

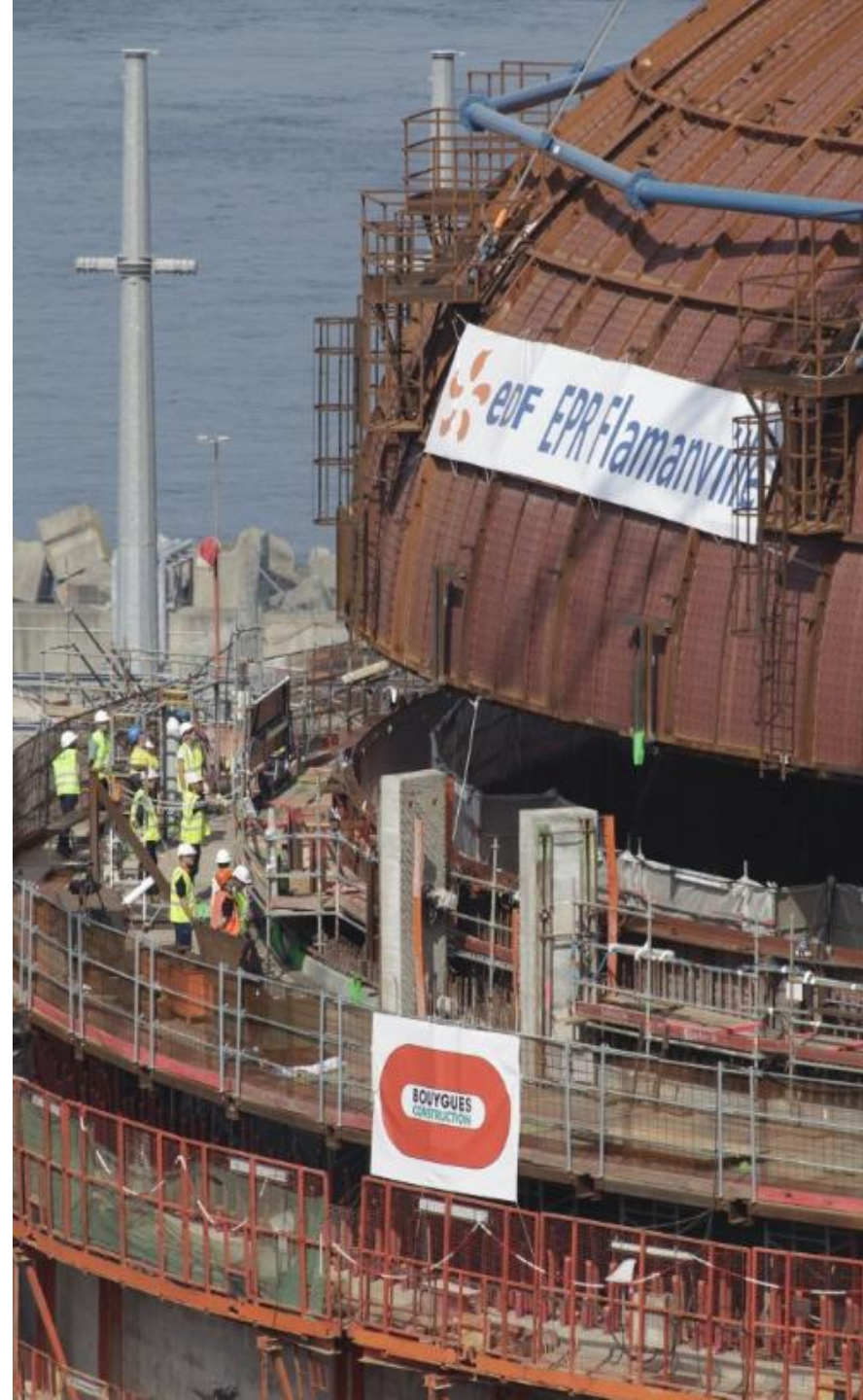


# Economics and competitiveness of nuclear generation

## EDF feedback experience

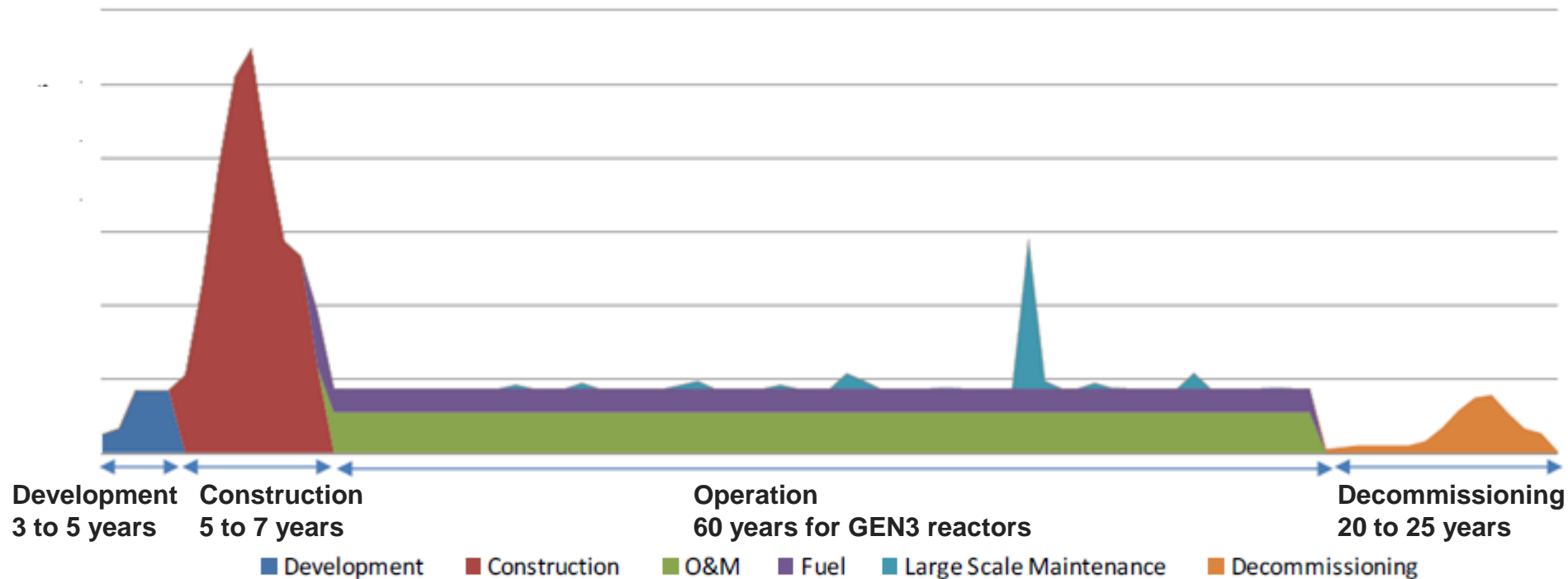
Perspectivas da Energia Nuclear no Brasil  
Rio de Janeiro – 12 September 2014

