Do interest rates matter for the transition? The role of cost of capital in energy system models

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Overview

Energy system models guide policymakers in implementing the energy transition in European countries. Despite their importance, several crucial aspects of models remain underexplored, one of which is the cost of capital (CoC), most often captured in the discount rate used (Steffen and Waidelich, 2022). The CoC directly influences the cost-competitiveness of different investment options (Polzin et al., 2021; Schmidt et al., 2019) and empirically varies considerably between technologies and regions (Steffen, 2020). Hence, using realistic CoC rates in energy system models is crucial for model results. However, there is no comprehensive review on how modelers are actually considering the CoC within their analysis nor guidelines for how to do it.

Methods

In this study, we aim to address this gap and bring structure to how CoC rates are and ought to be considered in energy system models. First, we present several quantitative examples how variance in interest rates and CoC can affect cost-optimal pathways for the low-carbon energy transition, drawing on exemplary system models. Then, we review 58 recent model-based publications concerning their approaches for addressing CoC. Next, we identify four barriers currently impeding a more thorough consideration of CoC. Finally, we provide recommendations for how CoC could be better accounted for in energy system models, including a heuristic guide to support modelers.

For the literature review part specifically, we first used the Scopus database to retrieve a long-list of 355 publications that explicitly considered CoC in their analysis. We consider English-language publications published between 2010 and 2021. As a second step, we manually filtered our long-list and discarded publications that did not feature a model-based analysis of energy investments, did not apply CoC within the modelling activity, or were otherwise irrelevant. This second step left us with a sample of 58 relevant publications.

Results and Conclusion

In our review, we find that of the 58 publications that explicitly considered CoC, about two-thirds applied differentiated CoC values in their analysis. Authors most commonly differentiate CoC according to asset location and/or policy scenario. About half of the papers consider more than one type of variation, e.g. considering the CoC to be a function of technology and location.

Concerning the method for determining the CoC, about one third of the publications explain CoC to be based on assumptions alone. Despite an increasing body of literature that provides empirical CoC values and approaches to estimate such, authors' own assumptions have remained the most used approach also in recent years. Meanwhile the use of other sources has changed: expert elicitation is becoming less prominent but the use of past project data and academic reference values are becoming more prominent as the data availability and the literature improve.

To improve the representation of CoC in the future, we then identify four barriers to a more accurate CoC reflection in models: (1) A lack of awareness of the relevance of CoC to model results, (2) An absence of best practices for how CoC rates ought to be differentiated, (3) The unavailability of data needed to inform CoC rates, and (4) Complexity associated with integrating CoC into models. Finally, we suggest practical steps for overcoming them, including heuristic guidelines to support modelers determine when differentiated CoC rates ought to be applied.

References

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