

Center for International Environmental Law (CIEL) Submission on Annex 15: Draft Recommendation: Activities involving removals under the Article 6.4 mechanism Removals

Thank you for the opportunity to comment again on the “[Draft Recommendation: Activities involving removals under the Article 6.4 mechanism](#).” CIEL has commented previously¹ on these recommendations and appreciates the ongoing opportunities to engage with the Supervisory Body on this topic.

It is critical that all activities sanctioned by the Article 6.4 mechanism avoid negative environmental impacts and human rights harms. We appreciate the commitments made in the rules at COP26 and the work the Supervisory Body is doing to avoid past mistakes and eliminate negative impacts. In addition to the commitments that have been made within the UNFCCC regime, both host (seller) countries and buyer countries have human rights commitments. Climate action, including activities taking place in the Article 6.4 mechanism, should not exacerbate or contribute to human rights harms. On the contrary, rights compatible climate action should be promoted as it is more effective climate action².

To that end, we wanted to provide the Supervisory Body with recent reports from human rights experts that are relevant for its consideration of recommendations on activities involving removals. In particular, we want to draw your attention to three specific reports that have recently come out. The Human Rights Council Advisory Committee,³ whose report is annexed to this submission, the Committee on the Rights of the Child, and the Special Rapporteur on Human Rights and Toxics have all issued reports of relevance to the Supervisory Body’s ongoing consideration of recommendations on activities involving removals. These reports look at the consideration of human rights and States’ human rights obligations in relation to climate change and climate actions, and in particular look at carbon removal technologies existing and new climate technologies. As can be seen from these reports, it is clear that the way to tackle the climate crisis is rapidly phasing out fossil fuels and not relying on dangerous distractions or proposals that would enable delaying this needed action, including reliance on unproven and unfeasible technologies. Further, many of the purported solutions, especially those involving new technologies, pose significant risks to human rights. As the Supervisory Body continues to develop its recommendations, including potentially what activities should be excluded, it should take into account these critical reports.

Advisory Committee to the Human Rights Council

Following a request from the Human Rights Council, the Advisory Committee to the Human Rights Council conducted an assessment and issued a report on the “Impact of new technologies intended for climate protection (NTCP) on the enjoyment of human rights.” In developing its report, the Advisory Committee

¹ CIEL has previously responded to calls for submissions including submitting [comments on the call for submission on the removals prior to SB003](#), in [response to the call for submissions from Decision 7/CMA.4](#), and in [response to the Structured Public Consultation on Removal activities under the Article 6.4 mechanism Questionnaire on Removals Activities](#).

² IPCC, 2023: Summary for Policymakers, in *Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, paras. C.5, C.5.2 (Lee & Romero, eds, 2023) (stating “Adaptation and mitigation actions, that prioritise equity, social justice, climate justice, rights-based approaches, and inclusivity, lead to more sustainable outcomes, reduce trade-offs, support transformative change and advance climate resilient development.”).

³ Advisory Committee to the Human Rights Council, *Impact of new technologies intended for climate protection on the enjoyment of human rights*, U.N. Doc. A/HRC/54/47 (July 12, 2023) (advanced unedited version), <https://www.ohchr.org/sites/default/files/documents/hrbodies/hrcouncil/advisorycommittee/A-HRC-54-47-AUV.docx>.

worked with the Special Rapporteur on Human Rights and Climate Change, assessed publicly available scientific knowledge, and consulted with a wide-range of stakeholders. We have annexed the full report, which is currently available in its advanced unedited version to this submission, for the benefit of the Supervisory Body.

Like many other bodies, and as made clear by the IPCC, the Advisory Committee emphasizes that rapidly phasing out fossil fuels is imperative and that rights-based approaches including deploying readily available existing and proven renewable technologies and conserving and restoring natural ecosystems is the best path⁴ and that a primary risk of reliance on geoengineering technologies is that they deter the emissions cuts needed.⁵ In contrast, the Advisory Committee notes that “at their current stage in development NTCPs cannot be considered viable mitigation or adaptation measures. *Most geoengineering technologies remain unproven, unavailable, and unfeasible at scale.*”⁶ The report, which defines NTCPs, primarily focuses on carbon dioxide removal (CDR) and solar radiation management, of which the former is more relevant to the Article 6.4 Supervisory Body, though does note that the findings apply to BECCS even though that is not considered given the definition they use.⁷

The Advisory Committee further emphasizes that “[t]he precautionary principle has been and should be applied to geoengineering” and that prevention of harm prior to it occurring should be the main approach given that reversing environmental damage is often impossible.⁸ It also warns about the “massive and disproportionate impact on Indigenous Peoples” and the disproportionate impact on peasants, fisherfolks and other rural people that may come with deployment of NTCPs.⁹

Notably the Advisory Committee states “At this stage of their development, given the lack of sufficient knowledge as to their risks and adverse impacts, a presumption may apply that all NTCPs are generally harmful to human rights and their deployment would be contrary to existing States obligations.”¹⁰ And further that there should be “restrictive regulations including potentially a moratorium ... adopted and implemented when large and foreseeable negative impacts can be advance[d] and rationally expected.”¹¹ The Supervisory Body should consider this approach and restrict such approaches from being used to generate credits.

Committee on the Rights of the Child:

The Committee on the Rights of the Child, which monitors the implementation of the Convention on the Rights of the Child by Member States and makes recommendations on issues relating to the rights of children, recently issued General Comment No. 26 (2023) on children’s rights and the environment, with a special focus on climate change.¹² The Convention on the Rights of the Child has near universal membership

⁴ *Id.* at paras. 4, 29.

⁵ *Id.* at paras. 12, 22.

⁶ *Id.* at para. 10 (*emphasis added*).

⁷ *Id.* at paras. 7-8.

⁸ *Id.* at para. 36; see also, para. 33.

⁹ *Id.* at paras. 55-56.

¹⁰ *Id.* at para. 66.

¹¹ *Id.* at para. 67.

¹² Committee on the Rights of the Child, *General Comment No. 26 (2023) on children’s rights and the environment, with a special focus on climate change*, U.N. Doc CRC/C/GC/26 (Aug. 22, 2023), <https://www.ohchr.org/en/documents/general-comments-and-recommendations/general-comment-no-26-2023-childrens-rights-and>.

with all but one UN country ratifying or accepting the rights articulated in it. In this General Comment, the Committee highlights the impact of environmental degradation and, in particular, the climate crisis on children and the realization of their rights, the imperative of taken urgent action to curtail the drivers of climate change (the production and use of coal, oil, and gas), and provides guidance and recommendations to States on how to implement the Convention and what they must do to prevent, mitigate and remediate harms faced by children.

The General Comment also specifically addresses climate change and provides recommendations related to mitigation, adaptation, loss and damage, and climate finance. The Committee calls for “urgent action” to mitigate greenhouse gas emissions, notes the insufficient process thus far, and calls on mitigation measures to be based on best available science.¹³ Notably and of relevance to the Supervisory Body’s consideration of activities involving removals, the Committee said in para. 98(e):

When determining the appropriateness of their mitigation measures in accordance with the Convention, and also mindful of the need to prevent and address any potential adverse effects of those measures, States should take into account the following criteria ... (e) Mitigation measures cannot rely on removing greenhouse gases from the atmosphere in the future through unproven technologies. States should prioritize rapid and effective emissions reductions now in order to support children’s full enjoyment of their rights in the shortest possible period of time and to avoid irreversible damage to nature.

Special Rapporteur on Human Rights and Toxics:

The UN Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes (“SR on Toxics and the Environment”) recently issued a report on “The toxic impacts of some proposed climate change solutions.”¹⁴ This report examines the overlaps between toxic pollution and the climate crisis, notably the potential for proposed climate solutions to contribute to toxic pollution. The Special Rapporteur acknowledges the threat the climate crisis poses to the enjoyment of human rights and the importance of decarbonizing in a way that does not contribute to toxic pollution. Throughout the report, the Special Rapporteur notes the potential toxic impacts of proposed climate technologies and emphasizes the need to take steps to prevent those harms.

Carbon capture and storage (CCS) coupled with bioenergy (as in BECCS) and direct air capture (DACCS) has been part of the discussion in the Supervisory Body. Amongst other technologies, the Special Rapporteur’s report notes the hazards related to CCS and defines CCUS as “technologies that either enable the mitigation of carbon dioxide emissions from large point sources such as refineries, power plants and other industrial facilities, or remove existing carbon dioxide from the atmosphere.”¹⁵ The report notes that “[t]hese processes can be highly energy-intensive,”¹⁶ which could then exacerbate the climate crisis if the energy used for CCUS is produced from fossil fuels. The report further states:

These technologies present health and safety risks. Amine-based solvents are often used to capture carbon dioxide from industrial facilities. This process relies on large amounts of

¹³ *Id.* at paras. 95-97.

¹⁴ Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes (Marcos Orellana), *The toxic impacts of some proposed climate change solutions*, UN Doc. A/HRC/54/25 (July 13, 2023), <https://www.ohchr.org/en/documents/thematic-reports/ahrc5425-toxic-impacts-some-proposed-climate-change-solutions-report>

¹⁵ *Id.* at para. 67.

¹⁶ *Id.* at para. 68.

chemicals and can release significant quantities of highly toxic ammonia into surrounding communities. At high concentrations, carbon dioxide is a toxic gas and an asphyxiant, which can cause circulatory insufficiency, coma and death. There are also risks relating to leakage during transport, injection and long-term storage. Leakage to adjacent geological formations may cause geochemical reactions, including stimulation of seismic activity, and mobilization of potentially polluting elements, such as heavy metals, which can contaminate drinking water. Underground storage also involves the risk of pipeline rupture, during which highly hazardous compressed carbon dioxide could be released.¹⁷

As the above paragraph highlights and of particular relevance for the Supervisory Body, CCS has leakage risks, which could undermine the integrity of any carbon credit generated from an activity involving CCS. The Special Rapporteur also notes “The inseparable link between carbon capture and storage and the use of fossil fuels underlines the risks posed by this technology to human rights. Carbon capture technology risks locking in place fossil fuel-reliance and the associated environmental injustices.”¹⁸

Given the activities the Supervisory Body is considering, the above should be taken into consideration. Similarly, the Supervisory Body is considering a number of engineering technologies. Of relevance the Special Rapporteur says:

Climate engineering is “large-scale, deliberate intervention in the Earth system to counteract climate change”. Such interventions are primarily considered as options to compensate for lagging international efforts to mitigate climate change. **There is a lack of scientific certainty about the efficiency of climate-altering engineering technologies, such as solar radiation modification, and they can have a wide range of potential impacts on the effective enjoyment of human rights.** Pinning humanity’s hopes on future technologies should not be used to justify insufficient action to reduce greenhouse gas emissions and phase out fossil fuels.¹⁹

The Special Rapporteur recommends, among other things, the adoption of mandatory standards on environmental and human rights due diligence, enforcing and strengthening environmental and social safeguards rather than exempting some technologies from them, and respecting Indigenous Peoples right to free, prior, and informed consent.

