The French nuclear industry and policy: insights from an international perspective

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Outline

- The French nuclear ecosystem
- The EU energy and competition policy
- The nuclear power deployment in France and worldwide
- The cost escalation in France and in the US
- The French nuclear policy between UK and Germany

Propositions derived from the French case that I submit to discussion

- Proposition 1: Old nuclear (i.e., existing NPPs) can survive to energy deregulation and restructuring but new nuclear (i.e., new builds) is much more at risk
- Proposition 2: Industrial concentration, product homogeneity and vertical integration of power companies into NPPs construction (i.e., acting as architect-engineer) are key for exploiting learning effects (i.e., decrease in $/ Mwe when more NPPs are built)
- Proposition 3: A few number of firms and a few number of products are required to counterbalance the negative effects of the increase in complexity (i.e, size and safety) of reactors on costs
- Proposition 4: Countries with a significant (but not too strong) domestic market enjoy a competitive advantage in exporting nuclear components and reactors
- Proposition 5: The objective to reduce, or even to eradicate, CO2 emissions from power generation is a competitive advantage for nuclear power in so far as a green party which makes phasing out of this technology a central plank of its platform does no exert a significant influence

The French nuclear ecosystem 1/2

- 58 reactors, 19 NPPs, 63130 MWe, 385 TWh (2012), 75% of energy mix
- A single owner and operator, EDF
  - State-owned (82,5%), vertically integrated in design and engineering of NPPs
- A single supplier of reactor pressure vessels, AREVA (formerly Framatome)
  - State-owned (87%), vertically integrated from mining to reprocessing

The French nuclear ecosystem 2/2

- An outsider, GDFSuez
  - Single operator of the Belgium nuclear fleet (7 reactors, 6000 MWe); first gas supplier and second power supplier in France; state-owned (37%)
- + more than 200 SMEs
- A single nuclear research institute, CEA
  - Civil and military applications
- A first class safety regulatory authority, ASN
  - Independent, transparent, competent, powerful
- An energy regulatory commission, CRE, which sets retail tariffs and a wholesale tariff for nuclear MWhs produced by EDF

The French ecosystem within the EU system

- The European Atomic Energy Community (Euratom, 1957)
  - An initial ambitious goal which came to little; still a legal person
- The Treaty on the Functioning of the European Union (based on Rome Treaty, 1957)
- EU law on safety standards for radioprotection (1996), nuclear safety (2009), and nuclear waste (2011)
- 147 reactors in 15 countries (out of 28)
- A nuclear patchwork
  - new potential entrants (e.g., Poland); exiting countries (e.g., Germany); renaissance countries (e.g., UK); banning countries (e.g., Austria)

The EU energy policy

- 1996-2014: A long process to build an internal energy market (opening-up electricity and gas market to competition, regulating networks according to same rules, developing interconnections, etc.) in order to ensure better prices for business and households
- Two other goals: security of supply and CO2 emissions reduction
- To make a long story short, the EU has succeeded in setting competitive day ahead markets and failed in providing long term signals for private investments
- The visible hand of government drives the choice of technology (nuclear, renewables,…) and investment (capacity, location,…) not the market

The EU competition policy

- Competition policy is a key pillar of the Union and competition law enforcement is a major power of the European Commission
- In addition to merger control and antitrust, EU competition law controls national state aids to prohibit national public intervention that distorts competition within the EU
  - For instance, the Commission has opened an investigation to examine whether the UK plans regarding the new nuclear build at Hinkley Point is compatible with EU state aid law
- EU guidelines on energy state aid are currently under discussion
  - A specific section devoted to nuclear power was included in a first draft and then has been withdrawn

