Researchers: Put a brake on bioenergy by 2050 to avoid negative climate impacts

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The burgeoning bioenergy sector must peak and decline in the next 30 years to alleviate extreme pressure on land, warns researchers in a new analysis published today in *Global Change Biology*. They assert that

projections envisioning the use of biomass from crops, trees or grasses for fuel through 2100 overlook the technology's high carbon footprint and excessive land use.

"As countries worldwide are seeking renewable energy alternatives to coal, oil and other carbon-spewing fossil fuels, we find ourselves at a crossroads—and how we proceed can make or break the renewable energy sector," said Walt Reid, the lead author of The Future of Bioenergy, and the director of the conservation and science program at the David and Lucile Packard Foundation. "If we listen to the latest science, it's clear that bioenergy opportunities are mostly short-term or limited. In the long term, land-intensive bioenergy is not only inferior to wind, solar and other best bet green technologies, it also can be a major source of carbon emissions. With the exception of bioenergy from waste and ecosystem-improvement projects, it simply doesn't make sense for the climate to invest in bioenergy. It must be on its way out by 2050."

An Intergovernmental Panel on Climate Change (IPCC) report released last year found that many scenarios capable of reducing the threat of climate change relied heavily on bioenergy, predicting that energy from biomass could make up 26% of primary energy in 2050 (up from 10% in 2020) and predicting that solar and wind combined would likely only account for 22%. Those scenarios often relied on significant use of bioenergy with carbon capture and storage (BECCS), which involves growing trees across a large area of land to produce wood pellets burned for energy, then capturing and sequestering the carbon emissions. In its analysis, though, the IPCC found significant challenges associated with a high reliance on bioenergy, noting in particular that the vast areas of land required to produce biomass for energy would compete with food production and other human needs.

"With a growing world population to feed, and a climate emergency to tackle, society needs to become much smarter in how it uses our limited

land resources," said Pete Harrison, executive director for EU Policy at the European Climate Foundation. "We should prioritize sources of bioenergy that do not use land, such as wastes and residues, and steer clear of using sources that leave a heavy footprint on agricultural land or forests. There is clear evidence that many policymakers have been making wrong choices; using tax payers' money to support bioenergy projects that cause deforestation; and it is now time to learn from those mistakes."

The authors of the new *Global Change Biology* assessment examine a flurry of recent reports that suggest even more problems with large-scale bioenergy projects reliant on large tracts of land, and also show that more cost-effective alternatives will be available in the coming decades. Pulling from these recent studies, the authors establish three reasons why large-scale bioenergy must and can peak and decline in the next 30 years:

- **Large-scale bioenergy emits carbon.** Carbon emissions from bioenergy can be greater in the near-term than emissions from the fossil fuels it is replacing, undermining the assumption that bioenergy is always a relatively low-emission and low-cost form of energy. Burning wood pellets, for example, creates a "double climate problem." Manufacturing and shipping wood pellets entails substantial emissions of fossil CO2, and it can take decades or centuries for harvested areas to return to pre-harvest carbon stocks.
- **Large-scale bioenergy puts a squeeze on land.** Land is already a scarce resource, and it will become even scarcer with time due to an increase in the human population and a rise in the appreciation of the conservation value of natural and mostly-natural ecosystems—even if agricultural yields continue to increase. Because land is so limited, we should use it as efficiently as possible for energy production. In contrast to land-

intensive bioenergy, the amount of electricity that can be produced from a hectare of land using photovoltaics is at least 50-100 times that from biomass.

- **Large-scale bioenergy is inferior to other solutions.** And, by mid-century, land-intensive bioenergy will face fierce competition from superior technologies such as wind and solar energy, the development of efficient storage and other flexibility solutions, and the advent of more effective carbon removal technologies such as direct air capture with carbon storage.

"The evidence is piling up that an energy system based on dedicating vast amounts of land for bioenergy simply uses too much land," said Reid. "More promising energy solutions—from solar power farms to carbon capture technologies—have the potential to provide much more energy from much less land in a post-2050 world. Investors are wise to think strategically about the long-term landscape of superior competitors, as well as the short-term trends."

The assessment comes at a time when the bioenergy industry is ramping up worldwide, with the European Union in the lead. Bioenergy currently accounts for 10% of the world's energy, and 50% of our renewable energy. In the European Union, bioenergy accounts for two-thirds of all renewable energy (nearly half from wood).

Two-thirds of the EU's "20% renewable energy by 2020" target depends on bioenergy. And the bloc is also about to greenlight the conversion of five large coal plants to bioenergy plants that burn imported wood pellets from overseas forests.

Land-intensive electrical power projects in particular are picking up steam as governments and industry leaders seek to transform disused coal factories into new profit centers. Between 2006 and 2015, the production of wood pellets for biomass energy use quadrupled to 26

million tons. Worldwide, demand for globally traded wood pellets destined for use in phased-out coal plants or new dedicated bioenergy plants is expected to rise 250% by 2027.

"Our assessment shows that before the EU and other countries commit to decades of expanding this technology, they must hit the pause button to recognize that bioenergy is actually increasing carbon emissions and to assess the worrying impact of dramatically increasing bioenergy on the world's most contested resource: land," said Reid. "Our need for food, conservation and the restoration of forests is simply incompatible with greatly enlarged bioenergy projects in need of land."

The study lays out a bioenergy trajectory that policymakers can use to encourage sustainable bioenergy while also opening the door for new technologies to replace land-intensive bioenergy in the very near future. These recommendations include improved accounting of the actual carbon emissions associated with the use of biomass, favoring biomass from waste, residues or land management practices that enhance carbon storage, and providing incentives for energy storage, direct air capture technologies, and low-carbon alternatives to fossil fuels.

Above all, the authors argue that bioenergy projects should be avoided if they involve natural forests, such as converting natural forests to bioenergy plantations, or use land best suited for food crops. And the authors caution that claims that bioenergy projects are a zero-carbon form of energy should be met with skepticism.

"Appropriate bioenergy can be an important part of solving the climate crisis and improving ecosystems, but if current bioenergy trends continue over the next few decades unabated, driven by well-intentioned but poorly conceived clean energy incentives, tax payers and investors may find themselves spending tens of billions in public subsidies to prop up a fuel destined for the waste basket of history, instead of directing

those investments to sure bets for a zero-carbon future, such as solar and wind," Reid said.

More information: Walter V. Reid et al, The Future of Bioenergy, *Global Change Biology* (2019). DOI: 10.1111/gcb.14883

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