Economy

Twisting global economics

"The difficulties that France is facing to secure its energy supplies in a satisfying way could only be solved in the medium term through largely turning to nuclear power: it is the only energy that can bring timely responses to the problems of costs, commercial bill, security of supply and national independency."

D'Ornano Report (justifying the launching of the 1973 Messmer programme of new reactors), 1974

"The era of cheap oil is over. Nuclear power is more than ever an industry with a future and an indispensable energy. […] The EPR generates electricity which is 30 to 50% cheaper than that generated by a gas or coal fired thermal plant. One can become an electricity exporter although one has neither oil nor gas. This is an historical chance of development."

Nicolas Sarkozy, President of French Republic, Speech delivered in Creusot (France), announcing the decision to build a 2nd EPR, 3 July 2008

Nuclear power is claimed to be a key positive feature of the French economy, both contributing to national energy security and providing abundant and cheap energy for French industry and households. Though one can hardly pretend to grasp the full balance of the nuclear option's positive and negative impacts on the whole economy, basic facts are there to show the gap between the perpetual stream of rhetoric from the nuclear industry and reality.

No clear competitive breakthrough

The idea that France's nuclear choice is good for the national economy is deeply rooted in many people's minds – and a strong belief of most politicians and economic leaders in the country. But what clear advantage has it got? In brief, France's economy did not perform better than those of comparable countries, but rather below average for the European Union, where countries with no nuclear power enjoyed higher GDP growth rates.

The benefit, if any, could just not be seen at such a global level. So one might look for a more specific indicator. The ongoing use of "energy independence" as a key argument to promote the use of nuclear power in France points to the French energy bill, i.e. the commercial balance between French energy imports and exports, as the most relevant indicator.

Failed protection against imports at any cost

Avoiding costly imports of energy is a major goal for the nuclear programme. The development of a 58 reactor fleet seemingly eased the energy bill in a significant way, bringing it down from €28 billion

in 1984, risen from just €3 billion in 1973, to €10 billion in 1988. But that is not in keeping with the fact that oil imports, the major contributor to the energy bill, have always been on the increase – and still are. In other words, the fall by 250 percent of oil prices in 1986 and their relative stability in the next years were the main reason for the drop in the energy bill.

Nuclear power's contribution appears very large, responsible for around 78 percent of the electricity produced in France in 2007. But in fact, electricity represented only 20.7 percent of the final energy consumption in France in 2007. And that is even though the French have the highest consumption of electricity per capita in the European Union. Taking into account the large share of nuclear power actually used for electricity exports, the overall share of nuclear power in the national consumption of final energy is rather more in the range of 14 percent, corresponding to 286 TWh.

No wonder then that France's final energy is provided over 70 percent by fossil fuels (oil, gas and coal), a situation which does not show much difference with comparative countries. If reducing oil dependence had been the real target, the development of nuclear power plainly failed. Already the largest consumer of oil in the early 1970s, the transport sector has developed to such an extent that its 70 percent increase in oil consumption largely outweighs the impact of nuclear substitution in the power sector.

The continuous increase in oil consumption, driven by the transport sector, brought French dependence on oil to a peak of 48 percent of final energy consumption in 2007. The limitation of nuclear power in face of this growing dependence on imports showed as early as the end of the 1990s in a jump in the energy bill. The current oil crisis further highlights the failure of nuclear power's promise to avoid a new shock like that of 1973 to the French economy, cruelly pushing up the energy bill to record levels close to €50 billion, a threshold most likely to be broken in 2008 (Figure 19.)[93] With €44.8 billion in 2007, the government recently noted, the energy bill brings down the overall commercial balance of France from a benefit of €5.6 billion without energy to a loss of €39.2 billion.[94]

