EARLY NUCLEAR POWER PLANT PHASE-OUT AND NUCLEAR DECOMMISSIONING FUNDS IN THE NEW YORK ELECTRICITY MARKET

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Overview

Over the past decade, the landcape of nuclear power plants in the United States has altered significantly. Since 2009, eleven reactors totaling 8.4 GW of capacity have officially shutdown, primarily due to adverse economic conditions. Owners of an additional ten nuclear reactors accounting for about 8.9 GW have announced plans to cease operations by 2025 (NEI 2019). To stem the tide of premature nuclear retirements, five U.S. states introduced short-term targeted subsidies for 'at-risk' nuclear power plants collectively known as 'Zero-Emission Credits (ZEC)'. The justification behind the introduction of such programs was to preserve the zero carbon attributes of nuclear power and to compensate nuclear plant owners for the clean energy produced (NEI 2018). However, the subsidies are short-term measures that are all set to expire by 2030, thereby raising the possibility of imminent nuclear shutdowns in the coming years.

Crucially, premature nuclear power plant retirements severely curtails income streams which has direct implications on the adequacy of funds for safely decommissioning the facility. In the context of the U.S, most nuclear plant owners are authorized to accumulate decommissioning funds over the lifetime of a plant. The funds are segregated in a decommissioning trust fund (DTF) for the sole purpose of decommissioning the facility at the end of its lifetime. Since much of the funds are accumulated over the later phase of the plant's lifespan, early retirement poses a potential risk on the adequacy of decommissioning funds.

In light of the aforementioned issues, two crucial policy-relevant questions emerge which form the basis of this paper: first, what are the total costs of phasing-out nuclear plants in the State of New York in comparison to the costs of the nuclear subsidy program and proposed policy mechanisms (i.e. carbon price)? Secondly, in the event of an early nuclear plant phase-out, what are the potential implications on the income streams of nuclear power plants and by extension the sufficiency of decommissioning funds? Ultimately, this paper bridges a significant gap in the literature by exploring the interconnection between electricity markets and the often-overlooked aspect of nuclear decommissioning funds as encapsulated in Figure 1.

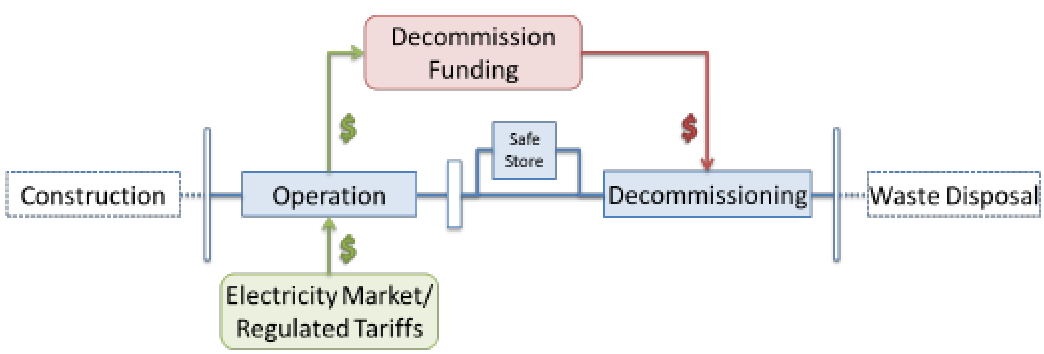

Figure 1: Schematic representation of a nuclear power plant life cyle (Weigt and von Hirchhausen, 2018)

Methods

The proposed model is being developed as part of project on the "*best practices for decommissioning of nuclear power plants***"**, a joint collaboration between the Chair of Energy Economics at the University of Basel and Workgroup for Infrastructure Policy at the Technical University of Berlin (TUB).

The core of the framework is a detailed bottoms-up economic dispatch model of the New York Independent System Operator (NYISO) zonal system, following a DC load flow approach. The model identifies the least cost dispatchable generation unit to satisfy total load for each NYISO zone at an hourly resolution, given a set of technical constraints. On the supply side, the model incorporates all existing resources in the NYISO market, operational constraints, generator costs, availability profiles for renewables (wind, solar), hydro power technologies (pumped storage, seasonal storage, run-of-river) and detailed network data. The model is calibrated to 2018, corresponding to a full year when upstate nuclear power plants in New York (Ginna, Nine-Mile and Fitzpatrick) were recipients of the ZEC's. In comparison to other recent bottoms-up dispatch model applications for Northeastern U.S. (Haratyk 2017; Tsai and Gülen 2017), our model is unique in the sense that it represents the NYISO system at a relatively high spatial resolution by incorporating the eleven internal NYISO zones and captures the features of the hydropower system in detail. In later stages of the project, the model would be expanded to incorporate neighboring electricity markets (i.e. ISO-NE, PJM) as aggregate nodes.

To address the first research focus, a base-line calibration model is set-up to replicate NYSIO market conditions for 2018. Hourly locational marginal prices are then retrieved using the dual of the energy balance. Subsequently, a phase-out scenario is implemented whereby upstate nuclear power plants are phased out prematurely. This assessment evaluates the total system costs of an early nuclear power plant shut-down and compares it to the cost of the current ZEC program. The second assessment takes into consideration the long-horizon income conditions of nuclear power plants and implements several scenarios under alternative policy mechanisms. The flexibility of the dispatch model, would allow for extended scenarios taking into account cross-nuclear plant effects and cross-technology effects such as renewables. Results generated from the market model scenarios are then combined with a simplified computational method to address the adequacy of decommissioning funds.

Expected Results

Results generated from the modeling framework would shed light on the total costs of phasing out nuclear power plants prematurely vis-à-vis the current subsidy legislation as well as proposed policy mechanisms. Additionally, results would highlight the potential implications arising from curtailed nuclear power plant revenues.

Conclusions

As more nuclear power plant owners in deregulated U.S market threaten early closures, it is crucial to take into account the potential feedback effect on the market. This paper provides a market-based comparative assessment between maintaining nuclear power plants under various policy mechanisms and prematurely phasing them out. At the back-end of the nuclear fuel cycle, adequate decommissioning funds are necessary to ensure the safe dismantling of nuclear power plants. However, the current decommissioning funding policies that specifically address funding risks arising from early shut-down scenarios are underdeveloped. This paper sufficiently addresses both the market and back-end of the nuclear power plant lifecycle.

References

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