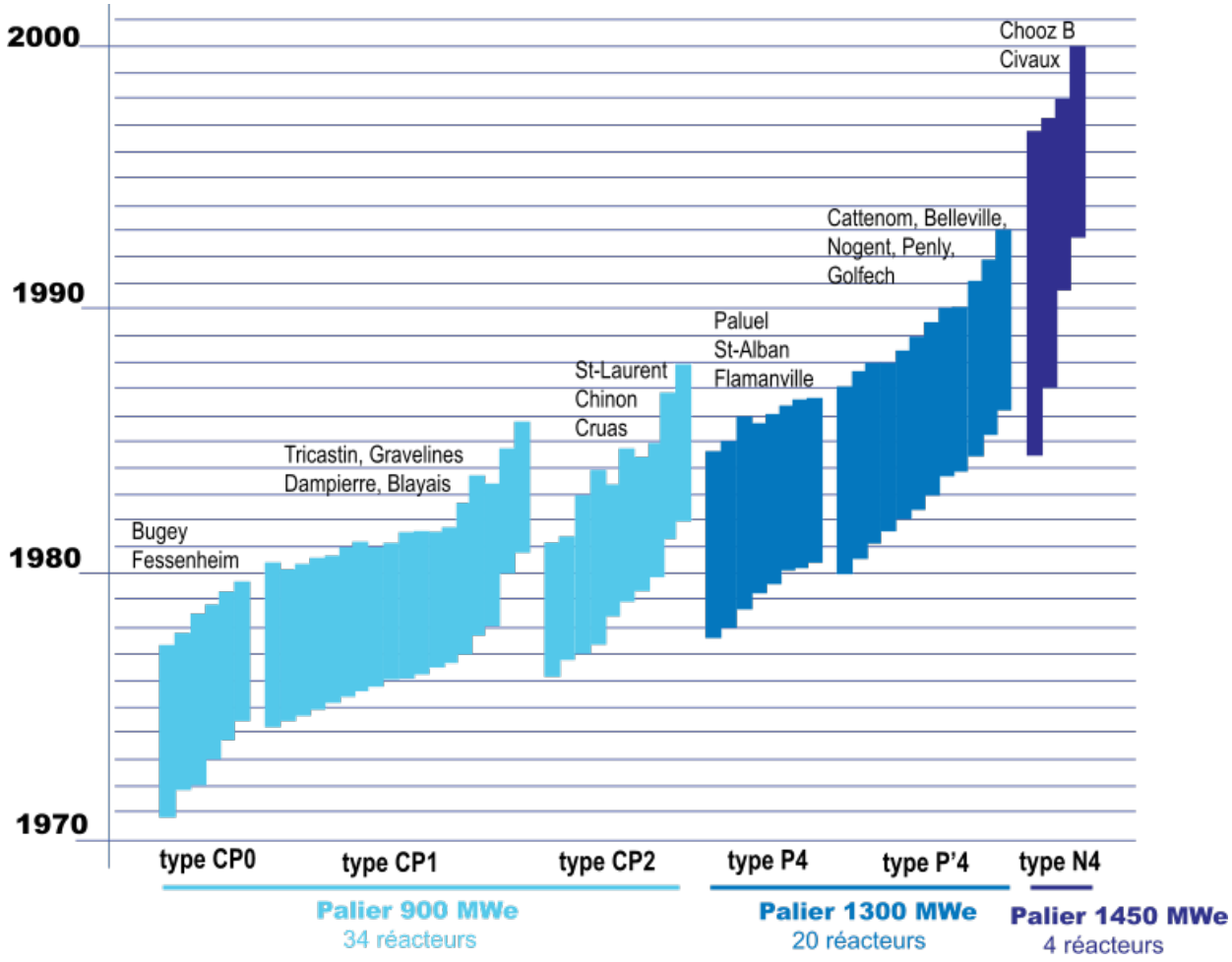
Old nuclear versus new builds

- The French case shows that old nuclear could survive in liberalized energy markets
  - Administrative tariffs, state ownership, unrestructured incumbent have remained in place
- Nuclear power suffers from a disadvantage in liberalized electricity systems
  - high fixed costs coupled with high uncertainties on future market price
  - regulatory uncertainties (e.g., CO2 price, safety standards)
- Hence, proposition 1: Old nuclear (i.e., existing NPPs) can survive to energy deregulation and restructuring but new nuclear (i.e., new builds) is much more at risk

