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Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions

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Targets and accounting for negative emissions should be explicitly set and managed separately from existing and future targets for emissions reduction. Failure to make such a separation has already hampered climate policy, exaggerating the expected future contribution of negative emissions in climate models, while also obscuring the extent and pace of the investment needed to deliver negative emissions. Separation would help minimize the negative impacts that promises and deployments of negative emissions could have on emissions reduction, arising from effects such as temporal trade-offs, excessive offsetting, and technological lock-in. Benefits for international, national, local, organizational, and sectoral planning would arise from greater clarity over the role and timing of negative emissions alongside accelerated emissions reduction.

Keywords: negative emissions technologies (NETs), carbon trading, offsetting, target-setting, climate policy

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INTRODUCTION

The United Nations Environment Assembly (UNEA) meeting in Nairobi in March 2019 was marked by resistance to a Swiss proposal to study geoengineering governance. Amongst other concerns, the US and Saudi Arabian delegations even explicitly objected to language intended to establish that geoengineering should not be seen as a substitute for accelerated emissions reductions. They argued that negative emission techniques (NETs) will and should be an *alternative*, rather than an *addition,* to emissions reductions (Emerson, 2019). The function of such technologies, the delegations suggested, would be to enable the continued exploitation of fossil fuels.

That debate marked a fundamental shift in understanding of the "mitigation deterrence" effects of carbon geoengineering (often called "moral hazard"). Until now, many researchers have suggested that greater attention to NETs would not significantly delay or deter essential emission reductions. The political stance of the US and Saudi Arabia suggests instead that such mitigation deterrence is already happening, and is actively promoted and defended by some political interests.

Some argue that it shouldn't matter *how* carbon dioxide levels are abated—whether through reductions in fossil fuel combustion, or through NETs. This may hold true if the two approaches do not interact politically in ways that might prevent their effective delivery. Yet we see clear evidence that emissions reductions can be deterred or delayed by efforts and suggestions to use NETs to sustain fossil fuel use. To have any hope of achieving a 1.5°C objective, decarbonization must be accelerated. In this context, substituting negative emissions for emissions reduction could be harmful in itself. Making promises of future negative emissions, instead of reducing emissions now, is even more risky (Fuss et al., 2014; Anderson and Peters, 2016; McLaren and Jarvis, 2018). There is an urgent need to avoid such substitutions. It is crucial to ensure that negative emissions are delivered *in addition to* rapid emissions reduction. This will require careful policy design.

This policy brief outlines a proposal for formal separation of negative emissions targets and accounting from emissions reduction. This proposal is rooted in an analysis of the prospects for effective deployment of negative emissions (or greenhouse gas removal) technologies based on expert interviews and stakeholder deliberation.

A POLICY OF SEPARATION

To avoid substitution, and hence ensure negative emissions deliver the necessary *additional* carbon removal, we suggest that targets and accounting for negative emissions should be explicitly set and managed separately from existing and future targets for emissions reduction. Targets, timetables, accounting methods and incentives could then be clearly and explicitly tailored to the different approaches and technologies involved. This principle should apply to all levels of targets: international, national, local, organizational, and sectoral.

Such separation was a central proposal emerging from stakeholder deliberations and expert interviews, involving 80 individuals (including policy makers, business people, academics, and non-governmental organization representatives) from nine countries, conducted between September 2018 and January 2019. The groups discussed politically and technologically diverse scenarios for deployment of negative emissions that spanned favorable and unfavorable contexts for climate policy, and featured several potential mechanisms of mitigation deterrence (Markusson et al., 2018; McLaren and Jarvis, 2018). Stakeholders suggested multiple policy measures to incentivise, accelerate, and underpin the practical delivery of negative emissions. Noticeably, though, all groups also either raised or broadly endorsed measures for the separation of emission reduction and negative emissions targets as a means to help ensure that promotion of carbon removal would not undermine emissions reduction. The discussions suggest that the proposed separation measures could be politically feasible, and also robust both in diverse political settings and for diverse technical options.

