Can carbon sequestration help Europe achieve carbon neutrality?

A new study suggests massive scale up of the tech is needed

The need for countries around the world to limit their greenhouse gas emissions is certain – but the question of how to accomplish this feat remains less clear. Even with a hard push for implementation of renewables, evidence suggests that we will need additional strategies to sufficiently reduce our emissions.

In a recent study, researchers in Europe explored various scenarios required to meet the European Union’s upper target of zero emissions by 2050. Their analysis suggests that carbon sequestration – whereby carbon is captured and transported into underground reservoirs offshore – could be a cost-efficient way to meet future emissions reduction targets, compared to strong reliance on synthetic fuels. The [results](https://ieeexplore.ieee.org/document/10161887) were published July 3 in [2023 19th International Conference on the European Energy Market (EEM)](https://ieeexplore.ieee.org/xpl/conhome/10161732/proceeding).

Carbon neutrality is the holy grail we need to attain in order to limit climate change. This is when the amount of carbon *released* into the atmosphere each year is counterbalanced with the same amount *removed* from the atmosphere. While the large bulk of the CO2 reduction has to come from an unprecedented ramp up of renewables and electrification, some parts of the economy require particular solutions. T~~echnology (as it is now) can only get us about 80% of the way there.~~

“The last 5-10 ~~10 or 20~~ percent of net CO2 reduction ~~decarbonization~~ is difficult, because there are these sectors which include heavy industry, shipping and aviation, that are very hard to decarbonize,” explains Fabian Hofmann, a postdoc at the Institute of Energy Technology at the Technical University of Berlin, in Germany, who was involved in the study.

Essentially, some sectors may still require fossil fuels for decades to come, despite incremental advances in green tech. Hofmann’s team sought to understand how additional strategies could help compensate for the continuing emissions of these sectors. One option is carbon sequestration, where carbon emissions are captured directly from sources (for example at the site of a factory) and transported via pipelines to offshore sites, where the carbon is injected into underground caverns under the seafloor and stored indefinitely.

Another option is the use of synthetic fuels. These are chemically the same as fossil fuels, but created using carbon that is already circulating in the atmosphere – therefore synthetic fuels do not add any additional carbon into the atmosphere, as is the case with fossil fuels extracted from the ground. Examples of synthetic fuels include manmade methane and methanol.

In their study, the researchers explored different ratios of renewable energy, carbon sequestration, and synthetic fuel use across 90 geographic regions in Europe that would be necessary to achieve carbon neutrality. They considered different levels of carbon sequestration, ranging from 200 to 1,000 million tonnes of carbon captured or removed from the atmosphere each year.

The results show that carbon sequestration is the more cost-efficient option for achieving carbon neutrality. Regardless of how much carbon sequestration occurs, it makes financial sense to implement the infrastructure. Plus, this approach would allow some industries to continue using fossil fuels, while still ensuring that Europe achieves carbon neutrality, the study shows. However, Hofmann notes that even sequestering the lowest amount of carbon analyzed in this study – at 200 million tonnes per year – would still require “immense capabilities.”

“When counting on sequestration as a large scale solution, the risk that we are facing is, in my opinion, twofold: On the hand, we cannot be sure that the sequestration industry will be ramping up as quickly as needed. On the other hand, there are still doubts that the sequestration projects, that we would need to realize, are really secure in the long term. Just imagine the case that we perceive strong leakage in the sequestration sites. How would we possibly deal with that situation? At immense costs, the CO2 would need to be captured and sequestered again, while making sure that that leakage is resolved. The responsible company would not be able to cover these costs, and I doubt that any insurance in the world would take over,. Therefore, one has to be aware this sequestration technology is quite new and we don’t know if we can rely on it or not“ explains Hofmann.

~~“When we’re talking about 200 million tonnes sequestered a year, that’s a very high number. We do not know at the moment if these numbers will be realistically applicable in the future or if this amount of sequestration will be realized. Therefore, one has to be aware this sequestration technology is quite new and we don’t know if we can rely on it or not,” explains Hofmann.~~

The study results suggest that if we rely less on sequestration, the system integrates more green hydrogen and synthetic fuel technologies to achieve carbon neutrality. The financial costs could be 10% higher, but the potential risks related to suquestration would also be reduced.

~~In contrast, the study results suggest that if we rely more heavily on synthetic fuels to achieve carbon neutrality, the financial costs could be 3-5% higher, depending on the level of sequestration that is implemented alongside synthetic fuel use.~~

“In the end, [a solution] probably has to involve a mix of everything,” says Hofmann, noting there are some limitations to their model and more work needs to be done to figure out the feasible ratios of renewables, sequestration and synthetic fuels. Moving forward, Hofmann says the team plan to build upon this study by refining their model and incorporating a larger array of technologies, particularly methanol for energy storage and transportation.