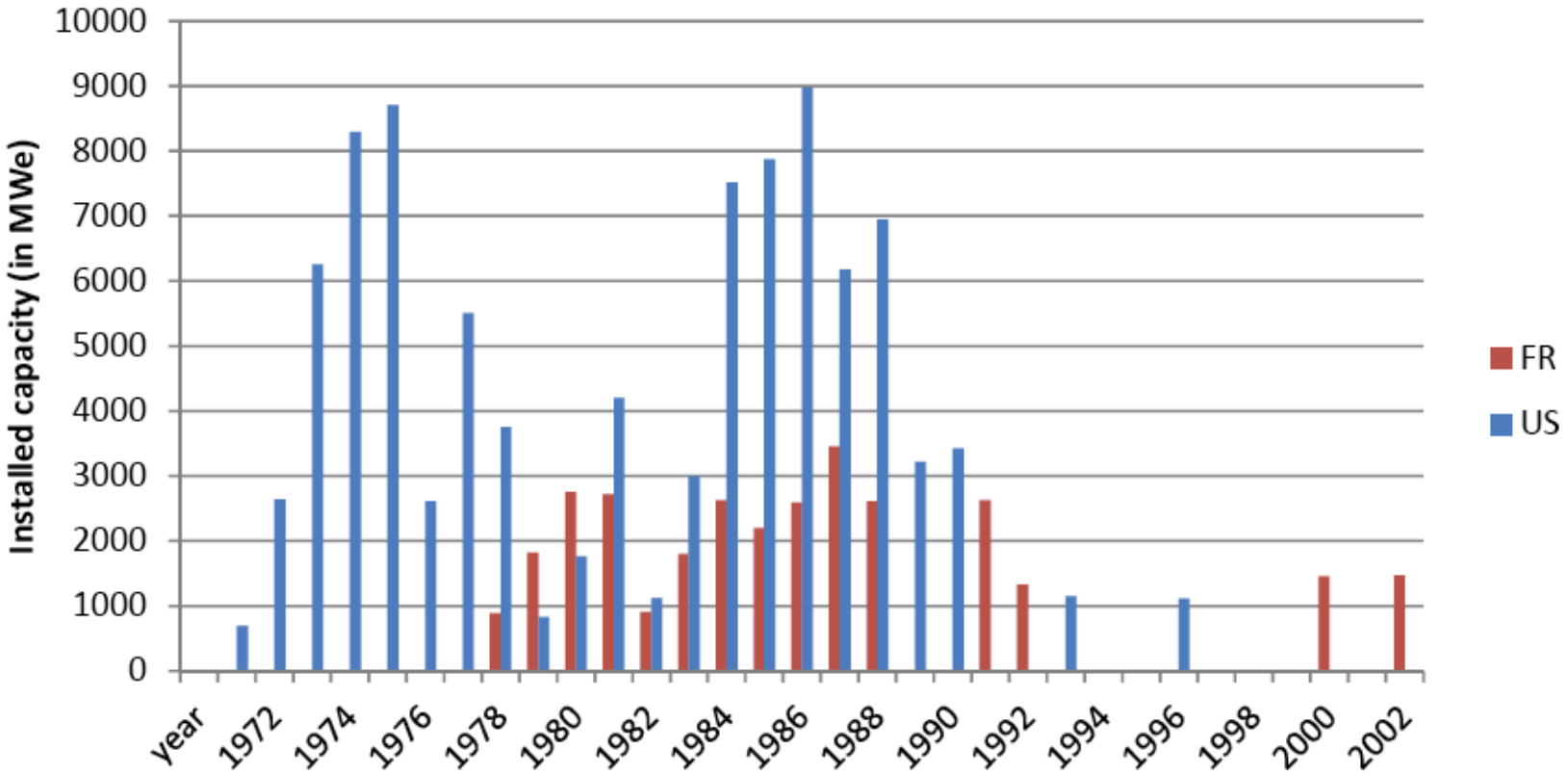
France, the last pioneer and the first follower

