
Gaining Ground: New Reforms from Old Europe

French Energy Policy

Nuclear Policy

Links between the State and the Industrial Sector
to Guarantee Nuclear Energy Production

Jacques BOUCHARD

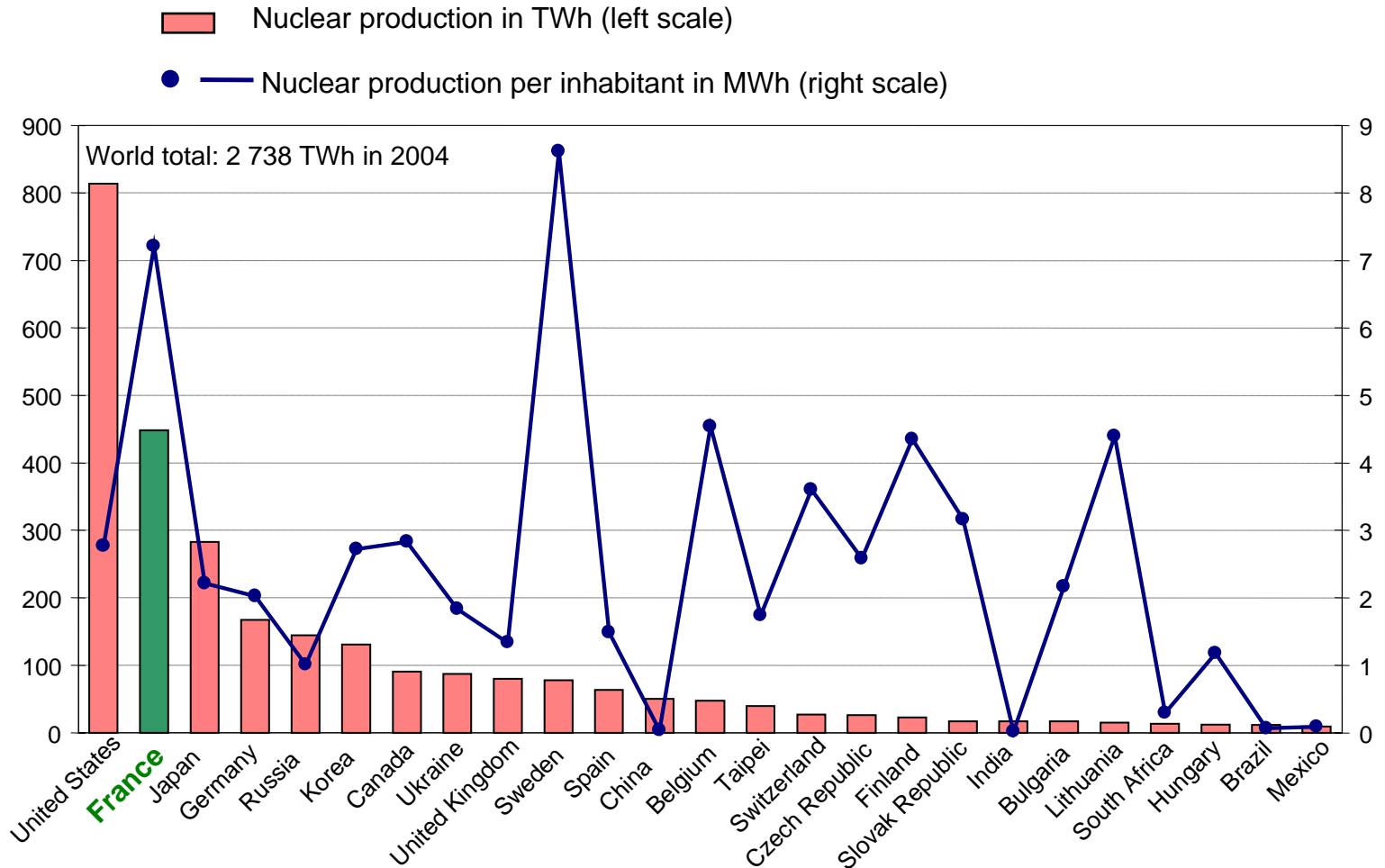
Advisor to the Chairman of the French Atomic Energy Commission (CEA)

Chairman of the Generation IV International Forum (GIF)

The French energy context: Key figures

- **Primary energy production (2006) : 138,1 Mtoe**
(1,3 % of global production, 17 % of EU production)
- **Primary energy consumption (2006) : 275,3 Mtoe**
(2,6 % of world energy supplies, 18 % of EU consumption)
- **Energy import cost of 46,2 billion € in 2006, accounting for 2,6 % of French GDP (versus 1,8 % in 2004 and 5 % in 1981).**
- **A rate of energy independence that has considerably increased, from 26 % in 1973 to 50 % in 2006.**

