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TE APĀRANGI

GEOENGINEERING NO REPLACEMENT FOR REDUCING EMISSIONS OF GREENHOUSE GASES

Commentary from the Royal Society of New Zealand

Yesterday, the Royal Society of London released a major report on geoengineering – "the deliberate and large-scale intervention in the Earth's climate system, in order to moderate global warming". Geoengineering may become the plan B if efforts to reduce the emissions of greenhouse gases continue to be insufficient. These schemes include placing sunshades in space, creating artificial trees to absorb carbon dioxide, or artificially brightening clouds to reflect more of the sun's energy away from the planet.

However, no geoengineering scheme is fully credible and none "can provide an easy or readily acceptable alternative solution to the problem of climate change". The key recommendation from the report is that mitigation – reducing emissions of greenhouse gases – is still the top priority for reducing climate change.

Dr Phil Boyd, from NIWA in Dunedin, contributed to the report and says: "This document will be the benchmark guide for policy-makers, scientists and other interested parties as it covers a wide range of geoengineering topics from technology to ethics and governance".

Despite the difficulties with geoengineering, the Royal Society of New Zealand considers that several schemes could become particularly important given New Zealand's situation, and deserve further research. Afforestation is the simplest way to remove carbon from the atmosphere and has a role to play for New Zealand. Using this wood to produce biochar and biofuels could be major new industries, if it can be proven and verified that they reduce overall emissions of carbon. Ocean fertilisation, the addition of iron to help plankton grow, has been promoted optimistically and our easy access to the Southern Ocean suggests we could act as a staging point. However, the limited research done so far shows that ocean fertilisation appears to be ineffective at locking away carbon from the atmosphere, suggesting that it does not offer the potential that some claim.

A wide range of schemes propose to engineer the climate

Geoengineering proposals fall into two camps, those aiming to reduce the level of carbon dioxide in the atmosphere and those aiming to reduce the net solar energy that heats the planet. The first type of schemes is generally lower risk but will take decades to have an effect; the second type could act much faster but are generally higher risk.

Proposals to remove carbon dioxide from the atmosphere include those intending to enhance the uptake and storage by: biological systems, such as afforestation or ocean fertilisation; direct capture of carbon dioxide by technological means such as artificial trees; and, enhancing the weathering of rocks that naturally removes carbon dioxide from the atmosphere. These proposals are, in general, based on enhancing existing natural mechanisms and removing human additions to the atmosphere. As some of these schemes are little more than just enhancements of natural processes they could be considered as part of a portfolio response to reducing climate change, if they are shown to be cost-effective and safe.

Proposals to reduce the heating of the planet by blocking or reflecting the sun's energy include placing giant sunshields in space, increasing the reflectivity of the planet through planting reflective crops, placing reflectors in deserts, whitening roofs on buildings or paving, enhancing the reflectivity of clouds by spraying seawater from specially-constructed ships, or producing sulphate aerosols in the upper atmosphere. These techniques could reduce global temperatures much more rapidly, if deployed on sufficient scale, but none are without side effects. Each would require active management and if their use was discontinued, warming would take place rapidly. As these approaches do not reduce the raised levels of carbon dioxide in the atmosphere, and the resulting ocean acidification, these schemes could play a role as options of last resort.

No proposal is a silver bullet for climate change

A fundamental challenge in geoengineering is the planetary scale of the efforts required. Reflectors in the desert would need to cover an area as large as Canada. Sun shades in space would need to have an area similar to Australia or Brazil. At this stage it is difficult to estimate the costs of these proposals.

The Royal Society of London's report provides a set of criteria to assess geoengineering proposals. Preferred proposals will be: cost effective; have few side effects and unintended results; effective in reducing global temperatures; will be socially acceptable, and without difficult issues of governance. Importantly, no known proposal meets all these criteria. For example, the introduction of sulphate aerosols into the stratosphere is expected to be more effective and affordable than other proposals. Natural aerosols from volcanic eruptions are known to cause cooling, proving the technique is effective, and the relatively small amount of sulphate needed reduces costs. However, the risk of unintended effects is high, with potential impacts upon weather patterns such as the Indian monsoon and further reduction in stratospheric ozone. While acid rain is not expected, as the amounts of sulphate are relatively small, there remains the risk of other unforseen side effects.

Beyond the scientific and engineering challenges, the Royal Society's report raises questions about the governance and ethics of these proposals. They suffer from the fundamental flaw that currently limits effective progress on reducing greenhouse gas emissions, i.e., that effort on the scale required to reduce climate change requires coordinated global action, but the costs, benefits, and risks are unevenly shared between nations. Clear governance and agreed international frameworks will be needed for even one of these proposals to make a difference to the climate.

The report also highlights our ignorance of side effects and unintended consequences, in terms of both the magnitude of their impacts and their probabilities. Geoengineering also presents a moral hazard, where the existence of geoengineering proposals may decrease efforts to reduce emissions of greenhouse gases because of "a premature conviction that geoengineering has provided 'insurance' against climate change.

But some proposals deserve further attention by New Zealand

For New Zealand, several approaches seem to have the most relevance. We are already playing a role in the research of afforestation, biochar and biofuels, and ocean fertilisation and our scientists are well linked in to international efforts in both research and informing policy.

Greatly increasing our forest cover will absorb and store carbon, and can be begun rapidly, offering the co-benefits of improvements in water regulation and quality, reduced soil erosion and potentially increased biodiversity. At a global level, afforestation is limited in the amount of carbon that can be stored, but given New Zealand's small emissions profile, large land area, and existing forestry industry, it could play a more significant role here. However, increasing forestry will require trade-offs to be made between forestry and food production, and between rapidly-growing exotic species and slow-growing natives that support our endemic biodiversity.

The increased biomass in expanded forests could be put to use (and could generate income) as biochar or biofuels. Biofuels are carbon neutral in use but when combined with carbon sequestration, could lock away large amounts of carbon while creating usable energy. The creation of biochar involves the heating of organic material such as wood to release usable fuel gases with only limited release of the carbon from the wood. The char can then be used as a soil conditioner, locking away carbon. The potential of this approach is not yet clear; biochar and sequestered biomass are not yet eligible for carbon credits. New Zealand is supporting research in this topic, with the recent MAF funding of the biochar research centre at Massey University.

The Southern Ocean has been put forward as the key region for ocean fertilisation, the proposal to add iron to promote the growth of plankton that absorbs carbon as they grow. New Zealand has existing research strengths in the marine physics, chemistry and biology of this region required to better understand this proposed approach. The effectiveness of these schemes is far from proven and the risks of side effects uncertain. There is an urgent need for global regulations that allow further research in this field, while preventing commercial developments until they are justified and effective.

The full report can be found online at:
http://royalsociety.org/document.asp?id=8729

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