Costs and Benefits of Saving Unprofitable Generators:
A Simulation Case Study for US Coal and Nuclear Power Plants

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We use a detailed power sector simulation model, the Engineering, Economic, and Environmental Electricity Simulation Tool (E4ST), to project multi-decade effects of preventing a set of unprofitable generators from retiring. We simulate the "Grid Resiliency Pricing Rule" proposed by the US Department of Energy in 2017, and several variations, as an illustrative case study for similar national, regional, or state policies in the US or elsewhere. In the proposed policy, eligible coal and nuclear generators would be guaranteed revenues sufficient to ensure profitability. We assume that the subsidies in each state are funded by a statewide uplift charge. Our analysis assumes that the policy does not otherwise affect the efficient functioning of the market, and it does not attempt to simulate resilience or reliability effects of the policies. The simulation results show that, in 2025, $7.6 billion in subsidy is required to guarantee coal and nuclear generator profits in the three ISO/RTO territories that would likely have been subject to the policy. If in effect from 2020-2045, the policy delays the retirement of 25 GW of coal capacity and 21 GW of nuclear capacity, causes 27,000 premature deaths from increased sulfur dioxide and nitrogen oxide emissions, and increases carbon dioxide emissions by 420 million short tons. It has costs with a net present value of $263 billion during that period, of which $217 billion are environmental damages. The policy's net non-environmental cost for electricity end-users is $72 billion and net benefit for generation owners is $28 billion. Figure 1 shows the effect of the policy on coal, nuclear, and natural gas-fired generation. Almost all of the displaced generation and capacity is fueled by natural gas. Figure 2 shows the effect on end-user electricity prices in 2025, by location. Figure 3 decomposes the system-wide average end-user electricity price effect into uplift charge and effect on locational marginal prices, showing that the latter offsets approximately half of the former. In alternative scenarios, preventing retirement of only nuclear capacity produces positive total net benefit, while guaranteeing only going-forward costs shifts $77 billion of costs from customers to generators, but does not reduce emissions or total net cost. In another alternative scenario, we estimate the effects of higher natural gas prices on the results of the potential policy. We find that higher natural gas prices reduce most of the effects of the policy, and estimate the extent of the reduction in end-user electricity price impact. We also examine the interaction of the policies with an emission cap-and-trade program. Under a cap-and-trade program such as the Regional Greenhouse Gas Initiative, preserving only nuclear capacity can cause a net increase in coal-fired generation, rather then crowding it out, because of the effect on the emission allowance price. Likewise, preserving only coal capacity can cause a net increase in nuclear generation, rather than crowding it out.

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Figure 1. Effects of Profit Guarantee on Coal, Nuclear, and Gas Generation (Change from BAU)

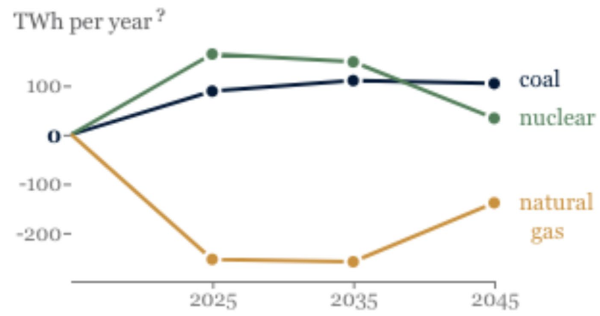

Figure 2. Effects of Profit Guarantee on End-User Prices, in 2025 (Change from BAU)

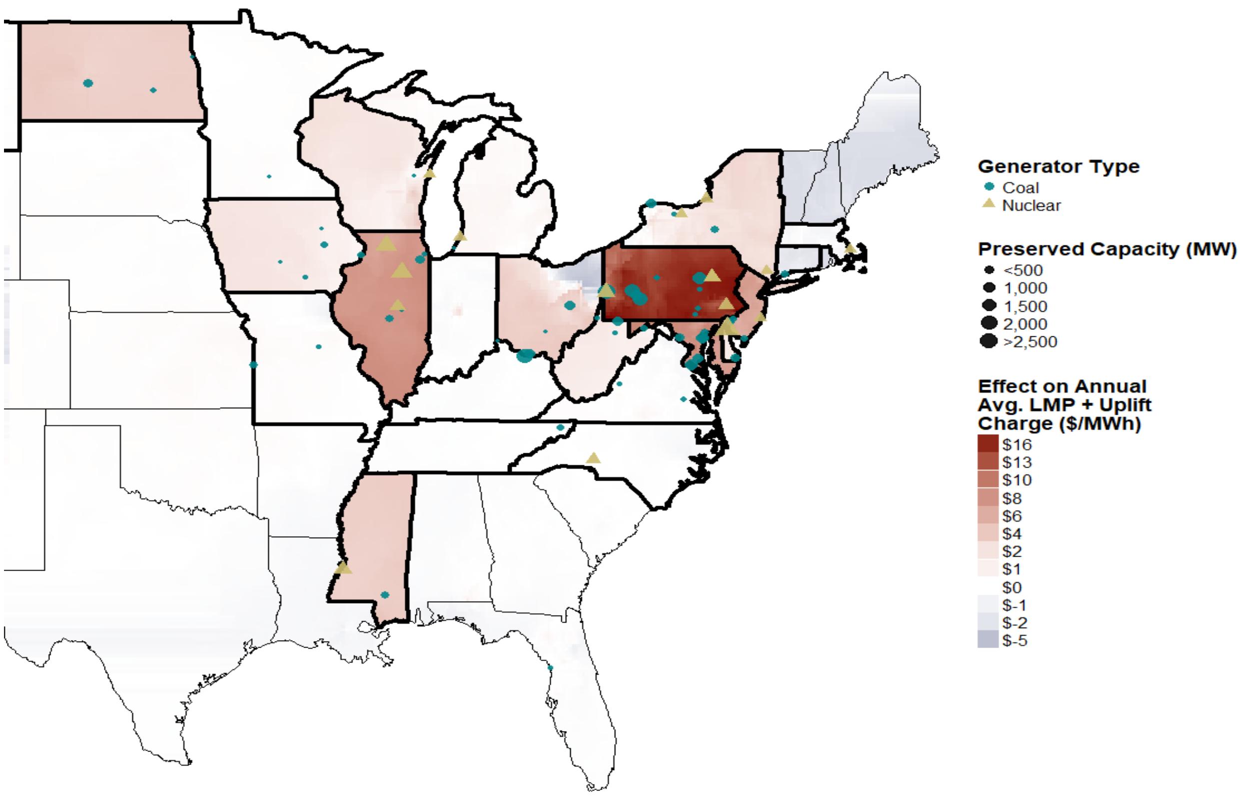

Figure 3. Decomposition of Effect on System-Wide Average End-User Electricity Price