Session 1: the Concept of Security of Energy Supply inside the Power Sector

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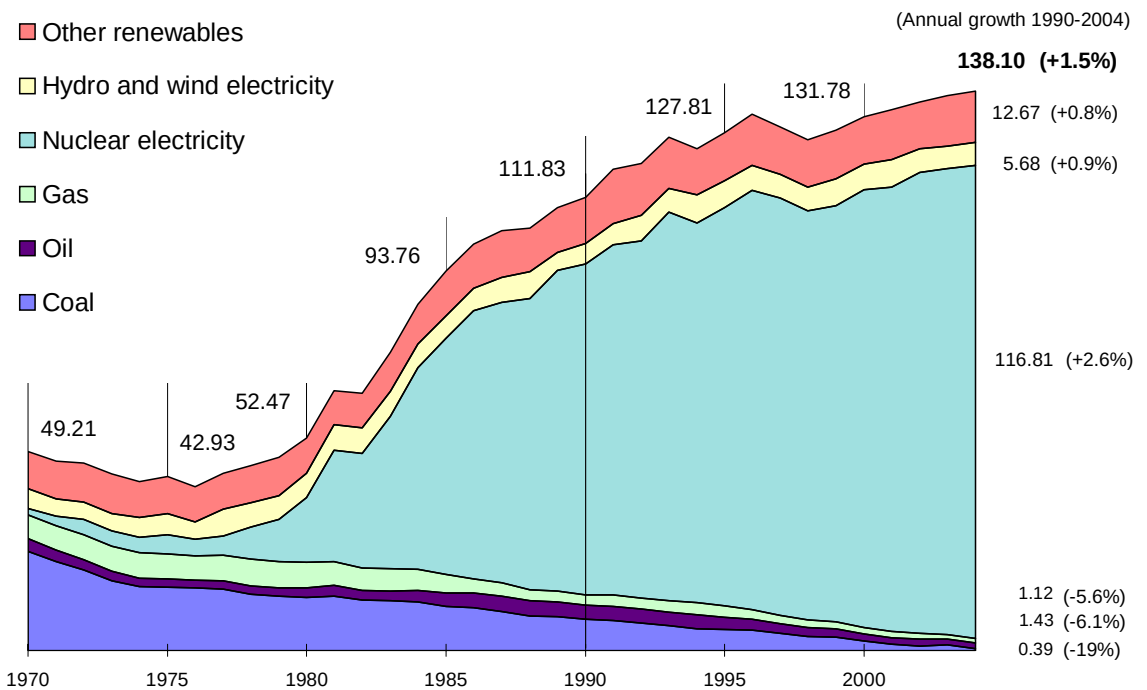
France has very few fossil resources

- Coal: extraction ended in April 2004
- Gas: production is less than 1.2 Mtoe p.a. and declines
- Oil: production is less than 1.5 Mtoe p.a. and declines

Primary energy production 1970-2004 in France (Mtoe):



