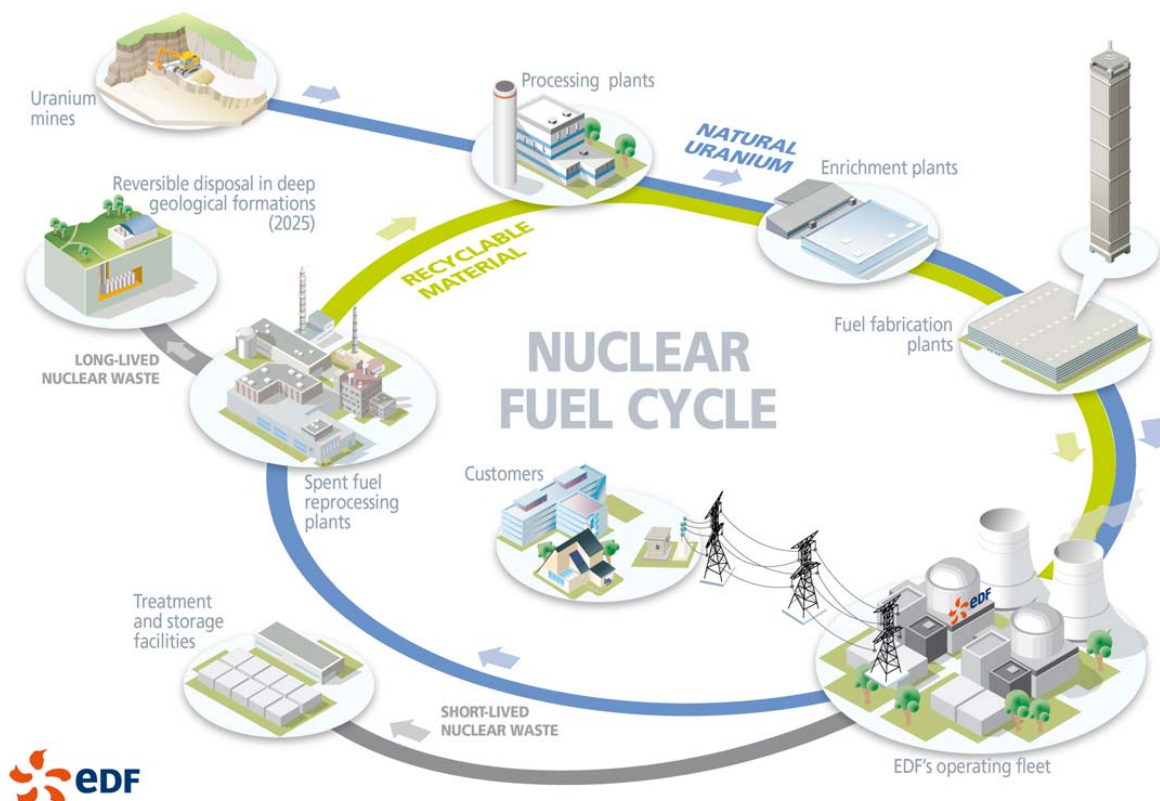
- front-end (upstream): the purchase of concentrates from uranium ore, fluorination (or conversion), enrichment and production of fuel;
- the core cycle, corresponding to the use of fuel in the reactor: receipt, loading, operation and unloading; the fuel stays four to five years in the reactor;
- back-end (downstream), for the reactor fleet in France: interim pool storage, reprocessing of spent fuel, conditioning of radioactive waste and recycling of reusable materials, the intermediate storage of treated waste prior to storage, as required by the French Law of 28 June 2006 on the sustainable management of radioactive materials and waste.

EDF coordinates all the operations in the fuel cycle. Generally speaking, upstream and downstream operations are carried out by subcontractors or suppliers, generally on the basis of multi-year contracts. EDF acquires most of the raw materials as uranium concentrates ( $U_3O_8$ ). Transformation into more processed products is carried out by industrial operators through service contracts (fluorination, enrichment and manufacture), and provides core cycle operations. EDF is the owner in most cases and is responsible for the fuel and materials it uses throughout all different stages of the cycle.

1. International Nuclear Event Scale.



## THE DIFFERENT STAGES OF THE NUCLEAR FUEL CYCLE IN FRANCE



### Front-end (upstream)

To ensure the continuity and security of the supply of its reactors in France and the UK, EDF retains overall control of all operations at each stage of the cycle, through a portfolio of contacts and by stockpiling at different stages of the front-end stage of the fuel cycle (natural uranium, fluorinated enriched or unenriched uranium, and warehousing of new assemblies).

The AREVA group is in this respect an important supplier (see section 2.3 "Dependency factors").

#### Natural uranium supply

Most of EDF's uranium supplies are guaranteed by long-term contracts for periods of 7 to 20 years with a policy of diversification in terms of sources and suppliers.

In 2015, EDF continued the securing of its long-term supplies with a number of major market suppliers, including Kazatomprom.

In addition, EDF signed in February 2016 a uranium supply contract with AREVA enhancing its coverage in the period beyond 2020.

Indexation formulas for portfolio contracts of natural uranium supply include fixed prices (base prices whether inflated or not) and variable prices (indexed

according to market price indexes) and are sometimes limited by floor and ceiling prices. Consequently, the effects of upward variations in market prices of natural uranium on supply costs are limited and smoothed out while enabling to benefit from potential price decreases.

#### Fluorination (or conversion)

EDF's needs are covered by the Comurhex plant of the AREVA group, as well as by other international producers, such as Cameco in Canada, Converdyn in the United States and Tenex in Russia.

In February 2016, EDF signed a conversion services supply contract with AREVA, to enhance coverage of its long-term needs.

#### Enriching natural uranium into uranium 235

With respect to supplies of enrichment services, EDF's needs have been significantly covered by enrichers such as Urenco (UK, Germany, the Netherlands, United States) and Tenex (Russia), primarily through fixed-price contracts, decreasing on a constant currency basis.

In February 2016, EDF signed an agreement with AREVA that helps secure its long-term supplies.

**Enriched reprocessed uranium**

Since the 1990s, reprocessing has made it possible to recycle within the reactors all or part of the uranium from processing spent fuel, which represents approximately 95% of the spent fuel mass.

This reprocessing was suspended in 2013, given the lack of economic incentive in light of the significant oversupply of natural uranium and pending the availability of a new industrial scheme. EDF is currently examining the conditions for restarting reprocessing by 2020.

Reprocessed uranium is stored in a stable form to be used at a later stage.

**Fuel assembly manufacturing**

Contracts with the fuel assembly manufacturers AREVA NP and Westinghouse, covering most of EDF's needs, were renewed in 2014 to secure provisions at least until 2020.

**Back-end (downstream)**

EDF is responsible for what happens to its spent fuel and how it is processed and for the related waste, without any possibility of transfer of responsibility or limitation in time. AREVA is responsible for processing and ANDRA for the management of the long-term storage of final waste, in accordance with the Codified Law of 28 June 2006 on the long-term management of radioactive materials and waste.

EDF's current strategy for the nuclear fuel cycle, in agreement with the French government, is to process spent fuel and recycle the plutonium separated in this process in the form of MOX fuel. The quantities handled are determined by the amount of recycled plutonium in reactors allowed to load MOX fuel ("equal flows principle"). The recycling capacity of nuclear units in the French fleet has allowed the processing of up to 1,100 tonnes of spent fuel per year.

**Processing of spent fuel from EDF's nuclear power stations**

Spent fuel awaiting processing is temporarily stored underwater in cooling pools, first in pools at the plants and subsequently in those of AREVA's reprocessing plant at La Hague. The storage conditions are recognised as being safe over long time periods. Approximately ten years after the spent  $UO_2$  fuel has been unloaded from the reactor, it is processed to separate the recyclable products from waste. The waste is subsequently conditioned and temporarily stored at the La Hague site in specific premises.

The relationship between EDF and AREVA concerning the transport, processing and recycling of spent fuel was formalised for the 2008-2040 period by a framework agreement signed on 19 December 2008.

In May 2015, EDF and AREVA signed an implementation agreement covering the 2013-2015 period. In February 2016, EDF and AREVA also signed an implementation agreement covering the 2016-2023 period as well as the associated supply contracts for the MOX assemblies.

**Storing conditioned ultimate waste**

Radioactive waste, depending on its nature, level of radioactivity and the lifespan of its radionuclide components, has been classified into different categories: from High-Level Waste (HLW), to Very Low-Level Waste (VLLW) passing by Low-Level Waste (LLW) and Intermediate-Level Waste (ILW). It is called Long-Lived (LL) when it remains active for more than 30 years.

**Long-Lived High-Level Waste (HLW-LL)**

The processing of spent fuel enables the vitrification of HLW-LL, which provides very high-quality conditioning with a reduced volume. The waste is then temporarily stored at La Hague in specific facilities. All of the Long-Lived High-Level Waste produced in this way, corresponding to the operation of the early Natural Uranium Gas Graphite plants (NUGG) and to

40 years of operation of the current PWR facilities, will represent a volume of approximately 6,700 cubic metres (see note 29 to the consolidated financial statements for the year ended 31 December 2015 in section 6).

**Long-Lived Intermediate-Level Waste (ILW-LL)**

The structures of the assemblies (shells and nozzles, clad pieces, etc.) separated during the processing of spent fuel, constitute ILW-LL. They are currently compacted and conditioned in stainless steel containers. The total volume of ILW-LL, including the waste resulting from the operation of the NUGG fleet and that resulting from 40 years of operating the current PWR fleet, will be approximately 37,000 cubic metres. Unlike HLW-LL, it does not generate heat and thus is suitable for faster storage than HLW-LL because it does not require cooling.

HLW-LL and ILW-LL from the reprocessing of spent fuel is temporarily stored in dedicated facilities in La Hague, pending decisions on storage in deep geological layers, as is currently envisaged as part of ANDRA's *Centre industriel de stockage géologique* (Cigéo) project.

**Long-Lived Low-Level Waste (LLW-LL)**

LLW-LL comes from the decommissioning of the old NUGG reactors (graphite, processing waste – see section 1.4.1.1.6 "Decommissioning of nuclear power plants"). Given its lifespan, this waste cannot be stored in existing surface facilities (see below), but due to its lower level of activity than that of Long-Lived High- and Intermediate-Level Waste, the Law of 28 June 2006 provides for special subsurface storage. In July 2015, ANDRA issued the progress report on the 2013-2015 national plan for the management of radioactive materials and waste. This report contains the safety assessment associated with the various sub-surface components in the area under investigation (*communauté de communes de Soulaïnes*). For graphite waste, the results open up the possibility to storage on the site investigated.

**Short-Lived Low- and Intermediate-Level Waste (LILW-SL) and Very-Low-Level Waste (VLLW)**

Short-Lived Low- and Intermediate-Level Waste comes from nuclear facilities (gloves, filters, resins, etc.) and from their decommissioning (concrete, scrap, lagging, piping, etc.). It is stored on the surface at the Soulaïnes and Morvilliers storage facilities managed by ANDRA, and its radioactivity is very close to natural radioactivity.

In order to minimise volumes, some waste is treated beforehand by melting or incineration at the Centraco plant owned by SOCODEI, a subsidiary of EDF.

**Consideration of future charges relating to the management of spent fuel and long-term management of radioactive waste**

Each year, EDF makes provisions for the downstream side of the nuclear fuel cycle in France (see note 29 to the consolidated financial statements for the year ended 31 December 2015 in section 6).

**1.4.1.1.5 Preparing for the future of the nuclear fleet in France**

EDF's industrial goal for the preparation for the future of the nuclear fleet rests primarily on the following strategic areas:

- the implementation of technical conditions for the extension of the operational lifespan of nuclear power plants beyond 40 years;
- continued safety improvements, primarily by integrating lessons learned from the Fukushima accident in Japan;
- implementation of a preventive policy with respect to ageing or obsolete equipment.

## Continued operation of the operating units well beyond 40 years

### Additional Safety Assessments (ASA) following the Fukushima accident

On 15 September 2011 and in light of the accident at the Fukushima nuclear plant in Japan, EDF submitted 19 Additional Safety Assessment reports to the ASN, one for each of its nuclear sites, encompassing all its existing reactors and all those under construction.

These assessments consisted of re-examining the defences of existing power plants and those under construction, in light of the events in Japan, taking into account issues set out in the specifications drafted by the safety authorities. Thus, the safety margins were reassessed against the risks of earthquakes and flooding, when dealing with situations of simultaneous loss of the cooling source and power supplies and the consequences of severe accidents. These assessments also led to inquire whether certain changes to the scenarios planned beyond situations used for the sizing of the protection systems, would lead to a worsening of the consequences in terms of safety ("cliff effects") and finally to deterministically consider the extreme situations that substantially exceed those used in the design of nuclear installations and subsequent safety reviews. The safety of EDF's nuclear fleet is based on the principle of continuous improvement: existing and new facilities continuously benefit from feedback from all power plants, and lessons are learnt from incidents and accidents that may occur in the world.

Finally, the ASAs also re-examined the rules applied in outsourcing.

These analyses confirmed first and foremost the adequate level of security throughout the EDF nuclear power fleet, particularly because of the periodic safety reviews carried out in France since the end of the 1980s and codified by the Law on nuclear transparency and safety (the "TSN Law") in June 2006, and codified later in the French Environmental Code. EDF also proposed additional measures to the ASN that exceed those considered for sizing safety systems, to contribute to further improving the current safety level of power plants.

In its opinion to the government published on 3 January 2012, the ASN states, on the basis of the analyses of its technical support, that *"after the additional safety assessments on priority nuclear facilities, the ASN considers that the facilities examined show an adequate level of safety, and that it will not thus request the immediate shutdown of any of them"*. At the same time, the ASN considers that *"continuing to operate these facilities requires increasing their robustness, as soon as possible, to an extent beyond existing safety margins, to handle extreme situations"*.

The ASN also recommended the "hard core" concept and the FARN system (see section 1.4.1.1.3 "Environment, nuclear safety, radiation protection"). The "hard core" will be made up of the plant's structures, systems and components that can withstand situations studied in connection with ASAs. On 26 June 2012, the ASN made 19 decisions requiring EDF to follow over 600 technical requirements, which set regulatory requirements according to the post-Fukushima action plan. These technical rules require that all nuclear sites must have an organisation and local crisis centres resistant to the occurrence of a large-scale event affecting several facilities. For EDF power plants, the prescribed "hard core" must in particular have "bunkerised" electrical resources in each unit, which must be installed before 2018. In the meantime, a temporary back-up diesel generator was installed at each of the 58 units in 2013. The complete definition of the "hard core" was covered in technical rules issued by the ASN in January 2014.

### Operating life of EDF's PWR fleet

The provisions of the French Environmental Code do not set a limit on operating life, but require a safety review of the facilities every ten years in light of best international practices ("safety standards").

As part of the studies related to the third ten-year inspections of the 900MW series, in early July 2009 the ASN publicly stated that it had not identified a generic problem that called into question EDF's ability to control the safety of its 900MW reactors for up to 40 years. The ASN's general opinion is supplemented by a decision on each reactor.

At end-2015, 27 of the 34 900MW units had passed their third ten-year inspection. Nine of these (Fessenheim 1 & 2, Bugey 2, 4 & 5, Tricastin 1, 2 & 3 and Dampierre 1) have completed the process of exchanging information with the ASN (the ASN's opinion and technical rules have been received). For all reactors, EDF has or will carry out the work required by the ASN pursuant to these prescriptions.

EDF's industrial strategy is to operate the fleet beyond 40 years in the best conditions of safety and performance, particularly in view of the significant investment linked to the third ten-year inspections on the one hand and to post-Fukushima improvements on the other. This target is consistent with trends observed around the world for reactors using similar technologies. To this end, EDF has implemented industrial and R&D action plans. Actions have been launched to renew the major components that can be renewed (see section 1.4.1.1.2. "Operation and technical performance of the nuclear fleet"), and solutions are being studied to demonstrate the capacity of non-replaceable equipment such as the confinement vaults and reactor vessels, to ensure their operation up to 60 years.

Concerning safety improvements to carry out to extend the operating life of units beyond 40 years, the ASN indicated that it would issue, following the April 2015 meeting of the Permanent Strategic Decisions Group, an initial position on the major strategic decisions of the safety review relating to the fourth series of ten-year inspections of the 900MW reactors and a final position in 2018-2019 on the "generic" phase of this review, the final authorisation for use beyond 40 years being made on a reactor by reactor basis. On 20 April 2016, the ASN sent a letter to EDF in which it defines its expectations to authorize a potential lifetime extension of the 900MW French nuclear reactors. After reviewing the file delivered by EDF's group in which it presents its approach and its methodology to extend the use of 34 reactors of this technology beyond 40 years, the ASN considers that the topics selected by EDF in its programme respond to safety issues and do not call any comments. However, the ASN asked EDF to complete its programme on several aspects, including the scope of control programme and the goals of investigation improvements.

An extension to the lifespan of the current nuclear fleet would enable, whilst respecting the absolute priority of nuclear safety and as part of the multi-year energy programme (see section 1.4.1.1.2 "Operation and technical performance of the nuclear fleet"), better use of the industrial base it represents, the deferral of financial flows associated with decisions for investment in new plants beyond 2025 and the spreading of the commissioning of new plants over time.

### 1.4.1.1.6 Decommissioning of nuclear power plants

EDF takes full regulatory, financial and technical responsibility for the decommissioning of its plants, the challenge being to demonstrate, through the decommissioning process, its control of the entire life cycle of the means of nuclear power generation.

The reference scenario adopted by EDF since 2001 is for decommissioning without a waiting period, consistent with French regulations, which provide for decommissioning *"in as short a time as possible on acceptable economic terms and in line with the principles set out in Article L. 1333-2 of the French Public Health Code and Article L. 110-1 II of this Code"* (see Article L. 593-25 of the French Environment Code).



The regulatory process for decommissioning is governed by the French Environment Code and Decree 2007-1557 of 2 November 2007 (see section 1.5.6.2.2 "Specific regulations applicable to basic nuclear facilities"). It is characterised, for a given site, by:

- a shutdown declaration at least two years prior to the planned shutdown date;
- a decommissioning request resulting, following examination by the authorities and a public inquiry, in a single decree allowing for decommissioning;
- key progress reviews with the ASN, included in a safety reference system relative to dismantling;
- an internal authorisation procedure for the operator, independent of the operational staff and audited by the ASN, allowing work to be started within the authorised safety reference limits;
- finally, once the work has been completed, the declassification of the facility to remove it from the legal regime governing basic nuclear facilities.

### Decommissioning of shut down power plants

Concerning power plants that have been shut down (a pressurised water reactor (PWR), Chooz A; a heavy water reactor (HWR), Brennilis; a fast-neutron reactor (FNR), Creys-Malville; and six graphite-gas-moderated reactors (NUGG) in Bugey, Saint-Laurent and Chinon), EDF has chosen to fully decommission them as soon as possible in line with the principles of the French Public Health Code and the French Environment Code while ensuring that the technical risks associated with these activities are managed. The sites remain the property of EDF, and they will remain under its responsibility and monitoring.

Given its role as responsible owner, EDF will act as the contracting authority for the decommissioning.

The decommissioning of EDF's nine first-generation units in final shutdown will produce approximately one million tonnes of primary waste materials, of which 80% is standard waste material and none is High-Level Waste. The remaining 20% comprises Very-Low to Intermediate-Level Waste including about 2% Long-Lived Waste requiring the availability of a storage facility for ILW-LL (Cigéo deep geological storage plan) and long-lived LLW-LL.

Existing means for removal of short-lived VLLW and LILW removal will be supplemented by:

- the project to build a packaging and intermediate storage facility for radioactive waste (Installation de conditionnement et d'entreposage des déchets activés, or ICEDA), under construction at the Bugey site. Mid-2017 has been set as the target commissioning date for this facility;
- the LLW-LL storage centre provided for by the Law of 28 June 2006 concerning the long-term sustainable management of radioactive materials and waste. Following an unsuccessful initial site search by ANDRA in 2008, and the sending of a report to the government at end-2012, in 2013 ANDRA restarted the search and in July 2015 issued the progress report on the 2013-2015 National Plan for the Management of Radioactive Materials and Waste (see section 1.4.1.1.4 "The nuclear fuel cycle and related issues"). This report contains the safety assessment associated with the various sub-surface components in an area under investigation. For graphite waste, the results open up the possibility to storage on the site investigated.

The decommissioning process for the Chooz A and Creys-Malville plants continues. Chooz A is a pressurised water reactor using a technology similar to the 58 units in operation, but of an older design. The reactor location in a rocky cave in a hillside means that access conditions and entry and exit of materials are more difficult than those of the rest of the existing PWR fleet.

Regarding Brennilis, pursuant to a 2008<sup>1</sup> agreement with the CEA, EDF has become fully responsible for its decommissioning. The decommissioning

work included in the scope of the original decree is in progress. However, the final and complete dismantling work should be allowed by an additional decree that EDF applied for on 29 December 2011. In accordance with the opinion that the ASN had expressed, the Mission for Nuclear Security and Radiation Protection notified EDF in December 2012 that the request for authorisation for full decommissioning of Brennilis could not be pursued in its current state due to the cancellation of the ICEDA building permit (see section 2.4.1 "Legal proceedings concerning EDF"). The decision of the Administrative Court of Appeal in Lyon of 4 December 2014, by restoring the validity of the ICEDA building permit, led EDF to relaunch the study of a file on the complete dismantling of Brennilis, taking into consideration any new regulations arising since the creation of the previous file, in particular the application of the INB regulation.

As for the six NUGG reactors, EDF's decommissioning programme involves directly removing graphite from these power plants to its storage facility in the Aube (CSA). The decommissioning schedule has been adapted from the schedule of availability of the storage centre by the ANDRA.

### Decommissioning costs

#### EDF nuclear power plants

Since the beginning of operations at its power plants, EDF has made provisions to cover decommissioning operations, engineering, monitoring and maintenance of facilities, and site security (see section 6.1 "EDF's consolidated financial statements", notes 29.1.3 and 29.1.5 to the consolidated financial statements for the year ended 31 December 2015).

An international comparison conducted by the OECD in late 2003 showed that EDF's estimates are consistent with the estimates made by other countries. With the exception of a few specific cases (Sweden, Japan), the costs considered by each party are actually fairly similar, with France at 10% to 15% below the average, mainly explained by the series effect that can be reasonably expected from the decommissioning of the PWR fleet.

Furthermore, EDF relies on national and international feedback (OCDE, AIEA, European Union, etc.), taking account of the following elements:

- differences in the estimate scopes;
- national and regulatory contexts;
- difficulties in comparing estimates in different monetary units;
- the irrelevance of using a comparison based on €/kWe.

EDF's benchmarking shows that the estimate of dismantling costs of French power plants is in the upper end of the funded costs range.

These benchmark elements were audited as part of the audit commissioned by the DGEC (General Division for Energy and Climate - *Direction Générale de l'Énergie et du Climat*) on the decommissioning costs of pressurised water reactors (PWR), conducted between July 2014 and August 2015. The main conclusions are:

- overall, the audit supports the estimate of EDF for the dismantling cost of its nuclear fleet;
- the auditors confirmed that restatements are required to make international comparisons, and that direct comparison of cost expressed in € per installed kWe is inappropriate;
- the auditors conducted an independent comparison in men/year that reflects the cost of dismantling, as manpower is a major factor in this activity, and is not sensitive to monetary effects. In terms of international benchmarking, the DGEC audit concluded that the men/year amounts converge when adjustments to homogenize the scope are performed, and that the French quote offers the highest estimate of overall needs.

1. With this agreement, the CEA has become fully responsible for the decommissioning of Phénix.

### Third-party facilities: La Hague (AREVA) and Phénix (CEA)

As the responsibility for the decommissioning of facilities is incumbent on their operator, EDF wished to free itself financially from these operations.

As such, the agreements signed with AREVA in July 2010 and the CEA in late 2008 clarified the financial responsibilities of the parties. Following a cash payment, EDF was released from any obligation to finance the decommissioning of the Phénix power plant, which has been shut down, and the La Hague power plant.

#### 1.4.1.1.7 Assets available to cover long-term nuclear commitments (outside the operating cycle)

Dedicated assets have been gradually accumulated since 1999 to cover long-term nuclear commitments. Article L. 594 of the French Environment Code and its implementing laws defined provisions that are not associated with the operating cycle and must therefore be covered by dedicated assets (see section 6.1 "EDF's consolidated financial statements", note 47.5 to the consolidated financial statements for the year ended 31 December 2015).

#### 1.4.1.1.2 New Nuclear projects

##### 1.4.1.2.1 Organisation

2015 saw the establishment of the New Nuclear Projects and Engineering Department, part of EDF group's CAP 2030 strategy which sets out the strategy for the future.

This department brings together the engineering units that play a role in the preparation of the reactors of the future, ongoing construction projects and supporting the operating fleet. It encompasses the Group's key priorities:

- improving the performance of nuclear new build projects (primarily Flamanville 3 and Hinkley Point C);
- preparing the reactors of the future;
- working more closely with the AREVA teams in order to increase efficiency.

##### 1.4.1.2.2 Update on the Flamanville EPR project

#### Architect-assembler engineering

To complete the Flamanville 3 EPR (European Pressurized water Reactor) project, EDF is performing the architect-assembler role itself; this matches the position adopted by EDF in the development, renovation and decommissioning of its power generation assets and is based on its internal engineering capabilities. This role allows direct control of the design and operation of its power plants, the organisation of development projects, the schedule and costs of construction, its relations with the ASN and the direct integration of operating feedback.

#### Interactions with the Nuclear Safety Authority (ASN)

EDF filed a request for authorisation to commission Flamanville 3 in March 2015 with the ASN, which acknowledged receipt in June and began the technical examination of the dossier, while identifying additional necessary information.

At the same time, EDF also filed a request for authorisation for partial commissioning with the ASN in March 2015 designed to authorise delivery of fuel to the site, which is also being examined.

In addition, EDF sent in October 2015 the French Ministry of the Environment, Sustainable Development and Energy a request to extend to April 2020 the deadline for commissioning Flamanville 3 as specified in the building authorisation Decree of 10 April 2007, the initial period of validity being 10 years from 2007.

#### Supply and work contracts

Nearly 70% of the construction budget represented by the six main contracts (boiler, civil engineering, control systems, piping, generator - condenser - water station, electricity) were, with the exception of the boiler contract signed with AREVA, awarded following international calls for tender.

#### Equipment manufacturing

The manufacture of the equipment required for construction is now well advanced. Most of the equipment for the nuclear section was available in 2015, except for a certain number of valves and security-classified equipment to meet regulations of nuclear equipment under pressure (ESPN) whose acceptance criteria are under discussion by the manufacturer and the ASN.

A programme of further testing to demonstrate the compliance of the reactor vessel and lid was approved by the ASN. In addition, the technical examination of the evaluation of the pressuriser valves is ongoing (final tests for the evaluation of the design and durability testing of the valve to be done).

#### Work on site

Several important steps of the construction of the Flamanville 3 reactor were completed in 2014 and 2015, marking the progressive transition of the project towards the testing phases:

- civil engineering finished (completion of concreting for the internal and external domes of the reactor building and prestressing operations);
- four boiler units brought in and primary circuit assembled;
- the command room of the EPR commissioned, the first in service for an EPR reactor;
- first system tests of the pumping station (in particular filtration) and in the machine room (including the lubrication system of the turbine shaft column);
- installation of the unit's command-control system on site, for overall system tests;
- water immersion and test of the pools in the nuclear island, in particular in the fuel building;
- the main diesel motors brought in and assembly commenced, as well for the final emergency diesel motors;
- first liquid tests of the cooling circuit in the nuclear island;
- first concrete poured for the local crisis centre of the Flamanville site (units 1-2-3), French first-in-series for this type of building following post-Fukushima recommendations that will be built at each French nuclear generation site.

At the end of 2015, electromechanical assemblies had significantly progressed (65%), and the test phase was launched on site, for the conventional island and for the nuclear island.

On 24 March 2016, the Group announced the achievement of the 1st milestone, with finalisation of the primary circuit mechanical erection (see section 5.2 "Subsequent events").

#### Commissioning schedule and budget

In September 2015, EDF released a new schedule and revised construction costs for the Flamanville 3 project of €<sub>2015</sub>10.5 billion.

EDF and its partners undertook a full review of the Flamanville EPR project and of its organisation to improve the industrial control of the project up to its commissioning.

A new organisational structure has been set up:

- complete review of the project organisation and working methods, centred around streamlined management reporting directly to the Group Senior Executive VP in charge of New Nuclear Projects and Engineering and the EDF Chairman and CEO;
- setting up of new ways of connecting EDF with its partners, to provide close leadership, coordination and monitoring of the project;
- enhanced accountability on site and stronger managerial presence as the construction phase comes to a close and test preparation gets underway;
- new contractual frameworks with key suppliers;
- enhanced dialogue with the Nuclear Safety Authority (ASN), particularly in respect of the new regulation on nuclear pressure equipment.

The new roadmap, to which EDF and its partners are committed, aims to optimise the management of the project. The new timetable sets out three key milestones:

- primary circuit mechanical erection to be finalised in the first quarter of 2016;
- electromechanical erection to be completed and system performance testing to begin in the first quarter of 2017;
- first fuel loading and start-up of the reactor in the fourth quarter of 2018.

#### 1.4.1.2.3 Progress on other New Nuclear Projects

##### 1.4.1.2.3.1 Hinkley Point C EPR

On 21 October 2015, EDF and China General Nuclear Power Corporation (CGN) signed a non-binding strategic investment agreement in London for the construction and operation of the proposed Hinkley Point C nuclear power plant in Somerset. This will enable the project to move forward and lay the groundwork for a final investment decision, which remains subject in particular to the following conditions:

- approval by the Boards of Directors of EDF and of CGN;
- finalisation of all the contractual documentation based on the agreements of 21 October 2015.

The approvals from competition authorities under the control of concentrations and other governmental authorities in China and Europe were obtained in the first quarter 2016.

EDF Energy also signed two other non-binding agreements with CGN relating to two nuclear construction projects in the United Kingdom: Sizewell C and Bradwell B (see section 1.4.5.1.2.5 "Nuclear New Build Division").

##### 1.4.1.2.3.2 Memorandum of understanding with AREVA

On 30 July 2015, EDF and Areva signed a non-binding memorandum of understanding that formalised the status of the progress of discussions concerning their contemplated partnership. This memorandum has 3 sections:

- EDF's acquisition of an exclusive control of AREVA NP. In this regard, EDF would take majority control of AREVA NP (at least 51%), AREVA would have a maximum stake of 25% as part of a strategic partnership, and the potential participation of other minority partners. This project enables

to better secure the most critical activities of the "Grand carénage" for the existing fleet in France, and to improve the efficiency of engineering services, project management, and some manufacturing activities through EDF's experience feedback;

- the creation of a dedicated company, 80% owned by EDF and 20% by AREVA NP, aimed at optimising the design and management of new reactors projects. The purpose of this company is to improve the preparation and management of projects as well as the export offering of the French industry by improving the coordination of strategic marketing to draw up offers in the upstream project phase, by developing offers that are more competitive and adapted to client needs, and by harmonising and expanding the range of reactors, all while ensuring the continuation of partnerships with the major industrial companies in Japan and China. This company will form part of an integrated generator/supplier model, which has been tried and tested in several countries;
- the signing of a strategic and overall industrial partnership, encompassing for example the promotion of integrated offers (fuel assemblies and material) in the case of the sale of new reactors for export, cooperation in the field of decommissioning (methods, tools, expertise, etc.) and in the intermediate storage of spent fuel (joint export offers), further studies into 4<sup>th</sup> generation reactors (boiler and fuel) and cooperation in R&D.

At its meeting held on 27 January 2016, following due diligence conducted during the second half of 2015, EDF Board of Directors reviewed the outcome of discussions with AREVA regarding the acquisition by EDF of exclusive control of AREVA NP activities.

The Board agreed on the final valuation of the operations to be acquired by EDF, which comes to €2.5 billion for 100% of AREVA NP's share capital<sup>1</sup>. This amount is likely to be adjusted, firstly, upward or downward depending on the financial statements prepared on the date of completion of the transaction, and secondly, with a possible price earn-out of up to €350 million, subject to the achievement of certain performance objectives measured after the closing date. This €2.5 billion valuation corresponds to a valuation of 8 times the normalised EBITDA.

With a contemplated EDF participation of between 51% and 75%, EDF will be in a position to make a binding offer, after consultation with the Central Works Council and authorisation by the Board of Directors, once the arrangements to completely immunise EDF against the costs and risks of the OL3 project and all the final contractual documentation are finalised.

##### 1.4.1.2.3.3 Taishan EPR

EDF is a shareholder in TNPJVC (Taishan Nuclear Power Joint Venture Company Limited), which was set up to build and operate two EPR nuclear reactors in Taishan, in the province of Guangdong in China.

In 2015, unit 1 moved into test phase and unit 2 into mass assembly phase.

The following milestones were achieved in 2015:

- July 2015: completion of concreting of the external dome of unit 1;
- September 2015: completion of the vessel mould block for unit 1;
- November 2015: first start of one of the four main diesel motors for unit 1 and completion of concreting of the external dome of unit 2;
- end December 2015: start of the hydropower test of the primary circuit of unit 1.

The project momentum will continue in 2016 with ongoing testing of all of unit 1 and the assemblies of unit 2 with a view to moving into the test phase.

Within EDF, structures were put in place to provide the Taishan project with technical support from EDF and to draw on the experience of these activities.

1. On a debt-free, cash-free basis.

#### 1.4.1.2.3.4 EPR New Model

In early 2015, EDF and AREVA jointly launched the "EPR New Model" (EPR NM) project designed to develop the basic design for a new third-generation nuclear reactor – an improvement on the EPR – that incorporates lessons from ongoing projects.

EDF and AREVA decided to develop the project together, as part of an integrated plan, to make the most of the synergies that exist between the two engineering firms.

The design of this new reactor is based on the EPR one and will satisfy the third-generation safety goals. It will be the first reactor to incorporate from initial design phase the lessons of the Fukushima accident and the resulting new international and French safety standards.

The EPR NM project aims to optimise this reactor on the basis of lessons learnt from ongoing projects and construction. To achieve this goal, three types of levers are employed:

- the incorporation, very early in development, of industrial aspects to take full advantage of the nuclear industry's industrial base;
- the development of methods and tools to make the engineering teams more efficient;
- the optimisation of some of the EPR's technical options.

The EPR NM model is intended to play a role in the renewal of the nuclear fleet currently operating in France and to enhance the nuclear industry's export business.

#### 1.4.1.3 Thermal generation in mainland France

EDF's electricity generation from its thermal power plants in mainland France represented approximately 1.5% of its total electricity generation in 2015. This fleet, which has an average age of 24 years, had a total installed operating capacity of 9,970MW.

Thermal generation assets have a number of advantages: they are very responsive and flexible (quick to start up and power can be modulated), they can be stopped for extended periods (set aside) or they can go back into operation at short notice, they have relatively low investment costs and short construction times.

Furthermore, the most modern thermal plants meet the environmental requirements of the latest directives in force.

Thermal generation assets are one of the key components of the energy mix to ensure the balance of generation and consumption in real time and to accommodate fluctuations in electricity consumption. Together with some hydropower facilities (lakes, pumped storage plants), they are used to meet mid-merit and peak demand electricity requirements. They also play an important role in adjusting EDF's generation capacities in response to changes in its customers' needs.

#### 1.4.1.3.1 EDF's thermal generation fleet

At 31 December 2015, the thermal generation facilities operated by EDF were of different types, both in terms of fuel and power:

Fuel	Unit capacity (in MW)	Number of units in operation at 31/12/2015	Total capacity (in MW)	Year commissioned	Output (in TWh)	
					At 31 December 2015	At 31 December 2014
Coal	580	3	1,740	in 1983 and 1984	4.6	5.9
	535	1	535	in 1974		
Fuel oil	585	3	1,755	from 1968 to 1975		
	685	4	2,740	in 1976 and 1977	0.1	0.1
Fuel oil and dual-fuel combustion turbines	85	4	340	in 1980 and 1981		
	203	1	203	in 1992		
	134	1	134	in 1996		
	125-129	2	254	in 1998 and 2007		
	185	2	370	in 2010		
	179-182	3	542	in 2008 and 2009	0.1	0.1
Combined-cycle gas turbines	427	1	427	in 2011		
	465	2	930	in 2012 and 2013	2.0	1.1

#### 1.4.1.3.2 Issues relating to thermal generation

##### Updating of the most recent coal-fired generating units to meet mid-merit load capacity demand

For mid-merit load capacity, maintaining the most recent (i.e., the most efficient) coal-fired units is the best solution to ensure availability of competitive capacities.

In particular, the most recent 600MW coal-fired units benefit from the lowest fuel costs of all of the thermal generation facilities (better efficiency, seaside units, and large capacity sites). Their power, along with the flexibility of their generation, are essential advantages. They are equipped with flue gas desulphurisation and denitrification systems (90% reduction in sulphur dioxide emissions and 80% reduction in nitrogen oxide emissions), as well as dust collectors that trap virtually all the dust. These processes enable the units to comply with environmental restrictions applicable since 2008, as well as to meet new regulatory requirements to be implemented from 2015.

A renovation programme for these coal-fired units is currently in progress, with the aim of improving their reliability and efficiency.

However, due to environmental regulation constraints (see section 1.5.6.2.3 "Regulations applicable to thermal energy generation"), EDF completed the final shutdown of its oldest coal-fired fleet, with the shutdown of the last five units in 2015 (La Maxe 1 & 2, Vitry-sur-Seine 3 & 4 and Bouchain 1). Overall, since 2013, EDF has shut down 2,835MW of coal-fired plants.

### Optimisation of the oil-fired fleet through seasonal shutdowns

To reflect the very low usage of oil-fired plants, EDF has carried out since 2014 a seasonal shutdown of this fleet (guaranteed long-term shutdown) from April to October.

EDF also decided to permanently shut down the thermal plant in Aramon on 1 April 2016, this plant scarcely being used over the past number of years.

### Commissioning of a combustion turbine centralised remote control centre

Since April 2015, the thermal fleet combustion turbines have been run from a remote control centre based in Vaires-sur-Marne, headquarters of the Combustion Turbine Operation Centre. This innovative system enables the remote control of the 13 turbines spread across six generation sites: 4 in Île-de-France and 2 in Brittany.

### Modernising the thermal generation fleet with natural gas combined cycle turbines

In 2011, EDF commissioned a first natural gas combined cycle turbine (GCCT) in France on the Blénod site, followed by a first combined-cycle turbine in Martigues in 2012 and a second in 2013. The GCCTs in Martigues are the result of the repowering of former oil-fired units, a part of whose facilities, such as the steam turbine, the condenser and the water treatment facilities, were reused. The repowering of a unit of this capacity is a first in Europe. The installed capacity of the Martigues site is 930MW and the return is over 50%, markedly higher than the return from traditional thermal units. This modernisation of the thermal generation fleet enables EDF to reduce atmospheric emissions of CO<sub>2</sub>, nitrogen oxides and sulphur oxides.

On the Bouchain site, EDF is building, in partnership with General Electric, a next-generation GCCT, equipped with the new General Electric high-capacity turbine, the "9HA". This combined cycle turbine, with innovative characteristics in terms of capacity (575MW achievable in less than 30 minutes) and return (61% versus average return for a standard GCCT of 57 to 58%), offering good environmental performance with CO<sub>2</sub> emissions of on average around 360g/KWh, 55% below those of the old neighbouring coal-fired plant shut down in 2015, is expected to be commissioned in summer 2016. The prototype will be tested for two years and then transferred to EDF, provided that the tests are conclusive.

### Evolution of the environmental regulatory framework

Today, EDF's thermal power plants are operated within the context of regulations that apply to installations classified for environmental protection purposes (*Installations classées pour la protection de l'environnement*, or ICPE), as well as regulations relating to greenhouse gas emissions and a specific regulation for air quality (see section 1.5.6.1 "Basic regulations applicable to the environment, health, hygiene and safety"). EDF set itself

the goal of cutting CO<sub>2</sub> emissions in mainland France by 30% (measured in tonnes) between 1990 and 2020, and of cutting SO<sub>x</sub>, NO<sub>x</sub> and dust emissions by at least 65% between 2005 and 2020 (see section 1.5 "Legislative and regulatory environment").

Thanks to the shutdown of the oldest thermal power plants, the updating of the most recent plants, the implementation of pollution-reducing procedures, the use of low sulphur fuel<sup>1</sup> and lastly the commissioning of natural gas combined cycle turbines, the environmental performance of the thermal fleet in mainland France has improved significantly:

- total CO<sub>2</sub> emissions of the EDF fleet in 2015 came to 5.3 million tonnes<sup>2</sup>, thereby confirming the improvement in the carbon footprint with CO<sub>2</sub> emissions down over 50% since 1990;
- The NO<sub>x</sub> and dust emission targets set for 2020 have already been achieved. SO<sub>x</sub> emissions have fallen by close to 55% since 2005, and it should be possible to achieve the 2020 target in the near future.

#### 1.4.1.3.3 Generation and technical performance

Thermal generation accounted for 6.8TWh in 2015. It represents about 1.5% of EDF's 2015 generation in mainland France.

The reliability of all components of the thermal generation fleet was confirmed in 2015 and is in line with European standards. The response rate achieved by combustion turbines to requests from optimisation services was very good. Minimising unplanned outages is the essential aim for facilities such as thermal plants, used for mid-merit and peak generation. The priority for these means of generation required on a variable basis all year round is to ensure system security by ensuring maximum reliability and availability. In 2015, coal units supplied 4.6TWh, GCCT plants supplied 2.0TWh, oil-fired units 131GWh and combustion turbines 101GWh.

The Martigues site was hit by a fire on 5 February 2015, which damaged unit 6, in particular the steam turbine, and caused collateral damage to unit 5. Unit 5 came back into service in June 2015, and unit 6 is scheduled to come back into service during the second quarter of 2016. Rehabilitation costs for EDF should be limited, fire being covered by insurance.

### Decommissioning of the existing fleet

EDF has planned all of the decommissioning operations for its existing thermal generation facilities. The provisions for these operations have been made in an amount that corresponds to the cost of decommissioning all of the units being operated and the clean-up of the sites (see section 6.1 "EDF's consolidated financial statements", note 30 to the consolidated financial statements for the year ended 31 December 2015).

In 2015, EDF continued the decommissioning work on sites that have been definitively shut down.

#### 1.4.1.4 Generation from renewable energies

Renewable energies<sup>3</sup> (hydropower, wind, solar, biomass, geothermal, marine energy, etc.), have seen robust growth worldwide.

The combined installed onshore wind capacity totalled worldwide 420GW at the end of 2015, almost 74GW of which was in the US and around 137GW in Europe. In 2015, more than 60GW of wind energy was commissioned worldwide, including around 30GW in China<sup>4</sup>.

1. The oil-fired units use fuel with an ultra-low sulphur content (less than 0.4% sulphur).

2. Within the Company's scope (EDF SA, i.e. including SEI and excluding PEI), total emissions amounted to 6.7 million tonnes in 2015.

3. Renewable, or "green" energies, are derived from natural resources that are replenished quickly enough to be considered non-depletable in human terms.

4. Source: Global Wind Statistics 2015; GWEC.

In solar photovoltaic power, total global installed capacity stood at close to 242GWp at the end of 2015, of which nearly 56GWp was from new capacity built in 2015<sup>1</sup>.

Today, it is largely wind, solar and biomass that are driving growth in renewable energy. Hydropower generation is nearing its maximum potential in many developed countries, although it retains significant development potential in other parts of the globe (of the 111GW of new renewable capacity development expected worldwide each year, around a quarter is hydropower capacity<sup>2</sup>).

The EDF group is now the leading producer of renewable energies in Europe and specifically the leading supplier of hydropower in the European Union; hydropower represents the Group's leading renewable energy, with an installed capacity of 20GW, 239 dams, 436 production sites worldwide). The Group plays a role in the rise of competitive sectors, particularly wind and solar.

In 2015, the Renewable Energy Division was established to manage and promote the EDF group's renewable energy activities, namely hydropower and the activities of EDF Énergies Nouvelles. This division also oversees all renewable projects (wind, solar, marine energy, etc.) undertaken by the Group, including those run by the foreign subsidiaries.

The EDF group's commitments in terms of developing renewable energy are described in section 3.1 "Corporate responsibility commitments".

#### 1.4.1.4.1 Hydropower generation in France

The electricity generated by EDF from its fleet of hydropower plants in 2015 totalled 38.9TWh, 8.5% of its total electricity output.

##### 1.4.1.4.1.1 EDF's hydropower generation fleet

EDF's hydropower fleet in mainland France comprises 433 plants:

- approximately 11% of these plants have a unit capacity above 100MW. They account for around 60% of total generation;
- approximately 51% of these plants have a unit capacity under 12MW. They account for around 6% of total generation.

The average age of the fleet is over 71 years<sup>3</sup>.

	31/12/2015	31/12/2014
<b>Hydropower plants with capacity lower than or equal to 12MW</b>		
Maximum capacity (MW)	989.3	997.5
Net pumping output (TWh)	2.4	2.8
Consumption by pumping operations (GWh)	32.7	40.0
Output including pumping (TWh)	2.4	2.9
<b>Hydropower plants with capacity greater than 12MW</b>		
Maximum capacity (MW)	18,939.4	18,949.2
Net pumping output (TWh)	29.7	34.7
Consumption by pumping operations (TWh)	6.8	7.8
Output including pumping (TWh)	36.5	42.5
<b>TOTAL MAXIMUM CAPACITY (GW)</b>	<b>19.9</b>	<b>19.9</b>
<b>TOTAL NET PUMPING OUTPUT <sup>(1)</sup> (TWh)</b>	<b>32.1</b>	<b>37.5</b>
<b>TOTAL OUTPUT INCLUDING PUMPING <sup>(2)</sup> (TWh)</b>	<b>38.9</b>	<b>45.4</b>

(1) These values correspond to the sum of the specific values, rounded to one decimal place.

(2) Including generation from the tidal power plant on the river Rance (518GWh in 2015).

Within mainland France, hydropower plants are mainly located in mountainous areas in the Pyrenees, the Alps, the Massif Central and the Jura, as well as on the Rhine. In all, they represent an installed capacity of approximately 20GW (excluding French overseas departments and Corsica), or 20% of EDF's fleet, for an annual generation capability of around 40TWh.

The various hydropower facilities are designed to optimise the use of water resources in the valleys where they are situated. Given the size and variety of its fleet, EDF has facilities able to respond to all types of desired uses, from base to peak generation, and which also offer levers for optimisation due to their flexibility: run-of-river plants, like the ones on the Rhine, which have no storage capacity and generate electricity depending on the available water

flow; plants with pondage, thus accessing average-sized reservoirs (smaller than lakes) for occasional use during the week or during the day, to cover peaks in demand; lake plants (seasonal reservoirs) located in mountainous areas (Alps, Massif Central and Pyrenees); pumped-storage plants (commonly known in France as STEPs, from their French acronym), which pump water from a lower reservoir to an upper reservoir during periods of low demand when electricity is also lower in cost, in order to build up reserves used to generate energy at peak times (by releasing the stored water through turbines from the upper reservoir to the lower reservoir); and a tidal power plant on the river Rance which, using the up and down movement of the tides, provides a very regular supply of electricity.

1. Source: Bloomberg New Energy Finance.

2. Source: International Energy Agency, World Energy Outlook 2015 – New Policies Scenario.

3. Arithmetic mean.



Category	Capacity	Average generation capability over 50 years
Run-of-river	3.6GW	17.1TWh
Lake-supplied	8.8GW	15.8TWh
Pondage	3.1GW	8.8TWh
Tidal	240MW	0.5TWh

EDF's pumped-storage hydropower plants in mainland France represent a capacity of 4.2GW for power generation of 4.72TWh in 2015. The generation capability of these plants tied to natural water supply from upstream reservoirs is 1.1TWh on average.

#### 1.4.1.4.1.2 Hydropower safety

Hydropower safety comprises all the measures taken when designing and operating hydropower plants to reduce risks and hazards to people and property associated with water and the presence or operation of facilities. Hydropower safety is a constant concern of the highest priority for plant operators (see section 2.2.6.2 "Management of hydropower safety risk"). It involves three main activities:

- the management of operational risks, including those associated with flow or level fluctuations in downstream waterways;
- the management of facilities during periods of exceptionally high water levels, in order to ensure safety at the facilities and for the surrounding communities;
- measures to address the major risk associated with dam or reservoir failures, through the regular monitoring and maintenance of facilities under the supervision of public authorities, mainly the French regional environment, land use and housing authorities (*Directions Régionales de l'Environnement, de l'Aménagement et du Logement*, or DREAL). Among the largest dams, 68 are subject to a specific administrative procedure (*plan particulier d'intervention*, or PPI) implemented by the relevant prefectural authority.

EDF performs regular monitoring and maintenance of its dams, in particular by means of continuous structural health assessments.

In addition, a comprehensive verification of each of the 150 largest dams is carried out every ten years, as well as a drain down or a structure inspection using underwater equipment. These operations are carried out under the supervision of public authorities (the DREAL office at the regional level as well as the *Service technique de l'énergie électrique des grands barrages et de l'hydraulique*, and STEGBH, the central French government agency specifically responsible for large dams and hydropower facilities).