The following section briefly reviews how the alternative, treating negative emissions and emissions reductions as entirely fungible, is playing out in current climate politics.

THE ALTERNATIVE: HISTORIC MYOPIA AND CONTINUING CONFUSION

Negative emissions have been included in climate modeling and policy pathways for at least a decade. But until the IPCC's fifth assessment report, and to some extent still, they have been subsumed into net emissions pathways that do not reach net-zero until 2050 or later (Peters and Geden, 2017). In our interviews experts highlighted that this approach unintentionally concealed the role of NETs in model pathways prior to the achievement of net-zero, giving an impression that such technologies were an issue for the post-2050 regime only. As such, failure to separate out negative emissions has fed policy myopia over the need to incentivise NETs early. At the same time this confusing presentation meant that for some years it was unclear that the absolute quantities of negative emissions deployed in the models [especially those arising from bio-energy with carbon capture and storage (BECCS)] were much larger than could be practically or sustainably delivered (Fuss et al., 2014). Furthermore, those same model pathways validated continued delays in mitigation because the later negative emissions—whose costs were heavily discounted—appeared cheaper than accelerating mitigation in the near future (Bednar et al., 2019).

We have tended to overlook the extent to which integrated assessment models replace near-future emissions cuts with *future* negative emissions. But we also overlook the extent to which negative emissions (from enhanced sinks) *have already* substituted for emissions reductions instead of supplementing them. Yet these are not equivalent: carbon captured by sinks is vulnerable to *future leakage*, while emissions reductions have *permanent impacts* on atmospheric concentrations. Furthermore, emissions reductions foregone in the present cannot be substituted in the global cumulative carbon budget by future emissions reductions. So this strategy *increases* future reliance on negative emissions while potentially *consuming* some of the resource (land, energy, or storage capacity) needed to deliver future negative emissions (which will be required not only to reduce atmospheric concentrations of carbon dioxide, but also to counter-balance any ongoing "recalcitrant" emissions). The downsides of policies that emphasize trading carbon in offset schemes as a means to finance forest protection and tree planting, in terms of continued emissions justified by projects that may well have happened anyway (Cames et al., 2016), would become far clearer with a regime that clearly separated negative emissions from emissions reduction.

The failure to separate negative emissions from emissions reductions has impacts at other scales too. The project level accounting of *net emissions* from BECCS has contributed to a common mis-conceptualization of BECCS as an *additional* energy source with negative emissions, rather than as an "energy penalty" on already low-carbon bioenergy to deliver negative emissions. In turn this has boosted BECCS' profile in models and policy, arguably far beyond realistic appraisal. In practice, BECCS development has not been directed toward maximizing negative emissions potential, instead being used to partially offset emissions from production of ethanol-based biofuels (Sanchez et al., 2018). This has helped lock-in a form of biofuel that is sub-optimal (in carbon terms). Moreover, BECCS development has been largely driven by demand for carbon dioxide for enhanced oil recovery, where it acts as an emissions multiplier (Masnadi and Brandt, 2017). All these problems are exacerbated by the opacity of subsuming negative emissions into net carbon calculations at the project level.

Although some of these problems have been recognized, the systemic issue of non-separation has not been addressed. Today we see similar risks emerging in analysis and promises around other carbon removal approaches, including "natural" climate solutions (NCS) and direct air capture (DAC). Economists advocate carbon markets to incentivise such technologies, and modelers produce studies in which huge future removals balance carbon budgets and enable continued delay in eliminating fossil fuel use (Fuss et al., 2014; McLaren and Jarvis, 2018). Some modelers have sought to expose this and produce pathways that minimize reliance on speculative future carbon removal (Grubler et al., 2018; van Vuuren et al., 2018). However, others have introduced alternative novel NETs such as NCS (Griscom et al., 2017) and DAC (Chen and Tavoni, 2013) to balance modeled global carbon budgets (despite the risks of enabling further delay in mitigation).

