



Governing Net Zero Carbon Removals to Avoid Entrenching Inequities

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Climate change embeds inequities and risks reinforcing these in policies for climate change remediation. In particular, with policies designed to achieve “net zero” carbon dioxide, offsets may be considered inequitable if seen to avoid or delay gross emission reductions; offsets to emissions through technologically mature methods of carbon dioxide removals (CDR) require natural resources at scales threatening food security; knowledge of the potential of immature CDR is largely a global north monopoly; and CDR in particular environments is ill-understood and its implications for development unexamined. The use of CDR to contribute to robust progress toward Paris climate goals requires global agreement on simultaneously reducing emissions and enhancing removals, equity in burden sharing, and an interdisciplinary effort led by individual jurisdictions and focused on the co-development of technologies and governance to create CDR portfolios matched to local needs.

Keywords: net zero, carbon removals, countering inequities, offsets, polycentric governance

INTRODUCTION

Bellamy and Geden (2019) make a case for the consideration of the potential contribution of CDR approaches to achieving 1.5–2.0°C pathways. They further propose that assessment proceeds technique by technique and locality by locality.

However, the sufficiency of local governance of carbon dioxide removal (CDR), although undeniably important, applies only where CDR actions are taken within the jurisdiction where the credits are to be accrued. This is quite unlikely to be the case for CDR roll-out of the magnitude required for global “net zero,” to the extent that these use the most likely current land-based technologies. The big-emitter countries, where the gap between easily-achievable emission reductions and net zero is largest, do not have enough affordable or re-allocatable land to plug the gap using land-based CDR, including forestry and bioenergy with carbon capture and storage, BECCS. Implicitly or explicitly, directly or indirectly, they would need to rely on developing countries to do it for them, on terms which may limit their food and energy supplies in the host countries and may not be seen as a fair global distribution of the burdens of managing climate change. The outcome would inevitably be compared with attempts to distribute burdens on an overall least-cost basis, on the lines used in integrated assessment models, or on approaches based on equity principles such as cumulative per capita emissions or current ability to pay (Fyson et al., 2020).

The scope and framing of these climate-related distributional issues have developed over time. Schlosberg and Collins (2014) have traced how the breadth of concerns of the environmental justice movement—rooted in studies of local pollution largely in the USA, defining the environment to include the places where people live and work and incorporating social justice—in turn influenced conceptions of climate justice. The pursuit of “just sustainability” (Agyeman, 2013) involves managing the distribution of benefits and harms not only between developed and developing countries but also between different communities and generations, with potentially different values. Policy needs to reflect that what is marginal land to a developed world policymaker or business in search of land-based offsets may have a different value to his or her counterpart in a developing country government and be different again from its significance to those who actually live on it. The issues at stake here go beyond the significance of large-scale CDR for energy supply and food security but biodiversity and the survival of a whole range of livelihoods and cultural practices, assuming CDR works and itself is not reversed through climate change (Dooley and Kartha, 2018). From a legal perspective, Tsosie (2007) argues for a right to environmental self-determination for indigenous peoples. It is against the background of these distributional concerns that we look critically at how CDR might be employed in the context of net zero policies and how potential inequities might be forestalled.

POLICY OPTIONS AND IMPLICATIONS

Potential Limits of Net Zero Framings

As Bellamy and Geden (2019) point out, the first misframing of CDR in climate policy occurred when “bioenergy with carbon capture and storage” (BECCS)—at that point a putative and undemonstrated combination of two techniques—was used in integrated assessment and climate policy models to fill the gap between overall carbon budgets and what could be achieved in a particular timeframe through emissions reductions. This was counterproductive in four respects:

- It led to over-optimism for the early achievement of carbon budgets.
- Particularly in the UK, it overestimated the role that BECCS could play and worked against critical analysis of this approach.
- The symbolic substitution of BECCS for all CDRs led to insufficient attention being given to other CDR techniques.
- It established a false sense of security, especially for the most climatically vulnerable communities.