Furthermore, carrying out exhaustive studies that contribute to safety is a regulatory requirement for dam owners and operators: danger assessments for class A facilities (dams whose height is greater than or equal to 20 metres) and class B facilities (dams whose height is greater than 10 metres and whose volume exceeds a threshold set by regulations), and safety reviews for class A structures. EDF adheres to the expected timetable: the 240 first generation danger assessments were delivered to the Control Department of the French government. The safety review timetable is also well under way, with 120 reviews delivered in 2015 out of the 157 expected by 2017. They consolidate a satisfactory overview of the structures and associated countermeasures<sup>1</sup>.

In 2015, the hydropower safety of EDF's fleet remained good with no hydropower safety incident (EISH) classified as "orange" (an incident that placed people in danger, within the meaning of the Decree dated 21 May 2010). 23 EISH classified as "yellow" (incidents reflecting non-compliance without putting anyone in danger) were recorded this year. The key indicators are still at good levels:

- increased detection of significant (non-serious) events (ESSH level 0) by the local teams, with 3,409 events detected;

- low number of incidents with external effects (ESSH level ≥ 1). 32 incidents took place;
- a reduction in the number of sites with high sensitivity to risks related to variations in water flow downstream of facilities, which fell from 114 in 2005 to 11 in 2015 (18 in 2014, 19 in 2013). Although it was marked by low hydraulicity levels (the 4<sup>th</sup> lowest since 1948 according to EDF data), 2015 saw a number of periods of high levels in the Northern Alps and on the Rhine (with occasional historically high levels in certain catchment areas such as the Arve). Nevertheless, the management of hydro-electric structures was properly controlled during these events.

Control of risks associated with the facilities ageing is a major concern in hydropower safety and has been strengthened, and the long-term maintenance policy was updated in 2012. With more than €800 million spent on hydropower safety between 2007 and 2014, EDF has undertaken the largest hydropower facility renovation programmes of recent decades. In 2015, safety work continued and a significant portion of the maintenance budget was dedicated thereto.

In 2006, EDF launched the "SuPerHydro" hydropower facility renovation programme (Safety and Performance) with a total budget of €1,122 million (current euro value). In 2015, this programme was superseded by the safety and performance components of the engineering programmes for the hydropower fleet in operation while carefully monitoring safety-related activities. The goal is the technical updating and improved maintenance of the facilities, in order to maintain a high level of hydropower safety and preserve the technical performance of the fleet over the long-term. At the end of 2015, 579 specific systems and measures were carried out and monitored in five priority facility groups: galleries, pipes, dams, penstocks and floodgates<sup>1</sup>.

These two programmes were reinforced by the "RenouvEau" project whose goal is to improve safety as well as performance and competitiveness of the hydropower fleet. The tools, methods and works defined as part of the "RenouvEau" project are currently being rolled out to all major facilities in the hydropower fleet (see section 1.4.1.4.1.3 "Performance of the hydropower generation fleet").

#### 1.4.1.4.1.3 Performance of the hydropower generation fleet

##### A highly automated fleet

In order to take advantage of the flexibility of its hydropower generation facilities, for some years now EDF has been initiating ambitious programmes involving automation, remote control of hydropower plants and centralised management of the valleys. Currently, the largest plants in EDF's hydropower fleet, representing just over 15GW, *i.e.*, around 75% of its installed hydropower capacity, are remote-controlled from four control centres able to make adjustments to the plants' operating programmes at any time in order to respond to the needs of the electrical system and to economic opportunities arising on the electricity market.

##### Technical performance of the fleet and 2015 hydropower conditions

Hydropower generation may witness substantial variations from one year to the next, depending on climatic fluctuations in water resources. Hydrological conditions in 2015 were unfavourable.

1. For further details, see the 2015 report of the Inspector of Hydropower Safety, available on EDF's website.

Hydropower electricity generation before the deduction of the power needed to operate pumped-storage plants was 38.91TWh in mainland France and 32.1TWh net of consumption by pumped storage.

The overall availability of the hydropower fleet, *i.e.* the percentage of time over the year during which the power plants are available at full capacity, was 80.38% in 2015, up compared to 2014. In 2015, 15.88% of the unavailability of EDF's hydropower fleet was due to asset maintenance work (planned unavailability) mainly as part of the "SuPerHydro" renovation programme (see above), while 3.7% of unavailability was due to work delays and breakdowns (unplanned unavailability). The demand response rate, *i.e.* the rate of success in responding to start-up orders received by the power plants, has been over 99% for several years.

In 2011, EDF also began an ambitious modernisation project to improve the industrial performance of its hydropower fleet, for an overall amount of €<sub>2010</sub>840 million by 2021. This project, known as "RenouvEau", aims to modernise the maintenance and operation of the hydropower fleet, specifically via the renovation of electrical facilities, control monitoring and computerised management, maintenance and operating tools, in order to improve the operating performance of the hydropower fleet. The full roll-out of the project will run from 2014 to 2020.

#### 1.4.1.4.1.4 Hydropower generation issues

The hydropower segment is currently working to address the following issues: implementation of the Energy Transition for Green Growth Law, managing access to water, and development.

##### Concessions renewal

Hydropower generation facilities are operated through concessions granted by decree for facilities exceeding 100MW, by prefectural order for facilities whose capacity is between 4.5MW and 100MW, and under prefectural authorisation for facilities under 4.5MW (see section 1.5.6.2.4 "Regulations applicable to hydropower facilities").

EDF currently holds the majority of the hydropower concessions in France.

Concessions have an initial term of 75 years, pursuant to the French Law of 16 October 1919 relating to hydropower use, and are in general renewed for terms of 30 to 50 years.

Under the current regulation, the former concession holder does not receive any compensation if an expiring concession is not renewed. Article L. 521-15 of the French Energy Code enacted by the amended Finance Act for 2006 provides for the reimbursement of unamortised expenses related to modernisation works or to works that enable the expansion of generation capability, provided that these works were carried out during the second half of the concession. However, if a concession is terminated by anticipation by the French government, the operator receives compensation. This compensation from the government is intended to offset the shortfall for the outgoing operator due to the early termination of the operation of the concession, as provided by the concession specifications.

In this context, for some years EDF has prepared itself to submit its best offer for each concession, combining improved energy efficiency, attention to aquatic environments, compensation of the government and municipalities through fees and regional development, while ensuring the safety and security of operations.

The European Commission (EC) initiated proceedings against the French State regarding hydropower concessions in France, based on Article 106 § 1 of the Treaty on the Functioning of the European Union (TFEU) read in conjunction with Article 102 of the same treaty. In this respect, on 22 October 2015 the EC sent the French State a letter of formal notice, in which it stated that the

awarding to and reservation for EDF of most of the hydropower concessions in France represented a breach of the aforementioned provisions in that such measures would strengthen EDF's dominant position in the French retail electricity market. The State responded to this formal notice, beginning a series of submissions and responses by the French State and the EC, which in no way prejudices the latter's final decision. As the chief interested party, EDF received a copy of the formal notice and sent its observations to the EC on 4 January 2016.

##### Managing access to water

Water reservoirs held by EDF's 239 large dams in France enable the storage of 7.5 billion cubic metres of water, corresponding to 75% of national surface storage reserves.

The hydropower facilities have positive effects on both economic development and the environment, and EDF applies a proactive management policy in relation to water resources, in liaison with various water stakeholders. Agreements are entered into with local elected officials, farmers, fishermen, managers of tourist sites and manufacturers (see section 3.2.2.6 "Protection of biodiversity").

The Law of 30 December 2006 on water and aquatic environments contains provisions relating to the management of water resources (in particular, the benefits of reserved flows<sup>1</sup> and the flexibility of hydropower plant operations). EDF estimates that these provisions have limited medium-term consequences for its hydropower activities (see section 1.5 "Legislative and regulatory environment").

##### Development

Currently, 95% of France's hydropower potential is being used. EDF is nevertheless continuing the development of its hydropower activities, through the study and realisation of new projects.

A micro-power plant project is in progress close to the Kembs dam on the Rhine, for a capacity of 8MW and a generation capability of 28GWh, with commissioning planned for 2016.

The Rondeau hydropower plant was inaugurated on 1 October 2015 in Isère in the Échirolles municipality near Grenoble. It is the most powerful of EDF's hydropower micro-plants. The plant uses water from a small 4.30 metre high waterfall near the end of the Drac tail race, an artificial canal bringing water from up the river. To make use of this small waterfall, it was necessary to have recourse to new "made in France" technology, the Very Low Head (VLH) turbine, designed and assembled by the Aveyron-based French SME, MJ2 Technologies. The installed capacity is 2.2MW with a generation capacity of 13.7GWh.

Generation from reserved flows will continue to be developed. The purpose is to equip a certain number of dams in order to process the reserved flow through the turbines and recover a portion of the associated energy. In 2015, five reserved-flow turbine sets were installed. Units were commissioned during the year at the Beaumont-Monnetaux dam on the river Isère, the Notre-Dame-de-Commiers dam on the Drac river, the La Chatre dam on the Creuse river and the Prétière dam on the Doubs river. These five sets generated total actual capacity of 3,323kW in 2015. Projects are under consideration or in progress for a total capacity of some 10MW and generation capability of about 70GWh, with expected commissioning dates ranging from 2016 to 2020.

In addition, EDF's objective is to use all available opportunities for expansion, and in particular to:

- optimise the potential of energy transfer by pumped-storage hydropower plants in France (STEPs);

1. Minimum flow maintained downstream of dams to protect aquatic life.



- look into the possibilities for “surplus generation” (for instance, by increasing the capacity of existing hydropower plants) detailed in Article L. 511-6 of the French Energy Code enacted by the Law of 13 July 2005 setting out the guidelines for the energy policy (provision repealed from 1 April 2016 by Order no. 2016-65 of 29 January 2016 on concession contracts), to contribute to the development of means to respond to peak demand. Construction is already ongoing at the La Coche and La Bâthie plants. The Decree of 17 June 2013 authorised EDF to build a new 240MW turbine generator set at La Coche STEP in Savoy. This Pelton set, construction of which began in 2016, will increase the capacity of the existing facility by 20% and will generate approximately an additional 100GWh every year. For the La Bâthie plant, excess output has been achieved by replacing the six generation sets and should total around 50MW. At end-2015, three sets were put in place;
- take the opportunity during facility upgrades to increase their capacities;
- adapt existing facilities (modernisation, optimising generation, etc.) as part of concession renewals. Accordingly, in the context of renewing the Middle Manche concession and in line with decrees published on 31 December 2010, EDF has begun work to replace six small existing plants with the construction of a new subterranean plant (Romanche-Gavet plant) with a capacity of 93MW and generation capability of 560GWh, or 155GWh more than existing plants;
- develop “small-scale” hydropower plants (with capacity under 12MW). One of the aims is to develop small-scale hydropower by:
  - optimising and increasing the generation capability of the existing fleet (renovation of 16 plants in the Mayenne department, renovation programme for plants in the Var, Lot and Dordogne departments),
  - acquiring existing small-scale hydropower facilities in France,
  - building new small-scale hydropower facilities,
  - forging partnerships for project development.

EDF has also strengthened the range of initiatives pursued by its entities in support of regional and local development. This approach is reflected in the establishment of the “One River, One Territory” development programme, which had opened seven agencies around France by the end of 2015.

#### 1.4.1.4.2 New renewable energies

##### 1.4.1.4.2.1 Wind power

A wind turbine uses the action of the wind to drive rotor blades connected to an electrical generator. There are various categories:

- onshore wind power: this is a mature sector which is now close to competing with, if not matching, traditional sectors in certain areas. It benefits from economic incentives in various countries, although an increasing number of projects are developed without a financial support mechanism (see section 1.5.3 “Electricity market legislation”). On average, the rated capacity of onshore wind turbines installed worldwide is around 2MW, a figure which is increasing steadily. The subsidiary responsible for developing wind power within the Group is EDF Énergies Nouvelles. The subsidiaries EDF Luminus and Edison also have wind farms in service. The EDF group generated 10.7TWh of wind-based electricity in 2015;

- offshore wind turbines: a less mature, high-growth sector, it currently requires a higher initial investment and is more expensive to connect to the grid than onshore wind power. Offshore operation and maintenance are also more difficult. The advantages of this sector are the higher rated capacity of each wind turbine (typically over 3MW) and increased productivity due to more reliable winds. The sector is on a learning curve that will enable it to reduce the cost differential with onshore wind generation. The EDF group has decided to ramp up its investment in offshore wind generation, which offers interesting development prospects, at least in two of the Group's key countries: France and the United Kingdom.

##### 1.4.1.4.2.2 Solar photovoltaic power

The operating principle of solar photovoltaic power is to convert sunlight directly into electricity. Photovoltaic solar power is used in two ways: it can either be connected to the grid, or it can generate electricity at isolated sites. Grid-connected photovoltaic systems have witnessed steady growth around the world in two markets: ground-based solar farms and residential rooftop installations.

Since 2014, the photovoltaic market in France has surged once more, with 950MW connected to the grid in 2014 and 880MW in 2015 (compared with 650MW in 2013)<sup>1</sup>.

The cost of generating solar power has fallen considerably in recent years. However, innovation offers considerable room for improvement. EDF R&D also conducts research on photovoltaic technology at its Chatou site, under the aegis of the French Institute for Photovoltaic Power Research and Development (IRDEP), established in partnership with CNRS (National Centre for Scientific Research) and ENSCP (Paris National School of Chemistry).

##### 1.4.1.4.2.3 Biomass and biogas

Technologies based on biomass mainly consists of burning certain types of waste, particularly from the timber and farming industries, or exploiting woodfuel forests, to produce heat or electricity.

Biofuels can come from a wide range of sources. There are three different energy streams: combustion plants for plant matter (wood, agricultural waste) or animal matter; biogas production plants (gas produced from the fermentation of organic animal or plant matter); household waste incineration plants.

Lastly, through its holdings, the Group owns shares in France (notably through its subsidiary Dalkia, see section 1.4.6.1.1 “Dalkia”), and abroad in several dozen heating networks and small-scale, mainly wood-fired generating plants. It also has a majority interest in Tiru, which is active in waste recovery (see section 1.4.6.1.3 “Tiru”).

##### 1.4.1.4.2.4 Geothermal energy

The temperature of the rocks in the earth's crust increases with depth (3°C on average every 100 metres). In some regions, geothermal energy reaches the surface in the form of hot springs, water or steam. The hot water is used directly in the form of heat: central heating in homes or heating of greenhouses.

Steam extracted from the ground is also used to generate electricity: as in a classic thermal power station, it drives a turbine. It is also possible to use hot and dry rocks as a source of electricity production from steam. To

1. Source: Wind and solar energy scorecard, French Commission on sustainable development (Commissariat général au développement durable).

develop this type of energy, EDF has joined forces with several partners (including Électricité de Strasbourg and German energy companies) as part of a European consortium that develops and operates a prototype geothermal power plant in the hot, naturally fractured crystalline rock around Soultz in Alsace (see section 1.4.6.4 "Électricité de Strasbourg").

France also has high-temperature resources located in its overseas territories. The EDF group is present in this activity mainly through its minority stake in the company Géothermie Bouillante in Guadeloupe.

#### 1.4.1.4.2.5 Other technologies

Renewable energies cover a wide range of sectors and technologies. To prepare for the future, EDF Énergies Nouvelles is responsible within the EDF group for identifying promising sectors and, with the support of the Group's R&D teams or industrial partners, contributes to the emergence of new technologies. Along with solar power (see above), marine energy is another area the Group is exploring in depth.

Two marine energy projects are currently in development:

- tidal turbines, which are underwater turbines harnessing the energy of tidal currents. EDF has built a prototype tidal current turbine farm on the Paimpol-Bréhat site in the Côtes-d'Armor department. This prototype should shortly move into a second test phase with the first electricity generation. The prototype was immersed on 20 January 2016 and should shortly be connected to the grid. EDF Énergies Nouvelles, in partnership with DCNS, Europe's leading manufacturer of naval vessels, is working on the "Normandie Hydro" project, a larger-capacity tidal current turbine farm at Raz Blanchard, at the tip of the Cotentin peninsula in Normandy;
- floating offshore wind turbines: EDF Énergies Nouvelles plans to bid in partnership to the call for proposals launched by the French government in August 2015 for pilot farms. The call for tenders is for farms with between three and six turbines, each with a rated capacity of at least 5MW, which should be located in one of the following four areas: in the waters off île de Groix (Brittany), the Faraman lighthouse (Provence - Alpes - Côte d'Azur), the marshes in Leucate and in the Gruissan municipality (Languedoc-Roussillon).

#### 1.4.1.4.3 EDF Énergies Nouvelles

The EDF group's involvement in renewable energies is undertaken mainly by the EDF Énergies Nouvelles (EDF EN) subsidiary, which is 99.99% owned (0.01% being owned by the employees<sup>1</sup>). The companies in the EDF EN group had a combined 3,029 employees at 31 December 2015.

The company, which is the Group's centre of expertise and development, particularly in the fields of wind and photovoltaic solar power, is one of the major players in electricity generation from renewables particularly in the major regions in which it is based: North America and western and southern Europe.

EDF EN generates electricity from renewable energy sources and is involved in every stage of the value chain. It operates upstream, in project development, as well as in the construction of power plants and their operation and maintenance. Each of these activities may be conducted on its own account or on behalf of third parties. As part of its project development activities, the Group is also involved in the Development and Sale of Structured Assets (an activity referred to as "DSSA"), which mainly consists of developing projects to be sold, in whole or in part, sooner or later, to third parties interested in such infrastructure assets.

With development focussing on wind and photovoltaic solar power (which represent around 97% of its installed capacity), EDF EN is also present in other renewable energy segments, primarily marine energy. Lastly, EDF EN is also present in the decentralised renewable energy sector (rooftop solar power).

Historically, EDF EN has primarily developed in two geographical regions: western and southern Europe (mainly France, UK, Italy and Portugal) and North America (USA, Canada and Mexico). Since 2012, the Group has become established in new countries with significant potential for renewables development, such as South Africa, Poland, Morocco in wind power, and Israel and India in photovoltaic solar power. This expansion continued in 2015 with new facilities in Chile and Brazil. At end-2015, EDF EN teamed up with a wind developer in India (SITAC Group) to develop this technology.

At 31 December 2015, EDF EN had a gross installed capacity of 9,063.3MW, a net installed capacity of 6,131.5MW and a gross capacity under construction of 1,408.8MW.

1. Following the alternative cash or exchange tender offer for EDF EN shares realised by EDF in 2011, EDF implemented a mechanism designed to ensure the liquidity of bonus shares granted to EDF EN employees and executive officers prior to the tender offer. Pursuant to this mechanism, EDF will ultimately hold all the shares which are still held as of today by EDF EN employees.

## INSTALLED CAPACITY BY SEGMENT AND BY COUNTRY

(in MW)	At 31 December 2015		At 31 December 2014	
	Gross <sup>(1)</sup>	Net <sup>(2)</sup>	Gross <sup>(1)</sup>	Net <sup>(2)</sup>
<b>Wind power</b>				
USA	2,818.2	2,233.4	1,983.1	1,695.0
France	1,040.4	754.0	952.2	665.8
Italy	440.4	246.6	440.4	246.6
Portugal	507.0	314.1	495.8	302.9
Greece	384.3	358.0	340.5	314.2
Canada	589.7	565.7	464.4	440.4
UK <sup>(3)</sup>	589.7	208.1	542.9	184.7
Turkey	612.8	250.7	566.8	228.2
Mexico	391.5	229.5	391.5	229.5
Poland	106.0	106.0	48.0	48.0
Belgium <sup>(4)</sup>	325.2	29.7	325.2	29.7
Germany	3.0	3.0	3.0	3.0
South Africa	104.1	50.0	—	—
<b>Total wind power <sup>(5)</sup></b>	<b>7,912.3</b>	<b>5,348.8</b>	<b>6,553.7</b>	<b>4,388.1</b>
<b>Solar power</b>				
France	209.2	153.1	209.7	153.6
USA	160.3	88.7	160.3	88.7
Italy	79.5	76.8	79.3	76.7
Spain	57.4	46.9	57.4	46.9
Canada	23.4	23.4	23.4	23.4
Greece	12.1	12.1	12.1	12.1
Israel	108.5	66.2	68.5	48.8
India	180.5	46.9	30.0	7.8
Renewable energy (France)	86.8	58.3	86.4	57.8
<b>Total solar power <sup>(5)</sup></b>	<b>917.6</b>	<b>572.4</b>	<b>727.0</b>	<b>515.7</b>
<b>Other segments</b>				
Hydropower	77.2	74.4	77.2	74.4
Biogas	51.0	51.0	78.0	73.2
Biomass/Cogeneration	85.2	64.9	80.8	60.5
Other	20.0	20.0	0.0	0.0
<b>Total other segments <sup>(5)</sup></b>	<b>233.4</b>	<b>210.3</b>	<b>236.0</b>	<b>208.1</b>
<b>TOTAL <sup>(5)</sup></b>	<b>9,063.3</b>	<b>6,131.5</b>	<b>7,516.7</b>	<b>5,112.0</b>

(1) Gross capacity: total capacity of the facilities in which EDF EN has a stake.

(2) Net capacity: capacity corresponding to EDF EN's stake.

(3) EDF EN owns 50% of EDF Energy Renewables (the other 50% is owned by EDF Energy). The net capacity shown of 208.1MW therefore includes only 50% of the wind capacity of EDF Energy Renewables.

(4) MW in offshore wind exclusively.

(5) Corresponds to the sum of the exact values rounded to one decimal place.

## Wind power

### Onshore wind power

EDF EN actively pursued growth in onshore wind energy in 2015, increasing its wind generation capacity by 1,358.6MW gross, bringing its total operating capacity of onshore wind energy to 7,525.1MW gross at end-2015.

Onshore wind farms with a gross capacity of 1,614.9MW were commissioned in 2015, onshore wind farms under construction representing a gross capacity of 1,060.2MW at 31 December 2015.

As part of its DSSA operations, 543.3MW of onshore wind power was sold in North America (Canada and United States).

### France

In 2015, EDF EN went over one Gigawatt of wind power in service (gross capacity of 1,040.4MW at 31 December 2015). It was a year that saw the acquisition of new farms located in eastern France totalling 44MW, and the commissioning of the first phase of the Pézilla wind farm (44MW). At 31 December 2015, 146.4MW of onshore wind power was under construction in France.

### United Kingdom

EDF Energy Renewables (50/50 joint-venture with EDF Energy) operated a total gross capacity of 589.7MW of wind power at end-2015 (a net capacity of 208.1MW).

At end-2015, the Burnhead Moss (26MW), Park Spring (8.6MW) and Rhodders (12.3MW) projects had been commissioned with the acquisition in November of the Dorenell wind farm project located in the Scottish Highlands. It has been granted permission by the Scottish government for a potential capacity of 177MW. At present, 67.2MW of onshore wind power is under construction in the United Kingdom.

### Turkey

Located in western Turkey, the Soma wind farm (240MW), which previously had two phases of 79.2MW and 60.9MW, now has a third phase consisting of 50 Enercon turbines with a unit capacity of 2MW each (i.e. 100MW) which was commissioned in July 2015. To date, EDF EN has built eight wind farms in the country, representing a total gross installed capacity of 612.8MW.

### South Africa

The first three wind farms won in the second call for tenders – Chaba (21MW), Grassridge (59.8MW) and Waainek (23.3MW) – were commissioned in 2015. Moreover, EDF EN was selected for an additional 33MW of wind power, during the fourth round (part b) of the call for tenders by the Ministry of Energy in June 2015. It also participated in the Round 4c call for tenders, the results of which are expected to be announced in mid-2016.

### United States

The Group operates in the United States through EDF Renewable Energy (EDF RE), an independent renewable energy producer that is wholly owned by EDF EN.

At end-2015, EDF RE had a gross installed capacity of 2,818.2MW (or 2,233.4 net) of onshore wind power in the United States.

At 31 December 2015, EDF Renewable Energy went over 1GW of installed capacity in Texas and had commissioned net wind power capacity of 987MW with in particular the Spinning Spur 3 (194MW) and Longhorn (200MW) wind farms in Texas, the Pilot Hill (175MW) wind farm in Illinois, the Slate Creek (150MW) wind farm in Kansas and the Roosevelt (250MW) wind farm in New Mexico.

Innovative partnerships have been established. A purchase price agreement was signed with Google for the construction of the Great Western wind farm (with a capacity of 225MW) and a similar agreement was put in place with Procter & Gamble to supply wind power electricity for the group's laundry and household product manufacturing facilities in North America.

EDF RE also commissioned a battery project (McHenry) designed to help stabilise the grid (20MW). 737.7MW in onshore wind power is currently under construction with in particular the Kelly Creek, Salt Fork and indeed the Great Western wind farms.

In 2015, 394.5MW was sold, primarily involving 50% of the Hereford and Longhorn North wind farms and 100% of Chanarambie.

### Canada

At end-2015, the Group's total gross installed wind power capacity in Canada was 589.7MW (or 565.7MW net).

In 2008, EDF EN won a call for tenders issued by Hydro-Québec to build five wind farms in Quebec with a total capacity of 954MW. All of the wind farms have now been built with the commissioning in 2015 of the Mont Rothery (74MW) wind farm as well as phase II of the wind farm at Rivière du Moulin (200MW).

A new project (Nicolas Riou, 225MW) was won following a call for tenders. Construction should begin in 2016.

Thanks to the DSSA programme in Canada, which in 2015 involved 148.8MW (Rivière du Moulin), investment partnerships enabled portfolio disposals totalling more than 698.8MW.

### Offshore wind power

Offshore wind power will be a growth driver over the next few years, particularly in France and the United Kingdom.

In France, for the three projects awarded in 2012 with a total capacity of 1,428MW, permits were applied for in October 2014, in accordance with the tender specifications. All three projects received favourable opinions from the public inquiries.

In the United Kingdom, through the subsidiary EDF Energy Renewables (a 50/50 joint-venture with EDF Energy), the Navitus Bay offshore project (630MW) continued its preliminary development phase in 2015. Following the refusal of the building permit, the project was suspended. The development rights were also obtained for the Blyth offshore prototype farm (41.5MW) in Northumberland. Comprising 5 turbines, it should allow new offshore technology to be tested in real conditions.

### Photovoltaic solar power

EDF EN pursued growth in solar photovoltaics, its second area of growth. At end-2015, installed solar capacity totalled 917.6MWp gross (572.4MWp net), an increase of 190.5MWp gross from end-2014. EDF EN also has a portfolio of solar projects under construction comprising 329.6MWp gross.

### North America

EDF RE commissioned and sold in 2015 the Cottonwood Solar (32.6MWp) and Catalina 2 Solar (25MWp) photovoltaic solar power projects in California. In North America, the Group has total photovoltaic solar power of 183.7MWp gross.

**India**

As part of the partnership with Acme Solar, in which EDF EN has a 25% interest, the NMS and Odisha solar farms were commissioned (150.5MWp gross). They are located in the Indian states of Rajasthan and Odisha, and were won in calls for tenders run by the Indian government for NSM and the State of Odisha for the project of that name.

In addition, 132MWp were under construction at 31 December 2015.

**Israel**

The Group operates photovoltaic projects with 108.5MWp gross in Israel and should shortly complete the construction of an additional 50MWp.

**Chile**

EDF EN established a new subsidiary in Chile in 2015 and is currently building a 146MWp photovoltaic solar farm in the Atacama desert.

**Operating & Maintenance**

As an integrated operator, EDF EN operates and maintains most of its own wind and solar facilities. This activity has grown significantly and is also carried out on behalf of third parties. Worldwide, EDF EN operated more than 13.9GW at end December 2015 in ten countries. In addition, EDF EN is the leading operation-maintenance company in the United States through its subsidiary EDF Renewable Energy Services, managing close to 11GW in North America. Its position in Europe has been enhanced, exceeding 3GW at end-2015.

The growth in this activity is driven by the commissioning of new wind farms and by taking over wind farms operated by turbine manufacturers whose contracts, under the warranty, ended.

In 2015, a new subsidiary was established in the UK in partnership with EDF Energy.

**Decentralised Energy**

EDF Énergies Nouvelles Réparties (EDF ENR) is wholly owned by EDF EN. EDF ENR is now an integrated player in decentralised photovoltaic solar power generation, involved in the design, build, operation and maintenance of rooftop installations. EDF ENR Solaire, a wholly owned subsidiary, markets and installs photovoltaic solar power solutions in France, with more than 14,000 residential customers and over 900 projects delivered to business customers and local authorities.

EDF ENR also generates around 30MW of clean energy from more than 200 rooftop photovoltaic plants that it owns in mainland France.

In addition, EDF ENR is present in the upstream segment. The company owns 100% of EDF ENR PWT (Photowatt brand), which designs and manufactures photovoltaic panels. EDF ENR PWT operates in a difficult market characterised by strong competition and low module prices. Faced with this situation, a proactive action plan was implemented to improve the product offering of EDF ENR PWT, with a view to continually improving the performance of modules that, thanks to the fact that they are 100% French-made, have a low carbon footprint.

Lastly, EDF ENR is the controlling shareholder of EDF Store & Forecast (51% owned by EDF ENR and 49% by EDEV). EDF Store & Forecast, founded in March 2014, markets software solutions to forecast, plan and optimise automatic control of renewable energy generation and storage.

**1.4.2 SALES AND SUPPLY ACTIVITIES****1.4.2.1 Presentation of the market in France****1.4.2.1.1 Demand**

Domestic electricity consumption in France (including Corsica) for the 2015 fiscal year stood at 475.4TWh<sup>1</sup>, up 2.2% in comparison with 2014. After adjustments for the weather factor, it was up a modest 0.5%.

Domestic gas consumption amounted to 426.9TWh<sup>2</sup> in 2015, or a drop of 7.7% in comparison with 2014. After adjustment for the impact of climate, it was up 3.4%.

**1.4.2.1.2 Competition**

Since 1 July 2007, the French market has been fully open for electricity and gas sales: all customers are free to choose their energy providers. They may opt at any time, and without advance notice, for an offer at market price from the supplier of their choice.

Among the electricity suppliers on the French market, the main competitors of EDF are Engie, E.ON (Uniper, SNET), Enel and Direct Énergie. The main competitor, Engie, has more than 11 million gas and electricity customers in mainland France and is also the leading supplier of gas<sup>3</sup>. In the gas market and in the corporate and local authority customer segment, the other major gas suppliers are Tégaz, Eni, Gaz Natural, Gazprom, E.ON (Uniper, SNET) and Antargaz. In the gas residential customer segment, the principle suppliers are ENGIE, Direct Énergie and Eni.

As of 31 December 2015, according to the CRE, the electricity market shares in terms of sites of alternative suppliers, *i.e.* excluding historical suppliers, were 11.6% in the residential market, and 11.7% in the non-residential market, and a gas market share, in number of sites, respectively of 19.7% and 35.4%.

The 2010 NOME Law established certain rules for the supply of electricity and gas, the main provisions of which, codified today in the Energy Code, are the following:

- regulated electricity and gas tariffs are partially covered by provisions described for electricity in section 1.4.2.1.3 "Regulated electricity sales tariff contracts" below;
- regulated access to historic nuclear power (ARENH) was put into place to the benefit of EDF's competing electricity suppliers (see section 1.4.3.3 "Regulated access to historic nuclear power (*Accès Régulé à l'Énergie Nucléaire Historique*, or ARENH)").

In order to supply their customers, EDF's competing electricity suppliers had access in 2015:

- to their own generation capacities;
- to 16.1TWh under the ARENH mechanism;
- to 0.3TWh<sup>4</sup> made available by the EDF group through the intermediary of "capacity auctions";
- to imports;
- to the wholesale electricity market.

1. Source: 2015 Electricity report published by RTE.

2. Source: GRT gaz, 2015 report of consumption.

3. Source: engie.com website, presentation press kit of the Énergie Europe branch.

4. Value corresponding to the sum of the specific values, rounded to one decimal place.

### 1.4.2.1.3 Regulated electricity sales tariff contracts

#### Access to regulated electricity tariffs

Since the NOME Law entered into force in 2011, the situation for electricity, by category of customer, is as follows:

- domestic and non-domestic final consumers who have subscribed power for their site(s) not exceeding 36kVA: these customers benefit, upon their request, from regulated sales tariffs. They can switch back and forth between regulated tariffs and market offers, without a legal time limit;
- domestic and non-domestic final consumers who have subscribed power for their site(s) greater than or equal to 36kVA: since 1 January 2016, these customers no longer benefit from the regulated sales tariffs for consumption by these sites; any customer that hadn't switched to a market offering by that date is supplied by EDF, for a period of six months, in accordance with the conditions defined in chapter III of Article 25 of the Law of 17 March 2014 on consumption;
- domestic and non-domestic final consumers for their site(s) located in areas not connected to the continental metropolitan network: these customers receive regulated sales tariffs upon request.

Moreover, as part of its public service missions, EDF has, since 1 January 2005, been offering the electricity basic necessity tariff (*tarif de première nécessité*, or TPN), for which the eligibility criteria were altered in 2013 to open it up to more consumers and enable all electricity suppliers to offer it. The Energy Transition for Green Growth Law, provides certain provisions to combat energy poverty, with the practical details regarding implementation being left to decrees and orders:

- implementation of an energy cheque, on trial in certain regions from 2016, to replace the basic necessity tariff;
- enabling the remote display of electricity consumption.

At 1 August 2015, the increase, excluding taxes, of the regulated sales tariffs was on average 2.5% for the residential Blue Tariffs, 0.9% for the Yellow Tariffs, and 4% for the Green Tariffs, with the professional Blue Tariffs being unchanged, pursuant to the Order of 30 July 2015. This change was not identical within each tariff colour; it was modulated by option in order to better cover the costs of each one of them. In its opinion issued on 28 July 2015, the Energy Regulation Commission (CRE) disagreed with the level of the increase in the yellow and green tariffs, deemed insufficient to make up the under-coverage of costs in previous years prior to the end of regulated tariffs for sites that subscribed power greater than 36kVA. Moreover, another Order of 30 July 2015, which came into force on 1 August, relating to the tariffs for the sale of electricity to the LDCs, introduced an increase in those tariffs of 3.64%, starting from 1 August 2015.

### 1.4.2.1.4 Market-rate electricity supply contracts

In France, customers are free to leave the regulated sales tariffs at any time and without advance notice for an offer proposed by any other supplier.

With the exception of customers directly connected to the transmission network, who must sign separate supply and delivery contracts, all other customers may enter into a single contract with the supplier of their choice for their electricity supply and delivery.

### 1.4.2.2 The Customer Division

EDF's sales and supply activities in France are managed by the Customer Division.

#### 1.4.2.2.1 Presentation and supply strategy

In France, EDF markets energy and services to nearly 26.7 million customer accounts (excluding overseas and Corsica), or almost 33 million sites. The offers are developed and implemented in compliance with the market risk policy of the Group.

On the electricity market, EDF's sales in 2015 were 355TWh, which represents a market share of 77.4%. In 2014, sales were 353.8TWh and market share 78.8%.

EDF provides gas supply to all types of customers. In 2015, EDF marketed 22.6TWh of gas, which represented a market share of 5%, to more than 1.2 million customers. At the end of 2015 year, EDF was supplying gas to more than 1.1 million residential customers (in comparison with 1 million at end-2014).

In addition to electricity supply and gas offers, the Group assists its customers in all market segments, in their actions and their investments in energy efficiency and decentralised production. The EDF group is presenting energy efficient offers to its customers in order to make it possible for them to better control their energy expenditures, and offers to put them in contact with qualified partners.

This procedure meets the objectives of the Law for the Scheduling and Orientation of Energy Policy of 13 July 2005, and to the Grenelle 2 Law of 12 July 2010 (see section 1.5.6.1 "Basic regulations applicable to the environment, health, hygiene and safety"), as well as to the governmental objectives of thermal renovation of housing, what enables EDF to obtain energy savings certificates (*certificats d'économies d'énergie*, or CEEs) in exchange for actions realised with all of its customers. Put into place in 2006, this mechanism changed on 1 January 2015, particularly in order to contribute to the achievement of the objectives set by the directive of 25 October 2012 pertaining to energy efficiency: the national obligation for the third period (2015-2017) is set at 700TWhc, doubled in relation to the second period. In addition, the Energy Transition for Green Growth Law places energy suppliers under an obligation to facilitate energy savings for households in energy poverty. The regulations published on 30 December 2015 set a target of 150TWhc over 2016-2017.

Moreover, EDF is positioning itself as a major player in energy transition by its visible and sustainable territorial action. Furthermore, EDF is also supporting the roll-out of smart meters and is committed to promoting the futur smart electrical systems.

#### 1.4.2.2.2 Activity by customer category

##### 1.4.2.2.2.1 Residential customers

At the end of December 2015, EDF had 27.1 million residential electricity sites and 1.1 million gas customers in France. For fiscal year 2015, the volume of its sales rose to 133.8TWh of electricity and 10.6TWh of natural gas.

EDF is striving to sustainably develop the confidence of its customers, by accompanying them in order to make energy savings. When contacting EDF, 9 out of 10 customers state they are satisfied with the response, regardless of the channel or why they contacted the company. The customer experience offered, underpinned by ongoing innovation, is a mix of digital and human. There are now over 10 million customer spaces with close to 5,000 advisers to serve them.



**Energy supply**

EDF supplies electricity at the regulated sales tariff and as part of market offerings.

EDF also supplies 1.1 million customers with natural gas as part of market offerings.

EDF innovates for its residential customers and at the end of 2015 year, EDF launched the renewable offering, under which EDF guarantees that enough electricity from renewable sources will be added to the grid to cover the consumption of customers taking up this offer. In addition, for every megawatt-hour consumed, EDF will contribute two euros to the "Previnergy" research programme, focussed on forecasting renewable energy generation.

**Functionality and services**

To facilitate the management of energy contracts, EDF offers digital tools and services: "EDF & Moi" application, electronic invoice, "Relevé confiance" service, etc. In March 2015, EDF launched a new digital solution "e.quilibre", designed to provide customers with greater transparency regarding their energy consumption in kilowatt-hour and in euros (electricity and gas) and allowing them to compare it with similar homes.

EDF also offers energy savings advice on the website travaux.edf.fr, and has a network of almost 4,000 EDF home solutions partners to help residential customers to improve the energy efficiency of their homes. Customers can also access financing solutions from EDF's financial partner (Domofinance) to see through these plans.

**Earning of energy savings certificates (CEE)**

With respect to residential customers, CEEs are earned from the thermal renovation of the home, primarily based on a network of EDF home solutions partners.

For information relating to the regulatory framework concerning the CEEs, see section 1.5.6.1 "Basic regulations applicable to the environment, health, hygiene and safety".

**Solidarity policy**

Solidarity is a core value of EDF, which has been pursuing a policy dedicated to economically disadvantaged customers for close to 30 years (see section 3.2.3.6.1 "Contributing to the fight against energy poverty and energy access").

**1.4.2.2.2.2 Corporate and business customers**

EDF, operating under the EDF Entreprises brand, has 1.6 million corporate and business customers. For the 2015 fiscal year, electricity sales were 175.8TWh at the regulated sales tariff and at market prices, and sales of natural gas were 10.6TWh.

EDF Entreprises supports businesses and professionals so as to make them more competitive, in particular by helping them in reducing their energy bill. This action is in keeping with the environmental dimension of the sustainable development strategy of the EDF group, and also has as an objective to contribute to the performance of the French electricity system, in avoiding investments in order to cover spikes in electricity.

**The range of offers**

EDF Entreprises provides businesses and professionals with competitive tailor-made electricity and gas supply offers. Offers are varied depending on customer expectations and consumption patterns.

The electricity offers provided by EDF Entreprises enable small businesses, very small businesses and professionals to optimise their energy supply through simple contractual arrangements. They allow customers that consume more to choose the length of their commitment at the offered prices, depending on their needs in terms of budget visibility. Lastly, EDF Entreprises is able to tailor solutions for the heaviest users depending on the structure of their consumption.

EDF Entreprises, through the structure of its offers, encourages its customers to optimise consumption having regard to generation costs, by offering different prices at peak and off-peak hours, and even summer and winter prices for heavier users. For large customers with greater control over their consumption, EDF Entreprises offers to reward their ability to shed load on peak winter days, even including in certain instances remote management solutions.

EDF Entreprises allows all customers to choose electricity from renewable sources to cover their consumption, with a view to contributing to the energy transition. For small and medium sized enterprises and professionals, it involves a specific offer, the renewable energy contract, which guarantees that 100% of their consumption will come from electricity generated from renewable energy sources in France and facilitates their communication with their own customers regarding their commitment. In addition, for every megawatt-hour billed EDF will contribute one euro to fund renewable energy research projects or to develop new renewable energy electricity generation units. For larger customers, it involves an option that allows them to decide themselves what proportion of their consumption will come from guaranteed sources, between 20% and 100%.

EDF Entreprises also enhanced its range of services intended for all its electricity and gas customers, whether small companies or large industrial customers: online consumption monitoring, electronic invoice, assistance and troubleshooting, advice (optimisation of subscribed power, efficiency and reduction of energy expenses, etc.), in particular for customers who want to use an energy management system.

In order to always be as close as possible to the various expectations of its customers, EDF has put into place offers dedicated to large customers, not only with tailor-made electricity and gas supply offers and offers that reward customers that can shed load, but also support controlling their energy consumption and their CO<sub>2</sub> emissions as well as CO<sub>2</sub> trading for businesses subject to the national quota allocation plan (see section 1.5.6.1 "Basic regulations applicable to the environment, health, hygiene and safety").

**Customer satisfaction**

EDF Entreprises includes in its goals the satisfaction of its customers, to whom it listens and surveys on a regular basis both in terms of how offers match needs, the monitoring of requests, and the information and advice offered. In 2015, overall satisfaction rose 2 to 9 points depending on the customer segment compared with 2014 to 80% of customers very satisfied and rather satisfied.

**1.4.2.2.2.3 Local authorities, low-income housing agencies, Local Distribution Companies (LDCs) and public service providers**

Against the background of regional reform and the energy transition, EDF offers customised solutions for local authorities and public institutions with decentralised decision-making powers (hospitals, universities and major graduate schools, chambers of commerce and industry, CROUS student service centres, ports and airports).

EDF is active for these customers in five areas:

- as a competitive market operator:
  - the supply of electricity and gas at market price, responding to their energy problems (proposal of offers and solutions adapted to the needs described in calls for tender),
  - the development of offers and services with the sustainable city in mind: local climate plans, eco-districts, local generation, street lighting, electric mobility, energy efficiency of buildings, etc.,
  - the fight against energy poverty;
- with respect to its public service missions:
  - the signing of concession contracts for the "supply" portion in relation with ERDF for the "delivery" portion,
  - the supply of electricity at the regulated sales tariff.

EDF manages over 56,000 customers in this market this way. These customers all together represent approximately 1.2 million electricity sites, more than 281,700 of which are for social-housing lessors, for an annual consumption of 29.3TWh and close to 8,000 natural gas sites for an annual consumption of 1.4TWh. In addition to that are the 16.1TWh of electricity sold to the Local Distribution Companies (LDCs) in 2015.

In 2015, satisfaction with EDF Collectivités ranged from 81% to 88% depending on the segment. The quality of the relations with a dedicated contact person, guidance, responses to claims, and actions in matters of poverty are well received. 92% of customers have confidence in EDF Collectivités.

### Controlling energy

Agreements are signed with local authorities, pertaining to control of their energy consumption. In addition, certain communities are in effect self-endowed with competence in the area of energy, and arrange specific actions in their region in matters concerning control of energy demand and renewable energies. A "Load Amount" device for social-housing lessors aims to improve the energy efficiency of social housing, and makes it possible for EDF to issue energy savings certificates. In 2015, over 173,000 social housing units were helped, more than 162,700 of which were for renovation work.

#### 1.4.2.2.3 For sustainable cities and regions

The energy development of cities and regions is today naturally associated with sustainable development objectives: environmental impact, local economic activity and poverty constitute major preoccupations of local governments (see section 3.2.2.3.3 "Helping customers consume less, more efficiently").

#### 1.4.2.2.4 Public electricity distribution concessions

Public electricity distribution concessions cover two distinct missions:

- the development and the operation of public distribution networks under ERDF's responsibility (see section 1.4.4.2 "Distribution – Électricité Réseau Distribution France (ERDF)");
- the supply of electricity to customers benefiting from regulated sales tariffs connected to the public distribution networks throughout the territory of the concession, under the responsibility of EDF for mainland France, excluding the LDCs. This mission is carried out in compliance with the commitments of the concession specifications and general terms and conditions of sale (subscription terms, payment and delivery terms, contractualisation, etc.).

Each concession contract in mainland France is co-signed by EDF, ERDF and the licensing authority, and concerns a municipality or a grouping of municipalities. The public distribution of electricity is taking place in the framework of 580 concession contracts, 49 of which are at departmental level.

In 2014 and 2015, around twenty concession contracts were negotiated, in particular with the Seine-et-Marne and Vaucluse energy consortia, the Douaisis municipal association and the cities of Melun and Tours. Some twenty concession contracts will expire in 2016 and in 2017. An organisation and tools have been put into place, particularly in order to renew the concession contracts, mobilise both national and regional competences, develop the expertise of EDF's contacts in the contracting authorities, draw up each year the concession activity reports (CRAC) and respond to inspection requests from the granting authorities.

The upcoming period will be particularly marked by the implementation of the regulations on the content of concession activity reports set out in the Energy Transition for Green Growth Law (TEPCV) of 17 August 2015, and by work to modernise the model concession contract done in conjunction with national bodies representing the granting authorities.

The Energy Transition for Green Growth Law, together with the MAPTAM<sup>1</sup> and NOTRe<sup>2</sup> Laws, reaffirmed that metropolitan areas and urban communities can act as granting authorities for the distribution and supply of electricity at regulated sales tariffs. For the operator, this means broader dialogue on the concession contract, changes to said contract, its management with the urban communities, which now have an interest in such matters.

The Energy Transition for Green Growth Law in particular introduces provisions that rebalance the governance between rural and urban communities within departmental electricity consortia. EDF is preparing if needs be to renegotiate concession contracts at metropolitan area or urban community level should the latter wish to have a contract just for their area.

### 1.4.3 OPTIMISATION AND TRADING ACTIVITIES

#### 1.4.3.1 Role and activities of the Upstream/ Downstream Optimisation & Trading Division (DOAAT)

DOAAT is responsible for managing the balance of EDF's upstream/ downstream electricity portfolio, optimising the electricity gross margin created by this portfolio, as well as managing the associated physical and financial risks.

Management of electricity supply/demand can be broken down from real-time to three years in advance, within the framework set by the policies of extreme risk (volume risks) and of price risks, developed pursuant to the directives of the Group Risk Control Department, and validated by its Executive Committee (see section 2.1.2 "Risks associated to the Group's activities"). For example, a drop in temperature of 1°C in winter leads to an increase in the consumption of electricity in France in the region of 2,400MW<sup>3</sup>, and the amplitude of hydraulic generation between two extreme years may reach around 20TWh. Thus, in order to address the "volume risk", DOAAT ensures that it has, in all time frames, sufficient power margins in order to enable it to meet its commitments in nearly all situations. It possesses a set of leverage actions: scheduling of maintenance operations of generation means (in particular nuclear), management of inventory (fossil fuels, hydraulic reserves and customer load shedding), purchases and sales in wholesale markets via EDF Trading, which is in charge of market access on behalf of DOAAT (see section 1.4.6.3 "Optimisation and trading: EDF Trading"). DOAAT also manages the exposure of EDF's upstream/downstream portfolio to price variations in the energy wholesale markets (electricity, gas, coal, petroleum products) and in the CO<sub>2</sub> emissions licensing market, with the assistance of EDF Trading.

With respect to RTE, DOAAT plays the role of "balance responsible entity" on EDF's perimeter in mainland France. In this regard, EDF is committed to financially compensate RTE in the case of a deviation onto its balance group. The optimisation consists of communicating to RTE an offer schedule that is balanced with the demand for the day after, which makes it possible to minimise the supply cost of EDF's contractual commitments. In addition, DOAAT analyses and evaluates the impact on the physical and financial balance of the "generation-supply" portfolio (C+P) of regulatory and institutional changes.

1. Modernisation of regional public action and the consolidation of metropolitan areas (MAPTAM – modernisation de l'action publique territoriale et d'affirmation des métropoles).  
2. New regional organisation of the French Republic (Nouvelle Organisation Territoriale de la République – NOTRe).  
3. Source: RTE.



### 1.4.3.2 Long-term electricity purchase and sales contracts

EDF maintains commercial relations through numerous energy purchase or sales contracts with European operators.

These contracts are of many types, and confer:

- rights to the energy produced by facilities, primarily nuclear, in which the counterparties hold a participating interest over the duration of the exploitation of the facility (see section 1.4.1.1.1 "EDF's nuclear fleet" – "Generation allocation contracts");
- drawing rights for totally or partially guaranteed electrical power, for a duration generally comprised between 15 and 25 years.

### 1.4.3.3 Regulated access to historic nuclear power (Accès Régulé à l'Énergie Nucléaire Historique, or ARENH)

Operational since 1 July 2011, the ARENH mechanism entitles competing suppliers to buy electricity from EDF, once they have signed a framework agreement, at a regulated price and at volumes determined by the Energy Regulation Commission (CRE). This mechanism can also be accessed by network operators for their losses. The CRE is responsible for managing the mechanism and for calculating entitlements of which it notifies the co-contracting parties. Thus, suppliers wishing to exercise their right to access the ARENH submit a request to the CRE, sending it forecasts of their customers' consumption. The detailed forecasts, along with the entitlements calculated for each supplier, are only known to the CRE and the supplier. The payments are managed by the *Caisse des Dépôts et Consignations*.

