



EDF's response to energy transition challenges, a focus on generation

METI, Round Table for Studying Energy Situation towards 2050

January, 31st 2018

EDF, worldwide leader of the energy transition

Operational figures

- ~ **37.1 million** customer accounts worldwide
- **132.3 GW⁽¹⁾** worldwide installed capacity, of which
 - 72.9 GW nuclear
 - 30.0 GW thermal
 - 29.2 GW hydro and other renewable energies
- **583.9 TWh** generated worldwide, of which
 - ~ 78% nuclear
 - ~ 10% hydro and other renewable energies
 - ~ 8% CCGT
 - ~ 4% thermal excluding gas
- ~ **154,845** employees, of which ~ 38,700 in French distribution, ~ 40,800 in French generation and engineering and ~ 13,400 at EDF Energy
- **Framatome** : ~ 14,000 employees

Financials

- Sales: **€ 71.2 bn**
- EBITDA: **€ 16.4 bn**
- Net income excluding non-recurring items: **€ 4.1 bn**
- Net financial debt: **€ 37.4 bn**
- **Ratings⁽²⁾ : A- stable (S&P) / A3 stable (Moody's) / A- stable (Fitch)**

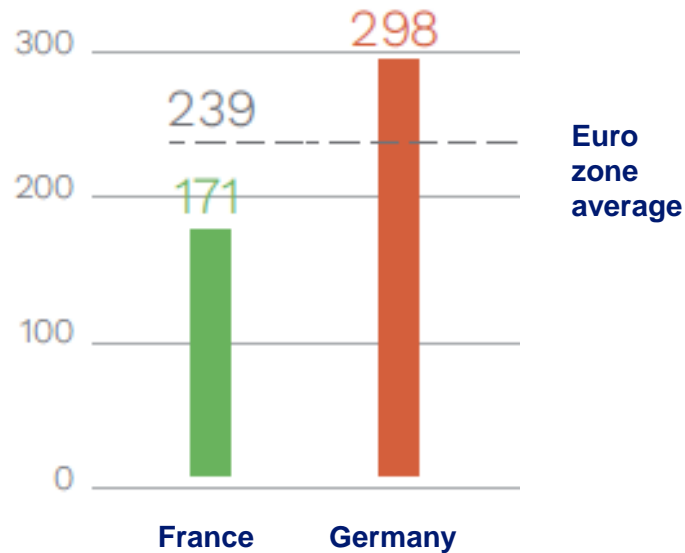
2016 figures (latest published results)

(1) Net consolidated capacities of EDF group
(2) As of 17/05/2016

2016 figures (latest published results)

A French mix that confers a benefit in terms of economics and CO2 emissions compared to Germany

Electricity prices for consumers



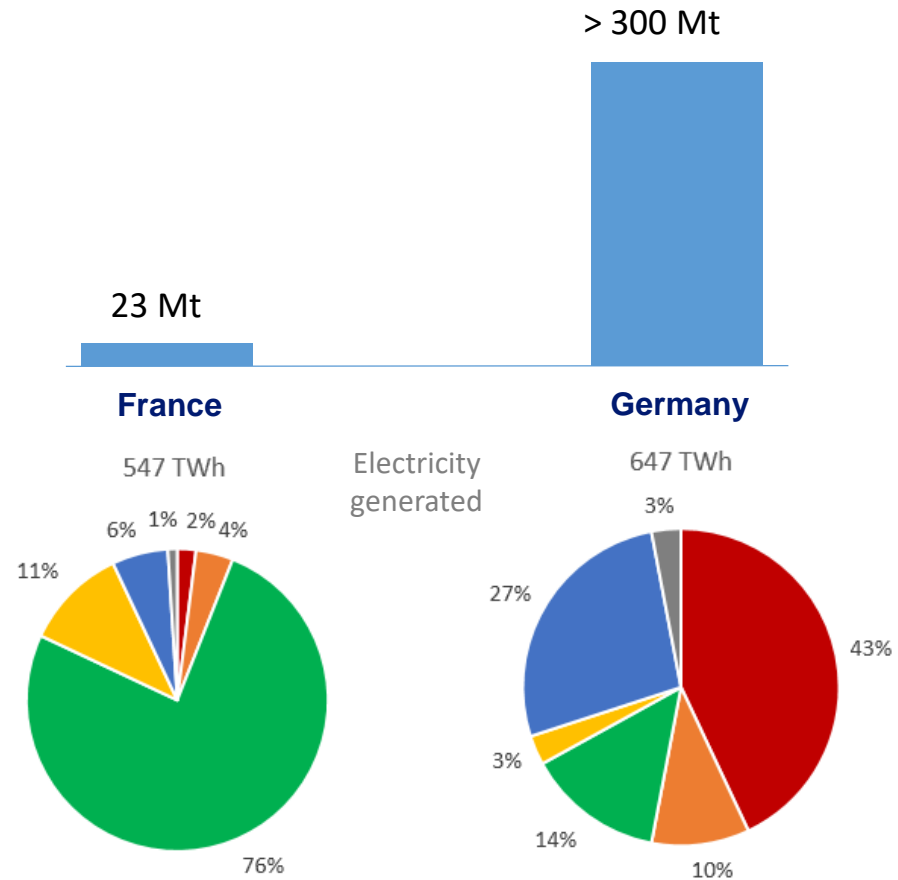
Power prices (€/MWh) all tax included for residential consumers 2nd semester 2016
DC trench : 2,5 MWh < Consumption < 5 MWh