We are now seeing the emergence of a second counterproductive misframing. It relates to the role of CDR in delivering national “net zero” targets. It is important to recognize that net zero is not an objective of Paris but an interim objective on the way to net-negative emissions sufficient to achieve temperature stabilization of well below 2°C above pre-industrial levels. Net zero CO₂ emissions, in the IPCC 1.5° Report definition, are achieved “when anthropogenic CO₂ emissions are balanced globally by anthropogenic CO₂ removals over a specified period” (IPCC, 2018). The scenarios in this report suggest that CDR

might typically be used to bring down net emissions faster than they would otherwise be achieved and in advance of the achievement of global “net zero.” The problematic issue arises around the circumstances under which CDRs could constitute a “moral hazard” or “mitigation deterrence effect” (Markusson et al., 2018), for instance by delaying or diluting other mitigation efforts.

There are some circumstances of CDR use in which moral hazard would not apply because the contributions of CDRs and emission reductions would be temporally as well as physically distinct. Thus, when emissions have been cut to zero, climate stability will still require the removal of residual greenhouse gases from the atmosphere, which have already locked in future temperature increases, and this is a task that only CDR techniques can perform. In addition, in cases where CDRs are more expensive, considered less safe, or less politically palatable than emission reduction, the risk of moral hazard and displacement does not arise. However, for several land-based CDR techniques, including afforestation, BECCS, and biochar, none of these circumstances may apply.

The potential for CDRs to deter other mitigation efforts has long been anticipated. The Royal Society Report on Geoengineering¹ (The Royal Society, 2009) recommended that “Geoengineering methods are not a substitute for climate change mitigation and should only be considered as part of a wider package of options for addressing climate change” (recommendation 3, p. 58), and the Royal Society/Royal Academy of Engineering Report on Greenhouse Gas Removal (The Royal Society and the Royal Academy of Engineering, 2018) (GGR/CDR) concludes “the goals of Paris can only be achieved if GGR is pursued alongside rapid and substantial emissions reductions. . . Large-scale GGR is challenging and expensive and not a replacement for reducing emissions” (recommendation 1, p. 114).

Despite these admonitions, the way in which “net zero” is currently framed in climate policy discourse, primarily considers CDRs as a simultaneous and fully substitutable (“fungible”) offsets to avoid gross emissions reductions. Moral hazard has moved from the realm of abstract risk to that of prospective operational mechanisms. The IPCC 1.5° Report makes clear that offsetting residual emissions is one role of CDR, along with shaving off a temperature peak:

“CDR would be used to compensate for residual emissions, and in most cases, achieve net negative emissions to return global warming to 1.5°C following a peak².”

Indeed, it could be argued that the “net zero” concept loses much of its meaning and attraction unless there is a large measure of substitutability between emissions reductions and CDR offsets. McLaren et al. (2019) have advocated separate, non-fungible targets for emissions reductions and CDR sequestrations, yet, as far as we are aware, only one jurisdiction to date has so far

¹Geoengineering Governance Research Project Briefing Note 6. Available online at: <https://web.archive.org/web/20160619032848/http://geoengineering-governance-research.org/perch/resources/cgg-briefing-note-6gerresearch-1.pdf>.

²IPCC 2018, Summary for Policymakers, C3.

embraced such an approach. This exception is Sweden, which, within its “net zero by 2045” overall strategic policy, has adopted separate targets for emission reductions and for something that is called “supplementary measures.” The latter includes both negative emissions *via* enhanced action in the land use, land-use change, and forestry (LULUCF) sector and specifically through BECCS, but it also includes international offsetting (including international negative emissions)^{3,4}. Thus, even in Sweden, the option of using CDR schemes in other countries to offset domestic emissions remains available.

For the majority of high emitting countries, fungibility between emissions and CDR sequestration targets provides a temptation to delay efforts with the more lifestyle-challenging or expensive policies of emission reduction, by ramping up CDR offsets either domestically or internationally. Alternatively, we might see another round of what Geden (2015), drawing on Brunsson (2007), has called “targetism,” by which setting unrealistic targets is primarily about making claims for legitimacy within climate policy processes and becomes dissociated from the need to deliver precision in defining climate action. The perceived political value to policymakers of constructive ambiguity (Geden, 2018) might provide an incentive not to look too closely at the effectiveness of CDR techniques or the unintended consequences of particular policy pathways toward their deployment. Non-state or sub-state actors, such as companies or cities, may feel even less constrained. We already have a clear warning of the dangers of similar climate policy fudges, as for instance regarding “reduction of emissions through degradation and deforestation” (REDD) programmes. These promote cynicism regarding the integrity of climate negotiations (Dooley et al., 2011), especially among environmental NGOs, and deliver very dubious long-term benefits to the climate system as well as to local communities (Jagger et al., 2014; Jagger and Rana, 2017). There will be strong benefits in attempting to learn from such past controversies and policy failures (Carton et al., 2020), recognizing that there may be particular problems in trying to rapidly scale up CDR (Buck, 2016) and that pursuit of environmental justice needs to go beyond a framework based on solely token adherence to the norms of transparency, equity, and legitimacy (Isyaku et al., 2017).