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Generation & Engineering EDF  
Deputy to Economy and Strategy Director



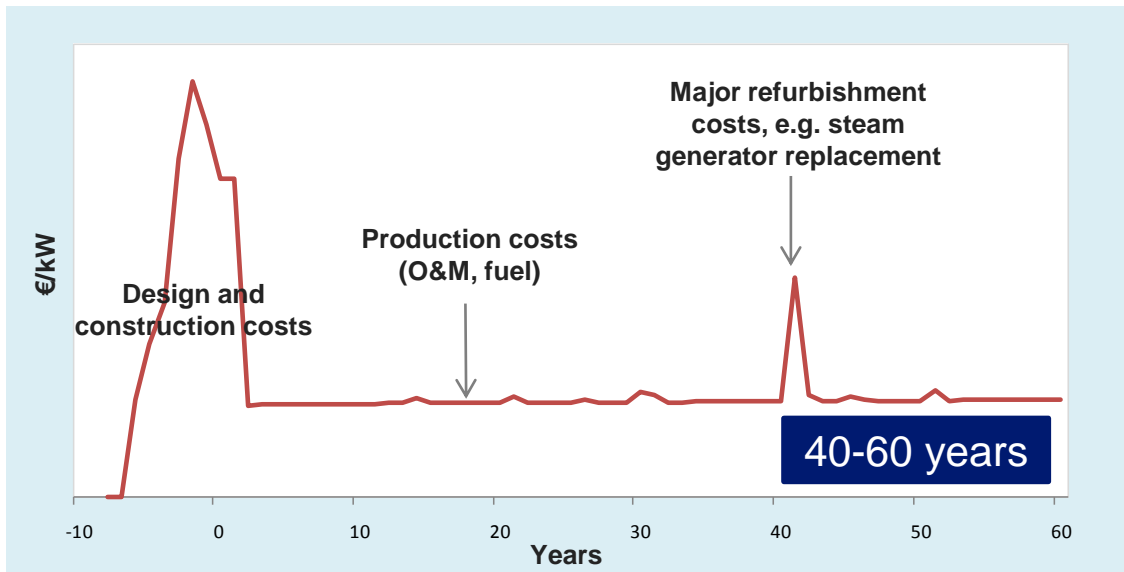
# Nuclear, a financial commitment for 100 years

- Four periods: development, construction, operation and decommissioning
- Costs and risks are concentrated during the first 10 years
- Once commissioned and financed, the annual costs are relatively low and stable



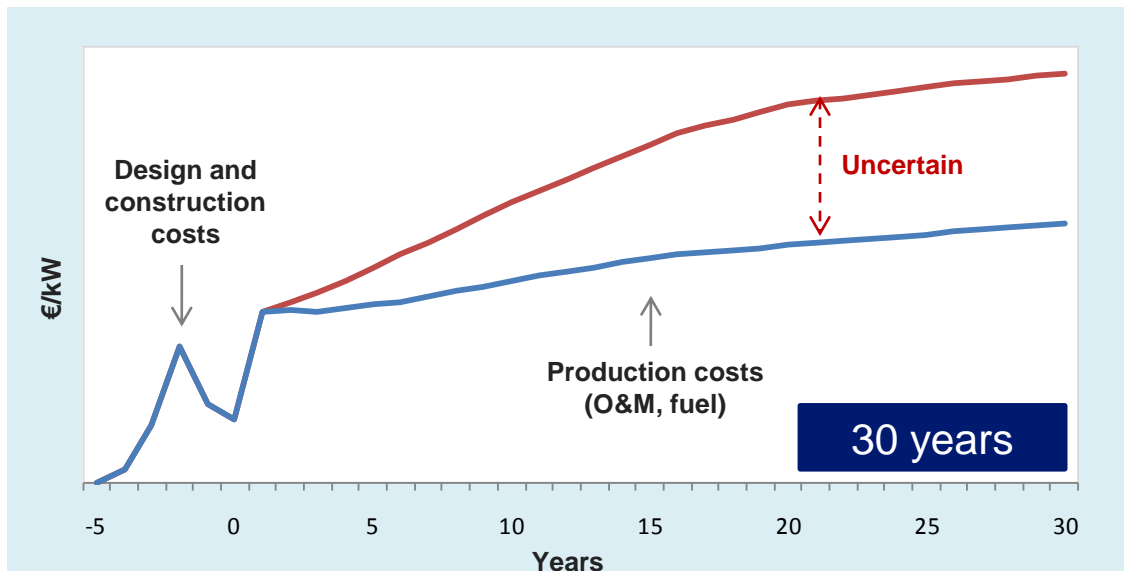
# Comparison of nuclear and gas plants

NUCLEAR



- High CAPEX during development and construction
- Balanced by regular and lower OPEX during the operating period

