Observations

A Different Kind of Clean Energy

The world needs carbon-capture technology now more than ever in the fight against climate change

By Madison Freeman and David Yellen on May 7, 2018

Exhaust from a coal-fired power plant. *Credit: Drbouz Getty Images*

The signing of the Paris Agreement in 2015 was supposed to be a turning point in the fight against climate change, with almost every nation committing to reduce their carbon emissions. But many countries have already fallen behind on the targets they set, and emissions worldwide have continued to rise.

Beyond that, the targets were too conservative to successfully limit global temperature rise to 2 degrees Celsius, the goal set out in the agreement—so even if all of the reductions happen, it will merely merely delay catastrophic climate change, not prevent it. As Julio Friedmann, a top Department of Energy official under President Obama, recently argued, "Winning slowly is the same as losing."

The only way to make up ground is to aggressively pursue an all-of-the-above approach that utilizes every strategy to reduce carbon emissions, or decarbonize. This must include investing heavily in carbon capture, utilization and storage (CCUS)—a cohort of technologies that pull carbon dioxide from smokestacks, or even from the air, and convert it into useful materials or store it underground. CCUS technology can zero out the carbon emissions from fossil fuels used in electricity generation and in industries that renewable energy sources cannot serve, as well as remove previous emissions directly from the atmosphere.

Although CCUS has been dismissed in the past as too expensive and unproven, and development and demonstration projects have faced opposition in the United States, recent gains in efficiency and drops in cost have made the technologies far more effective and scalable. Further investment will be critical to enable broader adoption of these recent improvements.

Broader adoption of CCUS will be crucial: the Intergovernmental Panel on Climate Change (IPCC), which comprises the world's foremost climate and energy experts, calculated that the cost of limiting warming to 2°C more than doubles if CCUS isn't deployed. Forecasts by the International Energy Agency (IEA) go further: the agency predicts that the reduction in emissions necessary to limit global warming to 2°C is

impossible without CCUS; through 2050, the technology must provide at least 13 percent of the emissions reductions needed to limit warming. The transition to clean energy has become an inevitability, rather than a possibility, but that transition's ability to achieve deep decarbonization will falter without CCUS.

BROAD DECARBONIZATION THROUGH CCUS: NOT A PIPE DREAM

Decarbonization through CCUS is possible through three primary paths: retrofitting existing power plants to decarbonize fossil fuel electricity generation, reducing emissions in heavy industries that renewables cannot penetrate, and directly removing carbon from the atmosphere.

Power plants can be retrofitted with CCUS technology to capture emissions from existing coal, oil and natural gas electricity generation. Even optimistic projections for the clean energy transition make it clear that fossil fuels will not disappear anytime soon: an IEA scenario for a sustainable future forecasts that fossil fuels will still make up 60 percent of the energy mix by 2040.

Though coal plants, the most carbon-intensive form of electricity generation, are closing in the United States, new capacity is growing in the developing world, and these plants are expected to produce power for decades. Cutting emissions from existing fossil fuel plants with CCUS technology will thus be critical to combating climate change. These retrofits could be made more appealing in a future with a circular carbon economy, in which captured carbon could be resold and recycled for other uses, including producing concrete or plastics.

Beyond the electricity sector, CCUS technologies can also help decarbonize other sources of emissions. CCUS can tackle emissions in heavy industry (including the production of cement, refined metals and chemicals), which account for almost a quarter of U.S. carbon emissions. In addition, direct carbon removal technology–which uses chemicals to capture and convert carbon dioxide from the air, rather than from a smokestack–can offset emissions from large emitting industries that cannot readily implement other clean technology, like agriculture. Though this form of carbon capture technology is much less developed than carbon capture from smokestacks, it offers promise as a way to retroactively address carbon pollution.

Though these approaches have historically been dismissed as too expensive for widespread adoption, CCUS technologies are becoming increasingly cost-effective. The newest CCUS technologies could drive the price of implementation as low as $20 per ton of carbon by 2025, down from $100 per ton in 2016. In the United States, the company NET Power has begun construction of a new natural gas plant in Houston that it claims has no water cost, will lead to no net emissions and costs no more than a standard natural gas powered plant. And in Iceland, the government has deployed carbon capture technology to capture both emissions from electricity generation and CO2 directly from the air, sending the carbon deep into the earth. A number of startups are also developing promising new approaches to CCUS, including converting captured carbon into fertilizer and employing an enzyme to manage carbon, that could spur a revolution in the technology.

SUPPORT FOR CCUS: GROWING BUT NOT FAST ENOUGH

Even though CCUS is critical to combating catastrophic climate change, it has faced opposition from many of the most passionate supporters of climate action.

Environmental groups and renewable advocates have opposed investing in CCUS, fearing that it would be used to justify further reliance on fossil fuels. But by limiting the scope of investment in decarbonization, the world would miss a major avenue for reducing emissions both in the electricity sector and in a variety of industries. To meet the 2-degree climate target, environmental advocates should support policies like low or zero emissions portfolio standards that are technology-neutral, which would encourage investment in a range of lower-carbon energy sources, including CCUS.

CCUS also faces opposition from some conservative voices, especially those who downplay or dismiss the threat of climate change, who see it as a needlessly expensive experiment that reduces power plant efficiency. However, many conservatives have found CCUS to be a more appealing solution to reducing CO_2 emissions than restricting electricity production. By creating a larger economy around carbon, CCUS can create jobs and revenue from what was previously only a waste material, and can fuel economic growth.

Overall, the tide seems to be shifting. CCUS has managed to attract a remarkably broad coalition of supporters, including climate hawks on the left and fossil fuel supporters on the right. Under an administration that has stepped away from many

important climate policies, including the Paris Accord and the Clean Power Plan, building bipartisan support for investing in this technology is critical to its future.

The federal government has an integral role to play in ensuring CCUS succeeds by supplementing critical funding for research and development. The Trump administration has repeatedly tried to slash energy technology R&D funding, with the Department of Energy's CCUS R&D budget cut by as much as 76 percent in proposed budgets. As funding for energy technology innovation in the United States has slowed, China is now set to lead the way in funding for CCUS R&D. The United States must protect and expand its R&D funding in order to play a leading role in the energy transition.

The government must also improve incentives for CCUS deployment. The FUTURE Act, recently enacted by Congress as part of the February 2018 budget bill and championed by a noticeably bipartisan coalition, is an important step toward making CCUS economical. The bill extends carbon dioxide capture, storage and conversion tax credits and increases the value of those credits. The same bipartisan group of senators has proposed another bill, the USE IT act, which would amplify support for CCUS technology by directly funding research and development and by setting up a prize competition to reward deployment in the private sector, especially of direct air capture technology. These are welcome steps forward in supporting this critical technology.

However, the government can and should go further by procuring CCUS technology for federal infrastructure and investing in national pipeline infrastructure to lower the costs associated with transporting CO_2 from retrofitted plants. By doing so and increasing R&D funding, it can spur innovation to lower the cost and increase the efficiency of products on the market and thereby incentivize CCUS deployment.

The energy transition is accelerating at a rapid pace, but it will fall short of averting catastrophic climate change if it does not employ a wide range of solutions, including broad deployment of carbon capture, utilization and storage. The Paris Agreement was an important step in combating climate change, but without CCUS as part of the solution, the goals established there will be impossible to meet.

The views expressed are those of the author(s) and are not necessarily those of Scientific American.

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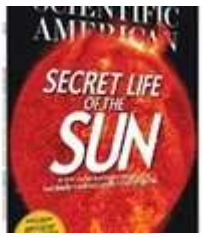

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