Do the Oxford Offsetting Principles Help to Mitigate the Risks?

A degree of cynicism about national actions may suggest a greater challenge to the myriad of non-state and sub-state actors to expand their actions in emissions reduction and in voluntary offset arrangements. Studies of voluntary standard setting in analogous contexts in the production of biofuels (Neville, 2015; Winickoff and Mandou, 2016) and palm oil (Clapp and Scott, 2018) suggest some potential hazards of such a course: continual contestation over discourses and narratives that frame governance, with alignment of interests between producers

and consumers being particularly powerful (Dauvergne, 2018). Allen et al. (2020) have sought to counter the broad risks—as well as specific failures in carbon accounting and storage and unintended consequences to humans and the environment—by the adoption of a set of principles designed to ensure “high-quality” offsets incorporating removals rather than substitution for emissions and incorporating long-term storage. They present these proposals as part of a program of “net zero aligned offsetting.” In their model, “a net zero society” has become the climate policy goal, and that means an expansion of existing voluntary carbon offsetting by “companies, organizations, cities, regions, and financial institutions.”

The detailed proposals in Allen et al. (2020) could make a significant impact if embedded in institutional arrangements with sufficient authority to review and enforce—see *ACTIONABLE RECOMMENDATIONS: THE CO-DEVELOPMENT OF APPROPRIATE CDR AND ITS GOVERNANCE IN THE CONTEXT OF LOCAL VALUES AND PRIORITIES* and *CONCLUSIONS: ROBUST AND EQUITABLE PROGRESS IN THE DEVELOPMENT OF CDR*. However, we consider their idea of a “net zero society” that presents significant governance challenges of its own, especially if delivered in a highly decentralized manner, with market power as its primary instrument:

- Net zero can be achieved in theory at any level of gross emissions, provided balancing removals are available as offsets. Achieving any level of offsets simply by developing a carbon market, initially through an accumulation of market signals, would give too much economic power to the high-emitting countries of the global north, which favor offsets. It risks that removals may be unreasonably prioritized over food production, biodiversity, or other sustainable development goals in the global south or that the financial or other terms of the deal may be inequitable.
- As already indicated, it is asking a too much of voluntary codes such as these to create a consistent, fair, and widely observed set of standards to be applied to processes and outcomes. It is not clear whether such voluntary arrangements are supposed to replace the role of governments under the Paris process, by constituting the means of implementation of NDC commitments or otherwise what the means of articulation of the national and non-state systems might be.
- The relationship of the short-term goal of a “net zero society” to a state of minimizing gross emissions, at least until Paris temperature targets are achieved and stabilized, is also unclear. Some effective global cap-and-trade system, with a shrinking cap applying both to emissions themselves and the trading of them, might be the way to secure further progress post mid-century. There is a scope for this within Paris Article 6, but a range of views among the parties as to its desirability was indicated in failure to make progress on mechanisms at COP25. There is of course an inherent tension between the need for governments to bear down on emissions and their delegation of that role to the market.
- Furthermore, there is a substantial chance that the achievement of any form of net zero will reduce the incentives

³<http://www.swedishepa.se/Environmental-objectives-and-cooperation/Swedish-environmental-work/Work-areas/Climate/Climate-Act-and-Climate-policy-framework/>.

⁴Fridahl, M., personal communication, 25 November 2019.

for policymakers to progress further toward minimizing gross emissions, at least without some technological breakthrough that significantly reduces the costs of such measures.