It can be argued that deployments of NETs as offsets, or in carbon utilization, would help developers improve the technologies and capture economies of scale and of learning, helping make the techniques commercially more viable for future removals. But if we continue to fail to separate and value negative emissions appropriately, such deployments risk locking-in particular socio-technical configurations that sustain or encourage fossil fuel use. Examples include enhanced oil recovery, and the manufacture of synthetic fuel from DAC—which also sustains use of combustion engines and associated technologies. Similarly the inclusion of DAC as a tradable contribution to measures of fuel carbon intensity, for example in the California Air Resources Board system, risks slowing the adoption of e.g., electric vehicles. Negative emissions offsets for air travel or oil production would have the same effect, and we have already seen Heathrow airport using offsets from peat-bog restoration to contribute to its goal of carbon neutrality, and oil major ENI promising expansive afforestation to offset its operational emissions from oil and gas production. Mechanisms and narratives that portray offsetting as possible and desirable overlook risks of socio-technical lock-in, both on the *supply* side, e.g., growing emissions from air-travel, and on the *demand* side, with systems that divert carbon removed from the atmosphere into utilization (and re-release) rather than storage. Our expert interviewees cited several examples of such risks, some of which have been confirmed by more recent events, including the UNEA meeting cited above. In another pertinent example, the chief executive of Carbon Engineering recently told a Senate committee that one advantage of DAC technology was that it could be commissioned independently to offset the emissions of, for example, a coal-fired power station, rather than controlling emissions at source (Senate Committee on Environment and Public Works, 2019, p. 71).

ACTIONABLE RECOMMENDATIONS

Separation has multiple implications for climate policy. Here we offer recommendations in four areas: target definition; offsets and carbon trading; incentives; and modeling and evaluation processes. In each case we outline the implications and advantages of separation, and note potential downsides.

Firstly, then, in *target setting*, the separation approach calls for explicit separate objectives and timetables for emissions reduction and negative emissions. The currently popular policy formulation of achieving "net-zero" by a specified date (used widely by governments and activists) should therefore be unpacked and disaggregated to provide separate goals and timescales for emissions reduction and carbon removal. Using this revised formulation for nationally determined contributions under the Paris Agreement would ensure explicit evaluation of the practicality of each element, and expose any backtracking on emissions reduction.

At the global level, the net concentrations resulting from targets framed as net-zero and from separated targets might be expected to be the same. But the risks of unanticipated shortfalls appear greater with "net-zero," and could escalate at the sub-global level if governments, sectors or businesses conflate emissions cuts and negative emissions. Take agriculture. As a sector it has huge capacity to contribute to net-negative emissions, but also significant recalcitrant emissions. Some of the latter (e.g., those related to meat production) are more politically difficult to reduce than technically (in that dietary change could deliver substantial reductions). Imagine then an agriculture sector, challenged to achieve net-zero, which invests in soil carbon management and perhaps some biochar or enhanced weathering, while continuing to produce large quantities of beef. Its emissions might be somewhat reduced by adoption of renewable energy and other changes in practice and management, and largely offset by its negative emissions from soil management. However, the same sector, pressed first to minimize emissions and supported by promotion of dietary change, could cut its residual emissions dramatically, and additionally free up land for biomass production, perhaps for BECCS. In this scenario the same sector makes a significant net-negative contribution to the national or global goal. It is equally easy to imagine a state with the capability to deliver overall net-negative emissions globally, but taking a politically or economically easier path to net-zero.

Similarly we can picture a transport sector that meets a net-zero goal by buying in offsets from negative emissions to enable further increased aviation, rather than first minimizing emissions by using alternative fuels, and alternative infrastructures to minimize flying. Here constrained capacities for negative emissions get allocated as offsets for emissions that could have been directly cut, increasing the costs of future carbon removals. States which refuse to transform consumption habits (or reduce oil production) but purchase international offsets offer a similar example. This problem is exacerbated by differential responsibility. The states and corporations with the greatest cumulative historical emissions arguably have the responsibility to make larger net-negative contributions. Clarity over the distribution of emissions reductions and negative emissions is essential in making such assessments of climate justice.