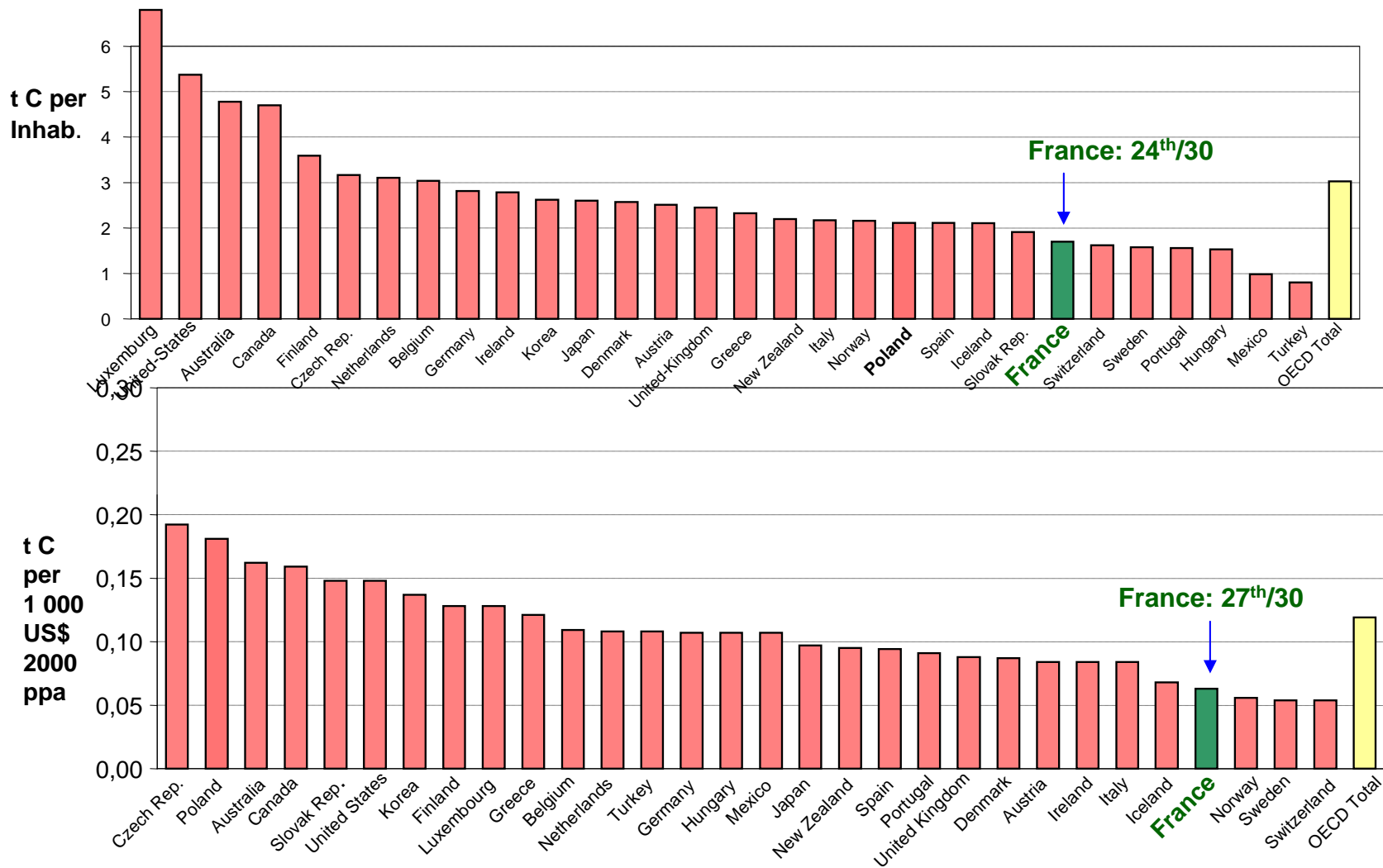
France is the world 2nd nuclear electricity producer



