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The future of the nuclear industry

A Summary of the final report of the special joint parliamentary committee on nuclear safety, the scope of nuclear industry and its future

Chair of the committee : Mr. Claude Birraux, M.P.

Rapporteurs : Messers Christian Bataille, M.P., and Bruno Sido, Senator.

After the intermediate report on nuclear safety, adopted June 30, 2011, this second report completes the study on nuclear safety, the scope of the nuclear industry and its future, assigned to a special joint parliamentary committee in March 2011, following the Fukushima events, created at the initiative of the Presidents of the National Assembly and the Senate. To carry out this study, seven members of the National Assembly economic affairs and sustainable development committees were also involved, as well as eight members of the Senate Committee on the Economy, Sustainable Development, territorial and regional planning.

The nuclear industry : an appropriate response to the French situation

The final report of the committee synthesizes information collected from September to December 2011, during four hearings open to the press, and two study trips in Germany and Japan. These visits, led by Mr. Christian Bataille, confirmed that energy choices depend primarily on the specific national and historical background. The same applies to France: using nuclear energy allowed France to respond to four strategic priorities despite the depletion of fossil energy in its subsoil.

The first priority is **to have adequate and appropriate electricity** outputs in terms of energy and power. In this regard, nuclear energy has enabled France to cope with electricity consumption that has doubled over the last thirty years.

The second priority is **energy independence**, both in supply and in know-how. While France imports almost all its fossil energy, thanks to nuclear power, the country's rate of energy independence is close to 50 %.

The third priority is to **preserve the development of the economic and industrial fabric** thanks to cheap and good quality energy. Nuclear energy, with its low and stable

production cost, provided a foundation for long-term growth in France.

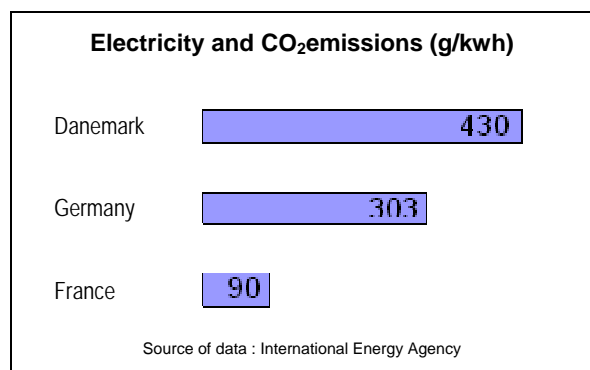
The fourth priority is **environmental neutrality of power generating infrastructure**. In the international context of the fight against climate change, the use of nuclear energy has the undeniable advantage of delivering considerable power without emitting carbon dioxide.

A continuing commitment to security

The issue of security has remained at the very heart of the concerns of the mission after the interim report dedicated to this subject was published. Thus, two unannounced inspections conducted in November 30, 2011, by Messers Claude Birraux and Bruno Sido in the nuclear power plants of Paluel and Blayais revealed some imperfections in written procedures and the importance of staff motivation, which has helped to overcome those shortcomings. In this regard, the intermediate report includes several recommendations to monitor subcontracting conditions better, which is essential to maintaining this motivation.

The consequences of a hasty exit from nuclear energy

Messers Christian Bataille and Bruno Sido highlighted what the situation in France would be like if a decision similar to that of Germany were to be made. Not having, as is the case of its neighbour across the Rhine, fossil resources in its subsoil, such a decision could only heavily increase France's gas imports, with serious consequences in terms of trade balance and energy independence. Such a development would expose France to the jolts of energy markets, to the inexorable depletion of fossil resources, and to increased greenhouse gas emissions.



Moreover, the rapporteurs consider that it would be unwise to challenge abruptly an industry that is one of the finest economical achievements of France. It represents 410,000 direct and indirect jobs, contributing to the competitiveness of the country and increasing the strength of its exports.

In addition, a decision to stop all or part of its nuclear activity could weaken the safety mechanisms which were set up in France, both in plant operating and radioactive waste management, and could jeopardize its expertise now recognized internationally.

First, **the dynamics of security can only be considered within a constant search for perfection.** Thus, the announcement of abandoning nuclear energy might increase the risks by putting an end to this process, both through its effect on material investment and know-how acquired and transmitted by staff. Who would indeed invest in or commit themselves to an industry with no future?

Next, **the organization of managing materials and radioactive waste, set up by the laws of**

1991 and 2006, would be undermined by a decision to close down nuclear power plants. The capacity of existing repositories would be insufficient to manage the consequent increase in the volume of waste that would result from accelerating decommissioning, and from abandoning nuclear waste recycling.

More generally, the demotivation of researchers and industrialists would result in a decline in the competitive edge of France in this advanced high-tech industry, with an immediate impact on the attractiveness of the EPR, or Pressurized European Reactor, although it is being developed in several countries.

France has now a competitive advantage in the development of new reactors known as Fourth Generation nuclear reactors. Participating in several international research programs, France assumes a major role in the project devoted to the fast neutron, sodium-cooled reactor, ASTRID.

It would be very damaging to abandon this path, which allows France to exploit the particular strengths of its research fully.

Above all, France does not have, as Germany does, coal reserves for 350 years. France has, however, a stockpile of reusable materials: depleted uranium and plutonium. With the new generation of reactors, **this stockpile would offer the potential to produce electricity for thousands of years.**

Messers Christian Bataille and Bruno Sido therefore considered that nuclear power should continue to play a role, complementary to other technologies, which can only replace it as they progressively mature.