Conclusion

As evidenced in these recent reports, removal technologies can pose significant risks to human rights and the environment. As it continues to assess how to ensure that its activities do not have negative environmental and social impacts, the Article 6.4 Supervisory Body should consider these reports and the human rights obligations of States in taking climate action. Not doing so risks the sanctioning of activities that undermine human rights and the rights of Indigenous Peoples, and cause environmental harm.

If you have any questions regarding this submission, please contact Erika Lennon, elennon@ciel.org.

¹⁷ *Id.* at para. 69.

¹⁸ *Id.* at para. 70.

¹⁹ *Id.* at para. 71.

Annex I: Advisory Committee to the Human Rights Council's Report on "Impact of new technologies intended for climate protection on the enjoyment of human rights"

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**Promotion and protection of all human rights, civil,
political, economic, social and cultural rights,
including the right to development**

Human rights bodies and mechanisms

Impact of new technologies intended for climate protection on the enjoyment of human rights

Report of the Human Rights Council Advisory Committee* **

* Agreement was reached to publish the present report after the standard publication date owing to circumstances beyond the submitter's control.

** The annexes are being circulated as received, in the language of submission only.

Contents

	<i>Page</i>
Background	3
I. Introduction	3
II. Risks and side-effects	5
A. Physical risks	6
B. Social, societal, and socio-economic risks	6
C. Vested interests	7
D. Emission cuts deterrence and ‘greenwashing’	7
E. Other ethical risks	7
F. Political and security risk	8
III. Applicable normative framework	8
A. Restrictions to the development and deployment of NTCPs	9
B. Principled approach	10
C. Operationalizing a human rights-based approach	11
D. Business regulation	12
IV. Assessing the human rights impact	13
A. Impact on specific rights	13
B. Impact on specific groups	14
V. Building-up a protective framework	15
A. Multilateralism and governance framework	16
B. Inclusiveness in decision-making	16
C. Ensuring accountability and oversight	16
D. Ensuring access to information, participation and access to justice in environmental matters	17
E. Operationalizing human rights approach and assessments	17
VI. Conclusions	17
VII. Recommendations	19
A. International community, States and policy-makers	19
B. Human Rights Council and Special Mechanisms	19
C. Office of the High Commissioner for Human Rights	20
Annex	
The technological component and additional information	21

Background

1. By its Resolution 48/14 of 8 October 2021 the HRC requested the Advisory Committee (AC) to conduct a study and to prepare a report on the “impact of new technologies for climate protection on the enjoyment of human rights” to be submitted at its fifty-fourth session. At its twenty-seventh session, the Committee established a drafting group, currently composed by Buhm-Suk Baek, Rabah Boudache, Milena Costas Trascasas (Chair), Ajai Malhotra, Javier Palumbo, Vasilka Sancin, Patrycja Sasnal (Rapporteur), Vassilis Tzevelekos and Frans Viljoen.

2. In the elaboration of this report, the Committee worked in cooperation with the Special Rapporteur on the promotion and protection of human rights in the context of climate change. The study is based on scientific knowledge publicly available, semi-structured interviews with stake- and rights-holders, including representatives of Indigenous Peoples, inputs from NGOs, States, public institutions, academics, and business.

3. The term “new technologies *intended* for climate protection” (NTCPs) reflects more accurately the current debate on the issue. Attributing at this stage a “protective” function to speculative technologies may be misleading as it presupposes evidence-based knowledge that they are all beneficial or desirable. It may give a false impression that there is a scientific certainty about the efficacy of these technologies, which is not currently the case.¹ NTCPs are examples of “geoengineering”, a larger and widely used term that refers to “a broad set of methods and technologies operating on a global scale that aim to deliberately alter the climate system in order to alleviate impacts of climate change.”²

4. Climate change is one of the biggest threats that humanity faces, requiring a global solution. States have human rights obligations to prevent to the greatest extent possible its current and future negative impacts. Successive Intergovernmental Panel on Climate Change (IPCC) reports have made it clear that phasing out fossil fuels is imperative to mitigate climate change and minimize its future negative human rights impact on people. It further emphasizes that rights-based approaches by employing readily available existing renewable energy technologies and conserving and restoring earth’s natural systems which serve as carbon sinks offer a sustainable pathway to keeping climate change below 1.5°C. On the other hand, climate engineering solutions pose risks, including moral hazard and delayed action, and are not presently feasible in terms of their accessibility and scalability.

5. The General Assembly (GA) and the Human Rights Council (HRC) have through several resolutions on interrelation between environmental protection and human rights³ stressed that climate change action needs to happen in accordance with States’ human rights obligations and commitments. Otherwise, climate policies and measures will lack coherency and legitimacy, and would not be sustainable.⁴ Moreover, principles of participation and information, transparency, accountability, (intergenerational) equity and non-discrimination need to guide global efforts to mitigate and adapt to climate change.

I. Introduction

6. So far, new and emerging technologies intended for climate protection have not been extensively examined from the human rights angle. Human rights law contains, however, norms and principles that apply to any new technological development or application,

¹ Speculative technologies should not be presented as measures taken in conformity with article 2 of the UN Framework Convention on Climate Change (UNFCCC), which requests States Parties to adopt “policies and measures to actively protect the climate system against human-induced changes”.

² IPCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland, p. 89.

³ See: <https://www.ohchr.org/en/climate-change/human-rights-council-resolutions-human-rights-and-climate-change>. Resolution 7/23 (March 2008) for the first time the Council expressed concern that climate change “poses an immediate and far-reaching threat to people and communities around the world”.

⁴ A/HRC/RES/10/4 (2009).

particularly when they have the potential of producing large and long-lasting impacts on the enjoyment of human rights and on the environment. This report is to provide States and other interested stakeholders with information useful for assessing such impacts and preventing human rights harms. It seeks to clarify applicable human rights obligations to ensure that climate change responses and measures are coherent and align with human rights framework. A human rights-based approach helps to ensure that those policies are not regressive in human rights terms and can effectively improve the lives of all people including through the realization of the right to a clean, healthy and sustainable environment.⁵

7. NTCPs are defined here as technologies developed in the last two decades that fulfil the following characteristics: a) *purpose and intent*- are exclusively aimed at abating the adverse effects of climate change and do not serve for energy or goods production; b) *scale*- have the hypothetical potential of altering the Earth's planetary climate if implemented at scale. This report primarily assesses human rights impacts of two general types of geoengineering: carbon dioxide removal from atmosphere (CDR), and solar radiation modification (SRM). CDR methods that meet the NTCP definition are: direct air capture, enhanced weathering, and ocean fertilization. The definition should not be considered binding as each single technology generates different risks to human rights and should be assessed individually, case by case. Potential new technologies beyond CDR, SRM and other geoengineering approaches exist to tackle climate change if using a broader definition of 'technology' that does not exclude system change approaches towards a zero waste circular economy or agroecological transformation.

8. However, industrial or agricultural production with carbon capture and storage or direct air capture with enhanced oil recovery cannot be considered protective for the climate by definition, since they are not exclusively deployed to produce negative emissions. Despite their potential for being transformative, this study does not assess nature-based CDRs, including agro-ecological techniques and circular economy approaches, which are not considered new. Widely used bioenergy with carbon capture and storage (BECCS), a technology posing grave risks to human rights, also falls outside the definition of NTCPs because it is neither novel nor an energy production method.⁶ However, the findings of this report apply to BECCS as well.

9. If GHG emissions are not cut and some of the worst future scenarios are realized, interventionist SRM technologies are being researched with the premise that, by increasing the Earth's reflectivity, they could lower global average temperature. However, SRM do not act on the core problem of GHG emissions, and in that are fundamentally different from CDR. NTCPs' modes of operation and impact on human rights are elucidated in Annex 1.

10. At their current stage in development NTCPs cannot be considered viable mitigation or adaptation measures.⁷ Most geoengineering technologies remain unproven, unavailable, and unfeasible at scale. Since hypothetical benefits of these technologies are still to be practically and scientifically proven, they are considered "speculative". NTCPs, as all other geoengineering technologies with the potential exception of some nature-based solutions, currently have no negative emission impact, as they all increase CO₂ in the system if the overall emission process of the relevant facilities construction and functioning is taken into account. Uncertainty and potential harms from SRM NTCPs are still much greater than CDR.

11. State Parties to the Paris Agreement agreed to hold the increase in global average temperature, caused by GHG emissions, to below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C. There is an increasing consensus, aligned with the best available science, that the higher ambition target of 1.5°C must be reached to prevent the worst impacts of climate change. Time is key to achieve it, because there is a "rapidly closing window of opportunity to secure a liveable and sustainable future for all", as elucidated in the IPCC 6th

⁵ A/RES/76/300.

⁶ See Günther, P.; Ekardt, F. Human Rights and Large-Scale Carbon Dioxide Removal: Potential Limits to BECCS and DACCS Deployment. *Land* **2022**, *11*, 2153. <https://doi.org/10.3390/land11122153>.

⁷ There is, for example, too big an uncertainty if SRM could constitute an adjustment to expected climate "in order to moderate harm or exploit beneficial opportunities" See definition of "adaptation": https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf

assessment report. GHG emissions reductions is the only scientifically and logically certain way of coming close to achieving “real zero emissions”. This term is advocated for by several civil society organizations because technologies to remove CO₂ from the planetary system are currently not only insufficiently developed, inefficient and financially unsustainable but may also be used as an excuse not to cut emissions⁸.

12. One of the gravest risks that geoengineering technologies pose is emissions cut deterrence (sometimes called “moral hazard risk”) as it makes disastrous future scenarios more probable.⁹ A number of civil society organizations, Indigenous Peoples and researchers underscore that counting on technological removal of CO₂ slows down reforms to cut emissions, including investing in renewables and circular economy, and diverts public attention from this utmost and primary goal, giving a false promise of a hypothetical future solution to a problem which requires immediate action now. They recall that real, fundamental, long-term solutions to climate change are already available, but a major obstacle for their implementation is the lack of clout of frontline communities, small-scale food producers, Indigenous Peoples and others compared to that of the polluting industry.