The ARENH price is regulated. A draft decree setting out the methodology for determining the ARENH price was reviewed by the Higher Energy Council (*Conseil Supérieur de l'Énergie*) on 19 June 2014, and subsequently sent to the European Commission where it is currently being examined. Pending the completion of this work, the government decided in its press release of 4 November 2014 to keep the current ARENH price at €42/MWh.

Article L. 336-8 of the Energy Code provides for an assessment of the implementation of the ARENH mechanism and of its impact on competition and the operation of the wholesale market, in 2015 and subsequently every five years. This assessment is presented by the government to the Parliament on the basis of the reports from the CRE and the Competition Authority. At 31 December 2015, the findings of this assessment hadn't been released by the competent authorities yet.

### 1.4.3.4 Balance group dedicated to the Purchase Obligations and selling on the wholesale market

EDF is a mandatory purchaser of the electricity generated by the generation facilities the government wishes to support and develop (renewable energy sources and energy efficient cogeneration). By law (Article L. 121-7 of the Energy Code), the additional costs stemming from this obligation are offset for EDF on the basis of an electricity market benchmark price (concept of "avoided cost").

At its meeting of 9 October 2012 on the costs for 2011, the CRE indicated that: "In theory, the avoided cost should be reduced by the imbalance costs borne by EDF due to the unpredictable nature of a portion of the generation covered by the purchase obligation. Such imbalances, which were negligible in past years compared with consumption-related imbalances, are becoming more significant."

With the development of renewable energies, the cost generated by the difference between anticipated generation and actual generation has become significant. As a result, at its meeting of 16 December 2014, the CRE changed the formula for calculating EDF's avoided costs to include such imbalance costs. In order to make objective and independently identify such imbalances, the CRE asked EDF to establish a balance group dedicated to the facilities subject to a Purchase Obligations contract.

This dedicated balance group was established on 1 July 2015, and DOAAT is now organising the sale of energy generated by the facilities under a Purchase Obligations contract directly on the energy markets. This allows such energy to be managed independently of EDF's own portfolio. Thus, since 4 November 2015, electricity volumes under Purchase Obligations that can be forecast over the short-term (one day for the next, known as the "random component of the Purchase Obligations") are sold on EPEX Spot. Since January 2016, volumes that can be forecast over the long-term (known as the almost certain component of the Purchase Obligations) are sold under transparent, non-discriminatory calls for tender.

### 1.4.3.5 Preparation of the future capacity mechanism

Articles L. 335-1 et seq. of the Energy Code, which are taken from the NOME Law (New Organization of the Electricity Market – *nouvelle organisation du marché de l'électricité*), obligate each electricity supplier to contribute to the security of electricity supply on continental metropolitan territory, in light of its customers' energy consumption patterns. Each supplier must therefore provide guarantees of load shedding and electricity generation capacities, which can be implemented to ensure balance between generation and consumption, in particular at peak periods.

To comply with this obligation, each supplier must therefore get capacity guarantees from producers, which must certify all their means of generation, or from demand response managers.

A new market will come into being to back such transactions with capacity guarantees. The mechanism thus creates a new commodity that, for EDF, is managed by DOAAT.

The first year of delivery is expected to be the 2017 calendar year, although there is currently a possibility that the implementation of the mechanism will be delayed.

In 2015, DOAAT certified most of EDF's means of generation for the 2017, 2018 and 2019 delivery years. Similarly, it is carrying out those for the means of generation under Purchase Obligations. DOAAT is preparing to operate in this newly created market in 2016 once the public authorities have approved the start of trading, against the background of the European Commission's announcement that it had started a formal investigation into the French capacity mechanism. This market will allow EDF to manage its annual positions established for each delivery year by its obligation volumes and its certified volumes.

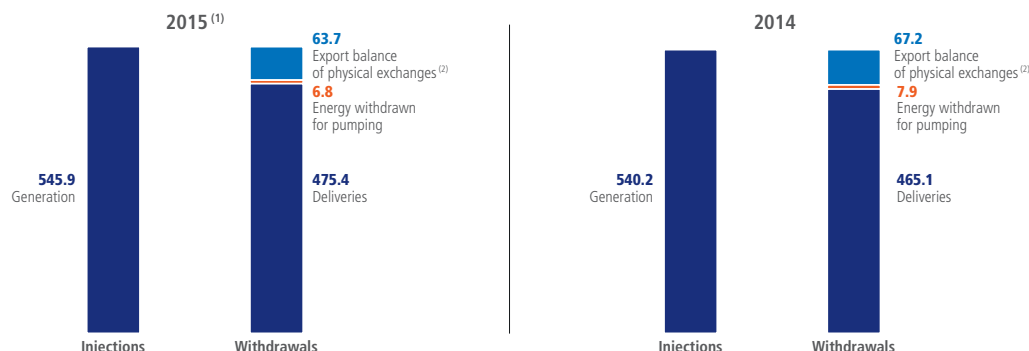
## 1.4.4 REGULATED ACTIVITIES IN FRANCE

### 1.4.4.1 Transmission – Réseau de Transport d'Électricité (RTE)

Created on 1 July 2000 and a subsidiary since 1 September 2005, RTE (the Electricity Transport Network) is the owner and operator of the French electricity transmission network, which it operates, maintains and develops. With over 100,000 kilometres of high and extra high voltage circuits and 50 cross-border lines, this is Europe's largest network. Its geographical location places it at the core of the European electricity market. RTE guarantees the correct operation and safety of the electricity system, and provides free and fair access to all the network users. The company also pays special attention to supporting the development of renewable sources of energy in France and their integration into the electricity system, which requires the development of the transmission network and interconnections.

RTE is wholly owned by EDF, but due to its specific conditions of governance (see section 1.4.4.1.2 "Organisation of RTE"), RTE wasn't fully consolidated by the Group but rather consolidated using the equity method. It should be noted that 50% of its shares were allocated to the asset portfolio dedicated to financing the dismantling of nuclear power plants.

## SIMPLIFIED REPORT OF ENERGY FLOWS ON THE RTE NETWORK



(1) Provisional data (the final data on electricity generation for 2015 will be available on RTE's website in July 2016: [www.rte-france.com](http://www.rte-france.com)).  
(2) Including water rights and exchanges via distribution network.

### 2015 energy balance

2015 was generally a warm year in France, although less than in 2014. Accordingly, gross consumption in mainland France settled at 475.4TWh, a 2.2% increase on 2014.

The peak annual electricity consumption occurred during a cold spell with 91.6GW on 6 February 2015, similar to levels in 2011 and 2013. Although the 2012 thermal regulations will moderate future temperature sensitivity, the sensitivity of consumption to temperature remains around 2,400MW/°C in winter.

Adjusted for climate factors, consumption outside the energy sector, which had been stable for three years, rose a modest 0.5% to 476.3TWh. Due to the growing penetration of renewable energies in the distribution networks, the change in withdrawals adjusted for climate factors on the RTE network no longer necessarily matches the consumption side, and has been falling since 2011 (-0.6% in 2015 compared with 2014).

Industrial consumption is similar to the past three years at 67.6TWh, masking varying trends across sectors.

France continues to have a trade surplus with Switzerland (13.9TWh).

The trade surplus was 19.7TWh with Italy, where the interconnection is saturated 78% of the time, and 14.1TWh with the United Kingdom, where the interconnection is saturated 86% of the time. New interconnection projects are in particular being planned on these two borders.

#### 1.4.4.1.1 Overall environment

##### Renewable energies continue to grow in order to foster the energy transition

Wind power exceeded the threshold of 10,000MW of installed capacity in 2015. Wind power generation was up 23.3% (to 21.1TWh) on 2014, and maximum wind power capacity exceeded 5,500MW every month of the year. A new record hourly wind generation was even set at 1 p.m. on 29 March 2015, with a capacity of 8,266MW, representing a load factor of 86.3%, while daily generation peaked on 29 November 2015 (at 184GWh).

In 2015, 895MW of solar capacity was connected in mainland France, raising installed solar capacity to 6,200MW. Around a quarter of this increase stems from the commissioning, in September 2015, on the RTE network of the Constantin farm at Cestas in Gironde, currently the largest photovoltaic solar farm in Europe.

##### French exports remain high due to continued low prices

The balance of trade is positive across all French borders. It totalled 61.7TWh, exceeding the 60TWh threshold for the third time in the past ten years. The new Baixas – Santa Llogaia interconnection, which has gradually been put into commercial operation since 5 October 2015, increases the transit capacities with Spain. France's trade surplus with Spain was 7.3TWh.

#### 1.4.4.1.2 Organisation of RTE

RTE is a public limited company (*société anonyme*) with an Executive Board and Supervisory Board.

RTE's Supervisory Board is comprised of twelve members appointed for five years:

- eight members appointed by the Shareholders' Meeting:
  - four government representatives, including the State as a legal entity, represented by an individual,
  - four representatives of the shareholder;
- four members elected by the staff.

A Government Commissioner was also appointed and attends Supervisory Board meetings in a consultative capacity.

RTE's Executive Board is made up of five members, who perform their work under the supervision of the Supervisory Board, within the limits fixed by the French Energy Code and RTE's articles of association. After the consent of the Energy Minister, the Supervisory Board appoints the Chairman of the Executive Board and upon the latter's proposal, it appoints the other members of the Executive Board.

#### 1.4.4.1.3 RTE's activities

In France, RTE manages the public transmission network and carries out its missions under the conditions set out in model specifications approved by applicable decree until 2051. In accordance with the French Energy Code, transmission network operators must be certified according to a process associating the CRE and the European Commission, which aims to ensure that the entity concerned fulfils the conditions of independence set out by this text. RTE was certified by the CRE in 2012.

Thus RTE manages the transmission infrastructure, guarantees access to the transmission network and manages energy flows.

RTE has to face various challenges in its mission as operator of the power transmission network: integration of the European market, extensive restructuring of the generation fleet, societal changes reinforcing the constraints of integrating new infrastructure of general interest and maintenance of its industrial facilities for meeting the requirements of customers and the community. To meet the requirements, RTE, with the consent of the CRE, marked a new stage in terms of investments: investments were increased to more than €1 billion annually between 2009 and 2013, and more than €1.3 billion per year in 2014 and 2015. To perform its missions, RTE has its own resources, consisting mainly of the tariff paid by the network users. This tariff is established in a non-discriminatory manner in order to cover all of RTE's costs, provided that these costs correspond to costs for an efficient transmission manager, and fair return on the capital invested across all the investment programmes approved by the CRE (see section 1.4.4.4 "Tariffs for Using the Public Electricity Transmission and Distribution Networks (TURPE)").

#### 1.4.4.1.3.1 Management of the transmission infrastructure

##### **Maintenance**

RTE manages the assets of the transmission network through daily maintenance, emergency repairs and replacement of structures that are at the end of their useful life or are damaged.

Following the storms of 1999, RTE implemented a mechanical safety programme, which is now almost complete. Overall, from now until the end of the programme in 2017, RTE should have dedicated a total of €2.4 billion on making its network mechanically secure at an average expense of around €160 million a year. This programme concerns 45,000 kilometres of aerial lines of the RTE network.

In 2015, equivalent outage time for RTE customers was 7mn 02s. This result incorporates the consequences of the heat wave that caused a whole series of faults on instrument transformers between 30 June and 4 July 2015, resulting in significant outages for customers. These events, which on their own accounted for 5mn 44s of outage time, obscure the good results achieved otherwise.

##### **Development and realisation of new investment in the transmission network**

Furthermore, RTE continues to develop and renew the network. The projects studied and implemented fall within the dynamics of the growing need to meet the challenges of energy transition. RTE draws up an annual investment programme that is submitted to the CRE. In 2015, RTE's total investments amounted to €1,402 million (within the scope regulated by the CRE). The main investments involved the reconstruction of the 400kV Charleville-Reims line, the commencement of construction work on the French side of the direct current link between France and Italy (Savoy-Piedmont) passing through the Fréjus safety tunnel, the completion of construction work on the direct current line reinforcing the interconnection between France and Spain in the eastern Pyrenees (the commercial capacity of which was put on the market in October 2015), along with the ongoing work to replace conductors making it possible to secure flows along the 400kV Montélimar-Lyon line. Almost 30% of investments in network structures involved restoration aiming at maintaining service quality.

RTE's 2016 investment programme approved by the regulator amounts to €1,550 million. The 2016 investment programme concerns the continuation of significant investment in developing and renewing the network, as well as developing and updating the IT systems, in particular in light of the changing environment associated with the energy transition and European market integration.

RTE's investments are also made in a context of growing needs for meeting the challenges of maintaining the power supply security level, acceptance of new generation means (including intermittent renewable sources of energy), integration of European electricity markets and gradual increase in the need to renew infrastructures.

In 2015, the Regulated Assets Base (RAB) increased by €411 million, up from €12,826 million as at 1 January 2015 to €13,237 million as at 1 January 2016<sup>1</sup>. For the record, the RAB is remunerated by the tariff at the Weighted Average Cost of Capital (WACC) of 7.25% before taxes. It represents RTE's industrial assets, after deduction of investment subsidies, and is calculated excluding property, plant and equipment in progress (which until the end of 2012 were remunerated at 4.8% by the TURPE 3 tariff, and are at 4.6% for the period from 2013-2016 in accordance with the CRE's pricing decision of April 2013).

#### 1.4.4.1.3.2 Management of energy flows

##### **Cost allocation**

The cost corresponding to the adjustments made by RTE and due to the negative differences between the projected flows and those already realised is passed on to the "Balance responsible entities" (producers, traders, suppliers, etc.) in proportion to their difference. In the case of a positive difference, RTE compensates the balance responsible entities financially.

##### **Interconnections**

RTE manages access to international interconnections in collaboration with the neighbouring European transmission network operators. These interconnections make it possible to ensure the transit of energy from one country to another and the operating safety of the electricity transmission networks, to develop the European electricity market, by enabling an electricity supplier to sell its energy to a customer in another European Union country, by taking advantage of the differences in the timing of peak load on either side of the border, and to better pool the means of generation at the European level.

##### **France-Spain interconnection**

INELFE (Electric interconnection between France-Spain), a Franco-Spanish company owned 50/50 by RTE and its Spanish counterparty REE (Red Eléctrica de España), was created in October 2008 to carry out the whole interconnection project between the two countries. A new ±320kV line was commissioned in October 2015, doubling the prior electricity exchange capacity between the Iberian peninsula and the rest of Europe, from 1,400MW to 2,800MW.

An agreement signed in 2011 between the European Investment Bank (EIB), INELFE, REE and RTE, provided for EIB's participation in financing the project through a €350 million loan granted to the two network managers, contributing half of the total €700 million budget. Furthermore, financing of the interconnection received a €225 million subsidy granted by the European Union in accordance with the EEP programme (European Energy Program for Recovery).

##### **Network coordination in Europe**

In December 2008, RTE and ELIA<sup>2</sup> created a common company named Coreso, which aims to coordinate the operation of electricity networks comprising France and Belgium. The creation of Coreso fulfils the need of reinforcing the operational coordination between transmission network operators (TNO) expressed both by the European Commission and by the players of the electricity market. Coreso must allow better integration of the original renewable energy generation at the regional level and guarantee secure management of rising cross-border flows.

1. Amounts still to be confirmed by the CRE, calculated on the basis of what has been realised.

2. Elia is the Belgian high voltage electricity transmission network operator (30,000 to 380,000 volts).

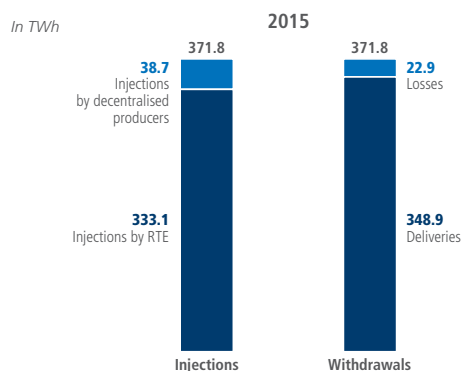
National Grid, the British network operator, Terna and 50 hertz, transmission network operators in Italy and Northern and Eastern Germany, and more recently REN, the Portuguese network operator, joined Coreso.

#### 1.4.4.1.3.3 RTE's international activities

RTE International, a subsidiary of RTE created in September 2006, is RTE's interface for all engineering and consultancy services outside France, in response either to invitations to call for tenders or individual solicitations.

RTE pursues a strategy of development and geographical diversification of its international services.

### ELECTRICITY VOLUMES ON THE ERDF NETWORK



Electrical losses are inherent to the distribution network and mainly result from physical effects which are directly dependent on the amount of electricity delivered. ERDF must compensate these losses to complete the amount of energy delivered to the final customers. In 2015, losses amounted to 22.9TWh, i.e. a rate of 6.2% of electricity injected into the network. The cost borne by ERDF to offset losses in 2015 was €1,137 million. To compensate these losses, ERDF buys the corresponding electricity from the wholesale market, either through organised market platforms, or through calls for tender open to around 20 qualified suppliers. Since 2014, ERDF benefits from ARENH deliveries for its electricity purchases to offset its losses, up to around 6.4TWh in 2015.

Technical specifications: the distribution network ERDF is the concession holder of (see section 1.4.4.2.2 "Distribution activities") is, at 31 December 2015, made up of around:

- 631,400 kilometres of A-type high-voltage (HVA) lines of 20,000 volts;
- 709,500 kilometres of low-voltage (LV) lines of 400 volts;
- 2,251 HVB/HVA source substations;
- 774,500 HVA/LV transformer substations.

#### 1.4.4.2.1 Organisation of ERDF

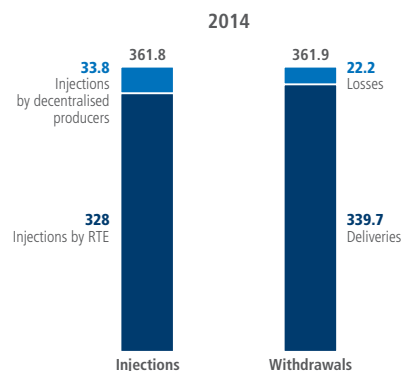
Distribution activities on French soil are, pursuant to the legal framework, almost exclusively conducted by ERDF, a French public limited company (*société anonyme*) with an Executive Board and a Supervisory Board responsible for the management of the public electricity distribution network.

#### 1.4.4.2 Distribution – Électricité Réseau Distribution France (ERDF)

ERDF's main objective is to operate and develop the public electricity distribution network, guaranteeing its security and safety, and overseeing the balance of electricity flows at all times. ERDF, a wholly owned EDF subsidiary in charge of the distribution business, has been operational since 1 January 2008. It services around 95% of the continental metropolitan population. The remaining 5% are provided by Local Distribution Companies (LDCs).

In 2015, ERDF provided electricity to over 35.6 million customers (delivery points) in mainland France through a network of about 1.3 million kilometres.

At 31 December 2015, ERDF employed 39,033 people.



Pursuant to Directive no. 2003/54/EC, the principles of which are applied in Directive no. 2009/72/EC of 13 July 2009, when the manager of the public distribution network is part of a vertically integrated company, its organisation and decision-making must be legally independent from other activities not related to distribution. Within this framework, the principle adopted by EDF and Gaz de France, now Engie, led them to spin out their distribution network. The two subsidiaries ERDF and GRDF share a "common service" pursuant to the legal framework (see section 1.4.4.2.3 "Service shared by ERDF and GRDF").

Pursuant to the Law of 9 August 2004, the business of public electricity distribution network operator was turned into a subsidiary in 2007.

The ERDF Supervisory Board is made up of 15 members, eight of whom are appointed by the Ordinary General Meeting, five of whom are employee representatives elected in accordance with the provisions of Law no. 83-675 of 26 July 1983 on the democratisation of the public sector, and two of whom are State representatives. The ERDF Executive Board is made up of five members who perform their work under the supervision of the Supervisory Board.

In application of the option provided for in Order no. 2014-948 of 20 August 2014 (Article 15) and pursuant to Decree no. 2015-38 of 19 January 2015, the State appointed, through a decision of 4 February 2015, a Government commissioner to attend the sessions of the ERDF Supervisory Board.

In few months, ERDF will change its branding name. This new name will reflect the company's strong commitment to the energy transition in the wake of COP 21. This will also enable the electricity distribution network operator to raise its profile and clarify its mission, as intended by the CRE.

**ERDF missions in France**

ERDF, pursuant to the conditions set by law and the concession contracts signed with each of the public electricity distribution contracting authorities (see section 1.4.4.2.2 "Distribution activities"), performs its missions as the public distribution network operator in mainland France.

These missions are:

- define and implement operational, investment and development policies in relation to the electricity distribution network;
- provide connection and access for users to these networks under objective, transparent and non-discriminatory conditions, as well as inter-connection with other networks;
- provide users with the information needed to access the network efficiently (information protected by regulations or law excepted);
- oversee relations with the energy regulation authorities (Ministry of Energy, the Energy Regulation Commission (CRE – *Commission de Régulation de l'Énergie*), public distribution contracting authorities) in line with its activities;
- oversee relations with local authorities;
- negotiate, conclude and manage concession contracts;
- operate, service and repair the electricity distribution networks;
- design and build infrastructure, as well as manage work on the networks;

- carry out metering activities for users connected to the networks, particularly as regards supply, installation, meter inspection, maintenance and renewal of metering devices, as well as managing data activities and any other missions relating to its work as a whole;
- provide services for the LDCs, distributors and organising authorities mentioned respectively in sections III and IV of Article L. 2224-31 of the French Local Authorities Code.

**1.4.4.2.2 Distribution activities**

ERDF's business is based on a number of activities: manage, in its capacity as the concession holder, the assets under concession; run and maintain the network in such a way as to ensure the continuity of supply; carry out work on the network (in particular, network connection, reinforcement and renewal work); provide access to the network to all users in the framework of contractual provisions in force; and manage the meter fleet, as well as obtaining, processing and transmitting data on network user consumption.

**Change in investments**

In 2015, ERDF invested €3.2 billion, €1.4 billion of which were mainly devoted to connections for new customers and producers, as well as to the reinforcement of the network. In addition, the contracting authorities invested €789 million in 2015. In all, almost €4 billion were invested on the distribution networks in 2015 in mainland France.

**GROSS INVESTMENTS OF ERDF**

(in millions of euros)	2015	2014
Connections and reinforcement	1,396	1,501
Regulatory, safety and transmission channel obligations	370	397
Network modernisation	1,089	979
Work instruments and operational resources	315	330
<b>Total ERDF investments</b>	<b>3,170</b>	<b>3,208</b>
Work allowances by third parties and local authorities <sup>(1)</sup>	789	833
<b>TOTAL NETWORK INVESTMENTS</b>	<b>3,959</b>	<b>4,041</b>

(1) After deducting PCT<sup>1</sup> and Article 8<sup>2</sup>.

The supplementary resources thus committed are devoted to the quality of service provision, to securing the networks, to safety, and to the preservation of the environment, areas where the identified expectations of customers, local authorities and contracting authorities are particularly high.

This level of investment allows ERDF to carry out asset renewal programmes.

To complement these investments, ERDF continues to increase the budgets for the preventative maintenance of networks, in particular for work relating to downsizing. This budget amounted to €342 million in 2015 (versus €334 million in 2014 and €273 million in 2013).

**The Public Service Contract and environmental and aesthetic concerns**

In order to meet the objectives of the Public Service Contract as well as environmental and aesthetic objectives, ERDF committed to burying 90% of new A-type high-voltage (HVA) lines and to using a "discreet technique" (twisted cable on building façades) for two-thirds of new low-voltage (LV) lines. ERDF does not intend to bury the entire network. Like an overhead network, an underground network remains subject to power outage risks: it can suffer from external assaults (heat waves, flooding, works, etc.) and the time needed to locate an incident and resupply customers is generally longer than in the case of an overhead network.

1. PCT (Portion Covered by the Tariff): portion paid to project manager contractors from the contributions to the delivery tariff for financing a connection.  
2. Article 8 of Annex 1 of the concession specifications relating to the integration of works into the environment (for example the works to bury lines).



In 2015, ERDF built over 98.2% of new underground medium-voltage lines and over 80.8% of new underground or discreet low-voltage lines. It thus went beyond its commitment to the State regarding the reduction of the visual impact of networks installed under its supervision.

### Quality of service

Quality of service is one of ERDF's main objectives. In 2015, the average outage time excluding transmission incidents and excluding exceptional incidents was 61.1 minutes. This is the best result in ten years. The quality of service provided is also reflected by maintaining steady voltage levels, kept as close as possible to the level set by regulations, and by minimising the number of outages.

As regards the quality of voltage, in 2015 over 99% of customers were considered as "well supplied" in terms of the regulations in force.

To respond to large scale incidents, ERDF relies on a Rapid Intervention Force (FIRE) which allows it to mobilise, at any time, in an affected region, the teams and resources from other regions in order to restore customers' electricity as rapidly as possible. In 2015, the FIRE team was mobilised in early July to repair the underground networks affected by the heat wave in the Île-de-France, Provence - Alpes - Côte d'Azur and Lyon regions, and subsequently at end-August, following the storms that affected the South-West.

As regards insurance cover for the protection of the overhead distribution network against the effects of large scale storms, see section 2.2.7.5.3 "Storm cover".

### Development of renewable energies

Across the scope of ERDF activities, the number of photovoltaic generation facilities connected to the grid increased once again: at the end of 2015, 5,217MW from photovoltaic facilities were connected (compared with 4,590MW at the end of 2014), which represented around 338,000 facilities (versus 321,000 at end-2014). The development of wind power generation connected to the public distribution network also continued, and more than 9,191MW were connected at the end of 2015.

At end-2015, a total of 14.4GW in photovoltaic and wind power generation was connected to the ERDF grid, respectively made up of 5.2GW from photovoltaic plants and 9.1GW from wind power generation. To the power thus generated are added other sources of power generation, in particular "historical" hydropower plants (1.5GW), cogeneration (1.8GW), biogas, biomass and dispatchable fossil-fuel thermal. In all, at the end of 2015, the generation fleet connected to ERDF was around 19.3GW.

### Electricity market

The French electricity sales market has been open to competition for all customers since 1<sup>st</sup> July 2007.

36 electricity suppliers operate on the French market. They have signed a contract with ERDF establishing the terms and conditions for the supplier and the distributor in the event that a customer subscribes to a single contract covering the supply and delivery of electricity.

ERDF took steps to achieve, for sites with subscribed power in excess of 36kVA, the end of regulated sales tariffs and their transition to market offers. To this end, ERDF put in place a national project structure designed to adjust metering to market offers by the deadline. The main projects underway involved the supplier change procedure, the roll-out of operating procedures, the roll-out of meters, the adaptation of IT systems and the preparation for a burst in activity at the end of 2015.

### Concessions

At 31 December 2015, ERDF and EDF were co-concession holders of 580 concessions contracts, covering around 95% of the population.

In France, public electricity distribution is operated under a concession plan that derogates from common law on local public service concessions. Pursuant to the provisions of the law, contracting authorities own the distribution networks, which are return property<sup>1</sup>. The concession contracts are generally concluded for a period of 20 to 30 years.

The development and the operation of public distribution networks (streamlined service for the country by the public distribution networks; connection and access, under non-discriminatory conditions, to the public distribution networks) are entrusted, pursuant to the French Energy Code (Article L. 121-4), to ERDF, to EDF in areas not inter-connected to mainland France, and to LDCs in the areas where they are exclusive service providers.

Pursuant to Article L. 334-3 of the French Energy Code, ongoing concession contracts are considered as jointly signed by the contracting authority (local authority or public cooperation institution), by EDF (or territorially competent LDC) for the regulated tariff supply portion, and by ERDF (or territorially competent LDC) for the distribution network portion. When concession contracts are renewed or amended, they are co-signed according to these terms.

See also section 1.5.6.2.7 "Regulations that are applicable to public markets".

#### 1.4.4.2.3 Service shared by ERDF and GRDF

The service shared by ERDF and GRDF, defined by Article L. 111-71 of the French Energy Code, sets out, in the electricity and gas distribution sector, to build installations, manage works projects, operate and provide maintenance for the networks, and conduct metering operations. It does not have the status of a legal entity.

ERDF and GRDF are related through a convention that sets out their relations in the framework of this common service, the scope of said service and the sharing of costs resulting from it. Concluded for an open-ended period, it can be revoked at any time, provided a prior notice of 18 months is given, during which the parties commit to renegotiating.

In November 2011, ERDF and GRDF signed a protocol agreement describing each distributor's role in the target vision of a common service organisation. The opening of markets and the differentiation of processes led to changes and specialisation of the organisation of certain activities. To date, ERDF has favoured organisation through the regional directorates integrating all its operational missions at local level. A more detailed fabric is reserved for local activities. Certain activities, such as metering and logistical activities, are carried out in common in view of the resulting efficiency gains generated.

#### 1.4.4.2.4 Future challenges (replacement, development, smart meters)

##### Smart grids and smart meters

ERDF, guarantor of the electricity distribution public service, invests at all times to develop, modernise and secure the electrical network. The adaptation of the electricity grid to the new needs of society is a major strategic challenge. To achieve this, ERDF is developing the Linky system, based on a new generation of meters, called "smart meters" that can receive orders and send data without the physical involvement of a technician. This system is the first stage of the smart grids.

1. Return property is that which is essential to carrying out the licensed service. Such property is deemed as belonging to the contracting local authority from the start. The concession contract foresees their mandatory restitution to the contracting local authority at the end of the concession.

After a successful pilot phase, which was validated by the public authorities, almost 300,000 Linky meters are in operation in Lyon and Touraine. On 1 December 2015, ERDF started the first phase of the Linky meter roll-out. The first phase consists of installing 3 million meters between December 2015 and the end of 2016 year. The goal is to replace 90% of the old meters in 35 million homes in France by 2021.

### Foster energy transition

Concurrently, ERDF is conducting large scale testing of a number of solutions to provide a deeply modernised network to consumers and companies. This research and development work covers the operation of low- and medium-voltage networks, the integration of renewable energies and electric vehicles, storage management, voltage stability, etc. ERDF is steering and/or supporting around 15 demonstrators in France and Europe with a diverse set of partners – industrialists, SMEs, start-ups and universities. The challenge for the distributor is to support energy transition while developing the networks at the lowest cost for society. Thanks to new technologies, a more detailed and responsive oversight is possible, based on a better understanding of consumption, generation and the state of the network. This “intelligence” makes it possible to avoid over-investment by adjusting it to consumption peaks, while guaranteeing the reliability of the network, pursuant to ERDF's double public service objective of performance and security.

Since the end of 2011, ERDF has coordinated the “GRID4EU” programme. This programme brings together a consortium of six European distributors (ERDF, Enel, Iberdrola, CEZ, Vattenfall and RWE); it contributes to exploring the potential of smart grids in the fields of renewable energy integration, electric vehicle development, network automation, energy storage, energy efficiency and disruption solutions.

### 1.4.4.3 Island Energy Systems

Island Energy Systems (IES) cover the electrical systems operated by EDF which are not inter-connected, or are marginally connected, to the mainland: mainly Corsica, the overseas departments (excluding Mayotte) and the overseas territories of Saint-Barthélemy, Saint-Martin and Saint-Pierre-et-Miquelon.

This situation notably implies that generation surcharges, which the legislator considers as a public service expense, are offset by the Contribution to the Public Electricity Service (see section 1.5.2 “Public service in France”).

EDF's organisation in each of these regions is therefore based on maintaining an integrated structure, providing both most of the generation and the entire range of functions of supply and demand balance manager, of network manager (HVB, HVA and LV) and of supplier.

EDF is the main actor in these regions in terms of electricity generation.

### MAIN CHARACTERISTICS OF THE IES

	At end-2015	
	Total	of which Corsica
Number of EDF employees <sup>(1)</sup>	3,374	750
Number of customers	1,119,620	249,209
Network length (in km)	35,869	11,461
Installed capacity of the EDF fleet (in MW)	2,123	585
of which hydropower fleet and other renewable energy sources	456	197
of which thermal fleet <sup>(1)</sup>	1,667	388
EDF output <sup>(1)</sup>	5,742	1,308
of which hydropower output	1,268	303
Energy purchases from third parties	3,966	918
of which renewable energies, including bagasse	1,281	226
of which other energies	2,684	691
<b>TOTAL ENERGY PRODUCED BY EDF AND PURCHASED FROM THIRD PARTIES</b>	<b>9,708</b>	<b>2,226</b>

(1) Data including EDF Production Électrique Insulaire (PEI), a wholly owned subsidiary of the EDF group, which is in charge of renewing the thermal plants in Corsica and overseas. The 48MW reduction in the thermal installed capacity in 2015 compared with 2014 was due to the commissioning of the final engines at Pointe Jarry, offset by the complete decommissioning of the IES engines at Jarry Nord (Guadeloupe) and the decommissioning of combustion turbine 11 at Dégrad-des-Cannes (French Guiana).

In view of the difference within these systems between the megawatt-hour generation costs and the sale price at the equalised tariff, EDF's sales activities look to implement, alone or in partnership with the Agency for Environment and Energy Management (*Agence de l'Environnement et de la Maîtrise de l'Énergie* or ADEME) and local institutions, energy efficiency actions.

## Changes and outlook

### Investments to modernise and reinforce the electricity generation fleet with guaranteed capacity

The 2009 Multi-year Electricity Generation Investment Programme (PPI) set the objective of implementing electricity generation at guaranteed capacity for Corsica and the overseas departments at 1,166MW by 2020. The 2009 PPI moreover foresaw the renewal of almost all the existing diesel plants.

The EDF group thus undertook to replace its main end-of-life plants, also built and operated by the EDF PEI subsidiary.

The four diesel plant construction projects were successfully completed between 2012 and 2015, involving a total capacity of close to 750MW: Port-Est in Réunion, Bellefontaine B in Martinique, Pointe-Jarry in Guadeloupe and Lucciana B in Northern Corsica. These new generation resources, equipped with innovative technologies, will allow the Group to deliver better industrial and environmental results and contribute to satisfying a part of the emerging electricity demands in these regions.

In addition, the Saint-Pierre-et-Miquelon plant (21MW), was refurbished in 2015 and inaugurated on 26 November 2015.

The extension to the Saint-Barthélemy plant (two new 16MW engines) has been operational since 2014.

The construction of the Saint-Martin plant is ongoing, with completion scheduled for the first half of 2016.

EDF invested €158 million in IES electricity generation in 2015.

### Investments in electricity networks

The continued growth in consumption in these regions despite the energy efficiency actions undertaken, as well as the development of renewable energies, have led the EDF group to continue the reinforcement of the electricity networks. In Corsica as in the overseas departments with natural fleets, some of the new high-voltage connections will be built using underground or underwater techniques.

EDF thus invested €175 million in networks in 2015.

### A commitment to projects devoted to a better integration of renewable energies in the electricity generation mix and to optimising the management of electrical systems

The EDF group supports the emergence and development of electricity generation methods based on renewable energies adapted to IES. The methods favoured are those that provide abundant and guaranteed energy

at competitive generation costs sustainable in the long term, in such a way as to position them as credible alternatives to thermal generation: biomass, marine and river energies, waste recovery, biogas. Studies are also underway on the use of LNG to substitute fuel oil.

EDF also contributes to making advances in technical capacities relating to the insertion of intermittent renewable energies into IES and is committed to experimental projects on smart grids in partnership with other industry actors, research laboratories and the ADEME.

### 1.4.4.4 Tariffs for Using the Public Electricity Transmission and Distribution Networks (TURPE)

#### Tariff for using the public electricity transmission network

Pursuant to Article L. 341-3 of the French Energy Code, the tariff for using the public electricity transmission network is set by way of a reasoned decision of the CRE. The current tariff for using the public transmission network (TURPE 4 HVB), set by the CRE decision of 3 April 2013, came into force on 1 August 2013.

RTE's tariff revenues were thus up 2.4% at 1 August 2015. This tariff will be changed on 1 August 2016 taking account of the impact of the mechanisms created by the Energy Transition for Green Growth Law. As the TURPE 4 HVB was meant to apply for a period of around four years, the CRE began working on a new tariff for using the public electricity transmission network (TURPE 5 HVB), which will come into force in summer 2017.

Financial compensation of RTE's assets is obtained by multiplying the amount of the regulated assets base (RAB), estimated at €12,826 million at 1 January 2015, by a fixed rate of compensation corresponding to a nominal rate before tax of 7.25% for the 2013-2016 tariff period. In addition, the repayment to network users of overpayments prior to 2013, via regulation mechanisms, moderates the tariff.

On this basis, in 2015, network access tariff revenues were around €4,085 million for the electricity transmission network, revenues from services €95 million and revenues from interconnections €460 million.

As regards the transmission and distribution of natural gas (Law no. 2003-08 of 3 January 2003), see section 1.5.3.2 "French legislation: Energy Code".

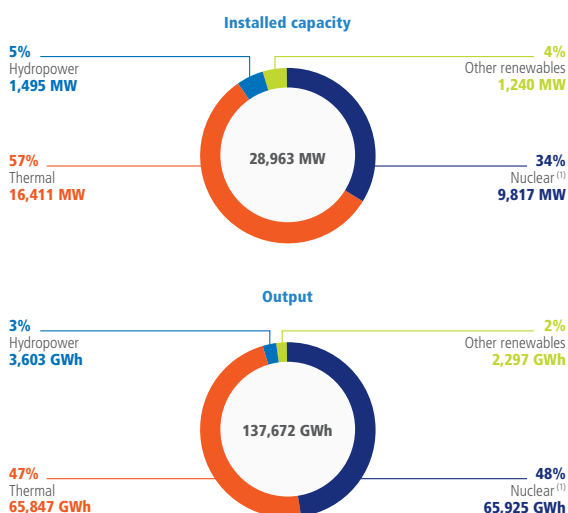
#### Tariff for using the public electricity distribution networks

Over 90% of ERDF sales are made up of revenues made from transmission. The tariff for using the public electricity network (TURPE), in terms of levels and structure, is set by the CRE in a transparent and non-discriminatory manner, in order to cover all the costs borne by the network operators.

At 1 August 2015, the TURPE increased 0.4%.



## 1.4.5 GROUP'S INTERNATIONAL BUSINESS

2015 INSTALLED CAPACITY AND OUTPUT  
OF THE INTERNATIONAL BUSINESS

NB: Excluding international data for EDF Énergies Nouvelles, part of the "Other activities" segment. Technical data calculated by applying the consolidation method and consolidation percentage of entities in the EDF group's consolidated financial statements.

(1) Excluding 100MW drawing rights on Chooz B.

## 1.4.5.1 United Kingdom

EDF group activity in the United Kingdom (UK) is led by EDF Energy focusing on energy supply and electricity generation. The Group is also active in oil and gas exploration and production in the North Sea with EDF Production UK, a subsidiary of Edison (see sections 1.4.6.2.2.3 "Exploration and Production (E&P)" and 1.4.5.2.3.2 "Hydrocarbon business").

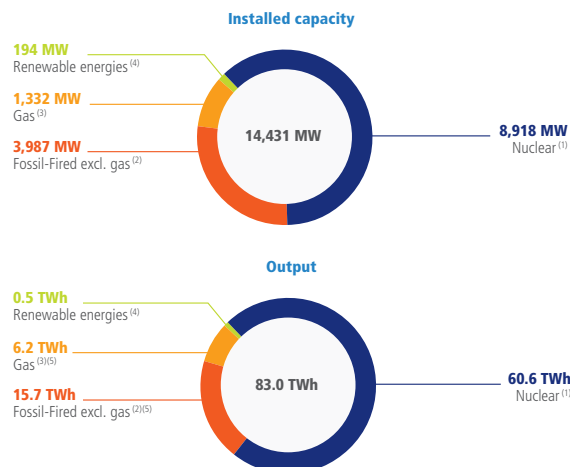
EDF Energy is one of the UK's largest energy companies and the largest producer of low-carbon electricity. The company produces around one-fifth of the nation's electricity from its nuclear power stations, wind farms, coal and gas power stations and combined heat and power plants.

The company supplies gas and electricity to 5.6 million business and residential customer accounts and is the biggest supplier of electricity by volume in Great Britain.

EDF Energy plans to build four new nuclear plants, subject to the right investment framework. These new plants could generate enough low carbon electricity for about 40% of Britain's homes.

It employs around 14,000 people at sites throughout the country. The workforce is highly engaged with 83% taking part in the annual employee survey with an engagement index score of 76%. 79% would recommend EDF Energy as a good place to work and are proud to tell people where they work. 90% of employees go the 'extra mile' to ensure the success of EDF Energy.

In 2015, EDF Energy maintained its position as the largest generator of electricity (by TWh produced) and of low carbon electricity<sup>1</sup>, and overall as the leading electricity supplier in Great Britain (by TWh sold<sup>2</sup>).

2015 INSTALLED CAPACITY AND OUTPUT  
IN THE UNITED KINGDOM

(1) The figures shown represent 100% of nuclear capacity and generation output, shared 80%/20% by EDF Energy and Centrica.

(2) Coal capacity represents transmission entry capacity. Net power including Biomass.

(3) Including 1 MW of Barkantine CHP.

(4) When EDF Energy holds more than 50% of assets, the capacities shown are 100% of the installed capacity and generation output. Renewables output excluding Biomass.

(5) Coal and gas data, excluding grid network losses, are respectively 15.6 TWh and 6.2 TWh. 2014 data adjusted to be comparable.

1. Source: Elexon Reporting.

2. According to the available data, excluding Northern Ireland.

	31/12/2015	31/12/2014
Electricity supplied <sup>(1)</sup> (GWh)	48,683	51,247
Gas supplied (GWh)	27,693	27,803
Number of residential customer accounts (thousands)	5,301	5,592
Number of employees <sup>(2)</sup>	13,920	14,716
Total Recordable Incident Rate <sup>(3)</sup>	0.68	0.95

(1) Power supplied to final consumer including previous year metering cut-offs.

(2) Includes staff on maternity leave.

(3) Total Recordable Incident Rate – Annual total combined number of Lost Time Incidents, fatalities, Restricted Work Injuries and Medical Treatment Injuries (excluding First Aid) / number of hours worked x 1,000,000. This covers all employees, agency and contractor staff. Excludes EDF Energy Renewables.

#### 1.4.5.1.1 Strategy

The vision for EDF Energy for 2030 starts with customers and their needs. Hence its strategy, which aims at ensuring a sustainable long-term business, is focused on supporting the transition to a lower-carbon economy through generation of safe, reliable and affordable low-carbon electricity. Equally, EDF Energy seeks to meet customer needs in an efficient, simple and responsible way, enabling customers to control their energy usage. All of their actions are underpinned by a focus on improving cost efficiency across the business.

In its customer-facing business, EDF Energy aims to be the energy partner of choice for residential and business customers, helping them to make the most of their energy consumption and production and of their increasingly connected, smart homes (and similarly connected public buildings, communities and cities), whilst providing excellent service and convenience. Through innovation and digitalisation, the company seeks to help customers control and save energy and to deliver attractive low-carbon solutions thus ensuring a competitive offering to customers is maintained in a rapidly evolving market.

In generation, EDF Energy seeks to create value through continued operational excellence of existing assets and by developing a portfolio of new investments. This includes leading the revival of nuclear new build in the UK. In partnership with China General Nuclear Corporation (CGN), EDF plans to build two new nuclear units at Hinkley Point in Somerset, and to work together to develop further new nuclear proposals at Sizewell in Suffolk and Bradwell in Essex. EDF Energy is also continuing to develop new renewable generation (mainly onshore wind) projects and maintains consideration of options for new, flexible gas-fired generation.

EDF Energy aims to secure value from its existing nuclear, coal and gas assets through continued safe and reliable generation. A key strategic programme is securing lifetime extensions for existing nuclear plant, when safe and commercially viable, to allow the UK to continue to benefit from nuclear energy until new low-carbon capacity can come online at scale. This will also provide ongoing nuclear employment opportunities and support the maintenance of skills in the UK nuclear industry. In February 2016, EDF Energy confirmed a five year life extension for Hartlepool and Heysham 1 nuclear power stations to 2024 and a further seven year life extension for Heysham 2 and Torness nuclear power stations to 2030. Other important strategic actions concerning the company's generation fleet include optimising the lifetime value of coal generation capacity under the UK capacity market mechanism and optimising the operations of the West Burton B Combined Cycle Gas Turbine (CCGT) power station.

EDF Energy is organised into three main business units: Generation, Customers, and Nuclear New Build.

#### 1.4.5.1.2 Activities

##### 1.4.5.1.2.1 Nuclear generation

EDF Energy owns and operates eight nuclear power stations in the UK with a total capacity of 8.9GW. The Nuclear Generation business unit employs over 5,500 people.

Since 2009, Centrica plc. ("Centrica") has held a 20% shareholding in Lake Acquisitions Limited, the company in which the nuclear generation assets sit (except Nuclear New Build).

##### Nuclear generation fleet technology

Seven of the eight nuclear power stations are Advanced Gas-Cooled Reactor (AGR) power stations (Dungeness B, Hartlepool, Heysham 1, Heysham 2, Hinkley Point B, Hunterston B and Torness) and the eighth is a Pressurised Water Reactor (PWR) power station (Sizewell B).

##### Safety and radiological protection

Nuclear safety is EDF Energy's overriding priority (see section 3.2.2.2.1 "Nuclear safety").

EDF Energy operates to strict procedures to minimise and control the radiation doses received by employees and contractors at all of EDF Energy's existing nuclear power stations. In 2015, the average individual dose received by all workers on EDF Energy's existing nuclear sites was 0.067mSv, the legal dose limit being 20mSv per year. The highest individual dose received in 2015 was 7.8mSv.

##### The operating lifetime of the nuclear power plants

The actual lifetime of each power station will be determined primarily by the technical and economic practicability of supporting its safety case. This is assessed at each statutory outage for the following operating period through inspection, maintenance, testing and assessment of plant performance. Following the outage, consent is required from the Office for Nuclear Regulation (ONR) before restarting the reactor. The operating period between statutory outages is normally three years for the AGR power stations and eighteen months for Sizewell B.

In addition, every ten years, the stations are subject to a more detailed and wide ranging Periodic Safety Review ("PSR"), which must also be accepted by the ONR in order to secure continued operation. Sizewell B was the last station to be assessed, and it received its 10 year consent in January 2015.

The AGRs were designed with a nominal 25 year lifetime, and Sizewell B with a 40 year lifetime. However, with the aggregation of technical information, and operational and safety experience, it has been possible to revise the expected AGR lifetimes. Prior to EDF Energy ownership, the AGRs had been extended by an average of 10 years, and it has been EDF Energy's intention, where possible and economic, to seek further lifetime extensions. This may require additional investment in the plant, and requires technical, safety, and economic justifications to be made; and since it may result in increasing the nuclear liabilities, the consent of the Nuclear Decommissioning Authority (NDA).

During EDF Energy ownership, the AGRs have been extended by an average of eight years. The most recent extensions were declared in February 2016. Hartlepool and Heysham 1 were extended by a further five years, and Heysham 2 and Torness were extended by seven years.

Although the work has not yet been carried out to support the extension of Sizewell B, the Company expects that it should be possible to extend it by c.20 years.

The current station lives (as formally declared by the company and approved by the NDA) and corresponding current scheduled closure dates of the power stations in the Nuclear Generation Fleet are set out in the following table:

Power Plant	Type of reactor	Start of Generation	Power Station Lifetime (Formally Declared)	Life Extensions (Already Formally Declared)	Associated Scheduled Closure Date	Scheduled Periodic Safety Reviews
Hinkley Point B	AGR	Feb. 1976	47 years	22 years	2023	2017
Hunterston B	AGR	Feb. 1976	47 years	22 years	2023	2017
Dungeness B	AGR	Apr. 1983	45 years	20 years	2028	2018
Heysham 1	AGR	Jul. 1983	41 years	15 years	2024	2019
Hartlepool	AGR	Aug. 1983	41 years	15 years	2024	2019
Torness	AGR	May 1988	42 years	17 years	2030	2020
Heysham 2	AGR	Jul. 1988	42 years	17 years	2030	2020
Sizewell B	PWR	Feb. 1995	40 years	–	2035	2025

## CAPACITY AND OUTPUT BY POWER PLANT

Power Plant	Capacity <sup>(1)</sup> (MW)	Output <sup>(2)</sup> (TWh)	
		2015	2014
AGR Power Plants			
Dungeness B	1,050	6.7	4.4
Hartlepool	1,180	6.2	5.8
Heysham 1	1,155	4.6	3.9
Heysham 2	1,230	9.4	10.4
Hinkley Point B	955	7.1	7.8
Hunterston B	965	7.5	6.6
Torness	1,185	8.7	8.5
PWR Power Plant			
Sizewell B	1,198	10.5	8.8
TOTAL	8,918	60.6	56.3
LOAD FACTOR <sup>(3)</sup>		78%	72%

(1) Capacities are stated net of all power consumed for the power stations' own use, including power imported from the Grid. Capacities are subject to review each year end. The capacities shown reflect the benchmark generation of units from 1 January 2015. In particular, Hinkley Point B and Hunterston B power stations have been adjusted to reflect planned operation at approximately 80% load, due to boiler temperature restrictions.

(2) Output in each year reflects any re-fuelling, planned and unplanned outages.

(3) Load factors are obtained by dividing the actual output by the output that would have been achieved by each power plant operated at its stated capacity appropriate for the period.

### Operational review of the existing nuclear generation fleet

Output from the nuclear generation fleet for 2015 was 60.6TWh, which was 4.4TWh higher than 2014 nuclear output of 56.3TWh. The increase principally reflects lower unplanned losses across the fleet.

During 2015, a programme of planned outages was carried out on the nuclear generation fleet. Statutory outages were completed on Dungeness B Reactor 22, Heysham 1 Reactor 2, Heysham 2 Reactor 7, Hinkley Point B Reactor 4, Hunterston B Reactor 3 and Torness Reactor 2.