CO2 specific emissions

- Below **20 g / kWh** for EDF in France.
- Below **71g / kWh** for the group at European level (European average 300g/ kWh)
- At about **77g / kWh** at world level



CO2 emissions from power sector

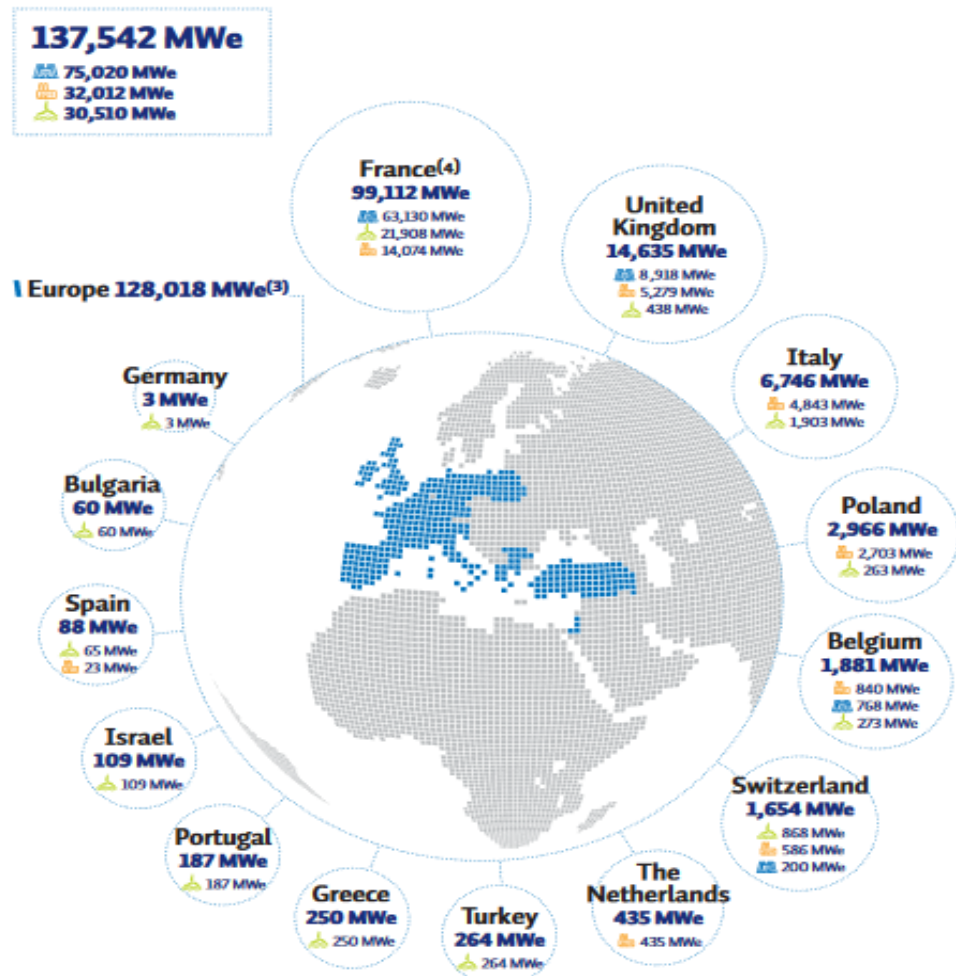


2015 figures

■ Lignite, coal, oil ■ Gas ■ Nuclear ■ Hydro ■ Other renewables ■ Various sources

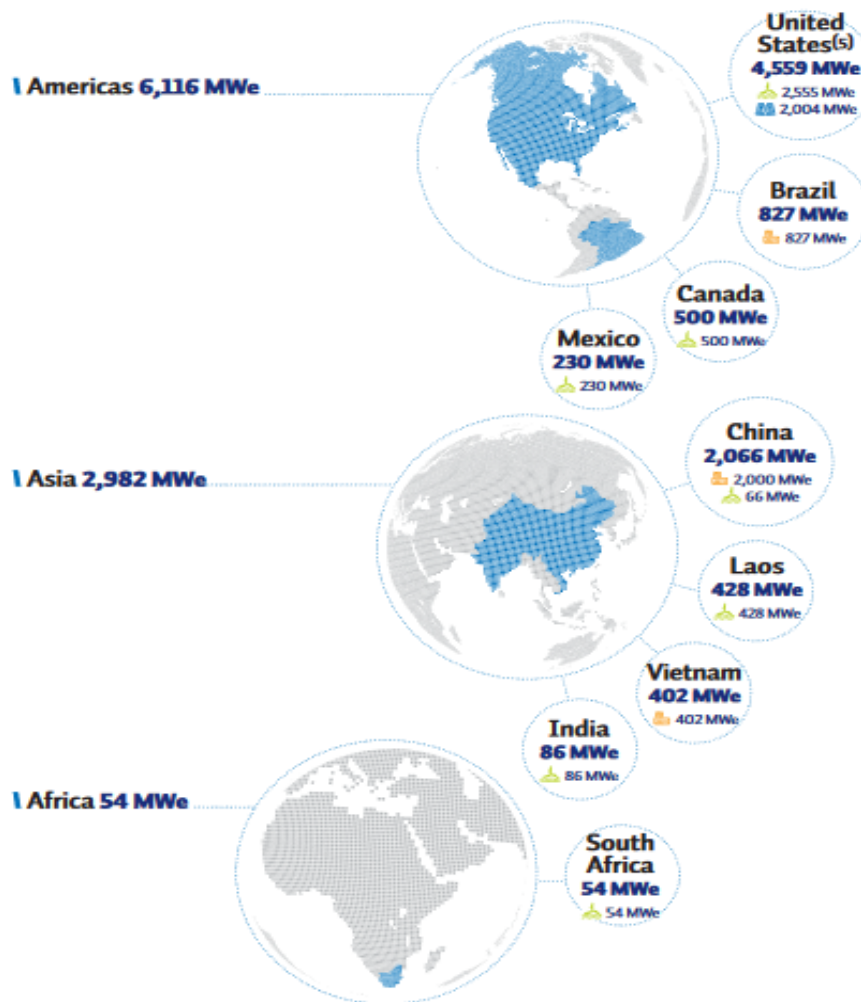
A worldwide footprint

EDF group's net installed capacity by country in 2016



The Group is driving its transformation forward based on an energy mix that combines nuclear and renewable power, with clearly defined objectives for 2020: commissioning of three EPRs⁽¹⁾, investments in existing nuclear facilities, and over €2 billion gross annual investments⁽²⁾ in renewable energy.

Data consolidated according to EDF's percentage ownership in Group companies, including associates and joint ventures.