13. Technological CDR solutions have gained traction as a *realpolitik* ploy to meet the Paris Agreement contributions, while SRM is often presented as a “Plan B” solution to the critical situation that the failure to reduce GHG emissions is creating and as the only means of addressing the “overshoot” (scenarios when temperature rises by more than 1.5° or even 2°C). However, relying on pre-emptive and emergency rhetoric without the backing of scientific certainty and in the absence of an appropriate international governance framework to deter and sanction inappropriate action will most probably lead to counterproductive results.¹⁰

14. In this context, proponents of SRM NTCPs call for a regulatory framework that would facilitate their potential use.¹¹ Opponents advocate for a *moratorium* or even a total ban until the environmental and human rights risks posed are understood.¹² Regardless of stance, as science stands today, the deployment of SRM in particular poses cascading global risks to people and the environment, the distribution of which would potentially be global.

II. Risks and side-effects

15. Planetary climate is characterized by intense interconnectedness, the nature of which is a subject of ongoing studies. IPCC finds that risks can arise from some responses that are intended to reduce climate change, e.g., adverse side effects of some emission reduction and CDR measures. Implementing SRM approaches, in particular, introduces a widespread range of new risks to people and ecosystems, which are not well understood.¹³

⁸ *Statement*, Real Zero Europe, <https://www.realsolutions-not-netzero.org/real-zero-europe>.

⁹ AR6 Synthesis Report, Climate Change 2023, (longer report), p. 53.

¹⁰ One of the first attempts at governance are the Oxford Principles but the proposal and other since have remained theoretical so far. See: <http://www.geoengineering.ox.ac.uk/www.geoengineering.ox.ac.uk/oxford-principles/principles/index.html>.

¹¹ A private initiative the “Climate Overshoot Commission” has adopted such a stance. UNEP proposed a regulatory framework in its report “One Atmosphere” of 2023. See also “Solar Radiation Modification, A Risk-Risk Analysis,” March 2022, Carnegie Climate Governance Initiative. For examples in scientific literature see G. Wagner, “Geoengineering: The Gamble”, Polity, 2021.

¹² See an open letter of more than 60 climate scientists and governance scholars <https://www.solargeoeng.org/non-use-agreement/open-letter/>. In literature see: Biermann, F., et al, “Solar Geoengineering: The Case for an International Non-Use Agreement” (2022), Wires Climate Change 1, p. 3. Or N. Markusson, ‘In case of emergency press here’: framing geoengineering as a response to dangerous climate change, Wires Climate Change, Volume5, Issue2, March/April 2014, pp. 281-290. <https://wires.onlinelibrary.wiley.com/doi/abs/10.1002/wcc.263>. And: « The restriction of Geoengineering under international law », Joint Opinion, Hands Off Mother Earth (HOME) submitted to the AC.

¹³ AR6 Synthesis Report, Climate Change 2023, (longer report), p. 37.

A. Physical risks

16. Implementing NTCPs is resource intensive. Physical risks posed by CDR NTCPs are listed in Table 1 in Annex 1, including extensive water and energy consumption, adverse impacts on marine biology and food web structure, health risks, ecological impacts of mineral extraction and transport, waste pollution, chemical footprint. Kinds of risks, however, are interlinked and mere compartmentalization will not tell the whole story of potential interlinkages and cascades, which hold true for all risks described herein. For example, technological and environmental risks for direct air capture (DAC) and enhanced weathering, amongst other types of NTCPs, could also negatively incite perceptions of social backlash, technological domination or new forms of colonialism.¹⁴

17. As for SRM the possible negative physical effects include unpredictable changes in hydrological patterns, harm to the ozone layer, dimming, reduced photosynthesis, crop growth changes resulting in decreased food production and access, as well as further cascading risks in the social and political systems and relations associated with the aforementioned.¹⁵

B. Social, societal, and socio-economic risks

18. NTCPs cause social risks, including for future generations. They generally require land or/and have impact on land and other natural resources and biodiversity. Exposure to effects on land is greater for frontlines communities, including Indigenous Peoples, local communities, peasants, fisherfolks, rural women, and other people working in rural areas. SRM risks disrupting local and regional weather patterns and further imbalance the already changed climate, with potentially catastrophic effects, including on water availability and food production. Several technologies could have transboundary side-effects in neighboring countries or across the world. Social consequences would likely be uneven geographically, for example through hydrological cycle disruption potentially harsher for poorer States and the Global South, depending on where certain technologies are used (see Annex 1). That may in turn strengthen entrenched inequalities and deepen climate injustice.

19. According to IPCC, many NTCPs can have adverse socio-economic impacts, especially if implemented at large scales and where land tenure is insecure. The Panel warns against dependence on CDR as constraint to sustainable development.¹⁶ It emphasizes that societal choices and actions implemented in this decade determine the extent to which medium- and long-term pathways will deliver higher or lower climate resilient development. In this light NTCPs only weaken the time pressure to take appropriate actions¹⁷ and they pose overarching risks to equity, inclusion and just transitions, which enable deeper societal ambitions for accelerated mitigation and climate action more broadly.¹⁸

20. Surveys show that people worldwide are not familiar with CDR nor SRM. This may result in increased distrust should a technology be used on a larger scale, fueling conspiracy theories in relation to NTCPs. Given popularity of disinformation campaigns and their usage as tools of internal and international political conflicts, climate technologies may become their subject, in which case it may be increasingly difficult to conduct an informed public debate about these methods. That would add to the growing distrust of technology and science.

¹⁴ B. K. Sovacool, C. M. Baum, S. Low, Risk–risk governance in a low-carbon future: Exploring institutional, technological, and behavioral tradeoffs in climate geoengineering pathways. *Risk Analysis*, 2022, 1–22.

¹⁵ Robock, A. (2008). 20 Reasons Why Geoengineering May Be a Bad Idea. *Bulletin of the Atomic Scientists*, 64(2), 14–18.

¹⁶ “Modelled pathways that assume using resources more efficiently or shift global development towards sustainability include fewer challenges, such as dependence on CDR and pressure on land and biodiversity, and have the most pronounced synergies with respect to sustainable development.” See AR6 Synthesis Report, Climate Change 2023, (longer report), *ibid.*, p. 54.

¹⁷ *Ibid.*, p. 56.

¹⁸ *Ibid.*, p. 66.

C. Vested interests

21. There would be vested interests (personal or group stakes) in promoting NTCPs. When the vested interest aspect is combined with a relatively small pool of scientists researching the climatic (physico-chemical) impact of these technologies there is a risk of group think. According to several interviewees, there is a tendency of these groups to exaggerate certainties of a technology in question, while underplaying uncertainties. Additionally, discussions about impacts of technologies are mostly confined to physicists, climatologists, or other natural scientists with very limited involvement of social scientists, political scientists, economists, and specialists in non-natural sciences. Most academic papers focus on nature-based CDR methods, and very few are published in social science or humanities journals. The scientific community working on CDR excludes social scientists at the research, development and implementation stages. Technofixes like climate engineering assume solutions without addressing root causes of climate change, and are often supported by proponents of polluting industries.

D. Emission cuts deterrence and ‘greenwashing’

22. The deterrence risk of NTCPs, as described in para 11, is multi-faceted. It can be exacerbated by States, which are top emitters but can afford investment in these technologies and hence present their climate and energy goals as in accord with the Paris Agreement, and by business entities, which are interested in continued emissions but can buy carbon credits by investing in NTCPs. Deterrence to cut emissions may be amplified in the near future by public debate increasingly focused on and saturated with the topic of carbon removals rather than carbon cuts, and research path-dependencies.¹⁹

23. Fossil fuels extraction and production companies can use the prospect of carbon capture and storage to justify continued fossil fuel production. The business model of NTCPs raises questions of lack of transparency about investors, who are often big emitters, and their intentions. Investment in these technologies may be used to improve their otherwise negative public image. However, ill intentions should not be automatically assumed, as some companies claim they began CDR research and/or investment because of climate concern and deficiencies of currently available carbon credits.

24. Another cluster of risks pertains to carbon markets and carbon credits, used to offset emissions. The portion of carbon offsets from artificial CDR technologies is growing. Overall demand for credits has become larger than supply. The offset market is unregulated, many of the credits sold do not meet efficiency goals or, simply, do not contribute to emissions reductions at all (see Annex 1). The problems, revealed in studies on the most common rainforest protection credits, may reoccur in CDR credits if methodologies, certification and oversight are not objectively and rigidly administered, regulated and conflicts of interest are not avoided. If the situation persists, it will not only work against emission cuts but expand opportunities for greenwashing, misinformation, and social distrust of these technologies. Currently, major emitters already put offsetting at the heart of their climate strategies rather than emission reductions.

E. Other ethical risks

25. NTCPs, which are unproven at large scale, may create climate-related harms in the future if these technologies prove not as efficient as assumed by some. If the gamble fails, present and future generations and the poorest within them will bear the cost of that failure. Another ethical risk is called “hubris” in literature. Large-scale NTCPs deployment, assumed in scenarios, may greatly overestimate the human ability to understand complex natural

¹⁹ “Research on NETs, like research on SRM, may create path-dependencies, locking in a requirement for NETs to meet climate goals.” P. 20, <https://iopscience.iop.org/article/10.1088/1748-9326/aabf9b/pdf>

systems and manage carbon cycle flows, thereby risking doing more harm than good. If climate change is a socially created problem, it may not be solvable technologically.

26. NTCPs may promote systemic close-mindedness and avert structural change. Inequalities are constantly rising, while solely profit-driven business model dominates global economy. Structural inequalities are also baked into economic modelling that underpins climate mitigation scenarios, thus limiting the number of imagined futures and they all assume continued injustices. Failure to design and implement effective and equitable mitigation plans that will rapidly achieve emission reduction targets is inconsistent with the obligation of States to protect human rights from grave and foreseeable risks.²⁰

F. Political and security risks

27. Climate change per se, apart from the principle of common but differentiated responsibilities and respective capacities, has largely not been a subject of international political conflict. Currently emissions are known to be harmful but there is no intended harm.²¹ With the usage of NTCPs this scenario could change, should countries begin to make large-scale investments or even to transgress boundaries by undertaking unilateral action. SRM projects would be intentional and therefore could be seen as deliberate and politically hostile acts.

28. Hostile use of weather-modification technologies is prohibited under international law. Still, even 'peaceful' use could pose immense risks and result in negative human rights impacts. If climate becomes a tool a state can use against another state, it could radically change climate politics, making it a political security issue. The use of SRM could bring about an unknown political and social order. SRM proponents recommend a well-structured global governance of it, but an international agreement on usage of such a controversial and uncertain technique borders on the impossible if it is not to ban it completely.