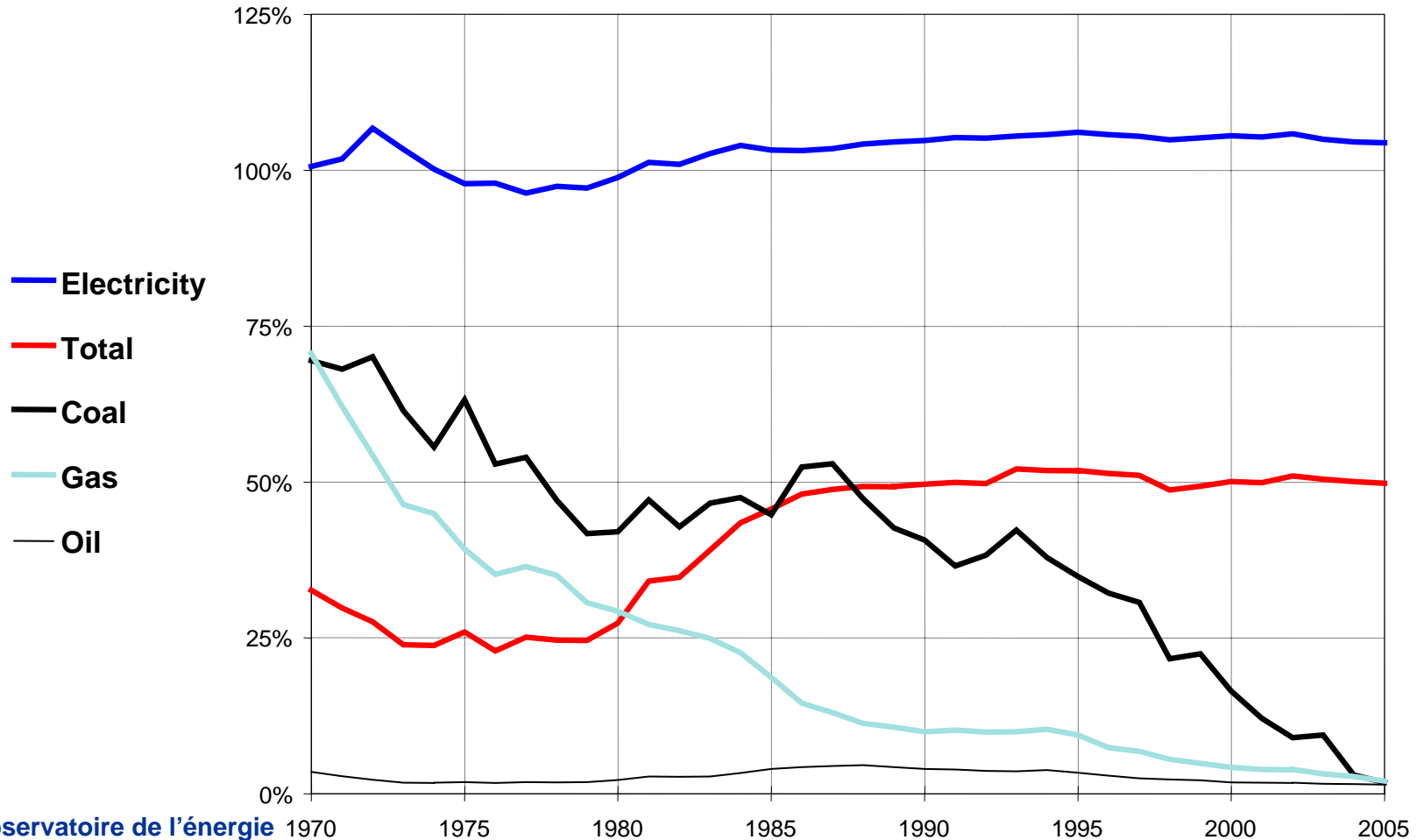
The French nuclear policy: Key data

- **CO₂ emission due to energy (2004, IEA) : 106 MtC / year (1,5 % of global CO₂ global emissions, 12 % of EU emissions).**
 - **The 4th highest energy consumer in the 30 OECD countries (275,3 Mtoe in 2006) but only ranked 27th for CO₂ emissions (2003, IEA).**
 - **Energy import cost of 46,2 billion euros in 2006.**
 - **A competitive electricity supply for companies and households, characterised by **steady prices**.**
 - **A self-sufficient national electricity production allowing France to be the **first electricity exporter in the world**.**
 - **Without nuclear :**
 - **Our energy bill would amount to 62 billion €(instead of 46 billion €)**
 - **France would produce additional 150 million tons of CO₂ /year (130 million tons for France + 20 million for neighbouring countries importing electricity from France).**
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CO₂ emissions in 2004 / inhabitant, and relating to GDP



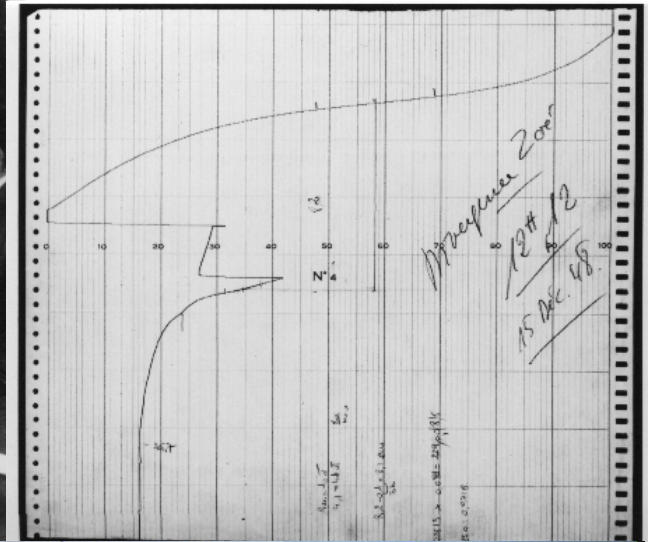
50 % since 1986



Source : Observatoire de l'énergie
ratio primary production/ primary consumption

- 1945 : CEA Creation (Commissariat à l'Energie Atomique)
- 1948 : ZOE criticality
- 1956 : First experimental generation of nuclear electricity
- 1963 : Chinon A1 : 1st EDF Nuclear Power Plant
- 1970 : Graphite gas Bugey
- 1974 : "Messmer" Program
- 1975 : PWR selection
- 1976 : COGEMA, La Hague UP2
- 1977 : Connection to the grid of Fessenheim 1, unit of 900 MWe
- 1978 : Eurodif start
- 1981 : End of the licence Westinghouse/ France
- 1999 : Connection to the grid of Civaux 2, unit of 1500 MWe
- 2007 : Start of construction of EPR Flamanville