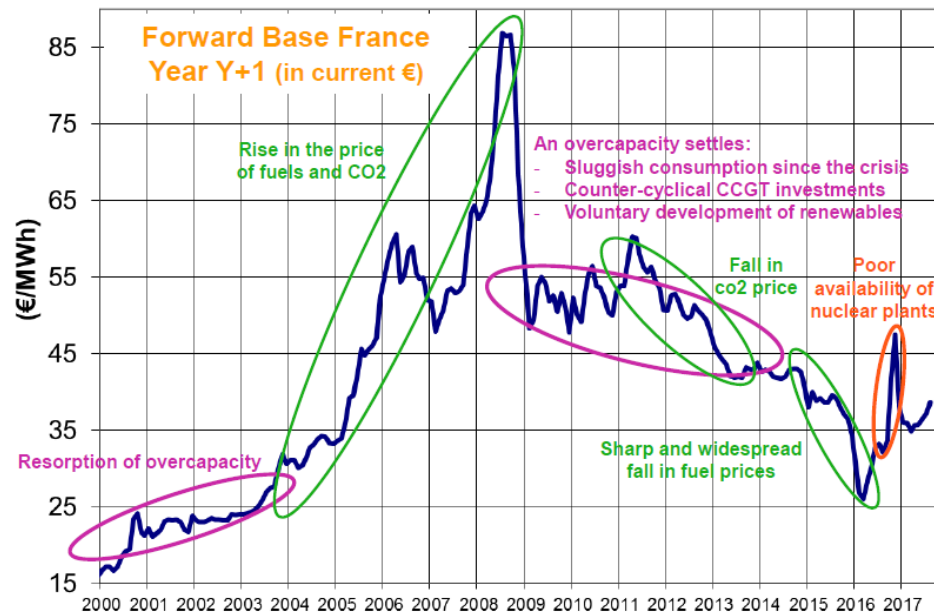


(1) Subject to approval by France's Nuclear Safety Authority (ASN) for Flamanville.
(2) Over the period 2017-2020.
(3) Europe excluding Turkey and Israel.
(4) Including small hydropower plants in France and assets in overseas France.
(5) Excluding 20 MWe of energy storage capacity and 70 MWe of EDF Energías Renovables biogas production capacity.

In France, in a context of competition and low prices, EDF is the major player

Significant price evolutions

Significant price evolutions since 2000 ; key factors : overcapacities, fuel and CO2 prices, nuclear fleet availability, etc.



The French power market

- **GENERATION** EDF responsible for 86% of the total domestic production
- **TRANSMISSION** Transportation and dispatching by RTE (50,1% owned by EDF)
- **DISTRIBUTION** : Distribution by ENEDIS (100% EDF owned) and around 160 local distributors.
- **SUPPLY** : Around 80 supply companies. EDF market share is 77% for final consumers
- **POWER EXCHANGE** : Day-ahead auction, Day-ahead continuous, Intraday Continuous

France is a large exporter of electricity (39,1 TWh in 2016) due to a low cost generation mix
Recent large development of wind and solar power plants,
Increasing role of the sectorial regulator.

In France, new policy priorities concerning energy and particularly electricity

Government / EDF : different responsibilities

- The French **future electricity mix** is the **responsibility of politics**.
- EDF as an **industrial actor contributes to the energy mix implementation** and is a **major contributor in the public service of electricity**.

New government priorities for energy transition

- **Present transition energy law (2015)** : nuclear capacity capped at the present level (63 GW). Start of Flamanville EPR reactor (1,6 GW) to coincide with the closing of Fessenheim NPP (2 x 0,9 GW). Nuclear share in the power mix at 50% around 2025.
- **New government priorities (October 2017)** :
 - Maintain very low carbon emissions, in order to respect its climate goals commitment.
 - No new thermal fossil plants (coal, gas) in the French mix.
 - The 50% nuclear share goal is **postponed** until new balance of the electricity mix is reached through significant **increasing part of renewables**.
 - **Security of supply, economic competitiveness**, and **financial sustainability** remain paramount criteria.

EDF ready to be a major player in the Energy Transition since its « DNA » combines high level HR skills, technology excellence and knowledge, and a big innovation push.

As the energy sector undergoes profound change, EDF's goal may be defined in terms of 3 strategic issues



The present presentation mainly focuses on issue n°1, regarding the development of competitive, low-carbon generation mix.