### Plant status

Following the discovery of a defect in a boiler spine on Heysham 1 Reactor 1 in 2014, all four reactors at Heysham 1 and Hartlepool have been operating at reduced load to manage boiler temperatures in the affected area and in the case of Heysham 1 Reactor 1 on three out of four boiler quadrants.

During 2015, modifications were carried out to the boiler cooling on all four reactors to allow a return to full load. The boiler temperature constraint has now been lifted on all four reactors. Heysham 1 Reactor 1 continues to operate on three out of four boiler quadrants.

### Radioactive Waste Management

In the UK, radioactive waste is classified as:

- Low Level Waste (LLW), for which a near surface disposal route exists for LLW – Including the LLW Repository at Drigg West Cumbria;
- Intermediate Level Waste (ILW), for which no disposal route is currently available in the UK;
- High Level Waste (HLW) is defined as radioactive waste in which the temperature may rise significantly as a result of the radioactivity, so this factor has to be taken into account in the design of storage and disposal facilities.

These last two categories are merged under the Higher Activity Waste (HAW) category, their final storage solutions being geological storage in deep layers, that are not yet available in the UK.

EDF Energy nuclear generation's strategy for LLW and HAW reflects that the UK and Scottish governments are focused on application of the waste hierarchy (reduce, reuse, recycle, recover). The use of a range of waste recycling and disposal routes will help to make the best use of the UK's Low Level Waste Repository (LLWR) in Cumbria. Only a disposal route for LLW currently exists in the UK.

HAW is stored for the medium-term in safe, purpose built facilities at EDF Energy's stations while longer term national solutions are being established within England and Scotland.

Under historic contractual arrangements, spent fuel from the AGRs is transported to Sellafield nuclear reprocessing site (owned by NDA) for reprocessing or long term storage. Heat generating HAW from the reprocessing of spent AGR fuel are converted into glass blocks for safe, long term storage.

Regarding Sizewell B, the spent fuel is stored on site and EDF Energy is currently building a further spent fuel dry storage facility on the Sizewell B site to allow the station to continue to safely store all of the spent fuel that will be generated over Sizewell B's life. Following long-term surface storage, the Sizewell B PWR spent fuel will be disposed to a future UK Geological Disposal Facility.

The nature of EDF Energy nuclear generation's business and its historic government link means that the strategy for spent fuel and the management of radioactive waste from EDF Energy nuclear generation's power stations is approved by the NDA. However EDF Energy has policies to continually improve and minimise the spent fuel and waste arising through the company's wider safety, sustainability and environmental policies.

### Costs relating to radioactive waste management and decommissioning – Restructuring Agreements

Restructuring Agreements were originally entered into in 2005 as part of the restructuring of the former British Energy Group of companies (hereafter referred to as "the EDF Energy Nuclear Generation Group") and were carried out from 2002 under the aegis of the UK government in order to stabilise the financial situation of the EDF Energy Nuclear Generation Group.

By virtue of these restructuring agreements:

- the Nuclear Liabilities Fund (NLF), an independent trust set up by the UK government as part of the restructuring, agreed (at the direction of the Secretary of State) to fund, to the extent of its assets: (i) qualifying uncontracted nuclear liabilities (including liabilities in connection with the management of spent fuel at the Sizewell B power station); and (ii) qualifying costs of decommissioning in relation to the existing nuclear power stations owned and operated by EDF Energy Nuclear Generation Group;
- the Secretary of State agreed to fund: (i) qualifying uncontracted nuclear liabilities (including liabilities in connection with the management of spent fuel at the Sizewell B power station) and qualifying costs of decommissioning, in each case in relation to the existing nuclear power stations owned and operated by EENG, to the extent that they exceed the assets of NLF; and (ii) subject to a cap of £2,185 million (in December 2002 monetary values, adjusted accordingly), qualifying contracted liabilities for the EENG's spent fuel (including in particular liabilities for management of AGR waste from spent fuel loaded prior to 15 January 2005); and
- EDF group is responsible for funding certain excluded or disqualified liabilities (mainly liabilities incurred in connection with an unsafe or careless operation of the power stations) and the potential associated obligations of its subsidiaries to the NLF and the Secretary of State are guaranteed by the principal members of the EENG.

Certain companies in the EENG, including EDF Energy Nuclear Generation Limited, entered into a separate contract, now with the NDA for management of AGR spent fuel loaded from 15 January 2005 (termed "new fuel") and have no responsibility/liability for this fuel after it is received at Sellafield.

The Secretary of State and EDF agreed to limited amendments to the Restructuring Agreements, in connection with the acquisition of EENG by Lake Acquisitions. The amendments, among other things and subject to limited exceptions, restrict the majority of rights and obligations imposed by the Restructuring Agreements only to EENG and its subsidiaries and subsidiary undertakings and accordingly, do not extend similar rights and obligations to EDF group, or its other subsidiaries and subsidiary undertakings. The amendments do not impact on the contractual funding commitments of the Secretary of State or NLF to the EENG.

Certain amendments have been made to the Restructuring Agreements, reflecting the EENG's access to an improved credit rating following the acquisition. In particular, EENG is required to maintain a minimum cash

reserve. The amendments reduced the minimum level to £290 million. The cash reserve may be further reduced to nil if the EENG achieves and maintains an investment grade rating or if irrevocable Committed Facilities of the same amount are put in place between third party financial institutions or a member of the wider EDF group with an investment grade rating and a member of the EENG.

#### 1.4.5.1.2.2 Renewable generation

Through EDF Energy Renewables (EDF ER), a joint venture between EDF Energy and EDF Énergies Nouvelles, EDF Energy is developing its own onshore and offshore assets. In addition, EDF Energy has signed power purchase agreements with renewable generators and supports independent developers. This ensures a balanced approach for compliance with its Renewables Obligations (RO) and the provision of renewable electricity to its customer base.

EDF ER currently operates 31 wind farm sites with a total generation capacity of nearly 600MW. In 2015, EDF ER brought into operation three onshore

windfarms: Burnhead Moss (26MW), Rhodders (12.3MW) and Park Spring (8.6MW). In addition, EDF ER acquired during 2015 the development rights to build a windfarm at Corriemoillie (more than 45MW) and at Dorenell, which at 177MW is one of the largest onshore wind projects due to be built in Scotland.

EDF ER's pipeline of projects in the construction phase includes a windfarm at Pearie Law (19.2MW) and a windfarm at Beck Burn (18MW), both of which are onshore. They are expected to begin operation respectively during 2016 and 2017.

As part of the 80% sale of Glass Moor II, Rusholme and Green Rigg windfarms to China General Nuclear Power Corporation, completed in 2014, EDF ER continues to provide asset management and operation and maintenance activities for the wind farms.

EDF ER also has joint ventures in the renewables field with AMEC Foster Wheeler, a construction group, to develop a c.130MW windfarm near Stornoway on the Isle of Lewis in Scotland.

#### 1.4.5.1.2.3 Thermal generation and gas storage

Power plant	Location	Year commissioned	Number of units	Type of station	Capacity (MW)	Output (TWh)	
						2015	2014
Cottam	Nottinghamshire	1970	4	Coal-fired	2,000	7.5	9.8
West Burton A	Nottinghamshire	1970	4	Coal-fired and OCGT <sup>(1)</sup>	1,987	8.3	10.0
West Burton B	Nottinghamshire	2013	3	CCGT	1,332	6.2	4.8

(1) Open Cycle Gas Turbine.

In 2015, Cottam and West Burton A coal-fired power plants generated 15.7TWh of electricity. Although lower than last year, this represents a good performance in a year of lower dark spreads, two major outages and a number of unplanned losses, notably at Cottam power station. West Burton B CCGT generated 6.2TWh, driven by strong availability performance and improved market spark spreads.

The coal plant strategy has been developed to provide flexible generation and meet EDF Energy's obligations of plant availability under the Capacity Market Auction held in 2014. The coal plants secured a capacity agreement of three years starting 2018 for seven of eight coal units at the clearing price of £19.40/kW per year (2012 prices). West Burton A Unit 3 participated in the 2015 Auction but did not secure a contract.

The decision regarding the Industrial Emissions Directive (IED) route has been taken and from 1 January 2016 both coal plants will operate under the UK Transitional National Plan (TNP) which requires coal power stations to comply with additional annual emissions limits for nitrogen oxides, sulphur dioxide and dust.

West Burton B CCGT was successful in the 2014 Auction and was awarded a 1 year contract for 2018-2019 at the clearing price of £19.40/kW per year (2012 prices). A further 1 year contract was secured in the 2015 Auction round for 2019-2020 at a lower clearing price of £18.00/kW per year (2014/15 prices). The same applies to the two OCGT units at West Burton A.

EDF Energy operates two fast cycle gas storage facilities in Cheshire. Hole House was purchased from EDF Trading in April 2014; the asset is fully operational with a total working gas capacity of c.18 million therms. Hill Top Farm became commercially operational in mid January 2015 with three cavities. The remaining two cavities are being developed and are scheduled to come on-line by mid next year. In 2015 integration of these gas storage activities into a single asset commenced and is continuing through 2016.

#### 1.4.5.1.2.4 Customer business

The Customers business is responsible for the supply of gas and electricity to residential and business customers across the United Kingdom and the wholesale market optimisation of EDF Energy's generation and customer assets.

EDF Energy sells energy to two major customer segments: residential customers, described as the Business to Customers segment (B2C); and business customers, described as the Business to Business segment (B2B). The size of business customers ranging from large industrial businesses to small privately owned businesses. EDF Energy adopts different risk management strategies for these two segments.

#### B2C

During the year, EDF Energy supplied 13.7TWh of electricity and supplied 27.6TWh of gas for the B2C segment. As at 31 December 2015, EDF Energy had 3.3 million electricity accounts and 2.0 million gas accounts on this segment.

#### Competition

The residential market has been exceptionally competitive in 2015, marked by steep falls in wholesale energy costs that has allowed new and smaller suppliers to offer a series of cheaper short term fixed priced tariffs. EDF Energy constantly reviews its prices to ensure that its tariffs attract new customers and offer good value to existing ones. During 2015 EDF Energy has continued to expand its portfolio of fixed price Blue tariffs, backed by low carbon nuclear generation. EDF Energy currently has 2.6 million product accounts on Blue tariffs.

### **Regulatory Change**

Some suppliers have responded to the increasingly competitive market by attempting to segment their customer base through white label offers and/or collective switches, the existence of which have not been notified to existing customers. The regulator has now clamped down on both of these practises to ensure that any cheaper tariff offered by a supplier is flagged to existing customers. The outcome of the CMA inquiry is expected to have a material impact upon the current regulations (see section 1.4.5.1.2.7 "United Kingdom Legal Environment").

### **Energy Company Obligation**

The Energy Company Obligation (ECO) is an energy efficiency programme which has been extended and will end on 31 March 2017 (see section 3.2.3.6.1 "Contributing to energy access and the fight against energy poverty").

The government has announced a 5-year replacement programme which will aim to improve the energy efficiency of ~200,000 homes p.a. and will be targeted at fuel poor households. The government will consult on detailed implementation of the new ECO programme in 2016.

### **Smart Metering**

UK energy suppliers are mandated to deliver the Government's Smart Metering Programme which requires all reasonable steps to be taken to deploy smart electricity and gas meters to the equipment of 100% of residential and small business customers by the end of 2020.

The programme will require EDF Energy's supply business to install an estimated 5.5 million meters, including communications hubs and in-home displays, to all of its domestic and small business customers. Around 1.5 million smart meters are planned to be installed annually, a four-fold increase on the current planned volume of expired meter renewals each year. This is the biggest programme in the Customers business over the next few years. EDF Energy aims to deliver its obligation more effectively than its competitors, and to maximize the enduring benefit in order to transform the customer relationship. It has already commenced smart meter installations and is piloting operations using the first generation of compliant smart meters. This is ahead of a steady ramp up in volume and the years of mass roll-out which are from 2017 onwards.

### **B2C Customer Services**

The B2C segment had an excellent year in 2015 with the improvement of the quality of its services, including the decrease of number of complaints, the rising level of recommendation by customers, its quality assurance and maintenance of control of its back office. During 2015 our Advisor Recommendation Score (derived from a post-call customer survey) has been increasing steadily and is now +53. Out of 19 suppliers, we have moved to second in the Citizens' Advice Complaints League Table. The Telephony Average Speed of Answer is currently 2 mn 9 s for the year with 52% of calls being answered within 60 seconds. Self-serve continues to improve with 64.2% of all transactions being self-serve in 2015.

### **B2B**

In 2015 B2B retained its leadership position in volume, supplying a total of 35.0TWh of electricity; 1.8TWh to 182,382 Small and Medium Enterprise (SME) accounts and 33.2TWh to 113,409 Industrial and Commercial (I&C) accounts, reflecting an overall B2B market share of 19.3%. The business continues to be well established in the large, national and multi-site customer segments, and it successfully retained large customers such as Nestle and Nissan, and acquired Airbus as a new customer.

Competition across all sectors remains fierce. This is demonstrated by the continued erosion of the combined market shares of large suppliers by smaller entrants and the increasing influence of third party intermediaries. This resulted in pressure on pure energy supply margins for business contracts. In addition, the UK government announced the removal of the exemption from the Climate Change Levy for renewable electricity from 1 August 2015. This will have significant implication on I&C margins for 2016 although is expected to deliver a more rational market for future years.

### **Optimisation and risk management activities**

#### **General principles**

The policies surrounding EDF Energy's energy purchasing and risk management activities are carried out in accordance with EDF group's policies and ensure that EDF Energy's activities are optimised and its services delivered at a competitive price while limiting its gross margin volatility.

The Optimisation division's purpose is to manage the wholesale market risk of EDF Energy in one place within pre-defined risk limits and control framework. It provides a unique interface with the wholesale markets, via EDF Trading. Optimisation also provides modelling services to the whole of EDF Energy, as well as negotiating and managing asset backed commercial structures with third parties e.g. NDA and Centrica.

#### **Electricity sales and procurement**

The power generated by the generation fleet is sold via the Optimisation division within EDF Energy's customers business. Since April 2010, 20% of the output from nuclear generation is separately sold to Centrica under the agreements made at the time of the Centrica transactions. The remaining 80% is sold to Optimisation under the same transfer price as used for the transaction with Centrica, based on published market prices, smoothed over forward electricity prices where liquidity allows.

Over and above its own generation, EDF Energy also sources electricity through export power supplied from power purchase agreements which are mainly with renewable and CHP generators. In 2015, EDF Energy acquired approximately 6.5TWh through this channel.

For delivery in 2015, EDF Energy's net position on the wholesale market was a sale of approximately 24.3TWh (including structured trades). In 2015, EDF Energy sold approximately 83.3TWh and bought 59.0TWh.

#### **Gas, coal and carbon rights procurement**

Coal and gas contracts (physical and financial) and CO<sub>2</sub> emissions rights are entered into by EDF Energy to hedge the requirements of its power plants and gas consumers.

Purchases are based on coal and gas asset generation forecasts and target coal stock levels. In 2015, 49% of EDF Energy's coal deliveries were from international suppliers and sourced through EDF Trading.

#### **1.4.5.1.2.5 Nuclear New Build business**

##### **Nuclear New Build (NNB) activity**

EDF aims to build up to four new EPR nuclear reactors in the UK: twin reactors at Hinkley Point and further twin reactors at Sizewell. The plans are conditional on the necessary consents being received and a robust investment framework being in place.



The EPR technology is already being deployed at the new nuclear power station being constructed by EDF at Flamanville in France (see section 1.4.1.2 "New Nuclear Projects") and at Taishan in China. Using the same technology, adapted for UK requirements, will enable the efficiencies that come with standardisation of design in the construction and operation of a series of plants to be realised.

EDF has also agreed Head of Terms with CGN (China General Nuclear Power Corporation) for the development of a further new nuclear project in the UK at Bradwell B in Essex.

### **Hinkley Point C (HPC)**

#### **Project update**

The HPC project is well advanced. It has achieved planning consent, design approval for the EPR reactor and a nuclear site licence has been granted. There is a well-developed supply chain with identified preferred bidders who are already heavily involved in construction planning. Training for skills needed is underway and industrial agreements with trade unions are in place.

EDF will be the "responsible designer" for the HPC project, with a central role in the design and engineering of the power station.

As announced on 21 October 2015, total construction costs to first operation are forecast to be £18bn nominal. The construction costs have remained stable in real terms since they were announced, in October 2013.

Final terms for contracts with a number of key suppliers for HPC have also been agreed:

- AREVA NP (Nuclear steam supply system, instrumentation and control);
- Alstom France (turbines) and Alstom UK (services during operations);
- Bouygues TP/Laing O'Rourke (main civil works);
- BAM Nuttal/Kier Infrastructure (earthworks).

A number of selected contractors are being engaged on Early Contractor Involvement (ECI) activities, including inputting into the HPC engineering and pre-construction planning teams to help de-risk the project and facilitate delivery of the construction schedule. Procurement also continues on other critical path contracts such as key installation and equipment supply contracts for the main site.

The project team is continuing the pre-development site preparation and enabling works to prepare the construction site ahead of the main construction works that will follow when a final investment decision is taken. These works include the construction of roundabouts and temporary construction roads to give access to the site for machinery needed for the main construction phase; remediation and enabling works for the earthworks, water management works, and the construction of office buildings and worker welfare facilities.

Contractual and commercial aspects have been carefully examined, especially by independent experts. A detailed review of the risk conducted at the end of 2015 established that risks are clearly identified and can be overcome through the implementation of a series of recommendations whose implementation has already begun. Other risk analyses will take place throughout the project, which is a usual practice for projects of this magnitude.

First operation of HPC, initially scheduled in 2025, will depend on the date of the Final Investment Decision.

EDF's current investment programme to safely extend the lives of its existing power stations contributes to maintaining a secure supply of low-carbon electricity for the UK prior to HPC coming on-line.

#### **Land Deals**

Land acquisition has mirrored the planning progress and reflects those sites included in applications subject to the Planning Inspectorate process (PINS).

In 2012, the land required at the main site for the terrestrial construction of HPC was secured with negotiations concluded with relevant parties to allow three 999-year leases of the HPC main site to be put in place when needed and one of these leases is now in place. The majority of the land needed to assemble the associated development sites required to support the construction process has now been secured. A number of these development sites were secured through Option Agreements, therefore EDF does not yet have possession of the land but has the right to acquire or lease it when the land is required by the project.

#### **Revenue Arrangements: Contract for Difference (CfD)**

As announced on 21 October 2015, NNb (Nuclear New Build) and the Department of Energy and Climate Change (DECC) have agreed the full terms of the CfD for HPC, which had already been approved by the European Commission in October 2014 following a 12-month investigation.

The CfD will mean that from the plant's start date:

- if the reference price at which the generator sells electricity on the market is lower than the strike price set under the terms of the contract, the generator will receive an additional payment and;
- if the reference price is higher than the strike price, the generator will be liable for the difference.

The key elements of the CfD are:

- the "strike price" for HPC is set at £<sub>2012</sub>92.50/MWh or £<sub>2012</sub>89.50/MWh if the Sizewell C planned power station goes ahead. There will be a payment from Sizewell C to HPC equivalent to £<sub>2012</sub>3/MWh upon a final investment decision being taken with respect to Sizewell C reflecting the fact that the first of kind costs of EPR reactors are shared across the HPC and Sizewell C sites;
- the strike price is fully indexed to inflation through the Consumer Price Index;
- the contract will last for 35 years;
- the project will be protected from certain changes in law;
- if savings are achieved in the construction of the HPC project, these will be shared with consumers through a lower strike price.

#### **Financing**

As announced on 21 October 2015, under the Strategic Investment Agreement signed by EDF and CGN, EDF's share in HPC will be 66.5% with CGN's share being 33.5%. Without reducing this initial stake below 50%, EDF intends to bring other investors into the project in due course.

The project will also benefit from the Government's Infrastructure Guarantee Scheme. The availability of the initial £2bn of the scheme was announced by the Chancellor in September 2015, subject to the conditions in accordance with market practices. The project should be financed with equity from each partner, at least in a first step. EDF will completely consolidate the project on its accounts.

#### **Funded Decommissioning Programme (FDP)**

Operators of new nuclear power stations are required under the Energy Act 2008 to have a FDP (Funding Decommissioning Programme) in place and approved by the DECC before nuclear safety related construction

begins. The overall objective of the FDP is to ensure that operators make prudent provision for:

- the full costs of decommissioning their installations;
- their full share of the costs of safely and securely managing and disposing of their waste; and that in doing so the risk of recourse to public funds is remote.

A preliminary version of the FDP was formally submitted in draft form to DECC in March 2012. There have been a series of subsequent discussions with DECC and their advisers, including the independent Nuclear Liabilities Financing Assurance Board. NNB and DECC agreed the full terms of the FDP in 2015 and the final version was approved by the Secretary of State on 21 October 2015.

On 9 October 2015, the European Commission approved the pricing methodology for the UK's waste transfer contract scheme which will apply to HPC as part of the FDP. This innovative scheme means that the full costs of decommissioning and waste management associated with new nuclear power stations are set aside during generation.

#### **Final Investment Decision**

A final investment decision on HPC will only be taken by the Group once the following steps have been completed:

- finalisation of the long form equity documentation with CGN, based on the Head of Terms agreed on 21 October 2015;
- approval by the boards of EDF and CGN.

The approvals from competition authorities under the control of concentrations and other governmental authorities in China and Europe were obtained in the first quarter 2016.

#### **Sizewell C**

As announced on 21 October 2015, EDF and CGN have signed a Head of Terms for an agreement in principle to develop Sizewell C in Suffolk to a final investment decision with a view to building and operating two EPRs at the site. During the development phase, EDF will take an 80% share with CGN taking a 20% share.

As part of the planning process, EDF's initial proposals for Sizewell C were published in November 2012 and the first round of formal consultation with local communities has already taken place. Work has continued to prepare for the launch of the second formal stage of consultation with local communities and stakeholders. This is expected in 2016, once a final investment decision has been taken for HPC. Ground investigations, transport and environmental studies have helped refine the project's transport and accommodation strategies and the understanding of the engineering requirements for the development. These studies are also being used to support the nuclear site licence and environmental permits applications, which are at an early stage of development.

Discussions will commence in 2016 on the majority of the permanent and construction land. Work has begun to acquire the land that has been identified for accommodation and for transport infrastructure.

In April 2015, 67 hectares of land was acquired close to Sizewell C, to develop as wetland habitat to compensate for any potential land taken from the local site of special scientific interest during the main construction of the Sizewell project. Good progress was made on these works throughout the rest of 2015.

#### **Bradwell B**

EDF and CGN have also signed a Heads of Terms for an agreement in principle to seek the regulatory approval (via the Generic Design Assessment process), from the UK nuclear safety regulator, for a UK version of the third generation HPR1000 reactor called Hualong. The HPR1000 will be based on CGN's Fangchenggang Plant Unit 3/4 in China, the reference plant

for the UK-adapted Hualong design. Under the terms of the agreement, a joint venture company will undertake and manage the Generic Design Assessment process.

CGN and EDF have signed a Heads of Terms for an agreement in principle to develop Bradwell B in Essex to a final investment decision with a view to building and operating the UK-adapted Hualong reactor technology approved by the UK regulator through the Generic Design Assessment process. During the development phase, CGN will take a 66.5% share and EDF will take a 33.5% share.

The UK's robust nuclear regulation ensures that all developers and operators of reactors and nuclear plants must demonstrate that they meet strict compliance requirements for safety and security.

#### **1.4.5.1.2.6 Commitments under European Commission Merger Regulation (ECMR)**

EDF Energy has continued to comply in 2015 with the commitment to sell minimum volumes of electricity on the UK wholesale market, ranging from 5 to 10TWh per year during the period from 2012 to 2015. This commitment was agreed with the EC at the time of the acquisition of British Energy under the ECMR. The delivery of these sales has now been completed and verified by the Monitoring Trustee who has notified the European Commission accordingly.

All other commitments agreed at the time of the purchase of British Energy have now been met.

#### **1.4.5.1.2.7 United Kingdom Legal Environment**

##### **Competition and Markets Authority (CMA)**

In June 2014, the Competition and Markets Authority (CMA) commenced its investigation into the "supply and acquisition of energy in Great Britain". The CMA is the UK's economy-wide competition and consumer authority with a primary duty "to promote competition for the benefit of consumers, both within and outside the UK".

In July 2015, the CMA published its Provisional Findings report, together with a Notice of Possible Remedies. The Provisional Findings report listed the features that the CMA had provisionally found as giving rise to adverse effects on competition (AECs) in the electricity and gas markets. The Notice of Possible Remedies set out possible actions that the CMA could take to remedy, mitigate or prevent the AECs it had provisionally identified (and the resulting detrimental effect on consumers). The CMA noted 9 AECs and identified 18 possible remedies in total. The possible remedies largely focused on the retail and regulatory framework, and in particular considered measures to improve customer engagement in the domestic and microbusiness markets.

The CMA published two further updates to the Provisional findings report and Notice of Possible Remedies:

- on 26 October 2015, the CMA published a Supplemental Notice of Possible Remedies which invited comments on a further possible remedy to encourage customer engagement by prohibiting the use of evergreen tariffs;
- on 16 December 2015, the CMA published an Addendum to provisional findings. The CMA stated that upon further consideration, it has provisionally found that a combination of features in the prepayment segment of the domestic retail supply of gas and electricity gives rise to an AEC. Alongside this document, the CMA published a Second supplemental notice of possible remedies. This sets out four additional possible remedies that the CMA may introduce to address the AEC it has provisionally identified in the Addendum.

On 21 September 2015, the CMA announced an extension to its statutory investigation deadline by six months from 25 December 2015 to 25 June

2016. It stated that this was necessary to allow sufficient time to take full and proper account of any comments received from stakeholders in response to the provisional findings and to reach a fully reasoned final decision. The CMA has announced its temporary decision about the corrective actions on 17 March 2016, earlier than its final report of June 2016.

### Electricity Market Reform (EMR)

The three most significant elements of EMR are the carbon price floor, introduced under the Finance Act 2011, the Capacity Market and Contracts for Difference, introduced under the Energy Act 2013.

The carbon price floor, which sets the price that fossil-fired generators pay for their carbon emissions is an important driver of the profitability of low carbon generation such as EDF Energy's nuclear and renewable plants. The "carbon price support rate" that underpins the carbon price floor was capped in the Budget 2014 on 19 March 2014 at £18/tonne of CO<sub>2</sub> for the four years, April 2016 to April 2020.

The Capacity Market is intended to ensure security of electricity supply. Annual auctions are held to procure capacity four years ahead of delivery with a subsequent auction one year ahead of delivery. The second capacity auction for delivery of capacity from October 2019 took place in December 2015 resulting in capacity agreements for 46,354MW of de-rated capacity at a price of £<sub>2014/2015</sub> 18/kW. EDF Energy's eight nuclear power stations, West Burton B CCGT plant and the open cycle gas turbines at West Burton A secured capacity agreements in the December 2014 auction for the period October 2018-September 2019 and in the December 2015 auction for October 2019-September 2020. The four coal-fired units at Cottam and three of the four coal-fired units at West Burton A secured capacity agreements in the December 2014 auction for the three year period October 2018 – September 2021. Unit 3 at West Burton A failed to secure a capacity agreement in both the December 2014 and December 2015 auctions.

Contracts for Difference are expected to support investment new low carbon generation including in particular the Hinkley Point C project. Results of the first Allocation Round (auction) for CfDs were announced in February 2015 with contracts awarded to 27 renewable energy projects, most of which were onshore or offshore windfarms. EDF Energy has subsequently acquired one of the successful projects from this auction, Dorenell Wind Farm, a 177MW onshore windfarm development, which was awarded a CfD with a strike price of £<sub>2012</sub> 82.50/MWh. The Government has said that it will hold up to three further CfD auctions by 2020, the first of these to be in 2016, and that these will support further development of offshore wind, conditional on the achievement of cost reductions.

## 1.4.5.2 Italy

### 1.4.5.2.1 EDF group's strategy in Italy

The Italian energy market represents a strong strategic interest for EDF due to the magnitude of its importance in both the European electricity and gas markets, and its connection to the French markets.

Like the majority of European energy systems, the Italian market is currently facing a certain number of challenges. Thanks to its current position and to its integrated presence in the gas and electrical energy value chain, Edison is well-placed to seize opportunities created by market changes, in order to sustain its growth, all while pursuing efficiency and profitability, in line with CAP 2030 priorities.

Edison could play an active role in the process of consolidation of the Italian market, notably by benefiting from the streamlining of EDF's presence in the country.

The main development factors are:

- in order to optimise its portfolio of electricity generation in Italy, Edison aims to increase its production of renewable energy by the promotion of specific investments in hydroelectricity and the development of new renewable sources, in particular, by using new business models, while focusing the thermal generation portfolio on the most efficient assets;
- in relying on the strong positioning of its brand, Edison is well placed to grow its portfolio of individual gas and electricity customers, and to improve the value of its offering with added-value energy services;
- in the area of gas, beyond the optimisation of the current portfolio, Edison can contribute to the development of Italy as a gas hub, in order to reinforce its competitiveness and that of the EDF group, and the flexibility and security of supplies;
- in the area of E&P (Exploration & Production), Edison intends to modulate its activity, by pursuing a selective development of Italian E&P activities, in integration with the gas and electricity value chain, all while optimising international projects.

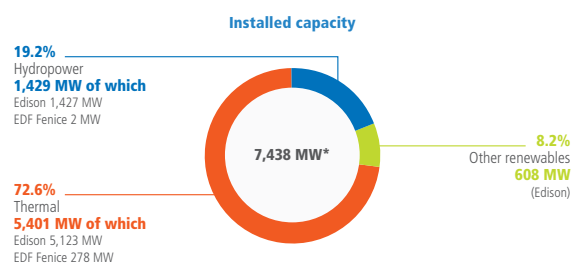
### 1.4.5.2.2 The EDF group's activities in Italy

As of the end of 2015, the Group was mainly present in Italy through its 97.405% shareholding in Edison, which is a major player in the Italian electricity and gas markets and a well-known Italian brand.

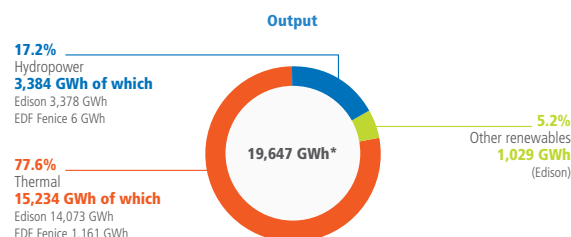
The EDF group is also present in Italy through subsidiaries and the following shareholdings:

- EDF Fenice, 100%-owned and specialised in environmental services and energy efficiency (see section 1.4.6.1.2 "EDF Fenice");
- EDF Énergies Nouvelles, which has one subsidiary located in Italy.

### 2015 INSTALLED CAPACITY AND POWER OUTPUT IN ITALY



\* Edison 7,158 MW.  
EDF Fenice 280 MW.

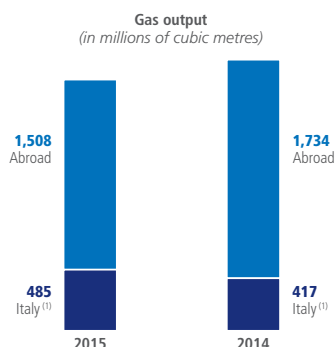


\* Edison 18,480 GWh.  
EDF Fenice 1,167 GWh.

In 2015, the EDF group's net electricity output in Italy was 19.6TWh, which accounted for around 7.2% of net Italian electricity generation. Gas sales to end customers, wholesale markets and for thermal generation amounted

17.6Gm<sup>3</sup> (13.2Gm<sup>3</sup> in 2014). Edison imported 12.7Gm<sup>3</sup> in 2015, i.e. 21% of total Italian gas import, which represents 91% of national demand.

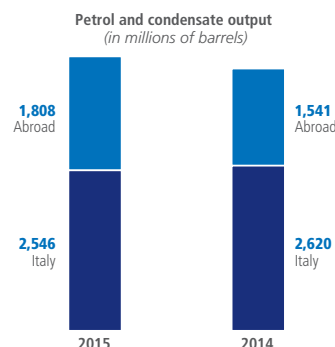
## OUTPUT OF GAS AND HYDROCARBONS



(1) Includes output from Croatia (Izabela gas field) imported into Italy since July 2014.

In Italy and abroad, the Group's gas output activities through Edison were down compared to 2014, reaching 1.99Gm<sup>3</sup> (-7.3% against the figure for 2014).

Oil and condensate output rose in 2015, with 4.35 million barrels produced (+4.6% compared with 2014), of which 2.5 million were produced in Italy.



### 1.4.5.2.3 Edison's activities

#### 1.4.5.2.3.1 Electricity generation business

At 31 December 2015, the Edison's installed generation capacity in Italy was 7,158GW, with net electricity output of 18.5TWh over the year, representing an increase compared with 2014. This increase was mainly due to increased thermoelectric and wind-powered generation, as a result of the demand for electricity in Italy and arbitrage transactions carried out between proprietary production and market purchases. Edison's generation fleet is currently made up of 48 hydropower plants, 19 thermal power plants, 35 wind farms, 9 photovoltaic power plants and 1 biomass plant. Combined-Cycle Gas Turbines (CCGT) account for 76.4% of electricity generation, while hydropower accounts for 18.3% and combined wind and solar for 5.3%.

Edison operates approximately 1,427MW of hydropower facilities with an output of 3.38TWh (-32% compared with the exceptional production of 2014).

In December 2015, Edison reached an agreement to sell its equity interests in Hydros (40%) and in Sel Edison (42%), the two hydropower joint ventures, with the Alperia company in the Bolzano province, in exchange for 100% of Alperia's hydropower facilities situated on the Cellina River. Because of this transaction, Edison, which would have had to deconsolidate the two equity interests starting from 2016, will entirely consolidate the business, including the Cellina facilities, increasing its installed capacity by 90MW, while reducing the risk connected to the renewal of the concessions in its hydropower portfolio.

In the area of renewable energies, Edison also maintains a critical size, thanks to E2i Energie Speciali srl (E2i), a company created in 2014 in partnership with the F2i fund, which holds 70% of the share capital, the 30% remaining being held by a holding company between Edison and EDF Énergies Nouvelles.

E2i holds 594MW of renewable assets (contributed 82% by Edison and 18% by EDF EN Italia) and transfers 100% of the energy generated to Edison, which utilises it to the benefit of an integrated management of its production portfolio.

A company headed by EDF EN and dedicated to services was also set up for the operation and maintenance of this platform.

Moreover, outside of Edison and the partnership with F2i, EDF EN is present in Italy (see section 1.4.1.4.3 "EDF Énergies Nouvelles").

Internationally-speaking, Edison benefits from a well-established presence in Greece, where it is one of the main electricity operators of the country, through ElpEdison SA, with a 38% equity interest with Hellenic Petroleum, Hellenic Energy and Development (the Hellactor group) and Halcor. ElpEdison owns two CCGT plants: one in Thessaloniki (389MW) and another in Thivri (410MW), built by Edison.

Finally, in Brazil, Ibiritermo, a 50%-owned subsidiary of Edison, operates a 226MW CCGT power plant.

#### 1.4.5.2.3.2 Hydrocarbon business

For the implementation of its gas strategy, the EDF group, through Edison, benefits from experience developed along the entire value chain, from exploration-production through to the direct sale of natural gas.

Edison's gas supply portfolio is mainly based on long-term contracts and, in 2015, it included approximately 12.7Gm<sup>3</sup> of imports via gas pipelines and LNG, with 0.49Gm<sup>3</sup> of own production in Italy and 4.2Gm<sup>3</sup> purchased on the market. Changes in inventory and network losses represent 0.20Gm<sup>3</sup>.

In 2015, in Italy, Edison delivered 3.4Gm<sup>3</sup> of gas to the industrial sector, 2.6Gm<sup>3</sup> to the residential sector, 5.7Gm<sup>3</sup> to the thermoelectric sector (including Edison's own internal needs), and 5.9Gm<sup>3</sup> to the wholesale market.

Due to the difficult gas market situation, since 2010, Edison, like all other players in the sector, has asked suppliers to adjust their contractual terms, by reviewing long-term contracts in force.

The price-revision arbitral proceedings were concluded on 27 November 2015, with the arbitral award rendered by the International Court of Arbitration of the International Chamber of Commerce in favour of Edison. It involved the dispute between Edison and ENI on the price revision of a long-term Libyan gas contract. Thus, Edison obtained a lowering of the gas price, effective retroactively.

In exploration and production, Edison possessed, at the end of 2015, 60 concessions and exploration permits in Italy and 66 abroad, and approximately 42 billion cubic metre equivalents in reserves. Abroad, Edison's most significant asset is the Abu Qir gas field in Egypt; in early 2009 Edison purchased the exploration, production and development rights for this field for an initial period of 20 years, extendable by a further 10 years.

In 2015, Edison enriched its hydrocarbons development portfolio with the acquisition of Apache Beryl I (a subsidiary of Apache Corporation) and its interest in the share capital of the Scott and Telford deposits (10.5% and 15.7%, respectively), situated in the North Sea. This acquisition contributed to an increase of approximately 1.1 billion cubic metres equivalent (85% petroleum and 15% gas) in the Group's reserves.

Finally, Edison is pursuing its exploration activities in Italy and abroad, particularly in the United Kingdom and in Norway, and currently holds licenses in the North Sea, in the Norwegian Sea and in the Barents Sea.

### Gas infrastructures

Edison holds an equity interest of 7.3% in the Adriatic LNG Terminal company, which manages the offshore regasification terminal of Rovigo (8Gm<sup>3</sup> per year). This terminal is powered with Qatari gas. The other shareholders are ExxonMobil Italiana Gas (70.7%) and Qatar Terminal Company Limited (22%). Edison, according to the contract terms signed with Ras Laffan Liquefied Natural Gas Company Limited II (RasGas II), owns 80% of the terminal's capacity, or 6.4Gm<sup>3</sup> per year.

Edison is involved in various gas import infrastructure projects (see section 1.4.6.2.2.2 "Infrastructure"), such as IGI Poseidon, 50%-owned by Edison, a company involved in the development of several projects that aim to connect Greece and Italy (IGI), Greece and Bulgaria (IGB, in 50/50 partnership with Bulgaria), as well as Greece and Cyprus (EastMed).

### 1.4.5.2.3.3 Sales and supply activities

In 2015, Edison sold 89.4TWh of electricity in Italy (compared with 95.5TWh in 2014, i.e. -6.4% compared with 2014), of which 18.5TWh were generated and 70.9TWh were purchased on the markets. Sales to end-customers amounted to 17.1TWh, down by 16.2% compared with 2014. At year-end 2015, Edison was serving 591,993 electricity customers and 521,399 gas customers, both in the business and residential segments.

In sales and marketing, Edison continues to grow its electricity and gas sales to individuals and to the SME segment, aiming for excellence in customer relationships and focusing on selected loyal customers. In parallel, Edison intends to maintain its position as a leader in the business-customer market, by developing an advisory approach in energy.

The Group will grow its presence in the region by reinforcing the cooperation between Edison and Fenice, in order to develop energy service offers for its customers.

### 1.4.5.2.3.4 Regulated activities

#### Gas transport and storage

Edison owns 100% of the Edison Stoccaggio company, dedicated to regulated gas-storage activities.

Edison also operates two storage sites in depleted reservoirs (fields which have been depleted of natural gas): Cellino (since 1984) and Collalto (since 1994), with a total volume of 700Mm<sup>3</sup>.

Moreover, Edison has been operating a third site, since 2013, San Potito & Cotignola, and is developing a storage project on the Palazzo Moroni site.

Finally, Infrastrutture Trasporto Gas SpA (ITG), wholly owned by Edison, owns and directly manages the Cavarzere-Minerbio gas pipeline, a functional link from the Rovigo terminal to the national network, with a transport capacity of over 9Gm<sup>3</sup> per year.

### Distribution

Gas distribution in Italy is regulated and supervised by AEEG, the electricity and gas authority that establishes, in particular, quality and safety parameters, as well as network access rules.

Infrastrutture Distribuzione Gas spa (previously called Edison Distribuzione Gas) is the company dedicated to the distribution of natural gas within the Edison group. In 2015, Edison DG distributed 257Mm<sup>3</sup> of natural gas to 150,368 users in northern and central Italy.

### 1.4.5.2.4 EDF Fenice

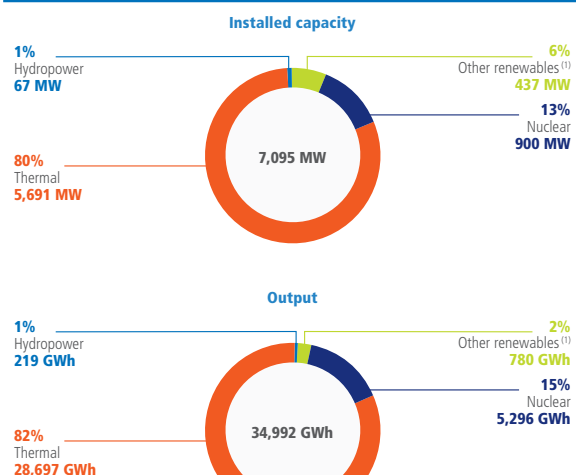
EDF Fenice, which is wholly-owned by the EDF group, is based in Turin, and benefits from an international presence, with subsidiaries in Spain, Poland, and Russia. Its principal activities, intended for industrial clients, consist of the development of solutions in the energy efficiency domain (see section 1.4.6.1.2 "EDF Fenice").

### 1.4.5.2.5 EDF Énergies Nouvelles

Following the adoption of the new regulatory framework for renewable energy in Italy, EDF Énergies Nouvelles did not commission any additional capacity in 2015 in Italy. Thus, the capacities held by EDF EN Italia at 31 December 2015 totalled 440.4MW gross wind power (or 246.6MW net power) and 79.5MW gross photovoltaic power (or 76.8MW net power) (see section 1.4.1.4.3 "EDF Énergies Nouvelles").

### 1.4.5.3 Other International

#### 2015 INSTALLED CAPACITY AND OUTPUT – OTHER INTERNATIONAL



(1) Excluding international data for EDF Énergies Nouvelles, part of the "Other activities" segment.



#### 1.4.5.3.1 Northern Europe

##### Belgium

The Benelux region features important interfaces with the Franco-German electricity marketplace and projects for new links with Germany and with Great Britain are also being examined. Benelux also constitutes an important link in the European gas market because of its numerous import and transit structures, such as the Zeebrugge hub and the Dunkirk LNG terminal nearby.

The EDF group is present in Belgium through its two subsidiaries, EDF Belgium and EDF Luminus.

##### EDF Belgium

As part of a long-term nuclear energy cooperation agreement with Electrabel, EDF holds 50% in undivided co-ownership of the Tihange 1 nuclear power plant, through its wholly owned Belgian subsidiary, EDF Belgium. The capacity attributed to EDF represents 481MW (or 2% of total Belgian generation capacity). Tihange 1 output, which is attributed to EDF Belgium is sold to EDF Luminus through a long-term contract which was renewed in late 2015 for 10 additional years.

Belgium's 2003 nuclear phase-out legislation originally provided for the closure of Tihange 1 on 1 October 2015. Nevertheless, it was finally decided to extend its operation upon 2025, following the adoption in 2012 by the Belgian government of the Equipment Plan, and the Law of 2013 amending the Law of 2003 pertaining to the timeframe for the phasing out of nuclear energy. This extension was the subject of an agreement concluded on 12 March 2014 between Electrabel, EDF and the Belgian State, defining its terms and conditions.

The extension of the life span of Tihange 1 requires significant investment, with EDF's share amounting to €300 million, spread over the period from 2011 to 2020.

##### EDF Luminus

At the end of 2015, the EDF group held 68.63% of the EDF Luminus company through its subsidiary EDF Belgium, with the remaining equity held by Belgian public shareholders (see below).

EDF Luminus is the second largest player in the Belgian energy market, holding a balanced upstream/downstream portfolio. The business accounts for nearly 10% of the country's output capacity, with an installed capacity of 1,955MW at end-2015. The electricity output of EDF Luminus reached 4,141GWh in 2015. The company employs 1,583 persons.

EDF Luminus worked to realise its strategic ambition, by reducing its costs while optimising its thermal production fleet, pursuing the development of wind farms, and launching the development of energy services.

##### Acquisition of ATS, a leading player in energy services for industrial clients

On 27 May 2015, EDF Luminus finalised the acquisition of a majority shareholding in ATS SA following the favourable opinion of the Belgian Competition Authority. In addition to the distribution of electrical equipment, ATS offers complete integrated solutions in electricity and heating: design and engineering, installation and maintenance of industrial electricity grids, automation, industrial cooling, fire detection, and hydraulics.

EDF Luminus and ATS can better assist their industrial clients and those from the tertiary and public sectors, thanks to an offer which has been enriched with energy-efficiency solutions and solutions to optimise their consumption.

##### New agreement on EDF Luminus shareholder agreement

On 26 October 2015, the shareholders of EDF Luminus, Publilec, Socofe, Ethias, Nethys and the EDF group signed an amendment to the EDF Luminus

shareholders' agreement, which extended the latter agreement up to 2025, and provides for the following reorganisation of the shareholding:

- the maintenance of four Belgian shareholders: Publilec (26.4%), Socofe (4.7%), Ethias (0.2%) and Nethys (0.1%) who, under the shareholders' agreement, benefit from a liquidity mechanism which makes it possible for them to withdraw from the share capital of EDF Luminus starting from the end of 2018;
- the acquisition by the EDF group of the equity interest of Publilum and VEH in EDF Luminus, representing in total 6.33%, which brings the equity interest of EDF in EDF Luminus up to 68.63% (instead of 62.3% as previously).

Consequently, the Board of Directors of EDF Luminus, which met on 26 October 2015, decided to cancel the planned initial public offering of EDF Luminus, initiated in May 2015. This change in the EDF Luminus shareholding made it possible for the Company to retain its local presence, thanks to an amendment of the agreement between EDF and its Belgian co-shareholders.

EDF Luminus owns 10.2% (419MW) of Belgium's Tihange 2 and 3 nuclear power plants (commissioned in 1983 and 1985 respectively) and the Doel 3 and 4 plants (commissioned in 1982 and 1985 respectively), which have a life span of 40 years. EDF Luminus also has 100MW drawing rights on the French Chooz B nuclear power plant, based on a band of guaranteed output according to the average availability of the French fleet.

The Doel 3 and Tihange 2 nuclear reactors, which represent approximately 20% of energy demand in Belgium, were shut down from 2012 to 2014, except for a brief period of relaunching between May 2013 and March 2014, following the detection of micro-cracks. On 17 November 2015, the Federal Agency for Nuclear Control authorised the return to production of these two reactors, following receipt of the final report of the US laboratory, Oak Ridge. Electrabel started the reactors back up at the end of December 2015.

Within the overall framework of the agreement concluded on 30 November 2015 between the Belgian State and Electrabel for the extension of the two Doel 1 and Doel 2 plants, an agreement was reached concerning the nuclear tax in Belgium for the years 2015 (200 million) and 2016 (130 million). The financial impact for the two Belgian subsidiaries of the EDF group was €34.2 million in 2015 and €13.2 million in 2016. A variable formula will apply from 2017 to 2019, with a minimum annual total of €150 million for the nuclear tax in Belgium.

Apart from the drawing rights in the nuclear fleet, EDF Luminus has a generation fleet consisting of power plants fired by natural gas, wind farms, and a few "run-of-river" hydropower plants.

EDF Luminus also operates four combined-cycle power plants in Angleur, Ringvaart, Seraing and Ham. In the latter, recoverable heat from the steam turbine is used for the district heating network in the town of Gand. In summer 2014, the Seraing power station was selected for Belgium's strategic reserve for a period of three years. In addition, the Angleur and Izegem power plants were also recently selected for Belgium's strategic reserve for the winters of 2015-2016. The Monsin power plant was definitively closed.

EDF Luminus is active in the renewable energy sector with 7 hydropower plants and 29 onshore wind farms, totalling 114 turbines spread across Wallonia and Flanders. As of 31 December 2015, the company became the leader in onshore wind-farming in Belgium, with an installed capacity of 254MW. In 2015, EDF Luminus built 16 wind turbines with a combined capacity of 42MW, and acquired a portfolio of 28MW of existing built capacity (13 wind turbines).

##### Sales and marketing

Under its "Luminus" brand, EDF Luminus supplies electricity and gas to more than 1.8 million residential and business customers (in delivery points) in Belgium, with a net gain of 85,000 customers in B2C (business-to-customer) in 2015. This excellent marketing achievement was awarded the top rating of "5" given by the Flemish regulator, VREG, for eight consecutive quarters.



EDF Luminus has pursued its strategy in pricing and services in order to better address customer expectations, and to affirm its price positioning in relation to its competitors, and has kept a stable market share of about 20%, in difficult market conditions marked by a relatively high attrition level.

#### Energy services

EDF Luminus has an expanded service offering, thanks to the recent acquisitions of three significant complementary energy service providers (Rami Services, Dauvister and ATS). The services offered to residential customers are, inter alia, installation and maintenance of boilers, sale and management of an intelligent thermostat (Netatmo), and comfort services in the event of unforeseen damages to housing during inclement weather. At the end of 2015, the B2C portfolio for these last three services exceeded 125,000 contracts. With close to 68,000 services sold during the course of the 2015 year, sales more than tripled in comparison to 2014. And thanks to cooperation with ATS, EDF Luminus can offer complete integrated electricity and heating solutions to industrial clients.