Secondly, the formal separation of negative emissions would also require redesign of most *offsetting and carbon trading* systems. Such systems aim to reduce economic costs: to take carbon out of the system where it is cheapest to do so in the current market. But the conflation of negative emissions and emissions reductions can increase overall abatement cost in the long term through lock-in or sub-optimal resource allocation. Moreover, allowing the economic case to determine policy structures reduces climate policy to economic interests and exacerbates injustice. Carbon trading is easily distorted by powerful economic interests, and typically permits luxury emissions while constraining the demands of the poorest (Caney and Hepburn, 2011). Combining emissions cuts and negative emissions in the same markets offers yet another opportunity for such distortions, delaying transformative changes, locking in fossil fuel use, maintaining the political power of fossil-heavy interests, and thus institutionalizing the circumstances in which accelerated emissions cuts continue to be politically and economically expensive. In general, we would recommend not permitting negative emissions to trade in existing carbon markets. A separate market for negative emissions trading might be considered instead. Or if negative emissions were to be included in emissions reductions markets, then the market cap should be reduced in line with the anticipated contribution from negative emissions to ensure that those negative emissions supplement rather than substitute emissions reductions.

Thirdly, separation also implies a different approach to *incentives and portfolio building*. Experience suggests that we cannot simply rely on a high carbon price and offset payments to fund carbon removal (Bolton et al., 2015). But such a mechanism would anyway be unable to generate the inter-temporal financial transfers needed to deliver adequate negative emissions later in the century when the whole world is in net removals territory (Bednar et al., 2019). Separation highlights the need for appropriate financial incentives including and beyond carbon pricing. Avoiding offsetting between removal and emissions cuts would push prices higher in emissions trading markets, stimulating more rapid decarbonization than if offsets were permitted. A counter-argument is that constraints on offsetting might reduce incentives for investments in carbon removal by high-emitting businesses. Other things being equal, this may hinder some negative emissions approaches from reaching commercial viability. For example, investments by oil companies, like those recently made into Carbon Engineering, might appear less likely. But higher carbon prices should drive more abatement of emissions, as well as indirectly supporting carbon removal, and the future market opportunity for removal would become more certain if governments had to deliver credible policies for financing future removals. Enhanced clarity would highlight the need for high support rates in early development of NETs, rather than high carbon prices later in the century. In short, if burdens on business and government are largely displaced onto speculative future agents, the pressure needed to begin transformational change now is lost.

This clarity also helps incentivise portfolios of NETs—another approach seen as essential by our interviewees, yet poorly served by a carbon market vulnerable to price bubbles as finance chases policy (Cretí and Joëts, 2017). Instead, separation enables the introduction of targeted support and risk-reduction for specific NETs or outcomes, perhaps using tools like those designed to increase renewable energy capacity (Mitchell et al., 2006; Ragwitz and Steinhilber, 2014). This would focus attention on the specifics of support needed, and enable the building of effective, context-specific portfolios of NETs varying over both time and space.

Finally, the separation approach implies differences in *evaluation and assessment* methods. Carbon removal potential should be evaluated by independent groups—avoiding vested interests in continued emissions or in carbon removal technology. At a minimum, effective evaluation implies separate processes within bodies like the IPCC, or the UK's Committee on Climate Change, maybe with the equivalent of the "Chinese walls" required in financial organizations to minimize the risks of insider trading. Revised approaches to integrated assessment modeling that are explicit in how they handle and incorporate NETs will also be needed, alongside more careful and reflexive interpretation of model findings to expose the risks of mitigation deterrence.

Separation also clarifies the need for detailed reassessment of baseline assumptions regarding natural climate sinks related to land-use and oceans, given the range of NETs that seek to enhance carbon storage in forests and soils, or through enhanced weathering. If negative emissions were simply absorbed into national net targets, and without such analysis, the risks of double-counting or inappropriate attribution could be significant, yet net emissions approaches leave this gap more easily overlooked.

