A CASH FLOW MODEL OF CARBON CAPTURE RETROFIT INVESTMENT IN TEXAS POWER GENERATION USING MONTE CARLO SIMULATION

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ABSTRACT

The retrofitting of carbon capture systems to fossil-based powerplants is increasingly critical to decarbonization efforts within the power sector. However, private retrofit investment remains limited due to substantial project costs and risks without adequate incentives. Ambiguity in climate policy design, feasibility, and influence adds to the preexisting commercial and technical risks of retrofitting. Consequently, power producers must make retrofit decisions under considerable uncertainty.

This research seeks to construct a flexible discounted cash flow (DCF) model to represent plant-level retrofit decision-making within the ERCOT power system of Texas. Through Monte Carlo simulation techniques, the model incorporates both user-determined and stochastic parameters representative of the technical, financial, and policy uncertainties associated with retrofitting coal and natural gas powerplants. The model separately evaluates both the net present value (NPV) of a hypothetical standalone retrofit project and the incremental NPV comparison to the existing, non-retrofitted status quo.

Model results indicate minimal commerciality for CCS retrofitting within the Texas and ERCOT markets. Disparities in parameter sensitivity by plant fuel type, driven by differences in retrofit costs and CO2 intensities, suggest that plant type partially dictates the efficacy of decarbonization policy proposals, including a carbon tax. Sensitivity results show that existing CCS incentives and policy designs overcompensate inefficient coal plants in maximizing electricity generation for the sake of subsequent capture of the CO_2 byproduct. Future policies will likely need to both reduce the upfront cost and offset post-retrofit additional operational and fuel costs to incentivize retrofitting. Overall, the model design establishes a simple, yet versatile, tool to improve the consensus on carbon capture retrofit sensitivities, policy design, and decision-making considerations.

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