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Preview

Is there a role for carbon capture and storage in a just transition?

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Carbon capture and storage (CCS) remains a polarizing issue in climate policy. In a recent *One Earth* review, Martin-Roberts et al. examine why CCS failed to deliver on early promises and how it might nevertheless help mitigate climate change. Here I synthesize their findings and discuss implications for a just transition.

Carbon capture and storage (CCS) lives in limbo. It has long been perceived, though not by the same people, as either right around the corner or as an expensive boondoggle that will never achieve commercial success—as either an essential element in mitigation policy or an excuse for more delay, foisted upon the public by fossil fuel interests. Some have hoped it could offer a lifeline to fossil fuel interests, while others feared it could offer a lifeline to fossil fuel interests. Both boosters and detractors can agree, though, that the bullish projections from the 2000s have not come to fruition. Why did CCS falter in the 2010s? Is there still a role for CCS in climate policy—and if so, what is it and how can policymakers support it? What do the future prospects for CCS mean for the fossil fuel industry and for a just transition for fossil fuel workers and their communities?

Past ambitions, future possibilities

To answer many of these questions, in a recent *One Earth* review, Emma Martin-Roberts and colleagues investigate the "lost decade" for CCS.[1] The lost decade manifests in a dramatic decline in projects in development or operation: of the 77 projects in development in 2010, at least 40 had been abandoned by 2017. Martin-Roberts et al.[1] offer several reasons for this trend. First, the early plans focused on CCS for coal-fired power plants; these plans were scuttled as coal use declined in the power sector, especially in Europe and the United States. Second, limited funding and the lack of consistent policies or market signals have made it hard to fund research, development, and deployment. Third, CCS has faced various institutional barriers that prevented its development in major developing countries, such as limited knowledge of geological storage resources in India and the absence of legislative or regulatory frameworks in China. In other words, in developed economies at least, the projects for which CCS was originally envisioned were abandoned partly for independent reasons and partly for lack of policy and market support.

Looking forward, Martin-Roberts et al.[1] identify a number of roles that CCS might play in the race to net zero. They allude to a potential role for CCS in the power sector in developing countries, especially China. They note that "upstream" CCS in gas processing facilities has achieved the greatest success so far and features prominently in plans over the next decade, but also that such facilities only capture carbon dioxide extracted together with natural gas, doing nothing to curb the emissions from the burning of the gas itself. They suggest that blue hydrogen—that is, hydrogen produced from natural gas whose carbon is captured and sequestered—could support the development of a hydrogen economy until the cost of green hydrogen falls enough to replace it. (The life cycle emissions from blue hydrogen are highly variable, but recent research by Christian Bauer et al. shows that it could be produced with relatively low emissions,[2] though ensuring low life cycle emissions would likely require strong policies.) They point to a number of materials-processing industries that face steep challenges to decarbonization, including steel, fertilizer and chemicals production, and cement, for which CCS could play an important role in limiting emissions from fuels and chemical processes. Finally, they note the role of CCS in two nascent negative emissions technologies: bioenergy with CCS (BECCS) and direct air capture with carbon storage (DACCS).

Noting how far off track the world is from achieving the levels of CCS envisioned in many modeled mitigation pathways, Martin-Roberts et al.[1] call for "a rapid step-change in policies" to accelerate deployment of CCS, citing several possibilities. One option to overcome the financing problem, they suggest, is government-led financing that puts a value on carbon sequestration beyond that of enhanced oil recovery, which can catalyze investment from the private sector. As examples, they mention the 45Q federal tax credit in the United States and California's Low Carbon Fuel Standard, along with Norwegian carbon taxes. Another way to reduce financial obstacles is to support industrial hubs and clusters in which carbon-capturing facilities can share transport and sequestration infrastructure; by sharing the up-front costs for those elements across multiple facilities, hubs and clusters can lower the start-up costs for each project. Relatedly, accelerating and improving assessment of storage sites can reduce the risk to new projects. (In a recent paper, Joe Lane and colleagues cite the identification and development of storage sites as an underappreciated challenge and financial risk in the development of CCS projects.[3]) They encourage governments to ensure that funding is better targeted toward hard-to-abate sectors and negative emissions, where CCS is most important, rather than using it to prop up incumbent