ACTIONABLE RECOMMENDATIONS: THE CO-DEVELOPMENT OF APPROPRIATE CDR AND ITS GOVERNANCE IN THE CONTEXT OF LOCAL VALUES AND PRIORITIES

To understand the impact of international CDR policy on those lower-emitting and still developing countries, we have to understand the challenges posed by a large dependence of the global climate policy regime on greenhouse gas removals. One arises from the very different states of technology readiness of different CDR approaches. The second derives from the principle of “common but differentiated responsibilities” of states to protect the climate as a global public good under international law in line with their capacities (Reynolds et al., 2018), an approach that is foundational to the UNFCCC and the Paris Agreement mechanism of nationally determined contributions (NDCs). Given this policy architecture of Paris, political realism would seem to suggest that more ambitious climate actions are most likely to be adopted if they are congruent with both national development aims and the full array of sustainable development goals (SDGs). Yet, the development of first-generation biofuels, as well as REDD+ programs as noted above, already provides examples of innovation to the detriment of local community rights, as well as to food security, and in some cases also the balance of greenhouse gas production (Mohr and Raman, 2013). By analogy, a balance between competing requirements on CDR will only be struck if clear governance principles are in place. These need to specify that CDR approaches are to be deployed if they are not only demonstrated to be effective, cost-effective, accountable, and safe by international standards but also interact with the local environment, culture, and economy in ways acceptable to each jurisdiction where they are to be deployed or where they will have impacts (CGG, 2014).

How might such a broad principle be developed into equitable global CDR policy? For lower-emitting, developing countries, where often CDRs do not yet have much of a place in climate policy, achieving a meaningful and sustainable role for CDRs will need to be based on careful and sensitive programs of technical assessment and stakeholder and public engagement. This relatively slow response to CDR provides a current window of opportunity for these assessments. They would need to consider *local* options, constraints, and goals and be informed by locally initiated research and governance. Achieving this, against a background where CDR research is largely concentrated in the Global North-West and is typically assessed only in technical and global terms that obscure national differences (for example, a reduction in the global mean temperature rise), will itself be a huge challenge, requiring a major development in local assessment and governance capacities. It risks being made politically more difficult if—as a result of unconditionally fungible “net zero” emissions framings—CDRs are seen as the

rich country escape route from assuming a historically fair share of gross emissions reductions. In order to speed widespread assessment, development, and take-up of CDR in the developing world, unconditionally fungible “net zero” emission framings need to be replaced or circumscribed so as to address and mitigate such perceptions. We suggest below some key principles and mechanisms for doing so. We recognize that given the interests of political and industrial incumbents, to be effective, any measures of this kind will need to be underpinned by strong international commitment to redress power inequalities in global climate policy, notably by recognition of local and indigenous rights and claims to land and resources.

CONCLUSIONS: ROBUST AND EQUITABLE PROGRESS IN THE DEVELOPMENT OF CDR

The challenges of achieving North-South justice of course are not confined to “net zero” framings or indeed to climate policy, and of course attempts to mitigate such risks should be based on principles and protocols that have a wider application. In summary, on the basis of the arguments presented, it is our assessment that robust but equitable progress in the development of CDR can be achieved through a number of such key developments in the governance and research system.

A first element should be a global agreement of the need to both reduce gross emissions and enhance removals at the fastest possible rate in pursuit of Paris objectives, coupled with a common view of what constitutes equity in national burden sharing in achieving these goals both in their overall scope and the process by which they are delivered.

A second element must be to ensure that those countries whose natural and social resources are targeted by others for large-scale CDR possess the capacities required to make them equal partners in their scientific assessment and governance of all options, in the context of their development needs and pathways (Workman et al., 2020).

The third element would be the introduction of a set of principles to protect the interests of local communities in the development CDR. These would be analogous to those applied to REDD+ by the Cancun safeguards (UNFCCC, 2011), which were designed to ensure the protection of the rights of indigenous peoples, the protection of natural forests, transparency, and accountability. In developing these, CDR would need to improve on and learn from the inadequacies of REDD+ safeguards.

Two innovations in the machinery of research and governance would buttress and implement these approaches.

An interdisciplinary, social-natural science, research, and policy effort would be the instrument for mitigating national inequalities in scientific and governance capacity in line with the second element above. This would be led by the policymakers and stakeholders of individual jurisdictions or through their voluntary networks and would center on the need for CDR policies to serve also wider economic and social needs, especially in developing countries. It would mobilize the scientific and governance capacities of the developed world—the sharing

of these capacities to be seen as part of the “common but differentiated responsibilities” of the developed world (see also United Nations, 2012)—and focus these on the rapid co-development of technologies and governance in creating portfolios of CDR matched to local circumstances and needs. The current authors declare an interest in this approach as members of an international network committed in principle to such work.

