FRENCH NUCLEAR PROGRAM
AND EXPERTISE OF THE FRENCH SUPPLIERS

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THE FRENCH ELECTRICITY MIX

Nuclear
385 to 420 TWh
(72 to 77%)

Renewables (hydro, wind, solar, bioenergies)
90 to 105 TWh
(16 to 19%)

Fossils (Gaz, coal, oil)
25 to 50 TWh
(5 to 9%)

Total electricity generation
530 to 550 TWh

Domestic consumption
470 to 480 TWh

Exports
70 to 90 TWh

Imports
25 to 35 TWh

Electricity production 1950-2015
Almost 40% of renewables (growing)
- Renewables constitute almost 40% and are on the increase
- All coal fired power plants (3 GW) will be closed by 2022

France has a very low carbon intensity electricity production
THE FRENCH NPP FLEET

- 58 operating PWR (22 MOX):
  - 34 x 900 MWe,
  - 20 x 1300 MWe,
  - 4 x 1450 MWe,

- Connections to the grid:
  - Fessenheim: April, 1977
  - Civaux 2: December, 1999

- 63.2 GWe installed capacity

- Excluding Fessenheim, 40% of the fleet (22 NPPs) will pass their 4th 10-year visit for LTO to 50 years by 2025

Number of reactors to reach their 4th decenal visit
The energy transition act, published in August 2015, aims to diversify our electricity mix, with a view to increase the energy resilience of France.

Some quantified targets:
- Reduction by 50% of the overall consumption of primary Energy in 2050
- Reduction by 40% of GHG emission in 2030 and 75% in 2050
- Reduction by 30% of fossil fuel in 2030
- With a 32% share of renewable energy in the energy mix in 2030

Smart metering
Housing
Transport

Renewables
Nuclear
THE “ENERGY TRANSITION FOR GREEN GROWTH” ACT

- Some major objectives:
  - 40% of renewables in the electricity mix by 2030
  - 50% of nuclear in the electricity mix by 2025
  - Nuclear-installed capacity capped at 63.2 GW
    (Fessenheim reactors should shut down when Flamanville EPR will starts)

- These fundamentals have been confirmed by the French Govt.
  - With a reassessment of the chronology

- The French Govt is, however, leading a thorough investigation of its energy policy, in order to prepare the next Multi-annual Energy Plan (MEP).

- Various scenarios have been investigated,
  - all based on a hypothesis of stability or decrease of demand by 2035
  - all relying on the shutdown of all oil-fired power plants by 2019 and coal-fired power plants by 2022
Published in January 2019, setting out the government's strategic priorities in terms of energy policy:

- completing the transition towards an energy system which is more efficient, less wasteful, more diverse and more resilient;
- Meeting our objectives to keep greenhouse gas emissions to a minimum in line with French commitments to the Paris Climate Agreement.

Confirms that nuclear power should reach 50% in the electricity production mix by 2035:

- 4 to 6 reactors to be shut down by 2030, + 2 at Fessenheim in 2020.
- 14 reactors to be shut down by 2035, after 50 years of operation (5th decennial visit).
- The precise closure schedule will depend on the increase of the share of renewable energies, security of supply, expansion of interconnection capacity with neighboring countries…

EDF requested to keep all nuclear sites active.

EDF requested to work on the development of a new nuclear build program (for decision in 2021)
FRENCH NUCLEAR SECTOR ORGANIZATION

FRENCH STATE

<table>
<thead>
<tr>
<th>83.5%</th>
<th>90%</th>
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<td>EDF</td>
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<td>19.5% MHI</td>
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<tr>
<td>Owner / O&amp;M EPC / Services</td>
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<tr>
<td>Expertise in nuclear from project development to decommissioning</td>
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<td>Industrial activities regarding NPP construction</td>
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<tr>
<td>Maintenance services</td>
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<td>Fuel assemblies &amp; services</td>
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<tr>
<td>Mines</td>
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<td>Conversion, enrichment</td>
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<td>Back-end</td>
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<td>Recycling</td>
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<td>Decommissioning</td>
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<th>5% MHI</th>
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<td>Orano</td>
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<td>Research, development and innovation</td>
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<th>5% JNFL</th>
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<tr>
<td>CEA</td>
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<td>Radioactive Waste Management Agency</td>
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<td>French Nuclear Energy Industry Group</td>
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- Minister for the Ecological and Inclusive Transition (F. de Rugy)
- Ministry of Economy and Finance (B. Le Maire)
- Chairman of the Strategic Committee for the Nuclear Industry (D. Minière)