- As Canada, the UK, the US and the USSR France has entered early into nuclear power generation and has chosen a specific route (gas-cooled graphite-moderated technology)
- As Germany, Japan, and many other followers, it has used technology transfers from the US to build its nuclear fleet and it has progressively became technology independent

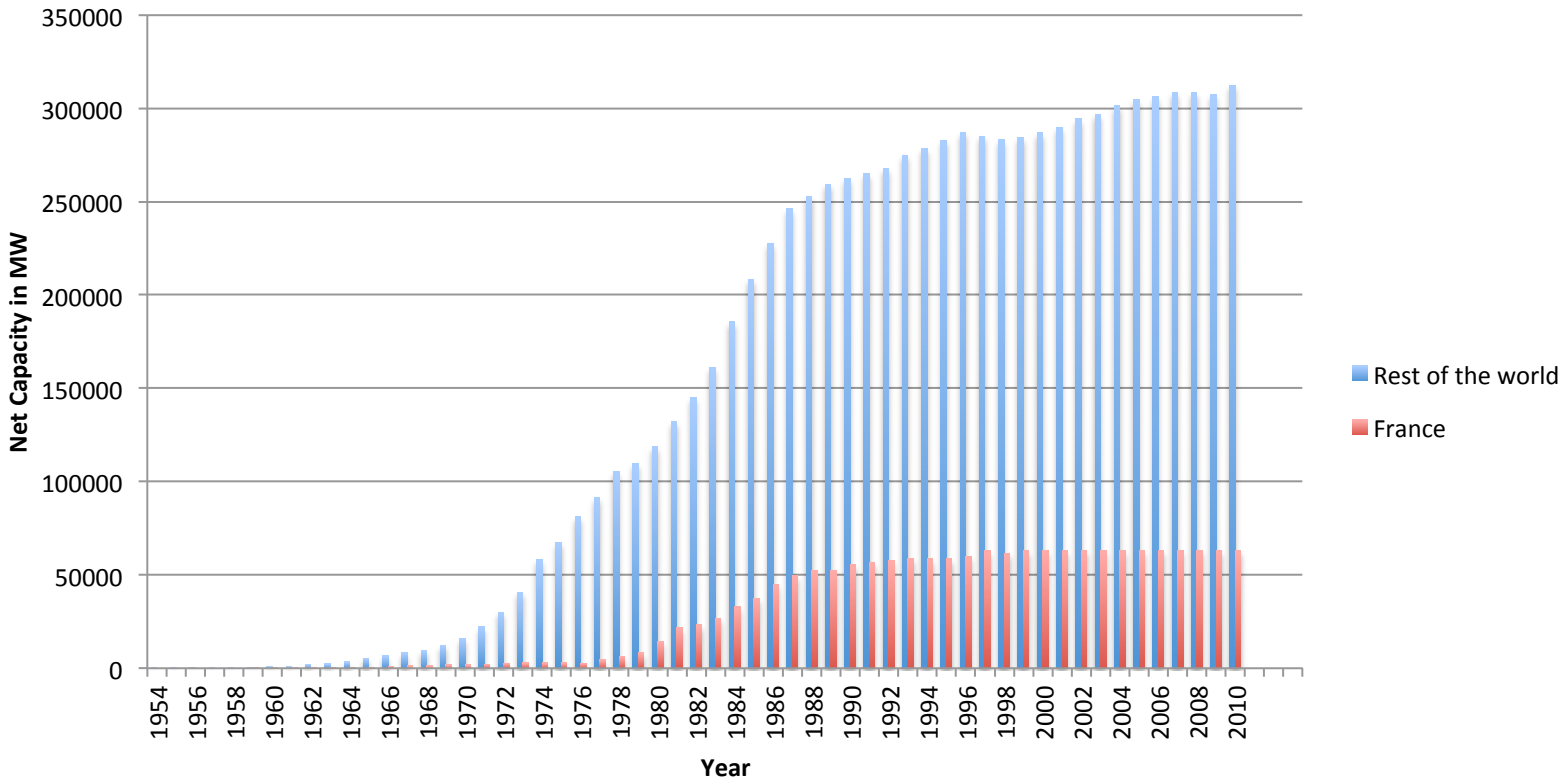
The French deployment



USA versus French deployment

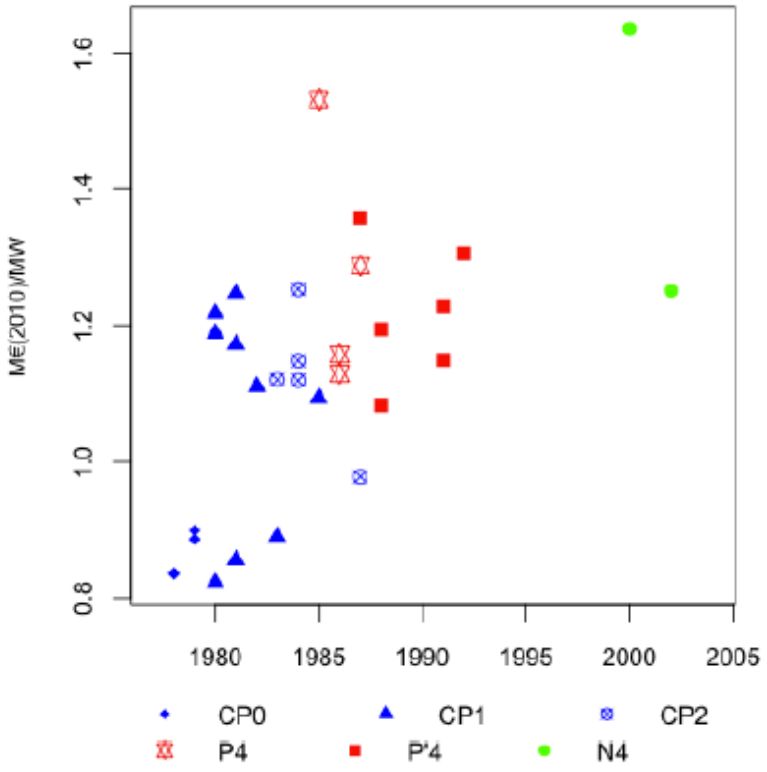


