

PUBLIC THEMATIC REPORT

Paris, 8 February 2012

The costs of the nuclear power sector

The Cour des Comptes report brings together all the factual data currently available concerning the past, present and future costs of generating nuclear electricity in France. It does not take a position as to the desirable level of this output or how it should be funded.

A - Past expenditure is reasonably well identified

1 - Heavy initial investment

The total cost of building the nuclear power generating facilities was €121 billion₂₀₁₀ (excluding the construction of Superphénix).

The **construction of the 58 existing reactors**, with total installed capacity of 62,510 megawatts (MW), cost **€96 billion**₂₀₁₀. In addition to this initial investment, the **cost of building the first generation** was a further **€6 billion**. Furthermore, the **investments required for the fuel cycle**, in particular the setting up of the **reprocessing industry**, currently operated by AREVA, cost France **€19 billion**₂₀₁₀.

2 - The construction cost per megawatt has risen over time

In terms of reactor power, initial construction costs have risen over time, from €1.07 million₂₀₁₀/MW in 1978 (Fessenheim) to €2.06 million₂₀₁₀/MW in 2000 (Chooz 1 and 2). For the prototype Flamanville EPR, with an estimated construction cost of €6 billion and an output of 1630 MW, the cost is €3.7 million per MW.

3 - Major research expenditure

If **private and public-sector research spending**, which came to **€55 billion**₂₀₁₀ (**1 billion** euros per year on average) and the cost of Superphénix (€12 billion for investment, operation and shutdown) are taken into account, the **total amount of past investment amounts to €188 billion**₂₀₁₀.

B - Clearly defined current operating expenses

EDF's annual operating expenses came to **€8.9 billion**₂₀₁₀ for a total power output of 407.9 terawatt-hours (TWh) in 2010. These costs are clearly identified and there is no particular difficulty involved in their calculation.

Similarly, public spending came to €414 million for research and **€230 million** for costs relating to **safety, security and information to the public**, for a total of **€644 million** in 2010.

C - Future costs that are uncertain by their very nature

The total of such costs as of the end of 2010 has been estimated at **€79.4 billion**₂₀₁₀, of which **€62 billion**₂₀₁₀ is to be borne by EDF.

These charges include **dismantling costs**, i.e. the costs of "demolishing" power plants, currently estimated at **€18.4 billion**₂₀₁₀ of gross expenditure to dismantle the 58 reactors currently in use. The Cour des Comptes is of the opinion that the calculation methods used by EDF are appropriate, but cannot validate their technical parameters in the absence of in-depth studies by experts.

Another significant future cost is **long-term waste management**, the estimated cost of which is **€28.4 billion**₂₀₁₀. This is a tentative estimate since no firm decision has yet been made about the project under consideration for the disposal of long-lived waste (i.e. placing it in a deep geological repository).

From its investigations, the Cour des Comptes has concluded **that all future costs have been properly identified** by operators, **but have not all been assessed with the same degree of accuracy**. Although the nature of these estimates is such that they are inevitably far from certain, **the Cour des Comptes is of the opinion that these future costs are likely to increase**.

D - Maintenance investments set to increase

Prepared in 2010, EDF's maintenance investment programme for 2011-2025 came to €50 billion: an annual average of approximately €3.3 billion and almost twice the amount of investment in 2010 (€1.7 billion). The cost of the investments needed to meet the requirements of the ASN, the French Nuclear Safety Authority is today estimated at some €10 billion, half of which is already planned in the initial €50 billion programme.

E – Overall generating costs to increase

Generating electricity from nuclear power is a long-cycle, capital-intensive industry in which the cost of capital is a variable – and one which has a highly significant impact when calculating the overall cost involved.

If remuneration of capital is taken into account, using the so-called current economic cost model, which reflects all costs throughout the operating lifetime of the fleet and enables comparisons with other types of power generation to be made, **the average generating cost per MWh comes to €49.5 on the basis of 2010 data**.

The Cour des Comptes has shown that **while the impact of changes in future costs relating to dismantling and waste management is limited, fluctuations in maintenance investment costs have far more impact, equivalent to around 10 percent of the average cost**.

F – Power plant service life: a strategic choice

Over and above the issues of dismantling and final waste disposal, **the Cour des Comptes' analysis shows that the service life of power plants currently in operation is a major factor in energy policy**. It has a **significant impact on the cost of the industry**, enabling investments to be written off over a longer period of time. In addition, it **defers both dismantling costs and the need to invest in new power plants**.

The Court has noted that **by the end of 2022, twenty-two of the fifty-eight reactors will have entered their fortieth year of service**. Consequently, assuming an average service life of 40 years, **a massive level of investment would be required**, equivalent to the construction of 11 EPR reactors, to maintain constant levels of nuclear power output – by the end of 2022. Implementing an investment programme of this scale in the short term appears **highly unlikely or indeed impossible**, not least due to industrial considerations.

In the absence of any such investment decision, an implicit decision has therefore been taken that already commits France: either its power plants must be made to last more than 40 years, or the energy mix must be quickly and significantly altered in favour of other sources of energy, which assumes additional investments.

Irrespective of the choices made, in order to maintain current levels of power generation, **major investments must be planned** in the short and medium term, representing at least **a doubling of the current pace of maintenance investment**. This doubling will mean **an increase in average generation costs of some 10 percent**.

The Cour des Comptes is of the opinion that rather than being made by default, **future investment decisions should involve an energy strategy which is formulated, debated and adopted in a fully transparent and explicit manner**.

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