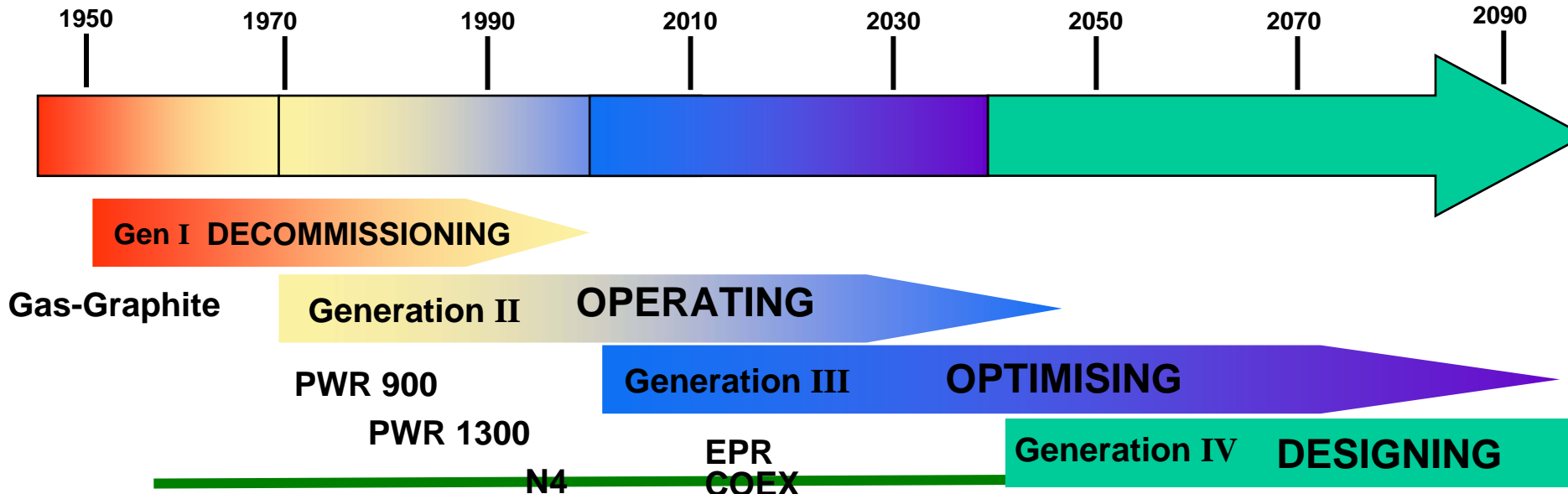
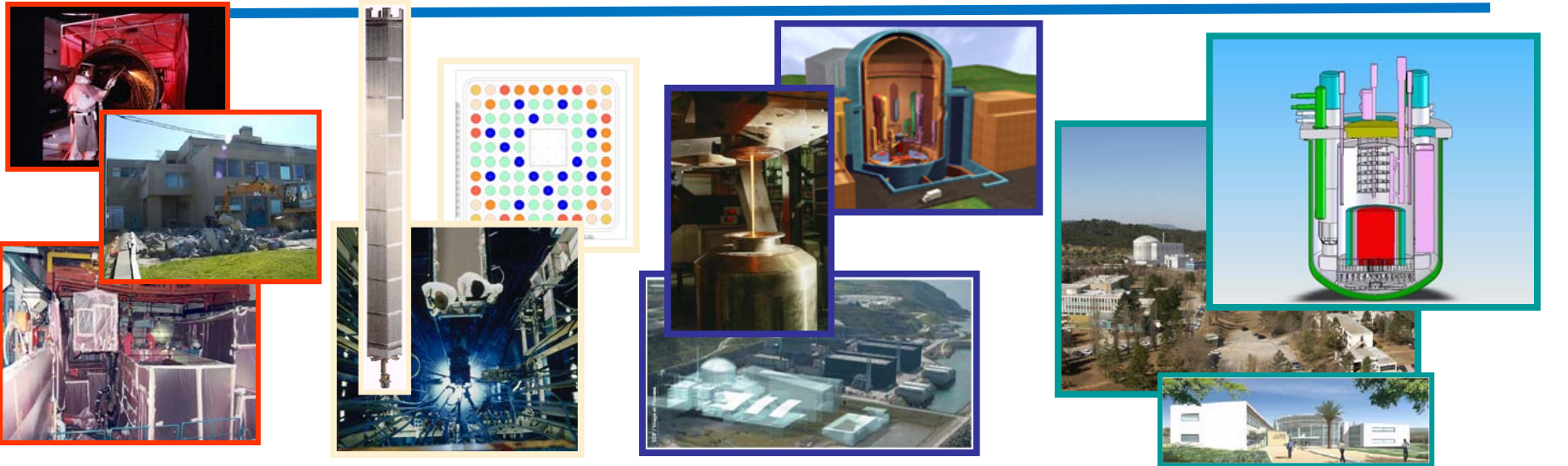
Pictures of the Past



Jacques BOUCHARD

AEI, Washington, February 20th, 2008

The evolution of nuclear power



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AEI, Washington, February 20th, 2008