Moreover, EDF Luminus is exploiting new, innovative niches for the development of service activities. For example, with regard to electric mobility, EDF Luminus is investigating different business models which make it possible to offer its customers electric mobility services. Four rapid charging stations were installed on a Campus site in Hasselt. A special feature of these stations: they integrate a software which makes it possible to maximise the use of local photovoltaic generation during the recharge.

#### The Netherlands

Through a joint venture, Sloe Centrale BV, EDF and Delta (each holding 50%) own an 870MW CCGT power plant in the southwest Netherlands, whose two 435MW units were commissioned in 2009 and serviced in mid-2013. Thanks to its very high technical performance, the Sloe plant was called upon to operate in 2015 for close to 3,500 hours, a significant period of time, under conditions which were not very favourable to gas-powered plants.

#### Switzerland

The EDF group is present in Switzerland through its investments in Alpiq Holding SA (25%) and in hydropower generation facilities in Le Châtelot (50%), Emosson (50%) and Mauvoisin (10%).

Alpiq is a player of significant size in the European energy market, at the heart of European electricity exchanges, active in the generation, sale, and trading of energy as well as in energy services. Alpiq accounts for over one third of the electricity supplied throughout Switzerland.

On the basis of its 2015 sales (CHF6,715 million), Alpiq is top-ranked among Swiss electricity companies. The financial and non-financial transactions of energy trading, carried out with third parties and with other associated and connected businesses, accounted for respectively 11.4TWh and 89TWh (mainly in wholesale markets and with major European clients from Southern, Central, and Eastern Europe). Alpiq also provides services to around 100,000 customers in north-west Switzerland. This activity is supported by significant generation assets in Switzerland and in other countries where Alpiq is developing its presence.

Alpiq's activities rest primarily upon generation assets, which strongly exposes it to variations in market price. In order to address the new marketing environment, which has been strongly degrading since 2011, the Alpiq group launched a plan for significant cost reduction as well as in-depth strategic thinking, in order to best enhance the value of its assets and to seize market opportunities, particularly in the energy services sector. In an initiative to become debt-free and to streamline its portfolio, several equity interests, including hydropower, had already been disposed of, and other divestitures are still expected.

#### Austria

EDF had held up till now 25% of the Energie Steiermark AG (Estag) holding company, alongside Land of Styria. Within the framework of its strategic orientations, the EDF group initiated, at the end of 2014, a process for the disposal of that minority equity interest, which was completed on 21 December 2015 by the buyback of EDF shares by Macquarie Infrastructure and Real Assets, an investment fund specialised in infrastructures.

#### 1.4.5.3.2 Central and Eastern Europe

##### Poland

The Group operates in Poland mainly through its EDF Polska SA subsidiary, which includes the following:

- the Krakow cogeneration plant, which has an installed capacity of 460MWe and 957MWth;
- the Wybrzeże cogeneration plant, comprising the Gdansk and Gdynia units with a total installed capacity of 333MWe and 1,134MWth;
- the Rybnik generation plant, with an installed capacity of 1,775MWe;
- the Warsaw plant, comprising the company headquarters and the Optimisation and Sales department, which is responsible for market sales and B2B customer sales of the electricity generated by all EDF group plants in Poland;
- the EDF Toruń company, a subsidiary of EDF Polska, which owns the municipal district heating distribution network in the town of Toruń, in addition to a coal-fired heat generation facility with an installed capacity of 398MWth and 2MWe, which powers the network. The replacement of the existing facility with a cogeneration facility equipped with two gas turbines and gas-fired boilers with a total capacity of 101MWe should take place from the winter of 2017-2018;
- the EDF Paliwa Sp. z o. o. company, also a subsidiary of EDF Polska, responsible for the supply of coal and biomass for all of the EDF group sites in Poland.

The Group also controls ZEW Kogeneracja SA, the cogeneration company in Wrocław. It has an installed capacity of 366MWe and 1,094MWth and owns 98.4% of the electricity and heat generation company EC Zielona Góra SA, powered entirely by a local gas source, the installed capacity of which is 183MWe and 302MWth.

In the field of environmental protection, the Group decided to implement an investment plan, particularly concerning the construction of desulphurisation and denitrification facilities for its assets in Poland, inaugurated on 19 November 2013 in Wrocław. It will enable the operation of the existing generation plants to continue until 2035 at least.

Moreover, the Group is present in Poland through its subsidiary, EDF Énergies Nouvelles, which owns two wind farms, of 48MW in Linowo and 58MW in Rzepin. Other wind power projects are also under development (see section 1.4.1.4.3 "EDF Énergies Nouvelles").

In October 2015, DK Energy Polska, a subsidiary of Dalkia SA in Poland, acquired 100% of the shares of the Zakłady Energetyki Ciepłej Katowice SA (ZEC), a company which is mainly specialised in generation and distribution of heat in the region of Katowice (Upper Silesia) and a leader in the area of mine gas recycling. This acquisition was intended to serve as a base for the development in the Polish market of the Dalkia offer in energy services for industrial businesses and local communities (heating networks and energy-efficiency) and to develop the use of mine gas as a substitute for coal.

In the framework of the CAP 2030 programme, a strategic review of the Group's thermal assets in Poland is currently underway.

## Hungary

### BE Zrt

On 30 June 2015, the Group has concluded an agreement for the sale of its shares (95.6%) in BE Zrt to EP Energy. After meeting the conditions precedent, in particular, the review by the competent Hungarian authorities, the transaction was finalised on 10 December 2015.

### EDF Démasz Zrt

EDF Démasz Zrt is wholly owned by EDF and is mainly engaged in the distribution and sale of electricity.

With regard to its supply activity, EDF Démasz Zrt supplies electricity to individuals, small businesses and public institutions in the south-eastern region of Hungary under the universal service concept (as defined by the Hungarian government Decree pursuant to the Hungarian Electricity Act of 2007). Since 2009, the company has supplied electricity and, more recently, gas, throughout Hungary to customers who opted for the open market. In 2015, EDF Démasz Zrt sold 3,040GWh to around 740,000 customers, including 1,440GWh on the open market.

Regarding its distribution business, the EDF Démasz Hálózati Elosztó Kft company, a wholly owned subsidiary of EDF Démasz Zrt, has been operating since 2007 in response to the legal requirement that network activities should be separated from generation/supply activities. It owns the electricity network assets (about 32,200 kilometres of high-, medium- and low-voltage lines) and operates the regulated electricity distribution business in Hungary's south-eastern region (19.6% of the territory). In 2015, it distributed 4.3TWh to 775,754 delivery points.

In 2014, faced with a depressed economic environment following the introduction of particularly punishing pricing and tax measures (a network tax of €0.45/m in 2013, and 25% price cuts imposed by the legislator between 2013 and 2014), the company implemented cost cutting measures.

The government announced its intention to progressively take back control of the utilities of the energy sector which had been privatised in the 1990s, and to create a sector under the control of the State. In 2015, the ENKSZ company was created to such end.

## Russia

The EDF group is present in Russia in the area of energy services, through EDF Fenice and its Russian subsidiary, Fenice Rus (see section 1.4.6.1.2 "EDF Fenice").

### 1.4.5.3.3 Southern Europe

#### Spain

At 31 December 2015, the EDF group held 31.48% of the equity of the Elcogas company that operates a 320MW power plant of the ICCG (Integrated Combined-Cycle Gasification) type in Puertollano. The other shareholders are Endesa Generacion (40.99%) and Iberdrola Generacion (12%).

In 2015, Elcogas produced 909GWh<sup>1</sup>, including 821GWh generated by ICCG.

The power plant, whose profitability was no longer assured as of 31 December 2014, the date upon which it ceased to collect a compensation supplement

under the Royal Carbon Decree, received administrative authorisation to close on 1 July 2015. The closure process of the power plant was to take place during the first half of 2016.

The Group is also present in the Spanish market through the local subsidiary of EDF Énergies Nouvelles (see section 1.4.1.4.3 "EDF Énergies Nouvelles") and that of Fenice (Fenice Instalaciones Iberica (see section 1.4.6.1.2 "EDF Fenice") and that of Citelum (see section 1.4.6.1.4 "Citelum").

EDF Trading operates in this market from its trading platform in London (see section 1.4.6.3 "Optimisation and trading: EDF Trading").

Lastly, in May 2015, EDF acquired, through its EDF Invest division, a minority shareholding in Madrileña Red de Gas, operator of the principal gas distribution network in the Madrid region.

### 1.4.5.3.4 North America

The EDF group operates throughout the North American continent, with a strong presence in the United States.

It has more than 5.2GW of installed capacity in North America. It also manages, on behalf of third parties, around 36GW of installed capacity under operation and maintenance or optimisation services contracts.

EDF's activities in North America mainly include:

- investments in nuclear generation, by owning 49.99% of three nuclear power plants operated by Exelon, the largest nuclear operator in the US, with a total installed capacity of 3.9GW (i.e. 1.95GW consolidated by the EDF group);
- renewable energies, with a net capacity of 3,251.7MW in the US, mainly through EDF Renewable Energy, a wholly-owned American subsidiary of EDF Énergies Nouvelles. Equally, EDF Renewable Services (a wholly-owned subsidiary of EDF Renewable Energy) manages close to 9.4GW in North America through operation and maintenance contracts on its own account or on behalf of third parties;
- trading, throughout the entire value chain in North American gas and electricity markets through EDF Trading North America, and the supply of energy management products in the US and Canada through EDF Energy Services (a wholly-owned subsidiary of EDF Trading North America).

#### 1.4.5.3.4.1 Nuclear activities in the United States

##### *Nuclear generation: Constellation Energy Nuclear Group (CENG)*

On 6 November 2009, the EDF group and CEG established CENG. Since the merger between Exelon and CEG, EDF and Exelon have owned stakes of 49.99% and 50.01% respectively in CENG. EDF and Exelon agreed in 2014 to transfer the operating licenses of CENG to Exelon, pursuant to this agreement, Exelon manages the day-to-day operations of the three CENG nuclear sites (five nuclear reactors).

As part of the transaction, CENG paid EDF US\$400 million in special dividends and EDF was granted a put option to sell its CENG shares to Exelon at fair market value exercisable between January 1, 2016 and June 30, 2022.

CENG is governed by a Board of Directors of ten members, five of whom are appointed by the EDF group and the other five, including the Chairman, by Exelon.

1. Figures on 100% basis.

**CENG's nuclear activities**

CENG's nuclear business is under the control of the US Nuclear Regulatory Commission (NRC).

CENG owns and operates five nuclear reactors, spread across three operating sites and representing a combined capacity of 4,167MW. The duration of licences for Units 1 and 2 of Calvert Cliffs, Unit 1 of Nine Mile Point and RE Ginna is 60 years.

Reactors	Capacity (in MW)	% interest	Company-owned capacity (in MW)	Output <sup>(2)</sup> (in TWh)	
				2015	2014
Calvert Cliffs 1	863	100	863	7.8	6.9
Calvert Cliffs 2	850	100	850	6.9	7.4
Nine Mile Point 1	630	100	630	4.9	5.4
Nine Mile Point 2 <sup>(1)</sup>	1,242	82	1,019	9.0	8.0
R.E. Ginna	582	100	582	4.8	4.7
<b>TOTAL</b>	<b>4,167</b>		<b>3,944</b>	<b>33.4</b>	<b>32.5</b>

(1) CENG owns 82% of this unit (i.e. 1,018.6MW of the unit's total capacity of 1,242.2MW). The 18% of Unit 2 of Nine Mile Point not owned by CENG belongs to the Long Island Power Authority ("LIPA"). LIPA receives 18% of the capacity and electricity generated by Nine Mile Point Unit 2, in consideration for payment to CENG of its share of the costs incurred by the unit, and is responsible for its 18% share of costs of dismantling the unit. CENG and LIPA are each required to provide specific funding for Nine Mile Point 2.

(2) These values correspond to the sum of the exact values expressed to one decimal place after rounding.

**Unistar Nuclear Energy (UNE)**

In a letter to the U.S. NRC dated February 27 2015, UNE directed the NRC to suspend its review of the Calvert Cliffs 3 Combined Operating License Application (CC3 COLA). The suspension of CC3 COLA resulted to the write-off of UNE's forging assets amounting to \$50.3 M (\$55 M under USGAAP) and capitalized COLA costs of \$13.4 M (\$0 under USGAAP). In a letter dated June 8, 2015, UNE notified the NRC of the withdrawal of the CC3 COLA. On June 17, 2015 the NRC notified UNE of its decision to accept the withdrawal of the CC3 COLA, effective upon publication of notice in the federal register on June 18, 2015.

**1.4.5.3.4.2 EDF Trading in North America**

EDF Trading operates in the North American markets for electricity (including transmission rights), gas, coal and environmental products. EDF Energy Services is the commercial and industrial retail arm of EDF Trading and provides management and optimisation services to large-scale energy intensive commercial and industrial users throughout North America (see section 1.4.6.3 « Optimisation and trading: EDF Trading »).

**1.4.5.3.4.3 EDF Énergies Nouvelles in North America**

EDF Énergies Nouvelles, through its subsidiaries EDF Renewable Energy, EDF Renewable Services, EDF EN Canada and EDF EN Mexico, continued its expansion in North America, commissioning 1,338.6MW of wind, solar photovoltaic and biogas capacity in 2015.

EDF Renewable Services manages wind and solar projects, both for the company's own accord and on behalf of third parties (see section 1.4.1.4.3 « EDF Énergies Nouvelles »).

**1.4.5.3.5 South America**

In South America, the EDF group is present in the Brazilian market. Its ambitions extend to certain countries in the area where it anticipates opportunities for development, such as Chile.

**1.4.5.3.5.1 Brazil**

Since April 2014, the Group has held 100% of EDF Norte Fluminense, following the buyback of the 10% equity interest held by Petrobras in the share capital of EDF Norte Fluminense. The company, which built and operates since end of 2004 the Combined-Cycle Gas power plant of Norte Fluminense, with an installed capacity of 827MW, situated in the region of Macaé, sells 725MWh annually to the Light distribution company (pursuant to the terms of a 20-year PPA), corresponding to about 6.3TWh per year. The remaining balance is sold on the open electricity market. EDF Norte Fluminense sold 260GWh in 2015.

EDF Norte Fluminense has an additional solar power plant, intended for industrial consumption, comprising 1,764 photovoltaic modules which generated 428MWh in 2015, helping to reduce its CO<sub>2</sub> emissions by around 250 tonnes a year.

In addition, on 11 December 2014, through its subsidiary EDF Norte Fluminense, EDF acquired a 51% stake in Compagnie Énergétique de Sinop (CES), which is responsible for the construction and future operation of Sinop's hydropower facilities of an installed capacity of 400MW. The two other shareholders are Eletronorte (24.5%) and CHESF (24.5%), subsidiaries of the Eletrobras group. Construction of the dam began in spring 2014 and commissioning for commercial operations is scheduled for the first half of 2018. With a 51% stake in the consortium, the EDF group has an industrial role in both the construction and the future operation of the dam. At year-end 2015, close to 50% of the civil-engineering work had been carried out on the project.

It should be noted as well that EDF Énergies Nouvelles has launched its operations in Brazil in February 2015, with the acquisition of 80% of the portfolio of Ventos da Bahia. The first electricity supply contract represented 66MW in wind projects situated in the State of Bahia, in partnership with Sowitec, a German group specialised in the wind energy development in the world. In November 2015, EDF Énergies Nouvelles won a second long-term 117MW electricity-supply contract, in the same portfolio of wind projects. The construction of these new capacities will begin in 2017, with commissioning expected at the end of 2018.

#### 1.4.5.3.5.2 Chile

In 2013, EDF entered a Joint Development Agreement with the Chilean BBG project-development company and the U.S. company Cheniere, with the aim of developing a gas-to-power project, combining construction, operation and maintenance of a CCGT electric power plant of approximately 600MW installed capacity, with infrastructure for offshore LNG storage and regasification of the FSRU (Floating, Storage & Regasification Unit) type.

In 2014, EDF created a subsidiary, EDF Chile, responsible for the development of this project and to anchor EDF's presence on the Chilean energy market.

In 2015, EDF signed a new agreement (Restated and Amended Joint Development Agreement) with the Chilean development company Biobio Genera (formerly, Australis Power), for the pursuit of the development of this project. In parallel, EDF and its partners are negotiating the financing of this project with commercial banks, on the basis of project financing with limited recourse.

In September 2015, EDF also took a 25% stake in project company, in charge of the development of the terminal of Penco-Lirquén, and signed agreements with its partners Biobio Genera and the Cheniere group's Chilean subsidiary, intended to define their respective roles, rights and obligations in the future organisation to be set up upon the conclusion of the project financing (expected in 2016).

The EDF Énergies Nouvelles subsidiary is also present in Chile, with construction of a 146MW solar project in progress (see section 1.4.1.4.3, "EDF Énergies Nouvelles").

#### 1.4.5.3.6 Asia-Pacific

The EDF group's activities in the Asia-Pacific region are focused on China and fast developing countries. The presence in the sectors of electricity generation, networks and services constitutes an industrial challenge for the Group. In nuclear power, in addition to the project to build and operate two EPR reactors in Taishan, China, new projects should provide the Group with access to technological innovation and enable it to develop its industrial expertise. EDF's objective is, thus, to maintain its competitive and technological advantages in the international arena focused on the global nuclear programme, the equipping of emerging countries, and the renewal of the French fleet.

##### 1.4.5.3.6.1 Activities in China

The EDF group has been present in China for more than 30 years through its advisory services in nuclear, thermal and hydropower technologies. Today it is one of China's most significant foreign investors in power generation, with investments in coal-fired thermal facilities that have a total installed capacity of 6,260MW<sup>1</sup>. With the Taishan project Phase I (two 1,750MW reactors), EDF also became an investor in an electricity-generation project involving an EPR nuclear power plant. Lastly, EDF is developing new partnerships, which are opening it up to new investment perspectives in nuclear power, gas power plants, hydropower, electricity distribution, and energy efficiency.

##### Nuclear power generation activities

##### Daya Bay, Ling Ao and Taishan EPR Phase 1 power plants

Having led the design, construction and commissioning in 1994 of Daya Bay (two 1,000MW nuclear reactors), and subsequently assisted the Chinese group, China General Nuclear Power Co. (CGN), with the construction of the

Ling Ao Phase I power plant (two 1,000MW reactors, commissioned in 2002 and 2003, respectively), and then Phase II (two additional 1,000MW reactors commissioned in 2010 and 2011), EDF now provides operational support to the CGN group and, in particular, to the Daya Bay Nuclear Operation and Management Co. Ltd. The performance achieved by these power plants since commissioning is one of the Group's main benchmarks in China. In addition, EDF owns a 30% shareholding in Taishan Nuclear Power Joint Venture Company Ltd., which was set up to fund, build and operate two EPR nuclear reactors in Taishan, in the province of Guangdong. The company will have a 50-year life span, the maximum period currently authorised in China for a nuclear power joint venture. Through this transaction, the Group represents the first foreign investor in Chinese nuclear power generation. The project's success will rest on the complementary expertise of the EDF and CGN groups. All of the equipment of Unit 1 has been installed, and the majority of that of Unit 2 has been delivered. The beginning of all testing for the commissioning of Unit 1 took place in December 2015.

##### Partnership agreements

The General Partnership Agreement between EDF and CGN was signed in 2007 and complemented in 2014 by implementation of agreements related to engineering, R&D, and plant operation. The EDF group has set up a facility based in Shenzhen, with the aim of promoting the EDF model of an integrated architect-assembler operator while acting as a flagship for French industry. Experts in this facility are working, in particular, to further promote French codes and standards, as well as the Group's nuclear safety guidelines.

In 2010, the Group concluded a partnership framework agreement with China National Nuclear Corporation (CNNC), extended in March 2014, aimed at developing their cooperation along deeper, global lines. Also in 2013, the Group signed an agreement with CGN and AREVA, which prepared the terms for the construction of future reactors and provided for EDF's contribution to CGN's operating fleet and its evolution.

The partnerships with CGN and CNNC have allowed discussions to take place concerning their participation in the Hinkley Point C project: a protocol to encourage industrial cooperation between EDF, CGN and CNNC in the British nuclear market was signed in March 2014, and the agreement of 21 October 2015 between EDF and CGN complemented this partnership project (see section 1.4.5.1.2.5 "Nuclear New Build business").

Lastly, in the context of the Franco-Chinese governmental declaration of June 2015, tripartite agreements (EDF and AREVA with CGN and CNNC) were signed over 2015, providing for the continuance of the EPR construction in Taishan, the participation of the Chinese industrials in Great Britain, as well as a partnership for the development of medium- and large-sized reactors.

##### Coal-fired thermal power generation activities

##### French Investment Guangxi Laibin Electric Power Company, Ltd. (Figlec)

On 3 September 2015, the concession contract for the Laibin B power plant (2x360MW of installed capacity), signed in 1997 to the benefit of the EDF group in the framework of a BOT (Build, Operate and Transfer) project, expired. This power plant was thus transferred to the government of Guangxi.

##### Shandong Zhonghua Power Company Ltd. (SZPC)

The EDF group holds 19.6% of SZPC, a company which owns three coal-fired power plants in the Shandong province, commissioned between 1987 and 2004, with a total capacity of 3,060MW. The other shareholders are the Guodian group and the Hong Kong electricity utility CLP.

1. Figures on 100% basis.

**Datang Sanmenxia Power Generation Company Ltd. (DSPC)**

The EDF group holds 35% of DSPC, the company that owns the Sanmenxia 2 power plant in Henan province, commissioned in 2007, with an installed capacity of 2x600MW, using a technology known as "supercritical coal". This investment was made through a joint venture with a fixed life span, established by the Chinese authorities, running until 2039. The other shareholders are two Chinese companies including Datang, the majority shareholder in DSPC.

**Fuzhou Power Generation Company (FPC)**

The EDF group holds 49% of FPC, a joint-venture created in 2014 with a subsidiary of the Datang group to build and operate an "ultra-supercritical" coal-fired thermal power plant (2x1,000MW) in the Jiangxi province. The first unit was commissioned on 29 December 2015, the second group being expected in the spring of 2016. Fuzhou is thus the first power plant of the "ultra-supercritical" type (in other words, having increased output and a limited environmental impact) operated by the EDF group. This technology allows to reach high levels of temperature and pressure in the boiler, assuring a better output (close to 44% for Fuzhou) than a traditional power plant, while decreasing coal consumption and CO<sub>2</sub> per kWh emission.

As a result of this cooperation, the Group has broad involvement in the industrial process of building and operating the future power station. It will thus be in a position to build on its thermal engineering and operational skills and to establish new industrial synergies with global leaders in the thermal power generation segment, such as Guangdong Engineering and Design Institute (GEDI), the designer and builder of the power station, and Dongfang, the supplier of the boilers and turbines.

**Hydropower generation activities**

Present in this segment since 1985, the EDF group is a well-known player. The Group operated as consultant on several plants installed in China and is looking at investment opportunities or service offers that will respond to the needs on the Chinese side, where an ambitious hydropower programme is under development.

**Research & Development (R&D) activities**

Four years after its creation, EDF's R&D centre in China is continuing to build up its network of scientific partners in that country, together with the R&D departments in France and the Group's other international R&D centres (see section 1.6.3 "International activity and partnerships"). The centre's activities involve the generation and storage of low-carbon electricity, tomorrow's electricity networks, sustainable cities and innovation, with digital simulation capacities being a strong component in each one of these fields.

**Electricity distribution activities**

Present in China since 2011, EDF International Networks has signed technical support contracts in China concerning the planning and performance improvement of the performance of distribution networks in the Shanxi and Shaanxi provinces. EDF International Networks hopes to grow its business in China so that it may apply its expertise, methods and most effective tools to optimise network management and performance, particularly in a context of cooperation with the two major players in China, State Grid and Southern Grid.

**Prospects for development and new projects**

In energy services, the contract signed in 2013 with Dongfeng Peugeot Citroën Automobile (DPCA) concerning energy efficiency for lighting, was extended in 2014 and 2015.

The EDF group, Datang and the city of Sanmenxia signed a cooperation agreement in 2015 to study a project for a district heating network from the recovery of unavoidable heat emitted by thermal power plants. In January 2016, EDF was selected as a preferred partner for the development of the project.

It also works with the municipality of Wuhan for the planning, development and operation of energy services in the Franco-Chinese eco-districts of the Caidian district.

The Group also hopes to bring innovative solutions to industrial users and eco-districts by drawing on EDF's expertise in Europe, particularly in the fields of cogeneration, waste heat recovery and decentralised renewable energies (heat pumps, district solar, biomass and geothermal power).

**1.4.5.3.6.2 Southeast and Southern Asia**

The EDF group's activities in South-East Asia and in Southern Asia are focused on the development of the electricity sector, particularly through involvement in projects for the design, construction and operation of new thermal gas and hydropower plants in countries offering Independent Power Plant (IPP)-type opportunities.

**Vietnam**

As of 31 December 2015, EDF owned 56.25% of Mekong Energy Company Ltd. (MECO), the company which owns Phu My 2.2, a combined cycle gas power plant with a capacity of 715MW. The other shareholders are Tepco and Sumitomo Corporation. This is the first IPP project financed exclusively by foreign investors in Vietnam. The BOT (Build, Operate, Transfer) contract has a term of 20 years. In 2005, EDF provided "turnkey" delivery of the power plant, and operations are now managed by MECO.

**Laos**

At 31 December 2015, the EDF group held a 40% stake in Nam Theun 2 Power Company (NTPC), which owns the hydropower complex Nam Theun 2 with an installed capacity of 1,070MW, built by the EDF group under a "turnkey" contract, and commissioned in 2010. The other shareholders are a Thai company, EGCO (Electricity Generating Public Company Limited), which holds 35%, and a Lao State company, LHSE (Lao Holding State Enterprise), which holds 25%. NTPC company operates the power plant on a 25-year concession contract concluded with the government of Laos.

**Research & Development**

Following an agreement signed in 2013 with the Singapore Housing and Development Board, Singapore City's largest construction firm, in 2014, with the aim of developing an innovative urban modelling scheme, the EDF group opened a centre of excellence for sustainable cities in Asia: EDF Lab Singapore. This R&D centre dedicated to urban planning has as its mission to reinforce existing collaboration and to initiate new collaborative relationships with Singapore and other cities of the region.

**1.4.5.3.7 Africa**

In Africa, the Group intends to tailor its operations according to the specific features of each geographic region and thus to be present in high-growth countries offering new markets. Also, it is pursuing its operations in regards to decentralised production.



## South Africa

The EDF group established a subsidiary in 2007 in Johannesburg, with a view to preparing the relaunching of the South African nuclear programme. The country's energy master plan, promulgated in May 2011, anticipates the commissioning of 9.6GW of nuclear power capacity between now and 2030. The South African government plans to double the country's installed power generation capacity (from 44 to 89GW) by 2030, confirming its commitment to the inclusion of nuclear power in its future energy mix. Consequently, in 2014 and 2015, South Africa signed a number of intergovernmental agreements with the various countries that have put forward nuclear proposals. In that respect, delegations from these countries, including France, were invited by the South African government to present their expertise across the entire nuclear cycle. These steps are prerequisites for the launch of a call for tenders.

In other segments, EDF Énergies Nouvelles gained a foothold in the South African wind power market in the second round of renewable energy tenders launched in 2011 by the Ministry of Energy. The company was selected via its subsidiary, Innwind (80% owned by EDF EN) to carry out three wind-farm projects, the construction of which began at the end of 2013, and the commissioning announced during 2015 (see section 1.4.1.4.3 "EDF Énergies Nouvelles"). Innwind was, moreover, selected for an additional 33MW of wind power, during the fourth round of the tenders by the Ministry of Energy in June 2015.

EDF is also present in South Africa through the KES (Kukhanya Energy Services) company, created in 2002 (see section 1.4.5.3.9 "Access to Energy Mission").

EDF is also exploring other fields, such as developing its technical and strategic partnership with the South African electricity utility Eskom, for the generation, transmission and distribution of electricity. In this regard, a technical partnership agreement was signed in November 2015 between the Agence Française de Développement, Eskom and EDF, for the sharing of technical expertise in the area of networks.

Finally, an EDF expert is managing the engineering training institute EPPEI (Eskom Power Plant Engineering Institute), which Eskom has been developing since 2011 and which is specialised in electricity production and, ultimately, in electricity transmission and distribution.

## Morocco

EDF has been active in Morocco since the 1970s, and has formed preferred partnerships with Morocco's national electricity and water office (ONEE), electricity distribution authorities, and industrials. To help support its development, the Group created EDF Maroc in 1977 and EDF EN Maroc in 2012.

EDF and ONEE continued their cooperation, pursuant to the general agreement signed in January 2012, in the areas of renewable, thermal and hydraulic generation, as well as in networks and training.

After having been selected by ONEE through a tender, the consortium led by EDF EN in partnership with the Japanese group, Mitsui & Co., is developing the 150MW Taza wind farm (see section 1.4.1.4.3 "EDF Énergies Nouvelles").

## Senegal

Facing a very serious crisis in its energy sector, the Senegalese government asked EDF for assistance in diagnosing the situation and defining an emergency plan to re-establish a long-term service quality.

For over three years, EDF's operations have been focused on renovating the generation fleet of over 111MW of Sénélec (the Senegales National Power Company).

## Cameroon

In the framework of a partnership with the State of Cameroon, the IFC (a World Bank group) and Rio Tinto Alcan (RTA), EDF is developing the Nachtigal 420MW hydropower project, situated on the Sanaga River, close to Yaoundé, for an investment decision aiming for mid-2017. A support feature, "Access to Energy", is being launched in order to allow the populations in the environs of this project to receive better electrical service.

## Republic of the Congo

In 2013 the Group signed a three-year term agreement with the Congolese Ministry of the Economy and Finance to reduce the technical and commercial losses of SNE, the national electricity company. This contract is being performed and expired at the end of March 2016. An amendment extending the contract for a six-month period has been signed in March 2016.

## Ivory Coast

EDF is developing a project for a biomass electricity power plant with two 23MW units in partnership with SIFCA, an Ivorian agro-industrial group in West Africa. This project is already written into the Ivorian State's development master-plan, and negotiations are underway in order to reach a concession agreement and agreement on the transfer price of the generated energy. The investment decision is envisaged before the end of 2016.

### 1.4.5.3.8 Middle East

The EDF group is present in the Middle East region through its subsidiary, EDF Abu-Dhabi, which, in particular, provides engineering and consultancy services for the building of transmission facilities, dispatching and network studies in the United Arab Emirates.

## Saudi Arabia

EDF and AREVA opened a joint office in Riyadh in June 2012 with a view to working with the Saudi government, which is planning to develop an energy policy that focuses on replacing fossil fuels with nuclear power and renewable energy sources (solar power). Together, the two companies are leading work to evaluate the local industrial fabric and the educational system, in order to prepare for the launch of a nuclear programme.

In 2014, EDF signed a partnership agreement with the Saudi Electricity Company (SEC), a benchmark electricity operator of the country, enabling a broad cooperation between the two groups, and including in particular, training initiatives.

## Israel

In Israel, EDF supports the development initiatives of its Edison subsidiary in the gas sector. EDF's hydraulic engineering division (CIH) supplies services to the first Israeli project for the storage of electricity through pumping, on Mount Gilboa. EDF Énergies Nouvelles has also been present there since 2010 (see section 1.4.1.4.3 "EDF Énergies Nouvelles"): the subsidiary operates 109MWp of photovoltaic projects connected to the network, and is completing the construction of an additional 50MWp.



### 1.4.5.3.9 Access to Energy Mission

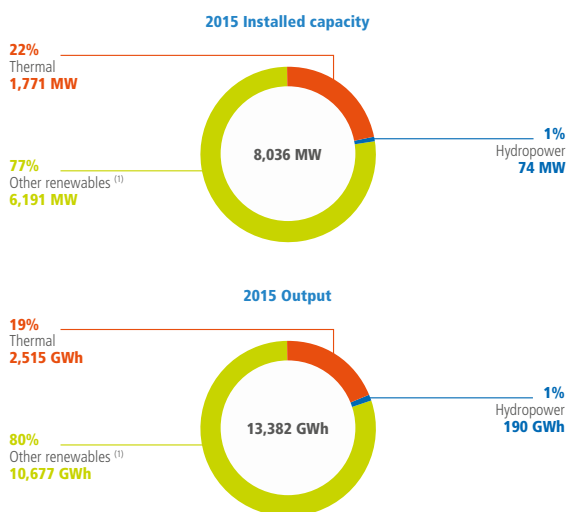
Since 2001, the Group has been pursuing a programme to provide access to energy in developing countries.

In South Africa, the KES (Kukhanya Energy Services) company, created in 2002, is 50% owned by EDF, 15% by the local operator, Calulo, and 35% by Total. It initially developed its business through photovoltaic kits in KwaZulu-Natal, then extended its activities into the Eastern Cape region. At the end of 2015, KES supplied solar electrical power to nearly 200,000 persons, representing an increase of around 25% between 2014 and 2015.

In Botswana, EDF has been chosen by BPC (Botswana Power Corporation), the national electricity operator, to assist as its strategic partner in the implementation of its decentralised rural electrification programme, using essentially photovoltaic systems. EDF holds 45% of BPC Lesedi, a local subsidiary owned jointly with BPC. The interest in pursuing this programme has been in question, and a procedure for disengagement, pursuant to a shareholder pact, is underway.

In Senegal, EDF has a 70% shareholding in ERA, alongside its local partner, Matforce. ERA is the operator of the rural electrification concession of Kaffrine-Tambacounda-Kédougou, which commenced the operational phase of its business in 2014 following the obtaining, at the end of December 2013, of the first tranche of the French Development Agency grant, through ASER<sup>1</sup>. It currently supplies power to approximately 25,000 persons.

## 1.4.6 ENERGY SERVICES AND OTHER ACTIVITIES



(1) Including the whole EDF Énergies Nouvelles entity.

### 1.4.6.1 Energy services

The EDF group is a major player in energy services in France. Its competences allow offering comprehensive solutions, covering various fields: advice, solution design, construction, operation, and maintenance of the facilities.

EDF is also active in sectors as varied as public lighting, heating networks, decentralised low-carbon generation, remote control of consumption, and electric mobility.

The Group's strategic plan places an important emphasis on the development of energy services, in order in particular to meet the needs of local communities and businesses. This ambition rests upon a context which advocates energy efficiency, decentralised generation with low-carbon emissions, and research into competitiveness and quality of life, regardless of what may be the business sector concerned.

Consequently, the Group's actions are built around five challenges:

- energy efficiency for public buildings and tertiary and industrial companies;
- providing support to regions during their project, and in particular to "sustainable cities" or "smart cities";
- local power generation and the associated heating and cooling networks;
- intelligent public lighting;
- electric mobility.

#### 1.4.6.1.1 Dalkia

The EDF group has held a 99.94% equity interest since July 2014 in Dalkia, a leading player in the European energy services market with a full range of services and an excellent sales network in France, serving to reduce energy consumption and to improve the performance of the facilities.

#### Dalkia's operations

Dalkia now operates in the face of three major challenges: global warming and the need to reduce greenhouse gas emissions, energy efficiency as a source of savings, and the territories transformation in an increasing urbanisation context and the resulting industrial development.

Dalkia brings expertise to its customers, in order to develop, realise, and manage innovative energy solutions, which are more ecological and more economical, for sustainable growth of cities and businesses.

From decentralised generation to demand-side management, while optimising distribution, Dalkia is present at each stage of the energy chain, in order to improve system performance. Thanks to its nearly 80 years of experience in managing heating and cooling networks, optimising industrial utilities, improving the energy performance of a building, or using alternative and renewable energies, Dalkia offers its customers tailor-made solutions to reduce their energy consumption and to improve the environmental and economic performance of their facilities.

In this way, Dalkia has allowed to avoid 2.46 million tonnes of CO<sub>2</sub> and realised 3.91TWh of energy savings in 2015.

1. ASER: Senegalese Agency for Rural Electrification (Agence sénégalaise de l'électrification rurale).

### Heating and cooling networks

The development of the networks was an important growth engine in the last few years for Dalkia which established a reproducible model for value creation, resting upon numerous optimisation levers:

- improvement of the efficiency of teams and organisations, optimisation of the performances of operations upon the takeover of networks;
- reconfiguration of generating plants and networks: anticipation of future network needs, taking into account organic growth potential and progression of energy efficiency, integration of the challenges of regulatory compliance, reduction of unnecessary redundancies;
- modification of the energy mix for greater efficiency and less CO<sub>2</sub>, with the optimisation of cogeneration and the development of renewable energies (biomass, geothermal, etc.);
- additional services in order to better enhance assets (for example, support service for the electricity grid).

Thus, Dalkia is one of the leaders in France in the management of urban heating and air-conditioning networks, operating 358 heating or cooling networks, both urban and local. Deploying this model across its geographic targets will constitute a significant part of its future growth.

### Industrial utilities

Dalkia is active in the industrial utilities business for 2,100 French industrial sites. The challenge is to improve environmental performance (particularly by controlling CO<sub>2</sub> emissions and the valuation of energy recovery), competitiveness and security of supply.

Dalkia's strategy is to allow its industrial clients to concentrate on their core processes, by assuming responsibility for and optimising the production of their utilities, their energy usage, and their greenhouse gas emissions. Dalkia differentiates itself by a large and coherent range of services, which includes the optimisation of industrial utilities (steam, electricity, compressed air); adjustment of usage to requirements, and identification of sources of unavoidable energy and recoverable co-products, optimisation of industrial building usage, and reduction of greenhouse gas emissions.

### Building energy services

Building energy services consist of management of the energy facilities in buildings: optimisation of local thermal energy generation, energy supply, operation and maintenance of technical facilities. They also seek to improve the operation of existing systems in order to maximise their effectiveness and to reduce their CO<sub>2</sub> emissions. Dalkia provides integrated energy services ranging from the design, construction and upgrading of facilities, to energy supply and management and maintenance of facilities, for tertiary, industrial, public-sector and private-sector customers.

In this respect, Dalkia manages 88,000 energy facilities in France.

### Key achievements for Dalkia in 2015

In October 2015, DK Energy Polska, a subsidiary of Dalkia in Poland, completed the buyback of 100% of the shares of the Zakłady Energetyki Ciepłej Katowice SA (ZEC) company, a company which is primarily specialised in the generation and distribution of heat in the region of Katowice (Upper Silesia), and of its subsidiary, EC Szopienice. The business's development project, which rests primarily on gas mine recycling, and development of heating networks, will allow to reduce carbon from the energy mix of the region, while enhancing the value of local resources and by utilising more effective processes.

Toulouse Métropole chose Dalkia for the construction of a new heating and cooling network for the equivalent of 15,000 houses, and thus created a new eco-virtuous public service from renewable and recovered local energies. The public service delegation contract was signed for a 26-year term, and concerns the design, construction and operation of the new heating and cooling network, "Plaine Campus".

Air France entrusted Dalkia with the overall management of its Orly and Roissy industrial sites. Dalkia thus has become its preferred partner for multitechnical and multiservice services for 105 airport buildings and maintenance hangars. Over the contract's five years, Dalkia has committed to reducing energy consumption by 15%.

In March 2015, Dalkia finalised the 100% acquisition of Cesbron, a specialist in industrial and commercial cooling and in climate engineering. This acquisition made it possible for Dalkia to position itself in the cooling sector, and to enlarge its services range.

In biogas, Verdesis was acquired from EDF Énergies Nouvelles on 11 February 2015 by Dalkia, due to their close business proximity. Verdesis has a 27.2MW capacity, in operation in Europe.

### Optimal Solutions

Optimal Solutions (the former EDF OS), a wholly owned subsidiary of the Dalkia group since 17 February 2015, has positioned itself as a specialist in the design and realisation of energy-efficient solutions in France, strongly complementing Dalkia's regions:

- in buildings or cities, through the renovation of buildings and eco-districts. It handles on its own the financial and legal setups, the design and construction of facilities, while integrating performance commitments throughout;
- in the design and works for the industrial and the tertiary sectors. The subsidiary has broad technical expertise, enabling it to adapt solutions to the needs of the customers, while seeking the optimum energy performance. These solutions integrate the following aspects: electricity, utilities, energy optimisation of processes, and some generation of renewable energy.

#### 1.4.6.1.2 EDF Fenice

EDF Fenice, an international group based in Italy, was set up by the Fiat group before being taken over (100%) by EDF in 2001. EDF Fenice is currently active in Italy, Spain, Poland and Russia.

EDF Fenice operates in the field of industrial energy and environmental efficiency. It designs, builds and manages either directly or on behalf of its customers assets such as combined generation plants, electricity substations, thermal power plants for industrial use or heating, cold generation power plants, compressed air generation units, fluid distribution systems (electricity, gas, hot or refrigerated air, compressed air, industrial gas and water) and industrial water treatment plants. EDF Fenice develops efficiency projects in the form of industrial partnerships or performance contracts with customers. These are complemented by a wide range of energy and environmental consulting services, waste treatment services, monitoring, analysis and environmental rehabilitation. EDF Fenice supplements its services with energy efficiency and environmental optimisation services for industrial sites and facilities.

At 31 December 2015, EDF Fenice had a total electricity production capacity of 280MW and a heat generation capacity of 2,789MWh. EDF Fenice has 52 thermal energy (steam, superheated water, hot water), electricity and compressed air production sites.

**Italy**

Contracts with the Fiat group still account for over half of EDF Fenice's business. A major goal in 2015 was to strengthen the relationship with this major customer by confirming the performance of the new contract and the excellent service provided under the new contractual model established in 2013. One of the benefits of this model is the development of efficient partnership initiatives, increasing the likelihood that the contract will automatically be renewed for a further five years in 2017.

In 2014, EDF Fenice built its Energy Management System according to ISO Standard 50001-2011, which encourages best practices in energy management (reduction of greenhouse gas emissions and other environmental impacts, energy savings). In the end of December 2015, 13 of the 22 sites of the Fiat contract were certified (including both sites located in Spain), with the objective of having them all certified in future.

**Spain**

EDF Fenice has operated in Spain since 2001 through its wholly owned subsidiary EDF Fenice Instalaciones Iberica.

Strongly impacted by the energy reform of 2014, EDF Fenice Ibérica demonstrated in 2015 its ability to surmount the crisis, thanks to the consolidation of its commercial model in the services of energy efficiency and the reinforcement of its position in the industry's market.

The implementation of the European Union Directive on Energy Efficiency in Spain, setting concrete obligations for the large industrial businesses, allowed EDF Fenice Ibérica to accelerate the development of the Global Energy Partner model through reinforced commercial activity, targeted operational marketing, and a strategy of commercial partnerships.

And so, in 2015, EDF Fenice Ibérica signed new contracts with significant industrial groups from the Spanish agri-food sector, and established partnership agreements with specialised companies, making it possible to reinforce its commercial offering, both in the area of energy management and in commodities management consulting.

**Poland**

EDF Fenice has a wholly owned Polish subsidiary, EDF Fenice Poland. This company operates principally in the field of outsourced management of industrial utilities (cogeneration, heating, cooling, compressed air, electricity grid, industrial gases). It also handles various energy and associated environmental services (potable water, waste treatment, and liquid effluents). EDF Fenice also has the administrative concessions which are necessary to supply customers connected to its distribution networks (electrical, gas, heating). Finally, EDF Fenice Poland developed a business connected to energy efficiency, with the objective of reducing its customers' consumption and environmental impacts.

**Russia**

EDF Fenice has a wholly owned subsidiary in Russia, Fenice Rus, which markets energy efficiency and environmental services to industrial companies. Since its creation, Fenice Rus has signed eight performance contracts with Avtovaz, a Russia's leading car maker, which are now fully operational. The facilities built for the TMH (TransMashHolding) company are also operational using the same business model. These projects have become a benchmark for customers and public authorities. They have the advantage that they can be replicated at other sites and in different business sectors.

In July 2015, and more recently, in early 2016, Fenice Rus also commissioned the sewage treatment units which had been constructed, and which will be operated for 10 years by Fenice Rus, on two of Danone's industrial sites in Russia. These projects have also become benchmarks and are the basis for the international cooperation between Fenice and Danone.

An Energy Management System project has also been put into place in one of the Schneider Electric plants in Russia. This contract, with a three-year term, makes it possible to both identify energy-efficiency projects "online" to be created on the site, and to provide a benchmark for this type of project, on such a scale.

EDF Fenice is continuing to support international groups that operate in Russia, such as Danone, Alstom and Renault Nissan.

**1.4.6.1.3 Tiru**

Tiru is 51% owned by the EDF group. It specialises in:

- energy recovery: incineration of household waste to generate energy (electricity and steam) for district heating or industrial applications;
- organic recovery: breakdown of organic matter and production of compost and biogas;
- materials recovery: sorting and packaging of recyclable materials (plastic, fibres, metals).

The remaining 49% is owned by Veolia Propreté (24%), CPCU (19%) and GDF Suez Énergie Services (6%).

Tiru designs, constructs and operates energy-from-waste and biomass facilities in France, Great Britain, and Canada, and has 1,096 employees. Its client portfolio is made up of municipalities, predominantly departmental and municipal consortia, waste management operators, as well as some private-sector clients (in particular, greenhouse producers and industrials).

Tiru recovers 3 million tonnes of waste per year, through its 32 sites. Its energy recovery units sold close to 2.63TWh of electricity and steam, 50% of which was renewable energy. Thanks to Tiru, this supplied heating to 316,000 inhabitants and electricity to 514,000 inhabitants in 2015. In 2015, Tiru saved the equivalent of 1.7 million barrels of oil, or 727,000 tonnes of avoided CO<sub>2</sub> emissions.

Tiru is a pioneer in the waste market and thus contributes to the challenges of energy transition. It industrialises new processes that are central to the development of energy systems, such as the anaerobic digestion of household waste and production of biogas, the production of solid recovered fuel, or supply of hot water to agricultural greenhouses from the heat produced in waste-to-energy plants.

In 2015, Tiru and the Henin-Beaumont Mixed Consortium for the Elimination and Recovery of Waste (Symevad) launched a new and innovative process with the new plant, which produces solid recovered fuels and biogas from household garbage.

**1.4.6.1.4 Citelum**

A wholly owned subsidiary of the EDF group since 2014, Citelum is one of the leading players in public lighting, not only in France, but throughout the rest of Europe and indeed worldwide.

With roughly 450 employees in France, Citelum employs close to 3,000 persons, active primarily in Europe (including France, Italy, Spain, and Denmark) and in the Americas (including the United States, Mexico, Brazil, and Chile).

Citelum accompanies cities and industries towards a more intelligent, more economic, and safer world of light. Citelum develops its expertise in street lighting in the areas of road signals, lighting installation and connected urban services: in particular, video-protection, recharging of electric vehicles and Wi-Fi.

Citelum's development in France and abroad is built around five key product lines, defined in energy services by the EDF group. To secure its long-term future and to stand out from its competitors, Citelum offers services that incorporate financing solutions, innovation as a key competitiveness factor and expertise in contract engineering.

Of note, in 2015, its expertise was selected in the call for tenders launched by the city of Rome, the subject of which was the renovation and maintenance of the stock of tricolour traffic lights, as well as the management of information billboards with changing messages and of access-control systems.

#### 1.4.6.1.5 Other service subsidiaries of the EDF group

Other subsidiaries within the EDF group complete the range of energy services that EDF offers. These focus on specific areas, targeting different categories of customers (individuals, professionals, businesses and local authorities) and cover a wide range of activities including research, construction, equipment maintenance, investment financing and assistance with obtaining permits and subsidies.

#### Energy management

To help customers manage their energy and fluid consumption, the EDF group provides facility monitoring and management solutions. Its subsidiaries Netseenergy and Edelia are active in this strategic area.

##### Netseenergy

Netseenergy is a company which is wholly owned by EDF, and has historically developed a range of services which enables business customers and regional municipalities to monitor the energy performance of their property assets. The company is a major player in the area of digitalisation of energy management through innovative auditing offers (100% digital audits), multi-fluid and multi-site monitoring, and personalised energy management.

##### Edelia (Edev Téléservices)

Edelia is a company which is wholly owned by EDF, and it historically handles, on behalf of EDF, the deployment and operation of demonstrators within the framework of intelligent distributed load-shedding electrical systems, for residential customers, particularly in Lyon (Smart Electric Lyon), in Nice, and in Brittany (with the experimental "Une Bretagne d'avance"). Edelia is also designing and developing a service hub aiming to deal with several millions of customers (display screens of consumption, warnings, advice, etc.).

The positioning of Edelia today is that of a captive subsidiary contributing a capacity of innovation to the EDF group on the "smarthome and data" topics (exchanges of data between connected objects in the home, in order to enhance services).

#### Electric mobility

The transportation sector today is very dependent upon fossil energies, which emit CO<sub>2</sub>. Low-carbon electricity constitutes a lever for developing electric mobility which is more respectful of the environment. This is why EDF, the champion of low-carbon growth, is investing in this field, particularly through its subsidiary Sodeltel.

The Group's commercial offering includes:

- consulting services for local authorities and businesses on the positioning and scale of electric vehicle charging infrastructure;

- installation of recharging infrastructure for all customer segments: residential, local authorities and businesses, car parks and supermarkets;
- remote management and supervision of charging stations;
- the Group has also participated in experimental ride-sharing in Grenoble, Nice and Monaco.

##### Sodeltel

Sodeltel, a company which is wholly owned by EDF, offers a range of electric mobility schemes for local authorities, energy consortia, and businesses. In this regard, it proposes a wide range of offers to its customers, from the provision and installation of charging infrastructure to commercial operation of associated services, also including tools for the supervision of charging stations and key solutions in hand for technical operation and maintenance. Sodeltel, in collaboration with its eco-mobility partners, also offers electric vehicle fleet management solutions.

