Geoengineering, other technologies won't solve climate woes

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The Earth's population is growing, and with it, greenhouse gas emissions. This photo shows gridlock in Bangkok, Thailand, where more than 10 million cars and motorcycles drive on roads designed for one-tenth of that many vehicles. Credit: Colourbox

The countries of the world still need to cut their carbon dioxide emissions to reach the Paris Agreement's climate targets, especially if that target is now 1.5 degrees C instead of 2 degrees C. Relying on tree planting and alternative technological solutions such as geoengineering

will not make enough of a difference.

"We can't rely on geoengineering to meet the goals of the Paris Agreement," says Helene Muri, a researcher from the Norwegian University of Science and Technology's (NTNU) Industrial Ecology Programme. She was one of the lead authors of a recent article inNature Communicationsthat looked at different climate geoengineering projects in the context of limiting global warming.

The average temperature on Earth is rising. The UN Intergovernmental Panel on Climate Change (IPCC) has recommended limiting this warming to less than 2 degrees Celsius, and better yet to less than 1.5 degrees. These targets were set in the 2015 Paris Agreement, which was ratified by nearly all nations.

Various geoengineering options are among the solutions being considered. They involve intervening directly in the Earth's climate system to prevent temperatures from rising as much as would otherwise happen due to the increasing amount of greenhouse gases in the atmosphere. Geoengineering comprises reducing atmospheric CO_2levels, or reducing the effect of the Sun.

Untested, uncertain, and risky

Can we remove greenhouse gases from the atmosphere with the help of technology, or capture more $CO_2$by planting millions of trees? Can we reflect more of the Sun's radiation by injecting particles into the atmosphere?

"Several techniques could help to limit climate change. But they're still untested, uncertain and risky technologies that present a lot of ethical and practical feasibility problems," say Muri and her colleagues.

In short, we just don't know enough about these technologies and the consequences of putting them to use, the researchers say.

Stumbling blocks

Tree planting sparks major political problems, for example. A lot of forest land has been cut to grow food, which limits how much acreage can be reforested. Recent research also raises the question as to whether or not additional forest land can predictably lower temperatures. Data simulations from NTNU and Giessen University show that temperatures may increase, at least locally.

Another mitigation proposal is the use of biochar, which is charcoal that can be ploughed into the ground to store carbon that would otherwise escape into the atmosphere as CO_2. Here the question is whether it is really conceivable to carry this out on a large enough scale to make a difference. The researchers' consensus? Hardly.

How about adding nutrients to the sea to spur phytoplankton blooms that could sequester carbon? This proposal involves fertilizing iron-poor regions of the ocean. However, the potential side effects could be huge, disrupting local nutrient cycles and perhaps even increasing the production of N_2O, another greenhouse gas.

We simply don't know enough yet. Some potential solutions might even do more harm than good. The authors of the article encourage more discussion and learning.

NETs and airy plans

So what about "negative emissions technologies", often abbreviated as NETs? NETs involve removing greenhouse gases from the atmosphere,

specifically CO_2. Some of these proposed techniques could work well on a global scale. But some of them are expensive and are still in their infancy in terms of technology.

Prototypes for direct carbon capture from the air already exist. This technology shows great potential, but would require a lot of energy and significant infrastructure if done at scale. Cost estimates range from $20 to more than $1000 per tonne of captured CO_2. If you consider that the countries of the world emitted more than 40 billion tonnes of CO_2in 2017 alone, it quickly becomes clear that financing this approach would be prohibitively expensive.

Adding particles to the air would require regular refills and probably planes or drones dedicated to the task. The concept might be feasible, but the side-effects are unclear.

And so it goes, for one potentially grand proposal after another. In sum, these ideas are simply too little, too late – or too expensive.

"None of the proposed techniques can realistically be implemented on a global scale in the next few decades. In other words, we can't rely on these technologies to make any significant contribution to holding the average temperature increase under the 2 degree C limit, much less the 1.5 degree limit, says lead author Mark Lawrence, Director of the Institute for Advanced Sustainability Studies (IASS) in Potsdam.

No substitutes for cutting emissions

Emissions reductions could still salvage the Paris Agreement's 2 degree C goal. But the challenge in meeting this goal is that the Earth's increasing population, which has also seen a steady increase in the standard of living, will have to decrease the amount of greenhouse gases that are being emitted into the atmosphere compared to today.

Most of the IPCC scenarios include some form of geoengineering, typically afforestation and bioenergy, coupled with carbon capture and storage, especially if the goal is to limit the temperature increase to 1.5 degrees by the end of this century.

The researchers behind the study warn against relying on solutions other than clear-cut emissions reductions. Otherwise, there is a danger that technological solutions may be seen as substitutes for cutting emissions, which they are not.

More information: Mark G. Lawrence et al. Evaluating climate geoengineering proposals in the context of the Paris Agreement temperature goals, *Nature Communications* (2018). DOI: 10.1038/s41467-018-05938-3

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