Gas CCGT\*



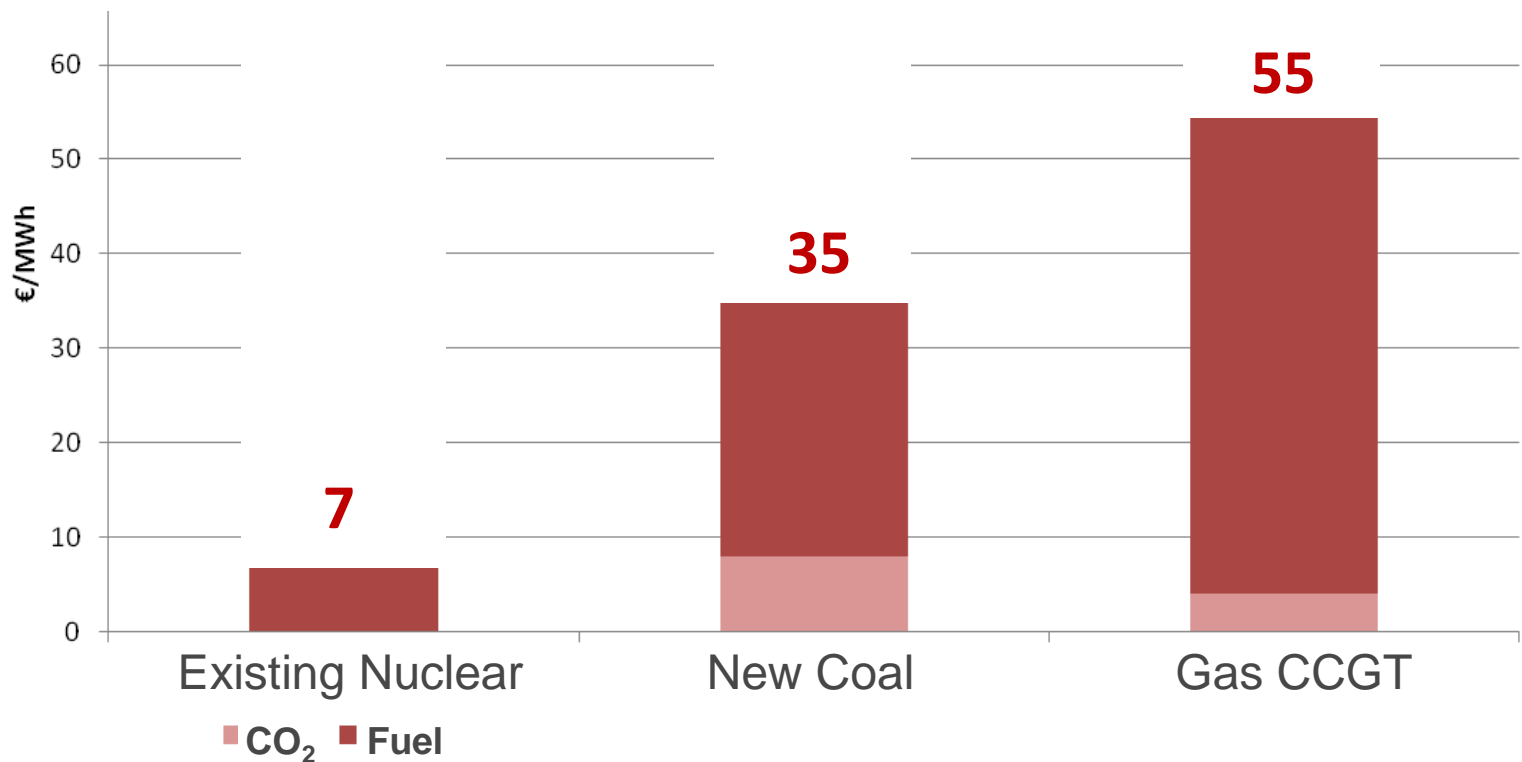
- Low CAPEX during development and construction
- Higher production costs due to fuel costs
- High and uncertain fuel and CO<sub>2</sub> costs



\*Note: CCGT plant in base load operation, 8,000h/year

# The fuel cost of nuclear is cheaper than for any conventional plant

## 1 Merit order driven by variable costs



Calculation for France. Baseload running.