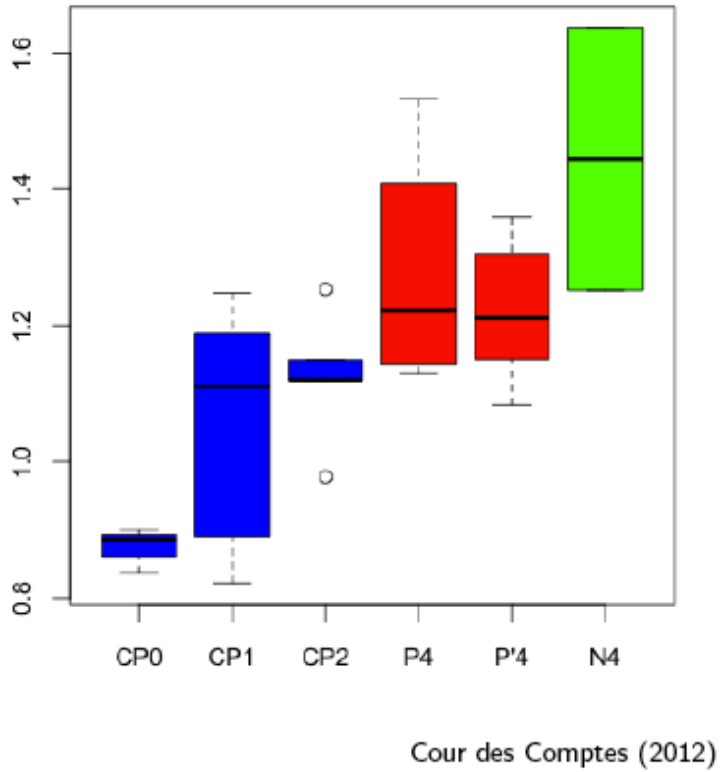
France and the rest of the world



French costs of builds

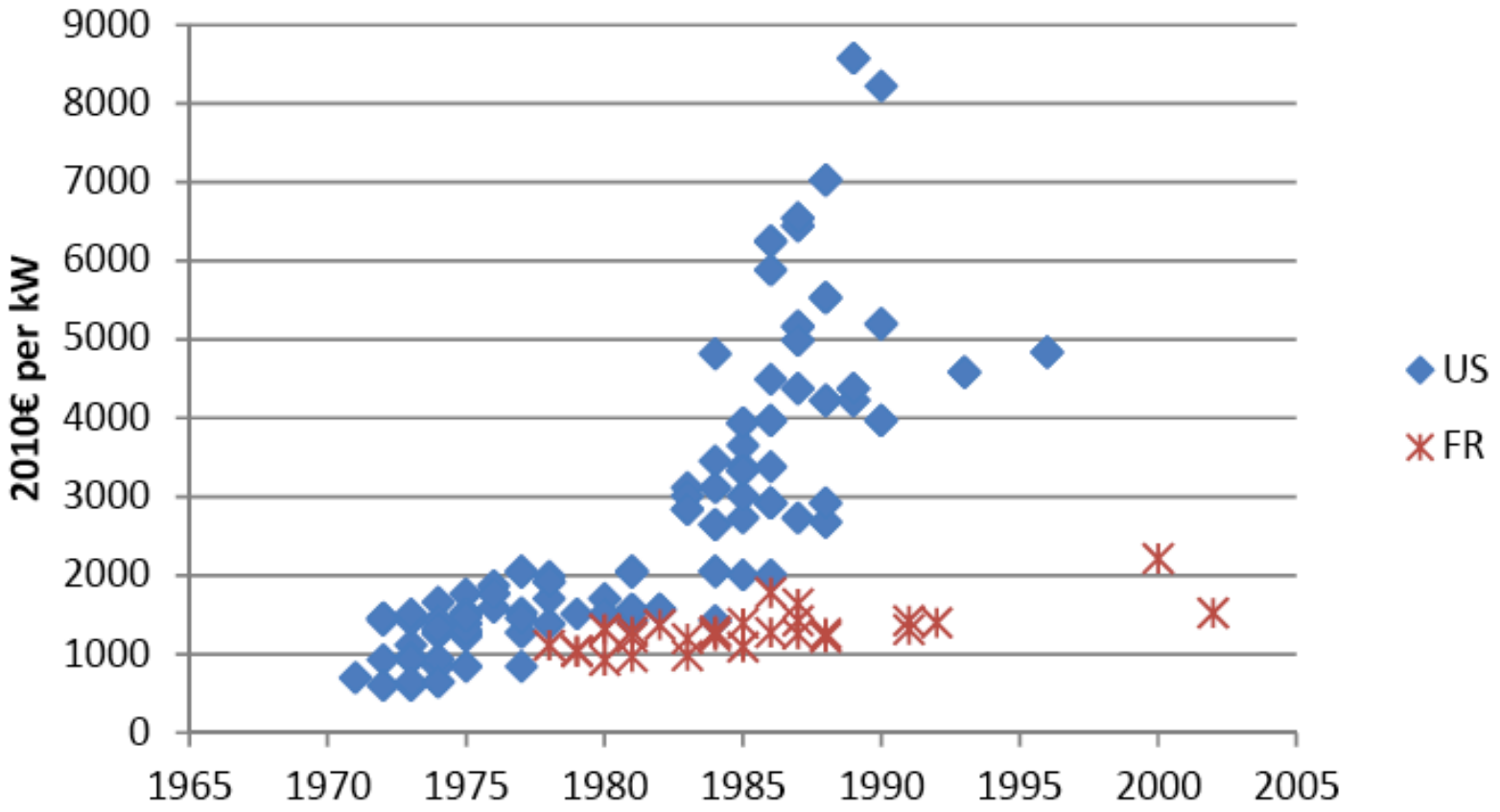
The more recent the reactor is and the bigger the reactor is, the more expensive in $€_{2010}$ /MWe