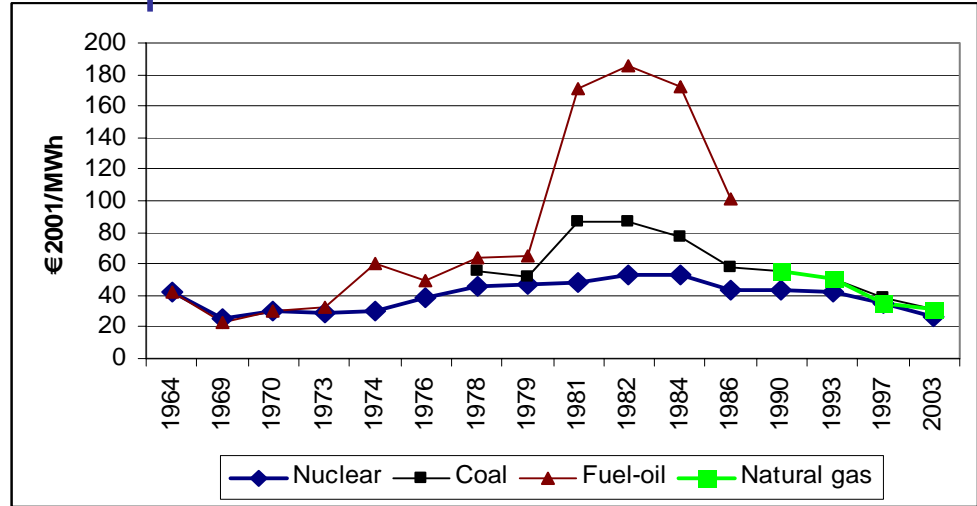
"Messmer" Program

- Reduce the dependence on oil imports

After the first oil crisis:

POLITICAL CONSEQUENCES
 FINANCIAL CONSEQUENCES
 ECONOMIC CONSEQUENCES

- **"In France, we have no oil, but we have ideas"**



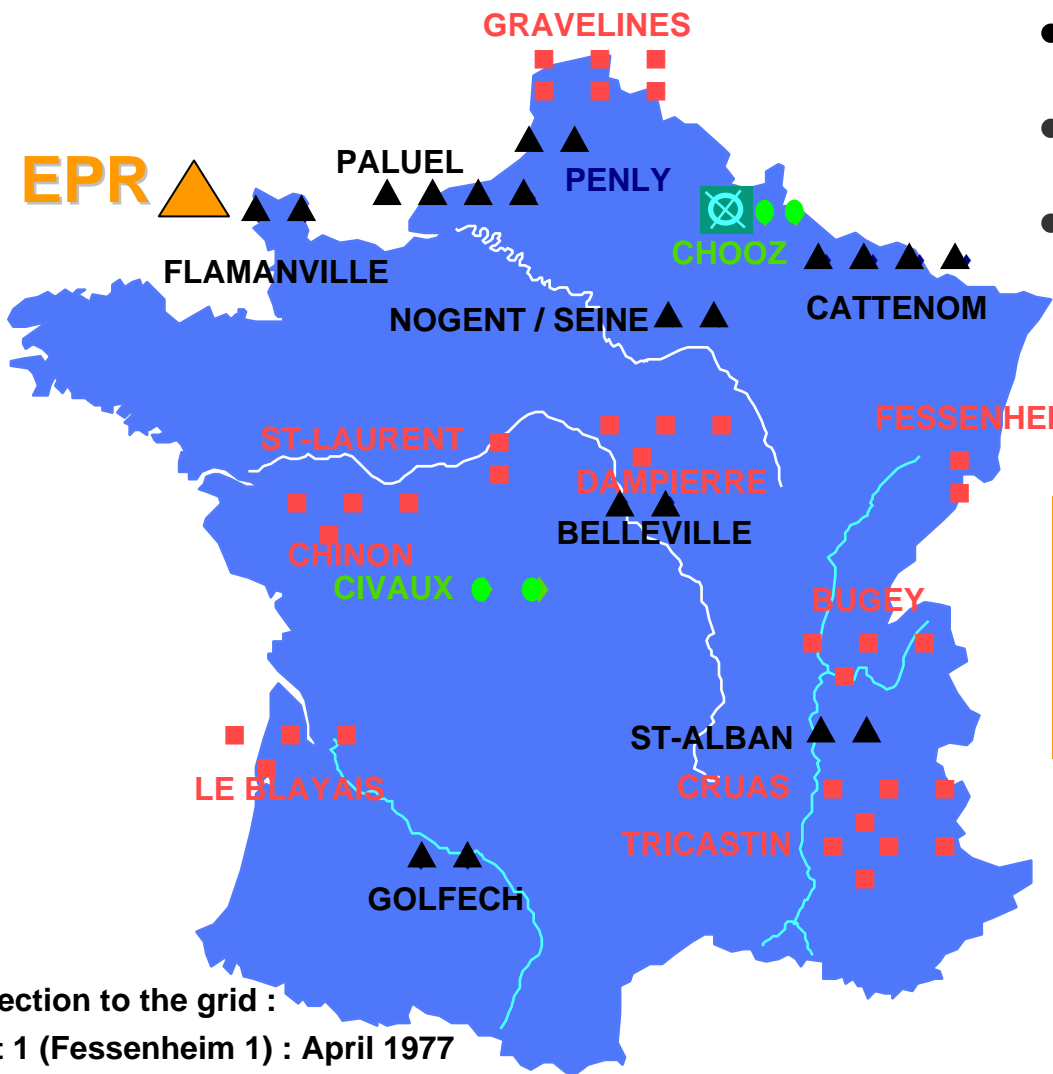
- Orders of 34 PWR (900 MWE)
- The first 900 MWE reactor was still in construction
- No significant series of this type all over the world
- A 1300 MWe was connected to the grid only 3 years after

The EDF Generation Fleet in France

- Optimization policy of generation assets depending on consumption
- Limited exposure to fluctuations in fossil-fuel markets
- Very low CO₂ emissions

- Installed capacity 96 GW (2006)
 - Nuclear: 65%
 - Hydro: 21%
 - Fossil Fuel: 14%
 - Other Renewable Energies: < 1%
- Generation 485 TWh (2006)
 - Nuclear: 88%
 - Hydro: 8%
 - Fossil Fuel: 4%
 - Other Renewable Energies: < 1%