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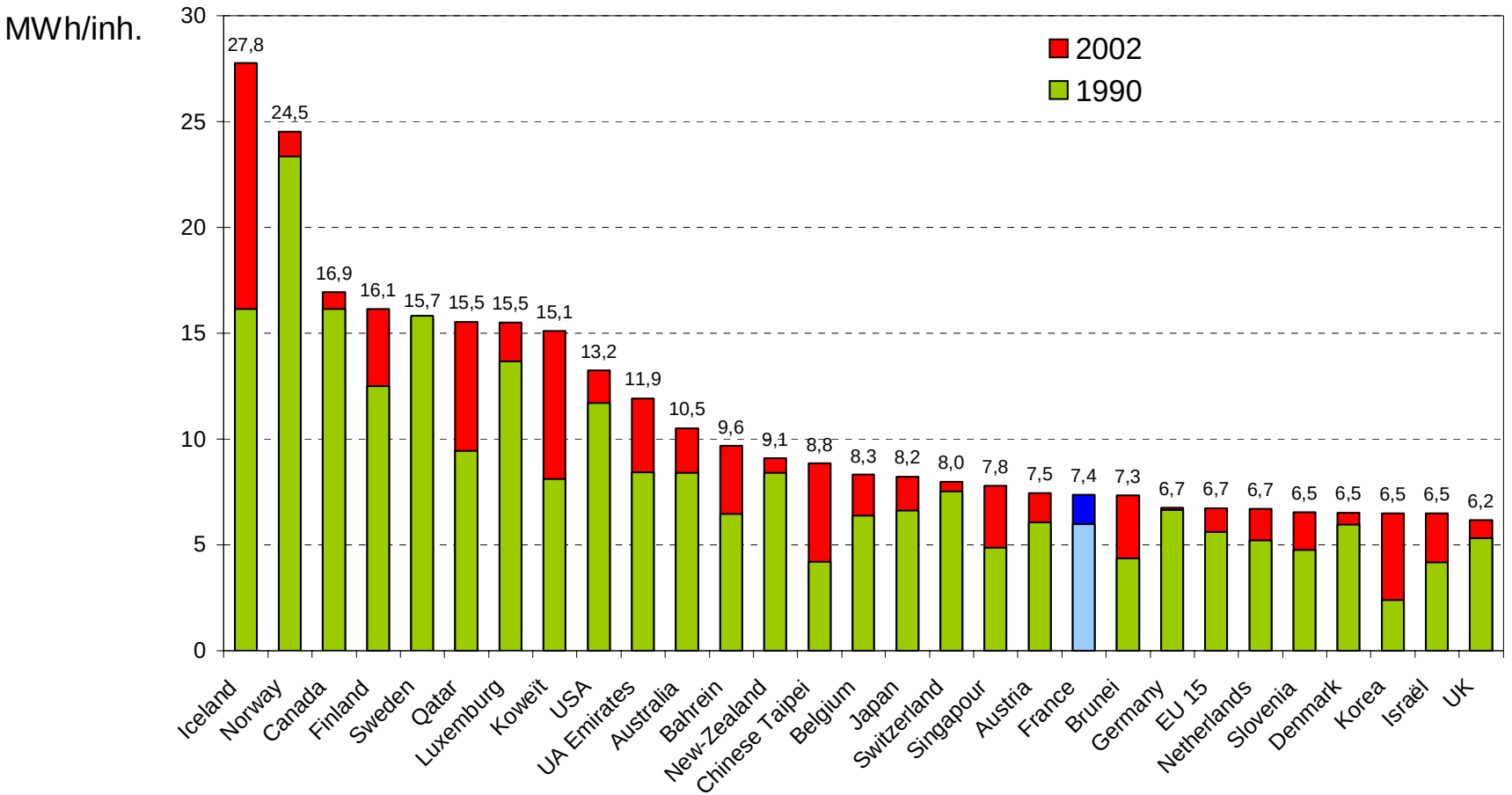
Increasing electricity needs

- France is the 20th-ranked consumer of electricity per inhabitant worldwide, with 7.4 MWh/inhabitant



French concept of electricity SoS

- SoS is part of the French "Public Service" for electricity, as defined in Art. 1 of the Electricity Act of 10 February 2000 (modified):
  - The "**public electricity service"** gives concrete expression to the **right of all to electricity**, a primary need, by respecting principles of **equality, continuity and adaptability**
  - Its purpose is intended to guarantee electricity supply across the whole country, in the national interest:
    - **Independence and security of supply**
    - Air quality and reduction in the greenhouse effect
    - Optimal management and development of national resources
    - Energy efficiency
    - Competitiveness of economic activity
    - Facilitate best technological choices
    - S**ocial cohesion** (right to electricity for all, contributing to social inclusion, careful land development, respect for the environment, etc.)