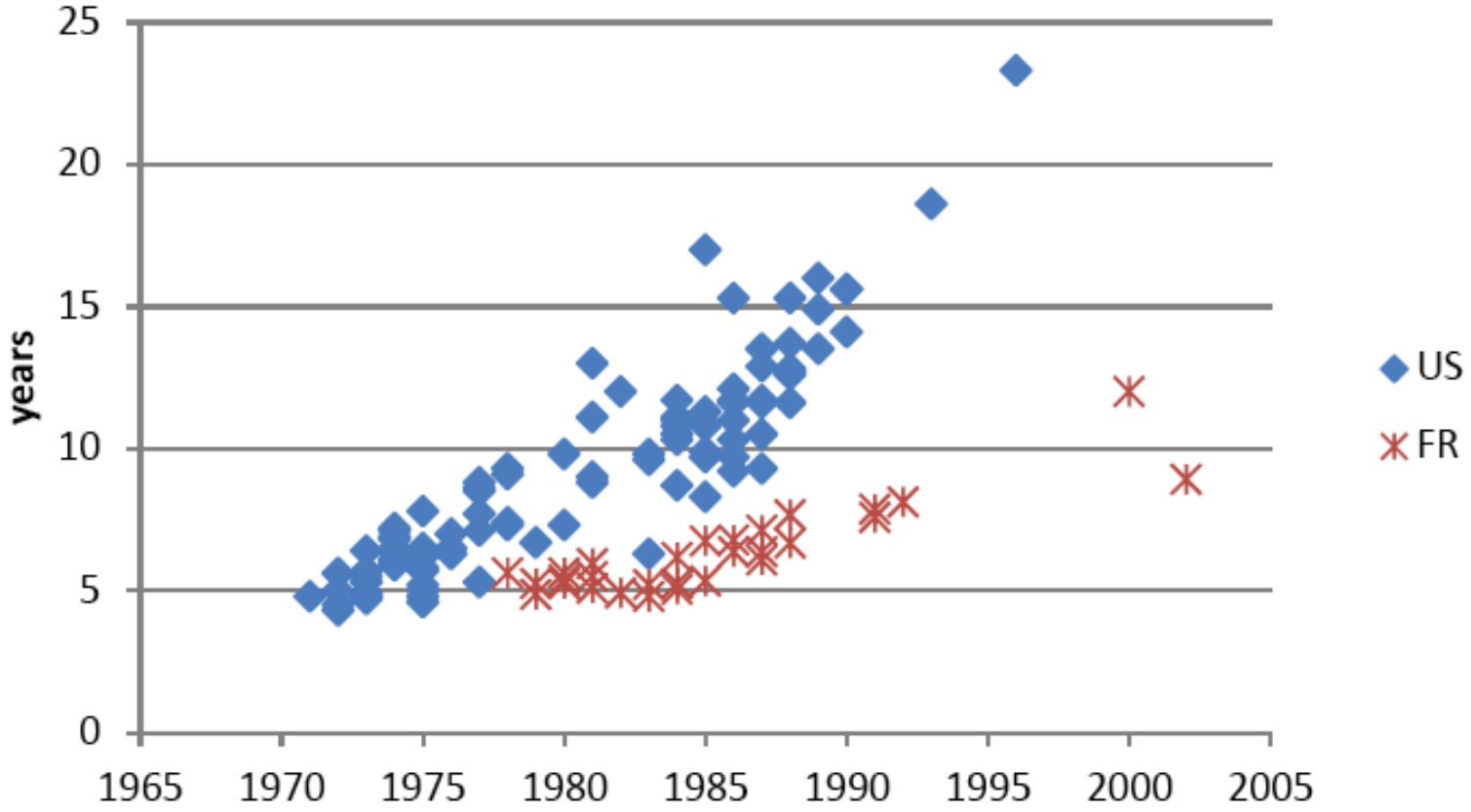


Cour des Comptes (2012)