In 2015, Sodeltel, in the framework of a consortium<sup>1</sup>, deployed a network of 200 rapid-charging stations that are interoperable on highways and compatible with all models of electric vehicles in the market.

##### Citelum

Active in the street furniture sector, Citelum supports the development of mobility by providing technical installation, operation and maintenance services (see section 1.4.6.1.4 "Citelum").

#### Electrical engineering: HTMS

HTMS, a wholly owned subsidiary of EDF, is involved in the operation and maintenance of high-voltage and medium-voltage equipment and substations, the supply and replacement of circuit breakers and transformers, troubleshooting, project management support and training. The company's core business is the optimisation of maintenance operations to ensure operator safety, the availability of facilities and the sustainability of plant and equipment.

The company also provides independent assessments and consulting (operational audits, definition of maintenance policies and equipment upgrades) and monitoring assignments for major projects.

Its activity is organised around three agencies (Lorette, Audruicq and Nantes), to which the operational branches are attached (Bordeaux, Lyon and Avignon).

In 2015, HTMS piloted and completed the retrofitting of six power transformers on behalf of the steelmaker Trimet, on the site of Saint-Jean-de-Maurienne. For this project, a temporary joint business grouping was created with the Transformateur Service Vénissieux company as the HTMS authorised representative. The amount of this operation was €4,700 thousand over 18 months. It involved a temporary alliance between businesses, which made it possible to organise in order to carry out a contract, for which they would not have been able to tender, had they been acting individually. They are referred to as co-contractors.

#### Heating: CHAM

Wholly owned by EDF, CHAM carries out its activity of maintenance of residential energy systems in individual homes, private multifamily dwellings, and to a lesser degree, social housing. The business and its own subsidiaries are in a period of dynamic external growth, which aims to extend the territorial grid.

1. This consortium brings together EDF, automobile manufacturers Renault, Nissan, BMW, and Volkswagen, and ParisTech. The Corri-Door project is being financed in half by the European Commission.

**Financial services: Domofinance**

Domofinance meets the financing needs of EDF's residential customers and building management companies who wish to integrate energy-efficient solutions into their home renovation projects. Specifically, it markets and finances renovation loans subsidised by EDF and communal works for building management companies.

In 2015, Domofinance granted more than 51,000 loans.

EDF consolidates using equity method 45% of Domofinance, the remaining 55% being held by BNP Paribas Personal Finance (a subsidiary of the BNP Paribas group).

**1.4.6.2 Gas activities**

In Europe, the EDF group requires over 20 billion cubic metres of gas, equivalent of half France's national consumption. As such, EDF has developed a gas strategy to ensure the security of gas supply for its 4.3 million customers (including more than 1.2 million in France), its cogeneration plants (owned by its subsidiary Dalkia in France), and its gas power plants.

The Group is thus present throughout the natural gas chain in France, but also in Europe, principally through its subsidiaries, EDF Energy, Edison and EDF Luminus. It also relies upon EDF Trading for its operations related to involvement in the wholesale markets, as well as with Dalkia.

**1.4.6.2.1 Natural gas end-market**

In 2015, the natural gas sales of the EDF group to its end customers in France totalled around 28.6TWh, equivalent to a market share of 6%. At 31 December 2015, some 1.2 million customers (ranging from residential customers to major accounts) had chosen EDF as their natural gas supplier.

In Italy, the United Kingdom, and in Belgium, the downstream customer portfolios consisted respectively of:

- in Italy: 521,000 customer accounts, 6.03Gm<sup>3</sup> of gas (around 63.9TWh) and a market share of 13.6%;
- in the UK<sup>1</sup>: around 2 million customers (27.7TWh), with a market share of around 5%;
- in Belgium: 589,000 customer accounts (13TWh), with a market share of around 18%.

**1.4.6.2.2 Gas assets and projects****1.4.6.2.2.1 Supply sources**

The Group's gas supply is provided mainly through a diversified portfolio of long-term contracts, originating from Qatar, Russia, the North Sea and North Africa.

The Group actively renegotiates these contracts with its suppliers to respond to fluctuations in the European gas markets and to restore profitability (see section 1.4.5.2.3.2 "Hydrocarbon business").

**1.4.6.2.2.2 Infrastructures****Gas pipelines**

Apart from its various rights to transport capacity in the European network, the EDF group participates, through its Edison subsidiary, in infrastructure projects for gas importation (see section 1.4.5.2.3.2 "Hydrocarbon business").

**Liquefied natural gas (LNG) regasification terminals**

In 2012, EDF, through its subsidiary, Dunkirk LNG (65% owned by EDF, 25% by Fluxys, and 10% by Total), commenced construction of a methane terminal with a capacity of 13 billion cubic metres per year, on the Grand Port Maritime de Dunkerque area, with commissioning planned in 2016. The terminal is equipped with three LNG storage tanks with a capacity of 190,000 cubic metres each, providing greater flexibility to the network to supply the gas-fired power plants, enabling them to cope with peak demand. This facility – unique in that it will be connected to two markets, France and Belgium – will be a major boost for efforts to secure and diversify European natural gas supplies. With respect to environmental considerations, EDF opted for system for heating of liquefied natural gas without production of CO<sub>2</sub>, using a portion of the warm water discharged from the Gravelines nuclear power plant. EDF will have 8 billion cubic metres of regasification capacity.

In Italy, Edison owns 7.3% of the share capital of Adriatic LNG Terminal, the company that operates the Rovigo offshore terminal, and 80% of the regasification capacity, i.e. 6.4 billion cubic metres per year (see section 1.4.5.2 "Italy").

The Group also holds regasification capacities in the terminal of Zeebrugge (Belgium).

**Storage**

In Germany, the EDF group has storage for natural gas in salt cavities situated in Etzel. The aboveground facilities are operated through a 50/50 joint-venture with EnBW. EDF has approximately 190 million cubic metres of volume capacity in this salt cavity storage.

With respect to storage activities of the Group in Italy and in the United Kingdom, see respectively, sections 1.4.5.2.3.4 "Regulated activities" and 1.4.5.1.2.3 "Thermal production and gas storage".

The Group also holds storage rights in the Netherlands, Belgium and France.

**1.4.6.2.2.3 Exploration and Production (E&P)**

The Group is developing its upstream activities in hydrocarbons exploration and production, through Edison (see section 1.4.5.2 "Italy"). Proven reserves total 42 billion cubic metres of gas equivalent, with 2.7 billion cubic metres produced in 2015.

**1.4.6.3 Optimisation and trading: EDF Trading**

EDF Trading is the interface between the Group and the energy wholesale markets providing optimisation and risk management services as well as access to new markets and regions. It also provides market services to third parties. The company is active in the wholesale markets for electricity, natural gas, LNG & LPG, coal and freight and environmental products. It also handles dedicated retail operations for end users in North America. EDF Trading is one of the largest wholesale energy market traders in Europe, it is one of the largest marketers of gas and electricity in North America, one of the main independent providers of energy management services for power generation companies and retailers in the US, and a top 10 retail supplier to large commercial and industrial users in North America through its subsidiary EDF Energy Services.

EDF Trading has offices in Europe, Asia and North America, and its registered office is in London. The company has 988 employees and is governed by the UK's financial market regulator, the Financial Conduct Authority.

1. Excluding Northern Ireland.



## European Electricity

EDF Trading is a leading participant in the European electricity wholesale market, providing a full range of risk management services to EDF group asset operators in Europe and to third parties. It has an extensive geographic footprint and scale of activity which makes it able to adapt quickly to changes in the market and to develop new business where appropriate. In 2015, EDF Trading developed its intraday activities and increased transaction flows with EDF group entities. It also expanded its geographic footprint to include Romania and became a market maker for Spanish Power Futures.

## European Gas

EDF Trading is a leading player in the European gas wholesale market. It manages EDF group entities' gas assets including production, transmission rights, long-term supply contracts and re-gasification and storage capacities. This enables it to support the EDF group and third party customers with complete gas wholesale market solutions. EDF Trading works with Group entities to optimise their short term assets. In 2015, EDF Trading continued to manage the Group's gas portfolio and signed agreements with EDF's larger commercial and industrial customers. On the flow side, EDF Trading has been developing wholesale market products for a growing number of third party customers.

## North American power and gas

EDF Trading is a leader in the North American wholesale electricity markets with an extensive geographic footprint. It is also one of the top gas marketers. EDF Trading contracts or manages about 4.2Gm<sup>3</sup> (15bcf) of natural gas storage and around 400Mm<sup>3</sup> (1.5bcf per day) of gas pipeline transportation. It has a portfolio of assets including long term electricity and gas contracts, virtual hydro plants, US tolling agreements, gas storage facilities and gas transportation contracts. In 2015, EDF Trading extended its footprint to the Mexican border and is currently looking at opportunities into Mexico. It partnered with EDF Renewable Energy on a natural gas contract in Pennsylvania and executed its first power supply deal in the Vermont Public Power Supply Authority. EDF Trading is also one of the leading traders of FTR's (Financial Transmission Rights) in North America.

## Environmental products

EDF Trading is active across the carbon, green energy and weather derivatives markets in Europe, North America and China. The company is also involved in trading a broad suite of environmental commodities and is one of the largest traders of renewable energy certificates in the US. In 2015, EDF Trading executed the first transaction regarding the contract nearly launched by Nasdaq on German wind energy.

## Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG)

EDF Trading offers a complete range of LNG services including supply and delivery and nominations into the appropriate network. In 2015, EDF Trading signed a long term LNG optimization and supply agreement with the Korean utility KOGAS and is looking to expand this arrangement with other Asian

buyers. It also signed an Egyptian gas tender and worked alongside EDF on its marketing initiatives ahead of the commissioning of EDF's Dunkirk LNG terminal. EDF Trading is still developing its LPG trading activities and expects its first physical delivery early in 2016.

## Coal and freight trading

EDF Trading operates a fully integrated coal and freight trading business with numerous supply sources across the globe. In 2015, EDF Trading closed a long term supply contract with Drummond and created a new joint venture in Singapore with the two largest Japanese utilities, Chubu and Tepco to optimize their coal procurement process, effectively doubling its current coal volumes into Japan.

## EDF Energy Services

EDF Energy Services is EDF Trading's dedicated business for large retail commercial & industrial (C&I) consumers operating in the North American electricity, gas and environmental products markets. It is also the premier asset management provider for power generators in the US with around 25,000MW of generation output under management with over 60 power stations that it dispatches and operates on behalf of its customers. Many of these large customers are European or present in Europe, which allows EDF Trading to service them on the different markets they operate on. In 2015, EDF Energy Services extended its C&I footprint into the New Jersey, Delaware and Maryland retail electricity markets and is now no. 8 on the DNV GL (merger of Det Norske Veritas and Germanischer Lloyd) list of top C&I retail energy providers. It added more than 3,000MW to its EMA (Energy Management Agreement) portfolio in 2015 including power plants in Louisiana, Mississippi and Alabama. EDF Energy Services also worked closely with EDF's C&I business in Europe developing services for major global clients.

### 1.4.6.4 Électricité de Strasbourg (ÉS)

The ÉS group is a regional multi-energy company focused on three business lines: electricity distribution, sales and marketing of gas and electricity, and lastly, energy services and renewable energies. This balance makes it possible for the ÉS group to better provide support to its customers in energy transition.

The ÉS group is 88.64% owned by EDF, and the remaining shares are owned by the public and its employees. Its shares are traded on NYSE Euronext Paris.

#### 1.4.6.4.1 Distribution

ÉS Réseaux (ESR) carries out, within the Électricité de Strasbourg SA company, activities of electricity distribution network management. ESR operates, maintains, develops and renews an electricity network more than 14,000km in length in the 409 Alsatian communes that transferred their electricity distribution network to Électricité de Strasbourg. The contracts of these concessions were renewed between 1993 and 2001 for a term of 40 years. The territory serviced covers three fourths of the Bas-Rhin department and includes more than 500,000 points of delivery for low-, medium- and high-voltage power, as well as connections with the ERDF network and two other downstream network managers.



ESR also provides services to businesses and Local Distribution Companies (Entreprises Locales de Distribution, or LDCs) of Alsace.

In order to comply with recent developments in the Energy Code, Électricité de Strasbourg engaged in a process to create subsidiaries for its distribution activities.

#### 1.4.6.4.2 Sales and marketing

ÉS Énergies Strasbourg is the sales and marketing subsidiary of the ÉS group.

ÉS Énergies Strasbourg provides energy to nearly 500,000 electricity customers (including renewable) and 110,000 gas customers, to both residential and business customers (services and industrial sectors) or to communities.

In addition to supplying electricity and gas, ÉS Énergies Strasbourg offers related services such as electricity, gas and plumbing corrective maintenance. Also, ÉS Énergies Strasbourg has continued, for its residential customers, the implementation of support services in renovation and construction.

With a view to the elimination on 1 January 2016 of regulated tariffs for sales of natural gas for business customers consuming over 30MWh per year, but also electricity for customers whose subscribed power is greater than 36kVA, ÉS Énergies offered market proposals to its clients and strengthened its positioning as a leading provider of electricity and gas in the Bas-Rhin department.

#### 1.4.6.4.3 Energy services et renewable energies

##### Écotral

Écotral is the main force of energy services of the ÉS group. Its activities cover design, engineering, construction, operation and maintenance, mainly in the field of renovation of low consumption buildings, electrical and thermal areas, heat networks and renewable energies.

Following the acquisition of Dalkia by the EDF group in 2014, the latter sought to reinforce its development in energy services in the Bas-Rhin department, by bringing together the strengths and competencies of the ÉS group, a local energy company rooted throughout the region, and of the Dalkia group.

And so, on 1 January 2016, Écotral became ÉS Services Energétiques, a subsidiary owned in equal parts by ÉS and Dalkia, and thereby integrated the activities of Dalkia in the Bas-Rhin department.

##### Deep geothermal energy

The ÉS group is one of the leading players in deep geothermal energy in France. It holds an equity interest of 40% in the ECOGI (Exploitation of Heating for Industry from Geothermal Sources) project. This company, the result of a partnership with the Roquette Frères company and the Caisse des Dépôts, with the support of ADEME (the French Agency for Environment and Energy Management), of the Alsace Region, and of SAF-Environnement, is leading the construction project of a superheated water production plant (24MW thermal) from a geothermal resource situated more than 2,500 metres deep. Besides the projects in the course of being studied, the ÉS group has also become involved with its partner EnBW in the transformation of the deep geothermal research site of Soultz-sous-Forêts into an industrial facility, with commissioning expected in the spring of 2016, the same as for ECOGI.

##### Biomass

In the area of biomass, the ÉS group has become involved, through its majority ownership in the ÉS Biomasse company, in the financing, construction and operation of a biomass cogeneration plant. Starting from the end of 2016, the plant will produce 70GWh of electricity per year, and 80GWh of heat, which will allow supplying one of the three principal heat networks of the city of Strasbourg.

#### 1.4.6.5 Other equity interests

##### 1.4.6.5.1 EDF Trading Logistics

With a fuel oil supply volume of approximately 1.1 million tonnes and 1.4 million tonnes of coal delivered in 2015, EDF Trading Logistics represents EDF's vehicle for fuel oil purchases. It organises fuel oil and coal supply logistics operations for all of the EDF group's thermal plants in mainland France, Corsica and France's overseas departments. EDF Trading Logistics also acts as a coal freight forwarder for several large industrial companies (cement manufacturers, heating specialists, etc.) working closely with EDF Trading, and controls the coal terminals at the ports of Le Havre and of Saint-Nazaire.

Furthermore, EDF Trading Logistics provides EDF with its expertise in the implementation of processes for managing risks relating to the transport of fuel oil (hazardous materials), an activity that has been awarded ISO 14001 certification, and in the management of environmental crises arising from this activity.

##### 1.4.6.5.2 Other equity interests

The non-exclusive property investment fund, created in the end of 2014 at the initiative of EDF Invest and Amundi, pursued its development in 2015, with in particular a new property investment in Germany.

Finally, as well as interests in local distribution companies or LDCs (SMEG, Enercal, Électricité de Mayotte, EDSB), the EDF group has industrial subsidiaries and holdings. These companies contribute, within their specific field of activities (generation, fuel, engineering) to the Group's missions, and more specifically, to those of the generation and engineering: namely to ensure the short and medium-term performance of EDF's portfolio of generation assets in France.

These companies include Cofiva, an EDF group holding company specialising in engineering; SAE, which specialises in fuel transport and trading operations on behalf of the EDF group; SHEMA, which specialises in hydropower generation by small power plants; SOCODEI, a wholly owned subsidiary of EDF specialising in the treatment and packaging of low- and intermediate-level radioactive waste.

## 1.5 Legislative and regulatory environment

EDF group entities are subject to a wide variety of regulations in conducting their business activities. In particular, EDF is subject to European legislation on the electricity and gas markets, which has been transposed into French law, as well as to the applicable environmental, nuclear power, health and safety regulations.

The following review of legal and regulatory provisions is not designed to be an exhaustive description of all such provisions that are applicable to the EDF group.

### 1.5.1 EDF AS A PUBLIC UNDERTAKING

As of 31 December 2015, the French State held 84.94% of EDF's share capital and 85.04% of EDF's voting rights and, pursuant to Article L. 111-67 of the French Energy Code, must at all times hold at least 70% of EDF's capital.

As an undertaking in which the French State is a majority shareholder, EDF is subject to the provisions of Order no. 2014-948 of 20 August 2014 on the governance and equity transactions of companies with a public shareholding and its implementing Decree no. 2014-949 of the same date.

The French Government Shareholding Agency (APE), which was founded by Decree no. 2004-963 of 9 September 2004, fulfils the State's remit in its capacity as Company shareholder and, in this respect, proposes and implements the State's decisions and guidelines, in consultation with the ministers concerned.

In accordance with the legislation that applies to all undertakings of which the State is a majority shareholder, EDF may have to undergo certain State audit procedures, in particular through an economic and financial evaluation assignment, pursuant to Decree no. 55-733 of 26 May 1955 on State economic and financial evaluation and Decree no. 53-707 of 9 August 1953 on State evaluation of national public undertakings and certain organisations, the purpose of which has an economic or social component.

EDF also has to undergo the audit procedures performed by the French General Accounting Office (*Cour des Comptes*) and Parliament. Thus, in addition to the control performed by the statutory auditors, the Company's accounts and management and, where applicable, those of its directly-held majority subsidiaries, fall under the control of the French General Accounting Office, in accordance with Articles L. 111-4, L. 133-1 and L. 133-2 of the French Code of Financial Jurisdiction.

Moreover, the Legislative Decree of 30 October 1935 allows the Minister for the Economy to have EDF audited by the General Finance Inspection Office.

Lastly, the disposal of EDF shares by the State, or the dilution of the State's stake in EDF's capital, is subject to a specific procedure under Order no. 2014-948 of 20 August 2014 on the governance and equity transactions of companies with a public shareholding. Among other things, this Order simplified the previous rules that resulted from the so-called "privatisation" Laws no. 86-793 of 2 July 1986, no. 86-912 of 6 August 1986 and no. 93-923 of 19 July 1993.

### 1.5.2 PUBLIC SERVICE IN FRANCE

#### Statutory definition of public service in France

Articles L. 121-1 *et seq.* of the French Energy Code outline the public electricity service (see section 1.5.3.2 "French legislation: Energy Code" below for a description of this regulation).

#### Public service missions

Articles L. 121-1 *et seq.* of the French Energy Code state that the purpose of the public electricity service is, *inter alia*, to guarantee electricity supply throughout French territory, while acting in the general interest, to develop and operate public electricity networks and to supply electricity at regulated sales tariffs and at the basic necessity rate.

#### Balanced development of electricity supply mission

The purpose of the balanced development of electricity supply mission, which is defined in Article L. 121-3 of the French Energy Code, is to achieve the objectives defined in the multi-year energy plan (PPE), which Law no. 2015-992 of 17 August 2015 on the Energy Transition for Green Growth substituted for the multi-year generation investment plan (PPI). Defined by decree, the PPE sets out priority courses of action for the public authorities for the management of all forms of energy in continental metropolitan France. It must be compatible with the greenhouse gas emission reduction targets set in the carbon budget and the low carbon strategy, which are defined by Decree no. 2015-1491 of 18 November 2015, pursuant to the aforementioned Law of 17 August 2015.

The PPE contains sections on (i) the security of supply, (ii) improving energy efficiency and reducing primary energy consumption, in particular fossil fuel, (iii) developing the utilisation of renewable energies and energy recovery, (iv) the balanced development of energy networks, storage, conversion and the energy demand monitoring, (v) the preservation of consumer purchasing power and the competitiveness of energy prices, in particular for undertakings that are exposed to international competition and (vi) the evaluation of the needs for professional skills in the field of energy and how training courses can be adapted to these needs.

It defines the quantitative objectives for the plan and the maximum indicative budget for the public funds that the State and its public institutions will mobilise in order to attain them. This budget is defined in terms of commitments and accomplishments. It may be broken down by objective and by industry sector.

The first PPE must cover an initial period of three years (2016-2018), then a second period of five years (2019-2023). Subsequent PPEs will be drawn up for two successive five-year periods.

The initial guidelines and actions for the period 2016-2023 that are contained in the PPE were presented and submitted for consultation on 19 November 2015, during the second meeting of the committee tasked with monitoring the PPE. The PPE is expected to be approved by decree and presented to Parliament in 2016.

The balanced development of electricity supply mission also involves guaranteeing the supply of areas that are not interconnected to continental metropolitan France (Corsica, and the overseas departments and territories) and some islands of Brittany.

As a power producer, EDF, along with the other producers, contributes to the performance of this mission.

## Mission to develop and operate public transmission and distribution networks

The mission to develop and operate the public electricity transmission and distribution networks, which is defined in Article L. 121-4 of the French Energy Code, involves ensuring:

- a rational electricity distribution service in France through the public transmission and distribution networks, in a way that is environmentally friendly, interconnection with neighbouring countries; and
- a connection and access to the public transmission and distribution networks, under non-discriminatory conditions.

The public network managers that are designated by law are responsible for this mission, namely RTE for transmission, ERDF and the Local Distribution Companies (LDCs) for distribution and EDF in the areas not interconnected to the continental metropolitan network.

## Mission to supply electricity

The public service mission to supply electricity, which is defined in Article L. 121-5 of the French Energy Code, involves ensuring the supply of electricity throughout France to customers who benefit from regulated electricity sales tariffs.

By law, this mission has been entrusted to EDF and to the LDCs.

The conditions under which customers can benefit from regulated electricity sales tariffs are defined in Articles L. 337-7 *et seq.* of the French Energy Code.

The mission to supply electricity also involves the application of the special "basic necessity" rate (TPN). This public service mission is assigned to all electricity suppliers. The Law of 17 August 2015 on the Energy Transition for Green Growth provides for the gradual replacement of the TPN by the "energy voucher". This voucher is a special mean of payment that allows households that are experiencing financial difficulties to cover part of their energy consumption expenses (electricity, gas, fuel oil, etc.) or their expenditure on improving the energy efficiency of their homes. The voucher system will first undergo an experimental phase before becoming standard practice by 1 January 2018 at the latest, in accordance with conditions that are to be defined by a decree.

The mission to supply electricity moreover includes supplying emergency power to customers who are connected to the public networks. The relevant administrative authority designates emergency suppliers through one or more tendering procedures. As the implementing regulations have not yet been adopted at the date of this reference document, this provision has still not entered into force.

## Social cohesion

Article L. 121-5 of the French Energy Code provides that the supply of electricity at regulated tariffs must contribute to social cohesion, in particular through the national equalisation of regulated electricity sale tariffs.

Article L. 115-3 of the French Social Action and Families Code prohibits electricity suppliers from cutting off electricity supplies to the primary residences of individuals or families during the winter period (from 1 November to 31 March) due to unpaid bills, including through contract termination. Electricity suppliers may, nevertheless, in certain cases, reduce the power supplied, except with regard to customers who benefit from the TPN or the "energy voucher".

In its capacity as an electricity supplier, EDF is required to maintain electricity supplies under the conditions laid down by said Article and by Decree no. 2008-780 of 13 August 2008 on the procedure that is applicable in the event of unpaid electricity, gas, heating and water bills, implemented in its amended form pursuant to Decree no. 2014-274 of 27 February 2014.

## Public Service Contract

On 24 October 2005, a Public Service Contract was signed by the State and EDF pursuant to Article L. 121-46 of the French Energy Code. This contract, which details the commitments made by EDF and the State and specifies the rules governing the financial consideration for service commitments, will remain in force until a new contract is signed, as provided for in the contract itself.

### Commitments by EDF (excluding network managers)

EDF's public service commitments include:

- access to the public electricity service and the supply of electricity to customers who choose to continue to benefit from regulated tariffs;
- production and sales. These areas include the implementation of the energy policy and maintaining secure power generation that is environmentally friendly;
- contributing to the safety of the electricity network. In this regard, EDF undertakes to enter into several contracts with RTE, in particular concerning the optimisation of work on generation facilities and the availability of the resources required to maintain network balance.

### Commitments by network managers

In the Public Service Contract, the ERDF and RTE network managers made commitments concerning the management of the public networks for the transmission and distribution of electricity and the safety of the electricity system. These commitments are financed by the Tariff for Using the Public Electricity transmission and distribution Networks (TURPE).

These commitments concern, above all, network safety, supply quality, third party safety and the preservation of the environment – four areas where customers' and local authorities' expectations are especially high.

## More accessible services

On 28 September 2010, the State and EDF, as well as eight other major public service operators, signed a partnership agreement entitled "*+ de services au public*" ("more services to the public"), which aims to develop access to a set of services intended for rural populations in France (information on bill payment, general information, travel ticket sales, etc.).

Reception staff and internet access points are some of the many resources made available to users through shared facilities such as Multiservice Conciliation and Information Points (PIMMS), Public Service Relays (RSP) and other structures such as town halls. Following the experimental phase, during which these services were deployed in 22 French *départements*, in July 2013, the Inter-Ministerial Committee for the Modernisation of Public Action (CIMAP) decided to extend this initiative throughout France.

## 1.5.3 ELECTRICITY MARKET LEGISLATION

### 1.5.3.1 European Legislation

Three European Directives, which form the basis for the current organisation of the electricity market in France, were successively adopted in order to lay down the common rules for the generation, transmission, distribution and supply of electricity. Directive no. 96/92/EC of 19 December 1996 laid the principles of the opening up of the electricity market to competition.

Directive no. 2003/54/EC of 26 June 2003 reiterated the major principles and took an additional step on the path to opening up the market, by progressively expanding eligibility to all customers.

Directive no. 2009/72/EC of 13 July 2009, known as the "Third Directive", was adopted as part of the third "Energy Package". This directive primarily strengthens the guarantees of the independence of transmission network managers and increases the power of the national regulatory authorities. These provisions have now been incorporated into the French Energy Code.

Moreover, the rules that govern the conditions for access to the network for cross-border exchanges in electricity are currently defined by Regulation (EC) no. 714/2009 of the European Parliament and of the Council of 13 July 2009, which is part of the third Energy Package. This Regulation, *inter alia*, provides for a compensation mechanism between transmission network operators for the costs incurred by hosting cross-border flows of electricity on their networks. This compensation is paid by the operators of the national transmission networks from which cross-border flows originate and the networks where those flows end.

Finally, the "Security of Electricity Supply" Directive no. 2005/89/EC, which was adopted on 18 January 2006, is intended to provide a better definition of the responsibilities of the various operators, ensure that minimum operational standards are respected, maintain balance between demand and supply, and direct investments toward the networks. The objectives of this directive have been taken into account in various French laws and regulations.

### The Agency for the Cooperation of Energy Regulators

Regulation (EC) no. 713/2009 of the European Parliament and of the Council of 13 July 2009, established an Agency for the Cooperation of Energy Regulators (ACER). The ACER has a role in developing network codes in the electricity and gas sectors, and can make decisions relating to cross-border infrastructures (on this subject, see also section 1.5.6.2.5 "Regulations applicable to renewable energy generation").

#### 1.5.3.2 French legislation: Energy Code

The various pieces of legislation on energy law<sup>1</sup> were incorporated into the French Energy Code by Order no. 2011-504 of 9 May 2011, with the exception of provisions on nuclear energy, which were incorporated into the French Environment Code, pursuant to Order no. 2012-6 of 5 January 2012. Moreover, Decree no. 2015-1823 of 30 December 2015 organised the regulatory section of the French Energy Code. Consequently, around one hundred decrees on energy law have been repealed.

The Law of 17 August 2015 on the Energy Transition for Green Growth amended numerous provisions of the French Energy Code, and in particular the objectives of the energy policy, which are now focused on the emergence of a competitive economy that creates an abundance of jobs through the mobilisation of all the industrial sectors (in particular the green growth sectors), security of supply and the reduction of reliance on imports, competitive and attractive energy prices, the preservation of human and environmental health, social and territorial cohesion, the fight against fuel poverty, and the contribution of an implementation of a European Energy Union.

### Generation facilities

Anyone can operate an electricity generation facility provided that, above a certain power threshold determined by decree, an operating licence issued pursuant to Article L. 311-5 of the French Energy Code is obtained. The

powers and responsibilities of local authorities with regard to electricity generation are defined in Articles L. 2224-32 and L. 2224-33 of the French Local Authorities Code, and in Article 88 of Law no. 2010-788 of 12 July 2010 on the national commitment to the environment.

### Regulated Access to Electricity from the Existing Nuclear Fleet (ARENH)

The rules governing Regulated Access to Electricity from the Existing Nuclear Fleet (ARENH), provided for in Articles L. 336-1 *et seq.* of the French Energy Code, have been implemented since 1 July 2011. See section 1.4.3.3 "Regulated Access to Electricity from the Existing Nuclear Fleet (ARENH)" on this point.

### Choice of electricity supplier

All customers, without exception, have been eligible since 1 July 2007, *i.e.* they may freely sign a contract for the purchase of electricity with a producer or supplier of their choice that is established on the territory of the European Union or on the territory of a State that is party to an international agreement with France (Article L. 331-1 of the French Energy Code).

Customers can choose to benefit from regulated electricity sales tariffs under the conditions set out in Articles L. 337-7 *et seq.* of the French Energy Code. Pursuant to these provisions:

- household and non-household final consumers whose power demand is less than or equal to 36kVA benefit, at their request, from regulated sales tariffs; this is also true for all customers in areas that are not interconnected to continental metropolitan France;
- household and non-household final consumers whose power demand is greater than 36kVA, who had not exercised their eligibility on 7 December 2010 were able to benefit from regulated sales tariffs until 31 December 2015. Since 1 January 2016, these consumers have no longer been able to benefit from regulated tariffs. Article 25 of Law no. 2014-344 of 17 March 2014 on consumption provided for a six-month transitional period, during which customers who had not signed a new contract with the supplier of their choice before 31 December 2015 could, in order to guarantee the continuity of their electricity supply, continue to benefit from a contract with EDF<sup>2</sup> during a maximum transitional period of six months, at the end of which they would no longer be supplied. Customers may terminate this contract at any time with no indemnity. EDF<sup>2</sup> has an obligation to inform the customers concerned, by letter, of the expiration of the transitional contract three months and one month before it ends. Order no. 2016-129 of 10 February 2016 provides for a system to ensure the continuity of gas and electricity supplies for customers who have still not accepted a market-based offer on 30 June 2016, starting on 1 July 2016. The CRE will launch the call for tenders for this contract, which will cover the post-transitional offer period, in March 2016.

Article L. 111-84 of the French Energy Code requires internal accounts to be kept that make it possible to distinguish between supply to customers who exercised their right to eligibility and supply to customers at regulated tariffs. The State and the CRE have a right of access to the electricity companies' accounts.

1. Law of 15 June 1906, Law no. 46-628 of 8 April 1946, Law no. 2000-108 of 10 February 2000, Law no. 2003-8 of 3 January 2003, Law no. 2004-803 of 9 August 2004, Law no. 2006-1537 of 7 December 2006 and Law no. 2010-1488 of 7 December 2010.

2. Or their Local Distribution Companies.

**Third-party access to networks**

Article L. 111-91 of the French Energy Code provides that network managers must guarantee access to the public transmission and distribution networks in order to:

- perform the public service missions to supply electricity at regulated electricity sales tariffs and at basic necessity special rates;
- perform electricity procurement contracts;
- perform electricity export agreements signed by a producer or by a supplier who is located on French national territory.

Disputes concerning third-party access to networks are heard by the Settlement of Disputes and Sanctions Committee (CoRDIS), which is part of the CRE.

The Tariffs for Using the Public transmission and distribution Networks (TURPE) mentioned in Articles L. 341-2 *et seq.* of the French Energy Code, which are currently in force, were established by the CRE Decision of 3 April 2013, which was published in the *Journal officiel* of 30 June 2013, for transmission (TURPE 4 HTB), and by the CRE Decision of 12 December 2013, which was published in the *Journal officiel* of 20 December 2013, for distribution (TURPE 4 HTA/BT).

For more details on the Tariffs for Using the Public transmission and distribution Networks, see section 1.4.4.4 "Tariffs for Using the Public Electricity Transmission and Distribution Networks (TURPE)" above.

**Supporting mechanisms for certain subsidiaries of generation**

EDF is subject to purchase obligations that result in contracts being entered into with the operators of facilities. The purchase obligation framework, which was created by Law no. 2000-108 of 10 February 2000 on the modernisation and development of the public electricity service, was amended by Law no. 2015-992 of 17 August 2015 on the Energy Transition for Green Growth, which clarify some aspects of the regime and create a new form of subsidy in the guise of additional remuneration. The supporting mechanism for certain subsidiaries of generation under the aforementioned Law of 17 August 2015 now includes three separate sets of rules.

Firstly, the purchase obligation regime provided for by Articles L. 314-1 *et seq.* of the French Energy Code. These articles provide that EDF (as well as the LDCs that are responsible for supply in their service area) must sign purchase contracts, at the request of producers, for the electricity generated by technology sectors, the development of which the public authorities wish to support, either because they utilise sources of renewable energies, or because they have a specific form of energy efficiency (e.g. cogeneration).

Article R. 314-6 of the French Energy Code provides that producer who benefits from the purchase obligation must sell all of his production to EDF under agreements entered into on the basis of indicative models approved by the Minister for Energy. Purchasing terms and conditions, specifically the electricity purchase prices, are set by order of the Minister for Energy and Economy.

Secondly, the additional remuneration regime, which was introduced by Law no. 2015-992 of 17 August 2015 on the Energy Transition for Green Growth, is governed by Articles L. 314-18 *et seq.* of the French Energy Code. The additional remuneration takes the form of a premium that is paid to producers as a complement to their income from selling the electricity they produce on the market, as well as the assignment of their capacity guarantees. In this respect, EDF will be obliged to enter into an additional remuneration contract with eligible producers who request one and with certain producers who currently benefit from a purchase obligation and who wish to benefit from an additional remuneration agreement for the remainder of the term of their initial purchase contract.

The additional remuneration, for which the implementing legislation will be published over the course of 2016, is designed to partially substitute the purchase obligation system for certain facilities.

Finally, the tendering procedure which, pursuant to Articles L. 311-10 *et seq.* of the French Energy Code, may be initiated by the Minister for Energy when production capacities do not meet the targets of the multi-year energy plan. EDF is required, excluded areas of the LDCs, to enter into an electricity purchase contract or a contract that provides for additional remuneration (this is a memorandum of understanding in the event that it is EDF itself in the capacity of "producer" that is chosen) with the selected bidder(s).

The additional costs for EDF and for the LDCs resulting from contracts signed pursuant to the obligation to purchase energy and the complement of income are compensated by the State and funded in particular by a contribution received from final consumers, the Contribution to Public Electricity Service costs or "CSPE".

**Mechanism for compensating the additional costs of public service****The Contribution to Public Electricity Service costs (CSPE)**

Article L. 121-6 of the French Energy Code lays down the principle that the State must compensate in full the costs that are attributable to the public service generation and supply missions that are assigned to EDF and the LDCs.

For electricity generation, the expenses defined by Article L. 121-7 of the French Energy Code include:

- the additional costs that result both from electricity purchase agreements entered into by EDF and the LDCs after tendering procedures (Articles L. 311-10 *et seq.* of the French Energy Code) and from purchase obligation agreements signed within the framework of Articles L. 314-1 *et seq.* of the French Energy Code, as well as additional remuneration agreements that are entered into pursuant to Articles L. 314-18 *et seq.* of the French Energy Code;
- in areas that are not interconnected to continental metropolitan France:
  - additional generation costs that are not covered by the generation portion in regulated sales tariffs, the costs of storage facilities managed by the electricity system manager, within the limits of the additional generation costs they help to avoid,
  - additional electricity procurement costs (other than those, mentioned above, linked to the purchase obligation) that are not covered by the generation portion in regulated sales tariffs, within the limit of the additional generation costs they help to avoid,
  - the costs paid by electricity suppliers in respect of energy demand control initiatives, less any income received through these initiatives, within the limit of the additional generation costs they help to avoid;
- the costs of studies paid by a producer or supplier with a view to implementing electricity supply projects that are identified in the decree on the multi-year energy plan.

For the supply of electricity, the costs defined in Article L. 121-8 of the French Energy Code include:

- the loss of income and the additional costs incurred by suppliers due to the implementation of the special "basic necessity" rate (TPN);
- the costs incurred by suppliers as a result of their participation in the plan established for low-income persons (within the limit of a percentage, which is set by order, of the cost borne by the supplier in respect of the TPN for the year in question).

Moreover, in accordance with Law no. 2013-312 of 15 April 2013 on the preparation of the transition towards a low energy system (known as the



"Brottes Act"), which, in particular, completed Article L. 121-10 of the French Energy Code, the purpose of the CSPE is to finance the premium owed to the demand response managers pursuant to Articles L. 123-1 and L. 271-1 of the same Code.

The mechanism for compensating public service costs, which is governed by Articles L. 121-9 *et seq.* of the French Energy Code, was reformed by Law no. 2015-1786 of 29 December 2015 (the Amended Budget Act for 2015), which aims to secure the financing of the costs of the public electricity service.

The compensation of public electricity service costs will now be financed by revenue from the domestic tax on the final consumption of electricity (the TICFE), now known as the Contribution to Public Electricity Service costs (CSPE). The CSPE will be collected directly from final consumers of electricity in the form of an additional levy on the sale price of electricity or directly from electricity producers that produce electricity for their own needs.

The amount of the CSPE is set at €22.50/MWh as from 1 January 2016 (*i.e.* the rate that would have been set for the CSPE if it had not been reformed). As an exception, for electro-intensive and hyper-electro-intensive undertakings and distribution companies, reduced tariffs of between €0.5/MWh and €7.5/MWh have been defined.

The financing of public electricity (and gas) service costs is now provided exclusively by the State budget, as follows:

- The costs linked to energy transition, which correspond to subsidy mechanisms for renewable energies, as well as the reimbursement of the compensation deficit supported by EDF, are recognised in a special purpose account (CAS) for "energy transition" that was created by the Amended Budget Act for 2015. Revenue for this CAS is for the most part allocated to the CSPE, as well as a fraction of the domestic tax on energy products (TICPE), the domestic tax on the consumption of natural gas (TICGN) and the domestic tax on coals, lignite and coke (TICC).
- The other public service costs (fuel poverty, tariff equalisation in areas not interconnected to metropolitan France, cogeneration, and the budget for the energy conciliator, etc.) are entered directly in the general budget.

Decree no. 2016-158 of 18 February 2016 specifies the rules for determining the costs that can be attributed to public service energy missions, the procedure for determining the amount of the costs to be compensated for each operator, and the transactions for paying the compensations to the operators who bear the expenses.

Each year, the CRE records the amount of the costs that can be attributed, in respect of the previous year, to public service energy missions that are the responsibility of the operators, assesses, for the following year, the provisional amount of the same costs and updates the forecast of costs for the pending year. Within this framework, it identifies the costs that are allocated to the CAS "energy transition" special purpose account.

The CRE addresses to the Minister for Energy, each year before 15 July, its estimation of costs.

The massive expansion of facilities that generate electricity using renewable energy sources (mainly wind power and photovoltaic facilities) and that benefit from the purchase obligation, for several years has led to a significant increase in the costs to be compensated by the CSPE. This phenomenon continues today: accordingly, the CRE cost forecasts for 2015 (€6.3 billion) are 20% higher than the costs recorded for 2013 (€5.3 billion). Since 2007, the amount of the CSPE has not been enough to compensate the increase in these costs (except for 2015). The deficit of a mechanism that is paid for exclusively by EDF weighs on the Group's debt.

In January 2013, EDF announced that it had reached an agreement with the public authorities, which provides for the repayment of the debt formed by the CSPE deficit at 31 December 2012 (around €4.3 billion, adjusted to €5.0 billion at 31 December 2013 to take into account on the one hand the deficits related to public service charges at 31 December 2012, as confirmed by the CRE decision of 9 October 2013 and on the other the brokerage

costs incurred by the Group of €0.6 billion). Under this agreement, this debt corresponding to the CSPC's deficit is to be paid off by 31 December 2018, according to a progressive repayment schedule, and is to be remunerated at a rate of 1.72% in accordance with the Decree of 7 October 2014. In the context of the reform of the CSPE, EDF and the public authorities have agreed to add the existing debt to the net accrued compensation recognised by the CRE in respect of the years 2013-2015 (*i.e.* an additional amount of €644 million). The initial repayment scheme, which was revised in agreement with the State, is now included in a Ministerial order that is expected to be published in the first half of 2016.

### Compensation for additional distribution costs

The purpose of the Electricity Equalisation Fund (FPE), the accounting management of which is entrusted to EDF under Article L. 121-29 of the French Energy Code, is to distribute the charges incurred as a result of public service missions assigned for managing the electricity distribution networks among the operators concerned, in particular those linked to the specificities of the networks operated and that will not be covered by the portion relating to the use of those networks in the regulated tariffs or by the tariffs for using the public electricity distribution networks. The costs linked to involvement in the development of areas with particular geographical, economic or social difficulties, as defined by Article 42 of Law no. 95-115 of 4 February 1995, are also concerned.

### Capacity guarantees

Articles L. 335-1 *et seq.* of the French Energy Code, which are taken from the NOME Act (New Organisation of the Electricity Market – *Nouvelle Organisation du Marché de l'Électricité*), obligate each electricity supplier to contribute to the security of electricity supply in continental metropolitan France, in light of its customers' power and energy consumption patterns. Each supplier must therefore provide annually, under penalty of an administrative sanction, an amount of guarantees of capacity according to its customers' consumption at peak periods. Suppliers will obtain these capacity guarantees from generation or load operators, which must first have their capacities certified by the public transport network manager.

The aims of this mechanism are:

- to make it possible to maintain or develop generation or load shedding capacities that ensure the level of supply security set by the public authorities;
- to improve the remuneration of these capacities;
- to share the expense of this security of supply among all suppliers.

The "capacity mechanism rules" proposed by RTE were approved by a ministerial order of 22 January 2015 after consulting the CRE.

The Law of 17 August 2015 on the Energy Transition for Green Growth adapted the capacity mechanism to small stakeholders by allowing the LDCs to transfer their capacity obligations not only to another LDC, but also "to any other supplier" and by allowing electricity suppliers to transfer their capacity obligations to a final consumer or to a public network manager (Article L. 335-5 of the French Energy Code).

Moreover, Article L. 335-3 of the French Energy Code introduced the possibility for all capacity operators to transfer to a third party their liability for discrepancies between effective capacity and certified capacity on the one hand, and the payment of the penalties in respect of said discrepancies on the other.

On 13 November 2015, the European Commission opened an in-depth investigation on the planned French capacity mechanism, in light of European rules on State aids.



## Electricity load shedding

The Law of 17 August 2015 on the Energy Transition for Green Growth amended the legal rules on load shedding and, in particular, Articles L. 271-1 *et seq.* of the French Energy Code on this subject.

These provisions amend the previous legal rules and stipulate, in particular:

- that load shedding is defined *"as the action to reduce temporarily the effective withdrawal level of electricity from the public electricity supply and distribution networks by one or more consumption sites, compared to a forward-looking consumption plan or an estimated consumption, when an ad hoc request is sent to one or more final consumers by a load manager or an electricity supplier"*;
- that there is the possibility for consumers to monetize each of their demand responses, either via their supplier as part of a demand response offer that is inseparable from the supply, or via the intermediary of load managers;
- that the Government will organise calls for tenders if the load management capacities do not meet the targets of the multi-year energy plan (this mechanism replaces that of the load shedding premium);
- finally, for load shedding that leads to significant energy savings, the law provides that the administrative authority may require the payment to the supplier to be shared between the load manager and RTE.

The terms of application of these mechanisms will be detailed by decrees and entail the amendment of two sets of rules that were adopted pursuant to the previous regulations: the rules for trading load shedding reserves on the energy markets, known as the "Nebef 2.0" Rules, which were approved by the CRE decision of 17 December 2014 on the one hand, and the rules on incorporating load shedding reserves into the adjustment mechanism that are contained in the rules on planning, the adjustment mechanism and the recovery of cost adjustments, in the version approved by the CRE decision of 3 December 2015 on the other.

## Electricity sector regulation

### The Energy Regulation Commission

The Energy Regulation Commission (CRE) is an independent administrative authority created by Article 28 of the Law of 10 February 2000.

Articles L. 131-1 *et seq.* of the French Energy Code give a general definition of the remit of the CRE, which is tasked with contributing to the correct functioning of the electricity and natural gas markets for the benefit of final consumers. In this respect, the CRE ensures, in particular, that the conditions for access to electricity and natural gas transmission and distribution networks do not impede the development of competition.

The CRE has significant powers: power to make proposals, advisory powers and decision-making powers (approval power and regulatory power).

The CRE makes proposals, in particular, to the Ministers for the Economy and for Energy regarding an amount of costs that are attributable to the public service missions assigned to power producers, and a net amount of related contributions. Once the decree has been published that specifies the methods for identifying and recognising the costs that are taken into account for the calculation of the ARENH price, the CRE will propose the ARENH price. Moreover, since 7 December 2015, it is its responsibility to propose changes in the regulated sales and transfer tariffs for electricity, on which it previously could only issue an opinion.

The CRE now has decision-making power to set the Tariffs for Using the Public Electricity transmission and distribution Networks (TURPE): it notifies its reasoned decision to the administrative authority, which can only ask the CRE for a new decision in the event of non-compliance with energy policy

guidelines. Under its residual regulatory power, the CRE takes network connection decisions, as well as decisions to define the rules for calculating and adjusting the rights of suppliers to the ARENH.

The CRE is also vested with very broad powers that enable it to obtain any information that it may deem useful for the fulfilment of its remit, as well as authority to settle disputes and to apply penalties, through the Settlement of Disputes and Sanctions Committee (CoRDIS).

The Law on the Energy Transition for Green Growth of 17 August 2015 also gives the CRE the possibility of having the information it obtains through its remits audited, at the expense of the audited undertakings.

## 1.5.4 GAS MARKET LEGISLATION

### 1.5.4.1 European legislation

Directive no. 98/30/EC of 22 June 1998 and Directive no. 2003/55/EC of 26 June 2003 were the major steps towards opening up the gas market to competition.

New rules aimed at improving the functioning of the internal natural gas market were defined in Directive no. 2009/73/EC of 13 July 2009, and by Regulation (EC) no. 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks.

Pursuant to this legislation, two network codes for capacity allocation mechanisms (CAM) and balancing rules officially entered into force on 1 November and 1 October 2015 respectively. The first requires the capacities at interconnection points between transmission networks to be commercialised by bundling the output capacity of the first network with the input capacity of the second network, and by selling these interconnection capacities via auction. The purpose of the second is to harmonise the balancing rules on transmission networks.

### 1.5.4.2 French legislation: the French Energy Code

Directive no. 2009/73/EC of the European Parliament and of the Council of 13 July 2009 was transposed into French law by Order no. 2011-504 of 9 May 2011, which organised the legislative section of the French Energy Code. The French Energy Code entered into force on 1 June 2011.

## Access to natural gas networks

The French Energy Code provides that customers, suppliers and their agents have a right to access natural gas transmission and distribution infrastructures, as well as LNG facilities, under the terms and conditions set forth in an agreement with the operators that run them.

Natural gas network operators must refrain from discriminating between users or categories of users in any way.

## Customers

Since 1 July 2007, all customers can freely choose their supplier.

Pursuant to the provisions of Article L. 445-4 of the French Energy Code, household and non-household customers who consume less than 30,000kWh per year may benefit from regulated tariffs, at their request and without having to meet any conditions. Household customers who are entitled to the special "basic necessity" rate for electricity may benefit from

a special solidarity tariff that is applicable to the supply of natural gas for part of their consumption. This special tariff will progressively be replaced by the “energy voucher” system (see section 3.2.3.6.1 “Contributing to energy access and the fight against energy poverty”).

Customers whose consumption exceeds 30,000kWh per year can only benefit from regulated gas sales tariffs for a site if no new market offering offer has been accepted for such site, pursuant to Article L. 445-4 paragraph 2 of the French Energy Code.

Non-household final customers who consume more than 30,000kWh per year and who still benefit from the regulated tariffs for the sale of natural gas that are stipulated in Article L. 445-3 of the French Energy Code have no longer been eligible for these tariffs since the following dates:

- for non-household consumers who are connected to the transmission network, since 18 June 2014;
- for non-household consumers whose consumption level exceeds 200,000kWh per year, since 31 December 2014;
- for non-household consumers whose consumption level exceeds 30,000kWh per year, since 31 December 2015.

