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PLOS CLIMATE

OPINION

# The Need-Efficiency Tradeoff for negative emissions technologies

**Kian Mintz-Woo**[1,2]*

**1** Philosophy and Environmental Research Institute, University College Cork, Cork, Ireland, **2** Equity and Justice Group, International Institute for Applied Systems Analysis, Laxenburg, Austria

* mintzwoo@ucc.ie

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## Introduction

Despite the lack of demonstrated scale [1], it has become increasingly clear that negative emissions technologies will be a necessary part of our climate change portfolio [2, 3]. Negative emission technologies involve a range of ways of capturing and sequestering carbon, such as from the ambient air (e.g. Direct Air Capture) or by growing biomass, burning it and capturing the resultant carbon from smokestacks (e.g. bioenergy with carbon capture and storage). In the words of the Sixth Assessment Report from the Intergovernmental Panel on Climate Change, negative emissions technologies are "an essential element of scenarios that limit warming to 1.5˚C or *likely* below 2˚C by 2100" [4, TS. §5.7, emphasis original]. If we had been mitigating sufficiently earlier, this might have been avoidable, but that time has passed.

There are many different strategies for capturing carbon, but regardless of which we adopt, all capture methods will require carbon *storage* capacity. Developing sufficient storage capacity will require massive investment [5]. If left to the market, we should expect that any development would be haphazard—and would neither necessarily address climate change nor promote any other moral values. If not leaving it to market forces, developing this capacity will require spending public resources. But we should be intentional about which values this spending reflects—in short, we should take this to be a question worthy of moral deliberation [6].

This Opinion aims to begin this deliberation by suggesting that the investment could be responsive to two particular values: need and efficiency—and that these values point us towards taking different actions. For negative emissions technologies, I suggest, we face a *Need-Efficiency Tradeoff*, i.e. a "NET effect". This tradeoff also highlights several contrasts: responding to need focuses on regional and short-term moral considerations; responding to efficiency focuses on global and long-term moral considerations.

## Responding to need

One way of thinking about where scarce resources should go is to think about where we expect that they are most needed. In the case of negative emissions technologies, we might be interested in where the demand for negative emissions is likely to grow in the near-term. There is evidence that the demand for carbon storage capacity will grow very quickly, especially compared to current oil and gas activity, in developing Asian regions [7]. In these regions, there is both active fossil fuel infrastructure and social expectations that this infrastructure will continue to operate. Some philosophers have argued that these kinds of expectations, under certain conditions, have significant moral weight [8]. Basically, they say that some plans for life

are put at risk when governments change policies in significant ways, and that these risks count against these policy changes.

Besides infrastructure lock-in, there is an independent sense in which we might reasonably say such developing regions are in need. Technology transfer from developed to developing countries (or investment resources) helps to redress global distributive inequality. In short, we can make the distribution of resources more just when resources are directed from countries with more to those with less.

These considerations favor funding the development and appraisal of potential storage capacity with an aim to increase negative emissions capacity in developing regions with fossil fuel commitments, perhaps especially in Asia. Doing so would answer to the moral value of need in the NET effect.

## Aiming for efficiency

The development of potential geological storage sites for carbon is strewn with uncertainties, including both political and economic challenges [7]. Any carbon storage investment, whether public or private, is subject to significant risk. Given that a primary goal is to contribute to mitigation capacity and thereby lessen climate impacts on future generations, another way of thinking about where to invest scarce resources is to think about where they are most likely to succeed. In short, one value we might embrace is efficiency: investing in such a way that we have the highest chance of effecting the highest sustainable rate of injection for negative emissions.

Generally speaking, both human capital and geological understanding track current oil and gas operations. The expertise needed for both surveying and injecting carbon is most likely to come from experience in oil and gas. Oil and gas investments have led to greater understanding of geological sites in areas of active extraction. In the context of capacity to inject carbon, this is key because geological features of one site do not easily generalize to other sites even when they are in the vicinity of each other—let alone when they are in different countries.

If trying to maximize efficiency, we might aim to develop capacity in regions with significant oil and gas operations where geological features are well-understood. However, this generally would *not* increase current global distributive justice, since large oil and gas operations tend to be in wealthy regions (especially in North America, northern Europe and the Middle East). This would respond to the importance of efficiency in the NET effect.

One final moral consideration is long-term justice. Investing in the development of carbon storage capacity in an efficient manner will increase our likelihood of preventing the worst climate outcomes, outcomes which are both difficult to reverse and which will reverberate for many generations.

## Conclusion

I have argued that negative emissions technologies are subject to a *Need-Efficiency Tradeoff Effect*, *or NET Effect*. Of course, this is not to gainsay other concerns, both technical and moral, that might arise with respect to such technologies. However, this tradeoff is a novel and underrecognized moral issue.

For a marginal economic contribution to increase capacity for negative emissions technologies, we might either respond to need or promote efficiency. On the one hand, we might be sensitive to near-term expectations in the developing world, where there is morally important fossil-fueled development need which requires negative emissions in the near-term. On the other hand, we try to maximize our long-term mitigation potential, independent of the effects on development, in order to efficiently reduce the probability of overshooting or failing to

meet global climate goals. While this Opinion does not settle the issue, it is a call to think about which values we want inflecting these important decisions.

## References


1. Fuss S, Canadell J G, Peters, GP, Tavoni, M, Andrew, R M et al. Betting on negative emissions. Nature Climate Change 2014; 4(10):850–853. https://doi.org/10.1038/nclimate2392
2. Galán-Martín Á, Vázquez D, Cobo S, Mac Dowell N, Caballero J A, Guillén-Gosálbez G. Delaying carbon dioxide removal in the European Union puts climate targets at risk. Nature Communications 2021; 12:6490. https://doi.org/10.1038/s41467-021-26680-3 PMID: 34764274
3. Minx J C, Lamb W F, Callaghan M W, Fuss S, Hilaire J, Creutzig F et al. Negative emissions—Part 1: Research landscape and synthesis. Environ. Res. Lett. 2018; 13:063001. https://doi.org/10.1088/1748-9326/aabf9b
4. Pathak M, Slade R, Shukla PR, Skea J, Pichs-Madruga R, Ürge-Vorsatz D. Technical Summary, in: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla J. Skea R. Slade A. Al Khourdajie R. van Diemen D. McCollum et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009157926.002
5. Bednar J, Obersteiner M, Wagner F. On the financial viability of negative emissions. Nature Communications 2019; 10:1783. https://doi.org/10.1038/s41467-019-09782-x PMID: 30992434
6. Mintz-Woo K, Lane J. Why and Where to Fund Carbon Capture and Storage. Sci Eng Ethics 2021; 27:70. https://doi.org/10.1007/s11948-021-00344-3 PMID: 34796377
7. Lane J, Greig C, Garnett A. Uncertain storage prospects create a conundrum for carbon capture and storage ambitions. Nature Climate Change 2021; 11(11):925–936. https://doi.org/10.1038/s41558-021-01175-7
8. Meyer L H, Sanklecha P. How legitimate expectations matter in climate justice. Pol Phil Econ 2014; 13 (4):369–393. https://doi.org/10.1177/1470594X14541522