TRADE-OFFS AND SYNERGIES IN THE ALLOCATION OF CARBON CONTRACTS FOR DIFFERENCES – A COMPREHENSIVE REVIEW

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Overview

Carbon Contracts for Difference (CCfDs) have emerged as an economic policy support tool to incentivize investments in low-carbon industrial production processes, which are currently hindered by high costs, as well as low and uncertain carbon prices. CCfDs are contractual agreements between governments and low-carbon projects' developers guaranteeing a fixed carbon price over the contract duration to bridge the cost gap with conventional industrial processes. While only theoretically introduced in 2017 by Richstein [1], the concept of CCfDs has rapidly entered academic and public discourse.

As CCfDs begin to be implemented in practice, the practical aspects of their implementation have received increasing attention in the literature [2-3]. One of the key implementation elements is the design of the CCfD allocation, which has a significant impact on whether CCfDs can achieve the intended objectives and the associated costs. In this context, it is important for policymakers and other stakeholders to be informed about the various CCfD allocation options and their respective implications. However, an analysis of the current literature on CCfDs reveals a lack of comprehensive overview of the relevant allocation aspects and the implications of allocation design options. While several studies touch upon the allocation of CCfDs [4-6], they often focus on single or limited aspects in isolation and provide rather general theoretical discussions of alternative design options.

This study aims to address the existing knowledge gap by conducting a comprehensive literature review on the allocation of CCfDs and the associated trade-offs and synergies in the choice of allocation options. In addition to providing an overview of the current state of the literature, it seeks to extend the scope beyond a traditional literature review by incorporating insights from an analysis of the first real-world implementations of CCfDs.

Methods

First, an extensive review of current academic and grey literature related to CCfDs is conducted. From the analyzed literature, key information on the allocation of CCfDs is extracted, summarized, and systematically categorized according to to their relevance for the following political evaluation criteria: effectiveness, static efficiency, dynamic efficiency, and practical and legal feasibility. These criteria are chosen because they allow for a systematic categorization of findings, making it easier to draw comparisons across different studies and allocation design options. Additionally, the allocation aspects are further categorized into the practical design aspects eligibility, award procedure, and award criteria, thereby linking policy evaluation criteria to tangible design options.

Second, a comparative analysis of CCfD schemes in practice is conducted, focusing on the Dutch "SDE++", the German "Climate Protection Contracts" (KSV), the British "Industrial Carbon Capture Contracts", and the French "Major Industrial Decarbonation Projects" programs. The analysis draws from regulatory documents and relevant literature in French, German, and English. For each of the analyzed programs, general information is gathered, alongside a detailed analysis of their allocation aspects. The analysis is categorized by practical elements, specifically focusing on the implementation of eligibility, award procedures, and award criteria. Furthermore, the impact of each design choice and the overall allocation design on the policy evaluation criteria outlined in the first part of the analysis is assessed. Additionally, the allocation design choices of the different programs are compared both among themselves and against the theoretical suggestions for allocation design options stated in the literature.

Results

In the first part of the analysis, beyond providing a comprehensive overview of design options and their implications, this study points to trade-offs and synergies in CCfD allocation design. Key insights include the following: There is a strong trade-off between static and dynamic efficiency, which can be addressed by specific measures such as ex-post technology pots in auctions. Generally, there exists a gap between theoretically optimal and politically feasible choices, and complex allocation designs can potentially deter company participation due to high entry costs. Synergies are also identified, such as that adopting less stringent entry requirements for smaller companies and using the

promotion of green lead markets as an award criterion can improve dynamic and static efficiency. The study also points to the fact that general CCfD design aspects, such as the accounting of energy price risk coverage, and payback modes, significantly influence risk coverage and bidder behavior but are inadequately addressed in the literature on CCfD allocation.

The analysis of implemented CCfD programs reveals both differences and similarities among the programs and in comparison to theoretical principles of CCfD. Notably, only the German "Klimaschutzverträge" closely adheres to the theoretical principles of a CCfD, while other programs only include some aspects of a CCfD. The programs are nevertheless comparable and provide insights into the practical implementation of CCfD allocation aspects, including: 1) All of the programs include competitive elements in their awarding mechanisms, although to different extents. 2) The SDE++, KSV and the French program have opted to implement competitive tenders without negotiations, diverging from literature recommendations for CCfDs. 3) All programs adopt a pay-as-bid model, despite literature on CCfDs suggesting either no specific model or favoring a pay-as-cleared approach. 4) Regarding award criteria, in line with the literature, for the British and French scheme multiple criteria are used, including both cost and non-cost criteria, which are weighted accordingly. 5) The differences in program objectives result in significant variations in the applied eligibility criteria, reflecting the variety of criteria discussed in the literature.

The literature identifies static and dynamic efficiency as key objectives for allocations, and their relevance is evident in practice. The British and German programs incorporated design aspects aimed at ensuring diversity from the outset, while the Dutch program adopted them later, after several years of program implementation. Thereby, approaches suggested in the literature [2, 4, 6], are used to some extent. Static efficiency appears to have varying levels of importance across different programs and is sometimes safeguarded through the use of price ceilings.

Conclusions

CCfDs are emerging as a key policy tool to incentivize low-carbon industrial processes. This study addresses the crucial aspect of their allocation design, revealing that current research lacks in-depth analyses on the matter. The paper provides a comprehensive overview of allocation design options and their implications, and also points to trade-offs and synergies in CCfD allocation design. The analysis of the practical implementation of CCfDs provides valuable insights into the detailed implementation of the relevant allocation aspects emphasized in the literature and thereby enriches the overview of allocation design options from the literature review. It reveals that there is no "standard" CCfD model; instead, programs are highly individualized, with specific objectives as well as tailored designs and allocation methods.

While these insights are valuable, further research is needed to better understand the complexity of CCfD allocations and provide guidance for policy decisions. Further policy-relevant research gaps include conducting quantitative analyses such as ex-post, marginal trade-off, and agent-based modeling analyses. Additionally, it is important to shed light on topics not yet covered in detail, such as pricing methods in auctions, bidding strategies, and the implications of allocation design options on effectiveness and their interplay with general CCfD design. Furthermore, the paper points to new aspects that need to be analyzed more thoroughly in the context of CCfDs including elements such as non-realization risks, lead times, bidding strategies, pricing rules and auction frequency.

References

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