R&D and innovation supporting EDF energy transition challenges



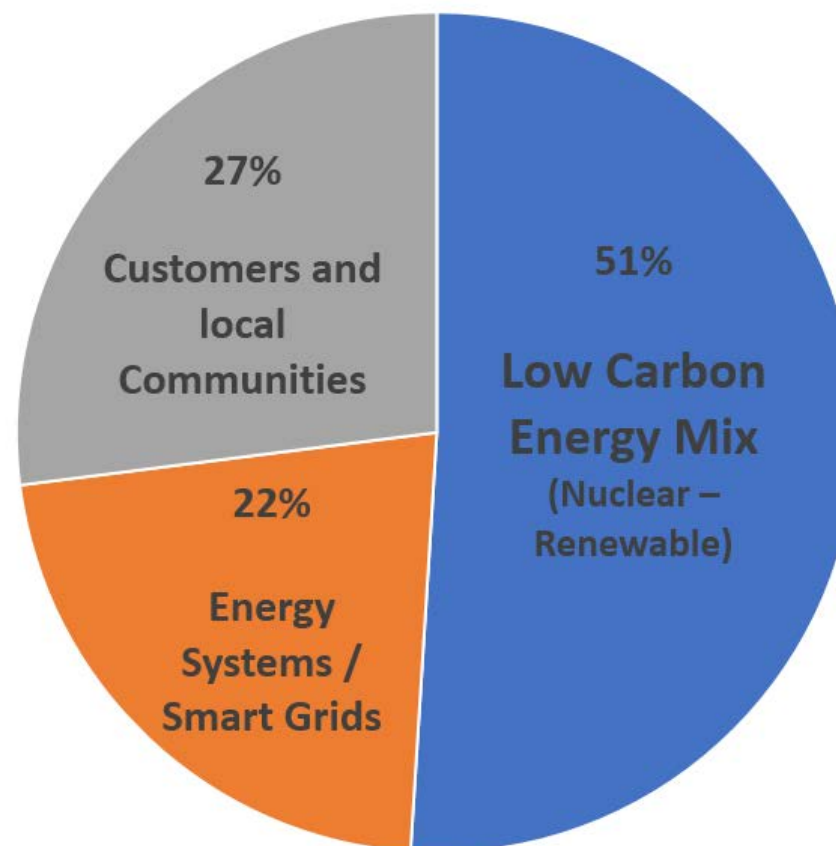
9 centres

In France and abroad: Europe, US, Asia

27 nationalities represented



76 Billions JPY budget in 2016

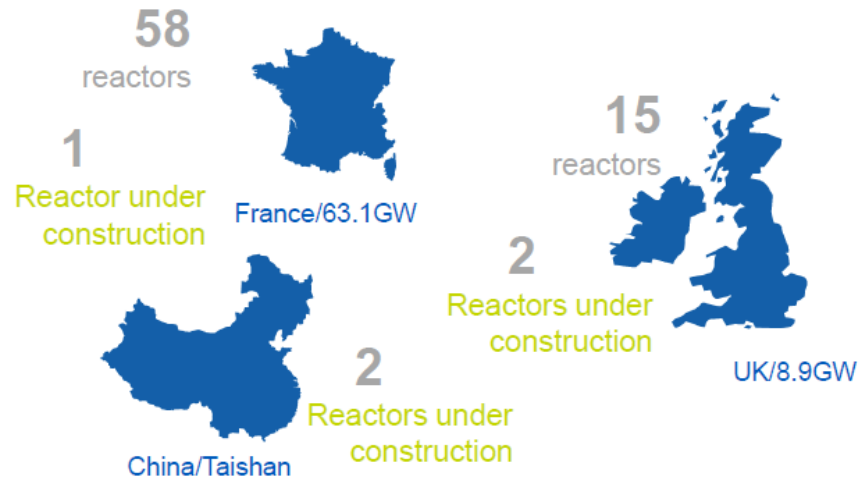


Strong Partnerships with key Japanese Companies



Worldwide nuclear : 5 reactors under construction, and 73 operating, as the French nuclear sector is restructuring

EDF, the world's leading nuclear operator



EDF, global expertise

Management of the entire lifecycle of nuclear generation facilities : design, operation, decommissioning

- EDF : world leading nuclear operator, a standardized fleet.
- Investing to continue the safe operation of its reactors beyond 40 years.
- Construction of EPR reactors in France, China, Great Britain, and development of an optimized EPR version, of Atmea1 with MHI, and SMR (Small Modular Reactors).
- Active in French and international markets for the decommissioning of plants and radioactive waste treatment.