If they did not sign a new supply contract with a supplier by these dates, and in order to benefit from the continuity of their gas supply, the customers concerned benefit from a contract with their supplier for a transitional period of six months, at the end of which they are no longer supposed to be supplied. Pursuant to these provisions, non-household consumers who consume more than 200,000kWh of natural gas per year and who have not signed a contract with a supplier of their choice, on 1 January 2015 were automatically switched to the transitional offer system. When the aforementioned period of six months expired, these consumers were supposed to have accepted a market-based offer from the supplier of their choice, failing which their supply of natural gas was supposed to have been cut.

In a decision of 28 May 2015, the CRE found that around 10,000 non-household consumers, including numerous local authorities and joint owners’ associations, apparently had not signed a gas purchase contract in response to a market-based offer by 30 June 2015, thereby exposing themselves to a risk of their supplies being cut. It therefore decided to maintain supplies to the sites concerned by the manager of the distribution network for a final period of three months, i.e. until September 2015, at a price increased by 20% compared to the regulated tariff, in order to encourage these customers to accept a market-based offer, before gradually cutting them off.

## Suppliers

Article L. 443-4 of the French Energy Code defines suppliers as persons who (i) are established on the territory of a Member State of the European Union or on the territory of another State pursuant to international agreements, and (ii) hold a licence issued by the Minister for Energy.

EDF is authorised to supply natural gas to non-household customers that do not provide services in the public interest, pursuant to an Order of the Deputy Minister of Industry of 14 September 2004, and, pursuant to an Order of 9 August 2005, to non-household customers that provide services in the public interest, as well as to natural gas distributors and suppliers, and, pursuant to an Order of 15 June 2007, to household customers.

EDF only supplies its customers with a market offering and not at regulated sales tariffs, which can only be proposed by Engie (previously GDF Suez) and the LDCs tasked with supplying gas.

## Underground storage and third-party access to natural gas storage facilities

Article L. 421-4 of the French Energy Code requires all suppliers to hold, on 31 October of each year, directly or indirectly through an agent, sufficient

inventories of natural gas in France to meet their direct or indirect contractual obligations to supply household customers and other customers that provide services in the public interest or that have not contractually accepted an interruptible gas supply, during the period between 1 November and 31 March.

Articles R. 421-1 to R. 421-2 of the French Energy Code specify the legal framework that applies to underground storage facilities for natural gas.

## Control and penalties

The French Energy Code grants the Minister for the Economy and the Minister for Energy, as well as the Energy Regulation Commission, power to oversee the gas market. The Minister for Energy may also levy a fine, or withdraw or suspend an authorisation to supply natural gas. The CRE can carry out investigations into whether offences that breach the provisions of the French Energy Code have been committed (Article L. 135-13 of the French Energy Code).

## 1.5.5 PUBLIC ELECTRICITY DISTRIBUTION CONCESSIONS

### French legal system applicable to concessions

In accordance with Articles L. 121-4 *et seq.* and L. 322-1 *et seq.* of the French Energy Code, and Article L. 2224-31 of the French Local Authorities Code, the public distribution of electricity is operated under a system of public service concessions. Pursuant to this body of law, the contracting authorities organise the public electricity distribution service through concession agreements and general specifications that set forth the respective rights and obligations of the concession grantor and concession holder. Currently, the contracting authorities are most often public institutions formed by associations of several municipalities cooperating together, however contracting authorities at *département* level are becoming more common.

The unbundling of supply and network operations required under Community Directives has led to the identification of two separate public service missions: firstly, the mission to supply electricity at regulated tariffs assigned to EDF and the LDCs in their exclusive service areas and, secondly, the mission to develop and operate the public electricity distribution networks assigned to ERDF and the LDCs in their service areas, and to EDF for areas which are not interconnected to the continental metropolitan network.

Article L. 334-3 of the French Energy Code provides that the signature of new concession agreements and amendments, as well as renewals of existing concession agreements, must be executed by three parties: the contracting authority, the distribution network manager (for the provisions relating to management of the public distribution network) and by EDF (or the LDC that has the authority in the geographic area) for supply at regulated tariffs. The current concession agreements in force are deemed to have been signed jointly by these three entities.

In accordance with the Order no. 2016-65 of 29 January 2016 on concession contracts and to the Decree no. 2016-86 of 1 February 2016, transposing into national law the European Directive no. 2014/23/UE of 26 February 2014, award of distribution and supply of electricity concession contracts to regulated tariffs is not subject to compliance with the obligation of competition.

## Rights of the contracting authorities

The rights of the contracting authorities are detailed in section 1.4.4.2.2 (“Distribution activities”).

**1.5.6 REGULATIONS APPLICABLE TO THE ENVIRONMENT, NUCLEAR POWER, HEALTH, HYGIENE AND SAFETY**

EDF's business in France, as well as in other countries where EDF operates, is subject to regulations that are applicable to the environment, nuclear power, health, hygiene and safety. Compliance with these increasingly strict and continuously changing regulations exposes the Group to significant costs in order to ensure it does business compliantly.

**1.5.6.1 Basic regulations applicable to the environment, health, hygiene and safety****Environmental regulations****Grenelle Laws 1 and 2**

Following the Grenelle Environmental Forum that was initiated in 2007, in Law no. 2009-967 of 3 August 2009, known as the "Grenelle 1 Law", the French government undertook to meet a certain number of objectives and to implement certain environmental measures concerning the reduction of greenhouse gas emissions, energy efficiency, the development of renewable energy sources, ensuring clean bodies of water, the protection of biodiversity, the prevention of risks to health and the environment, waste management and ecological governance.

These commitments and objectives were implemented by Law no. 2010-788 of 12 July 2010 (known as the "Grenelle 2 Law"), many provisions of which impact EDF's activities.

**Public involvement in environmental matters**

The general framework for the public's involvement in the preparation of regulatory and individual decisions by the public authorities that have an impact on the environment is laid down in Articles L. 120-1 *et seq.* of the French Environment Code. These provisions apply in the absence of specific provisions that are laid down by specialised legislation.

This legal framework is, however, expected to change with the reform of public involvement provided for by Law no. 2015-990 of 6 August 2015 on growth, business and equal opportunities (known as the "Macron Act"), following the workshop on "participatory democracy" initiated by the Government early in 2015 (see section 1.5.8.2 "Future regulations at national level (France)").

**Environmental Liability (the "LRE" Law)**

The purpose of the Law of 1 August 2008 on environmental liability (LRE), which is incorporated into the French Environment Code under Articles L. 160-1 to L. 165-2, is to promote the prevention and remedying of environmental damage to water, soil and biodiversity that reaches a certain level of seriousness. The remedy must be environmental only and must allow the natural environment to return to its previous state or an equivalent state.

**Balanced management of water resources**

The Water Framework Directive of 23 October 2000 is the foundation of Community water policy. It defines a framework for the management and protection of water, for each major river basin, and sets targets for maintaining and restoring the status of surface waters, in particular to ensure the correct ecological and/or chemical status of water by 2015.

In France, the Directive was primarily transposed into law through the Water and Aquatic Environments Act of 30 December 2006, which stipulates the measures that are designed to ensure that the Directive's targets are attained.

These targets are determined for each river basin in the master plans for water development and management (SDAGEs). All EDF's activities that could impact water and aquatic environments must be compatible with the targets set in the SDAGEs.

The Water Act also requires the various uses of water to be reconciled. The requisite balanced, sustainable management of water resources therefore has consequences for the operating rights of hydropower plants, and indirectly for all EDF's activities that affect aquatic environments.

**Protection of biodiversity**

As an occupant and user of natural land and water areas, EDF is directly concerned by biodiversity issues.

In order to protect and restore biodiversity, the Grenelle Environmental Forum set ambitious targets, which include the implementation of a national strategy for the creation of protected land areas (SCAP), which aim to provide extensive protection, by 2019, for at least 2% of metropolitan French land mass, as well as the creation of a green and blue belt, a tool for land-use planning that sets up green corridors to connect protected areas, thereby enabling flora and fauna to migrate.

The provisions on the green and blue belt, as well as the contents of the procedure for designing regional green coherence schemes (SRCE) that implement it have been incorporated into the French Environment Code, in Articles L. 371-1 to L. 371-6 and R. 371-16 to R. 371-35, and completed by Decree no. 2012-1492 of 27 December 2012 and Decree no. 2014-45 of 20 January 2014.

A bill on the restoration of biodiversity, nature and landscapes, which is currently being debated in Parliament, aims to improve the protection of biodiversity (see section 1.5.8.2 "Future regulations at national level (France)").

**Comprehensive environmental authorisation and project certificate**

Three experimental procedures concerning the environment, which are limited in time and confined to certain regions, were implemented pursuant to the Law of 2 January 2014, which empowered the Government to simplify and increase legal certainty for corporations.

Firstly, the experimental use of the project certificate (which was introduced by Order no. 2014-356 of 20 March 2014, then completed by the Macron Act of 6 August 2015). The project certificate is an instrument designed to provide legal certainty and stabilise the law whereby the Prefect notifies a commitment to a project manager regarding the various procedures to be complied with and the timeframes for issuing the authorisations requested.

Secondly, experimental use of a comprehensive authorisation system that is applicable to projects that require authorisation for facilities that are classified for the protection of the environment (which was introduced by Order no. 2014-355 of 20 March 2014, and completed by the Macron Act and the Law of 17 August 2015), and to projects that require authorisation under the Water Act (which was introduced by Order no. 2014-619 of 12 June 2014, completed by the Law of 17 August 2015). The comprehensive authorisation system allows for a coordinated appraisal of authorisation applications and the issuance in a single document, for a given project, of all the decisions required of the State (see section 1.5.6.2.1 "Regulations applicable to facilities classified for the protection of the environment (ICPE)"). The Macron Act empowers the Government to make these authorisations permanent via an order.

These procedures are liable to apply to EDF's projects.

**Social and environmental reporting obligation for businesses (RSE)**

Articles L. 225-102-1 and R. 225-104 of the French Commercial Code require companies whose securities are admitted to trading on a regulated market, as well as companies that employ more than 500 staff and whose

revenue or balance sheet total exceeds €100 million, to disclose in the management report information on how they take into consideration the social and environmental consequences of their activity, as well as on their societal commitments to sustainable development ("RSE reporting"). The Law of 17 August 2015 on the Energy Transition for Green Growth completes the list of the environmental information contained in the aforementioned Article L. 225-102-1 by requiring undertakings to make public, as from the financial year ended 31 December 2016, information on the consequences of climate change for their business activity and the usage of the goods and services they produce.

These provisions concern EDF and some of its subsidiaries.

Article L. 225-102-1 of the French Commercial Code authorises subsidiaries and controlled companies not to disclose their RSE information, provided that this information is published by the company that controls them in detail by subsidiary or by controlled company, and that they state how to access this information in their own management report. Moreover, when subsidiaries and controlled companies are established in France and have facilities that are classified for the protection of the environment (ICPEs that are subject to authorisation and registration), the information provided must concern each of them, if the information cannot be consolidated.

The social and environmental information provided in the management report must be verified according to a schedule that takes into account for non-listed companies, the number of their employees and their revenue, by a third party independent organisation, which is appointed in accordance with the provisions of Article R. 225-105-2 of the French Commercial Code. An Order of 13 May 2013 determined, in particular, the rules according to which the independent third party organisation will perform its assignment. The verification by this organisation leads to a certificate concerning the presence in the management report of all the required information and a substantiated opinion on the accuracy of the information itself (see section 3.1 "Corporate responsibility commitments").

### PCBs and PCTs

The Group is subject to regulations on polychlorobiphenyls (PCBs) and polychloroterphenyls (PCTs) in the various countries where it operates, particularly in Europe.

Directive no. 96/59/EC of 16 September 1996 required that an inventory of equipment containing PCBs and PCTs at levels of more than 500 ppm be drawn up, together with a national plan for decontamination and the gradual disposal of these substances, which are mainly found in certain electricity transformers and condensers. Decontamination of equipment containing these substances was to be completed by 31 December 2010 at the latest. EDF had a special disposal plan and has achieved this objective.

Pursuant to Decree no. 2013-301 of 10 April 2013, EDF must clean up and decontaminate polluted equipment at rates between 50 and 500ppm, with the possibility, as the holder of more than 150 pieces of equipment, of benefiting from a "specific plan" that is approved by order of the Minister for the Environment. This plan must, as a minimum, provide for the decontamination or destruction of one-half of the equipment before 1 January 2020 and all equipment before 31 December 2025. The contents of the application for the specific plan were defined by an Order of 28 October 2013. RTE's and ERDF's specific decontamination plans were approved by two orders of 14 April and 3 July 2014.

The Decree of 10 April 2013 also specified the new obligations in terms of identifying, labelling, declaring and using equipment with fluid containing PCBs with a volume of more than 5dm<sup>3</sup>. The rules for conforming to these obligations were stipulated in detail by two orders of 7 January and 14 January 2014.

## Greenhouse gases

### Allowance trading scheme

Some of the EDF Group's activities fall within the scope of application of Directive no. 2003/87/EC of 13 October 2003, as amended by Directive no. 2009/29/EU of 23 April 2009, which established a European scheme for greenhouse gas (GHG) emission allowance trading, using the project mechanisms set forth in the Kyoto Protocol (the Emissions Trading System (ETS) Directive).

In France, this Directive was transposed and integrated into Articles L. 229-5, R. 229-5 *et seq.* of the French Environment Code. The Group has an annual obligation to surrender allowances equal to the level of CO<sub>2</sub> emitted by its facilities. In order to comply with this obligation, under certain conditions, the Group may use credits issued under projects eligible for the project mechanisms provided for under Articles 6 and 12 of the Kyoto Protocol (joint implementation and clean development mechanism).

Under the ETS Directive, the third period for the greenhouse gas (GHG) emission allowance trading scheme started on 1 January 2013. The provisions of the French Environment Code on this scheme were amended accordingly by Order no. 2012-827 of 28 June 2012 (ratified by Law no. 2013-619 of 16 July 2013) and by Decrees no. 2012-1343 of 3 December 2012 and no. 2014-220 of 25 February 2014. Since 1 January 2013, the rule for the electricity sector is the auctioning of quotas, in accordance with the rules defined by Regulation (EU) no. 1031/2010 of 12 November 2010. Since that date, EDF has to purchase 100% of its allowances.

In order to support the price of GHG allowances on the European market, in Decision (EU) 2015/1814 of 6 October 2015, the European Parliament and the Council decided to create a market "stability reserve" that makes it possible to remove surplus allowances from the market. This mechanism will enter into force on 1 January 2019. This decision is an initial step towards an in-depth reform of the ETS that was announced as part of the "2030 Energy and Climate Package" (see section 1.5.8.1 "Future regulations at European level").

### GHG Reporting

Pursuant to Articles L. 229-25 and R. 229-46 *et seq.* of the French Environment Code (which were respectively amended by Order no. 2015-1737 and Decree no. 2015-1738 of 24 December 2015), companies with over 500 employees must provide an annual report on their greenhouse gas emissions and a summary of the actions they plan to take to reduce such emissions. Article R. 229-46, as amended by the aforementioned Decree of 24 December 2015, specifies that the "groups defined in Article L. 2331-1 of the French Labour Code may draw up a consolidated report on greenhouse gas emissions for all their companies that have the same level 2 nomenclature code for French activities" and that employ more than 500 persons.

The report is disclosed to public and must be updated every four years. The first EDF report was published in the Indicators section of the EDF annual report in March 2012.

Failure to draw up or file the report may lead to an administrative fine, the amount of which cannot exceed €1,500.

## Energy efficiency

### Energy Efficiency Directive

On 25 October 2012, the European Union adopted a Directive on energy efficiency (2012/27/EU). The purpose of this Directive, for which the transposition deadline was 5 June 2014, is to enable the European Union to reach its energy savings target of 20% by 2020. With this aim in mind, the Directive enhances the provisions of European legislation on energy efficiency services (no. 2006/32/EC) and cogeneration (no. 2004/8/EC).

The Directive of 25 October 2012 contains several provisions that are liable to impact the activities of the EDF group, first and foremost of which is the obligation for Member States to reach an energy savings target each year that is equivalent to an aggregate annual reduction in energy sales of 1.5% over the period 2014-2020, which can take the form of an obligation for energy distributors and/or suppliers to reduce sales. The Directive also contains provisions on providing customers with information on their consumption, the promotion of energy services, taking into account energy efficiency in heat and cold production, and in the transmission and distribution of energy.

Articles L. 233-1 *et seq.* of the French Energy Code (derived from Law no. 2013-619 of 16 July 2013, which transposed Article 8-4 of the Directive into French law), require large undertakings to perform an energy audit on their business activities in France by 5 December 2015 at the latest, then every four years. The thresholds above which undertakings are concerned, the scope of the audit and the conditions to be met by the energy auditors are laid down in Articles R. 233-1 and R. 233-2 and D. 233-3 to D. 233-9 of the French Energy Code, completed by the Order of 24 November 2014 on the terms of application of the energy audit. Undertakings that use a certified energy management system that is ISO 50001 compliant may, under certain conditions, be exempted from this obligation. In accordance with the regulations, on 4 December 2015, EDF sent the summary of its audit report to the Ile de France Prefect.

#### Energy savings certificates

At national level, the energy savings certificates (CEE) mechanism, which is provided for in Articles L. 221-1 *et seq.* of the French Energy Code, places energy suppliers under the obligation to save energy. This mechanism defines a three-year objective that is shared between persons subject to an obligation to achieve energy savings (the "obligors") based on their sales volumes. At the end of the relevant period and under penalty of sanctions, the obligors must produce energy savings certificates that correspond to the amount of the energy savings they are under the obligation to achieve, which are obtained either by carrying out (directly or indirectly) energy savings actions or by purchasing credits from the other "eligible" economic players through a national register of Certificates.

For the second period of the mechanism, between 1 January 2011 and 31 December 2013, the stated total savings target was 345TWhc (compared to 54TWhc for the first period). In order to ensure the continuity of the mechanism, and until the third period starts, the second period has been extended by one year, from 1 January to 31 December 2014, by a Decree of 20 December 2013.

The third period started on 1 January 2015 and will end on 31 December 2017. The energy savings target for the third period is set at 700TWhc (*i.e.* 233.4TWhc/year). Decree no. 2014-1668 of 29 December 2014 (now Articles R. 221-1 *et seq.* of the French Energy Code) and several implementing orders that were published in December 2014 determine the conditions and terms for the issuance of CEE for this new period.

The Law of 17 August 2015 on the Energy Transition for Green Growth amended the CEE system for the third period, by adding an additional system to the obligation that was already provided for, concerning the energy savings made for the benefit of households that are in a precarious situation in terms of energy. Decree no. 2015-1825 of 30 December 2015 (now Articles R. 221-1 *et seq.* of the French Energy Code) and several ministerial orders of the same date have clarified the rules on meeting the energy savings objectives that are specifically for the benefit of households that are in a precarious situation in terms of energy. The level of this specific obligation for energy suppliers is set at 150TWhc for 2016-2017.

Moreover, the Law of 17 August 2015 on the Energy Transition for Green Growth provides for a fourth period between 1 January 2018 and 31 December 2020. An order will specify the amount of the energy savings obligation for this next period.

#### Registered natural sites and classified sites (buried lines)

The EDF Group is also subject to regulations on classified and registered sites that are stipulated in Articles L. 341-1 to L. 341-22 and R. 341-1 to R. 341-31 of the French Environment Code.

The aim of these regulations is to preserve natural heritage sites and sites for which the conservation, from a landscape, artistic, historical, scientific, folkloric or scenic standpoint, is in the public interest. "Classification", which is reserved for the most singular sites, provides extensive protection, whereas "registration", for which the framework of rules is less restrictive, is proposed for less sensitive sites.

Under the French Environment Code, new electricity lines on classified sites must be buried. Registration and classification can also have an impact on the day-to-day operation of facilities (if more than one site is visible at the same time; obligation to obtain the opinion of the State architect – *architecte des Bâtiments de France*, etc.).

#### Protection of the environment through criminal law

Directive no. 2008/99/EC of 19 November 2008 on the protection of the environment through criminal law, the main purpose of which is to identify conduct that leads to serious environmental damage that must be punished by all Member States, was at the origin of French Order no. 2012-34 of 11 January 2012, which harmonised the criminal penalties laid down in the French Environment Code.

### Health, hygiene and safety regulations

#### Asbestos

In France, the regulations require, among other things, the identification of materials containing asbestos in buildings and, if necessary, monitoring procedures or asbestos removal work. EDF is also subject to regulatory obligations to inform and protect workers who may be exposed to asbestos dust inhalation.

#### Legionella

EDF operates air cooling towers that are needed, in particular, for its electricity generation business, which are now subject to ICPE Regulations on basic nuclear facilities (BNF). EDF must, among other obligations, carry out a methodical analysis of the risk of proliferation of legionella in its air cooling towers and implement a preventive maintenance plan for cleaning and disinfection. EDF is also required to carry out analyses once or twice a month, depending on the type of facility involved.

#### Nanoparticle substances

As from 1 January 2013, Articles L. 523-1 *et seq.* and R. 523-12 *et seq.* of the French Environment Code made it mandatory to report the quantities and uses of nanoparticle substances or nanomaterials produced, distributed or imported in France. Information on these substances must be made available to the public and to inspection authorities. The information to be declared and the rules governing the declaration were specified in an Order of 6 August 2012. EDF is likely to be concerned by these provisions as it uses nanoparticle substances.

#### Exposure to Electromagnetic Fields (EMF)

Pursuant to the Grenelle 2 Law, Decree no. 2011-1697 of 1 December 2011 requires managers of public electricity transmission networks to perform regular verifications of the EMF caused by electric lines that transmit electricity.



Law no. 2015-136 of 9 February 2015 on sobriety, transparency, information and consultation regarding electromagnetic wave exposure introduced an obligation to provide information for persons who install equipment that emits electromagnetic fields on residential premises. In due course, this obligation may concern some entities of the EDF group.

### Chemical products

Regulation (EC) no. 1907/2006 on the registration, evaluation and authorisation of chemicals, known as "REACH", which came into force on 1 June 2007, applies to EDF as a user, but also as a manufacturer and importer of chemical products. EDF has complied with its obligation to register substances that it manufactures or imports in quantities of more than 1,000 tonnes per year with the European Chemicals Agency. In May 2013, EDF registered the monochloramine that is manufactured in situ at certain nuclear plants.

In addition, the Biocides Regulation (EU) no. 528/2012 of 22 May 2012 provides for a new procedure, with an extended scope of application, of authorisations for placing on the market of biocidal products that are generated in situ. In this new regulatory environment, EDF is concerned as a manufacturer and user of monochloramine and sodium hypochlorite. Applications for authorisation will be prepared and filed within the framework of this Biocides Regulation.

### Health and the environment

Law no. 2013-316 of 16 April 2013 on the independence of expertise in the area of health, the environment and the protection of whistleblowers confirmed the recognition of an alert procedure in the area of public health and the environment within businesses and laid down the rules for using this procedure. This Law also organises a system to protect whistleblowers and set up the National Commission for Ethics and Public Health and Environment Alerts (CNDASE). Several decrees have specified the rules for the implementation of this system (Decree no. 2014-324 of 11 March 2014, Decree no. 2014-1629 and Decree no. 2014-1628 of 26 December 2014).

### 1.5.6.2 Regulations applicable to EDF group facilities and activities

#### 1.5.6.2.1 Regulations applicable to facilities classified for the protection of the environment (ICPEs)

#### Facilities concerned and main obligations

Certain facilities operated in France by the EDF Group, in particular thermal power plants, are subject to legislation on facilities that are classified for the protection of the environment (ICPEs), which is organised in the French Environment Code. These facilities are subject to a prior declaration, simplified authorisation (known as "registration") or to an authorisation depending on the magnitude of danger or adverse effects they may cause to the environment or public health.

The ICPE Regulation requires that the site be restored when a facility is taken out of service, depending on the expected future use of the land. Under Article L. 516-1 of the French Environment Code, lodging financial guarantees is also required for certain ICPE facilities that are subject to authorisation (including Seveso facilities) and registration. The basis and amount of the financial guarantees vary depending on the facility. The financial guarantees are designed to provide collateral for the financing of the measures that must be adopted in the event of an accident before or after closure, as well as the surveillance, safety works and restoration operations after closure.

These guarantees do not cover compensation owed by the operator to third parties who may suffer damages in connection with the activity carried out.

The list of the ICPEs concerned by the obligation to lodge these guarantees and the rules for calculating and lodging the financial guarantees are stipulated by the Order of 31 May (that was amended by an Order of 12 February 2015) and the Order of 31 July 2012. An Order of 5 February 2014 provides the framework for lodging guarantees via the intermediary of a private guarantee fund. The EDF Group operates facilities that are concerned by these new requirements. Decree no. 2015-1250 of 7 October 2015 increased the threshold above which guarantees are required from €75,000 to €100,000 (Article R. 516-1 of the French Environment Code). It also provides for additional financial guarantees to be lodged with the Caisse des dépôts et consignations, as well as the amendment of the rules governing how guarantees are triggered, in particular by allowing them to be implemented as soon as court-ordered liquidation proceedings are initiated.

#### Seveso facilities

Since 1 June 2015, "Seveso" ICPEs have been governed by the provisions of the Seveso 3 Directive (2012/18 of 4 July 2012), which replaced the Seveso 2 Directive (96/82/EC). The entry into force of the Seveso 3 Directive resulted in the use of dangerous products (under the CLP Regulation of 16 December 2008) that were not covered by the Seveso 2 Directive being incorporated into the scope of the Seveso regulations.

The Seveso 3 Directive also contains stricter provisions concerning access by the public to information related to safety, public participation in the decision-making process and access to justice, as well as improvements in the way information is collected, managed, made available and shared. The Seveso 3 Directive also introduced stricter standards for facility inspections. Law no. 2013-619 of 16 July 2013 transposed the legislative portion of the directive into French law by inserting into the Environment Code (Articles L. 515-15 *et seq.*) a section that is specific to Seveso facilities. These provisions, which are complemented by two Decrees (no. 2014-285 and no. 2014-284) of 3 March 2014 and by an Order of 26 May 2014, entered into force on 1 June 2015.

Decree no. 2015-1250 of 7 October 2015 amended the rules governing how the financial guarantees that are applicable to Seveso ICPEs are lodged, in particular by allowing operators of multiple facilities to pool these guarantees. A forthcoming order will specify the rules for lodging these guarantees, as well as the methodology for calculating pooled guarantees.

#### Facilities that are subject to the IED Directive

Directive 2010/75/EU of 24 November 2010 on industrial emissions (known as the "IED" Directive) revised and recast several existing Directives into a single piece of legislation, including the IPPC, LCP, Waste Incineration and VOC Directives, among others.

Chapter III of this Directive affects EDF as it regulates the combustion plants that are found in fossil fuel-fired plants, in particular. The applicable requirement levels depend on the nominal thermal power of the combustion plants concerned and on the fuel used. This Directive, which was partially transposed into French law by Order no. 2012-7 of 5 January 2012 (and incorporated into the French Environment Code in Articles L. 515-28 to L. 515-31), has the effect of broadening the application of the IPPC Directive to include new activities, enhancing the scope of the best available techniques (BAT) on which the fixed emission limit values will be based, causing a periodic reconsideration of operating conditions in order to take into account changes in BAT and, in certain cases, requiring a "baseline report" on the state of soil.

Decree no. 2013-5 of 2 January 2013 partially transposed the provisions of the IED Directive on the state of soil. Article 1 of the decree, which is now Article R. 512-4 of the French Environment Code, states that interim analysis of the soil will now be required in the event of a substantive change



of the facility and, if pollution occurs, the operator must propose measures. Another Decree no. 2013-374 of 2 May 2013 completed this transposition by introducing provisions into Articles R. 515-58 to R. 515-84 of the French Environment Code that are specific to facilities that are covered by the IED Directive. These provisions apply to thermal plants, under the conditions laid down, in particular, by the Order of 26 August 2013 on combustion plants with power of 20MW or more.

#### 1.5.6.2.2 Specific regulations applicable to basic nuclear facilities

In France, EDF is, in particular, subject to Law no. 2006-686 of 13 June 2006 on transparency and safety in the nuclear field (the "TSN Law"), which was integrated into the French Environment Code via its implementing Decree no. 2007-1557 of 2 November 2007, as amended, and the Order of 7 February 2012, as amended, which laid down the general rules for basic nuclear facilities (the "BNF Order"). This legislation establishes the legal rules that are applicable to Basic Nuclear Facilities (BNF). The Law was amended by Order no. 2016-128 of 10 February 2016 that contains various provisions on nuclear matters and which, in particular, transposed into French law Council Directive no. 2014/87/Euratom of 8 July 2014 amending Directive no. 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations and Directive no. 2011/70 of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste. It will also concern the NSA's powers of sanction.

The TSN Law created the Nuclear Safety Authority (NSA), an independent government agency, with the Ministers for Nuclear Safety retaining authority to issue the main authorisations and draft general regulations.

The construction of a BNF is authorised, following a public enquiry, by a decree, after consulting the NSA and on the basis of a report by the Ministers for Nuclear Safety. The decree that authorises the construction must state the identity of the operator, the nature of the facilities, its maximum capacity and its perimeter. The application for authorisation to set up a BNF must include, in particular, a preliminary security report (PSR), a study of the impact of the facility on the environment and health, a dismantling plan and a risk management study (RMS). The decree that authorises the construction of the BNF sets a time limit to commission the facility and the frequency of safety inspections if not equal to 10 years and, finally, lays down requirements to ensure the public safety, health and sanitation, and the protection of nature and the environment. The authorisation to commission the BNF (*i.e.* load the fuel into the reactor core) is issued by the NSA after consulting the public. In this respect, the operator provides the updated safety rule set and an internal emergency plan (IEP) that specifies the organisational measures, intervention methods and requisite resources that are implemented by the operator in the event of an emergency. An additional safety inspection assesses the compliance of the facility with the applicable regulations and updates the assessment of the risks that the facility poses to the interests mentioned above.

Pursuant to the decree that authorises the facility to be set up, the conditions applicable to pumping water, discharging liquid and gaseous wastes – whether radioactive or not – as well as the related limits placed on these activities are set by an NSA decision; decisions that set the limits for discharges by facilities into the environment require approval.

The NSA also issues regulations pursuant to the decree that authorises the facility to be set up, in order to prevent or limit the effects of any accidents or incidents, to define measures to protect residents on an individual and collective basis, limit noise pollution and manage the waste generated by and stored at the facilities.

#### Rules on the safety and inspection of nuclear facilities

The nuclear facilities operated by EDF are subject to the general regulations on basic nuclear facilities derived from the French Environment Code. Priority must be given to the protection of the interests mentioned by the law (public safety, health and sanitation, nature and the environment) via the

prevention of accidents and the limitation of their consequences in respect of nuclear safety, as specified by the BNF Order. In this respect, nuclear safety is defined as a set of technical provisions and organisational measures concerning the design, the construction, the operation, the shutdown and the decommissioning of BNF, as well as the transportation of radioactive substances, which are adopted with a view to preventing accidents or limiting the effects thereof.

The NSA also has the authority to issue regulatory decisions of a technical nature to complete the terms and conditions for application of the decrees and orders issued in the field of nuclear safety and radiation protection, with the exception of those related to occupational healthcare. These decisions are subject to the approval of the relevant ministers. Since the aforementioned BNF Order was published, out of the twenty or so decisions that are being prepared, nine have been published and approved.

The provisions of the French Environment Code concerning BNF also set up mechanisms for informing the authorities. In this respect, all accidents and incidents, whether nuclear or otherwise, that have or may have particular consequences for the security of a BNF, must be declared without delay by the operator, in particular to the NSA and to the State's representative in the *département* where the incident or accident took place. Moreover, the TSN Law created or improved tools used to inform the public, with, for example, the creation of a High Committee for transparency and information on nuclear safety or the possibility given to any person to ask the operator directly for information on the risks involved in exposure to ionising radiation and on the safety and radiation protection measures adopted to prevent or reduce these exposure risks.

Moreover, increasingly strict administrative and criminal law penalties have been established to punish BNF operators who do not comply with their legal and regulatory obligations, such as a three-year prison sentence and a €150,000 fine if a BNF is operated without authorisation, or a one-year prison sentence and a €30,000 fine if radioactive substances are transported without authorisation or approval.

In July 2014, the Council of Ministers of the European Union adopted Council Directive no. 2014/87/Euratom of 8 July 2014 amending Directive no. 2009/71/Euratom establishing a community framework for the nuclear safety of nuclear installations (see section 1.5.8.1 "Future regulations at European level").

The legal framework described above for safety and inspection was completed by certain provisions of the Law of 17 August 2015 on the Energy Transition for Green Growth and Order no. 2016-128 of 10 February 2016 that contains various provisions on nuclear matters.

In particular, the role of the local information commissions (CLIs) was reinforced: they can review all matters that fall within the scope of their remits of their own motion, they must be consulted if the specific intervention plan is amended and can inspect BNF at the request of the chair of the CLI in the case of an event rated 1 or higher on the International Nuclear and Radiological Event Scale, etc. Moreover, the NSA's power of sanction was enhanced with, in particular, the creation within the NSA of a Sanctions Committee composed of Council of State and Supreme Court judges.

#### Decommissioning of nuclear facilities

The decommissioning of a BNF is authorised by a Prime Minister's decree that is issued after a public enquiry and after an opinion by the NSA. This decree specifies the stages of the decommissioning, how long it will last and the intended final status. Once the decommissioning has been completed, the operator must send the NSA a declassification request, which, following an approval decision by the NSA, makes it possible to end the BNF status of the facility. The Law of 17 August 2015 on the Energy Transition for Green Growth, in particular its provision that is now Article L. 593-25 of the French Environment Code, gave legislative value to the decommissioning strategy implemented since the early 2000s by EDF in stating that decommissioning must take place within a timeframe that is "*as short as possible*" after final shutdown, under conditions that are economically acceptable and in compliance with the principles set forth in Article L. 1333-2 of the French Public Health Code and Section II of Article L. 110-1 of the French Environment Code.

A draft decree on the decommissioning of basic nuclear facilities will amend the Decree of 2 November 2007, known as the "Procedures Decree", with a view to implementing the provisions derived from the Law on the Energy Transition for Green Growth, in particular the content of the shutdown declaration and decommissioning application files.

### Radioactive waste

EDF's business is subject to French regulations on the sustainable management of radioactive waste. EDF bears liability for the radioactive waste resulting from its operations. In France, radioactive waste is managed by the National Agency for Radioactive Waste Management (ANDRA), a public institution of industrial and commercial nature created by Law no. 91-1381 of 30 December 1991 on research into the management of radioactive waste.

The method used to manage radioactive waste in France depends on the level of radioactivity and radioactivity lifespan of the waste (see section 1.4.1.1.4 "The nuclear fuel cycle and related issues"). The Law of 28 June 2006, which is now Articles L. 542-1 *et seq.* of the French Environment Code, defines the organisation and the financing of radioactive waste management, along with the terms for a framework to evaluate and cover the costs of decommissioning BNF, as well as managing spent fuels and radioactive waste, is incorporated into Articles L. 594-1 *et seq.* In particular, the assets allocated to cover provisions cannot be used for any other purpose by the operator, and separate accounting procedures for these assets must be used. The implementation of these provisions is controlled by the administrative authority, i.e. the Minister for Energy, which is itself overseen by a National Assessment Commission for the financing of decommissioning costs for BNFs and the management of spent fuels and radioactive waste.

Decree no. 2007-243 of 23 February 2007 on securing the financing of costs in the nuclear industry sets forth the terms and conditions for implementing the Law of June 2006.

A report is filed with the administrative authorities and the NSA every three years with a copy sent to the Statutory Auditors. This report includes, in particular, a valuation of the costs, the methods used for the calculation of provisions, and the composition of the assets. The administrative authorities may require any additional supporting documents, have an outside organisation conduct a study, or require an expert valuation of the assets at the operator's expense.

Council Directive no. 2011/70/Euratom established a framework for the responsible and safe management of spent fuel and radioactive waste for a certain number of European Union Member States, and clarifies several concepts. This Directive presents, in particular, deep geological disposal as the safest and most sustainable option to manage Long-Lived, High-Level Waste and considers the possibility of creating disposal facilities shared between several Member States, on a voluntary basis.

### Regulations on radiation protection

In France, nuclear activities that present a risk of exposing persons to ionising radiation are regulated by two separate sets of rules, depending on the category of persons to be protected. Regulations on the basic protection of the population against such radiation, which are governed by the French Public Health Code, are primarily based on all nuclear activities being subject to a declaration or authorisation. Authorisations granted to establish a Basic Nuclear Facility serve as the authorisation required under the French Public Health Code. Article R. 1333-8 of the French Public Health Code sets the maximum exposure level of the general public at 1mSv per year.

French Regulations on the protection of workers against the dangers of ionising radiation, which are governed by the French Labour Code, lay down various obligations for employers of workers who are likely to be exposed and, in particular, set a limit on exposure of workers to ionising radiation at 20mSv over a period of twelve consecutive months.

The French Health Code contains the provisions applicable to controlling high-level sealed radioactive sources and orphan sources.

Council Directive no. 2013/59/Euratom of 5 December 2013, which laid down "basic safety standards", repealed Directive no. 96/29 of 13 May 1996. This Directive must be transposed before 6 February 2018. The State services concerned have organised working groups in which employers and employees are represented, with a view to achieving transposition, the aim of which is to simplify the system.

### Civil liability of nuclear facility operators

Several international conventions govern the civil liability of nuclear facility operators, in particular the Paris Convention of 29 July 1960 on Third-Party Liability in the Field of Nuclear Energy and the Brussels Convention of 31 January 1963, which supplements the Paris Convention. These two Conventions are applicable in the signatory countries that have ratified them, including France and the United Kingdom.

The Paris Convention established a special liability derogation system, with specific characteristics. Liability for nuclear damage to persons and property is objective (even in the absence of a fault) and limited in terms of the amount and duration, and is focused on the operator of the nuclear facility only.

In France, the operator's liability was limited to approximately €91.5 million per nuclear accident at a facility and to approximately €22.9 million per nuclear accident during transport. These amounts were respectively increased to €700 million and €70 million on 18 February 2016 when Article 130 of the Law of 17 August 2015 on the Energy Transition for Green Growth mentioned below entered into force.

Over and above the maximum amount for which the operator is liable, the State where the incident occurred is responsible for compensating victims up to a maximum of €201.4 million (provided that said State is a Contracting State of the Brussels Convention); over and above this amount, Member States that have ratified the Brussels Convention (including France) contribute collectively to compensation up to a limit of €345.3 million.

The Convention also provides that the operator has an obligation to take out insurance or lodge a financial guarantee for the liability amounts established in order to guarantee the availability of funds. The Minister for the Economy monitors French operators' compliance with this obligation. EDF complies with the current coverage requirements (see section 2.2.7 "Insurance").

Protocols to amend the Paris and Brussels Conventions were signed on 12 February 2004 but have not yet entered into force. They require significantly higher amounts of compensation to be available in order to cover a greater number of victims and types of damage that are eligible for indemnification. The operator's liability will thus be at least €700 million per nuclear incident in a facility and €70 million per nuclear incident during transport. The State in which the nuclear facility of the operator that is liable for causing the damages is located is liable for amounts above the €700 million for which the operator is liable, up to €1,200 million (provided that said State is a Contracting State of the Brussels Convention). Over and above this amount, the Contracting States of the Brussels Convention are liable up to a maximum amount of €1,500 million. In addition, for personal injury only, the time limit to claim compensation has changed from 10 years to 30 years from the date of the incident. Another important change is the introduction of a detailed definition of "nuclear damage", which includes non material damage, the cost of preventive measures, the cost of measures to rehabilitate damaged environments, and certain other harms resulting from damage to the environment. These new provisions will, however, only be applicable when the protocol that amends the Paris Convention comes into force, i.e. when at least two-thirds of the sixteen Contracting States have ratified it. France has adopted a law permitting ratification of both Protocols (Law no. 2006-786 of 5 July 2006), but has not yet filed the corresponding ratification instruments.

Moreover, on 30 April 2014, France filed its ratification instrument for the joint protocol relating to the application of the Vienna Convention and the Paris Convention, which thus entered into force for France on 30 July 2014. This joint protocol establishes a link between the Paris Convention, which covers countries in Western Europe, and the Vienna Convention of 21 May 1963 on civil liability for nuclear damage, which covers (among others) countries in Eastern Europe. It enables the parties to one of these two conventions (Paris or Vienna) who adhere to the protocol to benefit from the coverage provided by the other convention.

### Protection of nuclear facilities and material

The purpose of the regulations on the protection and control of nuclear material governed by Article L. 1333-1 of the French Defence Code is to detect and prevent the loss, theft or misappropriation of nuclear material that is stored at facilities or being transported, or any attempts to alter, damage or disperse such material.

These regulations were completely recast by Decree no. 2009-1120 of 17 September 2009 on the protection and control of nuclear material, its facilities and its transportation, as set forth in the French Defence Code. The main purpose of this decree was to extend the protection of nuclear material to the facilities where it is stored. Several orders published in 2011 detail operators' obligations.

For nuclear power plants, the Order of 10 June 2011 on the physical protection of facilities that house nuclear materials, which can only be held with an authorisation, is based on in-depth defence of targets, namely the nuclear material, equipment or functions, which, in the event of default or damage by a malicious act, are liable to have radiological consequences. Accordingly, the operator must set up several lines of protection in the form of six zones (e.g. access control areas, a vital area, an internal area, etc.). Following an amendment by an Order of 15 September 2015, it now makes it possible to set up safety devices in dangerous areas if the assessment of the contents of the safety study provided for in Article R. 1333-4 of the French Defence Code reveal that the means implemented to meet the safety objectives appear to be insufficient.

The Order of 9 June 2011 organises the system for physically monitoring nuclear material, as well as the accounting conditions for nuclear material and operator obligations. Accordingly, operators must ensure that the physical monitoring and accounting are protected against the malicious actions identified when the authorisation is issued.

Law no. 2015-588 of 2 June 2015 on the improvement of the protection of civilian facilities that house nuclear materials created a specific criminal misdemeanour of trespassing in these facilities. For the implementation of these rules, Decree no. 2015-1255 of 8 October 2015 created Restricted Access Nuclear Areas (ZNAR) that must be delineated within each facility. Trespassing in a ZNAR constitutes a criminal misdemeanour that carries a one-year prison sentence and a €15,000 fine. These penalties are increased in the event of aggravating circumstances (to a three-year prison sentence and a €45,000 fine, in particular when the offence is committed in a group, and to a seven-year prison sentence and a €100,000 fine, in particular if the offence is committed with the use or threat of a weapon).

### 1.5.6.2.3 Regulations applicable to fossil fuel-fired energy generation

The EDF Group's thermal energy generation business is subject in France to the regulations that are applicable to ICPEs (see section 1.5.6.2.1 "Regulations applicable to facilities classified for the protection of the environment (ICPEs)"). EDF's thermal facilities must also comply with specific regulations on air quality, adopted mainly as a result of European Directive no. 2001/81/EC of 23 October 2001 on national emission ceilings for certain atmospheric pollutants (the NEC Directive), and Directive no. 2001/80/EC

of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (the LCP Directive), which, since 1 January 2016, has been repealed and replaced by Directive no. 2010/75/EU of 24 November 2010 on industrial emissions (the IED Directive). These directives have been transposed into French law by several orders, in particular the Order of 30 July 2003 on boilers that are present in existing combustion facilities with a power rating of more than 20MWth, which, since 1 January 2016, has been repealed and replaced by the Order of 26 August 2013 on combustion facilities with a power rating of 20MW or more, which are subject to authorisation under section 2910 and section 2931.

Exemptions from obligations concerning emissions into the air were possible until 31 December 2015. As of that time, the ceilings and the exemptions originating from the IED Directive mentioned above will apply, with, in particular, specific issues concerning production facilities in the overseas departments and emergency systems, for which the pollution levels require negotiating adapted provisions. Two orders of 26 August 2013, which entered into force on 1 January 2014, bring together all the provisions that are applicable to combustion facilities and specify the conditions under which these facilities will be allowed to exceed emissions limits.

Thermal energy production is also subject to the provisions of the Seveso 3 Directive and to the obligation to lodge financial guarantees (see section 1.5.6.2.1 "Regulations applicable to facilities classified for the protection of the environment (ICPEs)"). Decree no. 2014-1501 of 12 December 2014, which amended the nomenclature for classified facilities, concerns certain thermal facilities that store heavy fuel, and makes them subject to the Seveso 2 Directive.

Directive no. 2015/2193/EU of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants must be transposed into French law by 19 December 2017. It lays down rules designed to limit the air pollution caused by sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>) and dust from medium combustion plants, and to reduce the airborne emissions and their potential risks for human and environmental health. The facilities concerned are combustion plants with a rated thermal input of 1MW or more and less than 50MW, regardless of the type of fuel they use.

### 1.5.6.2.4 Regulations applicable to hydropower facilities

In France, hydropower facilities are subject to the provisions contained in Articles L. 511-1 *et seq.* of the French Energy Code. They require concession agreements granted by decree (for facilities generating over 100MW) or by order of the Prefect (for facilities generating between 4.5MW and 100MW), or an authorisation from the Prefecture (for facilities under 4.5MW), (see section 1.4.1.4.1.4 "Issues relating to hydropower generation" concerning hydropower concessions).

EDF's hydropower generation business is subject to the substantive provisions of water regulations. Such regulations cover in particular control over variations in water levels and flow rates, the safety of areas in the vicinity, downstream of hydropower facilities and, in general, maintaining balanced management of water resources (see section 1.5.6.1 "Basic regulations applicable to the environment, health, hygiene and safety").

### Competitive tendering for hydropower concession contracts

Until 1 April 2016, the competitive tendering procedure for hydropower concession contracts will still be governed by Decree no. 94-894 of 13 October 1994, which has now been incorporated into Book V of the regulatory section of the French Energy Code (cf. Decree no. 2015-1823 of 30 December 2015 on the organisation of the regulatory section of the French Energy Code). This decree, as amended by Decree no. 2008-1009 of 26 September 2008, places concessions within the legal framework

for public service delegation contracts defined by Law no. 93-122 of 29 January 1993, known as the "Sapin Act", it being specified that the former preferential right of the outgoing operator was eliminated by the Water Act (Law no. 2006-1772 of 30 December 2006) as it was incompatible with European law.

For all procedures initiated as from 1 April 2016, the award of hydropower concession contracts is now governed by Order no. 2016-65 of 29 January 2016 and by its implementing Decree no. 2016-86 of 1 February 2016 on concession contracts. This legislation has repealed the aforementioned provisions of the "Sapin Act", in order to modernise them and align them with European law (Directive no. 2014/23/EU of 26 February 2014 on the award of concession contracts).

The Law of 17 August 2015 on the Energy Transition for Green Growth has completed the legal framework for hydropower concession contracts by giving the State the possibility:

- of combining concession contracts that form a "series of facilities that are hydraulically linked", by setting a new deadline for all the concession contracts concerned (Articles L. 521-16-1 and L. 521-16-2 of the French Energy Code);
- of creating semi-public hydroelectric companies (SEM) made up of private-sector operators and a public division (State, local authorities, etc.), each of which holds at least 34% of the shares (Articles L. 521-18 *et seq.* of the French Energy Code);
- of extending certain concession contracts in return for investments by operators where these investments are necessary in order to reach national energy policy targets (Article L. 521-16-3 of the French Energy Code).

A draft decree on hydropower concession contracts, the purpose of which is to implement the provisions of the aforementioned Law of 17 August 2015 and to modernise the regulatory framework for hydropower concession contracts (in particular by clarifying certain aspects of the procedure for awarding hydropower concession contracts by approving a new model for general terms and conditions), was submitted to the CSE for an opinion on 20 October 2015. As soon as this decree is enacted, probably in the first semester of 2016, it will incorporate, by way of amendment, Book V of the regulatory section of the French Energy Code, which now contains the provisions of the aforementioned Decree of 13 October 1994.

Moreover, other pieces of draft legislation on hydropower concession contracts are expected to be adopted in the near future, in particular a draft order that will be enacted pursuant to powers granted to the Government by Article 119 of the Law of 17 August 2015, which was submitted to the CSE on 12 October 2015, which, in particular, amends the rules on the administrative and criminal penalties that are applicable to hydropower concession contracts.

#### Annual concession fee

In accordance with Article L. 523-2 of the French Energy Code, when a hydropower concession contract is renewed or extended under the conditions provided for by Articles L. 521-16-2 or L. 521-16-3 of the French Energy Code, an annual concession fee that is proportional to the revenues generated by the concession contract is levied, which is paid in part to the French State and in part to the French *départements* and municipalities through which the waterways used flow. A limit is set by the contracting authority on a case-by-case basis for each new or renewed concession contract. Article 69 of Law no. 2015-1785 of 29 December 2015 (the Budget Act for 2016) expressly confirmed that this type of concession fee excludes the application of the concession fees provided for by Article L. 523-1 of said Code, which apply to concession contracts that were renewed before 2006.

#### Safety and security of facilities

Articles R. 214-112 *et seq.* of the French Environment Code contain provisions that are applicable to the safety and security of hydropower facilities that are authorised, declared and operated under concession contracts. Dams are divided into three classes (A, B and C) according to their characteristics, in particular their height and the volume of the floodwaters. According to

this classification and the legal rules applicable to the facility, the regulations require the operator or concession contract holder to fulfil a certain number of obligations in order to guarantee the safety and security thereof (in particular by carrying out and updating hazard studies – see section 1.4.1.4.1.2 "Hydropower safety"). The aforementioned draft decree, on hydropower energy concession contracts, contains provisions that are designed to unify the regulations, regardless of the legal rules that are applicable to the facility.

