

Managing expectations through setting technological boundaries: the emergence of carbon capture and removal markets

Two page summary

The shift from fossil-based economies to green, net-zero modes of production is being driven by the need to manage the risks posed by climate change. This transition has spurred technological advancements to decarbonize industrial processes and energy production, while also creating new markets for green products. While research so far has extensively studied the antecedents and consequences of green technology policies (Bae and Feiock 2013; Karapınar 2018; Rabe 2004) and the adoption of green products by homeowners and commercial entities (Abreu, Wingartz, and Hardy 2019; Hoogland, Chakraborty, and Hardman 2022; Kwan 2012), it has focused less on the process of how innovation ecologies create emergent green technologies before they are exchanged on markets. Therefore, this paper goes beyond the analysis of the supply of solutions and opens the black box of green technology creation to reveal the challenges associated with the development of climate change products and markets. It investigates how startups create the necessary social structures to support norms of production and exchange for emergent green technologies. This process of technological creation poses several challenges. First, green products are often contested by parties involved in their production and consumption. Second, there is a host of uncertainties that permeate the production of green technologies and are primarily triggered by risks associated with technologies not being an effective answer to the urgency posed by climate change. These issues that characterize green technology development can reveal tensions between what the technology is supposed to achieve and the current stage of diffusion that actors need to address and resolve, otherwise, the technology risks losing legitimacy.

I am relying on insights from the sociology of markets (Fligstein and Dauter 2007; Zelizer 2017) and the sociology of expectations (Borup et al. 2006) to construct a theoretical framework. Specifically, expectations, particularly in the context of technological development, act as a “performative” force that “attracts the “interest of necessary allies” and builds mutually binding obligations and agendas” (Borup et al. 2006:289). However, technologists need to manage a series of competing innovation futures (Borup et al. 2006), therefore they also need to instantiate a series of “expectation narratives” that address the distinctiveness of the solution proposed among a series of broadly available technologies or ideas for fixing climate change. The multiplicity of expectations and solutions available can create tensions between disparate visions of how to achieve a common goal. These tensions can destabilize the emergence of a markets if they become points of contention for powerful stakeholder. Therefore, innovators attached to a particular technology seek to manage the tension by deploying justificatory frames (Boltanski, Thévenot, and Porter 2006) that have the purpose of binding the necessary allies to a common frame of reference regarding the usefulness of a vision for fixing a problem.

To illustrate the process of technological emergence, I am using the case of carbon capture technologies. Carbon capture is a set of geoengineering methods that comprise removing carbon from the air (direct air capture) or from industrial processes, such as oil extraction, cement production, or coal plants, and permanently sequestering or utilizing it (MIT Climate Portal 2023). The scale of deployment is relatively small despite seeing the first commercial application

nearly 30 years ago (Torp and Gale 2004). It has gained popularity among several governments, but faces opposition due to its ties with the fossil fuel industry. Proponents argue that it can be useful for reducing emissions in hard-to-abate industries. Therefore, I characterize carbon capture as a landscape of early-stage, emergent technologies that have gained regulatory legitimacy but necessitate narrative work to sustain its emergence and dispel tensions stemming from conflicting expectations.

For this paper, I am using in-depth interviews with key informants from startups in the carbon capture space in Canada and the United States. The fieldwork for this paper is still ongoing and is expected to be finalized by the end of 2024. Through this qualitative work so far, I uncovered the set of expectations that govern the emergence of the field and how innovators and policy actors manage the tension between conflicting expectations. They do that through two encompassing strategies. On the one hand, carbon removal startups deploy classifications of their technology that favor distinction from the broader geoengineering community and from ties with the fossil fuel industry. On the contrary, carbon capture and sequestration startups deploy narratives that justify the involvement of the fossil fuel industry, albeit framed as a moral issue: the fossil fuel industry should contribute to the clean-up but not benefit from it. This dichotomy helps to signal to stakeholders that tensions related to viewing carbon capture as delaying the transition can be resolved by moralizing the economic activity underlying the clean technology. Who will benefit from it is an important expectation-setting theme and each stakeholder necessitates an adjustment of expectational frames. Therefore, in the presence of uncertainties about scaling up, companies need to create social structures to sustain the process of emergence. They deal with technological uncertainty by engaging in relational work with key stakeholders that in turn shape their expectations. They deal with the tensions that come from disparate expectations based on the audiences they interact with and that are more likely to offer them legitimacy. The nature of technological development is safeguarded from potential criticism by means of classification and setting technological boundaries that delineate the fossil-fuel linked aspects of its development from the innovative, forward-looking characteristics. Innovators are attracted to this technology because it addresses an important problem. But the effervescence around carbon capture is primarily a function of institutional setting, where, as my informants put it, money slosh around. The investors look at carbon capture as a valuable proposition that could have unlimited upswing. Carbon is seen as a resource that is abundant rather than waste that needs to be managed, and, if priced right, it can create a flourishing market. Governments want to regulate but also participate actively in ensuring that the technology development phase and commercialization are supported. In fact, governments become key actors for this technology because they can create mandatory markets, where carbon credits are traded to offset emissions produced by businesses.

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