III. Applicable normative framework

29. The GA recently recognized that full implementation of multilateral environmental agreements under the principles of international environmental law is required for the realization of the human right to a clean, healthy and sustainable environment.²² Respect of this right is instrumental for the realization of other human rights, such as the right to life, to health, to food, to water, and to housing. In the context of climate change, human rights experts and bodies are urging States to step up their mitigation actions through emissions reductions.²³ There is a pressing need to determine whether the recourse to speculative technologies can be even considered as an alternative option to mainstream mitigation measures. The current focus of climate action should be to deploy existing, tested and safe measures and technologies using a rights-based approach in line with the IPCC findings.

30. Global action to combat climate change is shaped by several instruments, including the 1992 Rio Declaration on Environment and Development, the 1992 UN Framework Convention on Climate Change (UNFCCC), the 1997 Kyoto Protocol, the 2015 Paris Agreement and the 2030 Agenda for Sustainable Development.²⁴ States have to guarantee that actions undertaken in pursuing the set objectives do not endanger environment and human rights enjoyment as provided by human rights law. The two 1966 International Covenants as well as the other core human rights treaties and other principles and rules of general scope provide a comprehensive and authoritative normative framework for a

²⁰ Amicus curiae brief submitted by SR on toxics and human rights; SR on human rights and the environment; the IE on the enjoyment of all human rights by older persons, <https://www.ohchr.org/sites/default/files/Documents/Issues/ToxicWaste/AmicusKlimmaECtHR.pdf>.

²¹ Corry O. *The international politics of geoengineering: The feasibility of Plan B for tackling climate change*. Secur Dialogue. 2017 Aug;48(4):297-315.

²² A/RES/76/300.

²³ "COP27: Urgent need to respect human rights in all climate change action, say UN experts", 4 November 2022.

²⁴ A/HRC/RES/50/9, OP 7.

coherent, coordinated and collective response to climate change. This framework already provides standards and principles that require States to ensure access to information, participation in decision-making and access to justice in environmental matters. The principles of do no harm, transparency, prevention, precaution and polluter-pays are equally relevant and applicable to any policy or decision related to NTCPs.

A. Restrictions to the development and deployment of NTCPs

31. So far States have not responded to the need to regulate NTCPs. Lack of regulation does not mean that such speculative technologies are permitted or can be developed in a *legal vacuum*. On the contrary, general principles of international law from environmental and human rights law may apply to any assessment or policy decision related to them. Actually, in the context of multilateral environmental agreements (MEAs) the consideration of these principles has led to prohibiting the deployment of some NTCPs as a consequence of persistent uncertainties regarding their effectiveness and of potential negative human rights impacts they posed.

32. In the 1992 UN Convention on Biological Diversity (CBD) a general *moratorium* on climate-related geoengineering was introduced in 2012 by the COP and renewed in 2016 in view of the lack of transdisciplinary research.²⁵ The potential effects on the environment and biodiversity deriving from these activities and the “associated social, economic and cultural impacts” were decisive to prohibit climate-related geoengineering without adequate scientific basis and prior assessment on associated risks.²⁶ Small scale controlled scientific research could only take place exceptionally when justified “by the need to gather specific scientific data” and subject to a thorough prior assessment “of the potential impacts on the environment”.²⁷ The need to establish a global transparent and effective control and regulatory mechanism was recognized and that institutions should share knowledge to better understand impacts and options.²⁸

33. The governing body of the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter at Sea and its 1996 Protocol (LC/LP)²⁹ have also called for extreme precaution and are currently evaluating several marine geoengineering technologies, having already agreed to prohibit ocean fertilization. In a resolution of 2008 the LC-LP COP placed a ban, subject to review, on other marine geoengineering activities while allowing legitimate scientific research (without commercial motivation) to proceed.³⁰ While CO₂ sequestration, research and deployment were generally permitted following assessment of their environmental impact, ocean fertilization deployment was totally prohibited and attached research put under control as projects could only be conducted to increase knowledge without creating significant risks to the marine environment.³¹ In 2023, the Scientific Groups reporting to the LC-LP COP agreed that four marine geoengineering techniques have the potential to cause deleterious effects that are

²⁵ A decision on ocean fertilization activities (UNEP/CBD/COP/DEC/IX/16 (2008) was broadened to other climate-related geoengineering activities in UNEP/CBD/COP/DEC/XX/33 (2012), renewed in 2016. Such decisions are not legally binding but authoritative: they represent a broad consensus on this issue and are adopted by the governing body of this multilateral treaty with universal application.

²⁶ See par. 8(w) of the 2012 Decision. COP provides a definition of these technologies: that deliberately reduce solar insolation or increase carbon sequestration from atmosphere on a large scale that may affect biodiversity (excluding carbon capture and storage from fossil fuels when it captures carbon dioxide before it is released into the atmosphere). It is interpreted that it includes all geoengineering with the only exception of fossil fuel CCS.

²⁷ See Article 3.

²⁸ UNEP/CBD/COP/DEC/XIII/14 (2016), para. 5. This approach has been endorsed by the Global Biodiversity Framework (GBF) which includes Target 10 to maintain nature’s contribution to people, as well as CBD objectives in general.

²⁹ The Protocol entered into force on 24 March 2006 and currently has 53 Parties.

³⁰ Resolution LC-LP.1 on the Regulation of Ocean Fertilization (LC 30/16, Annex 6)

³¹ Ginzky, Harald. “Marine Geo-Engineering.” *Handbook on Marine Environment Protection*, Springer International Publishing, 2017, pp. 997–1011, https://doi.org/10.1007/978-3-319-60156-4_53.

widespread, long-lasting or severe.³² The level of uncertainty and of potential detrimental effects is the decisive criterium for such differentiated treatment.

34. The 1976 Convention on Prohibition of Military or any other Hostile Use of Environmental Modification Techniques (ENMOD Convention) expressly prohibits “all techniques that are intended to alter – through deliberate manipulation – the natural processes, dynamics, composition or structure of the Earth, including its biota, lithosphere, its hydrosphere and its atmosphere or of outer space.” In its recently adopted draft set of principles on protection of the environment in relation to armed conflicts, the International Law Commission (ILC) included specific principles on “environmental modification techniques” which provide that: “in accordance with their international obligations, States shall not engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State”.³³ Even if the scope of this treaty is to protect environment from damage in armed conflict, it seems self-evident that the use of techniques leading to such serious environmental consequences are even less acceptable in peacetime. According to the ILC in all circumstances “the environment remains under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience”.³⁴

B. Principled approach

35. In absence of a legal treaty or regulations on speculative technologies, decision and policy makers should follow a principled approach to preserve human rights and environmental protection from the risk of uncertain or uncontrolled impacts. This is in line with the environmental “Martens clause” referring to cases which are not covered by a specific rule or treaty or whenever the legal regulation provided by a treaty or customary rule is doubtful, uncertain or lacking in clarity.³⁵

36. The precautionary principle has been and should be applied to geoengineering.³⁶ States have a general obligation to adopt legislative, administrative, judicial and other measures to prevent harm to the environment at an early stage also with a view of ensuring that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction. Because the restoration of the situation that existed before environmental damage occurred often is impossible, prevention is the main approach to be followed by policy-makers.³⁷ Particularly where scientific evidence is not yet conclusive on environmental impacts of certain activities, States

³² These involve CDR and SRM: ocean alkalinity enhancement and electrochemical CDR; biomass cultivation for carbon removal; marine cloud brightening; and surface albedo enhancement involving reflective particles and/or other materials. “Marine geoengineering - assessing the impacts on the marine environment”, IMO, 23 March 2023.

³³ A/RES/77/114 (2022). Principle 17.

³⁴ A/77/10, p. 136. The ILC introduces an environmental “Martens Clause” which would apply in cases not covered by international agreements. A/77/10, p. 136. See also: World Conservation Congress, resolution 2.97, entitled “A Martens Clause for environmental protection” (Amman, 4–11 October 2000). This recommendation was adopted by consensus and was meant to apply during peacetime as well as during armed conflicts.

³⁵ The interpretation of human rights obligations in this area must be informed by fundamental principles under environmental law.

³⁶ At international level this principle was first codified in Principle 15 of the 1992 Rio Declaration: ‘In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation’. The preambles of the CBD and the 2000 Cartagena Protocol on Biosafety also contain this principle.

³⁷ IACHR, Advisory Opinion OC-23/17 of November 15, 2017, par. 130.

are required to act cautiously and diligently to avoid any steps that may cause harm to human health or environment.³⁸

37. Whether a given technological option for mitigating climate change should be pursued despite scientific uncertainty regarding its impacts must be evaluated against alternative options, including those about which there is more scientific certainty. In the event that there is a total or partial governance gap, the principle of precaution advises weighting alternatives, so that less uncertain and risky alternatives should be recognized as preferable. From this perspective, a *moratorium* on fossil fuel extraction could be the less potentially harmful option. Other existing proposals and low-cost technologies, such as peatland and forest management address climate change and its drivers, many of which have been tested and carry little to no risks but provide benefits for people and the planet. A human rights-based approach to climate action, interpreted in line with the Paris Agreement, primarily requires prevention of further emissions by stopping excessive levels of GHG emissions. Failure to take measures to prevent foreseeable harm to human rights caused by climate change, or to regulate activities contributing to such harm, could constitute thus a violation.³⁹

38. There is scientific uncertainty surrounding the risks and impacts of NTCPs on complex global planetary systems, but it is generally accepted that at the current stage of development these may be irreversible. Also, the existence of proven low-risk approaches and alternatives make the use of NTCPs at their current development untenable under both human rights and environmental law. In these circumstances, human rights obligations interpreted in the light of fundamental principles of environmental law advise for a rigorous application of the precautionary principle. This requires States to undertake action to diminish any potential environmental harm threatening human life or health in a serious and irreversible manner. Because the effects of such harm would be inequitable to present and future generations the possibility of accepting it is untenable.⁴⁰

39. National case-law follows this approach. It increasingly relies on the “*pro persona*” and “*in dubio pro natura*” principles to *prioritize the most favourable protection of individuals and environment*. They are used as interpretative criteria to solve gaps in rights protection or to enhance environmental protection against harmful activities, giving preference to the least harmful.⁴¹ These principles are endorsed in national case-law and apply to all matters before courts, administrative agencies, and other decision-makers.⁴² States are increasingly being brought before regional and UN international human bodies in climate change related claims.⁴³

C. Operationalizing a human rights-based approach

40. States’ obligations to take all measures necessary to respect, protect and fulfil human rights remains fully applicable in the context of NTCPs. These obligations apply to the phases of development and application of any emerging technology. Existing guiding documents, such as the 2018 Framework Principles on Human Rights and the Environment, the 2007 UN Declaration on the Rights of Indigenous Peoples (UNDRIP), together with the 2011 Guiding

³⁸ This principle “provides justification for public policy and other actions in situations of scientific complexity, uncertainty and ignorance, where there may be a need to act in order to avoid, or reduce, potentially serious or irreversible threats to health and/or the environment, using an appropriate strength of scientific evidence, and taking into account the pros and cons of action and inaction and their distribution.” “The precautionary principle. Definitions, applications and governance”. European Parliamentary Research Service, 2015, p. 10.