Two aspects to distinguish

- The consumers' individual choice, through a lot of tools:
  - **Technical tools**, such as:
    - electric inverters, as a protection against brown-outs or voltage drops
    - for those who have the resources, auto-production, often using co-generation facilities
  - **Commercial tools**, such as:
    - spot markets on electricity trading floors (Powernext in France)
    - interruptible contracts
    - long-term contracts, such as those which allowed the Finnish paper manufacturers to fund construction of a nuclear power plant
- What the Government considers to be the **socially and economically** necessary level of electricity SoS, which justifies its intervention, in particular as regards the 2000 Electricity Act → 3 management tools:
  - **Call to tender** (article 8)
  - **Request for authorization** (article 9)
  - **Obligation to purchase + feed-in tariffs** (article 10)

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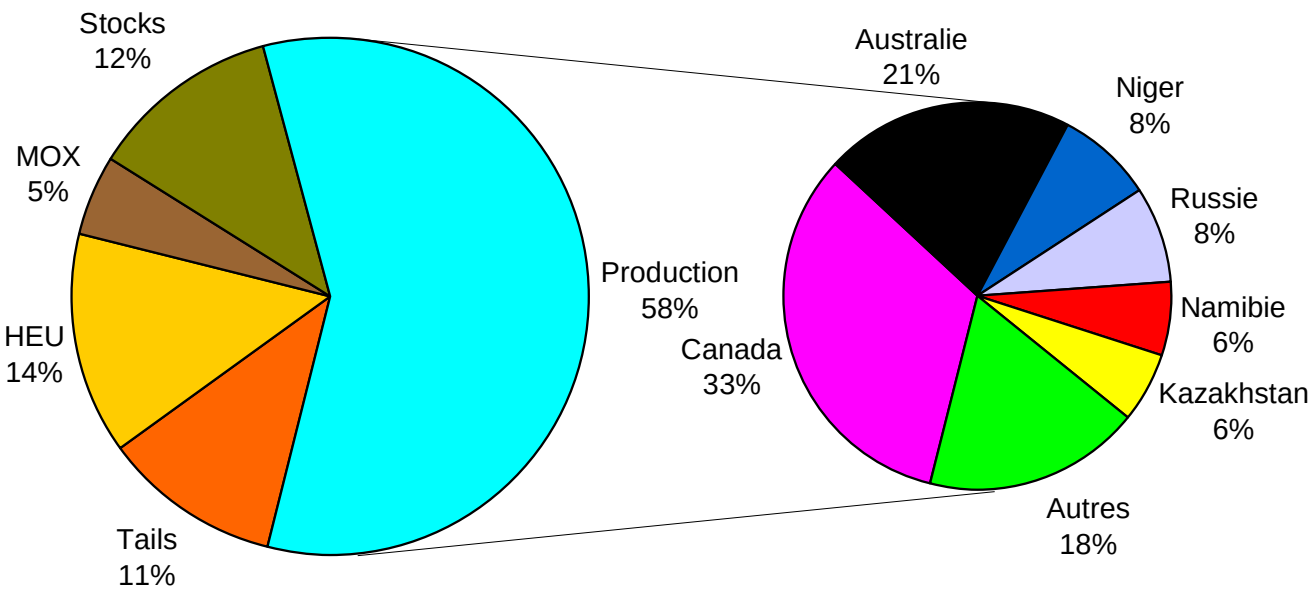
5 levels of possible State intervention for electricity SoS

- Primary energy → see uranium
- National objectives: independence + environmental constraints
- Infrastructure and equipments, new paradigm:
  - more and more potential suppliers (generation, transmission & interconnections, distribution)
  - profusion of small plants
  - high capital input → market alone lacks incentives to invest
  - electricity prices are not enough attractive
  - volatility of prices → lack of visibility for investors
  - difficulties with financing cost of new infrastructures
- On-demand actions
- Actions for people in need

Most uranium resources are reliable

- Since 1990, less than 60% of the total world uranium supply comes from extraction/production; the rest comes from:
  - old stocks built up by companies
  - reprocessed fuel (MOX)
  - impoverished uranium re-enriched in Russia ("tails")
  - reconverted military uranium (HEU)
- Current annual demand: 62,000 tU, of which 8,000 for France
- Current annual production: 37,000 tU
- Current worldwide reserves (at 80 US$/kg): more than 2,500,000 tU (about 40 years)



