

Nature spotlights deep skepticism about bioenergy with carbon capture and storage

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by Steven T. Corneliussen ([Physics Today](#))

To mitigate climate change, has the planet “gambled its future on the appearance in a puff of smoke of a carbon-sucking fairy godmother”?

During the Paris climate summit late last year, European policy analyst [Oliver Geden's](#) *New York Times* [op-ed](#) “The dubious carbon budget” warned that “we’re on the verge of repeating the same mistake that led to the financial crisis: relying on economic models that are completely detached from what’s going on in the real world.” With “magical thinking” and “questionable accounting,” Geden charged, climate scientists and economists are “betting primarily” on an unproven solution: BECCS, or bioenergy with carbon capture and storage. As a voice questioning BECCS, Geden isn’t alone in the media, but *Nature* in particular has been amplifying the warning.

Just before the Paris meeting, *Nature's* Jeff Tollefson contributed the [news feature](#) “Is the 2 °C world a fantasy?” The subhead cautioned, “Countries have pledged to limit global warming to 2 °C, and climate models say that is still possible. But only with heroic—and unlikely—efforts.” The piece examined the proposition that it’s possible to pull “Earth back from the brink” using the method of driving “emissions into negative territory—essentially sucking greenhouse gases from the skies—by vastly increasing the use of bioenergy, capturing the CO₂ generated and then pumping it underground on truly massive scales.”

Tollefson explained the use of a combination of bioenergy and carbon capture and storage (CCS):

The system starts with planting crops that are harvested and either processed to make biofuels or burnt to generate electricity, which provide carbon-neutral power because the plants absorb CO₂ as they grow. The CO₂ created when the plants are processed is captured and pumped underground,

and the process as a whole eats up more emissions than it creates. A consortium sponsored by the US Department of Energy has tested such a system at one facility that produces bioethanol fuel in Illinois, but neither bioenergy nor CCS has been demonstrated on anywhere near the scales imagined by the models.

Tollefson reported that some scientists argue that the 2 °C scenarios “seem so optimistic and detached from current political realities that they verge on the farcical.” He continued:

Although the caveats and uncertainties are all spelled out in the scientific literature, there is concern that the 2 °C modelling effort has distorted the political debate by obscuring the scale of the challenge. In particular, some researchers have questioned the viability of large-scale bioenergy use with carbon capture and storage, on which many models now rely as a relatively cheap way to provide substantial negative emissions. The entire exercise has opened up a rift in the scientific community, with some people raising ethical questions about whether scientists are bending to the will of politicians and government funders who want to maintain 2 °C as a viable political target.

Just after the Paris meeting, *Nature* published a [commentary](#) by Kevin Anderson, deputy director of the UK’s Tyndall Centre for Climate Change Research. He praised December’s Paris climate agreement as the 21st century’s equivalent to “the victory of heliocentrism over the inquisition,” but warned that “it risks being total fantasy.” He insisted that what’s required is “urgent and significant cuts in emissions.” He lamented, though, that “rather than requiring that nations reduce emissions in the short-to-medium term, the Paris agreement instead rests on the assumption that the world will successfully suck the carbon pollution it produces back from the atmosphere in the longer term.” He cautioned that a “few years ago, these exotic Dr Strangelove options were discussed only as last-ditch contingencies. Now they are Plan A.”

Anderson’s final paragraphs escalated in tone to an outright bitter ending:

The allying of deep and early reductions in energy demand with rapid substitution of fossil fuels by zero-carbon alternatives frames a 2 °C agenda that does not rely on negative emissions. So why was this real opportunity muscled out by the economic bouncers in Paris? No doubt there are many elaborate and nuanced explanations—but the headline reason is simple. In true Orwellian style, the political and economic dogma that has come to pervade all facets of society must not be questioned. For many years, green-growth oratory has quashed any voice with the audacity to suggest that the carbon budgets associated with 2 °C cannot be reconciled with the mantra of economic growth.

I was in Paris, and there was a real sense of unease among many scientists present. The almost euphoric atmosphere that accompanied the circulation of the various drafts could not be squared with their content. Desperate to maintain order, a club of senior figures and influential handlers briefed against those who dared to say so—just look at some of the Twitter discussions!

It is pantomime season and the world has just gambled its future on the appearance in a puff of smoke of a carbon-sucking fairy godmother. The Paris agreement is a road map to a better future? Oh no it’s not.

In a 10 February [editorial](#), *Nature*’s editors continued raising the BECCS alarm. They characterized interest in it as a fad, cited Anderson’s deep skepticism, and directed readers’ attention to a *Nature* [commentary](#) in which environmental scientist Phil Williamson, as the editors put it, “takes a hard look at some of the questions that BECCS seems to pose, and finds few answers.”

They summarized some of Williamson’s questions:

How would we preserve forests and grasslands, faced with such a demand for energy crops? How much carbon would be released during the agricultural stage? How much water will we need, and

where will we get it? How much will it cost to build the network of compressors, pipes, pumps and tanks that will be needed to liquefy and transport the separated CO₂? Can it even be separated at a sensible cost?

Williamson argued that it's time "to invest in new, internationally coordinated studies to investigate the viability and relative safety of large-scale CO₂ removal." One passage in particular indicted BECCS:

Limiting the global temperature rise to 2 °C, with any confidence, would require the removal of some 600 gigatonnes of CO₂ over this century (the median estimate of what is needed). Using BECCS, this would probably require crops to be planted solely for the purpose of CO₂ removal on between 430 million and 580 million hectares of land—around one-third of the current total arable land on the planet, or about half the land area of the United States.

Unless there are remarkable increases in agricultural productivity, greatly exceeding the needs of a growing global population, the land requirements to make BECCS work would vastly accelerate the loss of primary forest and natural grassland. Thus, such dependence on BECCS could cause a loss of terrestrial species at the end of the century perhaps worse than the losses resulting from a temperature increase of about 2.8 °C above pre-industrial levels.

A more fundamental concern is whether BECCS would be as effective as it is widely assumed to be at stripping CO₂ from the atmosphere. Planting at such scale could involve more release than uptake of greenhouse gases, at least initially, as a result of land clearance, soil disturbance and increased use of fertilizer.

In the *Times*, Geden's op-ed observed that the "public has taken little, if any, notice" of the BECCS basis for climate planning. In any case, the questions aren't new. In September 2014, for example, the *Nature Climate Change* [article](#) "Betting on negative emissions" summarized itself this way: "Bioenergy with carbon capture and storage could be used to remove carbon dioxide from the atmosphere. However, its credibility as a climate change mitigation option is unproven and its widespread deployment in climate stabilization scenarios might become a dangerous distraction."

In January 2016, *MIT Technology Review* published "[The dubious promise of bioenergy plus carbon capture](#):" Climate change agreements rest on negative emissions technologies that may be unachievable." BECCS questions have appeared in a few other places in the media as well, including at the *Guardian*.

There Geden published a [piece](#) based on his May 2015 *Nature* [commentary](#), whose warning to scientists was encapsulated in the headline and subhead: "Climate advisers must maintain integrity: As global negotiations fail on emissions reductions, scientific advisers need to resist pressure to fit the facts to the failure."

Rather than spread "false optimism" that purports to justify going deeply into emissions debt in hopes of catching up in later decades, Geden urged scientific advisers to "stand firm and defend their intellectual independence, findings and recommendations—no matter how politically unpalatable."

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