

The Economics of Radioactive Waste Management - Status Quo, Lessons Learned and Policy Perspectives

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Overview

Nuclear power and nuclear waste is a major research field in engineering, but not so much in economic policy neither in industrial organization; especially radioactive waste management has been sparsely addressed. Not a single site for long-term storage exists as of today, and few countries have accumulated sufficient funds to finance this activity, lasting at least a century and requiring safe storage for at least a million years. Due to this long-term nature and its high capital intensity, radioactive waste management is intimately related to financial issues. There are many different approaches to provide the financing of long-term storage in the 31 countries employing nuclear power for electricity generation. Given the expected massive shutdown of plants and the dire need to manage the waste safely for generations, there is an urgent need for a better understanding of the technological waste management process, as well as waste management policy, and regulations.

This paper analyses and compares the different national waste management policies and practices in Europe and the U.S. with a strong focus on five major nuclear countries: France, Germany, United Kingdom, Sweden, Switzerland, and the U.S. The paper is based on recent research projects by the authors (Wealer et al., 2015; Seidel and Wealer 2016; Wealer, Bauer, and von Hirschhausen 2017; Wealer et al. 2017; Fairlie, MacKerron, and Wealer 2018; Schneider et al. 2018; Hirschhausen 2017), and in-depth case studies on the technical, economic, and institutional developments for these countries

Methods

We deploy a comparative institutional approach to describe the strategic choices of plant operators and national and international governmental bodies, the “regulators”. We distinguish the two main elements of the process: waste management needs to be financed, and someone has to manage the production process of decommissioning (i.e. the provision of the services). The case studies are based on a detailed scheme of analysis (Beckers, Gizzi, and Jäkel 2012; Seidel and Wealer 2016), that provides for different “organizational models” for the sector: on the one hand different ways of financing, such as the federal budget, a dedicated fund (private or public), in-house financing by the companies, and yet others; and on the other hand the different actors carrying out the storage process, which can be private or public companies.

The empirical part of the paper includes recent case studies, that have been already been published by the authors for Europe and the U.S. The statistical analysis will focus on the technological status quo of the waste management process (i.e. volumes of waste, disposal facilities for low-and intermediate-level (LILW) and high-level wastes (HLW)), cost estimates and realized costs. In addition, the organizational challenges of the countries will be analyzed to identify possible policy issues.

Preliminary Results

The waste management process is technologically complex and poses major challenges in terms of the long-term planning of execution and financing. As of 2018, still not a single site for long-term storage exists for the around 370,000 t heavy metal (HM) of spent nuclear fuel, that has been generated worldwide (IAEA 2018, 35, 36). There is a dire need for establishing a common reporting format for the radioactive waste volumes, as the waste categories differ from country to country, even within the European Union making an exact and comprehensive comparison between the countries nearly impossible. The siting and future operation of a long-term storage facility for HLW is in most cases the scope of the government. Until today only a few countries have installed operational disposal facilities

for LILW. In Europe, only less than half of the observed countries even have installed disposal facilities for LILW (i.e. U.K., France, Spain, Hungary, Finland, Czech Republic, Sweden, and Germany) and waste is currently stored on the site of the nuclear power plants.

Financing of the waste management processes is a long-term challenge and cost estimations are underlying many uncertainties (e.g., long time-scales, estimated interest and inflation rates) and are hence prone to underestimation. In Germany, the financing and liability system was reformed in 2016 and the liabilities for storage are going to be transferred to a public fund. In Sweden, the financial resources are secured in the public Nuclear Waste fund, which is characterized by a high degree of authority control, transparency, and public participation. In the U.S., financial flows to manage the future storage of HLW are irregular at present. Following the 1982 NHPA, electricity ratepayers were required to pay a tenth of a cent per kilowatt-hour into the nuclear waste fund held by the DOE in exchange for the administration accepting SNF for disposal. As the DOE failed to deliver, the fee was abandoned in 2014. Already, DOE has spent over US\$10 billion in legal penalties, and the administration currently estimates that total damages could amount to \$20.8 billion—if the government begins accepting fuel in 2020. If the administration fails again to deliver, the liabilities could increase by hundreds of millions of dollars annually (BRC 2012, 79).

Conclusion

Radioactive waste management poses a complex challenge to utilities and regulators. This paper identifies lessons from the specific national approaches in Europe and the U.S.; in particular at the interaction between financing, service provision and regulation and derives lessons learned and policy perspectives for nuclear countries. In general, waste management has been underestimated from a financial as well as a technological point of view, which has led to poor outcomes. Going forward, waste management in Europe faces a challenge of finding long-term storage facilities for HLW in 18 countries. In the U.S. a reform of the financing scheme is urgent to restore stability in the sector. One unifying concept, observed in nearly every country, is the polluter pays principle, which makes the operator of a facility viable for paying for the costs caused by his commercial activities. Although, in reality, it seems that the polluter pays principle is not applied for the long-term storage of radioactive wastes. A variety of organizational models has evolved in which the national authorities more or less take over technical and financial responsibility for managing the very long-term issues of waste management from the operator of the nuclear facility. These long-term costs and risks are instead socialized, whereas the private investor may be required to contribute to the financing of the long-term costs. Overall, from a financing point of view, a public fund seems to be the most suitable option to finance the future costs and to mitigate the financial risks of the society even if it also could not overcome the problem of too low cost estimations. The payments to the fund should be spread over time in order to help the companies to adapt.

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