3 main technical tools implemented by the French Government

- Two time scales:
  - Short term: to prevent and to repair
  - Medium and long term: to plan future needs and to implement, as far as possible, an optimal supply structure

- Organisation of crisis tests
- Multi-year contractual objectives
- Legislation and regulations → RTE "multi-year electricity balance" and PPI

- Potential EU level: see draft EU Directive COM(2003)740

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Example of a major hazard: the 1999 storms in France

- 25-26 December 1999 (North West) and 27-28 December 1999 (Centre West)
  - one hundred deaths and a lot of damages
  - electricity cut to more than 10 million people
- EDF mobilized considerable resources to restore power and received massive help from its French industrial partners and from 17 of its foreign counterparts
- Around 5,300 generator sets, with a total power of 400 MW, had to be brought into service
- More than 18,000 people were mobilized across the country, and normal service was restored around 10 January 2000
- In most of the affected areas, the Government put the **ORSEC plan** into action, implementing optimal co-operation among public authorities, civil security agencies, the Army and EDF

- **Catalyst for action** on SoS, along with the heat wave of Summer 2003

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Energy outlook for France is key for SoS

- Governmental vision: the market should not be let alone to guide proper investment choices
- A **"PPI" order** was signed on 7 March 2003 setting targets for development of the installed electrical production system in France.
- This system of crisis preparedness applies in brief as follows:
  - below a minimum threshold ("**authorizing**", "**tendering**")
  - above a maximum threshold (suspension of "**authorizations**", etc.)
  - between the two limits is the normal case
- The French Government wants to have warning mechanisms and risk prevention resources in place relating to shortfalls or loss of quality in electricity supply.

- This is the context in which to consider the Government's decision to keep the nuclear option open, by deciding to build a new type of reactor, the EPR, at Flamanville, to be brought into service by 2012.

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Energy outlook for France to 2030:
"what will happen if no new measure...?"

- **Periodic exercise to set up a « BAU and Reference » scenario, in liaison with IEA In-Depth Reviews, e.g.:**
  - **DGEMP-OE(2000)**
  - **DGEMP-OE(2004)**