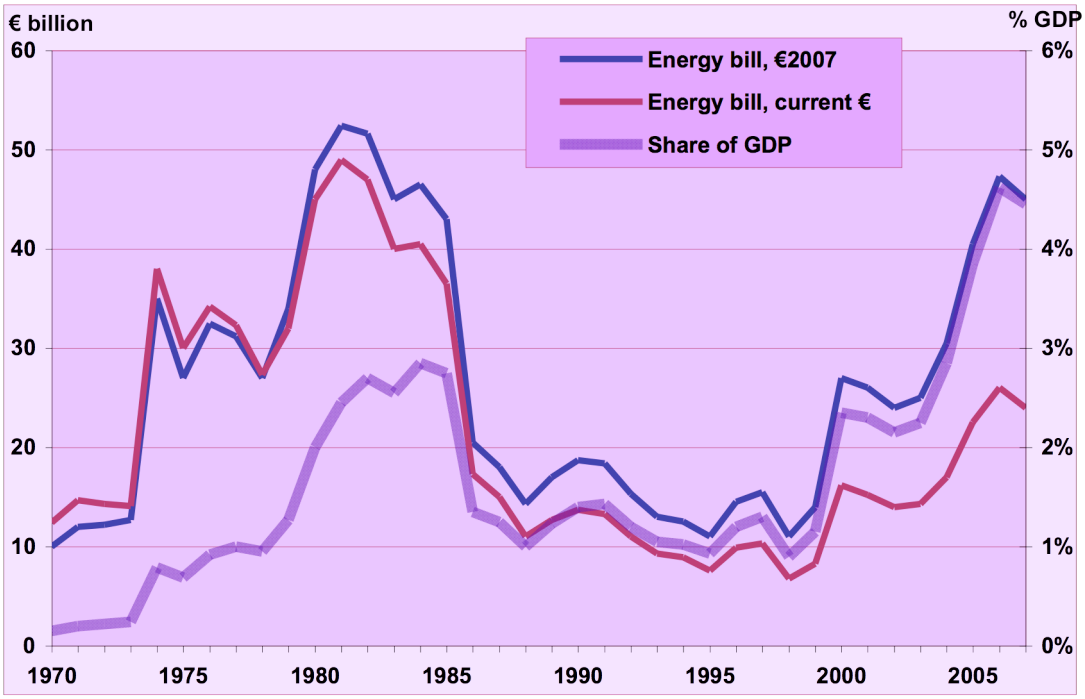
The impact of nuclear substitution, however, should be taken into account. This is obviously highly dependent on what one considers the nuclear reactors to be substitutes for. The French Ministry of Industry used to base any such calculation on a "substitution rule" where any nuclear generation would replace that of an oil-fired plant with a 38 percent efficiency ratio (corresponding to the old thermal plants of the 1970s). This method was used up until 2001, when France gave up this specific energy accounting and adopted the international IEA accountancy standards, to artificially increase the weight of nuclear substitution in the energy balance.

A more reasonable basis for comparison, as shown by the trends of generating capacity in the European Union, should be to consider the substitution of nuclear reactors to gas-fired power plants. The amount of natural gas needed to generate 310 TWh in order to deliver the equivalent 286 TWh of final electricity to French consumers that nuclear energy provides would amount to 47 Mtoe. This would represent an increase of € 10.7 billion of gas imports, based on the € 9 billion for the actual net import of 41.3 Mtoe of gas by France in 2007. However, this is an upper value for the need of gas in such a "what if" calculation. The French nuclear programme had a negative influence on other policies which could have been much more developed had another energy pathway been chosen as of the 1970s – renewable energies for heating and electricity, improved efficiency of buildings, etc. – reducing the final energy needs to provide the equivalent energy services to those provided by nuclear power. Also, the massive development of electric heating could have been avoided, and a significant part of that heating could have been much more efficiently provided by gas-based central heating systems instead of gas-fired stations and electric heating – again, reducing the amount of gas needed to provide the same service.

[93] In particular, if the further increase of oil prices in the first half of 2008 is confirmed in the second half. The small decrease of the energy balance in 2007 as compared to 2006 is essentially due to the combined effects of a mild winter and a strong change of € against $.

[94] Direction générale de l'énergie et des matières premières (DGEMP), *Facture énergétique de la France en 2007*, June 2008.

Figure 19 **French energy bill and its share of GDP, 1970-2007**



Source: DGEMP, 2008

Electricity exports: the soaring cost of overcapacity

So much for the protection provided by the use of nuclear power against rising imports of oil and gas at increasing costs. Yet another claimed line of contribution is the commercial benefit from electricity exports. France has always been since 1981 a net exporter of electricity, with a strong increase to reach 50 TWh by 1991 and a peak record of 77 TWh of net export in 2002. The average net exchange went down to 56.8 TWh in 2007 through the combined stabilisation of a small decrease of exports and increase of imports. This level is not matched by any country in Europe.

The electricity exchanges, accounting for a net export of 4.9 Mtoe, remain actually marginal compared to the oil and gas net imports of 130 Mtoe in 2007 (90 Mtoe of oil and 40 Mtoe of gas). This reflects in the breakdown of the French energy bill by source, which shows the very low contribution of electricity (Figure 20.) However, the pattern of electricity exports, as shown by the fact that they remain very high, even though the economic burden of oil and gas imports is rising, has nothing to do with energy security. Their driver is the overcapacity of French nuclear power plants.