³⁹ A/74/161, paras. 83 and 84.

⁴⁰ E/C.12/GC/25, paras. 56 - 57.

⁴¹ Baldin, Serena and De Vido, Sara, ‘The In Dubio Pro Natura Principle: An Attempt of A Comprehensive Legal Reconstruction’ *Revista General de Derecho Público Comparado* 32/2022, pp. 168-199. <file:///C:/Users/M-electronics/Downloads/SSRN-id4313438.pdf>.

⁴² The Climate Change Framework Law (Decree 7-2013) of Guatemala refers to these principles in article 6, noting they must be observed by all entities when making decisions and acting in their respective areas of competence.

⁴³ For example: *Sacchi, et al. v. Argentina, et al.* CRC/C/88/D/104/2019 or *Case of Verein KlimaSeniorinnen Schweiz and Others v. Switzerland* (application no. 53600/20).

Principles on Business and Human Rights as well as other relevant practice from human rights bodies and mechanisms should inform States when addressing challenges related to NTCPs. According to this framework States should avoid undertaking or authorising actions entailing environmental impacts that interfere with human rights enjoyment.⁴⁴

41. Human rights, including the right to a clean, healthy and sustainable environment have extraterritorial dimension which implies that States have a duty to refrain from causing environmental harm outside their own territory. This includes the duty to prevent that areas subject to its jurisdiction or control be used for acts that may cause serious adverse environmental consequences to others. Preventive measures have to be taken to avoid not only environmental damage to other States but also to areas beyond the limits of national jurisdiction, including the atmosphere and the high seas.

42. States have also a duty to protect all persons against potential human rights violations involving companies developing NTPCs.⁴⁵ Adequate measures need to be taken to protect people from human rights and environmental harms that can be caused by such companies. In particular, there is a duty to prevent exposure of individuals and communities to toxic substances by adopting positive adequate measures.⁴⁶ States have to ensure that their own activities, including those conducted in partnership with the private sector, respect and protect human rights; and where harms do occur to ensure effective remedies.

D. Business regulation

43. As part of the States obligation to exercise human rights due diligence with regard to the potential development and deployment of NTCPs, they are called to ensure that environmental and human rights standards are effectively enforced against private actors.⁴⁷ Private actors must participate responsibly in climate change mitigation and adaptation efforts, which imply acting with full respect for human rights and being accountable for negative environmental impacts and human rights violations⁴⁸ Compliance of businesses with these responsibilities is especially critical where States incorporate private financing or market-based approaches to climate change within the international framework including in the Paris Agreement.⁴⁹

44. States should adopt appropriate regulatory measures to prevent and address human rights abuses by companies. Even if some examples of relevant legislation can be found at the national and regional levels, a fragmented approach can be insufficient to effectively address global risks and challenges posed by speculative technologies. It has been observed that global regulations are needed to effectively manage these technologies as fragmented national responses create governance gaps, perpetuating the technological divide and economic disparities in detriment of the enjoyment of economic, social and cultural rights.⁵⁰

45. There are already more than a thousand climate engineering projects being developed and implemented, mostly in Europe, North America and Asia⁵¹. A moratorium on such projects should be put in place until a proper governance framework is developed.⁵² This should include prior assessment of the possible environmental impacts of proposed projects

⁴⁴ A/HRC/37/59, Framework principle 8 (FP 8).

⁴⁵ https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf.

⁴⁶ A/74/161, paras. 83 and 84.

⁴⁷ FP 12.

⁴⁸ Article 6 of the Paris Agreement calls upon Parties to incentivize and facilitate private participation in the mitigation of greenhouse gas emissions. In doing so, States should include adequate safeguards and take effective measures to protect human rights from business harms in line with their obligations as outlined by the UNGPBHR.

⁴⁹ OHCHR, Response to the request of Ad Hoc Working Group on the Paris Agreement (APA) to provide information, views and proposals on any work of the APA before each of its sessions. FCCC/APA/2016/2 (6 May 2017).

⁵⁰ E/C.12/GC/25, para. 74.

⁵¹ <https://map.geoengineeringmonitor.org>.

⁵² In practice, existing moratorium has not prevented violations from occurring (see Annex 1).

and policies, including on the enjoyment of human rights. Where feasible, the Framework Principles on human rights and environment provide guidelines for such an assessment.

IV. Assessing the human rights impact

46. Because NTPCs are meant to be applied on a global scale, they have the potential of affecting all people indiscriminately. They “could seriously interfere with the enjoyment of human rights for millions and perhaps billions of people”⁵³. The magnitude of the potential negative socio-economic and human rights impacts is currently incommensurable to any hypothetical benefits.⁵⁴

A. Impact on specific rights

47. There is a broad range of human rights that are at serious risk of adverse impacts by the tests and deployment of NTPCs.

48. *Right to life* – NTPCs could perpetuate and exacerbate the threats that climate change already poses to the life and the enjoyment of this right by present and future generations. As mentioned, the mere possibility of their use can delay the implementation of urgent climate action. In the hypothetical case of deploying certain NTPCs such as SRM, the potential environmental adverse impacts could increase food insecurity and diminish the quality of life of many people, particularly of those whose livelihood relies on natural resources. It could further lead to drought, delayed ozone recovery, changes in precipitation patterns, rapid warming pulses. If SRM deployment is not sustained (therefore irreversible) but abruptly terminated (so called termination shock, see Table I in Annex) it would have a devastating impact on ecosystems⁵⁵ and therefore be contrary to the principle of intergenerational equity.⁵⁶

49. *Right to a clean, healthy and sustainable environment* – Some NTPCs may potentially have negative to catastrophic effects on weather patterns, biodiversity and ecosystems as a whole. At the same time, anticipated diversion of efforts and resources from a rapid phasing out of fossil fuels may have major effects on the environment amounting to a violation of the right to a healthy environment, which includes the right to a clean air, a safe and stable climate, access to safe water and adequate sanitation, healthy and sustainably produced food, non-toxic environments in which to live, work, study and play; and healthy biodiversity and ecosystems.⁵⁷ The test and deployment of NTPCs in the current circumstances would further violate the procedural dimension of this right: access to information, the right to participate in decision-making, and access to justice and effective remedies. States have positive obligations relating to good governance and democratic accountability.

50. *Right to information and to public participation* – The ICCPR and other human rights instruments guarantee all persons the right to information and to free, active, meaningful and informed participation in public affairs. According to UNFCCC Article 6, all States shall promote and facilitate public access to information on climate change and its effects, and public participation in addressing climate change and its effects and developing adequate responses. The 1998 Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) includes important standards concerning the right: a) to receive environmental information ; b) to participate in preparing plans, programs, policies, and legislation that may affect the environment; and c) to have access to review procedures should their rights on access to

⁵³ UNEP, “Climate change and Human Rights”, 2015, p. 10.

⁵⁴ A/74/161, para. 83, A/77/2990, para. 65.

⁵⁵ UNEP (2023). One Atmosphere: An independent expert review on Solar Radiation Modification research and deployment. Kenya, Nairobi, <https://wedocs.unep.org/handle/20.500.11822/41903>.

⁵⁶ CCPR/C/GC/36, para. 62.

⁵⁷ OHCHR, UNEP and UNDP (2023). What is the Right to a Healthy Environment? Information Note, <https://www.ohchr.org/sites/default/files/documents/issues/climatechange/information-materials/2023-01-06/r2heinfofinalweb.pdf>.

information or public participation be violated.⁵⁸ A similar instrument has been adopted in the Latin American and Caribbean region, the 2018 Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters (Escazú Agreement).⁵⁹ UNGA has also recognized the importance of public participation in addressing the impacts of climate change and recognized the need to engage a broad range of stakeholders at the global, regional, national and local levels.⁶⁰

51. *Right to adequate standard of living and right to food and water* – NTCPs can be water-intensive, change precipitation patterns, and pollute freshwater resources and thus pose a threat to food and water security, imperil livelihoods and lead to mass displacement of people. Most CDR technologies require vast swathes of land and extensive water resources, potentially increasing the demand for water and therefore impacting food production and access to water. SRM could also reduce the availability of fresh water on islands that already face water shortages.⁶¹ SRM may have adverse impacts on the right to an adequate standard of living as a result of violations of right to food and water through manipulation of regional weather and precipitation patterns. Because of the massive water demands of these technologies, they are likely to affect the availability of safe drinking water. The potential termination shock effect could undermine food production globally, but specifically in vulnerable areas in the Global South.⁶²

52. *Access to justice and remedies* – The Universal Declaration of Human Rights, the ICCPR, and other human rights instruments guarantee effective remedies for human rights violations. States should ensure the necessary governance framework to effectively protect people against human rights violations and harms from technology companies' activities. Very often actions of economic actors causing severe, widespread, long-term damage to the environment go unpunished as no prosecution against the actor or economic compensation to victims take place.⁶³ States may in certain cases not be in position to effectively enforce legislation against business companies. While it is necessary to better understand NTCP-related risks before the international community decides on a course of action, negotiations for a global governance framework should ensure accountability and remedy for business-related human rights harms connected to NTCPs.

B. Impact on specific groups

53. Specific technologies would impact regions and peoples differently, disproportionately affecting the poor and others in vulnerable situations. Furthermore, the decisions and impacts of NTCPs could significantly impact the ability of children and future generations to exercise and fulfil their human rights. Women, children and persons with disabilities, who are systemically more impacted by climate change and the way climate action is performed, may be disproportionately exposed to the negative effects of geoeengineering technologies, which would deepen intersectional discrimination.

54. According to the IPCC, marginalized socio-economic groups such as migrants, people of colour, peasants, Indigenous Peoples and other frontline communities may be particularly exposed to the negative impacts of NTCPs.⁶⁴ They are at high risk of suffering the consequences of experiments or testing but do not have a say on the decisions that may hinder their rights.⁶⁵ Negative effects could compound for women, who already suffer from harmful

⁵⁸ 46 States have ratified this Convention.

⁵⁹ The treaty has only been ratified by 14 countries.

