Perceptions of Risk in Increasingly Capital-Intensive Electricity Grids: Measuring the Impacts of Accurate Cost of Capital Representation on Investment Planning for Future Energy Systems

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Abstract

The electric grid is going through an era of unprecedented change, propelled by deregulation and the expansion of carbon-free intermittent resources. Despite the complex financing dynamics that currently help determine the set of technologies being deployed onto the system, many tools used by stakeholders to guide long-term system planning instead opt for oversimplified financing cost representations. Through the modeling of the ERCOT electric grid using the Regional Energy Deployment System (ReEDS), this study assesses the significance of improved representation of financing costs for various stakeholders in large-scale capacity expansion models. This is achieved through the exploration of two distinct but connected research objectives, the first being relevant to energy modelers and the second to policymakers.

First, the impacts of representing financing costs in a more sophisticated manner across technologies and over time are measured through the investigation into empirically observed financing dynamics, including (1) the general level of risk associated with the electric power sector, (2) differences in technology-specific risk perception, (3) financing improvements as investors gain familiarity technologies, and (4) operational risk priced into "hurdle rates." ReEDS analysis finds that general system risk does matter, as a system modeled with a uniform 10% discount rate deploys 43.9% less renewable capacity compared to one with a market-weighted uniform 6.02% discount rate. Implementing financing learning rates can also have a material effect on system outcomes, increasing wind and solar deployment by 16.5% through 2050.

Secondly, a policy analysis, enabled by the improved financing representation developed in the first objective, is completed to predict system outcomes more precisely from a move to Direct Pay in a 10-year tax credit extension, recently proposed as part of Biden's *Build Back Better* infrastructure package. Through the construction of an investor-level discounted cash flow model to measure the impact of a switch to refundable tax credits on a project's debt capacity, the study demonstrates how the policy would increase renewable technologies' access to lower-cost capital, unlocking further grid deployment. Subsequent ReEDS modeling finds that Direct Pay's primary advantage lies in accelerating the deployment of wind and solar over the period 2022-2030, enabling the grid to reach a market saturation of renewable technologies sooner. This switch results in cumulative emissions reductions of 24% through 2050, compared to current nonrefundable tax credits due to the reduction in financing costs alone. This reduction increases to 35% when including the reductions in soft costs from the move to more simplified capital structures.

Keywords: Electricity, Investment Planning, Capacity Expansion Modeling, Financial Modeling, Risk Perception, Renewable Energy, Tax Credit Policy

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