#### 1.5.6.2.5 Regulations applicable to renewable energy generation

The "Climate Package" (known as the "2020 Energy-Climate Package") is the source of a set of measures aimed at ensuring that, by 2020, the EU will achieve the objectives of a 20% reduction of greenhouse gas (GHG) emissions, a 20% improvement in energy efficiency and a 20% portion of renewable energy (REN) in energy consumption. The "2020 Energy-Climate Package", which was adopted on 24 October 2014, set new targets for 2030: a 40% reduction in GHG emissions compared to 1990, 27% of renewable energies in the energy mix and a 27% improvement in energy savings.

One of the five instruments that make up the "2030 Energy-Climate Package" is Directive no. 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources, known as the "REN" Directive. It allocates the effort to reach the target of 20% of renewable energies in final EU energy consumption by 2020 among Member States, taking into account, among other aspects, the national energy mix, the potential of each State and their GDP, and requires Member States to adopt national renewable energy action plans.

According to Article 4 of the aforementioned REN Directive, France adopted its National Action Plan in favour of renewable energies (2009-2020). This plan, in accordance with the REN Directive, sets a national target of a 23% share of energy from renewable sources in the gross final consumption of energy by 2020. The Law of 17 August 2015 on the Energy Transition for Green Growth also provides for a target of 32% of renewable energies in energy consumption by 2030. Moreover, the same law provides that the national plan will be replaced by the part of the PPE that concerns the development of renewable energies and energy recovery.

In order to achieve the objectives of the REN Directive, the Grenelle 2 Law created new land planning instruments with a view to enabling balanced development between the various renewable energy sectors, which include:

- regional climate, air and energy schemes (SRCAEs), for which the legal framework is laid down in Articles L. 222-1 to L. 222-3 and R. 222-1 to R. 222-7 of the French Environment Code. As of 1 May 2014, all regions had adopted their SRCAE;
- regional schemes for connection to renewable energy networks (S3RERs), of which Articles D. 321-10 to D. 321-21 and D. 342-22 to D. 342-25 of the French Energy Code specify the content, approval rules, host capacity management and financial conditions for the connection of electricity producers.

Under Article 15 of the REN Directive, an Order of 14 September 2011 (ratified by Law no. 2013-619 of 16 July 2013) amended the legal rules on the guarantees of origin of the electricity produced using renewable sources or by cogeneration, laid down in Articles L. 314-14 *et seq.* of the French Energy Code. The terms and conditions to implement this new scheme and the rules for appointing the organisation in charge of managing guarantees of origin (issuing, transfer, cancellation) are stipulated in Articles R. 314-24 to R. 314-41 of the French Energy Code. As producer and mandatory purchaser of electricity produced using renewable energy sources, the EDF Group is concerned by these provisions.

The Grenelle 2 Law also contains exceptional provisions designed to encourage the development of sea-based energies, which were enhanced by the Law of 17 August 2015 on the Energy Transition for Green Growth.

In addition, Article 18 of Law no. 2014-1545 of 20 December 2014 on the simplification of corporate life empowers the Government to set up a dedicated, comprehensive authorisation system for sea-based facilities



that produce renewable energy and that are located in the maritime public domain, and for the connection structures for these facilities. Moreover, Decree no. 2016-9 of 8 January 2016 simplified the legal procedures that are applicable to sea-based renewable energy projects that win competitive tendering procedures.

Furthermore, the Law of 17 August 2015 on the Energy Transition for Green Growth provides an exceptional appeal timeframe for the benefit of "*facilities that produce energy from renewable sources*" of four months in which to contest an authorisation, as from, respectively, either the publication of the authorisation, or its notification.

#### 1.5.6.2.6 Regulations applicable to the generation of wind power

Pursuant to Articles R. 421-1 and R. 421-2 of the French Urban Planning Code, a building permit must be obtained for land-based wind farms with a height equal to or greater than 12 metres. The construction of wind farms on the public maritime domain is exempted from the requirement for a building permit, in accordance with Article R. 421-8-1 of the French Urban Planning Code.

In addition, the Grenelle 2 Law provides that land-based wind farms are now subject to the nomenclature applicable to ICPEs with the legal system of authorisation or declaration (see section 1.5.6.2.1 "Regulations applicable to facilities classified for the protection of the environment (ICPEs)") under section 2980 "Terrestrial facilities for the generation of electricity using mechanical wind energy with one or more wind-power generators". In connection with the application for a building permit, an impact study must be performed for wind farms that are subject to authorisation and submitted with the building permit file.

The Law of 17 August 2015 on the Energy Transition for Green Growth amended the rules on the distance required between wind farms and housing: the minimum distance of 500 metres is maintained, but may be increased in light of the impact study, which is part of the authorisation application. It also inserted provisions into Article L. 146-4.I of the French Urban Planning Code that are designed to facilitate the location of land-based wind farms in municipalities concerned by the "Coastline" Law. A decree is also expected to clarify the rules on wind farm location with regard to military facilities and sectors, weather monitoring equipment and air navigation equipment.

The operator of a wind farm, or in the event of default, the parent company, is responsible for decommissioning the farm and site restoration, as soon as operation is terminated for any reason (Articles L. 553-3 and R. 553-1 of the French Environment Code). For this purpose, the operator is required to lodge financial guarantees as of the start-up of generation and for subsequent accounting periods.

#### 1.5.6.2.7 Regulations applicable to public markets

The Directive no. 2014/24/EU on procurement and Directive no. 2014/25/EU on procurement by entities operating in water, energy, transport and postal services sectors, in which EDF is submitted as a marketer, have been transposed in national law by:

- Order no. 2015-899 of 23 July 2015 on public markets which proceed to an union of the different competitive procedures present so far in the *Code des Marchés Publics* and Order no. 2005-649 of 6 June 2005;
- Decree no. 2016-260 of 25 March 2016 related to the Order of 23 July 2015.

These texts entered into force on 1 April 2016.

### 1.5.7 REGULATIONS ON THE WHOLESALE ENERGY MARKETS

Inspired by the rules contained in Directive no. 2003/6/EC on market abuse applicable to financial markets (see section 4.1 "Corporate Governance Code"), Regulation (EU) no. 1227/2011, known as the "REMIT" Regulation on wholesale energy market integrity and transparency came into force on 28 December 2011. This Regulation is aimed at preventing market abuse and manipulation on wholesale energy markets and strengthening the confidence of market participants and consumers.

Strengthening wholesale energy market integrity and transparency must foster open and fair competition on these markets, in particular so that prices set on these markets reflect a fair and competitive interplay between supply and demand. The Regulation prohibits insider trading and market manipulation, and establishes an obligation to publish inside information as defined in the REMIT.

The European Agency for the Cooperation of Energy Regulators (ACER) is primarily responsible for monitoring wholesale trades in energy products, in order to detect and prevent transactions based on inside information and market manipulations.

ACER also collects the data needed to assess and monitor markets, inasmuch as the regulation provides that market participants, or a person empowered to do so on their behalf, must supply ACER with a detailed statement of wholesale energy market transactions.

Lastly, market participants that perform transactions for which a declaration to ACER is mandatory must register with the national regulatory authority of the Member State in which they are established (the CRE in France) or, if they are not established in the European Union, that of a Member State in which they do business.

### 1.5.8 PRINCIPAL PLANNED REGULATIONS THAT ARE LIKELY TO HAVE AN IMPACT ON THE EDF GROUP'S BUSINESS

Several planned regulations, both at community level and in France, could have a significant impact on the EDF group's business. The main regulations are described below.

#### 1.5.8.1 Future regulations at European level

##### European Energy Union

On 25 February 2015, the European Commission published its strategy to build a European Energy Union. This package "European Energy Union" calls for several legislation amendments and is based on three communication points concerning:

- the strategic framework for a resilient Energy Union that has a forward-looking climate change policy;
- the programme for the fight against global climate change after 2020 as part of the Paris Protocol;
- the achievement of the target of 10% of interconnection in the electricity sector.

There are five dimensions to the Energy Union: supply security, the internal energy market, energy efficiency, reduction in carbon emissions, and research and innovation in the field of energy. Each of these dimensions is accompanied by actions that will be developed and implemented during the coming years.

In a press release dated 10 November 2015, the European Parliament Committee on Industry, Research and Energy presented its demands concerning the construction of the European Energy Union.

On 18 November 2015, the European Union published a report on the state of the Energy Union. This report describes the progress made over the last nine months, states the key areas of action for 2016 and draws the initial conclusions concerning the policies that must be implemented at regional, national and European level. The report is accompanied by twenty-eight information sheets that assess, for each Member State, the progress of the Energy Union at national level. It also presents the roadmap for the Energy Union.

## Environment

### The 2030 Energy and Climate Change Package

On 24 October 2014, the 28 Member States of the European Union reached an agreement on their 2030 climate change and their energy objectives and policies (known as the "2030 Energy and Climate Change Package"). Within this timeframe, the agreement includes an objective of reducing European Union greenhouse gas emissions by at least 40% (compared to 1990), increasing the portion of the European Union's energy consumption to 27% of renewable energies and improving energy efficiency by 27%. The European Commissioner for Climate Action and Energy has announced that the 2030 Energy and Climate Change Package would be translated into legislative proposals. Accordingly, on 15 July 2015, the European Commission presented a draft directive designed to amend the Directive of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community (the "ETS Directive"), for the period 2021-2030. This reform is expected to be submitted to the Parliament and the Council in the coming months.

### Rules on the safety and control of nuclear facilities

In July 2014, the Council of Ministers of the European Union adopted Council Directive no. 2014/87/Euratom of 8 July 2014, which amended Directive no. 2009/71/Euratom that established a Community framework for the nuclear safety of nuclear facilities. The revised directive aims to update the European framework for nuclear safety following the Fukushima accident, in order to guarantee the uniform application of high standards for nuclear safety and control. Member States have until 14 August 2017 to transpose this directive into national law.

#### 1.5.8.2 Future regulations at national level (France)

### Draft bill on reconquest of biodiversity, nature and landscapes

The draft bill on reconquest of biodiversity, nature and landscapes, which was announced during the 2012 Environmental Conference, was adopted by the French Parliament during its first reading on 24 March 2015. This law is expected to improve protection for biodiversity and set up a French Biodiversity Agency. It also contains the provisions of the bill on compensation for environmental harm that the government announced in September 2013. The law is currently being finalised by the upper and lower houses; after being adopted by the Senate on 26 January 2016, it was adopted during its second reading by the French Parliament on 17 March 2016.

### Reform of environmental law

A reform that aims to make the application of environmental law simpler and more efficient has been started as part of the forum on the modernisation of environmental law. Preparatory work on this reform is currently being led by the Government, with the support of a specialised commission on the modernisation of environmental law, which was set up within the National Council for Ecological Transition (CNTE). The "Macron" Act of 6 August 2015 provides for the implementation of certain proposals that were made during this work, via orders, which must contain measures designed to (i) accelerate the completion of construction and development work to facilitate energy transition, (ii) reform environmental evaluation and transpose the provisions of Directive no. 2014/52/EU of 16 April 2014 on impact studies and (iii) accelerate the resolution of environmental disputes.

In parallel to the General Assemblies, on 6 January 2015, the Minister for Ecology launched the "Participative Democracy" workshop on environmental matters that is designed to generate concrete proposals for the reform of public participation. The proposals that are developed by this workshop were included in the "Macron" Act, which empowers the Government to reform the legal framework for public participation via orders. The measures to be published are expected to enhance, in particular, this participation at the public consultation stage, ahead of the filing of authorisation applications.

The orders provided for by the Macron Act are expected to be published before 7 August 2016.

All of these reforms are liable to impact the authorisation procedures that are applicable to the EDF group's projects.

### Non-financial reporting

At European level, Directive no. 2014/95/EU of 22 October 2014, which aims to improve the transparency of non-financial information between Member States, requires large undertakings to draw up a non-financial statement that includes information on "environmental matters, social and employee-related matters, respect for human rights, anti-corruption and bribery matters". It also requires these undertakings to provide a "description of the diversity policy applied in relation to their administrative, management and supervisory bodies". France has until 6 December 2016 to transpose this Directive.

### Draft bill on the duty of vigilance of parent companies and prime contractor companies

This bill includes the obligation for large companies to set up a vigilance plan and ensure its "effective" implementation, in order to identify and prevent the materialisation of risks of infringements of human rights and fundamental freedoms, serious bodily injury or harm to the environment or health risks that result from their activities and those of the companies they control, as well as the activities of their subcontractors and suppliers. A system for verification/sanctioning by the courts of compliance with this obligation is included in the bill. Parliament adopted the bill at its first reading on 30 March 2015. The Senate rejected it on 18 November 2015 but it has been adopted in its second reading by the French Parliament on 23 March 2016.



## 1.6 Research &amp; development, patents and licenses

The main missions of the EDF Group's Research and Development Division (R&D) are firstly, to support the Group's business lines and subsidiaries on a day-to-day basis, by providing them with its top-level expertise and high-performance practices, and secondly, to contribute to building the Group's future by anticipating the developments and major challenges with which it is confronted.

In particular, these challenges include the following:

- fossil fuels and global warming, prompting reflection and regulations on the rate of greenhouse gas emissions;
- water uses and management of the environment;
- the rapid development of emerging nations, and the resulting shift in areas of consumption;
- the significant development of information technology applied to energy sector, offering new opportunities for the electricity business;
- customers, individual and collective consumers, who are also becoming producers, and who want to use energy more effectively and live in more energy self-sufficient buildings, neighbourhoods and towns.

In this context, R&D's role is crucial when it comes to finding solutions to all of these challenges. Its avenues of research are structured on the basis of three broad priorities:

- consolidating and developing competitive low-carbon production mixes: one of the key issues in transition is to ensure the effective coexistence of conventional means of production, in particular by further improving the safety, performance and operating lifespan of existing nuclear power plants, alongside the development of new renewable energy;
- developing and experimenting with new energy services for clients, enabling demand-side management that is both flexible and low-carbon, thanks to improvements in knowledge of demand, the development by clients of energy efficiency, the promotion of new effective uses of electricity, often in combination with renewable energies (heat pumps, electric mobility, etc.), the development of technical and economic modelling to engineer buildings, industry and sustainable cities, and the development of uses and consumption being integrated into the electricity system itself through the use of smart grids and appropriate pricing;
- preparing the electricity systems of the tomorrow by optimising the lifespan of network infrastructures and accompanying adaptation of the electricity system by improving network asset management; implementing optimisation models and economic scenarios for new infrastructure projects relating to energy transport; inserting intermittent energies and developing smart grids.

In addition to its overall activity, R&D has also identified four research programmes that fall into the "disruptive – future-ready" category. These are:

- local energy services and systems, with industrial fine-tuning of technical resources for urban planning and definition of optimum procedures to incorporate local energy systems within an overall national system;
- the use of digital technology in customer relations to offer innovative services and, within our own industry, to improve monitoring of our installations and maintenance forecasting;
- energy storage, photovoltaic energy and electric mobility;
- Small Modular Reactors: small reactors that could be used, in particular, to address the market for areas that are isolated or suffer from weak transport links.

## 1.6.1 R&amp;D ORGANISATION AND KEY FIGURES

EDF's R&D is integrated and multidisciplinary in order to facilitate synergies and method transfers between the different business lines within the Group.

In 2015, the Group's overall research and development budget amounted to €658.9 million, €555.2 million of which was earmarked for the EDF R&D budget. This is one of the largest R&D budgets of any major electricity company. Approximately two-thirds of this budget is devoted to programmes put together on a yearly basis under contractual agreements with EDF's operational divisions and subsidiaries. The remaining third goes to medium and long-term anticipation initiatives that fall within Group R&D priority areas.

In 2015, around 21% of this budget was devoted to protecting the environment. In particular, expenditures covered research into energy efficiency, uses of electricity as a substitute for fossil energy, renewable energies and their insertion into the grid, sustainable cities, the local impacts of climate change and other environmental issues such as biodiversity, water quality, and the reduction of disturbances. EDF's R&D has a total staff of over 2,100, representing 29 nationalities; 80% have manager status, 33% are women, and 150 are Ph.D. students. 200 research lecturers teach in universities and major engineering schools. Each year, EDF's R&D hires some 100 people, and channels others towards other entities of the Group. The R&D Division has 15 departments. Its expertise covers the entire field of activity of the Group: renewable energies; networks; nuclear generation, fossil-fired, and hydro power generation; energy management; trade; Information Systems; the environment. It is both specific to a particular discipline, businesses, projects, as well as coming together for work on major systems. EDF's R&D is responsible for an internal training organisation, the Technology Transfer Institute (*Institut de transfert de technologie, ITeCh*), whose purpose is to disseminate EDF R&D practice, know-how and innovation to the rest of the EDF Group. Comprising some 100 courses, the training catalogue is updated every year; the offer is now incorporated in the Skills Academies (see section 3.3.1.3 "Skills development: preparing the future").

R&D is currently organised on a multi-site basis. Three of these sites are located in France, in the Paris region; seven are located abroad: in Germany, the UK, Poland, China, the US, Singapore and Italy. The Chatou and Les Renardières centres, near Fontainebleau both have a workforce of some 500 people. The Clamart centre has nearly 1,000 people. 230 researchers work outside France, including thirty or so expats.

In November 2010, EDF's Board of Directors approved a new project to relocate EDF's main R&D centre, currently located at Clamart, to the Paris-Saclay campus. The new centre is destined to provide workspace for up to 1,500 people, including Group researchers, Ph.D. students and interns. It is an expression of fresh ambitions on the part of EDF for its R&D, placing scientific and industrial innovation and research at the heart of its priorities. A new EDF training centre will also be located nearby. Together on one site, the new research centre and training centre will form the EDF Lab Paris-Saclay complex. This strategic decision positions EDF as a leading player on the Paris-Saclay campus, thereby enabling it to benefit from more dynamic collaboration with the higher education establishments and public and private-sector research centres located nearby.

In this regard, a new agreement came into force on 1 July 2014, following signing by EDF's R&D Division and all the trade union organisations representing R&D. This agreement, reached as a result of sustained social dialogue between the stakeholders defines the measures taken to support EDF Clamart employees as they move into the new centre in mid-2016.

In addition, a number of partnership agreements have been concluded with other institutions present on the future Paris-Saclay University campus:

- SEIDO, a joint laboratory between EDF and Telecom Paris Tech dedicated to the Internet of things and cybersecurity for electricity systems. Its mission is to prepare and facilitate the deployment of energy demand management and energy efficiency services, making use of interoperable, communicating energy-related objects (heating, air conditioning, white and brown goods, electric vehicles, etc.), thereby helping to provide cohesion of the entire system, as well as its safety (security, confidentiality, etc.);
- the shared Rise Grid laboratory, devoted to the modelling and simulation of smart grids, in association with the Supélec engineering school;
- the SEISM institute for earthquake modelling from fault to structures, bringing together EDF, the French Atomic Energy Commission (*Commissariat à l'Energie Atomique*), École centrale de Paris, ENS Cachan and the national scientific research council CNRS;
- PGM0, the Gaspard Monge Programme for optimisation and operational research, housed by the Jacques Hadamard Mathematics Foundation, and established with the patronage of EDF's R&D Division;
- IMSIA, the Institute of Mechanical Sciences and Industrial Applications, which since June 2015 has brought together ENSTA, CNRS, and CEA Saclay alongside EDF;
- the Energy Finance and Markets laboratory, shared with Dauphine University, ENSAE and École Polytechnique.

The R&D sites also accommodate two research units operated jointly with CNRS: IMSIA (formerly LaMSID, the Laboratory for the Mechanics of Sustainable Industrial Structures) and IRDEP, the Institute for Photovoltaic Energy Research and Development, as well as an international R&D centre, the Materials Aging Institute (MAI).

To conduct its research, EDF is continuing to invest in powerful and reliable digital simulation resources. It develops cutting-edge computing code and resources that are among the best in industry. Its current capacity is 1,400 teraflops.

In addition, the Group benefits from unique experimental resources; these include specific analytical loops (chemicals/corrosion, failure, aero-acoustics, etc.); loops focused on components or processes; resources for on-site test interventions; or resources dedicated to the characterisation of materials and their ageing. Two recent flagship installations are noted below:

- Concept Grid: a scaled-down electricity grid whose purpose is to try and test the insertion of the innovative hardware and "intelligent" systems that together make up a smart grid before installing them on the network. Concept Grid is designed to prepare future developments of the grid by studying the integration of new components and equipment from the world of information and communication technology to facilitate demand-side management. It is also intended to facilitate the integration of decentralised production, by studying the behaviour of production resources on the electricity system, and electricity storage applications. Concept Grid provides the missing link between a conventional research laboratory, in which innovations are tested in conditions that are not entirely representative of reality, and the actual grid, where quality of service considerations restrict experimentation;
- Vercors: construction of a reactor building to 1:3 scale in order to study the ageing of double containment buildings.

R&D is also increasing its capacity for industrialisation and value creation based on internal innovation, and with a view to benefiting further from external innovation. The aim is to be able to integrate innovations in the Group's industrial processes. This policy is structured around two approaches:

- improving value creation from internal innovation and accelerating time to business through initiatives conducted in collaboration with the business lines. For instance, a dedicated team helps to protect and leverage EDF R&D intellectual property and expertise potential, and also to accelerate the transfer and industrialisation of innovations;

- developing an opening on external innovations, and, as needed demonstrate external innovations.

EDF is the leading investor in Electranova Capital, a venture capital fund for startups specialising in cleantech, launched in May 2012 together with Allianz and Bpifrance, and managed by Idinvest Partners. With an investment capacity of some €90 million, the purpose of the Electranova Capital fund is to promote the emergence of innovative products using new technologies in order to meet the challenge of low-carbon energy models.

Ten investment have been concluded with new companies, four of which are French. All of them are related in some way to one or more of EDF's business lines:

- Actility: major French smart grid company;
- Enlighted: expert in energy optimisation, Enlighted provides lighting control solutions for retail, industrial, and service buildings;
- Forsee Power Solution: a French firm specialized in battery design;
- Seatower: a Norwegian firm that has developed innovative gravity foundations for offshore wind farms;
- SunFire: a German company specialized in fuel cells and electrolysis for stationary storage;
- Leosphere: A French SME established in 2004, and now the world leader in the use of Lidar, a technology using lasers and their reflection in the atmosphere;
- Techniwood: a French company that designs, manufactures and markets the latest industrial generation of a high-performance wood-insulation composite construction system known as Panobloc®;
- Sunrun: an American firm which is one of the leading vendors of solar panels to consumers in the US, on the basis of solar as a service;
- Organica Water: a Hungarian-based company that is developing and marketing a disruptive, energy-efficient technology for the organic treatment of municipal and industrial wastewater;
- First Fuel: a US firm providing a "digital" solution for carrying out mass energy audit campaigns for retail premises remotely.

EDF also has a stake in the Amorceage Technologique Investissement fund (ATI), managed by CEA Investissement, dedicated to new French companies working in technological innovation for energy, the environment, micro-technologies and nanotechnologies.

Lastly, EDF has taken out five stakes in venture capital funds in France, North America and China in order to provide access to a global pool of startups and innovations:

- Robolution Capital, a fund focusing on robotics, launched in March 2014;
- Chrysalix, a Canadian fund dedicated to cleantech venture capital, in December 2011;
- Tsing capital, the first Chinese fund dedicated to cleantech venture capital, in December 2011;
- DBL Investors in the USA, a fund set up in 2008;
- Mc Rock, a Canadian fund dedicated to industrial tools of internet, in 2015.

## 1.6.2 R&D PRIORITIES

EDF's R&D works for all the Group's business lines. For each of them, it offers technological solutions or innovative business and economic models designed to improve their performance, and prepare the Group's future in the longer term by means of medium and long-term anticipation initiatives. It is one of the factors in EDF becoming a global industrial group providing low-carbon electricity systems.

As the energy sector undergoes profound change, the goal of EDF R&D may be defined in terms of three strategic avenues: consolidating and developing competitive low-carbon production mixes, developing and testing new energy services for clients and preparing the electricity systems of tomorrow.

R&D also conducts research in information technology to support these three strategic avenues. This research is in turn structured around five major areas: complex systems; the management and processing of large volumes of data, the internet of things, cyber security; and the simulation of physical problems.

Research in this field has a twofold purpose:

- improving business line performance through advanced simulation technologies;
- facilitating the emergence of new opportunities for business lines through innovative uses of new information and communications technologies.

### 1.6.2.1 Consolidating and developing competitive carbon-free generation mixes

In the field of nuclear, hydro and thermal power generation, EDF's R&D develops tools and methods to improve the safety of the means of production, optimise the latter's operational lifespan, and increase their performance in terms of output and environmental impact. There are three key priority goals: ensuring the Group maintains its advantage in nuclear power over the long term; developing renewable energies; and examining the industrial feasibility of carbon capture and storage.

To secure the Group's advantage in nuclear power generation in the long term, R&D is also working to protect EDF's assets through actions in line with its policy to improve the safety of installations, particularly with regard to enhanced performance and extended operating lifespan. For instance, in 2014, R&D conducted research to better understand and model ageing phenomena in materials, in particular the steel used in reactor pressure vessels and the concrete used in containment buildings. This research is vital for managing the operating lifespan of installations, in particular for non-replaceable components.

Other actions in the field of nuclear power deal with issues relating to the fuel cycle. They include the design of new power plants, in particular fourth-generation plants and Small Modular Reactors (SMR).

Lastly, R&D actions contribute to greater familiarity and better control of the impact of installations on the environment, and at the same time, take environmental risks to industrial installations more fully into account. So, for instance, R&D is studying how the availability of water as a resource in the future may develop in view of climate and territorial changes. R&D research also contributes to understanding the possible risks and consequences on the power generation fleet (availability of a cold source, scope for modulation, location optimisation).

To support these programmes, R&D is developing digital solution tools and experimental test resources, as well as tools capable of taking up the fresh challenges raised by growing amounts of digital data, IT security, and new information and communication technologies.

The events at Fukushima in 2011 have resulted in more research into safety, the environment (external threats) and lifespan, as well as into new topics such as the rehabilitation of inhabited areas evacuated after a nuclear accident. Together with other European players in nuclear power, in March 2012, EDF's R&D set up NUGENIA, an international non-profit association whose purpose is to develop a single cooperative framework for R&D in Europe for second and third-generation nuclear systems, as part of the European Sustainable Nuclear Energy Technology Platform

(SNETP). The association brings together 80 members from 20 countries, including industrial players, research entities, safety authorities and others. EDF chairs this association, which will facilitate the emergence of synergies and joint projects between members or with national R&D programmes, in the following fields: safety and risk analysis; serious accidents; reactor cores and performance; component integrity and ageing; fuel, waste and decommissioning; "Innovative Generation III Design"; as well as cross-functional challenges regarding the harmonisation of practices (in particular in the field of safety), in addition to controls and non-destructive evaluation. For the 2014-2015 request for projects, in 2014 NUGENIA submitted some fifteen projects, most of them in the field of safety and the operating lifespan of the existing fleet. In addition, the NUGENIA+ project has launched its own request for projects using funding allocated by the European Commission.

In 2012, EDF was also behind the launch of the Connexion project, devoted to the digital nuclear Instrumentation & Control systems of the future, as part of the French state's "Investments for the Future" projects<sup>1</sup>. This project brings together industrial and academic partners working in the French nuclear industry in an ambitious research programme designed to prepare the future methods for the design, qualification and renovation of digital I&C systems for power plants. The initiative also addresses the need to harmonise industrial solutions within the industry. The systems engineering methods developed during the course of this project are feeding into other projects to design new nuclear power plant models, and contribute to the digital transition policy being implemented by the group.

The second priority is support for the development of renewable energies. These are playing a growing role in the energy landscape both within Europe and worldwide, and EDF is already a major player here, and is seeking to expand its role in the field still further.

For renewable energies, the goal of R&D is to identify technological breakthroughs offering significant competitive advantage, and to help the most promising technologies to emerge industrially, working in partnership with the academic and industrial worlds. EDF is investigating a wide range of renewable energies: hydro, photovoltaic, onshore and offshore wind farms, thermodynamic solar power, biomass, marine energies, geothermal energy, etc.

R&D is also working to develop tools and methods to enhance operational performance and optimise the cost of the EDF group's electricity production system projects based on renewable energies, with a number of aims in mind:

- reducing investment risks: for instance, EDF's R&D is providing expertise for the EDF group's offshore windfarm projects, in particular as regards the design of windfarm turbine systems and foundations, turbine certification, and methods to evaluate production potential. The qualification in 2015 of a floating Lidar system to measure wind at projected offshore windfarm sites has confirmed the improved performance delivered by this innovative solution. R&D is also preparing the future by studying floating offshore windfarm technologies, as well as supporting EDF EN in the development of the *Provence Grand Large* project;
- improving operational performance: for instance, R&D has developed a solution to measure machinery performance based on the monitoring of the operational parameters of turbines. This diagnostic tool allows underperforming turbines to be identified and a preliminary diagnosis to be carried out;
- controlling the technical and economic impact on the electricity system; and managing the electricity system balance as renewable energies are incorporated. Research relates to the definition of procedures for renewable energies to be inserted into electricity grids. This involves analysing the various solutions allowing intermittent renewable energies to be integrated, and evaluating the costs and limitations of their integration into large systems: storage, super grids, smart grids, energy management, etc.

1. "Investments for the Future" (Investissements d'avenir) is a loan initiated by the French government to fund research and innovation initiatives relevant to the economic development of France.

The third priority is carbon capture and storage, and more generally the limitation of CO<sub>2</sub> emissions from fossil-fired power plants (see section 1.4.1.3 "Thermal generation in mainland France"). The cost, the impact on infrastructure performance and the lead times required to implement such solutions constitute a major issue. Research by R&D is designed to provide clarity as to the technical and economic maturity of the various capture technologies in order for the group to have an informed view of the best strategy for cutting the Group's thermal power plants' CO<sub>2</sub> emissions.

For the existing power plants, the capture of CO<sub>2</sub> by processing exhaust gases now appears to be the most appropriate solution.

With the support of French research agency ADEME and its partners, EDF built and operated a CO<sub>2</sub> capture research demonstrator for a period of one year at EDF's coal-fired power plant at Le Havre. Tested on the CO<sub>2</sub> present in smoke from coal combustion, the technology involves the use of an advanced "amine scrubbing post-combustion capture" process. Capturing nearly 2,000 tonnes of CO<sub>2</sub>, the research demonstrator allowed the promising performance of this technology in an industrial environment to be verified with regard to its consumption of energy and solvents. Supplementary studies are being carried out to extrapolate the results to industrial scale.

Elsewhere, R&D is also examining new avenues to prepare the emergence of a second generation of CO<sub>2</sub> capture and storage technologies, with a lower energy penalty, and to evaluate breakthrough technologies that may increase installation performance considerably, with a corresponding decrease in CO<sub>2</sub> emissions.

### 1.6.2.2 Developing and experimenting with new energy services for clients

The development of energy efficiency and distributed renewable energies, regulatory and technological (digitalisation) changes, as well as the opening up to market competition, have all led to profound changes in the relationship between energy firms and their clients. They allow clients to become actively involved in their consumption and production of energy, both individually and across entire territories.

In this context, the EDG group's marketers face multiple challenges:

- changes to rate-price trajectories;
- demand-side management: under schemes such as "Green Deal" in the UK and Energy Savings Certificates in France, suppliers must assume an increasing number of obligations;
- the development of smart technologies: the arrival of smart meters and the emergence of connected objects will, for the general public, mean access to new services enabled by these new smart technologies (monitoring, customised offers, etc.);
- changes in customer relations, destined to become increasingly digital, with more demanding client expectations accompanied by changing behaviours. However, the modernisation of this relationship should not overshadow the parallel rise in energy poverty impacting customers in need of an adequate service from their energy company;
- the growing power of local stakeholders as a result of France's Energy Transition and "NOTRe" Boundaries Reform Acts: local authorities, already actively engaged in urban planning and public energy distribution, will be increasingly able to take control of their own energy destiny. The notion of sustainable territories, which combines aspects of development (eco-districts) and mobility (electric vehicles), will structure local policies. New potential areas of service are emerging at the intersection of the development of smart technologies and the increasing influence of local communities.

In order to meet these challenges, EDF R&D is restructuring its action around a number of topical priority programmes:

- developing load curve methods and models to provide close familiarity with demand, as well as new rate structures and prices to encourage dynamic demand-side management to meet new requirements in terms of the flexibility of the electricity network;
- innovating to develop new uses for electricity (heat pumps for buildings and industry, electric mobility) in order to stimulate future electricity demand and effective energy solutions in the long term for all client segments, in a way that is compatible with new regulatory frameworks;
- developing methods and resources to allow client relations to be modernised, enhancing commercial performance and cutting costs thanks to new information technologies and related data processing; experimenting with smart grids downstream from meters, and preparing the services and equipment to be used with Linky meters in buildings;
- designing and modelling local energy systems; developing the tools and technologies to deliver an innovative service offering for sustainable towns, cities and territories in France and internationally.

As a result, research has been conducted into new uses for electricity, such as electric mobility, heat pumps and more economic buildings. R&D has developed a prototype of an industrial high-temperature heat pump that allows waste heat from client processes to be recovered. The deployment of this technology as part of a service offering to clients is underway. Innovations that will ultimately allow the cost of heat pumps for buildings to come down have also been developed. Lastly, innovations relating to smart energy management for energy used for heating have been developed, in particular for residential heat pumps and to modernise storage tanks, making them more compatible with innovative control modes such as off-peak periods for solar.

These works are specifically carried out on the ground via smart grid demonstrators, such as Nice grid and Smart Electric Lyon, in which R&D examines new models aggregating various types of flexible demand (load management, deferred consumption, self-consumption, renewable energies, and energy planning and management at local levels). R&D has also launched an experimental project dealing with industrial load management based on the remote coordination of processes.

Regarding customer relationships, in order for residential clients to be aware of their electricity use between two bills, EDF has designed and developed a prototype range of features compatible with smart meters, including an application for smartphones and PCs that allows consumers to estimate their bill, taking into account their own particular characteristics, seasonal variations in their electricity consumption, and their past consumption history. EDF's R&D is also working on research initiatives to fight energy poverty, for example by designing relevant client relations offers and tools.

In sustainable territories, in order to meet the needs of cities that are seeking to optimise infrastructures and their management (transport, waste treatment, buildings, energy production, and networks) and aspiring to become sustainable, "smart cities", R&D is developing urban engineering resources for EDF marketers in France, such as the study performed for the Nice metropolitan area. R&D is also investing in a partnership with the city of Singapore to develop a decision support tool for urban planning. As a result, a development agreement for the City of the Future was signed in June 2013 between EDF and the Housing Development Board of Singapore, the leading builder of homes for the city, to develop an innovative IT solution for urban modelling. In collaboration with the Singaporean authorities, this solution covers: the energy efficiency of buildings and their air conditioning systems, as well as the collection of household waste. It also includes the possibility of addressing issues such as the incorporation of photovoltaics into buildings, green roofs, and local water recycling. This modelling is coupled

with innovative 3D visualisation tools at the level of individual buildings or a neighbourhood, of the impacts of planning decisions, for instance on greenhouse gas emissions. The platform developed for this solution was delivered on schedule in mid-2015. New fields of development are being studied in collaboration with Singapore. The experience has already allowed a project to be developed in Lyon for the new Gerland neighbourhood.

Electric mobility is another important aspect of sustainable cities: electric transport opens up the prospect of a fundamental transformation of modes of travel. Battery storage is the key technology for electric transport. R&D research in this respect consists, firstly, in characterising battery safety and performance in the laboratory, and secondly, in innovating in the terms of breakthrough technologies with the potential to deliver significant improvements in battery life or cost. R&D is also studying non-mobile applications of these battery technologies (combining them with renewable energies, system services, etc.).

More generally, the goals of R&D activities in the field of electric vehicles (EV) and rechargeable hybrid vehicles (PHEV) are as follows:

- support the development of this new use (monitoring initial experimentation, standardisation, innovations with the potential to remove market barriers, such as wireless charging);
- manage integration into the electricity system (smart charging, dimensioning and location of recharging stations);
- develop mobility service tools (fleet supervision platform, charging station operation software, tools for mobility consulting for local authorities);

in particular, through partnerships with leading transport players (Renault, PSA, RATP, and SNCF).

### 1.6.2.3 Preparing the electricity networks of tomorrow

Energy transition towards a low-carbon economy in Europe implies meeting new challenges:

- encouraging the insertion of production from energy sources that are renewable, but also intermittent;
- integrating new uses of electricity by optimising the means of production and grid requirements;
- and also developing active demand-side management for local-level decentralised energy systems integrated with larger-scale energy management systems;
- optimising energy flows in Europe, and developing grid infrastructures;
- and more generally, in line with the public interest and the competitiveness of electricity, optimising the economic equilibrium of the electricity system (generation investments, investments in networks, costs/benefits of energy and environmental efficiency solutions) without significant rise in bills or complexity for clients, while also maintaining the quality and reliability of the electricity system.

The trend towards more intelligent electricity systems, also known as smart grids, is one of the pivotal points of the transition to a low-carbon energy economy in Europe. The major challenges are technical, economic and regulatory and, apart from the integrating renewable energy and new uses, they are tied to the management of information for different network users and the need to control costs.

R&D has set itself a number of priorities to meet these challenges.

The first one concerns the management of the balance between energy supply and demand of all kinds:

- to anticipate the coming changes in the energy landscape, R&D is developing forecasting models for the global landscape in the medium to long term (the global macroeconomic environment; growth in energy demand; energy and climate policies; the competitive and regulatory environment; emerging technologies and potential breakthroughs, etc.);
- to anticipate the consequences of the development of new means of production or uses, it is developing electricity system models enabling an anticipation of flexibility requirements and the margins needed to ensure equilibrium between supply and demand. To evaluate the costs and benefits of the various options in an objective manner, it is implementing and proposing harmonised methods of analysis to the various stakeholders;
- lastly, for the operational management of supply/demand equilibrium in relation with EDF's own scope of equilibrium, R&D is developing decision support tools to optimise and manage EDF's portfolio risks on European electricity and gas markets.

The second priority is to improve the performance of electricity grids. Research conducted by R&D in this field has the following aims:

- improve the management of grid assets in France and abroad by working on equipment lifespans and network availability;
- increase the automation of distribution networks to optimise the quality of service and reduce operating costs.

The third priority is to prepare the transition to the electricity system models of tomorrow or smart grids, notably through the following goals:

- supporting the development of the Linky project (see section 1.4.4.2.4 "Future challenges: renewal, development, smart meters" and section 5.1.3.4.2.1 "ERDF: rollout of Linky smart meters") and anticipating new smart metering architectures and related services;
- preparing and contributing to smart grid experiments;
- inserting intermittent, decentralised energy production in networks; developing new system services and preparing for future local energy balances;
- trialling and industrialising new solutions based on storage systems to deliver value to electricity systems and networks.

R&D is also involved in the development of new functionality relating to the coordination and operation of the grid, as well as new solutions in the environment of new smart meters, such as ERDF's Linky project. For example, R&D has developed and trialled a new distribution network coordination feature associated with decentralised production. Based on an estimate of the condition of the network, this innovative coordination method makes it possible to maintain high-tension grid voltage within a contractual range even when there are fluctuations in output from decentralised production resources.

R&D is also testing electricity use management systems based on the Linky infrastructure. In particular, these experimentations have shown the feasibility of load disruption, such as electric heating, to reduce peak consumption periods.

It develops solutions to improve forecasts of losses on the network and develop local energy balance forecasts (source substations).

It contributes its expertise to every aspect of the Linky project, in particular the drafting specifications and qualifying equipment.



Lastly, R&D is also working on electricity systems and super grids, the direct-current networks that could emerge with the insertion of renewable energies that alter the technical and economic fundamentals of electricity networks.

In order to prepare the solutions to these new challenges, a number of smart electricity demonstrators are currently under development in France and Europe, based on a collaborative approach. R&D is heavily involved in this respect with NiceGrid, Smart Electric Lyon, Venteea, Pégase, etc., with the aim of shedding light specific issues relating to the transition of the electricity system, learning technical and economic but also social and environmental lessons, as well as considering business models and regulation. EDF's R&D is also testing multiple innovative solutions prior to deployment in the field using Concept Grid, its new test platform dedicated to the intelligent electricity systems of tomorrow. These projects also offer opportunities to reflect and innovate, together with the electricity sector as a whole and the 'new information and communications technologies' sector, in order to best adapt the equipment to the flexibility requirements of the electricity systems of the future. A large number of experiments are exploring all the potential of smart meters, the first link in the smart electricity network chain.

### 1.6.3 INTERNATIONAL AND PARTNERSHIPS

To conduct its research and development programmes, EDF's R&D develops a large number of partnerships worldwide, the purpose of which is to maintain its expertise at the highest global level in the disciplines central to EDF's concerns, and to supplement its internal reservoir of skills.

The partnership policy of R&D takes various forms both nationally and internationally.

In France, over the past few years R&D has set up 14 joint laboratories with academic partners and technical or industrial centres and participates with them in collaborative research projects funded by national agencies like the National Research Agency, the ADEME or the Single Interministerial Fund, via competitiveness clusters. Each joint laboratory offers an opportunity to establish a combined team around a common scientific and technical problem, in order to create value, expertise and knowledge for all partners, and constitutes a major asset when taking part in cooperative projects. R&D also supports four specially targeted teaching and research chairs.

In the field of nuclear R&D, the tripartite agreement between CEA, EDF and AREVA that expired at the end of 2012 was extended for a further year and followed by a new nuclear R&D agreement in early 2014. This new "Institute" agreement is designed to increase R&D programme coordination between partners and to have programmes defined with reference to detailed goals, particularly industrial goals. In practical terms, this entails the following:

- the establishment of a Tripartite Programme Team (*équipe programme tripartite*, EPT), in charge of the supervision and coordination of programmes. This team consists of four members per partner, for a total of 12 members;
- the organisation of these programmes into projects monitored by the EPT;
- the implementation of these programmes in the existing joint laboratories.

At the same time, the tripartite agreement on R&D between CEA, IRSN and EDF that expired in 2012 and was extended in 2013 was also the subject of negotiations in 2014; this has led to the signature of a four-party agreement including AREVA, allowing enhanced coordination with the "Institute" policy.

R&D is also present within the Energy Transition Institutes (*Instituts de la transition énergétique*, ITE) set up as part of "Investments for the Future" initiative:

- The *Institut photovoltaïque Île-de-France* (IPVF): this institut, of which EDF is a founding members, targets technological breakthroughs to make photovoltaic energy competitive in the market. Ultimately, the Institute will bring together some 150 researchers from the different partners at a state-of-the-art facility in Saclay;

- *France Énergies Marines*, devoted to marine energies and offshore wind farms;
- *Paris-Saclay Efficacité Énergétique* (PS2E), working on the energy efficiency of industrial procedures and energy controls in industrial parks;
- SuperGrid, focusing on major transport networks to connect remote renewable energy production sites;
- Vedecom, devoted to electric mobility;
- Efficacity, working on energy efficiency and sustainable cities; and
- INEF 4, working in the field of building rehabilitation and sustainable construction.

"EDF" was also behind the launch in 2012 of the Connexion project, focusing on future digital nuclear Instrumentation & Control systems as part of the "Investments for the Future" initiative (see section 1.6.2.1 "Consolidating and developing competitive carbon-free generation mixes"). In Europe, R&D participates in some thirty EU projects and has established links with the Joint Research Center, a European Union energy and transport research centre whose objective is to collaborate on low-carbon technologies and on electricity storage in particular. EDF is also a founding member of several European associations recognised at the EU level, such as Nugenia for nuclear power and EASE for storage.

Since the early 2000s, EDF has had a research centre in Germany - EIFER - in collaboration with the Karlsruhe Institute of Technology (KIT). This centre is chiefly devoted to decentralised production (fuel cells, hydrogen), sustainable cities and territories, geothermal energy, and biofuels. In recent years, partnership agreements have been signed with Fraunhofer institutes, the University of Stuttgart, and TU Berlin.

Since 2010, research activity has been strengthened internationally around several centres: in Poland, in the UK, in China, in Singapore, in the USA and in Italy.

The British centre consolidates the Group's positions in the British research ecosystem, particularly through Strathclyde University in the field of renewables, as well as with Manchester University, Imperial College, the National Nuclear Laboratory (NNL) and the University of Bristol in the field of nuclear energy. In 2012, this research centre became an independent legal entity, EDF Energy R&D UK Centre Ltd. This subsidiary is part of EDF Energy. This new status increases EDF's visibility and the research capabilities in the UK, in line with the Group's development strategy.

EDF Polska's research team is dedicated to advanced fossil fuel issues, biomass co-combustion, and more recently, heating networks. The R&D Polska Centre has developed collaborative work with Polish universities, including AGH at Krakow and Wroclaw University.

The centre based in Beijing is a particular asset when it comes to taking part in large-scale Chinese demonstrators for smart grids, sustainable cities, and a number of renewable energy technologies. This centre is also a resource in facilitating the implementation of the research partnership for nuclear power in China (see section 1.4.5.3.6 1 "Activities in China"). The creation of the centre has been accompanied by significant development of academic and industrial partnerships in China. For instance, EDF has signed a joint research programme in China relating to thermodynamic solar power. The cooperation underway with the Chinese Academy of Science's Institute of Electrical Engineering mainly concerns research and innovation work carried out on a testing platform dedicated to solar thermal power technologies located in Badaling. One of the challenges for EDF is to further improve its modelling capacities using measurements performed during experiments conducted on this platform.

The main goal of the Edison R&D team in Italy is to coordinate all gas research programmes for the EDF group. In 2015, Edison and the University of Turin set up a joint laboratory devoted to this topic.



In the US, the R & D and innovation sector is one of the most important and dynamic in the world. EDF has since several years an R & D Innovation team, located in Silicon Valley, which supports EDF's development in the United States and contributes to innovation in the group. The business areas of EDF Innovation Lab include the analysis of digital technology and regulatory trends, the evaluation of new business models for the group in the US linked to distributed energy resources and micro grids, smart cities, integration of renewable energies, and management of data for emerging energy services. EDF Innovation Lab also contributes to the partnerships developed a long time ago by EDF with excellence organizations such as EPRI, MIT and UC Berkeley, among others.

In Singapore, EDF labs Singapore was set up in early 2014 to support the service contract for the city's Housing Development Board. This centre is devoted mainly to research into sustainable cities.

#### 1.6.4 INTELLECTUAL PROPERTY POLICY

Intellectual property plays a major role in the protection of the EDF group's technologies and know-how against the competition, as well as the capitalisation of these assets through licensing.

EDF wants to strengthen its industrial property portfolio in order to make the most of its capacity for innovation and its technological expertise. The portfolio is made up of patents, registered software and formalised know-how.

#### Patents

As of the end of 2015, EDF's portfolio included 541 patented innovations, protected by 1,902 property titles in France and abroad.

Strengthening the patent portfolio is a priority. The aim of this is to facilitate R&D cooperation, protect the development of EDF's activities, contribute to EDF's external image, boost the motivation of researchers, and provide maximum leverage for inventions.

In 2015, EDF filed 64 patent applications<sup>1</sup> (60 in 2014).

#### Trademarks

"EDF" is a registered trademark in more than 90 countries. The Group's name is a vital component of its image and its heritage: as a result, the EDF brand, Internet domain names and logos are under constant surveillance, in order to protect them against any fraudulent use that could jeopardise to the image of the Group. Moreover, following the work to enhance the "EDF" brand, the Company has implemented brand licensing agreements with those of its subsidiaries that use the "EDF" brand.

The Group has also registered a large number of other brands, in particular those relating to the business of its various subsidiaries.

As of the end of 2015, the EDF group's brand portfolio included some 435 names, protected by over 1,300 property titles.

### 1.7 Property, plant and equipment

#### 1.7.1 SERVICE SECTOR REAL ESTATE ASSETS

EDF's Real Estate Division, attached to Group's Real Estate and Insurance Department, operates in France as the real estate provider of entities within EDF and ERDF by managing and optimising a real estate portfolio of nearly 4.4 million square meters of service premises, approximately 68% of which is owned outright by the Group and 32% is leased from third parties (leases and concessions).

The Real Estate Division is in charge of real estate asset management, lease management, the technical operation of building as well as the operation-maintenance of the facilities and the services provided to occupants, by offering areas through a sub-lease system for Group entities and units. By taking leases from third parties, the Real Estate Division made lease commitments for EDF amounting to €951 million for the period from 2016-2030.

#### 1.7.2 EMPLOYER PARTICIPATION IN THE CONSTRUCTION EFFORT

Each year, EDF is subject to an obligation to participate in the French construction effort program. Its contribution is 0.45% of its total payroll, which represented approximately €18 million for 2015 (€17.6 million for 2014).

In exchange for this payment, EDF's employees benefit from services intended to facilitate their residential mobility: assistance with renting, assistance with home purchase, assistance with mobility, advice on financing.

#### 1.7.3 SUBSIDISED HOME OWNERSHIP LOANS

As part of its social policy, EDF assists its employees to purchase their primary residence. Thanks to a partnership concluded with Crédit Immobilier de France (CIF), the bank manages the production, financing, and management of loans to the company's employees. EDF compensates the CIF for the difference between the subsidised rate at which CIF grants loans to EDF employees and the rate resulting from the bank survey conducted in 2005 on the basis of which the CIF was chosen.

As of 31 December 2015, the residual non-securitised balance for personal residence mortgages was €3.3 million on EDF's balance sheet (€3.9 million as of 31 December 2014).

1. Note: ERDF has also filed one patent application.