⁶⁰ Resolution 67/210, para. 12.

⁶¹ Similarly, the use of BECCS can result in displacement of agricultural production and higher prices, causing food insecurity, particularly for subsistence farmers and the poor, which would see endangered their livelihood.

⁶² Burns, p. 157-158.

⁶³ An independent expert panel convened by [Stop Ecocide International](#) has legally defined the crime of "ecocide".

⁶⁴ A/77/2990. Carbon capture programmes for example are often carried out in the so-called "racial sacrifice zones" already overburdened by the heavy concentration of toxic industrial pollution, increasing the emission of harmful air pollutants.

⁶⁵ [A/HRC/50/57](#).

gender-based discrimination that often excludes them from participating in environmental decision-making.⁶⁶

55. The potential deployment of NTCPs would have a massive and disproportionate impact on Indigenous Peoples whose traditional lands and territories are particularly exposed and at risk of experimental uses. NTCPs may expose them to forced displacement, deprivation of their lands, culture and traditional livelihoods through land-use and agricultural or weather pattern changes. UNDRIP requires States to consult and cooperate in good faith with the Indigenous Peoples concerned through their own representative institutions. They should obtain their free, prior and informed consent before adopting and implementing any legislative or administrative measure that may affect them. Such consent must be also given before undertakings that affect Indigenous Peoples' rights to land, territory and resources, including mining and other utilization or exploitation of resources.⁶⁷ Indigenous Peoples have not been systematically involved in technological planning or consulted in testing of NTCPs. Annex 1 provides examples of canceled SRM field experiments (Stratospheric Controlled Perturbation Experiment, SCoPEX in the USA and Sweden) that had been planned without respecting the requirement of free, prior and informed consent. Indigenous representative organizations underline that in the context of geoeengineering the implementation of this obligation has to represent a "dialogue that fosters understanding and provides for a consultation process that reflects higher standards of care than we have previously seen. Otherwise, it risks compromising the progress on Indigenous self-determination and increasing existing divisions on geoeengineering research".⁶⁸

56. Due to their special dependency and attachment to land also peasants, fisherfolks and other rural people risk being disproportionately affected by NTCPs. In particular, their lands are vulnerable to being grabbed and/or polluted (i.e. by NTCP-related mining), thus undermining their right to land and natural resources.⁶⁹ NTCPs carry high risks of undermining peasant food production due to interference with natural cycles, which are likely to affect their management systems by undermining their traditional knowledge, practices and innovations.⁷⁰ Importantly, land has not only economic functions for peasants and other people working in rural areas, but also social, cultural and spiritual dimensions. Similar to Indigenous Peoples, they may understand themselves as caretakers and custodians of ecosystems and the Earth. Consequently, many employ agroecological management practices based on the respect of Nature and its natural cycles, seeking to promote biodiversity and capture carbon in soils.

V. Building-up a protective framework

57. All the above leads to the conclusion that the deployment of NCTPs today would be contrary to the human rights and environmental framework. Even in the hypothetical scenario that there is no choice but to deploy NCTPs to address climate overshoot, the potential vastness of the adverse impacts and risks make imperative that a strong global rights-based governance framework, be set-up well in advance. The only way to overcome the several political, ethical and security risks posed by any potential deployment of climate engineering requires a governance framework that facilitates inclusive dialogue, transparent processes, accountability and active participation of all persons in decision-making processes.⁷¹ Such framework *as minimum* should include: 1) ex ante human rights and environmental impact assessments before climate altering technologies are deployed and continuous monitoring and evaluation thereafter; 2) a clear understanding of the human rights obligations of duty-

⁶⁶ A/HRC/52/33.

⁶⁷ Arts. 19 and 32.

⁶⁸ See Sami Council. <https://www.thearcticinstitute.org/sami-council-resistance-scopex-highlights-complex-questions-geoeengineering-consent/>

⁶⁹ Arts. 5 and 17 UNDRIP.

⁷⁰ Art. 20(2).

⁷¹ States should take steps to strengthen the governance framework where the existing instruments prove insufficient- FP 13.

bearers, including the obligation of States and private sector actors to exercise human rights due diligence.

A. Multilateralism and governance framework

58. Any decision related to the governance and deployment of any new technology for climate manipulation should not be taken in disregard of State's obligation to cooperate and outside the existing bodies for multilateral decision-making.⁷² Bodies tasked and endowed by the international community with such competences must be representative and act in accordance with the requested standards of democracy, transparency, independency and objectivity.⁷³ Cooperation to establish, maintain and enforce effective international legal frameworks is key and a legal duty to bring common understanding on the kind of solutions that are needed to prevent, reduce and remedy transboundary and global environmental harm that interferes with the full enjoyment of human rights.

B. Inclusiveness in decision-making

59. Ongoing NTCP projects have been researched, financed and/or implemented in the Global North while Global South expertise has not been sufficiently included neither in scientific production nor in public debates on the topic of NTCPs. Some refer to the operation of international climate institutions "as a form of indirect colonization" as many of these projects are often envisioned and directed by international institutions that tend to privilege Global North perspectives over Global South contributions.⁷⁴ It has been observed in this regard that "the current scientific and political framework structurally lacks diverse and inclusive representation, rendering participation of those most affected by geoengineering highly unlikely".

60. Access to information and public participation in global environmental decisions is of utmost importance when approaching geoengineering proposals. The views and opinions of affected groups, such as Indigenous Peoples and frontline communities who are the most impacted have been ignored.⁷⁵ This lack of diverse and inclusive representation in science and governance is at odds with the obligation to ensure that everyone enjoys the benefits of scientific progress without discrimination.

61. Lack of informed consent sought from communities where these technologies are being implemented is of utmost concern. Local communities, professional associations, Indigenous Peoples, amongst others, are not informed about these technologies and their participation is often obstructed. States have the duty to clarify any assumption related to the use of NTCPs and prohibit misinformation from private actors so as to protect the right to information - in line with the High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities conclusions.⁷⁶

C. Ensuring accountability and oversight

62. Accountability and oversight over research, development, patenting and deployment of geoengineering is critical but there is no way to ensure it today. Risks and potential of

⁷² The UNGA has been recognized as a representative body where this topic could be discuss in a transparent manner.

⁷³ Some private entities, such as the "Global Commission on Governing Risks from Climate Overshoot", have been criticized for not fulfilling these requirements. The goal of the commission is to "recommend a strategy to reduce risks should global warming goals be exceeded" through CDR and SRM. See <https://www.geoengineeringmonitor.org/2022/05/geoengineering-supporters-plan-to-set-up-a-new-climate-overshoot-commission/>.

⁷⁴ A/77/549, para. 67.

⁷⁵ Various international treaties and agreements, including principle 10 of the Rio Declaration and Agenda 21 provide the basis for public participation in sustainable development. Nine civil society groups are recognized as key actors, including indigenous peoples.

⁷⁶ <https://www.un.org/sites/un2.un.org/files/high-level-expert-group-update7.pdf>.

technical advancements or scientific research should be made public in order to enable society, through informed, transparent and participatory public deliberation, to decide whether or not the risks are acceptable.⁷⁷ As geoengineering offers a great potential for economic profit from NTCPs, profit maximization could come in the form of engaging in political and economic corruption and lobbying to get contracts and government-funded research as well as participation in regulatory norm-making in a manner that constitutes a conflict of interest.⁷⁸ This may become commonplace also in the carbon offset markets (see Annex 1). Patent and geoengineering technology concentration in a few individuals or corporate actors is the breeding ground for corruptive lobbying or influence buying practices. In this area, most patents are held by a few corporate patent holders, including those in the renewable energy, manufacturing, oil and chemical industries. Also the process of granting patents may not be completely transparent, exacerbating ultimately inequalities between States in relation to patent ownership.

D. Ensuring access to information, participation and access to justice in environmental matters

63. Inclusive monitoring and independent grievance redress mechanism need to be established in order to track potential human rights impacts or risks and ensure access to remedies should the NTCPs be deployed. Today, the exercise of these rights is key to avoid human rights violations and the deprivation of people from enjoying their rights (to life, food, healthy environment, health at a large scale) in the future. Increasingly, individuals are acting before human rights bodies to request protection against climate change impact both on their rights and on behalf of a more general public interest. These complaints strategically seek that States adopt urgent action to curb emissions in line with the Paris Agreement. Recognition of the right to a healthy environment has empowered people and organizations to exercise it including by seeking access to information, participation in decision-making and access to justice in environmental matters.⁷⁹

E. Operationalizing human rights approach and assessments

64. Risks assessments are important tools to ensure that human rights are protected, and that States adopt preventive and protective measures to face human rights risks. However, an important question is whether existing tools allow to determine if NTCPs are human rights compliant and mitigate potential impacts and if a more institutionalized framework to carry-out human rights standardized assessments is possible. Because of the speculative character of some NTCPs such assessments need to be adjusted to the particular features and potential risks attached to each of these technologies.

VI. Conclusions

65. Human rights standards and obligations apply to all climate action and should guide decision-making and risk assessment related to the potential deployment of NTCPs. In the current circumstances, these provisions which also reflect fundamental principles of humanity advise for a precautionary approach and would justify the imposition of a *moratorium* to speculative technologies as long as scientific uncertainty and the risk of causing serious, extensive and irreversible environmental and human damage remain high. The scope of such regime should be defined by the pertinent expert bodies.⁸⁰

66. NTCPs interfere with the enjoyment of human rights and can cause physical, political, social risks to frontline communities, including Indigenous Peoples, and harm the environment. There is scientific uncertainty about their scalability, further effects and there

⁷⁷ E/C.12/GC/25, para. 57.

⁷⁸ Transparency International, “Climate geoengineering technologies. Corruption and integrity gaps”, Policy Position, 2022, p. 6.

⁷⁹ A/73/188, para. 42.

⁸⁰ XIII/14, para. 2

exist less risky alternatives. It is urgent to underscore that as long as emissions are not globally cut, the development of any such technology and policies supporting them are not sufficient to meet the protective standards of the human rights regime. Without an adequate protection framework, it is hard to envisage how technologies aimed at manipulating climate could be developed and used for the good of humankind. At this stage of their development, given the lack of sufficient knowledge as to their risks and adverse impacts, a presumption may apply that all NTCPs are generally harmful to human rights and their deployment would be contrary to existing States obligations. Because of the moral hazard risk, they obstruct emission cuts and systemic changes.