- **Preparation of a draft « Steering Law on Energy » (2004-2005)**

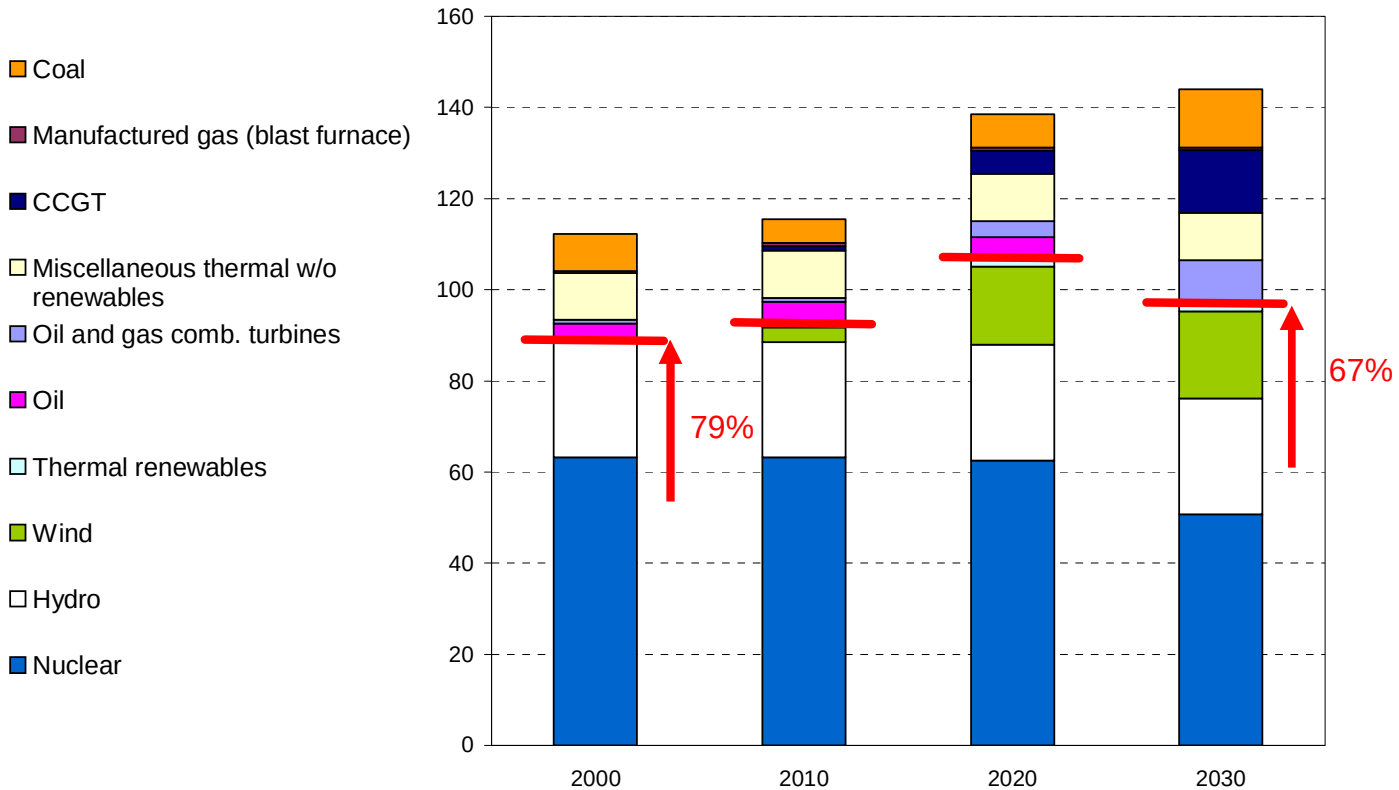
- **Presentation to the international Workshop MINEFI-DGEMP of 30 June 2004 on energy outlook in France and in Europe**
  - **more than 300 people attended, mainly from companies and academics (acts available on *www.industrie.gouv.fr/energie*)**
  - **scenario to 2030 as a "consensus" one in this logic**
  - **"work in progress", first step is a "factor 4" scenario to 2050**

Main BAU assumptions for electricity

- Reference costs for power generation: as contained in the 2003 DGEMP study
- Electricity export balance calculated for 2004-2030 according to a European optimization model developed by RTE and 0 in 2030!
- Nuclear:
  - average plant availability rate rises to 85% between 2003 and 2010
  - Eurodif is replaced by ultracentrifuge technology from 2015
  - nuclear power plants are assumed to be shut down after 40 years in use
  - nuclear power plants will not be replaced systematically but as follows over 2017-2030:
    - commissioning of a "demonstrator" EPR plant in 2013
    - start-up of two new EPR reactors each year starting 2020
- Constraints:
  - Environmental:
    - 21% of electricity of "renewable" origin in consumption achieved by 2010
    - the large combustion plants directive (LCP) EU Directive applies fully to electricity plants
  - Gas Infrastructures: limitations for gas-fired electricity generation in 2020-2030
- Giving a total installed nuclear capacity of 51 GW at the end of the period (versus 63 GW in 2003), the remainder of France's electricity generating capacity is calculated using the RTE optimisation model, with the aforementioned constraints.