technologies in the power sector. (As Holly Buck notes, however, we should not gloss over the political questions in deciding what counts as a hard-to-abate sector or how negative emissions technologies like BECCS and DACCS should be used.[4]) Finally, they mention the possibility of requiring anyone who plans to extract hydrocarbons to also plan for the capture and sequestration of the carbon those fuels contain—an approach that has recently attracted some attention from economists and policy analysts.[5–7]

CCS and a just transition

What do these findings and recommendations imply for the role that CCS might play in a just transition for fossil fuel workers and their communities? The question lies outside the scope of their paper, but it is possible to draw some conclusions from their findings, depending on how we understand the idea of a just transition. That concept has developed in a variety of ways.[8]

The oldest, labor-oriented conception of a just transition views it as an energy transition that includes social protections for workers displaced by the decline of fossil fuels, as well as for the communities that depend on those industries. One relevant way to protect displaced workers is by providing alternative employment. Martin-Roberts et al.[1] identify many uses of CCS that would provide ready-made job opportunities for displaced fossil fuel workers. For example, making blue hydrogen involves extracting and processing natural gas and reinjecting captured carbon dioxide into geological reservoirs, all of which fossil fuel workers already do. The CCS portions of industrial CCS, BECCS, and DACCS use skillsets that overlap with fossil fuel workers' existing skillsets. Converting old coal-fired power plants to BECCS plants would preserve at least some coal-related jobs as well. The observation that CCS of any kind is most likely to flourish in jurisdictions that already have a robust oil and gas sector[1,3] further supports the idea that workers in that industry could transition to CCS-related work. Both Wang and Lo[8] note, though, that, like other approaches to a labor-focused just transition, an emphasis on CCS could recreate gender inequalities that currently pervade the fossil fuel industry and are appearing in renewable energy industries as well.

If we zoom out to a broader notion of a just transition, things become more complicated. Tradeoffs begin to appear. Wang and Lo[8] identify a broader notion of a just transition that also incorporates environmental justice, climate justice, and energy justice—all of which are already complex ideas in themselves. Most obviously, to the extent that CCS can help ensure energy access (for example, by keeping energy costs down[1]) while also mitigating climate change, it could contribute to both energy justice and climate justice; but to the extent that it supports the extraction and combustion and fossil fuels and the combustion of biomass for BECCS, it will tend to exacerbate environmental injustice. Less obviously, tradeoffs appear in the distribution of CCS and its risks and benefits between societies. Mintz-Woo and Lane[9] argue that, given the technical, economic, and institutional capacities of Europe and North America, focusing CCS investment in developed countries would do the most to mitigate climate change but that focusing investment in developing countries, especially India and China, will best support energy justice and other aspects of climate justice: because that investment would likely have to come from developed countries, it represents one way in which developed countries can shoulder a more equitable share of the burden of climate action. Thus, CCS still offers opportunities for a just transition in this broader sense, but the opportunities are less straightforward, more subject to tradeoffs, and more sensitive to the specific uses of CCS.

Planning for the future

Martin-Roberts et al.[1] suggest that the world may well be able to meet its midterm climate targets—out to 2035 or so—without relying on CCS. They warn, though, that getting all the way to net zero will be extremely challenging without CCS, and if we want CCS in the toolbox after 2035, we need to accelerate its development now while steering it in the right direction. That is, in addition to focusing on the near- and midterm goals of reducing energy demand, electrifying final energy use, scaling up renewables, and so on, we also need to think ahead to the next generation of mitigation challenges. In showing us why CCS has so far failed to deliver on its boosters' early promises, how CCS might usefully contribute to a net zero future, and how to get CCS moving in the right direction, Martin-Roberts et al. help us navigate some of the most treacherous terrain in climate policy and illuminate one potential element of a just transition.

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