Restructuring of the French industrial sector under EDF's leadership

- **Framatome** (former Areva NP) is now held by EDF up to 75.5%, alongside Mitsubishi Heavy Industries (**19.5%**) and the French engineering group Assystem (5%). With nearly 14,000 employees worldwide, Framatome includes all nuclear power plant design activities, supply, and reactor maintenance.
- **Areva NewCo** focus on fuel cycle activities.
- **Edvance**, EDF's new subsidiary, endorses the convergence of EDF and Framatome engineering divisions.

Lifetime extension : continuing operation of the power plants beyond 40 years for a competitive energy mix

The lifetime extension program addresses three major challenges

1. **Renewal and replacement of major components** (eg. Steam Generators) at the end of their technical lifetime. These are exceptional maintenance operations
2. **Integration of safety improvement changes:** 'post Fukushima' improvements, and ten-year inspections.
3. **Demonstration of equipment qualification after 40 years.** Studies and tests that ensure that qualified equipment can operate after 40 years of operation.

EDF is confident on the technical capacity of the French nuclear fleet series to operate for at least 50 years. EDF has already included this life extension in its financial accounts for the 900 MW series.

A €45 billion (JPY 6000 billion) plan over the period 2014 - 2025

International cooperation to promote and increase safety

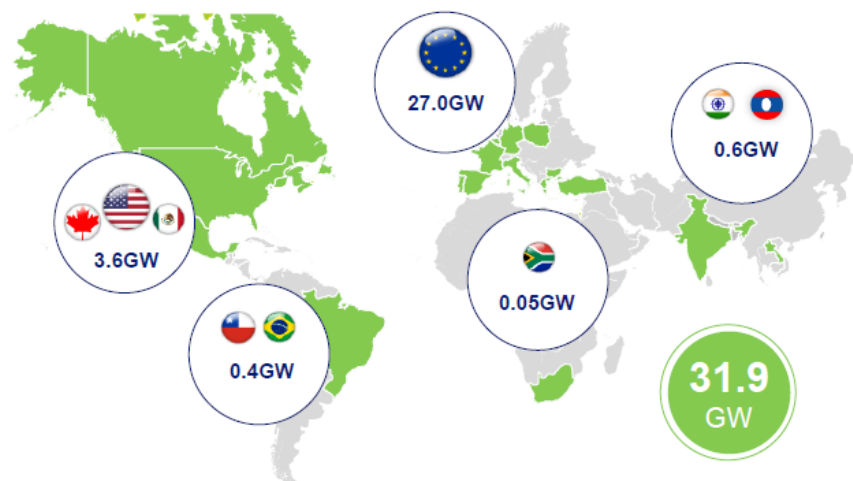
- Increase Safety, Training...
- International Cooperation with WANO, IAEA, INPO, JANSI and nuclear operators



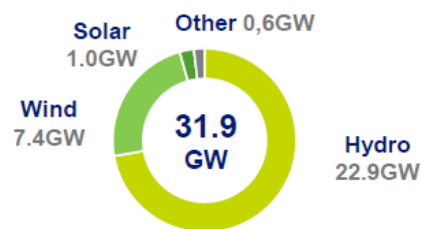
Nuclear power plant in Saint Laurent des Eaux, intervention in the machine room as part of the Grand Carénage project in October 2016

EDF's leadership in renewables activities (hydro, wind & solar) : a strong platform for growth

Global presence in 22 countries



Capacity by Technology



**BALANCED
CAPACITY MIX
WITH 30.5GW IN
OPERATION**

- Capacities in operation: 22.7GW of hydropower and 7.8GW of other renewable energies
- 1.4GW under construction