BAU Energy Outlook for France (1)

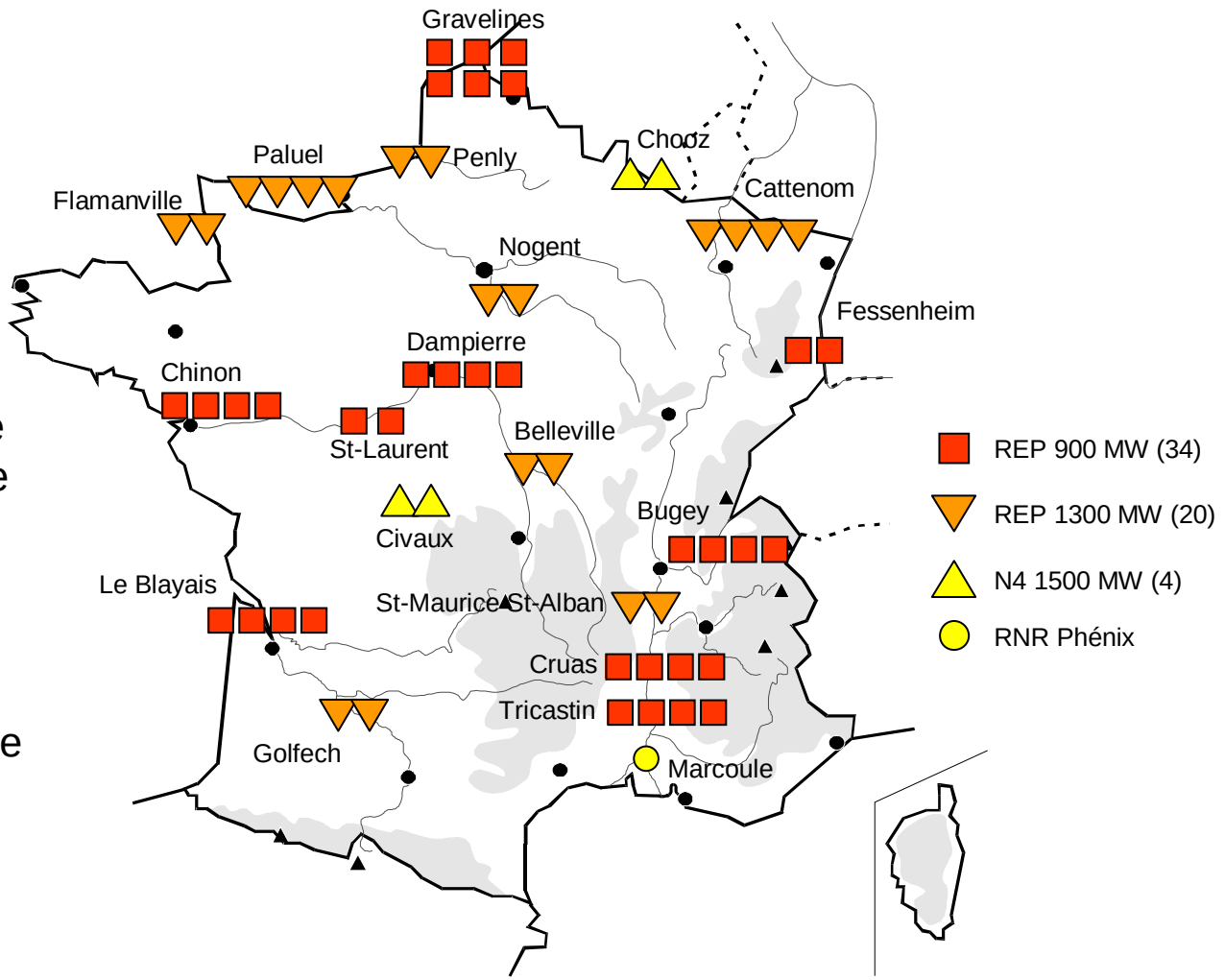
- Electricity generating capacity, 2000-2030, in GW:



of which:	- coal	7%		9%
	- gas	10%		24%
	- wind	-		13%
	- nuclear	56%		35%

Nuclear plants in France (2005)

- 58 PWR units which have been commissioned since 1977
- Total capacity: 63.4 GW (inc. Phenix)
- EPR demonstrator to be built in 2012 at Flamanville (1,600 MW)