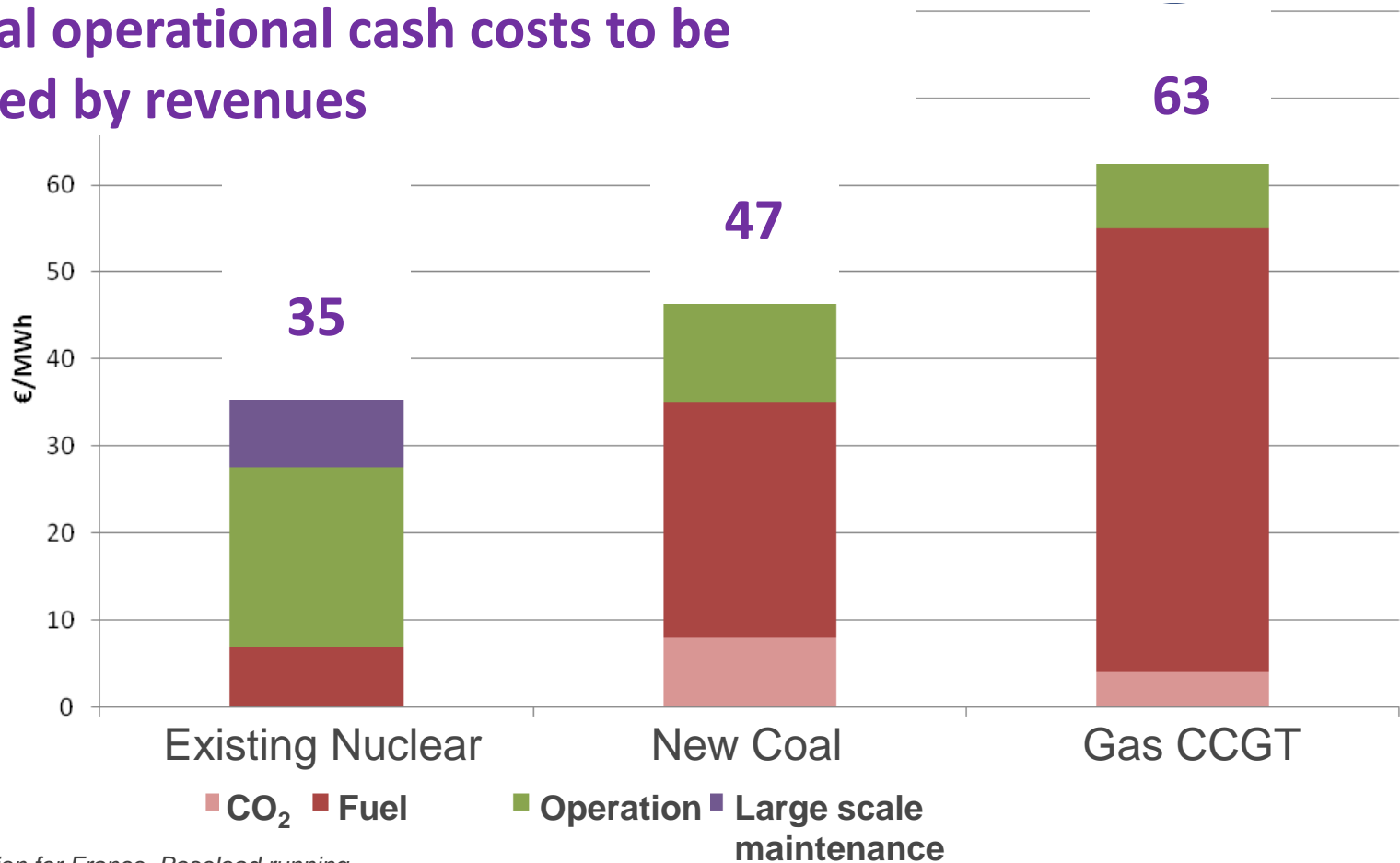
Assumptions:

CO<sub>2</sub>: 10 €/t – 1,25 USD/€

Gas: 10 \$/MBtu – Coal: 105 \$/t

# Operational costs of nuclear are cheaper than any conventional plant

## 2 Annual operational cash costs to be covered by revenues



Calculation for France. Baseload running.

Assumptions:

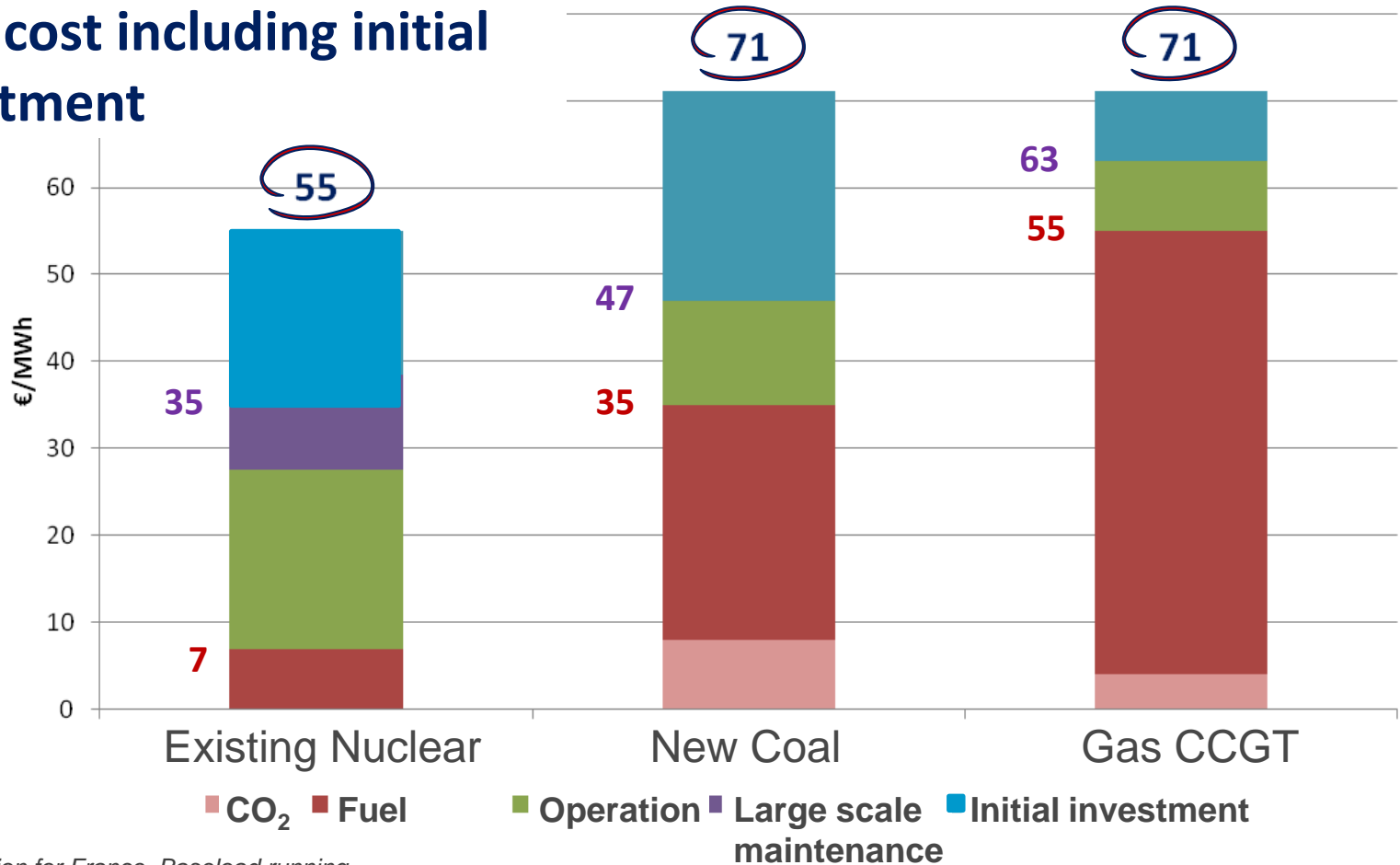
CO<sub>2</sub>: 10 €/t – 1,25 USD/€

Gas: 10 \$/MBtu – Coal: 105 \$/t



# Total costs of existing nuclear are cheaper than for any conventional plant

## 3 Total cost including initial investment



Calculation for France. Baseload running.