Cost escalation: France versus USA



Construction time: France versus USA



Industry organization and construction costs

- Econometric studies on US and/or French costs and lead-times (e.g., Rothwell 1986; Cantor and Hewlett, 1988; David and Rothwell, 1996; Escobar Rangel and Lévêque, 2013; Escobar Rangel and Berthelémy, 2013)
- In general, there is no evidence of learning effects at the industry level. On the contrary the diversity in the nuclear fleet is related with longer lead-times and construction costs
- At the Architect-Engineer (A-E) firm level, past experience is not directly transferable to any project thus it does not reduce costs
- In general, cost reductions in the construction process can be achieved if the same Architect-Engineer firm build several times the same type of reactor
- In the U.S, learning effects were observed only when the utilities managed the construction
- In the French case, learning effects were found within the construction of the same type of reactors

Propositions

- Proposition 2: A few number of firms and a few number of products are required to counterbalance the negative effects of the increase in complexity (i.e, size and safety) of reactors
- Proposition 3: Industrial concentration, product homogeneity and vertical integration of power companies into NPPs construction (i.e., acting as architect-engineer) are key for exploiting learning effects (i.e., decrease in $/Mwe when more NPPs are built)

France between the UK and Germany

- The UK has decided to go on with nuclear power in replacing too old reactors by new ones (e.g., Hinkley point)
- Germany has decided to stop with nuclear power
  - No new builds
  - Rapid phasing out of its NPPs (last reactor will shut down in 1922; 32 years as an average closure date for the whole fleet)
- France is building a third generation reactor, EPR, at Flamanville whereas it has also decided to early retire two reactors at Fessenheim and is envisaging to reduce the share of nuclear generation in the energy mix to 50% by 2025

New builds and exports

- The decision to build a new reactor at Flamanville was made in the beginning of the 2000s by EDF and the government to showcase the EPR and the French industry capability in nuclear engineering
  - No economic needs for new nuclear capacity in France to respond internal demand or power exportation to other EU countries
- It has been seen difficult to sell abroad a new model of reactor without building this new model of reactor at home
- One of the main challenge for France is to export new reactors whereas its domestic market is flat (i.e., no needs for new builds in France before 10-15 years)
- Export is critical for the life cycle of nuclear industry when national demand is declining but it becomes more difficult to export when national demand declined (see the US case)

Proposition 4

- Countries with a significant (but not too strong) domestic market enjoy a competitive advantage in exporting nuclear components and reactors
  - The example of Russia
  - The counter examples of the US (no domestic demand) and China (too strong domestic demand)

Early retirement of NPPs and green party influence

- The shut-down of Fessenheim in 2016 and the reducing of the nuclear power share to 50% in 2025 have been written in an agreement between the socialist party and the green party before the 2012 presidential election
- During the electoral campaign, the former president and presidential candidate, Nicolas Sarkozy, opposed these nuclear cutbacks whereas François Hollande, the now-elected socialist president, only committed for the Fessenheim shut-down
- The 50% in 2025 has not been decided yet. It will depend on a new French law on energy which will be discussed in 2014 at the Parliament. It is likely not to become an approved objective because of the decreasing influence of the green party and the increasing instability of the green/socialist alliance.
- Note that in Germany, the rapid phasing-out has been initially set by the alliance between the Social Democrat party and the green party but has been substituted with a slower phasing-out when Christian Democrats when back in power. However, Angela Merkel decided to fasten the phasing out after the Fukushima Daiichi accident.
- Note also that there is no influential green political party in the UK

Proposition 5

- The objective to reduce, or even to eradicate, CO2 emissions from power generation is a competitive advantage for nuclear power in so far as green party which makes phasing out of this technology a central plank of its platform does no exert a significant influence
  - UK versus Germany
  - France is closer to the UK for the green party is becoming marginal

Conclusion

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