67. Restrictive regulations including potentially a *moratorium* should be adopted and implemented when large and foreseeable negative impacts can be advanced and rationally expected. They should be kept in force as long as the contrary is not proven with regard to each existing and future technology separately.⁸¹ This approach is coherent with the UNFCCC framework by means of which States are called to “respect, promote and consider their respective obligations on human rights” in the context of action to combat climate change. IPCC has warned against overreliance on unproven technologies that could disrupt natural systems and disproportionately harm Global South communities, and underscored the central role of the principle of transparency of climate action. Human rights bodies and mechanisms have expressed concerns related to large-scale projects that may have massive impacts on human rights, severely disrupting ocean and terrestrial ecosystems, interfering with food production and harming biodiversity. Calls from experts, scientists and civil society for a complete ban on certain large-scale geoengineering projects cannot be ignored either, when it comes to SRM, specifically Stratospheric Aerosol Injection (SAI), which can endanger human rights in the most extensive and unimaginable way. SRM is ungovernable, which warrants a ban on its development and implementation, as well as regulation of related research.

68. Under the current international circumstances, the adoption of a multilateral treaty to regulate NTCPs or geoengineering more broadly is unlikely, but it is crucial to underscore the human rights norms and standards that remain applicable to the development of NTCPs and should be guiding policy and decision-makers. A set of principles could be drawn from relevant texts, such as the 2011 Guiding Principles on Business and Human Rights, the 2018 Framework Principles on Human Rights and the Environment and the 2020 CESCR General Comment No. 25.

69. Building confidence among public opinion and ensuring participation of the most affected populations is an indispensable requirement in order to take the decision about a concrete NTCP. These decisions should be informed by scientific knowledge, cultural values, Indigenous and local knowledge to adequately address adaptation gaps and avoid maladaptation. Often practice has demonstrated the opposite. Lack of informed consent sought from communities where NTCPs are being implemented and general obstruction of participation goes against the principle of transparency and States duty to prohibit misinformation from private actors so as to protect the right to information also jeopardizing other human rights.

70. There are positive and feasible alternatives to NTCPs. Existing proposals and low-cost technologies addressing climate change and its drivers should be considered. Many of them have been tested and carry little risk but provide benefits for people and the planet. The existence of such proven low-risk approaches should make the use of NTCPs untenable under human rights and environmental law, including the rigorous application of the precautionary principle.

⁸¹ Various respondents to the report’s questionnaire considered that NTCPs distract from the goals undertaken by States under international agreements on climate change, particularly, the Paris Agreement, and carry a wide range of human rights risks. Suggesting that NTCPs may contribute to the promotion and protection of human rights is misleading. Far from addressing the root causes of climate change, they are likely to have unintended and potentially catastrophic effects on planetary processes, resulting in great risks to the enjoyment of human rights. Submission by members of the network of academics for an International Non-Use Agreement on Solar Geoengineering.

VII. Recommendations

A. International community, States and policy-makers

- The main way for States to be human rights-compliant is to rapidly phase out fossil fuels only through viable, scientifically proven technologies and approaches. Rapid emission cuts, minimization of the negative impacts of livestock farming, and some nature-based solutions such as peatland, mangrove and forest management should form the core of a sustainable, rights-based pathway to mitigate climate change. Proposals to phase out fossil fuels, including for a fossil fuel non-proliferation treaty, are aligned with State obligations to respect and protect human rights from the adverse effects of climate change.
- States should rigorously apply the precautionary principle and develop and conduct meaningful, comprehensive risk, human rights and environmental impact assessments. Such assessments should be conducted by independent and impartial bodies (paying particular attention to avoid conflicts of interest) and with public participation and oversight. Their results shall be made public and inform measures to prevent any potential harm resulting from the development and use of NTCPs, and cease and remedy where applicable.
- States should adopt and implement restrictive regulations on SRM experiments, where necessary, including a ban on outdoor experiments, while only allowing conditional and controlled research. The lack of a mechanism to prevent the development of harmful SRM techniques should be addressed in a manner that includes the Global South, climate vulnerable states and communities.
- States shall consider disincentivizing CDR NTCPs development and deployment, also through withholding public support (including funding) to them, requiring research to be non-profit, while showing transparency, including by disclosing that financed by the fossil fuel industry.
- States shall put in place effective procedures to seek the free prior and informed consent of Indigenous Peoples and meaningfully consult peasants, local communities, and other affected or particularly interested groups.
- In cases where the effects of NTCPs research transcends a State's jurisdiction, under all circumstances the entity carrying out such works should ensure that human rights assessments are integrated in their work and specific protocols to assess human rights impacts are developed in advance and accept public accountability.
- Given limited financial and human resources, research on GHG emissions reductions should be given utmost priority. Expert bodies should be entitled to monitor and evaluate such assessments and to address recommendations to relevant decision-making bodies.
- States should enhance public participation in the scientific and broad public debate about NTCPs by including voices from the Global South, women, people of colour, Indigenous Peoples and frontline communities.

B. Human Rights Council and Special Mechanisms

- Human rights treaty bodies, special rapporteurs and the UPR shall address the impacts and risks posed by deployment of NTCPs and the adequacy of national frameworks to effectively regulate and manage those risks.
- The Special Rapporteurs (SRs) on climate change, on toxics and human rights and on environment lead the process of a holistic and coherent interpretation of environmental and human rights frameworks in the context of NTCPs.

- Propose means to enhance the protection of rights of potentially affected communities and groups, including Indigenous Peoples and other rights holders in the context of decisions regarding development, testing and deployment of NTCs;
- The Special Rapporteur on the Rights of Indigenous Peoples consider the elaboration of thematic report on the impact of climate engineering on their rights;
- Explore the possibility of establishing an ad-hoc mechanism for coordinating the action of relevant SRs in connection with NTCs.

C. Office of the High Commissioner for Human Rights

- Identify a set of international guidelines or operative standards allowing States to implement the precautionary approach with regard the development, testing and potential deployment of all speculative technologies from the human rights perspective.
- Support the right of potentially affected communities and groups, including Indigenous Peoples, to have access to information about NTCs.
- Organize a multi-stakeholder meeting on human rights.

Annex

The technological component and additional information

1. Annex 1 provides additional information on the technological components relevant to the study of the impact of NTCPs on the enjoyment of human rights. Some of the information from the main report is reproduced here in order to provide for a standalone reading.

2. Easing the climate crisis adequately requires immediate carbon dioxide emission cuts. Progress towards this goal has been very slow – global emissions keep rising and fossil fuel corporations have recorded historically highest profits in 2022. According to IPCC reports and UN Secretary General mitigating the crisis requires limiting temperature rise to 1.5 degrees by achieving global net-zero emissions by 2050.¹

3. Cutting emissions is the only scientifically and logically certain way of coming close to achieving real zero emissions – a term advocated for by several civil society organizations - since methods and technologies to remove CO₂ from the planetary system are currently not only insufficiently developed, inefficient and financially unsustainable but may also be used as excuse not to cut emissions². NTCPs present a moral hazard and dangerous distraction from emissions reductions and quite notably are regularly advanced by the fossil fuel industry to justify continued exploration and exploitation of deadly fossil fuels.

5. The offset carbon market, however, allows states and companies to balance unchanged or only slightly reduced emissions with purchasing carbon offsets, that is investment in emission reduction projects. As a result of these tendencies the need for emission reduction technologies has been growing. All the more so that, increasingly, CDR technologies have become the focus of states' policies to reach the so called "net zero emissions," while still continuing to emit. New private actors, or public-private partnerships, are involved in development and implementation of these technologies. In the near future CDR technologies will most likely expand the carbon market and become a major source of carbon credits, which in turn will provide more funding for these technologies' expansion.

6. If emissions are not cut and some of the worst future scenarios are to be realized, another cluster of technologies of the SRM kind is being researched. In its most advanced currently form in research and the most controversial in terms of effects on the environment and human rights it envisages stratospheric aerosol injection (SAI): in essence a continuous spray of aerosols in the upper atmosphere to partially block sunlight.³

Carbon Dioxide Removal (CDR)

7. CDR technologies durably store CO₂ on land, in the ocean or in geological formations⁴. They can be grouped into artificial and natural methods. Currently, natural methods,⁵ which primarily include reforestation, afforestation, improved forest management, agroforestry and soil carbon sequestration as the most popular ones, make up 99,9% of all

¹ The term "net zero emissions," defined as emissions achieved when anthropogenic CO₂ emissions are balanced globally by anthropogenic CO₂ removals over a specific period, implies a two-fold action: cutting emissions and removing carbon dioxide.

² *Statement*, Real Zero Europe, <https://www.realsolutions-not-netzero.org/real-zero-europe>.

³ Several private initiatives already propagate including SAI and other SRMs in international strategies for the future.

⁴ „Products” are another kind of storage. However, the definition of a “product” is broad and unclear for a human-rights based perspective.

⁵ The Fifth Session of the UN Environment Assembly defined nature-based solutions as “actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits”.

carbon dioxide removed. These technologies are not new, however, and even if they are currently the cheapest and most prevalent ones, they fall outside the scope of the study.⁶

8. Artificial methods include pre- and post-combustion Carbon Capture and Storage, Bioenergy with CCS (BECCS), Direct Air Capture (DAC), Enhanced Weathering (EW) and Ocean Fertilization (OF). With the exception of the first two, which are also either an energy production method or play a supplemental role to the production of other goods, the latter three kinds of artificial CDR technologies (DAC, EW, OF), satisfy the definition of NTCPs.

9. **Direct air capture (DAC).** Out of artificial CDRs, DACs in particular have recently developed rapidly without equal consideration of their human rights implications, which needs to be attributed to the small scale of implementation and relatively narrower spectrum of possible risks to human rights that certain DACs pose as opposed to other CDR technologies. In Europe, the United States and Canada 18 DAC plants are now operational, although they are small scale, and capture CO₂ for utilisation, including Enhanced Oil Recovery (EOR), except for two plants storing the captured CO₂ in geological formations for removal. DACs under consideration in this report are not paired with Enhanced Oil Recovery (EOR) – a method of using DAC to extract the remaining oil from oil wells – because such a technology is a fossil fuel producing technique, which is used by fossil fuel companies and cannot be considered a NTCP. Apart from being currently very expensive at the moment, DACs face biophysical constraints subject to geological storage underground, environmental side effects (see table 1.) and surface area⁷.