However, separation might exacerbate some challenges for carbon accounting, especially where techniques involve both emissions and negative emissions (such as habitat restoration and BECCS). Avoiding double counting across two distinct regimes for target setting and monitoring of progress would require careful design, and would not be politically trivial. Nonetheless, based on our stakeholder research, we conclude that such downsides are far outweighed by the potential advantages of a separation approach.

CONCLUSIONS

The arguments presented here validate previous calls for separating "gross-, and net-negative emissions" (Peters and Geden, 2017). They also suggest a need for a clearer formal separation of target-setting, incentivization, monitoring, and evaluation regimes for negative emissions.

"Going beyond net zero" means not only going further, to achieve net-negative emissions, but also reframing the challenge in ways that avoid the shortcomings of "net-zero" discussed here. Clear separation would expose interests and politics—deliberate efforts to substitute negative emissions for emissions reduction could no longer be hidden behind "net-zero" rhetoric; and the justice implications of who generates residual emissions would become clearer. Clarity would reveal both where negative emissions investment and development is inadequate, and where negative emissions (or future promises thereof) could undermine emissions reduction.

At the center of this problem is the myth that a tonne of CO_2 is just a tonne of CO_2 and therefore fungible. But a ton of CO_2 is an object (or indeed a concept) that is always inextricably embedded in technical, social, and political contexts which make different forms distinctive; for example, because of leakage risk, accounting uncertainty, systemic connection to other emissions, or economic or political interest. Climate justice has long distinguished essential from luxury emissions for both normative and substantive reasons (Shue, 1993). Today, for similar reasons, we need to distinguish negative emissions from emissions reductions.

ETHICS STATEMENT

This study was reviewed and approved by Lancaster University's Faculty of Science and Technology Research Ethics Committee. All subjects gave written informed consent in accordance with the Declaration of Helsinki.

AUTHOR CONTRIBUTIONS

All the authors collectively designed and conducted the deliberative workshops, which were facilitated by RW. DM conducted the interviews and drafted the manuscript. All authors contributed to manuscript revision and read and approved the submitted version.

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REFERENCES

Anderson, K., and Peters, G. (2016). The trouble with negative emissions. *Science* 354, 182–183. doi: 10.1126/science.aah4567

Bednar, J., Obersteiner, M., and Wagner, F. (2019). On the financial viability of negative emissions. *Nat. Commun.* 10:1783. doi: 10.1038/s41467-019-09782-x

Bolton, R., Foxon, T. J., and Hall, S. (2015). Energy transitions and uncertainty: Creating low carbon investment opportunities in the UK electricity sector. *Environ. Plan. C* 34, 1387–1403. doi: 10.1177/0263774X15619628

Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., et al. (2016). *How Additional is the Clean Development Mechanism? Analysis of the Application of Current Tools and Proposed Alternatives. Study Prepared for DG CLIMA.* Reference: CLIMA.B.3/SERl2013/0026r. Öko-Institut, INFRAS and SEI. Available online at: https://ec.europa.eu/clima/sites/clima/files/ets/docs/clean_dev_mechanism_en.pdf

Caney, S., and Hepburn, C. (2011). *Carbon Trading: Unethical, Unjust and Ineffective?* Grantham Research Institute on Climate Change and the Environment.

Chen, C., and Tavoni, M. (2013). Direct air capture of CO2 and climate stabilization: a model based assessment. *Clim. Change* 118, 59–72. doi: 10.1007/s10584-013-0714-7

Cretí, A., and Joëts, M. (2017). Multiple bubbles in the European Union Emission Trading Scheme. *Energy Policy* 107, 119–130. doi: 10.1016/j.enpol.2017.04.018

Emerson, S. (2019). *The US Opposed a UN Plan to Study Geoengineering to Combat Climate Change.* VICE. Available online at: https://motherboard.vice.com/en_us/article/3kgexv/the-us-opposed-a-un-plan-to-study-geoengineering-to-combat-climate-change