French Nuclear Power Plants in operation



- 34 900 MWe units ■
 - 20 1300 MWe units ▲
 - 4 1500 MWe units ●
- ~21 years in average

~78,5% electric generation

58 PWR units (20 MOX)

63184 MWe + *Phenix*

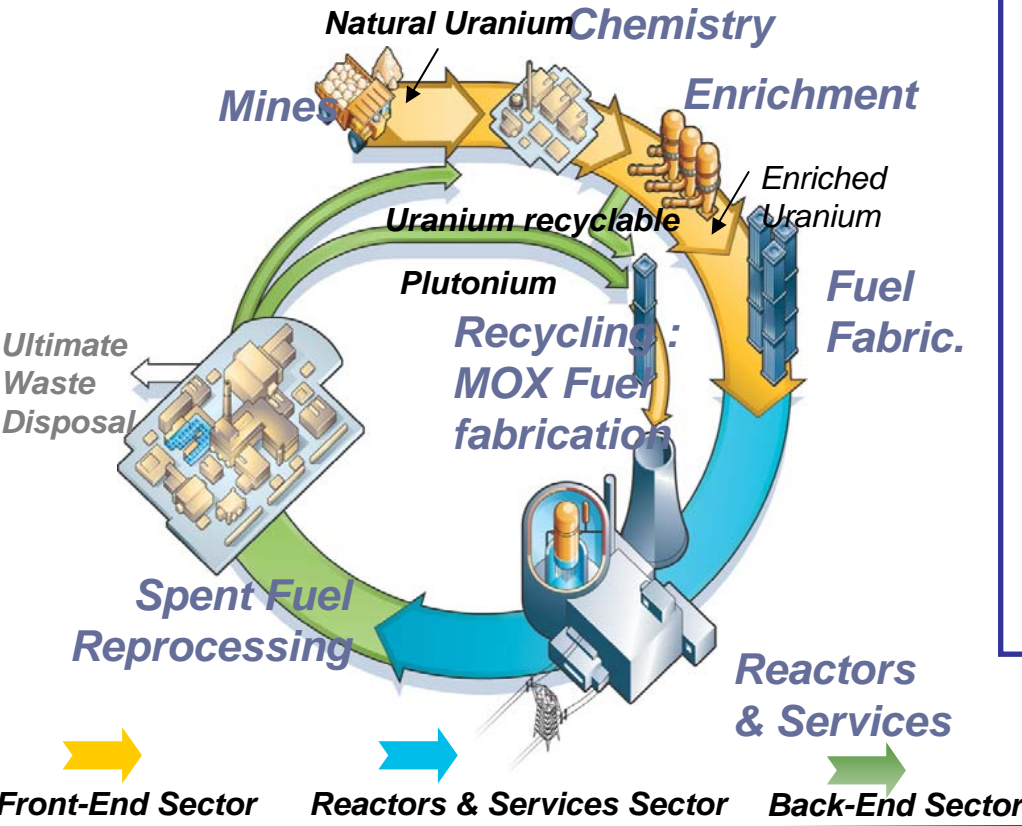
Lifespan Process of the PWR Fleet:

- 40 years lifespan technically achievable for existing units
- EDF objective: extension of average lifespan of its NPP > 40 years
- BUT: Safety Assessment every 10 years

Connection to the grid :
 - Unit 1 (Fessenheim 1) : April 1977
 - Unit 58 (Civaux 2) : December 1999