This would be complemented by, and iterated with, a small but effective global CDR governance machinery. This might be best established as an independent intergovernmental organization, analogous to IPCC but on a smaller scale, which would be able to bring together expertise to assess individual governments’ policies and practices as the Climate Change Committee is mandated to do within the UK. Its main role would be to lead an international dialogue aimed at vertically integrating systems for the assessment and governance of CDR so that progress toward and beyond “net zero” can be independently and consistently assessed and global standards and codes for best practice distilled. One detailed contribution this organization could make would not only be to underwrite or organize insurance to protect the supplier of any offsets but also to specify minimum contractual standards for monitoring, reporting, and verification of all CDR schemes, to protect offset purchasers.

These changes would have wider effects on the ways we assess the role of CDR in climate policy. Instead of each CDR technique being considered individually for its potential contribution at a global scale, using approximations of the environmental resources it would need to draw on, each technique would face the rigor of being evaluated comparatively in relation to other methods and in its approach being tested in real jurisdictions. The ambitious range of policies that some countries seek to integrate with climate action will provide additional challenges to the design of multilevel governance.

At the global level, instead of the pathway of removals being composed of technology wedges, allocated to countries top-down, it would be built bottom-up from the geopolitical wedges put forward by individual countries, based on local needs (Bellamy and Healey, 2018). This geopolitical anchoring of CDR plans should make them more realistic and sustainable and

help them to make the maximum responsible contribution to climate action.

AUTHOR CONTRIBUTIONS

PH and RS made substantial contributions to the text as joint first authors. PL and PY contributed to the text. All authors approved the work for publication.

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We dedicate this article to Professor Bob Scholes, news of whose untimely death reached us during this article’s production. He has passed away at a time when his scientific contribution to climate science is sorely needed. He will be remembered for his scientific leadership globally and specifically in the African continent.

REFERENCES

- Agyeman, J. (2013). *Introducing Just Sustainability: Policy, Planning and Practice*. London: Zed Books.
- Allen, M., Axelsson, K., Caldecott, B., Hale, T., Hepburn, C., Hickey, C., et al. (2020). *The Oxford Principles for Net Zero Aligned Carbon Offsetting*. University of Oxford; Smith School of Enterprise and the Environment. Available online at: <https://www.smithschool.ox.ac.uk/publications/reports/Oxford-Offsetting-Principles-2020.pdf> (accessed April 9, 2021).
- Bellamy, R., Geden, O. (2019). Govern CO2 removal from the ground up. *Nat. Geosci.* 12, 874–876. doi: 10.1038/s41561-019-0475-7
- Bellamy, R., and Healey, P. (2018). ‘Slippery slope’ or ‘uphill struggle’? Broadening out expert scenarios of climate engineering research and development. *Environ. Sci Policy* 83, 1–10. doi: 10.1016/j.envsci.2018.01.021
- Brunsson, N. (2007). *The Consequences of Decision-Making*. Oxford: Oxford University Press.
- Buck, H. J. (2016). Rapid scale-up of negative emissions technologies: social barriers and social implications. *Climatic Change* 139, 155–167. doi: 10.1007/s10584-016-1770-6
- Carton, W., Asiyani, A., Beck, S., Buck, H. J., and Lund, J. F. (2020). Negative emissions and the long history of carbon removal. *WIREs Climate Change* 11:e671 doi: 10.1002/wcc.671
- CGG (2014). What should we expect from geoengineering research? Climate
- Clapp, J., and Scott, C. (2018). The global environmental politics of food. *Glob. Environ. Politics* 18, 1–11. doi: 10.1162/glep_a_00464
- Dauvergne, P. (2018). The global politics of the business of “sustainable” palm oil. *Glob. Environ. Politics* 18, 34–50. doi: 10.1162/glep_a_00455
- Dooley, K., Griffiths, T., Francesco, M., and Saskia, O. (2011). *Smoke and Mirrors: A Critical Assessment of the Forest Carbon Partnership Facility*. Moreton-in-Marsh: FERN and Forest Peoples’ Programme.
- Dooley, K., and Kartha, S. (2018). Land-based negative emissions: risks for climate mitigation and impacts on sustainable development. *Int Environ Agreements* 18, 79–98. doi: 10.1007/s10784-017-9382-9

