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Title: Using Real Options to Evaluate Optimal Funding Strategies for Carbon Capture, Transport and Storage Projects in the European Union

Abstract: Several projects in the European Union (EU) are currently under development to implement the carbon capture, transport and storage (CCS) technology on a large scale and may be subject to public funding under EU support initiatives. These CCS projects may try to develop any combination of three types of operating levels: demonstration, up-scaling and full-scale, representing progressing levels of electric power generation capability. Several projects have commenced at the demonstration level, with full-scale commercial operation levels planned for approximately 2020.

Taking the perspective of a funding agency, we employ a real options framework for determining an optimal funding strategy for project selection for the development of full-scale CCS plants. Specifically, we formulate and solve a stochastic dynamic program (SDP) for obtaining optimal funding solutions in order to achieve success by a target year. We obtain the needed data on projects costs and technology success probabilities by subject matter expert interviews. The model demonstrates the improved risk reduction by employing such a multi-stage competition and explicitly considers the benefits of knowledge spill over among competing projects. We then extend the model to consider two sensitivities: 1) the flexibility to spend that budget among the time periods and 2) optimizing the budget, but specifying each time period's allocation *a priori*. State size and runtimes of the SDP model are provided.

Our results show that an optimal *a priori* budget allocation leads to objective function values similar to the fully flexibly budget allocation. The advantage of the optimal *a priori* budget allocation over the flexible allocation however is an increase in the credibility of the funding scheme from the perspective of the firms undertaking such high risk projects.