Assumptions:

CO<sub>2</sub>: 10 €/t – 1,25 USD/€

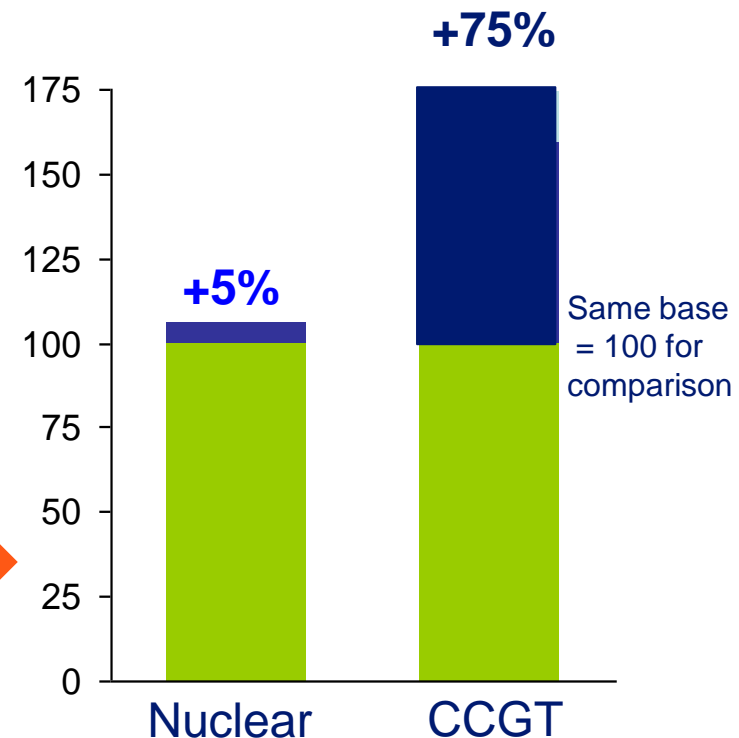
Gas: 10 \$/MBtu – Coal: 105 \$/t



# Nuclear, a low and stable cost of electricity

- Low variable cost of nuclear, mainly made of fuel costs.
- Low fuel supply risks. Uranium is a resource available worldwide, including in Brazil.
- Despite variations of uranium market price, the total electricity cost is stable and predictable.
- Once built and financed, nuclear provides long term stability of electricity prices.