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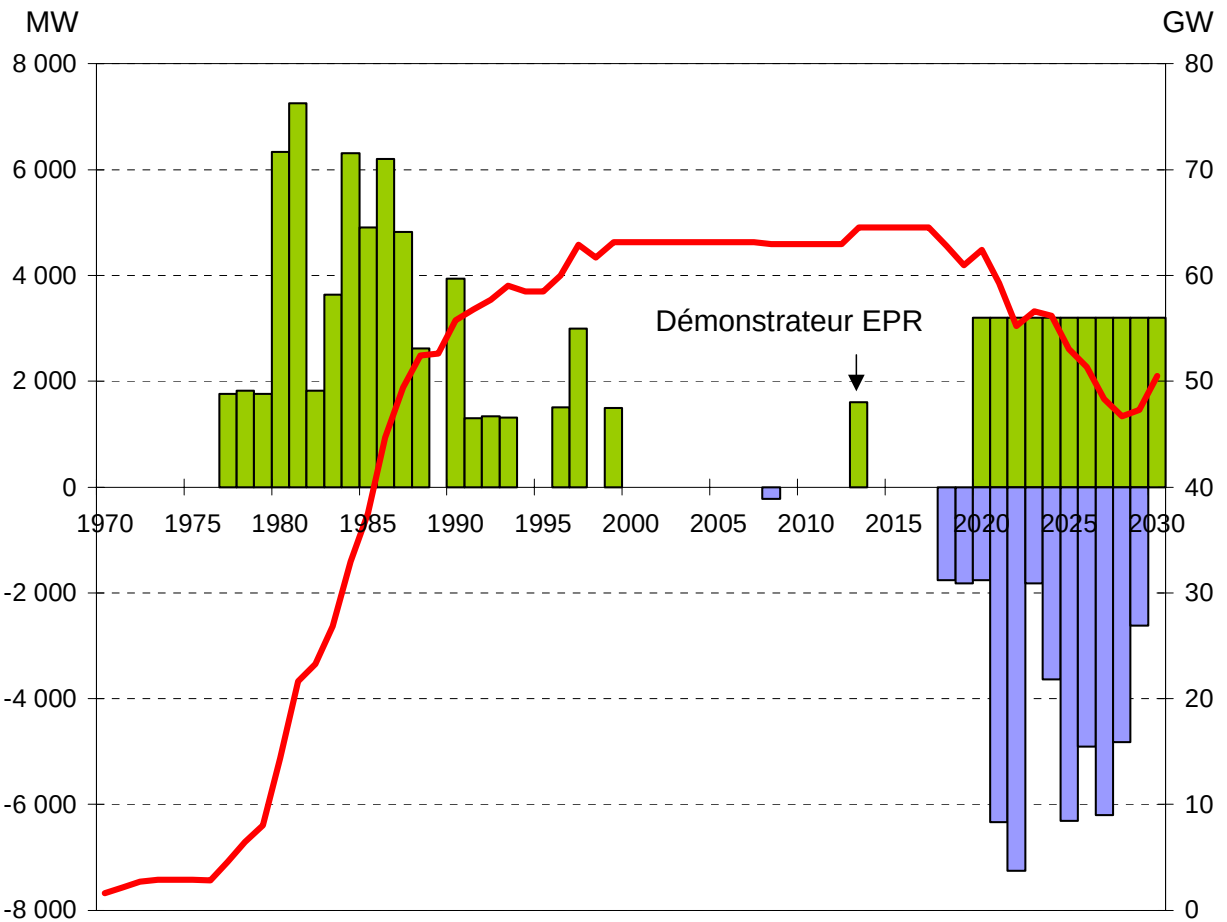
BAU Energy Outlook for France (2)