The prerequisites for the development of renewable energy

To date, a massive deployment of renewable energy is hindered by several difficulties.

First, despite a major research effort, they still face technological barriers and experience various degrees of maturity. The mature industries (hydroelectric, onshore wind generators) have a lower cost than developing technologies (photovoltaics, geothermal, offshore wind power). Although some technologies are making headway and the cost

is decreasing very rapidly, a few decades will be needed before real industrial sectors are developed.

Secondly, the supply of raw materials, including rare metals, can be a constraint in the long run.

Thirdly, the infrastructure also raises issues of social acceptability and conflicting uses of the resources. The deployment of renewable energy must undergo extensive consultation with local stakeholders.

Fourthly, the disconnection between the places where energy is produced and where it is consumed would issue the problem of planing a massive and rapid development of the infrastructure required for renewable energy management. **This involves developing networks to improve electricity delivery.** The question is not incidental, since construction time of extra high voltage lines is about 10 years, much higher than the start up time of new electricity generating facilities, which is 3 to 4 years.

Above all, the intermittency of wind and solar energy causes fluctuating production, i.e. a risk of shortage, or, conversely, congestion. **The integration of these energies within the electrical system presupposes the existence of relay sources that can be rapidly mobilized to offset fluctuations in production.**

Fossil-fuel plants are best suited to increase energy supply quickly; they are used primarily to supplement the contribution of renewable energy. This is the case in Germany, where there is an investment spree in last generation combined cycle gas-fired power plants, characterized by robust performance and great flexibility.

In a country like France, drawing most of its electricity from nuclear energy, **the large-scale development of intermittent renewable energy without any breakthrough in electricity storage would automatically imply an increase in the share of fossil fuels in electricity production.**

Also, the importance of developing technologies for managing intermittency is

great, if one wants to make sure the development of renewable energy does not involve using the additional capacity of thermal power stations.

Technologies for managing intermittency

First, thanks to information technology and communication networks, **"smart" networks can help to offset fluctuations in electricity supply.** Many experiments are underway. In France, they rely on the Linky electrical counter, which the Government has already decided to extend widely.

"Smart grids" are designed to optimize power flow between customers and producers, with possible variability depending on needs and pricing. However, no miracle shall be expected: the networks certainly increases, at constant centralized output, the adaptation ability to limited scale fluctuations in supply, **but is not a substitute to fossil-fired plants or mass energy storage devices, when these variations become significant.**

That is why we must commit ourselves now to a research effort in sustained development in the field of energy storage devices. The hearings have allowed us to update two ideas that seem well suited to meet the needs of the mass storage of energy.

On the one hand, **pumped storage power stations, which hold water in tanks for discharge at the appropriate time through turbines are capable of delivering several gigawatts in terms of power.** Today there is only one seawater station in the world, at Okinawa (Japan), but a French consortium led by EDF is considering a similar project in Guadeloupe within the "Investments d'Avenir" funding scheme.

On the other hand, **electricity storage in synthetic hydrocarbon by binding hydrogen produced by electrolysis** is an idea that would have the triple advantage of resolving the issue of intermittency, allowing the recycling of carbon, and securing energy supplies for countries that have mastered this technology. France must embark, as has Germany, on that promising direction, which will also appeal to emerging countries that produce large quantities of CO₂.

Conclusion

Messers Christian Bataille and Bruno Sido, advocate a "reasonable middlepath" for nuclear power until the end of this century, adopting an alternative scenario between putting an end to nuclear power or keeping it at current levels, thus maintaining the four strategic goals of the French energy system: adapted power supply, energy independence, climate neutrality, and economic development.

This approach leads to consider adjusting the number of **nuclear reactors being decommissioned**, as will be decided by the nuclear safety authority (Autorité de sûreté nucléaire), **at a rate of two reactors decommissioned for one new generation reactor built**.

The share of nuclear power would thus be reduced to a level of between 50 % and 60 % of today's total energy output by 2050 for Generation III EPR reactors, and at a level of about 30 % by 2100, for Generation IV reactors.

This progressive approach would allow the time necessary for **the industrial maturation of massive energy storage technologies (seawater pumped storage power stations or synthetic hydrocarbon) necessary to compensate for the intermittency of wind and solar energy** without being forced to use fossil fuel power plants, which emit CO₂. The concomitant development of "smart grids" would complete the system by enabling optimized use of these new production systems.

The two rapporteurs emphasize the role of energy efficiency, in particular, to counteract the strong growth in electricity demand caused by changes in technology, especially through the development of digital entertainment. **Anxious to increase the energy efficiency of buildings, they stress the need for genuine transparency in performance measurement, and in the conditions of diffusion of innovative products**, and call, in this regard, for the creation of a regulation agency along the lines of ARCEP (The French electronic communications and postal sector regulator), which has guaranteed the success of the revolution in electronic communications.

Finally, **they observed that, in order to avoid triggering off a "scissor effect", the energy transition to renewable energy should build on the current production system**, and that the remaining part of nuclear power generation, which will be then delivered by Generation IV reactors, will provide France, towards the end of the century, with a foundation for its **energy independence** equivalent to that supplied to Germany by its 350 years brown coal reserves, while avoiding the pitfalls of an excessive reliance on a single energy source. With the urgent closing down of all its nuclear plants, the example of Japan has shown the risk of such reliance and its consequences for the economy.

The full report in French can be downloaded at :
<http://www.assemblee-nationale.fr/13/rap-off/i3716.asp>
<http://www.senat.fr/notice-rapport/2011/r11-199-1-notice.html>

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