*Impact of a doubling of the fuel prices on the generation costs*

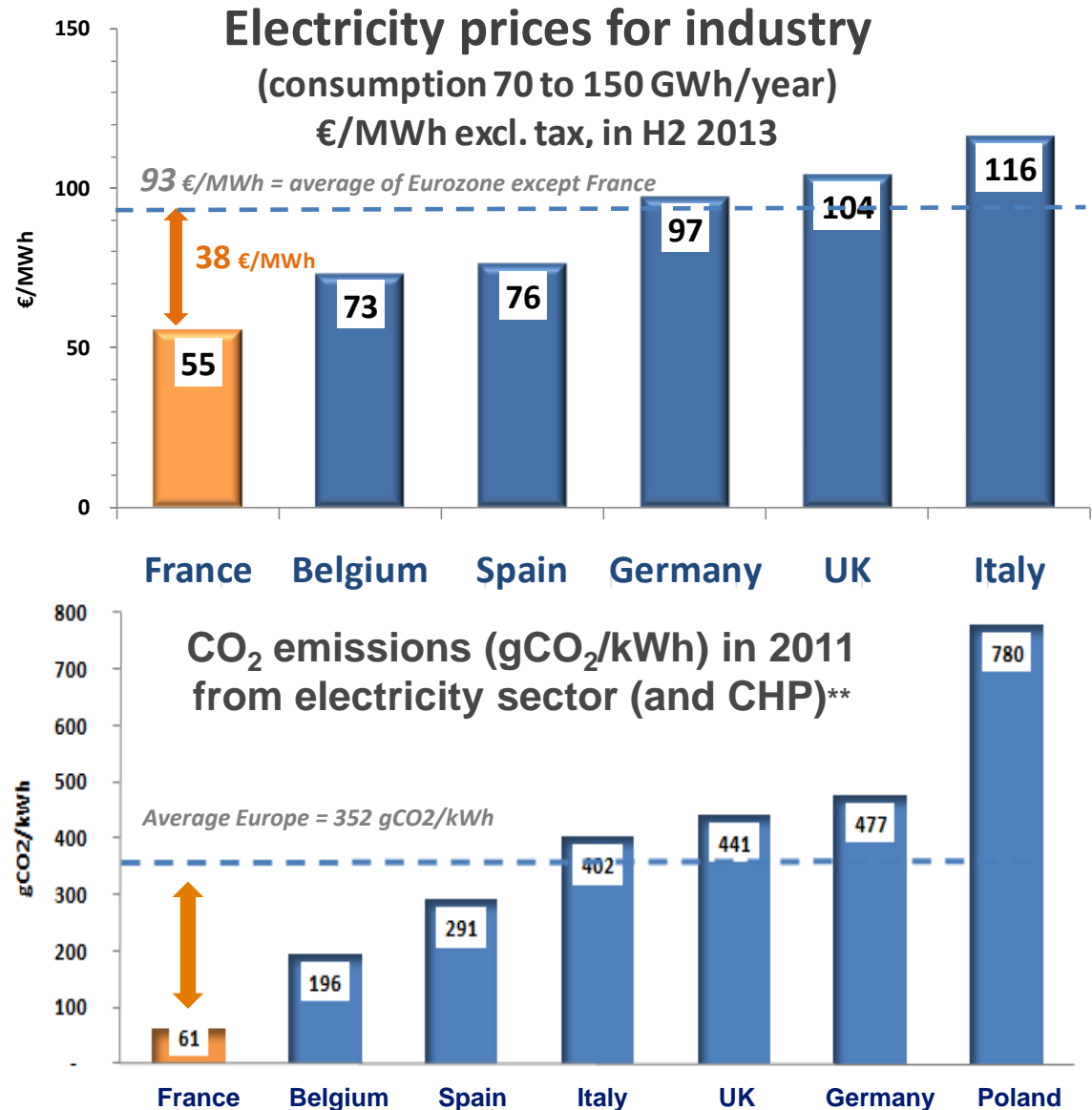


# Benefits procured by French nuclear

- **Affordable electricity tariffs**  
(30% lower than European average)
- **Security of supply and lower dependency to oil and gas prices**
- **Low carbon electricity generation**

\* Source: Eurostat May 2014

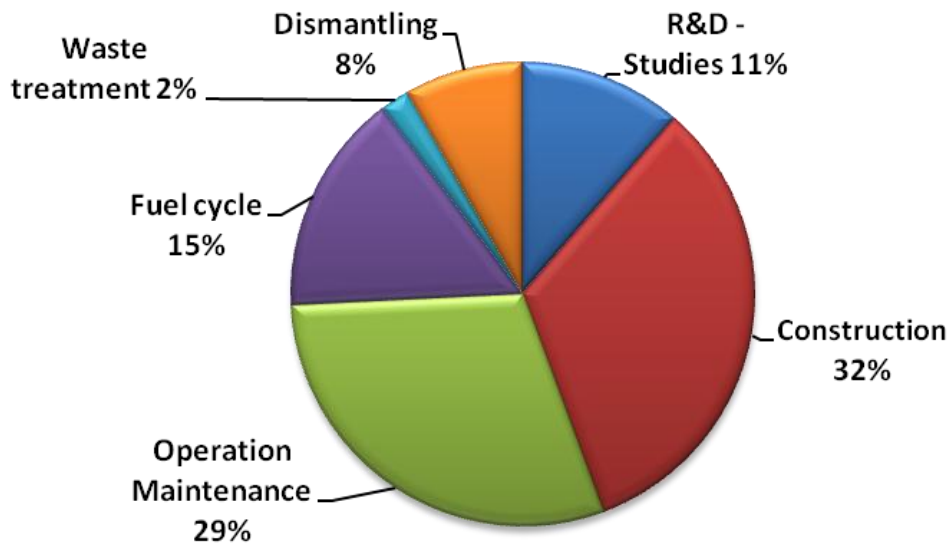
\*\* Source: IEA 2013



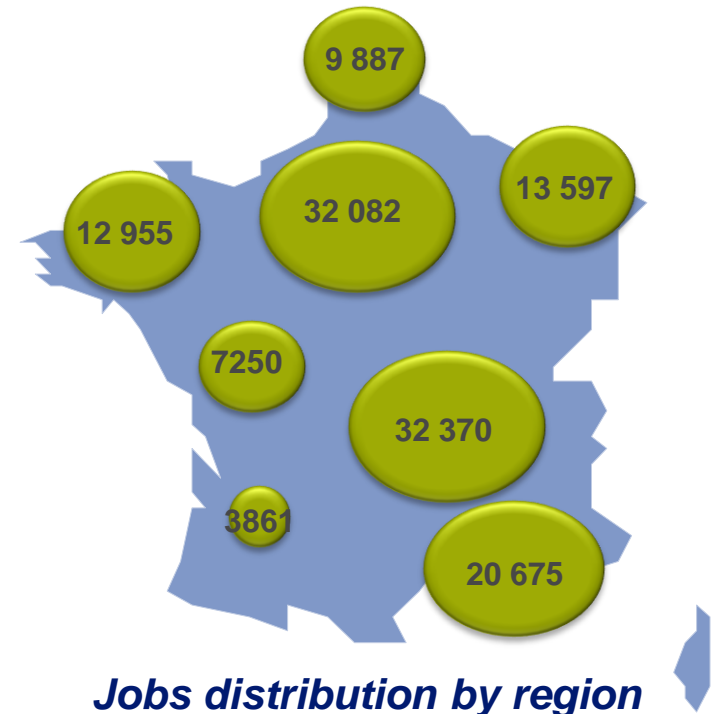


# Benefits procured by French nuclear: a major job provider

- ~220,000 direct jobs, 6% of the whole French industrial jobs.
- Nuclear sector creates stable jobs (93%).
- Jobs are concentrated around nuclear installations.