10. **DAC case study.** The largest DAC facility of this kind, operating since 2021, consists of CO₂ collectors that capture it from the atmosphere with a low carbon footprint and nominal capacity of 4000 tCO₂ per year, powered by 100% geothermal energy, with CO₂ being permanently stored underground through mineralization.⁸ The facility is said to be almost 1000 times more efficient than trees on the same land area, yet the current amount of CO₂ captured annually amounts to less than five return transatlantic flights emissions. The developers of the technology claim they advance it in order to defossilize in the vain of conventional mitigation, neutralize unavoidable emissions, and realize negative emissions. In the initial phase of research, it was publicly funded (through EU research funds).⁹ New DAC installations are being built in the Middle East, where there are potentially good conditions for mineralization and large abundant supply of renewable energy. The human rights implications from current DAC projects, apart from land and water usage (although unintensified in relation to other CDR methods) also include production of chemicals in the process and waste utilization, industrialization of the landscape, which is connected with identity of communities living in areas that had previously been untouched by industrial buildings and facilities.

11. **Enhanced weathering (EW).** The process, both terrestrial and oceanic, aims to simulate natural weathering (rock decomposition via chemical and physical processes) in an artificial way to speed up chemical reactions that permanently sequester CO₂ in carbonate minerals or ocean alkalinity. Rock material is ground into powder to maximize the reactive

⁶ When it comes to direct impacts on human rights special consideration should be given to land-related CDR that does not qualify as a nature-based solution, esp. biomass-reliant CDR at large scale such as BECCS. Those approaches can increase land usage conflicts and lead to a reduction of food supply and loss of biodiversity and ecosystem services thereby increasing global injustice and inequality and creating resource based civil conflict potential. Unsustainable production and transport of biomass could even result in additional net emissions instead of carbon dioxide removal.

⁷ The potential is estimated at 0.5-5GtCO₂ annually by 2050, or 40GtCO₂ by 2100, but there are doubts about its scalability. Unlike other CCSs DAC facilities can be located close to storage facilities and sources of renewable energy.

⁸ Mineralization into calcite, argonite, magnesite, depending on local circumstances in the reservoir. The storage is to be permanent, counting in thousands of years.

⁹ Later, private investors joined in, including large international corporations, while recently again large public investment was made into the project (US Department of Energy invested \$3.5bln in Climeworks projects in US). Local regulations in the United States theoretically require that DAC sites are safe and suitable for storage. The Safe Drinking Water Act stipulates that injecting CO₂ underground requires monitoring and characterization of the site. It needs to be a Class VI well, which there are few.

surface area and applied to soils, open ocean and coastal zones. It has the potential to improve soil quality in tropical regions but field experiments at scale are missing in order to evaluate EW impact on biogeochemical circles, biomass and carbon stocks in soils and plants.¹⁰ Side effects are enumerated in Table 1 in annex. EW is permanent meaning geological residence times. EW can be simultaneously used with other land-based technologies – afforestation, soil carbon sequestration and bioenergy – because of its effect on additional biomass production. The main carbon penalty of EW is created by the energy demand for rock grinding.

12. **Ocean fertilization (OF).** London Convention and London Protocol defines ocean fertilization as any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans, not including conventional aquaculture, or mariculture, or the creation of artificial reefs. It entails deliberately adding nutrients (often iron) to the upper ocean waters to increase biological production (mostly algal bloom) or upwelling of nutrient-rich deep ocean water. It requires acting upon large surfaces and velocities. Side effects are discussed in Table 1. OF is considered a low efficiency technology given wide impact on ecosystems, logistical costs, uncertain permanence of CO₂ storage and side effects.

Solar Radiation Modification (SRM)

13. SRM attempts to modify the reflectivity of the Earth system (albedo) to reduce incoming solar radiation. Unlike CDR, it does not act on the causes of climate change (concentration of CO₂ in the atmosphere) but on its impacts. It needs to be adequately stressed that SRM is a unique technology that has to be analysed in separation as it “contrasts with climate change mitigation activities, such as emission reductions and carbon dioxide removal (CDR), as it introduces a ‘mask’ to the climate change problem by altering the Earth’s radiation budget, rather than attempting to address the root cause of the problem, which is the increase in greenhouse gases (GHGs) in the atmosphere.”¹¹

14. Some forms of SRM, notably stratospheric aerosol injection (SAI), may result in regionally and globally unpredictable changes in hydrological patterns, harm to the ozone layer, dimming, reduced photosynthesis, crop growth changes and associated with the aforementioned further cascading risks in the social and political systems and relations. Despite the presumed average global temperature decrease, all these risks would be amplified by the fact that, once applied at scale, SAI would be irreversible and cause geographically uneven, potentially international conflict provoking consequences and would have to be continued to avoid the rapid and extensive warming after cessation (“termination shock”). There are other, more localized forms of SRM currently tested. The first field experiment of marine cloud brightening was conducted over the coral reef in Australia in 2021. Nano-sized droplets engineered to brighten clouds and block sunlight were dispersed over the reef.¹² Another method is used by the Arctic Ice project, which aims to improve the Arctic’s ice cap reflectivity by dispersing silica microbeads over the ice sheet. The project is criticized by indigenous communities.¹³ SRM marine engineering technologies (as well as CDR marine technologies: ocean alkalinity enhancement and electrochemical CDR or biomass cultivation for carbon removal) have the potential to cause deleterious effects that are widespread, long-lasting or severe.

15. **SAI case study.** In 2021 Harvard’s Solar Geoengineering Research Program, the most advanced in stratospheric aerosol injection (SAI) technology research group, attempted to conduct a stratospheric controlled perturbation experiment (SCoPEX) test at the Swedish Space Corporation in Kiruna, northern Sweden. It would entail dispersing a small amount

¹⁰ The highest sequestration potential is reported to be ca. 88 GtCO₂ yr⁻¹ when spreading pulverized rock over large areas in the tropics, although depending on place, rock kind, and methods employed the potential varies greatly, as does the global cost assessment (US\$50-200/tCO₂⁻¹). Median future sequestration potential is set at 2-4GtCO₂ yr⁻¹ from 2050.

¹¹ IPCC AR6 WGII.

¹² <https://www.nature.com/articles/d41586-021-02290-3>

¹³ One of the test sites is in North Meadow Lake, on Indigenous Iñupiat territories near Utqiagvik, Alaska. <https://www.geoengineeringmonitor.org/2022/05/support-alaska-native-delegation-to-stop-arctic-ice-project/>

(100g-2kg) of calcium carbonate or sulfates, material to “make quantitative measurements of aspects of the aerosol microphysics and atmospheric chemistry that are currently highly uncertain in the simulations” and, according to the testers, would “pose no significant hazard to people or the environment”¹⁴. However, there had not been any consultations with Indigenous Peoples conducted prior to the experiment, nor had they been informed if it.

16. The Saami Council learned in February 2021 of the plans for the experiment in Sápmi, Sámi land, and previous unrealized SCoPEX attempts in the United States from indigenous contacts from north America. In 2018 there was a field test to be conducted in Tucson, Arizona, which did not materialize. Communities of Indigenous Peoples opposed to it.¹⁵ In February 2021, the Saami Council together with Swedish environmental organizations sent an open letter to the SCoPEX advisory committee, copying the Swedish Space Corporation and three ministers in the Swedish government, saying that “SAI is a technology that entails risks of catastrophic consequences, including the impact of uncontrolled termination, and irreversible sociopolitical effects that could compromise the world’s necessary efforts to achieve zero-carbon societies. There are therefore no acceptable reasons for allowing the SCoPEX project to be conducted either in Sweden or elsewhere.”¹⁶ The letter focused on the physical risks of SRM and on the problematic ethics, responsibility and decision making, and – predominantly on the risk of deterring the necessary climate action.¹⁷ The Swedish Space Corporation contacted the Saami Council after receiving the letter, wanting to know more of the Saami Council position. Later the Swedish Space Corporation informed the Saami Council of the Corporation’s withdrawal from the experiment. After the cancellation of the test in Kiruna, the Saami Council initiated a letter to Harvard University reiterating the position of opposing to the development of solar geoengineering technology and invited other Indigenous Peoples organizations to sign the letter showing their support for the position. The letter gained the support of 36 Indigenous Peoples organizations from different regions of the world.

17. The case study shows lack of consideration for Indigenous Peoples rights in SRM field tests, the need for free prior and informed consent of Indigenous Peoples, lack of broader consultations with the government, local authorities, civil and scientific society and local communities.

Table 1. Positive and negative side effects of NTCPs

<i>CDR Technology</i>	<i>Positive side effects</i>	<i>Negative side effects</i>
DACCS Potential: 0.5-5 GtCO ₂ yr ⁻¹ Cost: 100-300 US\$/tCO ₂	certain applications can improve indoor air quality	CO ₂ penalty if high (thermal) energy demand satisfied by fossil fuels (not NTCP); currently high front-up capital costs; insufficiently studied; material/waste implications (the chemical footprint of the processes: production of chemicals, production of waste, and for hydroxide-based DAC, the amount of chlorine produced); spacial requirements

¹⁴ <https://www.keutschgroup.com/scopex>

¹⁵ From TONATIERRA input: “Upon learning of the SCoPEX project in Tucson, we communicated with our networks of kinship and traditional cultural alliances as Indigenous Peoples of the territory to inquire what they knew of the project. There was a complete lack of information. We then communicated with the traditional ancestral leadership of the O’otham Nations upon whose land the city of Tucson is situated and asked for a consultation. We accompanied the Nukutham (Traditional O’otham guardians of the Sacred Sites) to visit the compound where the project was to be launched. Afterwards, the Nukutham stated that not only were they not informed of the nature and scope of the experiment, but they could not consent to such a project on any O’otham lands.”

¹⁶ <https://static1.squarespace.com/static/5dfb35a66f00d54ab0729b75/t/603e2167a9c0b96ffb027c8d/1614684519754/Letter+to+Scopex+Advisory+Committee+24+February.pdf>

¹⁷ Ibid.

<i>CDR Technology</i>	<i>Positive side effects</i>	<i>Negative side effects</i>
Ocean fertilization Potential: extremely limited	Potential increase in fish catches, enhanced biological production	Limited potential; possible adverse impacts on marine biology and food web structure; deep water oxygen decline; changes to nutrient balance; anoxia in surface ocean; probable enhanced N ₂ O and CH ₄ production
Enhanced weathering Potential: 2-4 GtCO ₂ yr ⁻¹ Cost: 50-200 US\$/tCO ₂	Increase in crop yields; improved plant nutrition, soil fertility, nutrient and moisture; increase in soil pH	Human health risks from fine grained material (it may contain asbestos-related minerals); ecological impacts of mineral extraction and transport on a massive scale; direct and indirect land use change if biomass sourced from dedicated crops, potential heavy metal release (e.g. Ni and Cr) in case of inappropriate material use; changes in soil hydraulic properties

Table based on Jan C Minx *et al* 2018 *Environ. Res. Lett.* **13** 063001, amended.