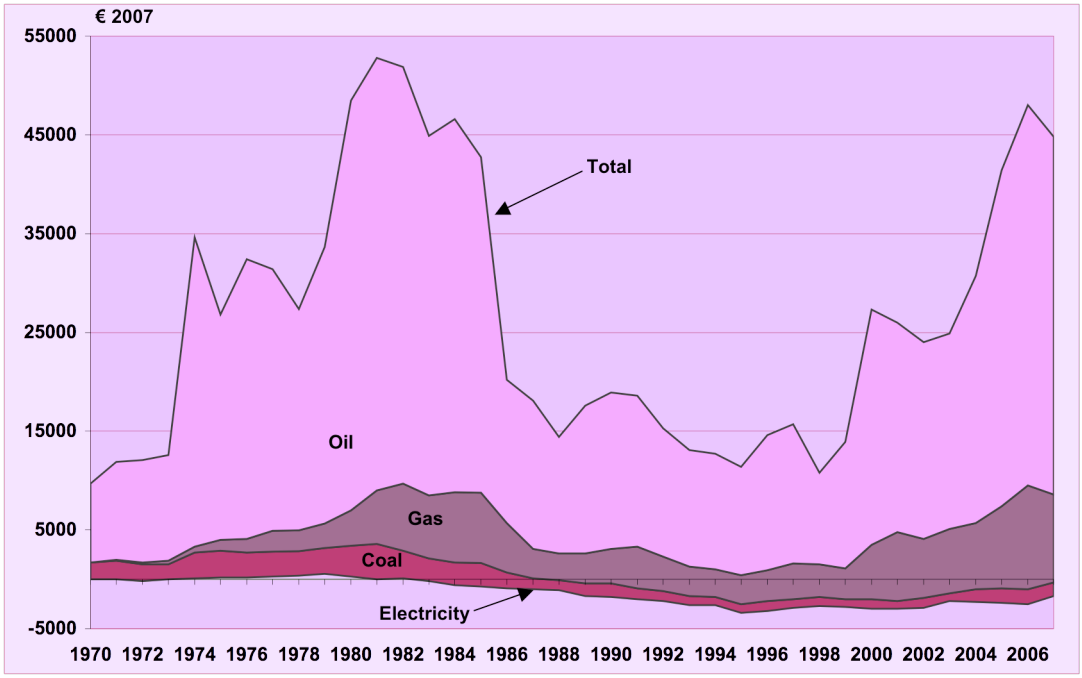
Faulty forecasting of electricity consumption, which did not rise as sharply as promised, and the lack of timely adaptation of the planning of construction of nuclear power plants, resulted as early as the mid-1980s in a large overcapacity of the French nuclear fleet, which could be estimated at 12 to 16 nuclear reactors. The total installed power generating capacity reached 115,9 GWe as of the end of 2007, of which 63,3 GWe was nuclear power. This compares to a peak demand of 89,0 GWe in 2007, but also a minimum demand of 31,6 GWe, respectively in mid-December and mid-August, the main reason for this huge gap being the extensive use of electric heat in French buildings.

The technical and economical need for the nuclear reactors to operate as much on a base-load basis as possible implies that their production is in excess for large periods of time throughout the year. Exporting electricity was therefore a mean to use some part of the overcapacity and pay for the stranded investment costs. In the mid-1980s, EDF started long-term contracts of base-load electricity supply to foreign utilities in Belgium, Switzerland, Germany, Italy, Spain and the UK, offering very low prices and very high guarantees of supply. The profits claimed from those contracts by EDF and the government are doubtful and commercial data have never been provided to confirm them. On the contrary, independent assessments show that official income from exports remained below the official

cost of nuclear generation, and suggest that power exports generated major losses estimated at €0.8 billion to €6 billion per year (through 1995-2001).[95]

Meanwhile, the continuous increase of peak demand brings some changes of priorities. Many of the long-term contracts were not renewed when they ended in 2005, and the need for imports linked to periods of high demand has increased. The electricity price can get much higher on the European market during such periods than it is when the French oversized nuclear plants have excess electricity to sell. The commercial balance of electricity exchanges remains positive but is evolving in a negative way. The mean prices of electricity exchanges for the years 2006-2007 show import prices between two and a half and three and one-tenth higher than export prices – a ratio to consider with some caution, as the range of prices from base-load to peak demand is much more extended and the physical exchanges seem to include the use of French lines for transit between neighbouring countries (mostly Germany to Switzerland).

Figure 20 French energy bill broken down by energy source, 1970-2007



Source: DGEMP, 2008

No clear pattern of electricity prices

Besides energy security issues, nuclear power was chosen on the grounds of its supposed competitiveness. Governmental estimates have regularly claimed that nuclear power plants were the cheapest available option for electricity generation in France, providing the country with the lowest electricity prices in Europe.

