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RESEARCH BRIEF

The Climate and Economic Rationale for Investment in Life Extension of Spanish Nuclear Power Plants

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Nuclear power provides more than 20 percent of Spain's electricity. As each of the seven plants approaches its 40 year design life, a decision must be made whether to invest in a life extension. This decision must be made in light of Spain's goal of reducing GHG emissions. This research shows that life extensions are the least-cost alternative for further reducing GHG emissions.

The transformation of Spain's generation assets is a fundamental question facing industry and government leaders. Earlier this year the Spanish government released a "Commission of Experts" report analyzing a variety of installed capacity scenarios for 2030. Scenarios with and without nuclear life extensions were explored. More recently, the Prime Minister announced draft climate and energy legislation targeting 100 percent renewables by 2050 and an end to subsidies for fossil fuel generating plants. However, the announcement was silent on the role of the existing nuclear assets in the interim.

This research looks at the total system cost of supplying Spain's electricity needs in 2030 with and without nuclear life extensions. If the nuclear plants are retired, then Spain must select a replacement for the lost generation. In order to maintain the same level of GHG emissions, we examine the cost of replacement with additional solar PV, or with wind, or a combination of the two. Alternatively, it could include some incremental use of fossil-fueled generation such as NGCC units, which would produce incremental GHG emissions.

To calculate system cost, we model the least-cost dispatch to meet a 2030 scenario for hourly load given scenarios for hydro, solar and wind resources. Given the scale of solar PV and wind penetration anticipated by 2030, curtailment is likely to have a significant impact on system costs. The dispatch model optimizes the use of Spain's hydro reservoirs, pumped hydro and future battery capacity in order to minimize curtailment of renewable generation. Our calculation of system cost captures the impact of curtailments after minimization using storage.

We utilized our dispatch model to determine portfolios of capacity that substitute different combinations of solar PV and wind capacity as a replacement for the nuclear life extensions. These substitute portfolios serve the same load and achieve the same level of total GHG emissions from generation, but have different cost.

Ultimately we show that investing in nuclear plant life extensions is the least-cost alternative for further reducing GHG emissions. Social cost savings on the extension of all seven plants are at least €8 billion relative to the next least cost option.

The research also examines the value of nuclear life extensions in comparison to natural gas-fired combined-cycle plants. We first do this without regard to any cost attributed to GHG emissions, and we again find nuclear plant life extensions are the most cost efficient option. Forecasted natural gas price would have to fall below €17/MWh before the avoided cost of combined-cycle generation fell below the incremental system cost of the nuclear generation and capacity. In addition, preserving the seven nuclear plants reduces GHG emissions by more than 16 million tons (CO2eq).

As this working paper emphasizes, nuclear life extensions are an element of the least-cost path to decarbonization. An earlier CEEPR working paper, now published, had shown the same result for the U.S.—see Haratyk (2017). The importance of preserving the existing nuclear fleet is one of the conclusions of the recently released MIT study on the Future of Nuclear Energy in a Carbon-Constrained World (2018). Other colleagues here at MIT have also demonstrated the value of nuclear to decarbonization using a more complex and robust modeling framework—see Sepulveda et al. (2018).

References

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