**HYDROPOWER:
"DNA" OF EDF**

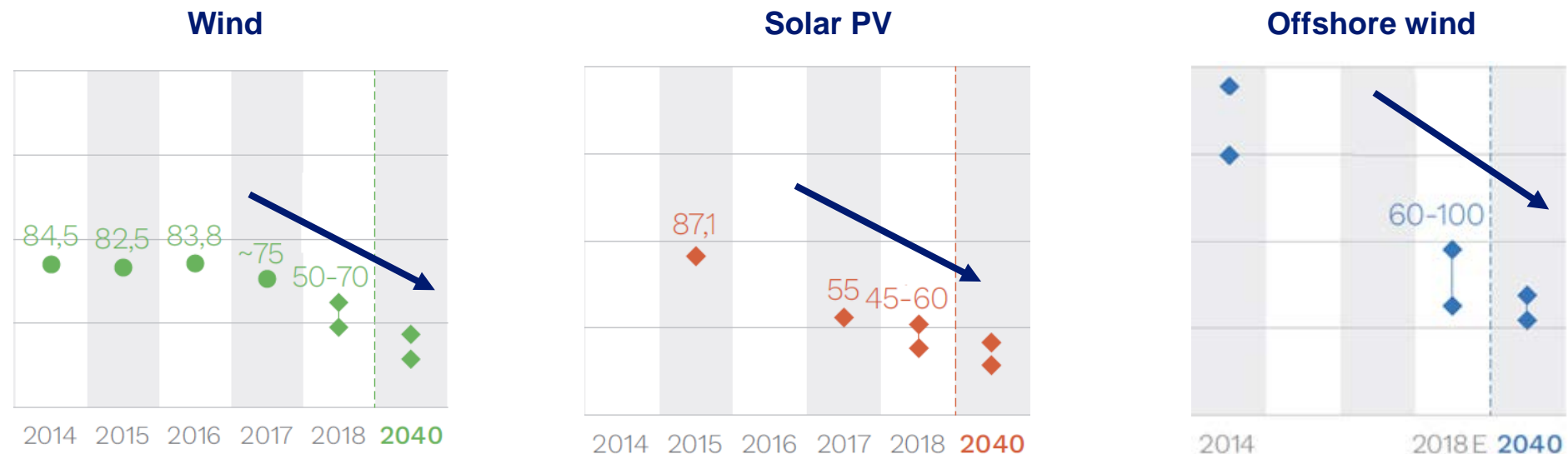
- Leader in Europe with a growing development pipeline

**SELECTIVE GROUP
INVESTMENT PLAN**

- Over €2bn gross investments p.a. and increasing over time

The cost of wind and PV technologies continues to fall rapidly

Lower costs make solar and wind increasingly competitive around the world. Prices have been falling for 10 years, and prices also fall for storage. The cost of wind and PV technologies continues to fall rapidly in France.



Evolution of feed-in tariffs (purchase obligation and tenders) and estimates of future prices (€/ MWh) in France

The future energy mix will be a combination of multiple solutions centralized and decentralized, of all sizes, with strong integration.
Competitive and clean renewable energy together with predictable, flexible, CO2 free and competitive nuclear energy are the two pillars of this future energy mix.

As a conclusion, EDF takes an active part in the Energy transition at a world level

- With strong decreasing costs, renewables will take a much wider place than today in the mix. EDF has strong commitments such as the 30 GW solar plan.
- Since a high share of intermittent renewable energy may jeopardize the electric grid stability and safety, EDF :
 - Improves its nuclear fleet flexibility capability,
 - Develops advanced smart grids solutions,
 - And innovates on new storage solutions (including rising electric vehicles contribution).
- Alongside renewables, nuclear power remains key with predictable, competitive and low-carbon electricity.
 - EDF extends its nuclear fleet life span.
 - EDF prepares the building of new series around 2040-2050 to take over from the existing fleet.

By developing a mix with renewable and nuclear, which guarantees security of supply, very low carbon and competitive power, EDF takes an active part in the energy transition in France and abroad.

Merci

ありがとうございました