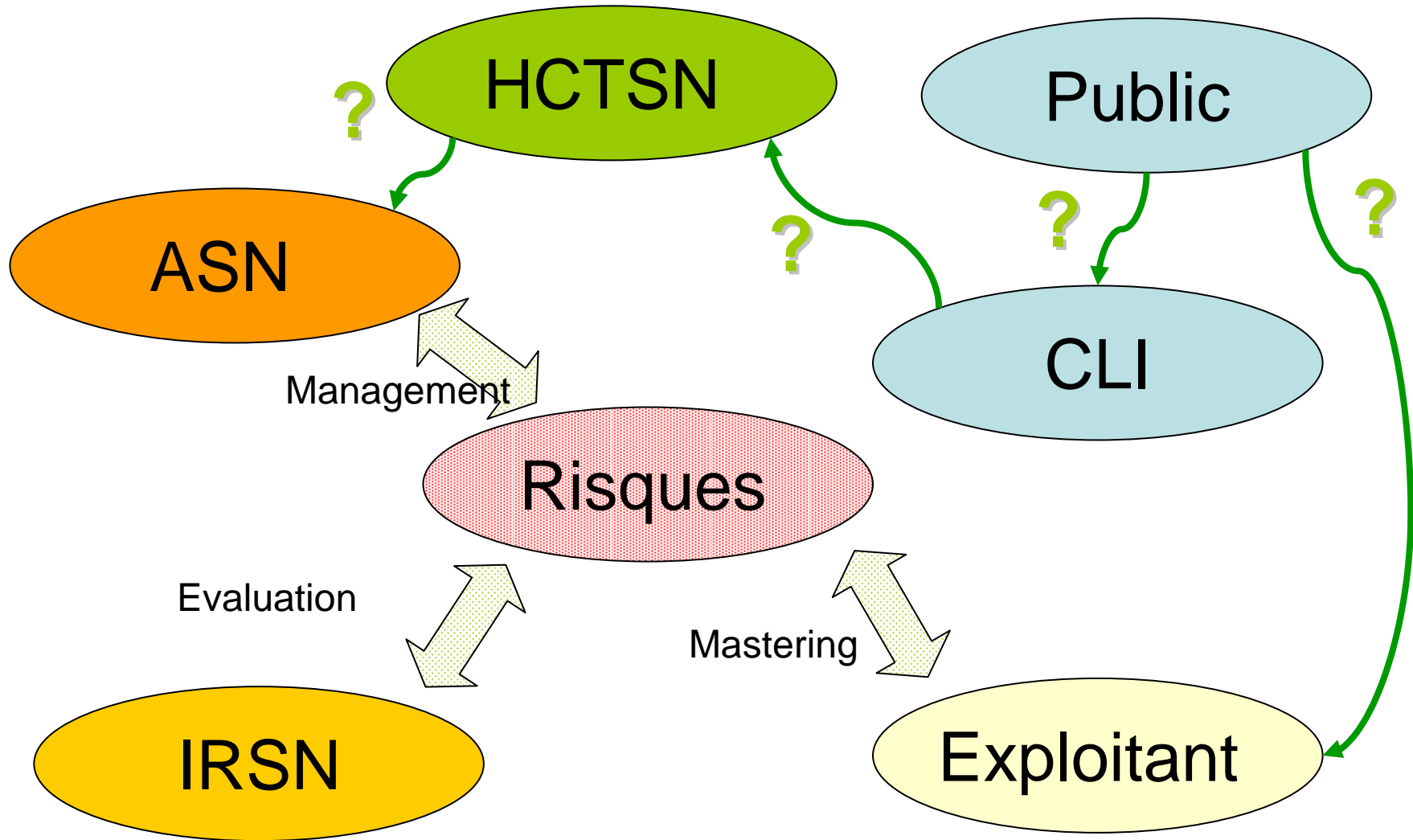


- **More than 25 years of unequalled experience in France :**
- **58 PWRs → 415 TWh in 2004**
- **Until now: ~ 20 000 Mt_{HM} spent fuel reprocessed and more than 1200 Mt_{HM} MOX fuel recycled**
- **1100 Mt_{HM} /yr of spent fuel discharged from the French PWRs**
- **up to 1 600 Mt_{HM} /yr of spent fuel reprocessed (domestic + foreign)**



The French nuclear policy: The main actors

- Definition of the French nuclear policy : **DGEMP** (Direction Générale de l'Énergie et des Matières Premières, General Directorate for Energy and Raw Materials)
 - Safety control : **ASN** (Nuclear Safety Authority) (expert : **IRSN** = Institut de Radioprotection et de Sûreté Nucléaire, Institute for Radiological Protection and Nuclear Safety)
 - Waste management : **ANDRA** (Agence Nationale pour la gestion des Déchets Radioactifs, National Agency for Radioactive Waste Management)
 - Research and development in the nuclear field : **CEA** (Commissariat à l'Énergie Atomique, Atomic Energy Commissariat), **IRSN**
 - Utilities : **EDF**
 - Suppliers : **AREVA** (AREVA-NP, AREVA-NC), **Alstom**
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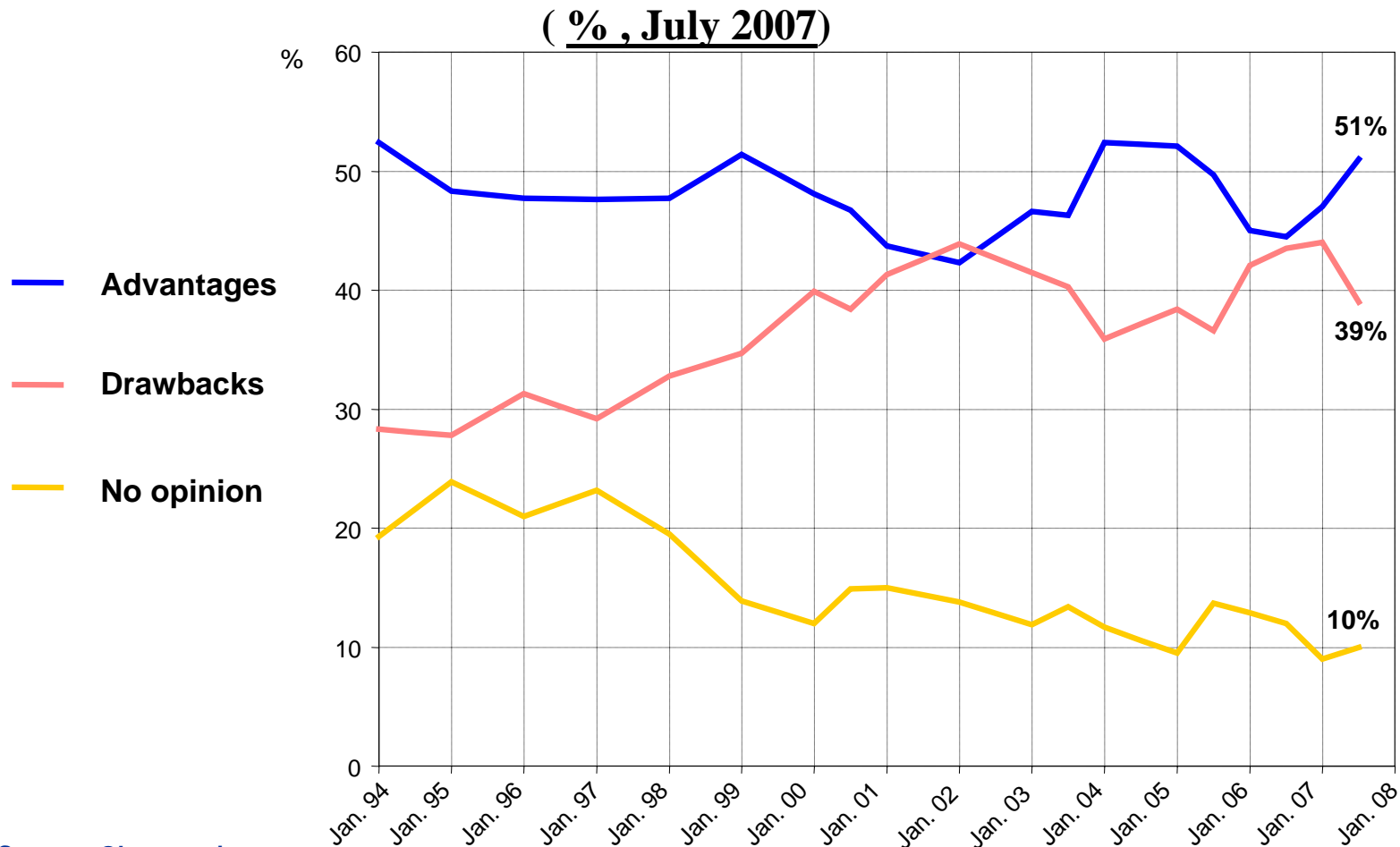