*Jobs distribution by activity*

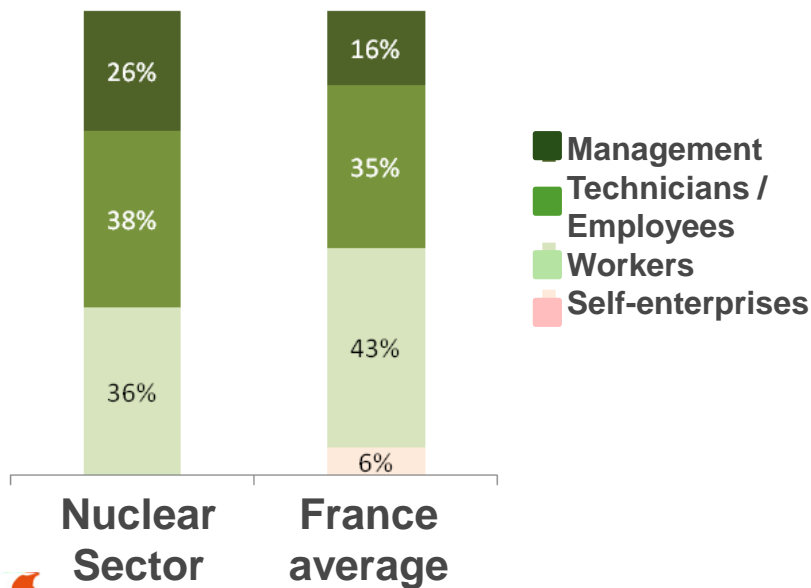


*Jobs distribution by region*

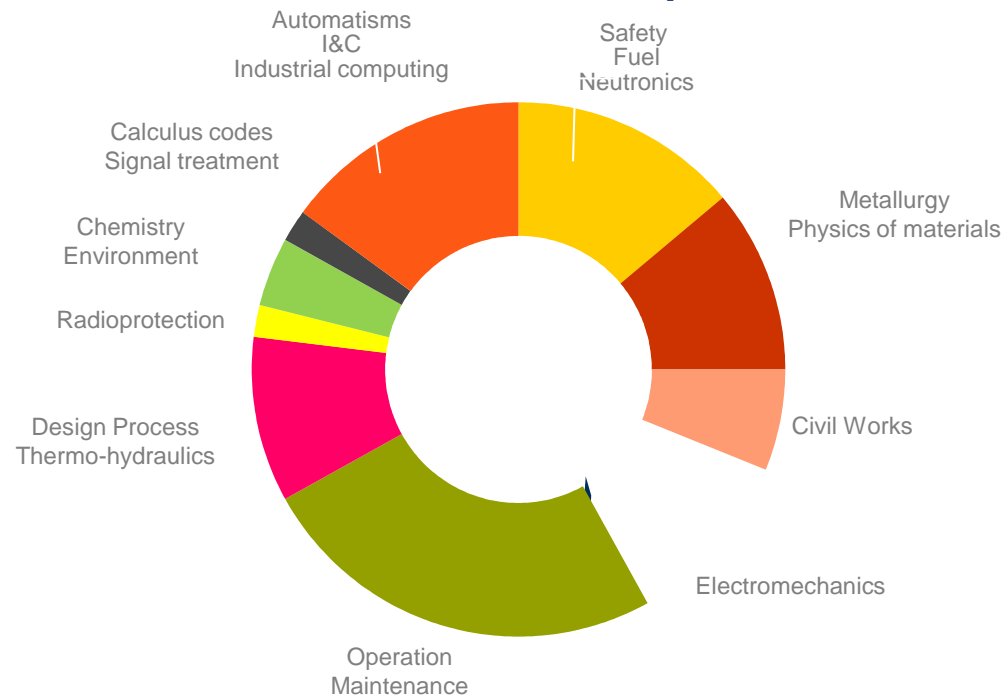
# The nuclear sector, a field of excellence

- 1.8 billion € investment in R&D activities
  - 4<sup>th</sup> position among the most innovative industries
- Nuclear jobs are more qualified, reflecting a high technical level