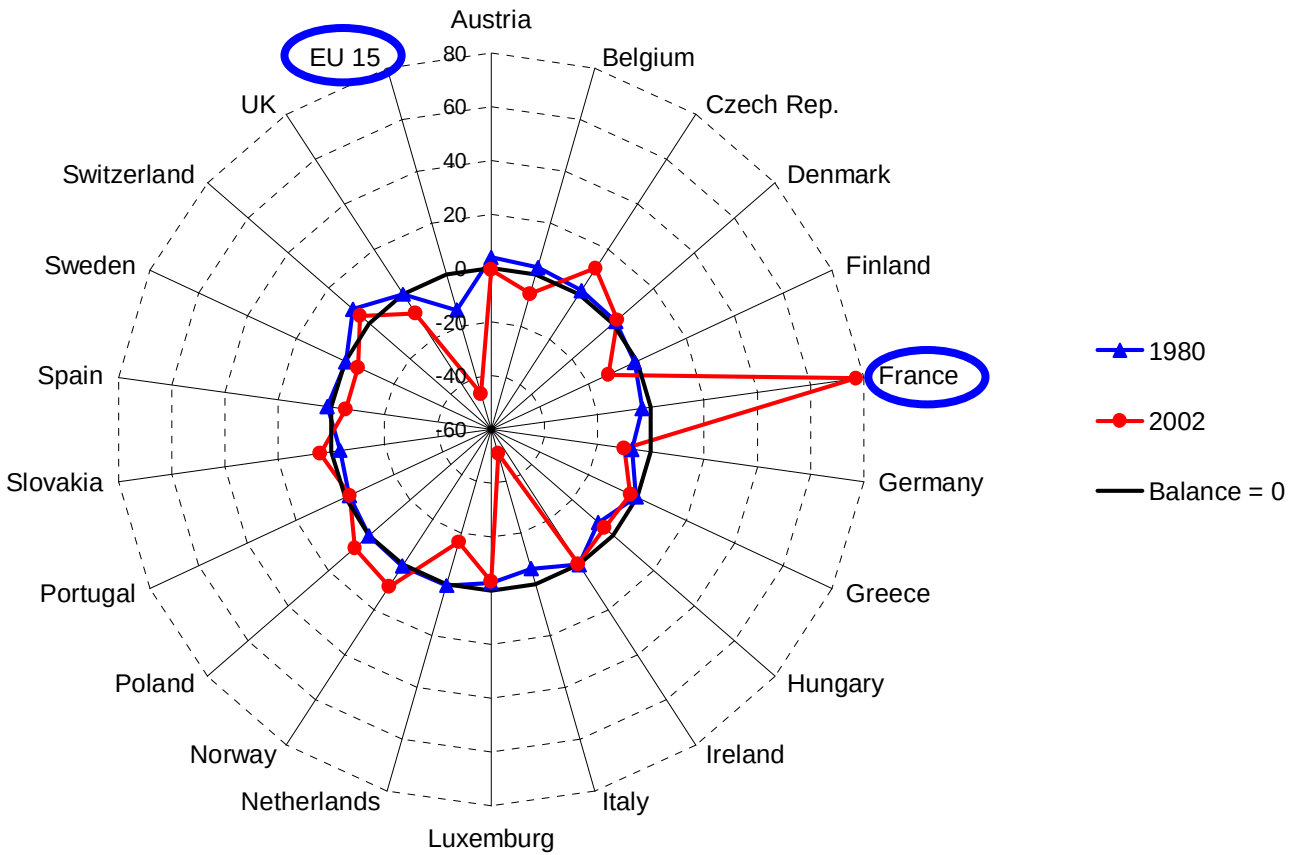
Main assumptions for nuclear:

- 40 years of length time for the current reactors (first decommissioning in 2017 for Fessenheim plant)
- 1 EPR demonstrator built in 2012
- 2 new EPR reactors each year starting 2020 (1,600 MW each)
- use of ultracentrifugation between 2010 and 2015



French net exports of electricity contribute to the European security of electricity supply

- Electricity international trade within Europe has dramatically changed in absolute numbers from 1980 to 2002 (in TWh):



Conclusion

- France has put a high profile in electricity SoS
- Analytical tools are needed
- New paradigm:
  - price cycles for electricity
  - period of adjustment is necessary for electricity market players
  - overcapacity for power generation is necessary