Prices of electricity for households are below the average prices in the European Union, but not the cheapest. Also, the price taken into account for France is that of the regulated market, excluding higher prices found on the small deregulated share of the market. For many reasons, this regulated tariff decided by the government does not necessarily reflect the full cost of nuclear power generation.

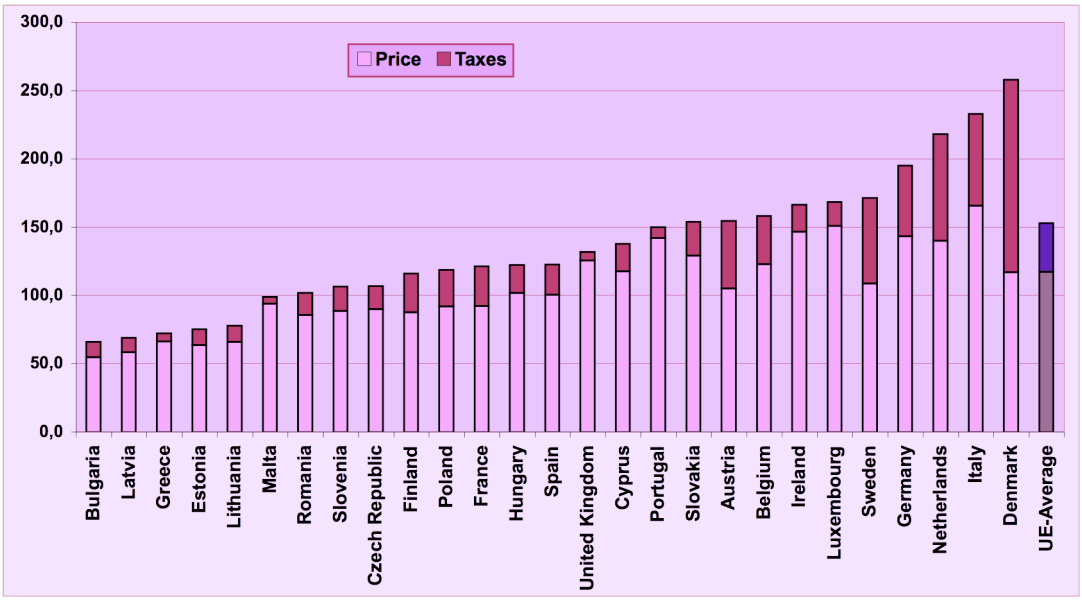
France comes third of EU-15 in the Eurostat comparison of electricity prices in the European Union, based on a standard household consumption of 3,500 kWh (Figure 21.) As for any comparison of that kind, the realness of assumptions behind the "normal" conditions considered in all countries is the key.

[95] A. Bonduelle, *Exportations de courant électrique : qui perd, qui gagne ?*, commissioned by Greenpeace France, Inestene, November 2002.

Another comparative study, by National Utility Service Consulting, ranked France sixth, with higher prices in 2006, and ninth in 2007 for industrial customers on the deregulated market – out of 14 countries, of which ten were European. Also, this study notes, "all European countries have reported their energy markets as being at their most volatile in several decades with this trend continuing in the future".

The good ranking of France is thus partly due to the predominance of a maintained regulated market, somehow disconnected from the real costs: energy planning, electricity generation and regulated tariffs are all managed by the state. Yet another factor should be taken into account when it comes to customers: how much one household has to pay depends on the price but also the amount it needs. One mean to improve the economics of French nuclear plants has been to develop the use of electricity, especially through a massive development of electric heating in the residential sector. With 145 TWh of electricity consumption in this sector, households use on average more than 7,000 kWh per year, or twice the "normal" condition considered for comparison in the Eurostat study.

Figure 21 Electricity prices for households in EU-25, as of 1st January 2007[a]



a. Prices in € per 100 kWh, for a yearly consumption of 3,500 kWh including 1,300 kWh at night.

Source: Observatoire de l'énegie, based on Eurostat, 2007

One key to nuclear economics is the higher share in the cost of nuclear power plants, as compared to other plants, of the investment. As both the regulator of electricity prices and the full owner of EDF, the French government could freely plan the rhythm of the return of capital costs, overcoming one of the main obstacles to the construction of nuclear reactors in deregulated economies. Moreover, this integrated framework, completed by the state ownership of the R&D body CEA and the operator Areva, allowed for large public funding in support of the nuclear industry in many ways, including very extensive R&D developments – up to the financing of industrial size prototype fuel cycle plants – ,costs linked to the electricity grid, adaptation of taxes, guaranteed loans with low rates, etc. This all points to the need to look for complete costs rather than drawing conclusions from prices…

Behind prices, the real costs

Government assessments of the projected costs of nuclear power plants started with the publication of the first report in 1964 by the PEON commission, followed by ten reports up to 1979 and replaced from 1981 on by the publications of the DIGEC, a department in the Directorate for Energy and Raw Materials (DGEMP) in the ministry in charge of energy [see Focus]. These official assessments have

been regularly challenged on grounds of their methodological flaws and the oriented choice of hypothesis.