*Qualification levels*

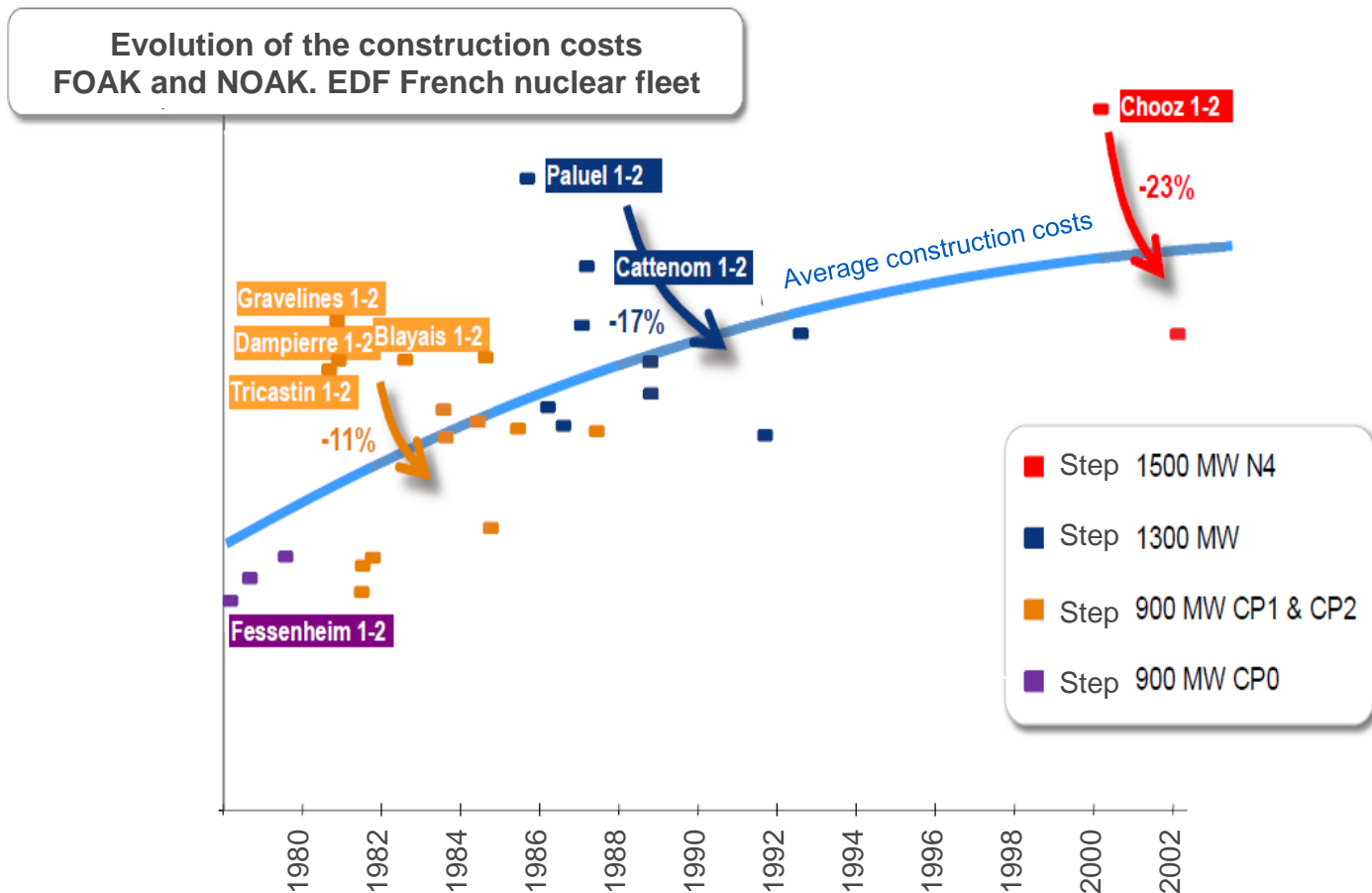


*Nuclear sector skills & competencies*

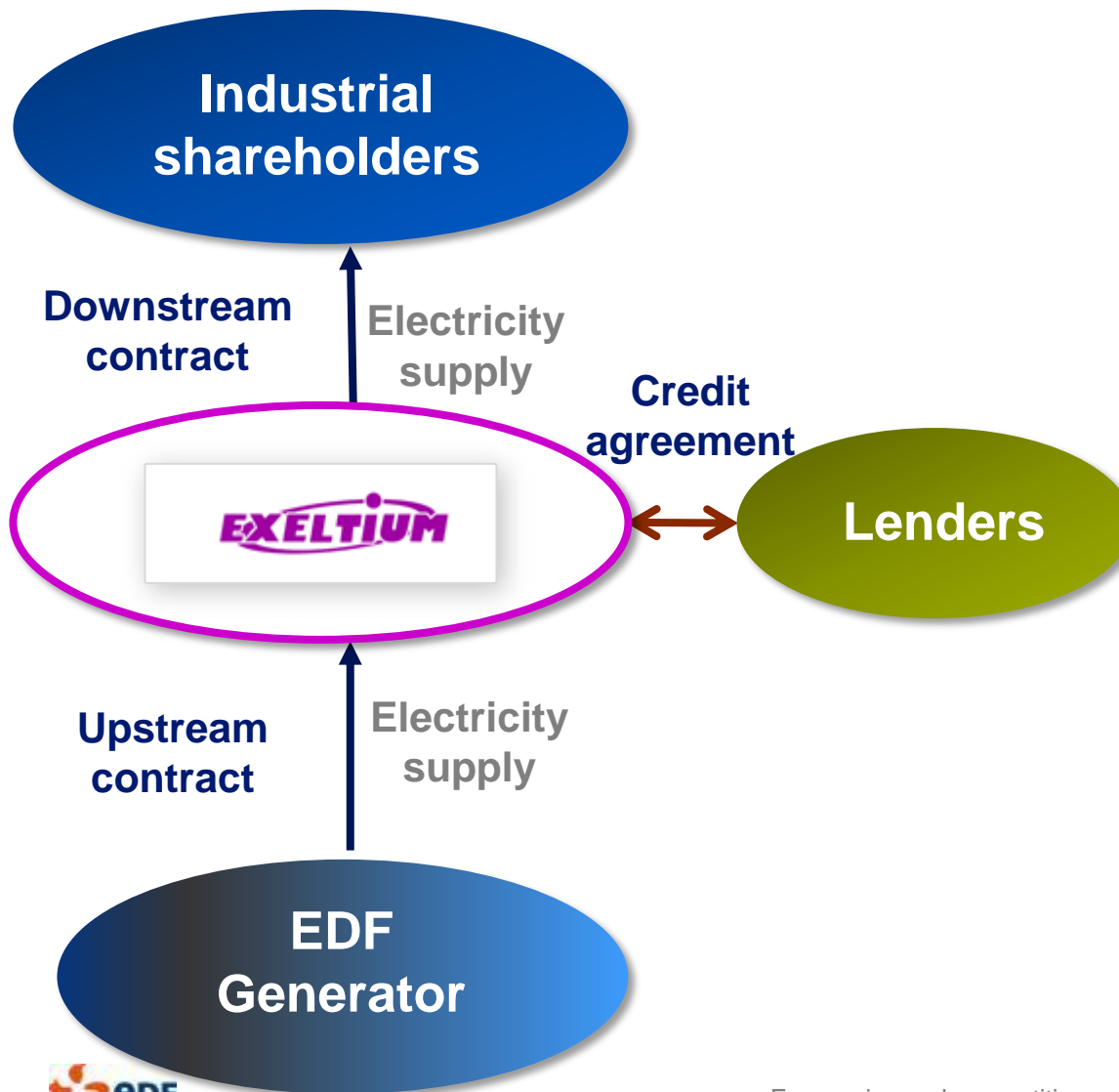


# Nuclear investment costs decrease with experience feedback

- Flamanville 3, first EPR reactor built in France → relearning of new build and of management of complex projects after a stop of 15 years.



# France: long-term price visibility for industrial customers under Exeltium



## Key advantages for EDF

- Upfront payment: financing available without debt consolidation
- Secures long term power sales

## Key advantages for clients

- Secures long-term supply of electricity
- Competitive electricity prices based on nuclear costs
- Limited risk sharing

# Conclusions



- **Nuclear provides competitive carbon-free electricity, available when needed, and stable electricity prices;**
- **The feedback from experience improves the control on construction risks;**
- **Launching a nuclear program is of high social and economic value;**
- **It strengthens an innovative industry in the country;**
- **Therefore it is a high political stake for a nation.**

**Obrigado por  
sua atenção**



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