- Fyson, C. L., Baur, S., Gidden, M., and Schleussner, C. F. (2020). Fair-share carbon dioxide removal increases major emitter responsibility. *Nat. Clim. Chang.* 10, 836–841 doi: 10.1038/s41558-020-0857-2
- Geden, O. (2015, December 14). Paris climate deal: the trouble with targetism. *The Guardian*. <https://www.theguardian.com/science/political-science/2015/dec/14/the-trouble-with-targetism> (accessed January 1, 2021).
- Geden, O. (2018). Politically informed advice for climate action. *Nat. Geosci.* 11, 380–383 doi: 10.1038/s41561-018-0143-3
- IPCC (2018). *Intergovernmental Panel on Climate Change: Global Warming of 1.5°*. Geneva: IPCC.
- Isyaku, U., Arhin, A. A., and Asiyambi, A. P. (2017). Framing justice in REDD+ governance: centring transparency, equity and legitimacy in readiness implementation in West Africa. *Environ. Conserv.* 44:212. doi: 10.1017/S0376892916000588
- Jagger, P., Brockhaus, M., Duchelle, A. E., Gebara, M. F., Lawlor, K., Resosudarmo, I. A. P., et al. (2014). Multi-level policy dialogues, processes, and actions: challenges and opportunities for national REDD+ safeguards measurement, reporting, and verification (MRV). *Forests* 5, 2136–2162. doi: 10.3390/f5092136
- Jagger, P., and Rana, P. (2017). Using publicly available social and spatial data to evaluate progress on REDD+ social safeguards in Indonesia. *Environ. Sci. Policy* 76, 59–69. doi: 10.1016/j.envsci.2017.06.006
- Markusson, N., McLaren, D., and Tyfield, D. (2018). *Global Sustainability*. Cambridge: Cambridge University Press.
- McLaren, D., Tyfield, D., Willis, R., Szerszynski, B., and Markusson, N. (2019). Beyond “net-zero”: a case for separate targets for emissions reduction and negative emissions. *Front. Climate* 1:4. doi: 10.3389/fclim.2019.00004
- Mohr, A., and Raman, S. (2013). Lessons from first generation biofuels and implications for the sustainability appraisal of second generation biofuels. *Energy Policy*. 63, 114–122. doi: 10.1016/j.enpol.2013.08.033
- Neville, K. J. (2015). The contentious political economy of biofuels. *Glob. Environ. Politics* 15, 21–40. doi: 10.1162/GLEP_a_00270
- Reynolds, J. L., Gerrard, M. B., and Hester, T. (2018). *Climate Engineering and the Law: Regulation and Liability for Solar Radiation Management and Carbon Dioxide Removal*. Cambridge: Cambridge University Press. p. 124.
- Schlosberg, D., and Collins, L. B. (2014). From environmental to climate justice. *Wires Climate Change* 5, 359–374. doi: 10.1002/wcc.275
- The Royal Society (2009). *Geoengineering the Climate: Science, Governance and Uncertainty*. London: The Royal Society.
- The Royal Society and the Royal Academy of Engineering (2018). *Greenhouse Gas Removal*. London: The Royal Society. p. 114.
- Tsosie, R. (2007). Indigenous people and environmental justice: the impact of climate change. *U. Colorado Law Rev.* 78:1625.
- UNFCCC (2011). *The Cancun Agreements Dec 1/CP.16*. Bonn: United Nations Framework Convention on Climate Change. p. 1–31.
- United Nations (2012). *Report of Special UN Rapporteur, Farsda Shaheed, in the Field of Cultural Rights: the Right to Enjoy the Benefits of Scientific Progress and Its Applications*. UN Dec A/HRC/20/26. New York, NY: United Nations.
- Winickoff, D. E., and Mandou, M. (2016). *The problems of epistemic jurisdiction in global governance: the use of sustainability standards for biofuels*. Social Studies of Science. doi: 10.1177/0306312716667855
- Workman, M., Dooley, K., Lomax, G., Maltby, J., and Darch, G. (2020). Decision making in contexts of deep uncertainty - an alternative approach for long-term climate policy. *Environ. Sci. Policy* 103, 77–84. doi: 10.1016/j.envsci.2019.10.002

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