Fuss, S., Canadell, J. G., Peters, G. P., Tavoni, M., Andrew, R. M., Ciais, P., et al. (2014). Betting on negative emissions. *Nat. Clim. Change* 4, 850–853. doi: 10.1038/nclimate2392

Griscom, B. W., Adams, J., Ellis, P. W., Houghton, R. A., Lomax, G., Miteva, D. A., et al. (2017). Natural climate solutions. *Proc. Natl. Acad. Sci. U.S.A.* 114, 11645–11650. doi: 10.1073/pnas.1710465114

Grubler, A., Wilson, C., Bento, N., Boza-Kiss, B., Krey, V., McCollum, D. L., et al. (2018). A low energy demand scenario for meeting the 1.5°C target and sustainable development goals without negative emission technologies. *Nat. Energy* 3, 515–527. doi: 10.1038/s41560-018-0172-6

Markusson, N., McLaren, D., and Tyfield, D. (2018). *Towards a Cultural Political Economy of Mitigation Deterrence by Greenhouse Gas Removal (GGR) Techniques. Assessing the Mitigation Deterrence Effects of GGRs.* Lancaster: Lancaster Environment Centre. Available online at: http://wp.lancs.ac.uk/amdeg/files/2018/03/AMDEG-Working-Paper-1.pdf

Masnadi, M. S., and Brandt, A. R. (2017). Climate impacts of oil extraction increase significantly with oilfield age. *Nat. Clim. Change* 7, 551–556. doi: 10.1038/nclimate3347

McLaren, D., and Jarvis, A. (2018). *Quantifying the Potential Scale of Mitigation Deterrence From Greenhouse Gas Removal Techniques. Assessing the Mitigation Deterrence Effects of GGRs.* Lancaster: Lancaster Environment Centre. Available online at: http://wp.lancs.ac.uk/amdeg/files/2018/12/AMDEG-Working-Paper-2-Quantifying-MD-GGR.pdf

Mitchell, C., Bauknecht, D., and Connor, P. M. (2006). Effectiveness through risk reduction: a comparison of the renewable obligation in England and Wales and the feed-in system in Germany. *Energy Policy* 34, 297–305. doi: 10.1016/j.enpol.2004.08.004

Peters, G. P., and Geden, O. (2017). Catalysing a political shift from low to negative carbon. *Nat. Clim. Change* 7, 619–621. doi: 10.1038/nclimate3369

Ragwitz, M., and Steinhilber, S. (2014). Effectiveness and efficiency of support schemes for electricity from renewable energy sources. *Wiley Interdiscip. Rev.* 3, 213–229. doi: 10.1002/wene.85

Sanchez, D. L., Johnson, N., McCoy, S. T., Turner, P. A., Mach, K. J. (2018). Near-term deployment of carbon capture and sequestration from biorefineries in the United States. *Proc. Natl. Acad. Sci. U.S.A.* 115, 4875–4880. doi: 10.1073/pnas.1719695115

Senate Committee on Environment and Public Works (2019). *Hearing to Examine S. 383, The Utilizing Significant Emissions With Innovative Technologies Act, and The State of Current Technologies That Reduce, Capture and Use Carbon Dioxide.* Committee on Environment and Public Works. Available online at: https://www.epw.senate.gov/public/index.cfm/2019/2/hearing-to-examine-s-383-the-utilizing-significant-emissions-with-innovative-technologies-act-and-the-state-of-current-technologies-that-reduce-capture-and-use-carbon-dioxide

Shue, H. (1993). Subsistence emissions and luxury emissions. *Law Policy* 15, 39–60. doi: 10.1111/j.1467-9930.1993.tb00093.x

van Vuuren, D. P., Stehfest, E., Gernaat, D. E. H. J., van den Berg, M., Bijl, D. L., Daioglou, V., et al. (2018). Alternative pathways to the 1.5°C target reduce the need for negative emission technologies. *Nat. Clim. Change* 8, 391–397. doi: 10.1038/s41558-018-0119-8

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