Cross-country survey on the decommissioning of commercial nuclear reactors: status, insights, and knowledge gaps

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Abstract. In the past, nuclear decommissioning has often been overlooked in the literature but will gain increasing relevance amongst researchers and industry alike as more and more nuclear power plants reach the end of their respective operational lifetimes (Laraia, 2018; Schneider et al., 2022). Existing research has up until recently focused mostly on technical challenges and liability issues of nuclear decommissioning, while analyses of the organization, regulation, and financing across various countries remain limited. In this cross-country survey paper, we compare the differing approaches for nuclear decommissioning organization in France, Germany, Sweden, Switzerland, the United Kingdom (UK), and the United States based on detailed country reports (Wimmers et al., 2023). We find that while, in theory, the countries follow the same standards, the implementation of responsibilities for nuclear decommissioning, financial liability, and oversight can differ quite significantly. For example, France is the only country in our survey to have implemented a centralized ownership of its nuclear reactor fleet, while all other countries have multiple operators that necessitate a different regulatory approach. In terms of financing, we observe that most countries follow a single approach, while Germany and the UK have different financing schemes depending on the nuclear reactors to be decommissioned (e.g., the former GDR reactors in East Germany and the UK’s non-PWR (pressurized water reactor) legacy fleet). Based on our analysis, we derive several insights that merit further research on the topic of nuclear decommissioning. For example, the interlinkage between ownership and nuclear decommissioning production should be of particular interest, as we determine potential organizational models (following the system approach coined by Beckers et al., 2012) emerging through corporate actors aiming at the monetization of swift decommissioning – a trend that cannot be observed where the state is in full control. We further find that only limited information on decommissioning costs exists. Reducing knowledge gaps in this regard would help further understand and potentially identify potential challenges in nuclear decommissioning in advance before more nuclear reactors are shut down. Further insight into nuclear decommissioning fund adequacy and liability issues might be required to avoid the transfer of financial liabilities from private operators to taxpayers. Other research gaps include an analysis of market-based decommissioning approaches and possible supply chain bottlenecks and the subsequent investigation of efficiency through economies of scale, the limitation of nuclear decommissioning production from limited access to nuclear waste management facilities, and the influence of regulation, e.g., the number of overseeing regulators, on the production.

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