The 2006 nuclear Acts: the public debate and the June 28th 2006 Act

- A **public debate** on radioactive waste took place from September 12th 2005 to January 13th 2006.
- **13 public meetings with 3000 persons.**
- A law on the management of radioactive materials and waste was adopted by the French Parliament on June 15th 2006 and published on June 28th 2006.
- This law has been widely approved and determines clear orientations towards safe and durable solutions for the management of all types of waste.

- This Act defines :
 - three main principles concerning radioactive waste and substances : (i) **reduce quantity and toxicity (reprocessing and recycling)**, (ii) **interim storage of radioactive substances and ultimate waste**, (iii) **deep geological disposal with the focus put on reversibility**.
 - financial arrangements on research axes, nuclear plants decommissioning liabilities, long term management of radioactive waste liabilities, financing of research programs by **additional taxes on nuclear power plants (EDF, CEA, AREVA...)**.
- This Act creates a **national management plan** that will be updated every three years and published (transparency).
- It insists on transparency and democratic control.

« Does nuclear choice to generate 75 % of electricity offer more benefits than drawbacks ? »



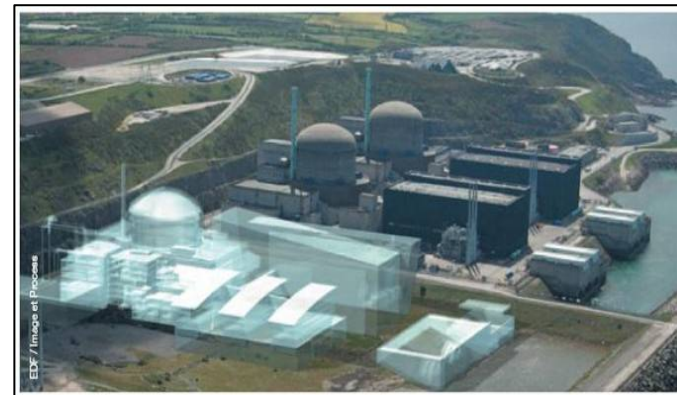
Source : Observatoire de l'énergie / CREDOC July 2007

- *A mature concept, based on current PWRs' experience*
- *Significant improvements in safety and economy*

→ *Under construction in Finland at Olkiluoto (TVO) in operation by 2011*



- July 05: French Energy Policy Act → *A Gen III plant by 2012*
- Oct 05 – Feb 06: Public debate to build an EPR in Flamanville
- April 11, 07: Site permit granted for an EPR unit at Flamanville



- Implementation of a National Plan for managing nuclear materials and radioactive waste (PNG-MDR)
- The Act defines a stepwise program for Long-Lived Waste (High and Medium Activity) that accounts for the complementarities of various approaches:

→ **Partitioning & Transmutation:**

- ✓ 2012: Assessment of Gen IV fast Reactors / ADS
- ✓ 2020: Fast reactor Prototype

→ **Retrievable Geological Repository:**

- ✓ 2015: Authorization decree
- ✓ 2025: Beginning of operation

→ **Interim storage:**

- ✓ Creation of new facilities in 2015

- The Act includes guarantees for long term funding of radioactive waste management



Atalante & Phenix



➔ New goals for sustainable nuclear energy

Continuous progress :

- Economically competitive
- Safe and reliable

Break-throughs :

- Waste minimisation
- Natural resources conservation
- Proliferation resistance

➔ Systems marketable from 2040 onwards

➔ True potential for new applications

Hydrogen, potable water, heat

➔ Internationally shared R&D