However, due to a lack of strong criticism of the nuclear option in the main government parties, it was not until 1997, almost 25 years after the choice in favour of a large number of pressurised water reactors had been made, that pursuing this option was challenged for the first time within the government after the victory of a left-wing alliance including the Green Party in general elections. This resulted in the first major attempt to draw a global public assessment of the economics of the nuclear option in France.

A report was thus commissioned, in May 1999, by the Prime Minister to Jean-Michel Charpin, Benjamin Dessus and René Pellat (then respectively Director of the General Planning Commission, director of a pluri-disciplinary programme on energy in the CNRS, and High Commissioner for Atomic Energy), to conduct "a study concerning the economic data of the entire nuclear industry" and "a comparative analysis of the various methods of generating electricity", taking the "full costs" into account for all options, including "all of the factors on which a public decision must be based: inherent competitiveness, externalities and long-term effects."

The report compiled data from the industry (EDF, Areva…) and had them analysed by experts inside and outside the industry to draw the economic balance of the existing nuclear fleet of 58 PWRs over its planned lifetime. The overall cost, not discounted, of investment (including specific R&D), operation and fuel (including front-end and back-end, up to final waste disposal) was estimated in the range of €418 to 446 billion (original costs are expressed in FrF of 1999), depending on assumptions on the reactors' lifetime and on the back-end. It showed the importance, in undiscounted calculations, of operation (€184 to €197 billion over 40 to 45 years) and fuel-chain costs (€124 to €144 billion) compared to the capital cost (€99 to €103), which is the dominant factor in discounted cost.

Finally, the report compared prospective scenarios up to 2050, introducing a mix of options on the demand side policy (high or low evolution of energy consumption) and on the supply side, from reinforcing the nuclear share in the energy mix to lowering it to a base-load level, or replacing out-of-date reactors with other sources of energy, mostly modern gas turbines. Calculations showed that economics could not strongly point to a cheaper option between pursuing the nuclear programme or replacing ageing reactors with alternative thermal power plants, e.g. gas-fired ones. How this result might differ if it took into account the changes in economic conditions since 2000 is not obvious. One might think at first that rocketing oil and gas prices would give a real advantage, in these official calculations, to the nuclear option, but large increases in reactors' costs or uranium prices could very well equalise the two options.

However, this growth of all energy costs reinforces what was already the main conclusion of the Charpin-Dessus-Pellat report. Low-demand scenarios appeared less costly in any case than high-demand scenarios, with the level of demand making a much higher economic difference than the energy mix for a given level of energy demand. Therefore – and even more so with today's cost conditions – energy efficiency should be a primary priority of any sustainable energy policy, while the choice of nuclear energy among alternatives for electricity generation should only be a secondary issue. Furthermore, the report concluded that the equivalent of the average difference between high- and low-demand scenarios, amounting to some €2 billion per year, could be spent on energy savings without losing any money. Again, a higher figure might be appropriate now, given today's energy costs.

Closing a vicious circle

The report was the first publication of its kind in the nuclear field to gain positive comments from most players, from the government to the industry, the political parties, trade unions and NGOs. At a time when no new reactor was on track, it gave a rare opportunity to review the priorities of the French energy policy. What happened next was the opposite: successive governments since 2001 have chosen to keep nuclear energy on the spot, and given priority to the construction of a new reactor, the first EPR. Although EDF insisted that its project was not driven by immediate priorities in energy needs

but was reponding to its industrial strategic goal to maintain its capability to build nuclear reactors, and admitted that it might be a loss maker, the administrations advising the government produced reference reports to justify the need for an EPR on the energy side and to show that it would be competitive.

After more than 30 years of rhetoric, the myth of the nuclear role in French competitiveness has become stronger than reality. Policy makers and their official advisers appear caught in a vicious circle, where new official assessments must confirm the same results – even though they might be repeating previous mistakes – while their conclusions encourage decisions increasingly remote from reality. The announcement by President Nicolas Sarkozy, as of 3 July 2008, that a second EPR will be built in France in the future, as the best response to the shock of oil prices on the French economy, takes this surreal policy even further.