Definition of a roadmap and reciprocal commitments between the industry, the State and trade unions

4 main topics:
- Jobs, skills and training
- Digital transformation
- Research & Development (including SMR technology)
- International cooperation
RELEVANT FIGURES OF THE FRENCH NUCLEAR INDUSTRY

Overall civil nuclear industry

- 2.600 Companies
- 220.000 Employees of the nuclear industry
- 50 Billion € turnover
- 50% made or willing to on export market
- 1.3 Billion euros invested in R&D

Only civil nuclear Supply chain*

- 2.555 Companies
- 115.000 Highly Skilled People
- 15 Billion € made on export market
- 20% made on export market
- 50% of the European nuclear industry

*Utilities, operators, reactor vendors and mining activities excluded

Source: CSFN 2012 and CSFN 2016
THE FRENCH NUCLEAR INSTALLED BASE

- The largest fleet in the world with
  - 58 units in operation
  - Flamanville 3 (EPR, 1650 MW) under construction

- 1700 Years of nuclear feedback experience* (2011)

- Grand Carénage Program: a life extension, modernization and refurbishment program

- Coverage of the entire value chain, including fuel supply and spent fuel management

### Operational experience accumulated (number of years)

<table>
<thead>
<tr>
<th>Country</th>
<th>Operational Experience</th>
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<tbody>
<tr>
<td>UNITED STATES</td>
<td>3499</td>
</tr>
<tr>
<td>FRANCE</td>
<td>1700</td>
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<tr>
<td>UK</td>
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<td>JAPAN</td>
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<td>RUSSIA</td>
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<td>GERMANY</td>
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<td>CANADA</td>
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<td>SWEDEN</td>
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<tr>
<td>UKRAINE</td>
<td>372</td>
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<tr>
<td>SOUTH KOREA</td>
<td>372</td>
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France Map of NPPs

[Map showing various nuclear power plants in France]
THE FRENCH NUCLEAR FUEL CYCLE
Representing more than 400 French Nuclear Companies
FRENCH SUPPLIERS HAVE CONTINUOUSLY SUPPORTED NATIONAL NUCLEAR PROGRAMS OVER THE YEARS

- 2000 reactor-years of nuclear feedback experience
- More than 30% of the global nuclear fleet supported with products and services
- Strong support to the construction of 6 EPR reactors
- Participation to several reactor designs in construction in the world
- I&C solutions for several reactor designs
- Track records on recycling facilities, research reactors, waste management and D&D projects

Present in 38 countries.
MUTUAL GAINS FROM A COLLABORATIVE APPROACH IN THIRD-MARKET COUNTRIES

- **Within their scope of activity, local companies:**
  - Have a thorough knowledge of country legislation
  - Are well versed in domestic standards & industrial practices
  - Experience of local nuclear market & regulations

- **Experienced nuclear suppliers:**
  - Have experience in reactor technologies
  - Are familiar with worldwide nuclear requirements
  - Benefit from experience feedback on previous and undergoing projects
DIRECTORY OF THE FRENCH NUCLEAR INDUSTRY

• French nuclear suppliers references and contacts
• English & French flipook digital version
• Digital Research Directory

FIND YOUR FRENCH PARTNER TO BOOST YOUR DEVELOPMENT

Your point of contact
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The French energy policy is oriented to fulfill the country’s commitment for Climate to climate protection.

Nuclear will remain a key component of the French electricity production mix, jointly with an export collaboration policy.
Thank you for your attention