

Assessments by the IPCC have made clear that the most feasible way for the world to meet its target of restricting climate change to below two degrees Celsius of warming includes rapid and [massive expansion of carbon removal technology](#) - technology that would extract carbon dioxide and permanently sequester that carbon dioxide underground. California has long been a leader in decarbonization, but proposed legislation in Sacramento would hamstring California's efforts to advance carbon removal.

Carbon removal technology takes two possible forms - one involves removing carbon dioxide from the exhaust of industrial systems (such as refineries or gas plants); the other involves removing carbon dioxide in the ambient air. The carbon dioxide then is transported to a geological formation where it can be sequestered permanently. In the case of carbon removal associated with industrial systems, the process prevents increased emissions of carbon dioxide to the atmosphere. In the case of carbon removal from the ambient air (what is often called direct air capture or DAC), the process reduces the concentration of carbon dioxide in the global atmosphere.

Carbon removal will be central to decarbonization efforts in the next several decades. We have a rapidly diminishing capacity in the atmosphere and oceans to absorb carbon emissions, and extreme weather events from the past few years make clear that the carbon emissions that have already occurred are causing real harm globally. DAC carbon removal allows for us to remove carbon pollution from the atmosphere - which can both buy us time to reduce emissions, and also in the long-run reduce the harm caused by past carbon emissions. Carbon removal associated with industrial operations may be crucial for industries that require high levels of thermal combustion to operate, and so may require combustion of carbon-based fuels.

The challenge, however, is [driving the investment in carbon removal needed to advance technology, reduce costs, and deploy at the massive scale required](#). We have seen two major success stories in decarbonization investment and technological change so far - renewable electricity, and advances in battery storage for electrifying transportation. However, both of these success stories were driven in part by revenue from sales of a product: Renewable electricity can be sold (like other electricity), and electric vehicles can be sold to consumers who want transportation.

Carbon removal is different. Absent a public subsidy to support it (such as through a payment for each unit of carbon removed and sequestered), there isn't much of a market where people are willing to pay for carbon to be removed and stuck underground. There has been some [investment by various companies to support these efforts](#), driven by a desire to advance carbon neutrality for their operations, but the amount of investment is far from

what is required to scale up the technology, and the investments are not generally part of the core revenue model for the companies, making them vulnerable to cuts in a recession. Various other revenue models for carbon removal - such as using captured carbon to produce carbon-neutral fuels - are still highly speculative.

There is [one revenue model for carbon removal that is currently economically viable at scale](#) - for decades, oil companies have injected carbon dioxide from geologic sources into the ground to facilitate the extraction of oil. If oil companies were paid, or required, to use carbon dioxide captured from the atmosphere or industrial facilities in these projects, that would create a market for the captured carbon. The oil that is produced and sold then provides a revenue stream to support future investments in carbon removal. Carbon dioxide injected in these projects can be permanently stored - indeed, if enough carbon dioxide is stored per barrel of oil removed, one can even make the oil extracted carbon neutral or negative.

California has been aggressive in pushing carbon removal technology, and existing state law even provides [a significant monetary incentive to use captured carbon dioxide for oil and gas extraction through the state's Low Carbon Fuels Standard](#) - a regulatory program that has also [significantly advanced electric vehicle deployment](#).

However, proposed legislation would stop the use of captured carbon dioxide for the extraction of oil and gas in California. [SB 1314](#), introduced by Senator Limon (D-Santa Barbara), would prevent the state from approving any injection of captured carbon dioxide into oil fields in the state. The goal, according to the Senator, is to prevent carbon capture from "[creating more fossil fuels](#)."

Unfortunately, the result of the legislation would be to foreclose one of our most promising pathways for advancing carbon removal technology in the near future. And time is urgent - we will need to massively scale up carbon removal on a global scale to achieve goals like limiting warming to two degrees Celsius, and that in turn requires investments today in technology and cost reductions.